FINAL

2010 HABITAT RESTORATION PLAN FOR THE PORTUGUESE BEND RESERVE IN THE PALOS VERDES NATURE PRESERVE

Prepared for

Palos Verdes Peninsula Land Conservancy
916 Silver Spur Road, Suite 207
Rolling Hills Estates, California 90274

Prepared by

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Los Angeles, California 90018

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1 OVERVIEW AND EXISTING CONDITIONS

1.1 INTRODUCTION

This Habitat Restoration Plan (HRP) has been prepared for the Portuguese Bend Reserve located on the Palos Verdes Peninsula in southern Los Angeles County, California. The Portuguese Bend Reserve, owned by the city of Rancho Palos Verdes and managed by the Palos Verdes Peninsula Land Conservancy (PVPLC), is approximately 399 acres. The Reserve is one of 10 Reserves that comprise the newly created 1,400 acre Palos Verdes Nature Preserve. The Palos Verdes Nature Preserve was designated as part of the Rancho Palos Verde Draft Natural Communities Conservation Plan (NCCP).

The Draft NCCP was prepared to "maximize benefits to wildlife and vegetation communities while accommodating appropriate economic development within the City of Rancho Palos Verdes and region pursuant to the requirements of the NCCP Act and Section 10(a) of the ESA (URS 2004a)." The creation of the preserve was proposed to conserve the habitat areas of regional importance and provide/improve linkages between habitats to benefit sensitive plants and wildlife.

The HRP was prepared as part of the requirements outlined in the Draft NCCP (URS 2004) that requires the initiation of restoration within five acres each year over a three year period for a total of 15 acres. The HRP is to be updated every three years, and shall identify additional areas for restoration.

This HRP proposes implementing restoration of 15 acres of coastal sage scrub (CSS) and cactus scrub habitats over three consecutive years in the Portuguese Bend Reserve. After initiation of restoration in each five acre area, establishment maintenance would continue for five years within each restoration area. The HRP documents the rationale, methods, and performance criteria for the three year phased restoration. Figure 1 shows the regional location of the Palos Verdes Nature Preserve.

This section of the HRP documents the existing conditions of the Portuguese Bend Reserve and rationale for restoration site selection. Section 2 provides an analysis of soils within the restoration areas. Section 3 defines the specifications for the habitat restoration. Performance criteria and monitoring methods are presented in Section 4 as a means to monitor the progress and success of the restoration.

1.2 EXISTING CONDITIONS

The Portuguese Bend Reserve is bordered by development (single family homes) to the north and southwest and by the open space Reserves Upper Filiorum to the west and Forrestal to the east. Gateway Park and Palos Verdes Drive South borders the Reserve to the south. The restoration area is at the northern edge of the Portuguese Bend Reserve near the

FIGURE 1
Regional Location
Palos Verdes Nature Preserve

end of Crenshaw Boulevard. Figure 2 shows the location of the proposed restoration area within the Palos Verdes Nature Preserve.

The proposed restoration area is comprised of a bowl shaped area within the landscape bordered by the Burma Road Trail. The center of the restoration area is low and flat surrounded by gentle upward slopes. An area to the south of Burma Road Trail on a north facing moderate slope is also included in the proposed restoration area.

Several trails within the Portuguese Bend Reserve are adjacent to or bisect the proposed restoration area. The Burma Road Trail is a high use public access trail used on a daily basis by hikers, mountain bikers, and equestrian riders. In addition, the Burma Road Trail provides vehicular access for facilities management. The Peacock Flats Trail borders the restoration area along the northwestern edge. The restoration area to the south of Burma Road Trail is bordered by the Eagle's Nest Trail on the south and east and the Ailor Trail bisects the restoration area on the northwest side. The Peacock Flats Trail and Ailor Trail are for use by pedestrians and equestrians only. The Eagle's Nest Trail is a multiuse trail.

1.2.1 DISTURBANCE FACTORS

Disturbance factors that have affected the proposed restoration area over time include grazing, agriculture, road construction, and wildfires.

1.2.1.1 GRAZING AND AGRICULTURE

Cattle ranching occurred on the Palos Verdes Peninsula from approximately the late 1700s to the early 1900s (City of Rancho Palos Verdes). In the early 1900s, land use practices switched to dryland farming and sheep herding. The extended duration and intensity of disturbance from grazing and agriculture activities allowed exotic species to invade and dominate much of the landscape even after ranching and agricultural activities were discontinued.

1.2.1.2 WILDFIRES

Three documented fires occurred within the Portuguese Bend Reserve in the last half century (California Department of Forestry and Fire Protection). The Crenshaw Fire that occurred on June 22, 1973 burned approximately two thirds of the Reserve and approximately one third of the proposed restoration area. The San Clemente Fire that occurred on July 13, 2005 burned approximately 10 acres in the upper northwest corner of the Reserve and was adjacent to but did not burn the proposed restoration area.

The Palos Verdes Fire that occurred on August 27, 2009 burned approximately 165 acres of the Reserve. The majority of the proposed restoration area burned during the Palos Verdes Fire. The fire boundaries of the Crenshaw Fire of 1973 and the Palos Verdes Fire of 2009 overlapped in the proposed restoration area.

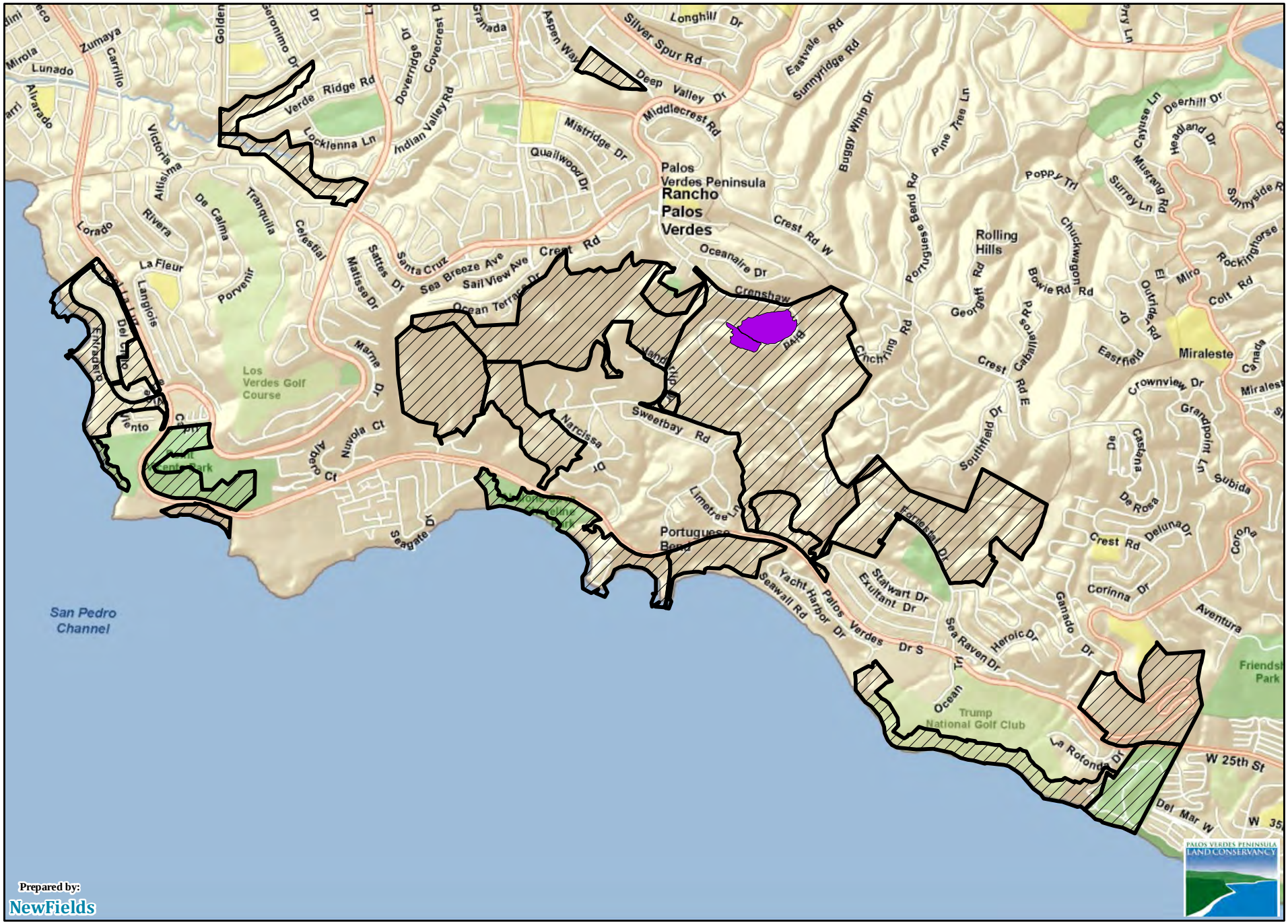


FIGURE 2
Vicinity Map
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

1.2.1.3 ROAD CONSTRUCTION

The Burma Road Trail was once the planned extension of Crenshaw Boulevard that would connect neighborhoods in the north with Palos Verdes Drive South. Several erosion control structures constructed in anticipation of the road installation are present within the restoration area. The erosion control structures include large diameter culverts with associated stone wall structures where the culverts daylight for trail stability, concrete lined ditches, and fill slopes to serve as road berms. Construction of Crenshaw Boulevard was abandoned after the occurrence of a large landslide in 1956 after which the area was considered too geologically unstable for road construction. The trail then became the Burma Road Trail and the erosion control structures were left in place.

1.2.2 PRE-FIRE VEGETATION COMMUNITIES

A map of vegetation classifications present in the Portuguese Bend Reserve was provided by PVPLC for use in developing this HRP. Vegetation mapping of the Palos Verdes Nature Preserve occurred in spring of 2009 using the California Native Plant Society's (CNPS) Vegetation Rapid Assessment protocol. PVPLC contracted with the CNPS to train and assist staff to conduct the vegetation mapping using the Vegetation Rapid Assessment method. The quantitative data collected in the field was the basis for developing the vegetation classification present in the Palos Verdes Nature Preserve. The subsequent vegetation classification based on analysis of the field collected data was based on the Manual of California Vegetation (Sawyer et al. 2009).

Vegetation communities mapped within the restoration area prior to the 2009 Palos Verdes Fire includes stands of Coyote bush (*Baccharis pilularis)*, black mustard (*Brassica nigra)* with sparse shrubs, fennel (*Foeniculum vulgare*), toyon (*Heteromeles arbutifolia*), mixed shrubs, Peruvian pepper (*Schinus molle*), and pine trees (*Pinus* sp.) vegetation communities. Figure 3 shows the vegetation communities within the Portuguese Bend Reserve restoration area mapped using the CNPS method prior to the 2009 fire.

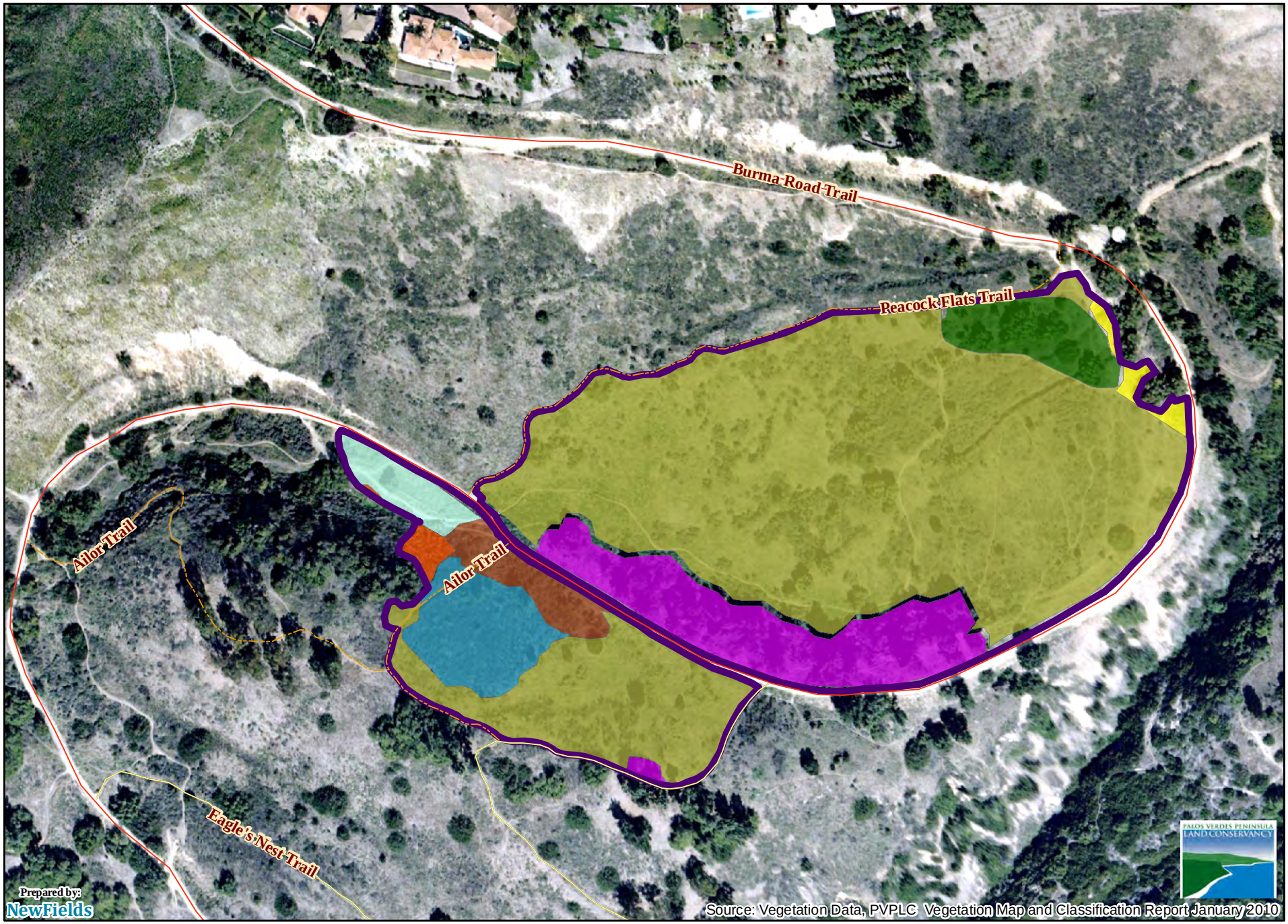


FIGURE 3
Vegetation Communities Prior to Palos Verdes Fire (August 2009)
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

1.2.3 EXISTING VEGETATION

In March of 2010, restoration ecologists from NewFields and PVPLC staff assessed Portuguese Bend Reserve for appropriate areas of native habitat restoration, particularly CSS habitat. Field data collected included dominant plant species, percent cover of native versus non-native species, soil characteristics, and landscape description.

The dominant vegetation of the restoration area is currently non-native species. The dominant non-native species include black mustard, ripgut brome (*Bromus diandrus*), and fennel. Small areas within the restoration area are dominated by the non-native species wild oats (*Avena fatua*), pine and pepper trees. Through a majority of the restoration area, scattered CSS species are present, including California sagebrush (*Artemisia californica*), lemonadeberry (*Rhus integrifolia*), laurel sumac (*Malosma laurina*), coyote bush, toyon, Mexican elderberry (*Sambucus mexicana*), and saw-tooth goldenbush (*Hazardia squarrosa*). Many of the native shrubs are resprouting from the 2009 fire while some individuals remained intact and unburned from the fire. Other native species present include arroyo lupine (*Lupinus succulentus*), wild cucumber (*Marah macrocarpa*), and bush sunflower (*Encelia californica*).

The dominant vegetation in the bowl shaped area consists of stands of dense black mustard along with areas dominated by non-native grasses. The restoration area has a native component of existing islands and scattered individuals of typical CSS species. The native species that are present within the restoration area consists of California sagebrush, toyon, laurel sumac, and California encelia. The area dominated by non-native grasses has a larger component of native species present. A north facing slope at the south end of the bowl shaped restoration area is an artificial fill slope constructed for the Burma Road Trail. Planted on the fill slope are several pine trees most of which burned during the Palos Verdes Fire. Other dominant weed species present on the fill slope are black mustard and non-native grasses. Native species present are wild cucumber and arroyo lupine on the slope while at the toe of the slope several resprouting toyons are present. An area at the Peacock Flats trailhead is dominated by Peruvian pepper trees with non-native grasses, black mustard, and coastal wattle (*Acacia cyclops*) also contributing to the cover of exotic species. Several recovering shrubs, particularly toyon, are present within the pepper tree area.

