SONOMA COUNTY AGRICULTURAL
PRESERVATION & OPEN SPACE DISTRICT

CALABAZAS CREEK OPEN SPACE PRESERVE RESOURCE MANAGEMENT PLAN

MAY 2016

747 Mendocino Avenue, Suite 100, Santa Rosa, CA 95401




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ACKNOWLEDGEMENTS

Special thanks and appreciation to the California Coastal Conservancy and the Bay Area Ridge Trail Council (BARTC), for their financial and technical support. The District would also like to thank the Calabazas Creek Open Space Preserve Volunteer Patrol members who have vigilantly monitored the Preserve since its acquisition in 2004 and provided countless hours towards the conservation and enhancement of the Preserve.

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Photo 1: Calabazas Creek Open Space Preserve

1.0 INTRODUCTION

1.1 BACKGROUND & PLAN PURPOSE

In 2004, the Sonoma County Agricultural Preservation and Open Space District (District) purchased 1,285 acres of a 1,600-acre property from Beltane Incorporated (owned by the descendants of Mr. and Mrs. Heins, namely Rosemary and Alexa Wood). Soon after the purchase, the District renamed the property Calabazas Creek Open Space Preserve (Preserve) to avoid confusion with the Beltane Ranch Bed and Breakfast, owned by Beltane Incorporated just north of Nunns Canyon Road. Today, the property is managed as an open space preserve to protect diverse habitats, ecosystems and cultural resources and to provide low-intensity public outdoor recreation. Since 2004, the District has offered docent-led outings led by District partners, and staff, and through a dedicated volunteer patrol and various partners has implemented a range of management practices, including erosion control, invasive plant management, and removing illegal marijuana grows.

In 2008, the California State Coastal Conservancy, with the support of the Bay Area Ridge Trail Council (BARTC), awarded a grant to assist the District in the development of a Public Access Plan, Management Plan, and an Operations and Maintenance (O&M) Manual for the Preserve. This Resource Assessment and Preliminary Management Recommendations (Resource Assessment) report represents the first product of this planning effort. The purpose of this Resource Assessment is to complete comprehensive studies and analyses in order to identify critical natural and cultural resources, determine the threats to these resources, and propose a prioritized list of management recommendations for the Preserve.

The specific objectives of this Resource Assessment are to:

- Provide a comprehensive assessment of existing natural and cultural resources;
- Identify special-status natural and cultural resources in need of management and/or protection;
- Present strategies for managing, enhancing and/or protecting special-status and sensitive resources and general ecosystem functions; and
- Provide assessments and preliminary planning for future development of public access infrastructure in a manner that minimizes detrimental impacts to sensitive resources.

1.2 LOCATION AND REGIONAL CONTEXT

The Calabazas Creek Open Space Preserve is located in southeastern Sonoma County in a rural area along the western slope of the Mayacama Mountains

and the northeastern portion of Sonoma Valley (also known as Valley of the Moon), approximately seven miles north of the town of Sonoma and ten miles southeast of the city of Santa Rosa (**Figure 1.1**). It is mapped on the Kenwood and Rutherford U.S. Geological Survey (USGS) topographic quadrangles and is most easily accessed via Nuns Canyon Road[1], which runs east from State Highway 12, just north of the town of Glen Ellen. The entire Preserve is within the Calabazas Creek watershed. The western-most boundary is at the former rock quarry at the bottom of Sonoma Valley, with the eastern boundary being the top of the Calabazas Creek watershed to the Sonoma-Napa county line, contiguous with the ridgeline of the southern Mayacama Mountains (**Figure 1.2**). Large landholdings with residential homes and some agriculture (a former turkey farm) and an active rock quarry form the southern border. There is extensive vineyard development north and west of the Preserve along with scattered rural residential development.

Several large public and private preserves have been established in the area to protect natural resources and provide recreational opportunities in the vicinity of the property. These protected areas include Annadel State Park, Jack London State Historic Park, Hood Mountain Regional Park and Open Space Preserve, Sonoma Valley Regional Park, Sugarloaf Ridge State Park, and Bouverie Wildflower Preserve, the latter two being in close proximity to the Calabazas Preserve (**Figure 1.2**). The District holds a conservation easement on an additional property in the immediate vicinity, the 234-acre Glen Oaks Ranch — owned and managed by Sonoma Land Trust (SLT). Finally, one of the first properties purchased by SLT in 1978 is the 300-acre Secret Pasture Preserve, which lies just east of the Bouverie Wildflower Preserve, creating a corridor of approximately 40 square miles along the western slope of the Mayacama mountain range. Refer to **Section 3.0** for details on land use and zoning.

1.3 DATA COLLECTION

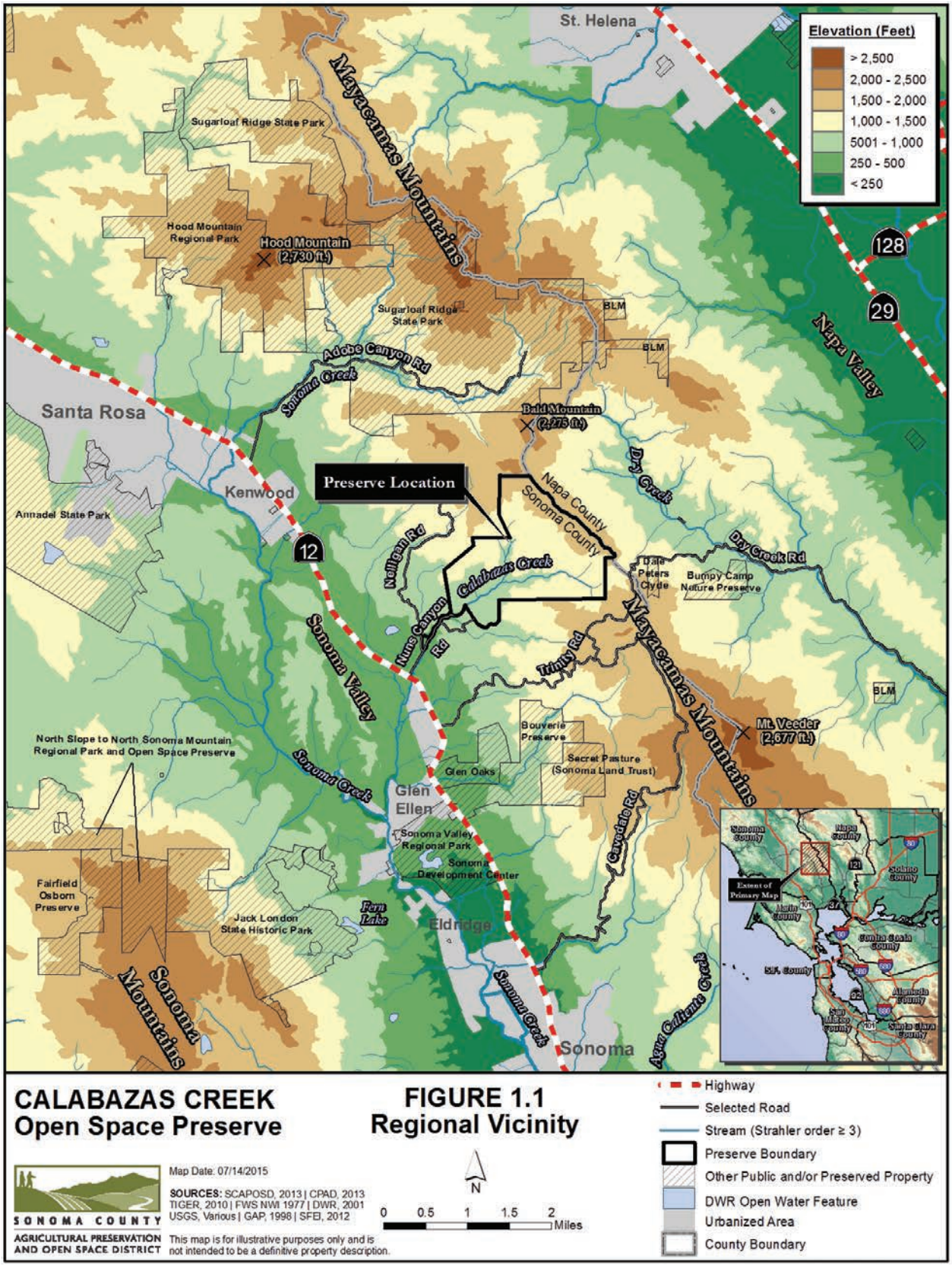
Extensive surveys were performed as part of the Resource Assessment. Vollmar Natural Lands Consulting (VNLC) conducted field surveys during the 2013 field season including vegetation and wetland mapping, floristic inventories, rare plant surveys, amphibian and freshwater shrimp surveys within streams, bird inventories, and camera station surveys for larger wildlife. The surveys were conducted to identify special-status and invasive animals with the highest potential to occur on the property, based on the presence of known habitat conditions. These field data were augmented by existing physical and biological data for the site. Restoration Design Group (RDG) and VNLC also obtained existing environmental data (e.g., topography, geology, soils, hydrology, and climate) and used these data to analyze distribution patterns of plants and wildlife. The results of the surveys were analyzed in order to evaluate potential management strategies to protect special-status species and their habitats and to minimize potential threats from invasive species.

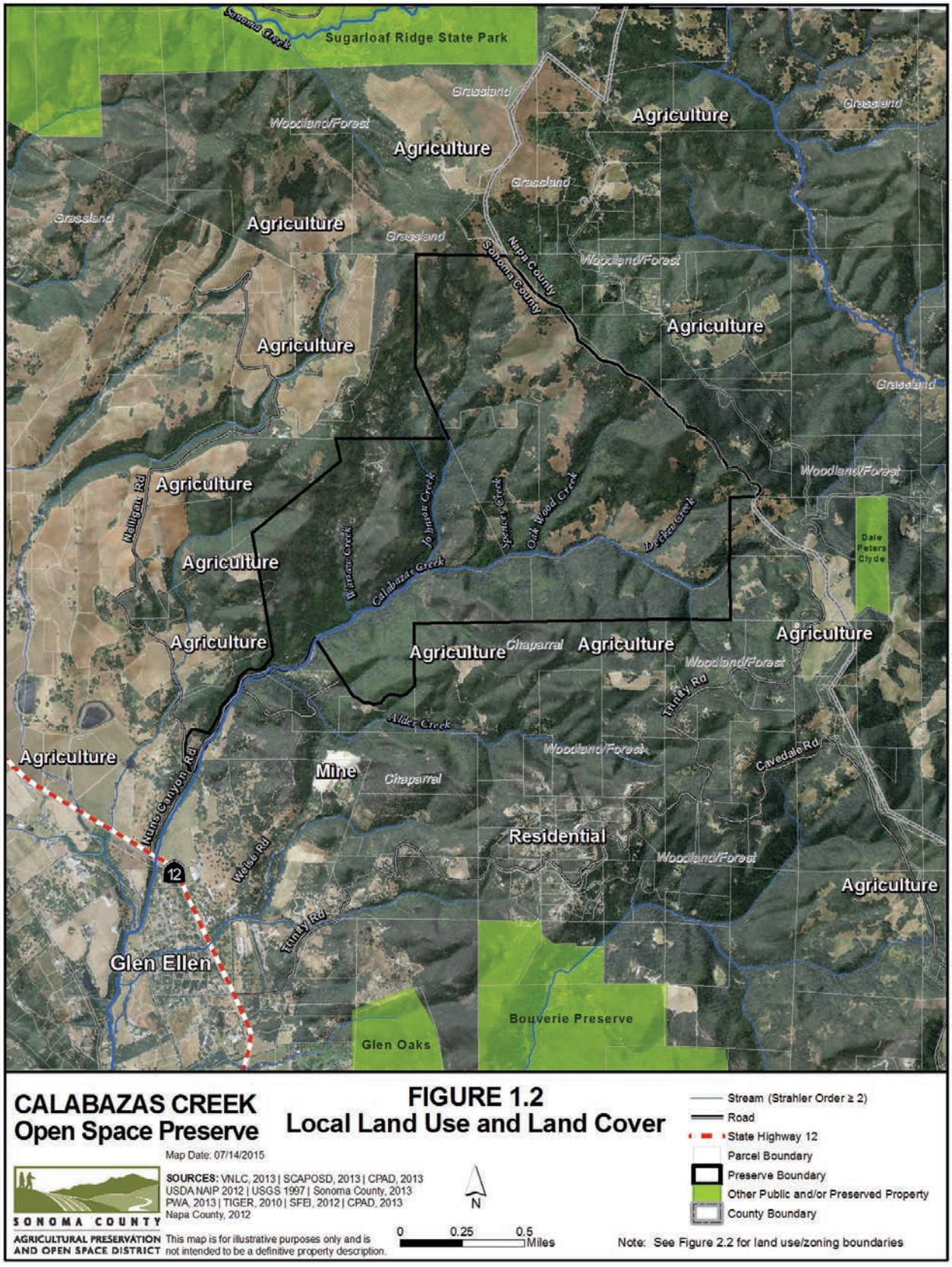
Anthropological Studies Center (ASC) at Sonoma State University conducted cultural resource surveys throughout the property. The cultural resource surveys consisted of two components: pre-field research and field inventory. The field surveys focused on known or recorded sites, potential trail corridors, and sites with potential homesteading activities. Baseline Consulting provided historical information based on an oral history completed for the property. This information helped substantiate the homestead sites and former landowners on the property.

1.4 NEXT STEPS

The next step will be to develop a Preserve Public Access Plan that will build upon the recommendations in this document. The Public Access Plan will be developed in close collaboration with the ultimate recreational landowner and will incorporate community input to guide public access. The trail planning process will incorporate the opinions and interests of potential user groups, conservation partners, former and neighboring landowners, and county and state park managers. The District intends to work with its partners to plan and create a Bay Area Ridge Trail connector trail to provide high-quality recreational access to the Preserve, while protecting its natural and cultural resources. The long-term vision includes a four to six mile trail that would connect a trailhead in Sonoma

1 The name of the road that enters Calabazas Creek Open Space Preserve goes by many spellings depending on the source. The District has elected to refer to the road on the Preserve as Nunns' Canyon Road and the road between the Preserve and Route 12 as Nuns Canyon Road (to be consistent with road maps).


St. Helena
Elevation (Feet)
> 2,500
2,000 - 2,500
1,500 - 2,000
1,000 - 1,500
5001 - 1,000
250 - 500
< 250
Mayacamas Mountains
Sugarloaf Ridge State Park
Hood Mountain Regional Park
Hood Mountain (2,730 ft.)
Sugarloaf Ridge State Park
BLM
Adobe Canyon Rd
Sonoma Creek
Santa Rosa
Bald Mountain (2,275 ft.)
Napa Valley
128
29
Preserve Location
Kenwood
Annadel State Park
Napa County
Sonoma County
Dry Creek
Nelligan Rd
Calabazas Creek
Dale Peters Clyde
Bumpy Camp Nature Preserve
Day Creek Rd
12
Sonoma Valley
Nuns Canyon Rd
Trinity Rd
Mayacamas Mountains
BLM
Mt. Veeder (2,677 ft.)
Bouverie Preserve
Secret Pasture (Sonoma Land Trust)
North Slope to North Sonoma Mountain Regional Park and Open Space Preserve
Sonoma Creek
Glen Oaks
Glen Ellen
Sonoma Valley Regional Park
Sonoma Development Center
Cavedale Rd
Fairfield Osborn Preserve
Jack London State Historic Park
Fern Lake
Eldridge
Sonoma Mountains
Sonoma Creek
Agua Caliente Creek
Sonoma
Extent of Primary Map
Sonoma County
Napa County
Solano County
Marin County
Contra Costa County
San Francisco County
Alameda County
San Mateo County
Santa Clara County
CALABAZAS CREEK
Open Space Preserve
FIGURE 1.1
Regional Vicinity
Map Date: 07/14/2015
SOURCES: SCAPOSD, 2013 | CPAD, 2013
TIGER, 2010 | FWS NWI 1977 | DWR, 2001
USGS, Various | GAP, 1998 | SFEI, 2012
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 0.5 1 1.5 2 Miles
SONOMA COUNTY
AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
Highway
Selected Road
Stream (Strahler order ≥ 3)
Preserve Boundary
Other Public and/or Preserved Property
DWR Open Water Feature
Urbanized Area
County Boundary


Sugarloaf Ridge State Park
Sonoma Creek
Grassland
Woodland/Forest
Agriculture
Sonoma County
Napa County
Nelligan Rd
Johnson Creek
Spencer Creek
Oak Wood Creek
Dutcher Creek
Dale Peters Clyde
Calabazas Creek
Chaparral
Trinity Rd
Alder Creek
Cavedale Rd
Nuns Canyon Rd
Mine
Residential
Weise Rd
12
Glen Ellen
Bouverie Preserve
Glen Oaks
CALABAZAS CREEK
Open Space Preserve
FIGURE 1.2
Local Land Use and Land Cover
Map Date: 07/14/2015
SOURCES: VNLC, 2013 | SCAPOSD, 2013 | CPAD, 2013
USDA NAIP 2012 | USGS 1997 | Sonoma County, 2013
PWA, 2013 | TIGER, 2010 | SFEI, 2012 | CPAD, 2013
Napa County, 2012
SONOMA COUNTY
AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 0.25 0.5 Miles
Stream (Strahler Order ≥ 2)
Road
State Highway 12
Parcel Boundary
Preserve Boundary
Other Public and/or Preserved Property
County Boundary
Note: See Figure 2.2 for land use/zoning boundaries

Valley to a segment of the Bay Area Ridge Trail along the rim of the southern Mayacamas Mountains.

The Preserve Public Access Plan will incorporate the BARTC Management Guide, addressing Bay Area Ridge Trail goals (such as safety of trail users, views of San Francisco Bay, and multiple-use trail standards [hikers, bicyclists and equestrians]). It will provide details on the nature and location of proposed public access, including:

- An overview of proposed public education and outreach programs;
- Maps that illustrate the recommended location(s) of potential trails and other public access infrastructure; and
- Specific recommendations for minimizing impacts to the Preserve's sensitive resources.

In addition, an Operations and Maintenance (O&M) Manual will be developed with community input to guide the stewardship of the Preserve. Building on the information in this document, the O&M Manual will contain detailed specifications for:

- Timing of recommended management activities (short-term, medium-term and long-term);
- Estimated management costs;
- Ongoing, low impact trail maintenance;
- Habitat enhancement;
- Land stewardship in the larger trail corridor (e.g., erosion control, invasive species control, native plant revegetation, pathogen control); and
- An ongoing monitoring and adaptive management program that will be linked to the initial assessment data including habitats, species, and cultural resources.

The O&M Manual will be detailed enough to be executed by community volunteers under supervision of the District and/or other future management entities. It will be available to District staff and partner organizations to be used as an adaptive operational tool to implement field-level management practices. This Resource Assessment, combined with the Preserve Public Access Plan and O&M Manual, will provide a solid foundation for management of the Preserve, integrating the protection of the conservation values with the facilitation of public access.

2.0 PRESERVE DESCRIPTION

2.1 LEGAL FEATURES

On October 22, 2004, a resolution was approved by the District's Board of Directors[2] to purchase 1,285 acres from Beltane, Inc. This resolution approved the acquisition of Assessor Parcel Numbers: 053-030-002, 053-030-003, 053-040-002, 053-040-003, 053-040-006, 053-040-024, 053-040-025, 053-040-032, and 053-040-033 in the County of Sonoma.

2.2 GEOLOGY, SOILS AND EROSION

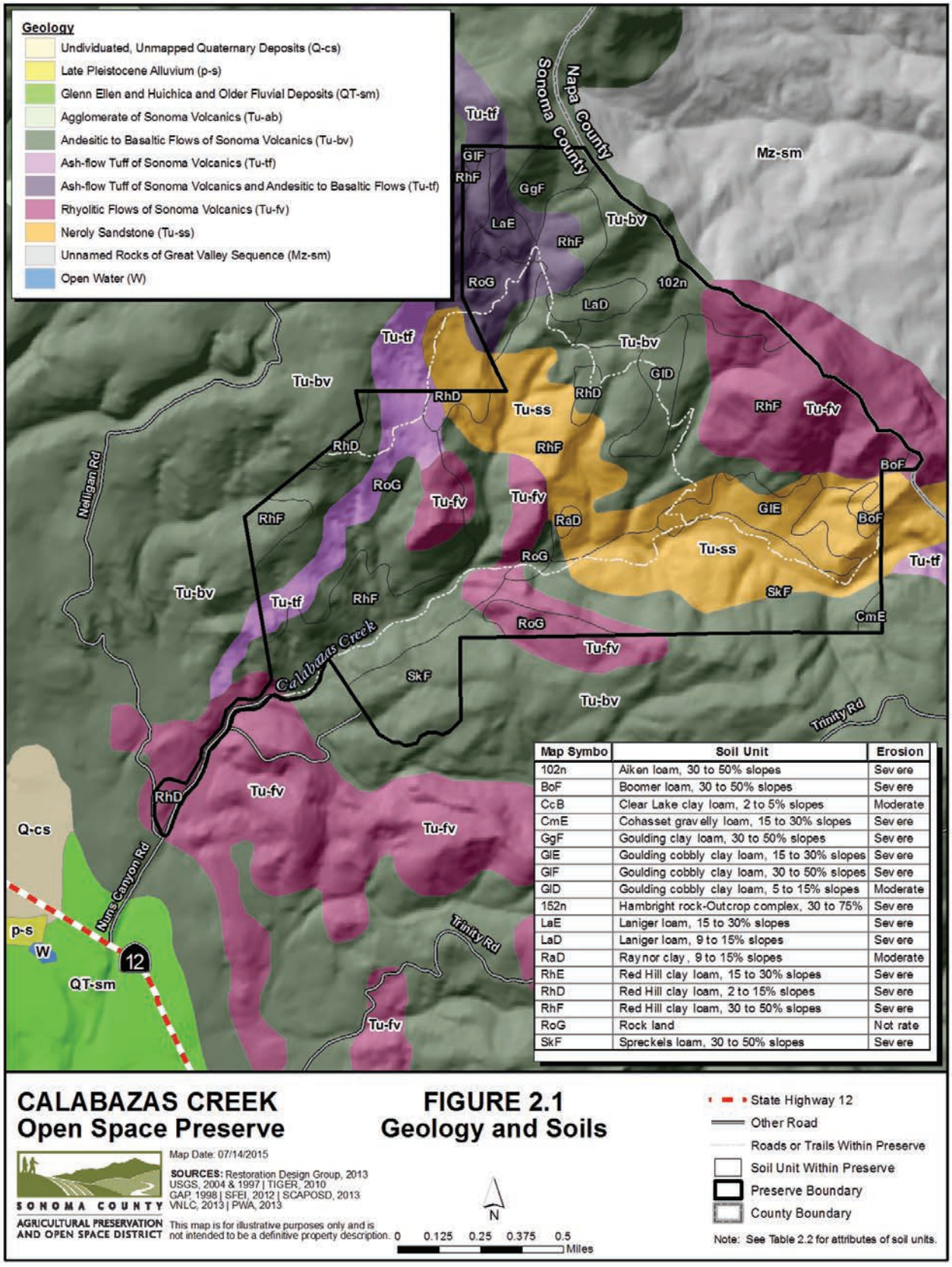
2.2.1 GEOLOGY

There are two geologic formations mapped on the Preserve — the Western Sonoma Volcanics that occur throughout most of the site, and a limited exposure of the older, underlying sedimentary Neroly Formation within the central and southeastern portions of the site (**Figure 2.1**).

Neroly Formation

The Neroly Formation was deposited approximately 10 million years ago (mya) and consists of sandstone and consolidated volcanic *alluvium* laid down in a deep to shallow marine environment that previously existed across the present day mid Central Valley and interior Central Coast Ranges (Wagner et al. 2011; USGS 1984). The alluvium is primarily from weathered andesite that erupted from volcanoes in present eastern California and western Nevada. The Neroly Formation underlies the Sonoma Volcanics and, interestingly, is exposed in only a few places in the North Bay region including the limited exposure on the Preserve (Wagner et al. 2013). This exposure is due to the erosion of the overlying Sonoma Volcanics

2 The Sonoma County Agricultural Preservation and Open Space District was established in 1990 as a special district to Sonoma County whereby public funding through a quarter cent sales tax is used to protect land throughout the county. The Sonoma County Supervisors serve as the Board of Directors for the District and are responsible for approving all acquisitions completed by the District on behalf of the citizens of Sonoma County. The District has protected close to 110,000 acres since 1990.


Geology
Undividuated, Unmapped Quaternary Deposits (Q-cs)
Late Pleistocene Alluvium (p-s)
Glenn Ellen and Huichica and Older Fluvial Deposits (QT-sm)
Agglomerate of Sonoma Volcanics (Tu-ab)
Andesitic to Basaltic Flows of Sonoma Volcanics (Tu-bv)
Ash-flow Tuff of Sonoma Volcanics (Tu-tf)
Ash-flow Tuff of Sonoma Volcanics and Andesitic to Basaltic Flows (Tu-tf)
Rhyolitic Flows of Sonoma Volcanics (Tu-fv)
Neroly Sandstone (Tu-ss)
Unnamed Rocks of Great Valley Sequence (Mz-sm)
Open Water (W)
Sonoma County
Napa County
Nelligan Rd
Calabazas Creek
Nuns Canyon Rd
Trinity Rd
Trinity Rd
Tu-tf
Tu-bv
Tu-fv
Tu-ss
Mz-sm
Q-cs
p-s
W
QT-sm
12
GIF
RhF
GgF
LaE
RoG
LaD
102n
RhD
GID
RaD
GIE
BoF
SkF
CmE
Map Symbo
Soil Unit
Erosion
102n
Aiken loam, 30 to 50% slopes
Severe
BoF
Boomer loam, 30 to 50% slopes
Severe
CcB
Clear Lake clay loam, 2 to 5% slopes
Moderate
CmE
Cohasset gravelly loam, 15 to 30% slopes
Severe
GgF
Goulding clay loam, 30 to 50% slopes
Severe
GIE
Goulding cobbly clay loam, 15 to 30% slopes
Severe
GIF
Goulding cobbly clay loam, 30 to 50% slopes
Severe
GID
Goulding cobbly clay loam, 5 to 15% slopes
Moderate
152n
Hambright rock-Outcrop complex, 30 to 75%
Severe
LaE
Laniger loam, 15 to 30% slopes
Severe
LaD
Laniger loam, 9 to 15% slopes
Severe
RaD
Raynor clay, 9 to 15% slopes
Moderate
RhE
Red Hill clay loam, 15 to 30% slopes
Severe
RhD
Red Hill clay loam, 2 to 15% slopes
Severe
RhF
Red Hill clay loam, 30 to 50% slopes
Severe
RoG
Rock land
Not rate
SkF
Spreckels loam, 30 to 50% slopes
Severe
CALABAZAS CREEK
Open Space Preserve
FIGURE 2.1
Geology and Soils
Map Date: 07/14/2015
SOURCES: Restoration Design Group, 2013
USGS, 2004 & 1997 | TIGER, 2010
GAP, 1998 | SFEI, 2012 | SCAPOSD, 2013
VNLC, 2013 | PWA, 2013
SONOMA COUNTY
AGRICULTURAL PRESERVATION
AND OPEN SPACE DISTRICT
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 0.125 0.25 0.375 0.5
Miles
State Highway 12
Other Road
Roads or Trails Within Preserve
Soil Unit Within Preserve
Preserve Boundary
County Boundary
Note: See Table 2.2 for attributes of soil units.

material along the deeper cut valleys of upper Calabazas Creek and its main tributaries on the site.

Western Sonoma Volcanics

The Sonoma Volcanics are part of a set of volcanic fields associated with the East Bay Fault System which itself is part of the greater San Andreas Fault System (Wagner et al. 2011). The volcanic fields in the region of the Preserve are part of the Western Sonoma Volcanics (WSV), deposited roughly 8 to 4 mya (Wagner et al. 2011). Both the Mayacamas Mountains to the east of Sonoma Valley (and including the site) and Sonoma Mountain to the west of the valley are part of the WSV.

Photo 2: Western Sonoma Volcanics rock outcrop

Within the Preserve, this formation consists of two disparate volcanic rock types — more basic andesitic and basaltic flows and more acidic rhyolitic flows and ash-flow *tuff* (Figure 2.5). This is a reflection of the 'bimodal' nature of the volcanic eruptions in the WSV whereby the overlying crust only partially melted and resulted in the formation and subsequent eruption of the two distinct volcanic rock types. These different volcanic rock types were laid down as subsequent flows and occur as interbedded strata. As shown on Figure 2.5, andesitic to basaltic flows are widely exposed on and around the Preserve and are capped in local areas by rhyolitic flows. They are interbedded in the western portion of the Preserve with ash-flow tuff.

2.2.2 SOILS

Appendix I includes an annotated list of the soil types mapped within the Preserve. **Figure 2.1** shows their site distribution. These soils formed through in situ weathering of the underlying parent materials (Neroly Formation or WSV) and local alluvial deposit of these materials within valleys and along the bases of hill slopes. The soils are primarily clay loams and loams. Most of the site consists of moderate to steep slopes, where the soils are typically shallow, highly weathered and relatively infertile due to the characteristics of the parent material and lack of accumulation of topsoil and organic matter. In more level areas, the soils are typically deeper and richer.

Areas mapped as Rockland (RoG) are some of the most unique areas on the site in terms of vegetation types and associated native and rare plant species. These areas have exposed volcanic rock outcrops with very shallow, erosive soils. The vegetation is predominantly one of several types of scrub habitat. All of the rare plant species documented on the site occurred on soils underlain by WSV. The rare manzanita scrub plant communities on the site are restricted to soils on rhyolitic flows. Also, the few blue oaks (*Quercus douglasii*) mapped on the site are restricted to soils on Neroly Formation.

2.2.3 EROSION

In 2013, the District hired Pacific Watershed Associates (PWA) to perform a road assessment and identify opportunities to address excess sediment delivery into the creeks. A summary of PWA's conclusions is found in **Appendix G**. PWA examined 49 sites and 8.76 miles of road on and in the proximity of the Preserve. Sites with the potential to increase sediment delivery and harm downstream habitat and water quality included stream crossings, ditch relief culverts, landslides, road discharge points, bank erosion sites, and gullies (PWA 2013).

All of the soils rated on the Preserve are rated as having "Moderate" or "Severe" erosive potential, with 13 of 17 of all soil types rated as "Severe." This is likely due in part to the steepness of the slopes on which the soils occur, with an average slope of 40 percent on the site, as well as the generally shallow, rocky nature of the soils. Gravelly soils overlaying bedrock on steep slopes are expected to experience erosion. While soil erosion is visible in some areas on the Preserve, these areas are surprisingly limited, even throughout large areas with limited vegetation cover. According to an

oral history of the property (Dawson 2013), the site has never been clear-cut or otherwise excessively logged.

The most conspicuous soil erosion on the site is located along the northern road, within an area of rhyolitic volcanic ash geology and fairly sparse vegetation. The erosion is visible at a small scale from aerial photography, in part because the exposed, eroded soils are bright white. It is not clear whether the erosion in this location is primarily of natural origin, but the road and its original construction may be partly responsible for the erosion.

2.3 TOPOGRAPHY

The Preserve extends from the low-lying eastern edge of Sonoma Valley upward toward a prominent ridge top of the southern Mayacamas Mountains, near the longitudinal center of California's Coast Ranges geomorphic province. Site elevation ranges from 380-2,047 feet above mean sea level and the varied topography consists of steep to moderate slopes with scattered rocky outcrops, ridges, deeply cut valleys, and occasional flats mostly bordering stream courses.

Notable topographical features in the vicinity of the Preserve include Sugarloaf Ridge (with an approximate maximum elevation of 2,755 feet), Bald Mountain (2,275 feet), and Hood Mountain (2,730 feet), all of which are north of the Preserve. Mount Veeder, at 2,677 feet, is the high point in the vicinity south of the Preserve. The elevation of Sonoma Valley at the Preserve's southwestern edge is approximately 380 feet. From this location, elevation dips slightly into Sonoma Creek and then rises again westward up toward Sonoma Mountain, which range from roughly 850 to 2,450 feet. The ridge line representing the property's eastern edge, with a maximum elevation of at 2,047 feet, divides Sonoma Valley from Napa Valley.

As indicated above, most of the topography in the region is due to faulting and volcanic activity. Thrust faults such as those that produced the Mayacamas Mountains, are common in the region, as evident in the prominent, generally north-south trending parallel ridgelines depicted on **Figure 1.1**. The ridges have been thrust up, and the valleys have dropped along the fault lines. However, these ridges are being actively eroded by seasonal and perennial drainages that have incised valleys along the east and west sides of the ridges contributing to their topographic complexity.

The regional geomorphic diversity of the region is well represented within the Preserve, which encompasses steep hill slopes, plateaus, and stream valleys ranging from 380 to 2,047 feet (a 1,667-foot range). Aside from the prominent north-south trending ridge that defines the site's eastern edge, Calabazas Creek and its tributaries have carved out deep, steeply sloping valleys along the lower Mayacamas hill slopes. The valleys are relatively narrow, as are the stream floodplains and terraces, ranging from 3-10 feet wide along the lower order seasonal tributaries, to over 100 feet wide along lower portions of Calabazas Creek. Slope on the Preserve ranges from nearly level along the stream floodplains and atop wider ridges and plateaus, to over 200 percent along the steepest, rocky slopes.

Along with soils, topography most directly influences the patterns of vegetation on the Preserve. In fact, the combination of topography and soils is the most important factor in determining plant (and thus to some degree, wildlife) distribution on the Preserve. The rugged terrain provides a variety of microhabitats, from windswept ridge tops, to steep drier south-facing slopes, to cool, moist north-facing slopes and valleys. Slope affects soil development and stability as well as drainage, plant dispersal, and other factors.

2.4 CLIMATE AND PRECIPITATION

The climate of Preserve and surrounding regions is characterized as "Mediterranean," with relatively hot, dry summers and cool, wet winters — more than 98% of precipitation occurs from October to May (NOAA 2013). Temperatures are moderate, with monthly averages in nearby Santa Rosa ranging in 2012-13 from 63.3°F in May to 44.9°F in January.

Photo 3: Southwest view from the Mayacama Mountains ridgeline through Nunns' Canyon to Sonoma Valley

Precipitation recorded at the Sonoma Airport Weather Station varied significantly from the norms almost every month during the 2012-2013 growing season. The region experienced above average precipitation from October to December, with substantially higher than average precipitation in November and December. However, every month from January through May experienced extremely low precipitation, amounting to just over five inches total, only 23 percent of normal for that time period. The total amount of precipitation for the 2012-2013 growing season, as recorded at the Sonoma Airport, was 27.47 inches, or 78 percent of normal (NOAA 2013).

In addition to providing suitable thermal habitat for wildlife, climate in the vicinity of the Preserve bequeaths a great diversity of vegetation, which in turn forms the basis for wildlife habitat, food, and other ecosystem functions. The Preserve's climate is suitable for many coastal as well as inland plants, and for plants of the San Francisco Bay region as well as those of the North Coast Ranges. Many of the dominant plant communities occurring on the Preserve are generally better developed in other regions, and reach their distributional limit in the general vicinity of the Preserve. As a result, the Preserve and surrounding region encompass a greater diversity of plant species and plant communities than occur in areas closer to the center of each of the three bioregions.

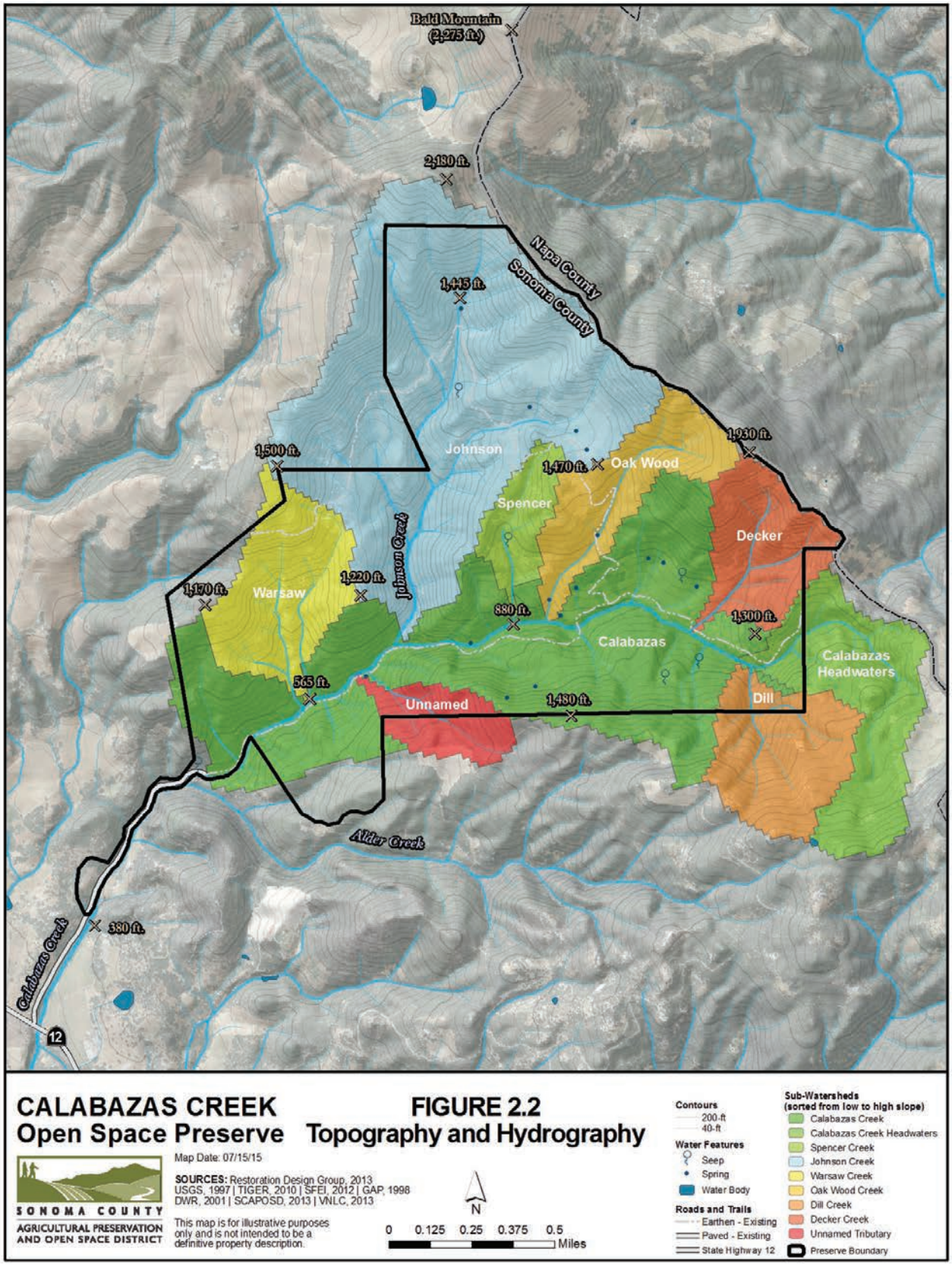
2.5 HYDROLOGY

At a regional scale, the Sonoma Creek watershed encompasses most of Sonoma Valley (from the community of Oakmont south to the bay) including the crests of the Mayacamas Mountains and Sonoma Mountain downward. Calabazas Creek is one of the principal drainages that flow westward from the county divide into Sonoma Creek. It is the second longest among Sonoma Creek's tributaries, after Agua Caliente Creek. Finally, the watershed empties into the San Pablo/San Francisco Bay whose health is dependent on its constituent watersheds, of which Sonoma Creek watershed is one of the largest.

Calabazas Creek traverses the southern portion of the property, flows westward from the county divide into Sonoma Creek (**Figure 2.2)**. The headwaters of the creek are on the property and all of the surface waters on the Preserve, from ephemeral swales to seasonal tributaries, drain into Calabazas Creek, such that a self-contained sub-watershed is contained within the Preserve boundaries. The fact that the majority of the main channel conducts water throughout the year, and supports a large number of deep pools (from a few inches to several feet) along most of its length, is evidence of the considerable amount of water conducted within the sub-watershed.

In addition to Calabazas Creek, the Preserve encompasses seven named seasonal streams, several of which support perennial pools and riparian vegetation along much of their lengths, as well as many more un-named seasonal streams and ephemeral drainages (**Figure 2.1**). RDG calculated and analyzed hydrology at the sub-basin level of the Preserve using the USGS Streamstats tool (see **Appendix H**). **Table H.1** in **Appendix H** shows the characteristics of the sub-basins on the Preserve and their respective hydrology.

Another notable aspect of the Preserve's hydrology is the presence of a large number of springs and seeps, which result from the downward percolation of water being re-directed by impervious sub-surface bedrock to hill slope surfaces. In a few cases, the discharge is in the form of running water (springs), but mostly the features are simply moist or saturated (seeps). The streams, springs, and seeps support riparian vegetation that is an important habitat element for terrestrial wildlife and riparian associ-


Bald Mountain
(2,275 ft.)
2,180 ft.
1,445 ft.
Napa County
Sonoma County
1,500 ft.
Johnson
1,470 ft.
Oak Wood
1,930 ft.
Spencer
Decker
Johnson Creek
1,170 ft.
Warsaw
1,220 ft.
880 ft.
1,300 ft.
Calabazas
Calabazas Headwaters
565 ft.
Unnamed
1,480 ft.
Dill
Alder Creek
380 ft.
Calabazas Creek
12
CALABAZAS CREEK
Open Space Preserve
FIGURE 2.2
Topography and Hydrography
Map Date: 07/15/15
SOURCES: Restoration Design Group, 2013
USGS, 1997 | TIGER, 2010 | SFEI, 2012 | GAP, 1998
DWR, 2001 | SCAPOSD, 2013 | VNLC, 2013
This map is for illustrative purposes only and is not intended to be a definitive property description.
SONOMA COUNTY
AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
N
0 0.125 0.25 0.375 0.5 Miles
Contours
200-ft
40-ft
Water Features
Seep
Spring
Water Body
Roads and Trails
Earthen - Existing
Paved - Existing
State Highway 12
Sub-Watersheds
(sorted from low to high slope)
Calabazas Creek
Calabazas Creek Headwaters
Spencer Creek
Johnson Creek
Warsaw Creek
Oak Wood Creek
Dill Creek
Decker Creek
Unnamed Tributary
Preserve Boundary

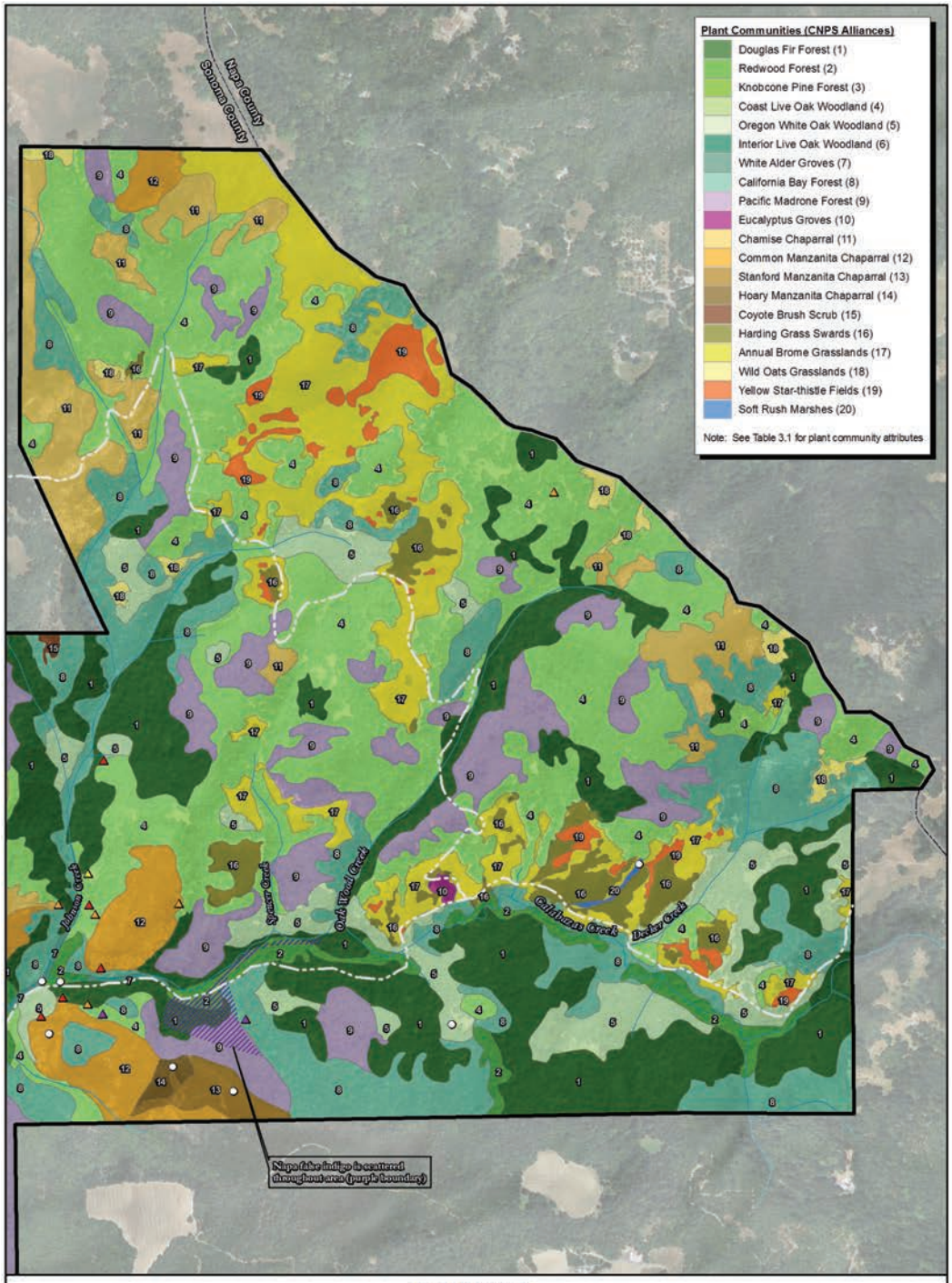


FIGURE 2.3a
Plant Communities and Special-status Plants Eastern Portion of Preserve

CALABAZAS CREEK
Open Space Preserve

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

Map Date: 07/14/2015

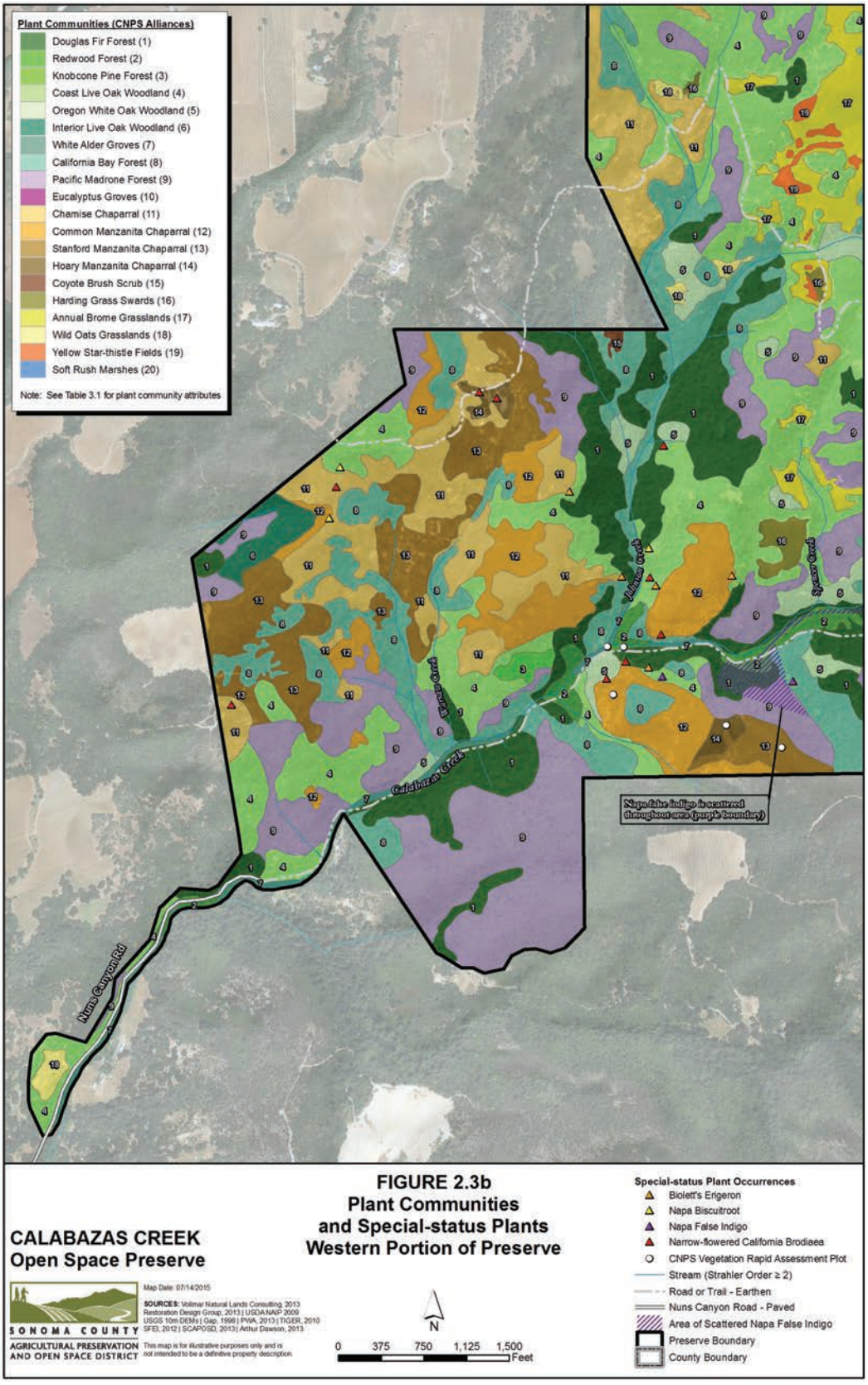
SOURCES: Vollmar Natural Lands Consulting, 2013 | Restoration Design Group, 2013 | USDA NAIP 2009 | USGS 10m DEMs | Gap, 1998 | PWA, 2013 | TIGER, 2010 | SFEI, 2012 | SCAPOSD, 2013 | Arthur Dawson, 2013

This map is for illustrative purposes only and is not intended to be a definitive property description.

N

0 375 750 1,125 1,500 Feet

Special-status Plant Occurrences
- Biolett's Erigeron
- Napa Biscuitroot
- Napa False Indigo
- Narrow-flowered California Brodiaea
- CNPS Vegetation Rapid Assessment Plot
- Stream (Strahler Order ≥ 2)
- Roads or Trails Within Preserve
- Area of Scattered Napa False Indigo
- Preserve Boundary
- County Boundary


Plant Communities (CNPS Alliances)
Douglas Fir Forest (1)
Redwood Forest (2)
Knobcone Pine Forest (3)
Coast Live Oak Woodland (4)
Oregon White Oak Woodland (5)
Interior Live Oak Woodland (6)
White Alder Groves (7)
California Bay Forest (8)
Pacific Madrone Forest (9)
Eucalyptus Groves (10)
Chamise Chaparral (11)
Common Manzanita Chaparral (12)
Stanford Manzanita Chaparral (13)
Hoary Manzanita Chaparral (14)
Coyote Brush Scrub (15)
Harding Grass Swards (16)
Annual Brome Grasslands (17)
Wild Oats Grasslands (18)
Yellow Star-thistle Fields (19)
Soft Rush Marshes (20)
Note: See Table 3.1 for plant community attributes
Nuns Canyon Rd
Calabazas Creek
Napa false indigo is scattered throughout area (purple boundary)
FIGURE 2.3b
Plant Communities
and Special-status Plants
Western Portion of Preserve
CALABAZAS CREEK
Open Space Preserve
SONOMA COUNTY
AGRICULTURAL PRESERVATION
AND OPEN SPACE DISTRICT
Map Date: 07/14/2015
SOURCES: Vollmar Natural Lands Consulting, 2013 | Restoration Design Group, 2013 | USDA NAIP 2009 | USGS 10m DEMs | Gap, 1998 | PAIA, 2013 | TIGER, 2010 | SFEI, 2012 | SCAPOSD, 2013 | Arthur Dawson, 2013
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 375 750 1,125 1,500
Feet
Special-status Plant Occurrences
Biolett's Erigeron
Napa Biscuitroot
Napa False Indigo
Narrow-flowered California Brodiaea
CNPS Vegetation Rapid Assessment Plot
Stream (Strahler Order ≥ 2)
Road or Trail - Earthen
Nuns Canyon Road - Paved
Area of Scattered Napa False Indigo
Preserve Boundary
County Boundary

ated birds. They also support a variety of aquatic or primarily aquatic species, including the special-status steelhead trout (*Oncorhynchus mykiss*) and foothill yellow-legged frog (*Rana boylii*) (See **Section 2.10**).

2.6 PLANT COMMUNITIES

2.6.1 MAPPING METHODOLOGY

The dominant habitat types on the Preserve may be broadly classified as grassland, chaparral, mixed evergreen forest, and oak woodland. These are mapped as 20 unique Manual of California Vegetation (MCV) alliances (see **Figure 2.3a & b**). The plant communities are mapped according to the California Native Plant Society (CNPS) alliance level. All of the alliances are listed in **Table 2.1** (at the end of this section) along with cross-listed classification systems as well as extent, location, and ecological characteristics on the Preserve. These are described below under common name alliance titles. A total of 403 plant taxa were identified within the Preserve boundaries, including 290 native California taxa (72 percent) and 113 non-native taxa (28 percent). All plant taxa identified on the Preserve are listed in **Appendix F.1**. In addition, details on the botanical survey methodologies used are included in **Appendix F.2**.

2.6.2 GAP ANALYSIS

With regard to habitat mapping, the use of LiDAR data and eCognition software, which were not available at the time of this Resource Assessment's preparation, may improve the boundaries of some plant communities, particularly highly diverse and inaccessible areas. The Sonoma County vegetation mapping team, which is just beginning their surveys in the area, will have these data and software at their disposal. Combining field data collected for this Resource Assessment with the additional tools should yield the best possible plant community data for the Preserve.

2.6.3 GRASSLANDS

Grasslands represent an important habitat type on the Preserve. The predominant grassland type on the site is introduced annual grasslands. While constituting only about 10 percent of the site (about 139 total acres), grasslands support plant and animal species that prefer or are endemic to this habitat type, and thereby add significantly to the overall site biodiversity. Some of the important grassland-oriented animal species in the area include grassland nesting and foraging birds (including peregrine falcons and other foraging raptors), insects and other invertebrates, rodents, snakes, and lizards.

Grasslands occur in the northern and eastern portions of the site in open stands surrounded by scrub, woodland, and/or forest types. The grasslands on the site are predominantly introduced annual grasslands dominated by non-native bromes [primarily soft chess (*Bromus hardeaceus*) and ripgut (*Bromus diandrus*)], Italian ryegrass (*Festuca perennis*), and, in pockets, slender wild oats (*Avena barbata*). The non-native perennial Harding grass (*Phalaris aquatica*) occurs in localized dense stands on moister soils within the grasslands just north of Calabazas Creek. There are also a few small but mappable stands of medusa-head (*Elymus caput-medusae*) in this area, restricted to moister soils at the base of hill slopes. There are small stands and scattered individuals of several native grass species within these grasslands, including purple needlegrass (*Stipa pulchra*) in more open areas, and tufted hairgrass (*Deschampsia cespitosa*) and blue wildrye generally along shaded areas bordering forest or woodland margins. Few of these stands are large enough or dense enough to map as 'stands'.

It is also worth noting that there are scattered individuals and small stands of plants associated with coastal prairie habitat such as western rush (*Juncus occidentalis*), California oatgrass (*Danthonia californica*), and tufted hairgrass (*Deschampsia cespitosa*). These plants tend to occur in deeper, moister soils near the base of hill slopes on Neroly Formation but were not dense enough to map as remnant coastal prairie. In some areas, these plants seem to be getting encroached upon by Harding grass, which occupies a similar microhabitat on the site.

Coyote Brush Scrub

A small but clearly visible stand of coyote brush (*Baccharis pilularis*), amounting to 0.6 acre, was mapped in the north-central portion of the Preserve. Despite sporadic encroachment of this species throughout portions of the lower, more mesic grassland habitats, this is currently the only mappable stand on the Preserve. The stand is located along a level terrace that also supports *ruderal*

(i.e., disturbed) grassland, with adjacent steeper slopes supporting California Bay Forest as well as scattered chaparral species such as chamise and buckbrush. Soils are loamy and relatively deep, and associated shrub species include common manzanita, poison oak (*Toxicodendron diversilobum*), and toyon. The herbaceous stratum consists primarily of species associated with introduced grassland such as soft chess, slender wild oats, Harding grass, and rose clover (*Trifolium hirtum*).

2.6.4 CHAPARRAL

The chaparral habitat on the Preserve represents an important habitat (207 acres) component that should be protected and maintained. Chaparral provides unique wildlife habitat and supports three sensitive chaparral habitat types on the Preserve that are defined by three individual manzanita species — common manzanita, Stanford's manzanita, and hoary manzanita (see below). Chamise (*Adenostoma fasciculatum*) is the most abundant chaparral species on the Preserve, forming Chamise Chaparral on 99 acres. As is typical for Chamise Chaparral, the habitat on the Preserve occurs primarily on shallow, rocky soils along steep, often south-facing hill slopes. Associate shrubs within the habitat include all of the manzanita species occurring on the Preserve, as well as buckbrush, scrub oak, and occasional California coffeeberry (*Frangula californica* ssp. *californica*). Immature chamise shrubs are present as well. The herb *stratum* is dominated by ladies' tobacco (*Pseudognaphalium californicum*), nude buckwheat (*Eriogonum nudum* var. *nudum*), purple false brome (*Brachypodium distachyon*), and rattail sixweeks grass (*Festuca myuros*). Scattered emergent coast live oaks, interior live oak, and California bay are present as well along more gentle slopes.

2.6.5 FORESTS AND WOODLANDS

Forests and woodlands are among the dominant plant communities (935 acres) on the Preserve with numerous individual alliances identified and mapped. They support a variety of native plant and animal species including some special-status species including Napa false indigo and northern spotted owl. Coast Live Oak Woodland, Oregon White Oak Woodland, Redwood Forest, and Riparian Forest are also on the Preserve, but are treated separately as sensitive habitats in **Section 2.9** below. In addition, non-sensitive native communities on the property are summarized below and on **Table 2.1**.

Oak Woodlands

Oak woodlands are comprised of several distinctive alliances that are widely distributed throughout the Preserve. The cumulative acreage of mapped oak-dominated habitats amounts to 372 acres, or 29 percent of the Preserve. Though one or more oak species occurs in nearly every habitat on the site, the best developed oak habitats occur along transitional zones between mixed evergreen forest and chaparral or mixed evergreen forest and grassland, where soil fertility and depth as well as solar radiation are intermediate between the two other habitats (with chaparral occurring on the most exposed sites with relatively infertile, shallow soils). By far the most widespread oak habitat is Coast Live Oak Woodland (*Quercus agrifolia* Woodland Alliance), amounting to 304 acres, followed by Oregon White Oak Woodland at 61 acres, and Interior Live Oak Woodland (*Quercus wislizeni* Woodland Alliance) at approximately six acres. These are described in detail below in the Sensitive Habitat section.

Other oak species commonly occur throughout portions of the Preserve but do not form stands of at least one acre (the MMU) that meet the percent cover value requirements of the MCV for the species. These include: black oak (*Q. kelloggii*), which occurs as scattered individuals within the mixed evergreen forest and in Coast Live Oak Woodland; canyon oak (*Quercus chrysolepis*), which occurs primarily along the northeastern and southern ridge tops along with mixed evergreen forest and chaparral; valley oak (*Q. lobata*), which occasionally occurs along the larger stream courses; and blue oak (*Q. douglasii*), which occurs as only a few trees at the north-central portion of the project within an area mapped as Neroly Sandstone geology, surrounded by Chamise Chaparral and Coast Live Oak Woodland (a stand of Blue Oak Woodland occurs just west of the Preserve boundary). In addition, several scrub oak species occur throughout chaparral habitats on the Preserve, but likewise do not form distinct, mappable stands.

The large number of oak taxa (11) on the Preserve is exceptional for a property of its size. This is a result of the Preserve's location within a cli-

matic transitional zone, where the ranges of multiple *Quercus* species overlap.

Pacific Madrone Forest

This alliance encompasses 169 acres of the Preserve, primarily along middle elevation convex ridges and plateaus (**Figure 2.3a & b**). It intergrades considerably with California Bay Forest, Douglas Fir Forest, and Coast Live Oak Woodland, but tends to be excluded from some of the more *mesic* sites (e.g., along drainages) that support the other alliances. This alliance is characterized by fairly even aged stands of Pacific madrone (*Arbustus menziesii*), many of which are multi-stemmed, as result of most trees having been killed during the 1964 Nunns' Canyon fire. The alliance was apparently once more widespread on the Preserve, but large areas are now overtopped by Douglas fir (*Psuedotsuga menziesii*), and the shady conditions are causing significant mortality among the Pacific madrone.

California Bay Forest

This alliance occupies 174 acres of the Preserve, on a variety of slopes and exposures (**Figure 2.3a & b**). California bay (*Umbellelaria californica*) trees form stands on perhaps the widest variety of habitats of any tree species on the Preserve, from deeply shaded riparian corridors, to high elevation, exposed slopes that are otherwise dominated by chaparral. It associates closely with Douglas fir, Pacific madrone, coast live oak, and even chamise in some areas. The species is well adapted to shade, to the extent that some of these areas that were mapped as Douglas Fir Forest actually feature a higher percent cover of California bay.

The understory is generally sparse, but occasionally includes shrubs such as California hazelnut (*Corylus cornuta*), dwarf rose (*Rosa gymnocarpa*), common snowberry (*Symphoricarpus albus*), and oceanspray (*Holodiscus discolor* var. *discolor*). *Sapling* California bay trees are also quite common, as the species is reproducing well on the Preserve. Scattered herbs and ferns include California milkwort (*Polygala californica*), star flower (*Trientalis latifolia*), modesty (*Whipplea modesta*), milk maids (*Cardamine californica*), western swordfern (*Polystichum munitum*), and coastal wood fern (*Dryopteris arguta*). More open, exposed California bay-dominated habitats feature understory species similar to the manzanita chaparral habitats as described above.

Douglas Fir Forest

This alliance occupies 188 acres of the Preserve, primarily along drainages and along north-facing slopes (**Figure 2.3a & b**). While the acreage occupied by the mapped habitat is substantial, its influence is even greater than its extent implies, due to its tall stature, *fecundity*, rapid growth, shade tolerance and other attributes that make it a very competitive species. It is perhaps the fastest growing habitat on the Preserve, with *seedlings*, *saplings*, and *poles* occurring throughout nearly all of the various habitats in the area.

The success of this species is due in large part to the suppression of fire in the region, which has facilitated its spread to habitats beyond its historic occurrence, where it is shading out plant species of all strata and thus reducing biodiversity. One of the few tree species that appears to be thriving under its shade is California bay, which is expanding along with Douglas fir on the Preserve. While areas featuring a mix of Douglas fir and other tree species tend to exhibit a moderate diversity of understory species, stands of pure mature Douglas fir tend to be nearly devoid of other plant species. Soils tend to be fairly deep and rich, but are often blanketed by a thick layer of Douglas fir needles and branches. The few understory species observed in the most developed Douglas Fir Forest include poison oak (generally within canopy openings), creeping snowberry (*Symphoricarpos mollis*), California milkwort, and a few ferns species, particularly western swordfern.

Knobcone Pine Forest

One moderately sized stand of knobcone pine (*Pinus attenuata*) totaling just over 2 acres was mapped on the Preserve, near the center of the property. Another stand occurs at the northeastern portion of the site, but was not mapped due to its small size (well under one acre). Both occurrences are on south-facing slopes.

The species occurs more commonly as individual emergent trees among chamise and manzanita chaparral habitats. The species and its eponymous community in general share a number of traits with chaparral, including an association with shallow, nutrient-deficient soils, and an evolution strongly influenced by fire (Quinn and Keeley 2006). Knobcone

pines are virtually dependent on fire for reproduction, as intense heat is required to open their cones and release their seeds. Once established they mature rapidly and are often prepared to reproduce at the next fire event, an important adaptation since fire often kills adult trees (Sawyer et al. 2009). The habitat on the Preserve is more open than is typical for Knobcone Pine Forest, which often forms closed canopy forest. All of the mature trees are approximately the same size, presumably having emerged following the 1964 fire, and are interspersed with shorter stature coast live oaks and Pacific madrone. A well-developed shrub layer includes common manzanita, toyon (*Heteromeles arbutifolia*), and sticky monkeyflower (*Mimulus aurantiacus* var. *aurantiacus*). There are few to no knobcone pine saplings. The herbaceous layer is sparse, with only scattered coyote mint (*Monardella villosa* ssp. *villosa*), California helianthella (*Helianthella californica* var. *californica*), and Fremont's death camas (*Toxicoscordion fremontii*).

Eucalyptus Groves

A single stand of Tasmanian bluegum, amounting to just 0.8 acre, occurs at the central eastern portion of the Preserve, at the site of a former homestead. The stand consists of only a few trees, but they are very large (>80 inches diameter-at-breast-height (DBH)) and stand out within the surrounding grassland habitats. Only one other Tasmanian bluegum was identified outside of this stand on the Preserve, just northeast of the stand and within an area otherwise dominated by coast live oaks and Pacific madrone. Associated plant species within the primary stand of bluegum include olive trees (*Olea europaea*), Douglas fir, Harding grass, Italian thistle, and various annual grasses.

