Sweetwater Reservoir Vernal Pool and Otay Tarplant Restoration Status Report

Performance Period
(March 2009 to August 2010)

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
November 22, 2010

Meagan Olson
Restoration Biologist

TABLE OF CONTENTS

1.0 Summary **1**

2.0 Background **1**

2.1 Project Location **1**

2.2 Summary of Overall Project **1**

2.3 Responsible Party **5**

2.4 Mitigation Goals and Success Criteria **5**

2.4.1 Non-Native Cover 5
2.4.2 Tarplant/Grassland Cover and Diversity 5
2.4.3 Vernal Pool Upland Cover and Diversity 5
2.4.4 Vernal Pool Basin Cover and Diversity 6
2.4.5 Special Requirements for the Vernal Pool Basins 6

3.0 Plan Implementation **6**

3.1 Site Preparation **6**

3.2 Pool Restoration and Enhancement **8**

3.3 Revegetation **8**

3.4 Maintenance Activities **10**

3.4.1 Weed Control 10
3.4.2 Trash Removal 11

4.0 Monitoring Methods **11**

4.1 Tarplant/Grasslands **12**

4.2 Vernal Pool Uplands **12**

4.3 Vernal Pools **20**

5.0 Results and Discussion **20**

5.1 Tarplant/Grasslands **21**

5.1.1 Non-native Cover 21
5.1.2 Native Cover and Diversity 21

TABLE OF CONTENTS (cont.)

5.2 Vernal Pool Uplands **24**

5.2.1 Non-native Cover 28
5.2.2 Native Cover and Diversity 28

5.3 Vernal Pool Basins **28**

5.3.1 Special Requirements 28

6.0 Burrowing Owl Recovery **32**

7.0 Conclusion **35**

8.0 References Cited **37**

FIGURES

1: Regional Location 2
2: Project Location on USGS Map 3
3: Tarplant/Grassland and Vernal Pool Restoration Areas 4
4: Vernal Pool Ponding, Fairy Shrimp Results, and Transect Monitoring Locations 13

PHOTOGRAPHS

1: Dethatching Restoration Site, August 2004 7
2: Removing Cut Material, August 2004 7
3: Vernal Pool Grading, September 2005 9
4: Looking East, Prior to Restoration, August 2004 14
5: Looking East, Two Years Following Vernal Pool Grading, October 2007 14
6: Looking East, Four Years Following Vernal Pool Grading, March 2009 14
7: Looking South, Prior to Restoration, August 2004 15
8: Looking South, Six Months Following Vernal Pool Grading, March 2006 15
9: Looking South, Four Years Following Vernal Pool Grading, June 2010 15
10: Looking West, Prior to Restoration, August 2004 16
11: Looking West, Six Months Following Vernal Pool Grading, March 2006 16
12: Looking West, Four Years Following Vernal Pool Grading, June 2010 16
13: Typical Vernal Pool, Six Months Following Grading, March 2006 17
14: Typical Vernal Pool, Four Years Following Grading, June 2010 17
15: Looking Southwest, Tarplant/Grasslands Transect 1, June 2010 18
16: Looking Northeast, Tarplant/Grasslands Transect 2, June 2010 18
17: Looking West, Associated Uplands Transect 3, June 2010 19
18: Looking North, Tarplant/Grasslands Along Common Tarplant (*Deinandra fasciculata*) Control Boundary, August 2010 22

TABLE OF CONTENTS (cont.)

PHOTOGRAPHS (cont.)

19: Looking West, Common Tarplant (*Deinandra fasciculata*) Invasion, April 2009 25
20: Looking North, Associated Uplands, June 2010 25
21: Looking West, Restoration Site Overview, June 2010 26
22: Toothed Downingia (*Downingia cuspidata*) within Vernal Pool Nine, April 2010 33
23. Spreading Navarretia (*Navarretia fossalis*) within Vernal Pool Nine, May 2009 34

TABLES

1: Total Plant and Seed Quantities Installed by Size 10
2: Maintenance and Monitoring Tasks March 2009 through June 2010 11
3: 2010 Sweetwater Reservoir Restoration Vernal Pools Fairy Shrimp and Hydrology Data 20
4: 2010 Vegetative Cover of the Sweetwater Reservoir for Tarplant/Native Grassland Restoration Area 23
5: 2010 Exotic Vegetative Cover of the Sweetwater Reservoir for Tarplant/Native Grassland Restoration Area 23
6: 2010 Vegetative Cover Summary of the Sweetwater Reservoir for Tarplant/Native Grassland Restoration Area 23
7: 2010 Vegetative Cover of the Sweetwater Reservoir Vernal Pool Upland Restoration Area 27
8: 2010 Exotic Vegetative Cover of the Sweetwater Reservoir Vernal Pool Upland Restoration Area 27
9: 2010 Vegetative Cover Summary of the Sweetwater Reservoir Vernal Pool Upland Restoration Area 27
10: 2010 Vegetative Cover of the Sweetwater Reservoir Vernal Pools 29
11: 2010 Additional Vegetative Cover of the Sweetwater Reservoir Vernal Pools 30
12: 2010 Exotic Vegetative Cover of the Sweetwater Reservoir Vernal Pools 31
13: 2010 Vegetative Cover Summary of the Sweetwater Reservoir Vernal Pools 31

1.0 Summary

This report documents maintenance and monitoring activities for Year 5 (March 2009 to August 2010) and summarizes restoration activities to date 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 square feet (ft^2) of vernal pool surface area has been restored or enhanced, which includes 3,929 ft^2 of restored vernal pools. Overall, the vernal pool and Otay tarplant mitigation efforts have been moderately successful; however, all Year 5 final success criteria standards have not yet been achieved.

