LAKE LOS CARNEROS
RESTORATION MASTER PLAN

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PROJECT OVERVIEW

PURPOSE

The purpose of this project is to support native biodiversity and build resistance to disturbances like wildfires, increased prevalence of non-natives, and species competition in the grasslands spanning the northeastern and southeastern quadrants of Lake Los Carneros. We also aim to increase soil stability by removing non-native plants and restoring California native plant communities.

By the end of summer 2026, we will meet the following objectives:

1. Restore 20 acres of the grassland by establishing native cover of at least 60% in grasslands and reduce non-native cover to <10%.
2. Reduce thatch cover in grasslands to 15% through prescribed burning.
3. Increase native species richness to 7 native species per acre and decrease non-native richness to 3 species per acre.
4. Strengthen community relationships and recreation around the grasslands by installing 10 infographics and educational signs around the project site and popular trails.
5. Increase native shrub cover to 60% around popular trails to increase aesthetic appeal and reduce human disturbance on the interior grassland.

USE POLICY

This project occurs within the city of Goleta and the recreational open spaces in the city, allowing designated land for preserving natural resources while maintaining areas for recreation. Public access during the restoration process will be restricted to designated areas using fencing and signage to limit any undesirable impacts from dogs and other human-related recreational activities. Work vehicles, local or state park official vehicles, fire trucks, and restoration machinery will be the only vehicles allowed to enter the restoration site via a single entry and exit point. Southern California Edison has a right to enter the area for power poles or any necessary electrical construction. All other cars or vehicles unrelated to restoration will be prohibited from entering the designated work area.

PERMITTING

Following the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA), an environmental impact assessment will be conducted to understand the potential impacts of the restoration efforts.

Permits will be needed to conduct controlled burning across Lake Los Carneros during low-fire-risk seasons. These will be issued by the Santa Barbara County Fire Department and State and Local Responsibility Areas. Their input dictates the best time of day and season to burn to prevent an unwarranted wildfire. To get this permit, the SBC Fire Department branch 14 will be contacted. The fire department and the Air Pollution Control District work closely together to

find out the best days for controlled burns, so contact with the SBC Air Pollution Control District may also be necessary.[1]

SITE INVENTORY AND ANALYSIS

REGIONAL CONTEXT

Location Description

Lake Los Carneros was originally a small natural wetland located in the heart of Goleta, California, at 34.4421994°N, -119.8487252°W. It is a Santa Barbara County open space, managed by the city of Goleta, and surrounded by residential neighborhoods, agriculture fields, and Highway 101. Historically, the small pond was known for having little to no open water during summer months and was commonly filled with aquatic plants for the rest of the year. Now a large, open natural preserve, the area provides substantial bird habitat with its large lake and rolling meadows, accompanied by groves of eucalyptus trees, and sparsely of oaks and pines. Meandered by trails and other infrastructure, the site also includes family attractions such as the Stowe House and South Coast Railroad Museum.

Land Use History

Historical records have repeated references to fire-prone grassland areas along the coastal plain, which naturally encourages the germination and growth of seeds for food. It is likely that some areas in and around the project site were formerly native perennial bunchgrasslands and may have experienced intended burning before.[2] However, in 1792, Spanish Governor Arrillaga outlawed traditional burning as a land management process, and traditional Indigenous burns have not occurred in the Santa Barbara region for hundreds of years.[3]

After Goleta Valley was developed in 1821, displacing the Indigenous Chumash people, land was granted to create ranches.[4] In 1871, 1,043 acres of land was purchased by William Whitney Stow to create La Patera Ranch. Some of this land now makes up Lake Los Carneros. The land was cleared of oak trees to create room for crops, starting out as a tobacco ranch but failed early due to climate. 30 acres of lemon orchard were planted in this area after the failure of tobacco, which became a popular success. Remaining lemon orchards still exist near the area.

A dam was raised on the lake, impounding water and creating other permanent reservoirs, expanding the formerly small wetland which was seasonally connected to the Goleta Slough. This required 35,000 cubic yards of soil to be imported to the area. In addition to orchards, cattle and horse grazing also occurred.

In 1960, plans to convert La Patera Ranch from agriculture to residential tracts began. The land surrounding the lake was set aside to be transformed into a golf course, but the plans fell through, and the land remained undeveloped. In 1974, 153 acres of land around the lake were sold to Santa Barbara County for use as a regional park. In 1987, a Master Plan was adopted to preserve the lake and land as wildlife habitat and recreational open space.[5]

Since the adoption of the Master Plan, a formal trail system has been established, native trees have been planted, water quality has been monitored, and certain recreational activities have been limited. The lake itself is subject to seasonal eutrophication due to low water levels and runoff from nearby agricultural areas, facilitating fish kills.[6]

Climate

Lake Los Carneros has a Mediterranean climate, with cool wet winters (average 52.6 °F and 10.40 inches of precipitation) and hot dry summers (average 64.7 °F and 0.22 inches of precipitation).[7] This area is influenced by marine winds from the Pacific Ocean. This site occurs between 30 and 90 feet in elevation, with the average elevation being around 60 feet above sea level.[8]

Geology

Lake Los Carneros is made up almost entirely from upper Pleistocene intermediate alluvial deposits, fanning from the Santa Ynez Mountains. The geology of this area is largely characterized by weakly-consolidated sand, silt, and pebble gravel and smaller, well-rounded clasts of marine sandstone (Figure 2). The soil consists of fine sandy loams, with varying levels of slope and erosion, allowing for good drainage and balanced levels of nutrients and moisture. The majority of erosion occurs around the lake itself, with steep slopes between 15 and 30%. The soil profile is poorly to moderately developed and are generally shallow. [9]

Vegetation

Comprising the diverse landscape, mixed evergreen woodland, grassland, and coastal scrub habitats commonly riddle the area. According to observations from iNaturalist, there are over ninety species of plants at the preserve, mostly introduced species, whereas there is one known threatened species - the valley oak (*Quercus lobata*) - and one endemic species - the rough cocklebur (X*anthium strumarium*). The vast majority of plant communities at the natural preserve are grasslands and woodlands containing common species such as perennial ryegrass (*Lolium perenne*), great brome (*Bromus diandrus*), and common wild oat (*Avena fatua*), and coast live oak (*Quercus agrifolia*), pacific poison oak (*Toxicodendron diversilobum*), and american sycamore (*Platanus occidentalis*), respectively. Another common plant community that is important to the ecosystem includes the riparian marshland; water smartweed (*Periscaria amphibia*), pacific poison oak (*Toxicodendron diversilobum*), and California bulrush (*Schoenoplectus californicus*).[10]

Disturbance

Lake Los Carneros has been historically disturbed since cultural burnings were outlawed in the area in the early 19th century.[3] The acquisition of the land in 1871 and cutting down the oak woodland for farmland had transformed the ecology of the area.[4] A few oak woodland pieces remain, but the fragmented state makes the community unstable. Fragmented habitat increases the probability of inbreeding depression and overcrowding/overconsumption of resources. In combination with fire prevention, this sort of habitat change has made Lake Los Carneros and surrounding areas prone to crown fires.

The Lake Los Carneros Dam changed the previous seasonal “duck pond” into a year-round lake. This change was done to interrogate water for human use, but it also caused a permanent change in habitat. Seasonal wetlands or vernal pools host annual plant species endemic to the specific habitat system, and changing this system has resulted in the disappearance of such species.[11]

Human recreational disturbances include fishing, soil compaction from foot traffic on hiking trails, plant picking, and litter.[12] Soil compaction is a major concern due to its effects on topography and soil condition. Plants cannot grow on compacted soil, which poses an issue with restoration. Many California wildflowers are forbidden to be picked by law, however this still poses an issue within areas with high human traffic. Litter, especially food litter, has attracted many animal species naturalized by human occupation, such as crows and raccoons.

