Sweetwater Reservoir Vernal Pool and Otay Tarplant Restoration Status Report

Performance Period

(August 2004 to August 2007)

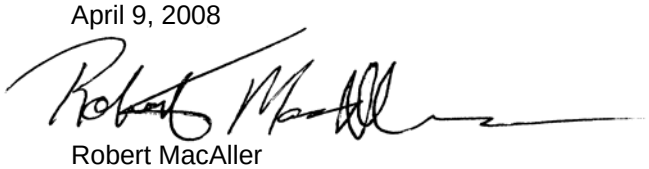
Prepared for

Sweetwater Authority
505 Garrett Avenue
Chula Vista, CA 91912
Contact: Pete Famolaro

Prepared by

RECON Environmental, Inc.
1927 Fifth Avenue
San Diego, CA 92101-2358
P 619.308.9333 F 619.308.9334
RECON Number 3967B

April 9, 2008



Robert MacAller
Principal

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1.0 Summary

. This document summarizes maintenance and monitoring activities from August 2004 to August 2007 for the vernal pool and Otay tarplant (*Deinandra conjugens*) restoration project at the Sweetwater Reservoir. The mitigation project includes 2.70 acres of vernal pool complex (vernal pools and associated uplands) restoration and enhancement, and 4.36 acres of Otay tarplant restoration and enhancement. Approximately 8,201 ft^2 of vernal pool surface area has been restored or enhanced, including 3,929 ft^2 of restored vernal pools. All areas restored and enhanced as part of this mitigation effort are becoming established and are progressing toward the Year 5 final success criteria standards.

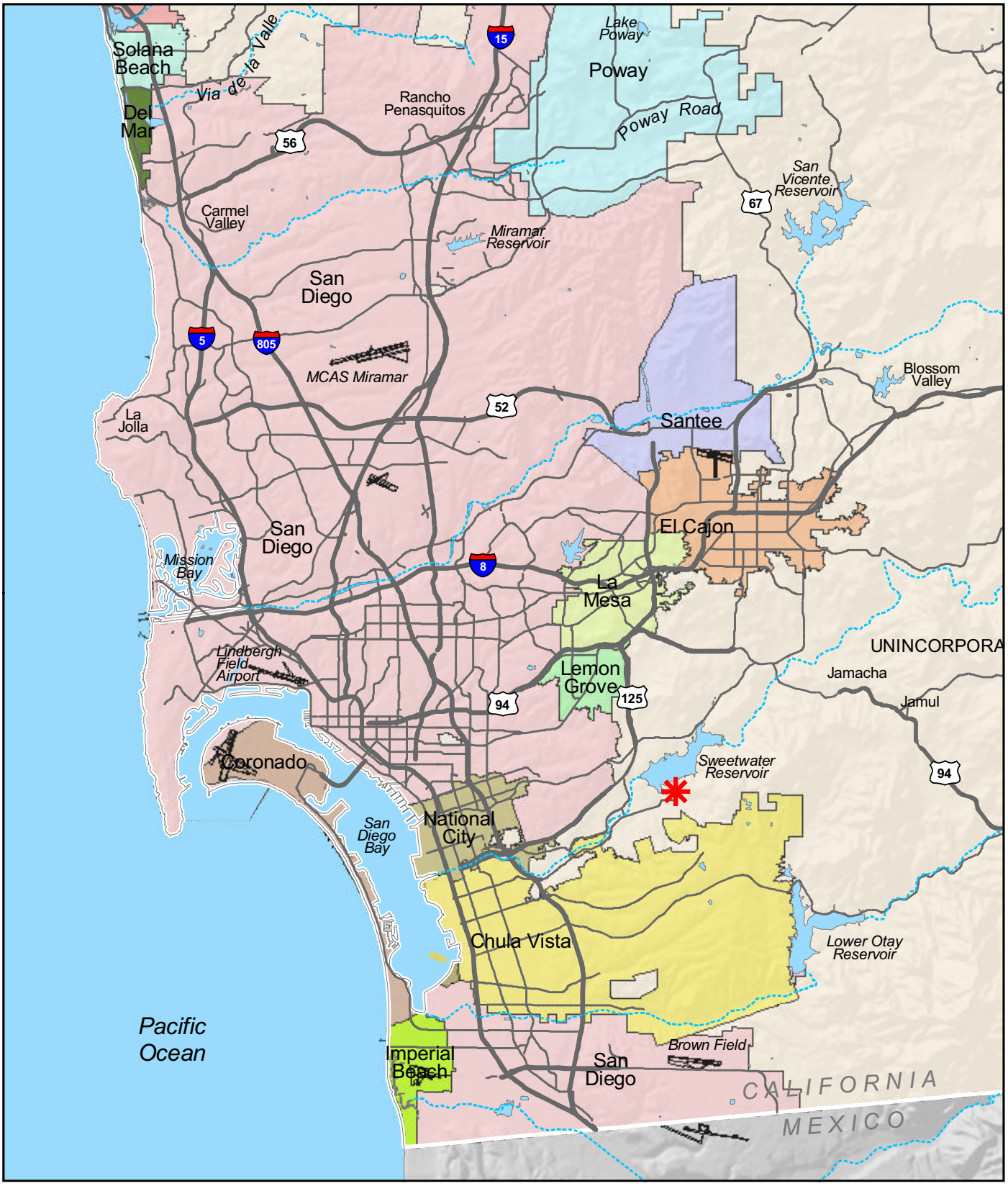
2.0 Background

2.1 Project Location

This 7.06-acre Sweetwater Authority vernal pool and Otay tarplant restoration site is located on Sweetwater Authority Property located north of San Miguel Road and State Route 125 and south and east of Sweetwater Reservoir (Figures 1 and 2).

2.2 Summary of Overall Project

This project is mitigation for impacts to vernal pools and Otay tarplant habitat resulting from a fishing program area developed on the southern portion of Sweetwater Reservoir (McMillan Biological Consulting 2001). Restoration of the vernal pool and Otay tarplant habitat began in August 2004. Planned restoration procedures, success criteria, and site conditions prior to restoration are presented in the Restoration and Management Plan for Vernal Pool and Otay tarplant Habitat at the Sweetwater Reservoir (Plan; McMillan Biological Consulting 2001). This document was used to guide all restoration procedures for this project.



