MEMORANDUM

Date:	18 May 2023
To:	Kristen Van Dam
Organization:	East Bay Regional Parks Department
From:	Erik Stromberg & Nat Quek, Restoration Design Group; Jake Schweitzer & Roxanne Foss, Vollmar Natural Lands Consulting
RE:	EBRPD Oak Woodland Restoration Draft Implementation Plan

Kristen:

This document serves as the draft deliverable for Task 3. Preparation of Implementation Plan of the Feasibility Study and Implementation Plan for Oak Woodland Restoration project. The memo outlines site analysis and field methodologies and provides a basis for the accompanying Oak Woodland Restoration Project draft construction drawings. Please note that this draft document is meant as an initial discussion point regarding restoration strategies with the East Bay Regional Park District. We look forward to input and feedback from the District.

Sincerely,

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EBRPD Oak Woodland Restoration
Draft Implementation Plan

Prepared for:

East Bay Regional Park District

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Project Overview

The East Bay Regional Park District (EBRPD), in coordination with the California Native Plant Society (CNPS), is undertaking oak woodland restoration in alignment with the EBRPD Wildfire Hazard Reduction and Resource Management Plan. In 2022, the EBRPD hired Restoration Design Group (RDG) and Vollmar Natural Lands Consulting (VNLC) to select restoration sites based on an environmental and site suitability analysis and develop an implementation plan and construction documents.

As of this draft document, Vollmar Natural Lands Consulting has performed spatial analysis and field surveys and Restoration Design Group has developed the draft implementation plan and preliminary restoration planting plans.

Background Review and Spatial Analysis

1. INTRODUCTION

This report summarizes the initial recommendations for oak restoration efforts as part of the development of an Oak Restoration and Implementation Plan (Plan) for the East Bay Regional Park District (EBRPD or District). This report provides descriptions of 22 potential restoration sites that were assessed in the field in order to support the decision to select at least one restoration site within EBRPD lands. This project falls under the umbrella of the Wildfire Hazard Reduction and Resource Management Plan (WHRRMP) and all potential restoration sites occur within Recommended Treatment Areas (RTAs), where fire fuels (primarily invasive trees) are slated for removal. This report builds on existing site suitability analysis documentation provided by EBRPD as developed by Golden Hour Restoration Institute (2020) and supports effective implementation and maintenance of the selected restoration sites. This section of the report represents the first stage of work, conducted by Vollmar Natural Lands Consulting (VNLC), to inform Plan development by Restoration Design Group (RDG).

2. METHODS

2.1. INITIAL SPATIAL ANALYSIS

All potential restoration areas were selected to occur within 1) defined RTAs; 2) historical woodlands; 3) soil types known to support oak woodlands; and 4) suitable range of lower solar radiation levels. RTAs identify the boundaries of potential restoration activities. Historical woodlands were selected to locate areas that are presumed to naturally support woodlands. Soil types were included as they have inherent properties, such as rooting depth, nutrient levels, and water retention capacity, that can support or exclude vegetation types. Solar radiation was selected based on observations that the most extensive oak woodlands in the East Bay are best developed on north-facing slopes, along drainages, and within other areas of relatively low solar radiation.

Additional parameters were analyzed as well, including precipitation, elevation, hydrology, mapped sudden oak death (SOD) occurrences, Wieslander historical vegetation data, and other available data. These data were not found to be especially useful for oak habitat analysis, were largely inaccurate, or were correlated with the selected factors described above. VNLC conducted initial analysis work using ArcGIS software to identify suitable restoration areas (based on the factors above) prior to conducting field visits.

2.1.1. RECOMMENDED TREATMENT AREAS

As indicated above, RTAs delineate areas targeted for EBRPD fire fuel reduction activities, which often include overstory invasive tree removal. EBRPD staff identified RTAs of interest for habitat restoration based on preliminary modeling and analysis work done by EBRPD and Golden Hour Restoration Institute. RTAs were identified throughout much of the western hillslopes of the greater East Bay Hills, from the hills above Richmond to the hills above San Leandro and Lake Chabot. For this project, EBRPD selected four regions to focus on, including areas near the Golf Course and Inspiration Point in Tilden Regional Park (RP), Skyline Gate in Redwood Regional Park, and areas surrounding Lake Chabot within Chabot RP. Although the majority of the selected RTAs had not yet been treated, some of the RTAs in Redwood RP were undergoing active vegetation treatment and RTA T1012 in Tilden had already been treated.

2.1.2. HISTORICAL WOODLANDS

Within the selected RTAs, VNLC staff mapped the extent of historical woodlands using the earliest available aerial photography, from the late 1930s to the mid-1960s. Specifically, sources include images of Redwood and Tilden RP flown in 1939 (Salomon 2011); images of Anthony Chabot and Lake Chabot RP flown May 1 to June 30, 1965 (California Division of Highways CAS-65-130; UC Regents 1965); and images of Redwood, Anthony Chabot, and Lake Chabot RP taken in 1939 (US Department of Agriculture C-5750; UC Regents 1939). VNLC staff mapped polygons of distinguishable vegetation types to a 0.5-acre minimum mapping unit at a constant scale of 1:3,500. Historical vegetation types were grouped into broad classes to maintain the highest level of accuracy; classes include Woodland/Forest (may include native, non-native, and/or a mix), Savanna, Mix of Woodland and Shrubland, Shrubland, Mix of Shrubland and Grassland, Grassland, and Other (developed, glare, etc.). Initial efforts to include additional detail on likely species composition of the Woodland/Forest type were discontinued and habitat coding focused on a more inclusive definition of areas historically supporting stands of trees.

2.1.3. SOIL UNITS

In order to identify soil units associated with oak habitats, VNLC staff identified soil units by using GIS software to overlay oak habitat GIS data with Alameda and Contra Costa County soil survey spatial data (USDA 2010, USDA 2005, respectively). The oak habitat data is contemporary plant community mapping produced for EBRPD and East Bay Municipal Utility District (EBMUD) lands (EBRPD 2021, EBMUD 2000). Oak

habitats, for the purpose of this analysis, include "Oak Forests" and "Woodlands and Savanna" from the EBRPD dataset, and "Oak Woodland and Forest" from the EBMUD dataset. EBMUD-mapped oak savanna habitat was excluded as it was very limited in extent and, within the RTAs, inconsistently mapped. Within Alameda County, the most common soil types found associated with oak habitats include Los Gatos-Los Osos complex, 45 to 75 percent slopes, eroded (representing 31% of oak habitat); Millsholm silt loam, 45 to 75 percent slopes, eroded (18%); and Millsholm silt loam, 30 to 45 percent slopes, eroded (9%). Within Contra Costa County, the most common soil types associated with oak habitat include Millsholm loam, 50 to 75 percent slopes (representing 19% of oak habitat), and Los Osos clay loam, 30 to 50 percent slopes (19%). All other soil types cumulatively covered less than 8% of mapped oak habitat and were not selected for analysis. Based on these results, all Los Gatos, Los Osos, and Millsholm soils (Table 1) were selected as suitable for oak restoration in the analysis. These soil types are all common in the region.

Table 1: Soil Properties of Soils Associated with Oak Woodlands (USDA 2010, 2005)

Soil Series	Detail	Texture	Drainage	Permeability	Parent Material	Root Zone
Los Osos	South facing	Silty clay loam	Well drained	Slow	Sedimentary, weathered shale	24-40 in
Los Gatos	North facing	Loam	Well drained	Moderately slow	Sedimentary, sandstone	24-40 in
Millsholm	Shallow	Silt loam	Well drained	Moderate	Shale and fine-grained sandstone	10-20 in

All slope classes for the selected soils were included in the analysis because limiting by soil slope class significantly reduced suitable areas for restoration. Additionally, the role of slope in determining suitability for oak habitat is captured more accurately within the solar radiation parameter.

2.1.4. SOLAR RADIATION

VNLC staff characterized solar radiation values associated with mapped oak habitat described above. The solar radiation values within mapped oak habitats are derived from the 10-meter digital elevation model (USGS 1998) grids available for all potential restoration areas. The Area Solar Radiation tool in ArcMap 10.3.1 uses topographic data and the direction of the sun's movement across the sky at a given latitude to create a relative solar exposure value across the defined area, as measured in kilowatt-hours. Topographic parameters accounted for include slope, aspect, and surrounding topography (e.g., hillslopes capable of blocking sun rays regardless of a specific site's slope and aspect).

Areas of solar radiation values below the mean value associated with oak woodlands (EBRPD and EBMUD oak data—see Section 2.1.3) were extracted as likely optimal areas for restoration, given that higher moisture associated with low solar radiation would likely be more suitable, especially in the absence of irrigation. Solar radiation values were extracted separately within the two primary southern and northern study area regions (Redwood RP and Chabot RP versus the Tilden Park areas). Within the two regions of the greater study area region, VNLC staff mapped areas below the mean solar

radiation value with a 0.5-acre minimum mapping unit at a 1:3,500 scale. Mapped polygons primarily reflected north-facing slopes and draws.

2.1.5. SITE SELECTION PARAMETERS

Potential restoration areas were identified as areas that were considered suitable for oak habitat according to the primary parameters described above, namely low-solar radiation areas with suitable soil types that supported historic woodland or forest. Areas fitting all three of the above parameters were digitized and mapped as GPS background files for field investigation. Individual parameters were also depicted in order to guide field checking of areas that may not have fit all three parameters.

Restoration Site Selection

3. FIELD SURVEY METHODS

Potential restoration areas identified during the spatial analysis were selected for field surveys, although nearby areas were also investigated in order to compare ecological conditions. Areas closest to the sites identified in the project Request for Proposals (RFP) were prioritized over other sites. These include the four major areas in the vicinity of the Tilden Golf Course, Inspiration Point, Skyline Gate (Redwood RP), and Lost Ridge (Anthony Chabot RP).

A GPS data dictionary was developed to facilitate standardized data collection within targeted polygons. Data collected at representative sites include the following parameters, as visible from the point of collection—roughly 0.5 acre (~150x150 feet, or 75 feet on all sides):

1. Habitat type (i.e., *Eucalyptus* or *Pinus*)
2. Other dominant trees
3. Dominant shrubs
4. Dominant herbs
5. Approximate number of oak trees, both adults and saplings/seedlings (recorded separately)
6. Approximate number of California bay (*Umbellularia californica*), both adults and saplings/seedlings (tracked as the primary vector of Phytophthora ramorum, the pathogen associated with SOD)
7. Presence and relative abundance of SOD
8. Presence and relative abundance of invasive weeds
9. Relative depth of litter/duff from *Eucalyptus* or *Pinus*
10. Soil conditions—qualitative assessment of surface texture and color (used to confirm accuracy of soil unit mapping)
11. Relative ease of access for restoration
12. General notes (primarily relating the data point location to surrounding areas)

VNLC Senior Ecologists Jake Schweitzer and Roxanne Foss surveyed the targeted RTAs and surrounding areas on April 21 and May 12, 2022. Mr. Schweitzer and Ms. Foss conducted an additional field survey on January 27, 2023, to assess an additional RTA of interest in Tilden RP. The ecologists walked meandering transects through the selected areas, stopping in representative areas to collect GPS points and record the parameters listed above using the data dictionary. They also took photographs of representative site conditions at survey points as well as additional photos to support findings. More general habitat data were recorded outside of potential restoration areas to provide context and ground-truthing of methods. The ecologists corresponded regularly during the surveys to ensure methods were consistent and calibrated to each other.

4. VNLC ASSESSMENT RESULTS

VNLC identified potential restoration areas within RTAs of interest in the four primary study areas (Tilden Golf Course, Inspiration Point, Skyline Gate, and Lost Ridge). Key opportunities and constraints pertinent to potential restoration areas within each region are summarized in **Tables 2 through 5** and depicted in **Figures 1 through 9** in Appendix A.

The results account for the remote analyses as well as multiple parameters documented during field surveys, including the apparent symptoms of sudden oak death, the presence of California bay trees, the presence of invasive plants aside from the invasive trees, the presence of existing native oaks, site accessibility, and topographic conditions. The presence of California bay trees, especially mature trees, is considered a constraint for EBRPD restoration efforts due to their potential to transmit SOD and related to challenges in removing many large individuals from a potential restoration site. Fuel treatment efforts include eradication of problematic invasive plant species, so the presence of such taxa is described to indicate level of existing disturbance, potential challenges for restoration, and suitability for ongoing weed treatment. Since invasive plants are considered problematic for other reasons, EBRPD managers consider their removal during fuels management to be opportunistic, representing an added benefit of the treatments, though management of such species could increase the cost of fuels treatments. Areas of notably steep slopes (e.g., >20-40%) are also less preferred by EBRPD due to impeded access and potential erosion concerns. The presence of oak trees, including seedlings, saplings, and mature trees, is considered to increase the restoration potential of the sites, since their presence is likely indicative of potentially suitable habitat conditions. Recommendations based on field survey results are provided below for the surveyed RTAs in order to inform future restoration efforts.

4.1. TILDEN GOLF COURSE

EBRPD indicated that restoration at RTA T1012, located near the Tilden Golf Course, would be ideal based on accessibility, visibility to the public, and timing of treatment. EBRPD also selected a minimum restoration area of 0.5 acre with a goal of restoring up to 10 acres in as contiguous an area as possible, and there are several sites that are well over the minimum size and are close to 10 acres. This RTA is also particularly suitable because many target *Eucalyptus* trees had already been removed and additional treatment

is planned for the near future. A subset of this RTA was selected for imminent work, which is depicted in **Figures 2 and 3** (Appendix A). Restoration work may occur in stages: 1) within treated areas that will not be revisited, 2) within areas after treatment in 2023-2024, and 3) in areas treated later in the future.

Seven potential restoration sites were assessed within RTA T1012 (**Table 2** and **Figures 1 through 3**). Of the seven potential restoration areas, all are greater than 0.5 acre. TGC04 was only briefly assessed and dismissed based on relatively intact native, mesic habitat. Four of the sites are at least partially treated to remove individual Tasmanian blue gum (*Eucalyptus globulus*) and/or Monterey pine (*Pinus radiata*) trees. As indicated above, the majority of the sites are relatively easy to reach and relatively visible to the public. Two of the seven potential restoration sites were identified during field examination and occur in areas with slightly higher than mean solar radiation for occupied oak habitat. As such, the Tilden Golf Course region is the only area where the recommended restoration areas extend beyond modeled habitat, though as discussed below, locally occurring summer fog may at least partially offset solar radiation in the area.

The western half of TGC01 is already treated and likely suitable for oak woodland restoration based on the modeled habitat parameters and the presence of oak trees in the vicinity. However, the relatively high cover of native herbaceous species indicates this location is already supporting desirable native species that would be impacted by oak restoration work. The eastern half of the site is relatively intact and supports higher cover of California bay and coast redwoods (*Sequoia sempervirens*), indicating this area may naturally support a more mesic and shade-tolerant community. TGC02 follows a shaded north-facing slope along Golf Course Road, which is planned for treatment in the near future. However, the area of planned treatment is relatively narrow and follows the road. Multiple problems were observed with this area, including 1) the narrow treatment band increases exposure to SOD transmission in an area with high California bay cover; 2) oak restoration should occur at least 10 feet away from roads and utility lines to reduce impacts to the future habitat; and 3) the high cover of native species associated with target problematic taxa would allow for natural succession to California bay, coast redwood, coyote brush (*Baccharis pilularis*), and small patches of oak woodland.

Both TGC03 and TGC04 had relatively intact native habitats that would naturally recover after target trees were removed.

Three of the sites (TGC05, TGC06, and TGC07) are most suitable for restoration based on field observations, though only TGC06 and TGC07 have been treated, so these may be most suitable; these are depicted in detail on **Figure 3**. TGC06 encompasses an area that is above the mean solar radiation value for oak habitats in the region. However, this area also occurs within a topographic bowl that may be slightly more mesic, and it is also possible that the calculated higher solar radiation in the area, which is primarily a function of topography, may be partially offset by the prevalence of summer fog, which is generally more common near the adjacent ridge top than in areas down-slope and to the east. Summer fog could reduce the solar radiation, in terms of direct sunlight as well as associated moisture levels. However, vegetation in the area suggests that solar radiation is indeed relatively high, such that savanna with a mixed understory of annual

grassland and coyote brush scrub taxa may be more appropriate as a targeted restoration habitat. In addition, it may be desirable to reduce tree cover since this area is slated to be part of a shaded fuel break (EBRPD pers. comm.). The northern portion of TGC05 coincides with TGC07, which expands further to the south. TGC07 includes treated habitat with varying levels of coast live oak (*Quercus agrifolia*) and California bay trees. This site also includes areas that are above the mean solar radiation value for oak habitats but may still be suitable for oak savanna for the same reasons as TGC06. The higher radiation area includes fields of coyote brush that may be converted to open oak habitat, thus reducing the potential fire hazard of the area.