The area is surrounded by an urban area and is isolated from other natural systems. Urban areas can continuously introduce non-native grasses into restored areas.

Map of the Site

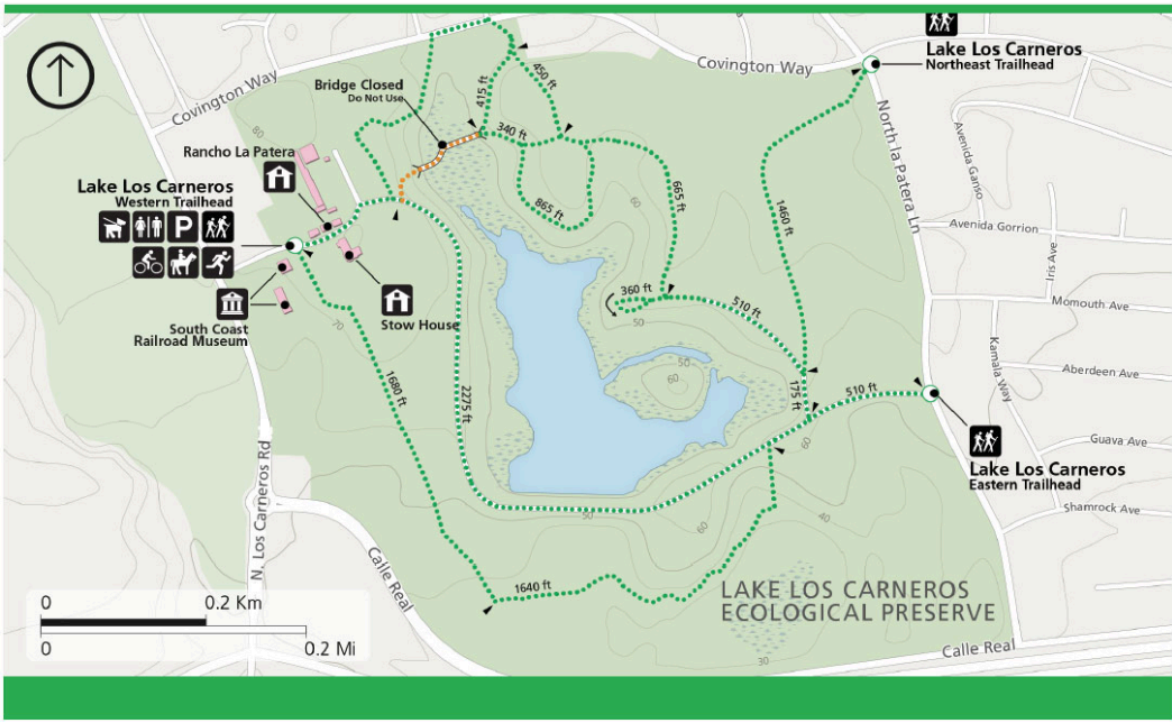

Figure 1. General site features of Lake Los Carneros; trails and elevation.[13]

Figure 2. Site map with areas marking different soil types. From Web Soil Survey.[14]

SITE VISIT

Figure 3. Selfie of our team at Lake Los Carneros. Members from left to right: Ryan Tang, Shelby Jarrett, Madison Lam, and Aidan Robertson

Inventory Methods

We conducted the site visit on April 28, 2024 - an adequate time for plants to be in bloom and for animals to forage. We surveyed for a total of approximately three hours, in which we observed various habitats within Lake Los Carneros. We identified four plant communities to conduct transects in: oak woodland, invasive grassland, eucalyptus grove, and riparian marsh (Figure 4). These were identified by changes in microclimate and presence of characteristic plants. For the oak woodland, this plant community was located at a lower elevation than the rest of the project site, and many coast live oaks (*Quercus agrifolia*) were present and, similarly, the eucalyptus grove was identified through the presence of many eucalyptus trees (Tables 1 and 3). The grassland was identified through the lack of many shrubs or trees on fairly flat ground, and the presence of many invasive grasses (Table 2). The riparian marsh was identified due to its proximity to the lake, lower elevation, and the presence of marshland plants (Table 4). In each of these plant communities, we conducted a 20-meter intercept transect to record each plant that occurred at each meter of the transect and recorded the substrate. Additionally, at each location, we took note of soil type, topography, microclimate, and any influence of water on the community, taking photos for reference (Figures 6, 7, 8, and 9). We also recorded occurrences of animals and human activities that were being conducted, taking notes on evidence of disturbance, landscape descriptions, and habitat types.

Topography

Lake Los Carneros is mostly flat, with slight dips in elevation beyond where the lake and oak woodland are. The topographic profile was measured using the Ruler Path Tool in Google Earth Pro. Using a point centered at the southeast most end to the northwest most end, the site's elevation profile has an average slope of 5.4% and a max slope of 24% (Figure 5). The elevation of the oak woodland area is slightly lower than the rest of the site, so water is able to catch there. Like most of Goleta, it sits on a coastal plain. The site is about 4,000 meters from the Santa Ynez mountain range.

Microclimate

The microclimate of the project site varies between plant communities around the lake. Grassland communities have few to no tall trees or shrubs, so these areas are exposed to direct sunlight for the majority of the day. In contrast, oak woodland communities have coast live oak canopies, among other taller trees, which provide shade throughout the day, decrease temperatures slightly, and hold onto water. A similar microclimate is found in the marshy riparian communities that surround the lake on most sides. Eucalyptus groves provide shade but do not maintain the moisture that the oaks do, creating a drier environment. Each of these plant communities receives differing amounts of sunlight and wind and retains moisture differently.

Soils

The most common soil type at Lake Los Carneros was fine or gravel sandy loam, like most of central Goleta. Places by the water's edge possibly have high phosphorus from influence by Bermuda buttercup (*Oxalis pes-caprae*) due to oxalic acid in these plants (Figure 9.).

Sandy soils cannot hold water as well, so the soil stays dry. Much of the soil present in the project site was drained from water and presented high runoff, such as in the oak woodland area with the remains of a creek from a previous rain event. According to previous soil surveys in the area, topography around the lake has been eroded. Erosion in this area indicates possible compaction from human overuse or effects of normal flooding events. Alongside erosion, heavy compaction was observed during the site visit, where it was clear that trails all around the site are compacted due to human activities such as biking and hiking, removing topsoil (Figure 6.4). Most soil in transect locations was covered in decomposing plant material and annual grass thatch.

Hydrology

Lake Los Carneros does not appear to be connected to any river system from the mountains to the ocean, although it used to be a natural wetland.[15] The majority of water coming into Lake Los Carneros is sourced from seasonal rainfall (around 10 inches in the winter). The lake has a depth of 19 ft and creates a marsh-like habitat for the plants and animals.

Marshes usually form at the shallow edges of lakes and rivers. They are typically characterized by herbaceous plants such as grasses, rushes, or sedges while small shrubs lining the perimeter show a transition to higher land elevations. These factors strongly characterize the margins of the lake and a few other areas in the park.

Small seasonal creeks have been observed to form in places such as the oak woodlands where elevation is slightly lower (Figure 5). Similarly, steep slopes and wet soil at lower elevations near the lake are indicative of erosion and infiltration of water into the ground.