The restoration area to the south of Burma Road Trail is dominated by fennel and black mustard. The area dominated by fennel includes several islands and individual CSS shrubs recovering from fire including toyon, laurel sumac, saw-tooth goldenbush, and coyote bush. Recovering native shrubs are also present to a much lesser degree in the area dominated by black mustard, consisting mainly of a few individuals of laurel sumac and toyon. In the southeast corner of the restoration, a small island of geophytes occurs. The geophyte area consist of 10 to 12 inches of soil overlaying a hard, impenetrable layer, likely a large slab of bedrock material. Several individuals of Catalina mariposa lily (*Calochortus catalinae*) and blue dicks (*Dichelostemma capitatum*) are present in the geophytes area. Figure 4 shows the existing conditions of the proposed restoration area.

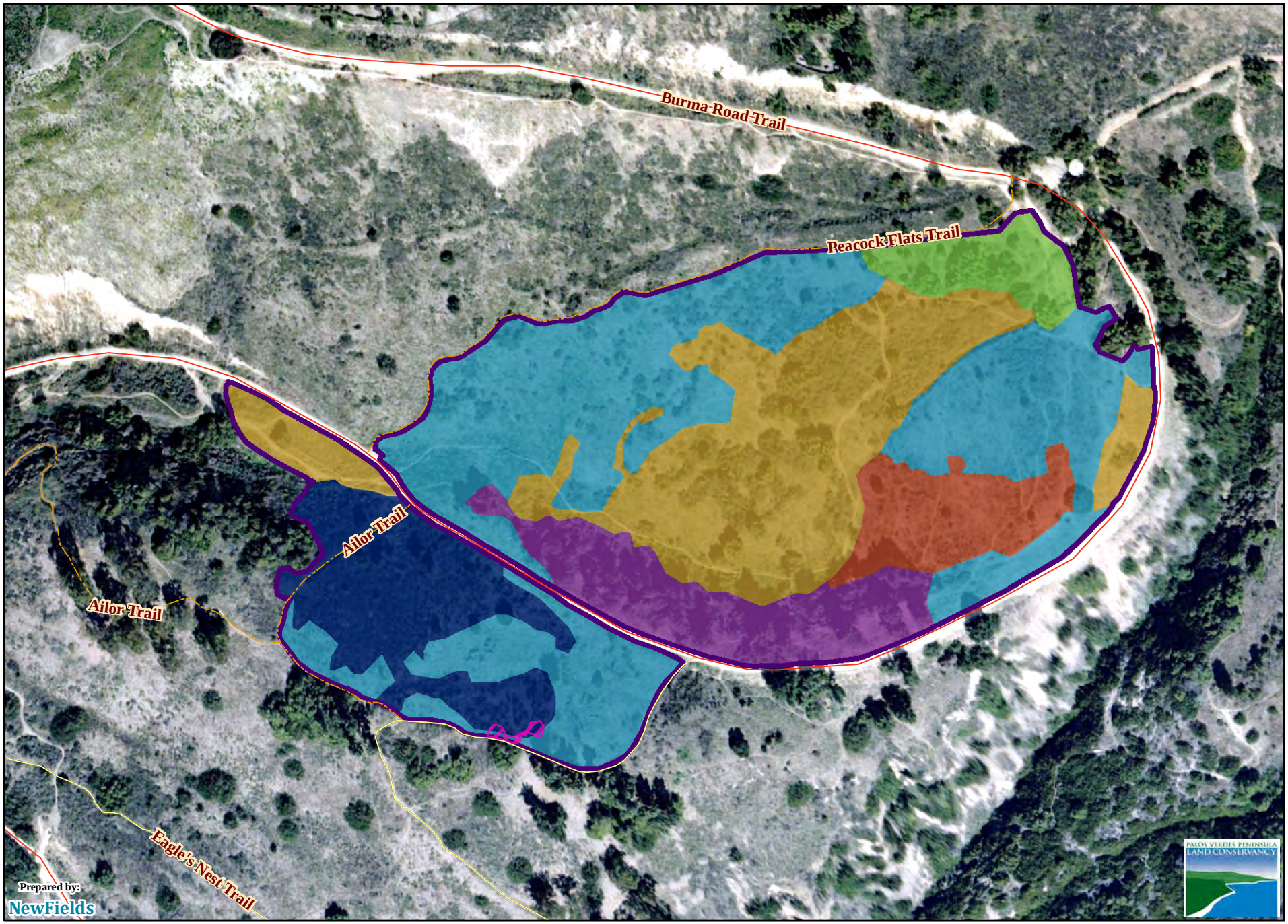


FIGURE 4
Existing Conditions
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

Beyond the proposed restoration area to the north, the slopes become very steep and are dominated by black mustard with a large component of native species consisting mainly of California encelia and caterpillar phacelia (*Phacelia cicutaria*). Portuguese Canyon, a deep canyon with steep sides, is directly to the east of the restoration area. To the south of the restoration site, the area is a downward steep slope dominated by black mustard. The area to the west of the restoration area is dominated by black mustard with a component of recovering individuals of CSS shrubs. A large north facing slope of existing CSS is also present to the east of the restoration. The existing CSS area is comprised of California sagebrush, toyon, laurel sumac, lemonade berry, coyote bush, and giant wild rye (*Leymus condensatus*).

1.2.4 GEOLOGY

The high topographical structure of the Palos Verdes Peninsula is underlain by several late Pleistocene age marine terraces. The underlying material consists of folded marine sedimentary and basaltic rocks that are of Miocene age. The two main parent rock types are sandstone and mudstone.

The Portuguese Bend Reserve is in a seismically active region. The Palos Verdes fault zone, a dip-slip fault, bounds the Palos Verdes Peninsula in the northeast and has uplifted the Palos Verdes Hills relative to the Los Angeles Basin by approximately one kilometer. The San Pedro fault zone has caused uplift of the Palo Verdes Hills relative to the offshore bedrock.

The restoration area is to the north of the Portuguese Bend Landslide, a slow moving landslide that has been conducive to ground failure for approximately the last 250,000 years. The land is constantly moving towards the ocean at approximately 7 to 10 cm per day. A unique feature of the Portuguese Bend Landslide is the underlying material consists of bedded rocks up to 10 feet in diameter.

The restoration area is within the Rancho Palos Verdes City's Landslide Moratorium Area. As a result, the installation of irrigation is not allowed without the approval by the City's geotechnical consultants. Due to the restrictions, for this HRP, irrigation is not proposed and subsequently restoration installation activities will include seeding and cactus pad planting only.

1.2.5 RECENT MANAGEMENT

Management of the Portuguese Bend Reserve consists of regular monitoring, exotic plant removal for the Targeted Exotic Removal of Plants Program outlined in the Draft NCCP, seed collection from local native plant species, and documentation of invasive species within the reserve and adjacent to the reserve. Additionally, the reserve is surveyed for the presence of sensitive plant and wildlife species covered under the Draft NCCP. No Draft NCCP-covered plant species were observed within or adjacent to the proposed restoration area during focused surveys. Two sensitive bird species covered under the Draft NCCP, the coastal California gnatcatcher (*Polioptila californica californica*) and the cactus wren (*Campylorhynchus brunneicapillus*), were observed adjacent to the proposed restoration area during past focused surveys.

A survey of species protected under the State or Federal Endangered Species Act was conducted in 2004 as part of the Draft NCCP. The 2004 survey verified and updated the original survey by Atwood et al. conducted in 1994. Adjacent to the proposed restoration area of this HRP, five California gnatcatchers and five cactus wren observations were observed during the 2004 surveys.

During the 2006 survey, 54 California gnatcatchers were observed and four cactus wrens were observed in the Portuguese Bend Reserve (PVPLC 2007). The population of documented California gnatcatchers consisted of 14 pairs, 23 juveniles, and 7 family groups. The population of documented cactus wrens consisted of four lone adults.

Surveys for California gnatcatchers and cactus wren were conducted in spring of 2009 and the results were compared to the 2006 survey data to observe trends in the population of the two species (Hamilton Biological, Inc. 2009). The 2009 survey results were presented as territories, which can consist of lone adults, pairs and family groups. During the 2009 surveys for the California gnatcatcher in the Portuguese Bend Reserve seven territories were observed, resulting in a 50 percent decrease in the number of observed territories compared to 2006 survey results. Two cactus wren pairs or family groups were observed within the Portuguese Bend Reserve in 2009. None of the 2009 observations for the California gnatcatcher or cactus wren were within or adjacent to the proposed restoration area.

Within the proposed restoration area, a portion of the area was treated once in February 2010 with herbicide to control non-native species. The dominant non-native species in the treatment area were non-native grasses and black mustard. A seed mix of typical CSS species was broadcast with a walk behind broadcast seeder on March 31, 2010 one meter on either side of the Peacock Flats Trail in the exotic species control area.

1.3 RESTORATION SITE SELECTION

The restoration site location was determined based on review of existing information and guidance from the PVPLC. The existing information included review of the NCCP and Portuguese Bend Reserve Fire Recovery Plan (PVPLC 2009). The NCCP presents information on potential restoration areas within the Palos Verdes Nature Preserve along with a priority ranking for the restoration areas. The priority ranking was based on the degree to which the restoration would enhance the Reserve design. The proposed restoration area was designated as a high priority for restoration in the NCCP. See Figure 5 for the proposed restoration areas and priority ranking in the NCCP.

The Portuguese Bend Reserve Fire Recovery Plan discusses post fire recovery recommendations for the Palos Verdes Fire of 2009. The recommended approach for recovery presented in the plan is the control of exotic species and re-vegetate burned areas with native species. The establishment of native species will provide much needed erosion control to stabilize soils and will help to limit the spread of exotic species infestations. Additionally, the revegetated areas will provide habitat for wildlife species, including the threatened coastal California gnatcatcher and cactus wren. The Recovery Plan recommends

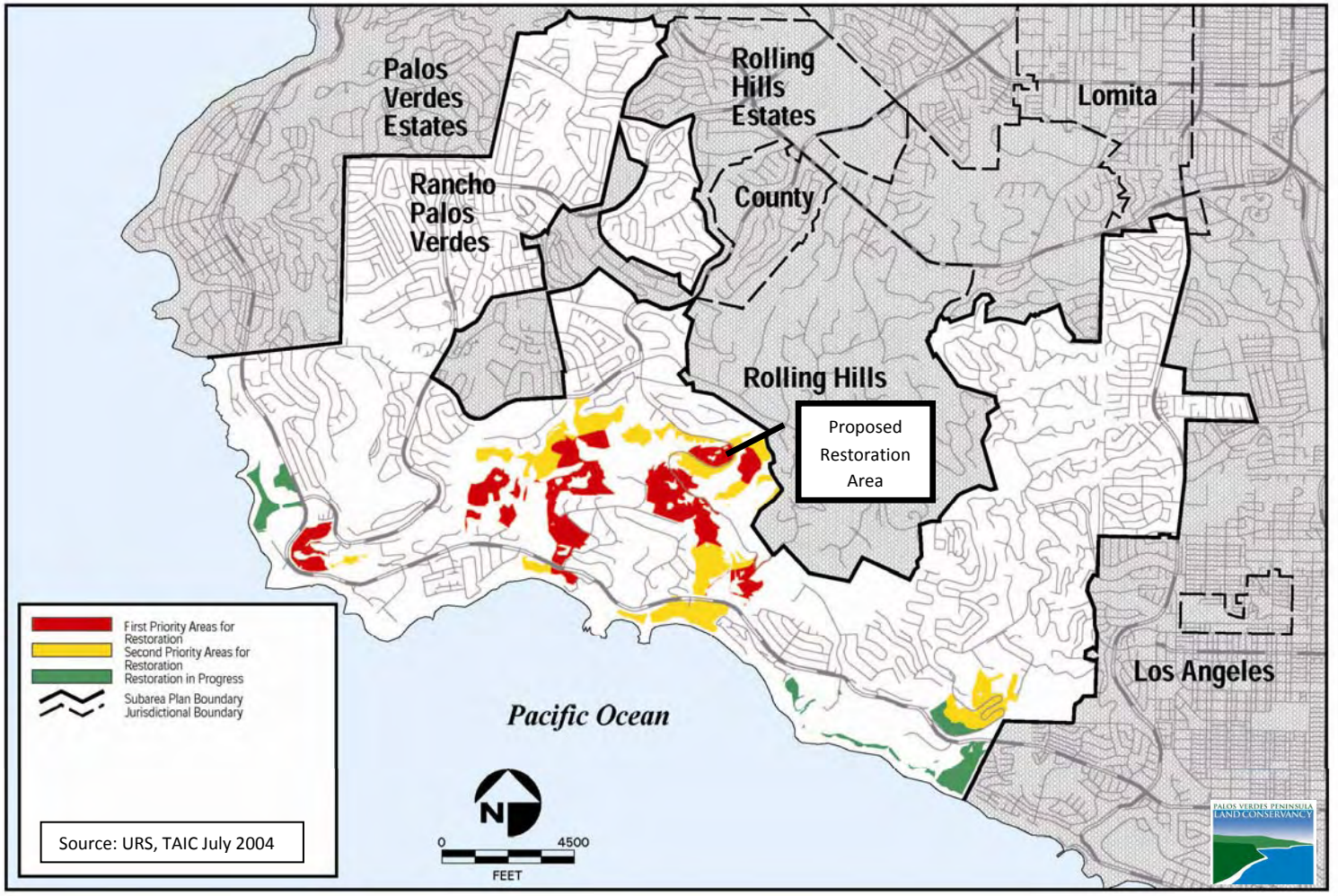


FIGURE 5
Priority Habitat Restoration Areas Presented in the NCCP
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

the control of exotic species and seeding with an appropriate native seed mix within the proposed restoration area.

The restoration site proposed in this HRP was selected based on the information provided in the NCCP and Fire Recovery Plan along with characteristics of the site such as access, the high visibility of the area to the public, and anticipated restoration success. The restoration site is accessible by motor vehicle and occurs on flat to moderate slopes. The restoration area is adjacent to a high use public trail close to the Burma Road trailhead and is highly visible to the public. An area with historic shade trees occurs alongside the Burma Road Trail adjacent to the northeast edge of the proposed restoration area. Although the dominant tree species is Peruvian pepper, the area was excluded from the proposed restoration because of the high public use of the area. Restoration success is expected to be high due to the presence of recovering native shrubs within several areas of the restoration and the likely presence of natives in the soil seed bank.

2 RESTORATION AREAS SOIL DESCRIPTION AND ANALYSIS

Soil analysis is critical to determine the appropriate habitat for restoration in areas that have been historically disturbed and lack clear indications of pre-European native plant communities. The proposed restoration and management recommendations presented in this HRP are based in large part on examination of soil characteristics and soil properties in the restoration areas.

Analysis of the Portuguese Bend Reserve soils began with a review of the Natural Resources Conservation Service's Soil Taxonomy (1999) along with the Report and General Soil Map, Los Angeles County (1969). The General Soil Map was mapped to the coarse level of soil associations. The mapped soil associations are comprised of two or more soil series that occur together in a characteristic pattern in a geographic area. Unlike more detailed soil surveys, soil series within a soil association are not mapped independently.

Within the Portuguese Bend restoration areas, two soil associations occur and each association is comprised of two main soil series. The two soil associations are the Diablo-Altamont Association and the Altamont-Diablo Association. Generally, the two main soil series comprising the soil associations of the restoration areas support similar vegetation communities as described in the following sections.

The soils within the proposed restoration areas were described and sampled to determine the appropriate native habitat for restoration. Soil characteristics were described in seven locations in the restoration areas. Soil characteristics that were described include soil texture, structure, presence of gravels, and soil color. Soil texture, or the proportion of different size mineral particles, is a basic property of the soil and not readily subject to change. Subsequently, texture is especially critical for understanding soil behavior and management (Brady and Weil 2000). Coupled with landscape position, texture is one of the main guides for appropriate habitat restoration. In addition to describing soil characteristics, three of the seven soil samples were tested for standard agricultural suitability and cation exchange capacity.