While varying in presence and density, the species composition under the *Eucalyptus* and pine trees within the Tilden Golf Course area was found to be quite consistent. Some coast live oaks of all size classes were observed within these areas. The presence of oaks suggests that habitat conditions are suitable for oak trees and may facilitate restoration—existing trees will provide some shade, reduce the potential for soil erosion, and provide an existing and continual source of acorns. However, the change in solar radiation, wind exposure, and available moisture after the overstory canopy is removed may alter the environment such that these individuals are less successful, particularly smaller trees. Other trees were also noted as well, with California bay being the most common species. The presence of California bay may likewise provide beneficial shade, soil stabilization, and other benefits, but its potential to spread SOD makes it undesirable. The most common species noted among the shrub/vine stratum include poison oak (*Toxicodendron diversilobum*), California blackberry (*Rubus ursinus*), pink honeysuckle (*Lonicera hispidula*), upright snowberry (*Symphoricarpos albus*), California toyon (*Heteromeles arbutifolia*), and California coffeeberry (*Frangula californica*). All of these most common shrubs and vines are native to California and the greater study area. The herb stratum featured a higher cover of introduced species but also included a modest cover of native species. Commonly observed introduced species include tall sock-destroyer (*Torilis arvensis*), Italian thistle (*Carduus pycnocephalus*), panic veldt grass (*Ehrharta erecta*), poison hemlock (*Conium maculatum*), and ripgut brome (*Bromus diandrus*). The most invasive of these were recorded at representative habitat check points and are presented below in **Table 3**. Associated native forbs noted include creeping snowberry (*Symphoricarpos mollis*), blue wild rye (*Elymus glaucus*), mugwort (*Artemisia douglasiana*), Pacific sanicle (*Sanicula crassicaulis*), hedge nettle (*Stachys sp.*), and roughleaf aster (*Eurybia radulina*). All of the understory species are relatively common and may be considered "generalist" species that are well adapted to a wide variety of habitats. Among the native species observed under the dense *Eucalyptus* canopy, it is worth noting the prevalence of vine species (especially poison oak and California blackberry), as well as species that reproduce vegetatively as well as by means of seed (e.g., the hedge nettles, mugwort, and the two vines noted above). It is likely that a creeping habitat and/or vegetative reproductive traits convey a competitive advantage in a dense, shaded understory and within thick leaf/needle and bark litter. Given such adaptability and heartiness, many of these species may be suitable for the restoration planting palette for this restoration project.

Table 2. Opportunities and Constraints at Tilden Golf Course Potential Restoration Areas (RTA T1012)

Site ID	General Area Description	Size (Acres)	Dominant Overstory	Approximate Coast Live Oak Density in 0.5 Ac.	Approximate California Bay Density in 0.5 Ac.	Access	Invasive Species of Concern	Notes*
TGC01	Northern extent of RTA T1012	5.10	*Eucalyptus* (partially treated)	0-5 immature; 0-20 mature	6-10 immature; 6-10 mature	Relatively easy	Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), pride of Madeira *Echium* sp.	Western half treated and may be more suitable for native grassland restoration. Eastern half has dense California bay understory.
TGC02	Narrow band following Golf Course Drive	2.11	*Eucalyptus* and pine	0-5 immature; 0-5 mature	6-10 immature; 51-100 mature	Easy	poison hemlock (*Conium maculatum*), panic veldt grass (*Ehrharta erecta*), little robin (*Geranium purpureum*)	Not suitable due to high density of California bay, close to road maintenance, and impacted by nursery operation.
TGC03	Draw north of Selby Trail	3.39	*Eucalyptus*	0-5 immature; 0-5 mature	1-5 immature; 6-10 mature	Relatively easy	French broom (*Genista monspessulana*)	Not suitable due to high coyote brush cover and relatively intact existing native community.
TGC04	Eastern extent of RTA T1012	10.04	*Eucalyptus* and pine	Not assessed	Not assessed	Relatively difficult	Not assessed	Not suitable due to slope, mesic conditions, and existing native habitat.
TGC05	Between Grizzly Peak Road and Golf Course Road	7.79	*Eucalyptus* (mostly cleared)	1-10 immature; 1-10 mature	6-10 immature; 6-10 mature	Easy	bull thistle (*Cirsium vulgare*), poison hemlock (*Conium maculatum*), cotoneaster (*Cotoneaster franchetii*), eggleaf spurge (*Euphorbia oblongata*), French broom (*Genista monspessulana*), summer mustard (*Hirschfeldia incana*), Harding grass (*Phalaris aquatica*)	South of Grizzly Peak Trail suitable. Area north of Grizzly Peak Trail is not treated and may be suitable for passive restoration after invasive tree removal.
TGC06	East of Summit Road	1.74	*Eucalyptus* and pine (partially treated)	0-5 immature; 0-5 mature	None	Relatively easy	black mustard (*Brassica nigra*), Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), eggleaf spurge (*Euphorbia oblongata*), cherry plum (*Prunus cerasifera*)	Area not initially selected by suitability model due to slightly higher solar radiation levels. However, treated habitat may be suitable for restoration.
TGC07	North of Grizzly Peak Road	5.39	*Eucalyptus* (mostly cleared)	0-10 immature; 0-5 mature	1-5 immature; 6-10 mature	Easy	French broom (*Genista monspessulana*), Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), eggleaf spurge (*Euphorbia oblongata*)	Consists of treated and untreated areas with varying *Eucalyptus* cover. Area includes portion of TGC05 and extends south into area with higher solar radiation than initially selected in model.

*All sites occur within RTA T1012 and have no evidence of SOD, although California bay was observed in all treatment areas.

Note: Shading indicates most suitable restoration areas.

4.2. INSPIRATION POINT

The Inspiration Point study area is comprised of two RTAs, including RTA-T1003 and RTA-T1004. The former is dominated by Monterey pine, while the latter is dominated by *Eucalyptus* species. The surveys focused somewhat more on areas dominated by *Eucalyptus* since those areas are in more need of restoration—the pine area consists of large numbers of native trees, especially coast live oaks, and a largely native understory. Assuming that the removal of the pine trees would not result in excessive damage to existing native vegetation, passive restoration would be a viable option in RTA-T1003.

A total of six potential restoration sites were identified in the two RTAs in this area (**Table 3** and **Figures 4 and 5**). Of the six discrete areas, two are greater than one acre, both of which encompass primarily *Eucalyptus* trees, including both Tasmanian blue gum and mana gum (*Eucalyptus viminalis*). The RTA to the north, which features smaller potential restoration sites, is dominated by Monterey pine. Habitat conditions at the sites vary according to slope, aspect, canopy density, and litter depth. Relative to the *Eucalyptus* tree habitats, areas dominated by pines were found to consist of a relatively intact understory of native herbs and shrubs as well as oaks. Habitat conditions below the *Eucalyptus* trees varied according to canopy density as well as associated litter depth, with more dense canopies featuring very low species cover and diversity (see below).

As with the Tilden Golf Course area, RTAs in the vicinity of Inspiration Point were found to consist of both coast live oak as well as California bay trees and featured a very similar understory of generalist shrubs, vines, and herbs (see section above).

Although the *Eucalyptus* -dominated restoration areas are most suitable for major restoration work based on guidance provided by EBRPD, the pine-dominated sites along Nimitz Way (IP02 through IP04 within RTA-T1003) would likely exhibit a natural transition to oak woodlands once the overstory pines are removed. Little to no active restoration work would be required due to the existing density of oaks of various age classes and relatively intact understory species. It is advisable to remove the overstory pine individuals with as little impact as possible upon existing oak and other native understory species in order to facilitate passive restoration.

Further subdivision of the two selected restoration areas may be warranted given the large size of the two areas (10.47 acres within RTA-T1004 and 3.74 acres within RTA-T1003). The larger area within RTA-T1004 features relatively accessible flat areas closer to the road and/or from a fire road (Sea View Trail) along the top of the ridge within the RTA. One such accessible area could provide the foundation for major restoration work and may be paired with adjacent areas with steeper slopes and variable aspects. Focusing on relatively accessible areas would decrease the resources needed for site access, irrigation, and site preparation. Including adjacent areas that encompass a greater range of slopes and aspects would provide an experimental opportunity to observe if areas with significantly lower solar radiation and/or closer proximity to drainages might provide better oak habitat in a drying climate. Restoration work within the selected areas will require significant rehabilitation to return the habitat to near pre-planting conditions. Specific aspects of concern include allelopathic soils from *Eucalyptus* duff, SOD transmission, and invasion and expansion by problematic weed species.

Although SG03 and SG04 occupy a large potential restoration area, very little of it would likely need to be restored. Much of the area is dominated by native tree species and some of the area could be planted with Pacific madrone (*Arbutus menziesii*) instead of oaks. SG03 and SG04 encompass a relatively intact oak and California bay forest interspersed with Monterey pines. The existing suite of species would likely produce natural recruits with overstory and understory species to fill openings left from selective removal of invasive pine trees. The southern end of this area is characterized by mature and decadent subdominant Pacific madrone trees. Given the more unique status of Pacific madrones within the regional context, this area may be more suitable for Pacific madrone restoration in openings. Coast live oaks may be better adapted to the drier habitat edges along the western boundary.

Table 3. Opportunities and Constraints at Inspiration Point Potential Restoration Areas

Site ID	RTA	General Area Description	Size (Acres)	Dominant Overstory	Approximate Coast Live Oak Density in 0.5 Ac.	Approximate California Bay in 0.5 Ac.	Access	Invasive Species of Concern	Potential for SOD	Notes
IP01	TI003	Northwest of Inspiration Point (Upper), west of Nimitz Way	0.41	Pine	1-5 mature	1-5 immature; 1-5 mature	Relatively easy	None noted	None noted (California bay present)	Within a draw
IP02			0.19		1-5 immature; 6-10 mature	None observed	Relatively easy	None noted	None noted	Large pines
IP03		Northwest of Inspiration Point (Lower), along Nimitz Way	0.29		1-5 mature	None observed	Relatively easy	poison hemlock (*Conium maculatum*)	None noted	Edge of pine habitat
IP04			0.53		11-20 mature; 11-20 immature	1-5 immature; 1-5 mature	Relatively easy	panic veldt grass (*Ehrharta erecta*)	None noted (California bay present)	Along ridgeline
IP05	TI004	South of Wildcat Canyon Road	10.47	*Eucalyptus*	Highly variable: 0-10 mature; 0-10 immature	Highly variable but generally present throughout	Highly variable: Relatively easy to difficult	panic veldt grass (*Ehrharta erecta*), Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), cotoneaster (*Cotoneaster franchetii*), French broom (*Genista monspessulana*), English holly (*Ilex aquifolium*), cherry plum (*Prunus cerasifera*), sweet brier (*Rosa rubiginosa*)	California bay present; one observation of potential SOD	Very dense *Eucalyptus* canopy. Variable slopes and aspects within area provide potential for success within microtopography. Area greater than 1 acre preferred for restoration design.
IP06		North of Wildcat Canyon Road	3.74		Highly variable: 0-5 mature; 0-5 immature	Not observed (but not investigated as thoroughly as IP05)	Highly variable: Relatively easy to difficult	ripgut brome (*Bromus diandrus*), Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*)	None noted (California bay in vicinity)	

Note: Shading indicates most suitable restoration areas.

4.3. SKYLINE GATE

The Skyline Gate study area within Redwood RP consists of five RTAs that were investigated, at least in part. These include RTA-RD001, RTA-RD002, RTA-RD003, and RTA-RD004. Of these RD002-RD004 were more intensively surveyed, as these areas are most dominated by *Eucalyptus* species—as with the Inspiration Point site, areas dominated by pine (primarily Monterey pine) are amenable to passive restoration as long as the extensive existing native habitats can be left largely intact during removal of the pines. These areas were not as intensively surveyed. However, even some of the areas dominated by *Eucalyptus* in these RTAs feature substantial covers of native trees and understory, as discussed below.

VNLC ecologists identified four potential restoration areas in this study area. The four areas are relatively close together and occur just south of the Skyline Gate staging area where *Eucalyptus* are most prevalent (Table 4 and **Figures 6 and 7**). The target trees were being actively removed during the spring 2022 survey in some of the surveyed RTA units.

At Skyline Gate, SG01 is not recommended for restoration; SG02 is a suitable small restoration site; and SG03 and SG04 would benefit from passive restoration after invasive pines are removed. SG01 was recently treated but continues to have a relatively closed canopy of Monterey cypress (*Hesperocyparis macrocarpa*) and a non-native, shade-tolerant herbaceous understory. This site is not suitable for establishing oak woodlands due to the desire to leave the non-native overstory for aesthetic reasons. SG02 was partially treated at the time of the field survey, resulting in an open canopy of native oak and California bay trees with scattered native shrubs and a thick mulch layer left from chipping removed trees. The remaining habitat in this area is suitable for oak restoration. SG03 and SG04 are immediately adjacent to one another and may be considered together as a larger unit, if desired. The potential restoration area spans a relatively intact oak and California bay forest with occasional invasive pines and a diverse suite of understory woody and herbaceous species. This area is most suited for passive restoration after removing any pines, allowing natural habitat expansion into open areas from the established native species.

Although less than an acre, SG02 would be an easily accessible restoration site within a recently treated area. The overstory remaining after treatment consisted of California bay and coast live oak with a diverse native shrub understory layer of poison oak, blue elderberry (*Sambucus nigra ssp. caerulea*), California coffeeberry, California blackberry, and sticky monkeyflower (*Diplacus aurantiacus*) in the shrub layer. The herbaceous layer was a combination of non-native species, including little robin (*Geranium purpureum*) and common bedstraw (*Galium aparine*), as well as native species such as Pacific sanicle and California milkwort (*Polygala californica*). The range of shade tolerance in the understory species demonstrates the variable positions along the concave topography as well as the previous distribution of shade from *Eucalyptus*. Restoration of the area should include a combination of shade tolerant and intolerant species. Shade-intolerant understory species

may be planted in openings with coast live oaks; these species may thrive initially and then give way to more shade-tolerant species as the oaks mature. The wood chips and litter remaining from removed *Eucalyptus* trees may impact restoration success, as discussed under Section 3.2.

Table 4. Opportunities and Constraints at Skyline Gate Potential Restoration Areas

Site ID	RTA	General Area Description	Size (Acres)	Dominant Overstory	Approximate Coast Live Oak Density in 0.5 Ac	Approximate California Bay Density in 0.5 Ac	Access	Invasive Species of Concern	Potential for SOD	Notes
SG01	RD004	Along Skyline Road south of gate	1.70	Monterey pine	1-5 immature; 6-10 mature	6-11 immature; 11-22 mature	Easy	panic veldt grass (*Ehrharta erecta*), Italian thistle (*Carduus pycnocephalus*)	None noted (California bay present)	Overstory Monterey cypress remain after treatment
SG02	RD002	Between Stream Trail and West Ridge Trail near gate	0.29	California bay (*Eucalyptus* actively being removed)	1-5 immature; 1-5 mature	11-50 immature; 1-10 mature	Relatively easy	None noted		Dense chip mulch from site treatment
SG03	RD004	West of West Ridge Trail east of Shirley Drive	3.63	California bay, coast live oak, and Monterey pine	1-5 immature; 1-10 mature	1-5 immature 6-10 mature	Relatively easy to difficult	None noted		Upper ridge accessible behind homes from Wilton Drive. Contiguous with SG04
SG04		East of West Ridge Trail east of Shirley Drive	0.76	California bay and Monterey pine	6-10 immature; 6-10 mature	1-10 immature 6-10 mature	Relatively difficult	None noted		Contiguous with SG03

4.4. LOST RIDGE

The Lost Ridge study area is located within Anthony Chabot RP, north of Lake Chabot, and consists of multiple RTAs, four of which were at least partially investigated through remote analysis and field surveys. These include the eastern sections of RTA-AG010 and RTA-AG011 as well as the northern and eastern portions of RTA AG013 and RTA-AG014. The five potential restoration areas within these RTAs are generally characterized as north- or east-facing slopes dominated by *Eucalyptus* trees. No significant stands of pine trees were noted in the surveyed areas. The five areas are located from north of Mirador Trail to the Honker Bay Trail (Table 5 and **Figures 8 and 9**). No treatment had occurred as of May, 2022.

The potential restoration sites fall into two categories: those with an adequate cover of coast live oak and more native understory cover that may be passively restored after *Eucalyptus* removal, and those with lower oak cover and dense understories of ruderal herbaceous species that may be suitable for active oak restoration. Generally, the areas with higher oak cover and more native understory are those along lower portions of the steepest, north-facing slopes. Examples of the more open habitats include Site LR01 and LR02, in the northwestern portion of the study area, and examples of the more shaded sites with relatively high oak cover include Sites LR03, LR04, and LR05.

LR02 was found to support relatively few coast live oaks—only a few along its northern margin were noted. This site is along a relatively inaccessible portion of Loggers Loop trail, along a moderate slope with fairly low plant diversity and light-colored, fairly dry soils. At the time of the survey, there was a dense understory of Italian thistle and only a few scattered native creeping snowberry. The nearby LR01 was not investigated but is assumed to be similar habitat, as the same conditions were observed to be consistent throughout the area.

LR03 is a large potential restoration area situated along the north-facing slope north of Two Rocks Trail. With moderately easy access, clay loam soil, and some oak cover, this is a suitable restoration site. The understory at LR03 is dominated by poison oak with ruderal herbaceous species such as ripgut brome, slender oat (*Avena barbata*), Italian thistle, tall sock-destroyer, as well as scattered native species, such as wood fern (*Dryopteris arguta*) and rough hedge nettle (*Stachys rigida*). Mulch from tree removal and regular weeding may be necessary to increase the site's restoration success.

LR04 consists of a narrow band of suitable restoration habitat along the upper limit of a drainage feature. The eastern end of this area is very accessible, just downslope from a developed family campground. The western extent is very narrow, less accessible, and thus less suitable for restoration. The widest part in the eastern extent of LR04 is the most suitable for restoration. This area has an overstory of *Eucalyptus* and dense understory of ruderal herbaceous species, such as ripgut brome, Italian thistle, and scarlet pimpernel (*Lysimachia arvensis*). Much of this area occurs on a north-facing slope and within a concave feature associated with the drainage. However, the presence of coyote brush and sticky monkeyflower indicates that this area has slightly higher solar radiation exposure than may be ideal for coast live oak under a drying climate.

Although LR05 is less accessible than some of the other sites, it would be a suitable restoration site due to its large size and existing coast live oak cover. There are two distinct regions within this site: the long area south of the hike-in campground has a high density of coast live oak trees under a *Eucalyptus* overstory, while the area to the northeast of the campground has a much lower oak cover and denser understory of ruderal annual grassland species. The southern section may readily recover after selective removal of *Eucalyptus* trees without the need for active restoration. However, the northeastern section may benefit from active restoration planting to increase the oak cover. Restoration of the understory may be more difficult in this area due to the dense ruderal herbaceous understory, dominated by ripgut brome, Italian thistle, and tall sock destroyer. Native blue wild rye was also observed in the area, which would be a suitable understory seed for restoration work.