The grassland and eucalyptus grove have dry, compacted soil, revealing reduced water infiltration. This would mean that rainwater moves down the slope and into the lake, resulting in seasonal flooding. This may become a concern when treating sites at higher elevations, specifically with pesticides or with the movement of soil.

Factors that contribute to the marsh-like areas of the lake are seasonal rainwater floods, a lower lake elevation that collects water from surrounding higher elevation areas like the grasslands and eucalyptus grove (Figure 5), and occasional urban runoff from pesticides or herbicides that can lead to eutrophication (algal growth) around the perimeter.[16]

Fauna

Birds are very abundant at Lake Los Carneros. Waterfowl such as mallards (*Anas platyrhynchos*) and American coots (*Fulica americana*) often forage in the lake as well as shorebirds in the genus *Larus*. Passerines such as the California towhee (*Melozone crissalis*), house finch (*Haemorhous mexicanus*), California scrub jay (*Aphelocoma californica*), song

sparrow (*Melospiza melodia*), and the red-winged blackbird (*Agaelius sp.*) are very common here. Other birds including the American crow (*Corvus brachyrhyncos*), cliff swallow (*Petrochelidon pyrrhonota*), and the wrentit (*Chamaea fasciata*) are also common residents.

Reptiles are not very common at the site, but lizards such as the Western fence lizard (*Scleroporus occidentalis*) were the most encountered, with many of them being heard rustling through the detritus in the oak woodland or basking on rocks and trails. The Southwestern pond turtle (*Actinemys pallids*) also inhabits the lake but is seldom seen. Beetles such as the dentate stink beetle (*Eleodes dentipes*), the wooly darkling beetle (*Eleodes acuticauda*) (Figure 8) and Coccinellidae species were commonly observed as insect diversity. Throughout the landscape, species of Hymenoptera, Diptera, Hemiptera, and Odonata were apparent. Evidence of arachnids, specifically Araneidae, were most abundant in the woodland habitats.

Mammals seen at this site were mostly California ground squirrels (*Otospermophilus beecheyi*), dusky-footed woodrats (*Neotoma fuscipes*), Botta's pocket gophers (*Thomomys sp.*), and Western brush rabbits (*Sylvilagus bachmani*) either by direct observations or evidence of nests.

The fauna seen at this site are as expected in such a natural preserve. Additionally, opportunistic species such as *C. brachyrhynchos* and *Larus spp.* have become increasingly abundant in the area, where they historically weren't, due to close association with human occupancy.

Flora

The dominant plant community at Lake Los Carneros appears to be grasslands which contain mostly non-native annual grasses and perennial forbs. The most common grasses that inhabit the area include common wild oat (*Avena fatua*), great brome (*Bromus diandrus*), and perennial ryegrass (*Lolium perenne*), riddled by weeds and forbs such as scarlet pimpernel (*Anagallis arvensis*), black mustard (*Brassica nigra*), and wild radish (*Raphanus raphanistrum*) (Table 2).

Among the abundant invasive plant species, there are also sparsely distributed native woody vines and shrubs which include the perennials: coast morning glory (*Calystegia macrostegia*), coyote brush (*Baccharis pilularis*), and toyon (*Heteromeles arbutifolia*).

Mixed evergreen woodlands and oak woodlands comprise other large portions of the area. These woodlands consist of both native and non-native trees which include coast live oak (*Quercus agrifolia*), American sycamore (*Platanus occidentalis*), and white gum eucalyptus (*Eucalyptus scoparia*). Below these canopies, grasses and forbs inhabit the understory such as common wild oat (*Avena fatua*), bristly oxtongue (*Helminthotheca echioides*), western ragweed (*Ambrosia psilostachya*) (Tables 1 and 3).

At a lesser scale, the coastal scrub plant community is sparsely distributed throughout the landscape, which houses mostly invasive species such as grasses and weeds but also contains minimal native woody shrubs. Of the introduced species, common wild oat (*Avena fatua*) and sea

figs (*Carpobrotus edulis*) comprise much of the biomass but native coyote brush (*Baccharis pilularis*) and California sagebrush (*Artemisia californica*) are found here too (Table 4).

Cultural Resources and Human Use

As Lake Los Carneros is a public-use recreation area, and is connected to the Goleta Stow House and South Coast Railroad Museum, it is frequented by many people and families for recreational activities like walking, biking, fishing, and picnicking. Dogs are allowed on the site, but must be kept on leash. There are asphalt roads, fences, trails, and benches throughout the project site. The walkable trails are very compacted, as bikers often go through the area (Figure 7). Additionally, a small encampment was observed close to the lake.

Sensitive Resources

Fresh water from the lake is a sensitive resource, as many plants and animals depend on it for drinking. It is also an essential part of their habitat and life history (reproduction, development, and survival). The lake's only source of water comes from the rain, which is around 10 inches over the course of the winter and around 1/4 an inch during the summer months.

No sensitive species, flora or fauna, were observed during the site visit. However, past site assessments have observed various insects, amphibians, reptiles, birds, and mammals, including monarch butterflies.[5] Monarch butterflies (*Danaus plexippus*) have been known to visit the eucalyptus trees, labeling Lake Los Carneros as an overwintering site. Monarchs are considered a sensitive species due to habitat loss, pesticide use, and climate change, which has notably reduced their population.

Table 1. Plant species from site inventory transect in Oak Woodland.

Meter Mark	Species List (Scientific name)	Substrate
1	*Rubus ursinus,* grass sp., *Platanus occidentalis*, *Geranium carolinianum*	Detritus
2	*Rubus ursinus,* grass sp., *Platanus occidentalis*, *Geranium carolinianum*	Detritus
3	*Rubus ursinus, Platanus occidentalis, Populus balsamifera, Geranium carolinianum*	Detritus
4	*Grass sp., Platanus occidentalis*	Detritus
5	*N/A*	Detritus
6	*Quercus agrifolia, Cenchrus ciliaris*	Soil
7	*Quercus agrifolia, Helminthotheca echioides*	Soil

8	*Quercus agrifolia*	Soil
9	*Quercus agrifolia, Salvia mellifera, Populus balsamifera*	Soil
10	*Quercus agrifolia*	Soil
11	*Quercus agrifolia*	Soil
12	*Quercus agrifolia*	Soil
13	*Baccharis halimifolia, Quercus agrifolia, Rubus ursinus*	Detritus
14	*Quercus agrifolia*	Mulchy soil
15	*Quercus agrifolia, Populus balsamifera*	Mulchy soil
16	*Quercus agrifolia, Salix lasiolepis*	Mulchy soil
17	*Quercus agrifolia, Salix lasiolepis*	Mulchy soil
18	*Quercus agrifolia, Salix lasiolepis*	Mulchy soil
19	*Salix lasiolepis*	Mulchy soil
20	*Baccharis pilularis*	Mulchy soil

Table 2. Plant species from site inventory transect in Grassland.

