Naval Facilities Engineering Command Southwest
San Diego, CA

FINAL
FIVE-YEAR REVIEW REPORT

Operable Units 1, 2 and MRP Sites 4 and 6

MARINE CORPS AIR STATION YUMA, YUMA, AZ

January 2020

DCN: BATL-9013-4225-0003

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San Diego, CA

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MARINE CORPS AIR STATION YUMA, YUMA, AZ

January 2020

Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southwest
1220 Pacific Highway
San Diego, CA 92132

Prepared by:

505 King Avenue
Columbus, OH 43201

Contract Number: N44255-14-D-9013; Task Order No. N4425518F4225
DCN: BATL-9013-4225-0003

Signature Page

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FIVE-YEAR REVIEW REPORT
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MARINE CORPS AIR STATION
YUMA, ARIZONA

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1220 Pacific Highway
San Diego, California 92132-5190

17 Dec 2019

Colonel David A. Suggs
Commanding Officer
MCAS Yuma
United States Marine Corps

Date

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ABBREVIATIONS AND ACRONYMS

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
amsl	above mean sea level
ARAR	Applicable or Relevant and Appropriate Requirement
ARS	Arizona Revised Statutes
AS/SVE	air sparge/soil vapor extraction
AWQS	Aquifer Water Quality Standards
bgs	below ground surface
BNI	Bechtel National, Inc.
CALA	Combat Aircraft Loading Area
CAOC	CERCLA Area of Concern
CCL	contaminant candidate list
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CHC	chlorinated hydrocarbon
COC	contaminant of concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CPT	cone penetrometer test
DCE	dichloroethene
DEUR	Declaration of Environmental Use Restrictions
DGM	digital geophysical mapping
DoD	United States Department of Defense
DON	United States Department of the Nay
DPT	direct push technology
ecoRfD	ecological reference dose
ELCR	excess lifetime cancer risk
ESD	Explanation of Significant Difference
FFA	Federal Facilities Agreement
FFAAP	Federal Facilities Agreement Assessment Program
FS	Feasibility Study
FYR	five-year review
GAC	granular activated carbon
GCE	Gutierrez Canales Engineering
gpm	gallons per minute
HBGL	health-based guidance level

HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IC	institutional control
ICP	institutional control plan
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISCO	in situ chemical oxidation
J&E	Johnson & Ettinger
JEG	Jacobs Engineering Group, Inc.
KTUA	Kawasaki, Theilacker, Ueno and Associates
LEPA	leading edge of the plume area
LTM	long-term monitoring
LUC	land use control
LUCIP	Land Use Control Implementation Plan
LUST	Leaking Underground Storage Tank
MC	munitions constituents
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MEC	munitions and explosives of concern
MNA	monitored natural attenuation
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
msl	mean sea level
NAVFAC SW	Naval Facilities Engineering Command Southwest
NCP	National Oil and Hazardous Substances Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	operation and maintenance
ODF	Ordnance Distribution Facility
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances

PFOA	perfluorooctanaoic acid
PFOS	perfluorooctane sulfonate
POC	point of compliance
POTW	publicly owned treatment works
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
ROI	radius of influence
RPM	Remedial Project Manager
RSL	Regional Screening Level
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SRL	soil remediation level
SSL	soil screening level
STRAP	Source Treatment/Reduction Alternatives Plan
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TCE	trichloroethene
TCRA	time critical removal action
TLV	threshold limit value
TOI	target of interest
TRPH	total recoverable petroleum hydrocarbons
UCOR	URS | CH2M Oak Ridge LLC
USBR	United States Bureau of Reclamation
U.S.C.	United States Code
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
UXO	unexploded ordnance
VI	vapor intrusion
VOC	volatile organic compound
VCT	vertical circulation treatment
VEMUR	Voluntary Environmental Mitigation Use Restriction

EXECUTIVE SUMMARY

This report provides the results of the fourth Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year review (FYR) conducted for Operable Unit (OU) 1 at Marine Corps Air Station (MCAS) Yuma, Arizona, the fifth CERCLA FYR conducted for OU 2, and the first CERCLA FYR for Munitions Response Program (MRP) Sites 4 and 6 at MCAS Yuma, Arizona. This review was conducted in accordance with the U.S. Department of the Navy's (DON's) *Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews* (DON, 2011) and the U.S. Environmental Protection Agency (U.S. EPA) *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001). The purposes of this review are to: (1) evaluate the performance of the remedies implemented at OU 1, OU 2, and MRP Sites 4 and 6 to ensure that they remain protective of human health and the environment, and (2) recommend actions for improvement if the remedies have not performed as designed or are no longer effectively protective.

This FYR comprises document and data reviews, site inspections (SIs), station personnel interviews, regulatory comment reviews, and report development. Because these remedies would not result in site conditions suitable for unlimited use and unrestricted exposure (i.e., residential use) at the time of this FYR and because the Records of Decision (RODs) for OU 1, OU 2, and MRP Sites 4 and 6 were signed after October 17, 1986, the effective date of the Superfund Amendments and Reauthorization Act (SARA), this statutory review is required by and conducted according to the applicable laws.

The site inspection was conducted on May 9, 2018 and document review was conducted between March and July 2018. The information presented herein reflects the status of the remedies during that review period. The timing of the site inspections and reviews was to ensure that the FYR is completed before the due date. The information will not be updated to reflect current status unless there is an issue that negatively affects protectiveness.

The following paragraphs summarize the review assessment results and future effectiveness of the remedies as implemented for OU 1, OU 2, and MRP Sites 4 and 6, after which the U.S. EPA FYR Summary Form is provided.

Operable Unit 1

A Federal Facilities Agreement (FFA) defines OU 1 as contaminated groundwater underlying MCAS Yuma and vadose-zone soil deeper than 10 ft below ground surface (bgs) that could potentially leach contaminants into groundwater. The plumes within OU 1 were identified as Areas 1 through 6, with the largest plume in Area 1. OU 1 Areas 4 and 5 were later identified as fuel sites rather than CERCLA sites and were assigned to the state of Arizona's Leaking Underground Storage Tank (LUST) Program with oversight by the Arizona Department of Environmental Quality (ADEQ). Therefore, OU 1 Areas 4 and 5 are not discussed further in this FYR. The OU 1 ROD describes the remedy selected for the remaining Areas of OU 1 as a full-scale air sparge/soil vapor extraction (AS/SVE) system in the Building 230 "Hot Spot" of Area 1; a vertical circulation treatment (VCT) system in the leading edge of the plume area (LEPA) of Area 1; monitored natural attenuation (MNA) in Areas 1, 2, 3, and 6; and institutional

controls (ICs) in the form of restrictions on groundwater use for all OU 1 areas. The OU 1 remedial action objectives (RAOs), as stated in the ROD, are to reach U.S. EPA maximum contaminant levels (MCLs) for the contaminants of concern (COCs) in contaminated groundwater in Areas 1, 2, 3, and 6 and to prevent off-site migration of COCs at concentrations exceeding MCLs. The COCs for OU 1 are 1,1-dichloroethene (DCE), tetrachloroethene (PCE), and trichloroethene (TCE).