Table 5. Opportunities and Constraints at Lost Ridge Potential Restoration Areas

Site ID	RTA	General Area Description	Size (Ac.)	Dominant Overstory	Approximate Coast Live Oak Density in 0.5 Ac.	Approximate California Bay Density in 0.5 Ac.	Access	Invasive Species of Concern	Potential for SOD	Notes
LR01	AC011	Intersecting Logger's Loop Trail	1.51	*Eucalyptus*	Not assessed	Not assessed	Relatively difficult	Not assessed	Not assessed	Not surveyed, but presumed to be similar to LR02
LR02		North of Mirador Trail	11.38	*Eucalyptus*	1-5 immature; 1-5 adult	1-11 immature; 12-50 mature	Moderately easy	Italian thistle (*Carduus pycnocephalus*)	None noted (California bay present)	Linear area along moderately steep ridgeline. Not optimal restoration site.
LR03		Between Mirador and Two Rocks Trail	11.58	*Eucalyptus*	0-5 immature; 0-5 adult	1-11 immature; 6-11 mature	Moderately easy	Italian thistle (*Carduus pycnocephalus*)		Linear area east of ridgeline
LR04	AC013	South of Quail Trail	6.90	*Eucalyptus*	1-20 immature; 1-5 adult	1-5 immature; 1-5 mature	Easy to relatively easy	Italian thistle (*Carduus pycnocephalus*)		Thin linear area at upland edge of woodland gully
LR05		East of Huck's Trail	8.38	*Eucalyptus*	0-20 immature; 1-50 adult	1-5 immature; 1-11 mature	Relatively difficult	Italian thistle (*Carduus pycnocephalus*)		Occurs east of ridge in dense *Eucalyptus*

5. VNLC RECOMMENDATIONS SUMMARY

Restoration of TGC06 (1.74 acre) and/or TGC07 (5.39 acres) is recommended based on EBRPD priorities, habitat suitability, and field results. Depending upon the influence of fog, TGC06 may be most suitable for oak savanna habitat given its higher solar radiation and lower cover of existing oak trees. The existing coyote brush cover may be used as nurse plants for supporting oak growth and eventual dominance by decreasing solar radiation exposure, and increasing moisture accumulation from natural mulch and fog precipitation. TGC07 is more complex. There are treated and untreated regions that may be restored in stages. Sections of the selected restoration areas may be restored incrementally as portions are treated. Only areas that have had all target trees removed should be restored. The variation in solar radiation exposure corresponds closely to tree versus brush cover where tree cover is higher in areas with lower solar radiation. This natural pattern may be followed by planting oak savanna within the brush and denser oak woodland within the (recent) tree cover areas. Where possible, fuel reduction crews may remove California bay trees from this restoration area to reduce potential exposure to SOD. Fuel reduction crews may also work to reduce cover and persistence of other problematic invasive species prior to restoration.

Any selected restoration areas, such as TGC06 and/or TGC07, that are adjacent to or that include untreated areas should incorporate a 20-foot buffer to allow heavy equipment to access the necessary treatment area. In cases where the restoration area may be staged based on treatment schedules, restoration may occur within areas that are fully treated first and expanded into other areas once target trees are removed.

Additional sites may be considered for restoration in the future after treatment. The other potential restoration sites, or major portions of each site, fall into three distinct restoration categories: not suitable, suitable for passive restoration, and suitable for active restoration. No restoration is recommended for Sites SG01 or LR01 due to an existing closed canopy of non-native trees and inaccessibility, respectively. Passive restoration, consisting of removing all target invasive tree species while leaving existing native vegetation intact, is recommended for IP01 through IP04, SG03 and SG04, LR04 (western portion), LR05 (southwestern portion), TGC01 through TGC04, and TGC05 (northern portion). Active restoration, consisting of planting oaks and associated native vegetation, is recommended for IP05 and IP06, SG02, LR03, LR04 (eastern portion), LR05 (northeastern portion), TGC05 (southern portion), TGC06, and TGC07. In general, passive restoration sites are relatively intact native habitats with scattered or co-dominant invasive tree cover while active sites have a more dominant canopy of invasive tree species and a lower cover of desirable native species. Of the recommended active restoration sites, only SG02 and portions of TGC01, TGC02, TGC05, TGC06, and TGC07 have already had target trees removed.

6. RESTORATION CHALLENGES AND SOLUTIONS

6.1. ALLELOPATHIC SOILS

Eucalyptus species are known to suppress understory growth, particularly in dense plantings, through allelopathic chemicals present in the leaves, bark, and stem of individual trees (May and Ash 1990). Specifically, red gum (E. camaldulensis) contains several volatile and water-soluble toxins, including highly toxic terpenes and acids (Moral and Muller 1970). The degree of suppression increases in drier climates, when leaf litter is chopped, and under evaporative condensation. Suppression levels decrease after five months of tree removal, frequent leaching from rain events, and decaying. In order to minimize potential allelopathic impacts, *Eucalyptus* leaf litter may be removed (Nelson et al. 2021), restoration may be postponed for more than 5 months after trees are removed (particularly effective if a wet winter occurs between treatment and restoration), and/or mangers may accelerate leaching (e.g., mulching, and watering) (Fikreyesus et al. 2011; Espinoza-Garcia et al. 2008).

However, native California plants appear to be much less impacted by such chemicals in Tasmanian blue gum than the typical crop and non-native species studied (Nelson et al. 2021). In this particularly applicable study, no allelopathic impacts were found when using soil from under Tasmanian blue gum litter to grow native plants, including coast live oak and various native herbaceous species. Light and water competition may be the main drivers in inhibiting understory growth in *Eucalyptus* plantations. It was found during field surveys that Tasmanian blue gum stands featured more dense canopies as well as deeper litter, and thus the understory was actually sparser. In any case, restoration work may focus on removing *Eucalyptus* trees and also associated litter prior to restoration planting—or the litter may be left onsite as mulch, to be removed only where plantings occur.

6.2. SUDDEN OAK DEATH TRANSMISSION

Best management practices to reduce SOD and other pathogen transmission include:

- Select nurseries following established phytophthora reduction protocols;
- Avoid restoration in areas with evidence of SOD;
- Clean vehicles of all plant debris before entering site and prior to completion of project;
- Sanitize boots, tools, and equipment with a 70% or greater solution of alcohol or a bleach solution (1 part bleach: 9 parts water) in restoration area;
- Remove known SOD hosts (e.g., California bay) from site;
- Avoid access routes through SOD-infected areas;
- Keep soil onsite and do not use imported soil for work; and
- Clean and dry tools in between restoration areas.
- Transfer delivered nursery plants to a cleaned and sanitized area (clean waterproof tarp or other sanitized surface). Dedicate one surface for contact with nursery stock
- Do not place nursery plants on soil or potentially contaminated surfaces until they are placed at specific planting sites as shown on restoration planting plans

- Any nursery stock that needs to be held for an extended period before planting shall be transferred to cleaned and sanitized raised benches

6.3. INVASIVE PLANTS

The expansion of existing invasive plant populations and introduction of novel invasive species are important to address in restoration planning. The inherent disturbance associated with canopy tree removal and any intensive site preparation for restoration work can enhance conditions for invasive plants. The species observed within the large potential restoration areas are summarized in **Table 6**. Recommended management solutions typically involve hand removal, mechanical methods, and herbicide. Prescribed fire and grazing are not recommended due to the high volume of woody fuels, toxicity of many problematic species, sensitivity of restoration plants, and visibility to public. In general, mulching and hand removal of all competitive vegetation is advisable, particularly within a few feet of restoration plantings. Where larger infestations occur, spot treatment and mechanical methods may be appropriate, as discussed for specific taxa in **Table 6**.

In addition to management of existing invasive species populations, best management practices should be followed to reduce the potential to introduce new species to the restoration sites. Potential best management practices are generally complementary to SOD reduction practices and may include:

- Clean all vehicles and tools prior to entrance onto restoration site;
- Where possible, minimize soil disturbance;
- Reduce exposed soil by mulching and seeding with preferred plants; and
- Utilize weed-free erosion control measures (e.g., wattles)

Table 6 Management Recommendations for Invasive Plant Species of Concern

Species	Cal-IPC Rating[1]	Priority Level	Recommendation
black mustard (*Brassica nigra*)	Moderate	Low	Not especially common in study area. Would eventually be shaded out in woodlands.
ripgut brome (*Bromus diandrus*)	Moderate	Low	Mulching around planted individuals, hand pull individuals in early spring before seeds ripen.
Italian thistle (*Carduus pycnocephalus*)	Moderate	Low	Regular timed mowing, herbicide
bull thistle (*Cirsium vulgare*)	Moderate	Low	Cut plants below soil surface prior to flowering. Herbicide treatment may be considered.
poison hemlock (*Conium maculatum*)	Moderate	Moderate	Hand removal of entire plant and taproot for small infestations. Spot treatment with herbicide of seedlings and/or rosettes recommended for large populations.
cotoneaster (*Cotoneaster franchetii*)	Moderate	High	Hand pull seedlings or small plants. Remove larger individuals to roots to prevent resprouting. Stump treatment with herbicides may be used to prevent sprouting.
panic veldt grass (*Ehrharta erecta*)	Moderate	Low	Manually remove entire plants, including root crown. Multiple years of treatment required.
eggleaf spurge (*Euphorbia oblongata*)	Limited	Low	This is widespread only in TGC but typically sparsely occurring and generally does not threaten native plant communities, and would be eventually shaded out within oak woodland.
French broom (*Genista monspessulana*)	High	High	Hand-pull small individuals, use weed wrench for larger shrubs. Extract entire root. Cutting annually in the spring before flowering and again in fall may deplete seed bank and reduce established plant energy reserves. Manual removal may be combined with herbicide treatment.
little robin (*Geranium purpureum*)	Limited	Low	This is widespread but generally not considered a significant threat to native plant communities.
summer mustard (*Hirschfeldia incana*)	Moderate	Low	This is widespread but typically sparsely occurring plant that generally does not threaten native plant communities and would be eventually shaded out within oak woodland.
English holly (*Ilex aquifolium*)	Limited	Low	Found in very low numbers. See cotoneaster recommendations. Remove debris from site to prevent resprouting.
Harding grass (*Phalaris aquatica*)	Moderate	Low	This is widespread but typically sparsely occurring plant that generally does not threaten native plant communities and would be eventually shaded out within oak woodland.
cherry plum (*Prunus cerasifera*)	Limited	Moderate	See cotoneaster recommendations.
sweet brier (*Rosa rubiginosa*)	N/A	Moderate	Treatment not well studied. Remove individuals as needed.

[1] California Invasive Plant Council 2023. High-rated species have "severe ecological impacts on physical processes, plant and animal communities, and vegetation structure." Moderate-rated species have "substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure." Limited-rated species are "invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score.

Draft Implementation Plan

7. RESTORATION STRATEGY

We propose the following steps to implement the Oak Woodland Restoration Project at Recommended Treatment Area (RTA) T1012. These recommendations are based on local acorn planting experience, Vollmar Natural Land Consulting's (VNLC) site assessments, and a field visit on March 24, 2023. The Oak Woodland Restoration Project is focused on restoration of Coast Live Oak (*Quercus agrifolia*) following fire fuels removal.

EBRPD plans for fire fuels removal within the RTAs include initial treatment to "reduce surface and ladder fuel loads, thin *Eucalyptus*, acacia, pine, and fir stands, reduce brush, etc.". This initial treatment will be followed by ongoing "weedeating, hand pulling, grazing, and herbicides to sustain lowered fire hazard and fuel loading at acceptable levels throughout the entire site" over the course of 30 years. For more information see the Tilden Park – TI012 Fuels Management Prescription provided by EBRPD (East Bay Regional Parks District 2017). The goal of the restoration work is to accelerate the development of oak woodland habitat following the disturbance resulting from the fuels reduction program.

As mentioned previously, RTAs delineate areas targeted for fire fuel reduction activities. Within the T1012 RTA, two sites analyzed by VNLC have been selected as restoration locations: Tilden Golf Course Site 6 (TGC06) and Tilden Golf Course Site 7 (TGC07). VNLC selected these sites based on East Bay Regional Park priorities, analyzed habitat suitability, and results from field assessments. These factors include site accessibility, size, and timing of fuels management treatment. (See VNLC Recommendations Summary, pp.23 for more information).

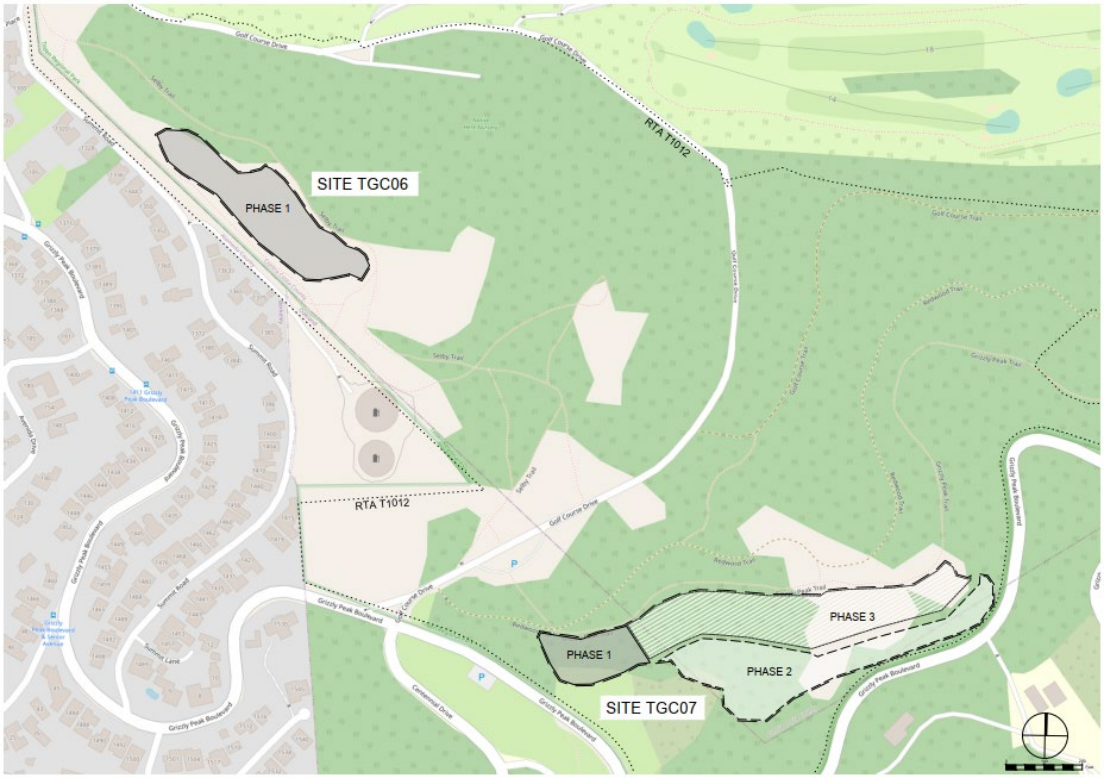


Figure 1: Tilden Golf Course - Overview Map

Hierarchy and definitions of areas:

1. RTAs- Recommended Treatment Areas for the Fuel Management Program
2. Restoration Sites – Study areas analyzed by VNLC (i.e. TGC06)

The following section lays out the approach to restoring oak woodlands within the two project sites. This includes recommendations for project phasing, acorn collection, site preparation, and finally acorn planting. This restoration strategy will be refined based on feedback from EBRPD and updated in the Final Implementation Plan. The goal is to begin planting acorns in fall/winter 2023-2024.

7.1. PROJECT PHASING

A phased approach allows this plan to be integrated into EBRPD's Wildfire Hazard Reduction and Resource Management program, adapted in real time as lessons are learned between plantings, and designed to budget and seasonal constraints.

RDG has designated acorn planting within both Restoration Sites. Costs have been estimated in 2023 dollars per phase. The first phase includes planting at both Restoration Sites, in locations previously treated for fuel reduction. Phase 2 and 3 include additional plantings at Site TGC07 where fuel reduction work is planned.

See accompanying draft construction documents for more information.

PHASE 1

Figure 2: Site TGC06

Phase 1 includes planting in both Site TGC06 and Site TGC07. These zones have already been treated by EBRPD for fire fuel reduction (2018-2022) and are suitable for immediate planting.

Table 7 Estimated Cost to Install Phase 1 Plantings

Item No.	Item Description	Estimated Quantity	Units	Unit Cost	Total Cost
	PHASE 1				**$56,754**
1.1	INVASIVE SPECIES REMOVAL	1	PER DAY	$2,412.00	$2,412
2.1	COLLECT ACORNS	1	LUMP SUM	$2,000.00	$2,000
3.1	STOCKPILE NEST MATERIALS	1	LUMP SUM	$4,000.00	$4,000
4.1	CLEARING AND GRUBBING (PLANTING AREA ONLY)	4368	SQ FT	$0.60	$2,621
5.1	PLANTING ONLY - ACORNS	336	PER PLANTING	$15.00	$5,040
6.1	MULCH (3" DEEP)	4222	SQ FT	$1.50	$6,333
7.1	STRAW/COCONUT COIR	1056	SQ FT	$1.00	$1,056
8.1	NEST INSTALLATION	50	EACH	$80.00	$4,000
9.1	CAGE INSTALLATION	286	EACH	$100.00	$28,600
10.1	ZIP TIES	858	EACH	$0.14	$120
11.1	3' WOOD STAKES	286	EACH	$2.00	$572
				Phase 1 Subtotal	**$56,754**
				Mobilization (15%)	**$8,513**
				10% Contingency	**$5,675**
				Phase 1 Total	**$70,942**

PHASE 2

Figure 3: Site TCG07 Partially Treated Area

Phase 2 is located in an area that is partially treated and has further treatment planned for 2023. Oak acorn planting should occur only after vegetation treatment is complete. Bay trees should also be removed prior to planting.