Meter Mark	Species List (Scientific name)	Substrate
1	*Plantago lanceolata, Avena fatua*	Thatch
2	*Calystegia macrostegia, Avena fatua, Plantago lanceolata*	Thatch
3	*Heteromeles arbutifolia, Calystegia macrostegia*	Thatch
4	*Heteromeles arbutifolia, Avena fatua, Calystegia macrostegia, Raphanus raphanistrum*	Thatch
5	*Raphanus raphanistrum, Avena fatua*	Thatch
6	*Avena fatua, Erodium sp., Erodium cicutarium*	Thatch
7	*Raphanus raphanistrum, Avena fatua, Bromus sp.*	Thatch
8	*Avena fatua*	Thatch
9	*Anagallis arvensis, Brassica nigra, Raphanus raphanistrum, Weed sp.*	Thatch
10	*Bromus diandrus, Brassica nigra*	Thatch
11	*Grass sp., Brassica nigra, grass sp.*	Thatch
12	*Anagallis arvensis, Brassica nigra, Vulpia myuros, Quercus agrifolia, Rumex crispus*	Thatch

13	*Rumex crispus*	Thatch
14	*Rumex crispus, Avena fatua, Pseudognaphalium leucocephalum*	Dry thatch
15	*Vulpia myuros, grass sp., Raphanus raphanistrum*	Dry thatch
16	*Avena fatua*	Dry thatch
17	*Lolium perenne, Avena fatua*	Dry thatch
18	*Raphanus raphanistrum*	Dry thatch
19	*Raphanus raphanistrum*	Dry thatch
20	*Lolium perenne, Avena fatua*	Thatch

Table 3. Plant species from site inventory transect in Eucalyptus Grove.

Meter Mark	Species List (Scientific name)	Substrate
1	*Quercus agrifolia, Heteromeles arbutifolia, Lolium perenne*	Dried eucalyptus leaves
2	*Eucalyptus scoparia, Avena fatua, Ambrosia psilostachya*	Dried eucalyptus leaves
3	*Eucalyptus scoparia, Avena fatua, Ambrosia psilostachya*	Dried eucalyptus leaves
4	*Eucalyptus scoparia, Lolium perenne, Avena fatua*	Dried eucalyptus leaves
5	*Eucalyptus scoparia, Lolium perenne, Avena fatua, Ambrosia psilostachya, Torilis nodosa*	Dried eucalyptus leaves
6	*Eucalyptus scoparia, Lolium perenne, Avena fatua, Ambrosia psilostachya, Torilis nodosa*	Dried eucalyptus leaves
7	*Eucalyptus scoparia, Avena fatua*	Dried eucalyptus leaves
8	*Eucalyptus scoparia, Avena fatua*	Dried eucalyptus leaves
9	*Eucalyptus scoparia, Avena fatua*	Dried eucalyptus leaves
10	*Eucalyptus scoparia, Avena fatua, Carduus pycnocephalus*	Dried eucalyptus leaves
11	*Eucalyptus scoparia, Avena fatua, Anagallis arvensis*	Dried eucalyptus leaves

12	*Eucalyptus scoparia, Avena fatua*	Dried eucalyptus leaves
13	*Eucalyptus scoparia, Avena fatua, Heteromeles arbutifolia*	Dried eucalyptus leaves
14	*Eucalyptus scoparia, Avena fatua, Heteromeles arbutifolia, Plantago lanceolata*	Dried eucalyptus leaves
15	*Eucalyptus scoparia, Avena fatua, Heteromeles arbutifolia, Plantago lanceolata*	Dried eucalyptus leaves
16	*Eucalyptus scoparia, Bromus diandrus*	Dried eucalyptus leaves
17	*Eucalyptus scoparia*	Dried eucalyptus leaves
18	*Eucalyptus scoparia, Trifolium sp.*	Dried eucalyptus leaves
19	*Eucalyptus scoparia, Vicia sativa*	Dried eucalyptus leaves
20	*Eucalyptus scoparia*	Dried eucalyptus leaves

Table 4. Plant species from site inventory transect in Riparian Marsh.

Meter Mark	Species List (Scientific name)	Substrate
1	*Salix sp., Carex sp.*	Marsh
2	*Salix sp., Carex sp.*	Marsh
3	*Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
4	*Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
5	*Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
6	*Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
7	*Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
8	*Grass sp., Toxicodendron diversilobum, Carex sp., Oxalis sp., Salix sp.*	Marsh
9	*Quercus agrifolia, Carex sp., Toxicodendron diversilobum, Salix sp.*	Marsh
10	*Carex sp., Salix sp., Baccharis pilularis*	Marsh

11	*Carex sp., Baccharis pilularis, Oxalis sp.*	Marsh
12	*Persicaria amphibia, Carex sp., Baccharis pilularis*	Marsh
13	*Persicaria amphibia, Oxalis sp.*	Marsh
14	*Baccharis pilularis, Carex sp., Persicaria amphibia*	Marsh
15	*Palm sp., Baccharis pilularis, Carex sp., Persicaria amphibia*	Marsh
16	*Carex sp., Periscaria amphibia*	Marsh
17	*Carex sp., Periscaria amphibia*	Marsh
18	*Carex sp., Periscaria amphibia*	Marsh
19	*Carex sp., Periscaria amphibia*	Marsh
20	*Carex sp., Periscaria amphibia*	Marsh

Table 5. All species observed per habitat, categorized by native or non-native.

Oak Woodland	**Native Species**	**Non-Native Species**
	Pacific Blackberry (*Rubus ursinus)*	Grass spp.
	American Sycamore (*Platanus occidentalis)*	Buffel Grass (*Cenchrus ciliaris)*
	Carolina Geranium (*Geranium carolinianum*)	Oxtongue (*Helminthotheca echioides)*
	Coast Live Oak (*Quercus agrifolia*)	Eastern Baccharis (*Baccharis halimifolia)*
	Black Sage (*Salvia mellifera)*	
	Western Cottonwood (Poplar) (*Populus balsamifera)*	
	Arroyo Willow (*Salix lasiolepis)*	
	Coyote Brush (*Baccharis pilularis)*	
Grassland	**Native Species**	**Non-Native Species**
	Coast Morning Glory (*Calystegia macrostegia)*	Ribwort Plantain (*Plantago lanceolata*)
	Toyon (*Heteromeles arbutifolia)*	Avena Oat (*Avena fatua)*
	Erodium (*Erodium macrophyllum)*	Wild Radish (*Raphanus raphanistrum)*

	Coast Live Oak (*Quercus agrifolia*)	Erodium (*Erodium cicutarium)*
	White Rabbit-tobacco (*Pseudognaphalium leucocephalum)*	Great Brome (*Bromus spp.)*
	California cudweed (*Pseudognaphalium californicum)*	Ripgut Brome (*Bromus diandrus)*
		Assorted Grasses (*Grass sp.)*
		Black Mustard (*Brassica nigra)*
		Scarlet Pimpernel (*Anagallis arvensis)*
		Rat's tail fescue (*Vulpia myuros*)
		Curly dock (*Rumus crispus)*
Eucalyptus Grove	**Native Species**	**Non-Native Species**
	Coast Live Oak (*Quercus agrifolia*)	Perennial Ryegrass (*Lolium perenne)*
	Toyon (*Heteromeles arbutifolia)*	Avena Oat (*Avena fatua)*
	Common Ragweed (*Ambrosia psilostachya)*	White gum eucalyptus (*Eucalyptus scoparia)*
	Bearded clover (*Trifolium sp.)*	Knotted hedge parsley (*Torilis nodosa)*
		Italian thistle (*Carduus pycnocephalus)*
		Scarlet Pimpernel (*Anagallis arvensis)*
		Ribwort Plantain (*Plantago lanceolata*)
		Ripgut Brome (*Bromus diandrus)*
		Common Vetch (*Vicia sativa)*
Riparian Marsh	**Native Species**	**Non-Native Species**
	Arroyo willow (*Salix spp.)*	Bermuda buttercup (*Oxalis*

		pes-caprae)
	Harford sedge (*Carex spp.)*	Grass sp.
	Pacific Poison oak (*Toxicodendron diversilobum)*	Palm sp.
	Coyote brush (*Baccharis pilularis)*	
	Coast Live Oak (*Quercus agrifolia*)	
	Smartweed (*Persicaria amphibia)*	

