2007 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS FRITZSCHE ARMY AIRFIELD FIRE DRILL AREA FORMER FORT ORD, CALIFORNIA

Prepared for

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

Contract No. DACA45-03-D-0029
Delivery Order CM01

February 2008

February 26, 2007

Fort Ord Base Realignment and Closure Office
ATTN: Gail Youngblood, BEC
Building 4463 Gigling Road
Monterey, CA 93944-5008

Subject: 2007 FONR Impact Assessment
Habitat and Rare Plant Species Survey Results
Operable Unit 1, Fritzsche Army Airfield Fire Drill Area
Former Fort Ord, California
Contract No. DACA45-03-D-0029, Delivery Order CM01

Dear Ms. Youngblood:

Enclosed are seven hard copies and two CDs of the *2007 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California* dated February 2008. The enclosed document provides the results of the habitat and rare species surveys conducted at OU-1 and an assessment of the environmental impacts of construction and operation of OU-1.

We appreciate the opportunity to support the U.S. Army on this project. If you have any questions, please contact me at (916) 614-8770.

Sincerely,

HYDROGEOLOGIC, INC.

/Michael J. Bombard/

Michael J. Bombard, P.G., C.HG., R.E.A.
Project Manager

Enclosures (7) and one CD

PUBLIC DISTRIBUTION LIST

2007 FONR IMPACT ASSESSMENT
HABITAT ANS RARE PLANT SPECIES SURVEY RESULTS
OPERABLE UNIT 1

Delivery Order No. 201, Former Fort Ord, California

Gail Youngblood, BEC Fort Ord Base Realignment and Closure Office Building 4463 Gigling Road Monterey, CA 93944-5008 Phone: (831) 242-7918 **7 copies + 2 CDs**	Greg Hibbard AIG Consultants, Inc. 121 Spear Street San Francisco, CA 94105 Phone: (415) 836-2770 **1 copy**
Erin Harwayne Denise Duffy & Associates 947 Cass Street Suite 5 Monterey, CA 93940 Phone: (831) 373-4341 **1 copy**	HydroGeoLogic, Inc. 4600 Northgate Boulevard Suite 207 Sacramento, CA 95834 Phone: (916) 614-8770 **2 copies Roy Evans**

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Prepared by:

HydroGeoLogic, Inc.
4600 Northgate Boulevard, Suite 207
Sacramento, CA 95834

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Prepared for:

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

Prepared by

HydroGeoLogic, Inc.
4600 Northgate Boulevard, Suite 207
Sacramento, CA 95834-1133

Contract No. DACA45-03-D-0029
Delivery Order CM01

Approved: Roy Evans Date: 25 February 2008
Prepared by: Roy Evans, P.E.

Approved: Date: 2/20/08
Michael J. Bombard, P.G., C.HG., R.E.A.
Project Manager

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ACL	aquifer cleanup level
BRAC	Base Realignment and Closure
Cal-IPC	California Invasive Plant Council
CDFA	California Department of Food and Agriculture
COC	contaminant of concern
DD&A	Denise Duffy and Associates, Inc.
EM	environmental monitor
FDA	Fire Drill Area
FONR	Fort Ord Natural Reserve
GAC	granular activated carbon
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HGL	HydroGeoLogic, Inc.
m^2	square meter
NWTS	Northwest Treatment System
OU	operable unit
ROD	Record of Decision
RTE	rare, threatened, or endangered
SOC	species of concern
TCE	trichloroethene
UCNRS	University of California Natural Reserve System
UCSC	University of California at Santa Cruz
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

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2007 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS FRITZSCHE ARMY AIRFIELD FIRE DRILL AREA 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 December 2003 by the USACE-Omaha District, under Contract Number DACA45-03-D-0029, and was administered through the USACE-Sacramento District. The objectives of this effort are the same as those of the Record of Decision (ROD) signed in July of 1995 by the U.S. Army, U.S. Environmental Protection Agency (USEPA), and the California Environmental Protection Agency.

The primary remediation objectives specified in the ROD are as follows:

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

Activities undertaken to achieve the OU-1 cleanup must adequately protect and maintain the critical habitat and protected species found within the Fort Ord Natural Reserve (FONR).

Figure 1.1 illustrates the location of Former Fort Ord and the OU-1 source area. Activities conducted at the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA) (i.e., OU-1) between 1962 and 1985 resulted in contaminants being released to soils and groundwater. Although 10 volatile organic compounds (VOCs) have been identified as contaminants of concern (COCs) in groundwater underlying the FDA, trichloroethene (TCE) is the contaminant that is detected at the highest concentrations and across the greatest extent of the affected aquifer. Thus far, data show that the TCE plume "footprint" encompasses that of the other nine COCs. Figure 1.2 shows the estimated extent of the TCE plume in September 2007. The area surrounding the OU-1 contaminant plume is part of the University of California Natural Reserve System (UCNRS) designated as the FONR. The FONR is managed by staff at the University of California Santa Cruz (UCSC).

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 March 30, 1999. The Army consulted again in 2002 and 2007 to address impacts to Monterey spineflower Critical Habitat and the California tiger salamander (*Ambystoma californiense*). 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 within the OU-1 area have been undertaken by others since 1998 (Harding Lawson Associates, 1998) and annual biological surveys were conducted by HGL, using subcontractor CH2M Hill, in 2004 and 2005 (HGL, 2004a Appendix A; CH2M Hill, 2005) and subcontractor Denise Duffy and Associates, Inc (DD&A) in 2006 (HGL, 2007a). These surveys have focused on mapping the extent and population of federally protected rare, threatened, or endangered (RTE) plant species within the FONR, including the endangered sand gilia (*Gilia tenuiflora ssp. arenaria*) and the threatened Monterey spineflower (*Chorizanthe pungens var. pungens*).

This document presents the results of the 2007 rare plant survey and discusses the potential impact to date on those plants associated with the OU-1 remediation activities conducted since 2004. The 2007 rare plant survey was conducted by DD&A under subcontract to HGL. The following are also 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 2007 and planned future activities, and
- Results of the 2007 rare plant survey and interim impact assessment.

These topics are addressed in the following sections.

1.1 SITE DESCRIPTION

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 UCSC and the FONR was established in June 1996. Additional information regarding past land use at this site is presented in the Final Operable Unit 1 Project Management Plan, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California (HGL, 2004b).

The former Fort Ord is located near Monterey Bay (Figure 1.1), which is located 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 found in OU-1 include coast live oak woodland, maritime chaparral, and annual grassland. The dominant habitats within 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 Game. The 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 endangered sand gilia, the threatened Monterey spineflower, and the threatened California tiger salamander. Several plant and animal species of concern (SOC) are also present in the FONR. Other plant SOC include coast wallflower (*Erysimum ammophilum*), Eastwood's ericameria (*Ericameria fasciculata*), Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*), Sandmat manzanita (*Arctostaphylos pumila*), and Toro manzanita (*A. montereyensis*). The California black legless lizard (*Anniella pulchra nigra*), California coast horned lizard (*Phrynosoma coronatum*), and the Monterey ornate shrew (*Sorex ornatus salarius*) are animal SOCs.

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 winds, which blow the seeds south and into the OU-1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU-1 area. Significant expansion of the non-native grasses could result in population declines of federally listed plants.

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 in 2004, 2005, 2006, and 2007 also observed Monterey spineflower in this region. Although sand gilia was not detected in this region during the 1998 – 2007 surveys, one sand gilia population was observed in 2007 within a small "island" of grassland species within the more extensive oak woodland habitat near the OU-1 plume source area (i.e., the former FDA; see Figure A3.4 in Appendix A). The small open area in which the sand gilia population was observed is bordered by grasses that are surrounded by oak woodland and understory habitat. Several Monterey spineflower populations were also observed thriving within dense patches of non-native grasses in the same vicinity.