Groundwater monitoring has been performed for OU 1 areas as required since the signing of the ROD on October 5, 2000. Sampling has indicated that all plumes have been shrinking in size and concentration, and that the remedies have contained COCs at concentrations exceeding MCLs. Areas 2, 3, and 6 have all achieved the MCL goals and have been closed with concurrence by U.S. EPA and ADEQ, and no further action (NFA) is required in these areas.

Active remediation systems were installed and operated in the Area 1 plume. An AS/SVE system was installed in the Building 230 vicinity to remediate groundwater in the most highly contaminated area (referred to as the "Hot Spot" area). The AS/SVE system reduced the chlorinated hydrocarbon (CHC) "Hot Spot" in size and magnitude such that modeling indicated that CHCs would not migrate offsite at concentrations greater than MCLs. The system was operated relatively continuously from November 1999 to May 2007 when it was placed in temporary shutdown status with concurrence by U.S. EPA and ADEQ because it had satisfied the ROD requirements for temporary shutdown. After system shutdown in 2007, COC rebound was observed in groundwater in the "Hot Spot" area. Therefore, the system was restarted in July 2013 and operated continuously through January 2014, when it was placed in temporary shutdown status once again when it had reached asymptotic conditions. Groundwater in the "Hot Spot" area is monitored in accordance with the long-term monitoring (LTM) plan, as stipulated in the ROD. Groundwater levels have declined over time, resulting in groundwater elevations below the top of the screen of the AS wells, and rendering the existing system ineffective for future operation. ADEQ and USEPA have concurred with permanent shutdown of the AS/SVE system in 2019 in letters dated January 25 and 29, respectively.

A VCT system was operated in the LEPA from June 2000 to May 2003 and again from July 2011 to present. The VCT system reduced COC concentrations to near or below MCLs and prevented off-site migration of COC concentrations exceeding MCLs. The VCT system was placed in temporary shutdown status in May 2003 after MCLs had been achieved and modeling indicated that COC concentrations in groundwater would not reach the MCAS boundary at levels exceeding the MCLs. Permanent shutdown of the VCT system occurred in December 2005 with concurrence by U.S. EPA and ADEQ. However, due to COC rebound observed in groundwater in the LEPA area since December 2005, the VCT system was returned to fully operational status in July 2011 and was operating at the time of the site inspection in May 2018.

MNA has been applied to all OU 1 areas through the development and implementation of a long-term monitoring (LTM) plan, as stipulated in the ROD. With the closure of OU 1 Areas 2, 3, and 6, the LTM plan has been revised to focus on monitoring the natural attenuation of COCs in Area 1. The Area 1 plume will continue to be monitored until the COC concentrations decrease below MCLs for a minimum of two years, at which time area closure may be requested.

The OU 1 ROD requires ICs to limit use and restrict exposure to contaminated groundwater at Areas 1, 2, 3, and 6 until MCLs are achieved. The ICs are no longer in effect for Areas 2, 3, and 6 because these areas have achieved the MCLs and received NFA. The current ICs are established in the revised *MCAS Yuma Master Plan* (Kawasaki, Theilacker, Ueno and Associates [KTUA], 2007) and implemented through the *Final Land Use Control Implementation Plan* (LUCIP) (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2017). MCAS Yuma Station Order 5090B (issued on May 25, 2014, as an update to Station Order 5090A) formally directs tenants and MCAS Yuma departments to comply with land use controls (LUCs) provided in the revised MCAS Yuma Master Plan and the Final LUCIP. The ICs established for OU 1 Area 1 are still effective and are to remain enforced until Area 1 has met its cleanup goals (i.e., MCLs).

A human health risk assessment (HHRA) conducted in 2012 evaluated potential exposure to human receptors via the vapor intrusion (VI) pathway because VI exposure was not assessed in the OU 1 RI risk assessment. Results of the VI assessment indicated that noncancer hazards and cancer risks were below de minimis levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents and that the remedies for OU-1 remain protective (Sealaska, 2013).

Emerging contaminants including 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS) have been identified in groundwater across OU 1 Area 1 subsequent to the ROD. In 2014, a groundwater characterization study was performed and a flow and transport model was prepared for OU 1 Area 1 to evaluate the spatial extent and migration potential of 1,4-dioxane in groundwater (Trevet, 2016). Several new wells were installed during the study and the LTM program was subsequently revised to routinely monitor 1-4-dioxane. Sampling results indicate that the 1,4-dioxane plume generally overlaps the CHC plume. The highest 1,4-dioxane concentrations occur in the Hot Spot area of the site, and elevated concentrations above the U.S. EPA regional screening level (RSL) exist in the LEPA. However, the RSL is a screening level rather than a cleanup level. The maximum concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4} (Trevet, 2016). 1,4-Dioxane concentrations do not exceed the U.S. EPA lifetime health advisory of 35 and 200 micrograms per liter (µg/L) for carcinogenic or non-carcinogenic effects, respectively, anywhere within the plume. There are no drinking water wells within a mile downgradient of the site, and results of a risk assessment conducted for the 2014 study showed that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016).

A groundwater treatment pilot study was conducted in 2016 and 2017 to evaluate: 1) the effectiveness of in situ chemical oxidation (ISCO) using sodium persulfate to lower 1,4-dioxane concentrations in the groundwater in the Hot Spot area; and 2) sorbent removal of 1,4-dioxane at the VCT (MMEC, 2018b). Significant decreases in 1,4-dioxane and CHC concentrations were observed following the ISCO treatment, but the radius of influence (ROI) of 5 to 7.5 feet was significantly smaller than the estimated 25 feet. A potential increase in bromate and hexavalent chromium concentrations was observed five months after the ISCO injection and continues to be monitored to evaluate if the condition is transitory. The small ROI indicates that this treatment technology may not be effective for 1,4-dioxane at this site given site-specific characteristics. Additionally, post-ISCO sampling in July and August 2017 analyzed PFAS concentrations to

address concerns that ISCO treatment could potentially mobilize PFAS in the subsurface. In comparison with the baseline PFAS concentrations in the same groundwater wells sampled in November 2016, no discernible effect on PFAS concentrations was observed following the ISCO application (MMEC, 2018b).