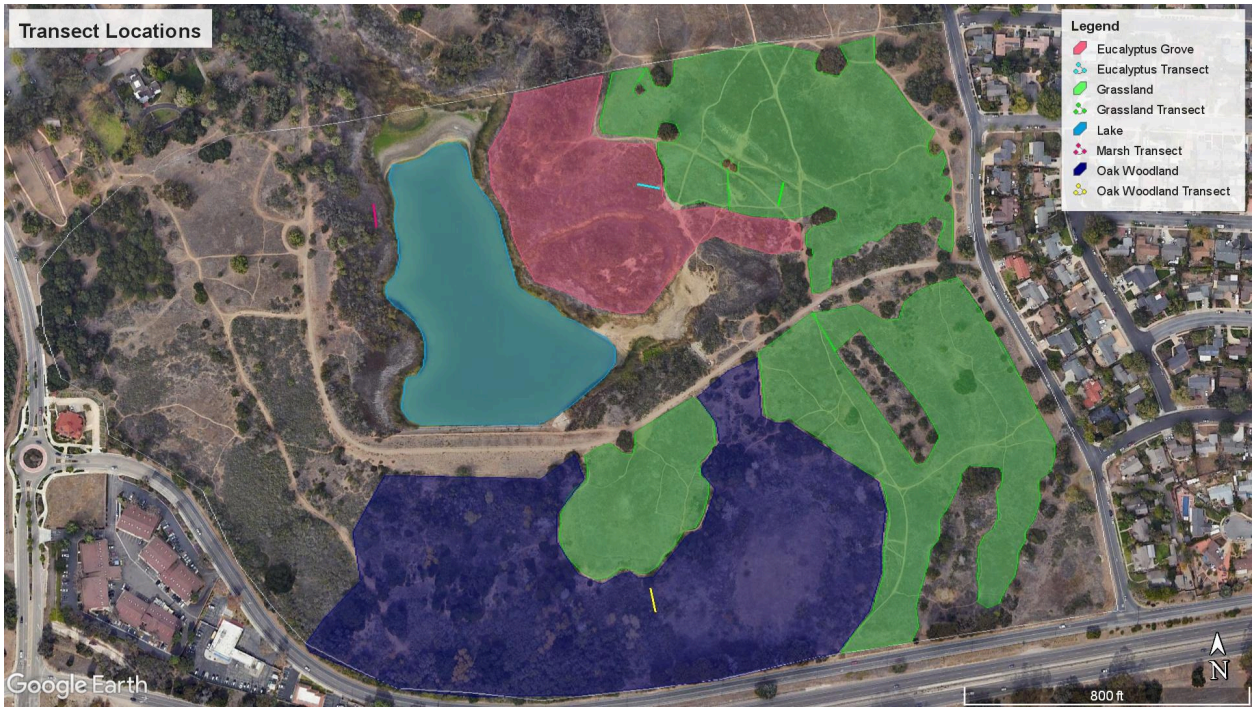

Figure 4. Location of transects used to assess plant cover, hydrology, and microclimate.

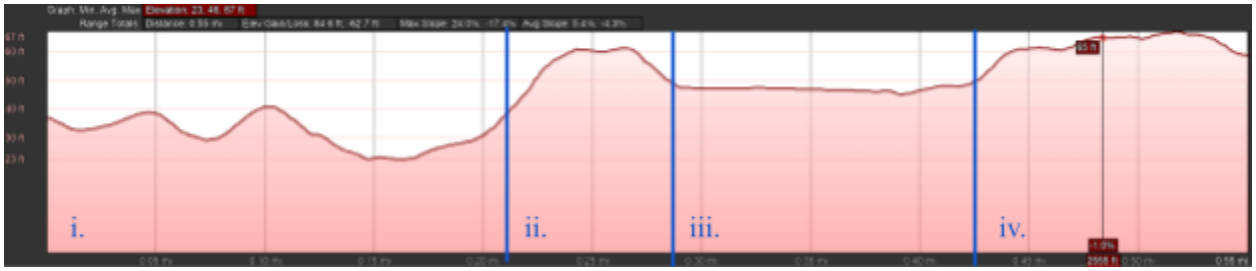

Figure 5. Elevation profile of the site, extending from the southeast corner to the northwest corner. Area i. shows the elevation in the oak woodland, areas ii. and iv. depict the elevation in grassland habitat, and area iii. shows the elevation of the lake itself. From Google Earth Pro.

Figure 6. Oak Woodland

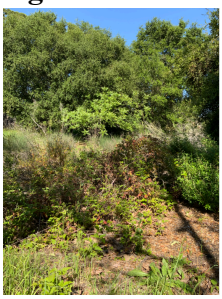


Figure 6.1 Variances in height and biodiversity of plants in the Oak Woodland
Figure 6.2 Viny poison oak (*Toxicodendron diversiloba)* in the understory of Coast live oak (*Quercus agrifolia),* American Sycamore (*Platanus racemosa),* and Western Cottonwood Poplar (*Populis balsamifera)*.
Figure 6.3 Soil erosion from a small, seasonal creek.
Figure 6.4 Trail impacted by soil compaction from bikers and other recreational activities.

Figure 7. Grassland


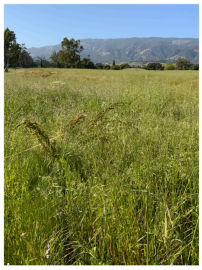


Figure 7.1 Transect through Grassland, featuring many invasive grasses like Rat's Tail Fescue (*Vulplia myuros)*, Wild Oat (*Avena fatua),* and Great Brome (*Bromus spp.)*
Figure 7.2 Side view of transect, not much height and very little species variation
Figure 7.3 Aidan and Ryan taking notes on the few native species present: Toyon (*Heteromeles arbutifolia)* and Coast Morning Glory (*Calystegia macrostegia)* among others.
Figure 7.4 Shocking array of invasive Wild Mustard (*Brassica nigra)* and Wild Radish (*Raphanus raphanistrum).*
Figure 7.5 UCSB Lagoon, an example of a healthy grassland/chaparral meadow, with an abundance of California Poppy (*Eschscholzia californica),* Silver Lupine (*Lupinus arboreus),* and Coyotebrush (*Baccharis pilularis)*. This is our ideal end goal for what the restored grassland should look like.

Figure 8. Eucalyptus Grove

Figure 8.1 Wooly Darkling Beetle (*Eleodes acuticauda*) observed near the Eucalyptus Grove.
Figure 8.2 White gum eucalyptus (*Eucalyptus scoparia*), a seasonal home for migrating Monarch Butterflies.
Figure 8.3 Compacted dirt path with bench leading to shaded Eucalyptus Grove.

Figure 9. Riparian Marsh Area

Figure 9.1 *Persicaria amphibia* surrounded by an abundance of *Oxalis pes-caprae* in the Riparian Marsh area
Figure 9.2 Wide photograph of Riparian Marsh Area surrounding the freshwater lake, featuring *Palm spp*. and Smartweed (*Persicaria amphibia)*
Figure 9.3 Riparian Marsh Area, home to American Coots (*Fulica americana)*, Mallards (*Anas platyrynchos),* Harford Sedge (*Carex spp.),* and other species.