1.2 OVERVIEW OF OPERABLE UNIT-1 REMEDIATION ACTIVITIES WITHIN THE FORT ORD NATURAL RESERVE

Numerous wells and soil borings were constructed within the FONR as part of the investigative effort to define the extent of environmental contamination or to remediate that contamination. Table 1.1 lists the wells that have been installed within the OU-1 portion of the FONR. Table 1.2 lists the abandoned well and the soil borings that were drilled within the FONR portion of OU-1 between 2004 and 2007 and left without constructing a well. Figure 1.3 illustrates the OU-1 well and soil boring locations. No new wells or soil borings were constructed by HGL within the FONR portion of OU-1 during 2007.

1.3 SITE ACTIVITY SUMMARY

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 remedial action for OU-1 groundwater. A groundwater extraction and treatment system (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 of the FDA. Extracted groundwater was transported through pipelines to a treatment unit located at the former FDA and passed through vessels containing granular activated carbon (GAC). 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 extraction zone. Additional wells installed between 1997 and 2001 (wells 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 is not captured by the extraction system (AHTNA, 2003).

The HGL remediation contract was awarded in December 2003 and 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 new data from the well installation and aquifer testing were processed; the final design was issued in the three-volume Final Engineering Design Report in 2006 (HGL, 2006a, 2006b, and 2006c). Figure 1.4 illustrates the layout and components of the recently completed OU-1 groundwater remediation project within the FONR. Construction of the first component of the GWETS expansion, the Hydraulic Control Pilot Project (HGL, 2006d), was initiated and completed in 2006. The remainder of the GWETS expansion (the FONR system) was constructed from July through September 2007. These construction activities were described in detail in the Final Hydraulic Control Pilot Project Construction Report (HGL, 2007b) and the Draft FONR System Construction Report (HGL, 2008). Additional details concerning the GWETS expansion and a summary of OU-1 site activities conducted during 2007 relating to habitat monitoring and impacts are provided in the following sections.

1.3.1 2007 Rare Plant and Habitat Surveys

Surveys for sand gilia and Monterey spineflower were conducted by DD&A between April 19 and April 24, 2007. The timing of the survey was intended to correspond with the peak blooming period and was determined through communications with UCSC staff and by observing a known occurrence of sand gilia in the vicinity of FONR. A survey was conducted along 15 existing or proposed roadway and access routes, 21 well sites, and three former staging areas

DD&A also conducted a habitat inventory within 10 of the 15 OU-1 roadway and access routes in areas of proposed new construction. The inventory included identifying the type and distribution of native and invasive, non-native plant species. Invasive species include plant species that are listed as a noxious weed by the California Department of Food and Agriculture (CDFA), included on invasive plant lists maintained by the California Invasive Plant Council (Cal-IPC), or considered to be a problematic species by the UCSC FONR management staff.

The areas surveyed in these efforts are shown in Figure 1.5. An overview of the biological survey results is presented in Section 2.0 of this report and a detailed description is included in Appendix A.

1.3.2 2007 Site Drilling, Testing, and Sampling Activities

No drilling activity was conducted by HGL within OU-1 during 2007. Aquifer pumping tests were conducted at selected wells from October 2-11, 2007. The aquifer pumping test procedure entails pumping water from or injecting water into a given well and monitoring the change in groundwater levels at nearby monitoring wells. The pumped water was conveyed through the recently constructed pipelines to the Northwest Treatment System (NWTS), processed through the GAC units to remove contaminants, and then returned to the aquifer through the infiltration trenches or the injection wells. Site activities in support of these pumping tests were limited to vehicle and foot traffic along the existing roadways as the field crew traveled to the individual well sites to collect measurements. All testing and well measurements occurred within the north-central part of the aquifer bounded by well MW-OU1-83-A on the north and well MW-OU1-24-AR on the south (Figure 1.3).

Groundwater samples were collected during 2007 from most of the existing wells within the FONR as part of the OU-1 groundwater long-term monitoring program. Wells are typically sampled quarterly, semiannually, or annually. The quarterly sampling usually occurs in March, June, September, and December of each year. Table 1.3 summarizes the 2007 sampling events conducted at each of the OU-1 wells.

Samples were collected from the NWTS and operating extraction wells at approximately two-month intervals.

1.3.3 2007 Facilities Construction Activities

The following remediation facilities within the FONR were constructed or upgraded in 2007:

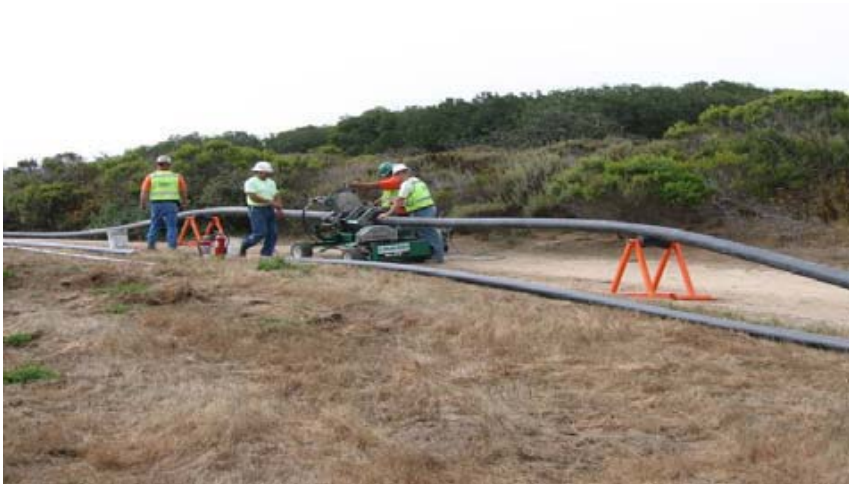
- The NWTS groundwater treatment plant was upgraded within the previously existing footprint (approximately 80 feet by 54 feet).
- Transmission pipelines were constructed from extraction wells MW-OU1-46-AD, MW-OU1-85-A, EW-OU1-71-A, and MW-OU1-87-A to the treatment plant.
- Transmission pipelines were constructed between injection wells IW-OU1-73-A and IW-OU1-73-A and the treatment plant.
- Two infiltration trenches were constructed in the grasslands adjacent to the east central portion of the FONR.

These facilities were constructed within the FONR as illustrated in Figure 1.4. Transmission pipelines were buried along the grassland edge or the approximate centerline of the roadway to connect the extraction and injection wells to the treatment plant and to convey treated water to the FONR infiltration trenches. The pipeline trench was approximately 1 foot wide by 4 feet deep. Photographs 1.1 and 1.2 show typical pipeline construction activities.

The FONR system infiltration trenches consist of two parallel trenches approximately 20 feet apart. Each infiltration trench was approximately 300 feet long, approximately 2 feet wide and 4 feet deep. Six-inch diameter perforated pipe was laid in a gravel bed and backfilled with at least 2.5 feet of native soil. Photograph 1.3 illustrates the injection trench excavation.

Environmental monitoring during the construction effort was conducted by DD&A staff. The results of that monitoring and the construction project itself are detailed in the Draft FONR System Construction Report (HGL, 2008). Monitoring results are summarized in Section 3.0 of this report.

Photograph 1.1 – Trench excavation with ditch witch in background.



Photograph 1.2 – Laying out high density polyethylene pipe along the pipeline route.

Photograph 1.3 – Excavation for injection trench.

1.3.4 Original Groundwater Extraction and Treatment System Operation

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. A rebound evaluation to assess if 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; preparation of the final report is currently under way. Groundwater pumping and treatment from the existing GWETS area was suspended in February 2006 as part of the rebound evaluation. Sampling from selected groundwater monitoring wells in this region will continue for some wells, though at a reduced frequency.