Project Location

FIGURE 1

Regional Location

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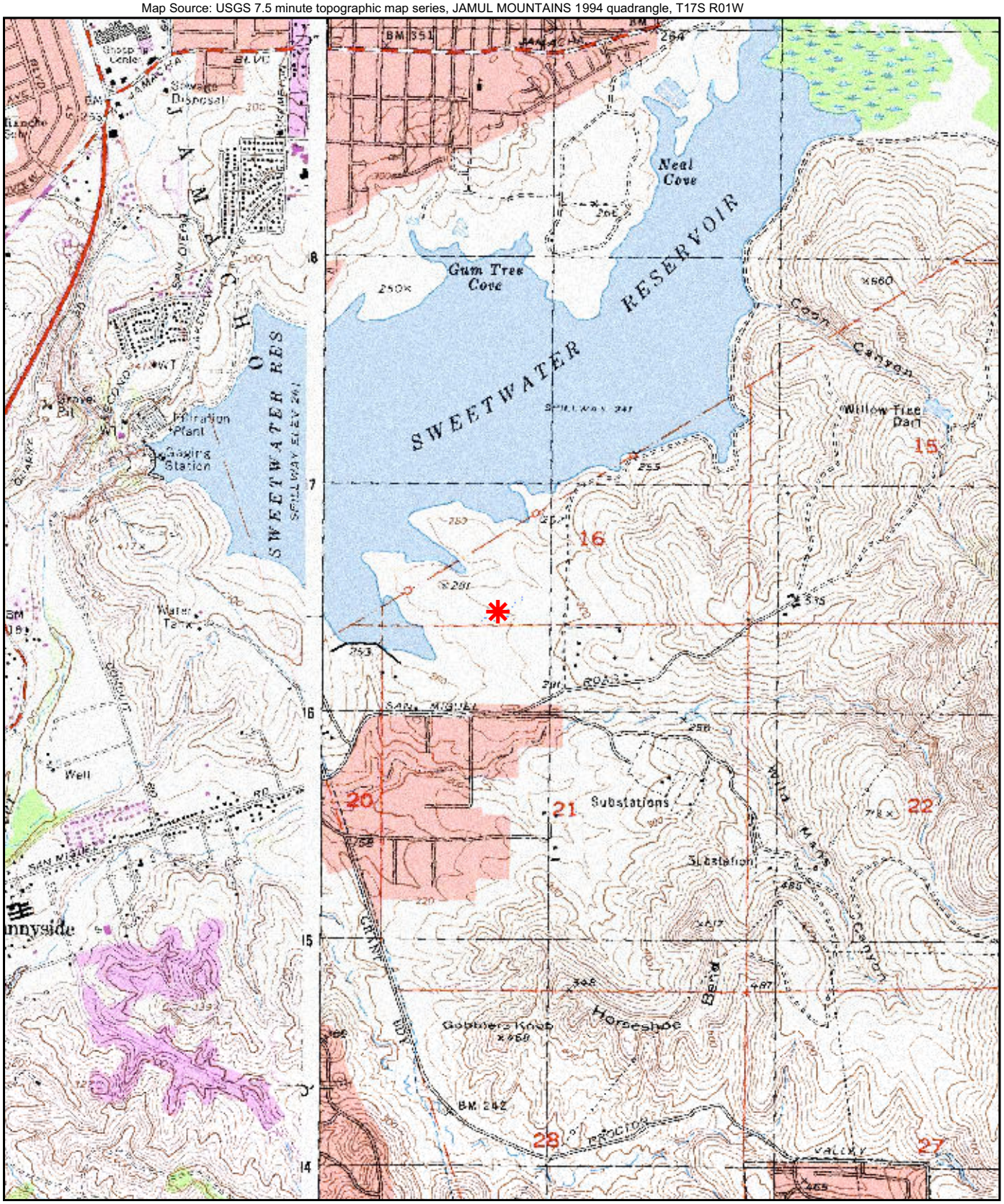
Map Source: USGS 7.5 minute topographic map series, JAMUL MOUNTAINS 1994 quadrangle, T17S R01W



✱ Project Location

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FIGURE 2

Project Location on USGS Map

2.3 Responsible Party

Sweetwater Authority
Contact: Mr. Pete Famolaro
Sweetwater Authority
Robert A. Perdue Water Treatment Plant
100 Lakeview Avenue
Spring Valley, CA 91977

Contributors to the data collection and analysis to produce this report are Robert MacAller, Scott McMillan (McMillan Biological Consulting), Bruce Hanson, Mark Dodero, Peter Tomsovic, and Lindsay Stallcup.

2.4 Mitigation Goals and Success Criteria

The goal of this mitigation project is to restore the disturbed areas within the site to native plant communities to support Otay tarplant populations and vernal pools and their associated uplands. Quantitative success criteria in the restoration plan were focused on non-native cover values at or below 10% (McMillan Biological Consulting 2001). More specific targets for vegetation cover and diversity were developed later during the contract proposal phase (McMillan Biological Consulting 2004). Although not described in the project permits, these updated quantitative values are what is targeted for success of this restoration project.

2.4.1 Non-Native Cover

Non-native cover should not exceed 10% in all areas.

2.4.2 Tarplant/Grassland Cover and Diversity

Native cover in the tarplant/grassland restoration area should be at least 80%, with at least 50% of the cover represented by Otay tarplant. The remainder of the cover should be represented by the species listed in Table 3 of the Plan. No more than 10% of the remaining cover should come from shrubs.

Native cover of the tarplant/grassland restoration area should be made up of at least 25 of the species listed in Table 3 of the Plan.

2.4.3 Vernal Pool Upland Cover and Diversity

Native cover of the uplands surrounding the pools should be at least 85%, with at least 10% cover represented by Otay tarplant. The remainder of the cover should (at least 75%) be represented by species listed in Table 3 of the Plan. No more than 40% of the remaining cover should come from shrubs.

Native cover of the vernal pool upland area should be made up of at least 25 of the species listed in Table 3 of the Plan.

2.4.4 Vernal Pool Basin Cover and Diversity

The native cover in the vernal pool basins should be at least 75%, represented only by those species listed in Table 4 of the Plan.

2.4.5 Special Requirements for the Vernal Pool Basins

All of the species listed in Table 4 of the Plan should have a cover of at least 5% in at least one of the restored basins.

Toothed downingia (*Downingia cuspidata*) should have a cover of at least 5% in at least 5 of the restored pools.

Spreading navarretia (*Navarretia fossalis*) should have a cover of at least 5% in all of the restored basins, and should have a cover of at least 25% in at least 5 of the restored basins.

3.0 Plan Implementation

Restoration and enhancement was implemented on existing disturbed land that formerly supported vernal pools and Otay tarplant populations. The physical setting and vegetation conditions were described in the Plan (McMillan Biological Consulting 2001). In summary, the site preparation methods included dethatching of weeds and thatch removal, follow-up herbicide spraying to control newly germinated weeds, grading vernal pools, hand seeding, and container planting.

3.1 Site Preparation

Exotic weeds were abundant on the site prior to restoration activities. In an effort to control weeds, an extensive weeding effort was implemented prior to initiation of planting or seeding beginning in August 2004.

The restoration site was dominated by invasive exotic species, with some native plants scattered throughout. To ensure that native species that were present were not impacted by weeding activities, dried weedy thatch material was cut using weed whips (Photograph 1). After the material was cut, the dried weeds were raked into piles (Photograph 2) and removed from the site and disposed in a landfill.

