2014 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS OPERABLE UNIT 1 FORMER FORT ORD, CALIFORNIA

Prepared for:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Contract No. W912DY-10-D-0023
Delivery Order CM03

Prepared by:

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October 2014

HGL
HydroGeoLogic, Inc

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ACL	aquifer cleanup level
COC	chemicals of concern
DD&A	Denise Duffy and Associates, Inc.
FDA	Fire Drill Area
FONR	Fort Ord Natural Reserve
ft^2	square feet
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HGL	HydroGeoLogic, Inc.
HMP	Habitat Management Plan
LTM	long term monitoring
NWTS	Northwest Treatment System
OU	operable unit
ROD	Record of Decision
RTE	rare, threatened, or endangered
TCE	trichloroethene
UCNRS	University of California Natural Reserve System
UCSC	University of California at Santa Cruz
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

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2014 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS OPERABLE UNIT 1 FORMER FORT ORD, CALIFORNIA

1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) was contracted by the U.S. Army Corps of Engineers (USACE), Sacramento District, to conduct a Fixed-Price Remediation with Insurance scope of work for Operable Unit (OU)-1 at the former U.S. Army Base Fort Ord located in Monterey County, California. This work was contracted in September 2013 by the USACE, Omaha District, under Contract Number W912DY-10-D-0023 Delivery Order CM03, and was administered through the USACE, Sacramento District. The overall goal of this effort is to achieve the primary remediation objectives specified in the Record of Decision (ROD) signed in July of 1995 by the U.S. Army, U.S. Environmental Protection Agency, and the California Environmental Protection Agency (U.S. Army, 1995). Those remediation goals are as follows:

- Establish hydraulic control and contain contaminated groundwater.
- Extract and treat groundwater exceeding aquifer cleanup levels (ACLs).

A groundwater extraction and treatment system (GWETS) was constructed in 1988 to remediate trichloroethene (TCE) and other groundwater contaminants.

A key factor affecting the design and implementation of the groundwater cleanup is that the area including and surrounding the OU-1 contaminant plume is part of the University of California Natural Reserve System (UCNRS), which is designated as the Fort Ord Natural Reserve (FONR). The FONR area potentially affected by the construction of OU-1 remediation facilities and activities is approximately 130 acres. Therefore, the project has the additional constraint that activities undertaken to achieve the OU-1 cleanup adequately protect and maintain the critical habitat and protected species found within the FONR. The FONR is managed by staff at the University of California at Santa Cruz (UCSC).

Figure 1.1 illustrates the location of Former Fort Ord and the OU-1 source area. The source area was the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA). Activities conducted at the FDA between 1962 and 1985 resulted in contaminants being released to soils and groundwater. Although 10 volatile organic compounds have been identified as contaminants of concern (COCs) in groundwater underlying the FDA, TCE is the contaminant detected at the highest concentrations and across the greatest extent of the affected aquifer. Data shows that the footprint of the TCE plume encompasses the extent of contamination contributed to by the other nine COCs. Figure 1.2 shows the estimated extent of the TCE plume in June 2014.

The Installation-Wide Multispecies Habitat Management Plan (HMP) (U.S. Army, 1997) established the guidelines for conservation and management of the plant species and wildlife that largely depend on the land within the former Fort Ord for survival. The HMP presents habitat management procedures to guide remediation and other activities conducted in habitat areas, including OU-1. The overall goal of the HMP is to provide for, at a minimum, no net loss of

populations or important habitat for any of the subject species. The U.S. Army consulted with the U.S. Fish and Wildlife Service (USFWS) in 1998 to assess potential impacts to the sand gilia (*Gilia tenuiflora ssp. arenaria*) and Monterey spineflower (*Chorizanthe pungens var. pungens*) populations resulting from groundwater investigation and remediation activities within the FONR. The opinion was issued on 30 March 1999. The opinion is consistent with the HMP. The Army consulted the USFWS again in 2002 and 2007 to address impacts to Monterey spineflower critical habitat and the California tiger salamander (*Ambystoma californiense*) (USFWS, 2002 and 2007). Various mitigation measures were identified as a result of these consultations and are implemented before, during, and after work within the FONR.

Intermittent biological surveys were conducted within the OU-1 area by others since 1998 (Harding Lawson Associates, 1998). Under the current and previous contract, HGL conducted annual biological surveys focusing on mapping the extent and population of federally protected rare, threatened, or endangered (RTE) plant species within the FONR. The 2006 through 2014 rare plant surveys were conducted by Denise Duffy and Associates (DD&A) under subcontract to HGL. These surveys included mapping the endangered sand gilia and the threatened Monterey spineflower. The findings of these surveys were submitted in the following reports:

- Appendix A of the *Draft Remedial System Modification Plan, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California* (HGL, 2004a);
- *Results of 2004 Monterey Spineflower and Sand Gilia Surveys, OU-1, Former Ft. Ord, California* (HGL, 2004b);
- *Results of 2005 Monterey Spineflower and Sand Gilia Surveys, OU-1, Former Ft. Ord, California* (HGL, 2005);
- *Final 2006 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL 2007a);
- *2007 FONR Impact Assessment and Habitat and Rare Plant Survey Results* (HGL, 2008a);
- *2008 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2009a);
- *2009 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2009b);
- *2010 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2011a);
- *2011 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2012); and
- *2012 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2013a).
- *2013 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2013b).

This document presents the results of the 2014 rare plant survey and discusses the potential impact on those plants from OU-1 remediation activities conducted since 2004. The following information also is included in this report:

- A description of the FONR site and overview of past activities,
- Descriptions of the actions taken and site management protocols implemented to minimize adverse impacts to the FONR habitat,
- A summary of the site activities conducted by HGL during 2014 and planned future activities,
- Results of the 2014 rare plant survey and interim impact assessment, and
- Recommendations for future work.

1.1 SITE DESCRIPTION

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the U.S. Secretary of Defense announced the downsizing/closure of the base. In August 1994, portions of the property were transferred to UCSC, and the FONR was established in June 1996.

The former Fort Ord is located near Monterey Bay, approximately 80 miles south of San Francisco. The base consists of approximately 28,000 acres near the cities of Seaside, Sand City, Monterey, Del Rey Oaks, and Marina. Monterey Bay marks the western boundary of the former Fort Ord. Toro Regional Park borders the base to the southeast and land use to the east is primarily agricultural.

OU-1 occupies approximately 590 acres of the FONR in the southwestern corner of the former Fritzsche Army Airfield, west of Imjin Road and north of Reservation Road. The dominant habitats within the OU-1 portion of the FONR are coast live oak woodland, coastal scrub, maritime chaparral and annual grassland. The maritime chaparral is considered a rare habitat by the California Department of Fish and Wildlife. The overall former Fort Ord area contains large areas of maritime chaparral habitat.

Several federally protected RTE species are known or suspected to be present within the FONR. These include the federally endangered sand gilia, the threatened Monterey spineflower, and the threatened California tiger salamander. Several plant and animal species of concern are also present in the FONR. Other plant species of concern include the following:

- Coast wallflower (*Erysimum ammophilum*);
- Eastwood's ericameria (*Ericameria fasciculata*);
- Monterey ceanothus (*Ceanothus cuneatus var. rigidus*);
- Sandmat manzanita (*Arctostaphylos pumila*); and
- Toro manzanita (*Arctostaphylos montereyensis*).

The California black legless lizard (*Anniella pulchra nigra*), and the Monterey ornate shrew (*Sorex ornatus salarius*) are animal species of concern.

The northern boundary of OU-1 is adjacent to a large expanse of privately owned, non-native grassland. Transmission of non-native grass species into OU-1 is accelerated by the prevailing southern winds, which blow the seeds into the OU-1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU-1 area. The significant expansion of these non-native grasses could cause federally listed plant populations to decline.

Sand gilia appears to be less tolerant of competing plant cover than the Monterey spineflower. This hypothesis is based on the observation that numerous small Monterey spineflower populations were identified within the dense grassland habitat bordering the main FONR habitat to the east and north or on the roadways bordering this grassland in the initial 1998 survey. Subsequent rare plant surveys conducted between 2004 and 2007 also observed Monterey spineflower in this region. Although sand gilia was not detected in this region during the 1998 through 2007 surveys, sand gilia population patches were observed in 2007 at open areas within a small zone of grassland species inside the more extensive oak woodland habitat near the OU-1 plume source area (sand gilia patches 20 through 22 appear on Figure A3.4 in Appendix A of the 2007 FONR Impact Report [HGL, 2008a]). The small open area in which the sand gilia population was observed is approximately 300 feet east of the source area and is bordered by grasses that are surrounded by oak woodland and understory habitat. Several Monterey spineflower populations also were observed thriving within dense patches of non-native grasses in the same vicinity.

1.2 OVERVIEW OF OU-1 REMEDIATION ACTIVITIES WITHIN THE FONR

Numerous wells and soil borings were constructed within the FONR as part of the investigative effort to define the extent of environmental contamination and remediate contamination. Table 1.1 lists the wells that were installed within the OU-1 portion of the FONR. Table 1.2 lists the soil borings that were drilled within the FONR portion of OU-1 between 2004 and 2014 without constructing a well. Table 1.2 also lists the wells that were destroyed during that period. Figure 1.3 illustrates the OU-1 well and soil boring locations. No new wells or soil borings have been constructed by HGL within the FONR since 2006. In September 2011, 55 wells were destroyed within the FONR. In June 2014, 18 wells were destroyed within the FONR. Figure 1.4 illustrates the layout and components of the OU-1 groundwater remediation system within the FONR as of September 2014.

Note that typical well identification formats—"MW-" prefix for monitoring wells, "EW-" prefix for extraction wells, and "IW-" prefix for injection wells—do not correspond to well function in all cases. The boundaries of the contaminated groundwater zone in OU-1 were refined as the remedial design progressed. The initial system performance pilot test and other field tests provided data that described potential pumping rates for several wells. This data was used during design of the FONR component. Formulating and evaluating design alternatives showed that the most effective OU-1 remedy required that some wells be used for different purposes than originally intended. Consequently, some wells that were intended and named as monitoring wells (MW-OU1-46-AD, MW-OU1-85-A, and MW-OU1-87-A) became extraction wells. Conversely, numerous wells with the EW- prefix have been used only for monitoring groundwater quality. Only the following EW- prefix wells have been used for groundwater extraction:

EW-OU1-60-A	EW-OU1-63-A	EW-OU1-71-A
EW-OU1-62-A	EW-OU1-66-A	

Several wells were named as potential injection well sites but only two (IW-OU1-73-A and IW-OU1-74-A) were connected to the Northwest Treatment System (NWTS) for this purpose. The rest of the "IW-" prefix wells have been used only for monitoring groundwater quality, with one exception: well IW-OU1-10-A was converted to an extraction well in October 2010.

1.3 SUMMARY OF SITE ACTIVITIES

In 1987, about 4,000 cubic yards of contaminated soils were excavated and replaced with clean fill. The OU-1 ROD (U.S. Army, 1995) indicated that remediation of the contaminated soils at the FDA was complete; the ROD also defined groundwater extraction and treatment as the selected remedy for OU-1 groundwater. A GWETS was constructed in 1988 to remediate TCE and other related groundwater contaminants. The 1988 GWETS consisted of extraction wells EW-OU1-17-A and EW-OU1-18-A and was located a short distance downgradient (north) of the FDA. Extracted groundwater was piped to a treatment facility located at the former FDA, where dissolved organic compounds were removed using granular activated carbon vessels. The treated effluent was spray-irrigated in the southern portion of the FDA.

Despite a steady overall decline in contaminant levels within the groundwater capture zone of the 1988 GWETS, COCs were subsequently detected at concentrations above ACLs in groundwater downgradient from the capture zone. Additional wells installed between 1997 and 2001 (MW-OU1-21-A through MW-OU1-46-A) revealed that TCE exceeded the ACL as far as 2,100 feet downgradient from the existing capture zone. Groundwater modeling showed that contaminated groundwater north and west of extraction well EW-OU1-17A was not captured by the extraction system (AHTNA, 2003).

The HGL remediation contract was awarded in December 2003. A draft design to expand the original GWETS was presented in the *Draft Remedial System Modification Plan* (HGL, 2004a). New wells were installed and aquifer testing began in 2004 and continued through 2007. The draft GWETS expansion design was adjusted as data from the newly installed wells and aquifer testing was processed; the final design was issued in the three-volume Final Engineering Design Report in 2006 (HGL, 2006a; 2006b; and 2006c).

In 2006, the first component of the GWETS expansion, the Hydraulic Control Pilot Project, was constructed (HGL, 2006d). Four additional extraction wells (the FONR system) were constructed from July through September 2007 to further expand the GWETS. These construction activities are described in detail in the *Final Hydraulic Control Pilot Project Construction Report* (HGL, 2007b) and the *Draft FONR System Construction Report* (HGL, 2008b). Additional details concerning the GWETS expansion and a summary of OU-1 site activities conducted during 2007 relating to habitat monitoring and impacts were provided in the *2007 FONR Impact Assessment and Habitat and Rare Plant Survey Results* (HGL, 2008a).

During 2010, HGL conducted sampling activities and constructed an underground pipeline and underground power line within the FONR habitat area. The underground pipeline and power line

connected IW-OU1-10-A to the terminus of the existing remediation system (at extraction well MW-OU1-87-A). The underground piping was laid within the existing roadway to minimize environmental impacts to the surrounding habitat. Converting IW-OU1-10-A to an extraction well has accelerated the overall groundwater cleanup. The design parameters for this expansion are described in the Remediation System Expansion Design Technical Memorandum (HGL, 2010). The 2010 construction activities and associated environmental monitoring are described in the *IW-OU1-10-A System Expansion Construction Report* (HGL, 2011b).

During 2011, activities conducted by HGL within the FONR habitat area included sampling, the 2011 rare plant survey, and destroying 55 monitoring wells (53 of which are located within the FONR). The 2011 well destruction activities are described in the Well Destruction Report (HGL, 2011c). In 2014, HGL destroyed 18 monitoring wells located within the FONR. The 2014 well destruction activities are described in the *Well Destruction and Former OU-1 Treatment Plant Decommissioning Completion Report* (HGL, 2014).

HGL conducts the following activities annually within the FONR habitat area:

- Collect performance monitoring samples from selected extraction wells and from the NWTS;
- Collect samples from the wells composing the OU-1 groundwater long term monitoring (LTM) network; and
- Perform rare plant surveys at locations where well construction or destruction has occurred within the previous 3 years.

Only light-duty vehicles (pickup trucks or sedans) are used for sampling activities, and travel routes were limited to established roadways.

Previous results from the groundwater quality monitoring program showed that cleanup targets within the capture zone of the original GWETS extraction wells (Figure 1.4) were achieved during 2005. Groundwater pumping and treatment from the existing GWETS area was suspended in February 2006 as part of the rebound evaluation. A rebound evaluation to assess whether the improved groundwater quality could be sustained without additional remediation was completed during 2007. The *Draft Rebound Evaluation Report* (HGL, 2007c) was submitted for regulatory review and it was agreed that the groundwater sampling frequency in this region can be greatly reduced. Sampling from selected groundwater monitoring wells in this region continued for some wells at a reduced frequency into 2011. Sampling results confirmed that groundwater quality meets the ACLs and all wells within this area were destroyed in September and October 2011.

Based on the cleanup progress, HGL and regulatory agencies agreed to reduce the groundwater pumping and sampling efforts in 2012 within the interior portion of the OU-1 FONR area. Pumping and sampling along the northwest boundary continued at the same rate and schedule. The decreased pumping and sampling in the interior portion of the OU-1 FONR reduced the number of site visits and vehicle miles traveled on FONR roads, thereby reducing the potential impact to the FONR habitat.

The following sections describe the 2014 activities and the 2014 rare plant survey.

1.3.1 2014 Rare Plant and Habitat Surveys

DD&A conducted surveys for sand gilia and Monterey spineflower on 24, and 29 April 2014. The timing of the survey was intended to correspond with the plants' peak blooming period (late April to early May). Survey dates were determined through communications with UCSC natural resource staff and by observing Monterey spineflower and sand gilia populations in the reference area near the FONR. The 2014 rare plant survey covered two areas:

- The reference area near the intersection of Reservation Road and Imjin Parkway, and
- Those well sites within the FONR habitat area where wells were destroyed in September 2011, except as noted below.

The evaluation of survey results from 2004 through 2012 indicated that the construction activity has not had significant adverse effects on the Monterey spineflower and sand gilia plant populations. Furthermore, HGL believes that the extended monitoring period has adequately characterized the impacts to Monterey spineflower and sand gilia populations from OU-1 remediation activities; therefore HGL recommended that monitoring be discontinued at seven destroyed well locations that were surveyed in 2011 and 2012 (HGL, 2012 and 2013a). The UCSC FONR management staff indicated that these seven well locations were not located in significant habitat area. After discussions between the USFWS, the Army, the UCSC FONR management staff, and HGL, the USFWS concurred and the following destroyed well locations were deleted from the 2013 and 2014 rare plant survey (USFWS, 2013):

- MW-OU1-10-A
- MW-OU1-36-A
- MW-OU1-01-180
- MW-OU1-03-180
- MW-OU1-07-A
- MW-OU1-37-A
- MW-OU1-02-180

Section 2.0 of this report presents an overview of the biological survey results, and Appendix A provides a detailed description.

1.3.2 2014 Sampling Activities

During 2014, HGL did not conduct drilling or aquifer testing activities within OU-1. Groundwater samples and / or groundwater level measurements were collected during 2014 from most of the existing wells within the FONR as part of the OU-1 groundwater LTM program. As the remediation effort has progressed, the number of wells included in the LTM network decreased and the monitoring frequency was reduced at others. Before 2009, wells included in the LTM network were typically sampled on a quarterly, semiannual, or annual basis. The quarterly sampling usually occurred in March, June, September, and December of each year. In 2009, the LTM sampling program was modified and samples from individual wells are now collected only on a semiannual or annual basis. Performance monitoring samples originally were collected at the NWTS on a bimonthly basis; however, in 2010, the sampling frequency was decreased to quarterly, and in 2012 sampling was reduced to semiannually. The September 2012

LTM results showed significant progress toward meeting the ACL and the overall system pumping increased in the fourth quarter of 2012. Consequently, HGL proposed revisions to the sampling schedule for 2013. After discussion and approval from the regulatory agencies, additional samples from selected wells were collected in January and February of 2013 and the number and locations of the March 2013 samples were reduced. From March 2013 on, samples were collected quarterly.

During the reporting period, LTM samples and NWTS performance samples were collected in December 2013, March 2014, June 2014, and September 2014. Table 1.3 summarizes the LTM and NWTS sampling events conducted at each of the OU-1 wells. At some wells only water level measurements are taken.

Groundwater elevations are measured semiannually at most wells within the OU-1 LTM network and are taken either concurrently with or within a few days of sample collection. Groundwater measurements collected from wells that are no longer sampled also are listed in Table 1.3.

1.3.3 2014 Well Destruction Activities

In 2014, HGL destroyed 18 monitoring wells located within the FONR, this effort is described in the *Well Destruction and Former OU-1 Treatment Plant Decommissioning Completion Report* (HGL, 2014). DD&A provided environmental field support for the destruction activity. All well destruction activities were conducted with an emphasis on minimizing impact to the existing habitat. Recommendations and requirements from DD&A and UCSC staff provided a baseline for well destruction activities at FONR OU-1 and were followed by all personnel. The well destruction methods and field procedures employed to minimize habitat impact are described in the *Well Destruction and Former OU-1 Treatment Plant Decommissioning Completion Report* (HGL, 2014).

1.4 IMPACT PREVENTION AND MITIGATION MEASURES

Activities conducted within the FONR are limited to those that are essential to achieving the remediation goals for the project. The remedial actions and ongoing operation of the remedial system have been and will continue to be consistent with the HMP and biological opinions. Compliance with these measures reduces or avoids impacts to RTE species of concern on the project site. Guidance for the remedial design and action(s) are as follows:

- *Installation-Wide Multispecies Habitat Management Plan* (U.S. Army, 1997).
- The 30 March 1999 *Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California* (USFWS, 1999); and supporting documentation, such as enclosure 2 to the request for consultation (Harding Lawson Associates, 1998);
- The 22 October 2002 *Biological Opinion on the Closure and Reuse of Fort Ord, Monterey County, California, as it affects Monterey Spineflower Critical Habitat,* (USFWS, 2002);
- The 14 March 2005 *Biological Opinion on the Cleanup and Reuse of Former Fort Ord, Monterey County, California, as it affects California Tiger Salamander and Critical Habitat for Contra Costa Goldfields* (USFWS, 2005);

- The 1 June 2007 *Amendment to Biological Opinion 1-8-04-F-25R, Cleanup and Reuse of Former Fort Ord, Monterey County, California, as it affects California Tiger Salamander and Critical Habitat for Contra Costa Goldfields* (USFWS, 2007); and
- Guidance and direction from UCNRS staff.

To avoid or minimize impact to the FONR during ecologically sensitive periods (defined as the rainy season, which typically ranges from November to April), construction is sequenced to begin after the flowering period for RTE plant species as much as possible within the overall project constraints. Generally, work can begin after June 1st or as determined by the on-site biologist and coordinated with the BRAC biologist. For example, the final FONR system construction began in July 2007 and was completed in September 2007 before the seasonal rains began. Likewise, the well destruction and road repair activities were performed and completed before the rainy season began.

In addition to complying with the guidance listed above, beginning in 2007, HGL subcontracted with UCSC to implement manual and mechanical weed control measures at selected locations within the OU-1 portion of the FONR. The weed control program was renewed annually and implemented by UCSC through 2013. Each area included in the weed control program received between one and three treatments (using a weed-eater and/or hand pulling) depending on site-specific phenology, observed response to past treatments, and species composition. UCSC staff also surveyed well sites to identify the composition of the plant population in the immediate vicinity of the wells. Weed control activities were not performed in 2014, pending an evaluation of the effectiveness of those activities. The areas where weed control were performed in 2013 and earlier are shown on Figure 1.5.

The objectives of the weed control activities were as follows:

- Cut down or remove undesirable vegetation from areas disturbed by past OU-1 construction activities—particularly those completed during 2004 through 2006—before such vegetation released seeds into the environment.
- Prevent or reduce the expansion of non-native plants into areas disturbed by construction related to OU-1 activities.
- Prevent the occurrence of unacceptable impacts to the Monterey spineflower and sand gilia populations within that portion of the FONR affected by OU-1 remediation activities.

Weed control activities typically consist of cutting the weeds using manual methods (hand pulling, clipping) and mechanical devices (such as powered string trimmers or similar, easily portable equipment). Herbicides or similar poisons have not been used as part of this effort in any year. Disposal of cut weeds depended on both the plant species and the timing of the weed cutting episode. Cut weeds were left on the ground if there was no danger that the seeds would germinate and sprout after cutting; otherwise, the cut weeds were bagged and removed from the site for proper disposal. The species subject to weed control included plant species that are listed as a noxious weed by the California Department of Food and Agriculture, included on invasive plant lists maintained by the California Invasive Plant Council, or considered to be a problematic species by the UCSC FONR natural resource staff.

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2.0 OVERVIEW OF 2014 RARE PLANT SURVEY RESULTS

The objectives of the 2014 rare plant survey and habitat inventory were to accomplish the following:

1. Identify locations of and estimate rare plant populations at an identified reference site and at selected FONR well destruction sites as described in Table 1.2 and Section 1.3.1, and
2. Map Monterey spineflower and sand gilia populations for comparison to past surveys and to facilitate planning if future construction or maintenance activities are needed.

The reference site encompasses approximately 0.5 acre located approximately 3,000 feet southeast of the former OU-1 source area (Appendix A, Figure A1.2). DD&A biologists have used this site since 2010 to identify the peak of the blooming period for Monterey spineflower and sand gilia. The time to initiate the rare plant surveys at former Fort Ord and other locations has been based, in part, on observations of plants within the reference area to ensure that such surveys are conducted at appropriate times.