1.4 IMPACT PREVENTION AND MITIGATION MEASURES

Activities conducted within the FONR are strictly limited to those that are essential to achieving the remediation goals for the project. The remedial design and construction as well as remedial actions have been and will continue to be consistent with the various biological opinions and guidance regarding mitigation measures to reduce and avoid impacts to RTE SOC on the project site. Guidance for the remedial design and action(s) includes the following:

- The March 30, 1999, Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California (1-8-99-F/C-39R) and supporting documentation, such as Enclosure 2 to the request for consultation (Harding Lawson Associates, 1998)
- The October 22, 2002, Biological Opinion on the Closure and Reuse of Fort Ord, Monterey County, California, as it affects Monterey spineflower Critical Habitat, (1-8-01-F-70R) (USFWS, 2002)
- The March 14, 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 (1-8-04-F-25R) (USFWS, 2005)
- The June 1, 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 (1-8-04-F-25R) (USFWS, 2007)

- Guidance and direction from UCNRS staff
- Former Fort Ord Habitat Management Plan (U.S. Army, 1997)

To avoid or minimize impact to the FONR during ecologically sensitive periods (i.e., the rainy season, typically ranging between November and April), construction was scheduled at other times insofar as possible within the overall project constraints. The FONR system construction began in July 2007 and was completed in September 2007 before the seasonal rains began.

The following sections describe the additional mitigation measures that have already been taken and will continue to be followed as standard procedures during upcoming activities.

1.4.1 Pre-Construction Surveys

To minimize potential impacts from remediation activities, the locations of Monterey spineflower and sand gilia populations were identified insofar as possible before the remedial design was finalized (HGL, 2006a, 2006b, and 2006c). To this end, in 2004, 2005, 2006, and 2007, HGL conducted biological surveys of those portions of the FONR that were thought most likely to be affected by the GWETS expansion. Plant populations identified in similar surveys conducted by UCNRS staff or others (intermittently since 1998) were also reviewed in preparing the final remediation design. The plant populations thus surveyed were mapped and used by the design team when selecting locations for new wells, piezometers, pipeline routes, and treatment/recharge facilities.

The results of the first two surveys (conducted by CH2M Hill) were presented in Appendix A of the Draft Remedial System Modification Plan (HGL, 2004a) for the 2004 survey and in the 2005 Monterey Spineflower and Sand Gilia Survey Results Fort Ord Operable Unit 1, Former Fort Ord, California (CH2M Hill, 2005). The results of the 2006 survey were presented in the 2006 Annual FONR Impact Assessment and Habitat and Rare Plant Survey Results (HGL, 2007a). The 2007 survey results are summarized in Section 2.0 and detailed in Appendix A of this report.

1.4.2 Impact Avoidance

The locations of plant populations identified in the biological surveys were considered in selecting locations for the new wells and the remediation facilities installed by HGL in 2006 and 2007. The draft design of the GWETS expansion, for example, was able to avoid excavation in all of the sand gilia and Monterey spineflower populations identified in the 2004 Baseline Survey (HGL, 2004b). In one instance, a proposed well location was relocated approximately 1,000 feet because of potential impact to Monterey spineflower and sand gilia populations.

The approved final FONR system well and pipeline routes avoided previously mapped sand gilia populations and had minimal overlap on mapped Monterey spineflower colonies. Overlap between Monterey spineflower populations and the project facilities constructed in 2007 are described in Section 3.2.

In addition, other mitigation measures identified in the 2007 Biological Opinion Amendment for the California tiger salamander were implemented as a part of the recent construction activities. These mitigation measures included conducting a pre-construction survey in the staging area adjacent to the FONR infiltration trenches to identify burrows that might be used by California tiger salamanders. Pipe and other construction materials were stacked such that contact with the ground was minimized.

1.4.3 Proactive and Reactive Construction Techniques to Minimize Impacts

The construction effort employed a range of procedures and actions to minimize or prevent environmental damage. Where construction was required in the vicinity of known populations of protected species, for example, the sensitive areas were identified in advance by installing small flags or temporary fencing to delineate the boundary of the area to be avoided.

The following rules governed site construction activity:

- Stay in or on designated routes, locations, corridors, or work areas whenever possible.
- Drive on existing compacted roadways, whenever possible.
- Use approved access roads only. Close and lock all entrance and exit gates. The contractor supervisor will log in and out for his or her group.
- If RTE species or SOC wildlife are encountered during field activities, they will be carefully removed by a qualified biologist from harm's way and deposited on the ground surface as near to their original location as possible but outside the work area. Each encounter with a California black legless lizard or California tiger salamanders will be documented on a form provided by the HGL Field Supervisor and submitted to the Fort Ord Base Realignment and Closure (BRAC) Office.
- Keep out of exclusion areas marked on the ground or on aerial photos.
- Inform the on-site environmental monitor (EM) and the HGL field supervisor if an SOC is found in a designated work area. Follow the instructions of the on-site EM and the HGL field supervisor as to how to deal with this situation.
- Avoid open trenches that may trap wildlife. The general practice will be to dig, place, test connections, and cover sections of trench in the same workday. Open ends of pipes are covered to prevent wildlife entrapment. Inspect trenches and surface well locations before work and provide escape ramps for wildlife.
- Do not litter. Remove trash from the job site on a daily basis.
- No pets or hunting are allowed.
- No fires are allowed. Report any smoke or open flame immediately to the subcontracting supervisor and to the HGL field supervisor. Keep fire fighting equipment in good operating order and readily available.
- Smoke only in approved areas or in vehicles. Extinguish and deposit all cigarette or cigar butts in an approved container.
- Do not feed or disturb wildlife. Report mountain lion (or other dangerous animal) sightings immediately to the subcontracting supervisor, to the HGL field supervisor, and to the on-site EM.

- Clean up and report any hazardous material spills immediately. Note that no hazardous material use is anticipated. Spills would most likely be the result of equipment malfunction, such as a ruptured hydraulic line.
- Keep fluid spill containment and cleanup materials readily available.
- Do not discharge water or drill cuttings into unapproved areas. Drill cuttings will be placed in bins for transport to the off-site disposal facility.
- Keep equipment either in approved work areas or travel corridors, or in approved staging and storage areas.
- No staging, parking, or vehicle or equipment movement will occur within drip lines of oak trees, except those authorized for removal.
- No grading will occur within drip lines of oaks not slated for removal. If project activities necessitate removing standing dead trees, these will be removed to an adjacent off-site area and left in a prone position.
- Keep vehicle speeds to a minimum (less than 10 miles per hour) in the FONR.

1.4.4 Field Environmental Monitor

BRAC-approved biologists were assigned to act as EMs during the field activities on the FONR. The purpose of these EMs is to make sure that field personnel follow the environmental mitigation guidelines discussed below and to ensure that protected species are not be harmed by project activities.

The EMs have the authority to stop project work on the FONR in the event of non-compliance with environmental regulations or non-compliance with environmental mitigation measures. The EMs did not need to exercise this authority during the OU-1 GWETS expansion. The EMs:

- Assisted in identifying and clearly delineating the least-damaging access routes, turn-around locations, work zones, pipeline trench corridors, and equipment/material staging areas. The EMs were consulted before changing designated routes, locations, corridors, or areas.
- Monitored on-site work as necessary to ensure environmental mitigation measures were implemented and resolved unanticipated environmental issues as they arose.
- Advised construction crews on how best to avoid adverse impacts to environmental resources.
- Assisted in supervising interim surface erosion control measures as needed.