2.1 SOIL ASSOCIATIONS

The Altamont Series and the Diablo Series, the two soil series that comprise the majority of the two soil associations, Diablo-Altamont association and Altamont-Diablo association of the Portuguese Bend Reserve, are delineated on the General Soil Map.

2.1.1 DIABLO ALTAMONT ASSOCIATION

Soils of the Diablo-Altamont association occur on gently sloping foothills at elevations ranging from sea level to 1,300 feet. The Diablo soils comprise 60 percent of the association and the Altamont soils 30 percent of the association. Typical vegetation found on these soils in the Los Angeles area is annual grasses and forbs. Other soil series included in the Diablo-Altamont Association are Cropley soils and San Benito soils each comprising five percent of the association.

2.1.2 ALTAMONT-DIABLO ASSOCIATION

Soils of the Altamont-Diablo association occur on steep slopes at elevations ranging from near sea level to 1,500 feet. The Altamont soils comprise 60 percent of the association and the Diablo soils 30 percent of the association. Typical vegetation found on these soils in the Los Angeles area is annual grasses and forbs. Typical vegetation of the Altamont-Diablo Association of the Portuguese Bend Reserve appears to be CSS. Other soil series included in the Altamont-Diablo Association are San Benito soils comprising 10 percent of the association.

2.2 SOIL SURVEY CLASSIFICATION

The soils in the Portuguese Bend Reserve were formed under the xeric moisture regime of southern California where the Mediterranean climate has cool, moist winters and warm dry summers. Since moisture levels fall during times of lowest evapotranspiration rates, this is conducive for soil leaching. The mean annual soil temperature is lower than 22 degree Celsius (C). At a depth of 50 cm from the soil surface, the mean annual summer and winter temperatures differ by 6 degrees C or more. By definition, xeric soil is dry for at least 45 consecutive days in the summer and is moist for at least 45 consecutive days in the winter (NRCS 1999).

Soil taxonomy is the process by which soils are classified based on key soil characteristics. Soil taxonomy is broken down into categories that are hierarchical; lower categories fit within the higher categories for diagnostic soil characteristics (Brady and Weil 1999).

The broadest category of soil classification is soil order. Soil orders are defined by formative elements, especially for the presence or absence of major diagnostic horizons. Determination of suitable habitat restoration can be facilitated by understanding the formation and classification of soil types. Relevant soil orders are described in the following sections for this HRP.

2.2.1 VERTISOLS

Vertisols are mineral soils that have high clay content, in particular shrinking and swelling type clays, to a depth of one meter or more in the soil. The clays shrink and swell during periods of drying and wetting based on their silica clay lattice structure. Almost all Vertisols are dark in color to a depth of one meter, but this dark color is not indicative of high organic matter content. Deep, wide cracks form due to shrinking in dry periods with the cracks closing as the soil swells in wet periods. The shrink/swell cracking is a key characteristic in defining a Vertisol soil. Vertisols generally occur in climates that allow for a dry period of several months, such as in southern California. Typical vegetation found on Vertisols is annual and perennial grassland as well as some shrub vegetation such as coyote bush scrub.

The soils of the Vertisol order in the Portuguese Bend restoration areas include the Altamont Series, Diablo Series, and Cropley Series. The soil series of the Vertisol order are described below.

2.2.1.1 DIABLO SERIES

The Diablo soils of the Diablo-Altamont Association are well drained and have slow subsoil permeability. Depth of the soil is 22 to 52 inches and the surface clay layer is approximately 20 inches thick. The surface clay layer is neutral and the underlying subsoils are strongly calcareous clays. At depths of 22 to 52 inches, strongly calcareous shale occurs. The surface can be rocky from hard shale outcrops. The available water holding capacity is moderate at 3.5 to 7.5 inches.

The Diablo soils of the Altamont-Diablo Association are similar to the soils described in the Diablo-Altamont association with the primary differences being the landscape position of the soils and soil depth. The soils in this association occur on steeper slopes that are moderately eroded, thereby reducing soil depth. Soil depth for these soils is 20 to 39 inches and the available water holding capacity is low at 2.5 to 5.5 inches.

2.2.1.2 ALTAMONT SERIES

The Altamont soils of the Diablo-Altamont Association are well drained and have slow subsoil permeability. Depth of the soil is 24 to 36 inches, and the surface clay layer is approximately 12 inches thick. The surface clay layer is neutral and the underlying subsoils are calcareous clays. At depths of 24 to 36 inches, partially weathered calcareous soft shale or sandstone occurs. The available water holding capacity is moderate at 4.0 to 6.0 inches.

The Altamont soils of the Altamont-Diablo Association are similar to the soils described in the Diablo-Altamont association. The primary differences are the landscape position of the soils and soil depth. The soils in this association occur on steeper slopes that are moderately eroded, thereby reducing soil depth. Soil depth for these soils is 20 to 27 inches, and the available water holding capacity is low at 3.0 to 4.5 inches.

2.2.1.3 CROPLEY SERIES

Cropley soils occur on nearly level alluvial plains and valley floors at elevations from near sea level up to 1,250 feet. Typical vegetation found on these soils is annual grasses and forbs.

The Cropley soils are well drained and have slow subsoil permeability. Depth of the soil is greater than 60 inches and the surface clay layer is approximately 38 inches thick. The surface clay layer is neutral to mildly alkaline clay and the underlying subsoils are moderately alkaline and calcareous clays. Clay loam containing approximately 20 percent gravels by volume comprises the substratum. The available water holding capacity is high at 9.0 to 10.5 inches for 60 inches of soil depth.

2.2.2 MOLLISOLS

Mollisols are mineral soils that are characterized by the accumulation of organic matter rich in calcium in the upper soil layer. Most Mollisols of Southern California have a mollic epipedon defined as a dark surface organic horizon that is formed from the accumulation and decomposition of the dense roots systems of the vegetation they support. The mollic

epipedon is generally high in calcium and magnesium, which can give it a cation exchange capacity of more than 50 percent saturated with base-forming cations.

Mollisols soils are not hard even when dry, which is a key characteristic of the mollic epipedon. The high organic matter content and the presence of swelling type clays prevent hardening of the soil even when it is dry. Typical vegetation found on Mollisols is annual and perennial grassland as well as some shrub vegetation.

San Benito is the only soil series classified in the Mollisol order within the Portuguese Bend Reserve. The San Benito series comprises five percent of the Diablo-Altamont Association and 10 percent of the Altamont-Diablo Association.

2.2.2.1 SAN BENITO SERIES

The San Benito series has a high organic matter content and shrink–swell clay characteristics. San Benito soils are 36 to 48 inches deep and are well drained with moderately slow subsoil permeability. They have a dark grayish-brown, neutral clay loam surface layers to about 28 inches with moderately alkaline, calcareous clay loam subsoil. Water-holding capacity is moderate at 6.5 to 8.5 inches.

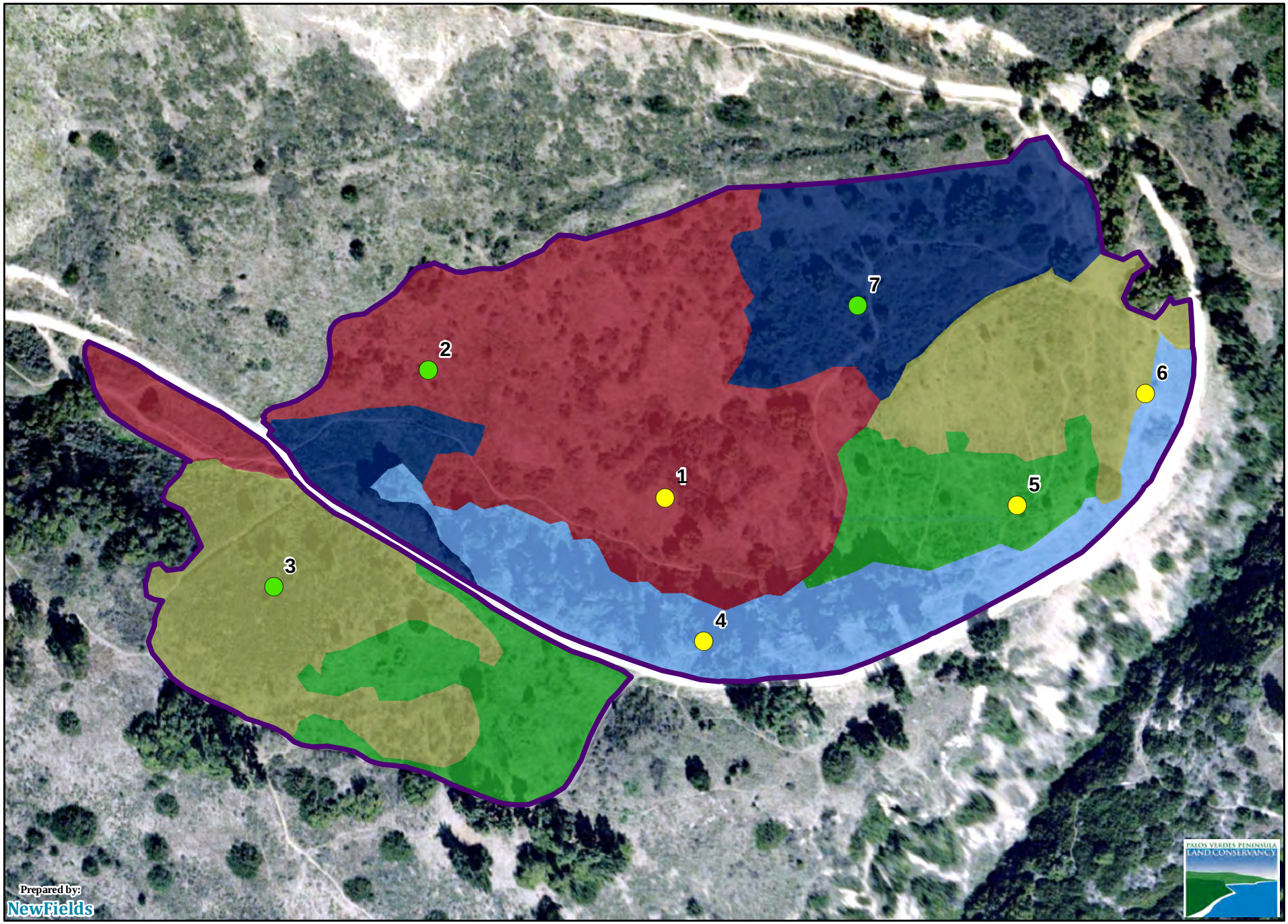
2.3 SOIL SAMPLE ANALYSIS

After a review of existing soil data for the Portuguese Bend restoration area, a field examination of the soils was conducted to guide restoration recommendations for this HRP. Soils were examined in areas with similar characteristics such as composition of weed species and soil texture. Seven soil samples were collected and described in the restoration area. Figure 6 shows the general location of the soil samples.

Soil samples were collected in the upper six inches of the soil profile. Within a sample area, soil was collected in three locations and pooled together for one composite sample. All of the soil samples were described for physical soil characteristics. Three of the soil samples were then sent to Wallace Laboratories to be analyzed for standard soil constituents, agricultural suitability, texture, and cation exchange capacity. Analysis of the three samples provided information on the physical properties of the soil and guided the recommendations for soil amendments to improve restoration success.

2.3.1 SOIL SAMPLE DESCRIPTIONS

Sample 1 was collected in the flat area of the bowl in the center of the restoration area. The sample area is dominated by non-native vegetation. Vegetation cover is approximately 80 percent. The dominant non-natives include ripgut brome, black mustard, milk thistle



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Proposed Restoration Area

0 75 150 300 Feet

Soil Sample

- Soil Characteristics
- Soil Characteristics and Properties

Soil Texture

- Clay
- Clay Loam
- Sandy Clay Loam
- Sandy Loam
- Silty Clay

FIGURE 6
Soil Sample Locations
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

(*Silybum marianum*), bristly ox tongue (*Picris echioides*), and sweet clover (M*elilotus indicus*). Natives present in the area recovering from the Palos Verdes fire include toyon, elderberry, and California sagebrush. The sample area is included in the area treated with herbicide to control non-natives in February 2010. The soil is sandy clay loam with many fine roots and small size gravels in the upper six inches. The soil in this area was dark in color with small cracks present on the surface.

Sample 2 also was collected in the western portion of the restoration area that is currently dominated by non-native vegetation on a gentle, southeast facing slope. Vegetation cover is dense at close to 100 percent and the dominant non-native is black mustard with ripgut brome also present. Scattered individuals of California encelia and laurel sumac are present within the sample area. The soil is a sandy clay loam with many fine roots and medium sized gravels present in the upper six inches. The soil sample was sent to the soil lab for analysis.

Sample 3 was collected on the southern end of the restoration area in an area dominated by non-native vegetation on a moderate, north facing slope. Vegetation cover is approximately 80 percent and the dominant non-native in the sample area is fennel with sweet clover and black mustard also present. Several native shrubs recovering from the fire are present and include saw-tooth goldenbush, toyon, and coyote bush. The soil is clay with many fine and coarse roots present in the upper six inches of soil. Small rocks were uncommon in the soil profile. The soil sample was sent to the soil lab for analysis.

Sample 4 was collected in the southern portion of the restoration area on a fill slope with planted pine trees. The area is dominated by non-native species on a steep north facing slope and vegetation cover is approximately 80 percent. The dominant non-native species present are pine trees and black mustard. Native species are present and include wild cucumber and arroyo lupine. Toyon shrubs recovering from the fire are also present at the toe of the slope. The soil is a sandy loam with many fine roots and small to medium gravels present in the upper six inches of the soil profile.

Sample 5 was collected in the eastern portion of the restoration area dominated by non-native vegetation on a gentle to moderate west facing slope. Vegetation cover is approximately 100 percent and the dominant non-native is wild oats with fennel and black mustard also present. Scattered individuals of native shrubs present in the sample area include bush sunflower, coyote bush, lemonade berry, and California sagebrush. The soil is silty clay with many fine roots and small gravels present in the upper six inches of the soil profile.

Sample 6 was collected in northeastern portion of the restoration area dominated by non-native vegetation on a gentle to moderate west facing slope. Vegetation cover is approximately 100 percent and the dominant non-native is black mustard with sweet clover, wild oats, and prickly ox tongue also present. A few scattered individuals of native arroyo lupine are present in the sample area. The soil is clay with many fine roots and small gravels common in the upper six inches of the soil profile.

Sample 7 was collected in the northern portion of the site in an area currently dominated by non-native vegetation on a gentle south facing slope. Vegetation cover is approximately 75 percent and the dominant non-native vegetation is wild oats with black mustard, Peruvian pepper, and sweet clover also present. Several native shrubs recovering from the fire are

present and include toyon, lemonadeberry, California sagebrush, California encelia, coyote bush, and laurel sumac. The soil is a clay loam with many fine to medium roots present in the upper six inches of the soil profile. Coarse roots and small to large gravels are also present. The soil sample was sent to the soil lab for analysis.

2.3.2 SOIL SAMPLE ANALYSIS RESULTS

The following section discusses the results of the three soil sample sent to the soil laboratory for analysis. While the results of the soil sample analysis will be discussed in the context of the reported suitability of the soil for agriculture, as plants in natural communities share many of the same nutrient and soil structure requirements as agricultural crops, there are some important differences in edaphic suitability between crops and native plants of southern California, which will be noted as applicable in the following discussion of soil sample analysis results. See Appendix I for the complete laboratory analysis results for the Portuguese Bend restoration area soil samples.

The target range of soil nitrogen measured as nitrate is 10 to 30 parts per million (ppm). Nitrogen levels are high for the non-native grass dominated sample, within target range for the mustard dominated sample, and low for the fennel dominated sample. The nitrogen levels of the soil samples are likely be the result of a short-lived pulse of nitrogen after the Palos Verdes Fire. Nitrogen levels are expected to decrease in the long-term since nitrogen is readily leached from the soil profile. Furthermore, the propensity for soil leaching is greater in southern California because of the xeric moisture regime. However, low nitrogen levels are not an impediment for CSS species since native vegetation has adapted to low soil nutrient levels and the CSS community is well suited to growing in nutrient poor soil conditions.