Coast live oak woodland is the dominant habitat in the reference area. Grassland and coast live oak woodland is adjacent to the reference site on the northwestern boundary. All other sides of the reference area are bordered by developed roads (Reservation Road, Mbest Drive, and University Drive). Non-native grasses and weedy forbs were already present throughout much of the reference area when the surveys began in 2010.

The 2014 rare plant survey was conducted at the reference site and at 30 well sites within OU-1. This section presents a summary of the key findings from those surveys. The complete survey report is presented in Appendix A.

A DD&A biologist and a DD&A technician conducted surveys for sand gilia and Monterey spineflower on 24, and 29 April 2014 using a global positioning system (GPS). The survey was timed to coincide with the peak blooming period insofar as possible. The peak blooming period was determined through communications with UCSC FONR natural resource management staff and by observing a known occurrence of sand gilia at the Fort Ord reference site near the FONR.

Each rare plant survey was conducted along existing or proposed roadways and access routes. The width of the survey area was approximately 10 feet beyond the edge of the roadway on either side. If a rare plant was identified, the survey in that area was extended to the boundary of the population encountered.

2.1 RARE PLANT SURVEY METHODS

Large areas of Monterey spineflower and sand gilia were mapped as polygons using a Trimble Pathfinder ProXH GPS unit. Smaller plant groups and individuals were mapped as points with attributes to identify the number of individuals at each location. When a rare plant was identified, the survey in that area was extended to the boundary of the population encountered.

Individual counts were made for all sand gilia populations whether they were mapped as points (population less than or equal to five) or polygons (population greater than five). The polygon

boundary was drawn to include all plants identified as a distinct population. However, Monterey spineflower was only counted as individuals when groups of less than five were mapped. For larger populations, Monterey spineflower was mapped as polygons and characterized according to the percent of cover; specifically, the percentage of the polygon covered by the Monterey spineflower divided by the total area enclosed within the polygon. The cover classes are defined as follows:

- Very Sparse (corresponding to an absolute cover of less than 3 percent);
- Sparse (3 to 25 percent);
- Medium Low (26 to 50 percent);
- Medium (51 to 75 percent);
- Medium High (76 to 97 percent); and
- Very High (greater than 97 percent).

GPS data was exported to shapefile format for use in a geographic information system (GIS) (ESRI ArcGIS) and mapped on high-resolution aerial photos. These maps are presented in Appendix A (Figures A3.1 through A3.8).

2.2 SAND GILIA SURVEY RESULTS

Sand gilia was observed and mapped at the DD&A reference site and at 11 of the 30 well sites. A total of 58 populations (46 points and 12 polygons) of sand gilia were mapped within the 2014 survey area (see Appendix A, Attachment A-1). A total of 1,018 individual plants were mapped at the 58 populations.

2.3 MONTEREY SPINEFLOWER SURVEY RESULTS

A total of 28 populations (9 points and 19 polygons) of Monterey spineflower were mapped at the reference site and also at 11 of the 30 well sites within the FONR. There were some sites where both Monterey spineflower and sand gilia were observed and in other cases only one or the other was present (see Appendix A, Attachment A-2). Because Monterey spineflower population size estimates are not as easily quantified as the sand gilia populations, individual Monterey spineflower plants were not counted within the GIS polygons. Populations of Monterey spineflower were estimated as a percentage of the overall ground cover using visual estimation. Of the 19 populations of Monterey spineflower that were mapped as polygons, three populations were identified as Medium Low (26 to 50 percent cover), and 16 populations were identified as Sparse (3 to 25 percent cover).

3.0 DISCUSSION OF 2014 SURVEY RESULTS

As noted earlier, the 2014 rare plant survey area overlapped the previous surveys with the exception of the number of well sites being reduced to 30 locations. The annual reference plot rare plant survey was initiated in 2010. Table 3.1 summarizes the survey results at the reference plot. Table 3.2 summarizes the results for all rare plant surveys conducted within the OU-1 footprint since 1998.

During well construction or destruction activities, the work area and drill rig footprint is approximately 30 feet in diameter and centered on the well borehole. Discussions comparing survey results in this report assume that a plant population or polygon is attributed to a given well site if any part of the population or polygon is within the potentially disturbed area. In some cases, observation wells were constructed within approximately 30 feet of an existing well. For the purpose of this impact assessment, these locations are considered and counted as a single location and data point.

Numerous environmental factors affect the growth of the rare plants monitored in this survey. Precipitation is an important factor, particularly during the rainy season that typically occurs from late October through May. The annual rare plant surveys are timed to coincide with the peak blooming season and are typically performed in April or May. The total precipitation for the October through March period preceding the annual rare plant survey is provided in Table 3.3 for reference in subsequent discussions.

Fifty-five wells were destroyed in the OU-1 area in 2011. Thirty-six of the wells destroyed in 2011 were located at 31 sites (more than one well was present at some sites) within the FONR habitat area and were included in the 2012 rare plant survey. The other OU-1 wells destroyed in 2011 were located in the grassland portion of the FONR or in grassland outside the FONR property and are therefore not included in any rare plant surveys at OU-1. In addition, the IW-OU1-10-A/PZ-OU1-10-A1 well pair is considered to be one site and was included in the survey as part of the 3-year post-construction monitoring that began after IW-OU1-10-A was converted to an extraction well in 2010. In 2013, the Army received approval from the USFWS to discontinue monitoring on seven well locations that were previously surveyed in 2011 and 2012. This section compares the results of the 2014 rare plant survey within the DD&A reference area and the 30 well locations on the OU1 FONR property with the results of the 2011, 2012 and 2013 surveys. Section 4.0 presents a comprehensive overall review of the 2004 through 2014 rare plant data for all wells within the FONR habitat area.

3.1 SAND GILIA

Within the FONR area surveyed, sand gilia populations were observed in more locations than Monterey spineflower populations for the fourth consecutive year. In each OU-1 rare plant survey performed from 2004 through 2007, Monterey spineflower populations were observed in more locations (no rare plant surveys were conducted from 2008 through 2010 within the 2014 survey area).

3.1.1 Reference Area

The reference area is located on property that is relatively undisturbed by anthropogenic activities. Sand gilia populations fluctuate from year to year because of natural variation in rainfall, temperature, and other factors. As seen in Table 3.1, sand gilia populations in the reference area have varied tremendously from one year to the next. Population counts ranged from a low of 70 individuals in 2012 to a maximum of 1,086 individuals in 2010. The rare plant survey results for 2014 showed the second lowest population count (97 individuals) since the reference area survey began in 2010. The data from the reference area surveys provides a frame of reference for assessing the variability observed at well sites within the FONR where remediation activities have been conducted over the years.

Sand gilia observed during the 2012 and 2014 survey efforts were substantially less when compared to the 2010, 2011 and 2013 survey efforts. In 2014, sand gilia populations declined from 2013 levels in terms of number of plants and were similar to the 2012 spatial distribution (Appendix A, Figure A4.1). Comparing the 2011 through 2014 population numbers supports the statement that the environmental factors necessary to yield abundant populations of sand gilia were not present in 2012 and 2014.

3.1.2 FONR Well Locations

In 2014, sand gilia was detected at 11 of the 30 well locations (Table 3.2). In 2014, 921 individual plants were mapped at the well locations consisting of 10 polygons of sand gilia totaling 3,629 square feet (ft^2) (827 individuals) and 44 points (94 individuals) (Appendix A Section 4.1.3). In 2013, sand gilia was found at 15 of 30 well locations. Sand gilia was found in 2011 at 9 of the 33 sites surveyed before well destruction activities were performed. At eight of these nine sites, sand gilia also was found in the 2012 survey. The number of sites at which sand gilia has been found after well destruction as opposed to before well destruction indicates no adverse impact to that plant population from the well destruction action.

As illustrated in Exhibit 1, the general direction of sand gilia population changes (increasing or decreasing) observed at the FONR well sites followed the same pattern observed at the reference area. However, the magnitude of the change as a percentage of the previous year's population count was much greater in the reference area than at the well sites. This data suggests that the observed sand gilia population changes in the three years following well destruction in 2011 could potentially be attributed to natural variation.

Exhibit 1
Sand Gilia Population Counts Observed in Reference Area and at Well Sites in the Three Years After Well Destruction

Year	2012	2013	2014
Total Number of Individual Sand gilia Plants			
Reference Area	70	736	97
FONR Well Sites	982	1,157	921
Percentage Change in Number of Individual Plants from Previous Year			
Reference Area	-78 %	951%	-87%
FONR Well Sites	-22%	18%	-20%

Overall, the data collected from 2010 through 2014 support the conclusion that the well destruction and maintenance activities did not adversely impact sand gilia populations in the survey area.

3.2 MONTEREY SPINEFLOWER

Previous rare plant surveys conducted by DD&A indicate that populations of Monterey spineflower were often observed in areas with sparse to moderately abundant non-native annual grass cover, which suggests that this species may be somewhat more tolerant of annual grass cover variations and environmental factors than sand gilia. Although sand gilia populations were observed more often than Monterey spineflower in 2014, both species were widespread in the 2012, 2013, and 2014 surveys. There are several environmental factors that affect the amount of Monterey spineflower that blooms in a given year. As with sand gilia, these results reinforce the statement that in 2012 and 2014 the environmental factors necessary to yield abundant populations of Monterey spineflower were not ideal and that 2011 and 2013 were more productive years for Monterey spineflower.

3.2.1 Reference Area

Table 3.1 summarizes the reference area survey results for Monterey spineflower. As shown in Table 3.1, the reference area has shown relatively few populations of Monterey spineflower and the population densities have primarily been sparse. Seven Monterey spineflower populations (six Sparse and one point with 4 plants) were mapped within the DD&A reference area in 2014. Although the number of populations observed in 2014 was the second largest since the survey of this area began in 2010, the area covered by the mapped populations was the lowest. The year to year variation in polygon areas and the number of polygons illustrate the high variability in Monterey spineflower populations resulting from natural factors.

3.2.2 FONR Well Locations

In 2014, 13 polygons totaling 2,841 ft^2 were mapped at the OU1 FONR well locations. The 13 polygon Monterey spineflower populations were as follows: 10 Sparse and 3 Medium Low. Monterey spineflower was found at 11 of 30 well locations in 2014. It was found at all 30 well locations surveyed in 2011 and at 24 of the 30 well locations in 2012 and 2013. All survey results are summarized in Table 3.2 and presented in detail in Appendix A.

The survey of Monterey spineflower populations in 2014 may have been biased lower by the unusual weather pattern that occurred before and during the survey. The 2014 temperature and precipitation pattern for the region was atypical when compared to the previous years in which surveys were conducted. Unusually warm and dry weather in the beginning of March 2014 resulted in an early blooming period for sand gilia and Monterey spineflower. Surveys were conducted on April 24 and 29 to ensure that the blooming period for sand gilia was not missed, as the ideal period of identification for sand gilia is typically shorter than Monterey spineflower. A substantial precipitation event occurred from March 29 to April 2, 2014, which was unusual for the time of year. This late rain event in addition to a drop in temperature potentially delayed the bolting of Monterey spineflower. Consequently, the Monterey spineflower may not have fully bolted at the time of the survey, resulting in under-measurement of Monterey spineflower populations in the survey areas.

As shown in Table 3.1, the reference area polygon size in "good" years (2010, 2011, and 2013) is quite stable at approximately 2,840 square feet. In 2012 and 2014 the area was 1,494 square feet and 1,119 square feet, respectively—the average value for those two years was 1,307 square feet. The relatively small number of Monterey spineflower populations found in the reference area tends to exaggerate the percentage change based on year-to-year comparisons and limits the usefulness of comparison to the observed changes at the FONR well sites. In addition, the polygon area determinations are significantly less precise than the individual plant counts performed for sand gilia. The presence or absence of just a few Monterey spineflower plants in the boundary area where these plants are frequently present can greatly skew the area calculation from year to year.

4.0 IMPACT ASSESSMENT AND CONCLUSIONS

Construction efforts were undertaken by HGL during the 2004 through 2014 time period to remediate contaminated groundwater within the OU-1 portion of the FONR. Construction activities included the following:

- Drilling soil borings;
- Constructing extraction, injection, and monitoring wells;
- Installing water conveyance pipelines;
- Installing infiltration trenches;
- Constructing a groundwater treatment facility;
- Converting IW-OU1-10-A from a monitoring well to an extraction well;
- Destroying a total of 73 wells within the OU-1 area; and
- Repairing road to address ruts created by heavy equipment traffic and erosion.

Figure 4.1 illustrates the areas in which construction occurred during 2004 through 2014. The locations of OU-1 wells destroyed in 2011 and 2014 are shown on Figure 4.2.

A critical concern throughout the project has been the protection of the rare plant species within the FONR. To that end, direct impacts of construction activities within the footprint of known populations of Monterey spineflower or sand gilia were minimized by using the results of the 1998 rare plant survey (Harding Lawson Associates, 1998). The results of the 1998 rare plant survey are provided on Figure 4.3. In addition, a pre-construction survey was conducted in the spring of 2004 (HGL, 2004b) to delineate population locations. The survey results were used to adjust the location of remediation facilities to avoid previously identified rare plant locations wherever possible. As discussed below, this strategy enabled the construction activity to mostly avoid overlapping known rare plant populations; the few exceptions to this approach are described later in this section.

UCSC staff responsible for managing the FONR expressed a significant concern that construction activities would cause indirect impacts to the rare plant species by altering the habitat in the work areas. They were concerned that the practice of clearing existing native vegetation to enable equipment access for well or pipeline construction may provide a pathway for non-native, invasive plant species from the surrounding areas to encroach farther into the FONR. The UCSC concern is that such encroachment may result in declining rare plant populations as the non-native newcomers outcompete the existing plants and come to dominate the overall species distribution. To address this concern, HGL has conducted annual rare plant surveys from 2004 through 2014 (through subcontractors) and conducted habitat surveys in 2006 and 2007. The data resulting from these surveys is evaluated annually and has not shown evidence of overall negative impact to rare plant populations. As will be described later in this Section, the survey results indicate the possibility that the remediation activities may have beneficially impacted the Monterey spineflower population.

HGL has also contributed funds to support manual and mechanical weed control efforts by UCSC from 2007 through 2013. UCSC is confident that the weed abatement efforts have had a positive impact on reducing weed populations on the OU-1 cleanup sites and, very importantly,

have removed large portions of the invasive weed seed source for the growing seasons. UCSC, HGL, and the Army will assess the effectiveness of the weed control actions after the suspension of those activities in 2014. Based on the results of that assessment, recommendations will be made regarding the resumption of weed control activities in 2015.

Table 3.2 summarizes the rare plant populations observed at the OU-1 well sites located within the FONR. To date, the survey results show that the impact-minimization and abatement efforts and proactive construction management techniques employed throughout the construction effort have been successful in minimizing the impact to rare plant populations. The data from Table 3.2 is discussed in the following sections.

Sixty-two wells were constructed in the OU-1 area between 1976 and 2004. Several wells constructed between 1986 and 2002 were co-located. A total of 45 new OU-1 wells were constructed at 42 locations within the FONR between 2004 and 2006 and a few of these were located near previously constructed wells. Where multiple wells were constructed within approximately 30 feet of one another, the group of wells was considered to be a single site to provide a more consistent basis for assessing the rare plant survey results. Consequently, the following sets of wells are counted as a single location when tabulating the occurrences of rare plant populations.

- MW-OU1-24AR replaced MW-OU1-24-A;
- MW-OU1-46-AD, MW-OU1-42-AD, and PZ-OU1-46-AD2;
- MW-OU1-64-A1 and MW-OU1-64-A2;
- EW-OU1-49-A and PZ-OU1-49-A1;
- IW-OU1-10-A and PZ-OU1-10-A1;
- IW-OU1-02-A and PZ-OU1-02-A;
- EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A;
- EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A; and
- MW-OU1-32-A and MW-OU1-33-A.

Wells located in the grassland area adjacent to the FONR to the north and east were excluded from the evaluation because that habitat is not supportive of sustainable rare plant populations. After aggregating the individual wells as noted above, rare plant population data was evaluated for 74 well locations and at 3 equipment staging areas used during the 2004 construction activities, for a total of 77 total sites. The following sections discuss the results of the rare plant surveys conducted from the initial survey in 1998 through the most recent survey in 2014. A total of 26 wells at 20 evaluation sites (based on the multiwell locations and other factors discussed above) were constructed before the initial rare plant survey was performed in 1998.

4.1 OPERABLE UNIT 1 IMPACTS ON MONTEREY SPINEFLOWER

Evaluation of the data showed that these 77 total locations fall into five categories as defined below. Wells constructed after the initial rare plant survey was completed in 1998 fall within one of the first four categories. Wells constructed before the 1998 rare plant survey are discussed in the fifth category.

1. Monterey spineflower not detected before or after construction (25 locations);
2. Monterey spineflower detected before but not after construction (8 locations);
3. Monterey spineflower detected before and after construction (10 locations);
4. Monterey spineflower not detected before construction but was detected after construction (14 locations); and
5. The well was constructed before the initial rare plant survey in 1998 (20 locations).

The rare plant survey results with respect to Monterey spineflower are discussed in the following subsections.

4.1.1 Monterey Spineflower Not Detected Before or After Construction

Approximately 32 percent of the sites fell within this category (25 of the 77 total). This data cannot be used to assess site-specific impacts.

4.1.2 Monterey Spineflower was Detected Before but Not After Construction

At eight locations where wells were constructed after the 1998 or 2004 baseline rare plant surveys were performed, Monterey spineflower populations were identified in one or both of the baseline surveys but were not observed in subsequent surveys. These locations are:

- MW-OU1-25-A
- MW-OU1-40-A
- EW-OU1-49-A/ PZ-OU1-49-A1
- MW-OU1-57-A
- EW-OU1-60-A
- EW-OU1-66-A
- MW-OU1-61-A
- MW-OU1-65-A

At six of the eight locations above, the wells were constructed along the roadways bordering the adjacent grasslands to the north and/or east. The rare plant populations observed in these areas in 1998 are considered of marginal value because they are adjacent to grassland habitat that is unsuitable for sustaining the rare plant species (HGL, 2006b). HGL discussed these proposed well locations with UCSC management staff before construction began to confirm that the potential disruption of these plant populations was an acceptable approach and would not present a significant impact. These six well locations were as follows:

- EW-OU1-49-A/ PZ-OU1-49-A1
- MW-OU1-57-A
- EW-OU1-60-A
- EW-OU1-66-A
- MW-OU1-61-A
- MW-OU1-65-A

Of the six wells listed above, only wells EW-OU1-49-A/PZ-OU1-49-A1 were surveyed in 2004. The other five wells were surveyed from 2005 through 2007. Plant surveys were not performed at these six well sites after 2007, except at EW-OU1-60A and MW-OU1-61-A, which also were surveyed in 2008. Annual rare plant surveys at these wells ceased after 2008 because 3 years of monitoring had been completed. Monterey spineflower was not detected at these locations during the surveys completed in 2005, 2006, and 2007. It is not possible to conclude that the absence of these populations since their detection in 1998 is the result of the construction activity because their location is adjacent to grassland areas and is susceptible to varying environmental conditions and competition from the grassland species. Natural variables, including precipitation

(Table 3.3), may be responsible for the lack of detected populations in post-construction surveys. These populations are of marginal value given that they are present within the edge of the grassland habitat.

Monterey spineflower was observed in 1998 at the site of two future wells MW-OU1-25-A installed in 1998 and MW-OU1-40-A installed in 1999. There was no activity other than sampling in this area thereafter. Given the population variability observed at the undisturbed reference plot, the data is inconclusive concerning the impact of construction activity on the Monterey spineflower population at these locations. Also, the fact that the 1998 data represented a "great year" for Monterey spineflower and sand gilia (UCSC, 2006) suggests that natural variability rather than construction impacts may be the reason it was not found in subsequent surveys.

4.1.3 Monterey Spineflower was Detected Before and After Construction

There were 10 locations where the 1998 or 2004 rare plant survey identified Monterey spineflower populations that also were observed at least once in subsequent surveys. The data in Exhibit 2indicates that OU-1 remediation activities did not impact Monterey spineflower populations at these sites.

Exhibit 2

Location	Number of pre-construction surveys	Number of pre-construction survey detections	Number of post-construction surveys	Number of post-construction survey detections
MW-OU1-39-A	2	2	4	3
MW-OU1-44-A	1	1	4	4
MW-OU1-46-A*	2	1	6	3
MW-OU1-46-AD*				
EW-OU1-53-A	2	1	3	2
IW-OU1-01-A	2	1	7	6
IW-OU1-25-A	2	1	7	2
MW-OU1-50-A	1	1	5	4
MW-OU1-56-A	1	1	3	1
Staging Area #1	2	1	3	2
Staging Area #2	2	1	3	3

*Indicates co-located wells—considered as a single site in assessing results.

Additional survey results are provided in Table 3.2.

4.1.4 Monterey Spineflower was Not Detected Before But was Detected After Construction

The rare plant survey results indicated potentially beneficial impacts on Monterey spineflower populations at 14 sites where this species was not observed before the OU-1 remediation

activities beginning in 2004 but was detected in post-construction surveys. The site locations and data are summarized in Exhibit 3:

Exhibit 3

Location	Number of pre-construction surveys (no detections)	Number of post-construction surveys	Number of post-construction Monterey spineflower detections
MW-OU1-30-A	2	2	2
MW-OU1-32-A*	2	4	4
MW-OU1-33-A*			
MW-OU1-38-A	2	5	2
EW-OU1-54-A	2	7	2
EW-OU1-55-A	2	7	3
IW-OU1-05-A	2	6	6
IW-OU1-24-A	2	6	3
MW-OU1-59-A	1	3	1
Staging Area #3	2	3	2
EW-OU1-71-A	2	4	1
IW-OU1-74-A	1	5	3
MW-OU1-82-A	1	5	2
MW-OU1-83-A	2	5	2
MW-OU1-84-A	1	5	2

* Indicates co-located wells, which are considered as a single site in assessing results.

This data suggests that natural variation may account for these conditions and/or the site disturbances from remediation activities had a potentially beneficial effect on Monterey spineflower conditions. Additional survey results details are provided in Table 3.2.

4.1.5 Well Was Constructed Before the Initial Rare Plant Survey

Monterey spineflower was observed in one or more rare plant surveys from 1998 through 2014 at 20 locations where wells were constructed before the 1998 survey was performed. Because these wells pre-date the earliest available survey results from 1998, it is not known whether rare plants were present before the wells were constructed. In total, 26 wells were constructed at 20 locations before the 1998 survey. Monterey spineflower was observed at 19 of these 20 locations in at least one subsequent survey. The only well (MW-OU1-07-A) where Monterey spineflower was not detected was located within the source area where the native soils were excavated and replaced with non-native fill as part of the soil remediation effort.

4.2 OPERABLE UNIT 1 IMPACTS ON SAND GILIA

As above, the 77 total well locations and staging areas fall into five categories:

1. Sand gilia was not detected in any survey (47 locations);
2. Sand gilia was detected before but not after construction (1 location);
3. Sand gilia was detected before and after construction (5 locations);

4. Sand gilia was not detected before construction but was detected after construction (4 locations); and
5. The well was constructed before the initial rare plant survey in 1998 (20 locations).

The rare plant survey results with respect to sand gilia are discussed in the following subsections.

4.2.1 Sand Gilia Not Detected Before or After Construction

Approximately 61 percent of the sites fell within this category (47 of the 77 total). This data cannot be used to assess site-specific impacts but they suggest that sand gilia is not widespread within the OU-1 portion of the FONR.

4.2.2 Sand Gilia was Detected Before but Not After Construction

There was only one location where a well was constructed after 1998 and the 1998 or 2004 rare plant survey identified sand gilia populations that were not observed at least once in subsequent surveys: IW-OU1-25-A.

At well IW-OU1-25-A sand gilia was observed in the 2004 survey but was absent in the 1998 survey. Sand gilia was not observed at this location in post-construction surveys from 2005 through 2007 and from 2011 through 2014. As noted previously, 1998 presented optimum environmental conditions to promote rare plant growth. Given the absence of sand gilia in 1998 and the population variability observed at the undisturbed reference plot, this data is inconclusive concerning the effect of construction activity on the sand gilia populations.

