

FINAL

**McCARRELLS CANYON
HABITAT RESTORATION PLAN**

Prepared for:

Palos Verdes Peninsula Land Conservancy
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Rolling Hills Estates, California 90274

Prepared by:

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SECTION 1 – OVERVIEW AND EXISTING CONDITIONS

1.1 INTRODUCTION

McCarrells Canyon is located within the Portuguese Bend Nature Preserve. Surrounded by urban development, the Portuguese Bend Nature Preserve is a 1,200-acre preserve located directly adjacent to the Pacific Ocean on the Palos Verdes Peninsula in Los Angeles County. McCarrells is a 70-acre, natural soft-bottom drainage course at the terminus of a 750-acre watershed. It is identified as a blue-line stream by the United States Geological Survey (USGS) 2003 topographic map; however, water flow within the canyon is ephemeral. McCarrells Canyon receives discharge from storm drain systems from residential development along Crest Road and conveys them via the historic coastal stream down to Palos Verdes Drive South where it enters a constructed 48-inch storm drain pipe and is discharged directly into the ocean near Abalone Cove Ecological Reserve.

McCarrells Canyon currently supports lemonadeberry (*Rhus integrifolia*) scrub and coastal sage scrub habitat with no typical riparian plant species within the canyon. However, in the downstream end of the canyon, a series of invasive non-native species such as coastal wattle (*Acacia cyclops*), sweet fennel (*Foeniculum vulgare*), and tree tobacco (*Nicotiana glauca*) are present. Recently in late 2009, the City of Rancho Palos Verdes Public Works Department cut down several Acacia trees from the banks of the canyon, leaving the banks open to erosion.

This restoration plan is part of the Coastal Conservancy Proposition 12 Grant Agreement No. 07-178 for lower McCarrells Canyon. The project includes: replanting areas where Acacia trees were removed, removing additional Acacia trees and other non-native species, and restoring adjacent upland native scrub habitat to increase runoff infiltration and control erosion along the public use trail.

1.2 EXISTING CONDITIONS

McCarrells Canyon is bounded on the east by the Three Sisters Reserve and development in all other directions. The canyon is incised with steep banks vegetated with large native and non-native shrubs. As described above, large Acacia trees have invaded the banks of the drainage at the downstream end of the drainage for approximately 1,000 feet. In addition, exotic species such as tree tobacco, sweet fennel and annual grasses dominate the adjacent upland slope to the east.

Vegetation along the drainage of the McCarrells Canyon is mainly lemonadeberry and Acacia. The adjacent slopes are dominated mainly by annual grasses with scattered native coastal sage scrub species. Occasional native species occurring on the slopes of the canyon include lemonadeberry, California bush sunflower (*Encelia californica*), California sagebrush (*Artemisia californica*), prickly pear cactus (*Opuntia littoralis*), and ashleaf buckwheat (*Eriogonum cinereum*).

The dominant exotic species, aside from Acacia, are wild oat (*Avena fatua*) and purple false brome (*Brachypodium distachyon*). Other exotic species found on the slopes include short pod mustard (*Hirschfeldia incana*) and tocalote (*Centaurea melitensis*).

Native habitat restoration is on-going to the east of McCarrells Canyon within the Three Sisters Reserve. Restoration has included weed control and site preparation, installation of irrigation, and seeding and planting for coastal sage scrub and perennial grassland habitat.

1.3 SOILS

The soils within McCarrells Canyon are the Altamont–Diablo Associations, 2–9 percent slope, and classified within the Vertisol Order. Vertisols are mineral soils that have a high content of clay, in particular clays that are sticky, and the swelling and shrinking-type clays to a depth of one meter or more in the soil. These soils have low to moderate water holding capacity. The soils in McCarrells Canyon and adjacent slopes were formed under the xeric moisture regime of southern California where the Mediterranean climate has cool, moist winters and warm, dry summers. Since moisture levels fall during times of lowest evapotranspiration rates, this is conducive for soil leaching. The mean annual soil temperature is lower than 22 degree Celsius (C). At a depth of 50 centimeters from the soil surface, the mean annual summer and winter temperatures differ by 6 degrees C or more. By definition, xeric soil is dry for at least 45 consecutive days in the summer and is moist for at least 45 consecutive days in the winter (NRCS 1999).