As part of the 1,4-dioxane pilot study conducted in 2016 (MMEC, 2018b) the synthetic adsorbent media AMBERSORB 560™ was used to evaluate the treatment efficacy of removing 1,4-dioxane and CHCs from the VCT system influent groundwater in the LEPA. The pilot study demonstrated that AMBERSORB 560™ effluent samples had 1,4-dioxane and CHC concentrations below project action limits, which met the treatment performance objectives. The AMBERSORB 560™ pilot study was performed prior to the initial PFAS sampling in November 2016, therefore PFAS analyses were not included in the AMBERSORB 560™ treatment study.

Recent groundwater monitoring results indicate that ROD-based COCs have met their respective MCLs at the LEPA. 1,4-Dioxane and PFAS are not COCs for the site. 1,4-Dioxane concentrations within OU 1 Area 1 exceed the RSL; however, the RSL is a screening level rather than a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Modeling results show that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016). 1,4-Dioxane concentrations do not exceed the U.S. EPA lifetime health advisory for carcinogenic or non-carcinogenic effects anywhere within the plume.

One well in the LEPA area contained a PFAS (i.e., PFOS + PFOA) concentration essentially equivalent to the lifetime health advisory (i.e., 0.074 µg/L versus the health advisory of 0.07 µg/L) and the remainder of the LEPA wells contained concentrations below the health advisory (MMEC, 2018b). There are no drinking water wells within a mile downgradient of the site. Further evaluation of these emerging contaminants is being conducted; however, existing data do not indicate excess health risk downgradient of the site. A Preliminary Assessment (PA) was conducted for PFAS in 2017 and early 2018 and the preliminary draft PA report was being reviewed by the Navy during the inspection and review period of this FYR.

Operable Unit 2

The FFA defines OU 2 as soil contamination from ground surface to 10 feet bgs. The FFA identified 18 CERCLA Areas of Concern (CAOCs), 12 of which required NFA. Three of the remaining six were remediated to residential land use standards in 1999, with NFA required. The OU 2 ROD describes the remaining three CAOCs (1, 8A, and 10) as requiring ICs to prevent unlimited use and unrestricted exposure.

The ICs required by the ROD were established in the MCAS Yuma Master Plan (KTUA, 2007) and implemented through the Final LUCIP (NAVFAC SW, 2017b). MCAS Yuma Station Order 5090B formally directed tenants and all MCAS Yuma departments to comply with the LUCs provided in the MCAS Yuma Master Plan and the Final LUCIP. The ICs established for OU 2 remain effective. The MCAS Yuma Environmental Department continues to review and coordinate all plans for future activities at CAOCs 1, 8A, and 10, in consultation with U.S. EPA

and ADEQ as necessary, to ensure continued compatibility with the ICs as specified in the OU 2 ROD.

MRP Site 4

MRP Site 4 is a former small arms range located in the northern central portion of MCAS Yuma and overlaps the boundaries of OU 2 CAOC 1. The majority of the approximately 240-acre site (about 198 acres) was developed with the current runways, aprons and associated airfield facilities and is almost completely covered by buildings and concrete surfaces, including runways, taxiways, parking aprons, and parking lots. The remaining area of the site is primarily covered with desert pavements including gravel and sand with sparse vegetation.

The source of potential munitions constituents (MCs) in subsurface soil is from ammunition when the site was used as a small arms range. According to the Archive Search Report (United States Army Corps of Engineers [USACE], 2001), no fixed firing facilities were established at the former range. Cartridge, ball, and rifle-related munitions types were used at the site. MCs typically associated with these types of munitions include antimony, arsenic, cadmium, copper, lead, and zinc. With regulatory agency concurrence, soil samples were not collected from MRP Site 4 because the majority of the site is located within OU 2 CAOC 1. Results of the OU 2 remedial investigation (RI) for CAOC 1 indicated the presence of arsenic, cadmium, copper, lead, and zinc at concentrations above background, as summarized in the OU 2 ROD. Risks and hazards associated with these metals may be attributed to MRP Site 4.

The selected remedy incorporates the ICs in place at OU 2 CAOC 1 and expands the IC boundary to include the portions of the site that lie outside of the boundary of OU 2 CAOC 1 (NAVFAC SW, 2017a). The MCAS Yuma Environmental Department continues to review and coordinate all plans for future activities at MRP Sites 4 in consultation with U.S. EPA and ADEQ as necessary, to ensure continued compatibility with the ICs as specified in the ROD. The ICs required by the ROD are implemented through the Final LUCIP (NAVFAC SW, 2017b).

MRP Site 6

MRP Site 6 is located in the south-central part of MCAS Yuma, in the southeastern portion of the runway area. The entirety of the approximately 1-acre site is within the restricted area of the airfield east of, and adjacent to, a combat aircraft loading area and has been developed with an airplane parking apron that is associated with an adjacent hangar complex.

The site is currently covered in its entirety by 3 feet of clean imported soil overlain by an approximately 18-inch-thick concrete apron that is part of the aircraft hangar complex. The site was formerly used as a firing-in butt range to zero-in fixed aircraft guns. A firing-in butt is an earthen mound used as a backstop or target area on a range. Ammunition used included 20-millimeter (mm), 25-mm, and 0.50-caliber (cal) projectiles, which are the typical munitions for the types of military aircraft operated at MCAS Yuma. Surface soil contamination was not identified; however, the potential for chemicals to be present in subsurface soils at concentrations posing an excess risk has not been determined. Multiple expended 20-mm projectiles classified as non-energetic munition debris (i.e., not an explosive hazard) were observed on the ground

surface during the Site Inspection (SI) (Alliance Compliance, 2011). The SI recommended further assessment of the residential and commercial worker exposure scenarios and evaluation of the construction worker scenario based upon the detection of arsenic at levels greater than U.S. EPA risk-based screening levels. A subsequent investigation of base-specific background concentrations indicated that arsenic concentrations were representative of base background levels. The SI also recommended additional investigation for munitions and explosives of concern (MEC) since multiple expended 20-mm projectiles were discovered and the potential for MEC could not be discounted on the basis of historical use of 20-mm, 25-mm, and .50-cal projectiles. The potential for associated subsurface MC exists based on the potential for subsurface MEC. Further evaluation for MEC (e.g., digital geophysical mapping) and subsurface MC concentrations in soil was not performed because of the subsequent use of the site for a critical military construction project (i.e., the aircraft hangar complex).

The selected remedy incorporates ICs in the form of LUCs to minimize exposure to the potential presence of subsurface MEC and MC (NAVFAC SW, 2017b). MCAS Yuma Station Order 5090B formally directed tenants and all MCAS Yuma departments to comply with the cleanup area LUCs provided in the MCAS Yuma Master Plan and the Final LUCIP. The ICs established for MRP Site 6 remain effective. The MCAS Yuma Environmental Department continues to review and coordinate all plans for future activities at MRP Site 6, in consultation with U.S. EPA and ADEQ as necessary, to ensure continued compatibility with the ICs as specified in the ROD. The ICs required by the ROD are implemented through the Final LUCIP (NAVFAC SW, 2017b).