4.2.3 Sand Gilia was Detected Before and After Construction

There were five locations where the 1998 or 2004 rare plant survey identified sand gilia populations that also were observed at least once in subsequent surveys. The data provided in exhibit 4 indicate that OU-1 remediation activities did not impact sand gilia populations at these sites:

Exhibit 4

Location	Number of pre-construction surveys	Number of pre-construction survey detections	Number of post-construction surveys	Number of post-construction survey detections
MW-OU1-38-A	2	1	5	1
MW-OU1-39-A west access road*	2	1	4	4
MW-OU1-44-A	1	1	4	1
Staging Area #2	2	2	3	3
Staging Area #3	2	1	3	1

*Co-located with well MW-OU1-39-A.

Additional survey results are provided in Table 3.2.

4.2.4 Sand Gilia Was Not Detected Before But Was Detected After Construction

The rare plant survey results indicated potentially beneficial impacts on sand gilia populations at four sites where this species was not observed before the OU-1 remediation activities beginning in 2004 but was detected in post-construction surveys. The site locations and data are summarized in Exhibit 5:

Exhibit 5

Location	Number of pre-construction surveys (no detections)	Number of post-construction surveys	Number of post-construction sand gilia detections
EW-OU1-53-A	2	3	2
EW-OU1-54-A	2	7	1
IW-OU1-01-A	2	7	1
MW-OU1-59-A	1	3	1

Additional survey results details are provided in Table 3.2.

4.2.5 Well Was Constructed Before the Initial Rare Plant Survey

Sand gilia was observed in one or more rare plant surveys from 1998 through 2014 at 11 of the 20 locations where wells were constructed before the 1998 survey was performed (note clarification in following paragraph). Because these wells pre-date the earliest available survey results from 1998, it is not known whether rare plants were present before the wells were constructed. One well (MW-OU1-07-A) was located within the source area and those soils were excavated and replaced with non-native fill. Thus, sand gilia was observed at a detection frequency of 58 percent (11 out of 19 native soil locations) in these wells.

During preparation of this year's annual rare plant survey report, two discrepancies were discovered in the 2013 discussion of sand gilia occurrence at wells constructed before 1998. The first was that the sand gilia populations observed in the vicinity of MW-OU1-09-A during the 2012 through 2014 surveys was approximately 40 feet from that well. The methodology used in assessing impact considered plants within 30 feet of the well location to be representative of the well site. Thus, sand gilia should not be counted as present at well MW-OU1-09-A and the number of well locations where sand gilia has been observed in rare plant surveys is 11 rather than 12. The second discrepancy was that the total well count (20) used in calculating the detection frequency at native soil locations should have been reduced by 1 (to 19) to reflect the fact that well MW-OU1-07-A was constructed in fill material that was placed after the contaminated native soils were removed. Thus, although the number of sand gilia occurrences reported in 2013 and earlier for wells in this category should have been 11, the detection frequency is essentially unchanged at 58 percent versus the previously reported 60 percent.

As noted earlier, the 1998 rare plant survey represented exceptionally favorable environmental conditions for Monterey spineflower and sand gilia (UCSC, 2006). Because pre-construction rare plant populations are unknown at these locations, it is not possible to make site-specific

comparisons to the post-construction rare plant survey results. However, the fact that sand gilia was found at 58 percent of the well locations in this category indicates that no adverse impact to plant populations occurred as a result of OU-1 remediation activities.

4.3 RARE PLANT POPULATIONS AT THE DESTROYED WELL SITES

Sections 4.1 and 4.2 described the rare plant survey results for the OU-1 area as a whole. The following test summarizes the post-destruction survey results for those wells destroyed in 2011. In 2011, 36 wells at 31 sites within the FONR habitat area were destroyed.

The survey results for Monterey spineflower are presented in Table 4.1 and show that Monterey spineflower was found at 26 well locations in one or more of the 1998, 2004, or 2011 pre-destruction surveys. Monterey spineflower was found at 23 of the 26 locations in either 2012, 2013 or 2014. As noted in Section 3.2.2, the Monterey spineflower population count may have been biased low because of the unusual weather conditions preceding and during the survey. Nonetheless, Monterey spineflower was found at 8 of the 26 locations in all three years (2012, 2013, and 2014) of the survey and at 17 of the 26 locations in both 2012 and 2013. At the three locations where Monterey spineflower was found before well destruction but not after, the following conditions are noted:

- At MW-OU1-20-A and EW-OU1-54-A, Monterey spineflower was not found in the 1998 or 2004 surveys before the well was constructed but was found in the 2011 survey after the well was built but before it was destroyed. These results suggest that the Monterey spineflower occurrence could have been enhanced by the well construction activity and/or these occurrences are a result of natural variation and that Monterey spineflower may return in the future.
- At well MW-OU1-10-A, Monterey spineflower was found only in the 1998 pre-destruction survey but not in the 2004 pre-destruction survey. This result suggests that Monterey spineflower population variability at this location may not be related to well construction or destruction actions.

Table 4.1 also shows that sand gilia was found at 15 of the 31 locations in one or more of the pre-destruction surveys. Sand gilia was found at 10 of 31 locations at least once in the post-destruction surveys, including 8 locations in all three years (2012, 2013, and 2014). Sand gilia was observed at 9 of the 15 locations (sixty percent) where it was present before well destruction occurred and at one additional location—MW-BW-10-A—where it was found each year from 2012 through 2014 but was not detected in any previous survey.

At five of the six locations where sand gilia was found before but not after the well was destroyed, it was detected in only 1 of the 3 pre-destruction surveys. At MW-OU1-38-A sand gilia was observed in 1998 and 2011 but not in the 2004 through 2007 annual surveys or the 2012 through 2014 surveys. Weather conditions in 1998 provided an exceptionally good year for sand gilia and 2011 was one of the better years in the reference area (Table 3.1). This observation suggests that sand gilia occurrence at MW-OU1-38-A may be more significantly affected by natural variation than remediation or well destruction activities.

4.4 WEED CONTROL ACTIVITIES

Weed control activities were conducted during 2007 through 2013. The road segment locations where weed control was performed are shown on Figure 1.5 and include the 10 well locations shown in Table 4.2. The species detected/not detected at these 10 locations are accounted for in the data presented in previous sections of this report. Sand gilia was not detected at any of the 10 locations in the 1998 and 2004 rare plant surveys but was found at 3 locations at least once in subsequent surveys. Monterey spineflower was noted in the 1998 rare plant survey at 4 of the 10 sites but was not detected in the 2004 pre-construction survey at any site. The 2005 through 2013 rare plant surveys showed the following results:

- At the four locations where Monterey spineflower was detected in 1998, it was detected multiple times in subsequent surveys.
- At the five locations where Monterey spineflower was not detected in 1998 or 2004, it was subsequently found once (one location), twice (three locations), and five times (one location).
- At one location, Monterey spineflower was not detected in 1998, 2004, or any subsequent survey.

These results suggest that weed control program is a successful mitigation measure, and/or that there were no adverse effects to these species. Further assessment of the effectiveness of weed treatment is planned.

The weed control effort was initiated as a proactive effort to mitigate potential impacts of invasive species. The initial effort in 2007 included a detailed survey to identify all species present and corresponding extent in each weed control area. Subsequent weed control efforts have focused on weed removal and detailed surveys of plant populations and extents have not been performed. Consequently, it is uncertain if the observed effectiveness of the weed control program to date provides a long term solution or if periodic future weed control efforts will be needed to sustain the gains made since 2007. To make this determination, UCSC will conduct a detailed survey similar to that performed in 2007 to identify all species present and corresponding extent in each weed control area. Recommendations for future weed control activities in 2015 or later will be made after evaluating the results of this survey.

4.5 SUMMARY

The post-construction rare plant surveys were compared with the 1998 and 2004 pre-construction rare plant surveys to assess construction impacts on the FONR rare plant populations. The results of that comparison indicate that the construction activity has not had significant adverse effects on the Monterey spineflower and sand gilia plant populations. Overall, the number of post-construction rare plant populations exceeded the number of populations found in pre-construction surveys. This result is partly attributed to the fact that HGL reviewed the 1998 and 2004 rare plant surveys when planning well locations and avoided known population occurrences. A summary of the supporting observations for this conclusion were described in the preceding paragraphs and are summarized in the following paragraphs.

At the 57 well locations constructed after the initial baselines survey in 1998 and/or 2004, Monterey spineflower was detected at 32 of the locations. At 10 of these 32 well sites, Monterey spineflower populations were similar to or greater than those in the pre-construction surveys. At eight well sites Monterey spineflower was detected before but not after well construction. However, at 14 well sites, Monterey spineflower was not detected in the pre-construction surveys but was found at least once in post-construction surveys. These results suggest a potential overall positive impact of remediation activities on Monterey spineflower populations. In addition, the reference area surveys showed wide variations in Monterey spineflower populations in areas not subject to intrusive activities. Together, these findings support the conclusion that remediation activities have not discernibly affected this plant population within the OU-1 area.

Monterey spineflower was found at each of the 19 native soil well locations where remediation activities were performed before the 1998 baseline survey. Although pre-construction rare plant surveys were not performed, the subsequent detection(s) at each location indicate that these sites fall into one of two categories (1) Monterey spineflower was detected both before and after construction, or (2) Monterey spineflower was absent before well construction but appeared afterward. These results clearly demonstrate that well construction and sampling activities have not affected Monterey spineflower populations within the OU-1 area.

At the 57 well locations constructed after the initial baselines survey in 1998 and/or 2004, sand gilia was detected at 10 of the locations. The absence of sand gilia in both pre- and post-construction surveys at 47 locations is consistent with the observation that sand gilia are much less common than Monterey spineflower throughout the OU-1 area. Five of the 10 well sites showed sand gilia populations similar to or greater than those in the pre-construction surveys. At one location, sand gilia was observed in the pre-construction survey but not in the post-construction survey. However, sand gilia was observed at four locations in post-construction surveys where it had not been seen in any pre-construction survey. As with Monterey spineflower, the reference area surveys showed wide variations in sand gilia populations in an area that is not subject to intrusive activities. Together, these findings support the conclusion that remediation activities have not discernibly impacted the sand gilia population within the OU-1 area

Sand gilia was found at 10 of the 57 surveyed locations (approximately 18 percent) where remediation activities were performed after the 1998 baseline survey. Sand gilia was found much more frequently—at 11 of the 19 native soil well locations (approximately 58 percent)—where remediation activities were performed before the 1998 baseline survey. The absence of baseline population data and the less than 100 percent occurrence of sand gilia at the pre-1998 sites prevent a definitive assessment of potential remediation impacts. However, the more frequent occurrence at the pre-1998 FONR sites in comparison to sand gilia occurrences at the post-1998 remediation sites and in contrast to the OU-1 area as a whole (21 of total 76 native soil sites or 28 percent) do not indicate a potential negative impact on sand gilia populations from remediation activities.

Manual and mechanical (nonchemical) weed control efforts were initiated throughout the UCSC in 2007 and continued through 2013 as a preventive measure. Weed control activities were not

performed in 2014. A detailed survey of those areas where weed control activities have been conducted in the past are planned to assess the overall effectiveness of these actions to date.

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5.0 RECOMMENDATIONS AND FUTURE WORK

In 2011, 36 wells at 31 locations were destroyed within the FONR. A rare plant survey was conducted at these locations in the spring of 2011 before the well destruction effort in September 2011. The 2014 rare plant survey was the third year rare plant survey at those locations since the wells were destroyed. This report completes the requirements of the HMP and the biological opinions to conduct such surveys for 3 years after site disturbance.

As described in the previous section, the construction and well destruction activities associated with the OU-1 groundwater remediation program have not discernibly affected rare plant populations within the FONR. This conclusion is based on an evaluation of the 1998 and 2004 through 2014 annual rare plant monitoring results providing 12 years of survey data. Based on these findings, no further action is needed at the well sites that were destroyed in 2011.

The well sites and roadways that border the adjacent grasslands to the north and east of the FONR represent marginal habitat for Monterey spineflower and sand gilia. Although isolated patches of Monterey spineflower are sometimes encountered in this area (sand gilia has not been detected), the predominant pre-construction populations are weeds and invasive grasses. Consequently, the potential impact as a result of the construction activities is not significant and the rare plant survey program was suspended in this region in 2010 (HGL, 2009b). Eleven of the 18 wells within OU-1 that were destroyed in 2014 were located in this grassland area or along the northwest road at the grassland/FONR habitat border. In 2015, HGL proposes to initiate the 3-year rare plant monitoring program at the 7 wells located within the FONR that were destroyed in 2014. The 3-year survey is in accordance with the requirements of the HMP and biological opinions listed in Section 1.4. These wells are:

MW-OU1-22-A	MW-OU1-23-A	MW-OU1-24-AR	MW-OU1-25-A
MW-OU1-40-A	PZ-OU1-46-AD2	MW-OU1-51-A	

The consistent recurrence of rare plant populations in the areas where weed control activities have been performed has clearly demonstrated that rare plant populations have been sustained or expanded. Consequently, it is recommended that these activities be suspended until further assessment.

In summary, the proposed recommendation for 2015 habitat related activities are as follows:

- The 3-year rare plant monitoring requirement at those locations affected by extending the groundwater remediation system to well IW-OU1-10-A is complete and no further action is recommended.
- Initiate the 3-year rare plant monitoring program at the 7 wells located within the FONR that were destroyed in 2014.
- Engage UCSC to survey weed populations in key segments as in the 2007 survey.
- Evaluate the long term effectiveness of weed control measures and report findings and recommendations.

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TABLE(S)

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Table 1.1
Wells Within the Fort Ord Natural Reserve

Wells Installed/Sampled Before 2004				Wells Installed for Enhanced Reductive Dechlorination Pilot Study		Wells Installed 2004 through 2006			
Identification	**Year Installed**	**Identification**	**Year Installed**	**Identification**	**Year Installed**	**Identification**	**Year Installed**	**Identification**	**Year Installed**
MW-B-10-A	1976	*MW-OU1-24-A*	1997	*IW-OU1-ERD-01-A*	2002	*IW-OU1-01-A*	2004	PZ-OU1-10-A1	2005
MW-OU1-01-A	1986	MW-OU1-24-AR	2003	*MW-OU1-ERD-01-A*	2002	IW-OU1-02-A	2004	PZ-OU1-46-AD2	2005
MW-OU1-02-A	1986	MW-OU1-25-A	1998	*IW-OU1-ERD-02-A*	2002	PZ-OU1-02-A1	2004		
MW-OU1-03-A	1986	MW-OU1-26-A	1998	*MW-OU1-ERD-02-A*	2002	*IW-OU1-05-A*	2004		
MW-OU1-04-A	1986	MW-OU1-27-A	1998	*IW-OU1-ERD-03-A*	2002	IW-OU1-10-A	2004	EW-OU1-60-A	2006
MW-OU1-05-A	1986	*MW-OU1-28-A*	1998	*MW-OU1-ERD-03-A*	2002	*IW-OU1-13-A*	2004	MW-OU1-61-A	2006
MW-OU1-06-A	1986	MW-OU1-29-A	1998	*IW-OU1-ERD-04-A*	2002	*IW-OU1-24-A*	2004	EW-OU1-62-A	2006
MW-OU1-07-A	1986	*MW-OU1-30-A*	1998	*MW-OU1-ERD-04-A*	2002	*IW-OU1-25-A*	2004	EW-OU1-63-A	2006
MW-OU1-08-A	1986	*MW-OU1-32-A*	1998	*MW-OU1-ERD-05-A*	2002	MW-OU1-46-AD	2004	MW-OU1-64-A1	2006
MW-OU1-09-A	1986	*MW-OU1-33-A*	1998	*MW-OU1-ERD-06-A*	2002	EW-OU1-47-A	2004	MW-OU1-64-A2	2006
MW-OU1-10-A	1987	*MW-OU1-34-A*	1998	*MW-OU1-ERD-07-A*	2002	*EW-OU1-48-A* *	2004	MW-OU1-65-A	2006
MW-OU1-11-SVA	1986	*PZ-OU1-35-A*	1998	MW-OU1-ERD-08-A	2002	EW-OU1-49-A	2004	EW-OU1-66-A	2006
MW-OU1-12-A	1988	*MW-OU1-36-A*	1999			PZ-OU1-49-A1	2004	MW-OU1-67-A	2006
PZ-OU1-13-A	1988	*MW-OU1-37-A*	1999			MW-OU1-50-A	2004	MW-OU1-68-A	2006
PZ-OU1-14-A	1988	*MW-OU1-38-A*	1999			MW-OU1-51-A	2004	EW-OU1-71-A	2006
PZ-OU1-15-A	1988	*MW-OU1-39-A*	1999			EW-OU1-52-A	2004	EW-OU1-72-A	2006
PZ-OU1-16-A	1988	MW-OU1-40-A	1999			EW-OU1-53-A	2004	IW-OU1-73-A	2006
EW-OU1-17-A	1987	MW-OU1-41-A	2001			*EW-OU1-54-A*	2004	IW-OU1-74-A	2006
EW-OU1-18-A	1987	MW-OU1-43-A	2001			*EW-OU1-55-A*	2004	MW-OU1-82-A	2006
MW-OU1-19-A	1993	*MW-OU1-44-A*	2001			MW-OU1-56-A	2004	MW-OU1-83-A	2006
MW-OU1-20-A	1993	MW-OU1-45-A	2001			MW-OU1-57-A	2004	MW-OU1-84-A	2006
MW-BW-10-A	1997	MW-OU1-46-A	2001			MW-OU1-58-A	2004	MW-OU1-85-A	2006
MW-OU1-21-A	1997	*MW-OU1-01-180*	2000			MW-OU1-59-A	2004	MW-OU1-86-A	2006
MW-OU1-22-A	1997	*MW-OU1-02-180*	2000					MW-OU1-87-A	2006
MW-OU1-23-A	1997	*MW-OU1-03-180*	2000					MW-OU1-88-A	2006

Notes:

Well name in Italics indicates that well has been destroyed.

ERD - enhanced reduction dechlorination

EW - extraction well

IW - injection well

MW - monitoring well

OU1 - Operable Unit 1

PZ - piezometer

SVA - Salinas Valley Acquiclude

Table 1.2
Soil Borings and Wells Destroyed within the Fort Ord Natural Reserve

Identification	Year Boring Abandoned or Well Destroyed	Identification	Year Boring Abandoned or Well Destroyed	Identification	Year Boring Abandoned or Well Destroyed
Soil Borings and Wells Destroyed 2004 - 2013. Post Destruction Rare Plant Monitoring Complete.					
SB-OU1-2004-I	2004	MW-OU1-01-180	2011	MW-OU1-32-A	2011
SB-OU1-2004-J	2004	MW-OU1-01-A	2011	MW-OU1-33-A	2011
SB-OU1-2004-K	2004	MW-OU1-02-180	2011	MW-OU1-34-A	2011
SB-OU1-2004-L	2004	MW-OU1-02-A	2011	MW-OU1-36-A	2011
SB-OU1-2004-M	2004	MW-OU1-03-180	2011	MW-OU1-37-A	2011
SB-OU1-46-AD1	2005	MW-OU1-03-A	2011	MW-OU1-38-A	2011
SB-OU1-60-A	2005	MW-OU1-04-A	2011	MW-OU1-39-A	2011
EW-OU1-48-A	2006	MW-OU1-05-A	2011	MW-OU1-42-A	2011
EW-OU1-17-A	2011	MW-OU1-06-A	2011	MW-OU1-44-A	2011
EW-OU1-18-A	2011	MW-OU1-07-A	2011	MW-OU1-ERD-01-A	2011
EW-OU1-54-A	2011	MW-OU1-08-A	2011	MW-OU1-ERD-02-A	2011
EW-OU1-55-A	2011	MW-OU1-09-A	2011	MW-OU1-ERD-03-A	2011
IW-OU1-01-A	2011	MW-OU1-10-A	2011	MW-OU1-ERD-04-A	2011
IW-OU1-05-A	2011	MW-OU1-11-SVA	2011	MW-OU1-ERD-05-A	2011
IW-OU1-13-A	2011	MW-OU1-12-A	before 2003	MW-OU1-ERD-06-A	2011
IW-OU1-24-A	2011	MW-OU1-19-A	2011	MW-OU1-ERD-07-A	2011
IW-OU1-25-A	2011	MW-OU1-20-A	2011	PZ-OU1-13-A	2011
IW-OU1-ERD-01-A	2011	MW-OU1-21-A	2011	PZ-OU1-14-A	2011
IW-OU1-ERD-02-A	2011	MW-OU1-24-A	2003	PZ-OU1-15-A	2011
IW-OU1-ERD-03-A	2011	MW-OU1-28-A	2011	PZ-OU1-16-A	2011
IW-OU1-ERD-04-A	2011	MW-OU1-30-A	2011	PZ-OU1-35-A	2011
MW-BW-10-A	2011	MW-OU1-31-A	2011		
Wells Destroyed in 2014					
EW-OU1-43-A	2014	MW-OU1-25-A	2014	MW-OU1-56-A	2014
EW-OU1-47-A	2014	MW-OU1-29-A	2014	MW-OU1-64-A1	2014
MW-B-10-A	2014	MW-OU1-40-A	2014	MW-OU1-64-A2	2014
MW-OU1-22-A	2014	MW-OU1-41-A	2014	MW-OU1-65-A	2014
MW-OU1-23-A	2014	MW-OU1-45-A	2014	MW-OU1-ERD-08-A	2014
MW-OU1-24-AR	2014	MW-OU1-51-A	2014	PZ-OU1-46-AD2	2014

Notes:

A - A-Aquifer
EW - extraction well
MW- monitoring well
PZ- piezometer
SVA - Salinas Valley Aquiclude
ERD - enhanced reductive dechlorination
IW- injection well
OU1- Operable Unit 1
SB - soil boring

Table 1.3
Summary of 2014 Groundwater Long Term Monitoring Program

Well Identification	Groundwater Sampling Events*			
	Mar-14	Jun-14	Sep-14	Dec-14
MW-OU1-46-AD	--	--	--	--
EW-OU1-60-A	X	--	X	--
EW-OU1-62-A	--	--	--	--
EW-OU1-63-A	--	--	--	--
EW-OU1-66-A	X	--	X	--
EW-OU1-71-A	X	--	X	--
MW-OU1-85-A	--	--	--	--
MW-OU1-87-A	X	X	X	X
IW-OU1-10-A	--	--	X	--
IW-OU1-02-A	water level only			
PZ-OU1-10-A1	--	--	X	--
MW-OU1-22-A	water level only			
MW-OU1-23-A	water level only			
MW-OU1-24-AR	water level only			
MW-OU1-25-A	water level only			
MW-OU1-26-A	X	--	X	--
MW-OU1-27-A	water level only			
MW-OU1-29-A	water level only			
MW-OU1-40-A	water level only			
MW-OU1-41-A	water level only			
MW-OU1-43-A	water level only			
MW-OU1-45-A	water level only			
MW-OU1-46-A	water level only			
EW-OU1-47-A	water level only			
EW-OU1-48-A	no longer sampled			
EW-OU1-49-A	water level only			
PZ-OU1-49-A1	--	--	X	--
MW-OU1-50-A	water level only			
MW-OU1-51-A	water level only			
EW-OU1-52-A	--	--	X	--
EW-OU1-53-A	--	--	X	--
MW-OU1-56-A				
MW-OU1-57-A	--	--	X	--
MW-OU1-58-A	--	--	X	--
MW-OU1-59-A	water level only			
MW-OU1-61-A	X	X	X	X
MW-OU1-64-A1	water level only			
MW-OU1-64-A2	water level only			
MW-OU1-65-A	water level only			
MW-OU1-67-A	water level only			
MW-OU1-68-A	water level only			

Table 1.3
Summary of 2014 Groundwater Long Term Monitoring Program

Well Identification	Groundwater Sampling Events*			
	Mar-14	Jun-14	Sep-14	Dec-14
MW-OU1-69-A2	--	--	--	--
MW-OU1-70-A	--	--	--	--
EW-OU1-72-A	--	--	X	--
IW-OU1-73-A	water level only			
IW-OU1-74-A	water level only			
MW-OU1-82-A (MW-G)	water level only			
MW-OU1-83-A (MW-F)	water level only			
MW-OU1-84-A (MW-E)	water level only			
MW-OU1-86-A (MW-C)	--	--	X	--
MW-OU1-88-A (MW-A)	X	X	X	X
MW-BW-10-A	water level only			
MW-OU1-ERD-08-A	water level only			

Notes:

-- no sample collected

* includes sampling of extraction wells

Identification in parentheses indicates temporary well name used in early planning documents.