Sudden Oak Death

Since the mid-1990s, the disease known as Sudden Oak Death (SOD) has caused the death of over three million of oaks, tanoaks, and other plant species along the west coast from southern Monterey County to southern Oregon (COMTF pers. comm.). The disease is caused by infection from the pathogen *Phytophthora ramorum* (*Phytophthora* translates to "plant destroyer"), a water-mold that effectively girdles the *cambium* and occludes vessels in tree *xylem*, thus starving the plant host of nutrients and water (Garbelotto and Hayden 2012). The common name refers to the rapid pace at which trees (mostly oaks and tanoaks) die following infection, though some trees may live for months or even years before suffering mortality from the disease (Swiecki and Bernhardt 2009). Its visible symptoms range from bark cankers, to leaf blotches or spots, to shoot dieback. It is most virulent in moist, often north-facing slopes and canyons of mixed oak or evergreen woodland, and its most effective vector host is California bay, which is not killed by the pathogen.

SOD is widespread in Sonoma County (COMTF 2013), including in the vicinity of the Preserve, and surveys conducted in the summer of 2013 confirmed its presence on the Preserve. VNLC's Jake Schweitzer participated in a "Sudden Oak Death Blitz" on the Preserve in early June of 2013, whereby leaf samples from California bay trees found adjacent to dead oak trees were collected and submitted to a U.C. Berkeley pathology laboratory for analysis. Leaf samples were collected from existing and potential trail corridors throughout the site, in order to determine the extent of the infestation as well as to assess potential management concerns related to public access on the Preserve. Of the 23 samples collected from 23 separate trees, 18 were confirmed as infected with SOD (**Figure 4.1**). All of the most obviously symptomatic trees on the Preserve were California bay and coast live oak. Black oaks on the site are not obviously symptomatic and do not appear to be suffering from significant mortality. The Pacific madrone is suffering high mortality on the site, and SOD may be in part responsible, but it is difficult to differentiate potential SOD symptoms from the many other diseases that affect this species — and many are clearly dying at least in part as a result of being shaded by Douglas fir.

2.7 SENSITIVE HABITATS

2.7.1 SURVEY METHODOLOGY

The project botanists assessed sensitive plant communities and other sensitive habitats with potential to occur on the project area. In this document, the terms "plant community" and "habitat" are often used synonymously, though the former refers more specifically to floristic composition, whereas the latter includes vegetation structure and physical characteristics such as geomorphology and hydrology. Thus all plant communities are habitat, but some

habitats are not distinct vegetation communities. In addition, plant communities are capitalized only in reference to formally named alliances, as treated in the Manual of California Vegetation (MCV).

For this report, sensitive habitats include:

- Wetlands and springs
- Riparian habitats and stream corridors
- Other plant communities identified as 'Sensitive' by the BLM, CNPS, and/or CDFW

The project team obtained high-resolution ortho-rectified digital aerial photography of the project area (NAIP 2009 and 2012, 2011 4-band color infrared photography from the District) and digital project boundaries from the District. The team also compiled and reviewed other digital layers of the project area and surrounding areas, including soils, geology, topography and general reference layers (roads and trails, hydrography, etc.). These GIS data layers were used to develop site field maps and GPS background files, to be used for survey planning and field navigation throughout the wide range of habitats (many with limited accessibility) on the project area. The layers were also used in analyses included in this report.

The sensitive plant communities and other habitats identified during the surveys are listed below. Note that a rank of "3" (i.e., G3=3 globally, and S3=3 statewide) indicates that there are only 21-100 viable occurrences worldwide/statewide, and/or more than 2,590-12,950 hectares that the community, and thus is considered "rare and/or threatened" in California. A rank of "4" indicates that there are greater than 100 viable occurrences worldwide/statewide, and/or more than 12,950 hectares (Sawyer et al. 2009). The "0.2" rank specifies an additional "Threatened" to the rank. For the purposes of this Plan, a rarity rank of "3" is considered special-status, while a rank of "4" is not. See **Appendix F.2** for details of survey and mapping methodologies.

2.7.2 RESULTS

The following sensitive plant communities and sensitive habitats (i.e., G3 or S3) were identified on the Preserve are (see **Table 2.1**):

- Streams and Riparian Corridors
- Spring and Seep Wetlands
- Oak Woodland Habitats including Mature and Oregon White Oak Woodland
- Redwood Forest
- Stanford Manzanita Chaparral
- Common Manzanita Chaparral
- Hoary Manzanita Chaparral

Below is a narrative description of each plant community or habitat type and in Table 2.1 a brief summary of characteristics and species list is provided.

2.7.3 STREAMS AND RIPARIAN CORRIDORS

Photo 4: Calabazas Creek riparian corridor in June 2013

Calabazas Creek and Johnson Creek (some maps refer to this creek as Guilicos Creek), a semi-perennial stream (i.e., flows most of the year), support riparian vegetation — trees, shrubs, and herbs that are adapted to (and often depend on) moist soils and/or a high water table. Trees occurring exclusively along these two streams include white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), and northern California black walnut (*Juglans hindsii*).

The shrub stratum consists primarily of western azalea (*Rhododendron occidentale*), spicebush (*Calycanthus occidentalis*), California blackberry (*Rubus ursinus*), and thimbleberry (*Rubus parviflorus*). A growing threat to these native species is the Himalayan blackberry (*Rubus armeniacus*), which grows primarily along the edges of larger streams on the site, crowding out natives wherever it grows.

The herbaceous layer is quite diverse and variable depending on sun exposure and soil texture as well as hydrology. As is typical in shaded, moist environments, commonly occurring taxa include a high percentage of perennials, such as, stinging nettle (*Urtica dioica* ssp. *holosericea*), elkclover (*Aralia californica*), panicled bulrush (*Scirpus microcarpus*), torrent sedge (*Carex nudata*), and spike bentgrass (*Agrostis exarata*). Common ferns include giant horsetail (*Equisetum telmateia* ssp. *braunii*) and giant chain fern (*Woodwardia fimbriata*).

Many, but not all of the most common plant species along the riparian corridors are associated with wetland ecology (i.e., *hydric soils* and wetland hydrology). Most of the areas mapped as White Alder Groves, totaling 7.7 acres, would likely constitute wetland as well as riparian habitat. A CNPS Vegetation Rapid Assessment data form for the White Alder Groves (*Alnus rhombifolia* Alliance), one of the most widespread riparian habitat alliances on the Preserve, is included in **Appendix E**.

The streams and riparian habitats on the Preserve provide wildlife habitat, movement corridors, and biological diversity in general. In addition, the water is sufficiently clear and cold to support special-status fish and amphibians that require such conditions.

2.7.4 SPRING AND SEEP WETLANDS

Photo 5: Mixed forest transition to open grasslands bisected by perennial seep wetland.

Aside from riparian corridors, wetlands on the Preserve are limited to areas around springs and seeps. Occurring along hill slopes that otherwise support upland habitats, these features represent conspicuous and unique habitats on the Preserve. However, due to the large number, small size (most well under a half acre), and dispersed nature of the springs and seeps, only the largest features and those occurring within potential impact areas were mapped as polygons; the remainder were mapped as points.

Only one feature is large enough to have mapped as a unique CNPS alliance — the Soft Rush Marsh Alliance (*Juncus effusus* Herbaceous Alliance). The rarity rank of this habitat is G4 S4?, indicating it is neither rare nor threatened as a plant community, but is treated as a sensitive habitat in this Plan because it is a wetland. The mapped Soft Rush Marsh Alliance is located within an open grassland area in the eastern portion of the Preserve (**Figure 2.3a & b**). A CNPS Vegetation Rapid Assessment data form was compiled for the alliance (see **Appendix E)**.

The following are the most common among springs and seeps within open grassland: Pacific rush (*Juncus effusus* ssp. *pacificus*), Davy's centaury (*Zeltnera davyi*), tinker's penny (*Hypericum anagalloides*), fringed willowherb (*Epilobium ciliatum* ssp. *ciliatum*), and the invasive pennyroyal (*Mentha pulegium*). Plants occurring among features within more wooded habitats giant chain fern, seep monkeyflower (*Mimulus guttatus*), and various sedges (*Cyperus* and *Carex* species).

A couple of the springs on the Preserve were developed to support livestock ranching operations in the past. The installation of water control structures may have contributed to the disturbed conditions of some of the features, as some are invaded by a number of weedy invasive plants such as bull thistle and pennyroyal.

2.7.5 COAST LIVE OAK WOODLAND

Photo 6: Coast Live Oak habitat type

Coast Live Oak Woodland, dominated by coast live oak (*Quercus agrifolia*), occupies 304 acres on the Preserve, primarily along steep, primarily higher elevation, south-facing hill slopes and along more open (i.e., within predominantly grassland) seasonal drainages. In these areas, it is commonly associated with only two or three other tree species, and occasionally is the only tree species. Associate tree species along the upper slopes include California bay, Pacific madrone and, along more sheltered habitats, Douglas fir. These same species accompany coast live oak along the lower slopes on the Preserve, though additional tree species there include black oak (*Quercus kelloggii*), Oregon white oak, bigleaf maple (*Acer macrophyllum*), coast redwood (*Sequoia sempervirens*), and others.

The understory among areas dominated by coast live oak on the Preserve is highly variable, depending on the degree of canopy closure and/or presence of deciduous trees (which effectively provide open canopy during winter months). Areas of dense coast live oak, primarily along the higher steep, south-facing slopes, are nearly devoid of understory plants. These are the oldest and largest of the coast live oaks on the Preserve, as the 1964 fire did not top-kill them, presumably due to the lack of ladder fuels or shrub layer in the understory. The understory consists only of scattered stands of dogtail grass (*Cynosurus echinatus*), field hedge parsley (*Torilis arvensis*), creeping snowberry (*Symphoricarpos mollis*), Pacific pea (*Lathyrus vestitus* var. *vestitus*), and Italian thistle (*Carduus pycnocephalus*).

Unlike most of the other oak tree species on the Preserve, coast live is regenerating relatively well, such that oak seedlings and saplings are relatively common in the understory of the community. In fact, coast live oaks are encroaching upon chaparral on the Preserve as a result of fire suppression, even as Douglas fir encroaches upon coast live oak in other areas for the same reason.

2.7.6 OREGON WHITE OAK WOODLAND

Oregon White Oak Woodland replaces Coast Live Oak Woodland as the dominant Coast Ranges oak species, from the vicinity of the Preserve northward. Despite its wide distribution and habitat variability, Oregon white oak is one of the most threatened oak species in the west, as substantial habitat loss has been reported throughout its range (Gucker 2007). Factors contributing to the decline of this species include fire suppression, altered land use (particularly in valley habitats), introduced invasive plant species, and low acorn production (e.g., MacDougall 2004).

On the Preserve, Oregon White Oak Woodland occurs along generally sheltered, narrow "shoulders," or gently sloping piedmonts above the major streams, amounting to 61 acres. The canopy of most stands of this habitat is dominated by evenly aged, moderately sized Oregon white oak, with only occasional California bay and Pacific madrone. In addition, nearly all stands include moderate to high numbers of Douglas fir saplings and small poles. These associates are indicative of the most common plant communities bordering Oregon White Oak Woodland, and of the likely long-term tree species composition of the woodland (particularly the Douglas fir and California bay) in the absence of disturbance mechanisms such as fire. There is a conspicuous absence of Oregon white oak seedlings or saplings, presumably due to the predominantly young age of the stands as well as to fire suppression.

The understory of the habitat is dominated by herbs and grasses, with a relatively high percentage of native species. The most common species include California fescue (*Festuca californica*), leafy bentgrass (*Agrostis pallens*), blue wildrye (*Elymus glaucus* ssp. *glaucus*), dogtail grass (*Cynosurus echinatus*), rough hedgenettle (*Stachys rigida*), and yampa (*Perideridia kelloggii*). Paradoxically, the relatively high percentage of native grasses and forbs in this community may be in part a

result of low acorn production by the oaks, since fewer acorns would result in less *bioturbation* than is typical among oaks. A CNPS form included in **Appendix E** provides additional ecological details for this habitat.

Photo 7: Interior live oak (*Q. wislizeni*) on the south-facing slopes of Nunns' Canyon.

2.7.7 INTERIOR LIVE OAK WOODLAND

Interior live oaks are a dominant species on only 6.4 acres within the Preserve. The substrate of the community consists of gravelly, shallow volcanic soils with a reddish hue. In addition, leaf litter is rather thick in many areas. As **Table 2.1** shows, tree associates of this community include principally California bay and Pacific madrone as well as a few coast live oaks. All of the trees are relatively young, as the area was apparently burned in the 1964 Nunns' Canyon fire.

A wide variety of shrubs generally associated with chaparral also occur in this community, namely chamise, common manzanita, Stanford's manzanita (*Arctostaphylos stanfordiana* ssp. *stanfordiana*), buck brush (*Ceanothus cuneatus*), poison oak, and toyon. Interior live oak appears to be recruiting well, as seedlings and saplings comprise a significant component of the understory.

Understory plants are quite sparse, due to the dark shade cast by the dense canopy of trees and shrubs as well as the shallow, rocky soils. There are scattered individuals of each of the following species in this habitat: indian warrior, California milkwort, and leafy bentgrass. Much of this habitat is inaccessible and was delineated according to a dominance of interior live oak along a trail near the edge of the habitat. It was difficult to confirm the dominance of interior live oak versus coast live oak farther from the trail, so it was assumed based on habitat conditions.

Photo 8: Redwood grove along trail corridor in stream channel.

2.7.8 REDWOOD FOREST

Redwood Forest on the Preserve is confined to the Calabazas Creek riparian zone and immediately adjacent hill slopes and drainages, most of which are north-facing. The total mapped area for the habitat on the Preserve amounts to 22 acres. The best developed stands of coast redwood trees (*Sequoia sempervirens*) occur along wider stretches of Calabazas Creek's floodplain from the far east to central portions of the Preserve, where large volcanic rock outcrops are less common and thus do not constrain the stream.

The soils are silty and overlain with a thick layer of litter. Along with smaller coast redwood, there are large, mature specimens that apparently survived the large Nunns' Canyon fire of 1964 (and probably others previously) — there are fire scars on many of the larger trees. Though coast redwood saplings are killed by fire, mature individuals, with bark as thick as 12 inches (which protects the tree's cambium), are resilient to even hot fires (Finney and Martin 1989).

There are also a number of coast redwood stumps, as some logging was permitted on the property subsequent to the 1964 fire. Associate tree species include Douglas fir, white alder, California bay, and bigleaf maple. Tanoak, a common associate tree species of the coast redwood, is conspicuously absent in the area, possibly due to insufficient precipitation. The Preserve is located along the eastern edge of the coast

redwood's range. The shrub/vine/sapling stratum consists of common snowberry (*Symphoricarpos albus* var. *laevigatus*), poison oak, California hazelnut (*Corylus cornuta* ssp. *californica*), California blackberry, and sapling coast redwood (the species seems to be successfully regenerating from seed as well as from sprouts). The herbaceous layer includes a number of mostly perennial herbs and ferns, such as star flower (*Trientalis latifolia*), yerba buena (*Clinopodium douglasii*), American trailplant (*Adenocaulon bicolor*), and western swordfern (*Polystichum munitum*). A CNPS Vegetation Rapid Assessment data form for this community is included in **Appendix E**.

The CNPS rarity ranking of G3 S3.2 indicates that Redwood Forest is rare and notably threatened both globally and in California.

Photo 9: Manzanita chaparral on the northern side of Nunns' Canyon

2.7.9 SPECIAL-STATUS MANZANITA CHAPARRAL

Of the five manzanita taxa identified on the Preserve, three are considered special-status or potentially sensitive plant communities. These include Stanford's manzanita, hoary manzanita (*Arctostaphylos canescens* ssp. *canescens*), and common manzanita, with the other two taxa consisting of subspecies of Eastwood's manzanita (*A. glandulosa* ssp. *glandulosa* and ssp. *cushingiana*). CNPS Vegetation Rapid Assessment data forms for all three of these communities are included in **Appendix E**.

Photo 10: Common manzanita

Stanford Manzanita Chaparral

Stanford Manzanita Chaparral occupies 49 acres of the Preserve, primarily along northwestern portions of the Preserve. The soils are generally shallow, rocky, and either pink or chalky white in color. Stanford's manzanita is *sympatric* with common manzanita on thicker soils, and with hoary manzanita on more shallow soils. Often these other species are nearly equal in percentage with Stanford's manzanita. Understory species within its habitat include Sonoma sage (*Salvia sonomensis*), California milkwort (*Polygala californica*), California helianthella (*Helianthella californica* var. *californica*), and goldwire (*Hypericum concinnum*). A moderate to large number of trees are encroaching upon this habitat, primarily California bay, coast live oak, and Douglas fir.

Common Manzanita Chaparral

Common manzanita forms an alliance on 55 acres of the Preserve, primarily along steep slopes near the center of the property (Figure 2.4). It also occurs as scattered individuals and small stands within many other habitats on the Preserve, including a wide variety of shrub and tree habitats. The mapped alliance occurs on slightly more developed soils and slightly more gentle slopes than support Chamise Chaparral, which often occurs adjacent to this habitat on the Preserve. Chamise also occurs as an associate in Common Manzanita Chaparral, and in fact is often more dominant than common manzanita — but common manzanita constitutes at least 30 percent as required for the CNPS habitat classification. Other

common shrubs in this community include buckbrush (*Ceanothus cuneatus*), toyon, scrub oak (*Quercus berberidifolia*), and sticky monkeyflower (*Mimulus aurantiacus* var. *aurantiacus*). Due to the relative open nature of the habitat, the herbaceous layer is relatively well developed, featuring occasionally dense stands of leafy bentgrass as well as nit grass (*Gastridium phleoides*), and indian warrior (*Pedicularis densiflora*).

Hoary Manzanita Chaparral

Covering just over 4 acres, Hoary Manzanita Chaparral is by far the most limited manzanita chaparral community mapped on the Preserve (**Figure 2.3a & b**). Its habitat on the Preserve is strictly of the rocky, barren variety, such that the shrubs are of low stature and constituent plants include relatively few trees. The two stands of this habitat occur on rhyolitic flow and ash materials, both of which consist of substantial gravels and large boulders. Associate shrubs include Stanford's manzanita, Eastwood's manzanita, and chamise, with Stanford's manzanita often comprising nearly equal cover. The herbaceous layer is generally quite sparse, with only occasional goldwire, indian warrior, and scattered grasses such as small fescue (*Festuca microstachys*) and purple false brome (*Brachypodium distachyon*). A few emergent interior live oaks and Douglas fir occur along the edge of the habitat.

2.8 SPECIAL-STATUS PLANTS

2.8.1 SURVEY METHODOLOGY

Prior to conducting field surveys, the project team botanists developed an annotated list of special-status plants known from or with potential to occur on the project area. Sources used to develop this list include California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California (CNPS 2013), California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB) (CDFW 2013), and a general list of plants known from the area included in the Calflora "What Grows Here" plant database (Calflora 2013). In addition, project botanists consulted directly with botanists and other specialists familiar with the region, including staff at the nearby Bouverie Wildflower Preserve. Jeanne Wirka, biologist with the Bouverie Preserve was particularly helpful, having provided information on the location of plants of interest in the area as well as information pertaining to management practices at the preserve.

A CNPS "Quad Search" was conducted on USGS topographic quadrangles, yielding a target special-status plant species list for the following four quadrangles: Kenwood, Rutherford, Sonoma, and Glen Ellen. This list was then refined to exclude taxa not occurring within the project area habitats or elevation range. In addition, CNDDB data were compiled in geographic information systems (GIS) format for the project area vicinity. **Appendix B** shows all special-status plant occurrences included in the CNDDB as well as plants mapped by VNLC.

For this report, special-status plants include:

- Plant taxa listed or proposed for listing by the federal government as Threatened or Endangered under the Federal Endangered Species Act (ESA) (50 CFR 17.12) and federal species of concern.
- Plant taxa listed or proposed for listing by the State of California as Rare, Threatened, or Endangered under the California Endangered Species Act (CESA) (14 Cal. Adm. Code 670.5).
- Plant taxa identified in CNPS's Inventory of Rare and Endangered Vascular Plants of California (CNPS 2011) as Rare, Threatened, or Endangered in California (Lists 1 and 2), or on the review or watch lists (Lists 3 and 4, respectively). Formerly known as CNPS List, it is now as California Rare Plant Rank, 'CRPR'.
- Plant taxa that meet the definition of Rare, Threatened, or Endangered under the California Environmental Quality Act (CEQA).

2.8.2 GAP ANALYSIS

Since early season botanical surveys were not conducted on the Preserve, some plant taxa — including some special-status plant taxa — may not have been in bloom and thus not observed during later surveys, which began in mid-April. Concerns over security related to illicit marijuana cultivation in the area caused additional delays during important time periods in the late spring and summer. Moreover, many remote and/or inaccessible areas on the site were not surveyed until even later, as access to such sites was often fortuitous (e.g., via unexpected discovery of

game trails). Open herbaceous habitats, particularly those with shallow and/or rocky soils and a low cover of tall grasses, have potential to support early-blooming special-status plant species that may not have been previously identified. The open herbaceous habitats of the steeper slopes along northern portions of the Preserve should be surveyed for botanical resources during the early spring (e.g., early-mid March).

In addition, the time period from January to May was one of the driest on record, and this followed a very dry 2011-2012 growing season. It is likely that some plant taxa, particularly herbaceous annuals, have been suppressed by the recent drought conditions. All of the special-status plants identified on the Preserve are perennial taxa. Ideally, additional botanical surveys should be conducted on the Preserve following average or above average winter/spring precipitation. Many early-blooming plants listed as occurring in chaparral and/or grasslands in **Appendix B** and not detected should be considered as having potential to occur on the site.

2.8.3 RESULTS

Four special-status plant taxa were identified on the Preserve during the 2013 field surveys.

- Narrow-flowered California brodiaea (*Brodiaea leptandra*) (CRPR List 1B.2)
- Napa false indigo (*Amorpha californica* var. *napensis*) (CRPR List 1B.2)
- Napa biscuitroot (*Lomatium repostum*) (CRPR List 4.3)
- Biolett's erigeron (*Erigeron biolettii*) (CRPR List 3)

Definitions for all CRPR rarity ranks are provided at the bottom of **Appendix B**. In addition to the plants above, broom rose (*Helianthemum scoparium*) was identified on the Preserve, a plant that was until recently considered a synonym of the rare Bisbee Peak rush rose (*H. suffrutescens*). This genus is still being studied by the CNPS for potential revisions (Sims pers. comm.).

All special-status plant occurrences, as well as special-status and common plant communities identified in the project area, are mapped on **Figure 2.3a & b.** Detailed accounts of the habitats are provided below. Note that the question marks accompanying CNPS habitat rarity codes indicate a lack of certainty as to the rarity of the habitats. The CNPS is in the process of collecting data in order to determine how rare these habitats really are. In addition to these, the Madrone Forest and California Bay Forest Alliances are ranked as G4 S3, however Dr. Todd Keeler-Wolf (pers. comm.) has indicated that these communities are more common than presumed prior to intensive mapping efforts, and so should be considered S4. It should be noted that none of the namesake plant species associated with the sensitive habitats are individually considered rare. Only stands of such species that constitute a mappable alliance are considered rare (as plant communities).

Photo 11: Narrow-flowered California brodiaea, a perennial bulb found on rocky outcrops.

2.8.4 NARROW-FLOWERED CALIFORNIA BRODIAEA

Narrow-flowered California brodiaea (*Brodiaea leptandra*) is a perennial bulb in the brodiaea family (Themidaceae, formerly Liliaceae). It features violet tepals (petal-like features) with a prominent green midrib that flower from April to May. Nine populations of narrow-flowered California brodiaea were mapped on the Preserve within rocky chaparral in the central and northwestern areas. The species is fairly widespread in several areas and it is expected that additional unmapped populations are present on the property, especially given the inaccessibility of much of its preferred habitat (rocky slopes within chaparral). Soils supporting the populations are very shallow and rocky and are derived from rhyolitic flows and andesitic to basaltic flows as well as ash flow tuff, both of which are derived from Western Sonoma Volcanics.

Associated plant species include chamise, common manzanita, purple false brome, bird's foot fern (*Pellaea mucronata* var. *mucronata*), and broadleaf stonecrop (*Sedum spathulifolium*). With a listing status of 1B.2, the species is endemic to California and is rare, threatened, or endangered in California and elsewhere.

2.8.5 NAPA FALSE INDIGO

Napa false indigo (*Amorpha californica* var. *napensis*) occurs along north-facing slopes and adjacent to Calabazas Creek, near the longitudinal center of the Preserve (**Figure 2.3a & b**). Napa false indigo inhabits the central-southern portion of the preserve along steep north facing slopes and a broad stream terrace. With a listing status of 1B.2, the species is endemic to California and is rare, threatened, or endangered in California and elsewhere.

Photo 12: Napa false indigo (*Amorpha californica* var. *napensis*), a perennial plant endemic to California and found on steep, moist riparian sites.

Soils supporting the populations are derived from rhyolitic flows of and andesitic to basaltic flows of Sonoma Volcanics, and are slightly acidic. The soils are deep and rich, with a thick layer of litter. Plant species observed in association are coast redwood, Douglas fir, California bay, Pacific madrone, poison oak, western sword fern, rough hedgenettle, and starry false lily of the valley (*Maianthemum stellatum*).

The plant has distinctive compound leaves and purple clustered flowers that bloom from May to July, and so it can easily be recognized for much of the year. However, because it is also deciduous, the plant could be overlooked during its leafless phase in the winter, (particularly less mature, smaller plants).

Photo 13: Napa biscuitroot (*Lomatium repostum*), a perennial herb found in oak woodland and chaparral habitat types.

2.8.6 NAPA BISCUITROOT

Napa biscuitroot (*Lomatium repostum*) is a low-growing perennial herb in the carrot family (Apiaceae) that features clusters of small yellow flowers and toothed basal leaves. The species is rather unique and may be identified outside of its flowering season, which extends from April through May. It grows within pine and oak woodland as well as chaparral, often on serpentine substrates. The plant carries a listing status of 4.3, indicating that its distribution is limited and is a "watch list" species — it is being monitored by the CNPS.

Three populations of Napa biscuitroot were identified on the Preserve, two in the far northwest, and on near the center of the site. Each population consisted of only a few plants over a small area. Soils supporting the species were very shallow, rocky, and apparently high in oxidized iron (red in color). The fact that this species often occurs on serpentine substrates, which are known to be highly limiting or even toxic to most plants, is an indication of the sterile nature of the volcanic soils supporting the plants. The soils are derived from rhyolitic flows as well as andesitic to basaltic flows of Western Sonoma Volcanics. Associated species consist of chamise, poison oak, common manzanita, sticky monkeyflower, and California helianthella.

Photo 14: Biolett's erigeron (*E. biolettii*), a perennial herb currently under review by CNPS found on rocky outcrops.

2.8.7 BIOLETT'S ERIGERON

Biolett's erigeron (*Erigeron biolettii*) is a mid-sized perennial herb in the sunflower family (Asteraceae) featuring small yellow disk flowers and purplish phyllaries. Flowers bloom from June to September. It is designated by the CNPS as List 3, a "Review List" that indicates a need for further study. The species is differentiated from its close relative, western rayless fleabane (*E. inornatus*) primarily by having spreading to appressed hairs throughout (as opposed to only proximally) and being densely glandular. However, the two species are known to intergrade, such that distinguishing features may be intermediate.

A total of six populations of Biolett's erigeron were mapped on the Preserve, primarily near the center of the property. Populations ranged from a few individuals to up to 100. Soils supporting the species are derived from rhyolitic flows as well as andesitic to basaltic flows of Western Sonoma Volcanics and are very shallow and rocky. Nearly all plants were observed on large rock outcrops adjacent to the principle drainages. Associated species include chamise, nude buckwheat, bird's foot fern, and canyon liveforever.

2.9 INVASIVE PLANTS

A total of 45 plant species identified on the Preserve are ranked by Cal-IPC as potentially having a "Low," "Moderate," or "High" impact on ecosystem functions, as follows (**see Appendix D**):

- 6 plant species with a Cal-IPC Invasive Rank of High
- 24 plant species with a Cal-IPC Invasive Rank of Moderate
- 15 plant species with a Cal-IPC Invasive Rank of Limited

All six of the plants ranked as High by the Cal-IPC are listed and discussed below. Three species ranked as Moderate, but which pose significant threats to ecosystem functions on the Preserve, are also included.

CAL-IPC RANK = HIGH
cheat grass (*Bromus tectorum*)
French broom (*Genista monspessulana*)
Himalayan blackberry (*Rubus armeniacus*)
jubata grass (*Cortaderia jubata*)
sweet fennel (*Foeniculum vulgare*)
yellow starthistle (*Centaurea solstitialis*)
CAL-IPC RANK = MODERATE
bigleaf periwinkle (*Vinca major*)
Harding grass (*Phalaris aquatica*)
Tasmanian bluegum (*Eucalyptus globulus*)

Photo 15: Invasive plant management is a high priority, short-term management strategy.

2.9.1 CHEAT GRASS

Cheat grass (*Bromus tectorum*) or downy brome is an annual grass species native to Eurasia. It is considered highly invasive in California occurring in open disturbed areas, roadsides, agricultural fields, rangelands and many natural communities. In some regions,

especially more arid environments, it can become the dominant grassland species, displacing other native and non-native species, degrading the overall ecological conditions, and reducing the foraging value of rangeland. Cheat grass often thrives in poorer soils where there is less competition with other vegetation.

2.9.2 FRENCH BROOM

French broom (*Genista monspessulana*) is an evergreen shrub native to the Mediterranean region and the Azores. It is considered highly invasive in California. It occurs primarily in the central Coast Ranges of California, but also occurs in other regions of the state. French broom is considered a serious threat in Sonoma County because of its ability to grow quickly, produce a high volume of viable seed and create a dense thicket that is impenetrable to wildlife and inhibits regeneration of other native plant species. It can inhabit grasslands, shrublands, oak woodlands, forest margins, coastal habitats, riparian corridors and disturbed areas. It does not tolerate freezing which limits its range. The stands also pose an increased fire hazard risk. This plant can fix nitrogen allowing it to invade sites with poorer soils. French broom typically flowers in mid to late spring and produces viable seeds in late spring to summer. It is a prodigious seed producer with a medium-sized shrub producing as many as 8,000 seeds per year. The seeds are dispersed by birds, ants and other animals and by waterways and rain wash. Seeds can survive in the soil for at least five years. The plants also re-sprout from the crown after cutting, freezing and sometimes fire.

2.9.3 HIMALAYAN BLACKBERRY

Himalayan blackberry (*Rubus armeniacus*) is an evergreen shrub native to western Europe. While it occurs in the Himalayas (hence its name), it is not actually thought to be native to the region but was likely introduced from its native range. It spreads through seed dispersal, by birds and mammals that eat the fruits, and vegetatively by rooting of cane tips. It is considered highly invasive in California where it occurs in both disturbed and undisturbed areas with moist soils. It is often a problem in riparian zones and within seasonally wet meadows. It has potential to completely displace native riparian shrubs and herbs, and its dense, thorny vines can create barriers to wildlife movement as well.

2.9.4 PURPLE PAMPAS GRASS

Purple pampas grass (*Cortaderia jubata*) is a large perennial bunchgrass native to regions in the Andes Mountains with similar elevations and climate as coastal California. It is considered highly invasive in California where it occurs predominantly in disturbed areas but it can also invade undisturbed habitats such as coastal shrubland, riparian habitat, and grasslands where sufficient soil moisture is available.

2.9.5 SWEET FENNEL

Sweet fennel (*Foeniculum vulgare*) is an aromatic, deeply tap-rooted perennial plant that is native to southern Europe and is considered highly invasive in California. It readily invades open disturbed areas including roadsides, and can be found in natural habitats such as grasslands, coastal scrub, riparian and wetland areas, particularly along the coast. Established plants can be very competitive, and soil disturbance can facilitate the formation of dense stands that displace desirable vegetation.

2.9.6 YELLOW STARTHISTLE

Yellow starthistle (*Centaurea solstitialis*) (YST) is a highly-competitive winter annual, to occasionally biennial, plant that is native to southern and central Eurasia. It is considered highly invasive in California and is one of the most problematic invasive weeds, currently occupying an estimated 15 million acres throughout the state (DiTomaso et al. 2006). It readily invades open disturbed places, grasslands, open woodlands, pastures and roadsides, often forming impenetrable stands that displace desirable vegetation, affecting the seasonal water balance and available soil moisture, and degrading wildlife habitat and rangelands. Since the species has deep roots, it can be especially competitive for water with deep-rooted native species associated with grasslands and open woodlands such as purple needlegrass and blue oaks (Benefield et al. 1998). The species is also toxic to horses though not to other species of livestock.

Stands of YST were mapped in a few locations in the grasslands on the site in areas underlain by both Neroly Formation and andesitic/basaltic flows of the WSV (**Figure 3.2**). The YST fields encompass just under 15 acres and have an average elevation of 1,459 feet and an average slope of 35 percent. The cover of YST

in these fields generally ranged from 25-75 percent, with associated species most commonly including slender wild oats, Italian thistle, and rose clover.

2.9.7 BIGLEAF PERIWINKLE

Bigleaf periwinkle (*Vinca major*) is an herbaceous perennial groundcover native to central Europe and the Mediterranean region and is considered moderately invasive in California. It displaces native vegetation by invading riparian corridors, moist woodlands, forest margins, coastal habitats and disturbed sites, growing best in moist, shady conditions.

2.9.8 HARDING GRASS

Harding grass (*Phalaris aquatica*) is a robust, tufted perennial bunchgrass native to Mediterranean Europe and is considered moderately invasive in California. It tends to be more invasive in coastal regions and invades riparian areas and rangelands, especially in areas with seasonally moist soils. The species has been widely planted in California due to its value as forage for cattle and it may be that it arrived on the Preserve in this manner. It is, however, toxic to sheep. Once established, it continues to spread within suitable habitat mostly through seed dispersal, however, it is capable of spreading short distances by rhizomatous growth as well. Flowering typically occurs in May or June. Seeds typically disperse only short distances primarily by wind and animals. It is not known how long seeds remain viable in the soil. Although Harding grass is an aggressive competitor once established, it is a weak competitor in the seedling stage and can be constrained by available soil moisture. Therefore, reseeding of treatment areas with replacement species is an important component of control.

2.9.9 TASMANIAN BLUEGUM

Tasmanian bluegum (*Eucalyptus globulus*) is a fast-growing tree native to southeastern Australia and Tasmania and is considered moderately invasive in California. It invades disturbed places in coastal California, especially riparian areas, grasslands, and forests. Because of its sheer biomass, 100-180' tall trees with diameters greater than 75" at breast height, these trees require significant moisture and will outcompete native vegetation for light, nutrients and available moisture. The aromatic volatiles of eucalyptus also serves as an allelopathic property to native vegetation that prohibits the establishment of native species under its dripline (Khan, E. A., Khan, M. A., Ahmad, H.K. and Khan F. U. 2004, Espinosa-Garcia, F.J. Martinex-Herandez, E. and Quiroz-Flores, A. 2008)

TABLE 2.1. Plant Communities/Habitats Mapped within the Preserve

MAP ID[1]	CNPS MCV CLASSIFICATION(S) AND RARITY RANKING	ASSOCIATED CWHR CLASSIFICATION	ASSOCIATED HOLLAND CLASSIFICATION	MEAN % SLOPE; MEAN ELEVATION	REPRESENTATIVE CONSTITUENT PLANT TAX[A]
Sensitive Communities					
4	Coast Live Oak Woodland[7] (*Quercus agrifolia* Woodland Alliance) (304.4 acres) G5 S4[5]	Coastal Oak Woodland	Coast Live Oak Woodland	66% slope; 1,195 feet	coast live oak (*Quercus agrifolia*), Douglas fir (*Pseudotsuga menziesii*), Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), creeping snowberry (*Symphoricarpos mollis*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), pink honeysuckle (*Lonicera hispidula*)
12	Common Manzanita Chaparral (*Arctostaphylos manzanita* Provisional Shrubland Alliance) (54.7 acres) G3?[10] S3?[10]	Mixed Chaparral	Northern Mixed Chaparral	59% slope; 1,178 feet	common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), buckbrush (*Ceanothus cuneatus*), toyon (*Heteromeles arbutifolia*), sticky monkeyflower (*Mimulus aurantiacus*), indian warrior (*Pedicularis densiflora*)
14	Hoary Manzanita Chaparral (*Arctostaphylos canescens* Provisional Shrubland Alliance) (4.1 acres) G3?[10] S3?[10]	Mixed Chaparral	Northern Mixed Chaparral	28% slope; 1,165 feet	Hoary manzanita (*Arctostaphylos canescens*), Stanford's manzanita (*Arctostaphylos stanfordiana*), Eastwood's manzanita (*Arctostaphylos glandulosa* ssp. *glandulosa*), chamise (*Adenostoma fasciculatum*), indian warrior (*Pedicularis densiflora*), small fescue (*Festuca microstachys*), purple false brome (*Brachypodium distachyon*)
6	Interior Live Oak Woodland[7] (*Quercus wislizeni* Woodland Alliance) (6.4 acres) G4 S4[4]	Montane Hardwood	Interior Live Oak Woodland	36% slope; 1,088 feet	interior live oak (*Quercus wislizeni*), California bay (*Umbellularia californica*), Pacific madrone (*Arbutus menziesii*), chamise (*Adenostoma fasciculatum*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), buck brush (*Ceanothus cuneatus*), poison oak (*Toxicodendron diversilobum*), indian warrior (*Pedicularis densiflora*), California milkwort (*Polygala californica*)
5	Oregon White Oak Woodland[7] (*Quercus garryana* Woodland Alliance) (61.3 acres) G4 S3[3]	Montane Hardwood	Oregon Oak Woodland	47% slope; 1,093 feet	Oregon white oak (*Quercus garryana*), California bay (*Umbellularia californica*), Pacific madrone (*Arbutus menziesii*), Douglas fir (*Pseudotsuga menziesii*), California fescue (*Festuca californica*), leafy bentgrass (*Agrostis pallens*), hedgenettle (*Stachys rigida*), yampa (*Perideridia kelloggii*)
2	Redwood Forest (*Sequoia sempervirens* Forest Alliance) (21.9 acres) G3 S3.2[2]	Redwood	North Coast Alluvial Redwood Forest	45% slope; 967 feet	coast redwood (*Sequoia sempervirens*), Douglas fir (*Pseudotsuga menziesii*), white alder (*Alnus rhombifolia*), California bay (*Umbellularia californica*), common snowberry (*Symphoricarpos albus*), California hazelnut (*Corylus cornuta*), star flower (*Trientalis latifolia*), western swordfern (*Polystichum munitum*)

MAP ID[1]	CNPS MCV CLASSIFICATION(S) AND RARITY RANKING	ASSOCIATED CWHR CLASSIFICATION	ASSOCIATED HOLLAND CLASSIFICATION	MEAN % SLOPE; MEAN ELEVATION	REPRESENTATIVE CONSTITUENT PLANT TAX[A]
20	Soft Rush Marshes[8] (*Juncus effusus* Herbaceous Alliance) (0.5 acre) G4 S4?[10]	Wet Meadow	Freshwater Seep	22% slope; 1,096 feet	spreading rush (*Juncus effusus* ssp. *pacificus*), Davy's centaury (*Zeltnera davyi*), tinker's penny (*Hypericum anagalloides*), fringed willowherb (*Epilobium ciliatum* ssp. *ciliatum*), pennyroyal (*Mentha pulegium*), giant chain fern (*Woodwardia fimbriata*), seep monkeyflower (*Mimulus guttatus*)
13	Stanford Manzanita Chaparral (*Arctostaphylos stanfordiana* Provisional Shrubland Alliance) (49.4 acres) G3 S3[2]	Mixed Chaparral	Northern Mixed Chaparral	42% slope; 1,057 feet	Stanford's manzanita (*Arctostaphylos stanfordiana*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), hoary manzanita (*Arctostaphylos canescens*), Sonoma sage (*Salvia sonomensis*), California milkwort (*Polygala californica*), California helianthella (*Helianthella californica*)
7	White Alder Groves[8,9] (*Alnus rhombifolia* Forest Alliance) (7.7 acres) G4 S4[4]	Montane Riparian	White Alder Riparian Forest	23% slope; 543 feet	white alder (*Alnus rhombifolia*), northern California black walnut (*Juglans hindsii*), Oregon ash (*Fraxinus latifolia*), coast redwood (*Sequoia sempervirens*), western azalea (*Rhododendron occidentale*), spicebush (*Calycanthus occidentalis*), California blackberry (*Rubus ursinus*), stinging nettle (*Urtica dioica ssp. holosericea*), elkclover (*Aralia californica*), panicled bulrush (*Scirpus microcarpus*),torrent sedge (*Carex nudata)*
Non-sensitive Native Communities					
8	California Bay Forest (*Umbellularia californica* Forest Alliance) (173.9 acres) G4 S3[11]	Coastal Oak Woodland	California Bay Forest	64% slope; 1,239 feet	California bay (*Umbellularia californica*), Douglas fir (*Pseudotsuga menziesii*), Pacific madrone (*Arbutus menziesii*), coast live oak (*Quercus agrifolia*), California hazelnut (*Corylus cornuta*), dwarf rose (*Rosa gymnocarpa*), common snowberry (*Symphoricarpos albus*), California milkwort (*Polygala californica*), star flower (*Trientalis latifolia*), western swordfern (*Polystichum munitum*), coastal wood fern (*Dryopteris arguta*)
11	Chamise Chaparral (*Adenostoma fasciculatum* Shrubland Alliance) (98.6 acres) G5 S5[6]	Chamise Chaparral	Chamise Chaparral	54% slope; 1,331 feet	chamise (*Adenostoma fasciculatum*), Stanford's manzanita (*Arctostaphylos stanfordiana*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), buck brush (*Ceanothus cuneatus*), California coffeeberry (*Frangula californica* ssp. *californica*), ladies' tobacco (*Pseudognaphalium californicum*), nude buckwheat (*Eriogonum nudum* var. *nudum*)
15	Coyote Brush Scrub (*Baccharis pilularis* Shrubland Alliance) (0.6 acre) G5 S5[6]	Coastal Scrub	Northern Coyote Brush Scrub	19% slope; 1,116 feet	Coyote brush (*Baccharis pilularis*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), soft chess (*Bromus hordeaceus*), slender wild oats (*Avena barbata*), Harding grass (*Phalaris aquatica*), rose clover (*Trifolium hirtum*)

MAP ID[1]	CNPS MCV CLASSIFICATION(S) AND RARITY RANKING	ASSOCIATED CWHR CLASSIFICATION	ASSOCIATED HOLLAND CLASSIFICATION	MEAN % SLOPE; MEAN ELEVATION	REPRESENTATIVE CONSTITUENT PLANT TAX[A]
1	Douglas Fir Forest (*Pseudotsuga menziesii* Forest Alliance) (188.0 acres) G5 S4[5]	Douglas Fir	Coast Range Mixed Coniferous Forest	65% slope; 1,157 feet	Douglas fir (*Pseudotsuga menziesii*), California bay (*Umbellularia californica*), poison oak (*Toxicodendron diversilobum*), common snowberry (*Symphoricarpos albus*), California milkwort (*Polygala californica*), California hazelnut (*Corylus cornuta*)
3	Knobcone Pine Forest (*Pinus attenuata* Forest Alliance) (2.1 acres) G4 S4[4]	Closed-cone Pine	Knobcone Pine Forest	38% slope; 765 feet	knobcone pine (*Pinus attenuata*), coast live oak (*Quercus agrifolia*), Pacific madrone (*Arbutus menziesii*), common manzanita (*Arctostaphylos manzanita* ssp. *manzanita*), toyon (*Heteromeles arbutifolia*), sticky monkeyflower (*Mimulus aurantiacus var. aurantiacus*), coyote mint (*Monardella villosa* ssp. *villosa*), California helianthella (*Helianthella californica* var. *californica*), Fremont's death camas (*Toxicoscordion fremontii*)
9	Pacific Madrone Forest (*Arbutus menziesii* Forest Alliance) (168.9 acres) G4 S3.2[11]	Coastal Oak Woodland	Mixed Evergreen Forest	54% slope; 1,146 feet	Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), Douglas fir (*Pseudotsuga menziesii*), coast live oak (*Quercus agrifolia*), toyon (*Heteromeles arbutifolia*), poison oak (*Toxicodendron diversilobum*), California milkwort (*Polygala californica*), California bedstraw (*Galium californicum*), beargrass (*Xerophyllum tenax*)
Non-native Communities					
17	Annual Brome Grasslands (*Bromus diandrus, B. hordeaceus-Brachypodium distachyon*) (93.7 acres) No CNPS Rank	Annual Grassland	Valley and Foothill Grasslands	45% slope; 1,502 feet	ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), wild oats (*Avena barbata, A. fatua*), rattail sixweeks grass (*Festuca myuros*), rose clover (*Trifolium hirtum*), longbeak stork's bill (*Erodium botrys*), hayfield tarweed (*Hemizonia congesta* ssp. *luzulifolia*)
10	Eucalyptus Groves (*Eucalyptus globulus* Semi-Natural Woodland Stands) (0.8 acre) No CNPS Rank	Eucalyptus	—	28% slope; 1,038 feet	Eucalyptus (*Eucalyptus globulus*), olive (*Olea europaea*), Harding grass (*Phalaris aquatic*), yellow starthistle (*Centaurea solstitialis*)
16	Harding Grass Swards (*Phalaris aquatica*) (21.5 acres) No CNPS Rank	Perennial Grassland	Non-native Grassland	30% slope; 1,186 feet	Harding grass (*Phalaris aquatic*), burclover (*Medicago polymorpha*), Italian ryegrass (*Festuca perennis*), ripgut brome, slender wild oats (*Avena barbata*), rattail sixweeks grass (*Festuca myuros*)
18	Wild Oats Grasslands (*Avena barbata, A. fatua*) (9.6 acres) No CNPS Rank	Annual Grassland	Valley and Foothill Grasslands	42% slope; 1,447 feet	Wild oats (*Avena barbata, A. fatua*), ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), purple false brome (*Brachypodium distachyon*), rose clover (*Trifolium hirtum*), longbeak stork's bill (*Erodium botrys*), hayfield tarweed (*Hemizonia congesta* ssp. *luzulifolia*)
19	Yellow Starthistle Fields (*Centaurea solstitialis*) (14.6 acres) No CNPS Rank	Annual Grassland	Non-native Grassland	35% slope; 1,459 feet	Yellow starthistle (*Centaurea solstitialis*), wild oats (*Avena barbata, A. fatua*), ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), purple false brome (*Brachypodium distachyon*)

1 = See Figure 2.3a & b (map of plant communities)

2 = G3 S3: CNPS sensitive plant community rating: 21-100 viable occurrences worldwide/statewide, and/or more than 518-2,590 hectares (Sawyer et al. 2009); Additional threat rank 0.2 = Threatened

3 = G4 S3: Greater than 100 viable occurrences worldwide, and/or more than 12,950 hectares; 21–100 viable occurrences statewide, and/or more than 2,590–12,950 hectares

4 = G4 S4: Greater than 100 viable occurrences worldwide/statewide, and/or more than 12,950 hectares

5 = G5 S4: Demonstrably secure because of its worldwide abundance; Greater than 100 viable occurrences statewide, and/or more than 12,950 hectares

6 = G5 S5: Demonstrably secure because of its worldwide/statewide abundance

7 = Habitat is provided protection under Oak Woodlands Conservation Act, 2009 California Fish and Game Code—SB 1334: Article 3.5

8 = Habitat is regulated under Clean Water Act, Sections 401 and 404, US Environmental Protection Agency

9 = Habitat is regulated under Streambed Alteration Agreement, California Department of Fish and Wildlife — Section 1600 *et seq.* (Fish and Game Code), as well as Section 404 of the Clean Water Act

10 = Status as an alliance is in review and subject to change (data still being collected on plant community); alliance and rarity ranking are provisional

11 = Not treated as a sensitive community in this plan per personal communication with Todd Keeler-Wolf as it has been determined that these communities are not rare

2.10 SPECIAL-STATUS WILDLIFE

Abundant and diverse plant communities and variable physical resources creates a wide range of wildlife habitat across the preserve. The assessment team used prediction modeling to determine the potential of wildlife to reside within the boundaries of the preserve. Then field surveys were coordinated to corroborate the conclusions of the predictive modeling. In addition, a network of motion-sensored cameras was established throughout the Preserve to identify the range of wildlife using the variety of habitat types on the property.

2.10.1 SURVEY METHODOLOGY

California Wildlife Habitat Relationships

The California Wildlife Habitat Relationships (CWHR) database and software program was developed by the CDFW to predict wildlife diversity based on micro as well as macro habitat attributes. **Table M.1A** in **Appendix M** presents the CWHR habitat types mapped on the Preserve, along with the number of vertebrate animal species predicted for each habitat type. The number and types of predicted animals are influenced by the "habitat elements" attributed to each of the plant communities, as listed in **Table M.1B** (**see Appendix M**).

While many of the CWHR habitat types are rather broadly defined — several include multiple CNPS alliances mapped on the Preserve (and in some cases other alliances not listed in the table) — they give some indication of the relative vertebrate wildlife diversity associated with general habitat types present on the Preserve. For example, as depicted in Table 3.2A, the CWHR model predicts over 150 vertebrate animals with potential to occur in oak woodland plant communities, which feature habitat elements present on the Preserve, including Coastal Oak Woodland and Montane Hardwood (which includes oak habitats). Note that these two plant communities include significant overlap among species.

The number and diversity of habitat elements present on the Preserve is also remarkable. Of 123 habitat elements considered in predicting species potential, 97 are present on the Preserve — nearly 80 percent of all habitat elements. As shown in **Table M.1B**, habitat elements include a wide variety of biotic and abiotic features that are known to provide wildlife habitat, including some animals (which would represent prey for other species). While habitat elements include many man-made features such as buildings, piers, and dumps, all of the habitat elements present on the Preserve are natural features, mostly related to the significant diversity of vegetation structure, topography, surface hydrology, and geologic features. Examples of habitat elements present on the Preserve include cliffs and caves, *snags* and downed logs, pine cones and sap, acorns, springs, and perennial and intermittent streams.

Wildlife Surveys

Wildlife surveys were conducted on the Preserve during the late spring and summer seasons of 2013. The surveys were conducted to identify special-status and invasive animals with the highest potential to occur on the property, based on the presence of known habitat conditions. The results of the surveys were analyzed in order to evaluate potential management strategies to

protect special-status species and their habitats and to minimize potential threats from invasive species. All of the surveys were reconnaissance in nature, as discussed in the methods sections for each survey type.

The following wildlife surveys were conducted on the Preserve:

- Special-status amphibian surveys
- Special-status bird surveys
- California freshwater shrimp surveys

Appendix B presents a list of all special-status animals documented in the vicinity of the Preserve.

Focused surveys for special-status fish were not conducted on the Preserve, as fish surveys have recently been completed in the area and on Calabazas Creek in 2013 (e.g., SSCRCD 2013).

Species surveyed for, but not detected, include California red-legged frog (*Rana draytonii*) and California freshwater shrimp.

Wildlife Camera Study

In addition to these surveys, a wildlife camera study was conducted (see **Appendix O**). Infrared motion-detection cameras were strategically installed in different habitats throughout the Preserve, in order to document the presence and general abundance of larger animal species, including invasive species. The cameras augmented incidental surveys for invasive animal species posing potential management concerns.

Special-Status Bird Survey

VNLC contracted Avocet Research Associates (ARA) to conduct special-status bird surveys on the Preserve. ARA was selected due to their extensive experience with northern spotted owl (*Strix occidentalis caurina*), one of the most likely special-status bird species to occur in the area. VNLC compiled species data and produced a series of maps indicating the locations of potential special-status bird habitat on the property. These data included the most recent eBird points data (not displayed on maps due to excessive number of common species occurrences), CNDDB data (including the spotted owl database), and critical habitat polygons for the area. VNLC provided these maps as well as survey instructions to ARA biologists. In addition to surveys conducted by ARA, biologists from VNLC recorded bird species detected during surveys for other biological resources.

The bird surveys were reconnaissance in nature, and conducted in order to detect the presence or potential habitat for special-status birds. The results of the surveys present confirmation of species present only during the specific timeframe of the surveys, and do not provide conclusive evidence of nesting on the site or of an absence of any species with potential to occur in the area. Therefore, unless presence is assumed, protocol surveys for special-status birds may be required prior to certain disturbance activities.

Appendix B presents all special-status animals documented in the vicinity of the Preserve and indicates whether suitable habitat for each species is present on the Preserve.

Special-Status Amphibian Survey

Prior to conducting field surveys, VNLC biologists reviewed documented special-status amphibians and investigated the presence of potential habitat in the vicinity of the Preserve. Documented occurrences in the CNDDB were reviewed and compared to aerial photography and GIS data, in order to examine potential habitat connectivity between the occurrences and the Preserve. The aerial photography reviewed was one-meter pixel resolution NAIP photography for Sonoma County (2012), and the GIS data consisted of detailed Bay Area Aquatic Resource Inventory (BAARI) streams and wetland data (SFEI 2009) as well as National Wetlands Inventory (NWI) wetlands and water body data (1977).

Surveys consisted of traversing along major stream corridors, listening for vocalizing frogs and using binoculars to scan stream pool margins from a distance. Pools were quietly approached and visually inspected for adult or larval frogs or other aquatic animal species. Night surveys involved the use of LED Lenser P14 spotlights, which were used to detect frog eyeshine. Night surveys provide an important compliment to daytime habitat and species surveys for special-status frogs.

The surveys conducted for amphibians were reconnaissance in nature and do not provide conclusive evidence of the absence of any species with potential to occur in the area. Therefore, unless presence is assumed, protocol surveys for

special-status amphibians may be required prior to certain disturbance activities. Surveys for strictly upland amphibians were not conducted due to the fact that no upland amphibian species known from the area are considered special-status.

2.10.2 RESULTS WILDLIFE RESOURCES DATA GAP ANALYSIS

The following measures would likely yield additional and/or more refined information pertaining to wildlife resources on the Preserve:

- Focused surveys for special-status animal species and animals of interest, such as ringtail, bear, badger, and special-status bats;
- Focused surveys for invasive animal species, particularly wild pigs and barred owls;
- Additional wildlife camera studies on and adjacent to the Preserve (as permitted by other landowners) to augment wildlife distribution and migration corridors data; and
- Benthic macroinvertebrate and water quality surveys within Preserve streams.

Surveys for benthic macroinvertebrates within representative stretches of the streams could shed light on stream habitat conditions. Stream invertebrates such as mayflies (order *Ephemeroptera*), stoneflies (order *Plecoptera*), and caddisflies (order *Trichoptera*) often provide a good indication of water quality, in terms of temperature, turbidity, dissolved oxygen, and chemical composition. An inventory of macroinvertebrates, along with an assessment of water quality in general, could be used to develop management guidelines for the streams and their surrounding watersheds, in order to maintain optimal habitat for sensitive aquatic biological resources.

A number of animals have potential to occur on the Preserve, based on the presence of suitable habitat, but were not detected during surveys or by the wildlife cameras. Among mammals, these include coyote (*Canis latrans*), black bear, ringtail, American badger (*Taxidea taxus*), and wild pig (*Sus scrofa*). Scat of coyote was observed on the Preserve, and the species is presumed to inhabit the Preserve. The species was probably not captured on camera because no cameras were installed within the grasslands on the site, due to problems with wind-blown vegetation triggering the motion detector sensors. Grasslands are the species' preferred habitat. No definitive signs of the other species were identified on the Preserve.

Bear have not yet been detected by recent wildlife camera studies nearby, most notably at Bouverie Wildflower Preserve; however, bear, boar, coyotes, and badger have been detected north of the Preserve in the Mayacamas Mountains including at Pepperwood Preserve in Mark West Creek watershed northeast of Santa Rosa (Townsend pers. comm.). Longtime residents in the area report that they have not encountered black bear in the area (Dawson 2013), though there is no mention of the other absent species. It is possible that black bears and wild pigs may inhabit the area on occasion and then move on to other sites in the larger region — both have been reported in other areas in Sonoma County (Townsend pers. comm.). Additional data on such species would be valuable from a management perspective.

The pallid bat (*Antrozous pallidus*) also occurs in the region, and there are a number of rock outcropping with shallow caves and crevices on the Preserve that could provide suitable habitat for this special-status bat (and other bats). However, the suitable habitat was not discovered until relatively late in the biological surveys, therefore bat surveys were not conducted on the Preserve.

The black swift (*Cypseloides niger*) is an example of a special-status bird species (CDFW Species of Special Concern) documented in the CNDDB (2013) in the vicinity of the Preserve (**Figure 2.5**), which does not nest in the area but has potential to use the site based on the presence of suitable habitat (Evans pers. comm.), but was not observed.

More intensive, field-based surveys and/or additional wildlife camera studies for the mammals listed above, as well as other animals with potential to occur on the Preserve, may provide important data pertaining to such species.

Preserve managers and volunteer patrol members should be on the lookout for additional invasive animal species on or near the Preserve. The nearest barred owl occurrence is recorded in eBird at a site located only six miles northwest of the Preserve, in Annadel State Park (recorded in 2009 and listed as the

southern-most known occurrence of the species). This species therefore must be considered to have potential to occur on the site, and its presence could be detrimental to the northern spotted owl. Additional invasive species potentially occurring on the Preserve include feral pets such as cats (*Felis catus*) and red-eared slider turtles (*Trachemys scripta elegans*), and the District should likewise be aware of the presence or absence of these species on the Preserve.

2.10.3 RESULTS

Special-status animal species documented on the Preserve during reconnaissance wildlife surveys include the following **(Figure 2.4):**

- steelhead trout (*Oncorhynchus mykiss*) (Federally Threatened)
- northern spotted owl (*Strix occidentalis caurina*) (Federally Threatened; candidate for State listing)
- American peregrine falcon (*Falco peregrinus anatum*) (California Fully Protected Species)
- Nuttall's woodpecker (*Picoides nuttallii*) (USFWS Bird of Management Concern)
- foothill yellow-legged frog (*Rana boylii*) (CDFW Species of Special Concern)
- California giant salamander (*Dicamptodon ensatus*)

2.10.4 STEELHEAD TROUT

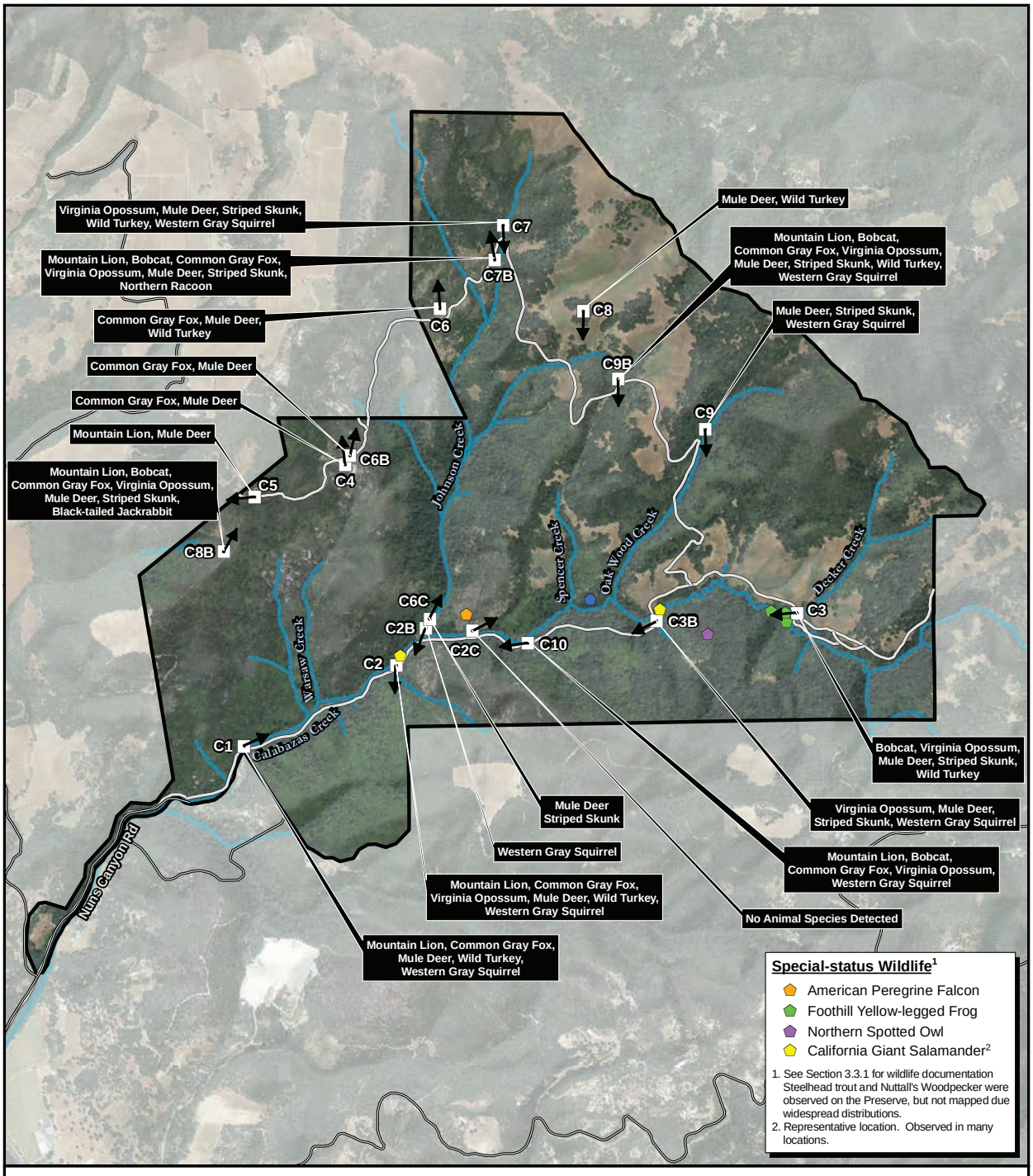
Calabazas Creek supports a native population of federally threatened steelhead trout (*Oncorhynchus mykiss)*. Focused surveys for special-status fish were not conducted on the Preserve, as fish surveys have previously been conducted in the area, and steelhead have been documented in Calabazas Creek (e.g., SSCRCD 2013). The presence of steelhead was confirmed during 2013 surveys for amphibians and other biological resources.

2.10.5 NORTHERN SPOTTED OWL

Photo 16: Northern Spotted Owl taken by Avocet Research Assoc. adjacent to Preserve.

The northern spotted owl (*Strix occidentalis caurina*) is a large dark brown owl with spotting on the head, back and under-parts. A pair of northern spotted owls was observed near the eastern edge of the Preserve on May 15, 2013. The pair was vocalizing and appeared to be setting up a platform nest in a large Douglas fir tree. While it is not certain whether the pair is nesting, they are approximately one half mile away from another pair observed just east of the Preserve during surveys, which is a typical distance between nesting Spotted Owls (Evans pers. comm.).

The Preserve provides optimal nesting habitat for the species in many respects, including the presence of its preferred nesting trees (mature coast redwood and Douglas fir), an abundance of one of its preferred prey species, the dusky-footed woodrat and an apparent lack of barred owls. Therefore it is expected that, assuming they are nesting (and this should be assumed unless proven otherwise by protocol surveys), the observed pair of owls will return to the location in the foreseeable future (though the species does not nest every year).


Virginia Opossum, Mule Deer, Striped Skunk, Wild Turkey, Western Gray Squirrel
Mountain Lion, Bobcat, Common Gray Fox, Virginia Opossum, Mule Deer, Striped Skunk, Northern Racoon
Common Gray Fox, Mule Deer, Wild Turkey
Common Gray Fox, Mule Deer
Common Gray Fox, Mule Deer
Mountain Lion, Mule Deer
Mountain Lion, Bobcat, Common Gray Fox, Virginia Opossum, Mule Deer, Striped Skunk, Black-tailed Jackrabbit
Mule Deer, Wild Turkey
Mountain Lion, Bobcat, Common Gray Fox, Virginia Opossum, Mule Deer, Striped Skunk, Wild Turkey, Western Gray Squirrel
Mule Deer, Striped Skunk, Western Gray Squirrel
C7
C7B
C6
C8
C9B
C9
C6B
C4
C5
C8B
C6C
C2B
C2C
C10
C2
C3B
C3
C1
Johnson Creek
Spencer Creek
Oak Wood Creek
Decker Creek
Warsaw Creek
Calabazas Creek
Nims Canyon Rd
Bobcat, Virginia Opossum, Mule Deer, Striped Skunk, Wild Turkey
Virginia Opossum, Mule Deer, Striped Skunk, Western Gray Squirrel
Mule Deer Striped Skunk
Western Gray Squirrel
Mountain Lion, Bobcat, Common Gray Fox, Virginia Opossum, Western Gray Squirrel
Mountain Lion, Common Gray Fox, Virginia Opossum, Mule Deer, Wild Turkey, Western Gray Squirrel
No Animal Species Detected
Mountain Lion, Common Gray Fox, Mule Deer, Wild Turkey, Western Gray Squirrel
Special-status Wildlife[1]
American Peregrine Falcon
Foothill Yellow-legged Frog
Northern Spotted Owl
California Giant Salamander[2]
1. See Section 3.3.1 for wildlife documentation Steelhead trout and Nuttall's Woodpecker were observed on the Preserve, but not mapped due widespread distributions.
2. Representative location. Observed in many locations.
CALABAZAS CREEK Open Space Preserve
SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
Map Date: 09/29/2015
SOURCES: VNLC, 2013 | USDA NAIP, 2012 SCAPOSD, 2013 | SFEI, 2012 | PWA, 2013
This map is for illustrative purposes only and is not intended to be a definitive property description.
FIGURE 2.4
Special-status Animals and Wildlife Camera Locations
N
0 500 1,000 1,500 2,000 Feet
Mountain Lion Observation*
Wildlife Camera Station
Existing Road or Trail on or Adjacent to Preserve
Direction of Camera
Major Stream
Preserve Boundary
* Direct observation

2.10.6 AMERICAN PEREGRINE FALCON

Photo 17: American peregrine falcon on the rock cliffs.