Vernal pool grading was scheduled to begin in October 2004; however, heavy early season rains occurred, with over seven inches falling in October (Sweetwater Reservoir weather station data). Rains were consistent throughout the season, and the site did not dry sufficiently during the winter to allow grading without damaging the existing vernal pools. This rainfall stimulated extensive weed species germination throughout the site. For the next year, (prior to restoring vernal pools, seeding, and planting) field crews conducted extensive weed control through application of Aquamaster herbicide to newly germinating species in upland areas, hand pulling within pools, and weed whipping adjacent to vernal pools. Field crews, ranging from three to eight personnel, conducted weed control over 34 separate days between August 2004 and August 2005. To adequately control weeds prior to planting and seeding activities, all exotic material was removed from the site and transported to a landfill.

3.2 Pool Restoration and Enhancement

The goal of the pool basin restoration and enhancement was to reverse the topographic disturbance of the site, caused primarily by the erosion and flattening of mounds and the compaction of the vernal pools. The topographic changes caused by disturbance reduced the capacity of the vernal pools on the site to capture and store rainwater.

The primary physical restoration task was to remove material from areas that may have historically been natural depressions to enable ponding and water retention. Material removed from the depressions was piled and compacted to reconstruct mounds between the depressions, enlarging the surface retention volume of the site.

In August 2004, existing topographic data was collected and analyzed to aid in vernal pool restoration/enhancement planning. This data was analyzed using a geographic information system (GIS) to determine the appropriate pool configuration and watershed size to meet permit obligations.

In September 2005, the pool sites were marked and staked using the final design/grading plan. The restored pools were graded the last week of September 2005. In November 2005, the restored pool topography was refined through minor final grading. Grading activities were conducted prior to significant heavy rainfall to minimize unintended compacting of the clay soils by grading equipment. All planned pool boundaries were located using global positioning system (GPS) equipment. The

PHOTOGRAPH 1
Dethatching Restoration Site,
August 2004

PHOTOGRAPH 2
Removing Cut Weed Material,
August 2004

grading was conducted under the direction of a biologist (Mark Dodero) with vernal pool restoration experience. The biologist used a laser transit to help direct the grading contractor and ensure that proper topography was restored. Eleven vernal pool basins were restored, six of which were newly restored (Figure 3; Photograph 3).

3.3 Revegetation

3.3.1 Vernal Pools

Seed and duff from surrounding pools and within pools adjacent to Otay Lake were collected by RECON's field crew who are specially trained in collecting native plant seed and maintaining restored native vegetation communities. Collection was supervised by Bruce Hanson, Mark Dodero, and Robert MacAller (RECON USFWS permit #797-665), and by Scott McMillan, who are permitted by the USFWS to handle federally listed vernal pool plant species for purposes of habitat restoration.

In February and March 2006, the restoration and enhancement vernal pools were seeded with species collected from the site and from pools near Otay Lake. Species seeded into the pools included annual hairgrass (*Deschampsia danthonioides*), toothed downingia, and adobe popcorn flower (*Plagiobothrys acanthocarpus*)

3.3.2 Upland Plant Communities

Planting of the restoration areas was scheduled for the winter of 2005. Since the site was not irrigated, planting needed to coincide with forecasted rain events. Significant rainfall did not occur until late in the season, (February 2006) and rainfall was sporadic through the spring. The San Diego region received less than half normal rainfall for the year. Since supplemental irrigation was not available, the restoration biologists recommended holding off on planting until the winter of 2006/2007 to ensure that plantings could become established and survive.

Planting of upland plant species took place between January 8 and February 1, 2007. Sweetwater Authority then seeded the site with Otay tarplant donated from the State Route 125 project. The 2006-2007 rainy season was also very dry, and irrigation of plantings with a water truck was necessary and funded by the Sweetwater Authority to ensure survival of the planted container stock. Plant material and planting rates for the project site are included in Table 1. Upland species were grown from seed or cuttings collected from the Otay River Valley area of southern San Diego County.

Image source: Copyright 2004 AirPhotoUSA, LLC, All Rights Reserved (flown April 2004)

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Restoration and Enhancement Area Boundary

Restored Vernal Pools

Enhanced Vernal Pools

FIGURE 3

Vernal Pool Restoration Area

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PHOTOGRAPH 3
Vernal Pool Grading,
September 2005

TABLE 1
PLANTS INSTALLED JANUARY AND FEBRUARY 2007

Species	Container Size	Number Installed
Allium praecox	4"	3500
Bloomeria crocea	4"	3500
Chlorogalum parviflorum	4"	3500
Calochortus splendens	4"	3000
Dichelostemma capitata	4"	3500
Deinandra conjugens	Seed	47.1 lbs
Zigadenus fremontii	4"	3000
Nassella pulchra / Chlorogalum parviflorum	Rose Pot	3000
Nassella pulchra / Bloomeria crocea	Rose Pot	3000
Nassella pulchra / Calochortus splendens	Rose Pot	500
Nassella pulchra / Dichelostemma capitata	Rose Pot	500
Nassella lepida / Chlorogalum parviflorum	Rose Pot	3000
Nassella lepida / Bloomeria crocea	Rose Pot	3000
Nassella lepida / Calochortus splendens	Rose Pot	500
Nassella lepida / Dichelostemma capitata	Rose Pot	500
Bothriochloa barbinodis	Rose Pot	200
Muhlenbergia rigens	Rose pot	100
Sisyrinchium bellum	Rose pot	500
Adolphia californica	1 gallon	20
Ferocactus viridescens	4"	100
Mirabilis californica	1 gallon	200
Rhamnus crocea	1 gallon	20
Sidalcea malvaeflora	1 gallon	100
Solanum parishii	1 gallon	10

3.4 Maintenance Activities

3.4.1 Weed Control

Weed control was a primary concern following vernal pool restoration from the winter of 2006 through the summer of 2007. Field crews, ranging in size from 3 to 7 personnel, conducted weed control over 25 separate days from March 2006-August 2007. The primary weeds removed from the vernal pools included wild oats (*Avena* sp.), loose-strife (*Lythrum hyssopifolium*), ryegrass species (*Lolium* spp.), rabbits-foot grass (*Polypogon monspeliensis*), Russian thistle (*Salsola tragus*), and sand spurrey (*Spergularia bocconii*). Upland problem species removed included scarlet pimpernel (*anagallis arvensis*), wild oats, filaree (*Erodium* spp.), Crete Hedypnois (*Hedypnois cretica*), ryegrass, tumbleweed (*Salsola tragus*), and brome (*Bromus madritensis*).

Weed species were hand pulled from vernal pool basins. The weeds were bagged and removed from the site. Weeds in the upland areas were sprayed with herbicide. No herbicide was applied to weeds in the basins.