Italicized well name indicates the well is not located within the Fort Ord Natural Reserve.

A - A-Aquifer

ERD - enhanced reductive dechlorination

EW - extraction well

IW - injection well

MW - monitoring well

OU1 - Operable Unit 1

PZ - piezometer

X - sample collected

Table 3.1
Rare Plant Survey Results for Reference Plot - 2010 through 2014

Sand Gilia

Year Surveyed	Number of Point Populations	Number of Individuals at Point Populations	Number of Polygon Populations	Number of Individuals at Polygon Populations	Total Number of Individuals	Area of Polygons (square feet)
2010	7	18	7	1068	1086	1,715
2011	12	40	4	278	318	1,410
2012	12	21	4	49	70	210
2013	7	17	13	719	736	1,281
2014	2	5	2	92	97	370

Monterey Spineflower

Year Surveyed	Number of Populations with < 5 Individual Plants	Total Number of Individual Plants	Number of Populations with > 5 Individual Plants	Plant Cover Density Summary for Areas With > 5 Individual Plants					Area of Polygons (square feet)
				Sparse	Medium-Low	Medium	Medium-High	Very High	
2010	0	0	2	1	1	0	0	0	2,846
2011	1	4	1	0	1	0	0	0	2,865
2012	1	4	2	2	0	0	0	0	1,494
2013	0	0	7	6	1	0	0	0	2,813
2014	1	4	6	6	0	0	0	0	1,119

Monterey Spineflower Plant Cover Density Categories Based on Percentage of Plant Cover of Total Ground Area

Very Sparse (less than 3 percent)

Sparse (3 to 25 percent)

Medium Low (26 to 50 percent)

Medium (51 to 76 percent)

Medium High (76 to 97 percent)

Very High (greater than 97 percent)

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Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Remarks Regarding Results for Given Year									
															2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed Before 1998																									
EW-OU1-17-A*[1]	1987	A3.2	MS, SG	N	--	N	N	--	--	--	MS	MS	MS	MS								MS#91[ML]; MS#92[S] nearby	MS#90[S]; MS#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]	MS#52[1]
PZ-OU1-13-A*[1]	1988	A3.2	MS	MS	--	MS	N	--	--	--	MS	MS	MS	MS	MS#216[100]		MS#46[S]					MS#91[ML]	MS#90[S]; MW#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]	MS#52[1]; MW#73[S]
PZ-OU1-14-A*[1]	1988	A3.2	MS, SG	N	--	N	MS	--	--	--	MS	MS	MS	MS				MS#49[VS]				MS#91[ML]; MS#92[S] nearby	MS#90[S]; MW#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]	MS#52[1]
EW-OU1-18-A*[2]	1987	A3.5	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG	SG#07[100]; MS#07[1000]			SG#22[75]				SG#35[4]; SG#36[2]	MS#93[S]; SG#48[13]; SG#6[4], SG#52[10]	MS#47[1]; MS#128[S]; SG#9[4]; SG#85[26]; MS#48[1]; MS#49[2]	SG#63[20]
PZ-OU1-15-A*[2]	1988	A3.5	MS, SG	MS, SG	--	N	N	--	--	--	MS, SG	MS, SG	MS, SG	SG	SG#07[100]; MS#07[1000]							MS#109[S]; SG#[35]; SG#[38]; SG#[37]	MS#93[S]; SG#48[13]; SG#6[4],	MS#47[1]; MS#128[S]; SG#9[4];	SG#63[20]
PZ-OU1-16-A*[2]	1988	A3.5	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG	SG#07[100]; MS#07[1000]			SG#22[75]				SG#37[9]; SG#38[3]; SG#39[2]	MS#93[S]; SG#48[13]; SG#6[4], SG#52[10]	MS#47[1]; MS#48[1]; MS#49[2]; MS#128[S]; SG#9[4];	SG#63[20]
MW-BW-10-A*	1993	A3.7	N	--	N	N	N	--	--	--	MS	MS, SG	MS, SG	MS,SG	MS#166, 167 & 215 nearby							MS#[78]; MS# [67]; MS#[66]	MS#82[S]; SG#9[1]; SG#10[2], SG#11[1]	MS#149[S]; SG#21[2]; SG#22[2]; SG#100[53]; SG#101[11]	MS#68[ML]; SG#60[26]; SG#61[12]
MW-OU1-01-A*	1985	A3.6	MS, SG	--	--	--	--	--	--	--	MS	MS, SG	MS, SG	SG								MS#68[1]; MS#79[S]; MS#80[S]; MS#81[S]	MS#42[1]; SG#53[17]	MS#60[1]; SG#98[12]; SG#99[35]; MS#124[S]	SG#20[1]; SG#21[2]; SG#22[2]; SG#62[23]
MW-OU1-02-A*	1985	A3.6	MS, SG	--	--	--	--	--	--	--	MS, SG	SG	MS, SG	SG								SG#11[2]; SG#7[3]; SG#8[3]; SG#9[1]; SG#10[4]; MS#111[ML]; SG#12, 54, 55, 56, 57, & 58 nearby	SG#55[10]; SG#15[1]; SG#16[4]; SG#17[1]; SG#14[2]; SG#54[10]; SG#13[2]; SG#56[11]	MS#61[1]; MS#62[5]; SG#23[4]; SG#24[1]; SG#25[1]; SG#102[6]	SG#4[1]; SG#5[1]; SG#6[4]
MW-OU1-03-A*	1985	A3.5	MS	MS, SG	N	N	MS, SG	--	--	--	MS, SG	MS	MS, SG	SG	SG#07[100]; MS#07[1000]			SG#21[100]; MS#44[S]				MS#99[S]; SG#34[5]	MS#93[S]	MS#47[1]; MS#48[1]; MS#49[2]; SG#85[26]; SG#87[24]; MS#138[S]	SG#27[4]; SG#28[4]; SG#29[2]; SG#64[9]
MW-OU1-04-A*	1985	A3.2	N	N	--	--	--	--	--	--	MS	N	MS	N								MS#70[2]; MS#71[5]		MS#131[S]	
MW-OU1-05-A*	1985	A3.4	MS	SG	N	N	N	--	--	--	MS	MS	MS	MS	SG#261[25]							MS#69[1]; MS#88[S]	MS#75[S]	MS#50[4]; MS#129[S]; MS#156[ML]	MS#75[S]
MW-OU1-06-A*	1985	A3.6	SG	--	--	--	--	--	--	--	MS	MS	MS, SG	MS,SG								MS#82[S]; MS#83[M]; MS#84 & 85 across street	MS#102[ML]	MS#157[M]; SG#97[6]	MS#71[M]; SG#26[4]
MW-OU1-07-A*	1985	A3.4, A3.5	N	N	N	--	N	--	--	--	N	N	--	--											
MW-OU1-08-A*	1986	A3.3	SG	MS	--	--	--	--	--	--	MS	MS	MS	N	MS#20[100]							MS#103[ML]	MS#40[1]; MS#80[S]	MS#135[S]	

Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Remarks Regarding Results for Given Year									
															2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed Before 1998 (continued)																									
MW-OU1-09-A*	1986	A3.2	MS	MS	MS	--	--	--	--	--	MS, SG	MS, SG	MS, SG	N	MS#20[100]	MS#82[S]						MS#94[ML]	MS#73[S]; MS#100[ML]; MS#45[1]	MS#148[S]; MS#152[ML]	
MW-OU1-10-A*	1987	NA	MS	N	N	--	--	--	--	--	N	N	--	--											
MW-OU1-11-SVA*	1986	A3.5	MS	MS	--	--	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG	SG	MS#220[1000]; extends far beyond well			SG#20; MS#42				SG#27[3]; SG#28[1]; SG#29[2]; SG#30[2]; SG#40[1]; SG#61[18]; MS#100[S]	MS#98[S]; MS#71[S]; SG#8[2]; SG#7[1]; SG#52[10], SG#6[4]	MS#45[1]; MS#46[4]; MS#127[S]; SG#86[31]	SG#30[1]; SG#31[2]
MW-OU1-12-A*[3]	1984	NA	N	--	--	--	--	--	--	--	--	--	--	--	Well destroyed in 2002										
MW-OU1-19-A*	1993	A3.2	MS, SG	MS	--	MS, SG	--	--	--	--	MS, SG	MS, SG	MS, SG	SG	MS#57[1000]; extends far beyond well		SG#33[375]; MS#45[S]					SG#53[697]; MS#89[S]	MS#76[S]; MS#77[S], MS#95[S]; SG#64[562]	MS#117[VS]; MS#118[VS]; SG#115[603]	SG#41[3]; SG#42[4]; SG#43[3]; SG#67[288]
MW-OU1-20-A*	1993	A3.3	N	N	MS	--	--	--	--	--	MS	N	N	N		MS#126[VS]						MS#95[S]			
MW-OU1-21-A*	1997	A1.3	N	--	N	--	--	--	--	--	MS	MS	N	N								MS#102[S]	MS#88[S]		
MW-OU1-22-A**	1997	NA	N	MS	N	N	N	--	--	--	--	--	--		MS#90[1000]; extends far beyond well										
MW-OU1-23-A**	1997	A3.1	MS	N	--	--	--	--	--	--	--	N	--	--											
MW-OU1-24-A[4]	1997	NA	MS	--	--	--	--	--	--	--	--	--	--	--	Well destroyed in 2003; see replacement well MW-24-AR										
MW-OU1-24-AR[4]**	2003	NA	MS	N	N	MS	N	--	--	--	--	--	--	--			MS#59[VS]								
Wells Installed from 1998 - 2001																									
MW-OU1-25-A**	1998	A3.1	MS	N	--	--	--	--	--	--	--	N	--	--											
MW-OU1-26-A	1998	NA	N	N	--	N	N	--	--	--	--	--	--	--											
MW-OU1-30-A*	1998	NA	N	N	--	MS	MS	--	--	--	--	--	--	--			MS#79[S]	MS#26[S]							
MW-OU1-32-A*[5]	1998	A3.3	N	N	--	--	--	--	--	--	MS	MS	MS	MS								MS#76[1]; MS#101[S]	MS#41[3]; MS#97[S]	MS#150[ML]; MS#126[S]	MS#79[S]
MW-OU1-33-A*[5]	1998	A3.3	N	N	--	--	--	--	--	--	MS	MS	MS	MS								MS#76[1]; MS#101[S]	MS#41[3]; MS#97[S]	MS#150[ML]; MS#126[S]	MS#79[S]
MW-OU1-36-A*	1999	A3.4, A3.6	N	--	--	--	--	--	--	--	N	N	--	--											
MW-OU1-37-A*	1999	A3.5	N	N	--	--	--	--	--	--	N	N	--	--											
MW-OU1-38-A*	1999	A3.5	SG	N	N	N	N	--	--	--	MS, SG	MS	N	N								MS#105[S]; SG#31 [5]	MS#96[S]		
MW-OU1-39-A*[9]	1999	A3.2, A3.5	MS	MS	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG	SG	MS#220[1000]; extends far beyond well							SG#17[5]; SG#18[2]; SG#15[1]; SG#16[4]; MS#98[MD]	MS#98[S]; SG#49[18]	SG#10[3]; SG#11[3]; SG#88[18]; SG#89[6]; MS#137[S]	SG#38[2]; SG#66[415]
MW-OU1-39-A west access road[9]	--	A3.2, A3.5	MS	MS, SG	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG	SG	MS#220 [1000]; SG#003 [50]; MS#002 [100]							MS#98[MH]; SG#59[66]; SG#19[1], SG#20[4]; SG#21[2]; SG#22[1]; SG#23[1]; SG#60[41]	MS#98[S]; SG#50[53]; SG#4[4]; SG#51[13]; SG#5[1]	MS#137[S]; MS#10[3]; SG#11[3]; SG#12[3]; SG#13[2]; SG#14[4]; SG#88[18]; SG#89[6]; SG#90[45]; SG#91[13]; SG#92[15]	SG#38[2]
MW-OU1-39-A east access road[9]	--	A3.2, A3.5	MS	MS	--	--	--	--	--	--	MS, SG	MS	MS	SG	MS#220[1000]							MS#98[MH]; SG#24[2]; SG#25[4]; SG#26[1]	MS#98[S]	MS#137[S]	SG#66[415]

Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Remarks Regarding Results for Given Year										
															2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed from 1998 - 2001 (Continued)																									
MW-OU1-40-A**	1999	A3.1	MS	N	N	--	--	--	--	--	--	N	--	--											
MW-OU1-44-A*	2000	A3.4	MS, SG	--	--	--	--	--	--	--	MS	MS	MS, SG	MS								MS#[87]	MS#101[ML]	MS#52[1]; MS#139[S]; MS#151[ML]; SG#15[1]	MS#77[S]
MW-OU1-45-A	2001	NA	N	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-46-A[6]	2001	NA	MS	N	N	N	N	MS	MS	MS	--	--	--	--					MS#34[VS]	MS#27[M]					
MW-OU1-01-180*	2000	A3.6	N	--	--	--	--	--	--	--	N	N	--	--											
MW-OU1-02-180*	2000	A3.7	N	--	--	--	--	--	--	--	N	N	--	--											
MW-OU1-03-180*	2000	A3.1	N	N	N	N	--	--	--	--	N	N	--	--											
Wells Installed in 2004 After the Rare Plant Survey																									
MW-OU1-46-AD[6]	No	NA	MS	N	N	N	N	MS	MS	--	--	--	--	--					MS#34[VS]	MS#27[M]					
EW-OU1-47-A	No	3	N	N	N	N	N	--	N	--	--	--	--	--	Located in grassland east of FONR.										
EW-OU1-48-A	No	NA	N	N	N	N	N	--	--	--	--	--	--	--	Located in grassland east of FONR.										
EW-OU1-49-A[7]	No	NA	MS	N	N	N	N	--	--	--	--	--	--	--											
PZ-OU1-49-A1[7]	No	NA	MS	N	N	N	N	--	--	--	--	--	--	--											
EW-OU1-52-A	No	NA	N	N	N	N	N	--	--	--	--	--	--	--											
EW-OU1-53-A	Yes	NA	MS	N	N	MS, SG	MS,SG	--	--	--	--	--	--	--			MS#92[S]; SG#21-#25 & 30	SG#24[16]; MS#52[VS]; MS#53 [VS]							
EW-OU1-54-A*	No	A3.2	N	N	MS	N	N	--	--	--	MS, SG	N	N	N		MS#126[VS]						MS#72[4]; MS#96[S]; MS#97[S]; SG#13 & #14 nearby			
EW-OU1-55-A*	No	A3.2	N	N	N	N	N	--	--	--	MS	MS	MS	N								MS#90[S]	MS#78[S]	MS#132[S]	
IW-OU1-01-A*	No	A3.2	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS	MS			MS#46[S]; and SG#2-6 nearby	MS#50[S]				MS#91[ML]	MS#90[S]	MS#57[2]; MS#153[ML]	MS#53[4]; MS#54[1]
IW-OU1-02-A	Yes	NA	N	N	--	N	N	--	--	--	--	--	--	--											
IW-OU1-05-A*	No	A3.4	N	N	--	MS	MS	--	--	--	MS	MS	MS	MS			MS#49[VS]	MS#46[VS]				MS#86[S]	MS#91[S]	MS#129[S]; MS#130[S]	MS#76[S]
IW-OU1-10-A[8]	Yes	NA	N	N	--	N	N	--	--	--	--	N	--	--											
IW-OU1-24-A*	No	A3.3	N	N	--	N	MS	--	--	--	MS	MS	N	N				MS#35[VS]				MS#104[S]	MS#81[S]		
IW-OU1-25-A*	No	A3.2	N	MS, SG	N	N	N	--	--	--	MS	MS	N	N	MS#135[5];and SG#30 [2]							MS#73[4]; MS#74[4]; MS#75[4]	MS#86[S]		
MW-OU1-51-A**	No	4	N	N	N	N	N	N	N	--	--	--	--	--											
Wells Installed in 2004 in Area Not Surveyed																									
MW-OU1-50-A	Yes	NA	MS	--	MS	N	MS	MS	MS	--	--	--	--	--		MS#21[MD]		MS#61[ML]	MS#49[ML]; and MS#50[S]	MW#36[S]; MW#4[2]; MW#5[2]					
MW-OU1-56-A	No	NA	MS	--	N	MS	N	--	--	--	--	--	--	--		MS#146[1] nearby	MS#76[VS] nearby								
MW-OU1-57-A	No	NA	MS	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-58-A	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-59-A	Yes	NA	N	--	MS	SG	N	--	--	--	--	--	--	--		MS#153[2]	SG#26[13]								
Staging Areas Used in 2004																									
Area # 1	No	NA	MS	N	N	MS	MS	--	--	--	--	--	--	--			MS#39[1]; MS#56[VS]; and MS#57[VS]	MS#9[3]; MS#39[VS]; MS#40[S]							
Area # 2	No	NA	MS, SG	SG	MS, SG	MS, SG	MS, SG	--	--	--	--	--	--	--	SG#011[10]	SG#045[1]; MS#047[S]	SG#35[110]; SG#37[80]; and MS#54[S]	SG#18[36]; MS#8[1]; MS#36[S]; MS#37[S]							
Area # 3	No	NA	SG[1]	N	N	MS, SG	MS	--	--	--	--	--	--	--			SG#7[1]; MS#50[S]; and MS#52[S]	MS#41[S]							

Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Remarks Regarding Results for Given Year									
															2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed in 2005 After the Rare Plant Survey																									
PZ-OU1-10-A1[8]	No	NA	N	N	--	N	N	--	--	--	--	--	--	--											
PZ-OU1-46-AD2[6]	No	NA	MS	N	--	N	N	MS	N	--	--	--	--	--					MS#4[1]						
HCPP Wells Installed Along Northwest Boundary Road in 2006 Before the Rare Plant Survey																									
EW-OU1-60-A	No	NA	MS	--	N	N	N	N	--	--	--	--	--	--											
EW-OU1-62-A	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
EW-OU1-63-A	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
EW-OU1-66-A	No	NA	MS	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-61-A	No	NA	MS	--	N	N	N	N	--	--	--	--	--	--											
MW-OU1-64-A1	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-64-A2	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-65-A	No	NA	MS	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-67-A	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
MW-OU1-68-A	No	NA	N	--	N	N	N	--	--	--	--	--	--	--											
Wells Installed in 2006 After the Rare Plant Survey																									
EW-OU1-71-A	Yes	NA	N	N	--	N	N	MS	N	--	--	--	--	--					MS#42[S]						
EW-OU1-72-A	Yes	NA	N	N	N	N	N	N	N	--	--	--	--	--											
IW-OU1-73-A	Yes	NA	N	--	N	N	N	N	N	--	--	--	--	--											
IW-OU1-74-A	No	NA	N	--	N	N	MS	MS	MS	--	--	--	--	--				MS#60[VS]	MS#39[S]	MS#41[S]; MS#33[ML]					
MW-OU1-82-A	Yes	NA	N	--	N	N	N	MS	MS	--	--	--	--	--					MS#51[ML]	MS#10[2]					
MW-OU1-83-A	Yes	NA	N	N	N	N	N	MS	MS	--	--	--	--	--					MS#26[1]; and MS#46[S] adjacent	MW#23[2]; MW#24[2]; MW#25[1]					
MW-OU1-84-A	No	NA	N	--	N	N	N	MS	MS	--	--	--	--	--				MS#58 across the road	MS#37[ML]; and MS#36[ML] across road	MS#28[M]; MS#15[3]					
MW-OU1-85-A	Yes	NA	N	N	N	N	N	N	N	--	--	--	--	--											
MW-OU1-86-A	Yes	NA	N	N	--	N	N	N	N	--	--	--	--	--											
MW-OU1-87-A	No	NA	N	N	N	N	N	N	N	--	--	--	--	--											
MW-OU1-88-A	Yes	NA	N	N	--	N	N	N	N	--	--	--	--	--											

[1] EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A considered to be one location
[2] EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A considered to be one location
[3] MW-OU1-12-A was destroyed before the 2004 survey and is not included in the evalu
[4] MW-OU1-24AR replaced MW-OU1-24-A, so they're considered to be one location
[5] MW-OU1-32-A and MW-OU1-33-A considered to be one location
[6] MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location
[7] EW-OU1-49-A and PZ-OU1-49-A1 considered to be one location
[8] IW-OU1-10-A and PZ-OU1-10-A1 considered to be one location
[9] MW-OU1-39-A, MW-OU1-39-A west access road, and MW-OU1-39-A east access road are considered one location

Notes:

No new wells have been installed since 2006.

*This well was abandoned in 2011.
**This well was abandoned in 2014.
-- not surveyed
EW - extraction well
FONR - Fort Ord Natural Reserve
HCCP - Hydraulic Control Pilot Project
ID - identification
IW - injection well
MD - medium high
ML - medium low
MS - Monterey spineflower
MS#49[VS] - population ID # [density category or number of plants]
SG[1] - Given map scale, it is possible that the observed sand gilia population was just outside the northwest boundary of the staging area.
#49 - indicates population ID number assigned in corresponding annual rare plant survey; [13] indicates number of plants.
SG - Sand gilia
SG#26[13] - population ID # [number of plants]
S - sparse
VS - very sparse
MW - monitoring well
N - area was surveyed; but no rare plants were detected.
OU1 - operable unit 1
PZ - piezometer
RP/HS - rare plant/habitat survey; population ID# & segment identification refers to Figures A3.1 through A3.3 in Appendix A.