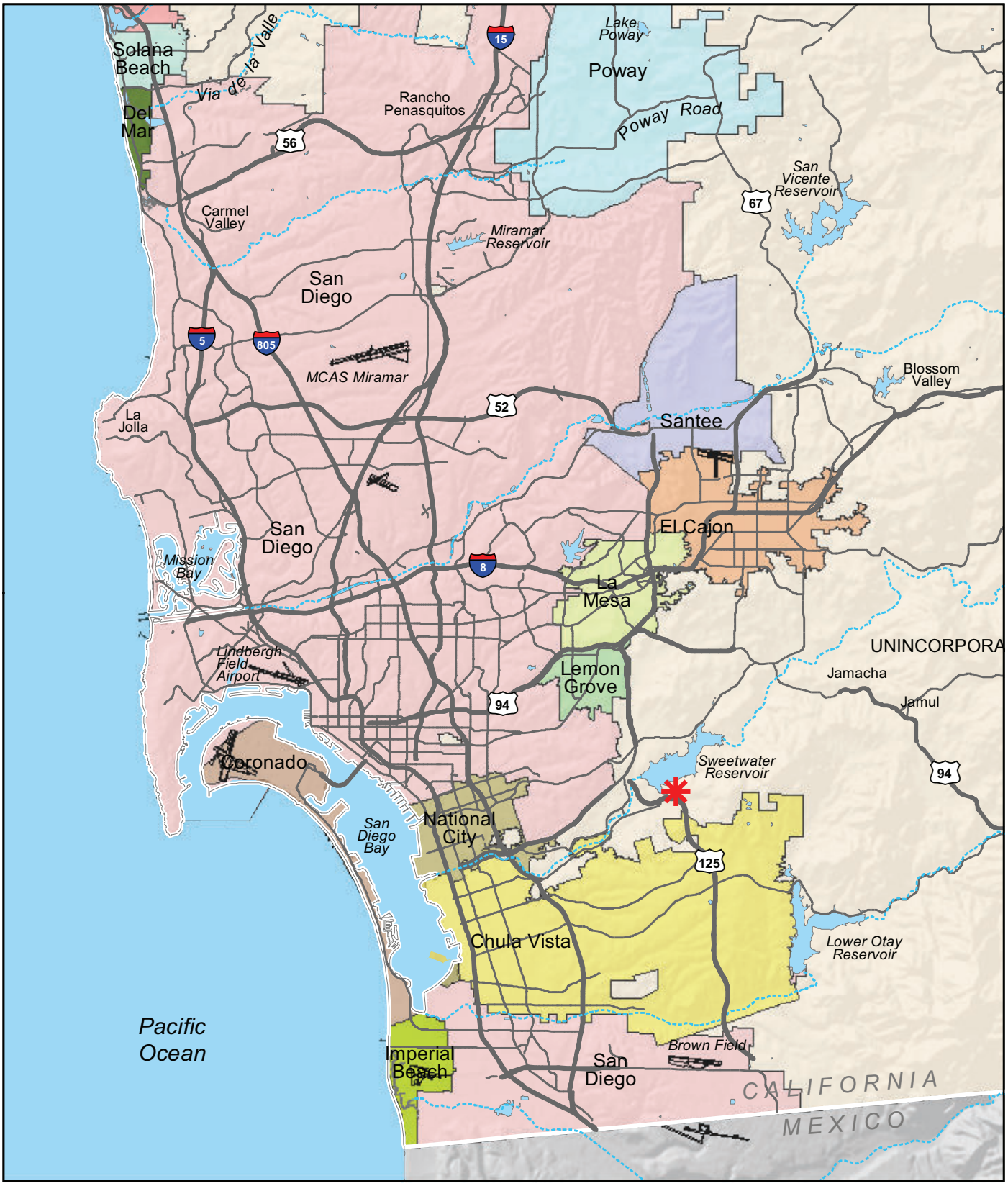
2.0 Background

2.1 Project Location

This 7.06-acre Sweetwater Authority (SWA) vernal pool (2.70 acres) and Otay tarplant (4.36 acres) 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 in San Diego County (Figures 1, 2, and 3).

2.2 Summary of Overall Project

This project is mitigation for impacts to vernal pools and Otay tarplant habitat from the development of a fishing program area on the southern portion of Sweetwater Reservoir (McMillan 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 2001). This document was used to guide all restoration practices implemented for this project.