The target range for soil phosphorus is 8 to 15 ppm. Phosphorus levels are low for the fennel sample and non-native grass sample while the levels of the mustard sample are within the target range. However, as described above, the native vegetation has likely adapted over time to low phosphorous levels in the soil.

The target range for soil sulfur is at least 25 ppm to an upward bound of 100 ppm. Sulfur levels were below target range levels for all three soil samples. Similar to nitrogen, sulfur is a nutrient that is mobile within the soil and is readily leached from the upper soil profile or root zone (Baird 1991). The native vegetation has likely adapted to low sulfur conditions in the soil.

Calcium levels are moderate for all three of the soil samples. The target range for magnesium is 25 to 100 ppm. Magnesium levels are very high for all of the samples, which could affect plant absorption of nutrients, particularly potassium uptake. In addition to high levels of magnesium, the ratio for calcium to magnesium is not optimum for plant nutrient uptake for the soil samples. The optimum calcium to magnesium ratio is between 2-3 calcium to 1 magnesium. For the mustard sample and non-native grass soil sample, the calcium to magnesium ratio is about 1 to 1 and the ratio for the fennel sample is 1 calcium to 3 magnesium. However, based on restoration experience in the southern California region where high magnesium levels are common, and the calcium to magnesium ratio is not optimum, these soil constituents do not pose an insurmountable obstacle to native species establishment (EARTHWORKS, unpublished data).

The soils of the Portuguese Bend Reserve are slightly alkaline with a pH ranging from 6.67 to 7.51. All three soil samples have a low electrical conductivity (ECe) reading and the sodium adsorption ratio (SAR) is within the target range. Sodium levels are low to moderate for the three soil samples and the levels are lower than potassium levels and should not interfere with nutrient and water uptake.

The target ranges for the minor soil nutrients copper, manganese and zinc are 0.3 to 0.5 ppm, 0.6 to 3.0 ppm, and 1.0 to 3.0 ppm respectively. For the three soil samples, the minor nutrients copper, manganese and zinc are high, but are not present at levels that are a detriment to plant health. Acceptable chloride levels are below 150 ppm, the target range for iron is 4 to 10 ppm, and the target range for boron is 0.2 to 0.5 ppm. Chloride and iron levels are within an acceptable range and boron levels are low.

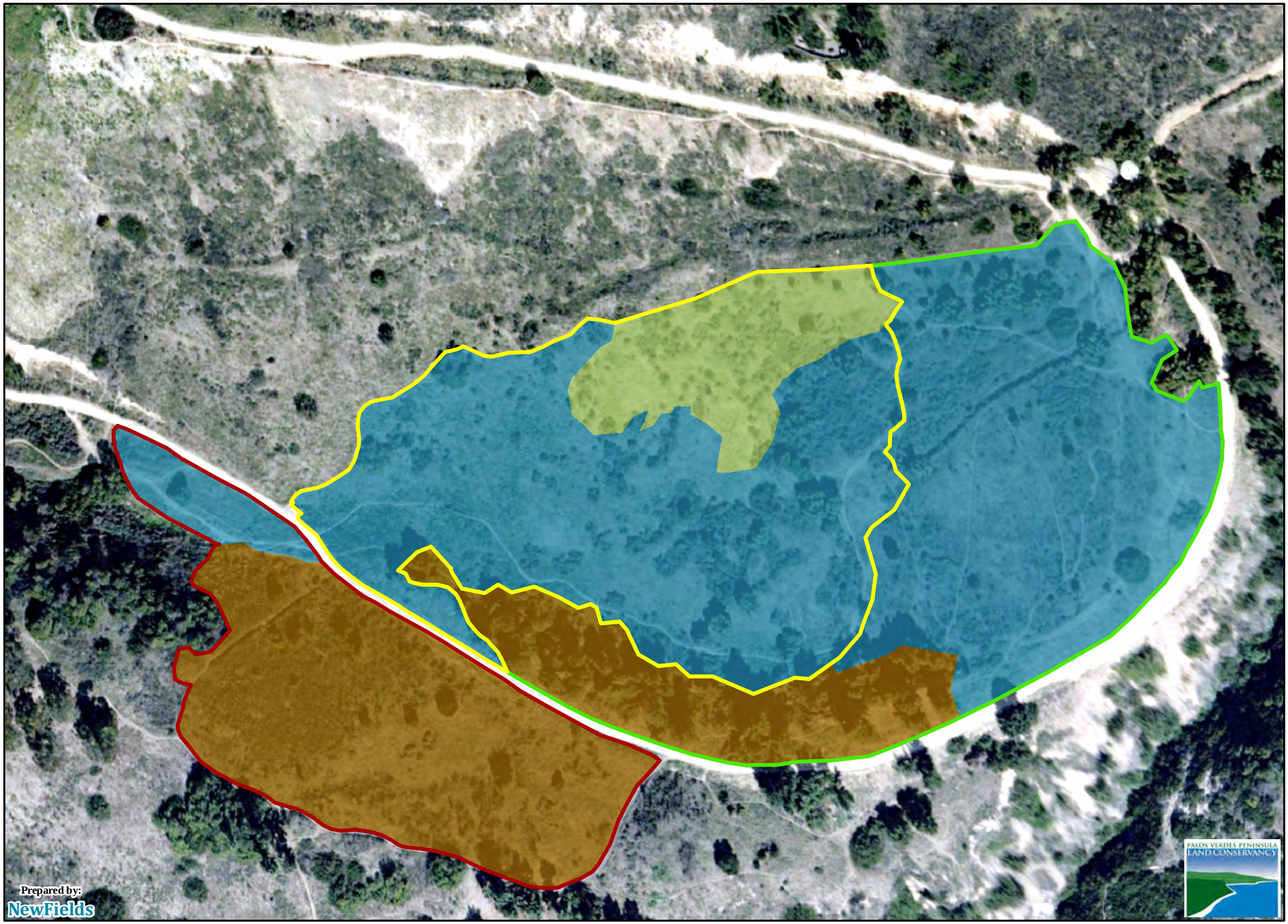
The results of the soil samples indicate that areas dominated by exotic species have less than optimum nutrient levels for some of the major and minor nutrients. Recent research has demonstrated that exotic species change the amount and availability of soil nutrients to their own benefit (Elviner 2008). Based on the soil sample analysis, soil amendments will be recommended that will aid establishment of native plants and discourage exotic species.

2.4 SUMMARY OF SOILS AND RESTORATION AREAS

The restoration within the Portuguese Bend Reserve is proposed within areas that have been historically disturbed by grazing and dryland farming and are recovering from the Palos Verdes Fire that occurred in August 2009. Evaluation of the available data for soil characteristics, slope and aspect, density and type of exotic species, presence of native species, and conditions of adjacent native habitats, specific restoration habitats within the restoration area were determined.

The proposed restoration is divided into three restoration areas, Restoration Area 1, 2, and 3, to provide a guideline for the phased restoration of five acres per year over three years. The restoration process will be initiated in each restoration area over the three year period. Each restoration area is larger than 5 acres, so refinement of the restoration areas prior to starting the restoration process should be conducted to choose the most optimum five acres for restoration in terms of success and project goals. Two habitat types were determined suitable for restoration based on the distribution of existing native plant species, soils, landscape position and dominant exotic species. The restoration habitats proposed in this HRP are CSS and cactus scrub. Figure 7 shows the restoration areas and the recommended restoration habitats.

Coastal sage scrub habitat is recommended on the gentle to moderate slopes currently dominated by black mustard, ripgut brome, wild oats, and fennel. Generally, CSS shrub species establish on slopes with well-drained soils. Cactus scrub habitat is recommended on the gentle south east facing slopes currently dominated by non-native grasses and mustard species.



N

0 75 150 300 Feet

Restoration Areas	Restoration Habitat/Seed Mix
1	Cactus Scrub
2	Coastal Sage Scrub - North-facing Slopes
3	Coastal Sage Scrub - South to West-facing Slopes

FIGURE 7
Proposed Restoration Habitats
Portuguese Bend Proposed Restoration Area
Palos Verdes Nature Preserve

Based on the soil agricultural suitability analyses, there does not appear to be any conditions that would interfere with establishment of either CSS or cactus habitats. Soil amendments will consist of adding AM fungi to the site to give the native seeded species an advantage over the exotic weeds in the mustard family. AM fungi aid plants in the uptake of phosphorus and water. However, members of the mustard family are not mycorrhizal, and AM fungi are detrimental to mustard plants.

3 RESTORATION SPECIFICATIONS

Based on review of information provided by the PVPLC and field surveys conducted on March 31 and April 7, 2010 of the Portuguese Bend restoration area as described in the previous sections, restoration guidelines and monitoring criteria were developed for this HRP.

The implementation of the HRP will proceed under the following restoration specifications utilizing an adaptive management approach. Several factors, including the level of historic disturbance, density and type of exotic species, soil series, and distance from existing native habitats may necessitate the need to change management strategies. Therefore, methods outlined in the following section will be used, or adapted, as necessary and in various combinations based on specific existing field conditions, including prevailing weather conditions each year.

Restoration generally can be divided into four phases: 1) site preparation, 2) seeding/planting, 3) establishment maintenance, and 4) post- establishment monitoring and management.

For the Portuguese Bend Reserve restoration area, site preparation may be necessary for more than one season to control the exotic weeds. Concurrent with the site preparation phase, seeds of appropriate native species will be collected and properly stored until installation. Application of specific seed mixes within the restoration areas will be implemented in the fall following site preparation weed control as determined by PVPLC staff. Establishment maintenance will likely be required for approximately five years, depending on rainfall and the development of the specified seed mixes and cover of exotic species. Long-term management following the five year establishment phase should consist of periodic site visits to observe composition and cover of exotic species along with the development of the native habitat. Appropriate management activities should be implemented based on observations during site visits.

The following sections will describe the restoration goals, implementation, maintenance, and monitoring.

3.1 PROJECT GOALS

The purpose of this HRP is to establish ecologically appropriate native habitats in areas disturbed by the August 2009 Palos Verdes Fire to enhance the ecological functions of the adjacent native habitats within the Portuguese Bend Reserve. The following general goals were determined for the habitat restoration after evaluating the existing conditions of the site:

Primary Goal
Increase native plant species diversity and structural diversity of the site by restoring and enhancing CSS habitats.

Additional Goals
Establish native habitats that will be self-sustaining in the long-term by encouraging conditions that will allow natural processes to proceed, including soil development, nutrient cycling, plant succession, natural regeneration, and resistance to perturbation.

3.2 RESTORATION GUIDELINES

The HRP for the Portuguese Bend restoration area addresses the issue of future uncertainties such as global climate change. Climate is the main driving force behind vegetation distribution and ecological succession in Southern California. A significant change in the current climate regime could have an effect on the Portuguese Bend restoration area. This HRP incorporates management strategies to facilitate restoration success by incorporating an adaptive management approach and the ecological succession model to address future unknowns.

3.2.1 CLIMATE CHANGE

Global climate is predicted to change dramatically within the next century from anthropogenic influence on the chemical composition of the Earth's atmosphere (USEPA 1997). The mean global temperature of the surface of the Earth is predicted to increase between 1.6 and 6.3 degrees Fahrenheit by the year 2100 (USEPA 1997). The effects of a rise in temperature on other climate variables is difficult to determine using climate models on a global scale and even more difficult to predict on a local scale (USEPA 1997). A rise in temperature in southern California would have dramatic impacts on the distribution and composition of vegetation communities. Changes to vegetation communities would be driven by change in temperature, precipitation, and fire regime (CCCC 2006).

The official spatial climate data sets of the U.S. Department of Agriculture for climate modeling were created through the interpolation of existing climate data using the latest version of the Parameter-elevation Regressions on Independent Slopes Model (PRISM) developed by the Prism Group of Oregon State University (Daly et al 2008). As a result, spatial climate data products were created through a joint effort between the Prism Group and NRCS National Water and Climate Center. The PRISM temperature and precipitation historic climate data sets for the Portuguese Bend restoration area were examined for this HRP to observe trends in average temperature and annual precipitation that may have occurred over the last century.

3.2.1.1 TEMPERATURE

The California Climate Change Center (CCCC) was established in 2003 by the California Energy Commission's Public Interest Energy Research program to monitor, analyze and model the climate. Using various climate model scenarios focused on California, the average temperature of California is predicted to rise anywhere from 3 to 10.5 degrees Fahrenheit by the end of the century (CCCC 2006). All climate model scenarios predict an increase in

temperature with a greater rise in temperature to occur in the winter and summer months compared to spring and fall in Southern California.

A scatter plot of the PRISM climate data set of average annual temperature of the years 1895 to 2009 for the Portuguese Bend Restoration area shows a linear trend towards a two and a half degree Fahrenheit (F) increase in temperature over the last century. See Graph A for the average annual temperature of the Portuguese Bend Reserve.

Additionally, a scatter plot of the average annual minimum and maximum temperature of the years 1895 to 2009 for the Portuguese Bend restoration area shows a linear trend towards an increase in temperature over the last century. The increase in annual maximum temperature over the past century is approximately a 3 degrees F. However, the change in average annual minimum temperature is an increase of approximately 2 degrees F. Therefore, it appears there has been a greater increase in the average maximum daily temperature compared to the change in average minimum daily temperature. See Graph B for the average annual minimum and maximum temperature of the Portuguese Bend Reserve.

3.2.1.2 PRECIPITATION

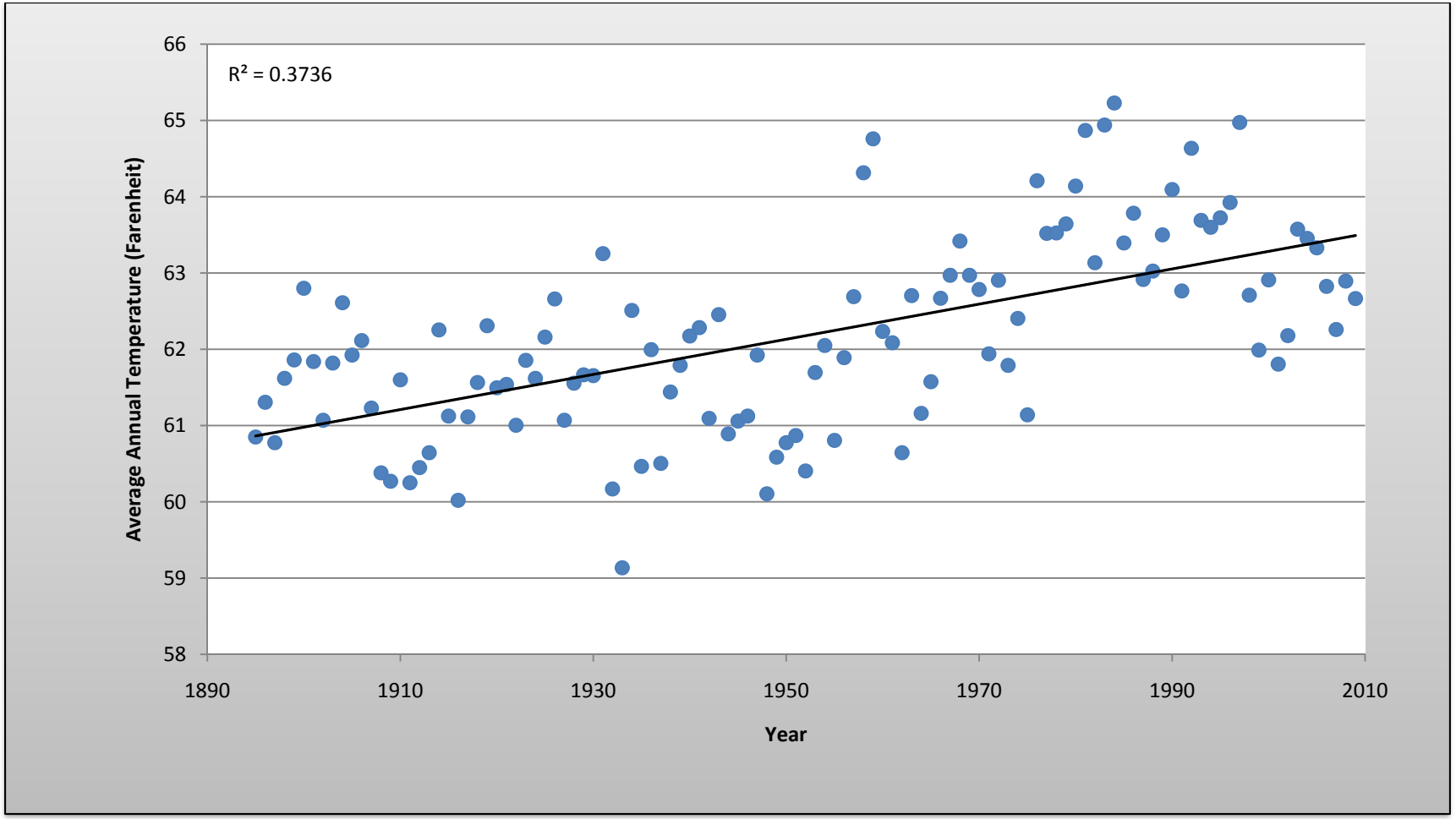
Future climate induced changes in precipitation of California are more difficult to determine than temperature change (CCCC 2006). Furthermore, it is difficult to predict the time of year the precipitation changes will occur, i.e. will an increase in precipitation occur during the current rainy season, will the rainy season be extended, will summer precipitation increase etc. Likely, the change in precipitation will vary dramatically across the state and the effects will be local. Climate models predict several varying scenarios for precipitation changes in Southern California from and increase to a decrease in annual total precipitation. Precipitation is a major determinant in the mosaic of California vegetation communities and any change would have a significant effect (Hulme 2005).