The American peregrine falcon (*Falco peregrinus anatum*) is a large bird of prey that features a dark head with a pale throat, a blue-slate neck and back, and a pale breast and belly with dark bars. The peregrine falcon was delisted from its status as federally and state endangered in 2008, but remains classified as a sensitive species by the California Department of Forestry, and is fully protected by the State and is listed as a USFWS bird of conservation concern. The main threats to the species include pesticide consumption, which reduces reproductive success by thinning eggshells and poisons birds, and habitat degradation from urban development.

A breeding pair of American peregrine falcons was documented on the site on May 13, 2005, by VNLC staff during botanical surveys. Their nest is located on a rock outcrop perched on a tall cliff near the center of the site along Calabazas Creek. The falcons have shown aggressive territorial displays including calling and circling overhead when people walk past the territory.

2.10.7 NUTTALL'S WOODPECKER

The Nuttall's woodpecker (*Picoides nuttallii*) is a small black and white woodpecker with a distinctive black and white barred back. Principally a cavity nester, this species provides important nesting habitat for other woodland species. Nuttall's woodpecker is mostly restricted to the oak woodlands of California. It is of conservation concern primarily due to its limited range (Baja California to southern Oregon), relatively low populations, and association with vulnerable oak and riparian forests (USFWS 2013). Nuttall's woodpecker is a migratory bird species protected by the Migratory Bird Treaty Act (U.S. Fish and Wildlife Service Migratory Bird Program), and is also a USFWS Bird of Conservation Concern (BCC) (U.S. Fish and Wildlife Service 2008).

A moderate number of Nuttall's woodpeckers were detected throughout the oak woodlands on the Preserve, but were most abundant along the Calabazas Creek riparian corridor (within non-oak riparian as well as oak habitats). The species occurs relatively commonly, in low to moderate numbers, in the general vicinity, and its presence on the Preserve was expected (Evans pers. comm.). Occurrences of the species were not mapped as a result of their relative abundance on the Preserve.

Photo 18: Foothill yellow-legged frog in Calabazas Creek

2.10.8 FOOTHILL YELLOW-LEGGED FROG

The foothill yellow-legged frog (*Rana boylii*) is a mid-sized frog that features gray, brownish, or olive coloring (depending upon surrounding habitat). It is a CDFW Species of Special Concern, and is under review for listing by US Fish and Wildlife Service. It was once considered the most abundant frog across much of California, but in a recent review of over 800 historical occurrence sites, only 30 had 20 or more adult frogs remaining (Fellers, 2005). The primary threats to this species include reservoir water releases, which wash away eggs, as well as introduced species, diseases (including the infamous "chytrid" fungus), and stream sedimentation from mining, logging, and grazing (CaliforniaHerps.com 2013).

Three individual foothill yellow-legged frogs, all recently metamorphosed, were observed in stream pools of the eastern-most stretch of Calabazas Creek. No eggs or tadpoles were observed. The pools were clear, featured gravelly substrate, and were two to eight inches deep. Surrounding vegetation includes stinging nettle, poison oak, and California maidenhair fern (*Adiantum jordanii*), with an over-hanging canopy of white alder, bigleaf maple, and California bay.

Photo 19: California giant salamander in Calabazas Creek (juvenile)

2.10.9 CALIFORNIA GIANT SALAMANDER

The California giant salamander (CGS) (*Dicamptodon ensatus*) is a one of the largest terrestrial salamanders in North America, with a large robust body, a massive head, and stout limbs. It appears likely that CGS will be listed as a Species of Special Concern in the near future, and this report treats it accordingly. Furthermore, where CGS is present it can represent a critical link in food chains, with larval *Dicamptodon* often the dominant vertebrate present in streams by biomass (Corn and Bury 1989). The loss of this species could represent a major disruption to the ecosystem of the Preserve.

CGS were observed within numerous stream pools within Calabazas Creek, as well as within Johnson Creek and Warsaw Creek. Both larva and adults were observed within and adjacent to the pools. The species' use of Calabazas Creek is most concentrated in the steeper upper reaches of the stream, with very few salamander larvae inhabiting the lower-gradient parts of the stream near the bottom of the site.

Photo 20: Prey and predator were captured by wildlife cameras established throughout the Preserve for 60 days.

This is likely due to a combination of factors, including lower sediment loads in high-gradient sections of the stream as well as more and larger predatory fish present in the lower stream reaches. While CGS show a strong association with old-growth forests, and larval densities are generally damaged by the siltation accompanying logging, their larvae also paradoxically show an increase in growth rate and number after disturbance creates openings in the canopy (Murphy and Hall 1981). This is likely due to increased primary productivity from greater light penetration to the stream.

2.11 MAMMALS

In addition to special-status species, several mid-sized to large carnivores were documented on the Preserve and are described in this document, due to their ecological significance and relative scarcity. A total of 10 animal species were recorded by the 18 wildlife cameras installed throughout the Preserve, including nine mammals and one bird. **Figure 2.4** shows the locations of each documented species, and **Tables O.1A and O.1B** in **Appendix O** present detailed information pertaining to the camera stations and species recorded.

The larger carnivores among the species are described below in terms of their ecological requirements and presence on the Preserve. Such species provide an important ecological function and are relatively uncommon, particularly in areas with moderate to high-density human habitation and development (unlike more generalist species such as raccoon and skunk).

2.11.1 MOUNTAIN LION

Photo 21: A mountain lion captured by the motion-sensor cameras on Nunns' Canyon road.

The mountain lion (*Puma concolor*) is the largest native feline species in North America. Mountain lions were documented at seven different locations on the site (**Figure 2.4**), via wildlife cameras as well as one personal observation. Deer, wild turkey, and other prey species are common on the site and the habitat conditions (including wooded areas, rocky outcrops and a lush riparian zone) are highly suitable for the species. However, interviews with property owners in the vicinity of the site by Arthur Dawson (2013) indicate that lions were not seen in the area until the past couple of decades. The presence of a top predator requiring an extensive range like mountain lions on the property is a good indicator of the ecological health of the Preserve.

2.11.2 BOBCAT

Photo 22: Bobcat triggered a motion-sensor camera during the wildlife surveys.

The bobcat (*Lynx rufus*) is a medium sized native cat that occurs from southern Canada through Mexico. They have a patterned tawny or yellow brown coat. Patterns include black spots on the body, stripes on the breast and legs, and dark tips on the ears and tail. The bobcat's distinctive short tail is an adaptation to hunting in brushy areas. They typically breed in February or March and litters usually consist of three kittens. Kittens remain with their mother for three to five months. Bobcats are ambush predators and generally feed on *lagomorphs*, although rodents, reptiles, amphibians, invertebrates, and some vegetation can also be eaten (Eder 2005). Bobcats are found in nearly all habitat types throughout California, optimal habitat includes brushy stages of low and mid-elevation conifer, oak, riparian and pinyon-juniper forests, and chaparral (Eder 2005).

Bobcats were documented via wildlife cameras at five different locations on the Preserve (**Figure 2.4**). The occurrences are within the Calabazas Creek riparian area and within chaparral habitat in northern portions of the Preserve.

2.11.3 GRAY FOX

The gray fox (*Urocyon cinereoargenteus*) is named for the gray fur over the back and tail. Their diet is omnivorous including small mammals, insects and fruits and grasses. Foxes den in a variety of locations, including ridges and underbrush cover in woodlands. They may den underground, digging their own burrow or refurbishing an abandoned burrow from another animal. Gray foxes typically breed in January or February, litters consist of one to seven young (Eder 2005). Gray foxes are known to occur throughout California in almost all habitat types. Their preferred habitat includes shrublands and forests that provide cover, and riparian areas for water.

Gray foxes were documented at eight wildlife camera stations throughout the Preserve (**Figure 2.4**). Photos recorded fox activity during the daytime as well as nighttime, and included juvenile foxes as well as adults. Several photos featured foxes carrying prey.

2.12 BIRDS

All bird species recorded on the Preserve, as well birds expected to occur based on the presence of habitat, are listed in **Appendix C**. The appendix also provides the habitat in which each bird was observed. A total of 57 bird species were recorded on the Preserve, including the three special-status species listed above. As the appendix table shows, many species were observed within several habitats, but some were found only within one or two habitats. Of

the broad habitat categories used to record species, the largest number of species were found in mixed evergreen forest (37 species) (excluding Douglas fir, which was counted separately), which is not surprising given the extent and diversity of this habitat on the Preserve. The second most diverse was oak woodlands (36 species), followed by riparian woodland (29). The diversity of habitats appears to be a factor in the high level of bird diversity in general.

The Preserve supports three different species of vireos and six species of woodpeckers (including northern flicker), both rather unusual situations. Also, the only non-natives are the ubiquitous European starling (*Sturnus vulgaris*) and wild turkey (*Meleagris gallopavo*). The presence of turkeys may account for the low number of quail (*Callipepla* spp.) due to competitive exclusion (Evans pers. comm.).

The reconnaissance bird surveys conducted on the Preserve were limited in their timeframe and scope, such that additional species have potential to occur that were not detected.

2.13 AMPHIBIANS

Non-special-status amphibians detected during field surveys include the following:

- Pacific chorus frog (*Pseudacris regilla*); and
- rough-skinned newt (*Taricha granulosa*).

2.13.1 PACIFIC CHORUS FROG

Pacific chorus frogs (*Pseudacris regilla*) were observed along Calabazas Creek and its larger tributaries. This species is among the most widespread and common amphibians in California. It inhabits a wide variety of aquatic habitats, from vernal pools, to seasonal drainages, to perennial stock ponds throughout non-desert regions in the state. The presence of this species on the Preserve was expected and does not present any management concerns.

2.13.2 ROUGH-SKINNED NEWT

Rough-skinned newts (*Taricha granulosa*) were observed along an eastern stretch of Calabazas Creek. Several individuals were observed within and adjacent to a deep stream pool. This species breeds in a variety of aquatic habitats, primarily ponds and larger streams, and also uses terrestrial habitats. It is sensitive to water quality and can be impacted by sedimentation from timber harvesting, especially clear-cutting, as well as other activities and natural processes. However, the species is widespread throughout its range and is not considered special-status or otherwise sensitive. Two other closely related newt species, California newt (*T. torosa*) and red-bellied newt (*T. rivularis*), are both known to occur in the area (CaliforniaHerps.com 2013), and despite not being detected are expected to occur on the Preserve.

2.14 INVASIVE WILDLIFE

Two animal species were identified on the Preserve that are known to detrimentally impact sensitive biological resources. These include the following:

- American bullfrog (*Lithobates catesbeianus*); and
- wild turkey (*Meleagris gallopavo*).

These two species were identified during the 2013 biological surveys conducted on the site and are discussed. Descriptions of additional invasive species of management concern that have potential to occur on the Preserve are also provided below.

2.14.1 AMERICAN BULLFROG

American bullfrogs (*Lithobates catesbeianus*), the largest true frog in North America, are light green to dark olive in color, with dark spots and blotches. They were observed at two locations along the eastern stretch of Calabazas Creek on the Preserve. Only one individual was observed at each location, but this invasive animal represents a species of serious management concern, as it competes with and preys upon a wide variety of native amphibians (including foothill yellow-legged frog) and other wildlife.

In areas where it occurs in California, the American bullfrog has contributed to alarming declines in native amphibian species (Hayes and Jennings 1986). The species is known to prey upon and compete with native amphibians such as California yellow-legged frog, California giant salamander, California red-legged frog, and California tiger salamander (*Ambystoma californiense*). It can impact a wide variety of other species as well, since adult frogs have notoriously voracious appetites and will consume essentially any animal it can swallow, including invertebrates, mammals, birds, fish, and reptiles.

2.14.2 WILD TURKEY

The wild turkey (*Meleagris gallopavo*) is a large ground-feeding bird in the pheasant family (Phasianidae) that features spurred pinkish to grayish-green legs and dark brown to black feathers (Alsop 2001). It causes ecological disruption in California by competing with smaller native birds as well as by consuming large amounts of pine nuts, oak acorns, grass seeds, and other plant material (*ibid*). The species weighs up to 20 pounds and can therefore easily displace smaller ground-feeding birds such as quail, which rely heavily on acorns for food. Quail are reported by long-time residents in the area as having declined in recent years, and wild turkeys are thought to have arrived in the area within the past two or three decades (Dawson 2013).

Acorns represent a particularly important food source for turkeys in the fall, and the large consumption by turkeys may contribute to the decline of oak recruitment in some areas (Quirin 2012). Finally, turkeys can cause considerable ground disturbance under oaks and around other habitat. Such disturbance can facilitate the colonization of a site by invasive plant species, which in turn may further impact oak recruitment (J. Schwietzer, pers. observation).

Turkeys were observed primarily in the oak woodlands, most often adjacent to the large grasslands. Eight different cameras recorded turkeys, yielding 36 separate detections. The observed presence of nests indicates that they are reproducing on the Preserve.

2.15 HABITAT CONTINUITY AND CONNECTIVITY

For many animal species, the mere presence of required habitat elements, in the form of food and shelter in a given localized area, is not sufficient to meet all of their needs for survival. Species need high quality habitat and dispersal pathways. Human disturbance, territorialism, effects of climate change (e.g., prolonged drought), and migratory tendencies influence habitat quality and thus suitability for a given species. For these and other reasons, habitat continuity and connectivity are important components of habitat suitability, not only for individual animal requirements, but for populations (Dudley 2008). Connectivity maintains genetic variability and allows for source populations to re-colonize patches of suitable habitat. For example, mountain lions are territorial, and the average home range for an individual may range from 36 to 125 square miles in the Coast Ranges (Grigione et al. 2002). Therefore, they require either large, contiguous habitat, or moderately-sized areas of suitable habitat that are connected via corridors. Stream courses and ridge tops are often used as travel corridors and hunting routes. Riparian vegetation along streams provides cover for mountain lions traveling in open areas (Spowart and Samson 1986).

As described in **Chapter 3**, the zoning codes of lands adjacent to the Preserve permit agriculture, mining, and forestry, among other developments. As **Figure 2.3a & b** shows, a narrow tract of natural grassland and woodland/forest habitats along the Preserve's northern boundary connects the property to Sugarloaf Ridge State Park. This ridge top and the adjacent riparian corridor (a headwater tributary of Sonoma Creek) are very likely important wildlife corridors linking home ranges in the Preserve with habitat in the park.

Of particular interest from a land management perspective is the extent of lands surrounding the Preserve that are zoned for agriculture **(Figure 3.1).** A large unit of Land Intensive Agriculture (LIA) extends along the parcels west and north of the Preserve within Sonoma County, effectively isolating the property from the nearest designated open space preserve, Sugarloaf Ridge State Park, located approximately three-quarters of a mile north of the Preserve. Likewise, large areas just south of the Preserve that are zoned as LIA, Diverse Agriculture, and Rural Residential (embodied by a large, fairly recently constructed housing development) isolate the Preserve from the Bouverie Wildflower Preserve, located approximately one mile to the south. East of the ridge is Napa county which zones this land as part of an agricultural watershed. Neighboring parcels east of the Preserve boundary contain some single family homes with some small-scale ranching activities such as equestrian services. Illegal pot gardens have been located on the preserve and negatively impact on landscape permeability for wildlife. Human activity repels wide-ranging top predators (Reed and Merenlender 2011) while pesticide use impacts all animal trophic levels including invertebrates, rodents, and predators (Rohr, Kerby, and Sih 2006).

Two key components to optimizing wildlife habitat on the Preserve are: 1) to maintain quality and intactness of the continuous mosaic of natural habitats within the property, and 2) maintain or enhance the quality of the remaining habitat corridors between the property and similar habitat types in the vicinity (Hilty and Merenlender 2004). Within the Preserve, coastal oak woodlands, chaparral, grasslands, and various Douglas fir forests are found as a mosaic of habitat patches within a matrix of montane hardwood. These habitats are fragmented only by the primary access road which sees very little use (see **Figure 2.3a & b**). Movement within the preserve by medium to large-sized mammals is facilitated by natural corridors (e.g., riparian and ridgetops) as well as man-made corridors such as old roads. For example, riparian corridors or old roads connecting separate stands of coastal oak woodlands or grasslands allow mule deer to travel through areas that otherwise support dense chaparral. Results of the wildlife camera study (for example, see Camera C8B on **Figure 2.4**) as well as direct observation indicate that medium to large-sized mammals, including mountain lion, are using these travel routes as expected.

2.16 FIRE ECOLOGY AND ITS INFLUENCE ON THE PRESERVE

Photo 23: Multi-stem growth indicating advanced regeneration after a significant fire.

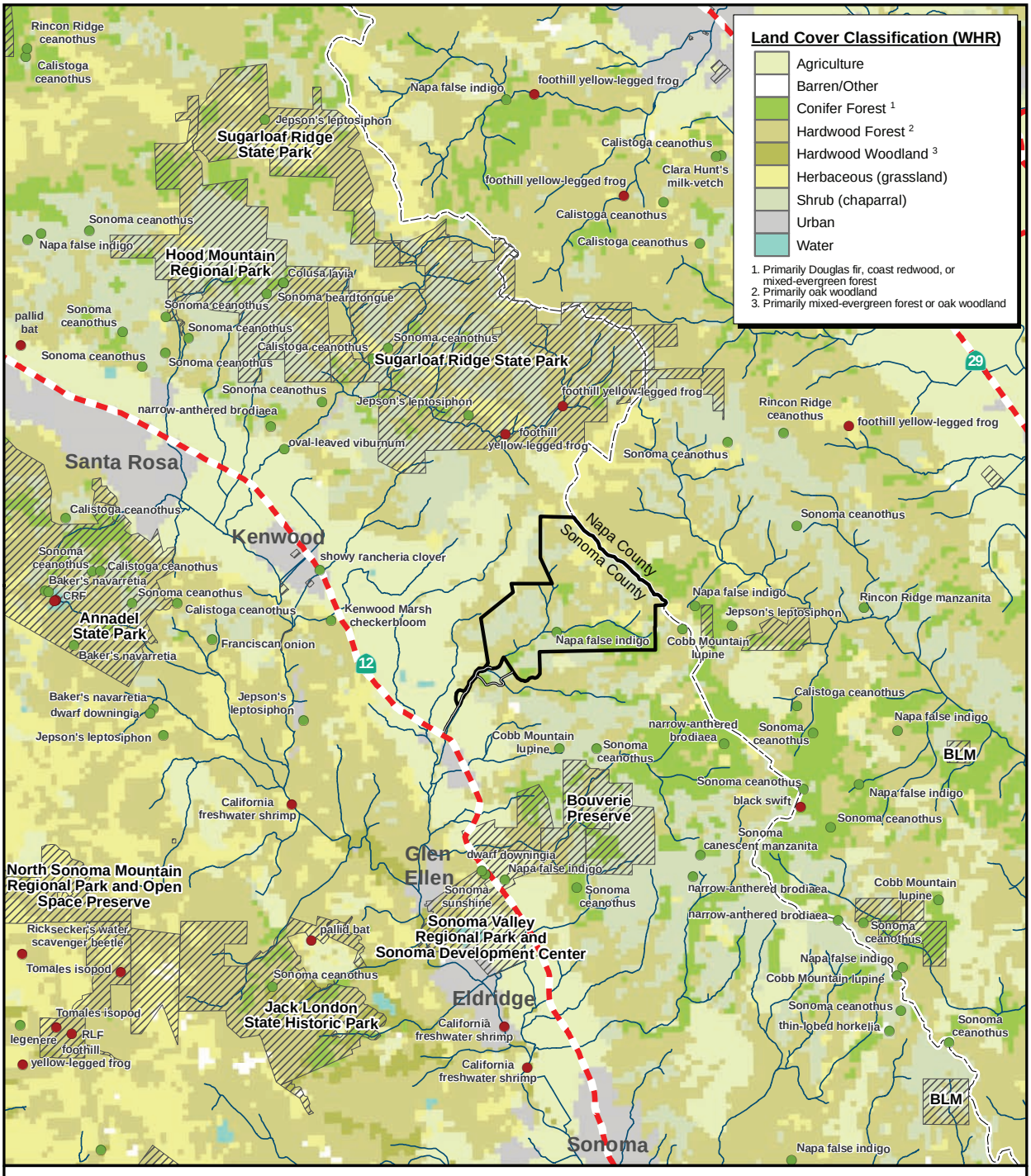
Fire is one of the most conspicuous environmental processes on the California landscape, in terms of active fires as well as their aftereffects. Similarly, the absence of fire is creating an equally significant impact to the biological diversity and ecological functions of the preserve. First and foremost, research shows that the absence of fire, often resulting from active fire suppression, will in some ecosystems lead to larger, hotter fires that are more difficult to control. This is due to the buildup of woody vegetation such as dense shrubs and saplings, which can act as *fuel ladders*, whereby high temperature fire within middle height vegetation is able to reach the crowns of trees, thus further increasing temperatures and facilitating the fire's expansion (Biswell 1999).

The absence of fire in California's Mediterranean ecosystems commonly results in a successional process of woody shrub habitat displacing herbaceous habitat (e.g., grassland), followed by trees displacing shrubs, and with more shade-tolerant, less fire-adapted trees becoming increasingly dominant in the long term (Edmonds et al. 2011). This process typically continues until an inevitable occurrence of a large, stand-replacing fire.

Such ecological *succession* is currently taking place on the Preserve as a result of fire suppression in the region. The most recent fire in the area, known as the Nunns' Canyon Fire, occurred in September of 1964 (FRAP 2011). That fire burned over 9,800 acres in Sonoma Valley, and its effects are evident on the Preserve in the form of large areas of even-aged trees and shrubs that sprouted following the fire. The previous major fire occurred in the late 1930s (Dawson 2013).

The majority of dominant tree and shrub species identified on the Preserve are adapted to — and many depend on — frequent, low-intensity fires; however such fires are not a natural component of the regional ecology. See **Table N.1** for a summary of the fire adaptations of dominant trees and shrubs occurring on the Preserve in **Appendix N**.

With only a very small portion of the Preserve having burned in the past five decades, shade-tolerant plants have become well established, including "fire avoider" tree species such as Douglas fir (*Pseudotsuga menziesii*), which are killed at the seedling or sapling stage by even low-intensity fires (Volland 1981). Within more optimal growing conditions on the Preserve (e.g., shaded stream valleys and north-facing slopes with deep soils), Douglas fir have overtopped and suppressed other trees, some of which are currently suffering widespread mortality due, at least in part, to being shaded out by these much taller trees.



CALABAZAS CREEK Open Space Preserve

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

Map Date: 07/14/2015

SOURCES: CDF FRAP, 2002
CPAD, 2013 | Sonoma County, 2012
TIGER, 2010 | USGS, 1997 | CNDDB, 2013
DWR, 2001 | SCAPOSD, 2013 | USFWS, 2013

This map is for illustrative purposes only and is not intended to be a definitive property description.

FIGURE 2.5
Regional Land Cover and Biological Resources

N

0 0.5 1 1.5 2 Miles

- CNDDB Special-status Animal
- CNDDB Special-status Plant
- Stream (Strahler order ≥ 3)
- Highway
- County Boundary
- Preserve Boundary
- Other Public and/or Preserved Property

Pacific madrone and several oak species are examples of trees being shaded out by Douglas fir, and there are countless examples of plants from lower strata as well. In addition, the Douglas fir within more optimal habitat have fairly recently become mature enough to set seed, and their abundant seed have made their way into slightly less optimal habitat within open oak woodland and savanna, and is becoming established within these habitats. A few have even become established within manzanita chaparral on the Preserve, along with a number of other tree species (e.g., California bay and various oaks).

It is important to note that all of the non-wetland/riparian plant communities on the Preserve are dependent on frequent fires, and all are being invaded to varying degrees by Douglas fir. Many of these plant communities are not regenerating well on the Preserve. In addition, a number of species associated with early stage fire succession are notably sparse or absent, such as yerba santa (*Eriodictyon californicum*), deerweed (*Acmispon glaber*), and many pyrophytic (fire-following) herbaceous species.

2.17 CULTURAL RESOURCES

2.17.1 SURVEY METHODOLOGY

The cultural resource survey consisted of two components: prefield research and field inventory. ASC personnel conducted a records search at the Northwest Information Center (NWIC) of the California Historic Resources Information System, located at Sonoma State University in Rohnert Park, California on 9 May 2013. NWIC is the official state repository of archaeological and historical records and reports for a 18-county area that includes Sonoma County. Additional research was conducted using the files and library of the ASC.

The Native American Heritage Commission (NAHC) was asked to review its Sacred Lands File for information on Native American cultural resources in the project area. NAHC responded with a letter stating that the search failed to indicate the presence of Native American cultural resources in the area. A Native American contact list was included with NAHC's response. ASC wrote to each individual on the contact list asking if they wished to consult about ASC's work or had information about the Preserve. Nick Tipon of the Federated Indians of Graton Rancheria (FIGR) expressed interest in the project and asked to be kept informed about the project.

Fieldwork conducted in May and November 2013 was overseen by ASC Staff Archaeologist Kate Erickson Green. A mixed strategy survey method was used, wherein intensity of inspection varied with vegetation, slope, and distance from potential trail corridors. The work focused on open meadows and ridgelines, mid-slope terraces, main access and trail routes, and creek basins, the areas considered most likely to contain resources. The survey area was narrowed following consultation with the District to focus on potential trail routes that encompassed the main access points and ridgeline. Steeper terrain, locations outside potential trail alignments, and areas deemed less sensitive for containing cultural resources were examined as time permitted.

In open areas, the team surveyed in transects 5 to 10 meters (about 15 to 30 ft.) apart, periodically removing duff and grass root mat to observe bare soil. Rodent burrow back-dirt piles were also checked for evidence of buried cultural deposits. Mid-slope benches and other flat areas were checked for cultural resources. Steeper, overgrown slopes were not examined unless adjacent to areas known to contain resources. Rock outcrops were checked for petroglyphs, bedrock milling, and evidence of quarrying. Extra time was also taken around spring locations. Vegetation in the survey area consisted of a range of thick grasses, open woodland, dense chaparral, and riparian corridors. Visibility ranged from fair to extremely poor. Relatively good ground visibility existed along established roads and trails, and beneath fir and redwood canopy. Surface scrapes to remove duff and vegetation were conducted at intervals to expose the ground surface in areas of reduced ground visibility.

A total of 140 acres and 8 miles of existing or potential trail corridors were surveyed. The unsurveyed areas represent locations that were beyond potential trail corridors, where archaeological sensitivity was considered low, or where field conditions made access excessively difficult. No artifacts were collected during the study. Global positioning system (GPS) coordinate data were recorded

for the locations of all features, prehistoric and historic-era artifact concentrations, and isolates.

2.17.2 RESULTS

Calabazas Creek lies in an area where the territories of three indigenous tribal groups converge. Ethnographic and linguistic evidence indicate that the boundaries between Gualomi (southern) Pomo, the Coast Miwok, and the southern Wappo met within the Sonoma Creek drainage system (Barrett 1908, Kroeber 1925). The Preserve is located near the eastern border of the traditional territory of the Coast Miwok with the Wappo to the east and Southern Pomo to the north. A portion of the eastern boundary of the Preserve along the ridgeline separating Sonoma and Napa counties may be the ethnographic boundary between Coast Miwok and Wappo territory.

2.17.3 INVENTORY OF KNOWN CULTURAL RESOURCES

The survey identified 11 cultural resources, consisting of nine historic-era, one prehistoric, and one multicomponent resources (**Table 2.2**). Additional resources may be present. Although most of the sites appear to be relatively simple with a low density and diversity of materials, others are more complex and may contain subsurface deposits. The known resources are summarized below and presented in more detail in **Appendix J.**

- **Multicomponent site (ASC-31-13-03):** This multicomponent site is a concentration of prehistoric lithics with a historic-era residence built on top. The prehistoric portion appears to consist of obsidian flakes and at least two formal projectile points. The historic-era component of this site consists of a large depression and associated rock pile, as well as non-native Vinca plants. An artifact concentration was observed within and surrounding the depression and included square cut nails, white improved earthenware, and Chinese brown glazed ceramic fragments, aqua, olive, colorless bottle glass fragments, as well as flat window glass that all appear to date to the late 1800s.
- **Prehistoric site (ASC-31-13-08):** This resource is the only other known prehistoric site within the Preserve, and the only example of bedrock milling found to date. It consists of a single boulder containing two mortar depressions. The larger of the two mortars is shallow and saucer shaped, with the second much smaller and deeper.
- **Historic Era Archaeological Sites (ASC-31-01, 02, 05-07, 09-11)**: These nine historic sites contain a range of historically significant features, ranging from a stone quarry (1950s), small outbuildings and building remains associated with the Nunn residences (1859 and 1876), remains of historic-era homestead residences, historic-era orchards, and remains of road alignments.

None of the resources have been evaluated with regard to their eligibility to the California Register of Historical Resources (CRHR), the usual standard for significance used in the CEQA context. General practice in the absence of an evaluation is to assume that the resource is significant.

TABLE 2.2. Summary of Identified Cultural Resources on the Preserve

ASC FIELD DESIGNATION	PREHISTORIC/ HISTORIC-ERA/ MULTICOMPONENT/ OTHER	DESCRIPTION
ASC-31-13-01	Historic-era	Quarry
ASC-31-13-02	Historic-era	Nunns'Canyon Road
ASC-31-13-03	Multi-component	Artifact concentration/ structural remains
ASC-31-13-04	Historic-era	Depressions/artifact concentration near Nunn House
ASC-31-13-05	Historic-era	Structural debris near Nunn House
ASC-31-13-06	Historic-era	Improved spring near Nunn House
ASC-31-13-07	Historic-era	Nunn homestead site
ASC-31-13-08	Prehistoric	Bedrock mortar
ASC-31-13-09	Historic-era	Nunn orchard
ASC-31-13-10	Historic-era	Crosby homestead site
ASC-31-13-11	Historic-era	Johnson homestead site

3.0 LAND USE AND MANAGEMENT

3.1 HISTORIC LAND USE AND MANAGEMENT

Land use on the property likely began with Native Americans hunting and gathering resources throughout the range and probably included habitat manage-

ment such as controlled burns. In the late 1800s, Anglo-Americans and European settlers introduced ranching, dairy operations, dry farming, and even mining (mercury, clay, rhyolite and opals) to the region. Perhaps one of the most famous former landowners was Mary Ellen Pleasant, former slave turned civil rights leader and San Franciscan entrepreneur in the late 1800s, named the property Beltane Ranch. In the 1930s, Ralph and Effia Heins purchased 1,600-acres, calling it Beltane Ranch. The Heins managed a small herd of beef cattle and encouraged neighbors and guests to hike, horseback ride, fish, hunt, and enjoy the many resources found on the ranch.

Following the 1964 "Nunns' Canyon" fire, timber was salvaged from the property. The property was inherited by Rosemary and Alexa Wood, the niece and grand niece of Mr. and Mrs. Heins, and stayed within the family until 2004, when it was purchased by the District from Beltane Inc. (represented by the Wood family). Since 2004, the District has managed the property as an open space preserve for the protection of natural resources and habitat typical of the Sonoma Valley and limited public access through docent-led outings. Originally, the District intended to transfer the Preserve to the California Department of Parks and Recreation. For a variety of reasons, including limited access and lack of available public funding to manage such a large property, the District was unable to negotiate an agreement to transfer the property.

3.2 CURRENT ZONING

Figure 3.1 depicts the designated zoning boundaries on and in the vicinity of the Preserve, as developed for the Sonoma County 2020 General Plan. The dominant zones on and in the vicinity of the Preserve include: Resources and Rural Development, Land Intensive Agriculture, Diverse Agriculture, Public/Quasi Public, and Rural Residential. The area within Napa County, just east of the Preserve, is designated as an Agricultural Watershed zone. These and other zones mapped in the region are described in **Table 3.1** below. It is noteworthy that the surrounding large parcels (greater than 100 acres) are largely zoned for Land Intensive Agriculture (LIA) along the western and northern borders of the Preserve. Many of these parcels have been converted to vineyards. LIA allows for agricultural and minimum development for outbuildings and farming infrastructure. To the south, parcels are zoned to permit LIA, Diverse Agriculture and Rural Residential further limiting habitat connections with nearby preserves or protected land (see section 2.15: Habitat Continuity and Connectivity).

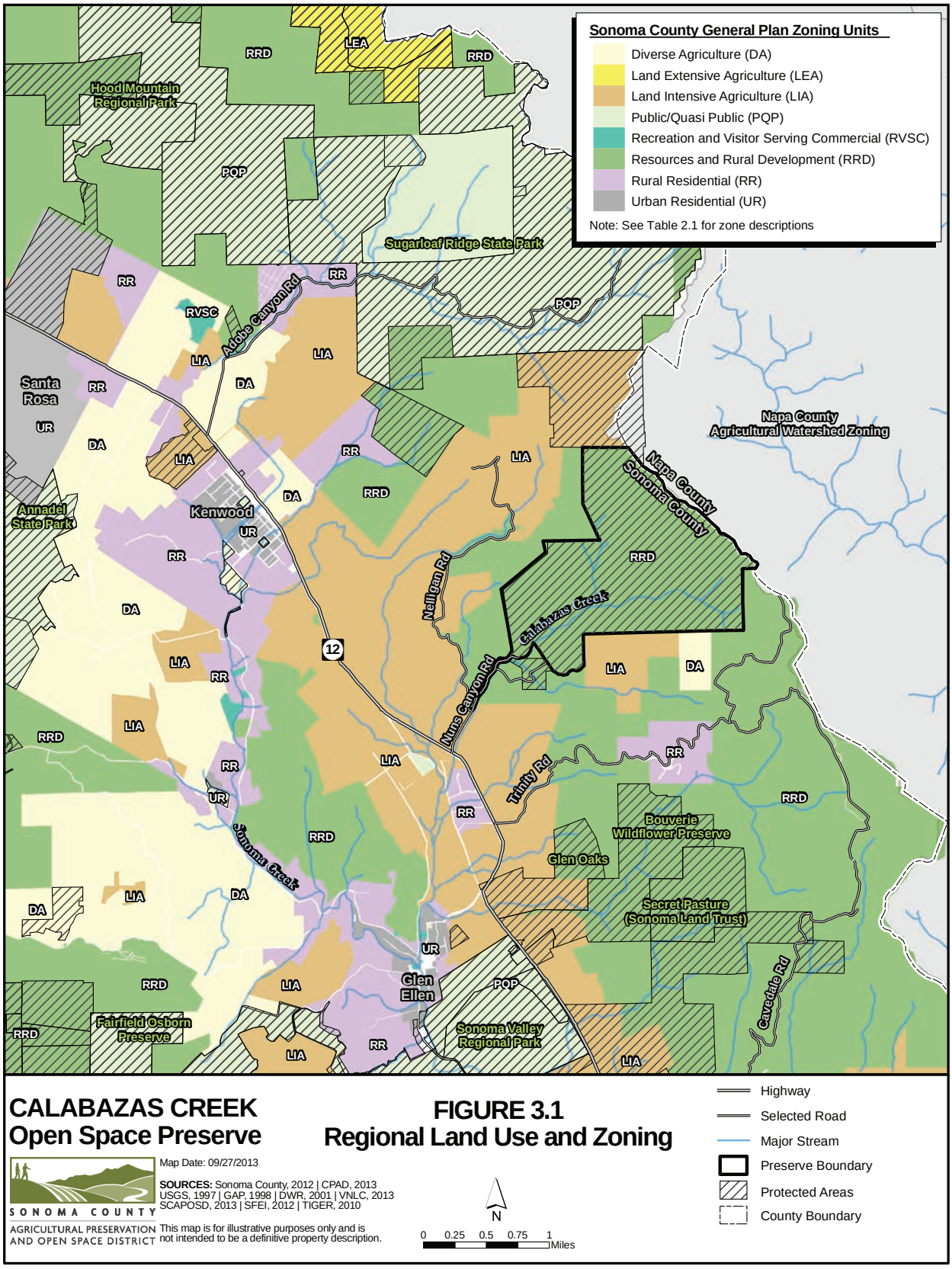
TABLE 3.1. Sonoma County General Plan (2020) Land Use Zones near the Preserve.

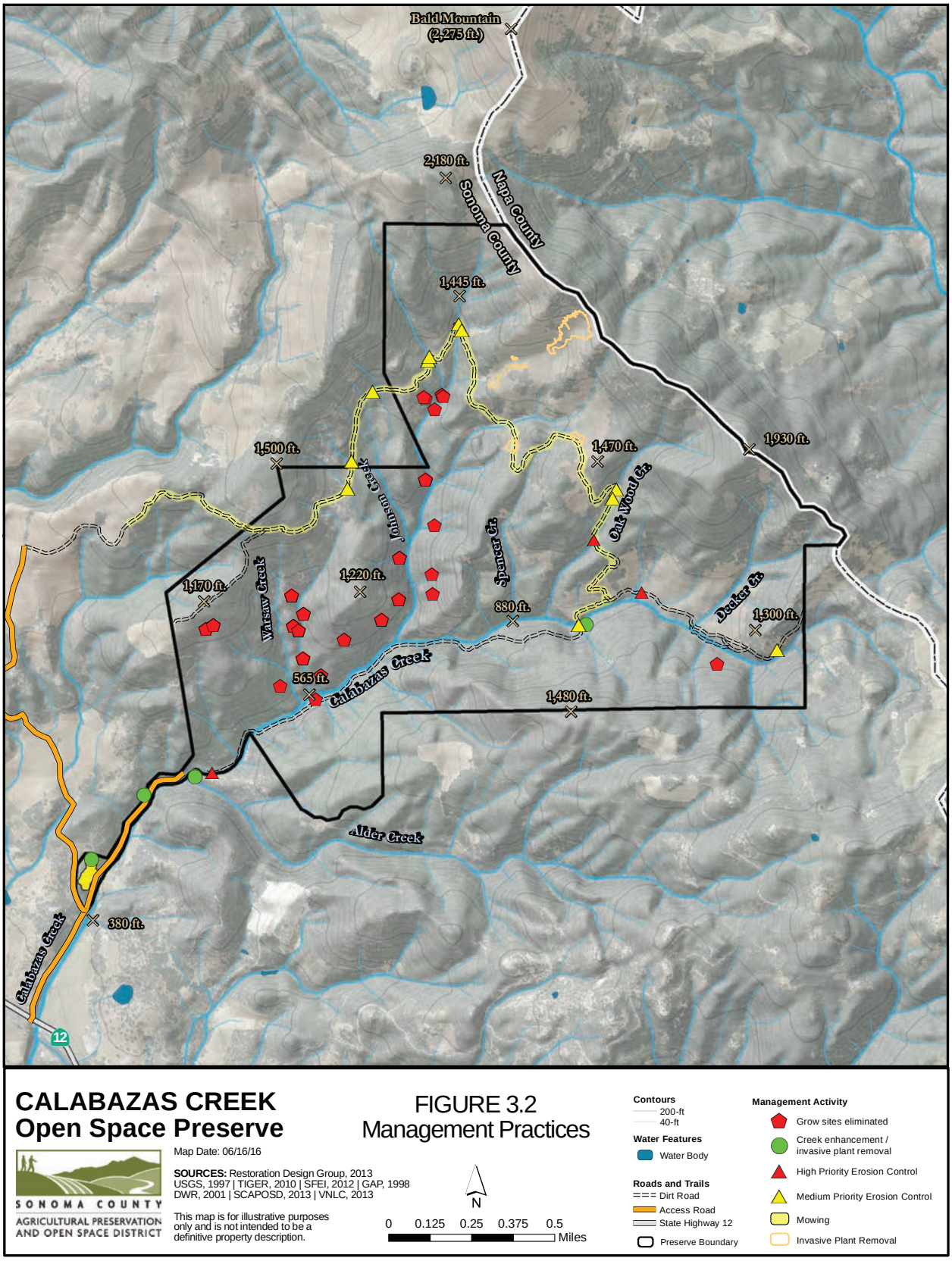
ZONE NAME (AND CODE/MAP LABEL)	ZONE DESCRIPTION (SYNOPSIS OF ZONE PURPOSE)
1. Diverse Agriculture (DA)	Sites suitable for small acreage intensive farming and part-time farming, but where farming may not be principle occupation of farmer.
2. Land Extensive Agriculture (LEA)	Sites suitable for larger acreage, permanent farming of relatively low production per acre land.
3. Land Intensive Agriculture (LIA)	Sites suitable for larger acreage, permanent farming of relatively high production per acre land.
4. Limited Commercial (LC)	Sites suitable for retail sales and services "necessary for daily self-sufficiency of urban and rural areas in keeping with their character." (e.g., tailor shops, restaurants, banks, clinics, feed stores, family day care).
5. Public/Quasi Public (PQP)	Sites that serve the community or public need and are owned or operated by government agencies, nonprofit entities, or public utilities (e.g., schools, parks, sewage treatment plants).
6. Recreation and Visitor Serving Commercial (K or RVSC)	Site suitable for a compatible blend of recreation and tourist-commercial uses (e.g., public parks, restaurants, bee keeping, restaurants, nurseries).
7. Resources and Rural Development (RRD)	Sites suitable to provide the provisions of rural development land use (e.g., to provide protection of lands needed for timber production, aggregate resources production, fish and wildlife habitat, and watersheds).
8. Rural Residential (RR)	Low density residential. "To preserve the rural character of lands."
9. Urban Residential (UR)	Sites suitable to high density residential housing.
10. Agricultural, Watershed, and Open Space (Napa County AWOS zone)	Sites suitable for agriculture as well as for the protection of water resources such as reservoirs and floodplain tributaries.

Sources: Sonoma County Permit and Resource Management Department (PRMD) (2013) and Napa County Planning Division (2013)

3.3 CURRENT LAND USE AND DISTRICT MANAGEMENT PRACTICES

Since the acquisition of what was then Beltane Ranch in 2004, the District has been responsible


Sonoma County General Plan Zoning Units
Diverse Agriculture (DA)
Land Extensive Agriculture (LEA)
Land Intensive Agriculture (LIA)
Public/Quasi Public (PQP)
Recreation and Visitor Serving Commercial (RVSC)
Resources and Rural Development (RRD)
Rural Residential (RR)
Urban Residential (UR)
Note: See Table 2.1 for zone descriptions
Hood Mountain Regional Park
Sugarloaf Ridge State Park
Adobe Canyon Rd
Santa Rosa
Annadel State Park
Kenwood
Napa County Agricultural Watershed Zoning
Napa County
Sonoma County
Nelligan Rd
Calabazas Creek
Nuns Canyon Rd
Trinity Rd
Bouverie Wildflower Preserve
Glen Oaks
Secret Pasture (Sonoma Land Trust)
Cavedale Rd
Glen Ellen
Sonoma Valley Regional Park
Fairfield Osborn Preserve
Sonoma Creek
12
CALABAZAS CREEK
Open Space Preserve
FIGURE 3.1
Regional Land Use and Zoning
Map Date: 09/27/2013
SOURCES: Sonoma County, 2012 | CPAD, 2013
USGS, 1997 | GAP, 1998 | DWR, 2001 | VNLC, 2013
SCAPOSD, 2013 | SFEI, 2012 | TIGER, 2010
SONOMA COUNTY
AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 0.25 0.5 0.75 1
Miles
Highway
Selected Road
Major Stream
Preserve Boundary
Protected Areas
County Boundary



CALABAZAS CREEK Open Space Preserve

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

Map Date: 06/16/16

SOURCES: Restoration Design Group, 2013
USGS, 1997 | TIGER, 2010 | SFEI, 2012 | GAP, 1998
DWR, 2001 | SCAPOSD, 2013 | VNLC, 2013

This map is for illustrative purposes only and is not intended to be a definitive property description.

FIGURE 3.2
Management Practices

N

0 0.125 0.25 0.375 0.5 Miles

Contours
200-ft
40-ft

Water Features
Water Body

Roads and Trails
Dirt Road
Access Road
State Highway 12
Preserve Boundary

Management Activity
Grow sites eliminated
Creek enhancement / invasive plant removal
High Priority Erosion Control
Medium Priority Erosion Control
Mowing
Invasive Plant Removal

for implementing a variety of management activities to protect and enhance the habitat and natural resources of the Preserve. Below is a list of those activities and the threat they aim to mitigate. See **Figure 3.1**: District Management Practices and Preserve Infrastructure (new figure pending)

3.3.1 INVASIVE PLANT REMOVAL

Beginning in 2010, the District contracted a licensed Qualified Applicator to inventory and map yellow starthistle (YST) populations within eastern grasslands. Approximately 11 acres of YST were identified and treated in 2010 and 2011. From 2012-2014, the District continued to treat the 11 acre populations and several new infestations totally approximately three acres were identified in two outbreaks, one in an area known as "secret meadow" (along the west side of Spencer Creek) and the other near the Nunns' family homestead along eastern portion of Calabazas Creek as the trail enters the eastern grasslands. Treatments have included the application of Milestone and Roundup to yellow starthistle plants prior to seeding. The objective of this treatment program is to eliminate the YST populations over time and allow native grasses to survive on these sites.

Himalayan blackberry has aggressively spread along some creek channels within the Preserve, and is a threat to biological diversity due to its tendency to outcompete native plants in the absence of natural predators to keep its growth in check. The presence of this non-native plant can change the behavior and holding capacity of a stream channel resulting in the detrimental effects of flooding and sediment discharge into the creeks. Infestations can also change stream habitat for steelhead trout by outcompeting tree species that might create more favorable conditions such as cooler water temperature and root balls that create deeper pools.

In 2012 and 2013, Eucalyptus ("Tasmanian blue gum") stems less than 14" in diameter were cut at ground level near the Nunns' homestead site. Roundup was applied to Eucalyptus stumps to prevent resprouting.

In 2013, the District partnered with Conservation Corps North Bay (CCNB) crews to remove Himalayan blackberry and plant native plants to restore the riparian corridor. The crews removed non-native blackberry and planted nearly 100 native plants along approximately 2,500 linear feet of riparian and grassland habitat types within the Preserve. The CCNB and volunteer patrol members were instrumental in removing French broom, vinca, and fennel with weed wrenches beginning in the quarry and along the trail corridor.

The objective of Himalayan blackberry removal is to reduce the vegetative cover of the non-native plant and facilitate the growth of native plants within the riparian corridor. The District will continue to organize volunteer workdays to help maintain the stream banks free of Himalayan blackberry and allow the native plants to regenerate on these sites.

3.3.2 EROSION CONTROL

In the winter of 2005-2006, a series of winter storm events caused substantial flooding of Calabazas Creek and its tributaries. Sections of Nunns' Canyon road were scoured and new seasonal stream crossings became sediment washes. The District applied for and received federal assistance through FEMA (Federal Emergency Management Agency) to repair the areas affected by the storm events.

Pacific Watershed Associates (PWA) completed an initial road prescription of the principal access road through Nunns' Canyon in 2006. PWA was contracted by the District to complete the prescribed treatments for portions of the road directly damaged by the flood events in order to reduce sediment delivery into the lower reaches of Calabazas Creek and beyond. PWA focused their work along the western portion of Nunns' Canyon Road beginning at the informal trailhead and working up to a large washout area along Nunns' Canyon Road near Johnson Creek. Five sites were addressed and improved in 2008 to reduce sediment deposition into Calabazas Creek, stabilize the road network, and improve the drainage of the roads and creek crossings to properly handle moisture from small and large storm events. Subsequent storm damage in 2010 occurred at the informal trailhead and was addressed by work conducted by Cats4U in summer.

The volunteer patrol members have traditionally monitored culvert crossings during winter storm events and successfully kept them cleared of sediment and vegetation so that they could function as best as possible given the conditions and design of each crossing. Given the *flashy* nature of Calabazas

Creek and the tendency of the watershed to capture a large amount of water in a short period of time along with the propensity for the soils to erode, this task has been an essential ingredient to reducing sediment deposits downstream and retaining the healthy conditions found within the preserve today.

As part of this resource assessment, the District requested a comprehensive evaluation of the entire road network, including abandoned roads, to follow up with these initial efforts in 2006-2008 and to evaluate the performance of the road network. PWA was asked to identify sites where further erosion control might be necessary. The results of the road assessment are discussed below in **Section 4.2.1** and a summary of their conclusions can be found in **Appendix G**. In 2015, the District hired PWA to prepare prescriptions to repair damage from winter 2014/15 storm events. The recommendations were based on the analysis completed in 2013 for this resource management plan. The prescription also included a long-term option of relocating the road upslope.

3.3.3 ILLICIT MARIJUANA GROW ERADICATION

Due to its size and remote location, this Preserve has experienced a large number of illicit marijuana grows. The District began identifying grow sites and working with the Sonoma County Sheriff's Department in 2006 and consequently has developed a protocol to be followed in the Preserve and other properties owned and managed by the District where suspected marijuana grows may be present (SCAPOSD, 2011). The environmental impacts of this activity are numerous, including stream water diversion, toxic chemical dispersion, severe erosion, public safety and habitat disturbance. The detection and prevention of illegal marijuana cultivation has been identified as a high priority in reducing impacts across the preserve and will require vigilant monitoring to detect any and all signs of this illicit activity.

Since 2006, approximately 15 grow sites ranging from 100 to over 6000 plants per site have been identified and remediated across the preserve. Initially, abandoned grow sites were identified by District staff and volunteer patrols and volunteer workdays were organized to haul irrigation lines and camp waste from old sites. Volunteer patrol members monitor permanent stream corridors to detect dam activities or watering lines and then trace them back to the sites. In 2012, active grow sites were detected and all volunteers, consultants and staff were asked to vacate the property until December, when the Sonoma County Sheriff's Department agreed that Cannabis operations were generally concluded for the year. All locations were geographically referenced and this data shared with the Sheriff's Department for their information. In 2013, the Sheriff's Department successfully identified a new grow and were able to eradicate 5,600 plants from the site.

In 2013, the CCNB and the District solicited funds from Proposition 84 to conduct watershed improvement work, which included completing a thorough cleanup of all marijuana camps identified within Calabazas Creek Open Space Preserve, removing French broom, Himalayan blackberry and other weeds and other vegetation management, and planting native species. The District received $200,000 of labor through CCNB to remove debris associated with these grow sites. Their efforts resulted in the removal of tens of miles of irrigation line and 70 cubic yards of waste including camp supplies, pesticides and herbicides, personal goods, and grow tools.

During a CCNB work day, a new grow was discovered in the preserve. Although the site had already been harvested, crews successfully removed the irrigation system, camp debris and all remaining infrastructure; reduced the risk of chemical contaminants and sediment from entering into the watershed; and served as a disincentive for growers to return to the site. As of June 2014, growers had not reoccupied the site or any other sites.

4.0 RECOMMENDED MANAGEMENT STRATEGIES

4.1 SUMMARY OF MANAGEMENT ISSUES

Building on **Chapter 2**, this chapter identifies the key impacts and/or threats to the Preserve's natural and cultural resources (**see Table 4.1**) and summarizes the recommended management strategies for managing and enhancing the natural and sensitive resources on the Preserve (**see Table 4.2**). It concludes with a summary of the recommended monitoring activities. Each recommended management activity is assigned one of three priority categories: short-term (1-5 years), medium-term (6-10 years), and/or long-term (11+ years). Short-term activities are the top-priority management activities for the District, while the medium-term and long-term activities are recommendations for future preserve management entities and other partners involved with management of the Preserve over the long-term.

The tables are divided into nine categories of management activities:[3]

1. Physical Resources (PR)(Sediment Erosion and Water Resources)
2. Plant Communities (PC)
3. Sensitive Habitats (SH)
4. Special-status Plants (SSP)
5. Invasive Plants Management (IPM)
6. Special-status Animals (SSA)
7. Invasive Animal Management (IAM)
8. Human Trespass (HT)
9. Cultural Resources (CR)

3 The initials following each of the management activities will be used to denote the management recommendation specific to that category.

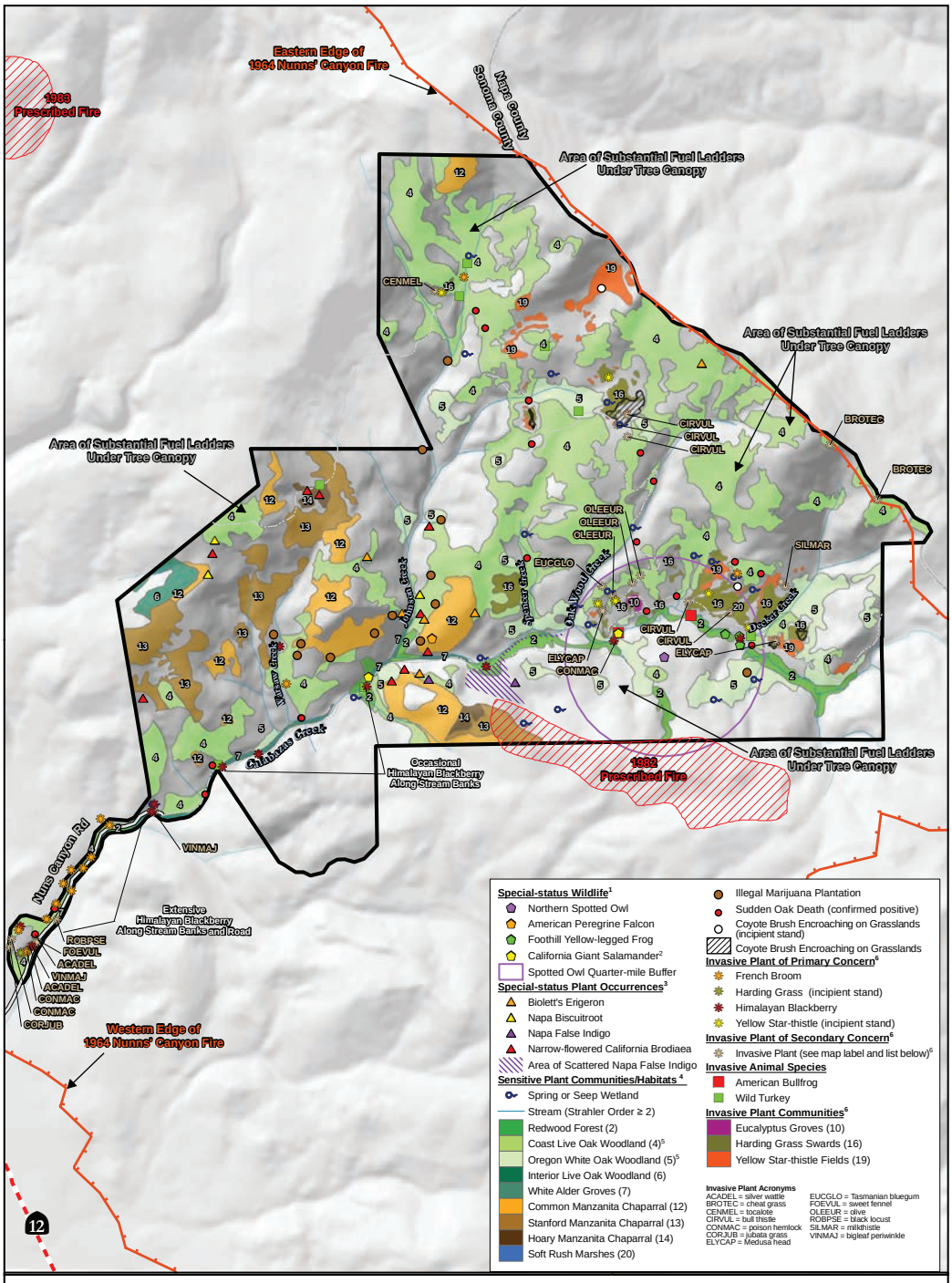

Eastern Edge of 1964 Nunns' Canyon Fire
1968 Prescribed Fire
Napa County
Sonoma County
Area of Substantial Fuel Ladders Under Tree Canopy
CENMEL
CIRVUL
BROTEC
SILMAR
CLEEUR
EUCGLO
ELYCAP
CONMAC
Johnson Creek
Sulphur Creek
Dark Wood Creek
Upper Dark Wood Creek
Walnut Creek
Calabazas Creek
Occasional Himalayan Blackberry Along Stream Banks
1982 Prescribed Fire
Nuns Canyon Rd
VINMAJ
Extensive Himalayan Blackberry Along Stream Banks and Road
ROBPSE
FOEVUL
ACADEL
CORJUB
Western Edge of 1964 Nunns' Canyon Fire
12
Special-status Wildlife[1]
Northern Spotted Owl
American Peregrine Falcon
Foothill Yellow-legged Frog
California Giant Salamander[2]
Spotted Owl Quarter-mile Buffer
Special-status Plant Occurrences[3]
Biolett's Erigeron
Napa Biscuitroot
Napa False Indigo
Narrow-flowered California Brodiaea
Area of Scattered Napa False Indigo
Sensitive Plant Communities/Habitats[4]
Spring or Seep Wetland
Stream (Strahler Order ≥ 2)
Redwood Forest (2)
Coast Live Oak Woodland (4)[5]
Oregon White Oak Woodland (5)[5]
Interior Live Oak Woodland (6)
White Alder Groves (7)
Common Manzanita Chaparral (12)
Stanford Manzanita Chaparral (13)
Hoary Manzanita Chaparral (14)
Soft Rush Marshes (20)
Illegal Marijuana Plantation
Sudden Oak Death (confirmed positive)
Coyote Brush Encroaching on Grasslands (incipient stand)
Coyote Brush Encroaching on Grasslands
Invasive Plant of Primary Concern[6]
French Broom
Harding Grass (incipient stand)
Himalayan Blackberry
Yellow Star-thistle (incipient stand)
Invasive Plant of Secondary Concern[6]
Invasive Plant (see map label and list below)[6]
Invasive Animal Species
American Bullfrog
Wild Turkey
Invasive Plant Communities[6]
Eucalyptus Groves (10)
Harding Grass Swards (16)
Yellow Star-thistle Fields (19)
Invasive Plant Acronyms
ACADEL = silver wattle
BROTEC = cheat grass
CENMEL = tocalote
CIRVUL = bull thistle
CONMAC = poison hemlock
CORJUB = jubata grass
ELYCAP = Medusa head
EUCGLO = Tasmanian bluegum
FOEVUL = sweet fennel
OLEEUR = olive
ROBPSE = black locust
SILMAR = milkthistle
VINMAJ = bigleaf periwinkle
CALABAZAS CREEK
Open Space Preserve
FIGURE 4.1
Ecological Management Detail
Map Date: 07/14/2015
SOURCES: Vollmar Natural Lands Consulting, 2013
Restoration Design Group, 2013 | USDA NAIP 2009
USGS 10m DEMs | Gap, 1998 | PWA, 2013 | TIGER, 2010
SFEI, 2012 | SCAPOSD, 2013 | CDF FRAP, 2011
SONOMA COUNTY
AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
This map is for illustrative purposes only and is not intended to be a definitive property description.
0 625 1,250 1,875 2,500 Feet
N
State Highway 12
Road or Trail - Earthen
Road - Paved
Extent of 1964 Nunns' Canyon Fire*
Extent of Other Fire
Preserve Boundary
County Boundary
* Referred to in California Dept. of Forestry FRAP database as "Nuns Canyon."
Notes
1. See Section 3.3.1 for wildlife documentation. Steelhead trout were confirmed in Calabazas Creek but not mapped. Nuttall's Woodpecker were detected within oak woodlands and along Calabazas Creek, but not mapped.
2. Representative location. Observed in many additional locations.
3. See Section 3.1.2.1 for special-status plant documentation.
4. See Table 3.1 for plant community documentation.
5. Douglas fir encroahment is widespread in this habitat.
6. See Section 4.7 and Appendix 3 for invasive plant documentation.
Note: Figure 4.2 shows spatial patterns of characteristics relevant to managment of biological resources. Figure 2.3 depicts all plant communities on the Preserve.

TABLE 4.1. Annotated List of Natural Resources and Management Issues on the Preserve

RESOURCE	PRIORITY[1]	DISTRIBUTION ON PRESERVE	PRIMARY MANAGEMENT ISSUES
Physical Resources (PR)			
Sediment Erosion	1	Entire Preserve with particular focus on road crossings.	Soil and road crossings need to be managed to minimize erosion and sedimentation, in order to protect water quality and aquatic habitats as well as topsoil that supports vegetation on hill slopes. Given the importance of water quality within the streams, soil management is considered a high priority.
Water Resources	1	Surface water occurs in streams, smaller drainages, springs, and seeps within the Preserve.	Protection and management of water quality within streams on the Preserve is important to maintain aquatic habitat for sensitive and native aquatic species. Springs provide unique wetland habitats and important watering sources for wildlife and can also be partially diverted to provide critical livestock watering sites, if grazing were to become a feasible management consideration on the preserve.
Plant Communities (PC)			
Grasslands	1	139 acres, primarily in northern and eastern Preserve.	Habitats are degraded on the Preserve and need to be managed to improve plant and wildlife habitat quality, maintain viewsheds, control invasive plants, and reduce wildfire intensity.
Chaparral	2	207 acres, primarily in northern and western Preserve.	Habitats may begin to senesce and/or be displaced due to natural succession if not managed appropriately.
Forests and Woodlands	1	935 acres, throughout preserve.	Habitats are suffering from excessive woody fuels build-up (and thus are susceptible to catastrophic wildfire), Douglas fir encroachment, and Sudden Oak Death.
Sensitive Habitats (SH)			
Streams/ Riparian Habitat	1	Primarily within central and southern Preserve. One perennial stream, two semi-perennial streams, and many seasonal streams.	Invasive plant species (especially Himalayan blackberry), sedimentation from erosion, human water diversions, and potential alterations in canopy cover and woody debris (e.g., from SOD-induced oak mortality).
Spring and Seep Wetlands	2	19 features scattered throughout Preserve.	Invasive plant species (primarily open, sunny areas), human trampling of plants (primarily wooded habitats along roads/trails), and sedimentation (primarily wooded habitats, and partly due to human trampling).
Coast Live Oak Woodland	1	304 acres throughout Preserve. Primarily south-facing slopes.	Significant SOD infections, encroachment of Douglas fir, build-up of fuel ladders, wild turkey foraging, and competition between seedlings and tall, dense grasses (in localized areas).
Oregon White Oak Woodland	1	61 acres, primarily on well-drained soils of middle elevations at central and southern portions of Preserve.	Encroachment of Douglas fir, wild turkey foraging, competition between seedlings and tall, dense grasses.
Interior Live Oak Woodland	2	6.4 acres, occurring only on ridge top along western portion of Preserve.	Build-up of fuel ladders.
Redwood Forest	2	22 acres, primarily along Calabazas Creek and adjacent north-facing slopes.	Some Douglas fir encroachment and limited build-up of understory plants around seedlings.
Stanford Manzanita Chaparral	2	49 acres, primarily along higher elevation, western portions of Preserve.	Lack of fire to induce seed germination. Encroachment of tree species.
Common Manzanita Chaparral	2	55 acres, primarily along convex hill slopes with moderately shallow soils within central and northern portions of Preserve.	Lack of fire to induce seed germination. Encroachment of tree species.
Hoary Manzanita Chaparral	2	4.1 acres, primarily along steep slopes with shallow, gravelly volcanic soils within central portions of Preserve.	Lack of fire to induce seed germination. Encroachment of tree species.
Special-Status Plants (SSP)			

RESOURCE	PRIORITY[1]	DISTRIBUTION ON PRESERVE	PRIMARY MANAGEMENT ISSUES
Narrow-flowered California brodiaea	1	9 populations mapped in chaparral within central and western Preserve.	Potential impacts from human trampling along edge of existing roads/ trails, competition from invasive plants (primarily purple false brome, red brome, and cheat grass), and degradation of chaparral habitat due to lack of fire, the use of pesticides and herbicides in illegal marijuana cultivation.
Napa false indigo	1	Hundreds of scattered individuals along Calabazas Creek floodplain and on north-facing slopes within southern-central Preserve.	Potential impacts from human compaction of soil (trampling) and trail maintenance along edge of existing or planned roads/trails and potential competition from invasive plants (primarily Himalayan blackberry, and secondarily, French broom).
Napa Biscuitroot	2	3 populations mapped in chaparral within central and western Preserve.	See narrow-flowered California brodiaea management issues above.
Biolett's erigeron	2	6 populations mapped in chaparral within central and eastern Preserve.	See narrow-flowered California brodiaea management issues above.
Invasive Plants [2](IPM)			
French broom	1	Small to large stands primarily at southwestern edge of Preserve. Small, isolated stands elsewhere.	Displaces native plants and animals. Can form dense stands which dominate plant communities by shading out seedlings. Increases the frequency and intensity of fires. Toxic to humans and livestock (except goats). Long soil seed bank viability. Shrubs can live for up to 30 years.
Harding grass	1	22 acres within less well-drained grassland habitat throughout Preserve.	Outcompetes and displaces native plant species. Addition of biomass from these tall, rhizomatous plants can increase fire hazard.
Himalayan blackberry	1	Small to large stands primarily along margins of Calabazas Creek.	Displaces native plants by outcompeting native species and creating a dense canopy which limits available light. The impenetrable thickets can reduce wildlife access to water and prevent access for forest maintenance and recreational pursuits. Creates dense shade along stream banks, which is detrimental to foothill yellow-legged frog.
yellow starthistle	1	15 acres mapped within well-drained grassland habitat throughout Preserve. Additional, smaller stands scattered throughout grasslands.	Displacement of native plants and animals and threatens natural ecosystems. Significantly depletes soil moisture reserves in grasslands. Interferes with grazing — long-term ingestion by horses causes a neurological disorder known as chewing disease.
Special-Status Animals (SSA)			
steelhead trout	1	Many immature fish observed within stream pools of southwestern stretches of Calabazas Creek.	Human water diversions, potential sedimentation from erosion, and potential reductions in canopy cover (e.g., from SOD-induced oak mortality and increase in water temperatures).
northern spotted owl	1	One pair observed on Douglas fir, likely nesting on platform.	Potential impacts related to excessive noise (noise should be limited during Feb. – July nesting season), potential displacement by barred owls (known from vicinity).
American peregrine falcon	2	One nesting pair and fledglings observed at top of cliff face at southern-central Preserve.	Potential impacts related to excessive noise (should be limited during Feb. – July nesting season).
Nuttall's woodpecker	2	Moderate numbers observed in oak woodlands and Nunns' Canyon	Degradation of oak woodland habitats.
foothill yellow-legged frog	1	Three juveniles observed in stream pools of the eastern-most stretch of Calabazas Creek. Additional occurrences expected.	Competition and predation from invasive American bullfrogs, human water diversions, and potential sedimentation from erosion, and reduction of basking/foraging habitat due to invasive plants (e.g., Himalayan blackberry).
California giant salamander	2	Numerous larva and several adults observed within streams along Calabazas Creek, Johnson Creek, and Warsaw Creek.	Competition and predation from invasive American bullfrogs, Human water diversions, and potential sedimentation from erosion.
Invasive Animals (IAM)			
American bullfrog	1	2 juveniles in eastern stretch of Calabazas Creek. Additional occurrences likely along other stretches of streams, particularly in perennial pools.	Bullfrogs prey upon and compete with foothill yellow-legged frog (FLF) and other amphibians; its control is critical for protecting/enhancing FLF; no breeding observed on site; dispersal to Preserve and breeding sites on adjacent lands should be controlled to the degree possible.