3.4.2 Trash Removal

Trash at this site has been negligible due to the fenced property boundary of Sweetwater Reservoir. A public riding and hiking trail traverses the southern boundary of the restoration site that presumably is the cause of the errant soda can, shopping bag, or miscellaneous paper goods that are occasionally found on-site. When encountered, this debris has been collected and removed in conjunction with periodic weeding efforts.

3.5 Artificial Burrow Installation

Modeled after similar burrowing owl recovery efforts on Otay Mesa, Sweetwater Authority took the opportunity to incorporate habitat for burrowing owl into the restoration site. Prior to the planting described in Section 3.3.2, Sweetwater Authority staff constructed and installed 15 artificial burrows. Burrow sites were coordinated with Scott McMillan to avoid any conflict with Otay tarplant and vernal pool restoration goals. Burrows quickly became occupied, including the successful use of one of the burrows for nesting. A summary report of this burrowing owl recovery effort is provided as Appendix A.

4.0 Monitoring Methods

Monitoring data has been collected by Scott McMillan to determine the success of the restoration activities to date. Representative images of the restoration complex over time are included in Photographs 4-14.

4.1 Tarplant/Grasslands

The tarplant grasslands were monitored for species cover and diversity. A total of two permanent transects were established to monitor grassland conditions, Otay tarplant populations, and exotic species.

PHOTOGRAPH 4
Looking East, Prior to Restoration, August 2004

PHOTOGRAPH 5
Looking East, Following Intitial Weed Control, October 2004

PHOTOGRAPH 6
Looking East, Two Years Following Vernal Pool Grading, October 2007

PHOTOGRAPH 7
Looking South, Prior to Restoration,
August 2004

PHOTOGRAPH 8
Looking South, Six Months Following Vernal Pool Grading,
March 2006

PHOTOGRAPH 9
Looking West, Prior to Restoration, August 2004

PHOTOGRAPH 10
Looking West, Following Intitial Weed Control, October 2004

PHOTOGRAPH 11
Looking West, Six Months Following Vernal Pool Grading, March 2007

PHOTOGRAPH 12
Looking West, Prior to Restoration, August 2004

PHOTOGRAPH 13
Looking West, Following Intitial Weed Control, October 2004

PHOTOGRAPH 14
Typical Vernal Pool, Six Months Following Grading, March 2006

4.2 Vernal Pool Uplands

The upland areas surrounding and supporting the vernal pools were also monitored for native and exotic species cover and diversity. One permanent transects was established to monitor these areas.

4.3 Vernal Pools

Vernal pools were surveyed for vernal pool plant and animal species. Surveys for vernal pool fauna were conducted during the aquatic phase of each pool to determine the presence of vernal pool animals. Vernal pool vegetation surveys were conducted within 30 days of the disappearance of standing water. The diversity and cover of vernal pool and non-native species was measured using the Braun-Blanquet cover abundance relevé method (Braun-Blanquet 1932; McMillan Biological Consulting 2001). In addition, the pools were monitored for duration of ponding, ponding depth, and for the presence of fairy shrimp.

5.0 Results and Discussion

Vernal pool and grassland/tarplant habitat are being successfully restored at the Sweetwater Reservoir site. Eleven pools with approximately 8,291 ft^2 of vernal pool surface area have been restored or enhanced within the restoration site (see Figure 3), and an Otay tarplant population and native grasslands are making progress toward restoration goals. Of the 11 restored vernal pools, six were newly restored pools, with an approximate surface area of 3,929 ft^2, exceeding the requirement of 900 ft^2 of vernal pool surface area restoration.

During the 2006 to 2007 rainfall year, pools 1, 2, 3, 5, 6, and 7 ponded for one to three weeks (Table 2). These pools had a maximum ponding depth of between 2.0 and 5.5 inches. San Diego fairy shrimp (*Branchinecta sandiegonensis*) were observed in four of the six ponded basins (see Table 2; Figure 4). It is anticipated that during a normal rainfall year, all of the restored/restored pools will pond, and over time all of the pools should support San Diego fairy shrimp.

Image source: Copyright 2004 AirPhotoUSA, LLC. All Rights Reserved (flown April 2004)

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Restoration and Enhancement Area Boundary

Restored/Enhanced Vernal Pools

Ponded 2007

San Diego Fairy Shrimp Present

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FIGURE 4

Vernal Pool Ponding
and Fairy Shrimp Results

TABLE 2
2007 SWEETWATER RESERVOIR RESTORATION VERNAL POOLS FAIRY SHRIMP AND HYDROLOGY DATA

FAIRY SHRIMP AND HYDROLOGY	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8	VP 9	VP 10	VP 11
NUMBER OF WEEKS PONDED	2	2	3	0	1	1	1	0	0	0	0
MAXIMUM DEPTH (INCHES)	4.5	4.0	5.5	0	2.0	3.0	3.5	0	0	0	0
SAN DIEGO FAIRY SHRIMP PRESENT	no	yes	yes	no	no	yes	yes	no	no	no	no

The results of qualitative and quantitative analyses and a comparison to the success criteria are included below.

5.1 Tarplant/Grasslands

Following two years of intensive weed control and six months following planting and seeding, the upland Otay tarplant and grassland restoration area is progressing towards meeting the success criteria (Tables 3 and 4).

5.1.1 Non-native Cover

Non-native plant cover was 21 percent, above the final year success criteria of no more than 10 percent. Intensive weed control activities will continue for the remainder of the maintenance and monitoring period to achieve this goal.

5.1.2 Native Cover and Diversity

Native tarplant and grassland species accounted for 59 percent of the cover in the tarplant/grassland restoration area. This level of native plant cover is on target for achieving 80 percent cover after five years. Approximately 22 percent of the total cover is represented by Otay tarplant. It is anticipated that Otay tarplant cover will increase greatly during a normal rain year. Approximately 7 percent of the cover was represented by shrubs, within the 10 percent requirement.

The native cover of the tarplant grassland area is currently comprised of 17 species listed in Table 3 of the Plan (see Table 1). Supplemental planting and seeding will be performed in the winter of 2007-2008 to achieve the goal of 25 species.

TABLE 3
2007 VEGETATIVE COVER OF THE SWEETWATER RESERVOIR FOR TARPLANT/NATIVE GRASSLAND RESTORATION AREA

Native Species	Percent Cover
Bloomeria crocea	
- common goldenstar	4
Convolvulus simulans	
- small-flowered morning-glory	5
Dienandra conjugens	
- Otay tarplant	22
Dienandra fasciculata	
- common tarplant	9
Eremocarpus setigerus	
- dove weed	2
Isocoma menziesii	
- coastal goldenbush	5
Lotus scoparius	
- deerweed	2
Mirabilis californica	
- coastal wishbone plant	4
Nasella pulchra	
- purple needlegrass	6
TOTAL	**59**

TABLE 4
2007 EXOTIC VEGETATIVE COVER OF THE SWEETWATER RESERVOIR FOR TARPLANT/NATIVE GRASSLAND RESTORATION AREA

Non-native Species	Percent Cover
Anagalis arvensis	
- scarlet pimpernel	3
Avena spp.	
- wild oats	4
Erodium spp.	
- filaree	5
Hedypnois cretica	
- Crete Hedypnois	1
Lolium spp.	
- rye grass	2
Salsola tragus	
- tumbleweed	4
Bromus madritensis	
- rip-gut grass	2
TOTAL	**21**

5.2 Vernal Pool Uplands

Following two years of intensive weed control and six months following planting and seeding, the vernal pool upland area is progressing towards meeting the success criteria (Tables 5 and 6).