A scatter plot of the PRISM climate data set of annual precipitation of the years 1895 to 2009 for the Portuguese Bend restoration area shows no apparent trend in the annual precipitation over the last century. The trend line falls at approximately the average annual precipitation amount, 12 inches, for the Portuguese Bend restoration area. See Graph C for the annual precipitation totals of the Portuguese Bend Reserve.

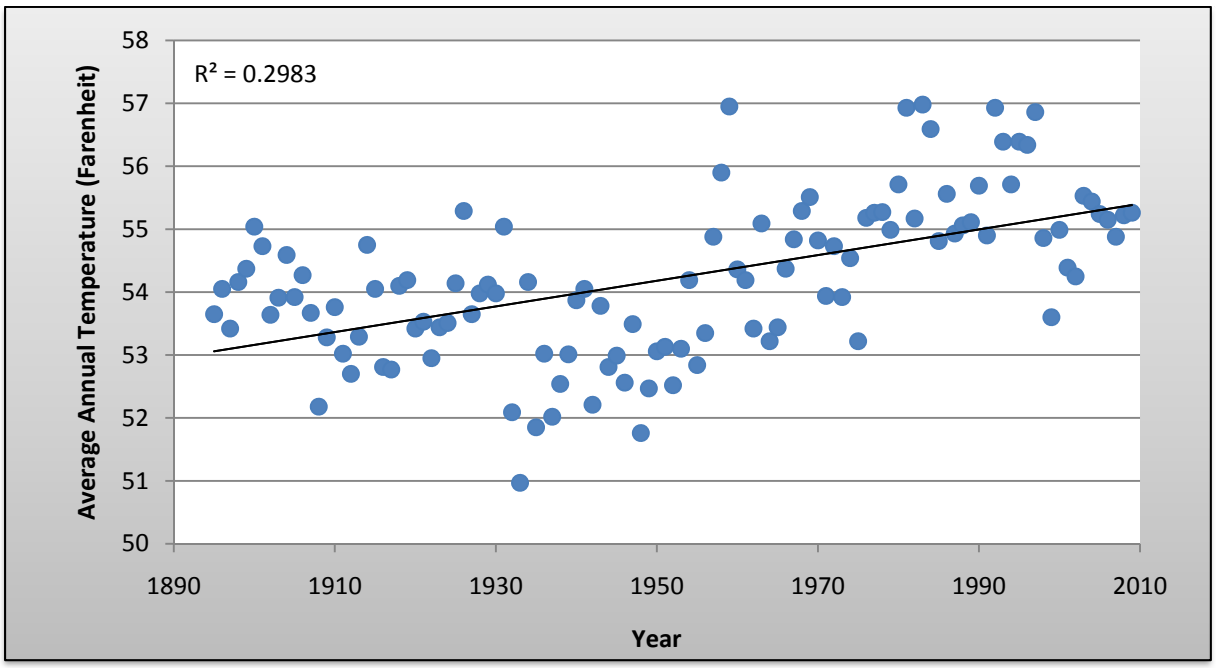
3.2.1.3 WILDFIRES

Results of all climate change scenarios analyzed by the CCCC predict an increase in wildfires regardless of change in precipitation (CCCC 2006). If annual precipitation decreases, summer drought would create favorable conditions for fire and subsequently the incidence of wildfires would increase. If annual precipitation increases, an increase in vegetative growth would occur, leading to higher fuel loads and subsequently an increase in wildfires.

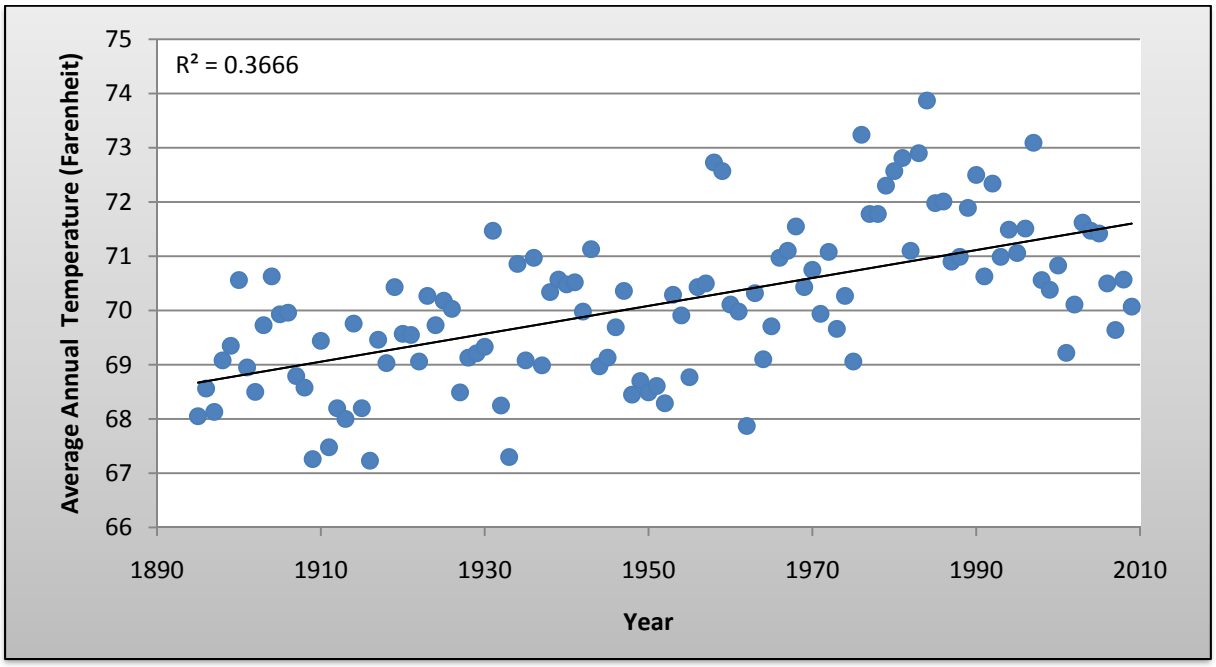
Based on comparisons of the climate scenarios and historic burn data the prediction is for a nine to 15 percent increase in total burn area due to climate change. Additionally, the climate scenarios predict one of the greatest increases in burn area will occur along the coast of Southern California (Lenihan et. al. 2006).



GRAPH A
PRISM Climate Data for the Portuguese Bend Reserve Proposed Restoration Area
Palos Verdes Nature Preserve
Average Annual Temperature

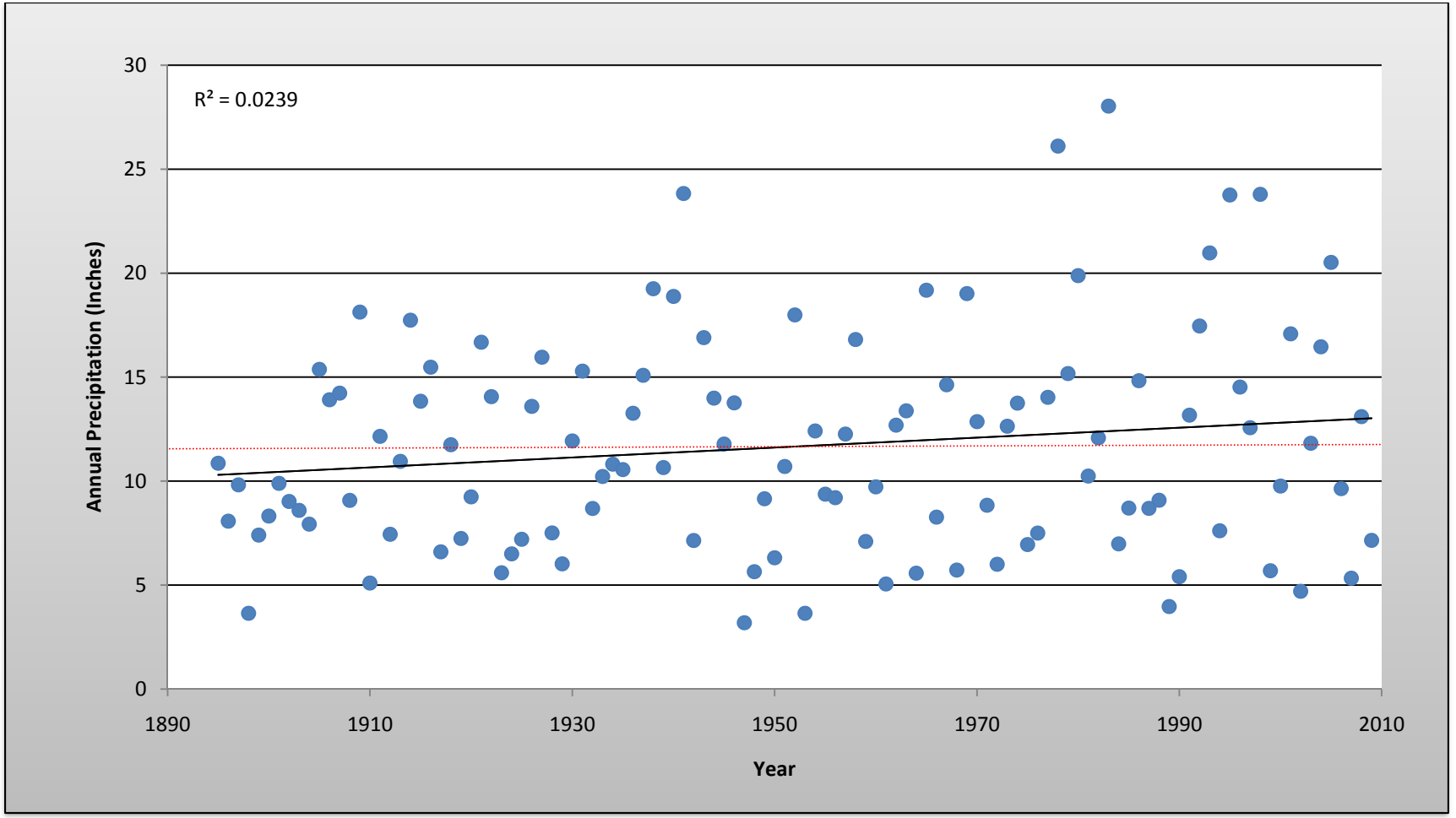


B1. Average Annual Minimum Temperature



B2. Average Annual Maximum Temperature

GRAPH B
PRISM Climate Data for the Portuguese Bend Reserve Proposed Restoration Area
Palos Verdes Nature Preserve
Average Annual Minimum and Maximum Temperature



GRAPH C
PRISM Climate Data for the Portuguese Bend Reserve Proposed Restoration Area
Palos Verdes Nature Preserve
Annual Precipitation

Studies reveal that one of the major determinants of vegetation distribution in California is fire regime. The change in the historic fire regime due to climate change will have dramatic effects on the vegetation communities of southern California. Studies of the shrub communities along the central coast of California have shown that woody vegetation communities are replaced by grassland communities when the time interval between fires is shortened as a result of the weakened resilience of woody species to regenerate after repeated burns (Keeley 2002; Callaway and Davis 1993).

3.2.1.4 VEGETATION DISTRIBUTION

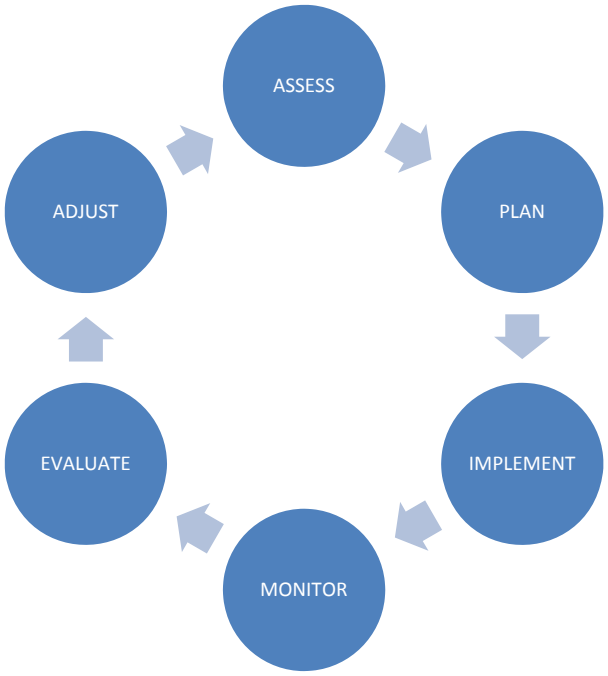
A study by the California Climate Change Center submitted in February of 2006 was conducted to simulate vegetation distribution patterns across the State of California in relation to future climate change scenarios. The study set out to simulate the response of vegetation to future climate change using a dynamic global vegetation model. Three climate change scenarios were used for the simulation. All three climate change scenarios involved an increase in temperature; however, the increase ranged from a slight increase to a large increase in average temperature. Two of the climate change scenarios predicted drier conditions and the climate scenario with the smallest increase in temperature predicted wetter conditions.

Based on the three climate change scenarios on the distribution of vegetation in California, all scenarios analyzed predicted a decrease in shrub land vegetation communities, which includes CSS. In all three scenarios, shrub land vegetation was replaced by grassland and the transition is attributed to increased frequency of wildfires (Lenihan et. al. 2006).

The climate data results predict type conversion of the vegetation from shrub land to grassland will likely be a result of the increased frequency of wildfires and not directly correlated to changes in temperature and precipitation. Therefore, it is concluded that CSS restoration is suitable in the Portuguese Bend restoration area. Utilizing a diverse seed mix and incorporating many early successional species into the plant palette will facilitate regeneration of the restoration areas to CSS and cactus scrub after disturbance, such as fire, to prevent the transition of the habitats to a grassland community.

3.2.2 ADAPTIVE MANAGEMENT

An Adaptive Management approach is proposed for the implementation of the Portuguese Bend restoration area HRP. The framework of an Adaptive Management approach is detailed in the following six-step process (Ecological Restoration Institute (ERI) 2009).



Adaptive Management is a framework that will allow for adjustments to management actions by incorporating flexibility into the plan (ERI 2009). Many fluctuating variables that influence native vegetation can affect the success of a restoration project, i.e. weather conditions, distribution and composition of exotic species, adjacent land management activities, etc.

The benefit of an adaptive management approach is the incorporation of regular monitoring of site conditions during the various stages of restoration that will provide important information to facilitate adjustment to the management approach if necessary. As changing conditions emerge, the effect on the restoration area can be recognized by regular monitoring of the site. Therefore, monitoring is a key component of adaptive management and is necessary for tracking changes to a restoration site over time. Prior knowledge and experience coupled with new research can guide adjustments to the HRP while still following the objectives of a restoration plan.