RESOURCE	PRIORITY[1]	DISTRIBUTION ON PRESERVE	PRIMARY MANAGEMENT ISSUES
wild turkey	2	Within oak woodland within eastern Preserve. Expected within other areas, (particularly oak woodland).	wild turkeys compete with native ground-feeding birds (e.g., quail), consume large amounts of oak acorns (thus potentially reducing oak recruitment), and disturb surface soils, thus potentially facilitating the spread of invasive plant species.
Human Trespass (HT)			
Riparian habitats and sensitive habitats	1	Due to the size and remote location, this property has been the site of a large number of illicit marijuana grows.	The environmental impacts of this activity are numerous, including stream water diversion, toxic chemical dispersion, severe erosion, and habitat disturbance.
Cultural Resources (CR)			
Cultural Resources	1		Damage to cultural resources can be caused by natural processes (e.g., erosion), project-related action (e.g., trail improvement), and vandalism and souvenir hunting.

Management Focus: 1 = Resources of 'primary management concern' which should be prioritized in terms of timing and funding; 2 = Resources of 'secondary management concern' which will be managed subsequent to or concurrently where possible during management of 'primary management concern' or through more general overall Preserve management efforts. Ranking is based upon rarity of sensitive resource and/or severity of existing or potential management concerns.

1 These are the most widespread and/or problematic invasive plant species on the Preserve. For a list of all invasive weeds with potential to be problematic, see Appendix D. Also see Figure 4.1 below.

Table 4.2: Overview of Recommended Management Activities

RESOURCE	RECOMMENDED MANAGEMENT ACTIVITIES [1]	TIMING[2]	LEVEL OF ANALYSIS[3]
Physical Resources (PR)			
Sediment Erosion	PR-1: Finalize and Implement Erosion Control and Prevention Plan	Short-Term	Project
Water Resources	PR-2: Erosion Control and Prevent Sediment Deposition	Short-Term	Project
Plant Communities (PC)			
Grasslands	PC-1: Invasive Weed Control (see IPM-9 through IPM-11 plus other relevant IPM measures)	Short-Term	Project
	PC-2: Update and formalize Grazing Management Plan PC-3: Grassland Fire Management Plan	Medium-Term	Program
Chaparral	PC-4: Chaparral Management Plan	Medium-Term	NA
Forests and Woodlands	PC-5: Manual Removal and Girdling of Douglas Fir PC-6: Selective Tree Removal and Pruning of Oaks	Short-Term	Project
	PC-7: Train Land Managers on Symptoms of SOD	Medium-Term	NA
	PC-8: Healthy Ecosystem Management	Medium-Term	Project
	PC-9: Public Education on SOD Best Practices	Medium-Term	NA
	PC-10: Restore Impacted Oak Areas	Long-Term	Program
	PC-11: Establish Shaded Fuelbreaks	Short-Term	Project
Sensitive Habitats Management (SHM)			
Streams/Riparian Habitat	SHM-1: Prepare Riparian Corridor Management Plan	Medium-Term	NA
	SHM-2: Prepare Riparian Corridor Enhancement Plan	Medium-Term	NA
Spring and Seep Wetlands	SHM-3: Invasive Weed Control (see IPM-4 through IPM-6 plus other relevant IPM measures) SHM-4: Protect from Human Trampling SHM-5: Avoid Diverting Water Flow SHM-6: Avoid Soil Disturbance	Medium-Term	Project
Oak Habitats	SHM-7: SOD Best Practices (see PC-6 through PC-10) SHM-8: Manage Douglas Fir Encroachment (see PC-5) SHM-9: Manage Invasive Wildlife (see IAM-1)	Medium-Term	Project
	SHM-10: Restore Oaks	Medium to Long-Term	Project

RESOURCE	RECOMMENDED MANAGEMENT ACTIVITIES [1]	TIMING[2]	LEVEL OF ANALYSIS[3]
Redwood Forest	SHM-11: Manage Himalayan Blackberry and Other Invasive Plants (see IPM 4-6 plus other relevant plus other relevant IPM measures)	Short-Term	Project
	SHM-12: Monitor Douglas Fir/Redwood Density	Long-Term	Project
Special-Status Manzanita Habitat	SHM-13: Manage SOD (see PC-6 through PC-10) SHM-14: Discourage Illicit Marijuana Cultivation (see HT-1)	Short-Term	Project
	SHM-15: Prescribed Burns	Long-Term	Program
Special-Status Plants Management (SPM)			
Napa False Indigo	SPM-1: Protect Shrubs along Existing and Future Trails SPM -2: Control Invasive Plants in sites where Napa false indigo is present. (see IPM-2, IPM-4 through IPM-6 and other relevant IPM measures)	Short-Term	Project
Special-Status Plants of Chaparral Habitats	SPM-3: Protect Special Status Plants along Existing and Proposed Trails and Roads	Medium-Term	Project
	SPM-4: Manage Invasive Plants in Chaparral Habitat (see IPM-1 and other relevant IPM measures)	Short-Term	Project
Invasive Plants Management (IPM) 4			
Cheat Grass	IPM-1: Cheat grass	Medium-Term	Project
French Broom	IPM-2: French broom	Short-Term	Project
	IPM-3: Assess Other Treatments for French broom	Medium-Term	Program
Himalayan Blackberry	IPM-4: Mechanical Removal of Himalayan blackberry IPM-5: Herbicide Treatment for Himalayan blackberry IPM-6: Plant Native Riparian Shrubs	Short-Term	Project
Purple Pampas Grass	IPM-7: Mechanical Removal of Purple pampas grass	Short-Term	Project
Sweet Fennel	IPM-8: Mechanical Removal of sweet fennel	Short-Term	Project
Yellow Starthistle	IPM-9: Review YST Management Guide	Short-Term	Project
	IPM-10: Develop Long-Term Integrated Management Plan	Medium-Term	Project
	IPM-11: Soil Disturbance Should be Minimized and Exposed Soils Immediately Seeded with Native Plant Stock[3]	Short-Term	Project
Bigleaf Periwinkle	IPM-12: Mechanical Removal of Bigleaf periwinkle IPM-13: Herbicide Treatment for Bigleaf periwinkle	Short-Term	Project
Harding Grass	IPM-14: Develop a Harding Grass Long-Term Integrated Management Plan	Medium-Term	NA
Blue Gum	IPM-15: Monitor and Control Existing Blue Gum Stand	Long-Term	Project
Special-Status Animals (SAM)			
Fish and Amphibians	SAM-1: Eliminate Bullfrog Populations	Short-Term	Project
	SAM-2: Habitat Protection	Medium-Term	Project
	SAM-3: Manage Human Activities	Medium-Term	NA
Birds	SAM-4: Manage Noise	Short-Term	Project
	SAM-5: Manage Human Activities	Medium-Term	Project
	SAM-6: Manage and Enhance Habitat	Medium-Term	Project
	SAM-7: Manage Invasive Species	Short-Term	Project
Critical Habitat Corridors (HC)			
	HC-1: Map Habitat Corridors on the Preserve	Short-Term	Project
	HC-2: Identify Regional Habitat Corridors and Protection Strategies	Medium-Term	NA
Invasive Animals Management (IAM)			
American Bullfrog	IAM-1: Bullfrog Eradication	Short-Term	Project
	IAM-2: Exclusion Measures to Control Bullfrog Population	Medium-Term	NA
Wild Turkey	IAM-3: Monitor Wild Turkey Population IAM-4: Control Measures	Medium-Term	Project

RESOURCE	RECOMMENDED MANAGEMENT ACTIVITIES [1]	TIMING[2]	LEVEL OF ANALYSIS[3]
Other Invasive Species	IAM-5: Monitor Wild Pig and Barred Owl Populations IAM-6: Consider Control Measures	Medium-Term	Project
Human Trespass (HT)			
	HT-1: Education and Enforcement Plan	Short-Term	NA
Cultural Resources (CR)			
	CR-1: Partnerships	Short-Term	NA
	CR-2: Interpretation Plan	Medium-Term	NA
	CR-3: Cultural Resources Protection Plan	Medium-Term	NA

Source: District 2016

1 Recommended Management Activities have been grouped according to the threatened resource, habitat type, or species that is being addressed. The numbering of each proposed activity uses a letter system highlighting the threatened habitat or species, for instance, PC-1 refers to Plant Communities Activity #1.

2 Timing: Short-Term (Years 1-5); Medium-Term (Years 6-10); and Long-Term (Years 11+).

3 NA (Not Analyzed): Implementation of activities categorized as NA would have no impact on the Preserve's environmental resources. As such no further analysis of these activities is provided below.

4 These are the most widespread and/or problematic invasive plant species on the Preserve. For a list of all invasive plant species with potential to be problematic, along with management recommendations, see Section 4.6 and Appendix D.

SOD—Sudden Oak Death

4.2 PHYSICAL RESOURCES MANAGEMENT (PR)

4.2.1 SEDIMENT EROSION

Management Issues

Natural erosion processes — when accelerated by human impacts — may have a variety of detrimental impacts on the Preserve. The translocation of topsoil and other sediments can degrade terrestrial, aquatic, and wetland habitats down-slope of the eroded areas. Sediment delivery from road networks is recognized as a significant impediment to creek health and salmonid habitat quality. Undersized culverts at creek crossings, improperly graded roads (in-slope vs. outsloped), in-board ditches, and other features associated with roads, combine to concentrate flows, expose bare soils, and increase erosion. Addressing excess sediment delivery from a road network can provide immediate benefits to downstream aquatic habitats by reducing the quantity of sediment delivered into sensitive habitats, improving the water quality, and allowing storm events to cleanse creek systems rather than harm them (PWA 2013).

PWA's road assessment (see **Appendix G**) identifies opportunities to address excess sediment delivery into the creeks. Sites with the potential to increase sediment delivery and harm downstream habitat and water quality include stream crossings, ditch relief culverts, landslides, road discharge points, bank erosion sites, and gullies (**Table 4.3**).

Management Strategies

Short-Term (Years 1-5)

- **Physical Resources (PR)-1: Finalize and Implement Erosion Control and Erosion Prevention Plan.** Finalize an Erosion Control and Prevention Plan to address erosion caused by roads and infrastructure. In its road assessment, PWA recommended the treatment of 36 sites and 3.84 miles of road on and near the Preserve (**Figure 4.2: Maps 4a and 4b and Table 4.3**). The treatment of the 36 sites (26 stream crossings, three ditch relief culverts, one landslide, two road discharge points, two bank erosion sites, and two gullies) would prevent 760 yd3 of sediment from entering Calabazas Creek and its tributaries. Treating 3.84 miles of road that are hydrologically connected to the creek would also prevent 3,755 yd3 from eroding over the next decade. Short-term erosion control and erosion prevention treatments recommended include:

» At existing partially plugged culvert, clear obstructions and remove sediment from the inlet to increase culvert capacity (Site #17).

» Install a trash rack at culvert inlet to prevent plugging (Site #14).

» Install a critical water bar to prevent stream diversions (Site #5).

PWA also recommends 10 different types of long-term erosion control and erosion prevention treatments (site-specific treatments and road surface treatments). These are detailed in **Table 4.3**. Treatment recommendations include culvert replacement, trash racks, creation of critical dips, rock armoring, soil excavation, rolling dips, cross road drains, road outsloping, and road surface rocking. Site descriptions, treatment priority, estimated sediment delivery, and recommended treatments are included in Appendix G.

Monitoring

Once the recommended Erosion Control and Prevention Plan has been implemented, post-project monitoring will be completed to evaluate and document project performance. Visual pre-evaluation and baseline photographs will be used to document pre-treatment conditions. Annual monitoring and photographic documentation will be used to evaluate post-treatment performance. In addition, baseline water quality samples should be obtained from stratified creeks and tributaries and post-treatment samples taken after erosion control implementation. Detailed protocols for monitoring management activities will be described in the Operations and Maintenance Manual.

During visual inspections, evaluate the effectiveness of the treatments by:

- Identifying any instability along treated road/trail segments;
- Documenting the structural integrity of implemented treatments;
- Identifying any areas with potential for erosion/sediment delivery;
- Quantifying sediment delivery due to any significant adjustments to the implemented treatments; and,
- Recording turbidity detected at any of the treatment sites.

Inspections and photographic documentation will be conducted yearly after implementation, in particular

Table 4.3: Recommended Erosion Control and Erosion Prevention Strategies[1]

TREATMENT TYPE	NO.	PROPOSED ACTIVITY AND SITE NUMBER
Short-Term Treatments		
Clean Culvert	1	At existing partially plugged culvert, clear obstructions (debris) and remove any stored sediment from the inlet to increase culvert capacity (Site#17).
Trash rack	1	Install at culvert inlet to prevent plugging (Site#14).
Critical water bar	1	Install to prevent stream diversions (Site#5).
Site Specific Treatments		
Culvert (replace)	3	Replace an undersized, poorly installed, or worn out culvert (Site# 5, 6, 14).
Trash Rack	1	Trash rack 1 Install at culvert inlets to prevent plugging (Site#14).
Armored fill or ford (wet) crossing	20	Install two armored ford crossings[2] (Site# 11, 30) and 18 armored fill crossings[3] (Site# 3, 4, 7, 8, 9, 10, 12, 13, 18, 19, 26, 27, 29, 31, 32, 33, 33.1, 43) using 290 yd3 of rock armor.
Critical dip	1	Install to prevent stream diversions (Site# 5).
Rock (armor)	3	At 3 sites (Site# 14, 15, 32.1), add a total of 25 yd3 of rock armor to buttress stream banks or dip outlet.
Soil excavation	27	At 27 sites, excavate and remove a total of 985 yd3 of sediment, primarily at fillslopes and stream crossings.
Road Surface Treatments		
Rolling dips	84	Install to improve road drainage on upgraded roads.
Cross road drains	19	Install to improve drainage on decommissioned roads.
Outslope road and remove ditch	28	At 28 locations, outslope road and remove ditch for a total of 14,810 ft of road to improve road surface drainage.
Road rock (for road surfaces)	1	At 1 location, use a total of 2 yd3 of coarse drain rock to rock the road surface.

1 All site numbers are referenced on Figures 4.2a & b.
2 A ford crossing may use rock armor to stabilize the roadway, but the road is built essentially on the natural streambed and fill is not used.
3 A properly constructed armored fill crossing is based on a site-specific design, using a mix of riprap-sized rock to minimize erosion while allowing the stream to flow across the road prism.

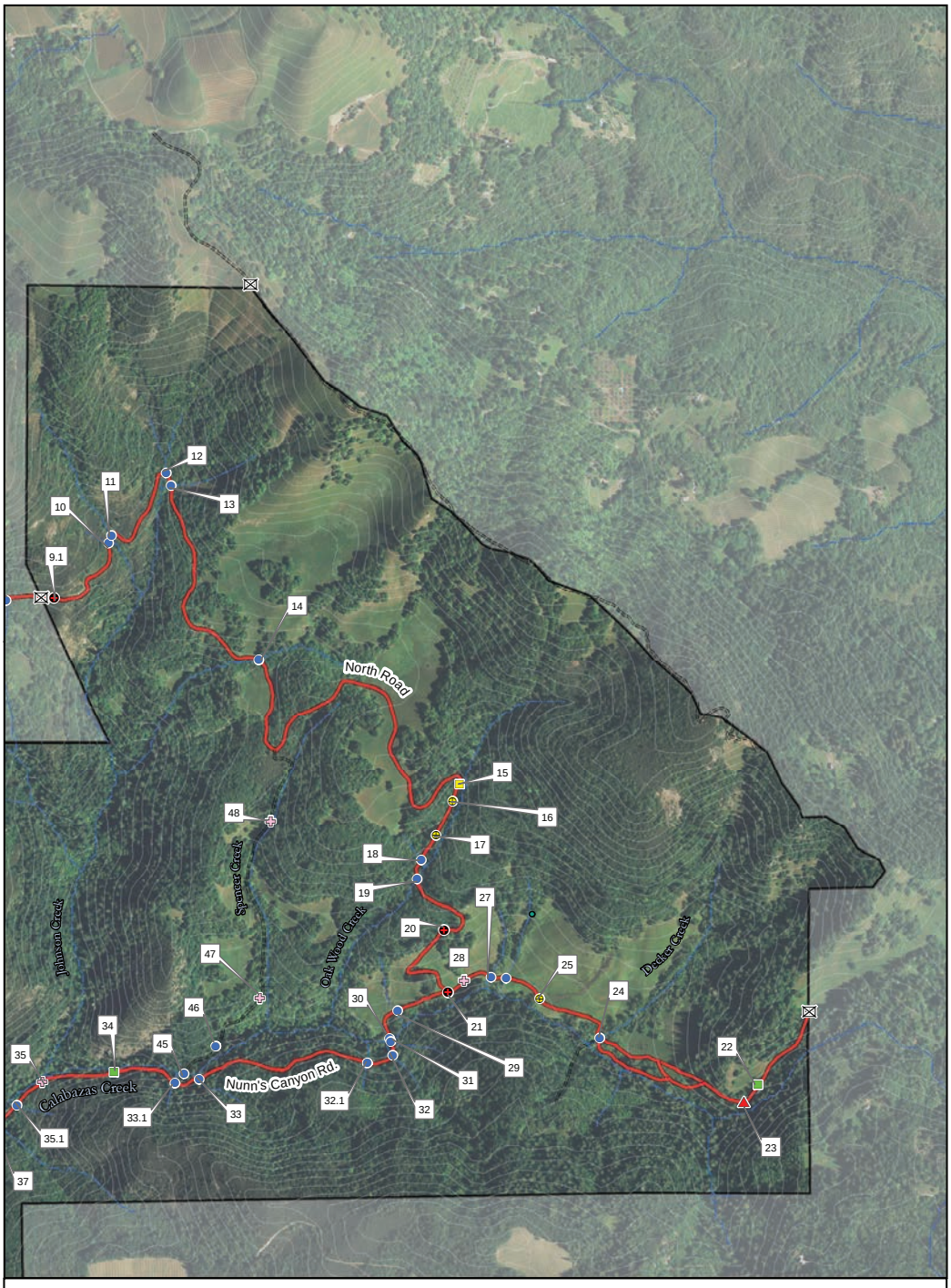
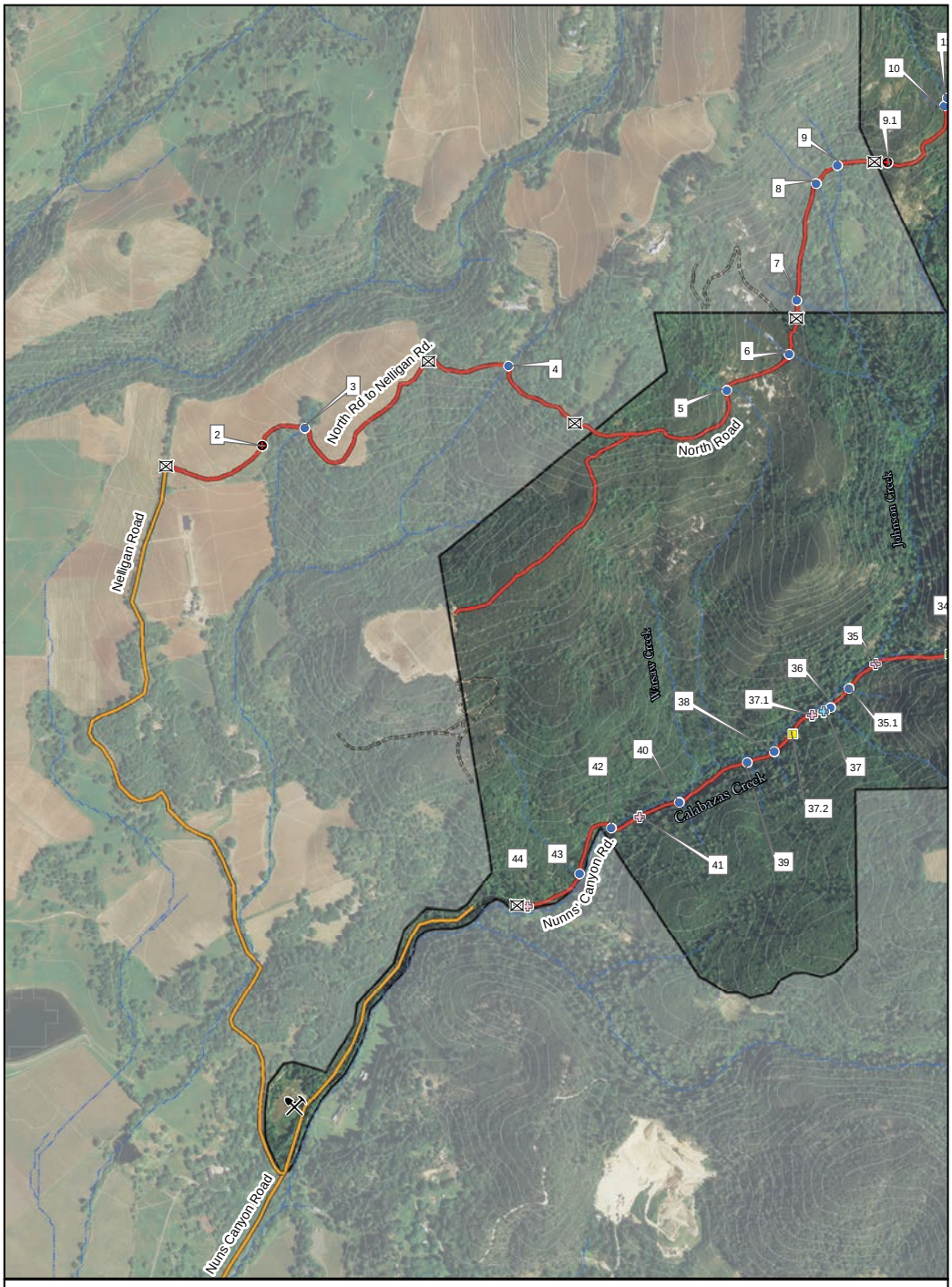


Figure 4.2 a: Road Assessment: Sites and Treatment (East side)



CALABAZAS CREEK
Open Space Preserve

0 325 650 1,300 Feet

N

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

Map Date: 09/30/2015

Sources: Digital Globe 2009 (aerial); Sonoma County GIS (roads, parcels); SCWA (streams).

This map is for illustrative purposes only and is not intended to be a definitive property description.

Figure 4.2 b: Road Assessment: Sites and Treatment (West side)

Gate
Quarry
3 Sites and treatments
Calabazas_Boundary

Features
Landslide
Ditch relief culvert
Road drainage discharge point
Gully
Bank erosion
Maintenance
Spring
Stream crossing
40' Contour
Streams

Roads
County Road
Access roads to Preserve
Internal Roads
abandoned roads

during the wet weather season (October through April) after the first major rainfall event and then later in the season within 48 hours after a large storm event where greater than 2" of rainfall is recorded within a 24 hours period. Adjustments in treatments can be expected; therefore, annual monitoring of implemented treatment plans will not only evaluate project performance, but it will also identify and adaptively manage any areas which may need fine tuning or maintenance before becoming a significant problem.

4.2.2 WATER RESOURCES

Management Issues

According to the San Francisco Bay Regional Water Quality Control Board (RWQCB 2004), a number of "Significant Issues and Water Quality Problems" have been identified in the greater Sonoma Creek watershed, some of which apply to Calabazas Creek. These include sediment and nutrient inputs, pathogens, and rising temperatures. Specifically, sediment yield and diversions are listed as problems associated with Calabazas Creek. The stream's sediment yield, as measured in 1996, was just below 1.4 tons per acre, the fourth largest yield among the eight principal tributaries of Sonoma Creek (NRCS 1996).

The PWA road assessment **(see Section 2.3 and Appendix G**) concluded that the largest cause of disturbance to the creek network is roads. Soil erosion from poorly designed or maintained roads will lead to water quality and habitat deterioration. The second most important threat to water quality and habitat conservation is water diversions, which can cause inadequate flow to support riparian and wetland habitats and/or aquatic wildlife.

Management Strategies

Short-Term (Years 1-5)

- **PR-2: Erosion Control and Prevent Sediment Deposition.** Application of erosion control and activities that prevent of sediment deposition into stream courses as outlined in **Table 4.3** will greatly improve water quality and preserve aquatic habitat.

Monitoring

Water quality and sediment delivery will be evaluated as baseline measurements and then monitored each year, especially after implementation of road improvements or decommissioning strategies. Detailed protocols for all monitoring activities will be described in the Operations and Maintenance Manual.

4.3 PLANT COMMUNITIES (PC)

4.3.1 GRASSLANDS

Management Issues

The grasslands on the Preserve have not been grazed since 2006 when the District had a license agreement with the former landowner. However, there does not appear to be a build-up of excessive thatch within the grasslands, especially in areas within volcanic geology. As described above, yellow starthistle treatments began in 2010 and have been consistently applied every year to reduce population expansion. The prolific seed production from YST requires treatment for many years to control outbreaks. The extent of shrub and tree encroachment within the grasslands while fairly limited at the present time, could help reduce YST populations by overshadowing and suppressing YST establishment.

Grasslands, as mentioned above, consist of a high percentage of non-native grasses and invasive plants that are not held in check by many natural predators. Below are some proposed management strategies that could help reduce the non-native plant populations.

Grazing

Carefully managed grazing can be a cost-effective tool that may help to achieve specific management objectives. Grazing can also be implemented in a consistent manner that targets specific non-native species and optimally, allows native grassland species to become an important part of the grassland habitat.

Grasslands on the site were historically grazed by cattle. Grazing was discontinued in 2002 according to former site ranchers (Dawson 2013). Economically viable ranching would be difficult on the Preserve, given the relatively small amount of grassland habitat (roughly 139 total acres), the remote and discontinuous distribution of the grasslands (**Figure 2.4**), and the current poor condition of the access connecting the different grassland communities to serviceable public roads (Nuns Canyon Road and Highway 12). Currently, there is only one access point from Nuns Canyon Road where a rancher could offload a herd to graze the land.

Livestock would then have to be herded up Nunns' Canyon traveling ~3 miles to reach the grasslands and then be rotated across 140 acres of mixed quality grasslands. In addition, the current grazing infrastructure is minimal. There are established fences along the eastern and northern property boundaries but otherwise the grasslands are not fenced. It is assumed that the bordering forest, woodland and scrub habitats acted as natural fences to generally keep the cattle within grassland areas (where their preferred forage exists). New fences would need to be built to keep livestock out of the streams and steep canyons and trespassing into other sensitive habitat or potentially dangerous terrain.

Lastly, there appears to be only two developed livestock-watering sources on the site (a trough fed by a spring in the northern grasslands and one along Oak Wood Creek, **Figure 3.2**). The only other water sources are natural streams and springs within the Calabazas Creek watershed. The larger tributaries and some of the springs and seeps are the only reliable water sources during spring and summer. If grazing is reintroduced on the site, the streams should be fenced off as needed to prevent livestock from damaging these sites. However, a viable water source would be required to support livestock grazing. The development of springs to supply troughs would be beneficial for distributing livestock across the property, facilitating even grazing of the grasslands (thus minimizing erosion and degradation of grassland habitat). However, wetland habitats currently supported by these springs would be impacted by such water diversion. In spite of these limitations, livestock grazing could be a viable option on the site with some infrastructure improvements and safeguards in place to protect sensitive resources.

Photo 24: Douglas fir encroachment into chaparral vegetation

While grazing may be a management option, the benefits must be measured against the potential negative impacts, which include introduced sediment into the stream corridor, trampling wetland habitat, loss of livestock to top predators, and introduction of non-native plant, among others.

Prescribed Burning

Wildfires have periodically burned on the Preserve. However, there has never been any attempt to conduct prescribed burns on the site, at least in recent decades. Burning can be controversial due to the effects to local air quality and the potential for wildfire moving onto neighboring lands. It is also more costly than livestock grazing in the long-term, since it must be conducted by individuals with expertise in prescribed burns. In addition, it can be difficult to implement on a regular and consistent basis due to difficulties in obtaining agency and neighbor approval. The benefits of a prescribed burn and controlled fire are that they mimic natural ecological processes and are seen as a more "natural" approach than livestock grazing. Fire can be effective for reducing certain invasive plants which livestock might not find palatable such as yellow starthistle. However, the key to being an effective tool is for the fire to be hot enough to have an adverse effect on the YST seed bank — which can store millions of seed in a square foot of soil. Since the fuel loads within the grasslands and YST populations are low, the fire temperatures are likely to be cool enough so as to cause limited impact on the YST seed bank.

While prescribed burning could technically work on the site, the political, liability and logistical challenges make is difficult for the District to execute as an interim manager. Future managers of the Preserve could consider application of this management tool.

Encroachment of Shrubs and Trees

Native shrubs and trees are slowly encroaching into the grasslands on the Preserve, potentially due to the absence of fire or as natural succession recolonizing artificially maintained grasslands. The conversion of grasslands to scrub and forest habitats in the absence of active management is well known throughout the Coast Range region (Tyler et al. 2007). Several incipient stands of coyote brush were mapped within the grasslands (**Figure 4.1**). All are

composed of relatively young plants that most likely became established after grazing was discontinued.

The encroachment and spread of coyote brush stands will likely continue without any management efforts and could ultimately result in the loss of much of the grassland habitat on the site due to competition for light, moisture and nutrients. Consequently, this successional process might then lead to encroachment from young Douglas firs currently found along the margins of some of the grasslands. In the successional process, Douglas fir often begins to invade as a second wave after coyote brush has established, but can also slowly encroach around grassland margins where it abuts an existing forest (Tyler et al. 2007). If left unmanaged, large areas of the current grasslands would likely end up as forest.

Management Strategies

Short-Term (Years 1-5)

- **Plant Communities (PC)-1: Invasive Weed Control.** See **Section 4.6** for details.

Photo 25: Coyote brush encroaching into grassland habitat.

Medium-Term (Years 6-10)

- **PC-2: Update Grazing Management Plan.** When feasible, an updated Grazing Management Plan would be prepared to assess reintroducing grazing on the Preserve. A plan should be developed by a Certified Rangeland Manager to address the livestock type, stocking rates, watering requirements, access analysis and a schedule of grazing to achieve target habitat management goals in the most the environmentally benign manner. The Grazing Management Plan should address issues like thatch reduction, native plant conservation and enhancement, invasive weed control, and shrub and tree encroachment control. The Grazing Management Plan should also include fencing requirements and proposed styles so that grazing regimens could be adhered to and yet wildlife passage is not excluded or adversely affected. (See Appendix P: Beltane Grazing Recommendations)

  This grazing plan should address adaptive management, which is essential in carrying out a successful grazing program with ecological goals, given year-to-year fluctuations in timing and amounts of precipitation, and future climate change. Timing of the grazing period and grazing intensity (stocking rates) should vary each year, depending upon condition of the vegetation, which will be determined by rainfall patterns. A successful grazing prescription (with priority given to ecological goals) during a drought year will be very different from a successful prescription during the heavy rainfall of an El Niño year. The grazing plan should carefully consider potential impacts on sensitive habitats (e.g., spring/seep wetlands), soil erosion, and water quality. The rancher that previously grazed the site should be interviewed during development of the plan to make sure it addresses site peculiarities as understood by the rancher.

- **PC-3: Fire Management Plan.** Future resource managers should consider the use of prescribed burns under a formal fire management plan prepared to address long-term habitat management. A Fire Management Plan would be prepared to guide the use of prescribed burns and include historic role of fire, weather analysis, suppression and prevention. This plan would also describe how tools like shaded fuelbreaks would be incorporated into the management of the preserve

Monitoring

Conduct annual monitoring to assess Residual Dry Matter (RDM or thatch) within selected grassland sites as well as selected reference invasive weed stands, general condition of the grasslands related to soil erosion, shrub and tree encroachment, overgrazing, etc.

4.3.2 CHAPARRAL

Management Issues

The primary threat to chaparral habitats on the Preserve is fire suppression, which can lead to encroachment of trees and eventual habitat replacement by forest and/or woodlands. In addition, the lack of periodic burning can lead to decadence of components of the chaparral habitat. For example, all three of the special-status manzanita species are obligate seeders (non-burl forming) with seeds that require *scarification* and chemicals from smoke to germinate (Keeley 1987).

Without the implementation of prescribed burning on the Preserve, it is likely that in the long-term some chaparral habitats will become senescent and will be reduced by the encroachment of woodlands, especially in manzanita habitats, which are more susceptible to tree encroachment. The conversion of chaparral on the Preserve will result in the degradation of wildlife habitat and biodiversity associated with these plant communities. The problem is variable across the different chaparral communities, but given the absence of fire on the property for nearly 50 years, all of the communities are mature and, despite good seed production, recruitment is low in most areas. Manzanita recruitment in particular is quite limited due to the seed requirements noted above.

Management Strategies

Implementation of prescribed burns is the most effective management strategy for protecting and maintaining healthy and diverse chaparral habitats on the site, but has its challenges, as discussed above. The District, as an interim management entity, does not believe it is feasible to pursue prescribed burning at this time so no short-term strategies are recommended for managing chaparral habitats.

Medium-Term (Years 6-10)

- **PC-4: Chaparral Management Plan:** Develop a Chaparral Management Plan that incorporates as appropriate:
  - » Girdling or felling of encroaching trees: This will not initiate germination of the Manzanita seeds, and the inaccessibility of many areas would hinder this approach.
  - » Specific, individual management strategies for the special-status manzanita species (see **Section 4.5.2**).
  - » Management of invasive or aggressive colonizing plants includes manual removal, mowing and chemical treatments, where appropriate (see IPM).
  - » Assesses long-term feasibility of fire management as a strategy.

Monitoring

Conduct periodic monitoring of chaparral stands for tree encroachment and overall stand health. Competition for light or soil will likely lead to plant mortality as many chaparral species cannot survive under full shade.

4.3.3 FORESTS AND WOODLANDS

Management Issues

While the forest and woodland communities are an important component of the overall ecology, the suppression of fire over the past many decades has resulted in the encroachment of Douglas fir into oak woodland habitats as well as the encroachment of Douglas fir and other trees into chaparral and grassland habitats. In the absence of active management, there will be a significant spread of these forest types, especially Douglas Fir Forest, at the expense of these other plant communities.

Photo 26: Douglas fir encroaching on oak woodland habitat.

Sudden Oak Death (SOD) is the other primary management issue within the forests and woodlands on the Preserve, affecting coast live oak and potentially black oak and canyon live oak. More specific, individual management strategies for the sensitive forest and woodland habitats mapped on the Preserve (Coast Live Oak Woodland, Oregon White Oak Woodland, and Redwood Forest) are presented in **Section 4.4** (Sensitive Habitat Management) below.

Expansion of Douglas Fir

The expansion of Douglas fir into other habitats on the Preserve is perhaps the most complex management issue on the Preserve, as it is intertwined with several of the other primary management issues on the property. The issue has direct connections to fuel loads and fire management, biodiversity, SOD, and special-status resource management. Nearly every habitat on the site with moderately to well-developed soils is experiencing an increase in Douglas fir cover, and the encroaching trees are likely to alter ecosystem dynamics and, ultimately, biodiversity. These fast-growing, shade-tolerant trees are prolific seeders and have the ability to out-compete other trees for light, nutrients and water and, by extension, understory species, by casting a year-round deep shade over other trees, and by covering the forest floor with branches and needles. Pacific madrone and oak tree species are particularly threatened by competition from Douglas fir, though the species also has the potential to have a detrimental impact on coast redwood, grasslands, and even chaparral habitats. Among the habitats potentially affected by Douglas fir encroachment, oak habitats are of the most significant concern. As noted above, Douglas firs may indirectly facilitate the spread of SOD, and yet are not killed by the pathogen, which has serious implications for coast live oaks.

It should be reiterated that Douglas Fir Forest is a natural and important plant community for biodiversity and wildlife habitat, and that the encroachment of Douglas fir into other habitats is a natural process. However, this encroachment appears to have been accelerated in the absence of fire. Douglas fir is a species that is native to California, and is a late *seral* species in northern California, particularly in the middle to southern North Coast Ranges. The expansion and dominance of the species in pre-historic and historic times has been kept in check by artificially increased fire frequency, first by Native Americans, and then by ranchers and foresters.

Douglas fir encroachment is most problematic for Oregon White Oak Woodland and Coast Live Oak Woodland, therefore control efforts should focus first on these habitats. Of these two, encroachment into Oregon White Oak Woodland should be the first priority, since this habitat is more limited on the Preserve, and because this oak is not regenerating well in the region as a whole. Experimental methods to reduce Douglas fir encroachment into Oregon White Oak Woodlands were employed in the mid 1990s at nearby Annadel State Park (Hastings et al., 2007), and the results are instructive for similar efforts on the Preserve. For instance, the cost of girdling and treating pole-sized trees is much more expensive than removing saplings. Timing of removal and proximity of trees to public trails need to be well planned so that public safety is not jeopardized and plants can be easily removed without significant soil disturbance. Also, prioritizing areas ideal for treatment will help to obtain positive results while maintaining a diverse landscape.

Sudden Oak Death (SOD)

As discussed in **Section 2.6.5**, of the 23 samples collected from 23 separate trees, 18 were confirmed as infected with SOD (**Figure 4.1**). All of the most obviously symptomatic trees on the Preserve were California bay and coast live oak. Given the prevalence of leaf blotches on California bay and cankers on coast live oak (and obviously dead oaks as well), it is likely that many additional trees on the Preserve are infected. In addition to the death of oak trees, problems associated with SOD include reduced forage (acorns and other plant material) for animals, increased dead fuel loads and thus potential for more intense wildfires, possible injury to humans and wildlife from falling tree limbs, and a variety of ecosystem changes resulting from reduced oak canopy closure and an increase in woody debris on the ground.

Coast live oak habitats being invaded by Douglas fir may experience increased SOD infection as a result of increased shade and accompanying increases in California bay tree cover, and oak mortality in turn would further increase the potential for the expansion of bay trees. Measures to minimize the

encroachment of Douglas fir and California bay into oak woodlands, via manual thinning, girdling, and/or prescribed burns, should be integrated into efforts to control SOD on the Preserve.

Management Strategies

Short-Term (1-5 years)

- **PC-5: Manual Removal and Girdling of Douglas Fir.** While prescribed burns are known to be effective at killing Douglas fir seedlings and saplings, larger trees survive all but the most intense fires. An effective Douglas fir management strategy must include measures to reduce reproductively viable and nearly mature trees within oak woodlands. As noted above, Douglas fir trees typically become reproductively mature between the ages of 30 to 40 years. Larger saplings and poles able to survive prescribed burns can be easily felled, and because the species does not have the ability to sprout, no further measures (such as the application of herbicides) are required as long as the tree is cut at the ground level. Since commercial harvesting is not a viable option on the Preserve, the most economical method to kill larger, mature Douglas fir is to girdle them, as was done at Annadel State Park in the mid 1990s (*ibid*). Approximately 460 mature (e.g., six inches or greater DBH) Douglas fir were cut with a chainsaw to the cambium layer, and a 50 percent solution of glyphosate (Roundup®) was applied to the cut area. A valuable lesson learned during the project is the importance of cutting deep enough into the cambium, as well as the necessity of applying herbicides to the cut areas. Projects to manually remove or girdle Douglas fir on the Preserve should be restricted to the time period between August and January, in order to minimize disturbance to nesting birds in the area.

  An added benefit from girdling large trees rather than cutting them (which is more difficult and more expensive), is that trees successfully girdled become snags (standing dead or dying trees). Snags provide important habitat for a large number of animal species during all or part of their life cycle (Ohmann et al. 1994). Snags are already present on the Preserve, but are generally restricted to the more mature forest areas along the perennial streams, therefore additional snags within other portions of the site would enhance wildlife habitat in those areas.

  In the event that prescribed burns are not permitted or not considered a viable option on the Preserve over the long-term, these manual methods for removing Douglas fir will have to suffice on their own. Without fire, seedlings and saplings will have to be removed manually. Seedlings and smaller saplings can be simply pulled from the ground, especially if the ground is wet from a recent rain. A weed wrench can be used to uproot larger saplings. Regardless, manual removal of Douglas fir would have to be conducted in areas where larger saplings to mature individuals are present. Guidelines will need to be developed to ensure the design of a proper buffer between trails serving the public and areas where Douglas fir is girdled (State Parks provided a 100-foot visible buffer between trails and roads and treated Douglas fir (Hastings, et al., 2007)).

  As noted above, the Oregon White Oak Woodlands should be prioritized for a Douglas fir removal program, due to the limited area of this habitat as well as the recruitment problems endemic to this habitat. Douglas fir trees should be removed not only from within the oak habitats, but from adjacent areas as well. Douglas fir is a wind-dispersed species, and most seeds are known to fall within approximately 360 feet from the parent tree (Fowells 1965), so removing mature trees within this distance will reduce the chances of rapid Douglas fir re-encroachment following removal efforts.

- **PC-6: Selective Tree Removal and Pruning of Oaks:** Given the limitations in treating SOD-infected trees, selective tree removal may be a more practical alternative strategy. Diseased or otherwise dying oaks adjacent to existing or potential trails or other areas of likely human congregation or infrastructure on the Preserve (e.g., picnic areas or parking lots) should be felled in order to reduce the hazard from falling trees or limbs. Particularly in dense stands, the removal of infected oaks may improve stand health by opening up the canopy for new oak recruitment. The *boles* of felled trees should be cut into

small pieces and branches and leaves chipped if possible, then left scattered in a sunny, open location on site, in order to dry out the wood. Rapid drying of the woody material is important to eliminate the presence of the SOD pathogen (Lee et al. 2011). Since as few as five percent of oak trees may produce up to 95 percent of acorns within a given stand (Standiford and McCreary 1996), high yield oaks should be preferentially protected from bay trees, and areas of elevated moisture, such as shaded north slopes, ravines, and streamside habitats, should be preferentially managed. Felled California bay trees should be similarly cut into small sections and/or chipped, and then scattered in a localized, dry, sunny location (Lee, C. et al., 2011). Any equipment used to cut potentially infected trees should be sprayed and wiped down with Lysol or a ten percent bleach solution in order to avoid transmitting the pathogen to other locations.

- **PC-7: Train Land Managers on Symptoms of SOD.** Infected oaks and bay trees often exhibit recognizable symptoms of SOD, and land managers should be familiar with these symptoms and monitor the Preserve to the degree possible. Symptoms in coast live oaks include at the most basic level multiple large, dead trees, and on a more subtle level an abundance of dead leaves, bark cankers (e.g., "seeping" or "bleeding" bark), and, in late stages the presence of fruiting bodies of *Hypoxylon* species or *Phellinus* species of fungi (Rizzo et al. 2005). Infected California bay trees often exhibit discoloration of leaf tips, due to the concentration of fungal spores where water drips off the leaves. The California Oak Mortality Task Force maintains a website (www.suddenoakdeath.org) which should be consulted on identification of symptomatic trees and for information regarding SOD management. District staff has participated in multiple trainings and courses on SOD detection and potentially successful treatments.
- **PC-8: Healthy Ecosystem Management.** Like many introduced pathogens, *Phytophthora ramorum* does not preferentially target stressed trees, however, good forest health is recommended to reduce conditions favorable to the spread of SOD (Lee et al. 2011). While coast live oaks tend to be stressed by shady, crowded conditions, California bay (the most significant infectious host on the Preserve), regenerates and grows well in such conditions, as evidenced by its dominance in the understory of Douglas fir on portions of the site. Aside from benefiting from closely spaced bay trees (multiple, accessible foliar hosts), *P. ramorum* is thought to thrive in higher relative moisture of such shaded environments.

  Forest stand conditions where species vulnerable to Sudden Oak Death (i.e., coast live oak, tanoak, madrone, etc.) are more susceptible to infection will be identified. Then a stand management prescription (forest thinning) will be implemented that will increase spacing between stems of these vulnerable species and reduce immediate contact with known carrier species like California bay trees. This treatment should be applied in areas where SOD has been documented and the potential to spread is high due to forest stand conditions (closed canopy, high moisture (i.e., north slope), poor circulation, suppressed trees, high basal area of California bay near vulnerable species.

Medium-Term (Years 6-10)

- **PC-9: Public Education on SOD Best Practices**. Researchers and regulatory agencies have compiled SOD best management practices. These can be used to educate forest professionals, land managers, and the general public on how to prevent the spread of SOD. It is advisable that land managers of public open spaces publicize such information, in the form of trail signs, pamphlets, seasonal website notices, and other media. The management practices summarized in Appendix L, which are applicable to District-managed properties, are recommendations for recreational users provided by the California Oak Mortality Task Force (suddenoakdeath.org [COMTF 2008]), and the measures may apply to other activities potentially occurring on the Preserve.

Long-Term (Years 11+)

- **PC-10: Restore Impacted Oak Areas.** The patchy distribution of oak mortality on the Preserve as well as throughout the range of SOD infections suggests that some oaks are less susceptible. In

fact, research indicates that both environmental and intra-specific genetic factors influence the distribution of SOD-related mortality (Garbelotto and Hayden 2012). As noted above, areas more impacted by the pathogen tend to be in more mesic habitats with large numbers of California bay trees in close proximity to coast live oaks (or other affected species). Such areas may experience widespread mortality of oaks on the Preserve even if some individuals are immune from the pathogen's effects. In order to reduce the net loss of coast live oak habitat on the site, these areas should be re-planted with coast live oak trees, preferably with individuals shown to be resistant or immune to *P. ramorum*. This may be accomplished by propagating with acorns derived from apparently uninfected mature trees within infected areas, or potentially by procuring tested genetic strains from research laboratories (e.g., the forest pathology labs at the University of California at Berkeley), which are currently conducting genetic tests on coast live oak material (*ibid*). In either case, acorns should ideally be derived from local oaks and from oaks growing in similar habitat, in order to minimize introduction of foreign genes, and to maximize survivorship of the planted oaks. It is beyond the scope of this Plan to present comprehensive methods for planting and monitoring oak trees, but Preserve land managers should consult reputable literature as necessary (e.g., Standiford and McCreary 1996, McCreary 2009).

Monitoring

Conduct periodic assessment and inventory of Douglas fir encroachment, woody fuel loads, and SOD infection within forest and woodland stands. This can be accomplished by stratifying the forests and woodlands into monitoring blocks that can be assessed on a rotational basis. UC Berkeley, CALFIRE, and California Oak Mortality Task Force created OakMapper in 2001 to track confirmed incidence of SOD. The District and future landowners should participant in this monitoring effort to post sites where SOD has been diagnosed within the Preserve.

- **PC-11: Establish Shaded Fuelbreaks.** A shaded fuelbreak is a linear landscape feature of variable width within a forest where the fuel profile has been altered. In forests, shaded fuelbreaks have lower surface fuel load, higher canopy base height, and often reduced canopy bulk density in comparison to the adjacent forest. Sufficient forest canopy is retained such that surface fuel is shaded and exhibits slightly higher fuel moisture content and lower eye-level wind speed than open areas with no canopy cover. Shaded fuelbreaks vary in width from 100 feet to 1,200 feet (See Agee and others 2000, Green 1977, and Schimke and Green 1970 for further discussion). A shaded fuelbreak can fulfill multiple purposes on the Preserve, including fire prevention, reduction of douglas fir encroachment, and SOD amelioration. This action would include identifying and implementing sites where shaded fuel breaks can be established to reduce the impacts of wildfire and improve the defensible space along strategically important corridors when attempting to combat wildfires on the property. Shaded fuelbreaks increase the spacing between stems and eliminates fuel ladders within a given corridor – such as along ranch roads or along ridge tops. Systematic thinning of the designated forest stands or corridors and pruning all low-hanging branches will allow fires to pass through the forest, but it remains on the forest floor burning at a relatively cool temperature and reducing the risk of spreading into the canopy and becoming much more difficult to control and causing more significant damage to the surviving plants and animals.

4.4 SENSITIVE HABITAT MANAGEMENT (SHM)

4.4.1 STREAMS AND RIPARIAN CORRIDORS

Management Issues

Threats to streams and riparian habitats on the Preserve include the following:

- Invasive plant species, in particular Himalayan blackberry;
- Sediment transport from human-induced and natural erosion processes (e.g., along Nunns' Canyon Road and along cultivated and naturally erosive hill slopes in the upland watershed);
- Illegal water diversions associated with illicit marijuana cultivation; and

- A potential for an excess of woody debris in stream channels and alterations in canopy cover due to tree mortality (e.g., due to SOD).

Management Strategies

Since the resources in riparian corridors are so interconnected with other ecological management processes (e.g., SOD management, invasive plant and animal management, human disturbance), most of the management strategies for streams and riparian corridors are addressed individually in other sections. However, disease or fire could adversely affect the conditions within a riparian corridor and threaten the health of the plants and animals that depend on this habitat type. Establishing baseline conditions and monitoring over time will allow the resource managers to detect a deterioration of these conditions so that proper actions can take place to reduce these impacts. For instance, if SOD causes a wide area of riparian habitat to be heavily impacted, then actions will need to be taken to restore or enhance the habitat to perform the necessary functions like canopy closure, stream complexity and overall health of each riparian corridor.

Short-Term (Years 1-5)

- **SHM-1: Prepare Riparian Corridor Management Plan:** This plan should incorporate the following measures:
  - » Reduce existing cover of Himalayan blackberry and minimize future spread of this and other invasive plants (see **Section 4.6** for details).
  - » Address principle road network concerns as described in **Table 4.3** to minimize erosion and sediment transport to streams.
  - » If livestock are reintroduced to the Preserve, prevent or limit access to stream riparian corridors.
  - » Prevent diversion of water resources, except as required for livestock management which will require monitoring to ensure sufficient water remains in the creek corridor.
  - » Regulate human access to riparian habitat. Maintain vigilance in preventing reestablishment of marijuana plantations and prohibit fishing, collecting, littering, and pet access (see **Section 4.10** for details).

Medium-Term (Years 6-10)

- **SHM-2: Prepare Riparian Corridor Enhancement Plan:** A Riparian Corridor Enhancement Plan should identify a strategy for re-establishing oaks and other trees in areas of significant SOD mortality and should determine the long term potential to enhance stream habitat complexity by native plant revegetation or by introducing large woody debris into the stream channel. Due to the substantial number of coast live oaks occurring along stream corridors, several large areas along the stream corridors have been affected by SOD. Ideally these areas should be re-planted with non-SOD oaks and other riparian tree species to maintain habitat integrity and reduce erosion for under-vegetated areas. Other potential enhancements to the streams and riparian corridors are more directly related to road or trail crossings described in **Table 4.3**.

Monitoring

Photo 27: Seeps are common throughout the preserve, some attractive non-native plants.

Monitoring of the streams and riparian corridors should be conducted at least once per year, in order to evaluate the threats listed and described above. Baseline conditions must be established prior to active management in order to measure the effects of each of the management recommendations. Once

the appropriate network of monitoring sites are chosen, then the timing and intervals will need to be established to best capture the range of potential impacts or to evaluate improvements along this habitat type. At a minimum, the perennial stream corridors will be spot-checked for evidence of such problems as water diversions or erosion from failed culverts. Water quality surveys will be dependent on stream flow — if seasonal, then tributaries can only be tested after the initial flush at the beginning of winter and during times of steady moisture delivery. For permanent stream courses, sampling could be done during the late summer and then again once winter storm events are more frequent and consistent. Areas more closely investigated will be recorded with a GPS or on a paper map and correlated with habitat condition notes. Monitoring will be conducted during the early summer (e.g., June to July), during the flower bloom period for a majority of riparian plant species, when invasive as well as native plants may be more readily observed and identified. This is also the typical dispersal time for bullfrogs and an appropriate time to collect samples for analysis of SOD infected California bay trees. In addition, illicit marijuana plots would require irrigation, so monitors will look for irrigation lines, dams and other signs of water diversion from the perennial streams and pools. Adjacent springs and seeps will be assessed for problems associated with erosion/sedimentation.

4.4.2 SPRING AND SEEP WETLANDS

Management Issues

Threats to spring and seep wetland habitats on the Preserve include the following:

- Invasive plant species (primarily open, sunny areas);
- Human trampling of plants (primarily wooded habitats); and
- Sedimentation (primarily wooded habitats, and partly due to human trampling).

Within open, principally grassland habitats, these wetlands are being invaded along their margins by species such as pennyroyal, bull thistle, and bristly ox-tongue (*Helminthotheca echioides*). Of these, pennyroyal is most abundant and widespread in the wetlands. While none of the invasive plants represent very serious management concerns within the wetlands at this time, proactive management of their spread using the measures presented in **Appendix D** would help protect and enhance the habitats.

In addition, the unchecked build-up of thatch along the edges of the features, especially the less mesic sites, could alter the plant composition and potentially the hydrology in the long-term. These issues should be considered in the Grazing Management Plan with respect to thatch management and the development of water resources. Any development of water resources should include measures to minimize the impact to associated wetlands (e.g., avoid diverting entire water flow) as well as to reduce the colonization of invasive plants (e.g., by minimizing soil disturbance).

The more shaded spring and seep wetlands occurring within wooded habitats have not been significantly colonized by invasive plant species, but several of them intersect existing road/trail routes. There are several of these along Nunns' Canyon Road, adjacent to Calabazas Creek, and one along the road northwest of the large Tasmanian bluegum trees (**Figure 4.1**). Human trampling is preventing the establishment of wetland plants in the portions of these features along the road, and water flowing across the road at a couple of locations is facilitating the transportation of sediment into the stream. This management issue is addressed in **Section 4.10**.

Management Strategies

The following management measures are recommended to protect and enhance spring and seep wetland habitats on the Preserve:

Short-term (Years 1-5)

- **SHM-3: Invasive Weed Control**. See **Appendix D and Section 4.6** for details.
- **SHM-4: Protect from Human Trampling.** Protect spring and seep wetlands from human trampling by routing trails away from wetlands or spanning them (*e.g.*, boardwalks, bridges). See **Section 4.10** for details.
- **SHM-5: Avoid Diverting Water Flow.** Avoid diverting total water flow from any spring developed for livestock grazing development (if reintroduced to the Preserve).

- **SHM-6: Avoid Soil Disturbance.** Soil disturbance would be avoided at any spring by eliminating direct access by livestock and creating appropriate watering stations for grazing livestock (if reintroduced to the Preserve).

Monitoring

The spring and seep habitats within or adjacent to open grassland will be monitored once a year for non-native weed infestations (**Figure 4.1**). Standardized photographic points will be established to document the extent of infestation. Monitoring will be conducted in July, during the peak bloom for a majority of invasive plants in these habitats. Assuming measures are taken to address problems with erosion and sedimentation along springs and seeps intersecting the road, it is unlikely that the features will be impacted, but incidental monitoring (i.e., concurrent with other monitoring on the Preserve) will be conducted to assess impacts for human or natural erosion and sedimentation problems.

Spring and seep habitats within wooded areas can be monitored less frequently — on the order of every five years, since there are no significant invasive plant infestations. Springs and seeps adjacent to streams will be monitored as part of annual riparian habitat monitoring, as an assessment of sedimentation will involve assessment of these habitats.

4.4.3 OAK HABITATS

Management Issues

The protection and enhancement of oak habitats, important for maintaining native wildlife and plant diversity, involves minimizing the threats to these habitats, and restoring impacted areas. Oak habitats are particularly important for wildlife — as **Table 2.1** shows, oaks support the greatest diversity of vertebrate animal species among all habitats on the Preserve, especially when accounting for oak-dominated riparian habitats. The special-status Nuttall's woodpecker is among the many species on the Preserve that depends on open oak woodlands for foraging habitat (Burridge 1995).

Threats to oak habitat on the Preserve include the following:

- SOD, primarily to Coast Live Oak Woodland and especially within dense, mesic woodland with high cover of California bay;
- Douglas fir encroachment to Coast Live Oak Woodland, Oregon White Oak Woodland, Interior Live Oak Woodland, and other un-mapped oak habitats;
- The build-up of fuels, which could result in high intensity, crown fires capable of killing oaks and other fire-resistant species;
- Competitive interaction between seedlings and tall, dense grasses; and
- The presence of invasive wild turkeys, which is likely contributing to a decline in the number of acorns available for oak regeneration on the Preserve.

Management Strategies

Management strategies to address the major threats to oak habitat on the Preserve are addressed in other sections of this report. They are summarized below. Refer to the appropriate section for additional details. The following measures are recommended to protect and enhance oak habitats on the Preserve:

Short-Term (Years 1-5)

- **SHM-7: SOD Best Management Practices** (see PC-6 through PC-10). Implement best management practices to prevent the spread of SOD (see **Section 4.3.3**). To the extent feasible:
  - » Identify and remove dead or dying oaks as well as surrounding California bay trees, particularly in more dense woodland to reduce SOD and improve ecosystem heath.
  - » Thin additional bay trees within dense, non-riparian woodland, preferentially from areas adjacent to high acorn-producing oaks in order to improve overall ecosystem health.
  - » Proactively cut or prune California bay trees around particularly desirable "heritage" coast live oaks, and/or those that may pose a hazard to people and/or infrastructure if infected by SOD.

» Identify forest stand conditions where species vulnerable to Sudden Oak Death (i.e., coast live oak, tanoak, madrone, etc.) are more susceptible to infection. Implement a stand management prescription that will increase spacing between stems of these vulnerable species and reduce immediate contact with known carrier species like California bay trees. This treatment should be applied in areas where SOD has been documented and potential for spread is high due to forest stand conditions (closed canopy, high moisture (i.e., north slope), poor circulation, suppressed trees, high basal area of California bay near vulnerable species.

- **SHM-8: Manage Douglas Fir Encroachment** (see PC-5). To the extent feasible, larger Douglas fir saplings and poles would be manually removed and mature Douglas fir stems would be girdled within and immediately surrounding oak woodlands. The Oregon Oak Woodland would be prioritized due to limited acreage and lower recruitment on the Preserve (see **Section 4.3.3)**.
- **SHM-9: Manage Invasive Wildlife** (see IAM-2). Reduce or eliminate the wild turkey population within the Preserve (see **Section 4.9)**.

Medium-Term (Years 6-10) or Long-Term (Years 11+)

- **SHM-10: Restore Oaks.** In addition to these protection/enhancement measures, it may be prudent to initiate restoration of oaks within heavily degraded habitats. Acorns, seedlings, or saplings (depending on budget) may be planted within open woodland habitat to replace dead oaks or to augment recruitment in areas of primarily senescent trees. The genetic stock used in restoration should be collected from trees found within the Calabazas creek watershed, and for coast live oaks, from stands apparently unaffected by SOD. Tubing or cages should be installed around the planted oaks, to protect from browsing and trampling of animals, especially if livestock is introduced to the Preserve, and weed mats should be installed and maintained to minimize competition. Acorn collection and planting methods should follow guidelines established in oak restoration manuals (e.g., McCreary 2009; California Department of Fish and Game 2010).

Monitoring

Oak habitats will be monitored annually to identify the presence of SOD, negative impacts of invasive wildlife, and to evaluate the success of any habitat enhancement efforts. Given the extensive area of susceptible forested habitat on the Preserve, the establishment of a standardized number of stratified random survey points may be advisable (e.g., 10 to 20 points per oak association). Because the leaves should be collected prior to the driest time of year (the fall), monitoring surveys and SOD sample collections will occur in the late spring/early summer. Periodic monitoring of chaparral stands for signs of *Phytophthora* infections will also be conducted. In addition, the most recent high-resolution aerial photography available for the Preserve can be used to identify SOD-infected areas, and those areas can then be preferentially targeted for field surveys. Line transects are not recommended due the inaccessibility of large portions of the habitats, especially the Coast Live Oak Woodland. Additional randomized points should be established in the event that some points are inaccessible. The primary threats listed above will be assessed, along with relative recruitment success and the overall health (e.g., relative abundance of seedlings and saplings and number of dying oaks, etc.) of each surveyed stand.

California bay leaves with discolored tips should be collected in potentially infected areas, and the samples submitted for analysis at either the U.C. Cooperative Extension program in Sonoma County, or to the SOD lab at U.C. Berkeley. Public "SOD Blitz" events, which are organized by the two organizations above and which typically take place in early summer, may represent a cost-effective option for monitoring SOD on the Preserve (as was conducted in 2013). The UC Berkeley OakMapper program can assist in mapping and tracking the presence of SOD and share locations of confirmed cases within the Preserve.

4.4.4 REDWOOD FOREST

Management Issues

Redwood Forests on the Preserve are generally in good condition. Accumulation of undergrowth is minimal and, with the exception of occasional stands of Himalayan blackberry along Calabazas Creek, invasive plants are limited. Redwoods are successfully reproducing via sprouting as well as by seed, though

the establishment of seedlings could be adversely impacted by the presence of Himalayan blackberry.

Key threats to Redwood Forest on the Preserve include:

- Encroachment of Himalayan blackberry; and
- Encroachment of Douglas fir.

Forest management in the context of redwood management primarily involves thinning Douglas fir trees to reduce competition, as well as the regulation of undergrowth (i.e., vegetation and litter). Experiments conducted in Redwood National Park showed that selectively removing Douglas fir improved redwood reproduction and vigor (Teraoka 2012). However, because redwoods are generally reproducing and growing well on the Preserve, removing Douglas fir would represent more of an enhancement measure than a protection measure. Likewise, the growth of other trees and shrubs in the understory among redwoods is not so problematic that redwood seedling growth is being hindered, though as noted above, the spread of Himalayan blackberry is a potential concern.

Climate change and alterations to surface hydrology and sedimentation regimes on the Preserve represent potential threats to stands of coast redwoods. A number of climate models predict a reduction in precipitation and summer fog in northern California, which would result in the decline of redwoods in the long-term (Bradbury and Firestone 2012). In terms of surface hydrology and sedimentation, erosion of silty soils along stream banks and/or terraces could result in exposure of the relatively shallow roots of redwoods, rendering them susceptible to *windthrow*. Likewise, severe flooding could replace silty soils with coarser materials that are too well-drained to support redwoods, which grow best in fine-grained silt.

The control of Himalayan blackberry is addressed in **Section 4.6** below. Prescribed burns within redwood habitat would simultaneously eliminate Douglas fir seedlings and clear other undergrowth, thus benefitting redwood reproduction and vigor. Since mature Douglas fir are not killed by low-intensity fire, these would require felling and/or girdling, as described in **Section 4.3.3** above. With the exception of controlling Himalayan blackberry, these actions should not be considered a high priority at this time.

Finally, since coastal redwoods tend to produce extensive, superficial roots, maintenance roads or trails can damage these root systems. Trail planning should avoid routes that may pass over redwood root systems and management activities should avoid compacting soils within redwood stands.

Management Strategies

Protecting and enhancing the Redwood Forest habitat on the Preserve primarily involves appropriate watershed management and forest management, including the control of invasive plant species. The following management measures are recommended to protect and enhance Redwood Forest on the Preserve:

Short-Term (Years 1-5)

- **SHM-11: Manage Himalayan Blackberry and Other Invasive Plants** (specific strategies can be found in IPM-1 to IPM-15). Prevent the establishment of Himalayan blackberry and other potentially invasive plants along stream terraces and adjacent hill slopes (see **Section 4.6**).

Long-Term (Years 11+)

- **SHM-12: Monitor Douglas Fir/Redwood Density.** Monitor Douglas fir/redwood density and spacing to determine if redwood stand health is adversely impacted by competition. (see **Section 4.3.3**).