5.2.1 Non-native Cover

Non-native plant cover was 15 percent, above the final year success criteria of no more than 10 percent. Intensive weed control activities will continue for the remainder of the maintenance and monitoring period to achieve this goal.

5.2.2 Native Cover and Diversity

Native species accounted for 62 percent of the cover in the upland area supporting the vernal pools. This level of native plant cover is on target for achieving 80 percent cover after five years. Approximately 10 percent of this is represented by Otay tarplant, meeting the success criteria. It is anticipated that Otay tarplant cover will increase greatly during a normal rain year. Approximately 11 percent of the total cover is represented by shrubs, within the 40 percent maximum, meeting the requirement.

The native cover of the vernal pool upland area is currently comprised of 17 species listed in Table 3 of the Plan (see Table 1). Supplemental planting and seeding will be performed in the winter of 2007 to 2008 to achieve this goal.

5.3 Vernal Pool Basins

Cover of native vernal pool indicator species was approximately 54 percent, on track to meet the 75 percent cover requirements by Year 5 (Table 7). Exotic species cover averaged less than 10 percent (Table 8).

TABLE 5
2007 VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOL UPLAND RESTORATION AREA

Native Species	Percent Cover
Baccharis pilularis - coyote brush	2
Bloomeria crocea - common goldenstar	1
Brodiaea jolonensis - mesa Brodiaea	1
Dienandra conjugens - Otay tarplant	10
Dienandra fasciculata - common tarplant	15
Eremocarpus setigerus - dove weed	9
Juncus acutus - southwestern spiny rush	4
Lotus scoparius - deerweed	2
Nasella pulchra - purple needlegrass	11
Rhus integrifolia - lemonade berry	7
TOTAL	**62**

TABLE 6
2007 EXOTIC VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOL UPLAND RESTORATION AREA

Non-native Species	Percent Cover
Avena spp. - wild oats	1
Erodium spp. - filaree	5
Hedypnois cretica - Crete Hedypnois	1
Lolium spp. - rye grass	4
Salsola tragus - tumbleweed	3
Bromus madritensis - rip-gut grass	1
TOTAL	**15**

TABLE 7
2007 VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOLS
(Percent Cover)

NATIVE INDICATOR SPECIES	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8	VP 9	VP 10	VP 11
Callitriche marginata - water starwort	1				1				1		
Crassula aquatic - pygmy weed	1	1	1		1	1	1	5	1	1	
Deschampsia danthonioides - annual hairgrass		1		1							
Downingia cuspidata - Downingia	1		1	1							
Eleocharis macrostachya - spikerush		5		1				35	75	10	2
Epilobium pygmaeum - smooth boisduvalia						1	1		1		
Juncus bufonius - toad rush	3	5	5	5	1	1	3	1		1	3
Plagiobothrys acanthocarpus - adobe popcorn flower	70	80		65	5				5		10
Psilocarphus brevissimus - woolly marbles			50		65	40	20				
Verbena bracteata - Verbena				1		1					
TOTAL	**76**	**92**	**57**	**74**	**73**	**44**	**25**	**41**	**83**	**12**	**15**

TABLE 8
2007 EXOTIC VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOLS
(Percent Cover)

NON-NATIVE SPECIES	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8	VP 9	VP 10	VP 11
Avena spp. - wild oats							1		1		
Lythrum hyssopifolium - loosestrife	1	1	1	5	3	5	1	5		1	3
Lolium spp - rye grass			1	1	3			1	5	5	
Polypogon monspeliensis - annual beard grass						1					
Salsola tragus - tumbleweed		1								2	2
Spergularia bocconii - sand spurrey	2	1	1	5			1	1	5		
TOTAL	**3**	**3**	**3**	**11**	**6**	**6**	**3**	**6**	**11**	**8**	**5**

5.3.1 Special Requirements

The 14 species listed in Table 4 of the Plan are required to have a cover of 5 percent in at least one of the vernal pools. As of the spring of 2007, five species meet this requirement (see Table 7): pygmy weed (*Crassula aquatica*) with 5 percent cover in pool 8; spikerush (*Eleocharis macrostachya*) with 5 percent or greater cover in pools 2, 8, 9, 10, and 11; toad rush (*Juncus bufonius*) with 5 percent cover in pools 2, 3, and 4; adobe popcorn flower with 5 percent or greater cover in pools 1,2, 4, 5, 9, and 11; and woolly marbles (*Psilocarphus brevissimus*) with 20 percent or greater cover in pools 3, 5, 6, and 7.

Toothed downingia was to have a cover of at least 5 percent in five of the restored basins. The spring season following seeding, this species had 1 percent cover in three basins (basins 1, 3, and 4). Additional seed will be collected and introduced into the remaining basins to achieve this criterion.

Spreading navarretia is to have at least 5 percent cover in all of the restored basins. This species did not occur in any of the pools in the spring of 2007. Seed will be applied in the winter of 2007 and 2008 and additional seed collected and dispersed to achieve this criterion.

6.0 Conclusion

The restoration and enhancement of 2.70 acres of vernal pool complex and 4.36 acres of Otay tarplant is being successfully implemented at the Sweetwater Reservoir mitigation site. Site preparation through intensive weed control began in the fall of 2004, followed by vernal pool grading in the fall of 2005, seeding in early 2006, and planting in early 2007.

During monitoring in the spring of 2007, San Diego fairy shrimp were observed in four of the six basins that ponded during this very dry year. Cover of native plant species within the uplands is at appropriate levels for this stage of the restoration process; however, plant diversity will be increased through supplemental planting in the winter of 2007-2008. In addition, weed levels were slightly higher than the final success criteria, and continued weed control efforts will be needed to achieve the success criteria.

Cover of vernal pool indicator species was also at appropriate levels for this stage in the restoration process. Cover levels for target species, including toothed downingia and spreading navarretia, will require supplemental seeding in the winter of 2007-2008 to achieve success criteria.

A normal rainfall season will also improve overall results for the restoration areas. Supplemental planting and seeding efforts are planned for winter 2007-2008, and intensive weed control efforts will continue to ensure success of the Sweetwater vernal pool and Otay tarplant restoration project.