Five-Year Review Summary Form

The following U.S. EPA FYR Summary Form provides additional information regarding the review assessment results and future effectiveness of the remedy as implemented.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Marine Corps Air Station Yuma, Operable Units 1 and 2, and Munitions Response Program Sites 4 and 6		
EPA ID: AZ0971590062 (MCAS Yuma)		
EPA Region: 09	**State:** AZ	**City/County:** Yuma / 027 Yuma

SITE STATUS	
NPL status: ☑ **Final** ☐ **Deleted** ☐ **Other (specify)**	
Remediation status (choose all that apply): ☐ **Under Construction** ☑ **Operating** ☐ **Complete**	
Multiple OUs? ☑ **YES** ☐ **NO**	**Construction completion date:** 16-Nov-1999
Has site been put into reuse? ☐ **YES** ☑ **NO**	

REVIEW STATUS	
Lead agency: ☐ **EPA** ☐ **State** ☐ **Tribe** ☑ **Other Federal Agency** U.S. Department of the Navy	
Author name: Naval Facilities Engineering Command Southwest	
Author title:	**Author affiliation:** U.S. Department of Defense
Review period: 17 June 2015 to 16 June 2018	
Date(s) of site inspection: 09 May 2018	
Type of review: ☑ **Post-SARA** ☐ **Pre-SARA** ☐ **NPL-Removal only** ☐ **Non-NPL Remedial Action Site** ☐ **NPL State/Tribe-lead** ☐ **Regional Discretion**	
Review number: ☐ **1 (first)** ☐ **2 (second)** ☐ **3 (third)** ☑ **Other**	
Triggering action: ☐ **Actual RA Onsite Construction at OU** ☐ **Actual RA Start** ☐ **Construction Completion** ☑ **Previous Five-Year Review Report** ☐ **Other (specify):** _____	
Triggering action date: 17 June 2015	
Due date ***(five years after triggering action date)*****:** 17 June 2020	

ISSUES/RECOMMENDATIONS	
OU(s) without Issues/Recommendations Identified in the Five-Year Review:	
None	
Issues and Recommendations Identified in the Five-Year Review	
Site(s): OU 1 Area 1	Issue Category: Remedy Performance
	Issue: 1,4-Dioxane has been included in the LTM program for OU 1 Area 1. Concentrations exceed U.S. EPA RSLs within the base boundary and at the furthest downgradient monitoring well at the LEPA. However, the RSL is a screening level, not a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is in the middle of the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Concentrations of 1,4-dioxane do not exceed the U.S. EPA health advisory anywhere within the plume. Results of modeling and a risk assessment conducted for a previous study indicate that downgradient risk and hazard are acceptable. There are no known drinking water wells within 1 mile in the downgradient direction of the LEPA
	Recommendation: Evaluate technologies that treat and contain 1,4-dioxane using the results of pilot studies which should consider risk assessment results, cost and feasibility of treatment.

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	TBD	DON	U.S. EPA, ADEQ	Ongoing
Site(s): OU 1 Area 1	**Issue Category: Remedy Performance**			
	Issue: PFAS concentrations exceed the U.S. EPA lifetime health advisory levels within OU 1 Area 1. However, Area 1 has an IC restricting against the use of groundwater so there is no excess risk or hazard associated with the presence of PFAS in site groundwater. One well in the LEPA contained a combined PFOA/PFOS concentration essentially equivalent to the health advisory. There are no drinking water wells within a mile downgradient of the LEPA. Therefore, there are no issues with regard to PFAS at Area 1. With regards to the remainder of OU 1, a base-wide PA for PFAS was under way during the review period and the preliminary draft PA report was being reviewed by the Navy and Marine Corps during the site inspection and document review period for this FYR. Other potential areas of PFAS groundwater contamination on the installation were identified and all areas were downgradient of the Installation's drinking water sources. However, it is currently unknown whether PFAS is present in groundwater at other areas of the Installation (i.e., other than Area 1) at concentrations exceeding the health advisory level.			
	Recommendation: The Area 1 remedy is protective of PFAS. Regarding the remainder of OU 1, complete the PA/SI that is currently under way and use the results to determine whether an RI for PFAS at other areas of OU 1 is necessary.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
TBD	TBD	DON	U.S. EPA, ADEQ	Ongoing
Site(s): MRP Sites 4 and 6	Issue Category: Remedy Performance			
	Issue: The MCAS Yuma Master Plan was last updated in 2007 prior to development of the MRP Site 4 and 6 ROD. The ICs required at Sites 4 and 6 have not been incorporated into the Master Plan. The Master Plan is a conceptual document which is updated infrequently. The Base GIS system which is used by the base planning department to develop site plans has been updated to reflect the site boundaries and ICs, and MCAS Yuma Environmental staff reviews all site approval requests and all dig permits. Therefore, risk is unlikely. However, an amendment to the Master Plan is specified in the ROD and the current lack of amendment should be corrected.			
	Recommendation: Create an addendum to the Yuma Master Plan to incorporate ICs and LUCs for MRP Sites 4 and 6.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	DON	U.S. EPA, ADEQ	December 2019
Site(s): OU 2 CAOC 8A	Issue Category: Remedy Performance			
	Issue: Base personnel have indicated the desire to implement a land-use change for OU 2 CAOC 8A, which may make the current exposure assumptions for the area invalid. No military construction is funded at this time. However, there is limited available space on-base to expand. Therefore, it is reasonable to assume that the need to change the land use at OU 2 CAOC 8A will arise. As stated in the OU 2 ROD, if any changes in land use are planned at the area, the DON, in consultation with the U.S. EPA and ADEQ, will reevaluate the remedy at OU 2 CAOC 8A before the onset of any site activities.			

	Recommendation: Base personnel have indicated the possibility of a future land-use change for OU 2 CAOC 8A, and documentation of that land-use change is required because a change in land use involving any activities that may disrupt or expose the landfill interior will require a reevaluation of the remedy. Because the current data set for the area is insufficient to evaluate the potential risk associated with future changes in land use, additional investigation will be needed before the remedy can be reevaluated. Thus, prior to the execution of any activities that may be construed as a land-use change at OU 2 CAOC 8A, further site investigations will be necessary to determine if remediation is required or if the ROD must be amended. As stipulated in the OU 2 ROD, all work pertaining to a change in land use for OU-2 CAOC 8A will be carried out in concert with the U.S. EPA and ADEQ. Because no military construction is currently planned or funded, the recommendation is to track the status of future use requests. The follow-up action is to engage the U.S. EPA and ADEQ when plans are developed for future land-use changes. The timing is to-be-determined because currently there are no plans or funding for land-use changes.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	DON	U.S. EPA, ADEQ	TBD

PROTECTIVENESS STATEMENT(S)		
Operable Unit: OU 1	*Protectiveness Determination:* Protectiveness Deferred	*Addendum Due Date (if applicable):* Ongoing

Protectiveness Statement:
The implemented remedy at OU 1 Area 1 is protective of human health and the environment with respect to the contaminants addressed in the OU 1 ROD (i.e., CHCs).