Table 8 Estimated Cost to Install Phase 2 Plantings

Item No.	Item Description	Estimated Quantity	Units	Unit Cost	Total Cost
	PHASE 2				**$47,998**
1.2	INVASIVE SPECIES REMOVAL	1	PER DAY	$2,412.00	$2,412
2.2	COLLECT ACORNS	1	LUMP SUM	$2,000.00	$2,000
3.3	STOCKPILE NEST MATERIALS	1	LUMP SUM	$4,000.00	$4,000
4.2	CLEARING AND GRUBBING (PLANTING AREA ONLY)	3575	SQ FT	$0.60	$2,145
5.2	PLANTING ONLY - ACORNS	275	PER PLANTING	$15.00	$4,125
6.2	MULCH (3" DEEP)	3456	SQ FT	$1.50	$5,184
7.2	STRAW/COCONUT COIR	864	SQ FT	$1.00	$864
8.2	NEST INSTALLATION	40	EACH	$80.00	$3,200
9.2	CAGE INSTALLATION	235	EACH	$100.00	$23,500
10.2	ZIP TIES	705	EACH	$0.14	$99
11.2	3' WOOD STAKES	235	EACH	$2.00	$470
				Phase 2 Subtotal	**$47,998**
				Mobilization (15%)	**$7,200**
				10% Contingency	**$4,800**
				Phase 2 Total	**$59,998**

PHASE 3

Figure 4: Site TCG07 – Untreated area with dense coyote brush cover

Phase 3 is located in an untreated stand of *Eucalyptus* and dense brush within Restoration Site TGC07. Phase 3 acorn planting can occur once *Eucalyptus* and Bay (*Umbellularia californica*) are removed.

Table 9 Estimated Cost to Install Phase 3 Plantings

Item No.	Item Description	Estimated Quantity	Units	Unit Cost	Total Cost
	PHASE 3				**$54,466**
1.3	INVASIVE SPECIES REMOVAL	1	PER DAY	$2,412.00	$2,412
2.3	COLLECT ACORNS	1	LUMP SUM	$2,000.00	$2,000
3.3	STOCKPILE NEST MATERIALS	1	LUMP SUM	$4,000.00	$4,000
4.3	CLEARING AND GRUBBING (PLANTING AREA ONLY)	4160	SQ FT	$0.60	$2,496
5.3	PLANTING ONLY - ACORNS	320	PER PLANTING	$15.00	$4,800
6.3	MULCH (3" DEEP)	4021	SQ FT	$1.50	$6,032
7.3	STRAW/COCONUT COIR	1005	SQ FT	$1.00	$1,005
8.3	NEST INSTALLATION	47	EACH	$80.00	$3,760
9.3	CAGE INSTALLATION	273	EACH	$100.00	$27,300
10.3	ZIP TIES	819	EACH	$0.14	$115
11.3	3' WOOD STAKES	273	EACH	$2.00	$546
				Phase 3 Subtotal	**$54,466**
				Mobilization (15%)	**$8,170**
				10% Contingency	**$5,447**
				Phase 3 Total	**$68,082**

Figure 5: Site TCG07 – Access Route and untreated areas in Restoration Site

FUTURE PHASES

Additional follow up planting can be considered to encourage an accelerated development of understory vegetation within the areas treated with acorn planting. See page 48 for a preliminary understory revegetation strategy.

7.2. ACORN COLLECTION

EBRPD has Propagule Collection Protocols in place (See Appendix C). Depending on EBRPD preference and seasonal stock of collected acorns prior to restoration planting for this project, the selected contractor may be able to use EBRPD-collected acorns for planting. The following guidance is derived from pertinent EBPRD protocols and additional practices gleaned from local restoration professionals (The Watershed Nursery 2022) (Van Dam 2019):

- Coordinate with EBRPD if collecting acorns from EBRPD sites
    - Coordinate with EBRPD botanist Michele Hammond, mhammond@ebparks.org
    - Collect no more than 10% of acorns available in any given site, or coordinate with EBRPD stewardship staff if greater than 10% will be collected
    - Map the locations of acorn collections digitally
    - Follow EBRPD decontamination protocols before entering parkland
- Follow *Phytophthora* and plant pathogen decontamination best practices
- Collect acorns from healthy local trees, choose parent trees depending on accessibility and acorn load – this is best done when ripe
- Process immediately

    - Soak for 1 hour, discard floaters, then soak for 1 minute in a 5% bleach solution
    - Surface dry with a clean towel, spread out on clean screen, let air dry
    - Put into cold stratification with a small amount of perlite for 1 month or until radicles emerge
- Store processed acorns for up to 3 months

7.3. SITE PREPARATION

The following outlines the proposed approach to planting preparation:

- Ensure EBRPD vegetation treatment is complete prior to planting
- Preserve and protect all existing oak trees and seedlings
- Remove invasive species from restoration areas (rated high per CAL-IPC or otherwise considered problematic, See **Table 6** above)
- Remove pine, California bay, and *Eucalyptus* trees and treat stumps as necessary
- Reserve and stockpile slash for use as Woody Debris Nests
- Meet with Owner Representative (O.R.) in the field prior to locating oak plantings to verify approach
- Stake out planting locations per plant spacing requirements. See Figure 11
- Verify final proposed locations in field with O.R. prior to planting
- Clear and grub planting areas prior to acorn planting

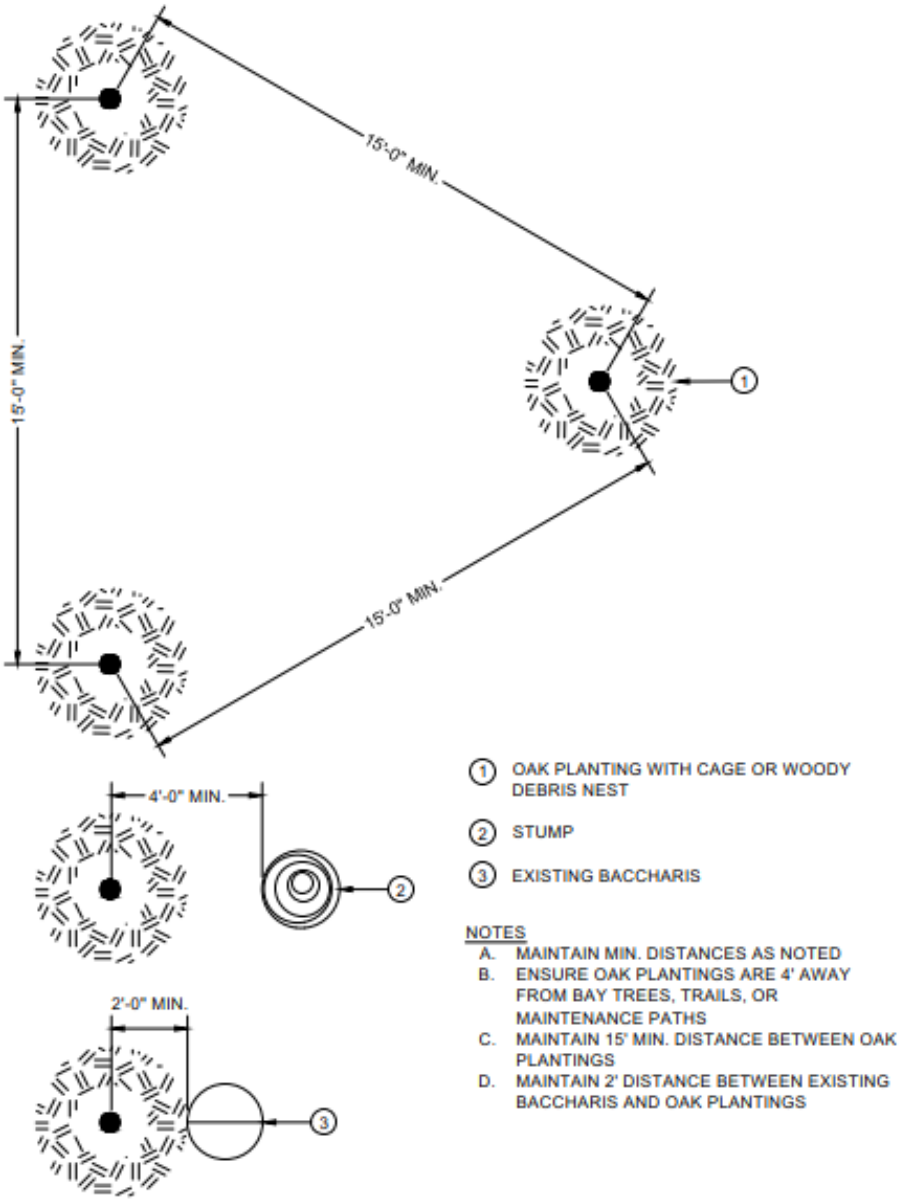
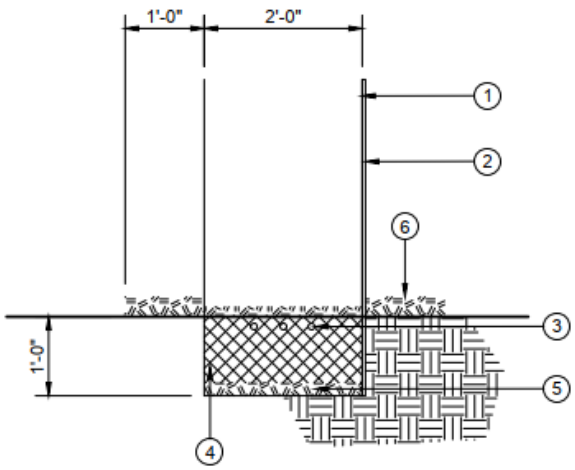


Figure 6: Plant Spacing Diagram

7.4. ACORN PLANTING

The following guidance has been derived from multiple sources including published materials and personal communications with local practitioners (AECOM 2020), (McCreary 2001), (Van Dam 2019), (Nomad Ecology 2022). Additional details are provided in **Figure 7** below.

- Plant early in growing season, as soon as soil has been moistened several inches down (ideally November – December)
- Hold acorn planting at least 20-ft from the edge of the restoration areas to allow a buffer between future treatment areas and the restoration areas.
- Locate acorn pits in favorable micro-habitats such as to the south and east side of existing coyote brush and setback from stumps, swale centerlines and existing oaks preserved during the fuel treatment work
- Prepare planting pit (2-foot diameter, 12-inches depth), install as many pits as noted on plans
- Use auger or other methods to allow acorn roots to penetrate downward if soil at site is compacted (McCreary 2001)
- Plant with straw mulch or coconut coir at base of planting pit
- Orient acorns vertically with radicle pointing downwards if germinated
- Plant three acorns per planting pit
- If rodent activity is present or anticipated, acorns can be installed with 0.5-inch square wire mesh
    - Install cage 12-inches below ground and 24-inches above ground
    - Hardware cloth or aviary wire disintegrate within three years and do not require removal (Lyngso Garden Materials 2023)
    - If using more robust wire that does not disintegrate, cages can be re-used if handled correctly (Van Dam 2019)
- Install mulch in planting area to suppress weeds
- Install herbivory deterrent (woody debris "Nest" or deer fencing) as shown on plans.



1. 2' DIAMETER CAGE, 12" BELOW GROUND LEVEL, 1/2" ALUMINUM WIRE MESH (36" WIDE, 100' ROLL), USE ZIP TIES TO SECURE IN CORRECT DIAMETER
2. 3' WOOD STAKES FOR STABILITY, EMBED 12" IN GROUND
3. THREE ACORNS PER PIT, SPACE 2-3" APART, 1/2-1" DEEP
4. PLANTING PIT, USE 24" AUGER TO DRILL HOLES, BACKFILL TO SURFACE
5. 2" STRAW MULCH/COCONUT COIR AT BASE OF PIT
6. MULCH, 3" DEEP, 4' DIAMETER OUTSIDE PLANTING PIT, 1" DEEP OVER PLANTING PIT

NOTES:

A. LOCATE PLANTINGS PER SPACING REQUIREMENTS 3/L-2.0
B. SEE L-1.0 AND LAYOUT FOR FOR PLANTING AREAS AND QUANTITIES

PLANTING INSTRUCTIONS AND NOTES	
QUANTITY + SPACING	Place three acorns per planting basin spaced 2" - 3" apart.
PLANTING DEPTH	Plant to 0.5"–1" deep.
SEED ORIENTATION	Orient acorns vertically, and with the radicle pointing downwards (if they have been pre-germinated). Be careful not to break the radicle.
HOLE PREPARATION	2'-DIAMETER, 12" DEEP
SEED TREATMENT	- Plant acorns immediately after harvesting or after cold storage. - Viability should be tested using a float test before acorns are stored. - If pre-germinating, soak to initiate germination and plant after the radicle emerges.
IDEAL PLANTING PERIOD	November - December. Plant them immediately prior to or during fall/winter rains.
NOTES	Refer to Section 2 of the guide for info on erosion control and other options for above ground protection.

Figure 7: Oak Planting with Cage Detail, adapted from (AECOM 2020) and (Van Dam 2019)

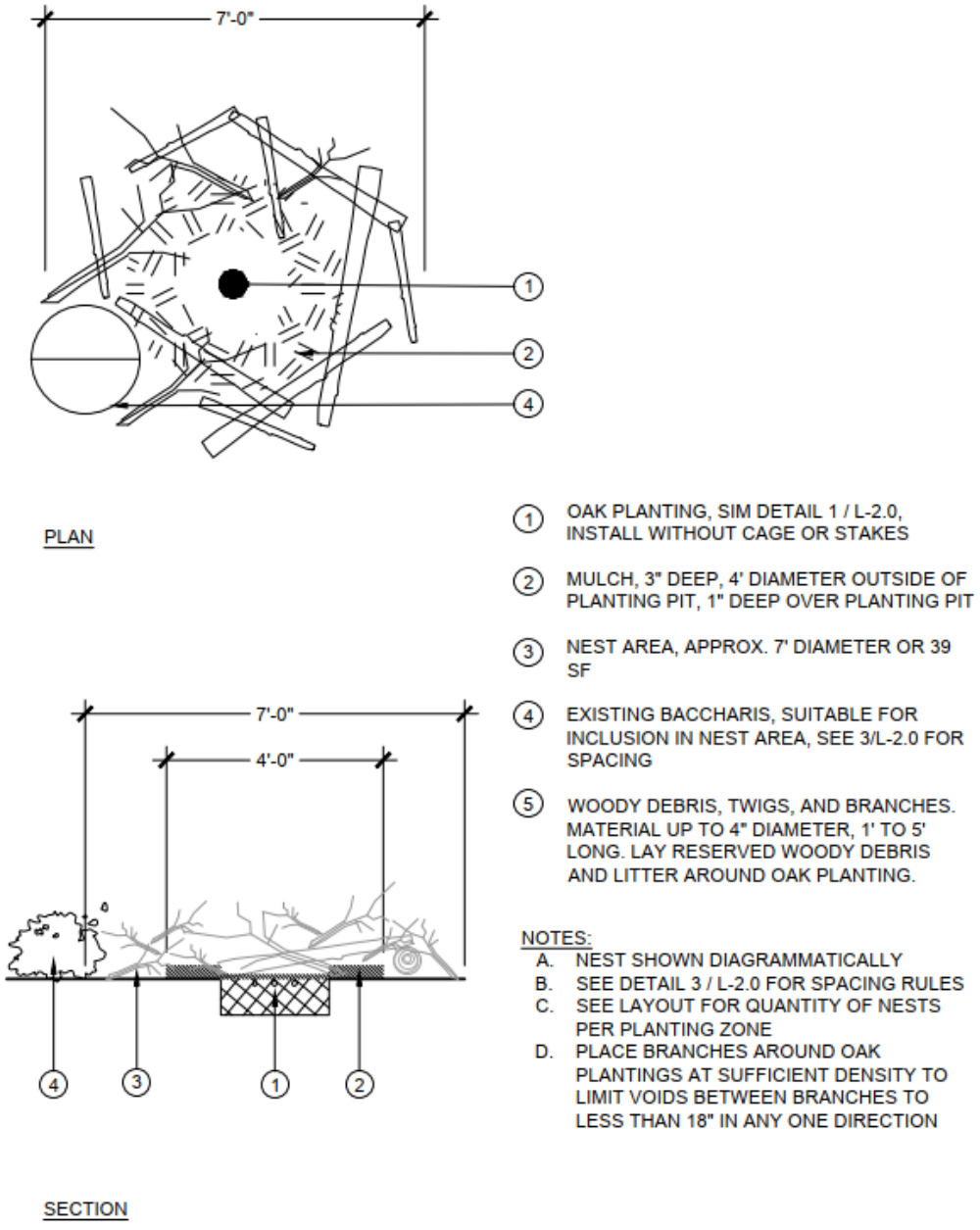


Figure 8 Oak Planting with Woody Debris Nest

8. BASIS FOR RESTORATION DESIGN

RDG has focused on the following considerations for restoring oak woodland habitat following fire fuel reduction activities. We focus on the factors that appear most pertinent to the overall success of the restoration project.

As discussed by VNLC, both selected restoration sites (TGC06 and TGC07) have slightly higher solar radiation and lower cover of existing oak trees than occupied oak habitat which may indicate that an oak savanna habitat is the more appropriate for TGC06 and at least a portion TGC07. However, VNLC notes that the presence of summer fog may reduce solar radiation and maintain moisture levels at the sites. Initial oak savanna habitat may become oak woodland once planted trees mature. *Quercus agrifolia* commonly occupies both savanna and open woodland habitat (Mahall, Davis and Tyler 2005).

For more specific maintenance and monitoring recommendations, see Sections 9 (pp. 43) and 10 (pp.46).

8.1. TREE SPACING

Figure 9 Oaks at Lost Ridge Reference Site

We define tree spacing as the distance between coast live oak trunks and use this metric as a measurable objective for tree density. To guide our target density, we evaluated three reference sites within the Lost Ridge Area at Anthony Chabot Regional Park. They were selected for their favorable characteristics as coast live oak woodland and similarities to the selected restoration sites. The following table summarizes our observations of spacing.