1.4.5 Worker Training

The worker environmental awareness training program provided an overview of the following:

- The sensitive biological resources in the project area,
- Environmental laws and penalties,
- General environmentally protective work practice,
- The responsibilities of project personnel and monitors, and

- Who to contact in case an environmentally related situation arises, or if a field worker has an environmentally related question.

Each worker was given a handout that summarized the environmental issues at the site relative to the construction program and underwent an orientation session before starting work at the site. The handout included photographs, descriptions of each plant or animal SOC, and a contact list with phone numbers if questions arose. The handout also summarized the work procedures to be followed to minimize impacts.

1.4.6 Recharge Method to Mitigate Impact

Three options for recharge of treated water were considered during the design of the remediation facilities:

- Spray irrigation (this practice was used at the original GWETS),
- Use of injection wells, or
- Infiltration through a seepage trench.

Recharge through seepage trenches was selected as the preferred method for returning treated water to the A-Aquifer wherever possible. In contrast to the existing method of spray irrigation, seepage trenches will not support growth of undesirable weeds (i.e., iceplant) nor provide a water source for wildlife. Deer feeding on iceplant at the existing treatment site has helped to spread ice plant across a greater area within the FONR (Fusari, 2005). The grassland area to the northeast of the principal Monterey spineflower and sand gilia habitat provided sufficient space to construct recharge trenches outside the most important FONR habitat.

Groundwater hydraulic and system performance factors were identified during the design of the FONR component of the groundwater remediation system. These factors led to the conclusion that some of the treated water needed to be returned to the A-Aquifer in the north-central portion of the FONR (HGL, 2006b). However, constructing additional infiltration trenches in the area would significantly disrupt important habitat. Spray irrigation facilities would also require clearing a relatively large area of important habitat and could promote the spread of weeds and provide a water source for wildlife. Consequently, two injection wells, IW-OU1-73-A and IW-OU1-74-A, were constructed in this region to achieve the design performance objectives with the least impact to the local habitat.

1.4.7 Weed Control Actions

During 2007, HGL subcontracted with UCSC to implement weed control measures at selected locations within the OU-1 portion of the FONR. The objectives of the weed control activities are:

- Cut down or remove undesirable vegetation from areas disturbed by OU-1 construction activities during 2004 through 2006 before such vegetation releases seeds into the environment.

- Prevent or reduce the expansion of non-native plants into areas disturbed by construction related to OU-1 activities during the 2004 through 2006 period.
- 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.

Figure 1.6 illustrates the locations where weed control measures were performed. Weed control consisted of cutting the weeds using manual methods and hand tools (such as powered string trimmers or similar, easily portable equipment). Herbicides or similar poisons were not used. Disposal of cut weeds was dependent 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 CDFA, included on invasive plant lists maintained by the Cal-IPC, or considered to be a problematic species by the UCSC FONR staff.

UCSC staff began weed control treatments on April 6, 2007, and continued through June 4, 2007. UCSC staff also surveyed well sites to identify the composition of the plant population in the immediate vicinity of the wells. UCSC prepared a report that describes and summarizes their efforts regarding weed control and plant surveys; the report is included as Appendix B.

1.5 FUTURE ACTIVITIES

Currently planned and potential activities for 2008 include the following:

- Continue operating the NWTS and FONR systems.
- Continue to sample groundwater quality at selected existing wells.
- Abandon selected wells and/or facilities at the original GWETS (upon approval of the USEPA, California Department of Toxic Substance Control, and the California Regional Water Quality Control Board).
- Monitor rare plants and habitat at selected locations.
- Continue weed control treatments through UCSC.

No new wells or construction within the FONR is planned at this time. As the remediation progresses, the number of wells that are included in the sampling program and/or the number of samples collected will be reduced. To date, sampling has been suspended at 45 wells. The eight extraction wells and the NWTS facility will be sampled approximately every other month. Of the remaining 47 monitoring wells, 21 wells will be sampled quarterly, 19 wells semiannually, and seven wells annually.

2.0 OVERVIEW OF 2007 RARE PLANT SURVEY RESULTS

The objectives of the 2007 rare plant survey and habitat inventory were to accomplish the following:

- Identify locations and estimate rare plant populations at each site for Monterey spineflower and sand gilia within the proposed construction areas for the remediation system.
- Map Monterey spineflower and sand gilia populations so that future activities could avoid or reduce impacts to those populations.
- Conduct a habitat assessment within each site to provide data on species composition, including the presence of non-native and invasive species.

A total of 15 potential construction sites and three previously used staging areas were surveyed for the presence of rare plants (Figure 1.5). A habitat inventory was also conducted at 10 of the 15 sites. This section presents a summary of the key findings from those surveys. The complete survey report is presented in Appendix A.

Two separate surveys were conducted. Surveys for sand gilia and Monterey spineflower were conducted by a DD&A biologist and a DD&A global positioning system (GPS) technician between April 19 and April 24, 2007. 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 management staff and by observing a known occurrence of sand gilia in the vicinity of FONR. The second survey, which was conducted between June 28 and July 3, 2007, was the habitat inventory in areas of proposed new construction.

Each of the rare plant surveys was conducted along existing or proposed roadways and access routes. In the absence of rare plants, 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. When surveying areas for new access routes (Sites 4 through 10 in Figure 1.5), the survey area was expanded as needed to identify alternative routes to bypass rare plant populations encountered during the survey effort. If terrain or the extent of native vegetation negated the possibility of an alternative route, the surveyed area included the route with minimal impact to the rare plant population.

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.

Individual counts were made for all sand gilia populations whether they were mapped using points (population less than 10) or polygons (population greater than 10). However, Monterey spineflower were only counted as individuals when groups of less than five were mapped. Monterey spineflower mapped as polygons were characterized according to the percent of cover. The categories ranged from 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 76 percent), and Medium High (76 to 97 percent) to Very High (greater than 97 to 100 percent). GPS data were exported to shapefile format for use in a Geographic Information System (GIS) (ESRI ArcGIS) and mapped on high-resolution aerial photography. These maps are presented in Appendix A (Figures A3.1 through A3.4).

2.2 SAND GILIA

Sand gilia was observed and mapped in 12 locations within the 15 potential construction sites, 21 well sites, and the three staging areas surveyed for rare plants (Table A3.1 and Figures A3.1 through A3.4 in Appendix A). Population size estimates range from a single plant to approximately 100 plants, with an average of 28 plants per population. The total estimate of plants observed and mapped during the survey effort was 335 individuals. Five occurrences of sand gilia were mapped as points while seven populations were mapped as polygons. Seven of the 12 total populations of sand gilia (32 percent) contained 10 or more plants with five locations exceeding 25 plants.

Sand gilia was encountered in open, sandy areas and along access roads in the coast live oak woodland, coastal scrub and maritime chaparral habitats, but was not observed in areas with dense woody vegetation. At one site, Staging Area 2, sand gilia was present within an opening located in a dense area of non-native annual grasses but total plant cover associated with sand gilia observations was generally low.

2.3 MONTEREY SPINEFLOWER

A total of 54 populations (42 polygons and 12 points) of Monterey spineflower were mapped along the 15 rare plant survey areas, 21 well sites, and three staging areas within the FONR (Table A3.2 and Figures A3.1 through A3.4 in Appendix A). A total of 21 individual plants were identified at the 12 mapped GIS points. 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 42 populations of Monterey spineflower that were mapped as polygons, one population had a Medium cover class (51 to 76 percent cover), one population had a Medium Low cover class (26 to 50 percent), 25 populations had a Sparse cover class (3 to 25 percent), and 15 populations had a Very Sparse cover class (less than 3 percent). None of the Monterey spineflower populations observed and mapped exceeded the Medium cover class.

Plant density estimates in the polygon areas were typically Very Sparse or Sparse. Approximately 95 percent (42 of the 44 populations) fell into these two categories. Sparse populations out-numbered Very Sparse populations by approximately 3:2 (56 percent of the total versus 36 percent).