JUSTIFICATION AND SOLUTIONS

CHALLENGES AND OPPORTUNITIES FOR RESTORATION

Challenges

I. The lake serves as a critical habitat for fish, waterfowl, and indirectly the rest of the ecosystem at the site. Chemical contamination can affect water quality like nitrate content and pH which can cause algae blooms in the water body. Algae blooms can cause mass die-offs in the lake, affecting the fish and bird populations as well as the rest of the ecosystem at Lake Los Carneros.

II. Grasslands at Lake Los Carneros make up around 20 acres of the project site, so any restoration efforts must be scaled up over a large swath of land. The large amount of invasives may pose an issue to the various types of treatments that can be implemented, as well as their costs. This also has implications on the neighboring communities and infrastructure that are susceptible to the processes of large-scale treatments - burns, heavy machinery, herbicides - which can affect them substantially.

III. The grassland area has experienced moderate levels of soil compaction, making the ground impenetrable for longer roots and prevents water infiltration and retention. The minimal pore space within the soil prevents deeper-rooted native plants from establishing. Shallow-rooted invasive grasses are still able to germinate. This is a result of the differences in water availability at the surface and at certain depths, which can preferentially recruit non-native species over native species.

Opportunities

I. The oak woodland has a larger population of native species in comparison to other plant communities on the site. The presence of water apart from the lake appears to vary seasonally, with streams present at lower elevated areas during the wet season which dry out in hotter seasons. The oak woodland is a thriving plant community and is not in need of intense restoration compared to more disturbed locations like the grassland. We emphasize more disturbed and impacted locations at Lake Los Carneros to restore in our project.

II. Designated trails and paved roads restrict human activity around the landscape to a minimal area. They serve as barriers against soil compaction, trampling, and litter away from wildlife. Proper signage, fencing, and adequate space between visitors and restoration activities may be necessary to ensure no further disturbance during and/or after the events have taken place. Nevertheless, human activities will not be affected by areas in need of burns or grazing, as there are appropriate locations designated for recreation at Lake Los Carneros.

III. The eucalyptus grove provides habitat for several sensitive resources such as various bird species (herons, raptors, and woodpeckers) and monarch butterflies. The eucalyptus is

invasive to our project site, but are useful resources for the aforementioned taxa. Monarch butterflies roost in these trees during their migratory season (November-February) and their larvae feed on their leaves to sequester their toxic compounds. Similarly, throughout Winter and into Spring, great blue herons, great egrets, great-horned owls, and acorn woodpeckers utilize this community for nesting purposes and to rear young. Due to these benefits to our wildlife today, the grove will not be taken down in our restoration plan.

Addressing Site Challenges

I. Due to the lake's presence and position down slope from the rest of the site, herbicides will be avoided entirely. Use of herbicides near a freshwater ecosystem increases the risk of runoff of those chemicals into the lake itself, which would lead to negative impacts on lake ecology. Use of herbicide was left out in our restoration project to avoid contamination.

II. A large, controlled burn will be implemented across the grassland habitat (avoiding existing woody shrubs and trees in the area) to reduce the non-native vegetation and built up thatch. This will help to restore an ecosystem in an area where fire has been suppressed. Clearing the grassland of overgrowth and thatch will free up space for the succession of native plants thereafter. Following this, a grow-kill strategy will be implemented to mitigate seeds in the seedbank that the fire is unable to manage. Additionally, as the grasslands are boarded by trails, roads, and eucalyptus trees, buffer zones will be created to minimize risk of the fire spreading.

III. The soil compaction will be addressed by using a light-tracked vehicle to score the soil and increase soil porosity for eventual succession. Ultimately this will allow for greater water and root infiltration, an increase in soil aggregates, and more stable soil. These soil characteristics will increase the success in seed germination which will also stabilize and build resilience through time.

PROPOSED RESTORATION ACTIONS

Reference Ecosystem

This restoration project will use a Californian perennial grassland as its reference ecosystem. This is a plant community found with a Mediterranean climate, dominated by bunchgrasses such as needlegrasses (*Stipa spp.*). These bunchgrasses are usually less than one meter in height and make up more than 10% of relative cover. These ecosystems also contain smaller amounts of perennial forbs, making up 5% or greater of relative cover, and woody plants such as *Artemesia californica* and *Rhus integrifolia*, making up less than 10% of absolute cover.[17] California perennial grasslands typically exist in drought and wildfire-prone areas, meaning that plants in these communities are drought and fire tolerant. They should also be able to tolerate common stressors and disturbances like soil compaction from human activities.

Prescribed Burn

A controlled burn will be implemented in July 2024 across approximately 20 acres of the invasive grassland (Figure 10). This treatment will do three things: (1) remove non-native vegetation that is not adapted to fire, as most California grassland vegetation is; (2) remove built up thatch cover from invasive grasses; and (3) prepare the project site for future soil and seeding treatments. This is a cost-effective method of vegetation removal, as the cost is the same for any acreage of land. Firefighters implementing the burn will be instructed to avoid pre-existing areas of native shrubs and trees, and pre-existing trails and roads will be used as buffer zones and breaks for the fire. These will separate the treatment zones from other plant communities, such as the nearby eucalyptus grove and oak woodlands (Figure 10). In selecting the day and time for the burn, wind strength and direction will be taken into consideration to ensure that these plant other plant communities and the lake are not affected by ash or other debris.

Site Preparation

Grow-Kill Cycle: Grazing

After the prescribed burn, a three-part grow-kill cycle will be implemented to exhaust the seed bank of non-natives (Figure 11). In September 2025, sheep will be introduced to the entire project site to graze on any non-native species that germinate after the burn. Another round of grazing will occur in December 2025, after the land is tilled, to further exhaust the seed bank. This is important because the prescribed fire will not remove seeds from the seed bank, but will free up space for them to grow. Continual grazing and disruptions will mitigate the establishment of non-natives in the seed bank, prepare the site to be reseeded with native grasses, forbs, and shrubs. This will occur across the entire grassland, including in areas with pre-established shrub and tree populations, to reduce thatch and non-native plant cover within areas that were not burned. Fencing will be added along edges that face the lake to ensure that sheep do not wander nearby the lake and pollute it with excrement.

Grow-Kill Cycle: Tilling

In between the grazing cycles, in October 2025, the grassland will be scarified using a light tracked vehicle in order to reduce soil compaction and prepare the site for seed installation. This will have three impacts: (1) reduce soil compaction to both increase water infiltration and prepare soil for plant roots; and (2) assist in the grow-kill cycle. Tilling the land will disrupt any growing non-native plants, further exhausting the seed bank. Tilling will take place in all areas that were burned as well as grazed (Figure 12). The already established plants, which include patches of *Quercus agrifolia* and *Baccharis pilularis,* will not be affected by this, as tilling will work around these areas.

Soil Amendments

After the grassland is tilled, biochar will be applied to reintroduce nutrients into the soil across the entire tilled area (Figure 12). This soil amendment will be used as there is potential for

runoff into the lake, and it will not have any negative effects that could cause an algae bloom. Additionally, this treatment will counteract any allelopathic effects that the presence of *Brassica nigra* in the grassland has had on the soil. This will help to prepare the project site for seed installation and increase the success of native plants in the area.