SECTION 2 – RESTORATION SPECIFICATIONS

Once a restoration plan is prepared, restoration generally can be divided into four phases: 1) site preparation, 2) seeding/planting, 3) establishment maintenance, and 4) post-establishment, long-term management. For the McCarrells Canyon restoration, site preparation will be necessary to remove and control Acacia trees within the drainage area, and to prepare the upland areas for seeding and planting. Concurrent with the site preparation phase, appropriate seeds will be collected, and container plants will be propagated. Planting and seeding will be implemented following the control of exotic weed species. Establishment and maintenance will likely be required for approximately two years, depending on rainfall and the development of the planted and seeded species versus weedy species. Long-term management should consist of periodic site surveys for exotic invasive plants and appropriate management activities based on results of the surveys.

2.1 PROJECT GOALS

The purpose of this habitat restoration is to restore appropriate native habitats and enhance the ecological functions of McCarrells Canyon and adjacent native slope area within the Three Sisters Reserve. The following general goals were determined for the habitat restoration after evaluating the existing conditions of the site:

- Remove exotic Acacia trees from lower McCarrells Canyon.
- Plant native shrubs along edge of drainage in areas of where invasive trees are removed to provide erosion control.
- Increase native plant cover in adjacent upland areas by establishing native vegetation to define trails and improve water retention on the slopes.

2.2 SITE PREPARATION

Restoration of the specified habitat requires site preparation which consists of removing remaining Acacia trees and controlling weeds on the adjacent slope area.

2.2.1 Weed Control

Recommended methods for control of particular species are based on experience within the Three Sisters Reserve, and methods that have been cross-referenced using CalWeed Database of the California Interagency Noxious Weed Coordinating Committee and Invasive Plants of California Wildlands (Bossard et. al. 2000). No herbicides will be used for control of these weed species.

For efficient control of exotic invasive species, weeds must be controlled before they produce viable seed. Methods of control will depend on the target species, the density of the target species, the area of infestation, and the ecological sensitivity of the existing habitat. Tree and weed removal will employ mainly hand pulling and mechanical methods such as chain saws and weed whips.

Areas will be evaluated after the initial site preparation to assess progress and to schedule the next step of planting and seeding. Areas will be released for planting and

seeding depending on whether enough progress has been made in management of the weed species.

The following methods are recommended for each of the main weed species or group of species:

- Approximately eight Acacia trees and one sapling shall be removed within the project area immediately adjacent to the drainage. Trees will be trimmed of branches near the base to allow access to the trunk. The trunk of each tree will be cut as close to the ground as possible. The trees will be chipped and the material can be used to mulch upland areas. The cut tree stumps shall be monitored for re-growth; however, recent experience within the Three Sisters Reserve indicates that no re-growth will occur.
- Sweet fennel and tree tobacco along the disturbed areas of the official trail and in the upland slope area designated for seeding and planting shall be removed by hand weeding prior to flowering. The bulb of sweet fennel must be removed with the least disturbance possible. An 'Extractigator' or similar tool can be used to remove the tree tobacco.
- Annual grasses within the upland area shall be controlled by weed whipping prior to seeding and planting. Cut material shall be removed by raking prior to seed fall.

2.2.2 Soil Amendments

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

Arbuscular Mycorrhizal (AM) Fungi

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

Fertilizer

General fertilization is not recommended over the site since lower nutrient soils may favor the establishment of native seedlings over weedy exotic species. Native species are adapted to lower nutrient soils, unlike weedy exotic species. Furthermore, the addition of AM fungi should favor the uptake of phosphorous and nitrogen of the seeded native species. However, fertilizer packets delivered to the root zone of container plants installed within the site will benefit the establishment of the plants without also supplying nutrients to the exotic weed species or allowing any runoff of fertilizer. Unlike seeded material, container plants generally need an initial supplement to become established.