Table 10 Tree Spacing At Reference Sites

Tree Spacing (ft)	Average	Median
Lost Ridge Site - lower slope	**18**	**20**
Lost Ridge Site - upper slope	**19**	**20.5**
Coffeeberry Trail Site (Chabot)	**19**	**18**

The measurements show a consistent average and median values around 18 to 20 feet, with significant local variance within each reference site with trees spaced between 3 and 44-ft apart. RDG's proposed spacing at 15-feet on center is denser than the average observed across the three reference sites. Specifying a higher density provides a flexible target that accounts for mortality. Specifying a target spacing is not a prescription for uniform spacing. Plant spacing should vary as they do in the reference sites. The variability allows flexibility to accommodate boulders, stumps, drainage patterns and other obstructions that affect plant locations.

Measuring appropriate tree spacing is also a function of scale. The above values are appropriate for the mapping unit scale of 0.5 acres used for this study, however at a larger scale, where gaps in the canopy are common and encouraged, the tree density will be measurably less. Research has noted that the tree density of California live oak woodland ranges between 20 and 80 trees per acre, with oak savanna being generally less than 20 trees per acre (Barbour and Keeler-Wolf 2007).

8.2. TREE SURVIVAL

In order to restore the live oak woodland in the treatment areas, it is recommended that the mature tree density reaches a level similar to the density observed in the reference sites, which is approximately 125 trees per acre, assuming a trunk spacing of 18 to 20 feet. The restoration plan specifies planting trees at a density of nearly 200 trees per acre (15 foot spacing). Each planted tree is represented by three individual acorns, indicating that the target density would be achieved if approximately 20% of the acorns successfully grow into mature or sub-mature trees. It is important to note that this estimation does not consider the natural recruitment of oaks within the restoration area, which is expected to be significant, nor does it account for the natural variability of canopy openings, which were not included in our tree spacing evaluation. Given the above, acorn survival as low as 10% may still provide the target density of a mature live oak woodland, and even less survivorship if the sites transition to oak savanna. If survivorship to maturity greatly exceeds this level, future restoration activities can consider reducing the density of plantings.

8.3. DIRECT SEEDING VS TRANSPLANTS

Most experts consulted on planting oaks agreed that direct planting of acorns is the best method. According to Phytosphere Research (Bernhardt, Elizabeth A. and Swiecki, Tedmund J. 2001), "(d)irect planting of acorns has several significant advantages over transplanting even though oak seedlings can be successfully established by either method."

These advantages include:

- Requiring less effort and care in planting than transplants (propagation, storing, transporting)
- Many California oak species produce a long taproot when directly planted, increasing drought resistance
- Nursery stock is more susceptible to pathogens
- Site specific selection occurs at the earliest possible stage of growth with direct-seeding (resistance to insects/herbivores, drought and temperature, response to local fungi/organisms, etc)

8.4. HERBIVORY

Herbivory is anticipated to be one of the primary constraints to oak survival.

CAGES

Cages are known to be an effective strategy to address herbivory. Plantings in Phase 1 will primarily be installed in wire cages to discourage damage from deer and rodents.

WOODY DEBRIS NESTS

Given that fuel reduction will be an ongoing management activity there reasons to be a need for additional effort focused on developing efficient and effective ways to restore ecological function and target habitats to these disturbed sites. One such strategy worthy of continued investigation is the use of Woody Debris Nests as a low-cost, easily implemented solution to foster new plantings and provide immediate habitat benefits. The Nests present a way to repurpose larger downed logs, limbs and branches removed as part of fuels treatment. Nests simulate traditional wire cages by creating a physical barrier around the seedlings using vegetation and branches. They have been used by the National Park Service at Muir Beach (Golden Gate National Recreation Area) and have been observed as natural phenomena occurring in oak woodlands within the Bay Area by RDG staff. Because they are in their infancy as a restoration strategy, RDG recommends implementing a limited portion (approximately 15% of total plantings) as Nests to further assess the effectiveness of this strategy.

Figure 10: *Quercus agrifolia* growing out of reach of deer browse in a natural 'nest' of debris and *Baccharis pilularis.*

Tilden Regional Park is known to have a large population of deer and we anticipate deer browsing being a significant constraint to oak establishment at these restoration sites. Unlike cages which protect only the first two feet of growth around young trees, the woody debris Nests discourage access to the entire oak and may prove to be more effective protection.

What is less certain is the interactions between rodents and Nests. This is in part due to the complexity of their behavior and the diversity of rodents in the park. With voles, gophers, and woodrats among the variety of rodents expected in the vicinity of the restoration site, it is difficult to anticipate how each species will interact with the structures. Observing the comparative success of these Nests to the traditional caged acorn planting may provide valuable insight into how effective woody debris Nests are in reducing rodent-based herbivory.

Besides addressing herbivory, repurposing sticks and twig byproducts from fuel reduction work can offer several benefits, including potential cost savings and habitat enhancements. Land management authorities across the country have been using brush piles to attract wildlife. The decaying woody material in these piles attracts insects and provides shelter for small mammals, amphibians, and birds. While it's unclear whether wildlife attracted to brush piles will harm oak seedlings, even if this strategy does not prove effective for oak recruitment, it can still be seen as a positive outcome since it creates early successional habitat and supplemental cover for wildlife (National Resources Conservation Service 2005).

See Section 7.4 Acorn Planting for construction details on cages and Nest methods.

COYOTE BRUSH AS NURSERY

RDG has found success planting groups of associated native plants together for restoration projects. Though coyote brush tends to grow in dense thickets and may be a concern for fuels management, *Baccharis pilularis* may serve as a useful tool for oak regeneration as a companion species that deters deer browsing.

Planting oaks among the existing coyote brush that remain after the fuel reduction activities, especially on northern and eastern edges, is a simple strategy to boost overall survivorship rate.

Figure 11: Site TGC06 – Existing Coyote Brush

8.5. INVASIVE PLANTS

Ensuring invasive plants are removed prior to planting is critical to ensure they do not overwhelm the restoration sites and inhibit the establishment of oak plantings. Mulch helps to suppress weeds and can allow the acorns to grow with less competition. Mulch should be created and placed as part of the EBRPD vegetation treatment. In the unlikely event that mulch needs to be imported, ensure mulch is pathogen free.

The following strategies can help support acorn growth while suppressing undesirable species from taking hold:

- Place mulch 1-inch deep above acorns to allow them to grow through the layer

- Place mulch a minimum 3-inches deep surrounding acorn plantings to deter weeds. If more material is available, the mulch layer can extend to over 12-inches in depth. An intensive initial application may be preferable to recurring labor involved with hand-pulling of weeds.
- Place remaining mulch in all treatment areas not receiving acorn plantings to the depth necessary to distribute the mulch generated from the fuel reduction activities.

According to EBRPD's Fuels Management Prescription for TI012 (East Bay Regional Parks District 2017), goat grazing is an acceptable treatment for the purpose of fuel reduction. However, RDG and Vollmar (see Section 6.3) do not recommend grazing in restoration areas due to the sensitivity of seedlings during establishment. Restoration areas may be fenced off while fuels management areas undergo grazing treatment.

8.6. IRRIGATION

Irrigation can be one of the most expensive components of a restoration project. Phytosphere Research claims that "irrigation can be one of the least cost-effective inputs in a restoration project" (Bernhardt, Elizabeth A. and Swiecki, Tedmund J. 2001) due to their observations of oaks becoming highly water-stressed after irrigation was discontinued and higher likelihoods of ground squirrel and gopher herbivory at irrigated sites. They conclude that irrigation does not always improve seedling growth or survival and benefits may be short-lived. However, many other sources do recommend frequent watering of young oaks to aid in establishment.

Low solar radiation sites were one criteria used by VNLC during the site selection process, with the specific purpose of reducing the need for irrigation. Given this strategy, irrigation is likely not required, however RDG recommends irrigating a selection of plants infrequently during the first two summers to hedge against unusually prolonged dry periods or extensive hot weather during the summer and fall. Generally, it is advised to provide infrequent, deep irrigation rather than frequent, shallow watering. Mulching will also help conserve soil moisture.

See the following section on maintenance for more detailed irrigation information.

9. MAINTENANCE

Maintenance costs can be expected to be between $50,000 to $200,000 a year depending on the number of site visits. Three visits a month for watering and weeding for an entire year are estimated to be upwards of $130,000.

Table 11 Estimated Cost to Maintain Phase 1 Plantings

Item Description	Estimated Quantity	Units	Unit Cost	Total Cost
MAINTENANCE				**$137,196**
WATERING	36	PER DAY	$1,340.00	$48,240
WEEDING	36	PER DAY	$2,471.00	$88,956

9.1. IRRIGATION

One way to address the high costs of irrigation is to vary watering methods. RDG has identified more accessible areas to receive consistent summer irrigation while the less accessible zones can receive no supplemental watering (an initial deep soak after planting is recommended for all plantings). This would have the dual benefit of reducing associated irrigation costs and serve as an experiment in watering methods for future phases.

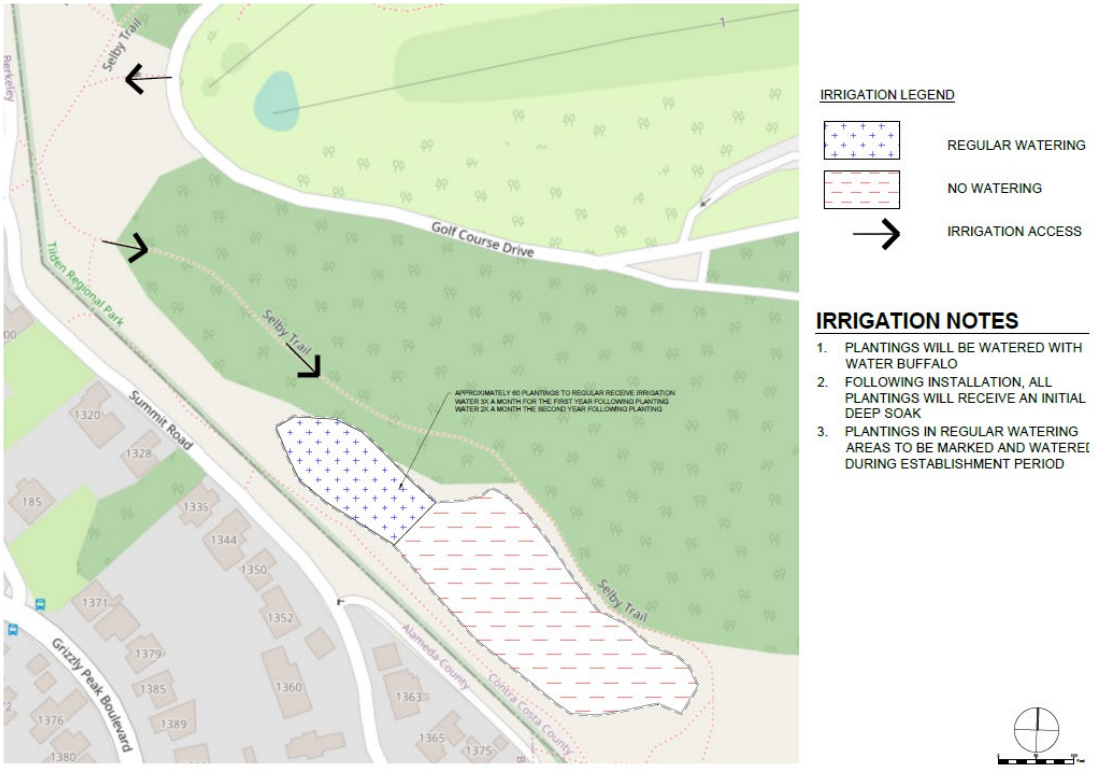


Figure 12 Proposed Irrigation for Phase 1 Plantings - Site TCG06

Figure 13 Proposed Irrigation for Phase 1 Plantings - Site TCG07

Access for irrigation and maintenance is shown in Figure 12 and Figure 13. RDG anticipates the use of an ATV or side-by-side to tow a mobile water buffalo along trails. It is estimated that about 150 plantings per site will be regularly watered in the dry summer season. This number may vary depending on planting location.

- Soak all plantings after initial installation
- Mark planting pits located in Regular Watering areas. This can be done with flags or staking
- Water each marked planting pit with 4 gallons of water per irrigation visit
- Water 3 times a month for the first year and 2 times a month the second year
- Observe plant response to irrigation over time and adaptively manage to increase or reduce plantings to be watered based on relative survivorship between irrigated and non-irrigated plants

9.2. INVASIVE PLANT MANAGEMENT

This is most important in the years immediately following *Eucalyptus* treatment and acorn planting and can take significant effort. The following approach focuses the intensity of effort around the areas of active revegetation and should be conducted in tandem with EBRPD's Fuels Management Prescription (Prescription) for RTA TI012 (East Bay Regional Parks District 2017).

While the Prescription covers the entire 91 acres of the RTA, areas designated for restoration (Sites TGC06 and TGC07) will require additional management once planting occurs. These areas should focus on removing invasive plants listed by CAL-IPC as moderate and high as identified by VNLC, such as French broom, along with a few species that are rated lower but that would likely be problematic for oak restoration in the region, such as cotoneaster. See **Table 6** Management Recommendations for Invasive Plant Species of Concern for more information.

Within the RTA, according to the Prescription, a combination of weed-eating, hand pulling, grazing, and herbicides is to be used to sustain lowered fire hazard and fuel loading at acceptable levels. In addition, the use of a thick application of mulch within the RTA and more intently within the restoration areas will prove the most effective in limiting the establishment of undesirable species.

For the Restoration Sites, grazing should be avoided to protect the revegetation efforts. Weed-eating is still acceptable but should avoid oaks (both volunteer and planted) in the landscape. Planted acorns should be easily identified by cages, and woody debris Nests.

Around the acorn planting areas themselves, a concerted effort should remove all non-native vegetation within cages or "Nests". Because non-natives compete with the seedlings for water and nutrient resources, the planting areas should be kept as weed free as possible for as long as possible.

10. MONITORING & ADAPTIVE MANAGEMENT

Monitoring is assumed to take place in conjunction with maintenance. Depending on number of visits desired by EBRPD, monitoring should fall under the same budget for maintenance. Some of the recommendations below require more frequent visits if preferred by the District.

10.1. TREE GROWTH AND SURVIVORSHIP MONITORING

Monitoring for emergence may be performed weekly if desired. Following emergence, monitoring the growth of trees can be done by measuring height on a monthly basis. A measuring tape or stick can be used. Additionally, visual observations can be used to monitor the overall health and survivorship of the trees, such as the presence of new leaves and branches, or signs of disease or stress. Tree growth and survivorship is an effective way for evaluating the success of plantings.

If there appears to be variability of growth across the acorn plantings, EBRPD should assess the potential conditions that may be influencing their success. The factors contributing to the variability of growth is typically intricate, and it is unlikely to be solely attributed to a single variable such as irrigation or deer browse. Nevertheless, regular observations enable early detection of any concerns related to plant growth, providing an opportunity for further investigations and timely management adjustments to prevent the loss of the plantings.

If tree survival greatly exceeds the target survivorship required to achieve an oak woodland (approximately 125 trees per acre or an average spacing of 18 to 20 feet apart), costly maintenance activities can be reduced, such as irrigation and intense weeding around each acorn planting. Weeding of the restoration areas and the greater RTAs should continue to ensure problematic invasive species do not gain a stronghold.

10.2. HERBIVORY

Herbivory of young plants and new growth can significantly reduce oak establishment. During the first few seasons, it is advised to check for signs of herbivory and damage from both deer and rodents. Monitoring is recommended on a monthly schedule.

Look for signs of browsing such as broken branches, bark stripping, or the presence of animal droppings and tracks. A wildlife camera can be used to monitor animal activity at the site. This would be particularly interesting at the woody debris "Nests" to better understand rodent interaction with the interventions. Signs of specific species would be important to note with camera footage or other observable indicators.

According to EBRPD wildlife biologist Tammy Lim, oak seedlings may be eaten or disturbed by dusky-footed woodrats, Botta's pocket gophers, or California ground squirrels. Monitoring the presence or absence of these species can provide insights into which ones are using the Nests, potentially helping identify the responsible species if rodent damage is observed. Look for the following signs of animals in the area:

- Browsing (deer)
    - Missing leaves
- Girdling (voles or gophers)
    - Look for wide patches of missing bark near the base of trees
- Burrowing (ground squirrels)
    - Tunnels or holes

Comparing relative success of acorn seedlings in Nests and in cages will help evaluate the effectiveness of woody debris Nests as a deterrent to herbivory.

If herbivory is observed to be a problem in the Nests, tree cages should be installed. Caging should remain for the entirety of the establishment period. Monitor cages to determine if removal is required at the end of their operational life.

If acceptable from an aesthetic and public safety standpoint, the cages can be left in place to disintegrate over time. If wire material shows no signs of damage, caging may be re-used for future oak plantings.

10.3. IRRIGATION

With the proposed watering methods, notable differences in tree growth should be evaluated between irrigated and non-irrigated acorn plantings. This will help inform irrigation methods at future oak restoration projects. Because irrigation has been known

to increase rodent damage, particular effort should be focused on observing if herbivory increases at irrigated plantings.

If herbivory is noted to increase at the irrigated plantings, EBRPD should consider limiting or eliminating irrigation.

If monitoring determines that irrigation is improving success, EBRPD should evaluate increasing supplemental watering if plantings appear water stressed.

10.4. INVASIVE SPECIES MONITORING

Regular surveys of the restoration site can identify invasive species that may be present. This can be done by walking through the site and visually inspecting for non-native plants. If invasive species are identified, they should be removed promptly. Invasive species can grow and spread quickly, so it's important to monitor for them frequently. Depending on the size and complexity of the site, invasive species monitoring can be done monthly, quarterly, or semi-annually. Monitoring should occur more frequently during the first few years of the project when the restoration site is still establishing.