Monterey spineflower was observed in each of the classified habitat types at the site and was usually restricted to open sandy areas with sparse vegetative cover. In the live oak woodland and maritime chaparral habitats, this species was often observed along access roads and other disturbed areas such as existing well locations, and in naturally occurring sandy or grassy open

areas. Monterey spineflower populations were often observed in areas with sparse to moderately abundant non-native annual grass cover, suggesting that this species may be somewhat more tolerant of annual grass cover than sand gilia.

2.4 HABITAT INVENTORY METHODS

The habitat inventory was conducted in areas of scheduled new construction – sites 4, 6, 7, 8, 9, 11, 12, and 13 (Figure 1.5). Site 11 was later split into two sites: 11A and 11B. The inventory included identifying the type and distribution of native and invasive, non-native plant species. Invasive species include any plant species that is listed as a noxious weed by the CDFA, included on invasive plant lists maintained by the Cal-IPC, or considered to be an invasive SOC by the UCSC FONR staff.

The habitat inventory was taken by placing 100-foot consecutive transects along the centerline of the surveyed area through the entire length of each site. A 1-square meter (m^2) quadrat was placed at 10-foot intervals along each transect. The quadrat was sequentially staggered (e.g., center of site alignment, right edge of adjacent habitat, center of site alignment, and left edge of adjacent habitat) to create a more accurate representation of the entire area along each FONR site alignment. Inventory observations were compiled into two data sets: one along the center of the alignment and one along the edge of adjacent habitat.

The percentage of total ground cover by vegetation (specifying type and species, where possible), soil crust, litter, and bare ground within each 1-m^2 quadrat was visually estimated by a DD&A botanist and recorded on data sheets in the field. Descriptions of the surrounding habitat were also described and recorded by a DD&A botanist.

2.5 HABITAT AND INVASIVE SPECIES

Observed habitat types were divided into five categories:

- Coast live oak woodland,
- Central maritime chaparral,
- Coastal scrub,
- Annual grassland, and
- Disturbed/developed.

The latter category, disturbed/developed, consists of dirt roadways, staging areas, well sites, and groundwater treatment facilities. Non-native grasses including rip-gut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), red brome (*Bromus madritensis ssp. rubens*), wild oat (*Avena fatua*), and rattail fescue (*Vulpia myuros*) are common and widespread in all habitats throughout OU-1. No iceplant or pampas grass species were observed within any of the sites. Maltese-star thistle was observed at just one location.

Plant species identification and percent cover data were collected for 279 quadrats. Plant species were categorized as either “native,” “non-native,” or “non-native, invasive.” Native refers to a plant species that normally lives and thrives in a particular ecosystem. Non-native refers to a

plant species that has been introduced to California as a direct or indirect result of human activity. The non-native, invasive category refers to plant species that:

- Are not native to, yet can spread into, ecosystems,
- Can displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes, and
- Are included on the Cal-IPC list and identified as being of particular concern to the FONR. These species are mostly composed of annual grasses.

This concern is based on the observation that non-native, invasive species generally compete for space and nutrients directly with and more effectively than native plants, including the protected Monterey spineflower and sand gilia.

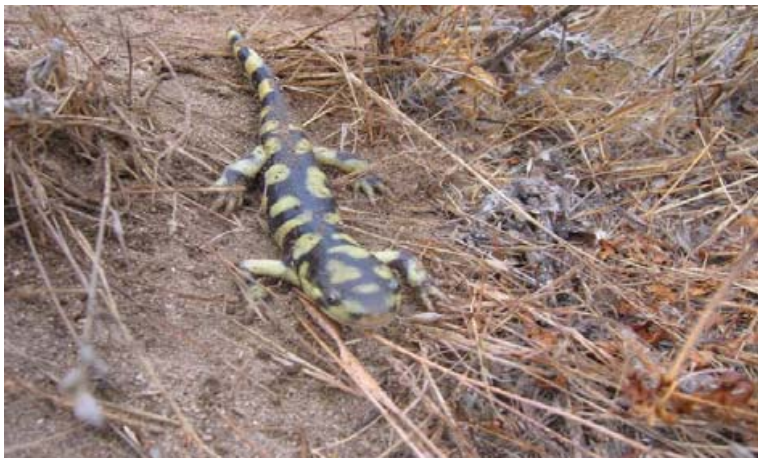
Ground cover was categorized as "bare ground," "leaf litter," or as one of the three plant categories defined above. Leaf litter refers to an area where the ground is covered by a layer of leaves and other debris that has accumulated from the surrounding vegetation. Bare ground refers to an area with no vegetation present.

Overall, annual grasses (considered non-native, invasive species) comprised 41 percent of the vegetative cover within the 259 quadrats and native species comprised 25 percent. The remaining ground cover consisted of non-native species, bare ground, well pad, or leaf litter.

2.6 SPECIAL STATUS WILDLIFE SPECIES

An adult salamander identified as a possible California tiger salamander was encountered by the trained construction staff on July 27, 2007. Recent information suggests that the animal may have been a hybrid between the California tiger salamander and the Arizona barred salamander based on genetic sampling results of larvae collected from the nearby irrigation pond. No other special status species other than a few coast horned lizards were observed during the rare plant or habitat surveys. All coast horned lizards were removed from areas with construction activity by the EM and placed in the nearest appropriate habitat not planned for construction. DD&A staff provided an EM during construction activities and made the following observations relative to the discovery above:

- On July 27, 2007, members of the construction staff alertly observed a possible California tiger salamander within the construction zone (Photograph 2.1). The HGL field supervisor notified the Fort Ord BRAC Cleanup Team biologist (William Collins) and the DD&A EM. Mr. Collins relocated the possible California tiger salamander to a safe area outside the construction zone in accordance with the requirements of the amended biological opinion authorizing incidental take. Figure 2.1 illustrates the possible California tiger salamander capture and release locations.



Photograph 2.1: Possible California tiger salamander

- On two occasions, a coast horned lizard was observed within or near the construction zone and relocated by the DD&A EM to a safe location. On several occasions, the DD&A EM observed barn owls in the vicinity of wells EW-OU1-71-A and MW-OU1-86-A. The DD&A EM related all relevant information to the HGL supervisor to minimize any impact from construction activities.
- No other special-status wildlife, including the black legless lizard was observed during the construction activities. All personnel and equipment stayed within approved work areas, designated access roads and staging areas. All open holes deeper than 1 foot were backfilled, ramped, and/or covered to prevent entrapment of wildlife.

The results of the environmental monitoring effort during construction are described in detail in Appendix C.

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3.0 IMPACT ASSESSMENT

Data collected during the 2007 rare plant survey were evaluated in conjunction with other observations to identify impacts to the FONR habitat resulting from OU-1 activities. This annual impact assessment represents current conditions only and will be considered along with future data in the overall impact assessment to be conducted upon completion of the OU-1 remedial action.

Approximately 1 acre of annual grassland was cleared in 2007 to construct the FONR system infiltration trenches. This area was grassland habitat before the new construction and part of the large expanse of grassland that comprises the eastern portion of the FONR. The grassland habitat continues to the east and north of the construction area for several thousand feet.

All other construction activity occurred within the existing roadways and well sites. Approximately 3,300 feet of pipeline were installed as described in Section 1.3.3.

3.1 SAND GILIA

No sand gilia populations were observed at any of the well locations during pre-construction rare plant surveys conducted in 1998 by the UCSC, in 2004 and 2005 by HGL through CH2M Hill, and in 2006 by HGL through DD&A. In 2006, a sand gilia population of 13 plants was present around the well site at MW-OU1-59-A (HGL, 2007a); this well was constructed in 2004. Sand gilia was not detected during the 2007 rare plant survey at this location, perhaps because of the reduced precipitation. According to the National Weather Service Climatological Station for Monterey, the spring (March, April, and May) rainfall total for 2006 was 12.63 inches, while the rainfall total for spring of 2007 was only 2.31 inches.