Project Location

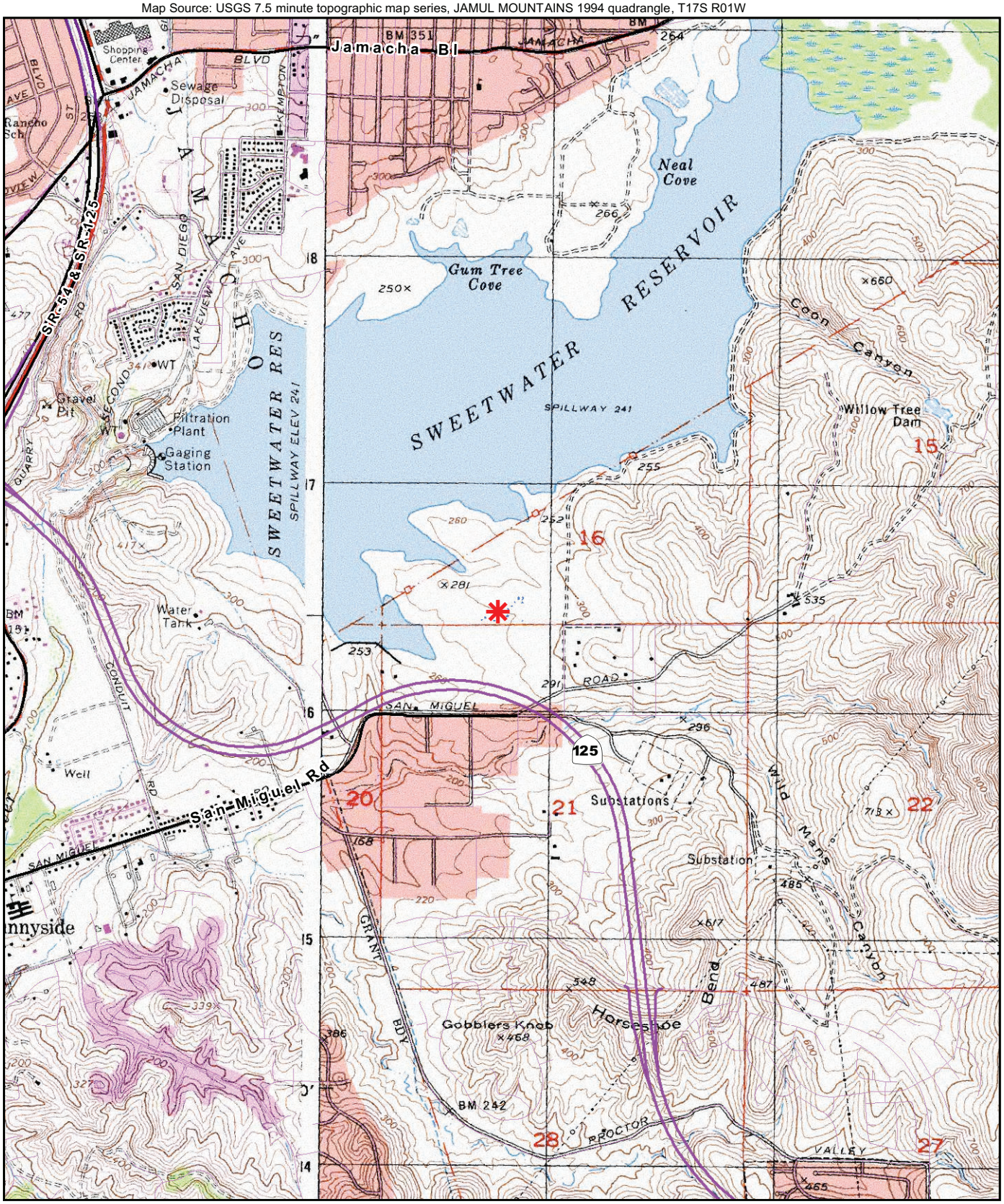
FIGURE 1

Regional Location

RECON

M:\JOBS2\3967\common_gis\fig1.mxd 9/2/2010

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



0 Feet 2,000

Project Location

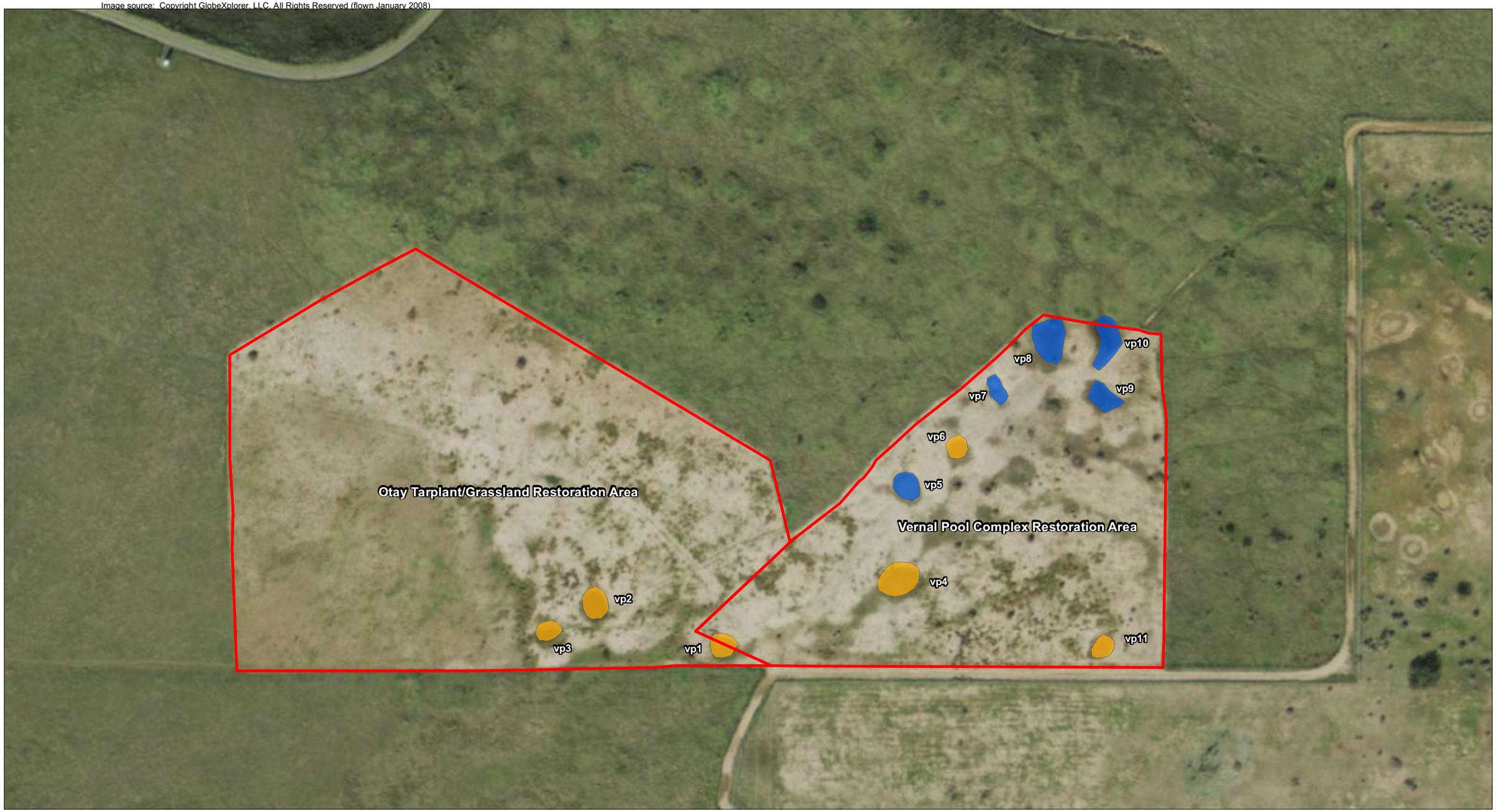
RECON

M:\JOBS2\3967\common_gis\fig2.mxd 9/2/2010

FIGURE 2

Project Location on USGS Map

Image source: Copyright GlobeXplorer, LLC. All Rights Reserved (flown January 2008)



0 Feet 100

Restoration and Enhancement Area Boundary

Restored Vernal Pools

Enhanced Vernal Pools

FIGURE 3

Tarplant/Grassland and Vernal Pool Restoration Areas

RECON

M:\jobs2\3967\common_gis\fig3.mxd 11/15/10

2.3 Responsible Party

Sweetwater Authority
Contact: Mr. Pete Famolaro
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 RECON biologists Meagan Olson, Raquel Atik, Anna Bennett, and Pete Famolaro of SWA.

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 in order to support vernal pools, their associated uplands, and Otay tarplant populations. Quantitative success criteria described in the Plan were focused on non-native cover values at or below 10 percent (McMillan 2001). More specific goals for vegetation cover and diversity were developed later during the contract proposal phase (McMillan 2004). Although not described in the project permits, these updated quantitative target values describe the measures for success of this restoration project.

2.4.1 Non-Native Cover

Non-native cover should not exceed 10 percent in any area.

2.4.2 Tarplant/Grassland Cover and Diversity

Native cover in the tarplant/grassland restoration area should be at least 80 percent, with at least 50 percent 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 percent 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 percent, with at least 10 percent cover represented by Otay tarplant. The remainder of the cover (at least 75 percent) should be represented by species listed in Table 3 of the Plan. No more than 40 percent 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 percent, represented only by those species listed in Table 4 of the Plan.

2.4.5 Special Requirements for the Vernal Pool Basins

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

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

Spreading navarretia (*Navarretia fossalis*) should have a cover of at least 5 percent in all of the restored basins, and should have a cover of at least 25 percent in at least five 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 2001). In summary, the site preparation methods included removal of accumulated weeds and thatch, follow-up herbicide spraying to control newly germinated weeds, grading of vernal pools, hand seeding, and container planting. A full description of restoration implementation activities is included in the 2007 Status Report (RECON 2008). A summary of past activities is included below.