If monitoring effort is limited, focus on areas around acorn plantings and then work out to the larger restoration sites and then finally the entire RTA.

If weeds are establishing through the mulch, consider augmenting the mulch by increasing the thickness.

If there are large infestations of invasive species, remove the satellite populations and individuals first to limit areas that could quickly become large populations. Focus on the core populations as time allows. In general, the EBPRD should follow their current principals of Integrated Pest Management program.

10.5. SUCCESS CRITERIA

The purpose of the success criteria is to evaluate the ecological progress of the restoration work and provide insights to improve future oak woodland restoration efforts. While there is potential to incorporate various factors such as cost/benefit analysis, ecological services, and fire fuel risk into the success criteria, we recommend that the primary measure of success should be whether the project achieves the target tree density and spacing comparable to the reference sites. If the restoration areas attain a spacing similar to the reference sites, the project can be deemed successful. Whether the rate at which the sites achieve this goal should be included in the success criteria can be determined by EBRPD; however, we have omitted it from the plan to reduce the monitoring burden and the need to compare relative rates of woodland habitat development with control sites.

11. UNDERSTORY REVEGETATION STRATEGY – FUTURE PROJECT PHASE

11.1. SEED MIX

Understory revegetation efforts should include a native seed mix to promote the growth of native grasses and annuals. Lightly mulched areas will be suitable for seeding a year or two after implementation. The following mix is composed of short-term species dependent on high sun exposure and will be shaded out as the woodland habitat matures.

In addition, given the apparent preference to vegetative reproductive species observed by VNLC staff growing in the thick duff layer of *Eucalyptus*, the following list includes species that reproduce vegetatively once established.

Table 12. Representative Seed Mix

Scientific Name	Common Name
Bromus carinatus	California brome
Elymus glaucus	blue wild rye
Elymus triticoides	creeping wild rye
Eurybia radulina	roughleaf aster
Sanicula crassicaulis	Pacific sanicle
Sisyrinchium bellum	Western blue-eyed grass
Solidago elongata	West coast Canada goldenrod
Stachys rigida	rough hedgenettle

Do not seed if remaining mulch is deeper than 1-inch. Mulch that was applied deeper can be seeded once it has decayed after being in place for a few seasons. A general rule of thumb is to delay seeding by one year for every 1-inch of mulch applied.

11.2. UNDERSTORY RESTORATION AS SHADED FUEL BREAK

When planning to plant trees and shrubs, it's essential to consider the proximity to Wildland Urban Interface (WUI) and the fire risk in the area. In this case, the restoration areas TGC06 & TCG07 are within the WUI and close to residential homes. As part of the project to restore oak woodlands at these sites, it's important to prioritize creating fire-resistant landscapes. Designing for defensible space versus habitat restoration requires different spacing for trees and shrubs, as well as different management strategies for fuels reduction (University of California Agriculture and Natural Resources 2007).

A shaded fuel break preserves overstory species while removing or thinning understory, invasive plants, and ladder fuels. It serves to slow the spread of fire and facilitate containment while maintaining a native canopy. Generally, shaded fuel break prescriptions call for reducing ground level fuels, increasing the height to live crown, and increasing canopy spacing (Natural Resource Conservation Service 2020). Specific prescriptions should be developed according to the site and management goals, but the following are general conditions from the NRCS for shaded roadside fuel breaks:

- "Apply roadside fuel breaks along county roads or private roads at an effective minimum width of 2 ½ times the height of the average codominant tree or brush species vegetation or a minimum of 200 feet. Add 10 feet to the width for every 10 percent increase in slope (e.g., for a 50% slope 200 ft + 50 ft = 250 feet total width), on level ground. Ideally, roadside fuel break widths are installed evenly on each side of the road (i.e.100 feet side of road)."
- "The maximum size live tree to be removed is 12 inches DBH. Dead/dying trees have no diameter size limit."
- "Generally, brush cover should be less than 20% cover."
- "Remove shrubs and small trees within the drip line of trees when sufficient space cannot be created between the tree crown and top of shrub/small trees. Pruning residual trees will also contribute to creating vertical separation of fuels."

Shaded fuel break prescriptions are generally compatible with oak savanna which, according to Vollmar's assessment, may be the most appropriate target habitat for Site TGC06 and portions of TGC07 (see Section 4.1 of this document). Understory planting for Oak Savanna can follow the Representative Seed Mix above and Representative Revegetation Palette below. Further consideration should be given to restoration areas where oak woodland, rather than oak savanna, is the targeted habitat.

Phase 1 Oak restoration at TCC07 has been analyzed by VNLC as suitable for oak woodland. More research may be needed to determine if "true woodland habitat" with a representative understory is compatible with a shaded fuel break with a focus on fire safety. In this context, fire-resistant species such as toyon (*Heteromeles arbutifolia*) or coffeeberry (*Frangula californica*) could the focus of understory revegetation. EBRPD goals may be site specific.

11.3. UNDERSTORY RESTORATION AS REPRESENTATIVE PLANT COMMUNITY

After planting acorns, restoring a diverse oak woodland and/or savanna understory may actively be pursued if it aligns with goals for the site. If funding is available, understory planting could occur within 1-5 years of planting acorns. Planting oaks together with native species ensures understories are not overtaken by aggressive non-native shrubs and annual grasses which can quickly shade out oak seedlings, consume all available soil moisture, and produce large numbers of seeds which attract rodents (Pavlik, et al. 1991). Herbaceous understory management is an important factor for regenerating young oaks and planning for oak savanna and woodland habitat restoration. Additionally, fire resistant species and spacing can be implemented to balance habitat considerations with fire management ones.

11.4. CONTAINER PLANTING - OAK HABITAT RESTORATION

The following table presents a list of species that are appropriate for container planting in the restoration areas. This information is based on VNLC's field visit, California Native Plant Society's Calscape, and Calflora. The presence of the species found within the study area sites suggests their suitability for the area, and also their tolerance for *Eucalyptus* and/or pine debris, which will be used as mulch materials. It would be beneficial to include a few of these species in the Oak Restoration Project if funding

permits. RDG recommends sourcing plants from native nurseries capable of providing restoration-grade container plants sourced from the local area.

Table 13. Representative Revegetation Palette

Oak Savanna	Oak Woodland
Aesculus californica **(California buckeye)**	***Aesculus californica*** **(California buckeye)**
Clematis lasiantha **(chaparral clematis)**	***Artemisia douglasiana*** **(mugwort)**
Elymus glaucus **(blue wild rye)**	***Frangula californica*** **(coffeeberry)**
Elymus triticoides **(creeping wild rye)**	***Corylus cornuta*** **(hazelnut)**
Hetermoeles arbutifolia **(Toyon)**	***Pteridium aquilinum*** **(eagle fern)**
Lonicera hispidula **(pink honeysuckle)**	***Ribes malvaceum*** **(chaparral currant)**
Ribes malvaceum **(chaparral currant)**	***Rosa californica*** **(California wild rose)**
Rosa californica **(California wild rose)**	***Rosa gymnocarpa*** **(baldhip rose)**
Stipa pulchra **(purple needlegrass)**	***Rubus ursinus*** **(California blackberry)**
Symphoricarpos mollis **(creeping snowberry)**	***Sambucus Mexicana*** **(blue elderberry)**
	Salvia spathacea **(hummingbird sage)**
	Symphoricarpos albus **(upright snowberry)**

If EBRPD chooses to revegetate by propagating field collected plant material (AECOM 2020), it can use nursery plants as a supplement. Alternately, if EBRPD opts for an external contractor to carry out this phase of the project, it may be simpler to use typical nursery container plants for installation.

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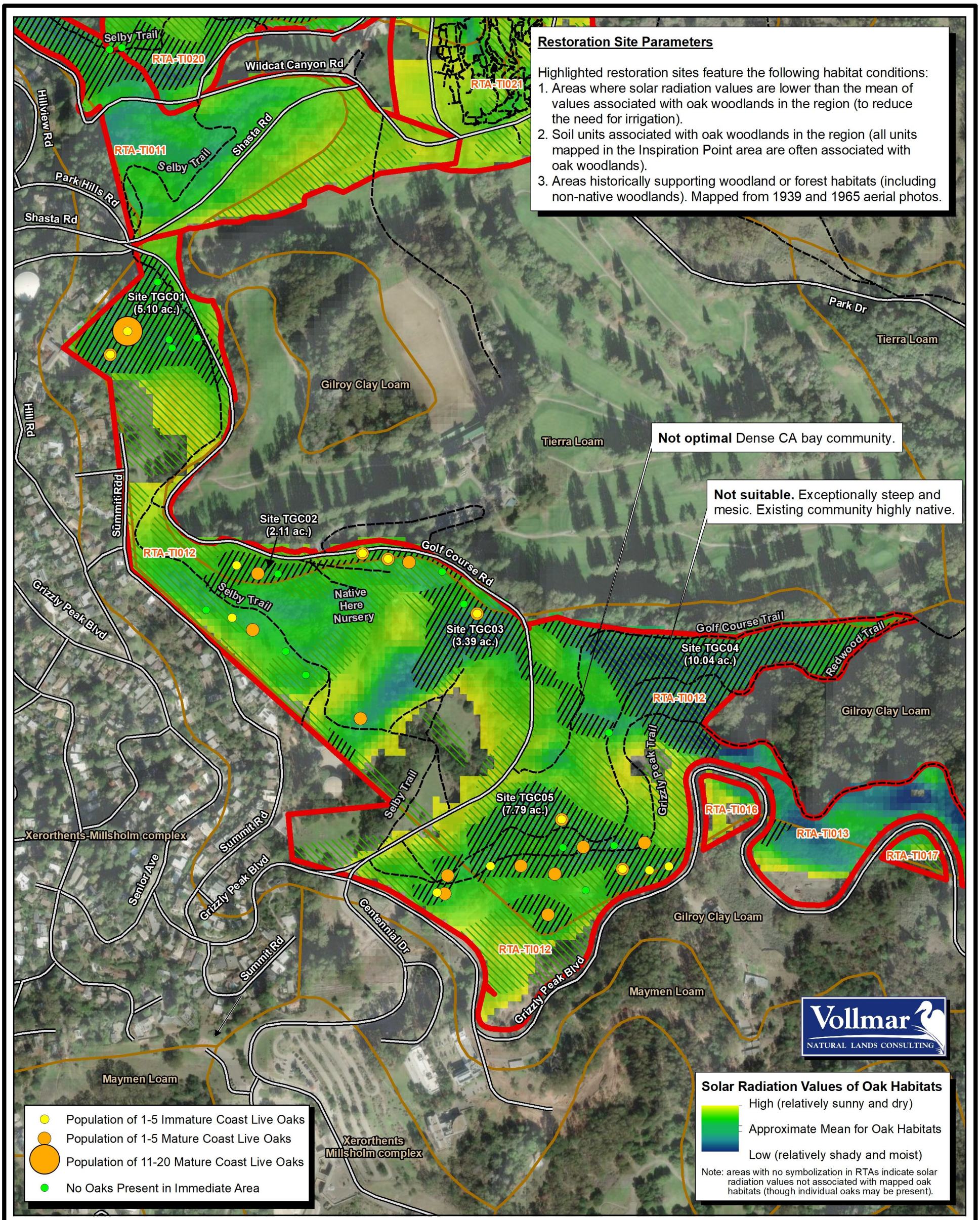
APPENDIX A:

MAPS



Legend

- Road
- Trail
- Soil Unit Boundary
- Potential Restoration Site (see notes)
- Historical Native Woodland or Forest
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional oak occurrences expected beyond mapped points. "Immature" is <4" diameter at breast height.

See also Figure 3 for most suitable restoration sites.

Data Sources: VNLC, 2023 | EBRPD, 2022 | TIGER, 2020
USGS, various years | USDA SSURGO
GIS/Cartography by J. Schweitzer & R. Foss, Feb. 2023
Map File: T1012-Oaks_530_B-P_2023-0306.mxd

FIGURE 1
Oak Woodland Restoration Analysis
Presence of Existing Oak Trees

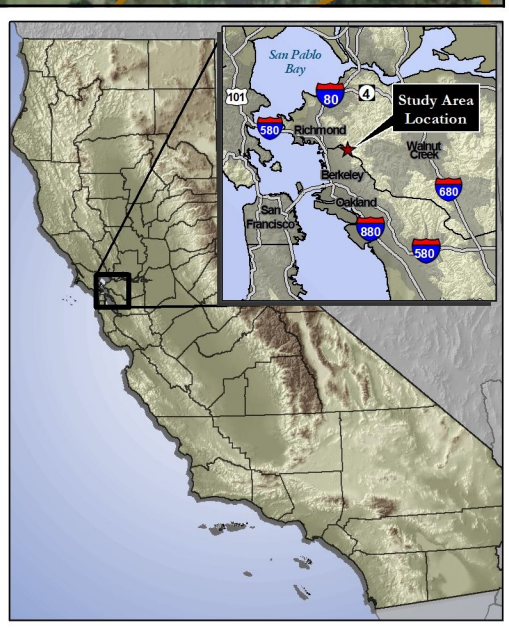
Tilden Golf Course (T1012) Study Area
East Bay Regional Park District
Contra Costa County, California

N W E S

1:3,600
(1 inch = 300 feet at tabloid layout)

0 75 150 Meters

0 150 300 600 Feet



Restoration Site Parameters (see Fig. 1 for other parameters)

Highlighted restoration sites feature the following habitat conditions:

1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Inspiration Point area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

Not suitable. Area too steep and mesic
Existing community highly native.

Selby Trail
RTA-TI020
Wildcat Canyon Rd
RTA-TI021
Hillview Rd
RTA-TI011
Selby Trail
Shasta Rd
Park Hills Rd
Shasta Rd
Italian thistle
poison hemlock
Site TGC01
(5.10 ac.)
ripgut brome
English ivy
Park Dr
Italian thistle
pride of Madeira
RTA-TI012
poison hemlock
Hill Rd
Summit Rd
purple geranium
Site TGC02
(2.11 ac.)
panic veldtgrass
panic veldtgrass
Golf Course Rd
Italian thistle
Native Here Nursery
French broom
Selby Trail
Italian thistle
poison hemlock
milk thistle
oblong spurge
Italian thistle
black mustard
Site TGC03
(3.39 ac.)
Golf Course Trail
Redwood Trail
Italian thistle
oblong spurge
cherry plum
Italian thistle
poison hemlock
oblong spurge
Site TGC04
(10.04 ac.)
RTA-TI012
poison hemlock
Harding grass
bull thistle
Grizzly Peak Trail
oblong spurge
poison hemlock
Italian thistle
Selby Trail
Site TGC05
(7.79 ac.)
RTA-TI016
RTA-TI013
RTA-TI017
Summit Rd
Grizzly Peak Blvd
poison hemlock
shortpod mustard
Senior Ave
French broom
orange cotoneaster
oblong spurge
poison hemlock
Italian thistle
RTA-TI012
Summit Rd
oblong spurge
Grizzly Peak Blvd
bull thistle
poison hemlock
cherry plum
Centennial Dr

Vollmar NATURAL LANDS CONSULTING

- Population of California Bay (potential SOD vector)
- Population of Invasive Weed (see map labels)
- Signs of Potential SOD Observed
- No Constraints Noted in Immediate Area

Legend

- Road
- Trail
- Potential Restoration Site (see notes)
- Historical Native Woodland or Forest
- Treated Area (2018-2022)
- Planned Treatment (2023)
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional oak occurrences expected beyond mapped points. "Immature" is <4" diameter at breast height.

See also Figure 3 for most suitable restoration sites.