Because 1,4-dioxane and PFAS were not included as COCs in the OU 1 ROD, and because it has not yet been determined whether remedial actions may be required for these constituents, the protectiveness determination for these constituents is deferred per U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Memorandum 9200.2-111 (U.S. EPA, 2012). If additional remedial actions are required to address these emerging contaminants, these requirements will be documented via the CERCLA process. The 1,4-dioxane pilot study report was being reviewed during the inspection and document review period of this FYR .

1,4-Dioxane concentrations within OU 1 Area 1 exceed the RSL; however, the RSL is a screening level rather than a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Modeling results show that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016) 1,4-Dioxane concentrations do not exceed the U.S. EPA health advisory for carcinogenic or non-carcinogenic effects anywhere within the plume.

PFAS concentrations exceed the U.S. EPA lifetime health advisory levels within OU 1 Area 1. However, Area 1 has an IC restricting against the use of groundwater so there is no excess risk or hazard associated with the presence of PFAS in site groundwater. One well in the LEPA contained a combined PFOA/PFOS concentration essentially equivalent to the health advisory level (MMEC, 2018b). There are no drinking water wells within a mile downgradient of the LEPA. Therefore, there are no issues with regard to PFAS at Area 1. With regards to the remainder of OU 1, a base-wide PA for PFAS contamination was under way and the preliminary draft PA report was being reviewed by the Navy and Marine Corps during the inspection and document review for this FYR. A SI is planned for areas requiring further investigation. The results of the PA/SI will be used to guide further investigations for PFAS contamination at MCAS Yuma. Work is ongoing and it is anticipated that the actions will be completed within 24 months, at which time a protectiveness determination of these emerging contaminants will be made.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU 2	Protective	Not applicable

Protectiveness Statement:
The implemented remedies at OU 2 are protective of human health and the environment.

ICs are in place to restrict exposure to contaminants in soil at CAOCs 1, 8A and 10 through MCAS Yuma Station Order 5090B. This order formally directed tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan (KTUA, 2007) and the Final LUCIP (NAVFAC SW, 2017b) into their existing land use planning and management programs.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
MRP Sites 4 and 6	Protective	Not applicable

Protectiveness Statement:
The implemented remedies at MRP Sites 4 and 6 are protective of human health and the environment.

ICs are in place to restrict exposure to contaminants in soil at MRP Sites 4 and 6 through MCAS Yuma Station Order 5090B. This order formally directed tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan (KTUA, 2007) and the Final LUCIP (NAVFAC SW, 2017b) into their existing land use planning and management programs.

1.0: INTRODUCTION

1.1 Purpose of the Five-Year Review

This report provides the results of the fourth Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year review (FYR) conducted for Operable Unit (OU) 1 at Marine Corps Air Station (MCAS) Yuma, Arizona, the fifth CERCLA FYR conducted for OU 2, and the first CERCLA FYR for Munitions Response Program (MRP) Sites 4 and 6 at MCAS Yuma, Arizona. This review was conducted in accordance with the U.S. Department of the Navy's (DON's) *Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews* (DON, 2011) and the U.S. Environmental Protection Agency (U.S. EPA) *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001). The purposes of this review are to: (1) evaluate the performance of the remedies implemented at OU 1, OU 2, and MRP Sites 4 and 6 to ensure that they remain protective of human health and the environment, and (2) recommend actions for improvement if the remedies have not performed as designed or no longer are effectively protective.

1.2 Authority for Conducting this Five-Year Review

The DON is preparing this FYR pursuant to CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA) and the National Oil and Hazardous Substances Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

U.S. EPA and the DON interpret this requirement further in the NCP, Title 40 *Code of Federal Regulations* (CFR) Section (§) 300.430(f)(4)(ii) (implemented by 42 *United States Code* [U.S.C.] § 9621[c]), which states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

1.3 Lead Agency Conducting the Five-Year Review

Consistent with Executive Order 12580, the Secretary of Defense is responsible for ensuring that FYRs are conducted at all qualifying Department of Defense (DoD) cleanup sites. The DON is the lead agency for conducting FYRs at Navy and Marine Corps installations. As such, the DON has conducted three and four FYRs of the remedial actions implemented at OU 1 and OU 2, respectively. This is the first FYR conducted for MRP Sites 4 and 6. This review was conducted in accordance with the following documents:

- *Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews* (DON, 2011).
- *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001). (This guidance document includes the report template used in preparing this FYR Report.)

This report documents the results of the review. For the purposes of completing this FYR, the DON tasked Battelle, under Delivery Order N4425518F4225 of Contract N44255-14-D-9013, to provide site analysis and document development.

1.4 Five-Year Review Characteristics

This FYR is a statutory review because:

- the remedies selected in the Record of Decision (ROD) for OU 1, OU 2, and MRP Site 4 and 6 do not result in site conditions being suitable for unlimited use and unrestricted exposure, and
- the RODs for OU 1, OU 2, and MRP Sites 4 and 6 were each signed after October 17, 1986, the effective date of the SARA.

This is the fourth FYR for OU 1, fifth FYR for OU 2, and the first FYR for MRP Sites 4 and 6 at MCAS Yuma. The triggering action for this review was the completion of the previous FYR dated June 2015 (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2015). The first FYR (OU 2 only) was completed on December 11, 2002 (NAVFAC SW, 2002b) and was triggered by the development of institutional controls (ICs) established in the OU 2 ROD, which was signed on December 2, 1997 (Uribe & Associates, 1997b). The second FYR (OU1 and OU 2) was completed in 2004. The second FYR was triggered by the start-up operations of the Remedial Action (RA) at OU 1; specifically, the startup of an air sparge/soil vapor extraction (AS/SVE) system. The AS/SVE system began operation on November 16, 1999 and represents the original triggering date of the OU 1 FYR schedule. The second FYR included a mid-sequence update to the first FYR and was included in the first FYR for OU 1 so that both OUs may be reviewed on the same FYR schedule (NAVFAC SW, 2004). Subsequent FYRs were completed in 2010 and 2015. This current FYR is a mid-sequence update to the 2015 FYR. This FYR is being conducted prior to 2020 to include MRP Sites 4 and 6 and to ensure completion of the FYR by its due date in 2020.