3.1 Site Preparation

Removal of accumulated dried weedy thatch began in August 2004 before planting and seeding. Thatch was removed using line trimmers and then raked and disposed of off-site. Existing native species were carefully avoided during weed removal activities (Photographs 1 and 2).

PHOTOGRAPH 1
Dethatching Restoration Site,
August 2004

PHOTOGRAPH 2
Removing Cut Weed Material,
August 2004

Following thatch removal, germinating weed species were removed using herbicides, hand pulling, and line trimmers.

3.2 Pool Restoration and Enhancement

Suspended due to early heavy rainfall in fall 2004, vernal pool site grading did not begin until the following year. Beginning in September 2005, excess soil was removed from existing depressions to allow for greater ponding and water retention (Photograph 3). In November 2005, final minor final grading was performed. All grading activities were performed before the onset of winter rains. In total, 11 vernal pool basins were restored or enhanced, six of which were newly restored, resulting in a total of 8,201 square feet of restored vernal pool basins. All vernal pools were mapped with a handheld Global Positioning System (GPS) unit (Figure 3).

3.3 Revegetation

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*). Although annual hairgrass does not appear on Table 4 of the Plan, it is a desirable vernal pool plant species that was determined to be beneficial for restoration efforts.

Due to below-average rainfall during the winter of 2005/2006, planting of the tarplant/grassland and associated upland areas was postponed until the following winter. 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 purity of this seed became questionable as most areas seeded with this material produced common tarplant (*Deinandra fasciculata*), and in extremely dense quantities where it had not been observed before.

Upon recommendation from the project biologist, remedial planting was performed to aid in meeting success criterion for the restoration site. Remedial planting occurred on several occasions by both RECON and SWA in January 2008.

All plant species were chosen based on the species listed in Table 3 of the Plan, as well as other native species that would do well in clay soils and contribute to desired habitat characteristics and vegetation diversity in grasslands, vernal pool uplands, and vernal pools themselves. Planting methods generally followed those described in the Plan. A summary of plant material installed during initial site planting and remedial planting is

PHOTOGRAPH 3
Vernal Pool Grading,
September 2005

included in Table 1. Upland species were grown from seed or cuttings collected from the Otay River Valley area of southern San Diego County.

TABLE 1
TOTAL PLANT AND SEED QUANTITIES INSTALLED BY SIZE

Container Size	Number Installed
4 inch	22,450
Rose Pot	16,600
1 gallon	502
Cactus Cutting	6
Seed	114.1 lbs
Total Plants	**39,558**
Total Seed	**114.1 lbs**

3.4 Maintenance Activities

The focus of maintenance activities during this restoration performance period primarily included weed control and control of common tarplant. These activities are detailed below. Maintenance activities conducted from March 2009 through August 2010 are presented in Table 2.

3.4.1 Weed Control

Weed control was a primary concern throughout site restoration. From March 2009 through August 2010, both RECON and SWA field crews conducted intensive weed control within the site. The primary weeds removed from the vernal pools included loose-strife (*Lythrum hyssopifolium*), rabbits-foot grass (*Polypogon monspeliensis*), swamp prickle-grass (*Crypsis schoenoides*), harding grass (*Phalaris aquatica*), and horseweed (*Conyza canadensis*). Upland problem species removed included pigweed (*Amaranthus albus*), scarlet pimpernel (*Anagallis arvensis*), mustard (*Brassica nigra*), prickly lettuce (*Lactuca serriola*), wild oats (*Avena* sp.), filaree (*Erodium* spp.), Crete hedypnois (*Hedypnois cretica*), Russian thistle (*Salsola tragus*), horseweed, and brome (*Bromus* sp.). Weed control within the tarplant/grassland area focused on the removal of non-native species and the control of common tarplant. Common tarplant was targeted for control in an effort to reduce competition for Otay tarplant as common tarplant had become prolific within the tarplant/grassland area.

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 an herbicide approved for use around aquatic systems or were removed using line trimmers and

rakes. No herbicide was applied to weeds in the vernal pool basins. Table 1 provides the maintenance activities and the dates they were performed.

TABLE 2
MAINTENANCE TASKS
MARCH 2009 THROUGH AUGUST 2010

Date	Task
Mar. 30, 2009	Herbicide Application & Hand Pulling, RECON
Apr. 17, 2009	Herbicide Application, RECON
May 1, 2009	Herbicide Application – uplands, RECON
May 11, 2009	Hand Pulling – vernal pools, RECON
May 14 – July 28, 2009	Upland weed treatments and common tarplant removal, SWA
Jun. 26, 2009	Herbicide Application & Hand Pulling – vernal pools, RECON
Feb. 3 – 5, 2010	Herbicide Application - uplands, RECON
Feb. 3 – June 25, 2010	Upland weed treatment, common tarplant removal, hand pulling in vernal pools, SWA
July 20, 2010	Upland weed treatments, SWA

3.4.2 Trash Removal

Trash at the site has been negligible due to the fenced property boundary of Sweetwater Reservoir. When encountered, debris has been collected and removed in conjunction with periodic weeding efforts.

4.0 Monitoring Methods

Monitoring of the habitat restoration site involves both qualitative and quantitative monitoring. Qualitative monitoring was performed jointly by RECON and SWA biologist during respective site visits over the Year 5 performance period. Qualitative monitoring was performed at approximately monthly intervals. Qualitative monitoring entailed a general site assessment, including identification of site vandalism, problematic weed species, or other management issues requiring remedial action. In conjunction with qualitative monitoring visits, SWA performed inspection of the artificial burrows on-site at no less than monthly intervals and recorded use by the species as encountered. Except as noted below, quantitative sampling was performed by RECON biologists in spring and summer 2010. Quantitative sampling involved fairy shrimp surveys of the vernal pools in the wet season, vernal pool Relevé vegetation surveys, vernal pool and upland habitat vegetation transects, and photographic monitoring of the site. Specific shrimp sampling was performed on February 4, 24, March 17, and April 9, 2010. Vernal pool Relevé vegetation surveys were performed on April 30 and June 17, 2010. Vegetation sampling

for the vernal pool and upland habitats were conducted on May 13 and June 17, 2010, respectively.

No quantitative monitoring was performed in 2009, and, prior to 2010, the last quantitative sampling effort was in 2008 by McMillan Biological Consulting (RECON 2009). In 2010, SWA contract RECON to conduct quantitative monitoring. This was the first year that RECON was tasked with this, and efforts were made to replicate past monitoring efforts. Transect starting coordinates and compass headings were obtained from the previous sampling efforts then marked on an aerial photograph using Geographic Information System (GIS). This information was uploaded to a handheld GPS unit to find transect start and end points in the field. The Braun-Blanquet cover abundance Relevé method that was used in previous years was replicated and used to determine vernal pool plant cover (Braun-Blanquet 1932; McMillan 2001). Representative images of the restoration complex over time are included in Photographs 4 through 14.