Data Sources: VNLC, 2023 | EBRPD, 2022 | TIGER, 2020
USGS, various years | USDA SSURGO
GIS/Cartography by J. Schweitzer and R. Foss, Feb. 2023
Map File: T1012-Othr_530_B-P_2023-0306.mxd

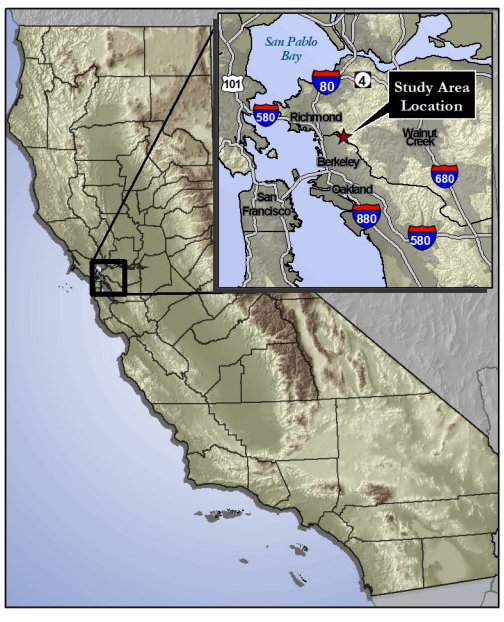
FIGURE 2
Oak Woodland Restoration Analysis
Potential Restoration Constraints

Tilden Golf Course (T1012) Study Area
East Bay Regional Park District
Contra Costa County, California

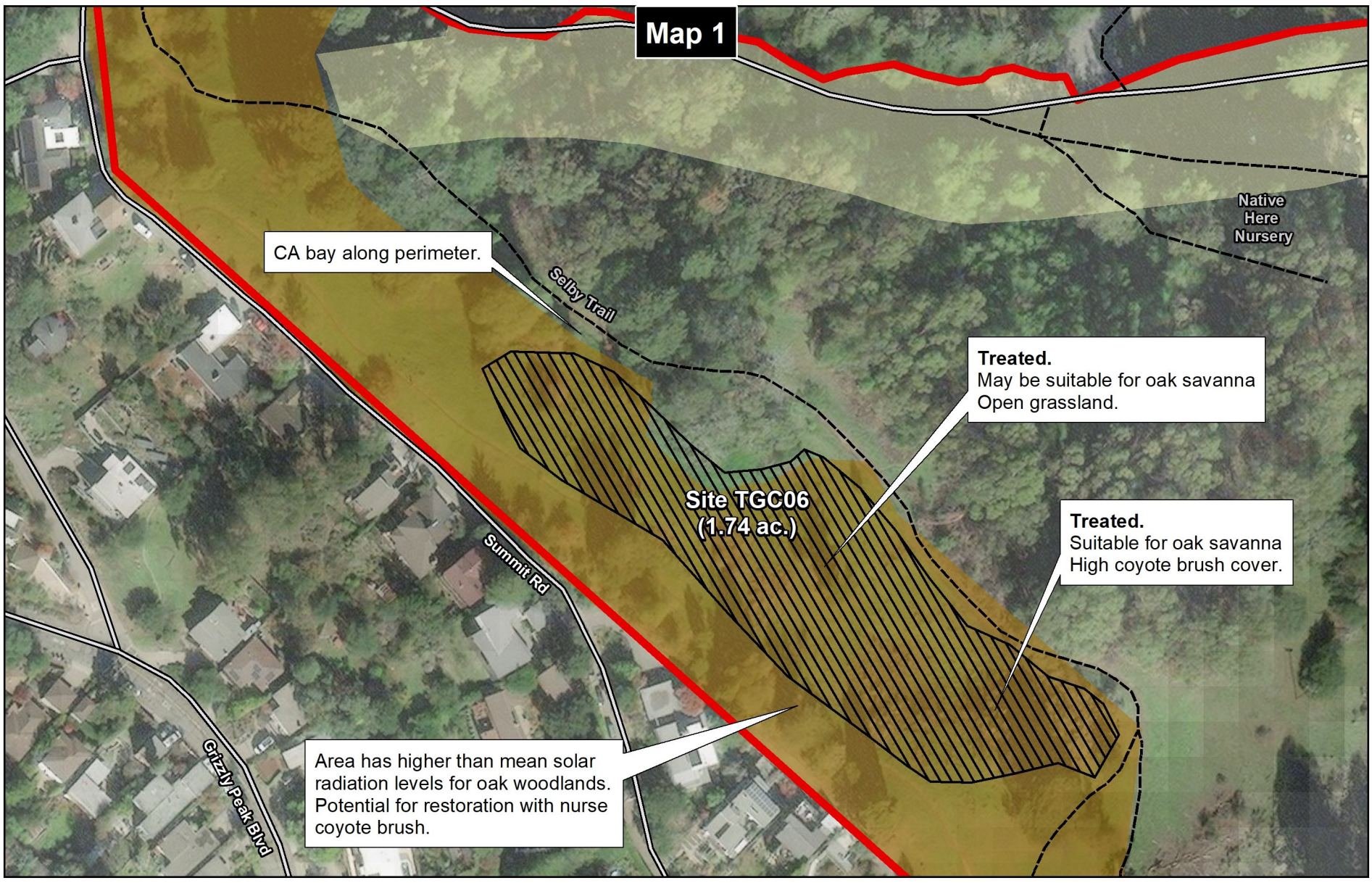
N W E S

1:5,400
(1 inch = 450 feet at tabloid layout)

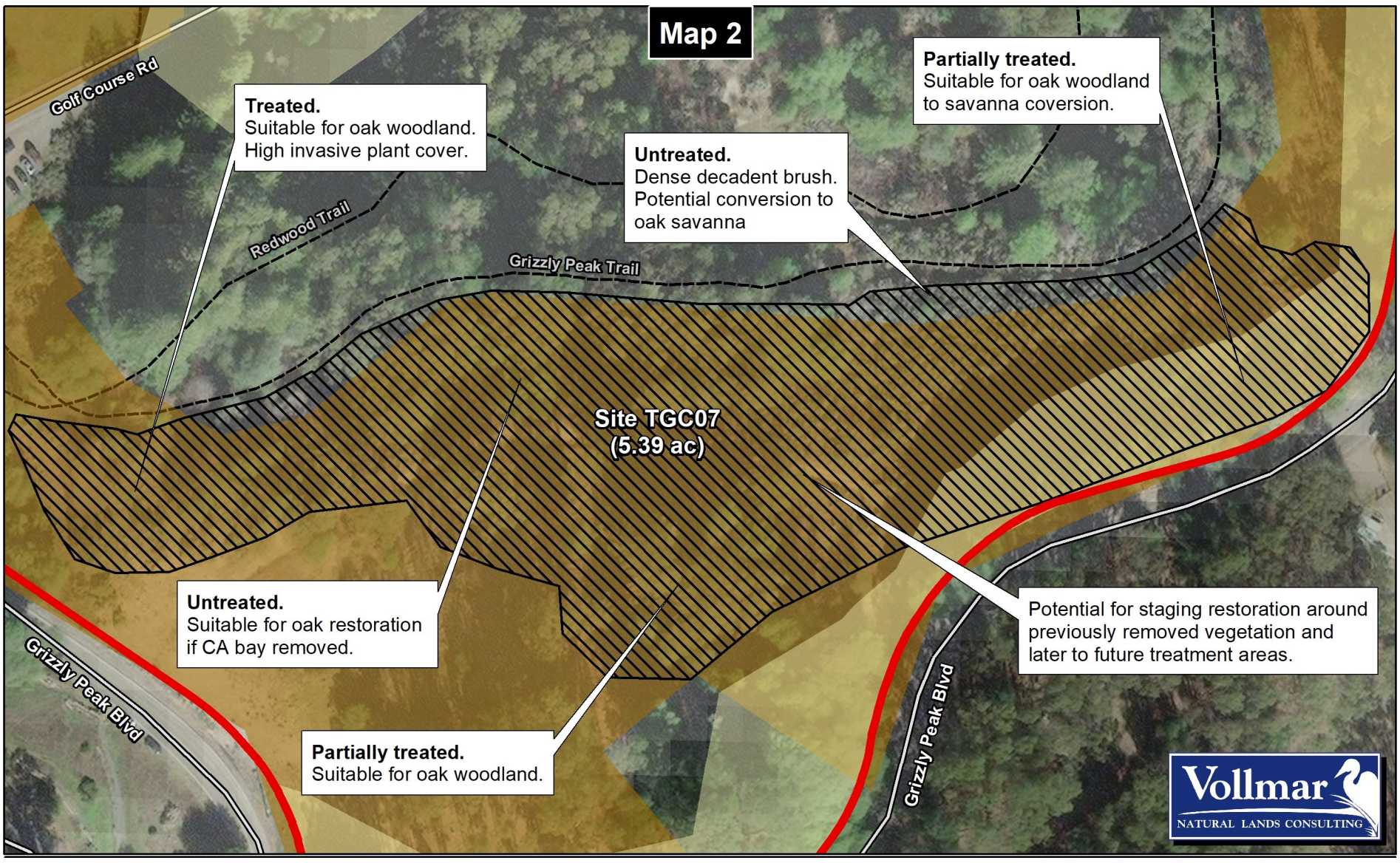
0 75 150 Meters
0 150 300 600 Feet



Map 1



Map 2



Legend

- Road
- Trail
- Field-selected Restoration Site
- Recommended Treatment Area (RTA) Boundary
- Planned Treatment (2023)
- Treated Area (2018-2022)

FIGURE 3
TGC06 and TGC07

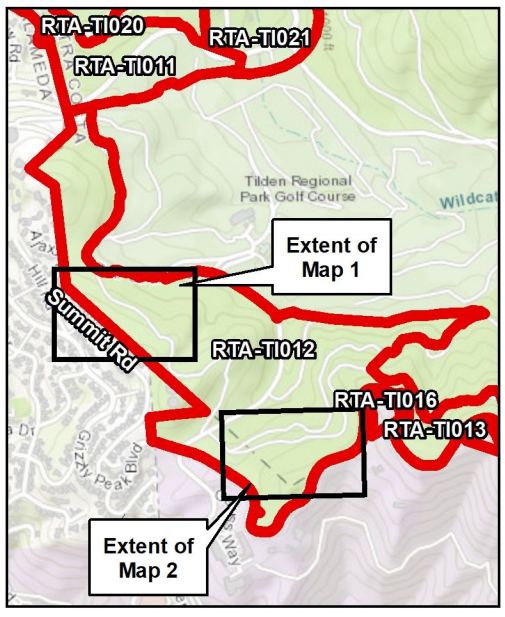
Tilden Golf Course (T1012) Study Area
East Bay Regional Park District
Contra Costa County, California

N
W E
S

1:1,500
(1 inch = 125 feet at tabloid layout)

0 25 50 Meters

0 75 150 300 Feet



Data Sources: VNLC, 2023 | EBRPD, 2022 | TIGER, 2020
GIS/Cartography by R. Foss & J. Schweitzer, Feb. 2023
Map File: T1012-Selected_530_B-P_2023-0306.mxd

Restoration Site Parameters

Highlighted restoration sites feature the following habitat conditions:
1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Inspiration Point area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

Site IP01 (0.41 ac.)
Site IP02 (0.19 ac.)
RTA-TI003
Site IP03 (0.29 ac.)
Site IP04 (0.53 ac.)
Site IP05 (10.47 ac.)
RTA-TI004
Site IP06 (3.74 ac.)

Dominated by invasive pines
Native understory is relatively intact.

Dominated by invasive *Eucalyptus*
Native understory is relatively sparse (except at canopy openings.)

Los Gatos Loam
Millsholm Loam
Gilroy Clay Loam
Inspiration Point Parking Area
Nimitz Way
Meadows Canyon Trail
Curran Trail
Wildcat Canyon Road
Seaview Trail
Lower Big Springs Trail
Quarry Trail
Lake View Trail

Solar Radiation Values of Oak Habitats
High (relatively sunny and dry)
Approximate Mean for Oak Habitats
Low (relatively shady and moist)
Note: areas with no symbolization in RTAs indicate solar radiation values not associated with mapped oak habitats (though individual oaks may be present).

Vollmar NATURAL LANDS CONSULTING

Legend
- Population of 1-5 Mature Coast Live Oaks
- Population of 6-10 Mature Coast Live Oaks
- Population of 1-5 Immature Coast Live Oaks
- Population of 6-10 Immature Coast Live Oaks
- No Oaks Present in Immediate Area
- Road
- Trail
- Soil Unit Boundary
- Potential Restoration Site (see notes)
- Historical Native Woodland or Forest
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional oak occurrences expected beyond mapped points. "Immature" is <4" diameter at breast height.

Data Sources: VNLC, 2022 | EBRPD, 2022 | TIGER, 2020 USGS, various years | USDA SSURGO
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: IP-Oaks_530_B-P_2023-0214.mxd

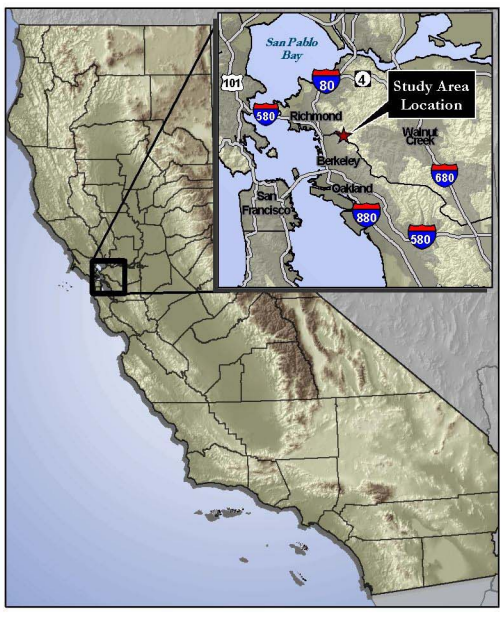
FIGURE 4
Oak Woodland Restoration Analysis
Presence of Existing Oak Trees

Inspiration Point Study Area
East Bay Regional Park District
Contra Costa County, California

N W E S

1:3,600
(1 inch = 300 feet at tabloid layout)

0 75 150 Meters
0 150 300 600 Feet



Restoration Site Parameters (see Fig. 1 for other parameters)

Highlighted restoration sites feature the following habitat conditions:
1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Inspiration Point area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

Site IP01 (0.41 ac.)

Site IP02 (0.19 ac.)

RTA-TI003

Dominated by invasive pines
Native understory is relatively intact.

Site IP03 (0.29 ac.)

poison hemlock

panic veldtgrass
panic veldtgrass
panic veldtgrass

Site IP04 (0.53 ac.)

Inspiration Point Parking Area

Nimitz Way

Meadows Canyon Trail

Dominated by invasive *Eucalyptus*
Native understory is relatively sparse (except at canopy openings.)

English holly
cherry plum
French broom
cherry plum
sweet brier
French broom
cotoneaster
Italian thistle
Italian thistle

French broom
Italian thistle
bull thistle

Italian thistle
French broom

RTA-TI004

Site IP05 (10.47 ac.)

Curran Trail

Site IP06 (3.74 ac.)

Italian thistle
ripgut brome
poison hemlock

Wildcat Canyon Road

Seaview Trail

Lower Big Springs Trail

panic veldtgrass

panic veldtgrass

panic veldtgrass
Italian thistle

Quarry Trail

Seaview Trail

Quarry Trail

Lake View Trail

Vollmar NATURAL LANDS CONSULTING

Legend

- Population of Invasive Weed (see map labels)
- Signs of Potential SOD Observed
- Population of California Bay (potential SOD vector)
- No Constraints Noted in Immediate Area
- Road
- Trail
- Potential Restoration Site (see notes)
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional occurrences of eached mapped feature type expected beyond mapped points.

Data Sources: VNLC, 2022 | EBRPD, 2022
USGS, various years | TIGER, 2020
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: IP-Othr_530_B-P_2023-0214.mxd

FIGURE 5
Oak Woodland Restoration Analysis
Potential Restoration Constraints

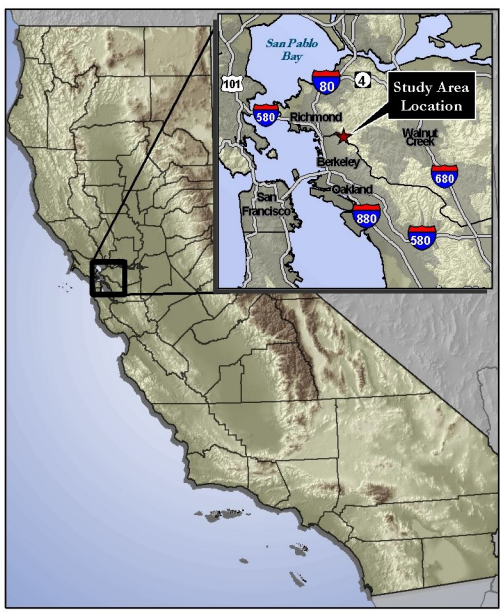
Inspiration Point Study Area
East Bay Regional Park District
Contra Costa County, California

N W E S

1:3,600
(1 inch = 300 feet at tabloid layout)

0 75 150 Meters

0 150 300 600 Feet



Restoration Site Parameters

Highlighted restoration sites feature the following habitat conditions:
1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Skyline Gate are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

RTA area dominated by invasive pines
Native understory is relatively intact.

RTA area dominated by invasive *Eucalyptus*
Native understory is relatively intact

RTA area includes invasive pines
Native understory is relatively intact.

Maymen loam
Millsholm loam
Garretson loam
Felton loam
Skyline Blvd
Pine Hills Dr
Pinehurst Rd
Skyline/Bay Area Ridge Trail
East Ridge Trail
West Ridge Trail
Stream Trail
French Trail
Phillips Loop
Wilton Dr
RTA-RD001
RTA-RD002
RTA-RD003
RTA-RD004
Site SG01 (1.70 ac.)
Site SG02 (0.29 ac.)
Site SG03 (3.63 ac.)
Site SG04 (0.76 ac.)

Oak Density
- Population of 1-5 Immature Coast Live Oaks
- Population of 6-10 Immature Coast Live Oaks
- Population of 11-20 Immature Coast Live Oaks
- Population of 1-5 Mature Coast Live Oaks
- Population of 6-10 Mature Coast Live Oaks
- Population of 11-20 Mature Coast Live Oaks
- Population of 21-50 Mature Coast Live Oaks
- No Oaks Present in Immediate Area

Solar Radiation Values of Oak Habitats
- High (relatively sunny and dry)
- Approximate Mean for Oak Habitats
- Low (relatively shady and moist)

Note: areas with no symbolization in RTAs indicate solar radiation values not associated with mapped oak habitats (though individual oaks may be present).

Vollmar NATURAL LANDS CONSULTING

Legend
- Road
- Trail
- Soil Unit Boundary
- Potential Restoration Site (see notes)
- Historical Native Woodland or Forest
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional oak occurrences expected beyond mapped points. "Immature" is <4" diameter at breast height.

FIGURE 6
Oak Woodland Restoration Analysis
Presence of Existing Oak Trees

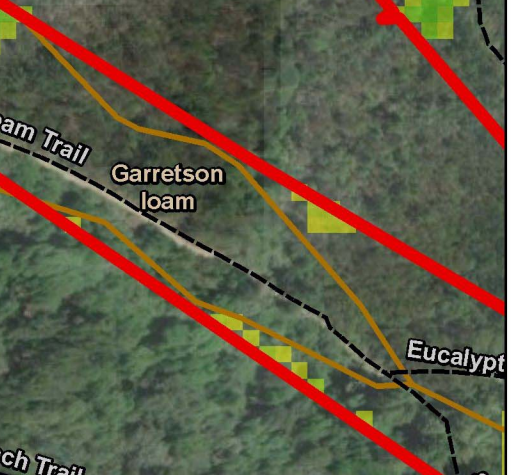
Skyline Gate Study Area
East Bay Regional Park District
Alameda County, California

N W E S

1:4,500

0 75 150 Meters

0 150 300 600 Feet



Data Sources: VNLC, 2022 | EBRPD, 2023 | TIGER, 2020
USGS, various years | USDA SSURGO
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: SG-Oaks_530_B-P_2023-0214.mxd

Restoration Site Parameters

Highlighted restoration sites feature the following habitat conditions:

1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Skyline Gate area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

RTA area dominated by invasive pines
Native understory is relatively intact.