Monitoring

- Redwood Forest on the Preserve should be monitored concurrently with riparian monitoring, as described above. Assuming riparian weeds are being monitored annually (including monitoring of Himalayan blackberry), a monitoring schedule of every five years should be sufficient to assess competitive interactions between redwoods and other plant species. Monitoring should include an assessment of competition from Douglas fir, the build-up of undergrowth among redwoods, the level of redwood recruitment, and general stand health. Monitoring of redwood stands should include direct impact on superficial root systems from public access or other management activities.

4.4.5 SPECIAL-STATUS MANZANITA HABITAT

Management Issues

While sensitive manzanita habitat on the Preserve is in generally good condition and is protected from development, a number of threats have the potential to impact these habitats on the Preserve, including:

- Potential future road and trail construction;
- Impacts associated with illicit marijuana cultivation (cutting of shrubs, application of herbicides, clearing of understory and leaf litter, induced soil erosion, etc.);
- Lack of regeneration due to the absence or suppression of fire;
- Encroachment of tree species into habitat (which can shade out manzanitas) due to absence of fire; and
- Potential for infection from *Phytophthora* pathogens.

Trail planning and public access should avoid manzanita habitat. Trail construction through this habitat type can lead to diminished wildlife habitat by reducing foraging and cover for prey. Exposed soils during trail construction can lead to introduced invasive species that can out-compete manzanita and other species for light, nutrients and moisture. Finally, use of manzanita habitat by humans can flush wildlife from a traditionally used habitat and reduce the viability of retaining certain populations of animals within the Preserve.

In order to clear areas for planting and to thin canopies for their crops, trespassers have cut large numbers of manzanitas on the Preserve, especially common manzanita (which grows on slightly richer soils). And like most other manzanita habitats on the Preserve, these cleared areas are not regenerating because their fruits/seeds require scarification and chemicals associated with heat and smoke in order to germinate (Keeley 1987). The lack of regeneration among manzanitas is being compounded by the encroachment of tree species on portions of the Preserve, particularly coast live oak, California bay, and Douglas fir, which historically were kept at bay by crown fires and "controlled" burns managed by native Americans.

Another management issue that has the potential to become problematic is the introduction of *Phytophthora* species that are known to kill manzanitas. Like *P. ramorum*, of Sudden Oak Death infamy, *P. cinnamomi* and *P. cambivora*, are causing significant mortality among manzanita species as well as other plants such as Pacific madrone (Swiecki et al. 2011, Swiecki pers. comm.). While *P. cinnamomi* is more common in California, *P. cambivora* has been shown to specifically infect hoary manzanita and Stanford's manzanita, and stands of these species have been found infected in Napa County — though no symptomatic manzanitas have been identified in Sonoma County (Swiecki pers. comm.).

In general, the motivation to protect manzanitas is driven by their importance to wildlife — their berries are consumed by many animals, including foxes, coyotes, bears, and a wide variety of birds (e.g., Van Dersal 1938). The shrubs are also valued for their aesthetic appeal as well as their remarkable phenotypic and taxonomic diversity.

Management Strategies

In addition to **Section 4.3.2**, the following management measures are recommended to protect and enhance Stanford, Common, and Hoary Manzanita Chaparral Habitats:

Short-Term (Years 1-5)

- **SHM-13: Manage the impacts of *Phytophthora*** (see PC6 through PC-10). Proactively prevent the spread of *Phytophthora* pathogens on to the Preserve (follow best management practices outlined in **Section 4.3.3**). With regard to *Phytophthora* pathogens, the most effective management strategy is to proactively avoid infection of manzanitas. As with *P. ramorum*, there is no "cure" for *P. cinnamomi* or *P. cambivora*, only treatment of individual shrubs using fungicide phosphonate (same as used for treating SOD). The same best management practices as suggested for SOD apply to these other species, which are also soil-borne pathogens that thrive in moist conditions. Ideally, a sanitary station for cleaning soils and plant debris should be installed at the staging area and/or trailhead, and visitors should be notified of the presence of potential

pathogens in the area, and of the importance of sanitation measures in preventing their spread.

- **SHM-14: Discourage Illicit Marijuana Cultivation.** Implement management strategies for discouraging illicit marijuana cultivation and other potential human impacts to manzanitas primarily involve monitoring efforts to detect the presence of such trespassers (see section **Section 4.10**).

Long-Term (Years 11+)

- **SHM-15: Prescribed Burns.** If feasible, over the long-term, implement prescribed burns to reduce or eliminate Douglas fir and California bay tree encroachment and stimulate seed germination among targeted manzanitas. The use of prescribed burns would be the most effective solution to maintain the long-term viability of manzanita habitats on the Preserve. Many chaparral plant communities are less susceptible to Douglas fir or California bay encroachment because of these plants successfully compete for light and nutrients on such sites. , Manzanitas are more likely to be outcompeted on these sites by such tree encroachments (Dunne and Parker 1999), eventually leading to habitat degradation. Fire would simultaneously eliminate encroaching trees (larger trees may need to be manually cut or girdled) and stimulate the germination of the seeds of the three obligate seeder manzanitas, thus revitalizing their eponymous special-status habitats.

  Prescribed burns should be conducted during the summer, subsequent to the peak reproductive season for most sensitive plants and animals in the chaparral. Required pre-burn actions may include the construction of a firebreak and/or thinning of brush as appropriate. Any prescribed burns to be implemented within the preserve should be carefully planned and executed by trained fire professionals from CalFire or consulting fire ecologists. Measures should be taken to prevent erosion following prescribed burns, for example by emplacing jute netting or wildlife-friendly wattles and/or seeding with native grasses suitable for chaparral, such as foothill needlegrass (*Stipa lepida*) (which currently occurs in the habitat). Burns should be conducted only periodically, when it becomes clear that trees are encroaching into the habitat.

Monitoring

Monitoring of the sensitive manzanita habitats should be conducted at approximately five-year intervals, in order to assess problems associated with encroachment of trees and invasive plant species. Surveys can be conducted concurrently with special-status plant assessments within chaparral habitats. However, land managers should remain watchful of the potential presence of *Phytophthora* species on the Preserve, which may be manifested by means of large stands of dead or dying manzanitas (Pacific madrones are affected by many other pathogens, so are not reliable indicators of *Phytophthora* infection). Land managers should also continue to look for signs of illicit marijuana cultivations, for example by looking for irrigation tubes during annual creek monitoring and coordinating with the Sheriff's Department conducting flyovers during the grow season (September – November).

4.5 SPECIAL-STATUS PLANTS MANAGEMENT (SPM)

This section summarizes specific threats to special-status plants and presents specific management strategies for minimizing the threats. Detailed information pertaining to management of the primary threats to these sensitive resources is presented in sections above (e.g., succession/habitat conversion) and below (e.g., invasive plant species and human activities).

The special-status plants on the site occur in two broad categories: mixed evergreen and riparian forest, which supports Napa false indigo, and open, rocky chaparral, which supports all of the other four species. Therefore, the protection of Napa false indigo is addressed individually, and protection of the others are addressed collectively.

4.5.1 NAPA FALSE INDIGO

Management Issues

Threats to Napa false indigo on the Preserve include the following:

- Potential impacts from human trampling and road/trail management; and
- Potential competition from invasive plants, particularly Himalayan blackberry and French broom.

Napa false indigo is a shrub that grows to several meters in height, and so is unlikely to be trampled by humans. However, several of these plants grow along the main trail that straddles Calabazas Creek, and so could be accidentally damaged as part of trail maintenance or by unwitting hikers, bicyclists, or equestrians. Shrubs adjacent to the main trail were mapped and flagged with ribbon during the 2013 biological surveys throughout the Preserve.

No invasive plant species with potential to impact the Napa false indigo were observed in the immediate vicinity of the shrubs. The two species with the greatest potential to displace Napa false indigo are Himalayan blackberry and French broom. Extensive stands of Himalayan blackberry grow adjacent to stretches of Calabazas Creek and, though it was not observed on the floodplain that currently supports a large stand of Napa false indigo, it could easily expand to the area from existing stands both up and downstream. French broom is currently concentrated along far southwestern portions of the Preserve, as well as in a few small stands in northern and eastern areas, but this invasive plant species has the potential to spread in the direction of the Napa false indigo. French broom is known to occur adjacent to streams and within mixed evergreen forest habitat.

Management Strategies

In addition to the measures recommended in **Section 4.4.5**, additional recommended strategies to protect Napa false indigo on the Preserve include the following:

Short-Term (Years 1-5)

- **Special Plant Management (SPM)-1: Protect Shrubs along Existing and Future Trails**. Avoid impacts to shrubs along edge of existing and future trails. Color metal tags could be a practical method of demarcating shrubs along existing or potential trails. Route all trails to avoid Napa false indigo and implement other measures to minimize human impacts. Any additional potential trails on the Preserve, particularly within the vicinity of mapped special-status plants, should be surveyed for special-status plants prior to finalizing their alignments.
- **SPM-2: Control Invasive Plants in Sites Where Napa false indigo is Present.** Prevent encroachment of Himalayan blackberry, French broom, and other potential invasive plants. See Section 4.6 for details.

Monitoring

No specific schedule is necessary for monitoring Napa false indigo on the Preserve, but individuals and stands along trails and riparian habitats may be incidentally assessed during monitoring of other sensitive biological resources (e.g., riparian corridors and special-status wildlife).

4.5.2 SPECIAL-STATUS PLANTS OF CHAPARRAL HABITATS

Management Issues

The primary threats to special-status plants of chaparral habitat on the Preserve include the following:

- Potential impacts from human trampling and road/trail management;
- Potential competition from invasive plants, purple false brome, red brome, and cheat grass; and
- Potential habitat conversion or degradation of chaparral due to encroaching tree species.

The majority of the stands of these sensitive species occur in remote, inaccessible habitat. For example, stands are located along the edges of large volcanic rock outcrops or within openings among dense chaparral. However, a few individuals of narrow-flowered California brodiaea and Napa biscuitroot occur along the edges of the existing northern access road as well as along an older trail-like road near the western edge of the site (**Figure 2.4**). While the latter of these is currently just a game trail, the northern access road is currently used on occasion by vehicles and is being considered as part of a trail alignment on the Preserve. Since the few special-status plants in these areas are restricted to the very edges of the trails/road, mostly under shrubs, they are not threatened by current activities.

While the rocky, shallow soils preferred by all of these species tends to be very sparsely vegetated and dominated by native plants, there are invasive plants that occupy the habitat. Mostly these

consist of annual grasses such as nit grass, purple false brome, and red brome (*Bromus madritensis*). Of these, only purple false brome is notably widespread in these habitats, and it is so well naturalized on the site that controlling it is impractical. Conversely, cheat grass is a species with potential to cause significant impact to these special-status plants, and its distribution is currently fairly limited. The eradication of cheat grass should be a management priority for the Preserve (see section 4.6.1).

In addition, the encroachment of trees into chaparral habitat could impact these special-status plants. All of these require relatively open, sunny habitat. Therefore, the conversion or degradation of chaparral in the long-term could detrimentally affect these species. Prescribed burns are likely the most effective management tool for maintaining healthy chaparral habitat.

Management Strategies

In addition to measures outlined above in **Section 4.4.5**, recommended measures to protect special-status plants of chaparral habitat on the Preserve include the following:

Short-term (Years 1-5)

- **SPM-3: Protect Special-Status Plants along Existing and Future Trails and Roads.** Avoid tramping or other human impacts (e.g., road/trail improvement) along the edges of trails and roads. In the event that these access routes require grading or maintenance, the rare plants should be temporarily flagged and, to the degree possible, protected from any potentially damaging activities. Route all new trails to avoid special-status plants and implement other measures to minimize human impacts.
- **SPM-4: Manage Invasive Plants in Chaparral Habitat.** To the extent feasible, prevent the encroachment of invasive plants, such as purple false brome, red brome, and cheat grass, into stands of rare plants (see **Section 4.6**).

Monitoring

No specific schedule is necessary for monitoring these special-status plants on the Preserve, but individuals and stands along roads/trails may be incidentally assessed during monitoring of other sensitive biological resources (e.g., chaparral habitat and special-status wildlife).

4.6 INVASIVE PLANTS MANAGEMENT (IPM)

4.6.1 CHEAT GRASS

Cheat grass (*Bromus tectorum*) occurs predominantly on thin, rocky volcanic soils within the Preserve (openings within woodland). Given the limited extent of its preferred habitat, it is not expected to become widely established. However, this habitat is also the primary habitat for three of the four special-status plants documented on the Preserve (all but Napa false indigo) and supports a high diversity of other native plant species largely restricted to this habitat. Therefore, the spread of this species could negatively impact special-status and native plant species diversity.

Treatments to address cheat grass populations are limited. Non-specific herbicides such as glyphosate (Roundup®) carry the risk of collateral damage to nearby special-status and native plants since the timing of application would likely coincide with critical growth stages of several of these plants. While grass-specific herbicides are available, including lipid synthesis inhibitors made from active ingredients Clethodim and Fluazipof, they are not generally registered for use in natural areas. Fire and heavy grazing tend to increase the cover of this species while moderate grazing in combination with herbicides may help control infestations (DiTomaso and Kyser 2013). Grazing, however, is probably not widely feasible since many of the thin, rocky soils where cheat grass occurs are not within open grassland habitats but are along ridges and outcrops, often within chaparral habitats.

Management Strategies

Short-Term (Years 1-5)

- **Invasive Plants Management (IPM)-1: Hand Pulling.** Since the populations are currently limited and given their setting, the most effective management method may be hand pulling. This should be done in early spring before seeds are ripe but after the plants have germinated and matured to ensure additional germination does not occur after the treatment. Viable seeds can remain for two to three years in the soil so the hand pulling would need to be repeated for at

least three consecutive years. Also, the effort would need to be thorough. This could be done as part of an overall annual monitoring regime.

4.6.2 FRENCH BROOM

Small, isolated patches of French broom (*Genista monspessulana*) weed currently occur on the Preserve along the graded roads, main trails and in a few isolated locations on the fringes of woodlands (**Figure 4.1**). Currently this species appears to have limited occurrence within the Preserve and does not have a significant impact on the resources. However, District staff has noticed a presence of healthy population of French broom in the Quarry and spots along Nun's Canyon road — essentially outside of the Preserve. If the species spreads — as it is prone to do — it would degrade or displace existing chaparral and grassland habitats and reduce the aesthetic qualities of the site. This species is a prolific seeder and is highly aggressive on disturbed sites and once it is established on a site it has the propensity to outcompete most native vegetation with few natural predators or competitors to restrict its growth.

Management Strategies

Short-Term (Years 1-5)

- **IPM-2: Integrated Management Approach.** Due to the current sparse and localized infestation of this species, eradication is feasible with focused effort. The most cost effective and viable treatment is likely mechanical removal using a weed wrench. Care must be given to time removal prior to seed dispersal and disturb the soil as little as possible to prevent viable seeds to penetrate more deeply into the ground, complicating on-going eradication efforts. Typically plants with stems less than 1 inch diameter can be easily removed in the spring with the soils are soft. Alternatively, an integrated approach that involves herbicide treatment to kill shrubs, followed by cutting and burning, if feasible, of dead shrubs, and continuing herbicide treatment or cutting of new sprouts for several years until the seed bank has been exhausted. Surveys should be conducted throughout the site for any additional unmapped stands not detected during the surveys for this Plan. Eradication efforts should focus first on the small, incipient stands along the edge of the eastern grasslands and edge of the northern road (**Figure 4.1**) in order to prevent these stands from becoming less manageable.

Medium-Term (Years 6-10)

- **IPM-3: Assess Other Treatments for Controlling French broom.** If manual removal is unsuccessful, such treatments as propane flaming could be tested to effectively reduce the threat of this plant. A relatively recent innovation in treating French broom, which does not disturb the soil, is the use of a propane "flaming" torch to kill seedlings of this and other broad-leaf invasive plants. The technique does not involve the use of an actual flame, but simply heat, which is used to destroy the cell walls of *cotyledons* or leaves of very young seedlings. The technique does however need to be employed during or shortly after a rain event, in order to eliminate the chance of accidently starting a fire. The only other limitation is that it is not effective for treating invasive "*monocots*" or plants that spread via vegetative features (e.g., rhizomes), such as invasive grasses or Himalayan blackberry. If conducted several years in a row, flaming can be highly effective in eliminating species such as French broom, and should be considered for controlling population on the Preserve. The following video presents a detailed tutorial on the use of flaming for eliminating French broom: http://www.cal-ipc.org/fieldcourses/videos/flaming.php

Regardless of the control method chosen, efforts should be carried out each year before seed pods are formed, to prevent adding that year's production to the seed bank. The plant begins to produce seeds at approximately two to three years of age.

Monitoring

After initial control, on-going monitoring for early detection of new or re-established invasions and rapid response efforts to eliminate them could lead to the eradication of this species from the site.

4.6.3 HIMALAYAN BLACKBERRY

Himalayan blackberry (*Rubus armeniacus*) is of significant concern on the Preserve, where it occurs in small to large stands primarily along the upland edges of Calabazas Creek (**Figure 4.1**). The special-status Napa false indigo grows along portions of the stream

terrace and thus is vulnerable to being displaced by Himalayan blackberry, which grows both upstream and downstream of this plant. Though the berries of this plant are consumed by a number of animals, extensive stands can be detrimental to wildlife movement, and excessive shade cast along streams banks would reduce basking/foraging habitat for foothill yellow-legged frog (Hayes and Jennings 1988).

Management Strategies

Short-Term (Years 1-5)

- **IPM-4: Mechanical Removal of Himalayan Blackberry.** Where the stands of this species are small, hand pulling or limited mechanical removal of blackberry shrubs is recommended. Removal efforts should focus first along more central portions of the Preserve, where large stands of Himalayan blackberry grow adjacent to and above the stream. Care must be taken to remove all plant parts to reduce re-sprouting, and also to minimize soil disturbance, since this could result in erosion and also facilitate colonization of other weeds on the site. Any existing native plants should be left in place.
- **IPM-5: Herbicide Treatment for Himlayan Blackberry.** Larger thickets may require more intensive mechanical treatment coupled with herbicide application (Bennett 2007). The selected herbicide needs to be safe and approved for application adjacent to water (DiTomaso and Kyser 2013) such as Rodeo®.
- **IPM-6: Plant Native Riparian Shrubs.** In addition, treatment areas should be planted with native shrubs in order to reduce erosion as well as to shade out the blackberry in the long-term. Thimbleberry, a mid-sized shrub with large leaves and berries that are consumed by a variety of animals, currently grows in similar habitat on the site and could compete with the blackberry. If possible, larger, more mature shrubs should be planted within treatment areas, though this is a more expensive and labor-intensive option compared to seed planting. All plants should be protected from herbivores for the first two years of establishment phase.

Monitoring

On-going monitoring and maintenance is the key to preventing re-establishment in treated areas and establishment in new places, especially since birds can disperse seeds far from existing stands (DiTomaso and Kyser 2013).

4.6.4 PURPLE PAMPAS GRASS

A few large, individual purple pampas grass (*Cortaderia jubata*) plants occur in the quarry area on the Preserve (**Figure 4.1**). As such, it currently has very limited impact on the Preserve, but this impact would increase if it became more widely established.

Management Strategies

Short-Term (Years 1-5)

- **IPM-7: Mechanical Removal of Purple Pampas Grass.** Due to the limited extent of this weed in an area that is already highly disturbed, mechanical control using mechanical equipment (such as a small backhoe) may be the most effective treatment option to ensure complete removal of the entire plant. Removal should be conducted before seeds develop to prevent spreading of seeds during the removal process. Follow up monitoring and removal of any seedlings is an important additional step to ensure that this plant is eradicated from the site. Due to its very limited distribution on the Preserve, complete eradication of purple pampas grass is possible with relatively little effort. Therefore this effort should be given priority.

4.6.5 SWEET FENNEL

The distribution of sweet fennel (*Foeniculum vulgare*) is currently limited on the Preserve to the quarry area (**Figure 4.1**). As such, it currently has very limited impact on the Preserve but this impact would increase if it became more widely established.

Management Strategies

Short-Term (Years 1-5)

- **IPM-8: Mechanical Removal of Sweet Fennel.** Mechanical removal by digging out individual plants and slashing just before flowering are the most effective physical methods available when infestations are locally restricted. Repeated removal and slashing of re-growth may

be required until the seed bank is exhausted. Due to its very limited distribution on the Preserve, complete eradication of sweet fennel is possible with relatively little effort.

4.6.6 YELLOW STARTHISTLE

Yellow starthistle (YST) (*Centaurea solstitialis*) is the most widespread problematic weed on the Preserve and also the most threatening in terms of ecological impact. It occurs primarily within open grasslands though there are limited stands in or near open woodlands with a grassland understory. There are scattered medium to large stands within the grasslands in the central and southern portions of the site (**Figure 4.1**). These stands occupy 15 acres or roughly 10 percent of the grasslands, representing a significant infestation. There are also scattered individuals and small, unmapped stands in these areas. The District has attempted chemical treatments of YST since 2010 and has monitored the population every year. The prolific seeding abilities of this plant and the longevity of viable seedbanks have led to some success in controlling YST by chemical means. But, with seed banks capable of surviving 7-10 years — success will not be measureable for a couple more years. However, treatments must remain consistent, especially if the District desires to fully capture the return on its investment into controlling this plant population.

Management Strategies

Short-Term (Years 1-5)

- **IPM-9: Review Yellow Starthistle (YST) Management Guide.** The Yellow Starthistle Management Guide (DiTomaso et al. 2006) is an excellent publication addressing YST ecology, impacts, and management. It is available in PDF form on-line at http://www.cal-ipc.org/ip/management/yst.php. The Preserve manager should review this publication as part of developing and implementing management actions. The management strategies presented below were developed through information provided in this and other publications as well as knowledge gained through other projects with YST control issues.
- **IPM-10: Develop YST Long-Term Integrated Management Plan.** Elimination or control of YST typically requires a long-term, integrated management plan. It is also important to note that YST is highly invasive and can be difficult to control regardless of treatment. In the long-term, livestock grazing, herbicide treatment, and seeding of replacement species are recommended on the Preserve given the size and nature of the infestation and the generally moderate to steep terrain where infestations occur. A Long-Term Integrated Management Plan should be developed that assesses the effectiveness of existing YST treatments on the Preserve to date and makes a long-term management recommendation, taking into account such factors as the current infestation, topography, access and environmental sensitivities of the infestation sites, restrictions on herbicide use, and funding limitations. The management plan should assess and identify the best options for controlling YST, including:

  » **Assess Mowing, Mechanical Removal, and Chemical Treatments.** Identify and assess best short-term options for controlling YST, including mowing, mechanical removal, and herbicide treatment, due to the logistical challenges of grazing and fire in the short-term. Continue to conduct thorough annual surveys and mapping of all significant YST infestations to ensure the control program will comprehensively treat the species. Chemical treatments need to be conducted for two to four consecutive years (depending on effectiveness as determined through annual monitoring). The specific herbicides to be used and the timing of applications should be developed in consultation with a licensed Qualified Applicator.

    All treatment areas should be seeded with replacement species, such as the annual grass species present on the site, to discourage re-establishment of YST. It is unlikely that YST will ever be fully eradicated from the site so the on-going efforts will need to be conducted in perpetuity.

    Herbicides can be applied using a backpack sprayer or boom mounted on an ATV. Many of the YST stands could be treated by ATV; however, the stands on steep terrain can only be accessed on foot. Helicopter spraying is an

option, but not recommend for the site given environmental concerns over herbicide drift and the location of some stands in close proximity to tree stands and sensitive wetland habitats. Four-wheel drive vehicles could also be used for access provided the existing roads are sufficiently improved. Following their use in habitats infested with YST, ATVs should be thoroughly washed down to prevent unintentional transport of seeds to areas without YST infestations.

» **Assess Long-Term Livestock Grazing.** Livestock grazing can be an effective control mechanism though it is usually not sufficient when used alone but must be integrated with other methods (DiTomaso et al. 2006). The plan should assess the feasibility of incorporating grazing onto the Preserve. Grazing needs to be conducted in manner that targets YST at a vulnerable stage. This would be after the plants have bolted in mid to late spring but before they have begun flowering. Either cattle or sheep can be used. To be effective, the livestock can either be grazed throughout the spring and early summer or they can be corralled within specific stands using temporary electric fencing. The latter method is probably the best for the site, especially for the larger stands, given the widespread distribution of the stands and the relatively small number of animals likely needed for the site. The specific grazing prescriptions for YST should be included within the grazing plan developed for the Preserve. Also, it is important to select a grazing operator that is interested and willing to implement the grazing plan as written. Some ranchers are resistant to grazing according to the stipulations of the landowner, which ends up being frustrating for both parties.

» **Assess Long-Term use of Prescribed Burns.** Three consecutive years of prescribed burns conducted in early to mid summer has been shown to greatly reduce the species (DiTomoso and Johnson 2006), and this is recommended if feasible as a long-term management strategy.

IPM-11: Soil Disturbance Should Be Minimized and Exposed Soils Immediately Seeded with Native Plant Stock. Future trail building or road network improvements will likely require soil manipulation and vegetation removal. These sites are highly prone to colonization of YST due to the extensive YST seedbank, longevity of seed viability and aggressive germination and growth of YST. All exposed soils will need to be treated immediately to establish native plants in order to out-compete YST and prevent a population of YST from being established.

Monitoring

On-going annual monitoring and maintenance is the key to preventing re-establishment in treated areas and establishment in new places. After the initial intensive treatments, an on-going integrated monitoring, management and spot eradication program will need to be continued to maintain low levels of infestation and catch new or incipient infestations before they spread.

4.6.7 BIGLEAF PERIWINKLE

Bigleaf periwinkle (*Vinca major*) is found growing along the roadside leading to the trailhead at the Preserve and along the main trailhead and trail (**Figure 4.1**). Though the two populations are small, this species has the potential to spread along riparian and mesic forest habitats on the site and control measures should be implemented as soon as possible.

Management Strategies

Short-Term (Years 1-5)

- **IPM-12: Mechanical Removal of Bigleaf periwinkle.** Manual weeding is the recommended management approach given the limited extent of the infestation. Hand pulling is a very effective treatment for this species but requires complete removal of all stems, nodes and stolons since the plant re-sprouts readily from all of these parts. Repeated treatment and follow up monitoring is necessary to successfully eradicate this plant. The milky sap produced by this plant makes it unpalatable to grazing animals.
- **IPM-13: Herbicide Treatment for Bigleaf periwinkle.** Chemical treatments with a non-selective herbicide like glyphosate can also provide effective control, especially after stem

cutting. Any herbicide treatments would need to be conducted carefully given the proximity of the infestations to Calabazas Creek. A licensed Qualified Applicator is required.

4.6.8 HARDING GRASS

Harding grass (*Phalaris aquatica*) is one of the most abundant weed species found on the Preserve with the most concentrated stands on Neroly Formation substrates in the southeastern portion of the site (**Figure 4.1**). Fortunately, it tends to occur on lower slope positions with deeper, more seasonally moist soils so is confined in its ability to propagate into more *xeric* conditions. Most of the stands are dense and nearly homogeneous, crowding out other plant species. These stands have a lot of biomass given the size of the culms and thus represent a fire hazard when they are dry in summer and fall. It should be noted that Harding grass does provide some beneficial aspects including good forage for both native grazers and cattle as well as habitat for some grassland-oriented animal species.

Management Strategies

Short-Term (Years 1-5)

- **IPM-14: Develop a Harding grass Long-Term Integrated Management Plan.** Control of Harding grass on the site will likely require a combination of treatments. Create a Long-Term Integrated Management Plan that assesses and incorporates the following:
  - » **Mowing**. Mowing is feasible on many of the stands given their proximity to the main access road provided the road is improved enough to allow vehicles to access the site. Mowing should be conducted in mid spring after most growth has occurred but before the plants have flowered.
  - » **Discing and planting native plants.** Cal-IPC suggests that mowing can spread more seed and prefer to disc the invasive population and then plant native grasses.
  - » **Livestock Grazing**. Livestock grazing can also be used to remove biomass, but cattle would likely need to be confined within temporary electric fencing to be effective. Grazing can be conducted throughout the winter and spring.
  - » **Herbicide Treatments.** The goal of both mowing and grazing is to reduce biomass, prevent or minimize flowering, and stimulate new growth that can then be treated with follow-up herbicide treatments. Post-emergent herbicides must be applied to actively growing plants to be effective. Pre-emergent herbicides can also be used, applied to soils. While grass-selective herbicides are available, they are not registered for use in natural areas. Non-selective herbicides can be effective when applied to rapidly growing plants (such as the stimulated re-growth). Collateral impacts to native species can be reduced through application of the chemical with a rope wiper. Herbicide treatments should be developed in consultation with a licensed Pest Control Advisor.
- **Seeding**. Areas where Harding grass has been reduced or eliminated need to be seeded with replacement species to limit re-growth. As noted above, Harding grass is a poor competitor during the germination and early seedling stage and the growth of replacement plants should effectively limit new growth.

Note that while the recommended treatment outlined above seems fairly straightforward, Harding grass is a tenacious weed that can be difficult to control. Several years of on-going treatment may be required to control the existing infestation.

Monitoring

Follow-up with an on-going monitoring, maintenance, and spot-eradication program.

4.6.9 TASMANIAN BLUEGUM

Management Issues

There is one stand of Tasmanian bluegum (*Eucalyptus globulus*) on the Preserve, consisting of several trees, and one lone individual in the same vicinity (**Figure 4.1**). It was likely established by the some of the original homesteaders as a windbreak and based on its current dimensions has thrived on the site. The species provides little value for forage or habitat and likely out-competes native plants for light, nutrients and moisture. However, these individuals represent an element of historical value from the legacy of the homesteaders, it is best that

the stand continue to be monitored and prevented from spreading into native stands or grasslands.

Management Strategies

Short-Term (Years 1-5)

- **IPM-15: Monitor and Control Existing Stand.** The existing stand has been treated in the past to reduce its spread. Hand pulling or use of a weed wrench can be used to remove small seedlings, saplings and small trees, taking care to remove the entire root to prevent stump sprouting. These can also be cut off at ground level and covered in plastic or treated with an herbicide as discussed above.

4.7 SPECIAL-STATUS ANIMAL MANAGEMENT (SAM)

All of the five special-status animals identified on the Preserve were documented primarily within the main canyon associated with Calabazas Creek (**Figure 4.1**). Steelhead trout, foothill yellow-legged frog, and California giant salamander inhabit or breed in the water of perennial streams on the site. Northern spotted owls were identified within mature Douglas fir/coast redwood forest upslope from the stream, within habitat that likely did not burn during the two most recent fires, due to the relatively moist riparian habitat conditions. American peregrine falcons were observed on a large rock outcropping, which has been incised by the stream. Nuttall's woodpecker's were observed in oak woodlands and riparian habitat primarily, particularly within Nunns' Canyon. Therefore, many of the potential threats to the species are associated with human activities and invasive species within or adjacent to the stream.

Detailed information pertaining to management of the primary threats to these sensitive resources is presented in sections above (e.g., erosion/sedimentation and vegetation management) and below (e.g., invasive animals as well as human activities).

4.7.1 FISH AND AMPHIBIANS

Management Issues

The primary threats to special-status fish and amphibians on the Preserve include the following:

- Invasive bullfrogs and potentially additional species (e.g., mosquito fish);
- Potential degradation of water quality from sedimentation and pollution related to natural processes and human activities (e.g., road construction and agriculture);
- Direct and indirect human-related disturbances such as fishing, rock-throwing, collecting, water diversion, refuse disposal, and pets; and,
- Potential alterations to water temperature due to decreased (or increased) canopy cover above streams (e.g., as a result of SOD-induced oak mortality or catastrophic wildfire).

Steelhead trout, foothill yellow-legged frog, and California giant salamander are all highly dependent on clear, cool, permanent running streams and associated stream pools. They also rely on a degree of habitat complexity such as a variety of gravelly and cobbly substrate, moderate woody debris, and a mix of shady and sunny habitats (with each species requiring different degrees of shade — see below). Therefore, significant alterations to hydrologic and sedimentation regimes or to canopy structure can degrade habitat quality for these species.

The invasive American bullfrog, which is present on the Preserve, competes with and preys upon these species to varying degrees. The control of this species is an important component in the protection of these three special-status animals, as addressed in further detail in **Section 4.8** below. In addition, invasive fish species, such as mosquito fish (*Gambusia* spp.), could likely compete with and/or prey upon these species. While not observed during 2013 surveys, and despite the unlikely possibility that the species will be introduced by humans, it could make its way into the Calabazas Creek watershed from adjacent streams.

Human activities can also have both direct and indirect detrimental impacts upon these species. Direct impacts include fishing, rock throwing, collecting, or other disturbance activities. Examples of indirect impacts include water diversions that reduce stream pool depths, as well as stream sedimentation and pollution via road construction and use, illicit and commercial agriculture, and other soil disturbances.

Habitat protection is key to the protection of many of the fish and amphibians within preserve and it starts with understanding the optimal conditions necessary to maintain and enhance this habitat. Baseline studies of water quality and species diversity will allow the land managers to determine what active management measures might be taken to allow special-status species to thrive. Percent canopy cover, water temperature and water quality can be managed by proactively thinning some stands or planting out areas with native plants and eliminating sources of erosion into the stream channels.

Management Strategies

Short-Term (Years 1-5)

Recommended measures to protect aquatic and semi-aquatic species on the Preserve consists of the following measures:

- **Special-Status Animal Management (SAM)-1: Eliminate Bullfrog Populations.** To the extent possible, bullfrog populations should be controlled within and around the Preserve (see **Section 4.9** below).

Photo 28: Calabazas Creek conditions demonstrating high percentage of large boulders indicating high velocity rain events capable of moving significant material.

- **SAM-2: Habitat Protection.** Protection of these species on the Preserve involves protection of their habitat. This habitat protection includes elimination of any illegal water diversions, minimizing stream bank and upland erosion and sediment transport, and ensuring a healthy riparian forest canopy to maintain shade. To the extent feasible, manage riparian canopy so that there are moderate canopy gaps. Ideally, the degree of shade and cool water temperatures should be managed to provide habitat for steelhead trout and California giant salamander, which generally prefer more shade, and foothill yellow-legged frog, which prefers some degree of sun. Measures pertaining to watershed and riparian habitat management are addressed in detail within **Sections 4.2** of this report. See **Section 4.10** for details on eliminating illegal water diversions.
- **SAM-3: Manage Human Activities.** Manage human activities to prevent direct and indirect disturbances to riparian habitat, including trampling and unleashed dogs in riparian areas (See **Section 4.10** for details). Guidelines and regulations should be established and clearly communicated with visitors to the Preserve, indicating that activities such as collecting, fishing, rock throwing, or other disturbance activities are strictly prohibited within the stream zones.

Monitoring

Monitoring for these special-status species should be conducted annually as part of bullfrog control surveys and riparian habitat surveys (see **Sections 4.9 and 4.4.1**). Monitoring should be conducted during the summer (e.g., in July), to maximize the potential to detect invasive bullfrogs. During the monitoring surveys, stream pools should be quietly traversed and binoculars should be used to inspect potential habitat (e.g., stream pools) for special-status amphibians. Pools should be quietly approached and further inspected for amphibian larva and adults as well as fish. The locations of any observed special-status species or invasive species should be recorded with a GPS or on a map, along with population information and habitat notes (e.g., water depth, substrate, and vegetation conditions).

4.7.2 BIRDS

Management Issues

The primary threats to northern spotted owl, American peregrine falcon, and Nuttall's woodpecker on the Preserve include the following:

- Excessive noise (e.g., from vehicles or equipment such as chainsaws) during the February to July breeding season;
- Invasive species such as barred owl (particularly to northern spotted owl);
- Human activities such as rock climbing (particularly to American peregrine falcon); and
- Potential alterations/reduction of preferred habitat and habitat diversity in general.

The primary threat to northern spotted owl, American peregrine falcon, Nuttall's woodpecker, and other birds on the Preserve is human disturbance during nesting season. All bird species, and particularly the two special-status birds of prey, are sensitive to noise during nesting. Decibel levels in the vicinity of nesting spotted owls are actually regulated by the USFWS. Specifically, noise levels exceeding 70 decibels within one-quarter mile of nesting northern spotted owls are considered "harassment" to nesting owls and prohibited from February to July (USFWS 2006).

Figure 2.5 shows the location of the presumed nesting pair of spotted owls on the site, along with a quarter mile (400 meter) buffer around the occurrence. The location is assumed to be sufficiently isolated from any existing or potential trails or other recreational infrastructure that typical human recreational activities are unlikely to affect owl nesting. However, louder noises associated with machines such as chain saws or trail-building equipment could impact owl nesting, and should be strictly prohibited throughout the Preserve during nesting season, especially in the absence of protocol-level nesting bird surveys (which have not been conducted on the Preserve). The potential disturbance to the peregrine falcons is more likely, given the close proximity of their nest to the primary existing trail (Nunns' Canyon road) along Calabazas Creek. Despite the inaccessibility of the nest — which is likely to be re-occupied in the future — it is above the trail on a large rock face, and thus subject to amplified noise levels from the trail.

In addition, birds on the Preserve may be detrimentally impacted by non-human disturbances, in the form of invasive species. Barred owls are known to displace northern spotted owls, and several barred owls have been documented at Annadel State Park, only six miles northwest of the Preserve, so it is possible this species could colonize the Preserve and displace Spotted Owls on the site.

In terms of habitat stability, although the area currently supporting spotted owls on the Preserve was spared devastation during the last two large wildfires, a future catastrophic fire could destroy the mature Douglas fir and coast redwood habitats on the site. A reduction in habitat diversity on the Preserve would also degrade spotted owl habitat, as the species requires not only nesting habitat, but foraging habitat, for example in the form of oak woodlands with abundant wood rats (Diller et al. 2012). The degradation of oak woodland habitats on the Preserve would directly impact Nuttall's woodpecker, which is signficantly dependent upon oak habitats.

Finally, though the problem may be resolved with greater activity on the Preserve, rodenticide products have been found within the marijuana grow camps. The bioaccumulation of such toxic products could impact birds of prey, in addition to direct reduction of prey populations.

Management Strategies

Short-Term (Years 1-5)

The following measures are recommended to protect special-status bird species on the Preserve:

- **SAM-4: Manage Noise.** Prevent disturbance to nesting birds by prohibiting noisy activities during the nesting season (from February to August). Pre-activity nesting bird surveys should be completed prior to initiating activities like mowing or trail construction.
- **SAM-5: Manage Human Activities**. Rock climbing in peregrine habitat would be strictly prohibited in nesting areas during the nesting season (February 1 to July 15) so as not to disturb peregrine falcons. Any other activity along the trail would be limited during the nesting season or signage would posted along the trail requesting silence within several hundred yards of identified nests Ideally, activity along the trail should be limited during the nesting season (February 1 to August 1), or at the very least, perhaps a sign requesting silence within several hundred yards of the nest should be posted along the trail.

- **SAM-6: Manage and Enhance Habitat**. For northern spotted owl, maintain habitat matrix consisting of mature Douglas fir/coast redwood forest for nesting and other habitats for foraging (e.g., oak woodlands). Manage ladder fuels and prevent the conversion of oak woodlands and other habitats to Douglas Fir Forest. For other raptors, maintain open grassland habitat for foraging. For Nuttall's woodpecker, manage and enhance oak woodland habitats (e.g., reduce SOD and woody fuels buildup and prevent encroachment of Douglas fir).
- **SAM-7: Manage Invasive Species.** Prevent colonization of the Preserve by barred owls (see **Section 4.9** below)

Monitoring

Monitoring of special-status birds should be conducted biannually on the Preserve, in order to confirm the presence and distribution of northern spotted owl, American peregrine falcon, other raptors, and other potential special-status birds. Monitoring surveys should focus on habitats known to support northern spotted owls and American peregrine falcons, such as late-seral redwood and Douglas fir forest and cliffs, and should include efforts to detect the presence of barred owls on the site. Monitoring should be conducted by biologists with sufficient experience and knowledge of the ecology and biology of birds of prey to detect such species. Protocol-level surveys are not necessary as along as disturbance activities are limited to timeframes outside the nesting season, from February to mid-July.

4.8 CRITICAL HABITAT CORRIDORS (HC)

It is recommended that any future trails or heavy human use be restricted along the most critical habitat corridors to protect wildlife including mountain lion, Gray fox, and bobcat. Ideally these corridors would eventually connect the Preserve to the larger protected open spaces in the region. The mountain lion home range size noted above exemplifies that fact that some animals require suitable habitat well beyond the Preserve boundaries — and even animals with smaller home ranges need to be able to disperse to other suitable patches of habitat to maintain population viability. Coarse-scale public vegetation data and aerial photography covering the region (see **Figure 2.6**), as well as CNDDB data and species lists from other nearby regional preserves, confirm that similar habitat types are widely distributed throughout the vicinity of the Preserve. However, lands between the Preserve and other protected areas, such as Sugarloaf Ridge State Park to the north and Bouverie Wildlife Preserve to the south, are vulnerable to habitat conversion.

Management Strategies

Short-Term (Years 1–5)

- **Habitat Corridors (HC)-1: Map Habitat Corridors on Preserve**. Based on a study of wildlife habitat and corridors in the region (see Management Recommendation HC-2), a Trail Plan would be developed to address future trails or heavy human activity along the most critical habitat corridors to protect wildlife, including mountain lion, gray fox, and bobcat. Incorporate the Bay Area Linkages and other habitat corridor work (Hilty & Merenlender, 2004).

Medium-Term (Years 6–10)

- **HC-2: Identify Regional Habitat Corridors and Protection Strategies**. Given the patchy distribution of native habitats in conjunction with mines, agriculture, housing development, and associated roads south of the Preserve, wildlife corridors linking the site with other protected areas will require more study. Identify essential habitat and wildlife corridors linking the site with nearby protected habitat and recommend strategies for protection, facilitating the long-term preservation of wildlife in the area. Following up on a study of wildlife habitat and corridors in the region conducted by Merenlender et al. (2010) and additional wildlife camera studies along potential corridors (e.g., along ridges and riparian corridors featuring fewer developments, fences, roads, and the like) on and adjacent to the Preserve (as permitted by other landowners) would augment wildlife distribution and migration corridor data.

4.9 INVASIVE ANIMALS MANAGEMENT (IAM)

Two animal species were identified on the Preserve that are known to detrimentally impact sensitive biological resources. These include:

- American bullfrog (*Lithobates catesbeianus*); and

- wild turkey (*Meleagris gallopavo*).

These two species were identified during the 2013 biological surveys conducted on the site and are discussed.

4.9.1 AMERICAN BULLFROG

Bullfrogs (*Lithobates catesbeianus*) were observed at two locations along the eastern stretch of Calabazas Creek on the Preserve (**Figure 4.1**). Only one individual was observed at each location, and both were juveniles. They were observed adjacent to stream pools, and were probably waiting for prey. Despite the observed small populations of American bullfrogs on the Preserve, the species presents a significant management concern for California yellow-legged frog, California giant salamander, and other species occurring or with potential to occur on the Preserve.

Bullfrogs typically require perennial ponds, or deep, slow-moving perennial stream pools for breeding, as metamorphosis to the juvenile/sub-adult stage requires one to two years. Surveys conducted in 2013 did not detect bullfrog breeding on the Preserve; however juvenile bullfrogs were detected in the upper reaches of Calabazas Creek (**Figure 4.1**). Juvenile bullfrogs often migrate away from their natal ponds and shelter in smaller aquatic habitats until they are large enough to migrate back to breeding ponds. The property is bordered by a number of farms that store water in large ponds. These ponds likely serve as bullfrog breeding habitat, from which juvenile bullfrogs migrate onto the Preserve.

Since eradicating bullfrogs from a network of large perennial ponds, which are not owned by the District, is likely to be impossible, the best course of action in this case is to ensure that no bullfrog-breeding habitat exists on the site. Fortunately, Calabazas Creek naturally has high winter flows that prevent bullfrogs from breeding there. The goal of maintaining natural hydrology for foothill yellow-legged frog also serves to help prevent the establishment of non-native species. As long as no significant impoundments are made in the streams on the Preserve, and no other perennial ponds are created, bullfrog populations on the site should be limited to a relatively small number of dispersing juveniles.

Management Strategies

Short-Term (Years 1–5)

- **Invasive Animals Management (IAM)-1: Bullfrog Eradication**. If annual monitoring identifies bullfrogs, eradication efforts should be implemented. Ideally, eradication efforts should be combined with detection surveys, such that detected bullfrogs are exterminated upon capture. Per Title 14 of the California Code of Regulations (COAL 2013) and the CDFW "Freshwater Sport Fishing Regulations" (2013), capturing or killing any wildlife requires a CDFG permit and/or hunting license. A sport fishing license would be required to kill bullfrogs, however, there are no restrictions on the timing or capture/kill number for the American bullfrog, and they may be taken by hand, dip net, hook and line, lights, spears, gigs, grabs, paddles, bow and arrow, or fishing tackle. It is unlawful to use any method or means of collecting that involves breaking apart of rocks, granite flakes, logs, or other shelters in or under which amphibians may be found (*ibid*).

Medium-Term (Years 6–10)

Photo 29: Silt fencing can be used as an exclusionary fencing option to prevent bullfrogs from entering in native amphibian habitat.

- **IAM-2: Exclusion Measures to Control Bullfrog Population.** If bullfrog populations appear to be increasing and thus likely to present a major threat

to native amphibians on the site, exclusion measures such as wildlife exclusion fencing may be the most efficient means of reducing the impact of bullfrogs. Exclusion fencing should be used only as a last resort, because it is expensive to install and maintain, and because it restricts the movements of native wildlife as well as invasive species. If it is determined that exclusion is needed to exclude bullfrogs, surveys should be performed to locate the source of migrating bullfrogs (or other invaders), and fencing should be installed only along the edges of the property that borders the source population. Drift fencing may facilitate the identification of the source population, since frogs tend to travel in straight lines. Exclusion fencing installed on Contra Costa Water District property near the Los Vaqueros Reservoir has been successful in drastically reducing bullfrog populations there (Alvarez pers. comm.). Exclusion fencing was installed in a "C" or "V" shape at migration corridors, with the bent ends facing away from foothill yellow-legged frog ponds, such that the frogs are re-directed away from these ponds. The District should also make efforts to identify the bullfrog source population and coordinate with neighboring landowners of properties to initiate control measures (e.g., hunting, trapping, or temporarily draining breeding ponds).

Monitoring

Annual monitoring of the bullfrog population should be conducted to detect and quantify bullfrog populations. The optimal timeframe for detecting the presence of bullfrogs is during summer (i.e., July or August), as adults tend to call more during this time, and a majority of juveniles are emerging and dispersing from breeding ponds. Surveyors should be very familiar with identification of American bullfrogs versus frogs such as foothill yellow-legged frog, and should bring dip nets, or other equipment (such as gigs) for the purpose of catching bullfrogs for positive identification.

4.9.2 WILD TURKEY

At present, the wild turkey population on the Preserve is relatively low, but in the absence of hunting or other control measures, the population could increase and become problematic. The consumption of acorns, especially of Oregon white oaks (which are already quite limited), as well as the impact turkeys have on native ground-feeding birds such as quail, represent significant management concerns.

Management Strategies

Short-Term (Years 1-5)

- **IAM-3: Monitor Wild Turkey Population.** It is recommended that the Land Manager monitor the wild turkey population on the Preserve. The populations and impacts of wild turkeys on the Preserve should be monitored concurrently with annual oak habitat monitoring (see **Section 4.4.3**), since these habitats are most occupied and impacted by turkeys. In addition to the presence of the animals, recorded information should include signs of their presence, such as feathers, nests, and soil disturbance.
- **IAM-4: Control Measures**. If monitoring shows an increase in the wild turkey population, the District should consider coordinating with the CDFW to implement turkey eradication measures such as hunting and/or trapping control measures to reduce or eradicate the species on the property.

4.9.3 OTHER POTENTIAL INVASIVE ANIMALS

Other invasive species potentially occurring on the Preserve include wild pigs and barred owls, as well as feral pets such as cats and red-eared slider turtles. These species were not observed during surveys, were not photographed by the wildlife cameras, and have not been documented by other camera studies in the area. However, more focused surveys for such species could yield important data from a management perspective. Feral cats can have devastating impact on native songbirds. Red-eared sliders have been implicated in the decline of California's only native turtle (USFWS 2009), the western pond turtle (*Actinemys marmorata*), a CDFW Species of Special Concern that was not observed on the Preserve. Like the wild turkey, wild pigs are known to consume large amounts of acorns as well as a large number of other native plant species (e.g., native bulb flowers), and to similarly disturb soil (McGlynn 2010). It should be noted that, according to interviews with neighbors of the Preserve, a wild pig eradication effort

was undertaken in the area in the early 1990s, and this may account for the lack of recent sightings.

Management Strategies

Short-Term (Years 1-5)

- **IAM-5: Monitor Wild Pig and Barred Owl Populations.**. It is recommended that the District monitor the wild pig and barred owl population on the Preserve. Providing information to volunteers and the general public, in the form of website pages, paper pamphlets, and trail signs instructing individuals to report any sightings of such animals to the District would also be valuable. Likewise, maintaining good communication with neighboring landowners would also be useful, especially regarding wild pigs and feral pets.

Photo 29: Illegal grow site with encampment within Manzanita grove within the northern region of the preserve.

- **IAM-6: Consider Control Measures.** If wild pigs or barred owl populations are detected, the most effective means of extermination on the Preserve would likely be to contract a professional hunter. A hunting license would be required to eradicate wild pigs, though there are no seasonal constraints or bag limits on pig hunting (CDFW 2013). The District will need to coordinate with the USFWS in any efforts to eradicate barred owls, as depredation permits will not be issued by the CDFW, due to the fact that the bird is protected by the Migratory Bird Treaty Act (Martinelli pers. comm.). Having obtained permission from the USFWS, Diller et al. (2012) found that shooting barred owls was an effective form of eradication in far northwestern California.

4.10 HUMAN TRESPASS AND ILLEGAL ACTIVITIES MANAGEMENT (HT)

Management Issues

This section addresses the broad category of management concerns related to illegal and/or inappropriate human activities known or with potential to occur on the Preserve. In balancing the District's mission to preserve natural resources with its commitment to provide public access to preserve lands, the District has a responsibility to plan for and manage human access and use in a manner that protects the natural and cultural resources on these preserves.

Examples of known problematic human activities include the following:

- Diversion of water, vegetation clearing, use of herbicides and pesticides near streams, and refuse accumulation associated with illicit marijuana grows;
- Illegal trespass via roads/trails and other access routes;
- Impacts resulting from horseback riding and mountain biking on un-maintained or un-designated trails; and
- Potential impacts from pets accompanying trespassing recreationalists.

Additional and potential future human activities that may need to be regulated and managed include hunting, unlawful camping, off-road vehicle access, garbage disposal, the collecting of natural or cultural resources, and otherwise benign recreational activities in sensitive and/or prohibited areas on the Preserve.

Illicit Cultivation of Marijuana

A number of human activities have already had detrimental impacts on the Preserve. First and foremost of these is the illicit cultivation of marijuana on the site. Numerous cultivated plots and associated camps have been discovered throughout the Preserve over the past few years, and the ecological impacts are quite evident. See **Chapter 3** for details on how the District has addressed this problem.

Often the first visible sign of the plots are the very long plastic irrigation tubes that siphon water from the perennial streams and springs to the plots. Presumably large amounts of water have been diverted for the purpose of irrigation as well as to supply the camps, and this adds to impacts associated with the tubes (which form large tangled piles and potential trip lines in some areas) as well as the presence of people utilizing important summer and fall wildlife corridors. The natural vegetation within cultivated areas has been thinned from below to create growing space, severely so at some locations, in order to increase light and reduce ground cover for the planted crops. The campsites were strewn with garbage, propane tanks, herbicides, rodenticides, and other chemicals. These operations were a threat to native plants, wildlife, and potentially unsuspecting, innocent passersby. The habitats most impacted by these activities have been chaparral, Oregon oak habitat, and the larger tributaries to Calabazas Creek.

Marijuana cultivators on public lands seek areas with sufficient water and sunlight that are remote and undetectable. As the Preserve opens to formal public access, the Preserve will become relatively less remote and more visited, increasing the chance and frequency of detection of grow sites. This increase in detection will hopefully discourage continued marijuana cultivation on site.

Illegal water diversions and upslope vegetation clearing (which contributes to erosion and sediment transport) for marijuana cultivation have been problematic up until recently. However, the clean-up efforts led by the District and presence of consultants and contracted land managers, especially combined with the monitoring vigilance of District staff and its volunteers, may prove effective in curbing this problem. A number of additional threats could materialize if the riparian corridors are not monitored and managed appropriately, such as increased stream bank erosion and infestations of invasive plant species.

Trespassing

In addition to the illicit cannabis growers, a sizable number of other people have been observed trespassing on the Preserve, despite clear signage indicating the site is not yet open to the public. People apparently traverse the property on a regular basis on foot, on bicycles, on horses, and with dogs. The bicycles and horses in particular can cause or exacerbate erosion on unplanned and unmanaged trails. Unleashed dogs pose a management challenge for a site demonstrating such a high level of species diversity as well as potential conflicts with volunteer patrollers, staff and consultants. Additional and potential future human activities that may need to be regulated and managed include hunting/poaching, unlawful camping, off-road vehicle access, garbage disposal, the collecting of natural or cultural resources, and otherwise benign recreational activities in sensitive and/or prohibited areas on the Preserve.

Management Strategies

Short-Term (Years 1-5)

- **Human Trespass (HT)-1: Education and Enforcement Plan.** For any illegal activities on site, the primary management tools are education and enforcement. Create an Education and Enforcement Plan to address illegal activities on the site. The Plan should assess and recommend education and enforcement strategies, including:
  - » Bilingual signs that articulate the rules governing public access on the preserve should be available at the quarry staging area.
  - » Implement consistent monitoring and cleanup of the sites by volunteer patrol members and management staff to decrease the frequency of illegal activities such as poaching, dumping, camping, or collecting.
  - » Develop an inter-agency approach with the Sonoma County Sheriff's Office and other law enforcement agencies for reporting, removing, and reclaiming cannabis grow sites. At the beginning of the grow season, the District and and volunteer patrols should patrol the primary drainages where grow sites have been found in the past and look for hoses or other irrigation infrastructure. A one day patrol on Johnson, Spencer, and Warsaw Creeks should quickly assess whether or not new grow sites have been established or old ones reoccupied. Fund the Sheriff or other entity to conduct consistent flyovers during peak growing season.

» Remove all of the site infrastructure and equipment. This includes destruction of water impoundments or cisterns and any other feature that would encourage and support continued reoccupation of particular sites (Mallery 2011).

Monitoring

District staff and volunteer patrols will actively inspect stream corridors active during the summer months to detect irrigation lines that could lead to new marijuana grows. South facing Manzanita and chamise vegetation serves as a conspicuous cover for illegal grows and should be monitored to determine if illegal activities are occurring. Between September and October, before the first rains of the season, all off-trail hiking will be prohibited by volunteer patrols, if an active grow has been detected. This period corresponds to the harvest season for marijuana when the plants are reaching commercial size and therefore worthy of protection by illegal field crews. These crews can be well-armed and sometimes establish deterrents to protect their crop. If suspicious activities are noted, then the District will work with the Sheriff's department to address the issue. After the rainy season has begun, then crews can return to prospective sites to eliminate the debris, agrichemicals and irrigation lines.

4.11 CULTURAL RESOURCES (CR)

Management Issues

Damage to cultural resources can be caused by:

- Natural processes (e.g., erosion);
- Project-related action (e.g., trail improvement); and
- Vandalism and souvenir hunting.

Management Strategies

Short-Term (Years 1-5)

The following strategies are recommended to enhance public appreciation for cultural resources while protecting important features:

- **Cultural Resources (CR)-1: Partnerships.** Develop partnerships with interested organizations to help District staff manage cultural resources. Organizations include local universities and colleges, Native American tribes, the Archaeological Conservancy, and the California Archaeological Site Stewardship Program (CASSP). These relationships will leverage the Preserve's financial resources while developing a local volunteer pool and a spirit of stewardship.
- **CR-2. Interpretation Plan.** Work with professional archaeologists and tribes to determine which resources may be appropriate to interpret to visitors.
- **CR-3: Cultural Resources Protection Plan.** Create a Cultural Resources Protection Plan that incorporates the following:
  - » Establish a list of activities such as erosion control, prescribed burn, and other significant ground disturbances that require Cultural Resource Assessment prior to initiation.
  - » Recommend specific measures to ensure that new construction and on-going maintenance do not harm cultural resources.
  - » Establish a parallel list of exemptions to requirements for cultural resources assessment such as: thinning and pruning along roads, road surface maintenance within existing corridor, previously inventoried areas, etc.
  - » Establish protocols to guide the identification, evaluation, and treatment of cultural resources.

Monitoring

Establish a schedule of consistent field visits (quarterly or annually) to monitor and report on the condition of known cultural resources. CASSP, a program of the Society for California Archaeology, offers stewardship training several times each year.

5.0 REGULATORY FRAMEWORK

The resource management tasks included in this report, as well as the future Public Access Plan, will be subject to regulatory review if there are potential impacts to sensitive habitats, special-status species and/or cultural resources. **Table 5.1** presents an annotated list of the primary environmental regulations and associated activities that may trigger the need for a permit or mitigation requirements.

Examples of actions that may trigger permits and mitigation requirements include:

- **Sections 401 and 404 of the Clean Water Act:** Any grading or excavation within stream corridors or wetlands would require a Section 404 permit from the U.S. Army Corps of Engineers (ACOE). Development of new livestock watering sites in existing seeps may require ACOE consultation. Any other actions that impact jurisdictional wetlands or water quality may require consultation and possibly Section 401 certification from the Regional Water Quality Control Board (RWQCB), including development of new livestock watering sites in existing seeps.
- **California Environmental Quality Act (CEQA):** Activities with potential to harm rare plants or animals (e.g., noise levels with potential to impact special-status birds during nesting season). If the proposed watershed or streams management and enhancement activities require CEQA review all will likely qualify for a Neg. Dec. Project effects on cultural resources will potentially trigger CEQA review.
- **Section 1600 Streambed Protection:** Any actions that impact a stream corridor may require consultation with California Department of Fish and Wildlife (CDFW) and possibly a Streambed Alteration Agreement, including riparian plantings.

In addition, certain herbicides and/or their chemical ingredients that may be considered effective in controlling invasive plant species on the Preserve are regulated by the State of California, and the use of such herbicides is restricted. District land managers should consult the State Pesticide Regulation website in planning for invasive plant control efforts on the Preserve and other properties. Additionally, the District or future landowners may need to retain the services of a Licensed Pest Advisor or Pesticide Applicator. The use of regulated chemicals requires a permit from the Sonoma County Agricultural Commissioner's Office. District land managers should consult the following website to be informed of currently regulated herbicide chemicals:

http://www.cdpr.ca.gov/docs/legbills/calcode/020401.htm#a6400

Finally, appropriate hunting and fishing licenses should be obtained from the CDFW prior to carrying out hunting of invasive animals such as wild turkey and American bullfrog.

TABLE 5.1 Primary Environmental Regulations of Concern for Implementation of Plan Tasks.

REGULATION	RESPONSIBLE AGENCY	REGULATED RESOURCE(S)	PERMIT AND MITIGATION REQUIREMENTS	ACTIONS THAT WILL TRIGGER PERMIT AND MITIGATION REQUIREMENTS
Section 404 of the Clean Water Act	U.S. Army Corps of Engineers (ACOE)	Jurisdictional streams and wetlands	Wetland Fill Permit required for impacting jurisdictional wetlands. Nationwide Permit for smaller wetland fill. Individual Permit for larger wetland fill. Typical mitigation requires avoidance measures to minimize impacts to existing wetlands and creation of new wetlands on or off site at a 2:1 creation to impact ratio.	Any grading or excavation within stream corridors or wetlands would require a Section 404 permit. Development of new livestock watering sites in existing seeps may require ACOE consultation.

REGULATION	RESPONSIBLE AGENCY	REGULATED RESOURCE(S)	PERMIT AND MITIGATION REQUIREMENTS	ACTIONS THAT WILL TRIGGER PERMIT AND MITIGATION REQUIREMENTS
Section 401 of the Clean Water Act	Regional Water Quality Control Board (RWQCB)	Jurisdictional wetlands and streams; water quality	Water Quality Certification required for impacting jurisdictional wetlands or potential impacts to water quality from upland run-off of sediments from a construction project. Typical mitigation requires creation of new wetlands on or off site at a 2:1 creation to impact ratio. Typical mitigation requires avoidance measures to minimize impacts to existing wetlands or water quality and creation of new wetlands on or off site at a 2:1 creation to impact ratio.	Any other actions that impact jurisdictional wetlands or water quality may require consultation and possibly Section 401 certification including development of new livestock watering sites in existing seeps. The RWQCB is generally more stringent than ACOE in the Bay Area region.
Federal Endangered Species Act	U.S. Fish and Wildlife Service (USFWS)	Federal-listed Threatened or Endangered Species	Biological Opinion required for potential impacts to federally-listed threatened or endangered species. Can be achieved through either Section 7 or Section 10 consultation. Section 7 consultation, which is conducted via another federal agency issuing a permit (such as the Corps for wetland impacts), is the simpler methods. Section 10 consultation requires preparation of a site specific Habitat Conservation Plan for which it is difficult to gain approval. Mitigation for 'take' of listed species includes avoidance measures as possible and preservation/creation of replacement habitat for the species.	Any actions with the potential to impact northern spotted owl or their potential habitats would require consultation with USFWS; significant noise within 400 meters of an owl nest may require consultation.
State Endangered Species Act	California Department of Fish and Wildlife	State-listed Threatened or Endangered Species	Take authorization required for potential impacts to state-listed threatened or endangered species. Mitigation for 'take' of listed species includes avoidance measures as possible and preservation/creation of replacement habitat for the species.	No state-listed species are known or likely to occur in the watershed.
Section 1600 Streambed Protection	California Department of Fish and Wildlife (CDFW)	Creeks and Associated Riparian Woodlands and Wetlands	Streambed Alteration Agreement required for impacts to any creeks with defined beds and/or banks including small ephemeral creeks.	Any actions that impact a stream corridor may require consultation with CDFW and possibly a Streambed Alteration Agreement, including riparian plantings.
California Environmental Quality Act (CEQA)	Designated Lead Agency (Federal, State or Local Government Agency)	All Environmental and Cultural Aspects	Negative Declaration (Neg. Dec.), Mitigated Negative Declaration, or Environmental Impact Report required for environmental impacts that trigger CEQA review. Mitigation is determined through the CEQA process and is usually consistent with mitigation required under other environmental and cultural permits.	Activities with potential to harm rare plants or animals (e.g., noise levels with potential to impact special-status birds during nesting season). If the proposed watershed or streams management and enhancement activities require CEQA review all will likely qualify for a Neg. Dec. Project effects on cultural resources will also trigger CEQA review.
Clean Air Act	Sonoma County Air Quality Management District (AQMD)	Air Quality	The County AQMD would need to be consulted and a permit obtained for any prescribed burns.	Prescribed burns.
Local Riparian Habitat Protection Ordinance	Sonoma County Planning Department	Riparian Woodlands and Forests	County permit required for potential direct or indirect impacts to riparian habitats. Indirect impacts occur within a buffer zone 50 feet from the edge of riparian habitat. Mitigation involves avoidance or reduction of impact if possible and protection/creation of replacement habitat if avoidance is not possible.	None of the proposed actions are expected to require a County permit.

REGULATION	RESPONSIBLE AGENCY	REGULATED RESOURCE(S)	PERMIT AND MITIGATION REQUIREMENTS	ACTIONS THAT WILL TRIGGER PERMIT AND MITIGATION REQUIREMENTS
Oak Woodlands Conservation Act	CDFW	Areas of oak canopy cover ≥ 10% and/or trees ≥ 5" DBH	Voluntary protection of oaks. No permitting or mitigation requirements.	No actions expected to trigger any permitting or mitigation requirements.
National Historic Preservation Act (NHPA) as amended (16 USC 470f) and its implementation regulations (36 CFR 800)	U.S. Army Corps of Engineers (ACOE) or other appropriate federal lead agency	Cultural Resources	Coordination with federal lead agency, State Historic Preservation Officer, and Native American tribes to identify adverse effects on important resources. Mitigation typically involves either impact avoidance or scientific study.	NHPA may be triggered by use of federal funds for project activities or by issuance of a permit by a federal agency, e.g., Section 404 of Clean Water Act.
Local Grading Ordinance	Sonoma County Planning Dept.	Soil and Streams	Grading permits may be required for trailhead construction. Permits are not required for backcountry trails.	Grading ordinance was modified in 2011 to allow backcountry public trails to be exempt. Trailhead design/construction requires permit.

6.0 MONITORING AND ADAPTIVE MANAGEMENT

6.1 RECOMMENDED MONITORING ACTIVITIES

Table 6.1 summarizes all recommended monitoring activities outlined above in section 4.2 to 4.11 pertaining to the management recommendations to protect, manage and enhance the natural and cultural resources on the Preserve. Recommended time intervals are included for monitoring activities, and the results of monitoring should guide the implementation of management strategies. In addition, the frequency of monitoring activities may be reduced in the event that management objectives are being met.

6.2 ADAPTIVE MANAGEMENT

Adaptive management is a structured, iterative process of educated decision-making where results are

evaluated and actions adjusted in order to improve future management based on what has been learned. It aims to simultaneously maximize one or more resource objectives and accrue site-specific information needed to improve future management. Adaptive management is often characterized as "learning by doing" and can change throughout the course of a project.