7.0 References Cited

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2004 Requirements for Vegetation Cover and Diversity. Attachment to Request for Proposal, Restoration and Management Plan for Vernal Pool and Otay Tarplant Habitat. Sweetwater Authority. January 16.

2001 Restoration and Management Plan for Vernal Pool and Otay Tarplant Habitat at the Sweetwater Reservoir. December 14.

APPENDICES

APPENDIX A

Sweetwater Reservoir Burrowing Owl Recovery
Project Summary

Prepared by
Peter Famolaro, Sweetwater Authority
September 24, 2007

Goal: The burrowing owl (*Athene cunicularia*) recovery project at Sweetwater Reservoir was initiated in an attempt to restore the species to its former occupied habitat. This project is in support of the future Joint Water Agency Natural Community Conservation Plan/Habitat Conservation Plan (JWA NCCP/HCP), which will provide protection and management for a number of sensitive plants and animals, including the burrowing owl. Through conservation and management, the JWA NCCP/HCP will protect, manage, and/or help recover species from extinctions and secure necessary permits to continue Sweetwater's water storage, production, and distribution operations. Burrowing owl recovery is being undertaken at this time as a "good faith" effort toward these future NCCP/HCP obligations.

Project location: Built in 1888, Sweetwater Reservoir is located in south coastal San Diego County along the western base of San Miguel Mountain (Figure 1). Spring Valley borders the reservoir to the west and northwest, with the community of Bonita located to the south. The San Diego National Wildlife Refuge Otay-Sweetwater Unit (SDNWR) adjoins almost half of the southerly and easterly reservoir property boundaries.

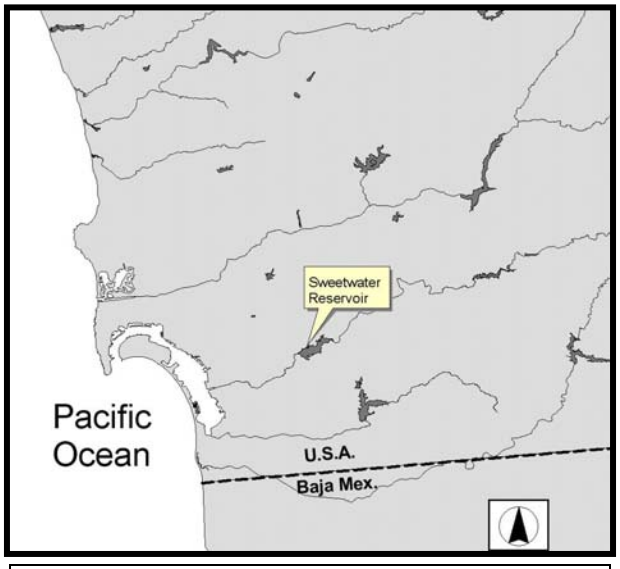

Figure 1: Location of Sweetwater Reservoir

Project setting: Sweetwater lands that surround the reservoir's aquatic habitat include regionally significant vernal pools, grasslands, coastal sage scrub, and riparian habitats. The burrowing owl recovery project area occurs within expansive grassland that continues onto the neighboring Refuge (Figure 2). The grassland community mostly exists in a disturbed state due to former agricultural activity and the proliferation of non-native grasses and forbs. Native grassland flora in varying density and distribution is also present as a relic example of its once pristine condition.

The site is within a seven-acre active vernal pool and native grassland habitat restoration area that provides mitigation for impacts associated with the Sweetwater Reservoir Shoreline Fishing Program (Sweetwater Authority 2001). As part of this restoration effort, formerly disturbed vernal pools and non-native grasslands were dethatched, a process which removes built up layers of dead grasses, weeds, and organic

matter, to allow for natural plant recruitment and/or supplemental planting to restore the native plant communities. Vernal pools were re-contoured to improve ponding and vernal pool species recovery. These continuing vernal pool mitigation services are

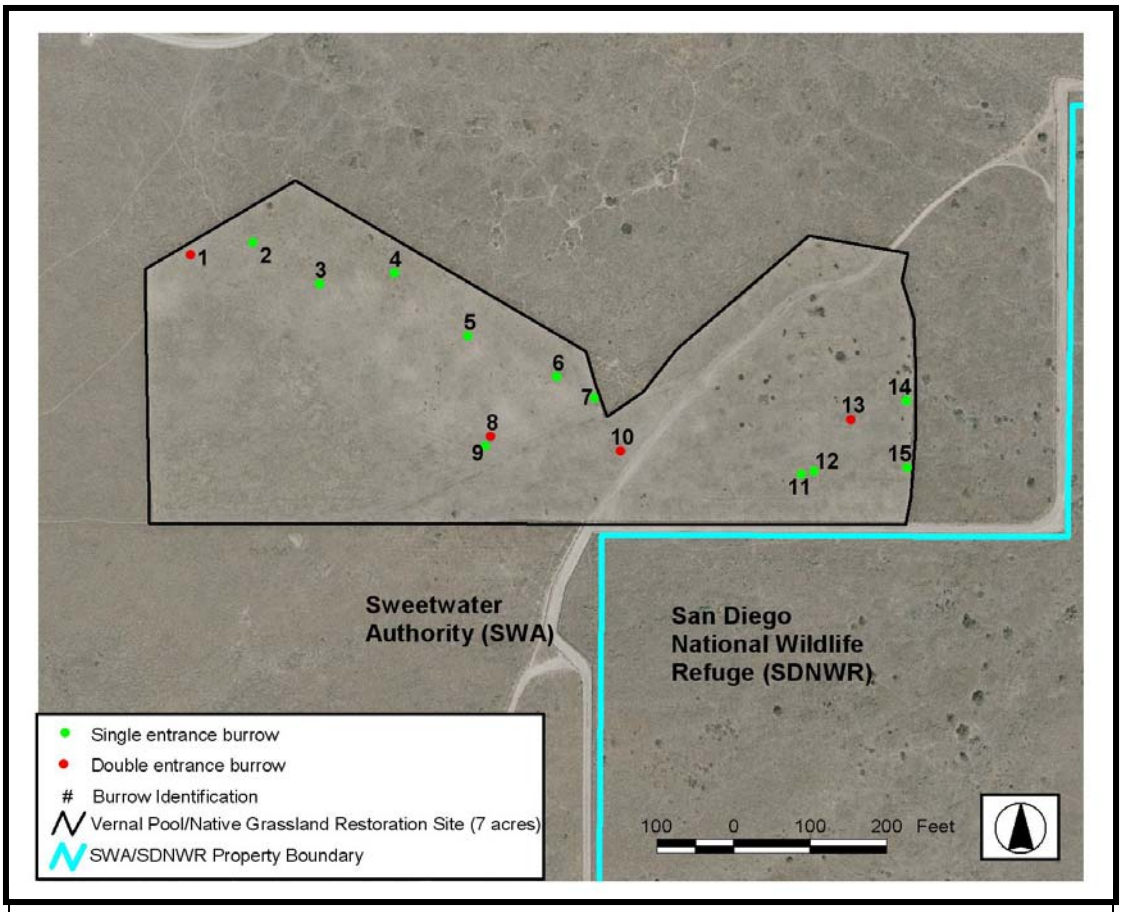

Figure 2: Burrowing Owl Artificial Burrow Complex

performed by RECON and McMillan Biological Services with Sweetwater Authority providing guidance and project oversight.