2.0: SITE CHRONOLOGY

This section summarizes the Installation Restoration Program (IRP) at MCAS Yuma with emphasis on the history of contaminant characterization and remediation events at OU 1, OU 2, and MRP Sites 4 and 6. Table 2-1 presents these events in chronological order. Appendix A presents the list of all documents reviewed during this FYR.

Table 2-1. Chronology of Significant Events

Event	Date
Initial Assessment Study was conducted to investigate past disposal practices at MCAS Yuma (Stearns, Conrad, Schmidt and Landau Associates, 1985a).	1985
MCAS Yuma was placed on Superfund National Priorities List (NPL).	February 1990
Site inspection was completed at MCAS Yuma (Malcolm Pirnie, Inc., 1990).	June 1990
The DON entered into a Federal Facilities Agreement (FFA) with U.S. EPA and Arizona Department of Environmental Quality (ADEQ). OUs were established, along with a schedule and framework for implementing environmental investigations and appropriate cleanup activities.	January 1992
Remedial Investigations (RI) identified six groundwater plumes as contamination areas for OU 1 (Jacobs Engineering Group [JEG], 1996b) and 18 CERCLA Areas of Concern (CAOCs) in near-surface soils (JEG, 1996a) of which 12 required no further action (NFA) for OU 2.	March 1996
Source Treatment/Reduction Alternatives Plan (STRAP) to address contamination in the Leading Edge Plume Area (LEPA) and Building 230 (Hot Spot) Area (JEG, 1996c).	April 1996
A soil sampling program for polycyclic aromatic hydrocarbons (PAHs) was performed at CAOC 10 (Uribe & Associates, 1996a) to better define the extent of the contaminants reported in surface soil during the RI.	August 1996
Feasibility Study (FS) of OU 2 (Uribe & Associates, 1996b) recommended RA for CAOCs 1, 4, 7, 8A, 9 and 10.	December 1996
Supplemental soil sampling program for PAHs was completed at CAOC 10 (Uribe & Associates, 1997a).	February 1997
Proposed Plan issued for OU 2.	March 1997
Final ROD for OU 2 signed with ICs selected as the RA for CAOCs 1, 8A and 10 (Uribe & Associates, 1997b).	December 1997
The OU 1 FS identified and evaluated remediation options for the six groundwater areas (JEG, 1998a). Areas 4 and 5 were determined to be fuel release sites and were addressed under ADEQ's leaking underground storage tank (LUST) program. Areas 4 and 5 have received NFA status and are not discussed further since they were not addressed by CERCLA.	July 1998
Draft ROD prepared finalizing RAs and allowing construction and operation of remedial systems for OU 1 (JEG, 1998b).	September 1998
Full-scale AS/SVE system installed in the Building 230 part of OU 1 Area 1.	June to November 1999
Land survey conducted at OU 2 CAOCs 1, 8A and 10 for implementation of ICs.	July 1999
Final RA Report for OU 2 issued with recommended addendum to the MCAS Yuma Base Master Plan containing ICs and Voluntary Environmental Mitigation Use Restrictions (VEMURs) for CAOCs 1, 8A, and 10. CAOCs 4, 7, and 9 required NFA following the RA (GEOFON, 1999).	September 1999
Full-scale AS/SVE system operation started in the Building 230 part of OU 1 Area 1.	November 1999
Full-scale vertical circulation treatment (VCT) system installed in the LEPA of OU 1 Area 1.	February to June 2000
Full-scale VCT operations started in the LEPA of OU 1 Area 1.	June 2000

Table 2-1 (continued). Chronology of Significant Events

Event	Date
Arizona Laws 2000, Chapter 225 amended *Arizona Revised Statutes* § 49-152 (Title 49, Chapter 1, Article 4) to eliminate VEMURs and replace them with Declarations of Environmental Use Restrictions (DEURs) as the appropriate document for recording a property's environmental land use restrictions with the state of Arizona. The DEURs require the recording of ICs as covenants running with the land, which is not allowed by the federal government. Therefore, the DEURs could not be recorded.	July 2000
Temporary AS/SVE systems installed in OU 1 Areas 2 and 3.	September 2000
Final OU 1 ROD signed by DON, U.S. EPA, and ADEQ (NAVFAC SW, 2000).	October 2000
MCAS Yuma Master Plan revised to include land use restrictions and recording of environmental-use restrictions required in ICs for OU 1 and OU 2 (Kawasaki, Theilacker, Ueno and Associates [KTUA], 2001).	September 2001
Draft (Revision 1) Land Use Control Implementation Plan (LUCIP) was issued as an addendum to the MCAS Yuma Master Plan to provide additional ICs and steps for implementation and monitoring for OUs 1 and 2, Federal Facilities Agreement Assessment Program (FFAAP) Area of Concern A, and conditions for closure of Former Underground Storage Tanks (USTs) at the Former Exchange Gas Station.	December 2001
MCAS Yuma Station Order 5090A provided for the implementation of land-use controls (LUCs) provided in draft LUCIP.	January 2002
Work Plan for Long-Term Monitoring (LTM) at OU 1 completed (Bechtel National, Inc. [BNI], 2002).	June 2002
Final Land Use Implementation Plan for MCAS Yuma OU 1 and OU 2 finalized, detailing ICs and monitoring (NAVFAC SW, 2002a). The report formalizes the MCAS Yuma LUC agreement among DON, U.S. EPA, and ADEQ.	September 2002
First FYR completed for OU 2 (NAVFAC SW, 2002b).	December 2002
OU 1 VCT system at Area 1 LEPA placed in temporary shutdown with concurrence from U.S. EPA and ADEQ.	May 2003
OU 1 Area 6 received NFA closure from U.S. EPA and ADEQ.	November 2003
OU 1 Area 6 wells decommissioned.	March 2004
The second FYR was completed. This FYR included an update so that both OU 1 and OU 2 could be included together and placed on the same FYR schedule (NAVFAC SW, 2004).	November 2004
OU 1 VCT system at Area 1 LEPA placed in permanent shutdown with concurrence from U.S. EPA and ADEQ.	December 2005
OU 1 Area 3 received NFA closure from U.S. EPA and ADEQ.	February 2006
OU 1 Area 2 received NFA closure from U.S. EPA and ADEQ.	May 2006
OU 1 Area 2 wells decommissioned.	August 2006
OU 1 Area 3 wells decommissioned.	October 2006
OU 1 AS/SVE system at the Building 230 "Hot-Spot" placed in temporary shutdown with concurrence from U.S. EPA and ADEQ.	May 2007
OU 1 Area 1, 37 selected Area 1 wells decommissioned.	September 2007
The MCAS Yuma Master Plan was updated to include ICs for OU 2 sites as identified in the ROD.	November 2007
The third FYR was completed for both OU 1 and OU 2 (NAVFAC SW, 2010). The review covered November 16, 2004 to November 16, 2009.	June 2010
Final SI Report Munitions Response Sites 1, 2, 3, 4, 5, and 6 was completed.	May 2011