Monitoring is a key component of adaptive management. Monitoring the outcomes of management actions provides the information necessary to adjust management strategies or implementation actions to achieve desired results. As monitoring data from individual project implementation is gathered and evaluated, direction toward stated goals and objectives will be evaluated. Where progress is being made toward goal achievement, long-term maintenance will be initiated, with monitoring and data analysis continuing to provide feedback into the management process. If monitoring data analysis indicates that project implementation is not creating or maintaining desired conditions, alternative strategies will be reviewed, and the optimal strategy or strategies will be implemented. Long-term monitoring will continue, with subsequent data analysis providing feedback to measure each subsequent implementation activity until progress towards objectives is achieved.

Monitoring and data analysis will continue long-term on the Preserve to ensure that stated objectives continue to be met under changing environmental conditions and visitor use patterns.

TABLE 6.1 Draft Monitoring Plan

RESOURCE	RECOMMENDED MONITORING ACTIVITIES	MONITORING FREQUENCY[1] (YEARS)
Physical Resources Management (PR)		
Water	Water quality and sediment delivery should be evaluated as baseline measurements and then monitored each year, especially after implementation of road improvements or decommissioning strategies.	1
Soils	Once erosion control has been implemented, conduct annual post-project monitoring consisting of visual surveys and photo documentation. Evaluate instability along treated road/trail segments, document structural integrity of implemented treatments, identify areas with potential for erosion/sediment delivery, quantify sediment delivery due to any significant adjustments to the implemented treatments, and record turbidity.	1
Plant Communities (PC)		
Grasslands	Conduct annual monitoring to assess RDM within selected grassland sites as well as selected reference invasive weed stands, general condition of the grasslands related to soil erosion, shrub and tree encroachment, overgrazing, etc.	1
Chaparral	Conduct periodic monitoring of chaparral stands for tree encroachment and overall stand health; investigate signs of *Phytophthora* infections; look for signs of illicit marijuana cultivation (e.g., irrigation infrastructure — can be investigated annually along with riparian monitoring).	5
Forests and Woodlands	Conduct periodic assessment and inventory of Douglas fir encroachment, woody fuel loads, and SOD infection within forest and woodland stands. This can be accomplished by stratifying the forests and woodlands into monitoring blocks that can be assessed on a rotational basis.	5
Sensitive Habitats (SH)		
Streams/ Riparian Habitat	Conduct an annual reconnaissance-level assessment to ensure the management measures are being appropriately carried out and that overall healthy ecological conditions are being maintained. Assess potential erosion/ sedimentation issues, the presence of irrigation tubes for illicit marijuana cultivation; note and map extent of SOD-infected trees; note and map the extent of invasive weeds, in particular Himalayan blackberry; investigate potential backwater pools and cover of woody debris; search for bullfrogs and exterminate if detected.	1
Spring and Seep Wetlands	Conduct annual monitoring of springs and seeps within grassland habitats, primarily for invasive plant species and any impacts related to erosion, human activities, or livestock use. Establish photo-monitoring points. Conduct monitoring every 5 years at woodland/forest springs and seeps.	1, 5
Coast Live Oak Woodland	Conduct annual monitoring remotely using aerial imagery to assess SOD infection. Conduct site surveys for Douglas fir invasion, wild turkey populations, and general ecosystem health every 5 years, unless SOD appears to be spreading rapidly, in which case more frequency field monitoring may be required.	1, 5
Oregon White Oak Woodland	Conduct site surveys for Douglas fir invasion, wild turkey populations, and general ecosystem health every 5 years, unless SOD appears to be spreading rapidly, in which case more frequent field monitoring may be required.	5
Interior Live Oak Woodland	Conduct site surveys for Douglas fir invasion, wild turkey populations, and general ecosystem health every 5 years, unless SOD appears to be spreading rapidly, in which case more frequency field monitoring may be required.	5
Redwood Forest	Conduct monitoring for sapling recruitment and general stand health. More frequent monitoring may be conducted along Calabazas Creek corridor as part of riparian habitat monitoring.	5
Stanford Manzanita Chaparral	Conduct monitoring of tree encroachment into habitat as well as signs of *Phytophthora* in the form of large numbers of dead or dying manzanitas. Check for signs of illicit marijuana cultivation in the form of irrigation infrastructure along creek (as part of riparian corridor monitoring).	5
Common Manzanita Chaparral	Same as above.	5
Hoary Manzanita Chaparral	Same as above.	5
Special-Status Plants Management (SPM)		
Narrow-flowered California brodiaea	Monitoring of selected stands every five years for population size, overall health, and potential threats.	5

RESOURCE	RECOMMENDED MONITORING ACTIVITIES	MONITORING FREQUENCY[1] (YEARS)
Napa false indigo	Same as above.	5
Napa biscuitroot	Same as above.	5
Biolett's erigeron	Same as above.	5
Invasive Plants[2] Management (IPM)		
French broom	Identify, map and monitor selected stands on an annual basis to assess success of control measures; monitoring can be reduced to less frequent interval if major infestations are controlled.	1
Harding grass	Same as for French broom (above).	1
Himalayan blackberry	Same as for French broom (above).	1
yellow starthistle	Same as for French broom (above).	1
Special-Status Animals Management (SAM)		
steelhead trout	Conduct annual monitoring surveys for bullfrogs and other potential threats as present under Streams/Riparian Habitat; census populations every 5 years.	1, 5
northern spotted owl	Conduct biannual monitoring surveys for northern spotted owls and barred owls on the site.	2
American peregrine falcon	Conduct biannual surveys for American peregrine falcon.	2
Nuttall's woodpecker	Conduct surveys as part of surveys for other special-status bird species.	2
foothill yellow-legged frog	Conduct annual monitoring surveys for bullfrogs and other potential threats as present under Streams/Riparian Habitat; census populations every 5 years.	1, 5
California giant salamander	Same as for foothill yellow-legged frog.	1, 5
Invasive Animals Management (IAM)		
American bullfrog	Conduct annual monitoring surveys; inventory number of bullfrogs observed and killed to track changes in bullfrog numbers; check for any breeding on site.	1
wild turkey	Conduct population monitoring. Additional incidental monitoring may be conducted concurrently with other monitoring activities.	5
Human Trespassing (HT)		
Illicit marijuana grows	District staff and volunteer patrols will actively inspect permanent stream corridors during the summer months to detect irrigation lines that could lead to new marijuana grows. South facing Manzanita and chamise vegetation should be monitored to determine if illegal activities are occurring.	1
Cultural Resources (CR)		
Cultural Resources	Establish a schedule of regular field visits to monitor and report on the condition of known cultural resources. CASSP, a program of the Society for California Archaeology, offers stewardship training several times each year.	To be determined.

1. Frequency in years for monitoring surveys.

2. These are the most widespread and/or problematic invasive plant species on the Preserve. For a list of all invasive plant species with potential to be problematic, along with management recommendations, see Section 4.6 and Appendix D.

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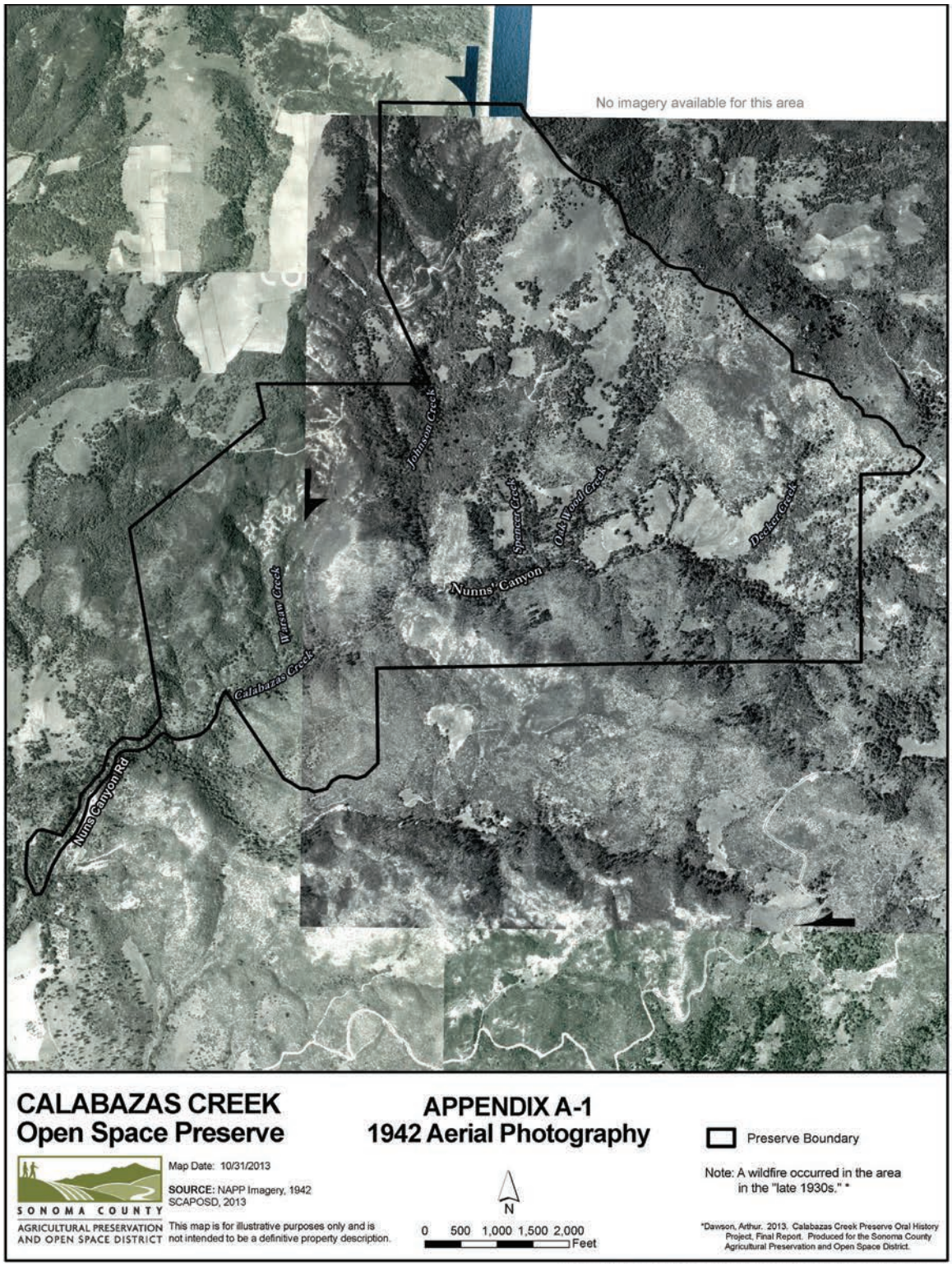
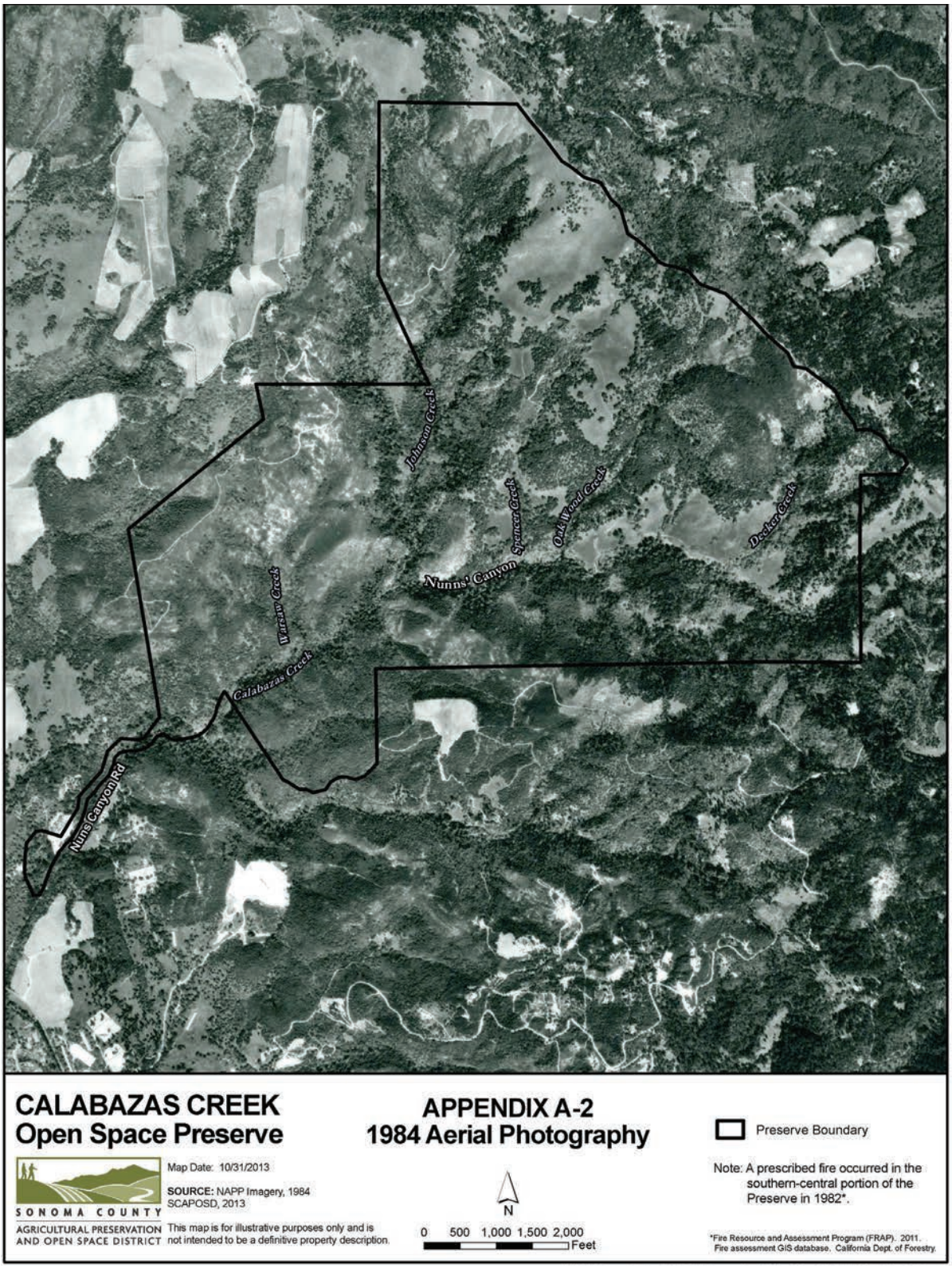
APPENDIX A HISTORICAL AERIAL PHOTOGRAPHY OF THE PRESERVE AREA




Johnson Creek
Spencer Creek
Oakwood Creek
Decker Creek
Nunns Canyon
Wrasaw Creek
Calabazas Creek
Nuns Canyon Rd
CALABAZAS CREEK
Open Space Preserve
APPENDIX A-2
1984 Aerial Photography
Preserve Boundary
Map Date: 10/31/2013
SOURCE: NAPP Imagery, 1984
SCAPOSD, 2013
SONOMA COUNTY
AGRICULTURAL PRESERVATION
AND OPEN SPACE DISTRICT
This map is for illustrative purposes only and is not intended to be a definitive property description.
N
0 500 1,000 1,500 2,000
Feet
Note: A prescribed fire occurred in the southern-central portion of the Preserve in 1982*.
*Fire Resource and Assessment Program (FRAP). 2011. Fire assessment GIS database. California Dept. of Forestry.

APPENDIX B

SPECIAL-STATUS PLANTS AND WILDLIFE DOCUMENTED IN THE VICINITY OF THE PRESERVE

APPENDIX B-1: Special-status Vascular Plant Taxa Documented in the Vicinity of the Calabazas Creek Open Space Preserve, Sonoma County, California. Compiled by Vollmar Natural Lands Consulting, 2013.

SCIENTIFIC NAME (COMMON NAME)	STATUS[1] FEDERAL/ STATE/ CRPR	HABITAT, ELEVATION AND BLOOM PERIOD	POTENTIAL FOR OCCURRENCE
Allium peninsulare var. *franciscanum* (Franciscan onion)	—/—/ 1B.2	Cismontane woodland, Valley and foothill grassland/ clay, volcanic, often serpentinite; 52-300 feet; May-Jun	Marginal habitat present. Not observed during 2013 surveys.
Alopecurus aequalis **var.** *sonomensis* (Sonoma alopecurus)	E/—/ 1B.1	Marshes (freshwater), Riparian scrub; 5-365 feet; May-Jul	No suitable habitat present. Not observed during 2013 surveys.
Amorpha californica **var.** *napensis Napa* (Napa false indigo)	—/—/ 1B.2	Broadleafed upland forest(openings), Chaparral, Cismontane woodland; 120-2,000 feet; Apr-Jul	Suitable habitat present. Observed during 2013 surveys.
Arctostaphylos bakeri **ssp.** *bakeri* (Baker's manzanita)	—/ R/ 1B.1	Broadleafed upland forest, Chaparral/often serpentinite; 75-300 feet; Feb-Apr	Suitable habitat present. Not observed during 2013 surveys.
Arctostaphylos canescens **ssp.** *sonomensis* (Sonoma canescent manzanita)	—/—/ 1B.2	Chaparral, Lower montane coniferous forest/sometimes serpentinite; 180-1,675 feet; Jan-Jun	Suitable habitat present. Not observed during 2013 surveys.
Arctostaphylos stanfordiana **ssp.** *decumbens* (Rincon Ridge manzanita)	—/—/ 1B.1	Chaparral (rhyolitic), Cismontane woodland; 75-370 feet; Feb-Apr (May)	Suitable habitat present. Not observed during 2013 surveys.
Astragalus claranus (Clara Hunt's milk-vetch)	E/ T/ 1B.1	Chaparral(openings), Cismontane woodland, Valley and foothill grassland/serpentinite or volcanic, rocky, clay; 75-275 feet; Mar-May	Suitable habitat present. Not observed during 2013 surveys.
Blennosperma bakeri (Sonoma sunshine)	E/ E/ 1B.1	Valley and foothill grassland(mesic), Vernal pools; 10-110 feet; Mar-May	No suitable habitat present. Not observed during 2013 surveys.
Brodiaea leptandra (narrow-flowered California brodiaea)	—/—/ 1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Lower montane coniferous forest, Valley and foothill grassland/volcanic; 110-915 feet; May-Jul	Suitable habitat present. Observed during 2013 surveys.
Ceanothus confusus (Rincon Ridge Ceanothus)	—/—/ 1B.1	Closed-cone coniferous forest, Chaparral, Cismontane woodland/volcanic or serpentinite; 75-1,065 feet; Feb-Jun	Suitable habitat present. Not observed during 2013 surveys.
Ceanothus divergens (Calistoga Ceanothus)	—/—/ 1B.2	Chaparral(serpentinite or volcanic, rocky); 170-950 feet; Feb-Apr	Suitable habitat present. Not observed during 2013 surveys.
Ceanothus purpureus (holly-leaved Ceanothus)	—/—/ 1B.2	Chaparral, Cismontane woodland/volcanic, rocky; 120-640 feet; Feb-Jun	Suitable habitat present. Not observed during 2013 surveys.
Ceanothus sonomensis (Sonoma Ceanothus)	—/—/ 1B.2	Chaparral(sandy, serpentinite or volcanic); 215-800 feet; Feb-Apr	Suitable habitat present. Not observed during 2013 surveys.
Downingia pusilla (dwarf Downingia)	—/—/2.2	Valley and foothill grassland(mesic), Vernal pools; 1-445 feet; Mar-May	No suitable habitat present. Not observed during 2013 surveys.
Erigeron biolettii (Biolett's erigeron)	—/—/3	Broadleafed upland forest, Cismontane woodland, North Coast coniferous forest/rocky, mesic; 30-1,100 feet; Jun-Oct	Suitable habitat present. Observed during 2013 surveys.
Erigeron greenei (Greene's narrow-leaved daisy)	—/—/ 1B.2	Chaparral(serpentinite or volcanic); 80-1,005 feet; May-Sep	Suitable habitat present. Not observed during 2013 surveys.

SCIENTIFIC NAME **(COMMON NAME)**	**STATUS[1] FEDERAL/ STATE/ CRPR**	**HABITAT, ELEVATION AND BLOOM PERIOD**	**POTENTIAL FOR OCCURRENCE**
Fritillaria liliacea (fragrant fritillary)	—/—/ 1B.2	Cismontane woodland, Coastal prairie, Coastal scrub, Valley and foothill grassland/Often serpentinite; 3-410 feet; Feb-Apr	Marginal habitat present. Not observed during 2013 surveys.
Hemizonia congesta **ssp.** *congesta* (white seaside tarplant)	—/—/ 1B.2	Valley and foothill grassland/sometimes roadsides; 20-560 feet; Apr-Nov	Marginal habitat present. Not observed during 2013 surveys.
Horkelia tenuiloba (thin-lobed horkelia)	—/—/ 1B.2	Broadleafed upland forest, Chaparral, Valley and foothill grassland/mesic openings, sandy; 50-500 feet; May-Jul(Aug),	Suitable habitat present. Not observed during 2013 surveys.
Leptosiphon jepsonii (Jepson's Leptosiphon)	—/—/ 1B.2	Chaparral, Cismontane woodland/usually volcanic; 100-500 feet; Mar-May	Suitable habitat present. Not observed during 2013 surveys.
Lessingia hololeuca (woolly-headed Lessingia)	—/—/3	Broadleafed upland forest, Coastal scrub, Lower montane coniferous forest, Valley and foothill grassland/clay, serpentinite; 15-305 feet; Jun-Oct	Marginal habitat present. Not observed during 2013 surveys.
Lomatium repostum (Napa biscuitroot)	—/—/4.3	Chaparral, Cismontane woodland/serpentinite; 300-2,700 feet; Mar-June	Suitable habitat present. Observed during 2013 surveys.
Lupinus sericatus (Cobb Mountain lupine)	—/—/ 1B.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Lower montane coniferous forest; 275-1,525 feet; Mar-Jun	Suitable habitat present. Not observed during 2013 surveys.
Micropus amphibolus (Mt. Diablo cottonweed)	—/—/3.2	Broadleafed upland forest, Chaparral, Cismontane woodland, Valley and foothill grassland/rocky; 45-825 feet; Mar-May	Suitable habitat present. Not observed during 2013 surveys.
Navarretia leucocephala **ssp.** *bakeri* (Baker's navarretia)	—/—/ 1B.1	Cismontane woodland, Lower montane coniferous forest, Meadows and seeps, Valley and foothill grassland, Vernal pools/Mesic; 5-1,740 feet; Apr-Jul	No suitable habitat present. Not observed during 2013 surveys.
Penstemon newberryi **var.** *sonomensis* (Sonoma beardtongue)	—/—/ 1B.3	Chaparral(rocky); 700-1,370 feet; Apr-Aug	Suitable habitat present. Not observed during 2013 surveys.
Sidalcea oregana **ssp.** *valida* (Kenwood Marsh checkerbloom)	E/ E/ 1B.1	Marshes and swamps(freshwater); 115-150 feet; Jun-Sep	No suitable habitat present. Not observed during 2013 surveys.
Trifolium amoenum (Showy Indian clover)	E/E/1 B.1	Coastal bluff scrub; 20-1,300 feet; Apr-Jun	No suitable habitat present. Not observed during 2013 surveys.
Viburnum ellipticum (oval-leaved viburnum)	—/—/2.3	Chaparral, Cismontane woodland, Lower montane coniferous forest; 215-1,400 feet; May-Jun	Suitable habitat present. Not observed during 2013 surveys.

Note: nomenclature corresponds to the most recent Jepson Interchange (December 2013)
Bold entries indicated observed during 2013 botanical surveys

1. State or federal listing: E = endangered; T = threatened

California Rare Plant Rank (CRPR)

CRPR: 'List 1B' = Plants rare, threatened or endangered in CA and elsewhere; 'List 4' = Plants of limited distribution, a watch list

CRPR: '.2' = Fairly threatened in CA; '.3' = Not very threatened in CA

Most CRPR List 4 are not included in CNPS nine-quad search option

Appendix B-2. Special Status Animal Species and Animal Species of Interest Occurring or Potentially Occurring on the Calabazas Open Space Preserve, Sonoma County, California. Compiled by Vollmar Natural Lands Consulting, 2013.

COMMON/ SCIENTIFIC NAME	STATUS[3]	PREFERRED HABITAT	POTENTIAL FOR OCCURRENCE
Invertebrates			
California freshwater shrimp (*Syncaris pacifica*)	FE SE	Perennial creeks and streams with slow moving water and intermittent pools.	Not expected: Potential habitat occurs onsite. Surveys in August 2013 did not detect the species.
Delta smelt (*Hypomesus transpacificus)*	FT	Freshwater side of mixing zone between salt and freshwater.	Not expected: Potential habitat does not occur onsite.
coho Salmon (*Oncorhynchus kisutch*)	FE	Freshwater, nearshore, and offshore environments.	Not expected.[1]
central California coastal Steelhead (*Oncorhynchus mykiss*)	FT	Freshwater, nearshore, and offshore environments.	Steelhead spawning has been observed in several tributaries of the Sonoma Creek watershed.[2]
Central Valley steelhead (*Oncorhynchus mykiss*)	FT	Freshwater, nearshore, and offshore environments.	Steelhead spawning has been observed in several tributaries of the Sonoma Creek watershed.[2]
California coastal chinook salmon (*Oncorhynchus tshawytscha*)	FT	Freshwater, nearshore, and offshore environments.	Chinook spawning has been observed in Calabazas Creek.[2]
Central Valley spring-run chinook Salmon (*Oncorhynchus tshawytscha*)	FT	Freshwater, nearshore, and offshore environments.	Chinook spawning has been observed in Calabazas Creek.[2]
Winter-run chinook salmon (*Oncorhynchus tshawytscha*)	FE	Freshwater, nearshore, and offshore environments.	Chinook spawning has been observed in Calabazas Creek.[2]
Amphibians			
foothill yellow-legged frog (*Rana boylii*)	CSSC	Breeds in slow moving streams; prefers rocky substrate.	Observed: One occurrence observed in Calabazas creek during amphibian surveys.
California red-legged frog (*Rana draytonii*)	FT CSSC	Breeds in perennial and seasonal ponds and sluggish streams; shelters in adjacent uplands.	*Potential:* Potential habitat exists on site, but no occurrences were detected during amphibian surveys.
California tiger salamander (*Ambystoma californiense*	FT ST	Burrows of small mammals; wetland breeding ponds.	Not expected: Potential habitat does not occur onsite.
Birds			
California Least Tern (*Sternula antillarum browni*)	FE SE	Breeds on exposed tidal flats and beaches	Not expected: Potential habitat does not occur onsite.
Northern Spotted Owl (*Strix occidentalis caurina*)	FT CSSC	Nests in old growth forests with multiple canopy layers, snags, and woody debris.	Observed: Pair observed May 15, 2013
American Peregrine Falco (*Falco peregrinus anatum*)	BCC CFP	Nests on cliffs and steep banks, preferably near water.	Observed: Nesting individual observed on multiple surveys, aggressive territorial behavior displayed.
Nuttall's Woodpecker (*Picoides nuttallii*)	BMC	Nesting cavities are excavated from dead trunk limbs, mostly in riparian habitat.	Observed: Individual observed foraging in riparian habitat.
Oak Titmouse (*Baeolophus inornatus*)	BCC	Builds nests in woodpecker holes or natural cavities.	*Potential:* Suitable nesting and foraging habitat present; not observed on the site but known to nest in the area.
White-tailed Kite (*Elanus leucurus*)	CFP	Nests in trees, often in isolated stands, surrounded by open foraging habitat.	*Potential:* Suitable nesting and foraging habitat present; not observed on the site but known to nest in the area.
Black-chinned Sparrow (*Spizella atrogularis*)	BCC	Nests usually concealed in the dense foliage of shrubs.	*Potential:* Suitable nesting and foraging habitat present; not observed on the site but known to nest in the area.

COMMON/ SCIENTIFIC NAME	STATUS[3]	PREFERRED HABITAT	POTENTIAL FOR OCCURRENCE
Lawrence's Goldfinch (*Spinus lawrencei*)	BCC	Builds nests in the dense foliage of trees or shrubs. Usually near water in open woodlands.	*Potential:* Suitable nesting and foraging habitat present; not observed on the site but known to nest in the area.
Mammals			
pallid bat (*Antrozous pallidus*)	CSSC	Oak savanna, coast redwoods, coniferous forest.	*Potential*. Suitable foraging habitat present.
Salt marsh harvest mouse (*Reithrodontomys raviventris*)	FE SE	Salt and brackish marshes.	Not expected: Potential habitat does not occur onsite.
Species of Interest (Not Federally or State listed)			
California giant salamander (*Dicamptodon ensatus*)	None	Breeds in creeks, streams and channels. Shelters and forages in adjacent forest uplands.	Observed: Individuals detected in several locations in Calabazas creek.

1 Leidy, R. A., G. Becker, et al. (2005). "Historical status of coho salmon in streams of the urbanized San Francisco estuary, California." California Fish and Game 91(4): 219

2 Sonoma Ecology Center: *Understanding Sonoma Valley Watersheds, Steelhead and Salmon* (based on a model provided by the Napa County Resource Conservation District).

3 Sensitivity Status: FE = Federally listed as Endangered; FT = Federally listed as Threatened; SE = State listed as Endangered; ST = State listed as Threatened; CSSC = California Species of Special Concern; CFP = California Fully Protected Species; BCC = Fish and Wildlife Service: Birds of Conservation Concern; BMC = Fish and Wildlife Service: Birds of Management Concern

APPENDIX C

BIRD SPECIES OCCURRING OR EXPECTED TO OCCUR ON THE PRESERVE

Bird Species Occurring and Expected to Occur on the Calabazas Creek Open Space Preserve, Sonoma County, California. Surveys conducted collected by Avocet Research Associates and VNLC, July–Sept. 2013.

SPECIES DETECTED		HABITAT IN WHICH DETECTED									
SCIENTIFIC NAME	COMMON NAME	REDWOOD	DOUGLAS FIR	MIXED EVERGREEN FOREST	RIPARIAN FOREST	CHAPARRAL	OAK WOODLAND	GRASSLAND	VOLCANIC ROCK OUTCROP	WETLAND SWALE	EDGE
Aphelocoma californica	Western Scrub-Jay			X	X	X	X	X			X
Bubo virginianus	Great Horned Owl	X	X					X			X
Buteo jamaicensis	Red-tailed Hawk		X			X	X	X	X		X
Buteo lineatus	Red-shouldered Hawk				X		X	X		X	X
Callipepla californica	California Quail			X	X	X	X			X	X
Calypte anna	Anna's Hummingbird	X	X	X	X	X	X				X
Cardellina pusilla	Wilson's Warbler	X	X	X	X						
Carduelis psaltria	Lesser Goldfinch						X	X			X
Carduelis tristis	American Goldfinch						X	X		X	X
Carpodacus purpureus	Purple Finch	X	X	X							X
Cathartes aura	Turkey Vulture			X		X	X	X	X		X
Catharus guttatus	Hermit Thrush	X	X	X							
Certhia americana	Brown Creeper	X	X	X			X				
Chamaea fasciata	Wrentit					X					X
Colaptes auratus	Northern Flicker	X	X	X	X	X	X	X			X
Corvus brachyrhynchos	American Crow							X			X
Corvus corax	Common Raven	X	X	X	X	X	X	X	X	X	X
Cyanocitta stelleri	Steller's Jay	X	X	X							X
Dryocopus pileatus	Pileated Woodpecker	X	X	X							
Empidonax difficilis	Pacific-slope Flycatcher	X	X	X	X		X				X
Falco peregrinus anatum[1]	Peregrine Falcon								X		X
Ixoreus naevius	Varied Thrush	X			X						
Junco hyemalis	Dark-eyed Junco	X	X	X	X	X	X	X	X	X	X
Megaceryle alcyon	Belted Kingfisher				X						
Melanerpes formicivorus	Acorn Woodpecker			X			X				
Meleagris gallopavo	Wild Turkey	X	X	X	X		X	X			X
Melospiza melodia	Song Sparrow			X	X					X	
Melozone crissalis	California Towhee					X	X	X			X
Molothrus ater	Brown-headed Cowbird			X	X	X	X				X
Oreothlypis celata	Orange-crowned Warbler	X	X	X	X		X				
Passerina amoena	Lazuli Bunting					X	X	X		X	
Patagioenas fasciata	Band-tailed Pigeon	X	X	X							
Pheucticus melanocephalus	Black-headed Grosbeak		X	X	X		X				
Picoides nuttallii	Nuttall's Woodpecker			X	X		X				

SPECIES DETECTED		HABITAT IN WHICH DETECTED									
SCIENTIFIC NAME	COMMON NAME	REDWOOD	DOUGLAS FIR	MIXED EVERGREEN FOREST	RIPARIAN FOREST	CHAPARRAL	OAK WOODLAND	GRASSLAND	VOLCANIC ROCK OUTCROP	WETLAND SWALE	EDGE
Picoides pubescens	Downy Woodpecker		X	X	X		X				
Picoides villosus	Hairy Woodpecker	X	X	X	X		X				
Pipilo maculatus	Spotted Towhee			X	X	X					X
Piranga ludoviciana	Western Tanager	X	X	X			X				
Poecile rufescens	Chestnut-backed Chickadee		X	X	X		X				
Psaltriparus minimus	Bushtit			X		X	X				X
Regulus satrapa	Golden-crowned Kinglet	X	X								
Sayornis nigricans	Black Phoebe				X			X		X	X
Sialia mexicana	Western Bluebird					X	X	X			X
Sitta carolinensis	White-breasted Nuthatch						X				
Spizella passerina	Chipping Sparrow						X				
Streptopelia decipiens	Mourning Dove				X		X	X			X
Strix occidentalis caurina[1]	Northern Spotted Owl	X	X	X							
Sturnus vulgaris	European Starling	X	X	X	X	X	X	X	X	X	X
Tachycineta thalassina	Violet-green Swallow	X	X					X		X	
Thryomanes bewickii	Bewick's Wren		X	X	X	X	X				
Toxostoma redivivum	California Thrasher					X					
Troglodytes aedon	House Wren			X		X	X	X			X
Troglodytes pacificus	Pacific Wren	X	X	X	X						
Turdus migratorius	American Robin			X	X	X	X				
Vireo cassinii	Cassin's Vireo			X	X						
Vireo gilvus	Warbling Vireo		X	X	X		X				
Vireo huttoni	Hutton's Vireo			X			X				
Bird Species Expected but not Detected											
Baeolophus inornatus	Oak Titmouse						X	X			
Catharus ustulatus	Swainson's Thrush	X	X	X	X						
Contopus sordidulus	Western Wood-Pewee	X	X	X	X	X	X	X			X
Elanus leucurus	White-tailed Kite						X	X			
Myiarchus cinerascens	Ash-throated Flycatcher				X	X	X				X
Oreothlypis celata	Orange-crowned Warbler	X	X	X	X		X				
Tachycineta bicolor	Tree Swallow			X	X	X	X	X		X	X
Aves Possible[2]											
Spizella atrogularis	Black-chinned Sparrow					X					
Carduelis lawrencei	Lawrence's Goldfinch					X					
Aimophila ruficeps	Rufous-crowned Sparrow					X					
Amphispiza belli	Sage Sparrow					X					

1. Bold entries indicated special-status birds that were detected on the Preserve during 2013 surveys. See Figure 3.2 for locations.

2. Species expected (but not detected) based on being known from the region and the presence of suitable habitat.

APPENDIX D

INVASIVE PLANT SPECIES OF CONCERN

Identified on the Calabazas Creek Open Space Preserve, Sonoma County, California. Compiled by Vollmar Natural Lands Consulting, 2013.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
Cal-IPC Rank: HIGH					
cheat grass (*Bromus tectorum*) High	Limited to a few small populations at the convergence of Coast Live Oak Woodland and Chamise Chaparral, in shallow rocky soils.	Displaces native plants and prevents native seedling establishment. Increases fire frequency and intensity.	Hand pulling small infestations or moderate grazing may be effective. The addition of chemical treatment in areas where no rare plant species are present may be the most effective.	Non-chemical	Individual plants or small patches can be pulled by hand or hoed in early spring before seeds are ripe. Mowing is not recommended unless applied multiple times throughout the season to control seed production. Burning tends to increase cheat grass abundance. Moderate grazing in combination with chemical treatment can be effective. Heavy grazing may increase dominance of this species.
				Chemical	Due to the sensitivity of the habitat where cheat grass occurs on the site, herbicides must be used with care. Grass-specific herbicides are available but are typically not approved for use in natural areas. Glyphosate and other nonselective herbicides can be used but present a risk of collateral damage to co-occurring rare plant species.
French broom (*Genista monspessulana*) High	Isolated individuals along main roadway and trail near trailhead within the riparian corridor, as well as on fringes of Douglas Fir Forest, Redwood Forest, and Coastal Live Oak Woodlands.	Displaces native plants and animals. Can form dense stands which dominate plant communities by shading out seedlings. Increases the frequency and intensity of fires. Toxic to humans and livestock, except goats. Long soil seed bank (30 years). Shrubs can live for up to 30 years.	Hand removal with weed wrenches with follow up seedling control. Cutting to the ground with follow up chemical control can be effective where damage to native plant community is not a concern.	Non-chemical	Weed wrenches are effective at removing established shrubs as long as care is taken to remove the entire plant, but create a disturbed area which is favorable for new sprouts. Burning is not effective and can even increase spread unless followed by herbicide treatment. The flowers and seeds are toxic to cattle and sheep, but goat grazing may be effective. Care must be taken to ensure native species aren't damaged by goats.
				Chemical	There are several herbicides which have been effectively used to control French broom. Most are used following a cut treatment to the shrub. Chemical treatments do not affect the well developed seed bank.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
Himalayan blackberry (*Rubus armeniacus*) High	Riparian Corridor and along trail in the southwestern portion of the Preserve, as well as open areas with moist soil within Douglas Fir Forest, Redwood Forest, Coastal Live Oak Woodland, and Chamise Chaparral.	Displaces native plants by out-competing native species and creating a dense canopy which limits the available light. The impenetrable thickets can reduce wildlife access to water and prevent access for forest maintenance and recreational pursuits. Creates dense shade along stream banks, which is detrimental to foothill yellow-legged frog.	Hand pulling for small populations and mechanical removal for larger infestations. Herbicide use can be effective, especially in combination with mowing or cutting but may negatively impact native riparian habitats.	Non-chemical	Small populations can be effectively treated by hand pulling. The most effective treatment for large infestations is mowing or cutting plus herbicide treatment. When using mechanical control, it is important to remove the canes, roots and root crowns to prevent re-sprouting. Care must be taken to not spread plant fragments as these can spread the weed. Grazing (especially by goats) can significantly reduce the spread of Himalayan blackberry; however their consumption is indiscriminate and could harm native plants. Managing for high levels of understory shade helps keep this weed in check in riparian areas. A commitment to long-term maintenance is key to effective control.
				Chemical	Chemical control can be effective, especially when paired with mechanical treatment, but caution must be taken when working near water in riparian areas. Herbicides such as Garlon 3A and Accord have been formulated for use in aquatic habitats. Additionally, some herbicides contain surfactants that may be harmful to aquatic organisms (Bennett 2007).
jubata grass (*Cortaderia jubata*) High	Limited to a single small stand in the quarry area at the southwestern edge of the Preserve.	Occurs in disturbed areas but can also occur in undisturbed habitats where soil moisture is abundant. Mature plants have prolific seed production, but the seeds don't last long in the soil seedbank. When established, this species is highly competitive with native vegetation.	Mechanical removal of established grasses using large equipment can effectively eliminate isolated occurrences of this species. Hand pulling should be used for controlling this plant in the seedling stage.	Non-chemical	Hand pulling of seedlings can effectively treat small infestations of this species. Mechanical control using large equipment is often necessary to effectively remove established plants. Chainsaws and weedeaters can be used to expose the base of the plant to gain access to the crown and roots so they can be removed for effective control. Grazing and fire are not considered effective methods for treating this species.
				Chemical	Glyphosate, when applied in the late summer or fall, may provide consistent control.
sweet fennel (*Foeniculum vulgare*) High	Limited to a few scattered individuals in the quarry area at the southwestern edge of the Preserve	Invades disturbed areas and excludes reestablishment of native plants. Forms dense, uniform stands and drastically alters the composition and structure of native plant communities.	Hand chopping or repeated slashing just before flowering can effectively control small infestations.	Non-chemical	Digging out individual plants and slashing just before flowering are the most effective physical methods available when infestations are locally restricted. Repeated slashing of re-growth may be required. Prescribed burns are only effective if followed by herbicide treatment. Grazing often spreads the population.
				Chemical	The herbicides Garlon and Roundup can effectively reduce fennel cover. Herbicides should be applied before flowering.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
yellow star-thistle (*Centaurea solstitialis*) High	Throughout the site and forms its own alliance.	Displacement of native plants and animals, threatens natural ecosystems. Significantly depletes soil moisture reserves in grasslands. Interferes with grazing—long-term ingestion by horses causes a neurological disorder known as chewing disease.	Significant population control will require several treatments and years of management. Spot eradication of new invasions is effective and will prevent the establishment of new large scale infestations. Properly timed physical and biological control methods are recommended, large populations will require several years of management. Chemical control can be an effective eradication method, but should be considered carefully for secondary effects to the site.	Non-chemical	Mowing can be effective if timed after 2-5 % of the seed heads are flowering with the blades cutting below the lowest branches. Prescribed burning can provide control of this species if conducted at the very early flowering stage. High-intensity, short-duration grazing by sheep or cattle can be effective if timed when the plants have bolted but prior to producing a flowering head. Goats will browse the plant even in the flowering stage. To gain effective control, several years of treatment, often including a combination of methods, is required due to the longevity of seeds in the soil seed bank. Treatment combined with re-vegetation with competitive plant species is recommended.
				Chemical	Several effective herbicides can be applied for control if timed correctly. Clopyralid is the most effective and creates little collateral damage due to the selectivity of the chemical. Other formulations can provide effective control when timed properly including 2,4-D, triclopyr, and dicamba, which should be applied in winter or early spring to control plants in the rosette stage. Glyphosate is the most effective herbicide for late season control. While it is nonselective, collateral damage can be limited with application after other annuals have senesced or using spot treatment.
Cal-IPC Rank: MODERATE					
annual false brome (*Brachypodium distachyon*) Moderate	Scattered throughout open areas in with shallow soils in chaparral communities.	Displaces native plants and prevents native seedling establishment.	Hand pulling small infestations may be effective. The addition of chemical treatment in areas where no rare plant species are present may be effective.	Non-chemical	Individual plant or small patches can be pulled by hand or hoed in early spring before seeds are ripe. Mowing may be effective if timed before seeds mature. A late spring burn can provide effective control. Due to the low palatability of this grass, grazing is not a reliable control treatment.
				Chemical	Due to the sensitivity of the habitat where this grass occurs on the site, herbicides must be used with care. Grass-specific herbicides are available but are typically not approved for use in natural areas. Glyphosate and other nonselective herbicides can be used but present a risk of collateral damage to co-occurring rare plant species.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
bigleaf periwinkle (*Vinca major*) Moderate	Limited occurrences near the trailhead and between the Nuns Canyon Road and the quarry at the southwestern edge of the Preserve, within Coast Live Oak Woodland.	Established populations form a dense cover that prevents the establishment of other species. Riparian habitats are especially sensitive.	Both manual and chemical control can be effective. Manual removal requires follow-up visits every three months, and monitoring twice a year after eradication. Chemical methods should be applied with care to avoid damaging the native community.	Non-chemical	Hand pulling is labor intensive but can be very effective if all stem, root nodes and stolons are removed to prevent re-sprouting. Mowing and cutting are not recommended. The stems contain milky latex that is unpalatable to foraging animals so grazing is ineffective.
				Chemical	Glyphosate is successful if it follows immediately after a cut. Lower concentrations can be used to reduce collateral damage to native species.
bull thistle (*Cirsium vulgare*) Moderate	Limited to a few small populations in the eastern and north-central area of the Preserve, within Annual Brome Grassland and Harding Grass Swards.	Displaces native plants. Not palatable to cattle.	Properly timed mowing, tilling and hand cutting is effective for low density or locally restricted populations. Chemical control is effective but should be considered carefully to restrict damage to sensitive native plants and riparian areas.	Non-chemical	Mowing can be effective if applied shortly before the plant flowers or when the plant is just beginning to flower. Mowing too early causes the plant to flower later. Multiple treatments will be necessary. Hoeing and hand cutting, or any treatment that severs the root below the surface can be effective when done before the plants flower. Burning may increase the spread of bull thistle. Biological control agents have been released that attack bull thistle, but the reports of their effectiveness vary.
				Chemical	Several herbicides are effective at controlling bull thistle, including dicamba and triclopyr for smaller plants. Timing of application is important, Autumn or spring application is best for rosette control.
Harding grass (*Phalaris aquatica*) Moderate	Throughout the site, particularly within concave areas in north-central and southwestern portions of the Preserve and forms its own alliance.	Outcompetes and displaces native plant species. Addition of biomass from these tall, rhizomatous plants can increase fire hazard.	Grazing and mowing can be effective when used in combination with chemical treatment. Application with a rope wiper helps reduce potential negative effects to the native plant community.	Non-chemical	Mowing and grazing are most effective when used late in the season to stimulate new growth that can then be treated with follow-up herbicide treatment. Burning in early spring can also be used to remove biomass and stimulate new growth that can then be chemically treated.
				Chemical	Glyphosate can be effective at treating regrowth, and use of a rope wiper can reduce collateral impacts to native plant species. Monitoring and repeat applications are necessary for complete control.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
Italian thistle (*Carduus pycnocephalus*) Moderate	Limited to a few populations within the Yellow Star-Thistle Fields, in the north-central and southeast portions of the Preserve.	Dominates sites and excludes native species. Reduces establishment of other plants and discourages grazing.	Herbicide treatment in the rosette or bolting stage for large infestations. Spot control using mechanical means for new infestations to reduce the spread of the species.	Non-chemical	Manual removal using a sharpened shovel or hoe to cut the plant just above the root crown (2-4" below soil surface) can effectively control small patches. Mowing can be effective when timed after plants bolt but before they begin to flower but needs to be repeated numerous times throughout the season since plants don't all flower at once. Fire may not burn hot enough to kill the root crown but a flamer can be sued to kill individual plants. Sheep or goat grazing may be useful. In general, thistles compete poorly in healthy established vegetation, so establishment of a dense cover of desirable grasses and forbs may be an effective cultural control for this species and the other thistles on the site.
				Chemical	Glyphosate, clopyralid aminopyralid and 2,4-D may provide effective control of Italian thistle. These herbicides are best applied during the rosette or bolting stage. Care must be taken to avoid damage to native plants.
pennyroyal (*Mentha pulegium*) Moderate	Scattered along the edges of seeps and springs within grasslands.	May displace native plant species, especially in wetlands.	Mechanical removal of small patches. Aquatic formulations of certain herbicides may work on heavy infestations though collateral damage to native plants must be considered.	Non-chemical	Small infestations can be removed using mechanical methods before the plants flower as long as all plant parts are removed including rhizomes and stolons. Seedlings should be removed immediately following emergence. While repeated late spring, early summer mowing may suppress infestations, it is often difficult to get mowing equipment into the wet places where this plant grows. Cutting generally results in crown re-sprouting.
				Chemical	Mature plants can be treated with an aquatic formulation of glyphosate or triclopyr, however great care must be taken to avoid collateral damage to native species when this species occurs in wetlands.

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
poison hemlock (*Conium maculatum*) Moderate	In isolated patches near the trailhead at the southeastern edge of the Preserve within Coast Live Oak Woodland and Wild Oats Grasslands.	Quickly spreads in disturbed areas and, once established, prevents native plant establishment. Toxic to livestock, wildlife and humans.	Hand removal by digging up the root of the plant is recommended for small infestations. Chemical control methods are effective, but have greater impacts on surrounding areas.	Non-chemical	Hand pulling is effective if done prior to seed set and if the entire root system is removed. It is important to wear gloves and wash hands thoroughly after touching this plant. Care should be taken to minimize soil disturbance when mechanically treating infestations as this encourages further germination. Spring mowing followed by a later summer mow is effective (a third year may be necessary). Do not burn, as toxins can be released into the air through smoke. Grazing is not recommended due to the toxicity of the entire plant.
				Chemical	Several post-emergent herbicides may be effective when applied to poison hemlock. These include 2,4 D and glyphosate plus surfactant when applied in the rosette stage. All methods should be applied in late spring.
Tasmanian bluegum (*Eucalyptus globulus*) Moderate	One large stand in the clearing at the end of the riparian trail, within the Pacific Madrone Forest. Single trees also found in forested habitat north of the grove.	Displaces native plant communities and wildlife habitat. Groves are highly flammable and increase fire risk, including "spot fires" that spread fire to non-adjacent sites.	Felling individual trees, followed by either physical (bagging) or chemical treatment of stumps is recommended. Follow up treatment of seedlings and saplings can be done by hand or using a weed wrench.	Non-chemical	Felling individual trees is effective, but can be difficult and expensive. Felling trees must be followed by stump treatment. Cutting a plant at ground level and then either covering it with plastic for a year or treating the stump with chemicals can give good control.
				Chemical	Sprouting control is most effective when applied directly to the outer portion of the stumps cut surface. Glyphosate is the most effective chemical for treating re-sprouting stumps.
tocalote (*Centaurea melitensis*) Moderate	Single small isolated patch within the Annual Grassland, located in the north-central portion of the Preserve.	Dense infestations displace native plants and animals.	Use same methods as yellow star-thistle.	See yellow star-thistle	
velvet grass (*Holcus lanatus*) Moderate	Isolated patches in poorly drained soils within grasslands.	Can reduce the growth of native herbaceous species and small tree seedlings.	Removal of entire plant for small, isolated infestations.	Non-chemical	Plant can re-sprout from basal shoots, so any mechanical treatment must remove the entire plant to be effective. Mowing can reduce infestations but may be impractical for treatment of dense infestations. Intensive grazing may reduce dense infestations, but low intensity grazing may enhance establishment and spread.
				Chemical	Grass-specific herbicides are available but may not be approved for use in natural areas.
Cal-IPC Rank: LIMITED					

SCIENTIFIC NAME (COMMON NAME) CAL-IPC RATING	PRESENCE ON PRESERVE	ASSOCIATED PROBLEMS	PREFERRED CONTROL METHOD	OTHER CONTROL METHODS	
black locust (*Robinia pseudoacacia*) Limited	Limited occurrence on the Preserve, located along the trail in the southeast, within the Riparian Corridor.	Dense stands of black locust can displace native plants.	Few treatments are effective for controlling this species. A cut stump application of herbicide may be the most effective but requires monitoring for re-sprouts.	Non-chemical	Cutting or girdling stems results in prolific root suckering, mechanical methods would require repeated cutting for several years to kill the plant.
				Chemical	Application of herbicides such as glyphosate are effective when applied to a freshly cut stump.
broadleaf forget-me-not (*Myosotis latifolia*) Limited	Limited to small patches along the edge of Nuns Canyon Road adjacent to Calabazas Creek.	Dense stands can reduce biodiversity in riparian or woodland communities.	Uproot individual plants to control small populations.	Non-chemical	Roots are easily uprooted and small populations can be effectively eliminated by hand pulling as long as the entire plant is removed to prevent re-sprout. Burning and grazing are not effective for control.
				Chemical	Chemical control is not recommended due to the collateral effects on native plants that may co-occur with this species.
cherry plum (*Prunus cerasifera*) Limited	Limited occurrence on the Preserve, located west of the trail in the southeastern area, within California Bay Forest.	Dense stands can displace native species in riparian and woodland communities.	Hand pull small plants. Use a weed wrench to pull larger saplings.	Non-chemical	Small plants can be hand pulled and larger plants pulled using a weed wrench. Adult plants will re-sprout.
				Chemical	Foliar treatment using a number of different herbicides including 2, 4-D, glyphosate and triclopyr may provide effective control. Care should be used to avoid damage to surrounding native vegetation.
milkthistle (*Silybum marianum*) Limited	Limited to a few small populations within the Annual Grasslands, located in the north-central and southeastern areas of the Preserve.	Suppresses germination and growth of surrounding native vegetation. The spiny nature of the plant can physically injure livestock.	Mowing of mature plants before flowers open is a viable control method.	Non-chemical	Mowing is effective after the plants are a foot high and before they flower. Grazing is not an option as the plants are typically too spiny for animals to forage.
				Chemical	Various formulations of herbicide can be used to treat this species and will depend on the sensitivity of the surrounding native vegetation.
Olive (*Olea europaea*) Limited	Scattered individuals co-occurring with Tasmanian bluegum within Coast Live Oaks Woodland fringes and Wild Oats Grasslands.	Dense stands can displace native species in riparian and woodland communities.	Hand pull small plants. Use a weed wrench to pull larger saplings.	Non-chemical	Small plants can be hand pulled and larger plants pulled using a weed wrench. Adult plants will re-sprout.
				Chemical	Foliar or cut stump application of triclopyr can provide effective control.

Sources:

Bennett, M. 2007. Managing Himalayan blackberry in western Oregon riparian areas (EM 8894). Oregon State University Extension Service. Corvallis, OR. 16 pp.

DiTomaso, J., G. Kyser et al. 2013. Weed control in Natural Areas in the Western United States. Weed Research and Information Center, University of California. 544 pp.

APPENDIX E.1

LIST OF ALL VASCULAR PLANT TAXA IDENTIFIED ON THE CALABAZAS CREEK OPEN SPACE PRESERVE, SONOMA COUNTY, CALIFORNIA. COMPILED BY VOLLMAR NATURAL LANDS CONSULTING, 2013

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Adoxaceae	Muskroot Family			
	Sambucus nigra ssp. *caerulea*	blue elderberry		Perennial	Shrub/Tree
	Agavaceae	Century-plant Family			
	Chlorogalum pomeridianum	wavyleaf soap plant		Perennial	Forb/herb
	Anacardiaceae	Sumac Family			
	Toxicodendron diversilobum	Pacific poison oak		Perennial	Shrub, Vine
	Apiaceae	Carrot Family			
Non-native	*Anthriscus caucalis*	bur chervil		Annual	Forb/herb
Non-native	*Apium graveolens*	wild celery	FACW	Perennial	Forb/herb
Cal-IPC Moderate	*Conium maculatum*	poison hemlock	FACW	Biennial	Forb/herb
Cal-IPC High	*Foeniculum vulgare*	sweet fennel	FACU	Biennial, Perennial	Forb/herb
	Heracleum maximum	common cowparsnip		Perennial	Forb/herb
	Ligusticum apiifolium	celeryleaf licorice root		Perennial	Forb/herb
	Lomatium californicum	California lomatium		Perennial	Forb/herb
	Lomatium caruifolium var. *caruifolium*	caraway leaved lomatium		Perennial	Forb/herb
	Lomatium dasycarpum ssp. *dasycarpum*	woollyfruited lomatium		Perennial	Forb/herb
CRPR 4.3	*Lomatium repostum*	Napa biscuitroot		Perennial	Forb/herb
	Osmorhiza berteroi	sweetcicely		Perennial	Forb/herb
	Perideridia kelloggii	yampah		Perennial	Forb/herb
	Sanicula bipinnatifida	purple sanicle		Perennial	Forb/herb
	Sanicula crassicaulis	Pacific blacksnakeroot		Perennial	Forb/herb
	Sanicula laciniata	coast sanicle		Perennial	Forb/herb
Non-native	*Scandix pecten-veneris*	sheperdsneedle		Annual	Forb/herb
Cal-IPC Moderate	*Torilis arvensis*	field hedge parsley		Annual	Forb/herb
	Yabea microcarpa	California hedge parsley		Annual	Forb/herb
	Apocynaceae	Dogbane Family			
	Asclepias californica	California milkweed		Perennial	Forb/herb
	Asclepias cordifolia	heartleaf milkweed		Perennial	Forb/herb
Cal-IPC Moderate	*Vinca major*	bigleaf periwinkle		Perennial	Vine, Forb/herb
	Araliaceae	Ginseng Family			
	Aralia californica	elkclover	FACW	Perennial	Forb/herb
	Aristolochiaceae	Birthwort Family			
	Aristolochia californica	California pipevine		Perennial	Vine
	Asteraceae	Aster Family			
	Achillea millefolium	common yarrow	FACU	Perennial	Forb/herb
	Achyrachaena mollis	blow wives		Annual	Forb/herb
	Adenocaulon bicolor	American trailplant		Perennial	Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Agoseris grandiflora	bigflower agoseris		Perennial	Forb/herb
	Agoseris heterophylla	annual agoseris		Annual	Forb/herb
	Anisocarpus madioides	woodland madia		Annual	Forb/herb
	Artemisia douglasiana	Douglas' sagewort	FACW	Perennial	Forb/herb
	Baccharis pilularis	coyotebrush		Perennial	Subshrub, Shrub
Non-native	*Calendula arvensis*	field marigold		Annual	Forb/herb
	Calycadenia truncata	rosin weed		Annual	Forb/herb
Cal-IPC Moderate	*Carduus pycnocephalus* ssp. *pycnocephalus*	Italian plumeless thistle		Perennial	Forb/herb
Cal-IPC Moderate	*Centaurea melitensis*	tocalote		Annual, Biennial	Forb/herb
Cal-IPC High	*Centaurea solstitialis*	yellow star-thistle		Annual	Forb/herb
Non-native	*Cichorium intybus*	chicory	FACU	Biennial, Perennial	Forb/herb
	Cirsium occidentale var. *venustum*	cobwebby thistle		Biennial, Perennial	Forb/herb
Cal-IPC Moderate	*Cirsium vulgare*	bull thistle	FACU	Biennial	Forb/herb
	Ericameria arborescens	goldenfleece		Perennial	Shrub
CRPR 3	*Erigeron biolettii*	Biolett's erigeron		Perennial	Subshrub, Forb/herb
	Erigeron inornatus var. *inornatus*	california rayless daisy		Perennial	Forb/herb
Non-native	*Erigeron sumatrensis*	tropical horseweed		Annual	Forb/herb
	Eriophyllum lanatum var. *achilleoides*	golden yarrow		Perennial	Forb/herb
	Eriophyllum lanatum var. *arachnoideum*	wooly sunflower		Perennial	Subshrub, Forb/herb
Non-native	*Logfia gallica*	narrowleaf cottonrose		Annual	Forb/herb
	Gamochaeta ustulata	featherweed		Annual	Forb/herb
	Helianthella californica var. *californica*	California helianthella		Annual	Forb/herb
Cal-IPC Limited	*Helminthotheca echioides*	bristly ox-tongue	FACU	Annual	Forb/herb
	Hemizonia congesta ssp. *luzulifolia*	hayfield tarweed		Annual	Forb/herb
	Hieracium albiflorum	white hawkweed		Perennial	Forb/herb
Cal-IPC Moderate	*Hypochaeris radicata*	hairy cat's ear	NO	Perennial	Forb/herb
Non-native	*Lactuca serriola*	prickly wild lettuce	FAC	Annual, Biennial	Forb/herb
	Lasthenia californica	California goldfields		Annual, Perennial	Forb/herb
	Madia elegans	common madia		Annual	Forb/herb
	Madia exigua	little tarweed		Annual	Forb/herb
	Madia gracilis	slender tarweed		Annual	Forb/herb
	Madia sativa	coast tarweed		Annual	Forb/herb
Non-native	*Matricaria discoidea*	pineapple weed		Annual	Forb/herb
	Micropus californicus var. *californicus*	slender cottonweed		Annual	Forb/herb
	Pseudognaphalium californicum	ladies' tobacco		Annual, Biennial	Forb/herb
	Psilocarphus oregonus	Oregon woollyheads	OBL	Annual	Forb/herb
Non-native	*Rhagadiolus stellatus*	endive daisy		Annual	Forb/herb
	Senecio aronicoides	rayless ragwort		Biennial, Perennial	Forb/herb
Non-native	*Senecio vulgaris*	old-man-in-the-Spring	NI*	Annual, Biennial	Forb/herb
Cal-IPC Limited	*Silybum marianum*	milkthistle		Annual, Biennial	Forb/herb
	Solidago velutina ssp. *californica*	Oreja de liebre		Perennial	Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
Non-native	*Soliva sessilis*	field burrweed		Annual	Forb/herb
Non-native	*Sonchus asper* ssp. *asper*	spiny sowthistle	FAC	Annual	Forb/herb
Non-native	*Sonchus oleraceus*	common sowthistle	NI*	Annual	Forb/herb
	Stephanomeria virgata ssp. *virgata*	rod wirelettuce		Annual	Forb/herb
Non-native	*Taraxacum officinale*	common dandelion		Perennial	Forb/herb
	Uropappus lindleyi	silver puffs		Annual	Forb/herb
	Wyethia angustifolia	California compassplant	FACU-	Perennial	Forb/herb
	Wyethia glabra	smooth mule ears		Perennial	Forb/herb
	Berberidaceae	Barberry Family			
	Berberis aquifolium var. *aquifolium*	Oregon grape		Perennial	Subshrub
	Betulaceae	Birch Family			
	Alnus rhombifolia	white alder	FACW	Perennial	Tree
	Corylus cornuta ssp. *californica*	California hazelnut	NI	Perennial	Tree
	Blechnaceae	Chain Fern Family			
	Woodwardia fimbriata	giant chainfern	FACW+	Perennial	Forb/herb
	Boraginaceae	Borage Family			
	Amsinckia intermedia	common fiddleneck		Annual	Forb/herb
	Cynoglossum grande	Pacific hound's tongue		Perennial	Forb/herb
	Eriodictyon californicum	yerba santa		Perennial	Shrub
Cal-IPC Limited	*Myosotis latifolia*	broadleaf forget me not		Perennial	Forb/herb
	Nemophila heterophylla	white nemophila		Annual	Forb/herb
	Nemophila parviflora var. *parviflora*	small flowered nemophila		Annual	Forb/herb
	Phacelia distans	distant phacelia		Annual, Perennial	Forb/herb
	Phacelia imbricata ssp. *imbricata*	imbricate phacelia		Perennial	Subshrub, Forb/herb
	Plagiobothrys nothofulvus	rusty popcornflower	FAC	Annual	Forb/herb
	Brassicaceae	Mustard Family			
	Athysanus pusillus	common sandweed		Annual	Forb/herb
	Cardamine californica	milk maids		Perennial	Forb/herb
	Cardamine oligosperma	bitter cress		Annual, Biennial	Forb/herb
Cal-IPC Moderate	*Hirschfeldia incana*	wild mustard		Annual, Biennial	Forb/herb
	Lepidium nitidum	shining pepperweed		Annual	Forb/herb
Non-native	*Lunaria annua*	annual honesty		Annual, Biennial	Forb/herb
	Nasturtium officinale	watercress	OBL	Perennial	Forb/herb
Non-native	*Raphanus raphanistrum*	wild radish		Annual, Biennial	Forb/herb
Cal-IPC Limited	*Raphanus sativus*	cultivated radish	NO	Annual, Biennial	Forb/herb
Non-native	*Sisymbrium officinale*	hedgemustard		Annual	Forb/herb
	Streptanthus tortuosus	shieldplant		Annual, Biennial	Subshrub, Forb/herb
	Thysanocarpus curvipes	sand fringepod		Annual	Forb/herb
	Turritis glabra	tower rock cress		Annual	Forb/herb
	Calycanthaceae	Strawberry-shrub Family			
	Calycanthus occidentalis	spicebush	FAC	Perennial	Shrub
	Campanulaceae	Bellflower Family			

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Githopsis diffusa ssp. *robusta*	San Gabriel bluecup		Annual	Forb/herb
	Caprifoliaceae	Honeysuckle Family			
	Lonicera hispidula	pink honeysuckle		Perennial	Vine
	Symphoricarpos albus var. *laevigatus*	common snowberry	FACU	Perennial	Subshrub, Shrub
	Symphoricarpos mollis	creeping snowberry		Perennial	Subshrub, Shrub
	Caryophyllaceae	Pink Family			
Non-native	*Cerastium glomeratum*	sticky chickweed	FACU	Annual	Forb/herb
Non-native	*Petrorhagia dubia*	hairypink		Annual	Forb/herb
Non-native	*Silene gallica*	common catchfly		Annual, Biennial	Forb/herb
	Silene laciniata ssp. *californica*	California indian pink		Annual	Forb/herb
Non-native	*Spergula arvensis*	corn spurry		Annual	Forb/herb
	Chenopodiaceae	Goosefoot Family			
Non-native	*Chenopodium album*	lambsquarter	FACU	Annual	Forb/herb
	Cistaceae	Rock-rose Family			
	Helianthemum scoparium	broom rose		Perennial	Subshrub, Shrub
	Convolvulaceae	Morning-glory Family			
	Calystegia purpurata ssp. *purpurata*	chaparral false bindweed		Perennial	Vine, Forb/herb
Non-native	*Convolvulus arvensis*	bindweed		Perennial	Vine, Forb/herb
	Crassulaceae	Stonecrop Family			
	Dudleya cymosa ssp. *cymosa*	canyon liveforever		Perennial	Forb/herb
	Sedum spathulifolium	broadlieaf stonecrop		Perennial	Forb/herb
	Cucurbitaceae	Cucumber Family			
	Marah fabacea	California manroot		Perennial	Forb/herb
	Marah oregana	coast man-root		Perennial	Forb/herb
	Cupressaceae	Cypress Family			
	Sequoia sempervirens	redwood		Perennial	Tree
	Cyperaceae	Sedge Family			
	Carex globosa	round-fruited sedge		Perennial	Graminoid
	Carex leptopoda	slender-footed sedge	FAC	Perennial	Graminoid
	Carex nudata	torrent sedge	FACW	Perennial	Graminoid
	Carex obnupta	coast carex	OBL	Perennial	Graminoid
	Carex tumulicola	foothill sedge	FACU	Perennial	Graminoid
	Cyperus eragrostis	tall flatsedge	FACW	Perennial	Graminoid
	Scirpus microcarpus	panicled bulrush	OBL	Perennial	Graminoid
	Dennstaedtiaceae	Bracken Fern Family			
	Pteridium aquilinum var. *pubescens*	western brackenfern	FACU	Perennial	Forb/herb
	Dryopteridaceae	Wood Fern Family			
	Dryopteris arguta	coastal woodfern		Perennial	Forb/herb
	Polystichum californicum	California swordfern		Perennial	Forb/herb
	Polystichum imbricans ssp. *imbricans*	rock sword fern		Perennial	Forb/herb
	Polystichum munitum	western swordfern	NO	Perennial	Forb/herb
	Equisetaceae	Horsetail Family			
	Equisetum telmateia ssp. *braunii*	giant horsetail	FAC	Annual	Forb/herb
	Ericaceae	Heath Family			