3.2 MONTEREY SPINEFLOWER

Overlap between the 2007 construction zones and populations of Monterey spineflower observed in the 2007 and previous surveys were limited, as described below:

- IW-OU1-74-A was constructed to the west of small, very sparse populations that were observed in 2005 and 2006 (absent in 2004). The 1998 survey also showed the presence of Monterey spineflower in this area. The 2007 survey showed that the boundary of the very sparse population area had expanded to include the well site. The pipeline constructed to that well passed adjacent to or along the edge of the population.
- An access road leads from the main northwest–southeast roadway bordering the FONR habitat (segment 3 in Figure 1.5) to the closely spaced wells MW-OU1-46-A (constructed in 2001), MW-OU1-46-AD (constructed in 2004), and PZ-OU1-46-AD2 (constructed in 2005). Monterey spineflower populations (very sparse) were observed in the central segment of this road in 2004 and 2006. The 2006 survey (Figure A3.1 in Appendix A) showed the boundary of the very sparse population extended along the full distance from the junction with the northwest–southeast road. The 2007 survey showed a very sparse Monterey spineflower along a much smaller segment of this roadway to the east of the MW-OU1-46-AD well cluster and a slightly larger population to the west. The pipelines

to extraction well MW-OU1-46-AD and injection wells IW-OU1-73-A and IW-OU1-74-A were constructed down the approximate center of this road to minimize impact to the spineflower population.

- Two small, very sparse populations were observed in the 2007 survey in the vicinity of monitoring well MW-OU1-83-A (constructed in 2006). One population was nearby to the northwest and the other population was more distant to the southeast. The 2004 and 2005 surveys also showed a similar presence of the southeast population. The northeast population observed in 2007 was not found in the previous surveys although two other populations of very limited extent were noted in the general vicinity in the 2004 survey. No disturbance was made to this area in 2007 other than vehicle (pick-up truck or sport utility vehicle) or foot traffic as part of groundwater sample collection.
- A small, medium density population was observed along the north access road to well site EW-OU1-71-A (constructed in 2006; Figure A3.2 in Appendix A). Monterey spineflower had not been observed at this location in previous surveys.
- The extraction well pipeline along the northwest–southeast roadway passed through the edge of or adjacent to seven Monterey spineflower populations located along this roadway in the segment between the NWTS facility and the intersection with the access road to MW-OU1-46-AD. These populations were identified as very sparse, sparse, or limited to a single plant and confined to narrow bands along the edge of the roadway (Figures A3.1 through A3.4 in Appendix A). These populations are observed at the edge of the grassland habitat and the UCSC FONR management staff indicated that these populations are of marginal value to the overall FONR population (HGL, 2006b).

In summary, the potential conflicts with rare plants in the FONR System project area are minimal—less than 600 feet out of a total pipeline distance of approximately 3,300 feet. Approximately 0.5-foot of that 600-foot total represents marginal value populations located at the edge of roadways adjacent to the grassland habitat that borders the FONR to the east and north.

3.3 HABITAT AND INVASIVE SPECIES

The habitat inventory collected data on plant species identification and percent cover from 279 quadrats. There were significant differences, however, in the plant population characteristics observed in the quadrats along the centerline of the roadways as opposed to those along the edge of the roadway. The summary below illustrates the results of the habitat surveys for the center quadrats and the edge quadrats, respectively.

Quadrat Type	Percentage of Quadrat Area Occupied by Given Species				
	Native	Non-Native	Bare Ground	Non-Native Invasive	Leaf Litter/Well Pad
Center	10	6	32	42	10
Edge	38	3	12	30	17

The data presented above display general categories of species. UCSC staff has identified 66 specific non-native, invasive SOC to the FONR habitat (Appendix D of the 2005 Rare Plant

Survey Report [CH2M Hill, 2005]). Only eight of these 66 species were observed in any of the 279 quadrats examined during the habitat inventory; these eight species are listed in the table below in order of decreasing frequency. A detailed presentation of the distribution of the 10 species identified in the survey is presented in Table A3.4 of Appendix A.

Plant	Number of Quadrats Observed			Average Ground Cover Where Present (%)	
	Total	Center	Edge	Center	Edge
Rattail fescue	234	130	104	32	20
Red brome	189	89	100	12	12
Cat's ears	71	53	19	2	2
Soft chess	57	33	24	4	4
Rip-gut brome	57	16	41	8	6
Wild oat	27	9	18	6	5
Red stem filaree	21	17	4	2	3
Rattlesnake grass	12	8	4	24	53
Maltese star-thistle	1	1	0	1	0

Only rattail fescue, red brome, and cat's ears were present in more than 25 percent of the quadrats surveyed; the average cover within a quadrat for these species, however, was less than 15 percent except for the rattail fescue. The data suggest that only rip-gut brome, red brome, and wild oat are more prevalent in the edge quadrats as opposed to the center of the roadway areas. Where present, the extent of area coverage did not vary significantly between the center portion of the roadway and the edge of the roadway adjacent to the undisturbed habitat except for rattlesnake grass and rattail fescue.

3.4 EROSION

HGL staff conducted visual reconnaissance surveys to detect erosion resulting from construction activity along the roadways used to access the construction areas and the monitoring well network. These erosion surveys are conducted routinely during the quarterly groundwater monitoring events and on occasion during routine system maintenance. Except for tire ruts at isolated locations during the construction effort, significant erosion was not observed on the FONR roadways. The construction areas where erosion was observed were back-filled, re-graded, and smoothed after the construction effort was complete (described in Appendix C).

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4.0 CONCLUSIONS

Construction efforts were undertaken by HGL to remediate contaminated groundwater within the OU-1 portion of the FONR during the 2004 through 2007 time period. Construction included:

- Drilling soil borings;
- Constructing extraction, injection, and monitoring wells;
- Installing water conveyance pipelines;
- Installing infiltration trenches; and
- Constructing a groundwater treatment facility.

Figure 4.1 illustrates the areas in which construction occurred during 2004 through 2007. No additional construction efforts within the FONR are anticipated at this time.

A critical concern throughout the project has been the protection of the rare plant species within the FONR. To that end, direct impacts (i.e., construction activity within the footprint of known populations of sand gilia or Monterey spineflower) have been minimized though use of pre-construction surveys to delineate population locations. The results of the surveys were used to adjust the location of remediation facilities to avoid previously identified locations wherever possible. As discussed below, this strategy enabled the construction activity to avoid direct impact except in a handful of cases described below.

UCSC staff responsible for the management of the FONR indicated significant concern regarding indirect impacts to the rare plant species through alteration of the habitat associated with the construction activity. Clearing existing, native vegetation to enable equipment access for well or pipeline construction may have provided 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 out-compete the existing plants and come to dominate the overall species distribution. To address this concern, HGL, through DD&A, conducted habitat surveys in 2006 and 2007 and funded weed control efforts by UCSC in 2007.

To date, the above efforts and the proactive construction management techniques employed throughout the construction effort to mitigate impacts (described in Section 1.4) appear to have been successful in minimizing the impact to rare plant populations. Table 4.1 summarizes the rare plant populations observed at the well sites for those wells constructed during 2004 and thereafter. The data from Table 4.1 are discussed in detail below.