For container plants, a fertilizer packet shall be added to the bottom of each planting hole prior to planting. Each packet (10 grams weight) shall contain a blend of 16% total nitrogen, 6% available phosphoric acid, and 8% soluble potash plus minor nutrients. The nitrogen, phosphorous, and potassium shall be coated with a polyurethane coating to provide 15.69% coated slow release nitrogen, 5.09 % coated slow release available phosphate, and 6.8% slowly available soluble potash. Bio-pacs® meeting these specifications are available from Reforestation Technologies Inc.

2.3 PLANT SOURCES AND SPECIES

To the extent possible, all plant material for the restoration shall be obtained from native plant communities growing within the Palos Verdes Peninsula. For those species that do not exist in large enough quantities within the specified seed collection area, it will be necessary to either use seed that is commercially grown or extend the collection area on a species by species basis. The PVPLC has in-house capabilities for seed collection or may opt to contract with a seed collection contractor specializing in native seed to ensure that seed material will be collected from Palos Verde Peninsula and other coastal sites ranging north through Malibu and south through Upper Newport Bay. The following sections list the species to be used in restoring the area along the drainage and the adjacent upland slope area.

2.4 SEEDING AND PLANTING

Areas where Acacia trees have been removed will be planted with shrub and grass species that are found in less disturbed areas of McCarrells Canyon upstream of the project site. The main shrub to be planted is lemonadeberry. The perennial giant wild rye (*Leymus condensatus*) will provide an understory component. Table 1 presents the species and the spacing for each species within the site. Planting will take place generally on both sides of the drainage within the area identified in Figure 1.

The restoration of disturbed areas in the adjacent upland slope along the trail will focus on coastal scrub and cactus scrub habitats as identified in Figure 1. The seed mix presented in Table 2 is designed to model species occurring on the adjacent slope areas. The species selected for the restoration represent the more common and abundant species observed in the existing adjacent habitat as well as species that are early colonizers in scrub habitats after disturbance such as fires. Some less common species have also been included. Additional species have been included in the seed mix as a nurse crop and for erosion control until the scrub species establish. Container plants will be planted in areas that can be easily accessed for planting and maintenance. Spacing within groups will follow the specifications in Table 3.

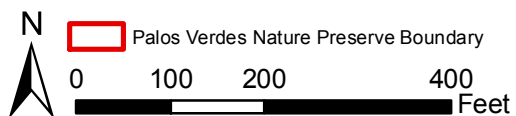


FIGURE 1
McCarrells Canyon Restoration
Palos Verdes Nature Preserve

Table 1
McCarrells Canyon Drainage Container Plant Palette

Scientific Name	Common Name	Spacing From Another Container Plant or Group (feet)	Number of Plants
<i>Leymus condensatus</i> ¹	giant wild rye	5 - 10	240
<i>Rhus integrifolia</i>	lemonadeberry	10	40
<i>Sambucus mexicanus</i>	Mexican elderberry	10	40
¹ Giant wild rye to be planted in groups of 3 plants, spaced at 2-feet on-center within the group and groups space 5 – 10 feet.			

Table 2
Coastal Scrub Seed Mix

Scientific Name	Common Name	Guidelines for minimum Purity/Germination ¹	Pounds of seed per acre ²
<i>Artemisia californica</i>	California sagebrush	15/50	1.5
<i>Encelia californica</i>	California encelia	40/60	2.5
<i>Eriogonum parvifolium</i>	bluff buckwheat	15/80	2.0
<i>Deinandra fasciculata</i>	fascicled tarweed	10/25	1.5
<i>Isocoma menziesii</i>	coast goldenbush	20/40	1.0
<i>Lotus salsuginosus</i>	alkali lotus	98/70	1.5
<i>Lotus scoparius</i>	deerweed	90/60	6.0
<i>Lupinus bicolor</i>	miniature lupine	98/80	3.0
<i>Lupinus succulentus</i>	arroyo lupine	80/80	0.5
<i>Nassella lepida</i> ³	foothill needlegrass	70/60	2.5
<i>Plantago insularis</i> ⁴	wooly plantain	98/75	20.0
<i>Salvia leucophylla</i>	purple sage	70/50	1.5
<i>Vulpia microstachys</i> ⁴	small fescue	70/70	6.0
¹ Minimum germination may be adjusted after germination tests on special local collection. ² Bulk seed rate may be adjusted depending on results of tests for germination. ³ Seeds of <i>Nassella</i> spp. shall be de-awned. ⁴ Erosion control and nurse crop species.			