Table 3.3
Fort Ord Precipitation Data - 1998-2014

Year	October - March Rainfall (inches)
1998	22.36
2004	10.32
2005	21.73
2006	14.18
2007	7.88
2008	9.71
2009	11.89
2010	16.85
2011	17.29
2012	11.3
2013	8.78
2014	7.35
Average	**13.30**

Notes:
Precipitation information obtained from
http://met.nps.edu/~ldm/renard_wx/

Table 4.1
Rare Plant Survey Results Relative to OU-1 Wells Destroyed in 2011

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed Before 1998														
EW-OU1-17-A*[1]	1987	A3.2	MS, SG	N	--	N	N	--	--	--	MS	MS	MS	MS
PZ-OU1-13-A*[1]	1988	A3.2	MS	MS	--	MS	N	--	--	--	MS	MS	MS	MS
PZ-OU1-14-A*[1]	1988	A3.2	MS, SG	N	--	N	MS	--	--	--	MS	MS	MS	MS
EW-OU1-18-A*[2]	1987	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG
PZ-OU1-15-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	N	--	--	--	MS, SG	MS, SG	MS, SG	SG
PZ-OU1-16-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG
MW-BW-10-A*	1993	A3.3	N	--	N	N	N	--	--	--	MS	MS, SG	MS, SG	MS, SG
MW-OU1-01-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS	MS, SG	MS, SG	SG
MW-OU1-02-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS, SG	SG	MS, SG	SG
MW-OU1-03-A*	1985	A3.2	MS	MS, SG	N	N	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG	SG
MW-OU1-04-A*	1985	A3.2	N	N	--	--	--	--	--	--	MS	N	MS	N
MW-OU1-05-A*	1985	A3.2	MS	SG	N	N	N	--	--	--	MS	MS	MS	MS
MW-OU1-06-A*	1985	A3.3	SG	--	--	--	--	--	--	--	MS	MS	MS, SG	MS, SG
MW-OU1-08-A*	1986	A3.2	SG	MS	--	--	--	--	--	--	MS	MS	MS	N
MW-OU1-09-A*	1986	A3.2	MS	MS	MS	--	--	--	--	--	MS	MS	MS	N
MW-OU1-10-A*	1987	A3.2	MS	N	N	--	--	--	--	--	N	N	--	--
MW-OU1-11-SVA*	1986	A3.2	MS	MS	--	--	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG	SG
MW-OU1-19-A*	1993	A3.2	MS, SG	MS	--	MS, SG	--	--	--	--	MS, SG	MS, SG	MS, SG	SG
MW-OU1-20-A*	1993	A3.2	N	N	MS	--	--	--	--	--	MS	N	N	N
MW-OU1-21-A*	1997	A3.2	N	--	N	--	--	--	--	--	MS	MS	N	N
Well Identification	**Year Installed**	**Appendix A Figure #**	**1998**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Wells Installed from 1998 - 2001														
MW-OU1-30-A*	1998	NA	N	N	--	MS	MS	--	--	--	--	--	--	--
MW-OU1-32-A*[3]	1998	A3.2	N	N	--	--	--	--	--	--	MS	MS	MS	MS
MW-OU1-33-A*[3]	1998	NA	N	N	--	--	--	--	--	--	MS	MS	MS	MS
MW-OU1-36-A*	1999	A3.3	N	--	--	--	--	--	--	--	N	N	--	--
MW-OU1-37-A*	1999	A3.3	N	N	--	--	--	--	--	--	N	N	--	--
MW-OU1-01-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--	--
MW-OU1-02-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--	--
MW-OU1-03-180*	2000	A3.2	N	N	N	N	--	--	--	--	N	N	--	--
MW-OU1-38-A*	1999	A3.2	SG	N	N	N	N	--	--	--	MS, SG	MS	N	N
MW-OU1-39-A*[4]	1999	A3.2	MS	MS	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG	SG
MW-OU1-44-A*	2000	NA	MS, SG	--	--	--	--	--	--	--	MS	MS	MS, SG	MS
Well Identification	**New Access Cleared to Install Well**	**2008 RP/HS Segment ID**	**1998**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	
Wells Installed in 2004 After the Rare Plant Survey														
EW-OU1-54-A*	No	Well Site	N	N	MS	N	N	--	--	--	MS, SG	N	N	N
EW-OU1-55-A*	No	Well Site	N	N	N	N	N	--	--	--	MS	MS	MS	N
IW-OU1-01-A*	No	12	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS	MS
IW-OU1-05-A*	No	13	N	N	--	MS	MS	--	--	--	MS	MS	MS	MS
IW-OU1-24-A*	No	Well Site	N	N	--	N	MS	--	--	--	MS	MS	N	N
IW-OU1-25-A*	No	Well Site	N	MS, SG	N	N	N	--	--	--	MS	MS	N	N

[1] EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A considered to be one location

[2] EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A considered to be one location

[3] MW-OU1-32-A and MW-OU1-33-A considered to be one location

[4] MW-OU1-39-A, MW-OU1-39-A west access road, and MW-OU1-39-A east access road are considered one location

Notes:

No new wells have been installed since 2006.

*This well has been abandoned.

OU1 - operable unit 1

PZ - piezometer

N - area was surveyed; but no rare plants were detected.

MS - Monterey spineflower

SG - Sand gilia

-- not surveyed

Table 4.2
Rare Plant Survey Results Relative to OU-1 Weed Control Segment Well Locations

Well Identification	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wells Installed from 1998 - 2001 (Continued)												
MW-OU1-46-A[1]	MS	N	N	N	N	MS	MS	MS	--	--	--	--
Wells Installed in 2004 After the Rare Plant Survey												
MW-OU1-46-AD[1]	MS	N	N	N	N	MS	MS	--	--	--	--	--
Wells Installed in 2005 After the Rare Plant Survey												
PZ-OU1-46-AD2[1]	MS	N	--	N	N	MS	N	--	--	--	--	--
EW-OU1-53-A	MS	N	N	MS, SG	MS,SG	--	--	--	--	--	--	--
IW-OU1-01-A*	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS	MS
IW-OU1-05-A*	N	N	--	MS	MS	--	--	--	MS	MS	MS	MS
MW-OU1-51-A	N	N	N	N	N	N	N	--	--	--	--	--
MW-OU1-50-A	MS	--	MS	N	MS	MS	MS	--	--	--	--	--
MW-OU1-59-A	N	--	MS	SG	N	--	--	--	--	--	--	--
Wells Installed in 2006 After the Rare Plant Survey												
MW-OU1-82-A	N	--	N	N	N	MS	MS	--	--	--	--	--
MW-OU1-83-A	N	N	N	N	N	MS	MS	--	--	--	--	--
MW-OU1-84-A	N	--	N	N	N	MS	MS	--	--	--	--	--

Notes:

*This well has been abandoned.

EW - extraction well

IW - injection well

MW - monitoring well

PZ - piezometer

N - area was surveyed, but no rare plants were detected.

OU1 - operable unit 1

SG - Sand gilia

MS - Monterey spineflower

-- not surveyed

[1] MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location.

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FIGURE(S)

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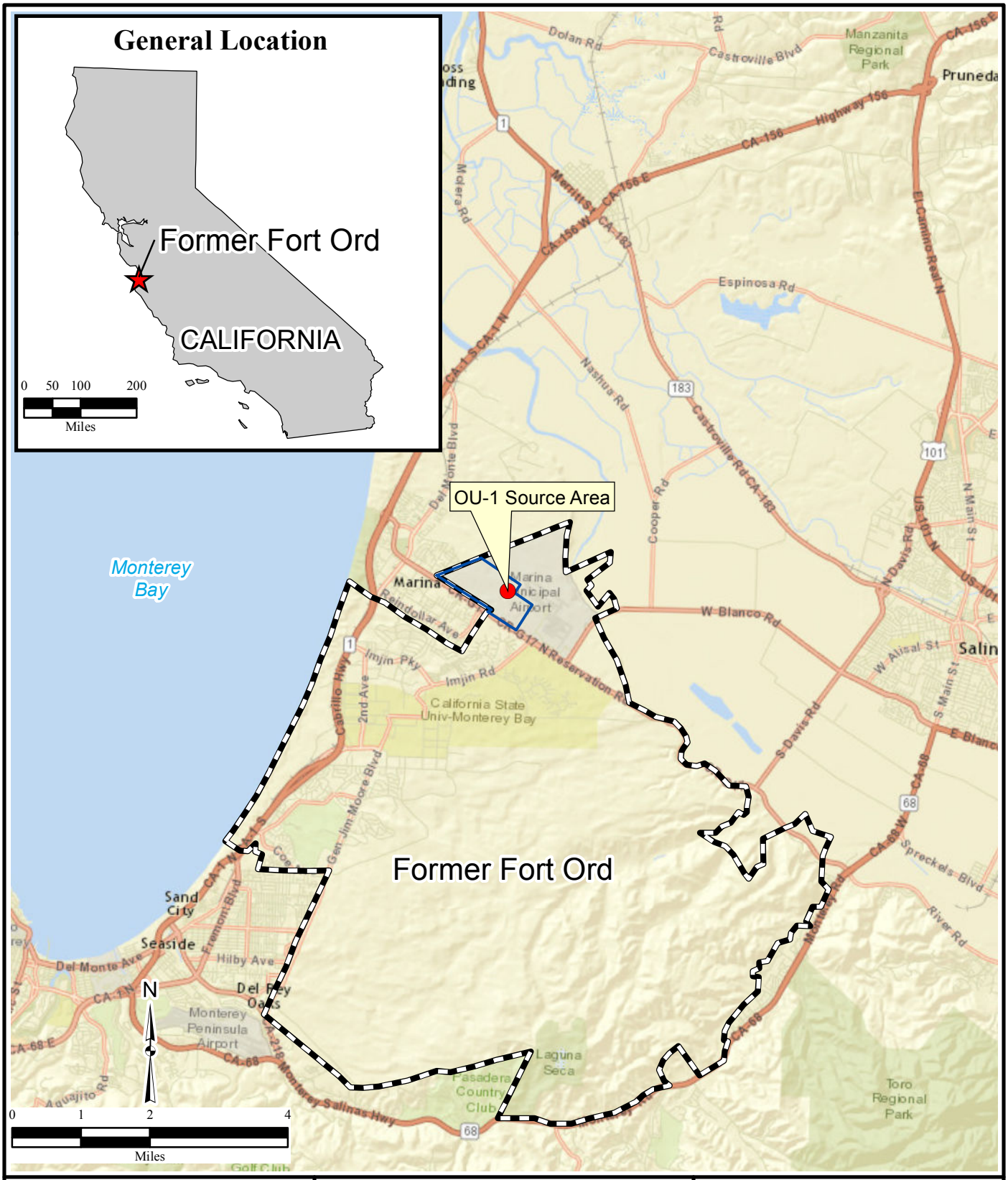

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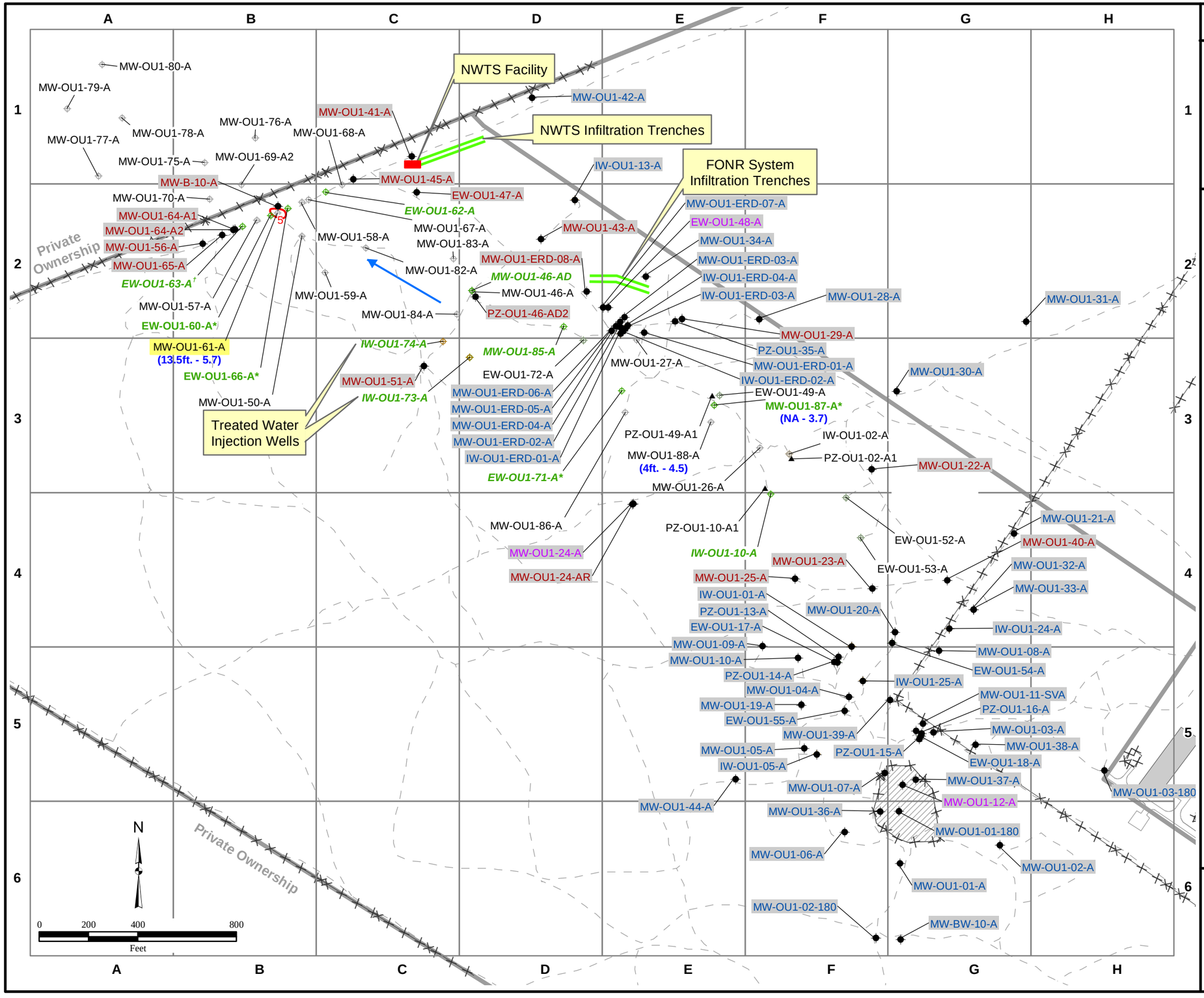
10/2/2014 PDB
Source: HGL
ArcGIS Online Streets Map

Legend

- OU-1 Source Area
- Fort Ord Natural Reserve
- Former Fort Ord

Figure 1.1
Former Fort Ord

Figure 1.2
OU-1 FONR A-Aquifer
TCE Concentration in Groundwater
June 2014



Legend

- Well
- Extraction Well
- Injection Well
- Well Destroyed
- Piezometer or 2-Inch Well
- Groundwater Flow Direction
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- MW-OU1-61-A — Location with TCE Concentrations at or above ACL (5 µg/L)
- (13.5ft. - 13) — June 2014 TCE Result (µg/L) / Sample Elevation (feet above mean sea level)
- 5 — TCE contour based on June 2014 Data
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Property Boundary
- Building
- Former Fire Drill Area

Notes:
Units of TCE concentration are in micrograms per liter.
Wells shown with an asterisk were not used to develop contour boundaries.
Wells for which no data are posted were not sampled.
Green font indicates extraction or injection well.
Italicized font shows pumping suspended.
µg/L=micrograms per liter
†=Disconnected extraction well. No longer operable.
ACL=Aquifer Cleanup Level
FONR=Fort Ord Natural Reserve
NA=Depth is not applicable - sample is from pumping well
NWTS=Northwest Treatment System
TCE=trichlorethene
OU-1=Operable Unit 1

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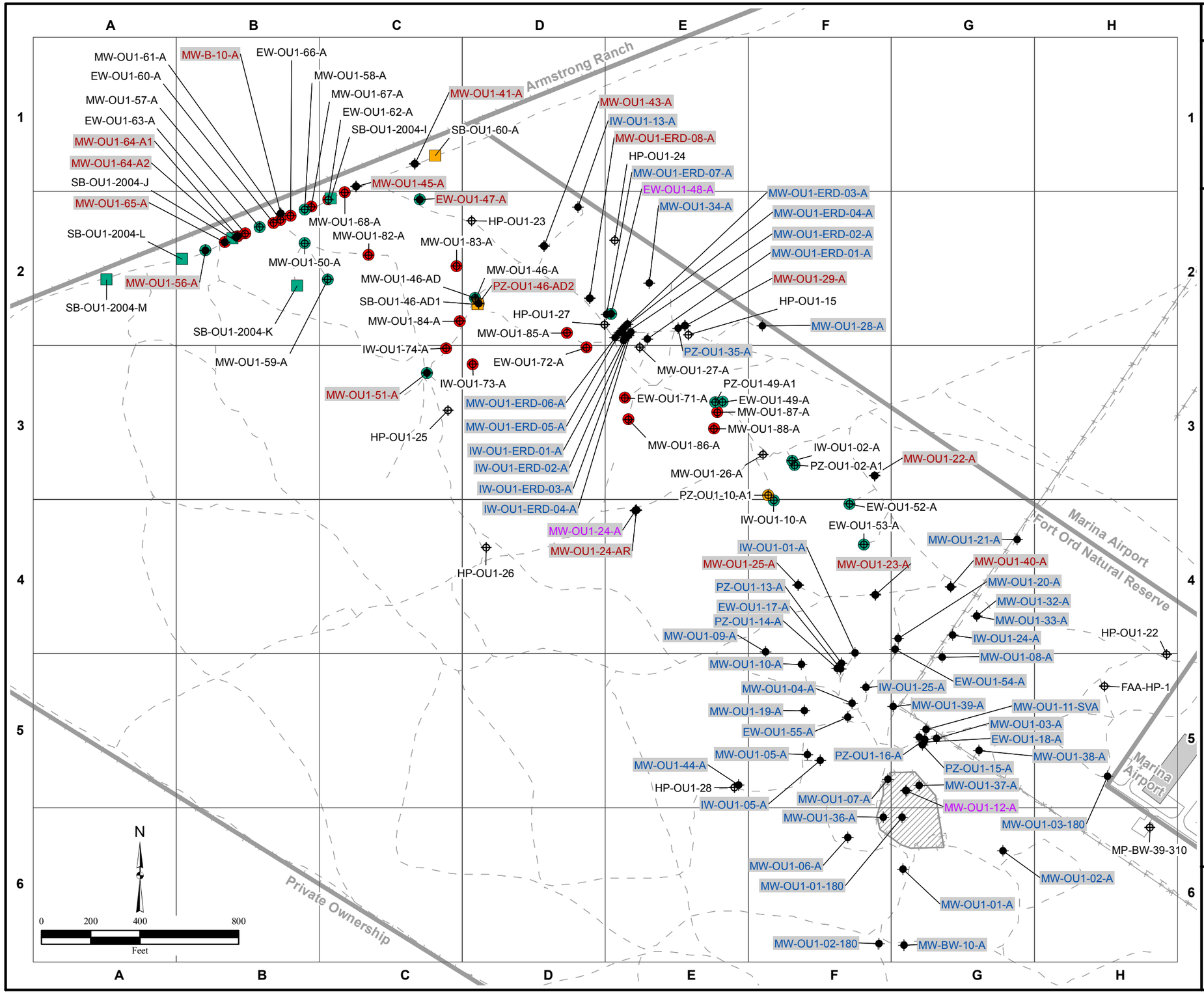
8/29/2014 CNL
Source: HGL

HydroGeoLogic, Inc

Figure 1.3
OU-1 Soil Borings, Wells, and Piezometers Constructed Within the FONR



Legend

- Well/Piezometer Drilled Before 2004
- Well Destroyed
- 2004 Well/Piezometer
- 2004 Soil Boring
- 2005 Well/Piezometer
- 2005 Soil Boring
- 2006 Well/Piezometer
- MW-OU1-26-A — Well or Boring ID
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- Trail/Unimproved Road
- Fence
- Property Boundary
- Building
- Former Fire Drill Area

Notes:
FONR=Fort Ord Natural Reserve
OU-1=Operable Unit 1

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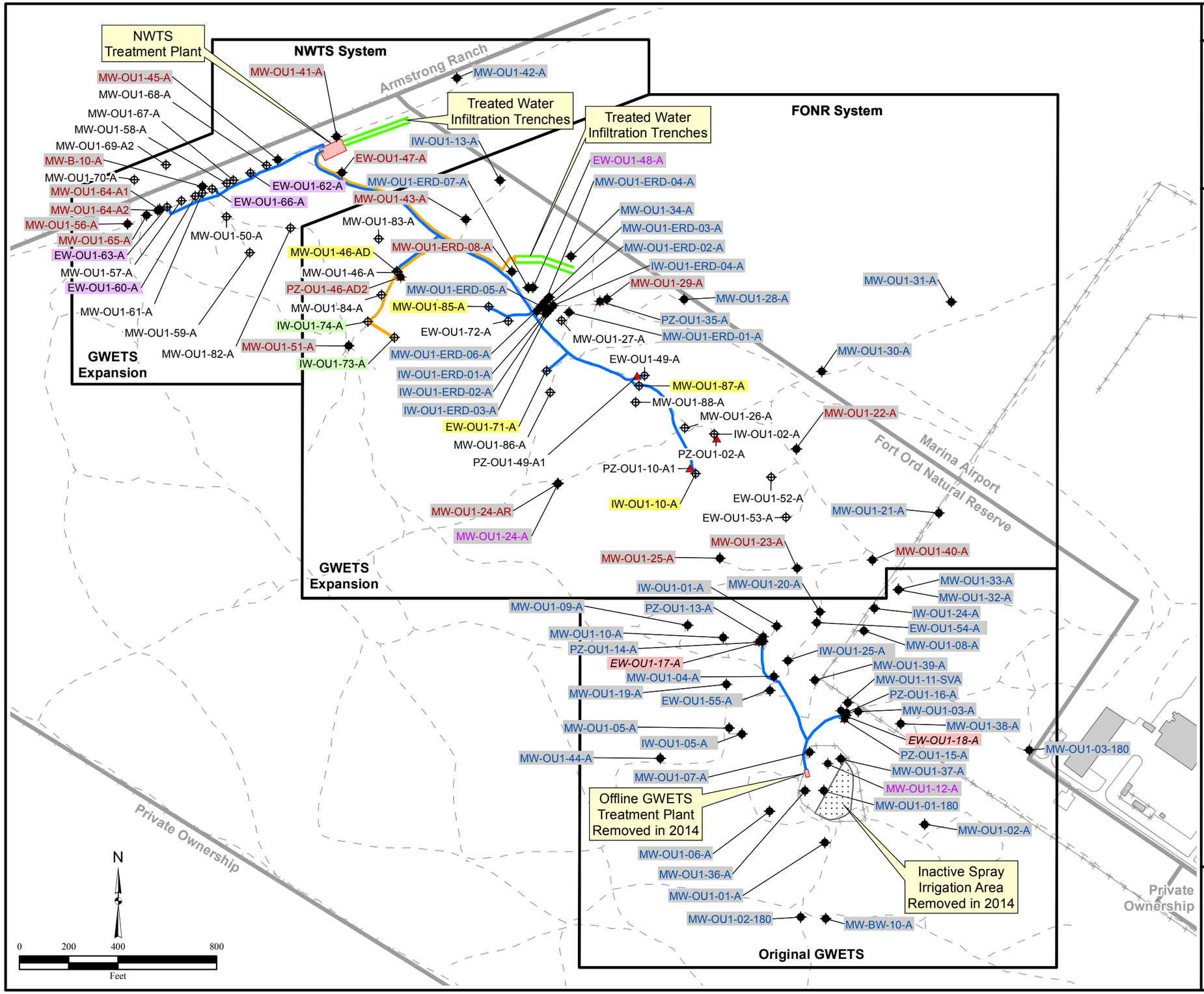
8/7/2014 PDB
Source: HGL

HydroGeoLogic, Inc

Figure 1.4
OU-1 Remediation System Areas Within the FONR



Legend

- Well
- Well Destroyed
- Piezometer
- MW-OU1-27-A — Well Identification
- EW-OU1-18-A — Original GWETS Extraction Well (Destroyed September 2011)
- IW-OU1-74-A — FONR Injection Well
- MW-OU1-46-AD — FONR Extraction Well
- EW-OU1-63-A — NWTS Extraction Well
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- Trail/Unimproved Road
- Fence
- Extraction Pipeline
- Treated Water Pipeline
- Treated Water Infiltration Trench
- Property Boundary
- Treatment Plant
- Inactive Spray Irrigation Area
- Building

Notes:
The treated water and extraction water pipelines are located in separate trenches within or near the existing roadway. The separation shown in this figure is exaggerated for clarity.