Species status: Although not formally listed as Threatened or Endangered, the western subspecies (*A. c. hypugaea*) is considered a federal and state Species of Concern. A statewide census in 1991-1993 estimated 9,266 pairs of burrowing owls in California with 71% and 24% residing in the Imperial and Central Valleys, respectively. The California Burrowing Owl Consortium indicates that the species has disappeared from a significant portion of its range (http://www2.uscs.edu/scpbrg/burrowingowls.htm). Recently the North American Breeding Bird Survey has detected a 6% increase in the California population (Sauer et. al. 2007). However, this increase is attributable primarily to large, expanding populations in the Imperial Valley. If the Imperial Valley data is disregarded, the overall statewide population is declining at an annual rate of 16.5% (Conway 2007). Population declines have been primarily attributed to the loss of habitat due to expansive land development, loss of burrow sites, and use of pesticides to control ground squirrels and other rodents.

In San Diego County, the current population has declined ten-fold since 1970. The population is currently estimated at 25-30 pairs (Wildlife Research Institute Inc.) with resident birds known to Naval Base Coronado (a.k.a. North Island), Otay Mesa, and the Ramona grasslands. Once common around the Sweetwater Reservoir, burrowing owls colonies were abandoned or became extirpated in the 1980s (D. Thomson pers. comm.). For the past decade, occurrence of the species on Sweetwater Reservoir property has been very rare, and each record has been only of a single wintering individual (P. Famolaro pers. obs.).

Project Design and Implementation: Sweetwater Authority took the opportunity to incorporate burrowing owl recovery within the required vernal pool and native grassland restoration/mitigation site (Figure 2). No burrowing owl impacts resulted from the fishing program improvements, and the burrowing owl recovery was not required or addressed by the project permits. Nonetheless, Sweetwater Authority believed the timing was appropriate to implement burrowing owl recovery to aid the imperiled species, while supporting future species management commitments under the JWA NCCP/HCP.

The seven-acre vernal pool and native grassland restoration site was dethatched in the late summer/fall of 2004, and vernal pools were recontoured in the following fall (2005). Drought conditions postponed planting until 2007, when an option to provide supplemental watering was developed. During this time, staff researched the use of artificial burrows to establish and sustain burrowing owls and collaborated with other wildlife professionals in burrow design, construction materials, number, and site specific arrangement. As originally planned, the burrowing owl recovery project would employ a passive attempt to restore the species by providing suitable nesting habitat and refugia, ultimately allowing for any migratory burrowing owls to find and occupy the site. Options to release salvaged burrowing owls that were injured and rehabilitated or removed due to over-predation on other locally managed species (e.g. California least tern *Sterna antillarum browni*) were later exercised.

The project planned for 15 artificial burrows scattered throughout the seven-acre site (Figure 2). The 15 burrows were thought to be able to support two to three burrowing owl pairs. Final burrow arrangement was decided in the field by the Sweetwater biologist with consultation from C. Winchell (U.S. Fish and Wildlife Services [USFWS]) and Scott McMillan (McMillan Biological Services - vernal pool restoration monitoring consultant). Proximity to vernal pools basins, elevation, soil texture, and slope were all considered in burrow placement. Burrows were placed primarily within natural mounded topography, mounds created from excess material generated during vernal pool recontouring, and sculpted mounds as excavated material was placed above each burrow system. Burrows were clustered, and distances between adjoining burrows ranged between 15 and 125 feet in order to provide maximum nesting options and protective refugia from predators.

Although other materials have been used successfully, Sweetwater chose wood as the preferred building material for this project. Burrows were constructed similarly to a full scale version provided by C. Winchell (USFWS) and modeled after Collins and Landry (1977). Constructed mainly of one-inch thick solid pine, each burrow contained a 2.25 cubic foot chamber (18 inches long x 18 inches wide x 12 inches deep) with six linear feet of access tunnel. The tunnels are six inches wide and 5.5 inches high, with a 90 degree angle four feet from the tunnel entrance to minimize light entering the chamber. Chamber and tunnel lengths were prefabricated at the Perdue Water Treatment Plant facility and transported to the field for final assembly. Some chambers were constructed with two entrances, one on each side of the chamber.

Burrow chamber sites were excavated with a compact excavator. Tunnel trenches were then hand dug with picks and shovels. Tunnel alignments were chosen and placed in a manner that would minimize erosion into the burrow. Each 90 degree tunnel angle was covered in two layers of burlap cloth to minimize soil instruction. Four burrows allowed for two tunnel entrances, and the remaining eleven were constructed with single entrances. Once in place, each artificial burrow system was buried using a tractor with bucket attachment and contoured to a natural topographical appearance with hand rakes. Chambers were covered with at least 12 inches of soil for thermoregulation purposes. Soil was placed up to the burrow entrance to camouflage the access tunnels. To further conceal the burrows by mimicking adjacent soil surface, available cobble and rock fragments were collected and placed on top of the burrow mounds.

Burrow construction and installation by Sweetwater Habitat Maintenance staff took approximately one week and was complete by mid-December 2006. Planting by RECON with various native grasses, bulbs, and shrubs was then implemented in January 2007.

Results: Periodic monitoring of the site by the Sweetwater biologist was initiated immediately following installation of the artificial burrows. As of August 2007, six adult and two fledgling burrowing owls were present within and using the artificial burrow complex. All of these adults were from natural immigration and the fledglings from successful nesting within one of the artificial burrows. With the exception of burrow #7, all other 14 artificial burrows have evidence of burrowing owl use by observations of an actual owl and/or owl castings at the entrance. One of the burrows was successfully used for nesting in which the two young mentioned above were fledged.

A monthly summary of the burrowing owl accounts recorded so far are as follows. All birds were observed as unbanded unless otherwise noted.

December 2006: A single burrowing owl was detected within the artificial burrow complex during the annual Audubon Christmas Bird Count on December 16, less than one week following installation of the burrows. This bird was observed again on December 20.

January 2007: Single burrowing owl present on January 8 and 17.