An adaptive management approach is crucial in the current restoration environment because of future global climate change. Several climate models predict an increase in temperature and changes to annual precipitation amounts that will have dramatic effects on vegetation. Therefore, it is essential to adopt a management approach that can address, track, and adjust to unknown variables that the adaptive management approach will provide.

3.2.3 Ecological Succession Model

Ecological succession is the change in species structure within an ecological community over time. The CSS ecological community has adapted to wildfire and recovers from wildfires along an ecological succession trajectory to a mature CSS stand. Using knowledge of CSS sites recovering from wildfire by observing the changing structure of the species composition over time is the basis for the ecological succession model for this HRP.

The ecological succession model for this HRP will involve using a seed mix that incorporates a broad range of appropriate native plant species that will mimic the succession of the CSS community after wildfire. The overall strategy is to rely on seeding to establish the proposed native habitat restoration types. Initially, fast growing, early germinating native annuals that are incorporated into the seed mix will out-compete exotic weeds and will dominate the restoration site over the first several years. In the following years, slower developing perennial species will begin to dominate beyond the third year of establishment.

Relying on seeding for habitat restoration will ensure the native plant species will develop in their preferred microclimate within a restoration site. A seed bank of the early successional species and later successional community stages, will build up over time. The seed bank will provide the basis for self-recovery of the restoration site in the event of natural perturbation. Seeding with fast growing early successional native species will encourage early development of arbuscular mycorrhizal associations between plant roots and fungi across the restoration site. Such associations are beneficial in establishing and maintaining native habitats and excluding some exotic species including mustards.

A broad seed mix is even more essential in the current restoration environment because of the changes that may occur from future climate change. A diverse seed mix of native species in terms of successional plant communities was built into the plant palettes for the Portuguese Bend restoration area. The species incorporated in the plant palettes have varied life form characteristics such as annuals and perennials, early and late season, and high and low drought tolerant species of all growth habits from grasses to herbaceous to shrub species.

3.3 RECOMMENDED METHODS FOR HABITAT RESTORATION

The restoration activities recommended for the HRP include, but are not limited to, site preparation, seeding and limited planting, weed management, and remedial seeding, if necessary. The following sections discuss general methods of recommended restoration actions. These recommended methods have been used successfully within the Palos Verdes Nature Preserve, as well as other CSS restoration sites in Los Angeles and Orange Counties.

3.3.1 SITE PREPARATION

Each of the three 5-acre restoration areas will require several seasons of site preparation weed control. Methods used for site preparation will vary depending on the type and density of exotic species present, density of native species, and access.

Site preparation will need to be performed for a minimum of one year prior to installation; however, two years of site preparation is recommended in Restoration Area 2 and 3. To implement two years of site preparation for Restoration Areas 2 and 3, the first year of weed control in these Restoration Areas can occur concurrently with the site preparation in progress for the present phase of the three year restoration. For example, site preparation can begin in Restoration Area 2 in the same year as site preparation in Restoration Area 1, followed by another year of site preparation activities in Restoration Area 2 for a total of two years of weed control.

More site preparation is required in Restoration Areas 2 and 3 because of the high density of exotic species and extensive weed seed bank that has accumulated over several decades in the degraded areas from past disturbance. Greater restoration success can be accomplished by spending more time controlling exotic species prior to installation of native seeds and plants to exhaust the weed seed bank, particularly for fennel and mustard species. If two years of site preparation followed by 5 years of maintenance is not possible due to budgetary constraints, it is recommended that more time should be spent for site preparation weed control in lieu of establishment maintenance post installation.

Regular monitoring during site preparation will be required for successful weed management. Monitoring is necessary to guide scheduling and particular control methods for the specified invasive species according to the phenology of each target weed species. Areas should be evaluated after each weeding event to assess the progress of site preparation and to plan the next step. Areas will be released for seeding and planting depending on whether enough progress has been made in management of the weed species.

In summary, the following methods will be employed over the Portuguese Bend restoration area in various combinations based on an adaptive management approach for site preparation.

- Cutting/goat grazing for annual grasses and mustards with at least three control events prior to installation;
- Hand pulling of seedlings and saplings where feasible;
- Specific herbicide application for target weeds such as sweet fennel, Peruvian pepper, and coastal wattle;
- Following site preparation weed control and prior to installation seeding; weed thatch will be evaluated and removed, as necessary, to facilitate seed/soil contact.

3.3.1.1 FENCING

Protective fencing delineating the perimeter of the restoration area to keep pedestrians out during plant establishment is recommended. Installation of the protective fencing should occur prior to any restoration activities and should consist of metal T-bar posts at 30-foot intervals with bright yellow nylon rope attached at a height of approximately four feet. This type of fence is strong and simple enough to be an effective barrier to humans, while not being an impediment to wildlife movement. The fencing material can also be easily removed without damage to the vegetation at the end of the vegetation establishment period. All-weather and graffiti protected signs should be placed at a few key locations along the fencing with information explaining the sensitivity of the restoration area, a no trespassing request, and a contact phone number for further inquiries about the project.

3.3.1.2 EXOTIC SPECIES CONTROL

All areas to be restored are presently dominated by exotic species. Weed control will be required to thin or remove exotic mustards, annual grasses, fennel, Peruvian pepper, and coastal wattle. Weeds shall be controlled before seed production to limit accumulation of the weed seed bank on the site. Weed control will include a combination of the following methods based on the conditions of the restoration areas.

The recommended control methods for the weed species are based on experience in Southern California, specifically within the Palos Verdes Nature Preserve, Puente Hills Preserve, Irvine Ranch Land Reserve, and the Nature Reserve of Orange County as well as other natural conservation areas within Los Angeles County. Methods have been cross-referenced using CalWeed Database of the California Interagency Noxious Weed Coordinating Committee and Invasive Plants of California Wildlands (Bossard et. al. 2000).

For efficient control of exotic invasive species, weeds must be controlled before they produce viable seed and are therefore no longer contributing to the seed bank. Methods of control will depend on the target species, the density of the target species, the area of infestation, and the ecological sensitivity of the existing habitat. Weed removal will employ hand pulling as well as mechanical methods, such as mowing and weed whipping. Limited use of selected herbicides is specified when no other effective alternative is feasible to remove and control the high priority invasive exotic species. Herbicide treatment is specified for mainly invasive weed species that may re-sprout from tap-roots or stumps. Only herbicides registered for use in California wildlands would be used judiciously in the Portuguese Bend Reserve.

A number of native species in varying densities occur within the restoration areas. Control methods need to be implemented with care to limit damage to native species. Areas with native species will be marked in the field by PVPLC staff prior to site preparation activities.

BIOLOGICAL CONTROL METHODS

A potential biological control method that could be used in the restoration areas during site preparation to control dense stands of exotic mustards and annual grasses is managed goat grazing. Goat grazing has been successfully used as a weed control method on other restoration projects with the Palos Verdes Nature Preserve (Verdone 2010).

Grazing activities should occur in the early spring through early summer to control the mustards and non-native grasses prior to the weed species setting seed. Particularly, grazing for non-native grasses should occur prior to seed set since seeds of grasses such as ripgut brome decrease palatability. Repeated treatments would be necessary to control the weed species. The follow up treatments shall be scheduled based on monitoring of the restoration areas after the initial grazing treatment and scheduled based on development of subsequent stand of weeds.

The goat herd should be closely monitored during grazing activities to ensure proper control of the target weed species, prevent overgrazing and erosional damage, and to limit damage to native species that are present in the treatment area.

CHEMICAL CONTROL METHODS

Herbicide treatment is specified mainly for high priority invasive weed species that may re-sprout from taproots or rhizomes. Limited use of selected herbicides is specified when no other effective alternative is feasible to remove and control the high priority invasive exotic species. For efficient control of exotic invasive species, these weeds must be controlled before they produce viable seed. Most herbicides are not selective for weeds only; in other words, herbicides must be applied with the least harmful effect to non-target native species.

Only herbicides registered for use in wildlands should be used judiciously within the restoration areas. Herbicides that are registered for use in California for natural areas are recommended for particular weed species at specific rates noted on the labels. The recommended herbicides registered for use in California that are proposed in this HRP are glyphosate, a non-specific herbicide registered for use on almost all weed species, clopyralid for the treatment of thistles in the rosette stage, fluazifop-p-butyl to control grasses, and triclopyr for stump cut treatment of Peruvian pepper. The following types of applications are recommended for each herbicide.

- clopyralid (e.g. Transline®) will be specified for foliar spray applications at application rates recommended on the label.
- Fluazifop-p-butyl (e.g. Fusilade®) will be specified for foliar applications at application rates recommended on the label.
- Glyphosate (e.g. Round-up®) concentrations shall be used according to the type of application required as per the product label for foliar spray application and cut stump treatment.
- Triclopyr (e.g. Garlon 4) will be specified for stump cut treatments of woody species at application rates recommended on the label.

PVPLC maintains a pest control business license which requires that at least one individual employed by the business be in possession of a qualified applicator's license. All licenses must be issued by the State of California and be currently registered in Los Angeles County. If a qualified applicator is not present during the herbicide treatment, all applicators must have undergone documented herbicide application training. Personnel must wear all protective clothing required by law and follow all label directions and precautions. All re-entry times specified on an herbicide label shall be observed and posted. Herbicide preparation shall be allowed only in approved staging areas more than 100 feet from a stream course or body of water.

A brightly colored dye is recommended in all herbicide applications to aid the applicator in achieving good coverage of the target species. The material shall be a non-toxic material such as Blazon®, Turf Mark® or the equivalent. The dye shall be mixed with the herbicide at no more than half the rate specified on the label.

Herbicide treatment shall be conducted only when weather conditions are conducive to effective uptake of the herbicide by the target species (e.g. sunny, dry with ambient temperatures 65 degrees Fahrenheit) and when plants are at the specified growth stage. Wind conditions should be five mph or less to minimize herbicide drift. Treated plants or stumps shall not be disturbed until the applied herbicide has had time to take effect per the manufacturer's instruction.

Foliar Spray Treatment

The foliar spray treatment involves applying a select herbicide at a specified concentration directly to the exposed foliage of the invasive species. In order for the foliar spray treatment to be effective, the exposed foliage needs a thorough coating of herbicide. The foliar spray treatment is typically best used on small statured plants to ensure adequate cover of the herbicide.

The disadvantage of the foliar spray treatment is the potential for damage to desirable species in the restoration area, especially if a non-selective herbicide like glyphosate is used. Additionally, the foliar application method is ineffective on invasive plants with thick waxy cuticles.

Stump Cut Treatment

The stump cut treatment method, used for woody or bulb forming species, is a process of cutting the stump of an invasive species flat at about 8 to 10 inches above the ground then treating the exposed cambium of the cut stump with a select herbicide at a specified concentration. A phased treatment is recommended for the control of invasive species in this HRP.

- Phase 1: The plants shall be cleanly cut, horizontally, close to the ground (using a saw, rotary brush cutter or similar tool). All the cut vegetation shall be removed from the project area the same day it is cut and disposed of legally off-site.
- Phase 2: The stumps or stems shall be re-cut, cleared of sawdust, and immediately painted with 100 percent herbicide within two minutes of cutting before the cut surface begins to congeal to ensure penetration of the herbicide. Plants should be checked a month after application to determine the success of the herbicide treatment. Any re-growth from the treated stumps should be treated with the foliar herbicide application in the same season or as re-growth appears in the next growing season.

The advantage of the stump cut treatment is the low quantity of herbicides required to treat the invasive species and the localized application of the herbicides reduces the likelihood of herbicide contact with non-target, i.e. native species, during application.

PHYSICAL CONTROL METHODS

Physical methods of weed control that are recommended in this HRP to use during site preparation are mechanical methods such as weed whipping/mowing and hand-pulling. Pulling can be accomplished by hand or with tools to treat isolated individuals of exotic species.

Mowing/Weed Whipping

Repeated mowing or weed whipping treatments prior to seeding is in general the most efficient and least disruptive site preparation method to use in areas dominated by annual grasses and mustards. Mowing can accomplished by machine on gentler terrain, or by hand-operated mowers on steeper terrain. Weed whipping can be accomplished with a gas operated weed whip fitted with a brush blade, or similar implement. Hand operated mowers and weed whips should be used in areas with a high density of native species present. Fire prevention measures must be taken to avoid accidental fires from sparks during machinery operation and these measures may be extensive during the dry season.

Raking and removal of the weed biomass after mowing or weed whipping is not necessary after each control event unless the weed species has set seed. Removal of the controlled weed material is recommended prior to seeding to ensure good seed to soil contact.

Hand/Mechanical Pulling

Isolated individuals of select invasive species can be pulled by hand or with a tool such as the Weed Wrench™. Pulling of weeds is one of the least disruptive methods of site preparation, but is not an efficient method of weed control in dense stands of weed species. The hand-pulling should be reserved for controlling isolated individuals, in areas that are not accessible by equipment, or when high densities of native species are present. When pulling is the weed control method used, as much of the root as possible should be removed, especially weed species with a long tap root such as mustard.

SPECIES SPECIFIC CONTROL TREATMENTS

The following guidelines for weed control treatments shall be followed for each specified weed species:

Black mustard (*Brassica nigra*)

All individuals of black mustard shall be removed from the restoration areas. Treatment of black mustard should occur prior to the development of seed pods. Dense stands of black mustard can be controlled by cutting or grazing the plants as close to the ground as possible to limit re-sprouting. Repeated treatments of cutting or grazing shall be used for the control of mustard during the site preparation phase. Isolated individuals of mustard can be pulled by hand or with a Weed Wrench™. As much of the tap root as possible should be removed to prevent re-growth. Individual plants can also be cut below the root crown with a pick or shovel. Foliar application of herbicide can be used when cutting or hand-pulling is not feasible. A two percent solution of glyphosate should be used and applied prior to flowering.

Non-native grasses (*Bromus diandrus*) and (*Avena Fatua*)

All individuals of non-native grasses shall be removed from the restoration areas. Treatment of non-native grasses should consist of cutting as close to the ground as possible to ensure the removal of the bolting crown of the plant. Goat grazing is another option for control of dense stands of non-native grasses. Foliar application of the grass specific herbicide fluazifop-p-butyl can be used when other treatment methods are not feasible. Control methods should be done in the spring time when non-native grasses are actively growing but before seeds reach maturity. Repeated treatments should be used for the control of non-native grasses during the site preparation phase.

Peruvian pepper (*Schinus molle*)

All individuals of Peruvian pepper shall be removed from the restoration areas. For larger individuals, the stump treatment method should be used and treatment should be in spring when the pepper tree is actively growing. Application of 100 percent triclopyr should be applied to the cut stump immediately after cutting. A phased treatment method is recommended as described above. Plants should be checked one month after herbicide application to determine the success of the treatment. Any re-growth from the treated stumps should be treated with foliar application of herbicide in the same season or as re-growth appears in the next growing season. Re-sprouts should be treated with a foliar application of two percent triclopyr or glyphosate. Peruvian pepper seedlings can be pulled with good results as long as majority of the root is removed.

Coastal wattle (*Acacia Cyclops*)

All individuals of coastal wattle shall be removed from the restoration areas. For larger individuals, the stump treatment method should be used and treatment should occur in spring when the acacia is actively growing. Application of 100 percent triclopyr should be applied to the cut stump immediately after cutting as described above. Plants should be checked one month after herbicide application to determine the success of the treatment. Any re-growth from the treated stumps should be treated with foliar application of herbicide in the same season or as re-growth appears in the next growing season. Re-sprouts should be treated with a foliar application of two percent triclopyr or glyphosate. Coastal wattle seedlings can be pulled with good results as long as majority of the root is removed.

Fennel (*Foeniculum vulgare*)

All individuals of fennel shall be removed from the restoration areas. For larger individuals the stump cut treatment method should be used and treatment should occur in the spring when the fennel is actively growing. Application of 100 percent triclopyr should be applied to the cut stump immediately after cutting. A phased treatment method is recommended as described above. Plants should be checked one month after herbicide application to determine the success of the treatment. Any re-growth from the treated stumps should be treated with foliar application of herbicide in the same season or as re-growth appears in the next growing season. Re-sprouts should be treated with a foliar application of two percent triclopyr or glyphosate. In dense stands of fennel where cutting is not feasible, a foliar application of triclopyr applied in early spring at a rate of 6 lbs/100 gallons of water is the recommended treatment method. Fennel seedlings can be pulled with good results as long as majority of the tap root is removed.