Table 3
Coastal Cactus Scrub Container Plant Palette

Scientific Name	Common Name	Spacing From Another Container Plant (feet)	Plants Per Acre
<i>Encelia californica</i>	California encelia	3	30
<i>Baccharis pilularis</i>	coyote bush	5	25
<i>Eriogonum parvifolium</i>	bluff buckwheat	3	100
<i>Isomeris arborea</i>	bladderpod	5	25
<i>Opuntia littoralis</i> ¹	prickly pear cactus	2	120
<i>Cylindropuntia prolifera</i> ¹	coastal cholla	2	60
¹ Cactus shall be planted in groups of 30 cactus of mixed species placing coastal cholla in the center of the group, ratio of 2:1, prickly pear to cholla.			

2.5 SEEDING AND PLANTING SPECIFICATIONS

The following methods will be used to seed and plant for restoration of native habitat within the McCarrells Canyon site.

2.5.1 Seeding

Seed shall be applied by hand with a bellyginder in the areas between container plants in restoration areas where weeding has been implemented. Prior to seeding, the soil will be lightly raked to provide a rough surface for the seed to find safe sites. Specified AM fungi will be spread by hand with a belly grinder over the seeding area prior to seeding. The seed will be mixed together as specified for the seed mix. The seed shall be broadcast and raked, where practical, into the ground to no more than a quarter of an inch to incorporate the seed into the soil to increase germination success.

2.5.2 Planting

Container plants will be planted in groups of mixed species in the upland area. Cactus species will be planted in groups of 30 with no other species planted within the group. The layout for container plants will be determined in the area between the existing trials and the drainage planting area. Planting sites will be marked using different colored pin flags under the supervision of the restoration ecologist or Palos Verdes Peninsula Land Conservancy (PVPLC) biologist. Spacing of plants within the groups will follow the specifications presented in the tables for container plant palettes. Groups of container plants will be spaced in a natural looking mosaic along the trails.

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

- Planting holes shall be made with the minimum disturbance to accommodate the containers.
- Prior to planting, the planting hole shall be filled with water, and allowed to drain.
- A fertilizer packet shall be added to each planting hole just prior to planting.
- Plants shall be set in the planting hole so that the crown of the root ball is approximately 0.25 inch above finish grade. Under no circumstance should the plant crown be buried.
- A watering basin shall be provided around each plant from 18–24 inches in diameter.
- Watering basins shall be filled with water after planting, at least twice.
- The drip irrigation system should be tested to ensure that all emitters are functioning.

2.6 IRRIGATION

The container plants will require at least one season of supplemental irrigation. It is recommended that irrigation be provided through the existing temporary system currently in use for the Three Sisters restoration. The system can be extended or hand watering from the existing system with hoses can be implemented. The system will have to be managed by one or more personnel during each irrigation event to avoid erosion problems.

The irrigation system will be used in the early fall and late spring seasons. The irrigation system will slightly lengthen the growing season to maximize the development of the habitat. Irrigation likely will be required for the first two growing seasons for establishment.

2.7 SITE MAINTENANCE

One of the goals for the restoration is to provide self-sustaining habitats. However, initially, maintenance of the restoration area will be necessary to establish the newly planted and seeded areas. Maintenance will include any activities required to establish the specified plants, in the estimation of the restoration specialist or PVPLC biologist. These activities include the following:

- Weed control, at a minimum for acacia, short-pod mustard, sweet fennel, and tree tobacco;
- Irrigation for the container plants;
- Replacement of container plants in areas with less than 80 percent survival in year two.