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Arbutus menziesii	Pacific madrone		Perennial	Tree
	Arctostaphylos canescens ssp. *canescens*	hoary manzanita		Perennial	Shrub
	Arctostaphylos glandulosa ssp. *cushingiana*	Cushing manzanita		Perennial	Shrub
	Arctostaphylos glandulosa ssp. *glandulosa*	Eastwood's manzanita		Perennial	Shrub
	Arctostaphylos manzanita ssp. *manzanita*	common manzanita		Perennial	Shrub
	Arctostaphylos stanfordiana ssp. *stanfordiana*	Stanford's manzanita		Perennial	Shrub
	Rhododendron occidentale	Rhododendron		Perennial	Shrub
	Fabaceae	Pea Family			
Cal-IPC Moderate	*Acacia dealbata*	silver wattle		Perennial	Tree, Shrub
	Acmispon brachycarpus	short podded lotus		Annual	Forb/herb
	Acmispon glaber var. *glaber*	deerweed		Annual	Forb/herb
	Acmispon parviflorus	hill lotus		Annual	Forb/herb
	Acmispon wrangelianus	Chilean bird's-foot trefoil		Annual	Forb/herb
CRPR 1B.2	*Amorpha californica* var. *napensis*	Napa false indigo		Perennial	Shrub
Cal-IPC High	*Genista monspessulana*	French broom		Perennial	Shrub
	Hoita macrostachya	large leather root	OBL	Perennial	Forb/herb
Non-native	*Lathyrus hirsutus*	rough pea		Annual	Vine, Forb/herb
Non-native	*Lathyrus latifolius*	perennial sweatpea		Perennial	Vine, Forb/herb
Non-native	*Lathyrus sativus*	white pea		Annual	Forb/herb, Vine
Non-native	*Lathyrus sphaericus*	grass pea		Annual	Vine, Forb/herb
	Lathyrus vestitus var. *vestitus*	Pacific pea		Perennial	Forb/herb
	Lupinus albifrons	silver lupine		Perennial	Subshrub, Shrub
	Lupinus bicolor	miniature lupine		Annual	Forb/herb
	Lupinus formosus var. *formosus*	summer lupine		Perennial	Forb/herb
Non-native	*Medicago polymorpha*	burclover		Annual, Perennial	Forb/herb
	Pickeringia montana	chaparral pea		Perennial	Shrub
Non-native	*Robinia pseudoacacia*	black locust		Perennial	Tree
	Rupertia physodes	California tea		Perennial	Forb/herb
	Trifolium albopurpureum	rancheria clover		Annual	Forb/herb
Non-native	*Trifolium campestre*	hop clover		Annual, Biennial	Forb/herb
	Trifolium ciliolatum	foothill clover		Annual	Forb/herb
Non-native	*Trifolium dubium*	suckling clover	FACU*	Annual	Forb/herb
Non-native	*Trifolium fragiferum*	strawberry clover	NI*	Perennial	Forb/herb
Cal-IPC Limited	*Trifolium hirtum*	rose clover		Annual	Forb/herb
Non-native	*Trifolium incarnatum*	crimson clover		Annual	Forb/herb
	Trifolium microcephalum			Annual	Forb/herb
	Trifolium microdon	thimble clover		Annual	Forb/herb
	Trifolium oliganthum	few flowered clover		Annual	Forb/herb
Non-native	*Trifolium subterraneum*	subterranean clover		Annual	Forb/herb
	Trifolium willdenovii	tomcat clover		Annual	Forb/herb
Non-native	*Vicia sativa* ssp. *nigra*	garden vetch	FACU	Annual	Vine, Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
Non-native	*Vicia sativa* ssp. *sativa*	spring vetch	FACU	Annual	Vine, Forb/herb
Non-native	*Vicia villosa* ssp. *varia*	winter vetch		Annual, Biennial	Vine, Forb/herb
	Fagaceae	Beech Family			
	Chrysolepis chrysophylla var. *minor*	giant chinquapin		Perennial	Shrub
	Quercus agrifolia	coast live oak		Perennial	Tree
	Quercus berberidifolia	scrub oak		Perennial	Shrub
	Quercus chrysolepis	canyon oak		Perennial	Tree
	Quercus douglasii	blue oak		Perennial	Tree
	Quercus durata var. *durata*	leather oak		Perennial	Shrub
	Quercus garryana var. *garryana*	Oregon oak		Perennial	Tree
	Quercus kelloggii	California black oak		Perennial	Tree, Shrub
	Quercus lobata	valley oak	FAC*	Perennial	Tree
	Quercus wislizeni var. *frutescens*	bush interior live oak		Perennial	Shrub
	Quercus wislizeni var. *wislizeni*	interior live oak		Perennial	Tree
	Quercus xmorehus	oracle oak		Perennial	Tree
	Gentianaceae	Gentian Family			
	Zeltnera davyi	Davy's centaury	FAC	Annual	Forb/herb
	Geraniaceae	Geranium Family			
Non-native	*Erodium botrys*	longbeak stork's bill		Annual, Biennial	Forb/herb
Cal-IPC Limited	*Erodium cicutarium*	redstem stork's bill		Annual, Biennial	Forb/herb
Cal-IPC Limited	*Geranium dissectum*	cutleaf geranium		Annual, Biennial	Forb/herb
Non-native	*Geranium molle*	dovefoot geranium		Annual, Biennial	Forb/herb
Non-native	*Geranium robertianum*	Robert geranium		Annual, Biennial	Forb/herb
	Grossulariaceae	Currant Family			
	Ribes roezlii var. *cruentum*	spiny fruited gooseberry		Perennial	Shrub, Subshrub
	Hydrangeaceae	Hydrangea Family			
	Whipplea modesta	modesty		Perennial	Shrub, Subshrub
	Hydrophyllaceae	Borage Family			
	Nemophila menziesii var. *atomaria*	baby blue eyes		Annual	Forb/herb
	Hypericaceae	St. John's Wort Family			
	Hypericum anagalloides	tinker's penny	OBL	Annual, Perennial	Forb/herb
	Hypericum concinnum	goldwire		Perennial	Subshrub, Forb/herb
	Iridaceae	Iris Family			
	Iris macrosiphon	bowltube iris		Perennial	Forb/herb
	Iris purdyi	Purdy's iris		Perennial	Forb/herb
Non-native	*Romulea rosea* var. *australis*	rosy sandcrocus		Perennial	Forb/herb
	Juglandaceae	Walnut Family			
	Juglans hindsii	Northern California black walnut	FAC	Perennial	Tree
	Juncaceae	Rush Family			
	Juncus balticus ssp. *ater*	Baltic rush	FACW	Perennial	Graminoid
	Juncus bolanderi	Bolander's rush	OBL	Perennial	Graminoid
	Juncus effusus ssp. *pacificus*	spreading rush	FACW	Perennial	Graminoid
	Juncus occidentalis	western rush	FACW	Perennial	Graminoid

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Juncus oxymeris	pointed rush	FACW	Perennial	Graminoid
	Juncus patens	spreading rush	FAC	Perennial	Graminoid
	Juncus phaeocephalus var. *paniculatus*	brownhead rush	FACW	Perennial	Graminoid
	Juncus tenuis	slender rush	FAC	Perennial	Graminoid
	Luzula comosa	hairy woodrush		Perennial	Graminoid
	Lamiaceae	Mint Family			
	Clinopodium douglasii	yerba buena		Perennial	Forb/herb, Subshrub
Non-native	*Lamium amplexicaule*	henbit deadnettle		Annual, Biennial	Forb/herb
Cal-IPC Limited	*Marrubium vulgare*	horehound		Perennial	Subshrub, Forb/herb
Non-native	*Melissa officinalis*	lemon balm		Perennial	Forb/herb
Cal-IPC Moderate	*Mentha pulegium*	pennyroyal		Perennial	Forb/herb
	Monardella villosa ssp. *villosa*	coyote mint		Perennial	Subshrub, Forb/herb
	Salvia sonomensis	Sonoma sage		Perennial	Subshrub, Forb/herb
	Scutellaria californica	California skullcap		Perennial	Forb/herb
	Stachys albens	whitestem hedgenettle	OBL	Perennial	Forb/herb
Non-native	*Stachys arvensis*	annual hedgenettle		Annual	Forb/herb
	Stachys rigida var. *quercetorum*	rough hedgenettle		Perennial	Forb/herb
	Stachys rigida var. *rigida*	rough hedgenettle	FACW+	Perennial	Forb/herb
	Lauraceae	Laurel Family			
	Umbellularia californica	California bay	FAC	Perennial	Tree, Shrub
	Liliaceae	Lily Family			
	Calochortus amabilis	golden globelily		Perennial	Forb/herb
	Calochortus luteus	yellow mariposa lily		Perennial	Forb/herb
	Fritillaria affinis	checker lily		Perennial	Forb/herb
	Lilium pardalinum ssp. *pardalinum*	leopard lily	FACW	Perennial	Forb/herb
	Prosartes hookeri	fairy bells		Perennial	Forb/herb
	Linaceae	Flax Family			
Non-native	*Linum bienne*	pale flax		Annual, Biennial	Forb/herb
	Malvaceae	Mallow Family			
	Sidalcea diploscypha	fringed checker mallow		Annual	Forb/herb
	Melanthiaceae	False-hellebore Family			
	Toxicoscordion fremontii	Fremont's deathcamas		Annual	Forb/herb
	Trillium albidum	giant wakerobin		Perennial	Forb/herb
	Xerophyllum tenax	beargrass		Perennial	Forb/herb
	Montiaceae	Miner's Lettuce Family			
	Calandrinia ciliata	red maids		Annual	Forb/herb
	Claytonia perfoliata	miner's lettuce	FAC	Annual, Perennial	Forb/herb
	Myrsinaceae	Myrsine Family			
	Trientalis latifolia	star flower		Perennial	Forb/herb
Non-native	*Anagallis arvensis*	scarlet pimpernel	FAC	Annual, Biennial	Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Myrtaceae	Myrtle Family			
Cal-IPC Moderate	*Eucalyptus globulus*	Tasmanian bluegum		Perennial	Tree
	Oleaceae	Olive Family			
	Fraxinus latifolia	Oregon ash	FACW	Perennial	Tree
Cal-IPC Limited	*Olea europaea*	olive		Perennial	Tree, Shrub
	Onagraceae	Evening Primrose Family			
	Clarkia affinis	chaparral clarkia		Annual	Forb/herb
	Clarkia concinna ssp. *concinna*	red ribbons		Annual	Forb/herb
	Clarkia purpurea ssp. *quadrivulnera*	purple clarkia		Annual	Forb/herb
	Clarkia unguiculata	elegant clarkia		Annual	Forb/herb
	Epilobium brachycarpum	slender willowherb		Annual	Forb/herb
	Epilobium canum ssp. *canum*	California fuchsia		Perennial	Subshrub, Forb/herb
	Epilobium ciliatum ssp. *ciliatum*	fringed willowherb	FACW	Perennial	Forb/herb
	Epilobium densiflorum	denseflower willowherb	FACW	Annual	Forb/herb
	Epilobium minutum	slender annual fireweed		Annual	Forb/herb
	Orchidaceae	Orchid Family			
	Piperia transversa	royal rein orchid		Perennial	Forb/herb
	Orobanchaceae	Broom-rape Family			
Non-native	*Bellardia trixago*	Mediterranean lineseed		Annual	Forb/herb
	Castilleja applegatei ssp. *martinii*	wavyleaf Indian paintbrush		Perennial	Forb/herb, Subshrub
	Castilleja attenuata	attenuate Indian paintbrush		Annual	Forb/herb
	Castilleja exserta ssp. *exserta*	purple owl's clover		Annual	Forb/herb
	Castilleja foliolosa	Texas Indian paintbrush		Perennial	Subshrub, Forb/herb
	Cordylanthus pilosus ssp. *pilosus*	hairy bird's beak		Annual	Forb/herb
	Pedicularis densiflora	Indian warrior		Perennial	Forb/herb
	Triphysaria eriantha ssp. *eriantha*	johnny tuck		Annual	Forb/herb
	Papaveraceae	Poppy Family			
	Dendromecon rigida	bush poppy		Perennial	Shrub, Tree
	Eschscholzia californica	California poppy		Annual, Perennial	Forb/herb
	Phrymaceae	Lopseed Family			
	Mimulus aurantiacus var. *aurantiacus*	sticky monkeyflower		Perennial	Shrub
	Mimulus cardinalis	scarlet monkeyflower		Perennial	Forb/herb
	Mimulus guttatus	seep monkeyflower		Annual, Perennial	Forb/herb
	Mimulus moschatus	musk flower		Perennial	Forb/herb
	Pinaceae	Pine Family			
	Pinus attenuata	knobcone pine		Perennial	Tree
	Pinus ponderosa	ponderosa pine		Perennial	Tree
	Pseudotsuga menziesii var. *menziesii*	Douglas-fir	NO	Perennial	Tree
	Plantaginaceae	Plantain Family			
	Collinsia sparsiflora var. *arvensis*	few flowered collinsia		Annual	Forb/herb
Non-native	*Kickxia elatine*	sharp point fluellin	UPL	Annual	Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Penstemon heterophyllus var. *heterophyllus*	foothill penstemon		Perennial	Forb/herb
	Plantago erecta	dotseed plantain		Annual	Forb/herb
Cal-IPC Limited	*Plantago lanceolata*	narrowleaf plantain	FAC-	Annual, Biennial	Forb/herb
Non-native	*Plantago major*	common plantain	FACW-	Perennial	Forb/herb
	Poaceae	Grass Family			
	Agrostis exarata	spike bentgrass	FACW	Perennial	Graminoid
	Agrostis pallens	leafy bentgrass	FACU	Perennial	Graminoid
Non-native	*Aira caryophyllea*	silver hairgrass	NO	Annual	Graminoid
Cal-IPC Moderate	*Avena barbata*	slender wild oats		Annual	Graminoid
Cal-IPC Moderate	*Avena fatua*	wild oats		Annual	Graminoid
Cal-IPC Moderate	*Brachypodium distachyon*	purple false brome		Annual	Graminoid
	Briza minor	little quaking grass	FACW-	Annual	Graminoid
	Bromus carinatus var. *carinatus*	California brome		Annual	Graminoid
Cal-IPC Moderate	*Bromus diandrus*	ripgut brome		Annual, Perennial	Graminoid
Cal-IPC Limited	*Bromus hordeaceus*	soft brome	FACU-	Annual	Graminoid
	Bromus laevipes	woodland brome		Perennial	Graminoid
Non-native	*Bromus madritensis*	red brome		Annual	Graminoid
	Bromus orcuttianus	Orcutt's brome		Perennial	Graminoid
Cal-IPC High	*Bromus tectorum*	cheat grass		Annual	Graminoid
	Bromus vulgaris	common brome	FACU	Perennial	Graminoid
Cal-IPC High	*Cortaderia jubata*	jubata grass		Perennial	Graminoid
Cal-IPC Moderate	*Cynodon dactylon*	Bermuda grass	FAC	Perennial	Graminoid
Cal-IPC Moderate	*Cynosurus echinatus*	bristly dogstail grass		Annual	Graminoid
Cal-IPC Limited	*Dactylis glomerata*	orchard grass		Perennial	Graminoid
	Danthonia californica	California oatgrass		Perennial	Graminoid
	Deschampsia cespitosa ssp. *cespitosa*	tufted hairgrass	FACW	Perennial	Graminoid
Cal-IPC High	*Elymus caput-medusae*	Medusa head		Perennial	Graminoid
	Elymus glaucus ssp. *glaucus*	blue wildrye	FACU	Perennial	Graminoid
	Elymus multisetus	Squirreltail		Perennial	Graminoid
Non-native	*Festuca bromoides*	Brome fescue	FAC	Annual	Graminoid
	Festuca californica	California fescue		Perennial	Graminoid
	Festuca elmeri	Elmer fescue		Perennial	Graminoid
	Festuca microstachys	small fescue		Perennial	Graminoid
Cal-IPC Moderate	*Festuca myuros*	rattail sixweeks grass		Perennial	Graminoid
Cal-IPC Moderate	*Festuca perennis*	Italian rye grass		Annual, Perennial	Graminoid
Non-native	*Gastridium phleoides*	nit grass	FACU	Annual	Graminoid
Cal-IPC Moderate	*Holcus lanatus*	velvet grass	FAC	Perennial	Graminoid
	Hordeum brachyantherum ssp. *brachyantherum*	meadow barley	FACW	Perennial	Graminoid
	Hordeum brachyantherum ssp. *brachyantherum*	meadow barley	FACW	Perennial	Graminoid
Cal-IPC Moderate	*Hordeum marinum* ssp. *gussoneanum*	Mediterranean barley	FACU	Annual	Graminoid
Cal-IPC Moderate	*Hordeum murinum* ssp. *leporinum*	mouse barley		Annual	Graminoid

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
Non-native	*Lamarckia aurea*	goldentop grass		Annual	Graminoid
	Melica geyeri	Geyer's oniongrass		Perennial	Graminoid
	Melica harfordii	Harford's oniongrass		Perennial	Graminoid
	Melica subulata	Alaska oniongrass		Perennial	Graminoid
	Melica torreyana	Torrey's melicgrass		Perennial	Graminoid
Cal-IPC Moderate	*Phalaris aquatica*	Harding grass	FAC+	Perennial	Graminoid
Non-native	*Poa annua*	annual bluegrass	FACW-	Annual	Graminoid
Non-native	*Poa bulbosa*	bulbous bluegrass		Perennial	Graminoid
	Poa secunda ssp. *secunda*	Sandberg bluegrass		Perennial	Graminoid
Cal-IPC Limited	*Polypogon monspeliensis*	rabbitsfoot grass	FACW	Annual	Graminoid
	Stipa lepida	foothill needle grass		Perennial	Graminoid
	Stipa pulchra	purple needle grass		Perennial	Graminoid
	Polemoniaceae	Phlox Family			
	Collomia heterophylla	varied leaved collomia		Annual	Forb/herb
	Gilia capitata ssp. *capitata*	bluehead gilia		Annual, Perennial	Forb/herb
	Gilia tricolor ssp. *tricolor*	bird's-eye gilia		Annual	Forb/herb
	Leptosiphon bicolor	true babystars		Annual	Forb/herb
	Navarretia intertexta ssp. *intertexta*	needleleaf navarretia	FACW	Annual	Forb/herb
	Navarretia mellita	skunk navarretia		Annual	Forb/herb
	Navarretia pubescens	purple navarretia		Annual	Forb/herb
	Navarretia squarrosa	skunkweed	FACU	Annual	Forb/herb
	Polygalaceae	Milkwort Family			
	Polygala californica	California milkwort		Perennial	Subshrub, Forb/herb
	Polygonaceae	Buckwheat Family			
	Chorizanthe membranacea	pink spineflower		Annual	Forb/herb
	Eriogonum nudum var. *nudum*	nude buckwheat		Perennial	Subshrub, Forb/herb
	Persicaria punctata	dotted smartweed	OBL	Perennial	Subshrub, Forb/herb
Cal-IPC Moderate	*Rumex acetosella*	common sheep sorrel	FAC-	Perennial	Forb/herb
Non-native	*Rumex conglomeratus*	clustered dock		Perennial	Forb/herb
Cal-IPC Limited	*Rumex crispus*	curly dock	FACW-	Perennial	Forb/herb
Non-native	*Rumex pulcher*	fiddle dock	FACW	Perennial	Forb/herb
	Polypodiaceae	Polypody Family			
	Polypodium californicum	California polypody		Perennial	Forb/herb
	Primulaceae	Primrose Family			
	Dodecatheon hendersonii	mosquito bills		Perennial	Forb/herb
	Pteridaceae	Maidenhair Fern Family			
	Adiantum aleuticum	five fingered fern		Perennial	Forb/herb
	Adiantum jordanii	California maidenhair fern		Perennial	Forb/herb
	Pellaea andromedifolia	coffee fern		Perennial	Forb/herb
	Pellaea mucronata var. *mucronata*	bird's foot fern		Perennial	Forb/herb
	Pentagramma triangularis	goldback fern		Perennial	Forb/herb

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Ranunculaceae	Buttercup Family			
	Delphinium nudicaule	red larkspur		Perennial	Forb/herb
	Delphinium variegatum ssp. *variegatum*	royal larkspur		Perennial	Forb/herb
	Ranunculus californicus	California buttercup	FAC	Perennial	Forb/herb
Non-native	*Ranunculus muricatus*	spinyfruit buttercup	FACW+	Annual, Biennial	Forb/herb
	Ranunculus orthorhynchus	straightbeak buttercup	FACW	Perennial	Forb/herb
	Rhamnaceae	Buckthorn Family			
	Ceanothus cuneatus	buckbrush		Perennial	Shrub
	Ceanothus foliosus var. *foliosus*	wavyleaf ceanothus		Perennial	Shrub, Subshrub
	Ceanothus parryi	Parry ceanothus		Perennial	Shrub
	Frangula californica ssp. *californica*	California coffeeberry		Perennial	Tree, Shrub
	Rhamnus crocea	redberry		Perennial	Tree, Shrub
	Rosaceae	Rose Family			
	Adenostoma fasciculatum	chamise		Perennial	Shrub
	Cercocarpus betuloides var. *betuloides*	mountain mahogany		Perennial	Shrub
	Fragaria vesca	woodland strawberry		Perennial	Forb/herb
	Heteromeles arbutifolia	toyon		Perennial	Tree, Shrub
	Holodiscus discolor var. *discolor*	oceanspray		Perennial	Shrub
Non-native	*Malus domestica*	apple		Perennial	Tree
	Physocarpus capitatus	Pacific ninebark	FACW	Perennial	Shrub
Cal-IPC Limited	*Prunus cerasifera*	cherry plum		Perennial	Tree
Non-native	*Prunus dulcis*	almond		Perennial	Tree
	Prunus virginiana var. *demissa*	western chokecherry	FAC	Perennial	Tree, Shrub
	Rosa californica	California wild rose	FAC	Perennial	Subshrub
	Rosa gymnocarpa	dwarf rose	NI	Perennial	Subshrub
	Rosa spithamea	ground rose		Perennial	Subshrub
Non-native	*Rubus armeniacus*	Himalayan blackberry	FAC	Perennial	Subshrub
	Rubus parviflorus	thimbleberry	FAC	Perennial	Subshrub
	Rubus ursinus	California blackberry	NO	Perennial	Subshrub
	Rubiaceae	Madder Family			
	Galium aparine	stickywilly	FACU	Annual	Vine, Forb/herb
	Galium californicum	California bedstraw		Perennial	Subshrub, Forb/herb
Non-native	*Galium murale*	yellow wall bedstraw		Annual	Forb/herb
Non-native	*Galium parisiense*	wall bedstraw		Annual	Forb/herb
	Galium porrigens var. *porrigens*	graceful bedstraw		Perennial	Vine, Shrub
	Galium triflorum	sweet scented bedstraw		Perennial	Forb/herb, Vine
	Ruscaceae	Butcher's-broom Family			
	Maianthemum racemosum	feathery false lily of the valley		Perennial	Forb/herb
	Maianthemum stellatum	starry false lily of the valley	FAC	Perennial	Forb/herb
	Salicaceae	Willow Family			
	Salix lasiolepis	arroyo willow	FACW	Perennial	Tree, Shrub
	Sapindaceae	Soapberry Family			
	Acer macrophyllum	bigleaf maple	FAC	Perennial	Tree

STATUS[1]	FAMILY/SCIENTIFIC NAME	FAMILY/COMMON NAME	ACOE[2]	DURATION	HABIT
	Aesculus californica	California buckeye		Perennial	Tree, Shrub
	Saxifragaceae	Saxifrage Family			
	Heuchera micrantha	crevice alumroot		Perennial	Forb/herb
	Lithophragma affine	San Francisco woodland-star		Perennial	Forb/herb
	Lithophragma heterophyllum	hillside star		Perennial	Forb/herb
	Micranthes californica	California saxifrage		Perennial	Forb/herb
	Scrophulariaceae	Figwort Family			
	Scrophularia californica	California figwort	FAC	Perennial	Forb/herb
Non-native	*Verbascum blattaria*	moth mullein	UPL	Biennial	Forb/herb
	Solanaceae	Potato Family			
	Solanum americanum	American black nightshade	FAC	Annual, Perennial	Subshrub, Forb/herb
	Themidaceae	Brodiaea Family			
	Brodiaea elegans ssp. *elegans*	harvest brodiaea		Perennial	Forb/herb
CRPR 1B.2	*Brodiaea leptandra*	narrow-flowered California brodiaea		Perennial	Forb/herb
	Dichelostemma capitatum	bluedicks		Perennial	Forb/herb
	Triteleia hyacinthina	wild hyacinth		Perennial	Forb/herb
	Triteleia laxa	Itheriel's spear		Perennial	Forb/herb
	Urticaceae	Nettle Family			
	Urtica dioica ssp. *holosericea*	stinging nettle	FACW	Perennial	Forb/herb
	Valerianaceae	Valerian Family			
	Plectritis macrocera	longhorn plectritis		Annual	Forb/herb
	Violaceae	Violet Family			
	Viola ocellata	two-eyed violet		Perennial	Forb/herb
	Viscaceae	Christmas Mistletoe Family			
	Phoradendron serotinum ssp. *tomentosum*	Pacific mistletoe		Perennial	Forb/herb
	Vitaceae	Grape Family			
	Vitis californica	California wild grape		Perennial	Vine
Non-native	*Vitis vinifera*	cultivated grape		Perennial	Vine, Shrub
	Woodsiaceae	Cliff Fern Family			
	Athyrium filix-femina var. *cyclosorum*	common ladyfern	FAC	Perennial	Subshrub

[2] Army Corps of Engineers wetland indicator status (2013)

Scientific nomenclature corresponds to the Jepson Interchange (online web site, 12/2013)

Note 1.
CRPR California Rare Plant Rank special-status plant ranking (formerly CNPS)
1B = rare, threatened, or endangered in California and elsewhere
3 = plants about which CNPS needs more information
4 = plants of limited distribution - a watch list
0.1 = seriously threatened in California
0.2 = fairly threatened in California
0.3 = not very threatened in California
Cal-IPC is invasive rank according to the California Invasive Plant Council (from http://www.cal-ipc.org/, 12/2013)
Plants without "Non-native" are native to California
Note 2.

APPENDIX E.2

SUMMARY OF BOTANICAL SURVEY METHODOLOGIES

Botanical

Prior to conducting field surveys, the project team botanists developed an annotated list of special-status plants known from or with potential to occur on the project area. Sources used to develop this list include California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California (CNPS 2013), California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB) (CDFW 2013), and a general list of plants known from the area included in the Calflora "What Grows Here" plant database (Calflora 2013). In addition, project botanists consulted directly with botanists and other specialists familiar with the region, including staff at the nearby Bouverie Wildflower Preserve. Jeanne Wirka, biologist with the Bouverie Preserve was particularly helpful, having provided information on the location of plants of interest in the area as well as information pertaining to management practices at the preserve.

A CNPS "Quad Search" was conducted on USGS topographic quadrangles, yielding a target special-status plant species list for the following four quadrangles: Kenwood, Rutherford, Sonoma, and Glen Ellen. This list was then refined to exclude taxa not occurring within the project area habitats or elevation range. In addition, CNDDB data were compiled in geographic information systems (GIS) format for the project area vicinity (see **Figure 2.6**). **Appendix B** shows all special-status plant occurrences included in the CNDDB as well as plants mapped by VNLC.

For this report, special-status plants include:

- Plant taxa listed or proposed for listing by the federal government as Threatened or Endangered under the Federal Endangered Species Act (ESA) (50 CFR 17.12) and federal species of concern
- Plant taxa listed or proposed for listing by the State of California as Rare, Threatened, or Endangered under the California Endangered Species Act (CESA) (14 Cal. Adm. Code 670.5)
- Plant taxa identified in CNPS's Inventory of Rare and Endangered Vascular Plants of California (CNPS 2011) as Rare, Threatened, or Endangered in California (Lists 1 and 2), or on the review or watch lists (Lists 3 and 4, respectively). Formerly known as CNPS List, it is now as California Rare Plant Rank, 'CRPR'
- Plant taxa that meet the definition of Rare, Threatened, or Endangered under the California Environmental Quality Act (CEQA)

The project botanists also considered sensitive plant communities and other sensitive habitats with potential to occur on the project area. In this document, the terms "plant community" and "habitat" are often used synonymously, though the former refers more specifically to floristic composition, whereas the latter includes vegetation structure and physical characteristics such as geomorphology and hydrology. Thus all plant communities are habitat, but some habitats are not distinct vegetation communities. In addition, plant communities are capitalized only in reference to formally named alliances, as treated in the MCV.

For this report, sensitive habitats include:

- Wetlands and other waters under potential federal jurisdiction through Sections 404 and 401 of the Clean Water Act (CWA)
- Riparian habitats and stream corridors under potential State jurisdiction through Section 1600, *et seq.* of the State Fish and Game Code and local regulations
- Oak woodlands including mature oak trees with a diameter-at-breast-height (DBH) of greater than or equal to five inches and thus under the potential jurisdiction of the State Oak Woodlands Protection Act and/or local protection ordinances. Sonoma County has a voluntary program for oak and other heritage tree protection, as well as General Plan Resource Conservation Element stating that "native oaks should be considered in review of development projects." In addition, valley oaks are afforded special protection within "Valley Oak Districts" (Oak Woodlands Management 2013). This ordinance requires valley oaks to be retained or replaced within a Valley Oak District (or payment of fee). The Preserve is not within a Valley Oak District.

- Other plant communities identified as 'Sensitive' by the BLM, CNPS, and/or CDFW

The project team obtained high-resolution orthorectified digital aerial photography of the project area (NAIP 2009 and 2012, 2011 4-band color infrared photography from the District) and digital project boundaries from the District. The team also compiled and reviewed other digital layers of the project area and surrounding areas, including soils, geology, topography and general reference layers (roads and trails, hydrography, etc.). These GIS data layers were used to develop site field maps and GPS background files, to be used for survey planning and field navigation throughout the wide range of habitats (many with limited accessibility) on the project area. The layers were also used in analyses included in this report.

Field Surveys

Botanical field surveys were conducted on the Preserve by VNLC staff, including Jake Schweitzer, John Vollmar, Rebecca Wayman, Jaymee Marty, and Patrick Furtado. Field surveys were coordinated by Jake Schweitzer, the biological surveys project manager. Dr. Todd Keeler-Wolf, Senior Vegetation Ecologist with the CDFW provided guidance on and assisted with plant community mapping.

Special-Status Plant Surveys

Focused special-status plant surveys were scheduled to coincide with peak spring, late spring, and summer blooming periods. Early spring botanical surveys were not conducted on the Preserve due to contractual delays in the project. In addition, botanical surveys on the Preserve were delayed for several extended time periods due to security concerns related to illicit marijuana cultivation on the site.

Botanical surveys were conducted for special-status plants throughout the Preserve using the CNPS "intuitive-controlled" survey approach, whereby all accessible areas were surveyed, with more intensive surveys conducted in areas considered to have higher potential to support special-status plants and sensitive habitats, such as areas with unique soils (e.g., volcanic ash), wetlands, riparian (i.e., stream or river) corridors, and rock outcroppings. Project botanists traversed the project area on foot in teams of two, visiting all accessible areas of the project area during each of the major survey rounds, and spot-checking more unique habitats at other times.

The botanical surveys were floristic in nature, whereby all vascular plants encountered were identified to species, subspecies, or variety as applicable. Plants that could not be readily identified in the field were collected and identified in the office using botanical field manuals (e.g., Baldwin et al. 2012 and/or Oswald 2002) and microscopes. Several potential special-status taxa which are notoriously difficult to identify were compared to specimens in the Jepson Herbarium at the University of California, Berkeley. A few plants were submitted to recognized experts to verify the taxonomic status, as in the case where the taxonomic treatment is currently under review, for taxa known to readily hybridize, or for plants lacking important phenological features (e.g., was encountered subsequent to flowering period).

Special-status plants identified during the field surveys were mapped using a professional global positioning system (GPS) unit with sub-foot or sub-meter accuracy (Trimble GeoXH and GeoXT, respectively), and habitat conditions of each taxa were noted in a GPS data dictionary (database). Due to the difficulty in obtaining consistent satellite signals, the ruggedness of the terrain, and the inaccessibility of many habitats, the locations of special-status plants were recorded as points, with information pertaining to population size and distribution recorded in the GPS data dictionary. The GPS data dictionary was designed by VNLC to conform to the CDFW's CNDDB submittal form template, so that all recorded occurrences could be submitted directly to the CDFW as GIS shapefiles.

Habitat Mapping

Detailed "alliance" level plant community/habitat mapping was conducted throughout the Preserve according to the MCV classification system. Team botanists delineated observed plant community boundaries on large-scale air photo maps, using professional GPS units with air photo background files to verify location as well as to record the dominant plant taxa into a GPS data dictionary. MCV plant community classification rules were used to delineate the boundaries — for example of an area consisted of greater than 50 percent canopy cover of Pacific madrone (*Arbutus menziesii*), the area as perceived on the map

was delineated and coded accordingly. Where community boundaries were not apparent on the air photo maps, GPS positions were logged along the community boundaries, or in cases of impenetrable vegetation, "remote" GPS positions were logged. Using a compass and laser range finder (Opti-Logic 1000LH), bearing and distance values were recorded in the GPS for distant but perceptible transitions in vegetation composition. The recorded GPS positions were then transposed using GIS software according to recorded bearing and distance values. The recorded field information was then compared with 2011 color infrared (CIR) aerial photography provided by the District, in order to refine boundaries, and the boundaries were re-checked in the field. A minimum mapping unit (MMU) of approximately one acre was established for more common communities, though this was reduced for habitats that are considered sensitive or that are notably distinctive as signatures on aerial photography, and/or occur along the edge of another habitat. Areas of significant invasive plant infestations amounting to less than one acre were also mapped. For sensitive communities, CNPS Vegetation Rapid Assessment data forms were filled out in order to collect comprehensive ecological data, and for other communities, more general data was recorded in a GPS data dictionary. Within open grassland areas, habitat mapping focused on grass species due to the fact that most habitat mapping was conducted subsequent to the rare plant surveys. Many diagnostic forbs within the grasslands were past bloom during the primary habitat survey period, thus these areas should be investigated in peak spring in order to more accurately map and classify herbaceous alliances.

It should be noted that extensive portions of the site are inaccessible due to the presence of dense scrub vegetation, and thus were not thoroughly investigated in the field. These areas are mapped primarily as "Chamise Chaparral"on **Figure 2.4**. It is likely that some of these and other areas that were investigated in the field may be more precisely delineated using additional data and more robust spatial analysis software. Highly precise elevation and plant height Light Detection and Ranging (LiDAR) data and eCognition spatial analysis software, which were not available at the time of this Plan's preparation, will be used to delineate plant communities on the Preserve in the near future. Combining the GPS vegetation field data with the LiDAR and using eCognition software should yield the most accurate plant community mapping.

Figure 2.4 depicts the plant communities as well as special-status plant taxa identified and recorded within the Preserve. The plant communities are mapped according to the CNPS alliance level. **Table 2.1** provides cross-referencing for the CNPS alliances versus other standardized vegetation classification systems, and also provides geomorphic and ecological details pertaining to each plant community mapped on the Preserve.

Though a formal wetland delineation was not conducted on the Preserve, an effort was made to identify and map all wetlands, which occur primarily as springs and seeps, since wetlands are federally protected habitats. Representative streams shown on USGS topographic maps as well as drainages rendered from DEMs were investigated in the field for dominant vegetation as well as indications of ordinary high water marks (e.g., bed and bank features). GPS positions were recorded using a data dictionary to log feature locations and ecological characteristics for mapping purposes. Similar features, as seen on aerial photography and/or DEM signatures in the office, were then mapped and classified according to their resemblance to features characterized in the field. Such features could be subject to the jurisdiction of regulatory agencies including the United States Army Corps of Engineers (ACOE), the CDFW, and/or the Regional Water Quality Control Board (RWQCB).

In addition, various disturbances to plant communities, such as erosion, noxious weed infestations, and human-induced disturbances (e.g., marijuana cultivation) were noted during the botanical surveys. Ecological notes and locations were recorded into a customized GPS data dictionary, and representative digital photographs of each disturbance type. For noxious weeds rated by the California Invasive Plant Council (Cal-IPC) as "Moderate" or "High" and/or considered to have potential to cause substantial detrimental ecological consequences, GPS polygons were recorded within open (e.g., grassland or chaparral) habitats, and points were recorded within forested and/or canyon habitats (due to unreliable satellite reception). In either case, an effort was made to record the perimeter of the invasive plants.

APPENDIX F

CALABAZAS CREEK OPEN SPACE PRESERVE ROAD ASSESSMENT

PROJECT SUMMARY

Calabazas Creek Open Space Preserve (Preserve) is a 1,290-acre property owned by Sonoma County Agricultural Preservation and Open Space District (District) located in eastern Sonoma County, northeast of Glen Ellen.

The District is in the process of developing a Management Plan that will outline goals, objectives and management strategies, to guide the Preserve's natural resource management and interim public use for the next 10 years. The goals of this project involved the following: (1) conduct a road related erosion and sediment delivery inventory; and (2) develop a final report summarizing road related sediment sources and results from the assessments, and develop a prioritized, cost-effective erosion control and erosion prevention plan.

Using field inventories and data analysis, PWA identified a total of 49 sites along approximately 8.76 miles of roads with the potential to deliver sediment to streams within the 3.92 mi^2 watershed area, and 4 sites that require maintenance but do not pose a water quality threat. Approximately 6.9 miles of the assessed road mileage and 45 identified sites are located completely within the Preserve boundaries and are managed by the District. Of the 49 sediment source assessment sites, PWA recommends that 36 sites be treated for erosion control and erosion prevention. PWA estimates that treating these sites will prevent the episodic, primarily storm-driven delivery of approximately 760 yd^3 of sediment to streams in the Calabazas Creek watershed in the next 30 years. In addition to individual, problematic erosion sites, field crews measured approximately 4.76 miles of road surfaces and/or ditches, representing nearly 54% of the total inventoried road mileage, that are currently draining to stream channels, either directly or via gullies. PWA recommends treating 3.84 miles of these road reaches to disperse road surface runoff and diminish chronic sediment delivery to the mainstem and tributaries of Calabazas Creek. PWA estimates that implementing the recommended road drainage treatments will prevent delivery of approximately 3,755 yd^3 of fine sediment to the stream system during the next decade alone.

The expected benefit of completing the road assessment and implementing erosion control and erosion prevention treatments recommended in this report lies in the reduction of long-term sediment delivery to Calabazas Creek, a tributary to Sonoma Creek with important spawning habitat for steelhead trout. This project includes a prioritized plan of action for cost-effective erosion prevention and erosion control, which, when implemented and employed in combination with protective land-use practices, can be expected to significantly contribute to the long-term improvement of water quality and salmonid habitat in the watershed. With this prioritized plan of action, entities interested in the sustainability of the watershed and preservation of salmonid habitat can advance efforts to obtain funding and implement the road related erosion remediation plan for the project area.

INTRODUCTION

BACKGROUND

The primary goal for this project was to assess all roads within the Preserve, identify sources of sediment delivery, provide prioritized recommendations for short and long term erosion control and erosion prevention implementation strategies, and assist the District with their ultimate goal of superior land stewardship and protection of sensitive species.

One of the most important watershed management elements of long-term restoration plan and maintenance of both water quality and fish habitat is the reduction of future impacts from upland erosion and sediment delivery. Sediment delivery to stream channels from roads and road networks has been extensively documented, and is recognized as a significant impediment to the health of salmonid habitat. Unlike many watershed improvement and restoration activities, erosion prevention through "storm-proofing" rural, ranch, and forest roads provides immediate benefits to the streams and aquatic habitat of a watershed. It measurably diminishes the impact of road related erosion on the biological productivity of the watershed's streams, and allows

future storm runoff to cleanse the streams of accumulated coarse and fine sediment, rather than allowing continued sediment delivery from managed areas.

In this report, PWA provides results of the field assessment and data analysis, and a prioritized plan of action for implementing short and long term erosion control and erosion prevention treatments to reduce road related erosion in the project area. All treatment prescriptions follow guidelines described in the Handbook for Forest and Ranch Roads (Weaver and Hagans, 1994), as well as Parts IX and X of the California Department of Fish and Wildlife (CDFW)4 Salmonid Stream Habitat Restoration Manual (Taylor and Love, 2003; Weaver et al., 2006).

Assessment data is summarized in Tables 1-4; Maps 2-4b; and Appendix A-B. Select photos of sediment delivery sites are found in Appendix C. Recommended treatments, projected requirements for heavy equipment, and estimated project costs for sediment delivery sites are provided in Tables 5-8 and for maintenance sites in Tables 9-10. Details on construction and installation techniques for the recommended erosion control and erosion prevention treatments are provided in Appendix D. For an overview of terminology and techniques used in road related erosion assessment, see Section 12: Supplementary Information.

Reasons given for the detrimental effects of roads include the fact that road construction tends to inhibit the natural dispersal of water, thereby concentrating runoff and creating gullies and triggering landslides. In addition, road networks have created drastic changes in the natural drainage patterns of the watershed by diverting water to follow roads rather than natural patterns. One of the purposes of this project is to evaluate road related sources of erosion and sediment delivery in the Preserve, and develop a prioritized plan of action to reduce sediment delivery to Calabazas Creek that can be included in the Preserve's Management Plan.

SCOPE OF WORK

The project scope described in the contract between PWA and the District contained 3 components: Task 1) Complete a comprehensive road assessment; Task 2) Develop a final report and sediment reduction plan; and Task 3) Provide technical feedback on Management Plan.

ROADS ASSESSED IN CALABAZAS CREEK OPEN SPACE PRESERVE

Five individual roads were assessed within the Calabazas Creek Open Space Preserve: Nunns' Canyon Road, North Road, North Road Spur 1, Spencer Creek Road, and Ridge Road. The inventoried roads include 8.76 miles of road length with 6.90 miles within the Preserve and 1.86 miles outside the Preserve's boundary. Additional roads lie within the Preserve boundary but were not included as part of this assessment due to access restraints, timing, and/or at the District's request. However, these roads may be included in future road assessments on the property. Roads included in the assessment that were located outside of the Preserve were done so either (1) at the District's request, (2) if they proved to be used as an access easement, and/or (3) straddled the property boundary. Assessed roads show varying levels of maintenance and accessibility.

Road uses include year round access, seasonal access and abandoned reaches. The Preserve can be traversed almost completely by an all-terrain vehicle (ATV); however multiple routes must be taken as site specific conditions at Site 24 and Site 35 which block ATV passage. All road surfaces are native, unsurfaced and often include extensive bedrock exposures with varying degrees of erodible surfaces. Roads within the Preserve contain outdated and unstable culverted stream crossings, ineffective ditch relief culverts, and significant hydrologically connected road lengths. Concentrated runoff and erosion of these road surfaces, ditches, and cutbanks has resulted in fine sediments being transported and delivered directly into the stream system. However, selected road reaches have already been effectively storm-proofed as per PWA recommendations provided in 2006 and 2008.

NUNNS' CANYON ROAD

This 2.51 miles long assessed road segment is a continuation of the County maintained Nun's Canyon Road accessible from Highway 12 (Maps 1-4b). It is called Nunns' Canyon Road where the road travels through the Preserve. It trends west to east in a mostly inner gorge setting along Calabazas Creek. Streams, includ-

4 California Department of Fish and Wildlife, formerly known as California Department of Fish and Game.

ing Calabazas Creek, cross the road through armored fills, fords and culverts. The road is accessible by ATV for approximately 0.72 miles to a point where the road has been incorporated into the stream, and is now covered in large boulders passable only by foot (at Site 35). The other side of this 120' bouldery section can be accessed on ATV through an alternate route, such as via North Road. A large section of Nunns' Canyon Road leading up to Site 35 was storm-proofed by PWA in 2006 and 2008 and includes effectively installed road drainage structures and armored stream crossings.

As the road leaves the inner gorge setting and travels east toward the Old Homestead meadow, the road traverses uphill at road grades in excess of 25%. Before reaching the Old Homestead and meadow area the road crosses a failing culvert over Calabazas Creek in need of repair (Site 30). Nunns' Canyon Road traverses the meadow at a relatively low gradient and crosses several small tributaries. Most of these stream crossings have already washed out; however, small volumes of unstable remnant road fills remain, representing future sediment sources. The uppermost stream crossing on Decker Creek is washed out and again restricts travel to foot traffic only beyond this site (Site 24). The easternmost extent of this assessment of Nunn's Canyon Road terminates at a locked gate into private property. The gate, lock, and road beyond looks abandoned with no recent use.

NORTH ROAD

This 3.59 miles road lies predominantly in mid-slope locations of the Preserve and neighboring parcels. It connects Nelligan Road, a County maintained road, to the meadow section of Nunn's Canyon Road near the Old Homestead (Maps 2-4b). From the access point on Nelligan Road, North Road crosses through 0.57 miles of neighboring vineyard property before entering the Preserve. The full extent of North Road is drivable by 4-wheel-drive vehicles along native and rutted bedrock surfaces, weaving in and out of the Preserve in forest, chaparral, and grasslands. Approximately 2.4 miles of the assessed road lies within the Preserve property with 1.19 miles lying off the Preserve; all 2.4 miles are included in this assessment.

Much of this road is located on steep hillslopes, although a portion occupies low-gradient benches. Most stream crossings contain undersized culverts installed at shallow grades which are prone to plugging; however, local volunteers maintain the structures by clearing obstructions and removing stored sediment. As the road nears the eastern extent towards the Old Homestead and meadow area, it occupies the streamside of Oak Wood Creek. At this location, the road laterally confines the stream along the right bank, and the fillslope of the road intermittently extends to the channel. The road along Oak Wood Creek is currently accessible by 4-wheel-drive vehicles but drivable road surfaces is less than 10 ft wide. Vehicle access ends shortly after the intersection with Nunns' Canyon Road.

NORTH ROAD SPUR 1

North Road Spur 1 extends for 0.44 mile southwest along a small ridge from North Road to a fenced off vineyard at the property boundary with no gate and no continued access (Maps 3a, 4a). It is accessible by foot only and significantly grown over with brush and small trees. The road has been abandoned for some time and exhibits a faint road alignment with no road-related erosion visible. The road now appears more like a trail and offers excellent vistas of the Calabazas Creek watershed and beyond.

SPENCER CREEK ROAD

This 0.65 mile abandoned road trends north-south along Spencer Creek, a large tributary to Calabazas Creek (Maps 3b, 4b). It connects North Road to Nunns' Canyon Road at a long washed out *Humboldt crossing* (see definitions in Section 12) across Calabazas Creek (Site 45). The northern half of this road is little more than an old bulldozer track through the narrow headwaters of the stream valley with little to no road fill. The remnant roadbed becomes more significant to the south as it leads towards Calabazas Creek. Absence of road surface drainage structures to properly disperse flow has caused large gullies to develop through the road surface for significant lengths.

RIDGE ROAD

This 1.23 mile road weaves in and out of the watershed and Preserve boundary with nearly 0.68 miles lying outside of the property (Maps 2-4b). Complicating ownership of this road is the Napa/Sonoma County boundaries and the District's property boundary. The District does not have an access easement to the Ridge

Road; however, informal permission can be sought from property owners north of the preserve (Bald Mountain Ranch). District staff has received permission to access through this privately owned vineyard from Wall Road (Map 1) but there are multiple private entrances along its length of this road. There are several small intersections with private roads coming in from the Napa County side, showing varying levels of usage. Multiple landowners use and manage different sections of the road, as it travels on and off the properties. The road disappears in and out of dense vegetation frequently as it travels southeast, crossing a gateless barbwire fence. The easternmost portion of the road was recently brushed and shows evidence of recent 4-wheel-drive access. It travels down toward a gate on private property, and it is unclear whether the road later returns to the ridge and re-enters the Preserve. There are intermittent steep stretches of road in excess of 45% gradient which does not allow for viable access by vehicles.

1. RESULTS

ROAD RELATED SEDIMENT DELIVERY SITE ASSESSMENT RESULTS

PWA field crews identified a total of 49 sites and approximately 4.76 miles of hydrologically connected road surfaces with the potential to deliver sediment to streams in the Calabazas Creek Open Space Preserve Road Assessment area (Maps 3a-4b; Table 1; Appendix A). Of the 49 sediment delivery sites, 5 exist outside the Preserve boundary. PWA recommends that 36 of these sites and 3.84 miles of the connected road segments be treated for erosion control and erosion prevention (Table 1). Field data shows that treating the 36 sites will prevent the future episodic delivery of approximately 760 yd^3 of sediment to streams in the Calabazas Creek watershed, and that treating the 3.84 miles of connected road segments could prevent delivery of approximately 3,755 yd^3 of fine sediment during the next decade alone (Table 2).

PWA recommends treating 26 stream crossings (5 of which are located outside the Preserve) that account for 72% of all treatment sites (Table 1). Inventoried stream crossing sites designated for treatment include 16 crossings with culverts, 9 fill (unculverted) crossings, and 1 ford crossing. PWA projects that approximately 630 yd^3 of future road related sediment delivery will originate from the 26 stream crossings if they are left untreated, which is approximately 83% of total future episodic sediment delivery from sites recommended for treatment in the project area (Table 2).

Table 1. Inventory results for sediment delivery sites and hydrologically connected road segments.

SOURCES OF SEDIMENT DELIVERY[A]	SEDIMENT DELIVERY SITES		HYDROLOGICALLY CONNECTED ROADS ADJACENT TO SITES		TOTAL LENGTH OF ROADS SURVEYED FOR PROJECT (MI)
	INVENTORIED (#)	RECOMMENDED FOR TREATMENT[B] (#)	INVENTORIED (MI)	RECOMMENDED FOR TREATMENT (MI)	
Stream crossings[C]	33	26	3.35	2.95	-
Ditch relief culverts	3	3	0.16	0.16	-
Landslides	1	1	0.02	0.02	-
Road drainage discharge points	7	2	0.70	0.20	-
Spring	1	0	0.02	0.00	-
Bank erosion	2	2	0.26	0.26	-
Gully	2	2	0.25	0.25	
Total	**49**	**36**	**4.76**	**3.84**	**8.76**

a No *maintenance* sites are included since they are not considered a source of sediment delivery.

b Upgrade sites (33 total) include: 25 stream crossings, 3 ditch relief culverts, 2 road drainage discharge points, 1 gully, and 2 bank erosion. Decommission sites (3 total) include: 1 stream crossing, 1 landslide, and 1 gully.

c Inventoried stream crossing sites designated for treatment include 16 crossings with culverts, 9 fill (unculverted) crossings, and 1 ford crossing.

PWA identified 10 stream crossings on maintained and unmaintained roads that have drainage structures not sufficiently designed for the 100-year peak storm flow (Table 3). Furthermore, of the total 33 inventoried stream crossings, 13 have the potential to divert in the future and 6 streams are currently diverted. Of the 16 existing culverts at stream crossings, 10 are currently undersized and 15 have a moderate or high potential to become plugged by sediment and debris (Tables 1, 3).

Table 2. Estimated future sediment delivery for sites and road surfaces recommended for treatment.

SOURCES OF SEDIMENT DELIVERY[A]	ESTIMATED FUTURE SEDIMENT DELIVERY (YD3)	PERCENT OF TOTAL
1. Episodic sediment delivery from road related erosion sites (indeterminate time period)		
Stream crossings	630	83%
Landslides	75	10%
Ditch relief culverts	10	1%
Bank erosion sites	20	3%
Discharge points for road surface drainage	5	<1%
Gully	20	3%
Total episodic sediment delivery	760	100%
2. Chronic sediment delivery from road surface erosion (estimated for a 10 yr period)[b]		
Total chronic sediment delivery[c]	3,755	100%
Total estimated future sediment delivery for the project area	4,515	100%

a No *maintenance* sites are included since they are not considered a source of sediment delivery.

b Sediment delivery for rocked and native surface roads is calculated for a 10 yr period. It assumes a combined width of 25 ft for the road, ditch, and cutbank contributing area, and a uniform empirical value of 0.2 ft/10 yr for road surface lowering and cutbank retreat based on field analyses by PWA staff.

c Estimated total chronic sediment delivery is approximately 83% of the projected future sediment delivery of 4,515 yd3 for the entire project area.

Table 3. Erosion problems at stream crossings.

STREAM CROSSING PROBLEM	# INVENTORIED	PERCENT OF TOTAL[A]
Stream crossings with diversion potential	13	39%
Stream crossings currently diverted	6	18%
Crossings with culverts likely to plug[b]	15	45%
Crossings with culverts that are currently undersized[c]	10	30%

a From Table 1, total stream crossings inventoried = 33.

b Culvert plug potential is moderate to high. Total culverted crossings evaluated = 16.

c Culverts in stream channels larger than 3 ft x 1 ft that are too small to convey the calculated 100-year peak storm flow.

Ditch relief culverts were inventoried if they showed the potential to deliver future, site-specific sediment, or were currently functioning as conduits for delivery of road surface sediment. PWA recommends treatment for all 3 inventoried ditch relief culvert sites in the project area (Table 1). Ditch relief culverts represent approximately 8% of all treatment sites, with a projected potential sediment delivery of 10 yd^3, or 1% of the total (Table 2).

Field crews identified 1 road related landslide that requires treatment (Table 1). The total estimated sediment delivery from landslides is 75 yd^3, which is approximately 10% of the total future episodic sediment delivery from recommended treatment sites (Table 2).

Discharge points for road surface drainage are locations along poorly drained road segments where accumulated concentrated flow from road surface/ditch/cutbank erosion exits the road to be delivered to a stream. The accumulation and subsequent discharge of large quantities of road surface runoff frequently results in the erosion of a length of native hillside or fillslope between the road and the receiving stream channel. In addition, these sites are also commonly found along streamside roads in close proximity to a stream channel. Of the 7 discharge points identified in the project area, 2 are recommended for treatment (Table 1). Estimated site-specific future sediment delivery from these sites totals 5 yd^3, less than 1% of the total future episodic sediment delivery from recommended treatment sites (Table 2).

PWA inventoried 2 *fillslope gullies* with the potential for sediment delivery and recommended treatment (Table 1). Total estimated future sediment delivery from the gullies recommended for treatment is 20 yd^3 (Table 2).

A bank erosion site is the result of stream erosion at the base of road fill, as compared to a landslide site that includes other kinds of hillslope mechanisms. PWA recommends treatment for both of the inventoried bank erosion sites in the project area (Table 1). Estimated future sediment delivery for these sites is 20 yd^3 which accounts for 3% of the total future episodic sediment delivery from recommended treatment sites in the project area (Table 2).

PWA field crews measured approximately 4.76 miles of road surfaces and/or ditches (representing 54% of the

total 8.76 miles of inventoried roads) currently draining to stream channels, either directly or via gullies (Table 2). Based on assessments PWA has conducted over the last 2 decades in many similar forested watersheds, this represents a moderate to moderate-high connectivity value. Our field data shows that approximately 3.84 miles of hydrologically connected road reaches are feasible to treat, which could prevent 4,515 yd^3 of fine sediment from being delivered to stream channels in the project area over the next decade.

Of the 49 total sites assessed, 13 sites were not recommended for treatment. Of these "no treat" sites, 8 were upgraded in 2008 (Site 35, 35.1, 36, 37, 37.1, 38, 39, 40). All previously upgraded sites are considered to be adequately storm-proofed with the exception of one problematic road surface discharge point (Site 35). Site 35 is not recommended for treatment due to the narrow bedrock walls and existing road location. The remaining "no treat" sites include 2 stream crossings and 2 road surface discharge points on Spencer Creek Road (Sites 45-48) and 1 road surface discharge point on upper Nunns' Canyon near the Old Homestead (Site 28). Additional detail regarding these sites can be found in Section 6.1.1 below.

PWA staff assigned immediacy ratings to all sites recommended for treatment (Table 4, Maps 4a-b). Of the 36 sites recommended for treatment, 2 stream crossing sites and 0.04 miles of associated hydrologically connected road length were assigned a low treatment immediacy rating. Estimated potential sediment delivery for the 2 upgrade sites is approximately 45 yd^3, with an additional 40 yd^3 of sediment projected to be delivered from the road reaches during the coming decade.

PWA staff assigned moderate-low to moderate priority ratings to 20 sites (18 upgrade and 2 decommission), including a total of 2.20 miles of associated hydrologically connected road reaches. Estimated future site specific sediment delivery for these 20 sites is approximately 400 yd^3, which is about 52% of the projected episodic sediment delivery for the project area. PWA projects that the hydrologically connected road segments adjacent to these sites could deliver approximately 2,150 yd^3 sediment (58% of the total) to the stream system during the next 10 years.

The remaining 13 sites and 1.60 miles of hydrologically connected road were assigned high-moderate to high treatment immediacy and represent 42% of the projected episodic sediment delivery (315 yd^3) and 41% of chronic sediment delivery (1,565 yd^3).

ROADS AND SITES WITH EXTENUATING CIRCUMSTANCES

Of the 49 total sediment delivery sites identified in the project area, 6 sites are particularly noteworthy for either their treatment complexity and\or limited accessibility through the site and beyond.

Spencer Creek Road (Sites 45-48)

Spencer Creek Road, the 0.65 miles abandoned spur of Nunns' Canyon Road traveling streamside along Spencer Creek, deserves specific mention. Field evaluations identified 4 sites along the road: 2 stream crossings and 2 road surface discharge points. Sites 45-47 lie less than 50' from the large tributary with Site 48 located in the upper reach occupying both the road and stream due to confined valley walls (Maps 2-4b; Appendix A, C). Sites and hydrologically connected road were assigned low erosion potential with future erosion volumes determined to be minimal. Erosion at the identified sites has already occurred resulting in past sediment delivery to Spencer Creek. Sites have adjusted and stabilized to their current conditions which is noted by bedrock exposure, vegetated gully sideslopes and bottoms and the growth of small trees on the road surface.

Access to Sites 45-48 would be difficult for most heavy equipment, and impossible for dump trucks, which would force spoils to be deposited within the 100-year floodplain. Therefore, it is our conclusion that generating and depositing unconsolidated spoils in this manner would be more detrimental than leaving the remaining road in place. Re-opening the road for equipment access to properly decommission Spencer Creek Road would not result in cost effective sediment reduction; therefore, PWA does not recommend treating this road.

Locations with restricted vehicle access (Sites 24, 35)

Vehicle access is restricted through Site 35, a road surface discharge point located along Nunns' Canyon Road nearly 0.73 miles from the paved portion and Preserve gate (Maps 2-4b; Appendix A, C). The site is located on a streamside road segment confined by steep bedrock walls. Calabazas Creek runs parallel

to the road here and at this location likely acts as a high water channel during the winter. For nearly 120' all road fill is eroded away and underlying bedrock is exposed with large cobbles and boulders making up much of the road surface. Previous attempts were made to rebuild the road for vehicle use during the 2008 repair; however, no evidence remains of prior treatments. Current truck and emergency vehicle access to the site is available from the west along Nunns' Canyon Road. In addition, 4-wheel-drive truck or ATV access is possible from the east coming down from North Road to Nunns' Canyon Road. Currently, the only way to pass through the site is by foot. PWA's conclusion is that there is no cost-effective solution to repair this site for through vehicular traffic and no viable options for re-routing the road due to the large bedrock exposures. Therefore, it is PWA's recommendation that this site not be treated and access is maintained from either direction.

Vehicle access is also restricted beyond Site 24 due to a washed out stream crossing (Map 3b, 4b; Appendix A). There is approximately 0.7 miles of Nunns' Canyon Road beyond Site 24 that is inaccessible before reaching a gate at the Preserve's eastern boundary. Access from the adjacent property along the eastern road segment to Site 24 is through the Stubbs family property — no formal access agreement exists with this landowner. Based on the level of use and access to additional areas of the Preserve, it is recommended that the remaining fill at the stream crossing be removed and site decommissioned.

MAINTENANCE SITE ASSESSMENT RESULTS

PWA field crews identified a total of 4 maintenance sites with 3 located within the Preserve boundary and 1 located outside of the Preserve near Nelligan Road (Maps 3a-4b; Table 4; Appendix B). PWA identified 3 ditch relief culverts (Site 2, 9.1, 20) and 1 point of road drainage discharge (Site 21). All sites were located high in the watershed with no potential to deliver sediment to streams within the Calabazas Creek Watershed. PWA has assigned low to moderate-low treatment immediacies for 3 of the 4 sites based on the low likelihood to cause major erosion problems and subsequent maintenance. However, Site 2 (ditch relief culvert) was assigned high-moderate immediacy and should be addressed as soon as possible to arrest the incision that is occurring in the bare ditch and along the road surface.

2. SHORT TERM EROSION CONTROL AND EROSION PREVENTION PLAN

Based on the results of the field assessment, PWA proposes the following short term erosion control and erosion prevention plan. This plan is recommended to be implemented in the next 6 months to 2 years. The majority of PWA's recommendations for treatment on the Preserve include measures that require more planning, funding, and permitting to implement and are, therefore, considered long term treatment recommendations.

PWA's recommended short term treatments are categorized as site-specific treatments and can be accomplished through hand labor, hand tools, and materials only. The recommended treatments included in Table 5 may or may not be listed as recommended treatments in Appendix A. These are short term fixes only and are not considered or recommended to be implemented without following through with the long term plan described in Section 8. However, if time and funds are available, and the recommended short term treatment plan falls within the District's overall Management Plan timeline, PWA recommends the following measures be taken to reduce the likelihood of short term erosion and sediment delivery on the Preserve. A cost analysis was not included for the short term plan as no heavy equipment is required; and all materials, tools, and labor needs are minimal.

In addition to the recommendations listed in Table 5, PWA considers *routine observation* and *as-needed maintenance* the most crucial element in any short term erosion control and erosion prevention plan. PWA has provided maps and documentation of all road related structures on the Preserve as part of this report. It is recommended that District staff, or volunteer patrol, conduct routine monitoring along roads and at stream crossings annually prior to the onset of winter rains and after each large storm event. As staff or volunteers monitor these road reaches and stream crossing sites, they should identify the need for any minor hand labor work. Prior to implementing any recommendations, PWA has identified problems at over 50% of the stream crossings on the Preserve, particularly along Calabazas

Creek. Therefore, it is highly recommended that the District focus efforts at these stream crossings and in particular along the North Road.

Table 5 below should be a working table of recommendations during the life of the project (before and after long term plan implementation) and included in the road's operations and maintenance manual. For example, if there is a 6" rainfall event in January 2014 over a 2-3 day period, then a monitoring visit should be scheduled immediately to evaluate the impacts and performances at these stream crossings. Because, if a large storm event like this mobilizes woody debris and/or sediment and partially plugs additional culvert(s) not identified as plugged during this assessment, the District should add them to the list of short term treatment recommendations. Likewise, if action is taken, the recommendations should be removed. Keeping copies of all dated records is highly recommended. See Section 12 for further discussion regarding inspections and maintenance.

3. LONG TERM EROSION CONTROL AND EROSION PREVENTION PLAN

RECOMMENDED TREATMENTS FOR SEDIMENT DELIVERY SITES

This long term plan assumes implementation within the next 2-5 years depending on available funding, planning efforts, and permitting requirements. PWA recommends 10 different types of long term erosion control and erosion prevention treatments for the Calabazas Creek watershed project area. The treatments are organized into 2 categories (site-specific treatments and road surface treatments), and include both upgrading and decommissioning measures (Table 6). A summary of recommended treatments is listed in Table 6. For additional detailed treatment information for each site, refer also to Appendix A, which is taken from the assessment database. Overviews of construction and installation techniques for the recommended treatments are provided in Appendix D.

Stream crossing treatments are primarily implemented to reduce the risk of catastrophic failure and sediment delivery resulting from road fill erosion or stream diversion along road surfaces. Road surface treatments are designed to control road drainage by reshaping the roadbed, dispersing road surface runoff onto stable slopes and preventing delivery of concentrated runoff to streams. Upgrading treatments to redirect flow include outsloping the road; installing rolling dips and cross road drains. Road surface erosion is curtailed by adding road rock, which fortifies the surface and reduces production and transportation of fine sediment. Table 6 provides a summary of the road surface treatments prescribed in the project area.

Table 6. Recommended long term erosion control and erosion prevention treatments.