It should be noted that most of the vegetation sampling was performed after major weed treatments were completed. Consequently, cover values presented do not fully represent the degree of ambient weed cover on the site.

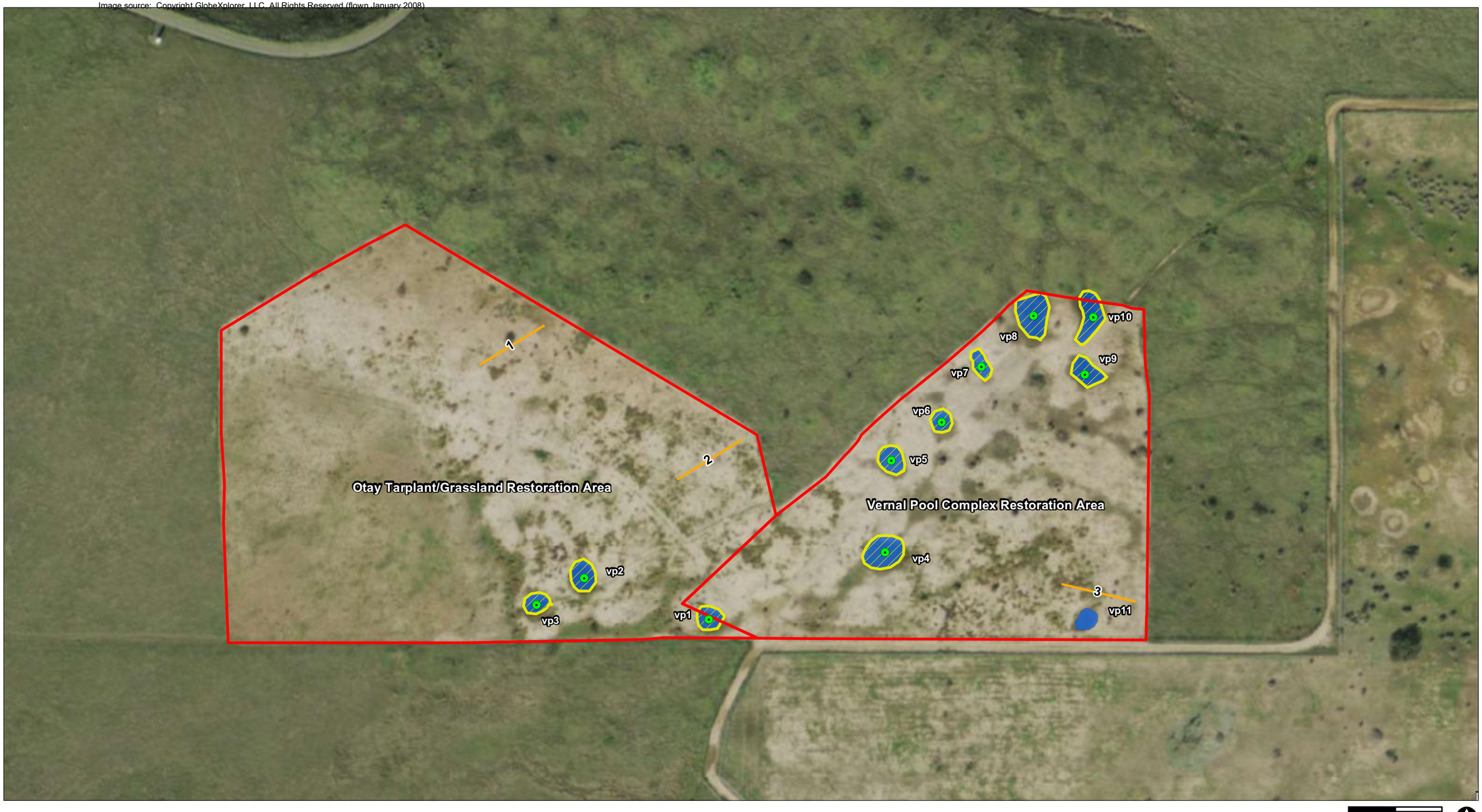
4.1 Tarplant/Grasslands

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 (Photographs 15 and 16; Figure 4). Point intercept data was taken every 0.5 meter along a 25 meter transect. This data was then used to determine vegetative cover. As supplementary monitoring, Otay tarplant coverage was visually estimated. The Otay tarplant boundary was delineated with a GPS unit by SWA, and coverage was estimated according to the Daubenmire cover classes: 0-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100% (Daubenmire 1959). Visual estimation was performed in August after the peak of Otay tarplant growing season.

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 transect was established to monitor these areas (Photograph 17; see Figure 4). The same methods were followed for the vernal pool uplands as for the tarplant/grasslands.

Image source: Copyright GlobeXplorer, LLC. All Rights Reserved (flown January 2008)



0 Feet 100

Restoration and Enhancement Area Boundary
Transects
Ponded 2010
Restored/Enhanced Vernal Pools
San Diego Fairy Shrimp Present

RECON

M:\JOBS2\3967\common_gis\fig4_10.mxd 11/15/2010

FIGURE 4

Vernal Pool Ponding, Fairy Shrimp Results, and Transect Monitoring Locations

PHOTOGRAPH 4
Looking East,
Prior to Restoration,
August 2004

PHOTOGRAPH 5
Looking East,
Two Years Following
Vernal Pool Grading,
October 2007

PHOTOGRAPH 6
Looking East,
Four Years Following
Vernal Pool Grading,
June 2010

PHOTOGRAPH 7
Looking South,
Prior to Restoration,
August 2004

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

PHOTOGRAPH 9
Looking South,
Four Years Following
Vernal Pool Grading,
June 2010

PHOTOGRAPH 10
Looking West,
Prior to Restoration,
August 2004

PHOTOGRAPH 11
Looking West,
Six Months Following
Vernal Pool Grading,
March 2006

PHOTOGRAPH 12
Looking West,
Four Years Following
Vernal Pool Grading,
June 2010

PHOTOGRAPH 13
Typical Vernal Pool, Six Months Following Grading,
March 2006

PHOTOGRAPH 14
Typical Vernal Pool, Four Years Following Grading,
June 2010

PHOTOGRAPH 15
Looking Southwest, Tarplant/Grasslands Transect 1,
June 2010

PHOTOGRAPH 16
Looking Northeast, Tarplant/Grasslands Transect 2,
June 2010

PHOTOGRAPH 17
Looking West, Associated Uplands Transect 3,
June 2010

4.3 Vernal Pools

Vernal pools were surveyed for vernal pool floral and faunal species. Surveys for vernal pool fauna were conducted during the aquatic phase of each pool to determine the presence of vernal pool faunal species. 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 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 restoration efforts have been moderately successful 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 the final performance 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 2009 to 2010 rainfall year, ten of the 11 pools ponded for 11 to 14 weeks (Table 3). The ten pools that ponded had a maximum ponding depth between 3.5 and 9.4 inches, with an average maximum depth of 4.7 inches. San Diego fairy shrimp (*Branchinecta sandiegonensis*) were observed in all ten of the ponded basins (see Table 3; see Figure 4), an increase of two pools from 2008 monitoring results. It is anticipated that, over time, all of the pools should support San Diego fairy shrimp.