Seed Installation

All 20 acres of grassland will receive a seed mixture at ~20 lbs/acre (Table 6). The mixture contains perennial bunchgrasses, wildflowers, and drought tolerant forbs. The forbs and wildflowers are included at smaller ratios to increase the diversity of the mixture (Table 6). As most of the grassland is flat, these seeds will be installed using a drill-seeder, as the land is easily accessible for a machine (Figure 13). All seeds will be collected from Santa Barbara County to ensure both that the plants are native to the area, and have genetic diversity. California poppy (*Eshscholzia californica*) seeds will be specially collected from the Goleta and Isla Vista areas to ensure that they are a local genotype which is adapted to coastal areas. This will also ensure that other local poppies do not crossbreed with other local genotypes from other areas.

Additionally, 150 sage scrub shrubs will be grown externally and purchased in pots to be installed manually after drill seeding (Table 7). These will be installed mainly along popular trails and sparsely in existing shrub areas (Figure 13). In total, these shrubs will cover a little less than 2 acres of the grassland, meaning that they will make up around 10% of the absolute cover characteristic of the reference ecosystem, a California perennial grassland.[17] These shrubs will provide habitat for grassland animals, create a diversity of plants for community members to enjoy, and to reduce human disturbance on the grasslands as the shrubs will act as a deterrent for entering some areas of the grassland.

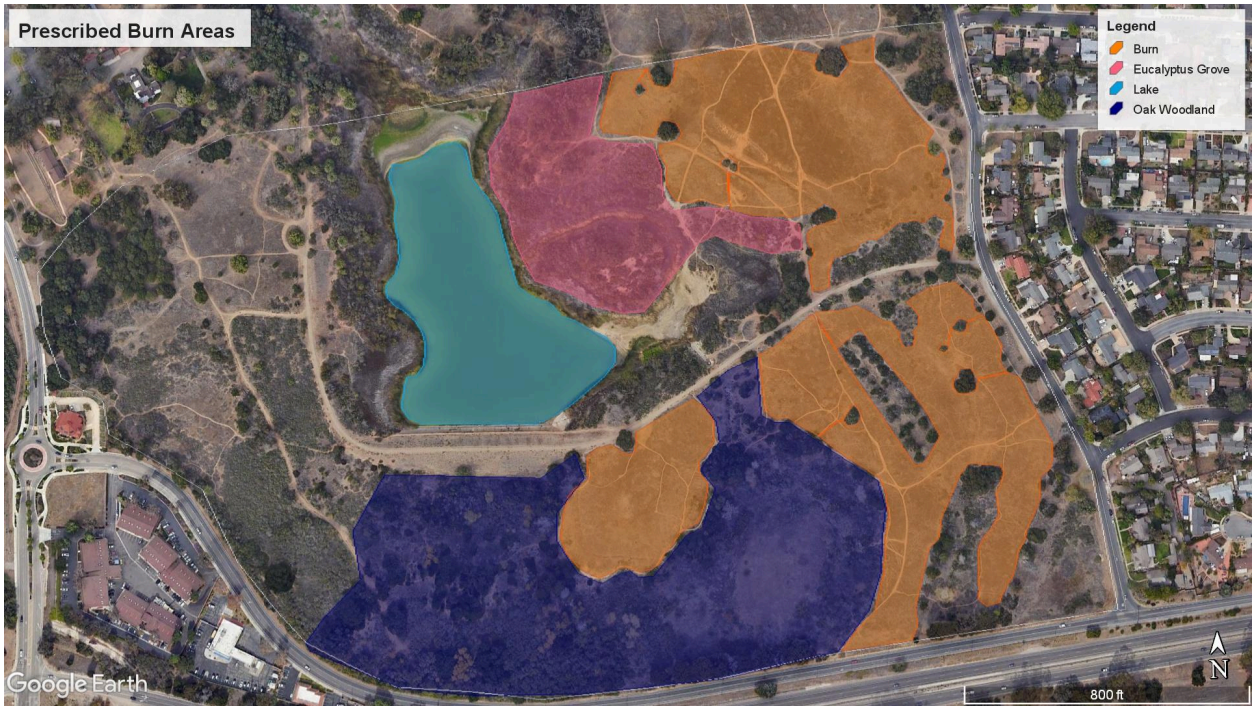

Figure 10. Treatment location for prescribed burn. This will avoid pre-established shrubs and trees.

Figure 11. Treatment location for sheep grazing. This will occur across the entire grassland, including in ares with pre-established shrubs and trees.

Figure 12. Treatment locations for tilling and soil amendments. This will avoid pre-established shrubs and trees.

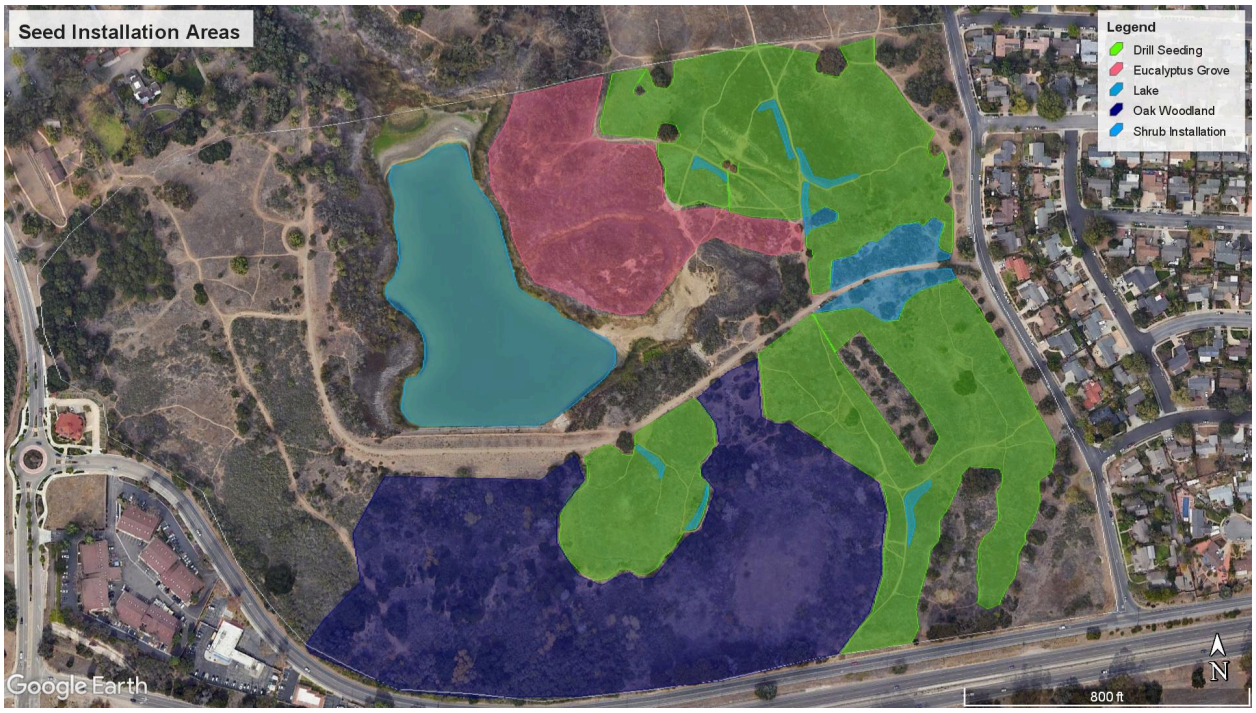

Figure 13. Treatment locations for seed installation. Purple indicates where a seed mix will be drill seeded, and yellow indicates where shrubs will be manually installed.

Table 6. Seed mixture with amounts.