February 2007: Single burrowing owl present on February 15. Two Project Wildlife burrowing owls (one from Camp Pendleton and one from eastern Chula Vista) were banded by USFWS (C. Winchell) and released to the project site also on February 15. These birds were placed in discrete artificial burrows, fed and held there one day before release. On this day, February 16, two other burrowing owls were observed together for a total of four burrowing owls onsite. The new bird was a male as determined by his noticeably paler underpart plumage. This male was then recorded within the site on February 22 and 26. On February 22, an additional owl was present within a complex of ground squirrel burrows (*Spermophilus beecheyi*) below the South Dike, approximately 2000 feet from the artificial burrow complex.

March 2007: A single banded burrowing owl was detected within the artificial complex on March 16 and 26.

April 2007: One and possibly two burrowing owls were detected at opposite ends of the artificial burrow complex on April 17.

May 2007: A male burrowing owl was detected within the artificial burrowing complex on May 9 and 11. This male was observed with a second bird, presumably female based on plumage, on May 22. Burrow investigation with a Peep-A-Roo® infrared video probe on loan from the U.S. Geological Survey Western Ecological Resource Center did not detect any nesting activity. Once inside the burrow, the probe's flexibility was limited and would not allow for complete viewing of the chamber.

June 2007: No data**.**

July 2007: Two burrowing owls were observed within the artificial burrow complex at opposite ends of the site on July 6. On July 17, two adults were again observed. A male, however, was exhibiting agitated behavior in the vicinity of the artificial burrow #1. Investigation of this burrow with a Peep-A-Roo® infrared video probe revealed a single burrowing owl chick, but the equipment did not contain necessary hardware to capture the images. A couple days later, July 19, a video capture device was set up, and images of the single chick were taken from burrow #1. The parents were simultaneously detected in the vicinity. In addition to this pair, a third adult burrowing

owl, also with male plumage, was detected at the opposite northeast end of the artificial burrow complex.

August 2007: Pair was recorded in the vicinity of burrow #1 on August 2. Investigation with the Peep-A-Roo® probe now found two chicks. On August 2, a second pair was also confirmed for a total of four adults within the artificial complex. By August 14, the two chicks had fledged and were photographed with their father by Anthony Mercieca. By August 17, the population had again increased when six adult burrowing owls were detected in addition to the two newly fledged young. From a higher mound, seven of these eight birds were observed simultaneously, and minutes later while approaching one of the occupied burrows, the Sweetwater biologist observed a second burrowing owl not previously counted. These results were corroborated by C. Winchell and J. Martin (USFWS) on August 21 during an evening attempt to capture and band the young and/or adults.

No predation or mortality of burrowing owls has been observed since inception of the recovery program, although two predatory attempts were observed. The first was on an adult owl from a Peregrine falcon (*Falco peregrinus*) on February 16, and the second was on the family group by a northern harrier (*Circus cyaneus hudsonius*) on August 17. In each case, all owls successfully retreated to their associated artificial burrow seconds prior to the intended predatory strike. No evidence of burrow excavation by coyotes (*Canis latrans*) or domestic dogs has been observed, and no vandalism has occurred.

Conclusions and Future Activities: The burrowing owl recovery project has been an extraordinary success to date and exemplifies Sweetwater's future NCCP/HCP management commitment. Within eight months of providing suitable habitat, the site was occupied by six adults and two fledgling owls. None of these were actively introduced. These owls apparently found the artificial burrow site suitable, as indicated by their successful use of the constructed wood boxes for nesting. Future evaluation of the population is planned at monthly intervals to determine if the site's current population stabilizes or continues to increase. Additional monitoring will be performed next spring/summer to assess the level of breeding activity.

To this end, modifications to the chamber boxes are planned for this fall to mitigate the limitations of the Peep-A-Roo® video probe and allow for more accurate and efficient assessment of nesting burrows. Modification will include installation of a 1 ¼-inch diameter PVC pipe from the top of the burrow mound into the lid of the burrow chamber. The pipe will be adapted with a threaded cap and buried just below the surface, or camouflaged with rocks and/or vegetation. The cap would be removable to allow insertion of the Peep-A-Roo® probe and thus allow for full, accurate assessment of any suspected nesting activity.

It is unknown where these adult owls that have occupied the Sweetwater site originated. Some may have been winter migrants who found a reason to stay, while others may be part of a regional southern California population. Adult recruitment during the breeding season is considered somewhat atypical and may suggest the presence of a displaced or transient owl population in the southern portion of San Diego County. Similar burrowing owl recruitment has also been recently identified at the State Route 125 vernal pool mitigation site on Otay Mesa, and the disturbance created by the highway construction may be facilitating burrowing owl movement between the Sweetwater and Otay Mesa sites (S. McMillan pers. comm.). Further evaluation through the use of color leg bands is recommended to determine any exchange between Otay Mesa and North Island populations and to provide useful species conservation and management data.

Concurrent with later burrowing owl recruitment, the immediately adjacent SDNWR had initiated a large scale, 30-acre, dethatching effort as part of vernal pool and native grassland habitat restoration effort. It has been theorized that this vegetative clearing may enhance burrowing owl habitat by opening up available foraging area (J. Martin pers. comm.). This clearing in concert with resident burrowing owls may have attracted any transient burrowing owls to the site, and thus would explain such rapid colonization.

The banded Project Wildlife birds did not stay on-site, and were last detected in March as described above. Their absence is not surprising given the relatively low success of such "hard release" attempts (C. Winchell, pers. comm.). Further release of captive owls should be accommodated only if necessary space is deemed available. Any such release should be performed as a "soft-release", where animals are provided with an adequate hacking cage and cared for until site habituation can be achieved.

The SDNWR is also undertaking burrowing owl recovery on its adjoining 30-acre site, with plans to install ten artificial burrows in late September 2007. In addition, Sweetwater has been working with the U.S. Army Corps of Engineers to restore 23 additional acres of vernal pools and interstitial grassland habitat. Installation of additional artificial burrows is intended for that project as well, and similar results are anticipated. The end result of all sites would be a significant contribution towards burrowing owl recovery, and possibly could help sustain the southern California coastal population of this severely restricted and compromised species.

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Sweetwater Authority Project Team:

Rick Alexander, Director of Environmental and Governmental Services
Cesar Alcaraz, Habitat Maintenance Crew Supervisor
Dennis Bostad, General Manager
Peter Famolaro, Biologist
Leslie Filippi, Communications Specialist
David Gallegos, Habitat Maintenance Worker I
Sue King, Communications Coordinator
Nick Molsberry, Biologist Intern
Troy Murphree, Senior Planner
Mark Rogers, Operations Manager
Don Thomson, Director of Water Quality
Sweetwater temporary labor crew

Project Collaborators:

Jeff Lincer, PhD. Wildlife Research Institute, Inc.
David Mayer, California Department of Fish and Game
John Martin, USFWS, San Diego National Wildlife Refuge Otay-Sweetwater Unit
Scott McMillan, McMillan Biological Consulting/EDAW
Anthony Mercieca, Wildlife Photographer
Joyce Remp, Project Wildlife
Clark Winchell, USFWS, MSCP BioMonitoring Program