TREATMENT TYPE			NO.	COMMENTS
Site specific treatments	Stream crossing treatments	Culvert (replace)	3	Replace an undersized, poorly installed, or worn out culvert (Site# 5, 6, 14).
		Trash rack	1	Install at culvert inlets to prevent plugging (Site#14).
		Armored fill or ford (wet) crossing	20	Install 2 ford crossings (Site# 11, 30) and 18 armored fill crossings (Site# 3, 4, 7, 8, 9, 10, 12, 13, 18, 19, 26, 27, 29, 31, 32, 33, 33.1, 43) using 290 yd3 of rock armor.
		Critical dip	1	Install to prevent stream diversions (Site# 5).
	Other	Rock (armor)	3	At 3 sites (Site# 14, 15, 32.1), add a total of 25 yd3 of rock armor to buttress stream banks or dip outlet.
		Soil excavation	27	At 27 sites, excavate and remove a total of 985 yd3 of sediment, primarily at fillslopes and stream crossings.
Road surface treatments		Rolling dips	84	Install to improve road drainage on upgraded roads.
		Cross road drains	19	Install to improve drainage on decommissioned roads.
		Outslope road and remove ditch	28	At 28 locations, outslope road and remove ditch for a total of 14,810 ft of road to improve road surface drainage.
		Road rock (for road surfaces)	1	At 1 location, use a total of 2 yd3 of coarse drain rock to rock the road surface.

Once road shaping is complete and road drainage structures constructed, moderate to high use sections of the road will need to be watered and recompacted as a final road treatment. Following the completion of all construction and road rocking, bare soil areas with the potential to deliver sediment to streams should be seeded with native grasses appropriate for the area. Once seed has been applied, areas should be mulched with weed-free straw to prevent sediment delivery to nearby gullies or streams.

RECOMMENDED TREATMENTS FOR MAINTENANCE SITES

As previously stated, funding for this project was intended to identify and evaluate sediment delivery sites and then make treatment recommendations. However, PWA has included a long term erosion control and erosion prevention plan for maintenance sites.

PWA recommends four different types of maintenance treatments for the project area (Table 9). Treatments are similar to those proposed for the sediment delivery sites. Therefore, in addition to the treatment summaries in Table 9 refer to treatment information in Appendix B and construction details in Appendix D.

Recommended treatments are designed to control road drainage by reshaping the roadbed, dispersing road surface runoff onto stable slopes in hopes to reduce overall yearly maintenance needs. Recommended treatments are described below in Table 9. Once road shaping is complete and road drainage structures constructed, moderate to high use sections of the road will need to be watered and recompacted as a final road treatment.

Table 9. Recommended treatments for maintenance sites

TREATMENT TYPE	NO.	COMMENTS
Ditch relief culvert (install or replace)	4	Install or replace ditch relief culverts to improve road surface drainage.
Rolling dip	12	Install to improve road drainage and reduce erosion.
Outslope road and remove ditch	2	Outslope road and remove ditch for a total of 640 ft of road to improve road surface drainage.
Outslope road and keep ditch	1	Outslope road and keep ditch for a total of 265 ft of road to improve road surface drainage.

4. POST PROJECT MONITORING RECOMMENDATIONS

Once the recommended Erosion Control and Erosion Prevention Plan(s) has been implemented, a post-project monitoring should be completed to evaluate and document project performance. Annual monitoring to assess project performance should be evaluated through visual inspections of the project and comparing post-construction photographic documentation.

During visual inspections, evaluate the effectiveness of the treatments by: (1) identifying any instability along treated road/trail segments; (2) documenting the structural integrity of implemented treatments; (3) identifying any areas with potential for erosion/sediment delivery; (4) quantifying sediment delivery due to any significant adjustments to the implemented treatments; and (5) recording turbidity detected at any of the treatment sites.

Inspections should be conducted yearly after implementation, in particular during the wet weather season (October through April) after the first major rainfall event and then later in the season within 48 hours after a large storm event where greater than 2" of rainfall is recorded within a 24 hours period.

Adjustments in treatments can be expected; therefore, annual monitoring of implemented treatment plans will not only evaluate project performance, but it will also identify and adaptively manage any areas which may need fine tuning or maintenance before becoming a significant problem.

5. CONCLUSIONS

This assessment includes a comprehensive evaluation of road related erosion and sediment delivery sources to the Calabazas Creek watershed along a total of approximately 8.76 miles of roads in southeastern region of Sonoma County, California. This report provides a summary of analyzed field data that identifies and quantifies currently observable and possible future sources of sediment and erosion along roads within Calabazas Creek Open Space Preserve. In addition, the road assessment includes an evaluation of non-sediment delivery sites, or maintenance sites, that display the potential to erode and affect road conditions and performance but do not have direct hydrologic connectivity to the watershed.

An integral part of this assessment is the set of prioritized plans of action for cost-effective erosion control and erosion prevention for the project area, both short and long term. When implemented and employed in combination with protective land use practices, the treatment prescriptions outlined in this report may be expected to significantly contribute to the long-term protection and improvement of water quality and salmonid habitat in the Calabazas Creek watershed.

APPENDIX G

CALABAZAS CREEK OPEN SPACE PRESERVE SUB-BASIN CHARACTERISTICS

Table H.1 below shows the characteristics of the sub-basins on the Preserve and their respective hydrology.

TABLE H.1 Sub-basin Characteristics

CREEK NAME	ANNUAL PRECIP (INCHES)	DRAINAGE AREA (SQ MI)	AVG SLOPE	ESTIMATED PEAK ANNUAL DISCHARGE (CFS)							BANKFULL DIMENSIONS		
				2 YEAR	5 YEAR	10 YEAR	25 YEAR	50 YEAR	100 YEAR	500 YEAR	WIDTH (FT)	AREA (SF)	DEPTH (FT)
Calabazas Creek	44.10	2.57	0.097	233	360	477	608	741	834	1160	29.2	20	1.5
Johnson Creek	44.17	0.82	0.168	77	122	165	215	264	300	429	11.3	11.8	1
CB Headwaters	44.70	0.22	0.123	21	35	48	64	79	91	133	3.8	6.4	0.6
Warsaw Creek	44.22	0.18	0.200	26	40	53	68	81	90	123	3.2	5.8	0.5
Dill Creek	44.90	0.16	0.240	22	35	48	64	80	91	134	2.9	5.5	0.5
Oak Wood Creek	43.65	0.15	0.210	22	35	48	63	78	89	129	2.7	5.3	0.5
Decker Creek	43.68	0.13	0.255	12	19	26	35	43	49	71	2.4	5	0.5
Unnamed Trib	43.70	0.07	0.262	14	21	29	37	44	49	67	1.4	3.7	0.4
Spencer Creek	44.07	0.06	0.159	13	20	27	36	44	49	70	1.3	3.5	0.4

APPENDIX H

CALABAZAS CREEK OPEN SPACE SOILS UNITS MAPPED WITHIN PRESERVE

TABLE I.1 Soils Units Mapped within the Preserve.

NAME AND ACREAGE WITHIN PRESERVE AREA*	PARENT MATERIAL	DEPTH OF "A" PROFILE (IN.)	AMOUNT OF ROCK FRAGMENTS/CLAY (HORIZONS A, B AND C)	PH OF "A" PROFILE IN SOIL COMPLEX	DRAINAGE	EROSIVE POTENTIAL	HYDRIC?	OTHER GENERAL CHARACTERISTICS
Aiken loam, 30 to 50 percent slopes (102n) (82.92 ac.)	Volcanic Rock	0–20	up to 25% rock fragments in some areas (more in upper and lower-most horizons)	6.0	Well drained	Severe	Not hydric	Surface is dark brown to reddish brown or reddish dark brown to a depth of 20 inches. Below that is a yellowish red to light or reddish brown layer to a depth of up to 100 inches.
Boomer loam, 30 to 50 percent slopes (BoF) (7.63 ac.)	Metavolcanics	0–3	A: 18-28% clay B: 25-35% clay < 15% coarse sand	5.8–6.5	Well drained	Severe	Not hydric	Surface is typically brown or dark reddish brown, slightly acid loam to about 19 inches deep. Subsoils are a reddish-brown, slightly acid clay loam and gravelly clay loam about 36 inches thick. At about a 55 inch depth the soil is fractured basic igneous rock mixed with very gravelly clay loam.
Clear Lake clay loam, 2 to 5 percent slopes (CcB) (0.90 ac.)	Metavolcanics	0–13	C: gravel content <15%	6.0–8.0	Poorly drained	Moderate	Partially hydric	Soil layers tend to include a dark gray to black, strongly acid to neutral top layer about 39 inches thick. Underlying this is a dark gray, moderately alkaline clay that has light gray mottles. At 46 inches the soil is gray and light brownish-gray and moderately alkaline clay. At 60 inches it is light gray to white, mildly alkaline sandy clay loam.
Cohasset gravelly loam, 15 to 30 percent slopes (CmE) (4.01 ac.)	Igneous Rock	4–15	coarse fragment content ranges from 5-35% in all horizons	6.0–6.5	Well drained	Severe	Not hydric	Soil layers are brown and light yellowish-brown, slightly acid gravelly loam to a depth of 9 inches. Under this is 10 inches of light-brown medium acid gravelly loam. The subsoil is slight-brown strongly acid gravelly clay loam. Weathered volcanic rocks such as andesitic tuff and breccia lie at 29 inches.
Goulding clay loam, 30 to 50 percent slopes (GgF) (23.99 ac.)	Metavolcanics	0–4	A: 15% rock fragments	6.5	Well drained	Severe	Not hydric	The typical profile for this series is a top layer of brown and dark-brown, slightly acid and medium acid clay loam about 11 inches thick. Beneath that is a dark-brown slightly acid very gravelly clay loam about 11 inches thick. Fractured basalt occurs at about 22 inches. Runoff is rapid, and the erosion risk is high.

NAME AND ACREAGE WITHIN PRESERVE AREA*	PARENT MATERIAL	DEPTH OF "A" PROFILE (IN.)	AMOUNT OF ROCK FRAGMENTS/CLAY (HORIZONS A, B AND C)	PH OF "A" PROFILE IN SOIL COMPLEX	DRAINAGE	EROSIVE POTENTIAL	HYDRIC?	OTHER GENERAL CHARACTERISTICS
Goulding cobbly clay loam, 15 to 30 percent slopes (GlE) (41.08 ac.)	Metavolcanics	0–4	A: 25% rock fragments	6.5	Well drained	Severe	Partially hydric	The surface layer contains as much as 25 percent cobblestone and stones and ranges in depth from 16-20 inches.
Goulding cobbly clay loam, 30 to 50 percent slopes (GlF) (3.17 ac.)	Metavolcanics	0–4	A: 25% rock fragments	6.5	Well drained	Severe	Not hydric	This soil is shallower than Goulding 5 to 15 percent. The effective rooting depth is 14-20 inches.
Goulding cobbly clay loam, 5 to 15 percent slopes (GlD) (27.24 ac.)	Metavolcanics	0–4	A: 20% rock fragments	6.5	Well drained	Moderate	Not hydric	The A horizon contains as much as 20 percent gravel, cobblestones, and stones. Subsoil permeability is moderate.
Hambright rock-Outcrop complex, 30 to 75 percent s (152n) (0.33 ac.)	Basic Volcanic Rock	0–6	A: 50-60% rock fragments B: 60% rock fragments 20-27% clay	5.6	Well drained	Severe	Not hydric	The surface is dark grayish brown to dark brown. Beneath that is a brown to dark reddish brown layer to a depth of 6 inches. Contains 50-60 percent pebbles, cobbles and stones.
Laniger loam, 15 to 30 percent slopes (LaE) (24.26 ac.)	Rhyolite	0–16	-	5.5–6.0	Well drained	Severe	Partially hydric	Less deep then Laniger loam 9-15% (only 24-30 inches deep). Runoff is medium to rapid. Available water capacity is 4-5.5 inches.
Laniger loam, 9 to 15 percent slopes (LaD) (15.82 ac.)	Rhyolite	0–16	-	5.5–6.0	Well drained	Severe	Not hydric	Layer profiles are typically grayish-brown, strongly acid and medium acid loam about 17 inches thick. Subsoils are grayish-brown, medium acid loam about 12 inches thick. Rhyolite rock mixed with brown sandy loam occurs at a depth of 29 inches.
Raynor clay, 9 to 15 percent slopes (RaD) (3.01 ac.)	Andesite	-	-	-	Well drained	Moderate	Not hydric	Typical soil profiles include a surface layer of black and olive-gray, slightly acid to moderately alkaline clay about 47 inches thick. Below this is pale-olive, moderately alkaline very cobbly and stony clay. Basaltic cobblestones and stones are at a depth of 56 inches.
Red Hill clay loam, 15 to 30 percent slopes (RhE) (0.45 ac.)	Andesite	0–16	-	6.3–6.5	Moderately well drained	Severe	Not hydric	This soil is similar to Red Hill clay loam, 30-50 percent, but is not as steep.

NAME AND ACREAGE WITHIN PRESERVE AREA*	PARENT MATERIAL	DEPTH OF "A" PROFILE (IN.)	AMOUNT OF ROCK FRAGMENTS/CLAY (HORIZONS A, B AND C)	PH OF "A" PROFILE IN SOIL COMPLEX	DRAINAGE	EROSIVE POTENTIAL	HYDRIC?	OTHER GENERAL CHARACTERISTICS
Red Hill clay loam, 2 to 15 percent slopes (RhD) (30.20 ac.)	Andesite	0–16	-	6.3–6.5	Moderately well drained	Severe	Not hydric	This soil is similar to Red Hill clay loam, 30-50 percent, but is not as steep.
Red Hill clay loam, 30 to 50 percent slopes (RhF) (535.04 ac.)	Andesite	0–16	-	6.3–6.5	Moderately well drained	Severe	Not hydric	The soil profile includes a surface layer of brown and reddish-brown, slightly acid clay loam about 16 inches thick. This layer is covered with litter from Douglas-fir needles and deciduous leaves about 2 inches thick. The subsoil is reddish-brown clay loam/ heavy clay loam and reddish-brown/ yellowish-red clay. Reaction in the subsoil is medium acid.
Rock land (RoG) (232.48 ac.)	Igneous, Metamorphic and Sedimentary Rock	—	-	-	Excessively drained	Not rated	Not hydric	Rock land consists of stony steep slopes and ridges. These are generally in rough mountainous areas with little soil material.
Spreckels loam, 30 to 50 percent slopes (SkF) (250.06 ac.)	Metavolcanics	0–18	A: 0-20% gravel	6.5	Well drained	Severe	Not hydric	This soil is light brownish gray to gray or grayish brown through the A horizon. Below that, at a depth of 18-34 inches, it is brown to grayish brown to light gray or pale brown.

Notes:
See Figure 2.5
"-" indicates data not available.

* Source: U.S. Department of Agriculture (USDA) Soil Conservation Service. 1989. Soil Survey of Sonoma, California. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions.

Available online at http://soils.usda.gov/technical/classification/osd/index.html. Accessed [10/24/2013].

APPENDIX I

SUMMARY OF CULTURAL RESOURCE STUDY OF PORTIONS OF CALABAZAS CREEK OPEN SPACE PRESERVE

CULTURAL RESOURCES SURVEY METHODOLOGY

ASC conducted cultural resource surveys throughout the property. The cultural resource survey consisted of two components: pre-field research and field inventory. ASC personnel conducted a records search at the Northwest Information Center (NWIC) of the California Historic Resources Information System, located at Sonoma State University in Rohnert Park, California in May, 2013. Fieldwork conducted in May and November 2013 used a mixed strategy survey method, wherein intensity of inspection varied with vegetation, slope, and distance from potential trail corridors. A total of 140 acres and eight miles of potential trail corridor were surveyed. The unsurveyed areas represent locations that were beyond potential trail corridors, where archaeological sensitivity was considered low, or where field conditions made access excessively difficult.

INVENTORY OF KNOWN CULTURAL RESOURCES

The survey identified 11 cultural resources, consisting of 9 historic-era, 1 prehistoric, and 1 multicomponent resources (**Table J.1** and **Figure J.1**). Additional resources may be present. Although most of the sites appear to be relatively simple with a low density and diversity of materials, others are more complex and may contain subsurface deposits.

TABLE J.1. Summary of Identified Cultural Resources on the Preserve

ASC FIELD DESIGNATION	PREHISTORIC/HISTORIC-ERA/ MULTICOMPONENT/OTHER	DESCRIPTION
ASC-31-13-01	Historic-era	Quarry
ASC-31-13-02	Historic-era	Nunns'Canyon Road
ASC-31-13-03	Multi-component	Artifact concentration/ structural remains
ASC-31-13-04	Historic-era	Depressions/artifact concentration near Nunn House
ASC-31-13-05	Historic-era	Structural debris near Nunn House
ASC-31-13-06	Historic-era	Improved spring near Nunn House
ASC-31-13-07	Historic-era	Nunn homestead site
ASC-31-13-08	Prehistoric	Bedrock mortar
ASC-31-13-09	Historic-era	Nunn orchard
ASC-31-13-10	Historic-era	Crosby homestead site
ASC-31-13-11	Historic-era	Johnson homestead site

None of the resources have been evaluated with regard to their eligibility to the California Register of Historical Resources (CRHR), the usual standard for significance used in the CEQA context. General practice in the absence of an evaluation is to assume that the resource is significant.

Prehistoric and Multicomponent Archaeological Sites

ASC-31-13-03. This multicomponent site is a concentration of prehistoric lithics with a historic-era residence built on top. The prehistoric portion appears to consist of obsidian flakes and at least two formal projectile points.

The historic-era component of this site consists of a large depression and associated rock pile, as well as non-native Vinca plants. An artifact concentration was observed within and surrounding the depression and included square cut nails, white improved earthenware, and Chinese brown glazed ceramic fragments, aqua, olive, colorless bottle glass fragments, as well as flat window glass that all appear to date to the late 1800s. The historic-era artifacts continued down into the drainage to the south across the road. Branches of Nunns'Canyon Road (ASC-31-13-02) run on both the northern and southern sides of the site. The site is located on a round knoll at the confluence of Calabazas Creek and a small tributary. The site is located within Hugh Nunn's homestead holdings on the boundary with the land of his brother Alexander. The site appears to have been a small residence, and may have been owned by either of the Nunn brothers. It appears undisturbed and may contain undiscovered or subsurface features.

This site may be eligible for listing on the CRHR because of its importance in Native American history and for its research values. The site should be protected from impacts until its CRHR status has been determined.

ASC-31-13-08. This resource is the only other known prehistoric site within the Preserve, and the only example of bedrock milling found to date. It consists of a single boulder containing two mortar depressions. The rock sits at an angle within a small seasonal drainage and appears to have been slightly displaced over time by erosion. The larger of the two mortars is shallow and saucer shaped, with the second much smaller and deeper. No artifacts were noted at the site. The open grassland surrounding the site was covered in extremely dense grass at the time of survey and this impeded ground visibility. A more extensive site may be present in this location.

This site may be eligible for listing on the CRHR because of its importance in Native American history and for its research values. The site should be protected from impacts until its CRHR status has been determined.

HISTORIC ERA ARCHAEOLOGICAL SITES

ASC-31-13-04. This resource is a series of small depressions and flats on an open, south-facing slope near the Nunn homestead (ASC-31-13-07). The features appear to represent a series of small outbuildings or structures associated with the Nunn residence. The largest flat contains a rough rock retaining alignment forming its northern side. Another contains two small depressions with associated rock and backdirt piles. A light concentration of artifacts was noted: aqua bottle glass, flat window glass, and white improved earthenware fragments. Two wooden posts on the slope contained square cut nails. This site may be eligible for listing on the CRHR for its research and/or other values. The site should be protected from impacts until its CRHR status has been determined.

ASC-31-13-05. This site is a small concentration of structural artifacts located on a flat terrace above Calabazas Creek. The site contains a galvanized metal water heater tank, two in-situ posts, a larger downed post, and an electrical box or power source for the water heater. Several pieces of corrugated sheet metal were noted along the edge of the creek bank. A building is shown in this rough location on the 1951 Rutherford topographic map (USGS 1951).

This site may be eligible for listing on the CRHR for its research and/or other values. The site should be protected from impacts until its CRHR status has been determined.

ASC-31-13- 07. This is the most extensive historic-era resource within the Preserve. It probably represents the 1859 and 1876 residence of the Nunn family. The site consists of the remains of a residence, non-native plantings, several rock foundations or retaining walls, and a small artifact concentration. A large, dressed stacked stone foundation is the central feature of the site. At the same elevation of the house foundation are two large eucalyptus trees. Below the house is an orchard of large olive trees running south to the bank of the creek. An artifact concentration surrounds the foundation. It consists of porcelain, amorphous melted aqua, olive, and colorless glass fragments, cut and wire nails, butchered animal bone, cast iron stove fragments, window glass, and white improved earthenware fragments. Two additional rock alignments or retaining walls were noted below the olive grove and may have been additional building foundations, animal pens, or road alignments. In addition to the features noted here, the homestead appears to be associated with several nearby sites: a series of small depressions and flats on the same slope to the east (ASC-31-13-04), a road and improved spring (ASC-31-13-06), and an extant apple orchard (ASC-31-13-09). This site appears to be largely undisturbed and likely contains undiscovered features.

This site may be eligible for listing on the CRHR for its association with the Nunn family, as well as its research values. The site should be protected from impacts until its CRHR status has been determined.

ASC-31-13-10. This site contains the remains of a historic-era homestead residence. A large rock-lined cellar marks the site of the house. Immediately behind the cellar is a small depression that contains an artifact concentration consisting of gasoline cans, barrel hoops, colorless, aqua, and olive bottle fragments (two with embossing), white improved earthenware fragments, and a sewing machine oil bottle fragment. The artifacts appear to date the site to the late 1800s. Further north on the road is a stone circle or enclosure that may have been a pen or garden.

The residence likely belonged to James Crosby and his family. In 1880, the Crosby residence had cows, chickens, and four acres of vineyard. The Crosby homestead was occupied into the early 1900s. The site appears to contain intact archaeological deposits.

This site may be eligible for listing on the CRHR for its association with the Crosby family, as well as its research values. The site should be protected from impacts until its CRHR status has been determined.

ASC-31-13-11. This site consists of the remains of a building consisting of a stone-lined depression with a gap on one side that may indicate an entrance. Nearby are two small rock piles and another possible depression. A single white improved earthenware fragment and a barrel hoop was observed at the site. Three in-situ fence posts containing square nails were also noted in the nearby drainage and may represent the remains of a fenced enclosure within the meadow. The residence is likely that of Charles Johnson, who patented his homestead on the surrounding parcel in 1877 and sold to Mary Ellen Pleasant in the 1890s. The site may contain additional features that were not observed.

This site may be eligible for listing on the CRHR for its association with the Johnson family, as well as its research values. The site should be protected from impacts until its CRHR status has been determined.

HISTORIC ERA ROADS, TRAILS, AND OTHER RESOURCES

ASC-31-13-06. This site is the remains of a road alignment, rock retaining wall, and an improved spring surrounded by non-native trees. The road is above the homestead site (ASC-31-13-07). This unimproved dirt road is mostly visible in a vegetation gap and supported by an extensive rock retaining feature. The rock appears to be locally quarried and is drylaid and unfaced. The rock feature traverses the length of the road as it cuts across slope. The spring has been built up with existing rocks to create small pools. The road is likely related to the Nunn homestead and may have connected Nunn's house to that of his neighbor, Thomas Wilson.

This site may be eligible for listing on the CRHR for its association with the Nunn family, as well as its research values. The site should not be improved or subject to other impacts until its CRHR status has been determined.

ASC-31-13-02. This structure consists of multiple segments of Calabazas Creek or Napa Road that run through Nunns'Canyon. The road alignment runs roughly east-west through the southern half of the Preserve along Calabazas Creek and is depicted on historic maps as early as 1859 and connected the Sonoma and Napa valleys. Over the years, portions of the road have been improved by grading, paving, and re-routing. It likely began as an indigenous trail, was widened for horse and wagon traffic and eventually for cars and logging trucks. At least seven segments of road illustrate these changes as they traverse Nunns'Canyon. All have variously been a part of Nunns'Canyon Road during its lengthy history. The older portions of the road have been unused for many years and are in disrepair. Along the creek they have been washed out in places or covered by fallen trees and vegetation.

This structure may be eligible for listing on the CRHR for its association with the development of the Nunns'Canyon area, as well as its research values. It should be protected from significant changes until its CRHR status has been determined.

ASC-31-13-01. This resource is the remains of the Rock Candy Quarry, a stone quarry that operated during the 1950s. Owned and operated by V.O. Campell, the quarry produced colored building stone in gray, green, and pink rhyolite. The quarry is today a large, flat open circular cut containing a pile of debris left over from road work on Highway 12.

This structure may be eligible for listing on the CRHR for its association with the development of the Nunns'Canyon area. The quarry's current use as a parking lot by the District does not appear to be affecting the resource's values. The structure should be protected from significant changes until its CRHR status has been determined.

ASC-31-13-09. This site consists of a historic-era orchard consisting of five apple trees adjacent to the Nunn homestead (ASC-31-13-07). Although several trees are partially dead or dying at least three continue to produce large quantities of fruit. Although the orchard may have been laid out by Hugh Nunn, it is likely that the existing trees were planted by John Hendley, a tenant who rented the

Nunn homestead after Hugh's death in 1880 and who reportedly had a 40-tree apple orchard.

This site may be eligible for listing on the CRHR for its association with the Nunn family and the development of local agriculture. The trees may have value as genetic stock in addition to their historic significance. The site should be protected until its CRHR status has been determined.

APPENDIX J

ACRONYMS AND GLOSSARY OF TERMS

ACRONYMS

ARA	Avocet Research Associates
ARSSC	California Amphibian and Reptile Species of Special Concern
ASC	Sonoma State University Anthropological Studies Center
Cal-IPC	California Invasive Plant Council
COMTF	California Oak Mortality Task Force
CASSP	California Archaeological Site Stewardship Program
CDF	California Department of Forestry
CDFW	California Department of Fish and Wildlife
CGF	California Giant Salamander
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRF	California Red-legged Frog
CRPR	California Rare Plant Rank
CWHR	California Wildlife Habitat Relationships
DBH	Diameter at Breast Height (Typically considered to be 4.5 feet from a tree's base)
DEM	Digital Elevation Model
District	Sonoma County Agricultural Preservation and Open Space District
FRAP	Fire Resource and Assessment Program
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GPS	Global Positioning Systems
LiDAR	Light Detection and Ranging (topographic or plant height data)
MCV	Manual of California Vegetation
MMU	Minimum Mapping Unit (employed in habitat classification)
MMWD	Marin Municipal Water District
NAIP	National Agricultural Imagery Program (aerial photography)
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PRISM	Parameter-Elevation Regressions on Independent Slopes Model (climate data)
PRMD	Sonoma County Permits and Resource Management Department
RDG	Restoration Design Group
RWQCB	Regional Water Quality Control Board
SCAPOSD	Sonoma County Agricultural Preservation and Open Space District
SSURGO	Soil Survey Geographic Database (Soils GIS Data)
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VNLC	Vollmar Natural Lands Consulting
WSV	Western Sonoma Volcanics

GLOSSARY OF TERMS

Alluvium: Eroded rock material carried down and deposited along a stream course.

Archaeological Site: A place that contains the evidence of past human activity at that location. A category of cultural resource.

Bioturbation: The disturbance of sedimentary deposits (soils) by living organisms.

Bole: The trunk of a tree.

Cambium: A cellular plant tissue from which xylem (or phloem or cork) grows by division, resulting (in woody plants) in secondary thickening.

Cotyledon: An embryonic leaf in seed-bearing plants, one or more of which are the first leaves to appear from a germinating seed.

Cultural Resources: Cover term that includes archaeological sites, places of traditional importance, and historic buildings and structures.

Endemic: Pertaining to a species that is only found in a specific region, location or habitat type.

Fecundity: Capacity, especially in female animals, of producing young in great numbers. Fruitfulness or fertility.

Flashy stream: A stream or river that is characterized by dramatic fluctuations in flow, in which sharply higher flows in wet weather can be followed by very low flows in dry weather.

Fuel Ladder: Live or dead vegetation that allows a fire to climb up from the landscape or forest floor into the tree canopy. Examples include tall grasses, shrubs, and tree branches, both living and dead.

Hydric Soil: A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions.

Lagomorph: "Hare-sized" mammal, pertaining to Lagomorpha order — rabbits and hares.

Lignotuber: A burl. A rounded woody growth at or below ground level on some shrubs and trees that grow in areas subject to fire or drought, containing a mass of buds and food reserves.

Mesic: A relatively moist habitat or environment.

Monocot: A plant that features only one cotyledon (see definition of cotyledon above), such as grasses, orchids, and palms.

Pole: A small, immature tree, typically 5-11 inches diameter (see also sapling and seedling).

Riparian: Of, on, or relating to the banks of a natural course of water (e.g., riparian vegetation).

Ruderal: Pertaining to disturbed habitat. Characterized as weedy or impacted by refuse.

Sapling: A small, immature tree, typically 1-4 inches diameter at breast height.

Scarification: In botany: involves cutting the seed coat using abrasion, thermal stress, or chemicals to encourage germination.

Seedling: A small, immature tree, typically 0-1 inch diameter (see also sapling and pole).

Seral: An intermediate, or non-climax stage in ecological succession.

Snag: A standing dead or dying tree (usually applied to mature trees).

Stratum: A defined, uniform layer or life form of vegetation (e.g., herbs versus shrubs versus trees).

Sympatric: Related taxa (e.g., species within a genus) occurring within the same geographical area.

Succession: The process of change in the species structure of an ecological community over time.

Tuff: Rock type composed of consolidated volcanic ash.

Windthrow: In forestry, windthrow refers to trees uprooted or broken by wind.

Xeric: A relatively dry habitat or environment.

Xylem: One of the two types of transport tissue in vascular plants (phloem is the other).

APPENDIX K

SUDDEN OAK DEATH BEST PRACTICES

Where to go: If possible, avoid areas that are, or appear to be, diseased. If you cannot avoid infested areas, follow the sanitation practices listed below when recreating in known infested areas. If you do not know whether or not the site is infested, play it safe and assume that it is.

When to go: During wet periods, the organism seems to be most active and therefore most likely to start new infections. If possible, do not work or recreate in infested forests during the wet, rainy, and cool times of the year. Avoid working in muddy conditions whenever possible.

How to prevent spread: Familiarize yourself with the symptoms of Sudden Oak Death on common forest plants and stay clear of those areas.

- Stay on established trails and respect trail closures. Park your vehicle in designated parking areas and out of the mud.
- Do not collect and transport wood, plants, acorns, leaves, soil or water from streams, lakes or rivers.
- Carry cleaning materials in your car to use at the end of your visit. An old screwdriver, stiff brush, and towel are useful items for removing mud and other debris. An additional level of sanitation can be achieved by washing with soap and water or spraying with a disinfectant, such as Lysol or a 10 percent bleach solution.

Hikers/Runners: Remove soil and plant material from your shoes, followed by a water rinse and a disinfectant.

Bicyclists: Remove soil and plant material from your bike, shoes, and clothes. Rinse your bike and shoes with water and follow with a disinfectant.

Equestrians: Keep yourself and your horse clean by staying on established trails and out of contaminated forest areas. Clean any plant material and mud from the horse and its hooves with towels and brushes before leaving the site.

Plant collectors (mushrooms, firewood, etc.): Remove soil and plant material from your shoes and tools, follow with a water rinse and a disinfectant. If you intend to move host plants out of an infested county, you must first contact the local Agricultural Commissioner for a permit.

Given the emphasis above in removing or disinfecting soils and plant materials from shoes, bicycle tires, and other surfaces, it may be advisable to install a "sanitation station" at the Preserve staging area and/or trailhead. Ideally, a faucet would be installed, along with a shoe mud cleaner, and perhaps Lysol spray cans. Recreationalists should be notified of the presence of SOD in the area, and of the importance of sanitation measures in preventing its spread.

APPENDIX L

CWHR HABITAT ASSESSMENT METHODOLOGY

The California Wildlife Habitat Relationships database and software program was developed by the CDFW to predict wildlife diversity based on micro as well as macro habitat attributes. Table M.1A below presents the CWHR habitat types mapped on the Preserve, along with the number of vertebrate animal species predicted for each habitat type. The number and types of predicted animals are influenced by the "habitat elements" attributed to each of the plant communities, as listed in Table M.1B. A given element may simply augment habitat suitability (coded as "Preferred"), or the element may be essential ("Essential") or typically essential ("Secondary Essential") in order for a given animal to occupy a habitat. For example, northern spotted owls often, but do not exclusively, nest in tree cavities, so tree cavities would be a "Preferred" habitat element for the species — the features render a site more suitable for owls, but their absence does not preclude the species. However, acorns are essential for Acorn woodpeckers, such that a complete absence of oaks precludes the species from an area.

While many of the CWHR habitat types are rather broadly defined — several include multiple CNPS alliances mapped on the Preserve (and in some cases other alliances not listed in the table) — they give some indication of the relative vertebrate wildlife diversity associated with general habitat types present on the Preserve. It is worth noting, for example, the number of species associated with oak woodlands, as depicted in Table M.1A. The CWHR model predicts over 150 vertebrate animals with potential to occur in oak woodland plant communities, which feature habitat elements present on the Preserve, including Coastal Oak Woodland and Montane Hardwood (which includes oak habitats). Note that these two plant communities include significant overlap among species.

The number and diversity of habitat elements present on the Preserve is also remarkable. Of 123 habitat elements considered in predicting species potential, 97 are present on the Preserve — nearly 80 percent of all habitat elements. As shown in Table M.1B, habitat elements include a wide variety of biotic and abiotic features that are known to provide wildlife habitat, including some animals (which would represent prey for other species). While habitat elements include many man-made features such as buildings, piers, and dumps, all of the habitat elements present on the Preserve are natural features, mostly related to the significant diversity of vegetation structure, topography, surface hydrology, and geologic features. Examples of habitat elements present on the Preserve include cliffs and caves, snags and downed logs, pine cones and sap, acorns, springs, and perennial and intermittent streams.

TABLE M.1A. California Wildlife Habitat Relationships (CWHR) Species Richness Predictions for Habitats Present on the Preserve.

CWHR HABITAT TYPE (MCV)[1]	SPECIES COUNT/SPECIAL-STATUS SPECIES COUNT	BIRDS	MAMMALS	REPTILES	AMPHIBIANS	TOTAL NUMBER OF SPECIES
Montane Riparian (White Alder Groves)	Total Species Count	110	47	13	12	182
	Special Status Species Count	21	17	6	3	47
Coastal Oak Woodland (Coast Live Oak Woodland/ Pacific Madrone Forest/ California Bay Forest)	Total Species Count	116	40	12	13	181
	Special Status Species Count	22	16	4	4	46
Wet Meadow (Soft Rush Marsh Alliance)	Total Species Count	110	35	9	8	162
	Special Status Species Count	27	16	6	4	53
Montane Hardwood (Oregon White Oak Woodland/ Interior Live Oak Woodland)	Total Species Count	103	39	11	9	162
	Special Status Species Count	18	13	5	1	37
Douglas Fir (Douglas Fir Forest)	Total Species Count	82	42	11	11	146
	Special Status Species Count	15	15	4	2	36
Perennial Grasslands (Harding Grass Swards)	Total Species Count	97	28	7	4	136
	Special Status Species Count	24	11	2	1	38
Annual Grassland (Annual Brome Grasslands/ Wild Oats Grasslands/ Yellow Starthistle Fields)	Total Species Count	96	26	8	5	135
	Special Status Species Count	23	12	3	2	40
Redwood (Redwood Forest)	Total Species Count	73	34	9	12	128
	Special Status Species Count	12	11	3	2	28
Coastal Scrub (Coyote Brush Scrub)	Total Species Count	70	32	10	5	117
	Special Status Species Count	18	14	3	2	37
Mixed Chaparral (Stanford Manzanita Chaparral/ Common Manzanita Chaparral/ Hoary Manzanita Chaparral)	Total Species Count	62	33	13	4	112
	Special Status Species Count	11	13	5	1	30
Closed-Cone Pine-Cypress (Knobcone Pine Forest)	Total Species Count	66	18	10	4	98
	Special Status Species Count	9	6	3	1	19
Chamise-redshank chaparral (Chamise Chaparral)	Total Species Count	54	22	11	3	90
	Special Status Species Count	10	9	4	0	23

CWHR Query Information

- Results were retrieved using the single condition query species-summary report in CWHR Version 8.2.
- Habitat Suitability level (H-High, M-Medium, L-Low) was set to M — which retrieves species which would likely occur at both moderate and high population densities.
- Excluded Elements are listed in Table M.1B below (habitat elements which are not present on the site).
- Excluded Elements (E-essential, S-Secondary Essential, P-Preferred) was set to E — which excludes only those species which require an excluded element for survival
- Special-status designation refers to those species listed as: Endangered (Federal/State), Threatened(Federal/State), Fully Protected (CA), Species of Special Concern (CA), Proposed Endangered (Federal), Proposed Threatened (Federal), Candidate (Federal), BLM Sensitive, USFS Sensitive, and CDF Sensitive.

1. MCV alliance represents closest match to CWHR habitat type. Some CWHR habitat types include one or more additional MCV alliances.

TABLE M.1B. CWHR Habitat Element Checklist.[1]

CWHR HABITAT ELEMENT CHECKLIST		
ACORNS — Fruit of an oak	LAYER, HERBACEOUS ›10% herb. understory	SNAG, LARGE (ROTTEN) ›30" dbh
ALGAE — Any algae other than kelp	LAYER, SHRUB ›10% shrub understory	SNAG, LARGE, (SOUND) ›30" dbh
AMPHIBIANS — Frogs, Toads, etc.	LAYER , TREE ›10% sub-canopy trees	SNAG, MEDIUM (ROTTEN) 15-30" dbh
AQUATICS, EMERGENT	LICHENS	SNAG, MEDIUM (SOUND) 15-30" dbh
AQUATICS, SUBMERGED	LITHIC — Rock scatter ‹10" diam.	SNAG, SMALL (ROTTEN) ‹15" dbh
BANK — Cut, hollow or lake border	LITTER — Residue ‹1" in diam.	SNAG, SMALL (SOUND) ‹15" dbh
BARREN — Devoid of veg. within veg. area	LOG, LARGE (HOLLOW) ›20" diam.	SOIL, AERATED — Well drained
BERRIES — S mall, pulpy fruit	LOG, LARGE (ROTTEN) ›20" diam.	*SOIL, FRIABLE — Easily crumbled*
BIRDS, LARGE — › 450g (1lb)	LOG, LARGE (SOUND) ›20" diam.	SOIL, GRAVELLY — Gravel .8-3" diam.
BIRDS, MED . — 110-450g (4oz-1lb)	LOG, MEDIUM (HOLLOW) 10-20" diam .	SOIL, ORGANIC — › 20% organic matter (wght.)
BIRDS, SMALL — ‹ 110g (4oz)	LOG, MEDIUM (ROTTEN) 10-20" diam.	*SOIL, SALINE — Alkaline soils/veg.*
BOGS — Low-lying, residue rich areas	LOG, MEDIUM (SOUND) 10-20" diam.	SOIL, SANDY — Sand .05-2mm diam.
BRUSH PILE — ›1m high, ›=15m2 basal area	MAMMALS, LARG E — › 227 0g (5lb.)	SPRINGS-Freshwater springs, seeps
BUILDINGS — Houses, sheds, etc.	MAMMALS, MED. — 110-2270g (4oz-5lb)	*SPRINGS, HOT*
BURROW — Excavation made by animal	MAMMALS, SMALL — ‹ 110g (4oz)	*SPRINGS, MINERAL*
CAMPGROUND	MOSS — Bryophytes	STEEP SLOPE-Slopes › 50%
CARRION — Any dead animal matter	*MUD FLATS — contiguous with water body*	STREAMS, INTERMITTENT
CAVE — Natural chamber open to surface	NECTAR	STREAMS, PERMANENT
CLIFF — Steep, vertical overhanging face	*NEST BOX — Constructed nesting cavity*	STUMP (ROTTEN)-snag‹3m (10') high
CONES — From gymnosperm trees	NEST PLATFORM — Const. large platform	STUMP (SOUND)-snag‹3m (10') high
DUFF — Non-structured decaying matter	*NEST ISLAND — Man-made nesting island*	TALUS-Slope from rock accumulation
DUMP — Sanitary landfill	NUTS — Hard-shelled, dry fruit.	*TIDEPOOLS*
EGGS — Any bird or reptile eggs	*PACK STATION — with assoc. human use*	*TRANSMISSION LINES*
FENCES — Any type	PONDS — Permanent, ‹2ha (5 acres) surf. area	TREE LEAVES
FERN — Spore-forming plants with fronds	REPTILES	TREE, BROKEN LIVE TOP ›11" dbh
FISH	RIPARIAN INCLUSION — Riparian veg. (small)	TREE, W/ CAVITIES
FLOWERS	*RIVERS — Perm., ›6m (20') wide in dry season*	TREE, W/ LOOSE BARK
FORBS — Herbaceous dicotyledons	ROCK — Outcrop ›10" diam.	TREE/AGRICULTURE — Interface
FRUITS — Pulpy fruit	ROOTS	TREE/GRA SS — Interface
FUNGI — Mushrooms, molds, etc.	*SALT PONDS — Saline ponds*	TREE/SHRU B — Interface
GRAIN — A single, hard cereal seed	*SAND DUNE*	TREE/WATER — Interface
GRAMINOIDS — Grass-like plants	SAP	TREES, FIR -Abies sp. (Douglas fir) ›11" dbh
GRASS/AGRICULTURE — Interface	SEEDS — Other than listed above	TREES, HARDWOOD — ›11" dbh
GRASS/WATER — Interface	SHRUB/AGRICULTURE- Interface	TREES, PINE — Pinus sp. › 11" dbh
INSECTS, FLYING — Insect eaten in air	SHRUB/GRASS — Interface	*VERNAL POOLS*
INSECTS, TERRESTRIAL	*SHRUB/WATER — Interface*	WATER — Any source of free water
INVERTEBRATES	SHRUBS — Woody plants, not trees	WATER, FAST — Un-silted; ›2ft/sec. flows
INVERTEBRATES, AQUATIC	SLASH, LARGE (ROTTEN) Residue 3-10" diam.	*WATER, CREATED BODY — Guzzler, well, etc.*
JETTY — Rock/concrete extending into water	SLASH, LARGE (HOLLOW) Residue 3-10" diam.	WATER , SLOW — Some silt.; flows ‹ .5ft/sec.
KELP — Large, coarse, brown algae	SLASH, LARGE (SOUND) Residue 3-10" diam.	*WATER/AGRICULTURE- Interface*
LAKES — Permanent › 2ha (5 acres)	SLASH, SMALL Residue 1-3" diameter	*WHARF*

1. Habitat elements that are NOT present on the Preserve are shaded and italicized. All other elements are present onsite and are included in the CWHR query presented in Table L.1A above.

This information was accessed on the CDFW website at http://www.dfg.ca.gov/biogeodata/cwhr/

APPENDIX M FIRE ADAPTATION

Table N.1 Fire Adaptations of Dominant Trees and Shrubs Occurring on the Preserve.

SPECIES NAME (COMMON NAME)	FIRE INTERVAL	TYPE OF FIRE RESPONSE			SUMMARY
	MEAN	SPROUTING	SEEDLING	SAPLING TO MATURE	
Tree Species					
Acer macrophyllum (bigleaf maple)	29	stimulated	neutral	survive/ top-killed	Sprouts from the root crown after top-kill by fire.
Alnus rhombifolia (white alder)	-	N/A	neutral	not tolerant	Disturbance is primarily from flooding. It can establish rapidly by seed an may sprout weakly after fire. High intensity fires (those that top-kill) result in plant mortality.
Arbutus menziesii (Pacific madrone)	29	stimulated	stimulated (establish-ment)	survive/ top-killed	Sprouts prolifically from root crown after fire, frequent fires promote multi-stemmed shrubs. Frequent fires also maintain *A. menziesii* by preventing conifers from establish-ing and living long enough to overtop the hardwoods.
Pinus attenuata (knobcone pine)	(20-50)	N/A	stimulated (establish-ment)	not tolerant	Fires kill trees. However, the species is dependent on stand-replacing crown fires for reproduction which makes it an obligate fire type. Dependant on fire to open cones. Natural fires are prob-ably less frequent in knobcone pine forests than other closed cone communities (infertile sites support little undercover).
Pseudotsuga menziesii var. *menziesii* (Douglas fir)	29	none	stimulated (establish-ment)	sapling killed; mature survive	Ability to survive fires increases with age. Frequent low- to moder-ate- severity fires that occasionally create crown gaps of varying sizes. Re-colonization limited by wind dispersal. The number and distance of surviving source trees determines how quickly seedlings establish.
Quercus agrifolia (coast live oak)	29	stimulated	neutral	survive	Large trees generally recover well from a fire. Severely burned crowns, trunks, and root crowns may require several years to sprout. Smaller trees are less resistant. Seedling and sap-lings are often killed by low-moderately severe fires.
Quercus garryana var. *garryana* (Oregon white oak)	(3 - 30)	stimulated	stimulated (establish-ment)	survive/ top-killed	*Q. garryana* stands developed with relatively high fre-quency, low-intensity fires. Seedling recruitment is enhanced when litter layer has been removed. Howard (1992) sug-gests a minimum fire frequency of around 5 years.
Quercus kelloggii (California black oak)	11	stimulated	stimulated (establish-ment)	survive/ top-killed	Fire regimes are characterized by low-to moderate-severity surface fires in intervals averaging 3.5 years. These create open canopies for seedling establishment and sprout growth. Fire intensity tends to be lower than in surrounding chapar-ral because of relatively low volatility of foliage and bark.
Quercus lobata (valley oak)	12	stimulated	top-killed	survive/ top-killed	Larger trees are usually resistant to moderate-severity fire. Seedlings and saplings are top-killed by such fires, juveniles sprout from root crowns (older trees do not have this ability). Regeneration is facilitated by wildlife that buries acorns.
Quercus wislizeni (interior live oak)	12	stimulated	not tolerant	survive	Larger trees are well adapted to survive fire, Smaller trees (seed-lings and saplings) are often killed during fires. Frequent fires may create shrublands. Woodlands have shorter fire return intervals and more, less intense, surface fires than forests.
Sequoia sempervirens (coast redwood)	25	stimulated	stimulated (establish-ment)	survive/ top-killed	Ability to survive fires increases with age. Sprouts from trunks, branches, stumps and roots if damaged. Younger stands have more litter and are drier, therefore more flammable.

SPECIES NAME (COMMON NAME)	FIRE INTERVAL	TYPE OF FIRE RESPONSE			SUMMARY
	MEAN	SPROUTING	SEEDLING	SAPLING TO MATURE	
Umbellularia californica (California bay)	29	stimulated	neutral	survive/ top-killed	Fire regime is variable, depending on the adjacent habitat type. Stand replacing fire creates shrubby stands, surface fires form tree stands. Moderate-severity fire kills seedlings and top-kills saplings and mature trees. Severe fire kills the seeds. Top-killed plants recover rapidly.
Shrub Species					
Arctostaphylos glandulosa (Eastwood's manzanita)	10	stimulated	stimulated (establishment)	not tolerant	Fires can burn to ground level, *lignotubers* generally survive and sprout. Fire stimulation may germinate dormant soil stored seeds.
Arctostaphylos manzanita (common manzanita)	27	stimulated	stimulated (establishment)	not tolerant	Establishes from fire-stimulated germination of dormant seeds stored in the soil. New seedlings may take 10 or more years before producing seeds.
Arctostaphylos stanfordiana ssp. *stanfordiana* (Stanford's manzanita)	-	-	-	-	No information available on this rare habitat. Based on associated plant species, assumed to be adapted to frequencies similar to *A. manzanita*
Ceanothus cuneatus (buckbrush)	27	stimulated	stimulated (establishment)	not tolerant	Plants are highly flammable. Fire is required to break seed dormancy. Seedlings emerge during the first year after a fire. Fire return intervals between 30-100 years favor the maintenance of *C. cuneatus*. Fires can be intense and fast spreading.
Adenostoma fasciculatum (chamise)	55	stimulated	stimulated (establishment)	not tolerant	Sprouts from lignotuber after fire. Dormant seeds are stimulated to germinate. Shrubs can persist through long fire-free intervals. High intensity fire may delay sprouting and possibly kill seeds near the surface. Susceptible to negative effects from short-interval fires. Fires may completely eradicate post fire seedling reproduction if the soil seed reserve is not well established and reproductive maturity has not been reached.
Annual Grasslands	-	stimulated	stimulated (establishment)	survive/ top-killed	Annual grasses generally shorten fire intervals, providing more fuel to areas that previously had insufficient fuels. This can be damaging to other habitat types which are adapted for a longer fire interval, but are burned more frequently due to the presence of annual grasses. (Many grasses establish from off-site sources after a burn).

Sources: Van de Water, K. M.; H.D. Safford. 2011. A Summary of Fire Frequency Estimates for California Vegetation Before Euro-American Settlement. Fire Ecology Vol. 7.3

Stuart, J.D.; Stephens, S.L.; North Coast Bioregion. In. The History and Ecology of Fire in California Bioregions

Sawyer, J.O., Keeler-Wolf, T., Evens, J.M., A Manual of California Vegetation.

U.S. Forest Service. Fire Effects Information. http://www.fs.fed.us/database/feis/plants/

APPENDIX N

WILDLIFE CAMERA STUDY

METHODS

On May 18th of 2013, Dr. Sue Townsend and VNLC's Katie Young installed ten Bushnell Trophy Cam motion-sensing infrared wildlife cameras at strategic locations throughout the Preserve (Figure 2.6). Dr. Sue Townsend, an associate of VNLC with considerable experience in designing wildlife camera studies, assisted with the development of the study plan. The cameras were configured and tested, then installed at locations where the detection of animal species of interest would be maximized, such as along stream corridors and other hydrographic features, roads and trails (particularly within densely vegetated habitat), and habitat transitions. Specific locations were selected based on indicators of wildlife habitat within these zones, such as within areas with observable scat, scratch marks, or foot tracks. The cameras were installed at heights of one to four feet on stable features (e.g. trees) or on wooden stakes if suitable natural features were not available in that habitat type, and in a manner, which maximizes resolution (e.g., close enough to features of interest) and minimizes impedances such as vegetation or sun glare (for daytime photography). The geographic coordinates of each camera station were recorded with a professional GPS unit. Cameras that were not recording additional species after several weeks in place, or that were otherwise problematic (e.g., due to often being triggered by wind-blown vegetation), were relocated to other habitat throughout the site, in order to minimize redundant data and maximize aerial coverage on the Preserve. Cameras were left on site until August 16th, 2013 (approximately three months). The data disks were replaced and the photos processed approximately every other week.

RESULTS

A total of ten animal species were recorded by the 18 wildlife cameras installed throughout the Preserve, including nine mammals and one bird. The recorded animal species and the number of occurrences recorded by each camera are presented in Table O.1B below. The larger carnivores among the species are described below in terms of their ecological requirements and presence on the Preserve. Such species provide an important ecological function and are relatively uncommon, particularly in areas with moderate to high density human habitation and development (unlike more generalist species such as raccoon and skunk).

TABLE O.1A. Wildlife Camera Stations Information.

CAMERA STATION LOGISTICS						
CAMERA STATION ID	**SET UP DATE**	**REMOVAL**	**DAYS ACTIVE**	**HABITAT TYPE**	**CAMERA DIRECTION**	**PHYSICAL LOCATION DESCRIPTION**
C1	5/18/2013	6/18/2013	31	Pacific Madrone Forest	Northeast	On main trail, in southwest of Preserve, adjacent to Calabazas Creek, moderate cover of Pacific madrone and tall oaks.
C2	5/18/2013	6/17/2013	30	Redwood Forest	South	On main trail, in southwest of Preserve, at small spring intersecting Calabazas Creek, moderate cover of redwood, tall oaks, and brush.
C2B	6/3/2013	6/10/2013	7	California Bay Forest	Southwest	Across Calabazas Creek from main trail, facing rock outcrop with cave, high tree cover.
C2C	6/10/2013	6/17/2013	7	California Bay Forest	Northeast	Along wildlife trail up slope from main trail, near rock outcrop and peregrine falcon nest, high tree cover.
C3	5/18/2013	8/16/2013	90	Coast Live Oak Woodland	West	Facing small grassland opening within oak woodland, high tree cover.
C3B	6/18/2013	8/16/2013	59	Oregon White Oak Woodland	Southwest	Oak woodland adjacent to Calabazas Creek, slightly east of main trail, high tree cover.
C4	5/18/2013	8/16/2013	90	Hoary Manzanita Chaparral	North	South of main trail in northwest of Preserve, sparse vegetation cover, open rocky area within chaparral.
C5	5/18/2013	8/16/2013	90	Coast Live Oak Woodland	West	Smaller trail that joins with main trail, high cover of oak, pine, and manzanita.
C6	5/18/2013	6/3/2013	16	Chamise Chaparral	North	On hillslope north of main trail in the northwest of the Preserve, sparse vegetation cover.
C6B	6/3/2013	7/19/2013	46	Chamise Chaparral	North	Slightly north of main trail, moderate cover from chamise and manzanita, facing open area within chaparral.
C6C	7/19/2013	8/16/2013	28	California Bay Forest	Northeast	On trail across Calabazas Creek from main trail, along tributary, well used wildlife trail, high cover of California bay, oaks and pines.
C7	5/18/2013	6/18/2013	31	Coast Live Oak Woodland	South	North of main trail in north of Preserve, adjacent to tributary, moderate tree cover.
C7B	6/18/2013	8/16/2013	59	Coast Live Oak Woodland	North	Along main trail in northwest of Preserve, moderate tree cover, facing steep slope.
C8	5/19/2013	6/3/2013	15	Coast Live Oak Woodland	South	Within oak woodland at the top of a grassland dominated hill, east of main trail, moderate cover of large oaks.
C8B	6/3/2013	8/16/2013	74	Common Manzanita Chaparral	Northeast	Southwest of main trail in southwest of Preserve, moderate cover of manzanita.
C9	5/18/2013	6/18/2013	31	Douglas Fir Forest	South	North of main trail in central-north of Preserve, moderate cover from scattered Douglas fir and oaks
C9B	6/18/2013	8/16/2013	59	Oregon White Oak Woodland	South	North of main trail in central-north of Preserve, moderate cover from oaks and large manzanitas.
C10	5/18/2013	6/18/2013	31	Redwood Forest	West	Along main trail in south of Preserve, cover of redwood, brush, and tall oaks adjacent to trail.

TABLE O.1B. Species and Occurrence Numbers Recorded at Wildlife Camera Stations.

CAMERA MAP ID	SPECIES DETECTIONS (NUMBER OF DETECTIONS)										
	WESTERN GRAY SQUIRREL *(Sciurus griseus)*	**MULE DEER** *(Odocoileus hemionus)*	**WILD TURKEY*** *(Meleagris gallopavo)*	**VIRGINIA OPOSSUM*** *(Didelphis virginiana)*	**COMMONGRAY FOX** *(Urocyon cinereoargenteus)*	**BOBCAT** *(Lynx rufus)*	**MOUNTAIN LION** *(Puma concolor)*	**STRIPED SKUNK** *(Mephitis mephitis)*	**NORTHERN RACCOON** *(Procyon lotor)*	**BLACK-TAILED JACKRABBIT** *(Lepus californicus)*	**NUMBER OF DETECTIONS**
C1	1	5	1		4		4				15
C2	1	3	6	1	5		4				20
C2B	1										1
C2C											0
C3		13	11	2		1		3			30
C3B	3	7		7				2			19
C4		6			3						9
C5		3					2				5
C6		3									3
C6B		8	3		1						12
C6C		1						1			2
C7	1	2	3	1				3			10
C7B		1	5	5	17	3	5	3	1		40
C8		9	1								10
C8B		1		1	159	2	1	7		2	173
C9	2	5						1			8
C9B	4	37	6	1	1	1	1	1			52
C10	1			2	9	3	9				24
Total	**14**	**104**	**36**	**20**	**199**	**10**	**26**	**21**	**1**	**2**	**433**

* = not native to California

Note: See Figure 2.5

APPENDIX O

BELTANE RANCH GRAZING RECOMMENDATIONS

by Lisa Bush
May 2005

INTRODUCTION/BACKGROUND

The Sonoma County Agricultural Preservation and Open Space District (the District) has acquired a 1,291-acre portion of the Beltane Ranch, near Glen Ellen. The District's fee acquisition consists of a parcel referred to as "Parcel D" on various maps and in documents pertaining to the acquisition transaction.

Kathleen Marsh, Stewardship Planner for the District, has enlisted my services as a California State Certified Rangeland Manager (License # 18) to assess the potential for conducting a grazing program on this property. Although the property is mostly wooded, there are roughly 90 to 100 acres of open grassland that could benefit from grazing. Some portions of the grasslands are exceedingly steep, which limits livestock access, so the useable portion of grassland acreage may actually be closer to 50 or 60 acres. Cattle, which are the recommended species, will select appropriate areas for grazing. This brief report outlines Existing Conditions, Management Recommendations, and Implementation steps related to livestock grazing on the property. Site locations referred to in this report are identified on the attached map titled Beltane Property Aerial Map.

Beltane Ranch grasslands were examined during a site visit that I conducted with Kathleen Marsh on May 2nd, 2005. Additional information about the property was provided by a personal interview with Alexa Wood, one of the former owners of the property, on May 11th, 2005. During the May 2nd site visit, Kathleen Marsh and I accessed the grasslands by walking up the unpaved road that follows Calabazas Creek from the westernmost point of "Parcel D". Open grasslands on the property consist of several distinct patches that are separated by heavily wooded areas. The northernmost and steepest parts of the grasslands were not examined due to access and time constraints. All of the grassland patches that were examined would probably benefit from grazing, primarily to reduce buildup of thatch and provide openings in the grassland canopy for small statured plants to germinate and grow. The two largest grassland patches, hereinafter referred to as the Upper Pasture and the Lower Pasture, may be large enough to accommodate a cattle operation. Potential benefits of grazing as well as constraints are discussed under Management Recommendations, below.

1. EXISTING CONDITIONS

Grassland Vegetation — Grassland vegetation in the Lower Pasture is dominated by non-native annual grasses including ripgut brome (Bromus diandrus), soft chess (B. hordeaceus), wild oats (Avena spp.), purple false brome (Brachypodium distachyon), hedgehog dogtail (Cynosaurus echinatus). There is also a small patch of medusahead (Taeniatherum caput-medusae), a noxious, invasive, nonnative grass. Two species of nonnative annual barley—farmer's foxtail (Hordeum murinum ssp. leporinum) and Mediterranean barley (H. marinum ssp. gussoneanum) also occur in relatively small amounts. Nonnative perennial grasses observed include bulbous bluegrass (Poa bulbosa) and Hardinggrass (Phalaris aquatica). Bulbous bluegrass is confined to highly disturbed areas such as road margins and Hardinggrass, although well established, appears to be limited to moist swales. These same swales contain large patches of presumably native rushes and sedges that were not identified.

Three native perennial grass species were observed in small patches. These include purple needlegrass (*Nassella pulchra), California oatgrass (Danthonia californica), and in wet areas, meadow barley (Hordeum brachyantherum).*

The forb component of the Lower Pasture grasslands is poorly developed, probably due to the tall grassland canopy and thatch buildup, which tends to impede germination and growth of small statured plants. Forbs that were observed are mostly nonnative species including storksbill or filaree (Erodium spp.), sheep sorrell (Rumex acetecella), clovers (Trifolium spp.), rough cat's ear (Hypocheris radicata), wild pea (tentatively identified as Lathrys sphaericus). The only native forbs noted in the Lower Pasture were California poppy (Eschscholzia californica) and baby blue eyes (Nemophila sp.).

Grassland biomass production appeared to be modest throughout much of the Lower Pasture. With the exception of low lying moist areas, biomass production was visually estimated at roughly 2,000 pounds per acre (on a dry weight basis). The moist areas produce more biomass, especially the Hardinggrass patches, which likely produce well over 10,000 pounds per acre. On hillslopes and in other areas where biomass production is lower, thatch build up was observed to be minimal considering that the property has not been grazed in five years. Despite this observation, the thatch that has accumulated in some areas is probably negatively affecting grassland species diversity.

Grassland species in the Upper Pasture are similar to those in the Lower Pasture, although a much higher proportion of both clovers and filaree were noted. In areas with gentle terrain, biomass production was higher. There are portions of the Upper Pasture that are so steep that cattle usage would probably be low.

Weeds — Weedy species that merit attention and, depending on available resources, should be controlled, include medusahead, yellow star-thistle (*Centaurea solstichialis), and possibly, Hardinggrass. Only a small patch of medusahead was noted, although there may be other infested areas that were not observed during the site visit. Because this plant is extremely invasive and can greatly diminish grassland biodiversity and forage quality, controlling it should be considered. Effective control methods include repeated burning and very carefully timed short duration, high intensity grazing*5. Either of these techniques would require ongoing monitoring and repeated treatment and should only be attempted if adequate staff resources are provided to manage such a program for several years.

Yellow star-thistle, which was not observed during the site visit but is known to occur in several large patches, may also be a candidate for control. Alexa Wood, one of the former property owners, has observed an increase in this plant in the years since grazing was removed for the site. Yellow star-thistle would also require diligent, on-going monitoring and treatment for effective control. Because it is already well established, investing significant resources in a control program may not be worth while. Yellow star-thistle is palatable to livestock in spring before spiny flowering stalks develop. Working with the Sonoma County Agricultural Commissioner's office to introduce the experimental yellow star-thistle rust (*Puccinia jaceae var. solstichialis) would be the most practical way to address this weed problem.*

Some people consider Hardinggrass to be an invasive weed as it can invade moist (wetland) areas. However, it is already well-established in moist areas on the property, so the "threat" of invasion is moot. When property ownership is transferred to State Parks (as planned), the State may choose to undertake an eradication program if the presence of Hardinggrass is thought to diminish the property's resource values. For now, weed control efforts would be better spent on species whose spread might actually be controllable, such as medusahead.

Grazing Infrastructure and Access — There are no cross fences on the property nor are there boundary fences along the north and northwestern property lines. The condition and extent of boundary fencing in other areas is not known. Presumably, cattle moved on to the property would stay on-site because most of the grasslands are surrounded by forest, which is not an appealing environment for cattle and therefore, would not attract them away from the grasslands. The only temptation to leave the property might be at the northern edge, above the Upper Pasture, where grasslands continue onto the adjacent property. However, this area is extremely steep and may not be accessible to cattle. Alexa Wood stated that there is plenty of water for livestock from four good springs, but that new troughs are needed.

Historically, livestock access has been via the Calabazas Creek canyon. Cattle have been driven up the canyon from the southern part of the property. Because the road by the creek may not be maintained on a regular basis, this may or may not remain a feasible access route. If not, permission to enter via "Parcel C"6 from Nelligan Road should be sought. Either way, interested livestock producers should evaluate the access routes and decide which is best.

5 Experimental methods for controlling medusahead with grazing are outlined in the Grazing Management Plan for the Jacobs Ranch, January 2005, by Lisa Bush.

6 Parcel C is under private ownership and the District has access rights through the property although the number of annual trips allowed is limited.

MANAGEMENT RECOMMENDATIONS

The Beltane Ranch grasslands should be grazed by cattle seasonally from about February through June for the following reasons:

1. To provide a disturbance regime to increase grassland biodiversity[7];
2. To support Sonoma County agriculture by making District properties available for productive use by farmers and ranchers;
3. To maintain a historical use that has been a part of the property's history for many decades.
4. Cattle are the most appropriate type of livestock because sheep would be killed by predators and other species are not as well-suited to the task of consuming herbaceous biomass.

A February through June grazing season should provide an adequate level of disturbance, prevent thatch buildup, and create openings in the grassland canopy for small statured plants. However, this season can be adjusted based on the needs of the grazing lessee, annual weather conditions and resultant and forage production. Cattle should remain on the property until the grassland vegetation and soils have dried up enough that vegetation will not regrow. The property should be able to support approximately 10 animal units8 (AUs)9 for five months (February through June) in an average year. This number should be adjusted as needed in years with exceptionally high biomass production or in drought years.

Limitations to a potential grazing program include:

1. Lack of grazing infrastructure especially water developments10;
2. Limited acreage, steep terrain, relatively low forage production, and potentially difficult access, may mean that it isn't "worth it" for a livestock producer to bring cattle on-site.

Weedy species should be controlled, as resources permit, to maximize forage quality and native species diversity.

IMPLEMENTATION

The following steps should be taken to implement a grazing program in 2006:

1. Summer 2005 — Contact potential lessees to assess their interest in utilizing the property.
2. Summer/Fall 2005 — Potential lessee(s) should examine site access and infrastructure to determine feasibility of grazing. This could be facilitated by District staff or with the help of Alexa Wood.
3. Fall/Winter 2005 — Repair water sources so that they are operational before animals are brought in.
4. Winter 2005/2006 — Develop lease or other agreement between District and cattle operator.
5. Early Spring 2006 — Bring animals to site.
6. Early Summer 2006 — Take animals off when herbaceous vegetation is grazed down to the desired level.

7 Although cattle are not native animals and their grazing pattern does not mimic that of native grazers, they do provide a regular disturbance regime that is a necessary part of a dynamic grassland ecosystem. Many of the grassland species on the property are introduced annuals, which are more competitive and productive than native species. They produce copious amounts of biomass which requires management.

8 Assuming an average of 1,000 pounds of available forage per acre (this is high for some areas and low for others), each AU would require 5 acres for 5 months. If 50 acres are actually grazable, then 10 animals could be supported for 5 months. This number should be considered a "ballpark" estimate and the actual stocking rate should be established based on annual conditions.

9 A 1,000-pound animal or equivalents based on weight.

10 Maintaining or re-establishing the watering sources that were historically used can remove this limitation.