Species (CA Natives)	Common Name	lbs/acre
Stipa pulchra	Purple Needlegrass	10
Melica californica	Melic Grass	5
Sisyrinchium bellum	Blue-eyed Grass	1
Dichelostemma capitatum	Blue Dicks	1
Eschscholzia californica	California Poppy	1
Diplacus longiflorus	Sticky Monkeyflower	0.5
Clarkia purpurea	Winecup Clarkia	0.5
Castilleja exserta	Purple Owl's Clover	0.5
Salvia spathacea	Hummingbird Sage	0.5

Table 7. Plants to be installed manually.

Species (CA Natives)	Common Name	Amount	Total Percent Cover
Encelia californica	California Brittlebush	30 individuals	3%
Rhus integrifolia	Lemonadeberry	20 individuals	2%
Baccharis pilularis	Coyote brush	10 individuals	1%
Artemisia californica	California Sagebrush	40 individuals	4%

MEASURES FOR SENSITIVE RESOURCES

Lake Los Carneros

The usage of chemical treatments against plants will be avoided to avoid chemically disturbing the water in the lake. Chemical treatments like herbicides or pesticides may get trapped in water runoff and induce eutrophication in the lake, causing a phosphorylation cascade that can negatively impact all ecosystem inhabitants.[18] This is due to the high amounts of nitrogen and phosphorus in fertilizers or other chemical influencers, which results in excess nutrients spilling into the lake and can lead to harmful algal blooms (HABs) that restrict light from other underwater plants, hypoxia (oxygen poor dead zones that can kill fish), and a general loss of aquatic life.[19]

Natural fertilizer will also be avoided due to the heightened risk of chemical disturbances. Dung from grazers will be removed before the fire (grazing treatment 1) to prevent the burning of fertilizers and possibly releasing harmful gasses in the atmosphere, and after the second grazing period to prevent reintroduction of the nonnative seeds the grazers just cleared.[20] By removing the dung both times, lake eutrophication can be further avoided and the seeding and tilling step of restoration will have less competition from nonnatives.

Monarch Butterflies

Monarch butterflies (*Danaus plexippus*) in California roost in eucalyptus trees during their migration in the Fall/Winter months. Since the introduction and spread of Eucalyptus tree species in coastal California, the monarch butterfly prefers to roost in such trees at Lake Los Carneros. Thus, the eucalyptus grove will be unaltered, and wind direction will be taking into account when implementing the prescribed burn to ensure that the grove is not affected.

Raptor Nesting Habitat

Raptors that live within Santa Barbara Country visit Lake Los Carneros and will occasionally nest in the eucalyptus trees. Native raptor species include the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), Cooper's hawk (*Accipiter cooperii*), and the rarer ferruginous hawk (*Buteo regalis*). Due to the degradation of taller native tree cover such as coast live oak and the remaining trees being too small or young, raptors as well as other bird species roost in the white or blue gum trees which have more prevalence in the area. Similar to monarch butterflies, eucalyptus trees are considered part of the sensitive resources in natural habitat areas due to their extensive naturalization in coastal California. This is another reason why the grove will not be altered during restoration.

ALTERNATE MANAGEMENT PLAN

If grazing and tilling is not as effective in the grow-kill cycle as we expect it will be, then we will employ volunteers to continually hand weed through sensitive areas to reduce non-natives manually. This will still serve to exhaust the seed bank, but is not the ideal management plan, as it requires a lot of human labor. If a prescribed burn is not approved and cannot be conducted, a more intensive grow-kill cycle will be implemented. The grassland area that was intended for burning will be re-tilled 2 or 3 times to ensure that the seed bank is thoroughly exhausted before implementing the same planting scheme as outlined earlier.

THE HUMAN ELEMENT

Lake Los Carneros is a public park full of hiking trails. Our restoration options may close down portions of the park and disrupt the hikes around the area. Other activities at the park include bird watching, fishing, walking, biking, and observing wildlife. We believe the

community has a positive relationship with the park as it provides an oasis of nature and activity for the people, and animals, within the community.

Our restoration project impacts this relationship because the site we intend to focus on is located in the grassland areas of the park (Figure 9). The area is a densely packed grassland filled with many invasive species such as (Wild Mustard (*Brassica nigra)*, Wild Radish (*Raphanus sativus)*, and the infamous Italian Ryegrass (*Lolium multiflorum*).

Although there are trails intertwining the grassland area, restoring this particular part of the park could disrupt the homes of gophers and other fauna, and human recreational activities. By isolating the grassland area with either fences or signs, we are also isolating the ecosystem processes that occur there, forcing humans and animals to go around. Some humans may find the restoration barrier inconvenient, so they may just go through it.

The impact could be reduced by creating a green chain-linked fence (maybe with sandbags to hold the metal in place) that prevents humans and animals from entering into the area, so it could eventually be restored and become better than before. Birds and seeds unfortunately may also get into the space, so maybe a protective covering can also improve the restoration process. Signs could be added around the fence detailing the process of restoration. These signs could include the area's history, how we are restoring the area, and why we are doing the restoration.

Our restoration efforts may impact other stakeholders such as the City of Goleta or Santa Barbara County, residents living in the surrounding community that have access to the park, and possibly the South Coast Railroad Museum that is located next to the park. It is important to emphasize that the restoration efforts will be beneficial to the community and the environment, despite being disruptive to the trails and certain parts of the park. Eventually, community members will come to realize that the restoration efforts were able to bring back native species and even more flora and fauna than before.

BUDGET AND WORK PLAN

WORK PLAN

Task	Sub Task	Target Completion Date
1. Planning	1.1 Contact NEPA, approval for project	January 2025
	1.2 Contact Santa Barbara County Fire Department to conduct prescribed burn	January 2025
	1.3 Obtain plant collection permit	January 2025
	1.4 Contracting for drill seeding	January 2025
	1.5 Native seed collection, bulking, purchasing	April 2025
	1.6 Site inventory and analysis	May 2025
2. Removal of Non-Native Cover in Grassland	2.1 Prescribed burn of grassland	July 2025
	2.2 Grow-kill cycle (grazing round 1)	September 2025
	2.3 Grow-kill cycle & soil decompaction (tilling)	October 2025
	2.4 Add soil amendments	October 2025
	2.5 Grow-kill cycle (grazing round 2)	December 2025
3. Restoration of Native Plants in Grassland	2.1 Seed installation with drill seeder	Late February 2026
	2.2 Manually install shrubs with volunteers	April 2026
4. Protection of Project Site	3.1 Print, assemble, and install informational signs across project site	May 2026

BUDGET

Item		Justification	Total
Prescribed Burn		To burn non-native grasses	$10,000
Grazing		For grow-kill cycle, around bushes and trees, before and after tilling	$184,000
Light Tracked Vehicle		For grow-kill cycle and scarifying the ground, lessening soil compaction	$87,400
Soil Amendments		Fertilizer after tilling	$19,000
Bulk Seed Purchase		For purchasing 18 pounds of seed mix per 20 acres	$54,000

Custom Local Seed Collection		For collecting 20 pounds of California poppy (*Eschscholzia californica)* seed from Isla Vista and Goleta area	$25,300
Plant Containers		For 150 plant pots of shrubs to install manually	$1,500
Drill Seeding		Drill seeding seed mix across 19 acres	$109,250
Volunteer Labor		To plant potted shrubs and install signs	$4,600
		Total Indirect Cost	$53,550
		Total Direct Cost	$441,500
		TOTAL COST	$494,050

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