FONR=Fort Ord Natural Reserve
GWETS=Groundwater Extraction and Treatment System
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

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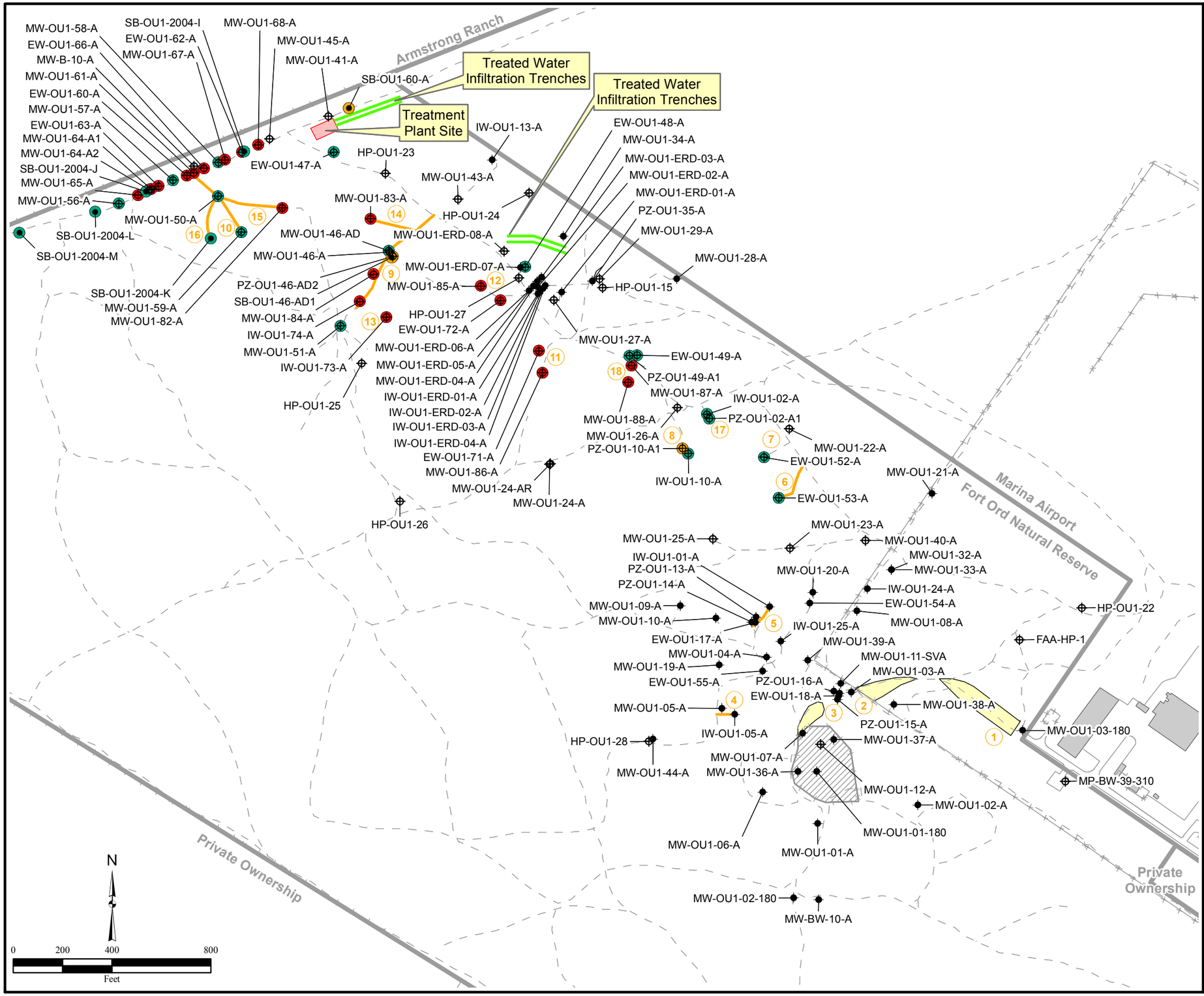
9/11/2014 PDB
Source: HGL

HydroGeoLogic, Inc

Figure 1.5
OU-1 Weed Control Segment Locations



Legend

- Well/Piezometer Drilled Before 2004
- Abandoned Soil Boring
- Well Destroyed September 2011
- 2004 Well/Piezometer
- 2004 Soil Boring (abandoned)
- 2005 Well/Piezometer
- 2005 Soil Boring (abandoned)
- 2006 Well/Piezometer
- MW-OU1-21-A — Well or Boring ID
- Active 2013 Weed Control Segment
- (1) Weed Control Segment Identification Number 2007-2013
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Property Boundary
- Southern Staging Area in 2004
- Treatment Plant
- Building
- Former Fire Drill Area

Note:
OU-1=Operable Unit 1

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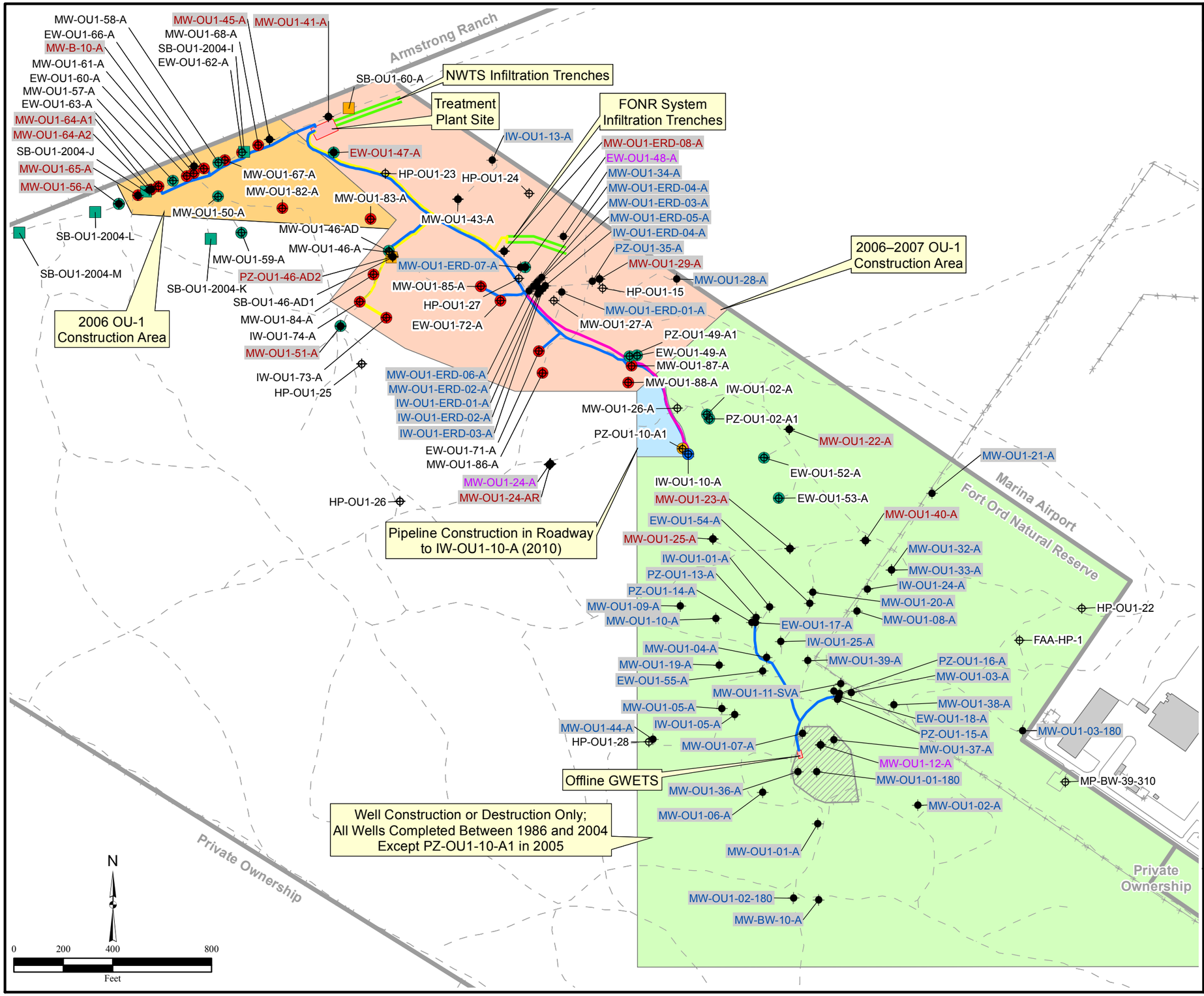
9/9/2014 PDB
Source: HGL

HGL HydroGeoLogic, Inc

Figure 4.1
OU-1 Construction Activities
2004–2014



Legend

- Well/Piezometer Drilled Before 2004
- Well Destroyed
- 2004 Well/Piezometer
- 2004 Soil Boring
- 2005 Well/Piezometer
- 2005 Soil Boring
- 2006 Well/Piezometer
- Existing Well Modified in 2010
- MW-OU1-86-A — Well or Boring ID
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- IW-OU1-10-A Pipeline Route
- Extraction Pipeline
- Infiltration Trench
- Treated Water Pipeline
- Trail/Unimproved Road
- Fence
- Property Boundary
- Treatment Plant
- Building
- Former Fire Drill Area

Notes:
The treated water and extraction water pipelines are located in separate trenches within or near the existing roadway. The separation shown in this figure is exaggerated for clarity.

FONR=Fort Ord Natural Reserve
GWETS=Groundwater Extraction and Treatment System
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

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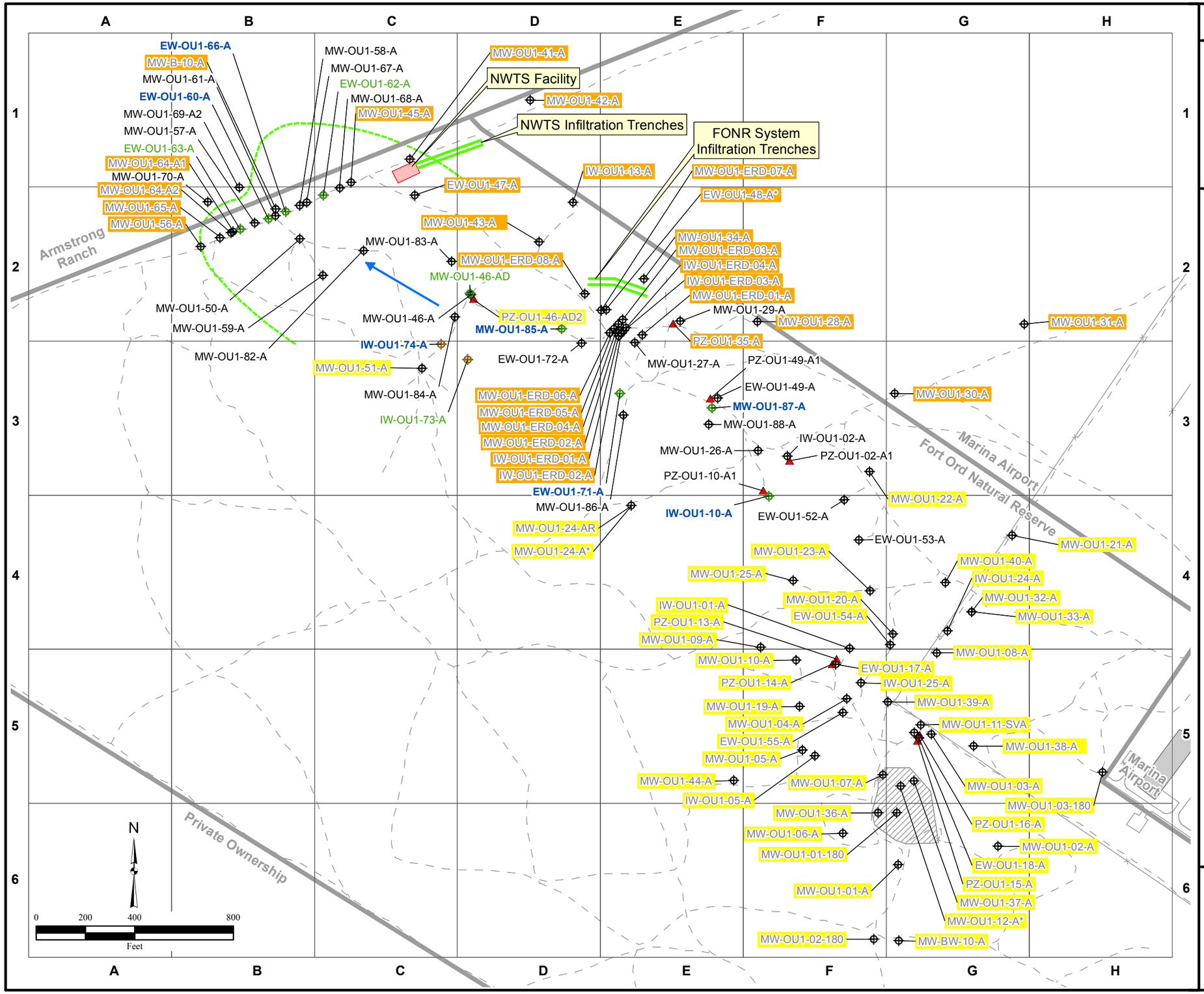
8/7/2014 PDB
Source: HGL

HydroGeoLogic, Inc

Figure 4.2
OU-1 Wells Destroyed 2011 and 2014



Legend

- Monitoring Well
- Extraction Well
- Injection Well
- Piezometer
- MW-OU1-88-A — Well ID
- MW-OU1-87-A — Active Well
- EW-OU1-62-A — Inactive Well
- MW-OU1-30-A — Well Destroyed in Grassland or Northwest Boundary Road
- MW-OU1-02-A — Well Destroyed Within FONR Habitat Area
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Estimated Northwest Treatment System Capture Zone
- Groundwater Flow Direction
- Property Boundary
- Treatment Plant
- Building
- Former Fire Drill Area

Notes:
*=Well destroyed before 2006
FONR=Fort Ord Natural Reserve
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

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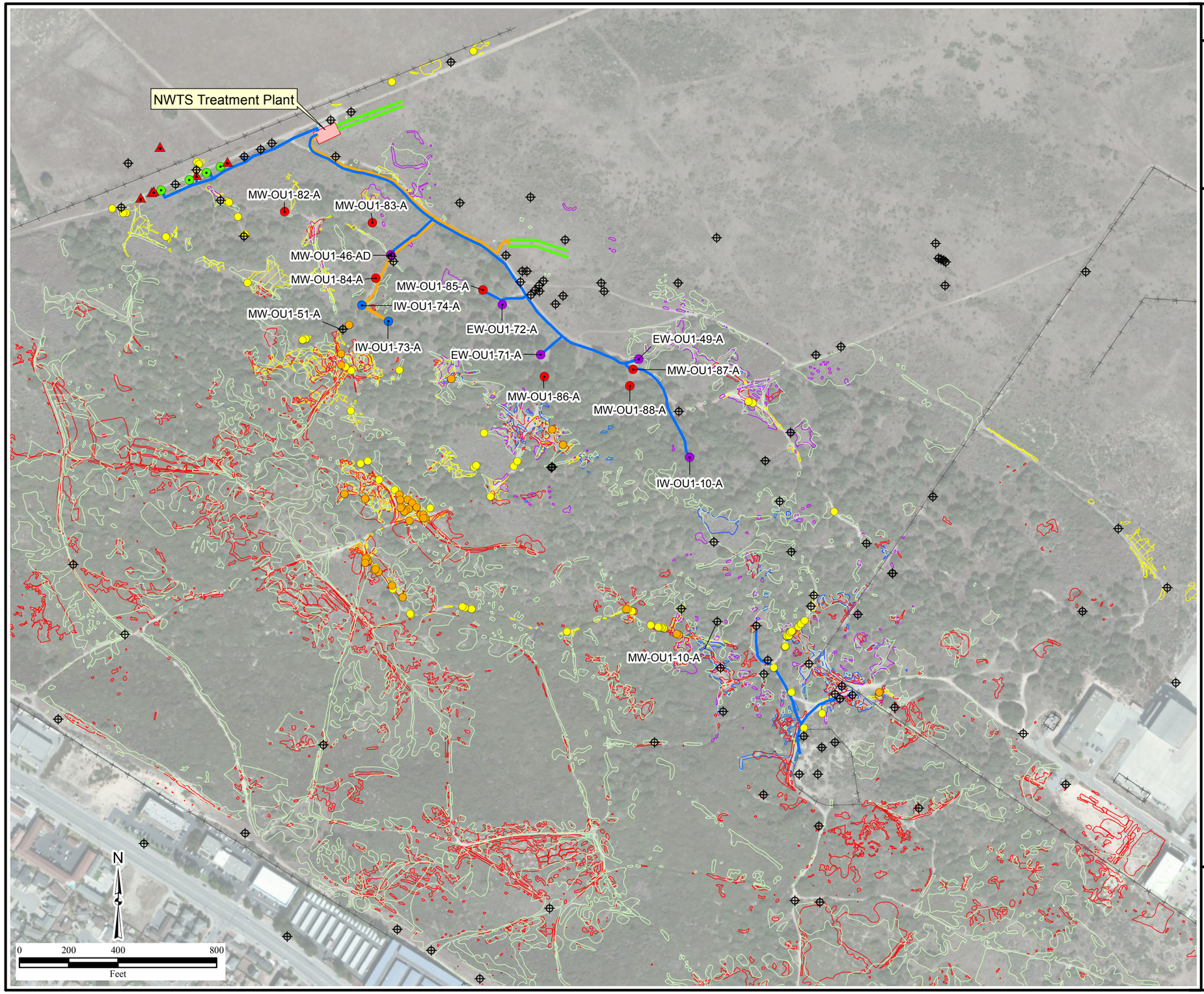
10/2/2014 PDB
Source: HGL

HydroGeoLogic, Inc

Figure 4.3
Summary
of Rare Plant Survey Results
1998–2005



Legend

- Monitoring Well
- Northwest Treatment System Extraction Well
- Northwest Treatment System Performance Monitoring Well
- FONR OU-1 Monitoring Well
- FONR OU-1 Extraction Well
- FONR OU-1 Injection Well
- Extraction Pipeline Route
- Infiltration Trench
- Treated Water Pipeline Route
- Fence

1998 Rare Plant Survey (UC Santa Cruz):

- Sand Gilia
- Monterey Spineflower

2004 Rare Plant Survey (CH2MHill):

- Sand Gilia
- Monterey Spineflower

2005 Rare Plant Survey (CH2MHill):

- Sand Gilia
- Monterey Spineflower
- Sand Gilia
- Monterey Spineflower–High Density
- Monterey Spineflower–Medium Density
- Monterey Spineflower–Sparse Density
- Monterey Spineflower–Very Sparse Density

Notes:
FONR=Fort Ord Natural Reserve
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

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8/7/2014 PDB
Source: HGL, CH2MHill, UC Santa Cruz
ArcGIS Online Imagery

HydroGeoLogic, Inc

APPENDIX A

RESULTS OF 2014 MONTEREY SPINEFLOWER AND SAND GILIA SURVEYS

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Results of the 2014 Monterey Spineflower and Sand Gilia Surveys

OU-1, Fort Ord Natural Reserve, California

Prepared for HydroGeoLogic Inc.

Prepared By Denise Duffy & Associates, Inc.

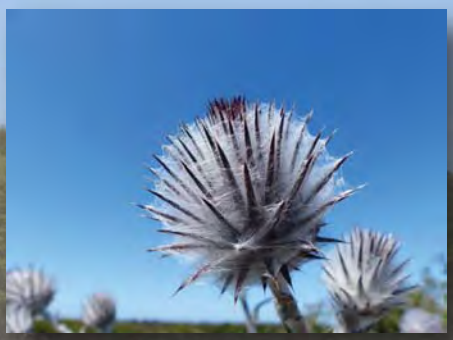

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Table A4.4 Monterey Spineflower Population Comparisons at OU1 FONR Well Locations

Acronym List

CDFW	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
DD&A	Denise Duffy & Associates, Inc.
FDA	Fire Drill Area
FONR	Fort Ord Natural Reserve
ft^2	square feet
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HGL	HydroGeoLogic, Inc.
HMP	Habitat Management Plan
OU	operable unit
TCE	trichloroethene
UCNRS	University of California Natural Reserve System
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound

A1.0 Introduction

HydroGeoLogic, Inc. (HGL) is executing a groundwater remediation project at Operable Unit (OU1) at the former Fort Ord U.S. Army Base located in Monterey County, California (Fig. A1.1). The U.S. Army Corps of Engineers (USACE)-Sacramento District under Contract Number DACA45-03-D-0029 awarded this work to HGL in December 2003. Denise Duffy & Associates (DD&A) performed biological survey work described herein under subcontract to HGL.

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the Secretary of Defense announced the downsizing/closure of the base. In August 1994, portions of the property were transferred to the University of California and the Fort Ord Natural Reserve (FONR) was established in June 1996. The former Fort Ord is located near Monterey Bay approximately 80 miles south of San Francisco. The base consists of approximately 28,000 acres near the cities of Seaside, Sand City, Monterey, Del Rey Oaks, and Marina. Monterey Bay marks the western boundary, Toro Regional Park borders the base to the southeast, and land use to the east is primarily agricultural.

Activities conducted at the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA) (the source area for OU1 contaminants) between 1962 and 1985 resulted in the release of contaminants to soils and groundwater. Although 10 volatile organic compounds (VOCs) were identified as contaminants of concern in groundwater underlying OU1, trichloroethene (TCE) is the contaminant that was detected at the highest concentrations and across the greatest extent of the affected aquifer. A groundwater extraction and treatment system (GWETS) was constructed in 1988 to remediate TCE and other groundwater contaminants. In 2004 HGL assumed control of the remediation efforts.

A key factor that affected the design and implementation of the groundwater cleanup is the fact that the groundwater plume lies beneath a part of the University of California Natural Reserve System (UCNRS) designated as the FONR. The FONR area potentially impacted by the construction of OU1 remediation facilities is approximately 130 acres. Rare plant surveys are required by the Habitat Management Plan (U.S. Army, 1997) (HMP) in areas that are disturbed during construction activities associated with remediation efforts. Project activities undertaken to achieve the OU1 cleanup must protect and maintain the special-status species found within the FONR, specifically two federally listed plant species: Monterey spineflower (*Chorizanthe pungens* var. *pungens*) and sand gilia (*Gilia tenuiflora* ssp. *arenaria*). As part of the current remediation project, rare plant surveys were conducted in OU1 FONR area in 2011, 2012, 2013, and 2014 to meet the overall objective of protecting these two special-status plant species in areas affected by construction activities. This report details the surveys completed in April 2014.

A1.1 Survey Objectives

The objectives of the 2014 rare plant surveys were to:

1. Map Monterey spineflower and sand gilia at a DD&A reference site southeast of the FONR property (Fig. A1.2);
2. Map Monterey spineflower and sand gilia at well locations within the sensitive habitat portions of the FONR where various wells constructed as part of the ground water remediation project were dismantled and destroyed in late 2011 (Fig. A1.3).

In 2013, the Army contacted the United States Fish and Wildlife Service (USFWS) and requested that monitoring be discontinued on seven well locations that were surveyed during 2011 and 2012. Following discussion with USFWS, the list of well locations was modified from the survey conducted in 2012 and no longer includes the following well sites:

- MW-OU1-10-A, MW-OU1-07-A, MW-OU1-36-A, MW-OU1-37-A, MW-OU1-01-180, MW-OU1-02-180, and MW-OU1-03-180.

A1.2 Site Location and Description

The dominant habitats in the area surrounding the well locations include coast live oak woodland, maritime chaparral, coastal scrub, disturbed/developed land, and annual grassland. Several special-status plant and wildlife species occur within the FONR, including sand gilia and Monterey spineflower. The northern and eastern boundaries of OU1 are adjacent to a large expanse of non-native grassland. Transmission of non-native grass species into OU1 is accelerated by the prevailing southern winds, which blow seeds into the OU1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU1 area. The spread of non-native, invasive species into newly disturbed areas may result in population declines of Monterey spineflower and sand gilia. Sand gilia is especially vulnerable as it is less tolerant of competing plant cover than Monterey spineflower.