Table 2-1 (continued). Chronology of Significant Events

Event	Date
Full-scale VCT operations restarted in the LEPA of OU 1 Area 1.	July 2011
Quarterly 1,4-dioxane sampling initiated at OU 1.	January 2012
A data gap investigation and human health risk assessment (HHRA) for OU 1 Areas 1 and 3 and for OU 2 CAOCs 1, 8A, 8B, and 10 showed that noncancer hazards and cancer risks were below *de minimis* levels for all subject areas. For soil, the remedies in place were found to remain protective and remediation of soil at OU 2 CAOCs 8A and 8B was not required. For soil gas, the remedies in place were found to remain protective and remediation of soil gas at OU 1 Areas 1 and 3 and OU 2 CAOCs 1, 8A, 8B, and 10 was not required (Sealaska, 2013).	August 2012
Full-scale AS/SVE system operation restarted in the Building 230 part of OU 1 Area 1, with a scheduled operational duration of 6 months.	July 2013
Final FS Report, MRP Site 4, evaluated no action and ICs as two remedial alternatives for MRP Site 4.	September 2013
Final FS Report, MRP Site 6, evaluated no action and LUCs as two remedial alternatives for MRP Site 6.	December 2013
The AS/SVE system at the OU 1 Building 230 "Hot-Spot" area was placed in temporary shutdown after 6 months of scheduled operations. Results of operation showed that the system reached asymptotic conditions again.	January 2014
Proposed Plan issued for MRP Site 4.	March 2014
Proposed Plan issued for MRP Site 6.	March 2014
Soil Background Characterization Report prepared to characterize background distributions of metals and anthropogenic background distributions of PAHs in soil at MCAS Yuma.	April 2014
MCAS Yuma Station Order 5090A was updated by Station Order 5090B (Appendix B1), which reiterates the requirement to implement LUCs at environmental areas of concern.	May 2014
An Explanation of Significant Differences (ESD) to the Final ROD for OU 2 removed the VEMUR (now DEUR) submittal requirements (NAVFAC SW, 2014c). The VEMUR submittal requirement was removed because VEMURs were subsequently replaced by DEURs, which require recording LUCs as covenants running with the land. Recording covenants as running with the land is not allowed by the federal government. Therefore, the DEURs could not be recorded.	August 2014
The final LUCIP for MCAS Yuma OU 1 and OU 2 was updated, outlining the removal of the VEMUR (now DEUR) submittal requirements and correcting several figures (NAVFAC SW, 2014b).	September 2014
Based on the results of 1,4-dioxane concentrations found in OU 1 Area 1 groundwater in January/February 2012, a groundwater investigation was recommended at OU 1 Area 1 to (1) further delineate the lateral and vertical extent of 1,4 dioxane; (2) provide additional data to support the development of a groundwater fate and transport model to assess the potential for off-site migration of 1,4 dioxane; and (3) evaluate the potential human health risk associated with 1,4 dioxane. Volatile organic compounds (VOCs) are included in this investigation to provide a complete and current assessment of site characteristics (Trevet, Inc., 2014a).	November 2014
The third FYR for OU 1 and fourth FYR for OU 2 was completed (NAVFAC SW, 2015). The review covered November 16, 2009 to November 17, 2014.	June 2015
Record of Decision for MRP Sites 4 and 6 signed by DON, U.S. EPA, and ADEQ (NAVFAC SW, 2017a).	May 2017
Conducted: 1) an in situ chemical oxidation (ISCO) injection pilot study at OU 1 Area 1 to treat 1,4-dioxane and evaluate the effects of ISCO on PFAS mobilization; and 2) a pilot study of the Ambersorb technology to provide containment and treatment of 1,4-dioxane at the base boundary (Multimedia Environmental Compliance Group [MMEC Group], 2018b).	June 2017
Updated Land Use Implementation Plan for MCAS Yuma OU 1, OU 2, and MRP Sites 4 and 6 was finalized, detailing ICs and monitoring. The report formalizes the MCAS Yuma LUC agreement among DON, U.S. EPA, and ADEQ and adds additional sites to the 2002 version of the LUCIP (NAVFAC SW, 2017b).	October 2017

3.0: BACKGROUND

This section describes the fundamental aspects of the MCAS, providing a description of site characteristics. The purpose of this section is to identify the threat posed to the public and environment identified at the time of signing of the OU 1 ROD (NAVFAC SW, 2000), OU 2 ROD (Uribe & Associates, 1997b), and MRP Sites 4 and 6 ROD (NAVFAC SW, 2017a) so that the performance of the remedies can be easily compared with the site conditions that the remedies were intended to address. Information provided in the RODs regarding station history and site history have been updated in this section using information provided in recent RA Reports, Semi-Annual Groundwater Monitoring Reports, OU 1 Area 1 Pilot Study (MMEC Group, 2018a), OU 2 ESD (NAVFAC SW, 2014c), the Final LUCIP (NAVFAC SW, 2017b), the revised Master Plan (KTUA, 2007), and previous FYRs (NAVFAC SW, 2010; NAVFAC SW, 2015).

3.1 Station History

On February 21, 1928, Yuma County, Arizona, leased 640 acres of desert land near the city of Yuma from the federal government for use as an airfield. The airfield was established in the same year. Through the United States Bureau of Reclamation (USBR), Yuma County leased the acreage for 20 years with an option for an additional 20 years. In 1937, Yuma County constructed a small aircraft hangar and runway.

From l941 to 1946, the U.S. Army Air Corps leased the facility for pilot and bomber crew training. During this period, the facility was one of the busiest flight schools in the Army Air Corps. Flight activity ceased with the end of World War II, and the area was returned to the control of the USBR. In 1948, Yuma County obtained rights from the USBR to use the airfield, pursuant to Section l6 of the Federal Airport Act.

On July 7, 1951, the U.S. Air Force reactivated the site as a weapons proficiency center for fighter-interceptor units, and the site was declared a permanent Air Force installation in 1954. The Air Force reestablished joint use of the airfield with Yuma County in 1956.

In January 1959, the site and its associated range facilities were transferred to the DON. MCAS Yuma was then established on January 10, 1959 to maintain and operate the facilities and provide services and materials to support operations of the Marine Aircraft Wing and its subordinate units.

Since 1959, major improvements have included construction of a 13,300-foot-runway, development of the Instrumented Special Weapons System, and addition of a Tactical Aircrew Combat Training System. MCAS Yuma currently operates the airport facility as a joint military/civilian airport with the Yuma County Airport Authority.