4.1 OPERABLE UNIT 1 GROUNDWATER EXTRACTION AND TREATMENT SUMMARY EXPANSION IMPACTS ON MONTEREY SPINEFLOWER

Forty-six new OU-1 wells were constructed within the FONR between 2004 and 2007. Previously existing Monterey spineflower populations were identified at only 12 of these locations. At eight of these 12 locations, however, the wells were constructed along the roadways bordering the adjacent grasslands to the north and east, and the habitat/rare plant populations are considered of marginal value (HGL, 2006b). HGL discussed the proposed well locations with UCSC management staff before well construction began to confirm that the

potential disruption of these plant populations was an acceptable approach and would not present a significant impact. These eight well locations were:

EW-OU1-49-A	PZ-OU1-49-A1	MW-OU1-56-A	MW-OU1-57-A
EW-OU1-60-A	MW-OU1-61-A	MW-OU1-65-A	EW-OU1-66-A

As shown in Table 4.1, Monterey spineflower was not detected at these locations in the 2005, 2006, or 2007 surveys. Monterey spineflower also was not detected at these locations in the pre-construction survey of 2004. Consequently, it is not possible to conclude that the absence of these marginal populations since their detection in 1998 is the result of the construction activity. Natural variables, including precipitation factors, may be responsible for the lack of detected populations in recent years. In either case, these populations are of marginal value given that they are present within the edge of the grassland habitat.

The remaining four wells with a construction footprint that overlapped the population boundary were as follows:

- MW-OU1-46-AD and PZ-OU1-46-A1. These wells were located within the boundary of a narrow, north-south oriented Monterey spineflower population identified in 1998 (Figure 4.2). Monterey spineflower was not observed at the well site in the 2005 – 2007 surveys. The plant population also was not observed at this location during the 2004 pre-construction survey. The 2006 survey did show the presence of a very sparse Monterey spineflower population that extended approximately 200 feet along the access road to these wells and terminated approximately 20 feet to the east of the well sites. Given the scale of the maps available, it is possible that one or both of the wells are located outside the plant population boundary observed in 1998. It is thus uncertain if there have been any negative impacts to the rare plant population at this location.
- EW-OU1-53-A. Monterey spineflower was detected in 1998 but not in 2004. Although absent in 2005, Monterey spineflower was present in both the 2006 and 2007 rare plant surveys. The data suggest that the well construction activity did not significantly impact the rare plant population.
- IW-OU1-01-A. Monterey spineflower was detected in 1998 but not in 2004. Although absent in 2005, Monterey spineflower was observed in both the 2006 and 2007 rare plant surveys. As in the previous case, the data suggest that the well construction activity did not significantly impact the rare plant population.

At five well locations, Monterey spineflower was identified in one or more post-construction surveys, although that species was not detected in either the 1998 or 2004 surveys. These wells were EW-OU1-54-A, IW-OU1-05-A, IW-OU1-24-A, MW-OU1-59-A, and IW-OU1-74-A. These occurrences suggest a possible temporary beneficial impact of ground disturbance associated with construction activity relative to the Monterey spineflower population.

4.2 OPERABLE UNIT 1 GROUNDWATER EXTRACTION AND TREATMENT EXPANSION IMPACTS ON SAND GILIA

Sand gilia was not detected at any of the well sites shown in Table 4.1 during the 1998 or 2004 rare plant surveys. In the absence of any previously known populations, it is concluded that the construction activity did not adversely affect the sand gilia population. Further support for this conclusion is found in the 2006 survey results at well MW-OU1-59-A, constructed in 2004. Although absent in previous surveys, the 2006 survey team encountered a population of 13 sand gilia plants surrounding the well site.

4.3 PREVIOUS OPERABLE UNIT 1 CONSTRUCTION VERSUS RARE PLANT OCCURRENCES

Twenty OU-1 wells (counting MW-OU1-24-A and replacement well MW-OU1-24-AR as one well) were installed by previous investigators between 1985 and 1997, and one well was installed along the northwest boundary of the FONR in 1976. As these wells pre-date the earliest available survey results in 1998, it is unknown whether rare plants were present before the wells were constructed. These 21 wells have each been included in at least one of the rare plant surveys from 1998 through 2007. As shown in Table 4.2, Monterey spineflower has been detected in 15 of these 21 wells in one or more of those surveys. If wells MW-B-10-A, MW-OU1-07-A, and MW-OU1-12-A are discounted as not representative, then Monterey spineflower has been detected at 15 of 18 well sites at least once since construction was completed. These wells can be deemed unrepresentative because well MW-B-10-A is located in the grassland at the northern edge of the FONR, and wells MW-OU1-07-A and MW-OU1-12-A are located within the footprint of the former FDA and subject to far more disturbance than simple well construction. Even with the most conservative possible assumption that Monterey spineflower was present at all 18 sites before construction, this high percentage (83 percent) of post-construction occurrences suggests that well construction does not significantly affect the population's sustainability.

An additional 17 wells were constructed between 1998 and 2001. Monterey spineflower was present at nine of these sites in the 1998 rare plant survey. This suggests that the assumption in the preceding paragraph that this species was present at all 18 sites is too high and therefore the 83 percent figure calculated for the recurrence of Monterey spineflower may be low. At six of the nine sites, Monterey spineflower was present in one or more of the surveys conducted between 2004 and 2007. Of the remaining three sites, MW-OU1-44-A was not surveyed after 1998 and is thus not useful for this assessment. The other two were sampled only once (MW-OU1-25-A in 2004) or twice (MW-OU1-40-A in 2004 and 2005). Thus, Monterey spineflower was detected at least once in six of the eight sites (75 percent) even with limited post-construction surveys. In addition, Monterey spineflower was detected in the 2006 and 2007 surveys at MW-OU1-30-A even though it was absent in both the 1998 and 2004 surveys.

For sand gilia, the results are similar (Table 4.2) to those described above. Of the 21 wells installed before the initial 1998 plant survey, sand gilia was detected at nine locations in one or more of the rare plant surveys. During the 2004 rare plant survey, which covered a larger area than the more focused surveys that followed, sand gilia was observed at 90 locations in comparison to 209 locations for Monterey Spineflower (43 percent). The 2005 survey covered

somewhat less area overall but included areas in the northwest part OU-1 plume that were not included in the 2004 effort. Nonetheless, the results were quite similar to the 2004 survey—102 occurrences of sand gilia in comparison to 215 instances of Monterey spineflower (47 percent ratio). For the 18 relevant well sites installed before 1998, the nine subsequent sand gilia occurrences compare to 15 subsequent Monterey spineflower occurrences (a ratio of 66 percent). Thus the presence of sand gilia at nine of the 18 relevant locations for the pre-1998 wells is quite reasonable and does not show any adverse impact related to well construction.

Sand gilia was present at five of the 17 additional well sites constructed after 1998. Wells MW-OU1-36-A and MW-OU1-37-A are located within the footprint of the former FDA and MW-OU1-45-A is located at the edge of the grassland on the northern edge of the FONR. Excluding these non-representative sites, sand gilia was detected in the 1998 survey at five of the 14 well locations; this frequency of occurrence is similar to that observed for the group of wells constructed before 1998 (nine detections at 18 locations). The ratio of sand gilia detections to Monterey spineflower detections for these 14 well locations is also similar to that for the pre-1998 group—5:9 (56 percent) in comparison to 9:15 (66 percent). In two of these five locations, sand gilia was subsequently detected in at least one of the 2004 – 2007 surveys. One location (MW-OU1-44-A) was not included in any subsequent survey. Sand gilia was not detected in subsequent surveys at the other two wells (the 2004 survey at MW-OU1-38-A and the 2004, 2006 and 2007 surveys at PZ-OU1-14-A).