TABLE 3
2008 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	11	11	11	11	14	11	14	11	11	11	0
Maximum Depth (Inches)	4.7	4.7	5.5	4.7	7.1	4.3	9.4	3.5	3.7	3.9	0.0
San Diego Fairy Shrimp Present	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no

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

5.1 Tarplant/Grasslands

After five years of intensive weed control and three years following planting and seeding, the upland Otay tarplant and grassland restoration area is progressing towards meeting the success criteria (Tables 4–6; Photograph 18). While native cover has decreased from the previous year, non-native cover has also decreased and exceeded the success criteria. Otay tarplant cover also decreased, but occupies a larger proportion of the vegetative cover.

5.1.1 Non-native Cover

Non-native plant cover was at 3.0 percent, which is much lower than the 17.5 percent cover for 2008 and below the final year success criteria of no more than 10 percent. Continued weed competition has been the primary management concern and has resulted in intense and on-going maintenance effort. During the 2009 to 2010 season, weed presence in the tarplant area has been high due to above-average rainfall levels and continued competition from adjacent weed-infested grasslands. It has also been observed that weeds common to wetland areas of the reservoir have dispersed to the site. Such seed dispersers may include the Canada goose (*Branta canadensis*), horned lark (*Eremophila alpestris*), American pipits (*Anthus rubescens*), and savannah sparrow (*Passerculus sandwichensis*), which have been observed in good numbers in both habitats on-site (P. Famolaro, pers. obs.).

5.1.2 Native Cover and Diversity

Native tarplant and grassland species accounted for 20 percent of the cover in the tarplant/grassland restoration area, a 44.5 percent decrease from the previous year. Although this level of native plant cover is much lower than the five-year success criteria of 80 percent cover, Otay tarplant represented 10 percent of the total cover and 50 percent of the vegetative cover. This was an 11 percent decrease from the total cover in the previous year; however Otay tarplant occupied a greater proportion of the vegetative cover, an increase of 17 percent from the previous year.

PHOTOGRAPH 18
Looking North, Tarplant/Grasslands along
Common Tarplant (*Deinandra fasciculata*)
Control Boundary, August 2010.

TABLE 4
2010 VEGETATIVE COVER OF THE SWEETWATER RESERVOIR FOR TARPLANT/NATIVE GRASSLAND RESTORATION AREA

Native Species	***Percent Cover***
Centaurium venustum - canchalagua	1.0
Dienandra conjugens - Otay tarplant	10.0
Lotus scoparius - deerweed	6.0
Nassella pulchra - purple needlegrass	3.0
TOTAL	**20.0**

TABLE 5
2010 EXOTIC VEGETATIVE COVER OF THE SWEETWATER RESERVOIR FOR TARPLANT/NATIVE GRASSLAND RESTORATION AREA

Non-native Species	***Percent Cover***
Brachypodium distachyon - purple false-brome	1.0
Conyza canadensis - horseweed	1.0
Crypsis schoenoides - swamp prickle-grass	1.0
TOTAL	**3.0**

TABLE 6
2010 TOTAL COVER SUMMARY OF THE SWEETWATER RESERVOIR FOR TARPLANT/NATIVE GRASSLAND RESTORATION AREA

Cover	***Percent Cover***
Rock/cobble and bare ground	77.0
Native vegetation	20.0
Non-native vegetation	3.0
TOTAL	**100**

Intensive control of non-native plants and common tarplant were priorities for the past two growing seasons, 2009 and 2010. The common tarplant control measures resulted in the decrease of native cover; however, common tarplant control was necessary to aid in establishing a larger population of Otay tarplant. Common tarplant cover within the tarplant/grassland was zero percent, where last year it represented 9 percent of the total cover and 14 percent of the vegetative cover. It is anticipated that Otay tarplant cover will increase as non-native plants and common tarplant are controlled.

Additionally, reseeding of selected portions of the tarplant/grassland area with Otay tarplant may be necessary. Approximately 6 percent of the cover was represented by shrubs, which meets the requirement of no more than 10 percent.

The native cover of the tarplant grassland area is currently composed of 33 observed species, with 19 of those from Table 3 of the Plan. This is a decrease of four species from last year and does not meet the success criteria of 25 species.

Two species that were observed within the tarplant grassland area, but were not on Table 3 of the plan, are California Native Plant Society (CNPS) listed species. These species include southwestern spiny rush (*Juncus acutus* ssp. *leopoldii*), which is a CNPS List 4.2 species, and San Diego marsh-elder (*Iva hayesiana*), which is a CNPS List 2.2 species. In addition, several species that were installed from container stock were observed in the tarplant/grasslands area, but were not included in Table 3 of the Plan, suggesting that these species are candidates to be included in Table 3.

Data presented in Tables 4 through 6 is a close comparison with previous monitoring efforts but may underestimate actual conditions on-site. Supplemental visual estimation performed in 2010 indicates approximately 35 percent of the total cover of the Tarplant/Grassland area is from Otay tarplant. This occurs in an extremely robust concentration in the western portion of the site (Figure 4 and Photograph 18). Additionally, prior to control efforts in 2009, common tarplant occupied between 50 and 75 percent of total cover on-site, including both the tarplant/grassland and vernal pool upland areas (Photograph 19).

5.2 Vernal Pool Uplands

After five years of intensive weed control and three years following planting and seeding, the vernal pool upland area is progressing towards meeting the success criteria (Tables 7–9; Photographs 20 and 21). While native cover has decreased from the previous year, non-native cover has also decreased and exceeded the success criteria. Native diversity also met the final success criteria.

PHOTOGRAPH 19
Looking West, Common Tarplant (*Deinandra fasciculata*) Invasion, April 2009

PHOTOGRAPH 20
Looking West, Restoration Site Overview, June 2010

PHOTOGRAPH 21
Looking West, Restoration Site Overview,
June 2010

TABLE 7
2010 VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOL UPLAND RESTORATION AREA

Native Species	***Percent Cover***
Nassella pulchra - purple needlegrass	18.0
TOTAL	**18.0**

TABLE 8
2010 EXOTIC VEGETATIVE COVER OF THE SWEETWATER RESERVOIR VERNAL POOL UPLAND RESTORATION AREA

Non-native Species	***Percent Cover***
Conyza canadensis - horseweed	2.0
TOTAL	**2.0**

TABLE 9
2010 TOTAL COVER SUMMARY OF THE SWEETWATER RESERVOIR FOR VERNAL POOL UPLAND RESTORATION AREA

Cover	***Percent Cover***
Rock/cobble and bare ground	80.0
Native vegetation	18.0
Non-native vegetation	2.0
TOTAL	**100**

5.2.1 Non-native Cover

Non-native plant cover was at two percent, which is a decrease from 13 percent cover for 2008 and below the final year success criteria of no more than 10 percent.