Pine trees (*Pinus* sp.)

All individuals of pine trees should be removed from the restoration areas. Several pine trees killed in the Palos Verde Fire are still standing in the restoration area and should be removed prior to installation of the recommended habitats. A few of the dead pine trees can be left as snags to provide habitat for raptors. Living pine trees in the restoration areas should be controlled and removed from the restoration area. Saplings and small diameter trees can be removed by hand-pulling or use of a tool such as a Weed Wrench™. Larger individuals can be controlled by girdling or removing a strip of the bark and applying a 100 percent solution of triclopyr immediately after bark removal. The tree should be removed from the site once the individual has died.

It may be possible to arrange for removal of the pine trees as part of a state or local fire department training exercise for cutting trees in wildland conditions.

3.3.1.3 SOIL AMENDMENTS

Several soil amendments have been shown to be important tools in native habitat restoration while other amendments are still experimental. Most of these amendments facilitate restoration of the soil ecosystem. The following sections outline the potential use of soil amendments for restoration within the Portuguese Bend restoration area.

ARBUSCULAR MYCORRHIZAL (AM) FUNGI

Studies on the establishment of CSS showed no significant difference in establishment of native species between plots treated with and without commercial AM fungi; although plots treated with AM fungi had less mustard and wild radish (EARTHWORKS, in preparation). It is generally known that the Mustard (Brassicaceae) family is not mycorrhizal, and it is believed that AM fungi may have a detrimental effect on mustard species.

The restoration areas with dense stands of black mustard present may benefit from the addition of AM fungi in the applied seed mix. Also, the AM fungi would aid the establishing seedlings in the uptake of phosphorus and water.

Commercially available *Glomus intraradices* is recommended since this is a ubiquitous species and will not impede the development of other native species. The AM fungi used for the project should be provided by a person or company with experience in AM fungi development. The AM fungi supplied for the project should be applied at the rate of at 60 liters per acre (approximately 3,600,000 live propagules per acre) based on the guarantee of the supplier.

FERTILIZER

Analysis of the soils in the Portuguese Bend restoration area showed sufficient to low major and minor nutrient levels overall. However, general fertilization is not recommended for the restoration areas since lower nutrient soils may favor the establishment of native seedlings over weedy exotic species. Native CSS species are adapted to lower nutrient soils, unlike weedy exotic species. Furthermore, the addition of AM fungi should favor the uptake of phosphorous and nitrogen of the seeded native species.

3.3.2 PLANT PALETTES

Ecologically appropriate plant species are selected for installation in the restoration area. Plant palettes were developed from site specific observations and local reference sites within the Portuguese Bend Reserve. As noted by Bowler (1993), species lists that are based on local intact habitat fragments and nearby undisturbed habitats are essential to a restoration project. Additional regionally native species have been included to aid initial soil development and soil stabilization. A combination of native species has been specified with both above and below ground structural diversity to meet the goals of the project. The range of native plants provides understory species such as perennial grasses and ground covers that have dense root systems to hold surface soils as well as shrub species that have deeper, branching roots to provide stability on the slopes. The combination of species in the plant palettes will provide long-term soil stabilization. The above ground diversity of

structure and height will provide a range of habitats for wildlife that presently is lacking at the site.

3.3.2.1 PROPOSED RESTORATION HABITATS

As previously described, there are two restoration habitats proposed for the Portuguese Bend restoration area. The habits proposed for restoration are CSS and cactus scrub. Three seed mixes were developed for the HRP; two CSS seed mixes for the differing aspects of the slopes in the CSS restoration area and one seed mix for the cactus scrub habitat.

COASTAL SAGE SCRUB

The CSS seed mixes are designed to model species occurring on corresponding aspects in the mature CSS present in the Portuguese Bend Reserve. The species selected for restoration represent the more common and abundant species observed in the existing CSS habitat as well as species that are early colonizers in scrub habitats after disturbance such as fires. Some less common species also have been included in the seed mix to increase the species diversity. Additional species have been included in the seed mix as a nurse crop and for erosion control until CSS species establish in the restoration area. The seed mix and container plant palette are presented in Table 1 and Table 2 respectively for the Northerly facing slopes in the restoration area. The seed mix and container plant palette are presented in Table 3 and Table 4 respectively for the Southerly and westerly facing slopes in the restoration area.

Typical vegetation of the CSS restoration areas will consist of California sagebrush, California buckwheat, toyon, and bush sunflower. CSS is recommended in this HRP to create suitable habitat for the California gnatcatcher, a target Draft NCCP-covered species. It should be noted that based on very local soil conditions, a mosaic of shrubs and native grasses will result from the three types of seeded areas.

Table 1 Coastal Sage Scrub Northerly Facing Slopes Seed Mix

Scientific Name	Common Name	Guidelines for minimum Purity/Germination[1]	Pounds of bulk seed per acre[2]
Artemisia californica	California sagebrush	15/50	2.0
Castilleja exserta	purple owl's clover	50/60	0.5
Deinandra fasciculata	fascicled tarweed	10/25	1.5
Encelia californica	California encelia	40/60	1.5
Eriogonum cinereum	ashyleaf buckwheat	TBD	2.0
Eriogonum fasciculatum	California buckwheat	10/65	3.0
Eschscholzia californica var. *maritima*	California poppy	TBD	1.5
Gnaphalium californicum	California everlasting	10/25	0.5
Hazardia squarrosa	saw-toothed goldenbush	TBD	0.5
Heteromeles arbutifolia	toyon	TBD	0.1
Isocoma menziesii	coast goldenbush	20/40	1.5
Leymus condensatus	giant wild rye	70/80	1.0
Lotus scoparius	deerweed	90/60	6.0
Lotus strigosus	strigose lotus	98/70	1.5
Lupinus bicolor	miniature lupine	98/80	3.0
Lupinus succulentus	arroyo lupine	80/80	1.0
Malosma laurina	laurel sumac	TBD	0.1
Melica imperfecta	melic grass	90/60	2.0
Nassella lepida[3]	foothill needlegrass	70/60	2.5
Nassella pulchra[3]	purple needlegrass	70/60	2.5
Phacelia cicutaria	caterpillar phacelia	80/70	0.4
Plantago insularis [4]	wooly plantain	98/75	20.0
Rhus integrifolia	lemonadeberry	TBD	0.1
Salvia leucophylla	purple sage	70/50	1.5
Vulpia microstachys [4]	small fescue	70/70	6.0

[1] Minimum germination may be adjusted after germination tests on special local collection.
[2] Bulk seed rate may be adjusted depending on results of tests for germination.
[3] Seed of *Nassella* spp. shall be de-awned.
[4] Erosion control and nurse crop species.

Table 2 Coastal Sage Scrub Northerly Facing Slopes Container Plant Palette

Scientific Name	Common Name	Container Size	Container Plant Spacing[1]	Plants per Acre
Bloomeria crocea[2]	blooming stars	bulb	1.5	As-available
Dichelostemma capitatum[2]	blue dicks	bulb	1.5	As-available
Calochortus catalinae[2]	Catalina mariposa lily	bulb	1.5	As-available
			TOTAL	TBD

[1] Spacing = feet on-center distance from other planted bulb species.
[2.] Species should be planted in clay textured soils.

Table 3 Coastal Sage Scrub Southerly and Westerly Facing Slopes Seed Mix

Scientific Name	Common Name	Guidelines for minimum Purity/Germination[1]	Pounds of bulk seed per acre[2]
Artemisia californica	California sagebrush	15/50	2.0
Castilleja exserta	purple owl's clover	50/60	0.5
Deinandra fasciculata	fascicled tarweed	10/25	1.5
Encelia californica	California encelia	40/60	2.0
Eriogonum cinereum	ashyleaf buckwheat	TBD	2.0
Eriogonum fasciculatum	California buckwheat	10/65	6.0
Eschscholzia californica var. *maritima*	California poppy	TBD	1.5
Gnaphalium californicum	California everlasting	10/25	0.5
Heteromeles arbutifolia	toyon	TBD	0.3
Isocoma menziesii	coast goldenbush	20/40	1.5
Lotus scoparius	deerweed	90/60	6.0
Lotus strigosus	strigose lotus	98/70	1.5
Lupinus bicolor	miniature lupine	98/80	3.0
Lupinus succulentus	arroyo lupine	80/80	1.0
Malosma laurina	laurel sumac	TBD	0.1
Melica imperfecta	melic grass	90/60	2.0
Nassella lepida[3]	foothill needlegrass	70/60	3.5
Nassella pulchra[3]	purple needlegrass	70/60	1.5
Phacelia cicutaria	caterpillar phacelia	80/70	0.4
Plantago insularis [4]	wooly plantain	98/75	20.0
Rhus integrifolia	lemonadeberry	TBD	0.1
Salvia mellifera	black sage	70/50	1.5
Sisyrinchium bellum	blue-eyed grass	90/70	0.5
Vulpia microstachys [4]	small fescue	70/70	6.0

[1] Minimum germination may be adjusted after germination tests on special local collection.
[2] Bulk seed rate may be adjusted depending on results of tests for germination.
[3] Seed of *Nassella* spp. shall be de-awned.
[4] Erosion control and nurse crop species.

Table 4 Coastal Sage Scrub Southerly and Westerly Facing Slopes Container Plant Palette

Scientific Name	Common Name	Container Size	Container Plant Spacing[1]	Plants per Acre
Bloomeria crocea[2]	blooming stars	bulb	1.5	As-available
Dichelostemma capitatum[2]	blue dicks	bulb	1.5	As-available
Calochortus catalinae[2]	Catalina mariposa lily	bulb	1.5	As-available
			TOTAL	TBD

[1] Spacing = feet on-center distance from other planted bulb species.
[2] Species should be planted in clay textured soils.

CACTUS SCRUB

The cactus scrub seed mix is designed to model species occurring in existing cactus scrub habitats present in the Portuguese Bend Reserve. The species selected for the restoration represent the more common and abundant species observed in the existing adjacent habitat as well as species that are early colonizers in scrub habitats after disturbance such as fires. Some less common species also have been included. Additional species have been included in the seed mix as a nurse crop and for erosion control until the cactus scrub species establish. The seed mix for the cactus scrub habitat is presented in Table 5 and the container plant palette is presented in Table 6..

Typical vegetation of the southern cactus scrub restoration areas will consist of prickly pear cactus (*Opuntia littoralis*), coastal cholla (*Cylindropuntia prolifera*) California sagebrush, California buckwheat, lemonade berry, and California encelia. Cactus scrub is recommended in this HRP to create suitable habitat for the cactus wren, a target Draft NCCP-covered species.

Table 5 Cactus Scrub Seed Mix

Scientific Name	Common Name	Guidelines for minimum Purity/Germination[1]	Pounds of bulk seed per acre[2]
Artemisia californica	California sagebrush	15/50	2.0
Castilleja exserta	purple owl's clover	50/60	0.5
Deinandra fasciculata	fascicled tarweed	10/25	1.5
Encelia californica	California encelia	40/60	1.5
Eriogonum cinereum	ashyleaf buckwheat	TBD	2.0
Eriogonum fasciculatum	California buckwheat	10/65	6.0
Eschscholzia californica var. *maritima*	California poppy	TBD	1.5
Gnaphalium californicum	California everlasting	10/25	0.5
Isocoma menziesii	coast goldenbush	20/40	1.5
Lotus scoparius	deerweed	90/60	6.0
Lotus strigosus	strigose lotus	98/70	1.5
Lupinus bicolor	miniature lupine	98/80	3.0
Lupinus succulentus	arroyo lupine	80/80	1.0
Melica imperfecta	melic grass	90/60	2.0
Nassella lepida[3]	foothill needlegrass	70/60	2.5
Phacelia cicutaria	caterpillar phacelia	80/70	0.4
Plantago insularis[4]	wooly plantain	98/75	20.0
Rhus integrifolia	lemonadeberry	TBD	0.1
Salvia mellifera	black sage	70/50	0.5
Sambucus mexicana	Mexican elderberry	TBD	0.5
Sisyrinchium bellum	blue-eyed grass	90/70	0.5
Vulpia microstachys[4]	small fescue	70/70	6.0

[1] Minimum germination may be adjusted after germination tests on special local collection.
[2] Bulk seed rate may be adjusted depending on results of tests for germination.
[3] Seed of *Nassella* spp. shall be de-awned.
[4] Erosion control and nurse crop species.

Table 6 Cactus Scrub Container Plant Palette

Scientific Name	Common Name	Container Size[1]	Container Plant Spacing[2]	Plants per Acre[3]
Cylindropuntia prolifera	coastal cholla	1-gallon	3'	40
Opuntia littoralis	coast prickly pear	1-gallon	3'	120
			TOTAL	160

[1] A combination of pads, 1-gallon, and 5-gallon cactus can be used.
[2] Spacing = feet on-center distance from other cactus within planting groups. Spacing of 5-gallon cactus should be 6' from next closest cactus.
[3] Cactus should be planted in groups of 30. Planting groups can consist of a combination of cactus pads, 1-gallon, and 5-gallon plants at the specified number of plants per acre.

3.3.3 SOURCES OF PLANT MATERIAL

To the extent possible, all plant material for the restoration shall be obtained from native plant communities growing within the Palos Verdes Peninsula. For those species that function as erosion control (small fescue and wooly plantain) or do not exist in large enough quantities within the specified seed collection area, it will be necessary to either use seed that is commercially grown or extend the collection area on a species by species basis. The PVPLC has in house capabilities for seed collection or may opt to contract with a seed collection contractor specializing in native seed to ensure that seed material will be collected from Palos Verdes Peninsula and other coastal sites ranging north through Malibu and south through Upper Newport Bay.

3.3.4 SEEDING AND PLANTING SPECIFICATIONS

The following seeding methods will be used for installation of the Portuguese Bend restoration area. Seeds shall be collected in the year prior to planting. Collected seeds should be dried and stored in airtight containers in a cool, low humidity environment until installation begins. Seed application should be timed with the start of the winter rains in late fall/early winter to germinate the seed mix soon after installation and to take advantage of the entire rain season.

3.3.4.1 SEEDING

The following section defines the method of seeding that is best suited in the Portuguese Bend restoration area. The hydroseeding technique is recommended to be used after site preparation weed control and weedy thatch removal from the areas to be seeded.

HYDROSEEDING

Hydroseeding is a seeding method that can be used in all of the restoration areas once weedy thatch has been removed from the areas. A one-step hydroseeding technique shall be used to apply the seed mix as described below. A hydraulic application of a slurry mixture containing water, cellulose wood fiber, seed, and AM fungi is applied as follows:

- 2000 pounds lbs/ac of virgin cellulose wood fiber,
- AM fungi amendment 60 L per acre;
- Specified seed mix;
- 160 pounds lbs/ac organic M-binder.

The hydroseeding method does not require scarifying the ground prior to application of the seed mix; however, dense weedy thatch should be removed. Additionally, raking the seeds into the ground after seed application is not necessary since the cellulose wood fiber will cover the seed and keep it in place to promote germination and loss of seed from wind, erosion, and seed predation.

3.3.4.2 PLANTING

Planting will consist of planting coast prickly pear and coastal cholla in groups of 30 in the proposed cactus scrub restoration area. The planting groups can consist of a combination of cactus pads, one-gallon, and five-gallon plant material. Spacing of the cactus plants within the planting groups should follow the specifications presented in Table 4.

All container plants are to be planted according to the following specifications:

- Planting holes shall be made with the minimum disturbance to accommodate the containers.
- Prior to planting, the planting hole shall be filled with water, and allowed to drain.
- Plants shall be set in the planting hole so that the crown of the root ball is approximately 0.25 inch above finish grade. Under no circumstance should the plant crown be buried.
- A watering basin shall be provided for each plant approximately 18 inches in diameter.
- Watering basins shall be filled with water after planting, at least twice.