4.4 2004 CONSTRUCTION STAGING AREAS IMPACT ON RARE PLANT POPULATIONS

Three staging areas were established in the southern portion of the FONR during the 2004 construction period. These areas are shown in Figure 1.6 and were used only during 2004. Subsequent construction activity took place in the northern half of the FONR and staging areas were established in the grassland area east of the prime FONR habitat. The staging areas were used to temporarily store construction materials (well pipe, bags of cement, etc.) and vehicle parking.

In 1998, Monterey spineflower was identified within Staging Areas 1 and 2 while sand gilia was present in Staging Area 2 and possibly in Staging Area 3. The map scale and precision of the location data is such that it is uncertain if the staging area and plant population boundaries actually overlap; it is possible that they are close but separate. For the purpose of this comparison, the conservative assumption was made that Staging Area 3 included a part of the sand gilia population observed in 1998.

As shown in Table 4.1, sand gilia was not observed in Staging Area 3 in any subsequent survey. However; the 1998 population only partly overlapped with the staging area. The complete absence of that population in subsequent surveys suggests that other factors may be more important than the potential impact from the staging operations. In addition, Monterey spineflower was identified within the former Staging Area 3 in both 2006 and 2007.

At Staging Area 2, sand gilia was detected within the former boundary in each annual survey from 2004 through 2007 and Monterey spineflower was also observed in 2005, 2006, and 2007.

The regular recurrence of both species indicates that there was no significant impact from the use of this site during the construction effort.
At Staging Area 1, sand gilia was detected within the former boundary in the 2005 annual survey and Monterey spineflower was observed in 2006 and 2007. The recurrence of both species indicates that there was no significant impact from the use of this site during the construction effort.

4.5 SUMMARY

Data from the annual post-construction rare plant surveys for the expansion of the OU-1 groundwater remediation system was compared with the 1998 and 2004 pre-construction rare plant survey data to assess construction impacts on the FONR rare plant populations (Monterey spineflower and sand gilia). The results of that comparison indicate that the construction activity has not had significant adverse effects on those populations. The supporting observations for this conclusion were described in the preceding paragraphs and are summarized below:

- Neither Monterey spineflower nor sand gilia was detected in the 2004 pre-construction rare plant survey at any of the locations where wells were subsequently constructed. The absence of these plants before construction began is taken as one indication of the lack of construction impact.
- During planning discussions before well construction began, the UCSC FONR management staff characterized the 1998 rare plant survey as representing a "great year" for Monterey spineflower and sand gilia (UCSC, 2006). Nonetheless, sand gilia was not detected in 1998 at any of the well sites where construction occurred during the 2004 – 2007 period. Monterey spineflower was detected in 1998 at only 12 of the 46 locations where wells were subsequently constructed between 2004 and 2007:
    - At eight of these 12 locations, the well sites were located at the edge of the grassland in areas already impacted by invasive species and outside the critical FONR habitat; potential construction impacts to these areas are not considered significant.
    - Two wells were located within approximately 25 feet of one another and possibly overlapped with a Monterey spineflower population. Although that plant was not detected in subsequent surveys at the well sites, it is unclear if there have been any negative impacts to the rare plant population because of uncertainty regarding the boundary of the plant population relative to the well locations.
    - At the other two well sites, Monterey spineflower was detected in both the 2005 and 2006 surveys.
- At five of the 2004 – 2007 well locations, Monterey spineflower was identified in one or more post-construction surveys although that species was not detected in either the 1998 or 2004 surveys. Although absent in previous surveys at well MW-OU1-59-A, the 2006 survey team encountered a population of 13 sand gilia plants surrounding the well site. These occurrences suggest a possible temporary beneficial impact of ground disturbance associated with construction activity relative to the rare plant population.
- For 15 of the 18 wells constructed before 1998 in relevant FONR locations, Monterey spineflower was detected in one or more subsequent rare plant surveys. This represents a minimum recurrence rate of 83 percent under the most conservative possible assumption that this species was present at all 18 sites before construction began. Similary, sand gilia

was detected at nine of the 18 wells sites detected in one or more subsequent rare plant surveys. The frequency of occurrence for sand gilia relative to Monterey spineflower in subsequent surveys suggests that well construction activities resulted in no adverse impact to the sand gilia population.

- For those wells constructed between 1998 and 2001, Monterey spineflower was detected in 1998 at eight sites included in subsequent surveys and recurred at least once in six of those sites during the 2004 – 2007 surveys. In addition, this species was detected in 2006 and 2007 at well MW-OU1-30-A although it was not identified in 1998. Sand gilia in this group of wells was observed at four locations included in subsequent surveys and recurred at two locations.

Although the habitat survey showed an increase in a few non-native, invasive species in the roadway areas surveyed, the rare plant data do not indicate any corresponding impacts at this time. Weed control efforts were also undertaken in 2007 as a preventive measure (Section 1.4.7 and Appendix B). Visual observations of the extent of the weed populations were made by UCSC field staff in regard to the effectiveness of the weed control program during 2007. These observations indicated that the program appeared to be successful in limiting the spread and seed production of non-native, invasive SOCs within the weed control treatment areas (McStay, 2008). This positive preliminary assessment of the effectiveness of the weed control program will be re-examined in 2008 in light of the weed population data collected during implementation of the 2008 weed control program.

5.0 RECOMMENDATIONS

Four years of annual rare plant monitoring have shown that the 2004 – 2007 construction activities associated with the expansion of the OU-1 groundwater remediation program have not significantly impacted rare plant populations within the FONR. As shown in Figure 4.1, there has been no construction activity over the last three years in the southern part of OU-1 within the FONR. Consequently, the HGL rare plant sampling program will be suspended in this region.

As noted previously, 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 the former species are sometimes encountered in this area (sand gilia has not been detected), the predominant pre-construction population is weeds and invasive grasses. Consequently, the potential impact due to the construction activities is not significant and the HGL rare plant sampling program will also be suspended in this region.

At three well locations in the northern portion of the FONR, rare plants were not detected in any of the surveys conducted before construction began. These wells are:

- PZ-OU1-10-A1 – Area surveyed in 1998 and 2004; well constructed in 2005,
- MW-OU1-87-A – Area surveyed in 1998, 2004, 2005 and 2006; well constructed in 2006, and
- MW-OU1-88-A – Area surveyed in 1998, 2004, and 2006; well constructed in 2006.

Given the absence of rare plants before well construction in the above cases, these well sites will be omitted from the HGL 2008 rare plant survey program.

The HGL rare plant monitoring program for 2008 will include the following areas:

1. Weed control segment 15 (Figure 1.6), including well sites MW-OU1-50-A and MW-OU1-82-A;
2. Weed control segment 14 (Figure 1.6), including well site MW-OU1-83-A;
3. Weed control segment 9 (Figure 1.6), including well sites MW-OU1-46-AD, PZ-OU1-46-AD1, MW-OU1-51-A, IW-OU1-74-A, and MW-OU1-84-A;
4. Weed control segment 13 (Figure 1.6), including well site IW-OU1-73-A;
5. Weed control segment 12 (Figure 1.6), including well sites MW-OU1-85-A and EW-OU1-72-A; and
6. Weed control segment 11 (Figure 1.6), including well sites MW-OU1-86-A and EW-OU1-71-A

The weed control program will also be continued in 2008. The areas in which weed control will be implemented and the methodology used will be the same as in 2007 (Figure 1.6). In addition, the following actions will be taken to minimize impacts:

- Minimize roadway traffic during quarterly groundwater sampling activities to the extent practical.
- If approved by regulatory stakeholders, reduce the sampling frequency from the groundwater monitoring well network to minimize road traffic wherever such reductions

can be made consistent with remediation and performance monitoring objectives for the OU-1 cleanup.

The results of the recommended 2008 rare plant and habitat inventory surveys will be described in the 2008 Annual FONR Impact and Habitat and Rare Plant Survey Results.

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