The establishment maintenance period is generally three years duration with the most intense maintenance in the first and second year, and only seasonal weeding activities in the third year. The amount of maintenance each year will depend on weather conditions and how well the site develops. The following specifications for maintenance may require adjustments as determined by the restoration specialist or PVPLC biologist over the three-year maintenance period.

2.7.1 Weed Control

Weeds will be controlled during late winter through early summer, as necessary, before they set seed and/or before they reach approximately 12 inches in height. Three weeding events should be estimated for a normal rainfall season, with more or less events as dictated by rainfall.

2.7.2 Irrigation of Container Plants

Temporary irrigation will only be used in the areas where groups of container plants are to be planted. Irrigation will be used in the first and possibly second season from planting to extend the rainy season and establish the shrubs, as necessary. The timing of irrigation events will depend on evapotranspiration between irrigation events and soil moisture. The following management scheme is anticipated as a guideline for water management of native trees and shrubs:

- Irrigate soil to full field capacity to the desired depth (approximately 18 inches after planting; and 18–24 inches during plant establishment).
- Allow soil to dry down to approximately 50-60 percent of field capacity in the top 6-12 inches before the next irrigation cycle. Depth of soil dry down between irrigation events will depend on development of container plants.

Wetting of the full root zone and drying of the soil between irrigation events is essential to the maintenance of the plants and the promotion of a deep root zone that will support the vegetation in the years after establishment. A soil probe or shovel should be used to examine soil moisture and rooting depth directly.

2.7.3 Plant Replacement

Survival of the container plants within the first growing season should be 80 percent. Plants shall be replaced if survivorship falls below 80 percent in the first season. Replacements will be planted as previously specified and maintained for one growing season, as necessary. Replacement planting after the first season shall only be specified if the visual estimate indicates substantial mortality.

2.7.4 Pest Management

Local wildlife such as pocket gophers and ground squirrels may be expected to browse on the plantings. If the restoration specialist or PVPLC biologist determines that the plantings are being jeopardized by wildlife, corrective measures such as organic, nontoxic deterrents and fencing/plant cages maybe used. Invertebrate pests are rarely a serious problem coastal sage scrub restoration.

2.7.5 Summary of Implementation, Maintenance, and Monitoring

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

density of weed species as well as native species that will germinate in any given year and season.

Horticultural monitoring will guide weeding and irrigation schedules for the project, and there should be a close coordination between the maintenance supervisor and the restoration ecologist if they are not the same person. Horticultural monitoring should take place daily during planting and seeding, then weekly until seed germinates and plants establish, followed by monthly monitoring during the remainder of the first year. Quarterly monitoring should suffice after the first year through the third year.

Table 4
Summary of Implementation and Maintenance Schedule

Restoration Tasks	Year 1 2010				Year 2 2010/11				Year 3 2011/12			
	F	W	S	S	F	W	S	S	F	W	S	S
Seed Collection		X	X	X	*	*	*	*				
Site Preparation Weeding		X	X		X							
Final Site Preparation: Mowing & Weed Thatch Removal					X							
Initial Site Seeding and Planting					X							
Irrigation of Container Plants					X	*	X	*	X	*	*	*
Maintenance Weeding						X	X	X	*	X	X	*
Remedial Seeding									*			
Horticultural Monitoring		Qt	Qt	Qt	W	BW	M	Qt	Qt	M	M	
Performance Monitoring											X	
* = if necessary Qt = once per quarter unless conditions require more oversight W = weekly oversight BW = bi-weekly (every other week) oversight M = monthly oversight unless conditions require more oversight												

SECTION 3 - RESTORATION REPORTING

The restoration site should be monitored annually after installation for three years. Photo-documentation at permanent points conducted with qualitative description of the species developing over the site, the maintenance that was performed, and recommendations for future maintenance should be included in an annual letter report.

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

SECTION – 4 REFERENCES

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