The cactus pads may be salvaged in a specified area by PVPLC staff within the Palos Verdes Nature Preserve. The pads shall be collected at least two weeks prior to installation to allow a hardened callous to develop at the cut location. Installation of the cactus will consist of burying the pad deep enough to cover any root that may have developed and approximately one inch of the pad.

3.3.5 SITE MAINTENANCE

One of the goals for the restoration is to establish native habitats that will be self-sustaining long term. However, initially, maintenance of the restoration areas will be necessary to establish the newly seeded areas. Maintenance will include any activities required to meet the performance standards set forth in this HRP, in the estimation of PVPLC staff. For the Portuguese Bend Reserve, these include the following:

- Weed control, at a minimum for coastal wattle, fennel, mustards, Peruvian pepper, ripgut brome, and wild oats;
- Replacement hand seeding in areas of more than 200 sq. ft where germination of the specified seed mix failed after one good season of rainfall;
- Pest and disease control, if necessary.

The establishment maintenance period will be for five years following installation with the most intense maintenance in the first through third year and only seasonal spot weeding activities in the fourth and fifth years. The amount of maintenance each year will depend on weather conditions, development of the native habitat, and density/species composition of weed species in the restoration areas. The following specifications for maintenance may require adjustments as determined by PVPLC staff over the five-year maintenance period.

3.3.5.1 EXOTIC SPECIES CONTROL

During the active maintenance period, the target cover from exotic weed species will be generally 10 percent or less. Control of the ripgut brome and wild oats is especially important because annual grasses have been shown to compete with shrub species in restoration (Eliason and Allen 1997; Corbin and D'Antonio 2004).

Weed control will occur during late winter through early summer, as necessary, before the weed species set seed and/or before they reach approximately 12 inches in height. Three weeding events should be estimated for a normal rainfall season, with greater or fewer weed events as dictated by rainfall timing and amount. Since removal of weeded material is expensive, weeded material may be left on site as organic mulch material if seeds have not yet set. Removal of herbicide treated material is not an issue.

Weed control during establishment maintenance will mainly consist of hand pulling, mechanical methods, and spot spraying of herbicides for certain species such as coastal wattle, fennel, and Peruvian peppers using methods as described in Section 3.3.1.2.

3.3.5.2 SEEDING REPLACEMENT

Target values for relative cover of the native vegetation, including nurse and erosion control species, will be as follows with at least 50 percent cover in Year 1, mainly from annual plant species. Over the next two years, perennial species will begin to increase in cover, and may comprise 40 percent of the total cover in Year 3. Actual cover values will vary and depend mainly on weather conditions (seasonal rainfall and temperature) during the establishment period.

Areas of significant erosion shall be repaired and re-seeded in the first fall season after damage. Re-seeding will occur in areas if coverage is less than 20 percent of native species over any contiguous area of 200 sq ft.

3.3.5.3 PEST MANAGEMENT

Local wildlife such as rabbits, pocket gophers and ground squirrels may be expected to browse on the native species in the restoration area. If PVPLC staff determines that the restoration areas are being jeopardized by wildlife, corrective measures such as organic,

nontoxic deterrents and fencing/plant cages maybe used. Invertebrate pests are rarely a serious problem in CSS and cactus scrub restoration.

3.3.6 SUMMARY OF IMPLEMENTATION, MAINTENANCE, AND MONITORING

Table 4 summarizes the timing and activities for the implementation, maintenance, and monitoring of the habitat restoration. The timing is described in general terms by season. Exact dates for each phase of implementation and maintenance will depend on the onset and duration of seasonal rainfall as well as other factors such as the temperatures prior to, during and following rain events. However, it is important to plan for the site to be ready to seed by early fall. Rainfall and temperature will define the type and the density of weed species as well as native species that will germinate in any given year and season.

Horticultural monitoring will guide weed scheduling for the project, and there should be a close coordination between the maintenance supervisor and PVPLC staff. Horticultural monitoring should take place daily during seeding, and then weekly until good germination of the seed mix is observed, followed by monthly monitoring during the remainder of the first year. Quarterly monitoring should suffice after the first year through the fifth year.

Table 7 Summary of Implementation and Maintenance Schedule

RESTORATION TASKS	SITE PREP & INSTALLATION†				YEAR 1 MAINTENANCE				YEAR 2 MAINTENANCE				YEAR 3 MAINTENANCE				YEAR 4 MAINTENANCE				YEAR 5 MAINTENANCE			
	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F
Seed Collection		**X**	**X**	**X**	•	•	•	•																
Site Preparation Weeding†	**X**	**X**	**X**	**X**																				
Final Site Preparation: & Weed Thatch Removal				**X**																				
Installation – Seeding				**X**	**X**																			
Maintenance Weeding				**X**	**X**	**X**	•	**X**	**X**	**X**	•		•				•	•			•	•		
Remedial Seeding								•				•												
Horticultural Monitoring		Qt	Qt	W	BW	BW	M	Qt	Qt	Qt	Qt	Qt	Qt	Qt	•		•	•			•			
Annual Performance Monitoring						**X**				**X**				**X**				**X**				**X**		

† = Site preparation weeding may be repeated an additional year
• = If necessary
W =Weekly oversight
BW = Bi-weekly (every other week) oversight
M = Monthly oversight unless conditions require more oversight
Qt = Once per quarter unless conditions require more oversight

4 RESTORATION MONITORING

The restoration site should be monitored annually following installation through the fifth year of maintenance. Reports will be prepared for the restoration areas after installation is complete in years 1 through 3 and year 5. Each report will include qualitative data, photo documentation, and future recommendations for site maintenance. In years 3 and 5, quantitative data will be collected in the restoration areas and be included in the annual report.

Qualitative monitoring should consist of a general description of site conditions including the community structure composition and plant health along with a qualitative evaluation of native plant cover for the restoration areas. Additionally, a summary of the site maintenance performed to date and recommendations for future maintenance activities should be included.

Photo-documentation will consist of establishing permanent photo points in the restoration area to collect photos and track the development of the site over the 5 year maintenance period. The photo point locations should be established at appropriate representative locations within the restoration site.

Quantitative monitoring should consist of field sampling to measure native plant cover, weed cover, and plant composition to evaluate the progress and success of the restoration areas. The point intercept method following the California Native Plant Society field sampling protocol will be used to collect data (Sawyer and Keeler-Wolf 1995).

Annual performance monitoring should take place each year in mid-spring or as close to mid-spring as each year's rainy season permits to capture the majority of annual as well as perennial CSS species. Results from the annual performance monitoring will be used to evaluate the progress of each habitat toward the ultimate goals of the project. Performance monitoring should be conducted by qualified plant ecologists.

4.1 RESTORATION GOALS

Restoration criteria have been developed to assess the functions and values of the CSS and cactus scrub restoration areas to evaluate the development of the site and progress towards reaching the final goals of the project. Thus, the restoration will be assessed as the habitats develop trends in cover, species diversity, as well as soil development so that the habitat quality of the site is restored. Specifically, the restoration will be evaluated by the following criteria for the specified habitats:

Coastal Sage Scrub

- Soil at the site is stable and shows no significant erosion
- After the fifth year of maintenance, non-native plant cover is less than 25% with less than 5% cover of invasive perennial species and there will be no Cal-IPC List A species present with the exception of non-native annual grasses.
- Native plant cover after the third year of maintenance in the CSS community should be greater than 40% with at least 30% cover from perennial species. At the end of the fifth year of maintenance, total native cover should be greater than 50% cover.

Cactus Scrub

- Soil at the site is stable and shows no significant erosion
- After the fifth year of maintenance, non-native plant cover is less than 25% with less than 5% cover of invasive perennial species and there will be no Cal-IPC List A species present with the exception of non-native annual grasses.
- Native plant cover after three years in the cactus scrub community should be greater than 30% with at least 20% cover form perennial species and 5% cover from cactus species. Native plant cover after five years in the cactus scrub community should be greater than 40% with at least 10% cover from cactus species.

4.2 QUANTITATIVE MONITORING METHODOLOGY

The quantitative variables measured in the third and fifth year of performance monitoring are based on the goals of the project, development characteristics of the CSS and cactus scrub community, and the restoration criterion outlined above. Variables will include native species cover, exotic species cover, percent bare ground and litter, as well as species frequency and seedling frequency in monitoring transects. Where applicable, shrub height will also be measured to provide an additional parameter to assess habitat suitability. The number of sampling transects in each restoration area will be determined to ensure statistical confidence based on the variation over the site, but generally one transect for every two acres for each habitat type is sufficient.

4.2.1 COASTAL SAGE SCRUB AND CACTUS SCRUB QUANTITATIVE VEGETATION SAMPLING

Vegetation sampling of the CSS and cactus scrub habitat will utilize the point-intercept method to measure vegetation cover. The point intercept method is well suited to measure scrub vegetation and will provide the most efficient method for estimating cover and species composition over the restoration site. This method has been tested within the Nature Reserve of Orange County for accuracy and efficiency for estimating vegetation cover as documented by Deutschman and Strahm (2009).

Quantitative monitoring should consist of 50-meter fixed transects randomly selected over each restoration area with the same transect locations used each year for monitoring. Locations of transects will be determined randomly within the restoration area using a numbered grid system. At each fixed transect, a 50 meter tape will be stretched taut. Fifty points will be sampled at each transect along the tape at 1 m intervals starting at 1 m and ending at 50 m. A one meter long, 1/4 inch round steel bar will be placed vertically at each sampling point, consistently on the same side of the tape.

All live species that contact the bar, or in the case of overhanging vegetation, intercept the upward projection of the bar are counted and recorded. If no vascular plants are intercepted at a sample point, it is recorded as "bare." Total cover is based simply on how many points are covered by vascular plants, regardless of the number of plant species overlapping a given point. In other words, total cover is based on how many points are not recorded as bare of vascular plants. Since several plants often overlap a single sample point, the sum of individual species covers is generally more than the total cover.

Seedlings will be identified for shrubs and sub-shrubs and will be determined by being small in size, having a non-woody base, and usually the result of germination during the same year as the transect reading. Juveniles and adults will be identified as definitely woody at the base of the stem, with adults in flower and/or with seed. Litter will be recorded in areas of no vegetative cover but with dead vegetative matter covering the ground. Data on the height of the shrubs will also be recorded for all woody shrubs contacted by the bar along each transect.

Cover will be reported as total percentage of points with native plants; cover will also be reported for individual native species and exotic species. Percent cover is determined for a species simply by dividing the number of points covered by that species by the total number of sample points. Total cover is similarly determined. Relative cover for a species is determined by dividing the percent cover for an individual species by the sum of the percent covers for all species (not by total cover). Frequency data will be reported as the percent of transects a species is reported to occur. Height data will be reported as the average height of the shrub species. Species diversity will be a measure of the number of species encountered in transects.

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APPENDIX

APPENDIX A

SOIL SAMPLE RESULTS FOR THE PORTUGUESE BEND RESERVE PROPOSED RESTORATION AREA

WALLACE LABS
365 Coral Circle
El Segundo, CA 90245
(310) 615-0116

SOILS REPORT

Print Date May. 6, 2010 Receive Date 5/5/10

Location Portuguese Bend

Requester Melissa Riedel-Lehrke, New Fields

graphic interpretation: * very low, ** low, *** moderate

ammonium bicarbonate/DTPA * * * * high, * * * * * very high

extractable - mg/kg soil

Interpretation of data

low medium high

	Sample ID Number	10-125-16		10-125-17		10-125-18	
	Sample Description	Sample 2 Mustard		Sample 3 Fennel		Sample 7 Non-native grass	
	elements		graphic		graphic		graphic
0 - 7 8-15 over 15	phosphorus	10.74	***	6.24	**	5.51	**
0-60 60 -120 121-180	potassium	528.03	*****	124.82	****	143.66	****
0 - 4 4 - 10 over 10	iron	3.17	**	6.02	***	2.46	*
0- 0.5 0.6- 1 over 1	manganese	1.63	****	2.82	****	2.62	****
0 - 1 1 - 1.5 over 1.5	zinc	2.24	****	1.39	***	2.29	****
0- 0.2 0.3- 0.5 over 0.5	copper	6.97	*****	3.26	*****	5.31	*****
0- 0.2 0.2- 0.5 over 1	boron	0.14	**	0.08	*	0.08	*
ratio of calcium to magnesium	calcium	389.51	***	364.40	***	381.36	***
needs to be more than 2 or 3	magnesium	312.13	*****	1,129.62	*****	379.45	*****
should be less than potassium	sodium	85.55	**	168.28	***	94.47	**
	sulfur	17.89	*	11.91	*	17.12	*
	molybdenum	0.03	***	0.01	**	0.02	**
	nickel	2.74	**	5.95	***	2.97	**
The following trace	aluminum	n d	*	n d	*	n d	*
elements may be toxic	arsenic	0.02	*	0.05	*	0.02	*
The degree of toxicity	barium	1.13	*	1.46	*	1.44	*
depends upon the pH of	cadmium	2.18	**	0.71	*	1.42	**
the soil, soil texture,	chromium	n d	*	0.02	*	n d	*
organic matter, and the	cobalt	0.07	*	0.10	*	0.06	*
concentrations of the	lead	2.37	**	1.34	**	1.89	**
individual elements as	lithium	0.20	*	0.21	*	0.20	*
well as to their interactions.	mercury	n d	*	n d	*	n d	*
	selenium	n d	*	n d	*	n d	*
The pH optimum depends	silver	n d	*	n d	*	0.32	***
upon soil organic	strontium	0.69	*	1.04	*	0.68	*
matter and clay content-	tin	n d	*	n d	*	n d	*
for clay and loam soils:	vanadium	2.85	***	1.76	**	1.81	**
under 5.2 is too acidic							
6.5 to 7 is ideal	Saturation Extract						
over 9 is too alkaline	pH value	7.51	****	6.67	***	7.19	***
The ECe is a measure of	ECe (milli-mho/cm)	0.62	**	0.27	*	0.69	**
the soil salinity:			millieq/l		millieq/l		millieq/l
1-2 affects a few plants	calcium	65.6	3.3	23.3	1.2	75.3	3.8
2-4 affects some plants,	magnesium	14.9	1.2	11.5	0.9	18.5	1.5
> 4 affects many plants.	sodium	29.3	1.3	30.5	1.3	35.2	1.5
	potassium	12.9	0.3	4.4	0.1	4.0	0.1
	cation sum		6.1		3.6		6.9
problems over 150 ppm	chloride	61	1.7	2	0.1	17	0.5
	nitrate as N	13	0.9	8	0.6	41	3.0
	phosphorus as P	0.5	0.0	0.8	0.0	0.5	0.0
toxic over 800	sulfate as S	14.2	0.9	9.0	0.6	18.4	1.1
	anion sum		3.5		1.2		4.6
toxic over 1 for many plants	boron as B	0.16	*	0.11	*	0.18	*
increasing problems start at 6	SAR	0.8	*	1.3	*	0.9	*
est. gypsum requirement-lbs./acre		1,422		12,934		2,384	
	infiltration rate inches/hour	fair		very slow		very slow	
	soil texture	gravelly clay loam	gravel > 2 mm	clay	gravel > 2 mm	clay	gravel > 2 mm
	sand	25.9%	27.0%	9.3%	11.8%	18.9%	16.5%
	silt	35.7%		28.5%		31.9%	
	clay	38.4%		62.2%		49.3%	
	lime (calcium carbonate)	low		slight		no	
	moisture content of soil	21.0%		20.4%		28.0%	
	half saturation percentage	41.7%		65.2%		40.5%	

ideal percentages of cations				% saturation		% saturation		% saturation
abt 5 %	potassium	millieq K	1.55	4%	0.36	1%	0.48	1%
< 3%	sodium	millieq Na	0.44	1%	0.75	2%	0.54	1%
abt 70%	calcium	millieq Ca	32.51	76%	30.55	61%	34.56	74%
15 - 20%	magnesium	millieq Mg	5.68	13%	14.79	29%	7.40	16%
5-10%	hydrogen	millieq H	2.64	6%	3.76	7%	3.92	8%
		total millieq/100 grams	42.82		50.21		46.91	

Elements are expressed as mg/kg dry soil or mg/l for saturation extract.

pH and ECe are measured in a saturation paste extract. nd means not detected.

Sand, silt, clay and mineral content based on fraction passing a 2 mm screen.