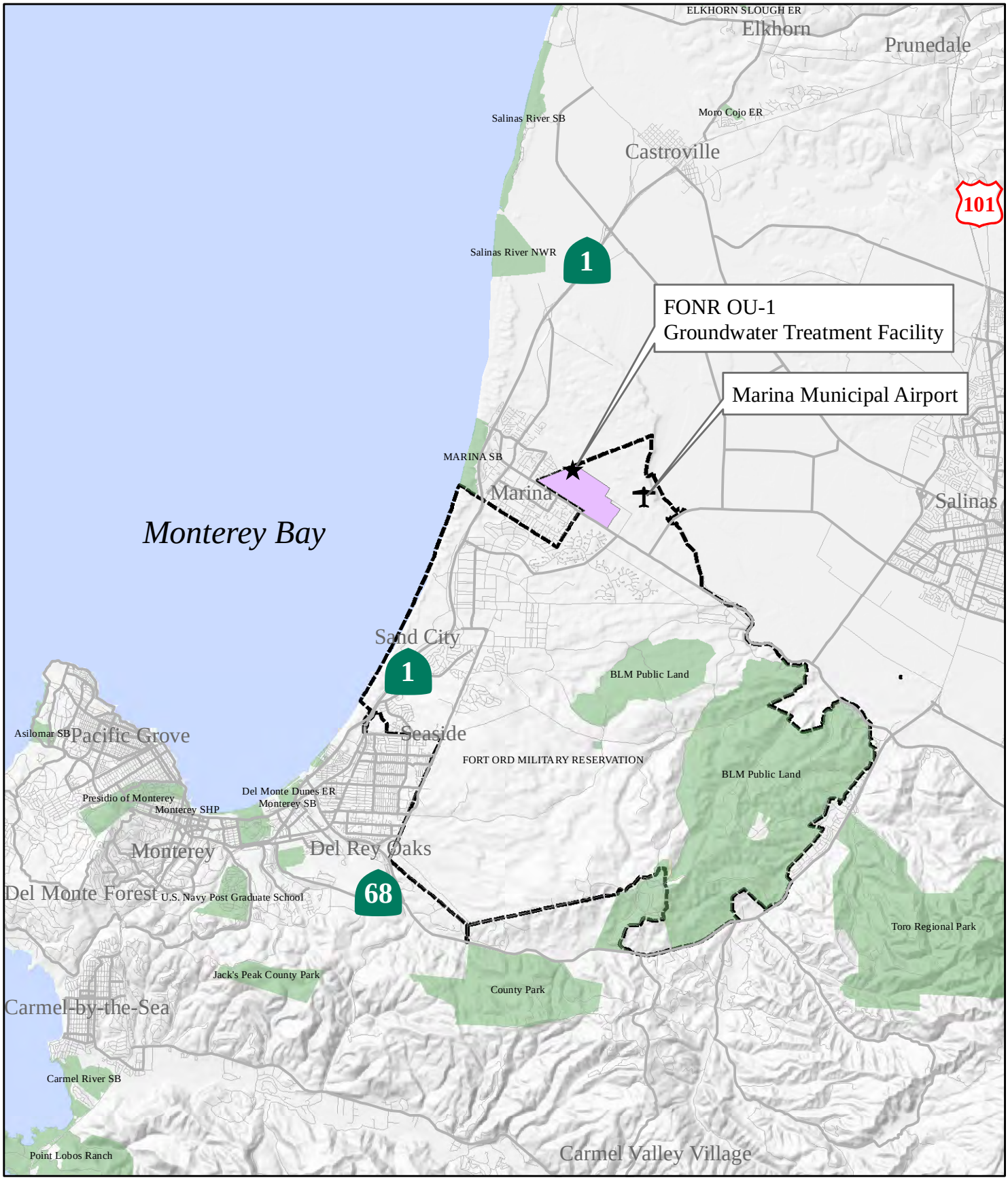
In the reference site coast live oak woodland is the dominant habitat type. Grassland and coast live oak woodland is adjacent to the reference site on the northwestern boundary. All other boundaries of the reference site are bordered by paved roadways (Reservation Road, MBEST Drive, and University Drive). Non-native grasses and weedy forbs are present throughout much of the reference site.

A1.2.1 Sand Gilia

Sand gilia is a small annual in the phlox family (*Polemoniaceae*). Plants range in height from two to six inches with a small, basal rosette of leaves. The lower branches of the stem are generally densely glandular. Plants typically bloom from April through June and have funnel-shaped flowers with narrow, purple to pinkish petal lobes and a purple throat. This species occurs in open sandy soils in dune scrub, coastal sage scrub, and maritime chaparral habitats. Sand gilia is endemic to Monterey Bay and the peninsular dune complexes. According to the California Natural Diversity Database (CNDDB) there are 28 occurrences within Monterey County, including the occurrences at Fort Ord (CDFW, 2014). It is likely that some of these occurrences are no longer present and the exact number of extant (still in existence) occurrences are unknown.

A1.2.2 Monterey Spineflower

Monterey spineflower is a small, prostrate annual in the buckwheat family (*Polygonaceae*) that blooms from April to June. The white to rose floral tube of Monterey spineflower distinguishes it from the more common, but closely related diffuse spineflower (*Chorizanthe diffusa*), which has a lemon-yellow floral tube. This species typically occurs on open sandy or gravelly soils in coastal dune, coastal scrub, and maritime chaparral habitats. There are 24 records of Monterey spineflower within Monterey County in the CNDDB (CDFW, 2014); however, it is not known how many of these are extant.



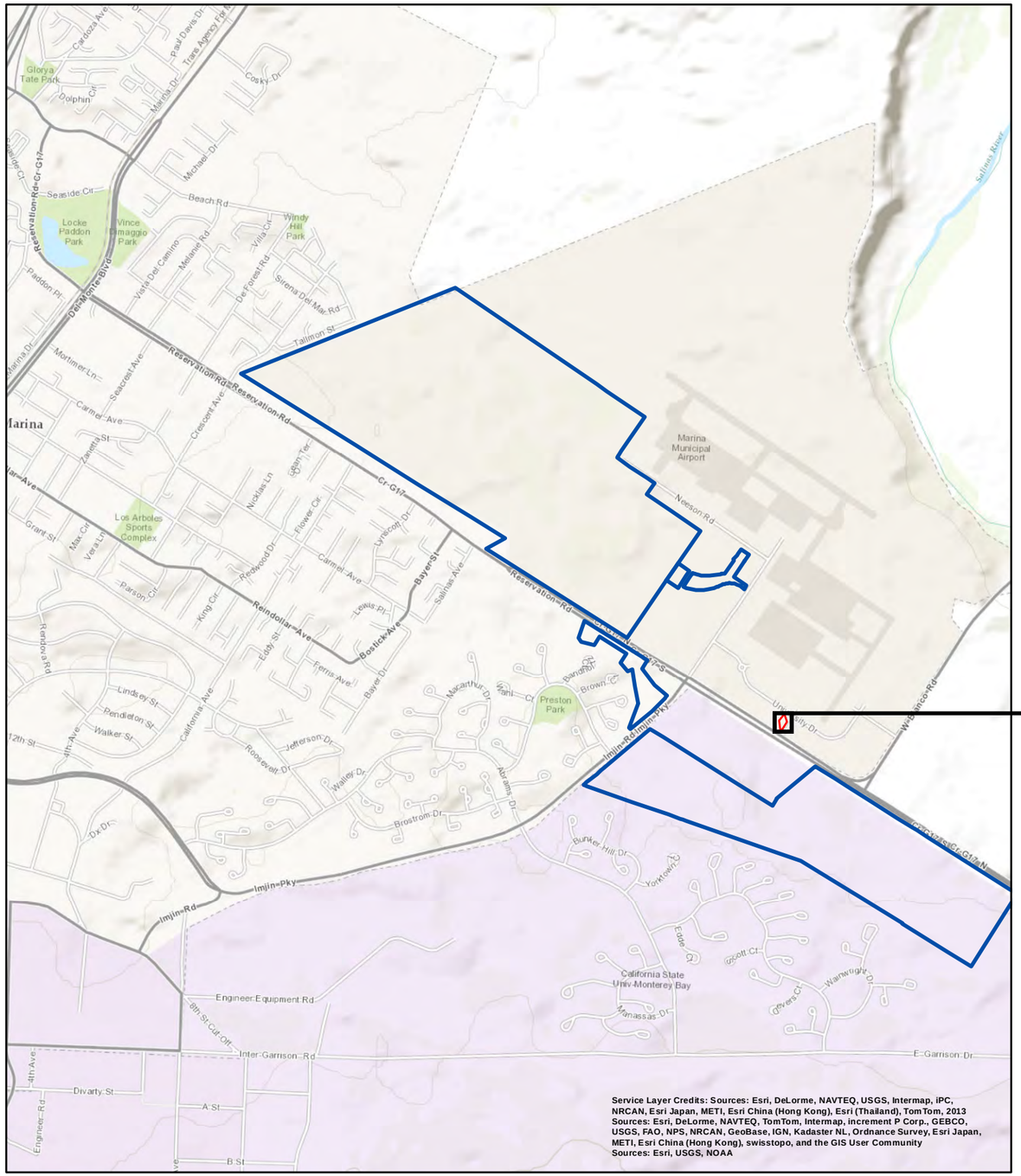
N

0 1.25 2.5 5 Miles

0 2.5 5 10 Kilometers

Figure A1.1

Project Vicinity Map

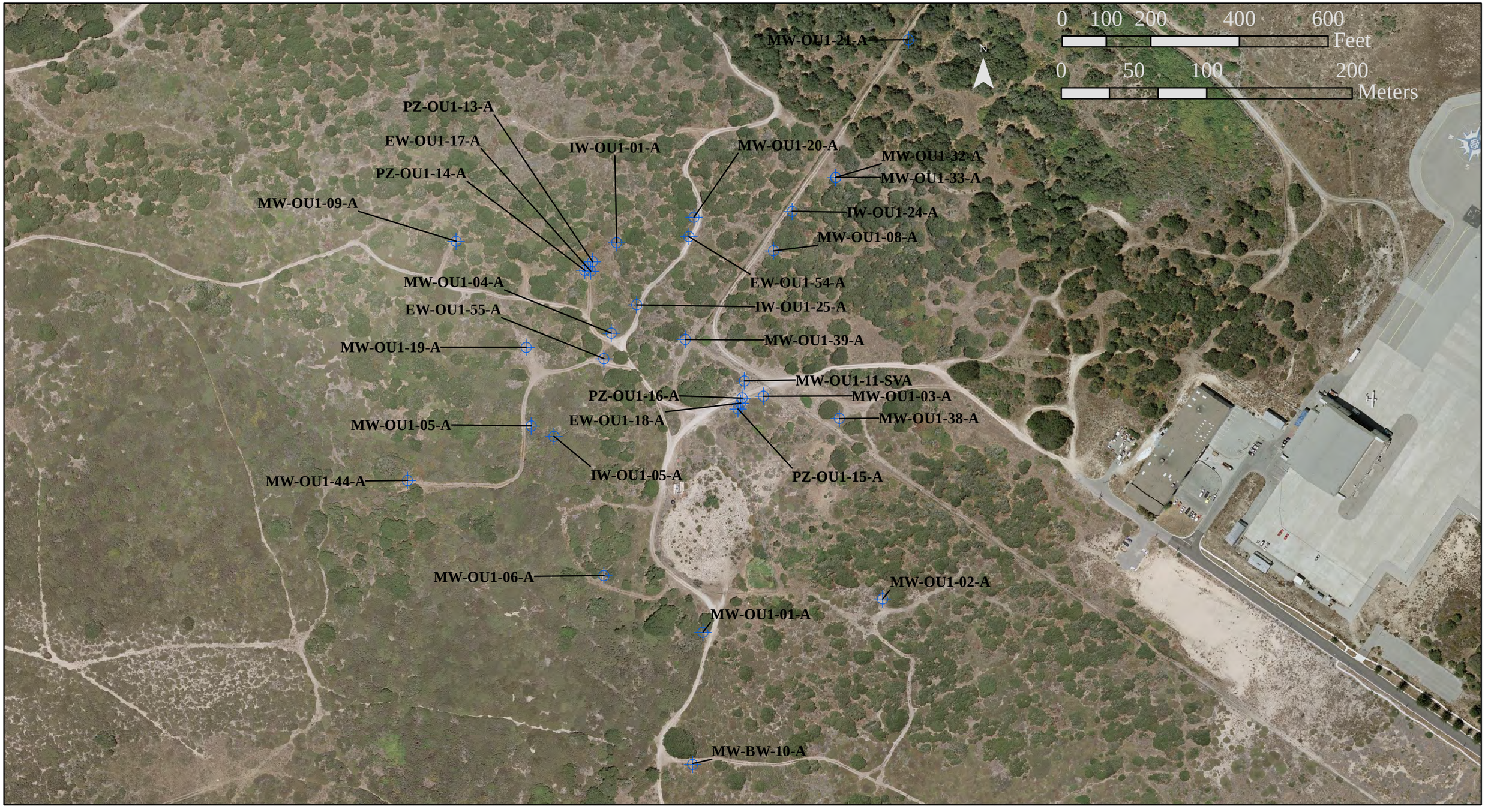


Survey Area

UC FONR Boundary

Figure A1.2

2014 Survey Area
DD&A Reference Site



Wells Surveyed in 2014

Figure A1.3

OU-1 Wells Surveyed in 2014

A2.0 Rare Plant Survey Methods

The survey areas consisted of the DD&A reference site (Fig. A1.2) and the OU1 FONR well locations (Fig. A1.3). These areas were completely surveyed for the two rare plants (i.e., Monterey spineflower and sand gilia) during two survey efforts conducted on April 24 and 29, 2014.

Mapping of the two rare plant species was accomplished using a Trimble Pathfinder ProXH GPS unit. When either Monterey spineflower or sand gilia was identified, the survey in that area was extended to the boundary of the population encountered. Large areas of Monterey spineflower and sand gilia were mapped as polygons, with attributes to identify number of individuals or percent absolute cover. Smaller groups and individuals were mapped as points with attributes to identify the number of individuals at each location.

Individual counts were made for all sand gilia populations whether they were mapped using points (population $\leq$5) or polygons (population $\geq$6). However, Monterey spineflower were only counted as individuals when groups of five or less were mapped. Monterey spineflower populations consisting of greater than five individuals were mapped as polygons and characterized according to the percent of cover. The categories used were:

- Very Sparse (corresponding to an absolute cover of less than 3 percent),
- Sparse (3-25 percent absolute cover),
- Medium Low (26-50 percent absolute cover),
- Medium (51-75 percent absolute cover),
- Medium High (76-97 percent absolute cover), and
- Very High (>97-100 percent absolute cover).

Locations were mapped using GPS units and data defining the population boundaries and/or point location(s) were exported to shapefile format. Shapefiles were imported for use in the Geographic Information System (GIS) ESRI ArcGIS and overlaid on high-resolution aerial photography/satellite imagery. An overview of the FONR survey area results, the populations identified for each species within FONR and the populations identified for each species within the reference site are discussed below.

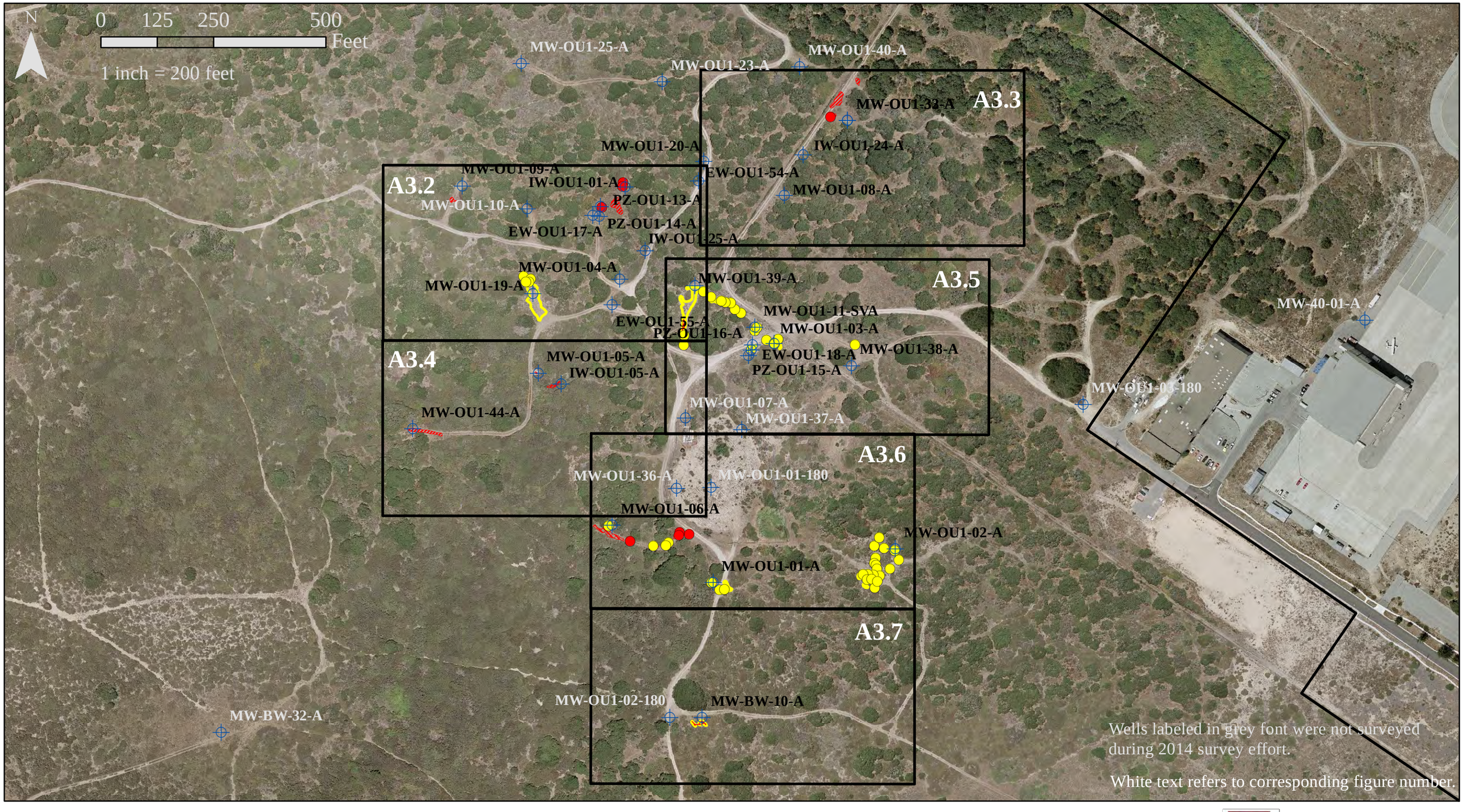
A3.0 Rare Plant Survey Results

A3.1 Sand Gilia

Sand gilia was observed and mapped at the DD&A reference site and 11 of the 30 OU1 FONR well locations (Fig. A3.1 through Fig. A3.8; Attachment A-1). In all, 58 populations (46 points and 12 polygons) of sand gilia, totaling 1,018 individual plants were mapped within the DD&A reference site and OU1 FONR well locations.

A3.2 Monterey Spineflower

Monterey spineflower was observed and mapped at the DD&A reference site and 11 of the 30 OU1 FONR well locations (Fig. A3.1 through Fig. A3.8; Attachment A-1). In all, 28 populations (9 points and 19 polygons) of Monterey spineflower were mapped within the DD&A reference site and the OU1 FONR well locations. Population size estimates for Monterey spineflower were not as easily quantifiable; therefore, individual Monterey spineflower plants were not recorded within the GIS polygons. Populations of Monterey spineflower were categorized by percent cover based on visual estimation. Of the 19 populations of Monterey spineflower that were mapped as polygons, sixteen populations were Sparse (5-25 percent cover), and three populations were Medium Low (26-50 percent cover).



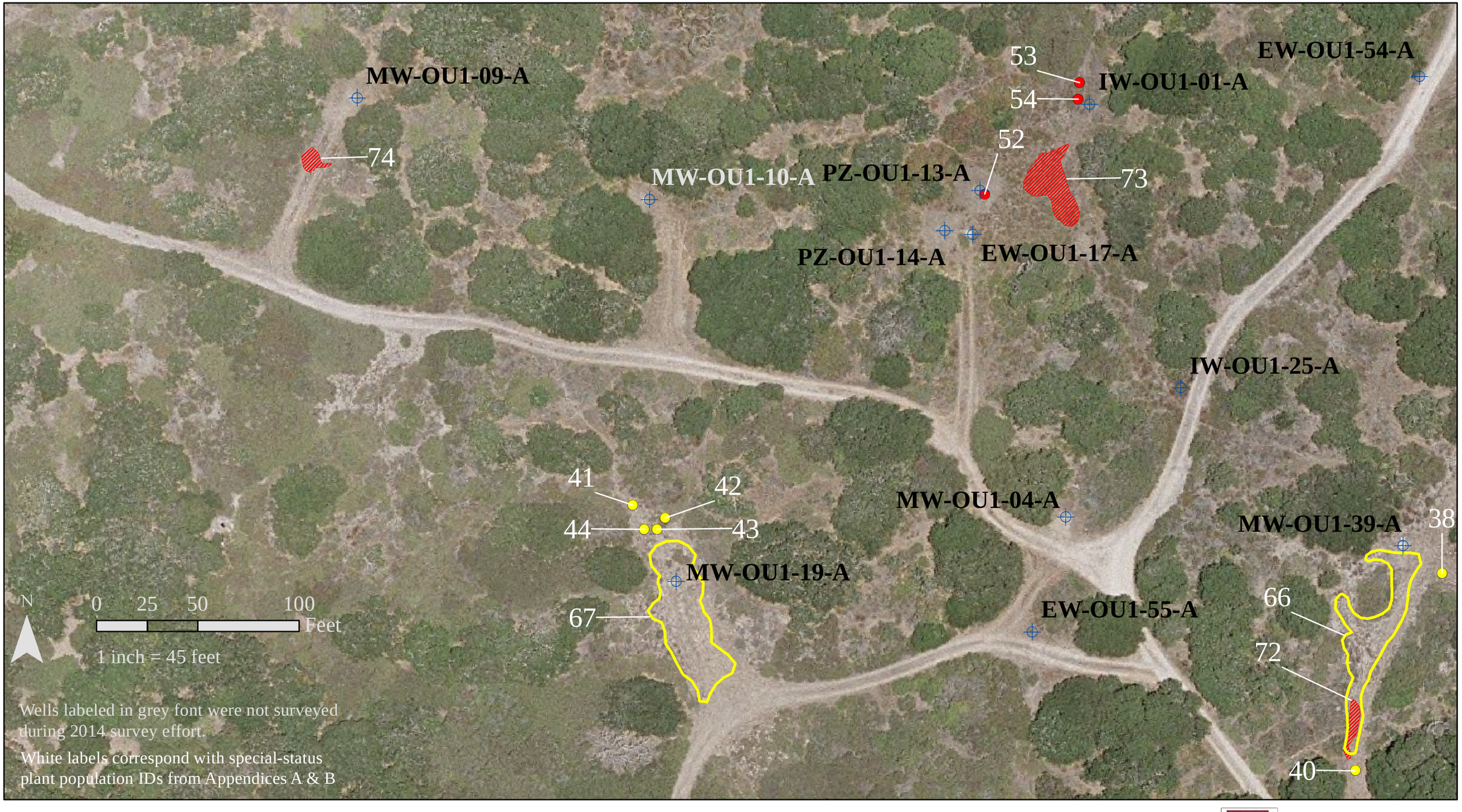
Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.1

2014 Survey Area Rare Plant Population Locations Overview Map



Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

Figure A3.2

2014 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.3

2014 OU1 FONR Well Survey - Rare Plant Locations

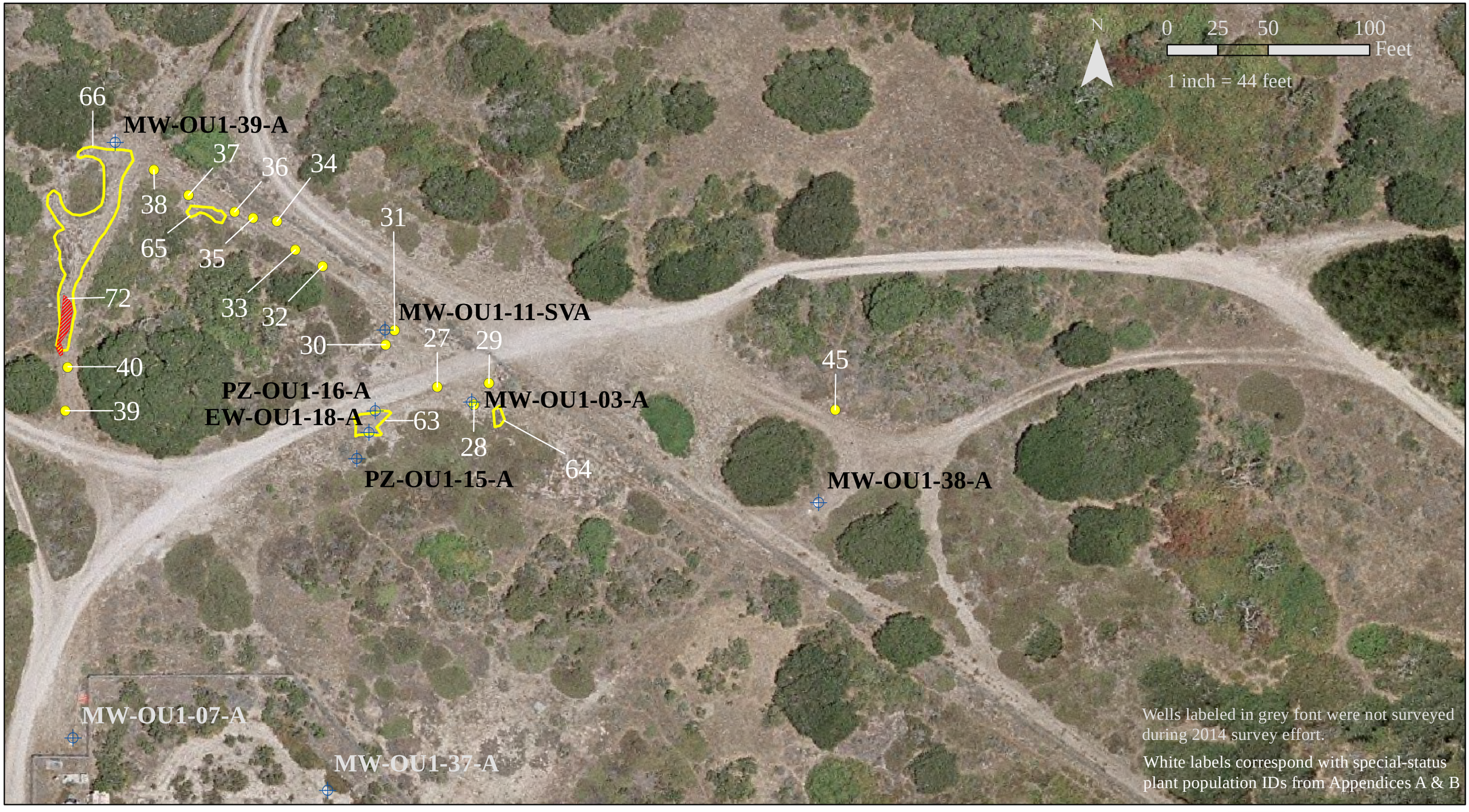
Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.4

2014 OU1 FONR Well Survey - Rare Plant Locations



Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.5

2014 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.6

2014 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons
- Sparse
- Medium Low

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

Figure A3.7

2014 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Survey Area
- Monterey Spineflower Points
- Sand Gilia Points

Figure A3.8

2014 DD&A Reference Area Survey - Rare Plant Locations

A4.0 Conclusions

A4.1 Comparisons

As required by the HMP, surveys are conducted for three years, after the disturbance occurs, in areas that are disturbed during the remediation effort. In 2013, after a discussion with the USFWS, the number of well sites surveyed on OU1 FONR was reduced to 30 locations. This section compares the results of the 2014 rare plant survey within the DD&A reference site with the results of the 2010, 2011, 2012, and 2013 surveys. Additionally, the survey results for 2014 at the 30 well locations on the OU1 FONR property are compared with the results of the 2011, 2012, and 2013 surveys at the same locations. No well locations within the OU1 FONR property were surveyed in 2010.