5.2.2 Native Cover and Diversity

Native species accounted for 18 percent of the cover in the upland area supporting the vernal pools, a decrease of 50 percent from the previous year. This level of native plant cover is much lower than the final year success criteria of 80 percent cover. Otay tarplant was not observed within the transect, which does not meet the success criteria and is a 15 percent decrease from the previous year. Shrubs were also not observed in the transect, meeting the requirement of no more than 40 percent of the cover being represented by shrubs.

The native cover of the vernal pool upland area is currently composed of 44 observed species, 27 of which are from Table 3 of the Plan. This is the same number of species from last year and meets the success criteria of 25 species. It should also be noted that two species that were observed from within the vernal pool uplands, but were not on Table 3 of the plan, are CNPS listed species. These species include southwestern spiny rush and small-flowered microseris (*Microseris douglasii* spp*. platycarpha*), both of which are CNPS List 4.2 species. Several species that were installed from container stock were observed in the vernal pool uplands area, but were not included in Table 3 of the Plan, suggesting that these species are candidates to be included in Table 3.

5.3 Vernal Pool Basins

Cover of native vernal pool indicator species was approximately 51 percent, which does not meet the Year 5 requirement of 75 percent cover (Table 10). Additional native plant species, though not necessarily vernal pool indicator species, present in the vernal pools are shown in Table 11. Exotic species cover averaged less than 3 percent (Table 12). A summary of vegetative cover is presented in Table 13.

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 spring 2010, five species meet this requirement (see Table 10): water starwort (*Callitriche marginata*), with 5 percent or greater cover in pool 8 and pool 10; spikerush (*Eleocharis macrostachya*), with 5 percent or greater cover in pools 1, 2, 3, 4, 8, 9, and 10; toad rush (*Juncus bufonius*) with 5 percent or greater cover in pools 1, 2, 9, and 10; adobe popcorn flower, with 5 percent cover in

TABLE 10
2010 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			10			1	1	10	
Crassula aquatic - pygmy weed								1	1	1	
Deschampsia danthonioides - annual hairgrass	1	1	2	2			1				
Downingia cuspidata - Downingia									1		
Eleocharis macrostachya - spikerush	15	5	15	15	1	1		5	15	30	
Epilobium pygmaeum - smooth boisduvalia											
Juncus bufonius - toad rush	10	15	1	1	1	1	2	4	10	8	
Navarretia fossalis - spreading navarretia									3	1	
Plagiobothrys acanthocarpus - adobe popcorn flower				1	1	5			1	1	2
Psilocarphus brevissimus - woolly marbles	20	50	40	30	30	27	60	2	40	40	20
Verbena bracteata - Verbena											
TOTAL	**46**	**72**	**58**	**49**	**43**	**34**	**63**	**13**	**72**	**92**	**22**

TABLE 11
2010 ADDITIONAL VEGETATIVE COVER OF SWEETWATER RESERVOIR VERNAL POOLS
(percent cover)

OTHER NATIVE SPECIES	***VP 1***	***VP 2***	***VP 3***	***VP 4***	***VP 5***	***VP 6***	***VP 7***	***VP 8***	***VP 9***	***VP 10***	*VP 11*
Baccharis pilularis - coyote brush					1		3	1			
Bloomeria crocea - golden stars						1					
Centaurium venustum - canchalagua									1		
Chamaesyce sp. - rattlesnake spurge	2						1				1
Dienandra fasciculata - common tarplant	1	1	1	7	10		2	1		1	
Eremocarpus setigerus - dove weed			1								
Gnaphalium palustre - lowland cudweed								1			
Lasthenia sp. - goldfields						1					
Lepidium sp. - peppergrass						1					
Microseris douglasii var. *platycarpha* - small-flowered microseris						1					
Nassella pulchra - purple needlegrass	1			1		1	1	1	1		
Plantago erecta - California plantain										1	
Scirpus californicus - California bulrush								1			
TOTAL	**4**	**1**	**2**	**8**	**11**	**5**	**7**	**5**	**2**	**2**	**1**

TABLE 12
2010 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											
Bromus hordeaceus - soft chess					1						
Conyza canadensis - horseweed						1		1			1
Crypsis schoenoides - swamp prickle-grass	1		1	1		1					
Lactuca seriola - prickly lettuce											1
Lythrum hyssopifolium - loosestrife	2	1		1	1		1	1			
Lolium spp - rye grass							1				
Phalaris aquatica - harding grass									1		
Polypogon monspeliensis - annual beard grass			1	1	1					1	
Salsola tragus - tumbleweed	1										
Sonchus oleraceus - sow-thistle										1	
Spergularia bocconii - sand spurrey											
Vulpia myuros - rat-tail fescue						1			1	1	
TOTAL	**4**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**

TABLE 13
2010 VEGETATIVE COVER SUMMARY OF THE SWEETWATER RESERVOIR VERNAL POOLS
(Percent Cover)

*COVER**	*VP 1*	*VP 2*	*VP 3*	*VP 4*	*VP 5*	*VP 6*	*VP 7*	*VP 8*	*VP 9*	*VP 10*	*VP 11*
Rock/cobble and bare ground**	46	26	38	40	43	58	28	80	24	3	75
Native indicator species	46	72	58	49	43	34	63	13	72	92	22
Other native species	4	1	2	8	11	5	7	5	2	2	1
Non-native species	4	1	2	3	3	3	2	2	2	3	2
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

* Absolute vegetative cover ** Not counted in vegetative cover

pool 6; and woolly marbles (*Psilocarphus brevissimus*), with 5 percent or greater cover in pools 1, 2, 3, 4, 5, 6, 7, 9, 10, and 11.

The goal for toothed downingia was a cover value of at least 5 percent in five of the restored basins. Three years after seeding, this species had 1 percent cover in one basin (basin 9; see Table 10; Photograph 22). Although not detected in quantitative sampling, tooth downingia was observed in low numbers in basins 1- 4 in previous quantitative monitoring (RECON 2008 and 2009) as well as basin 11 (P. Famolaro, pers. obs.).