RTA area dominated by invasive *Eucalyptus*
Native understory is relatively intact

Skyline Blvd
Pinehurst Rd
Skyline/Bay Area Ridge Trail
East Ridge Trail
Pine Hills Dr
French broom
cherry plum
Italian thistle
poison hemlock
RTA-RD001
Phillips Loop
Site SG01 (1.70 ac.)
Italian thistle
RTA-RD002
Site SG02 (0.29 ac.)
RTA-RD004
RTA-RD002
Stream Trail
Site SG03 (3.63 ac.)
Site SG04 (0.76 ac.)
RTA-RD003
West Ridge Trail
Stream Trail
RTA-RD004
Italian thistle
Wilton Dr
Eucalyptus Trail
French Trail
Stream Trail
Tres Sendas Trail

Vollmar NATURAL LANDS CONSULTING

Legend

- Population of Invasive Weed (see map labels)
- Signs of Potential SOD Observed
- Population of California Bay (potential SOD vector)
- No Constraints Noted in Immediate Area
- Road
- Trail
- Potential Restoration Site (see notes)
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional occurrences of eached mapped feature type expected beyond mapped points.

Data Sources: VNLC, 2022 | EBRPD, 2022
USGS, various years | TIGER, 2020
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: SG-Othr_530_B-P_2023-0214.mxd

FIGURE 7
Oak Woodland Restoration Analysis
Potential Restoration Constraints

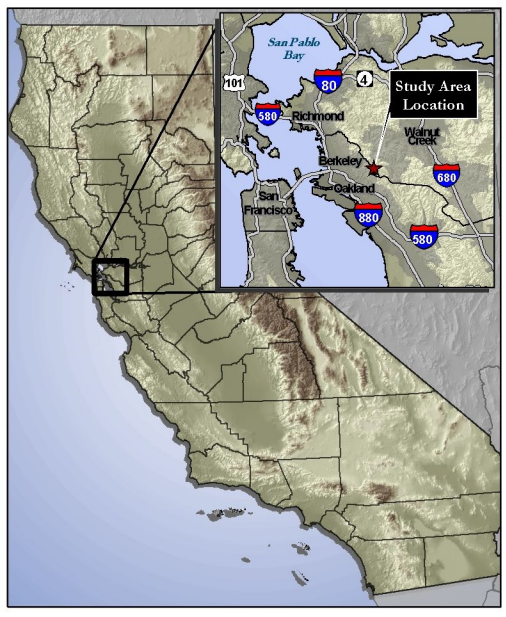
Skyline Gate Study Area
East Bay Regional Park District
Alameda County, California

N W E S

1:4,500

0 75 150 Meters

0 150 300 600 Feet



Restoration Site Parameters

Highlighted restoration sites feature the following habitat conditions:

1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Lost Ridge area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

Solar Radiation Values of Oak Habitats

- High (relatively sunny and dry)
- Approximate Mean for Oak Habitats
- Low (relatively shady and moist)

Note: areas with no symbolization in RTAs indicate solar radiation values not associated with mapped oak habitats (though individual oaks may be present).

Oak Density

- Population of 1-5 Immature Coast Live Oaks
- Population of 6-10 Immature Coast Live Oaks
- Population of 11-20 Immature Coast Live Oaks
- Population of 1-5 Mature Coast Live Oaks
- Population of 6-10 Mature Coast Live Oaks
- Population of 11-20 Mature Coast Live Oaks
- Population of 21-50 Mature Coast Live Oaks
- No Oaks Present in Immediate Area

Note: All surveyed RTAs dominated by *Eucalyptus* species

Legend

- Road
- Trail
- Soil Unit Boundary
- Potential Restoration Site (see notes)
- Historical Native Woodland or Forest
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional oak occurrences expected beyond mapped points. "Immature" is <4" diameter at breast height.

Data Sources: VNLC, 2022 | EBRPD, 2021 | EBRPD, 2022
TIGER, 2020 | USGS, various years | USDA SSURGO
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: LR-Oaks_530_B-P_2023-0214.mxd

FIGURE 8
Oak Woodland Restoration Analysis
Presence of Existing Oak Trees

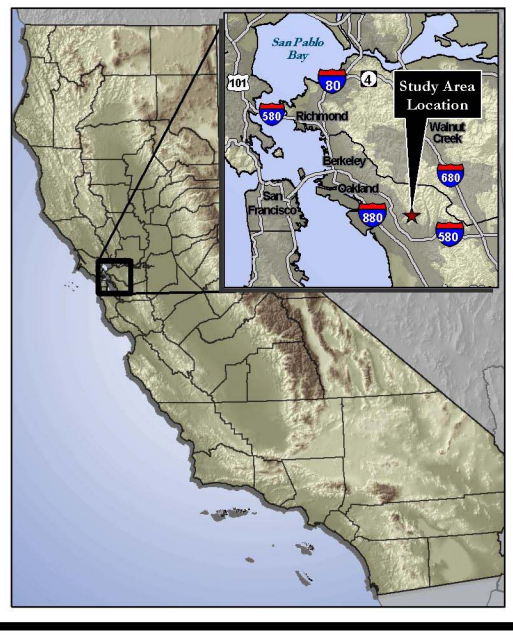
Lost Ridge Study Area
East Bay Regional Park District
Alameda County, California

N W E S

1:9,000
(1 inch = 750 feet at tabloid layout)

0 187.5 375 Meters

Feet 0 375 750 1,500



Restoration Site Parameters

Highlighted restoration sites feature the following habitat conditions:

1. Areas where solar radiation values are lower than the mean of values associated with oak woodlands in the region (to reduce the need for irrigation).
2. Soil units associated with oak woodlands in the region (all units mapped in the Lost Ridge area are often associated with oak woodlands).
3. Areas historically supporting woodland or forest habitats (including non-native woodlands). Mapped from 1939 and 1965 aerial photos.

Note: All surveyed RTAs dominated by *Eucalyptus* species

Legend

- Population of Invasive Weed (see map labels)
- Signs of Potential SOD Observed
- Population of California Bay (potential SOD vector)
- No Constraints Noted in Immediate Area
- Road
- Trail
- Potential Restoration Site (see notes)
- Recommended Treatment Area (RTA) Boundary

Notes: Field data point locations selected as representative habitats of RTA and indicate conditions of visible vicinity (~0.5-1-acre). Additional occurrences of eached mapped feature type expected beyond mapped points.

Data Sources: VNLC, 2022 | EBRPD, 2021 | EBRPD, 2022
USGS, various years | TIGER, 2020
GIS/Cartography by Jake Schweitzer, Nov. 2022
Map File: LR-Othr_530_B-P_2023-0214.mxd

FIGURE 9
Oak Woodland Restoration Analysis
Potential Restoration Constraints

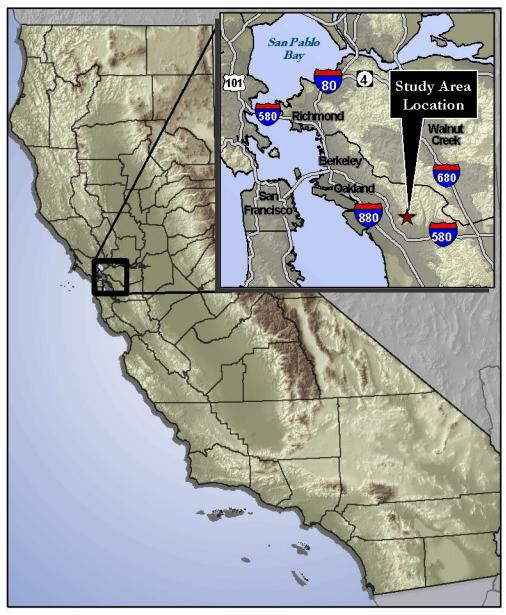
Lost Ridge Study Area
East Bay Regional Park District
Alameda County, California

N W E S

1:9,000
(1 inch = 750 feet at tabloid layout)

0 187.5 375 Meters

0 375 750 1,500 Feet



APPENDIX B:

REPRESENTATIVE PHOTOGRAPHS

Treated area with native herbaceous species (TGC01).
Western portion of site, facing west.

Partially treated area with dense California bay (TGC02).
Western portion of site, facing west.

Untreated Tasmanian blue gum with intact California bay and native understory (TGC03). Western portion of site, facing north.

Steep, mesic native community under Tasmanian blue gum (TGC04). Central portion of site, facing north.

Shrub opening within mostly treated area (TGC05).
Central portion of site, facing west.

Treated field with annual grassland and brush (TGC06).
Southern end of site, facing northwest.

Partially treated Tasmanian blue gum with California bay and coast live oak (TGC07).
Southern portion of site, facing west.

Untreated Monterey pine stand with mesic native understory (IP01).

Northern end of site, facing south.

Untreated Monterey pine with intact native trees and understory (IP04).
Central portion of site, facing southwest.

Untreated Tasmanian blue gum stand with scattered oaks (IP06).

Central portion of site, facing southwest.

Untreated Monterey cypress with open panic veldt grass understory (SG01).
Central portion of site, facing north.

Treated habitat with existing oak and California bay cover (SG02).

Central portion of site, facing west.

California bay and oak with scattered Monterey pine on slope (SG03). Northern portion of site, facing east.

Intact California bay, oak, and madrone forest with scattered Monterey pine (SG04). Central portion of site, facing south.

Untreated Tasmanian blue gum forest with dense California bay and some oaks (LR03). Eastern portion of site, facing north.

Untreated Tasmanian blue gum with many oaks and California bay (LR04). Southern-central portion of site, facing west.

Untreated Tasmanian blue gum with many oaks and California bay (LR05). Southern-central portion of site, facing south.

Coyote brush acting as nurse plant.
Tilden Golf Course area, facing northeast.

APPENDIX C:

EBRPD PROPAGULE COLLECTION PROTOCOL

This protocol only covers common plant species, in other words, plant species that are NOT considered rare with a special status (Federal or California threatened, endangered or rare OR California Rare Plant Rank). A propagule is any structure that can give rise to a new individual plant, especially parts of a plant that serve as means of vegetative reproduction, such as corms, tubers, offsets, or runners. Seeds and spores are also propagules. Propagule collection for the purposes of these guidelines refers to non-mechanized, hand collection of propagules. If your seed collection differs from the above guidelines, please contact the District botanist Michele Hammond, mhammond@ebparks.org or 510-544-2348

1. Permit Application information:

A. Why?

What is the PURPOSE of your propagule collection? Restoration project? Have you considered propagules or plants from other local sources or native plant nurseries for your project?

B. Where?

Please include a MAP of the locations where you would like to collect propagules. If map is not possible, include a list of parks and vegetation communities e.g. grassland, chaparral, riparian, etc.

C. When?

What months of the year do you plan to collect?

D. What?

List all species including subspecies or varieties of plants that you plan to collect.

2. PROPAGULE/SEED COLLECTION

a. Quantity of seed collected

Target collection of propagules from more than one patch of the plant species and from more than one individual per patch where possible. For common plant species, ideally collect 2-5% but no more than 10% of propagules available in any given site; collection of more than 10% would require the permission of EBRPD stewardship staff or botanist, Michele Hammond.

Seed collection forays may occur before, during or after peak seed production; because of this, the seed collector will need to consider how much seed has dropped or will drop in order to assess percentages.

3. Requirements AFTER seed collection:

A) Location of seed collection

EBRPD requires that the location of all plants where propagules are collected are digitally mapped with 10 meter or less accuracy and archived with Stewardship. Please record gps coordinates, preferably in decimal degrees format, to create either individual plant points or a polygon of the area where seed are collected. Complete the collection spreadsheet and also include either a spatial file or the gps coordinates to EBRPD Stewardship botanist Michele Hammond.

B) Spreadsheet information

Include species, location, quantity of seed, and name of collector in the spreadsheet provided. This information will be attached to the digital spatial layer for archiving the location and quantity of propagule collection that is happening on EBRPD parkland.

C) Diseased plant material

Please photograph and document any areas with dead or diseased plants where they are in the area of propagule collection. Do not collect from diseased plant material.

4. Decontamination Protocol:

This protocol must be followed BEFORE entering any EBRPD parkland.

Make sure vehicles and gear are free of any soil, weed propagules or seed and are decontaminated following procedures below.

A. Cleaning and sanitation: EQUIPMENT and GEAR

Decontaminate footwear, equipment, and/or tools ('gear') according to decontamination procedures (as stated below) **before** entering the park, and also between visiting ponds, wetlands, marshes and riparian areas.

After cleaning all gear with brushes to remove as much visible mud and debris as possible, saturate or soak gear with quaternary ammonia compound, isopropyl alcohol, or bleach solution.

Decontamination solutions:

- 70% or higher isopropyl alcohol
- Freshly diluted bleach solutions: household bleach can be diluted 1 part bleach to 10 parts water; pool chlorination granules diluted in water
- Quaternary ammonia solutions: dilute Physan 20 (or Green-Shield brand of quaternary ammonia) 1 Tablespoon per gallon water; Lysol is another formulation

Apply the decontamination solution with a spray bottle, or one gallon hand-held pump sprayer or similar device, making sure to completely saturate gear. All application of solution and rinsing should occur in upland areas away from water source or wetland. Do not dispose of extra decontamination solution on park property.

If in a known *Phytophthora* or plant pathogen infested area, gear should be decontaminated after leaving the infested area.

Riparian or wetland areas:

The only time that decontamination after leaving an infested site or between sites would not be required is when moving in a downstream direction for pond or wetland areas that are hydrologically connected via surface flow and when moving in a downstream direction when working in riparian areas.

Always work from upstream to downstream in riparian areas and when moving between ponds that are within a single drainage. Decontaminate and clean boots and equipment before moving to a new upstream location.

2. Cleaning and decontamination: VEHICLES

Vehicles that only travel and park on paved public roads do not require external cleaning.

Before arrival at the site, vehicles must be free of soil including debris on tires, wheel wells, vehicle undercarriages, and other surfaces. A high pressure washer and/or compressed air may be used to ensure that soil and debris are completely removed. Vehicles may be cleaned at a commercial vehicle or appropriate truck washing facility. The interior of vehicles and equipment (cabs, etc.) must be free of mud, soil, gravel and other debris (vacuumed, swept or washed).

3. More information

Recent developments of phytophthora and other plant pathogens are important to keep out of our plant communities – especially for people moving outside regularly traveled areas.

More resources and information at the CalPhytos website:

http://www.suddenoakdeath.org/wp-content/uploads/2016/04/Sensitive-contam-site-bmp-FINAL-111716.pdf

Send information to:

Michele Hammond, Botanist
510-544-2348
mhammond@ebparks.org

Local Native Plant Resources:

Native Here Nursery http://nativeherenursery.org/wp/catalog/

The Watershed Nursery http://www.watershednursery.com/

Included below is a summary of propagule collection guidelines that can be applied to seed collection in EBRPD properties (adapted from Dorner 2002 and accessed September 4, 2015 from http://www.nps.gov/plants/restore/pubs/intronatplant/planning.htm):

Do's and Don'ts of Seed Collection	Why?
Do match the donor and restoration site conditions as much as possible: slope, aspect, hydrology, soil type, frost dates, temperature patterns, elevation, etc.	Plants adapted to similar environmental conditions are more likely to succeed at the planting site.
Do collect in an area geographically near to planting site.	Locally adapted plants are more likely to succeed at the planting site.
Don't collect in sensitive areas.	Protect sensitive populations.
Do make sure none of the seeds collected are from rare species – check with EBRPD staff or East Bay chapter of CNPS website for resources	Protect rare species.
Don't collect from ornamental plantings or near other exotics.	Ornamental varieties of the same species may not have the environmental adaptations needed for establishment at the planting site.
Do avoid collecting in weed infested areas. If collection must be done in those areas, be careful not to collect weed seed.	Helps keep weed seeds out of the seed mix.
Do obtain permission from the landowner to collect seed on private land or the required permit(s) for public lands.	This is legally required, as well as common courtesy.
Do try to collect dry seeds on a dry day. Wet fruits such as berries can be collected on wet or dry days.	Collected seeds with high moisture content will lose their viability more quickly than drier seed.
Do make sure to collect when seeds are mature. The seed should not dent under a fingernail and should detach easily from the plant.	Increases germination success.
Do use paper bags or other "breathable" containers for dry seeds. Berries and fruits can be collected in plastic buckets.	Helps the seed dry out more quickly so it will retain its viability longer.
Do collect from large populations.	Helps increase genetic diversity, thus increasing the chances of successful establishment.
Don't concentrate on one small area of the plant population, instead collect from a wider area.	Helps increase genetic diversity, thus increasing the chances of successful establishment.
Do collect from different microhabitats within the site.	Helps increase genetic diversity, thus increasing the chances of successful establishment.
Do know the factors affecting seed viability of the species before collecting and processing them.	Short-lived seed such as willows and alders need to be planted immediately after collection, and kept cool until planting.
Do collect a few seeds from many plants rather than many seeds from a few plants.	Helps increase genetic diversity, thus increasing the chances of successful establishment. Also protects intact populations.
Do collect from a wide range of plants: short or tall, scrawny or robust.	Helps increase genetic diversity, thus increasing the chances of successful establishment.
Do leave at least 2/3 of the available seeds.	Protect natural populations.
Do communicate with other local collectors about where collections are taking place as well as report locations to EBRPD.	Important to protect the intact natural population to make sure one site is not getting collected from too many times.
Don't harm donor or source populations.	Protect natural populations.

Resources and references:

CNPS (California Native Plant Society), 2001. Inventory of Rare and Endangered Plants of California (sixth edition). Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. Sacramento, California. 388 pp.

Dorner, Jeanette. 2002. An introduction to Using Native Plants in Restoration Projects. Center for Urban Horticulture, University of Washington. Developed for the Bureau of Land Management, US Department of the Interior. November 2002.

Lake, Diane. 2010. Rare, Unusual and Significant Plants of Alameda and Contra Costa Counties. California Native Plant Society. 8th Edition.