A4.1.1 DD&A Reference Site Sand Gilia Populations

DD&A has monitored the number of populations, the number of individual plants, and the approximate area occupied by sand gilia at the reference site each year consecutively from 2010 to 2014 (Table A4.1). The spatial distribution of sand gilia and the number of individual plants at the reference site have varied from year to year (Fig. A4.1). The largest number of recorded individual plants occurred in 2010 and 2013 with 1,086 and 736 observed, respectively. The lowest number of sand gilia occurred in 2012 with 70 individual plants observed.

Table A4.1 Sand Gilia Population Comparisons at DD&A Reference Site 2010-2014

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (sq. ft.)
2010	14	1,086	7	7	1,715
2011	16	318	12	4	1,410
2012	16	70	12	4	210
2013	20	736	7	13	1,281
2014	4	97	2	2	370

The reference site is located in an area relatively undisturbed by anthropogenic activities. Natural variation in environmental factors, including rainfall and temperature, can cause fluctuations in the distribution and abundance of sand gilia between years. The environmental conditions conducive to large populations of sand gilia may have been lacking in 2012 and 2014, while in 2010, 2011 and 2013 conditions appear to have been more favorable.

A4.1.2 DD&A Reference Site Monterey Spineflower Populations

DD&A has also monitored the number of populations, the density, and the approximate area occupied by Monterey spineflower at the reference site each year consecutively from 2010 to 2014 (Table A4.2). The distribution of Monterey spineflower at the reference site

has changed from year to year, evident by the change in number and area of polygons between years (Fig. A4.2).

Table A4.2 Monterey Spineflower Population Comparisons at DD&A Reference Site 2011-2014. Polygon Density Class: Sparse (5-25 percent cover), and Medium-Low (26-50 percent cover)

Year	# of Populations	# of Points	Polygons Per Density Class		Total Area of Polygons (sq. ft.)
			Sparse	Medium-Low	
2010	2	-	1	1	2,846
2011	2	1	-	1	2,865
2012	3	1	2	-	1,494
2013	7	-	6	1	2,813
2014	7	1	6	-	1,119

As with sand gilia, there are several environmental variables that can influence the distribution and abundance of Monterey spineflower between years. Similar to the sand gilia data, 2012 and 2014 appear to be a less favorable year for Monterey spineflower.

A4.1.3 OU1 FONR Well Locations Sand Gilia Populations

DD&A has monitored sand gilia presence around 30 destroyed well sites in area OU1 of FONR from 2011 to 2014 (Table A4.3). Consistent with observations at the reference site, 2012 and 2014 fewer individual sand gilia plants were observed compared to 2011 and 2013. The number of well sites with sand gilia present has varied, with the largest number occurring in 2013. Seven well sites (EW-OU1-18-A; MW-OU1-02-A; MW-OU1-11-SVA; MW-OU1-19-A; MW-OU1-39-A; PZ-OU1-15-A; PZ-OU1-16-A) have had sand gilia present every year from 2011-2014.

Table A4.3 Sand Gilia Population Comparisons at OU1 FONR Well Locations 2011-2014.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (sq. ft.)	# of Wells Where Present	Well Location Where Present
2011	49	1262	40	9	7,463	9	EW-OU1-18-A
							MW-OU1-02-A
							MW-OU1-11-SVA
							MW-OU1-19-A
							MW-OU1-39-A
							PZ-OU1-15-A
							PZ-OU1-16-A
							EW-OU1-54-A
							MW-OU1-03-A

(Table A4.3 continued)

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (sq. ft.)	# of Wells Where Present	Well Location Where Present
2012	44	982	26	18	5,721	9	EW-OU1-18-A
							MW-OU1-02-A
							MW-OU1-11-SVA
							MW-OU1-19-A
							MW-OU1-39-A
							PZ-OU1-15-A
							PZ-OU1-16-A
							MW-OU1-01-A
							MW-BW-10-A
2013	69	1157	37	32	4,275	12	EW-OU1-18-A
							MW-OU1-02-A
							MW-OU1-11-SVA
							MW-OU1-19-A
							MW-OU1-39-A
							PZ-OU1-15-A
							PZ-OU1-16-A
							MW-BW1-10-A
							MW-OU1-01-A
							MW-OU1-03-A
							MW-OU1-06-A
							MW-OU1-44-A
2014	54	921	44	10	3,629	11	EW-OU1-18-A
							MW-OU1-02-A
							MW-OU1-11-SVA
							MW-OU1-19-A
							MW-OU1-39-A
							PZ-OU1-15-A
							PZ-OU1-16-A
							MW-BW1-10-A
							MW-OU1-01-A
							MW-OU1-03-A
							MW-OU1-06-A

A4.1.4 OU1 FONR Well Locations Monterey Spineflower Populations

Monterey spineflower was found at all 30 well locations surveyed in 2011, 24 of the 30 well locations in 2012 and 2013, and at 11 of 30 well locations in 2014.

Table A4.4 Monterey Spineflower Population Comparisons at OU1 FONR Well Locations 2011-2014. Polygon Density Class: Very Sparse (>3 percent), Sparse (5-25 percent cover), and Medium-Low (26-50 percent cover)

Year	# of Populations	# of Points	Polygons Per Density Class					Total Area of Polygons (sq. ft.)
			Very Sparse	Sparse	Medium-Low	Medium	Medium-High	
2011	41	11	-	24	4	1	1	27,940
2012	38	7	-	26	5	-	-	12,133
2013	63	27	3	25	6	2	-	11,100
2014	21	8	-	10	3	-	-	2,841

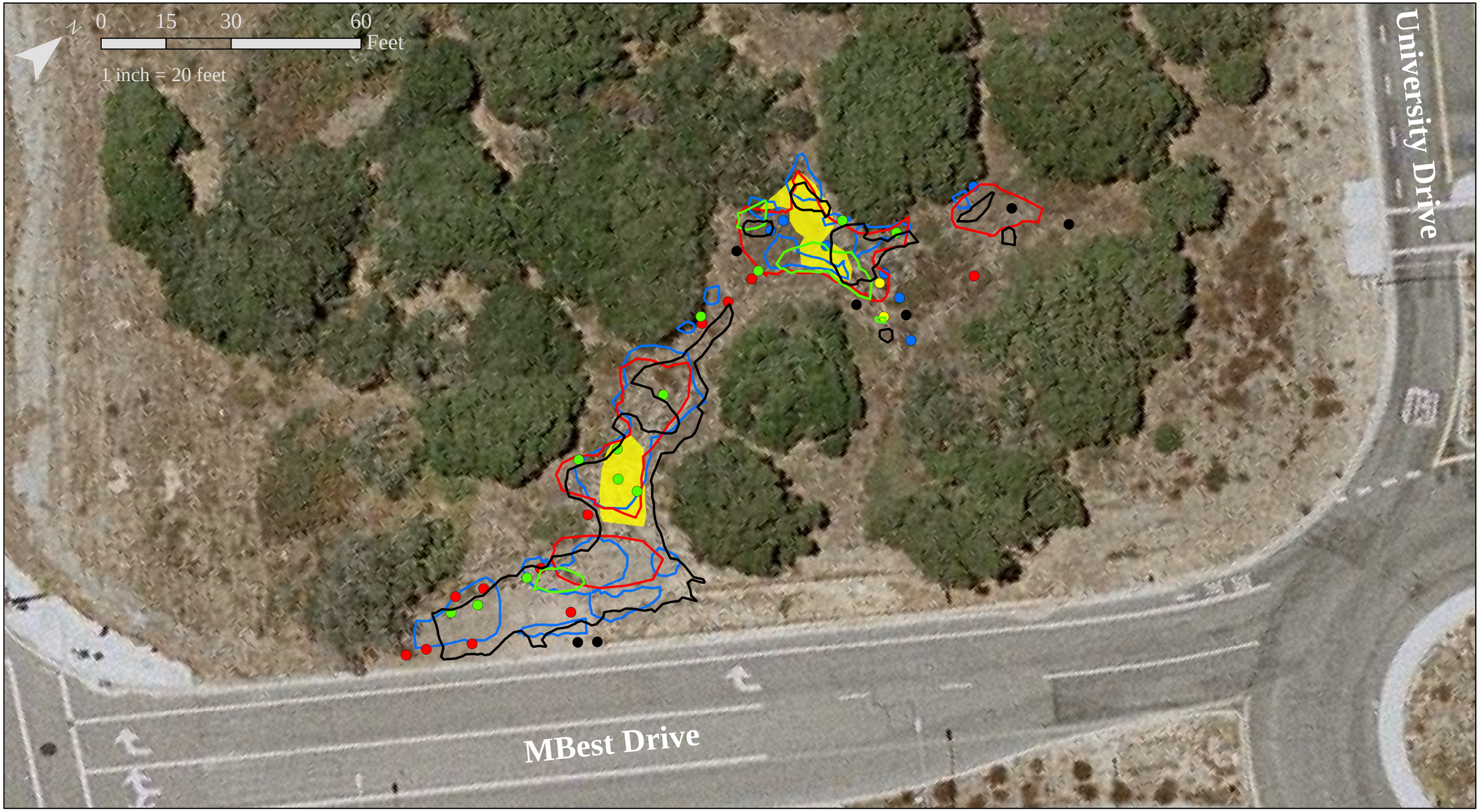
A4.2 Population Sustainability

Sand gilia at the OU1 FONR well locations have historically fluctuated because of natural variation in rainfall, temperature, and other factors. An example of this fluctuation at OU1 FONR was observed during the 2006 survey effort. The 2006 survey found 40 sand gilia plants in five areas at the west end of Survey Site 6; an area north of the well locations surveyed in 2014. Based on their presence in 2006, HGL avoided activity in this area and relocated the well that was originally proposed at this location to approximately 180 feet to the east. However, none of the populations observed in 2006 were found in subsequent years. The annual survey data at the 2006 location illustrates population fluctuations in an area that was not impacted by human disturbance.

The spatial distribution of sand gilia at the OU1 FONR area has changed somewhat, but the number of individual plants have been fairly consistent between years 2011-2014.

The Mediterranean climate of Fort Ord is characterized by dry summers, and mild winters with the majority of the precipitation occurring between October and March in a typical year. The reduction in 2014 Monterey spineflower coverage at the OU1 well locations may be explained by an unusual weather pattern that year. The 2014 temperature and precipitation pattern for the region was atypical when compared to the previous years in which surveys were conducted. Unusually warm weather and little rain in the beginning of March 2014 resulted in an early blooming period for sand gilia and Monterey spineflower. Surveys were conducted on April 24 and 29 to ensure that the blooming period for sand gilia was not missed, as the ideal period of identification for sand gilia is typically shorter than Monterey spineflower. A substantial precipitation event occurred, from March 29 to April 2, 2014 which was unusual for the time of year. This late rain event in addition to a drop in temperature potentially delayed the bolting of Monterey spineflower. As Monterey spineflower had not fully bolted at the time of the survey, the measured area of Monterey spineflower in the survey areas was potentially diminished.

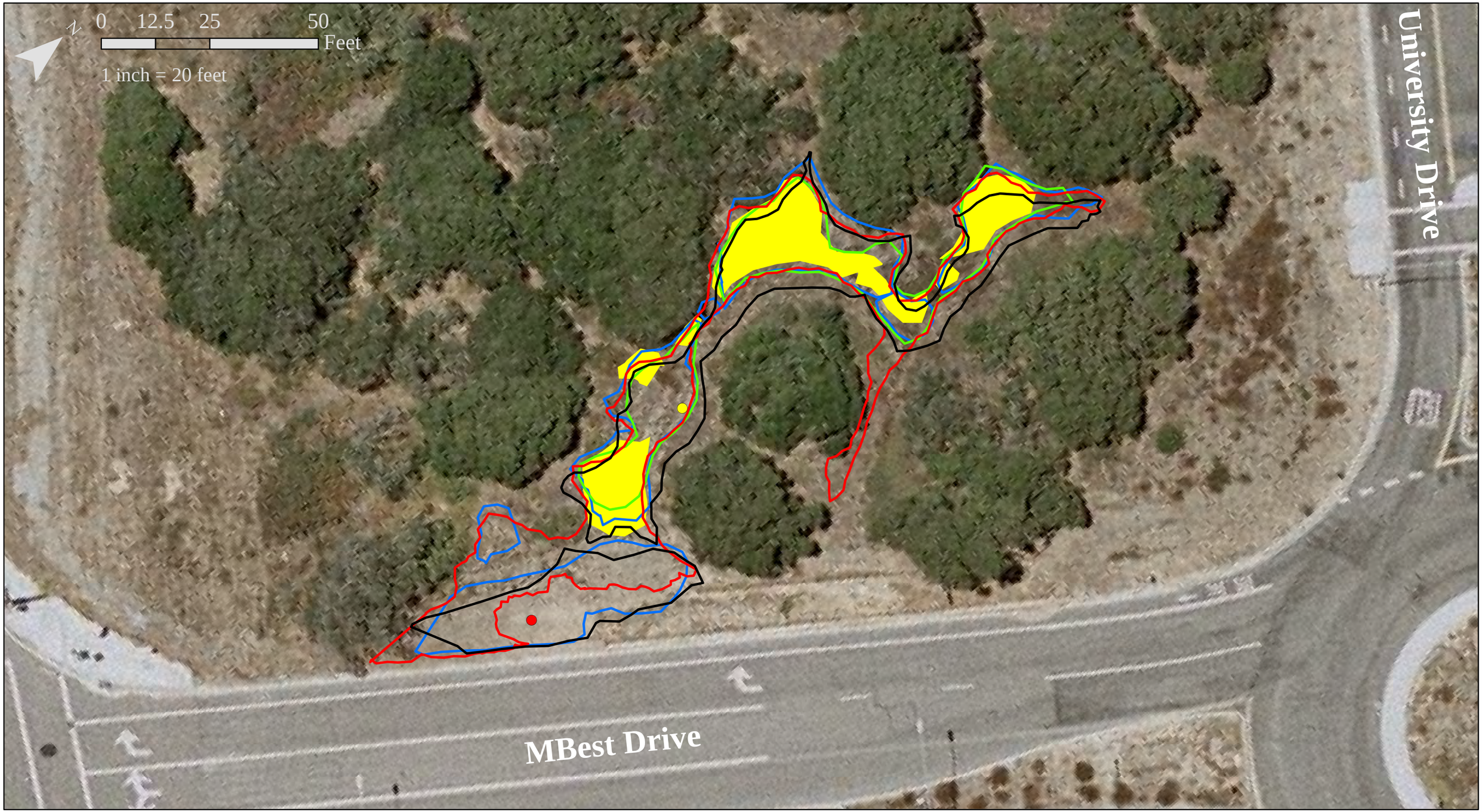
The overall trend of a decline in Monterey spineflower could potentially be attributed in part to the state of California is suffering through the third year of a drought. In 119 years of recorded history, 2013 was the driest calendar year for the state of California (USGS, 2014).



2010 Sand Gilia Points
2010 Sand Gilia Polygons
2011 Sand Gilia Points
2011 Sand Gilia Polygons
2012 Sand Gilia Points
2012 Sand Gilia Polygons
2013 Sand Gilia Points
2013 Sand Gilia Polygons
2014 Sand Gilia Points
2014 Sand Gilia Polygons

Figure A4.1

2014 DD&A Reference Area Survey
Sand Gilia Spatial Distribution Comparison 2010-2014



2011 Monterey Spineflower Points
2013 Monterey Spineflower Points
2014 Monterey Spineflower Points

2010 Monterey Spineflower Polygons
2011 Monterey Spineflower Polygons
2012 Monterey Spineflower Polygons
2013 Monterey Spineflower Polygons
2014 Monterey Spineflower Polygons

Figure A4.2

2014 DD&A Reference Area Survey
Monterey Spineflower Spatial Distribution Comparison 2010-2014

A5.0 References

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Attachment A-1. Sand Gilia Populations Identified During 2014 Survey

Population #	Number of Individuals	GIS Feature Type	Survey Date	Figure Number
1	1	Point	4/29/2014	**A3.8**
2	4	Point	4/29/2014	**A3.8**
3	1	Point	4/24/2014	**A3.6**
4	1	Point	4/24/2014	**A3.6**
5	1	Point	4/24/2014	**A3.6**
6	4	Point	4/24/2014	**A3.6**
7	4	Point	4/24/2014	**A3.6**
8	1	Point	4/24/2014	**A3.6**
9	2	Point	4/24/2014	**A3.6**
10	4	Point	4/24/2014	**A3.6**
11	2	Point	4/24/2014	**A3.6**
12	1	Point	4/24/2014	**A3.6**
13	2	Point	4/24/2014	**A3.6**
14	4	Point	4/24/2014	**A3.6**
15	1	Point	4/24/2014	**A3.6**
16	1	Point	4/24/2014	**A3.6**
17	1	Point	4/24/2014	**A3.6**
18	3	Point	4/24/2014	**A3.6**
19	4	Point	4/24/2014	**A3.6**
20	1	Point	4/24/2014	**A3.6**
21	2	Point	4/24/2014	**A3.6**
22	2	Point	4/24/2014	**A3.6**
23	1	Point	4/24/2014	**A3.6**
24	2	Point	4/24/2014	**A3.6**
25	1	Point	4/24/2014	**A3.6**
26	4	Point	4/24/2014	**A3.6**
27	4	Point	4/24/2014	**A3.5**
28	4	Point	4/24/2014	**A3.5**
29	2	Point	4/24/2014	**A3.5**
30	1	Point	4/24/2014	**A3.5**
31	2	Point	4/24/2014	**A3.5**
32	1	Point	4/24/2014	**A3.5**
33	2	Point	4/24/2014	**A3.5**
34	1	Point	4/24/2014	**A3.5**
35	1	Point	4/24/2014	**A3.5**
36	3	Point	4/24/2014	**A3.5**
37	1	Point	4/24/2014	**A3.5**

Population #	Number of Individuals	GIS Feature Type	Survey Date	Figure Number
38	2	Point	4/24/2014	**A3.2/A3.5**
39	2	Point	4/24/2014	**A3.4/A3.5**
40	1	Point	4/24/2014	**A3.2/A3.5**
41	3	Point	4/24/2014	**A3.2**
42	4	Point	4/24/2014	**A3.2**
43	3	Point	4/24/2014	**A3.2**
44	1	Point	4/24/2014	**A3.2**
45	4	Point	4/24/2014	**A3.5**
46	2	Point	4/24/2014	**A3.6**
56	19	Polygon	4/29/2014	**A3.8**
57	73	Polygon	4/29/2014	**A3.8**
58	8	Polygon	4/24/2014	**A3.6**
59	11	Polygon	4/24/2014	**A3.6**
60	26	Polygon	4/24/2014	**A3.7**
61	12	Polygon	4/24/2014	**A3.7**
62	23	Polygon	4/24/2014	**A3.6**
63	20	Polygon	4/24/2014	**A3.5**
64	9	Polygon	4/24/2014	**A3.5**
65	15	Polygon	4/24/2014	**A3.5**
66	415	Polygon	4/24/2014	**A3.2/A3.5**
67	288	Polygon	4/24/2014	**A3.2**

Attachment A-2. Monterey Spineflower Populations Identified During 2014 Survey

Population #	Number of Individuals or Percent Cover	Cover Class	GIS Feature Type	Survey Date	Figure Number
47	4	N/A	Point	4/29/2014	**A3.8**
48	2	N/A	Point	4/24/2014	**A3.6**
49	3	N/A	Point	4/24/2014	**A3.6**
50	1	N/A	Point	4/24/2014	**A3.6**
51	4	N/A	Point	4/24/2014	**A3.6**
52	1	N/A	Point	4/24/2014	**A3.2**
53	4	N/A	Point	4/24/2014	**A3.2**
54	1	N/A	Point	4/24/2014	**A3.2**
55	1	N/A	Point	4/24/2014	**A3.3**
68	30	Medium Low	Polygon	4/24/2014	**A3.7**
69	40	Medium Low	Polygon	4/24/2014	**A3.6**
70	15	Sparse	Polygon	4/24/2014	**A3.6**
71	45	Medium Low	Polygon	4/24/2014	**A3.6**
72	10	Sparse	Polygon	4/24/2014	**A3.2/A3.5**
73	5	Sparse	Polygon	4/24/2014	**A3.2**
74	25	Sparse	Polygon	4/24/2014	**A3.2**
75	15	Sparse	Polygon	4/24/2014	**A3.4**
76	20	Sparse	Polygon	4/24/2014	**A3.4**
77	5	Sparse	Polygon	4/24/2014	**A3.4**
78	25	Sparse	Polygon	4/24/2014	**A3.3**
79	5	Sparse	Polygon	4/24/2014	**A3.3**
80	20	Sparse	Polygon	4/24/2014	**A3.3**
81	3	Sparse	Polygon	4/29/2014	**A3.8**
82	10	Sparse	Polygon	4/29/2014	**A3.8**
83	3	Sparse	Polygon	4/29/2014	**A3.8**
84	3	Sparse	Polygon	4/29/2014	**A3.8**
85	3	Sparse	Polygon	4/29/2014	**A3.8**
86	3	Sparse	Polygon	4/29/2014	**A3.8**