The goal for spreading navarretia was a cover value of at least 5 percent in all of the restored basins. This species occurred in two of the pools in the spring of 2010 (basins 9 and 10; see Table 10; Photograph 23). It should be noted that the previous status report misstated that spreading navarretia was present in basin 7, when it was actually observed in basin 9 (RECON 2009).

6.0 Burrowing Owl Recovery

Fifteen artificial burrows for the western burrowing owl (*Athene cunicularia hypugaea*) were installed by SWA prior to planting in December 2006 and are an integral component of the habitat restoration project. The San Diego National Wildlife Refuge (SDNWR) installed another 10 burrows within the adjacent Shinohara parcel, which resulted in a total of 25 artificial burrows within the SWA-SDNWR complex (SWA 2009). No burrowing owls were regularly present within either site before installation of the burrows. Burrowing owls used the SWA site to breed successfully in the first season, 2007. For the past few years, burrowing owl use of the SWA site for breeding has not occurred. Rather, identified burrowing owl pairs have shown preference to the artificial burrows on the adjacent SDNWR. However, use by wintering owls for foraging and refuge has been constant on the SWA site since the burrows were installed. In 2010 after removing a large amount of common tarplant thatch from the site, a burrowing owl pair remained and may have attempted to breed (P. Famolaro, pers. obs.). Two burrows were lined with nest material and were occupied throughout the breeding season. No eggs or chicks were observed, although on one occasion a California kingsnake (*Lampropeltis getula californiae*) with a large, swollen abdomen was observed in one of the lined burrows, suggesting it may have consumed burrowing owl eggs or a chick(s) (P. Famolaro, pers. obs.). In total, four burrowing owl pairs occupied the joint SWA-SDNWR complex in 2010. At least two of these pairs breed successfully in 2010 on the SDNWR site. Overall, these joint SWA-SDNWR efforts have proven successful in establishing a breeding population.

In the past two years, California ground squirrels (*Spermophilus beecheyi*) have naturally colonized the site and are making use of several of the artificial burrows and

PHOTOGRAPH 22
Toothed Downingia (*Downingia cuspidata*) within
Vernal Pool Nine, April 2010

PHOTOGRAPH 23
Spreading Navarretia (*Navarretia fossalis*)
within Vernal Pool Nine, May 2009

associated mounds. Some burrows are taken over by ground squirrels, but this appears to be short term as burrowing owls have been found to later occupy these same burrows (P. Famolaro pers. obs). The ground squirrels are also increasing the number of burrow entrances and providing a potential prey base for burrowing owls and other predators in the area. This natural dynamic is precisely what was anticipated and increases the viability of an established burrowing owl colony.

7.0 Conclusion

The restoration and enhancement of 2.70 acres of vernal pool complex and 4.36 acres of Otay tarplant at the Sweetwater Reservoir mitigation site has been moderately successful, although the timing to meet target criteria has taken longer than anticipated. 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. Supplemental planting and seeding of the vernal pools and their associated uplands has also occurred at various times since initial planting. Weed competition, including common tarplant, continue to be the major management issue for the site. Consequently, no reduction in weed control efforts can be anticipated at this time.

Cover within the Otay tarplant/grasslands area was lower than the final success criteria, although a larger proportion of Otay tarplant was observed compared to past years where common tarplant was more abundant. A lower proportion of common tarplant within the vegetative cover was also observed compared to past years. The increase in Otay tarplant cover compared to common tarplant as well as the overall decrease in cover is a result of the intensive weed control efforts within the site. In addition, the number and length of transects only represent 0.3 percent of the site. With such a low proportion of the site being monitored for quantitative data, this data may not accurately represent the site. As an example, Photograph 18 shows an area of the site where tarplant covers portions of the tarplant/grasslands at a very high density. Photographs 19 and 20 also present an overview of the associated uplands (Photograph 19) and the associated uplands with the grassland/tarplant area in the distance (Photograph 20). These two photographs suggest that native cover is higher than the quantitative data suggests.

Weed control efforts have been very successful in reducing the cover of weed species in the tarplant/grassland area and it is anticipated that in the following years weed and common tarplant control will result in an overall increase in target native plant cover.

Cover of native plant species within the associated uplands is lower than the final success criteria; however, intensive common tarplant removal resulted in the low cover values and the decrease in cover from 2008 to 2010. In addition, while transect monitoring is intended to be objective, biologists' subjectivity can sometimes influence

monitoring results. This year's change in monitoring biologist from the previous year could have resulted in coverage discrepancies between this year and the previous year.

Due to the continued weed maintenance, weed levels are lower than the final success criteria. However, it is recommended that regular weed visits continue during the following spring to continue to keep weed cover low and allow the establishment of native species. Weeding efforts should be concentrated in the tarplant/grasslands area and the two northern pools, as these areas have been problematic in the past.

Overall, plant diversity decreased within the tarplant/grasslands and remained the same within the associated uplands. This might also be a result of the intensive common tarplant removal. Although the current diversity does not meet success criteria, it is expected that diversity will increase over future growing seasons. Several species that have been observed on-site in past years were not observed this year, and it is anticipated that diversity will vary from year to year depending on the germination of annual species.

During monitoring in the spring of 2010, San Diego fairy shrimp were observed in ten of the 11 basins and all of the basins that ponded. Cover of vernal pool indicator species did not meet the final success criteria; however, non-native species cover exceeded the final success criteria. Cover levels for target species, including toothed downingia and spreading navarretia, is expected to increase over future growing seasons; however, additional seeding may be required. It should also be mentioned that the final success criteria was established during the contracting period for the project and are not included in the final permits. Success criteria for the vernal pools include high coverage percentages for species that were not impacted by the fishing program. A re-evaluation of final success criteria and permit requirements should be considered to establish more realistic project expectations. Future monitoring should also consider increasing the number and distribution of monitoring transects as there may be too few to adequately characterize site conditions.

Inclusion of artificial burrows into the restoration site by SWA and collaborative efforts by the neighboring SDNWR has shown a direct benefit toward recovery of the burrowing owl in the vicinity of Sweetwater Reservoir. Efforts to maintain and/or improve site use should continue as part of the overall management of the site.

8.0 References Cited

Braun-Blanquet, J.
1932 Plant Sociology: The Study of Plant Communities. McGraw-Hill, New York.

Daubenmire, R.F.
1959 Canopy coverage method of vegetation analysis. *Northwest Science* 33:43-64.

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

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.

RECON
2008 Sweetwater Reservoir Vernal Pool and Otay Tarplant Restoration Status Report Performance Period (August 2004 to August 2007). April 9.

2009 Sweetwater Reservoir Vernal Pool and Otay Tarplant Restoration Status Report Performance Period (September 2007 to March 2009). May 1.

Sweetwater Authority
2009 Sweetwater Reservoir Burrowing Owl Recovery Update. April 29.