3.2 Physical Characteristics

MCAS Yuma consists of approximately 4,800 acres located in the city and county of Yuma, Arizona (Figure 3-1). The station resides at an average elevation of 180 feet above mean sea

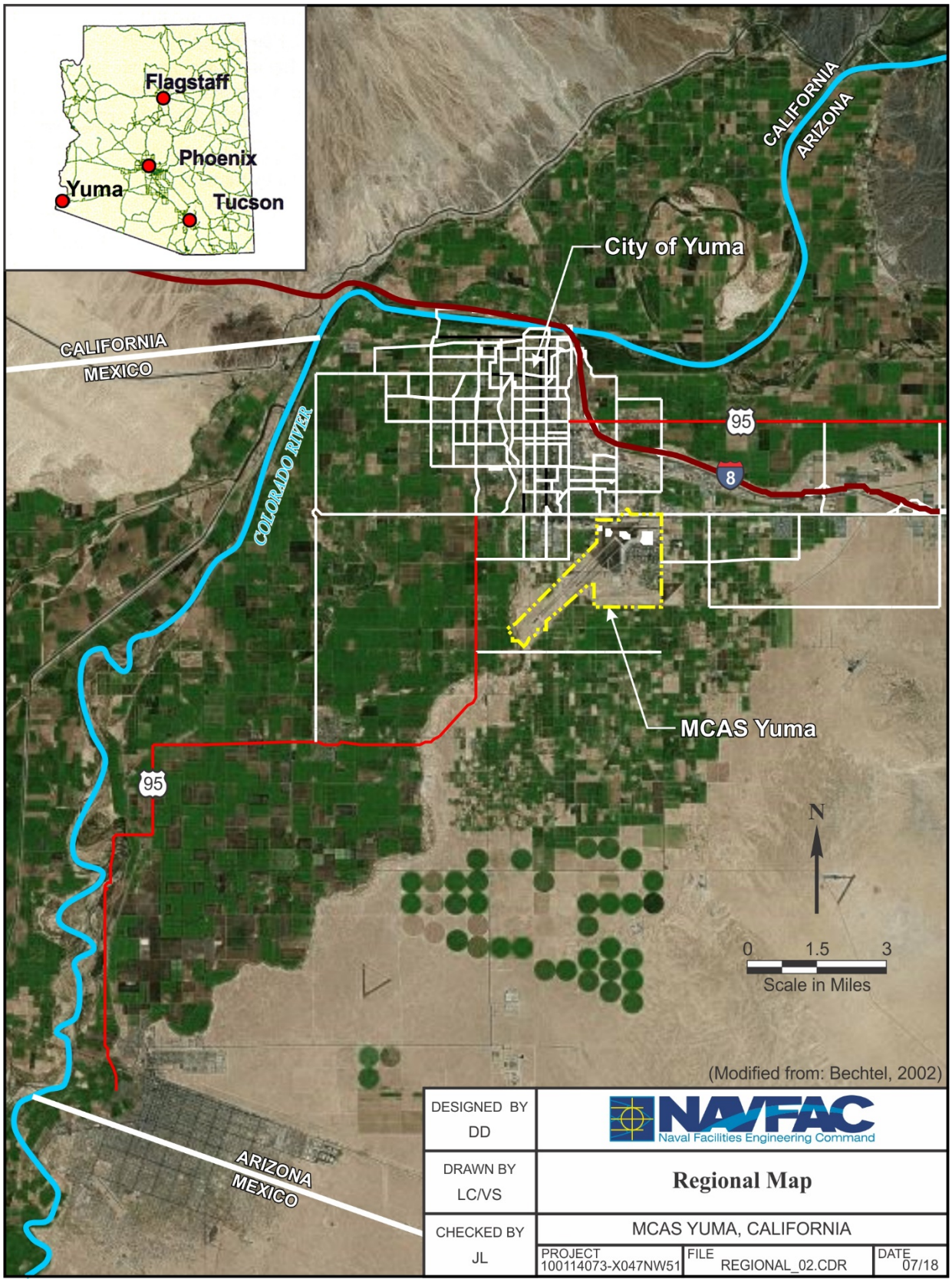

Figure 3-1. Regional Map

level (amsl), on the northern portion of Yuma Mesa, and is approximately 60 to 70 feet above and 4 miles east of the Colorado River. Yuma Mesa is separated from the Colorado River Valley by a north-trending bluff approximately 5 miles west of the MCAS. The climate is arid, and the land type is desert. The following subsections describe the regional and local geology and hydrogeology associated with the facility.

3.2.1 Geology. Sedimentary deposits on Yuma Mesa are predominantly alluvial (stream) deposits interbedded with some aeolian (windblown) deposits in the upper 180 to 200 feet below ground surface (bgs). Most of the interbedded deposits consist of alluvium from Colorado River deposition that has been reworked by local ephemeral streams and sheetflow. The alluvium is highly variable and ranges in grain size from silt and fine sand up to very coarse gravel.

Locally at MCAS Yuma, silt and clay deposits form small discontinuous lenses that retard the vertical migration of groundwater. The primary stratigraphic units underlying the MCAS are "younger alluvium" including minor aeolian sand and "older alluvium." The bottom of the older alluvium may extend more than 2,000 feet bgs in some areas. These alluvial units appear to directly overlie pre-Tertiary bedrock.

Granitic bedrock crops out in the Yuma area as a series of north- to northwest-trending low hills known as the "Yuma Hills." The bedrock outcrops on and adjacent to the station indicate that relatively shallow bedrock zones exist in this region.

According to the Yuma Soil Conservation Service (U.S. Department of Agriculture [USDA], 1980), the principal soil type occurring at MCAS Yuma is Superstition Sand. This soil is deep and somewhat excessively drained with low to moderate available water capacity.

3.2.2 Hydrogeology. The principal stratigraphic units containing groundwater usable for agricultural and domestic applications are the alluvial deposits. These unconsolidated deposits are divided into (1) the upper fine-grained zone, (2) the coarse gravel zone, and (3) the wedge zone (Olmsted et al., 1973).

The upper, fine-grained zone includes the vadose zone and shallow groundwater and extends approximately 180 to more than 200 feet bgs. This zone comprises the majority of the younger alluvial stratigraphic unit and may include the upper portion of the older alluvium. The upper fine-grained zone represents alluvial and, to a lesser degree, aeolian deposits. It consists of sand and silt with interbeds of sandy clay and sandy gravel.

Water quality in the upper fine-grained zone is highly variable, probably as a result of the relatively shallow depth to water (40 to 80 feet) and the presence of irrigated agriculture in the area. Groundwater is generally unconfined in the upper fine-grained zone over much of Yuma Mesa. However, locally confined conditions associated with fine-grained lenses have been reported (Olmsted et al., 1973). Figure 3-2 shows groundwater elevations and interpreted flow direction in the upper fine-grained zone across OU 1 at MCAS Yuma using data from the November 2017 groundwater monitoring event (MMEC Group, 2018b).

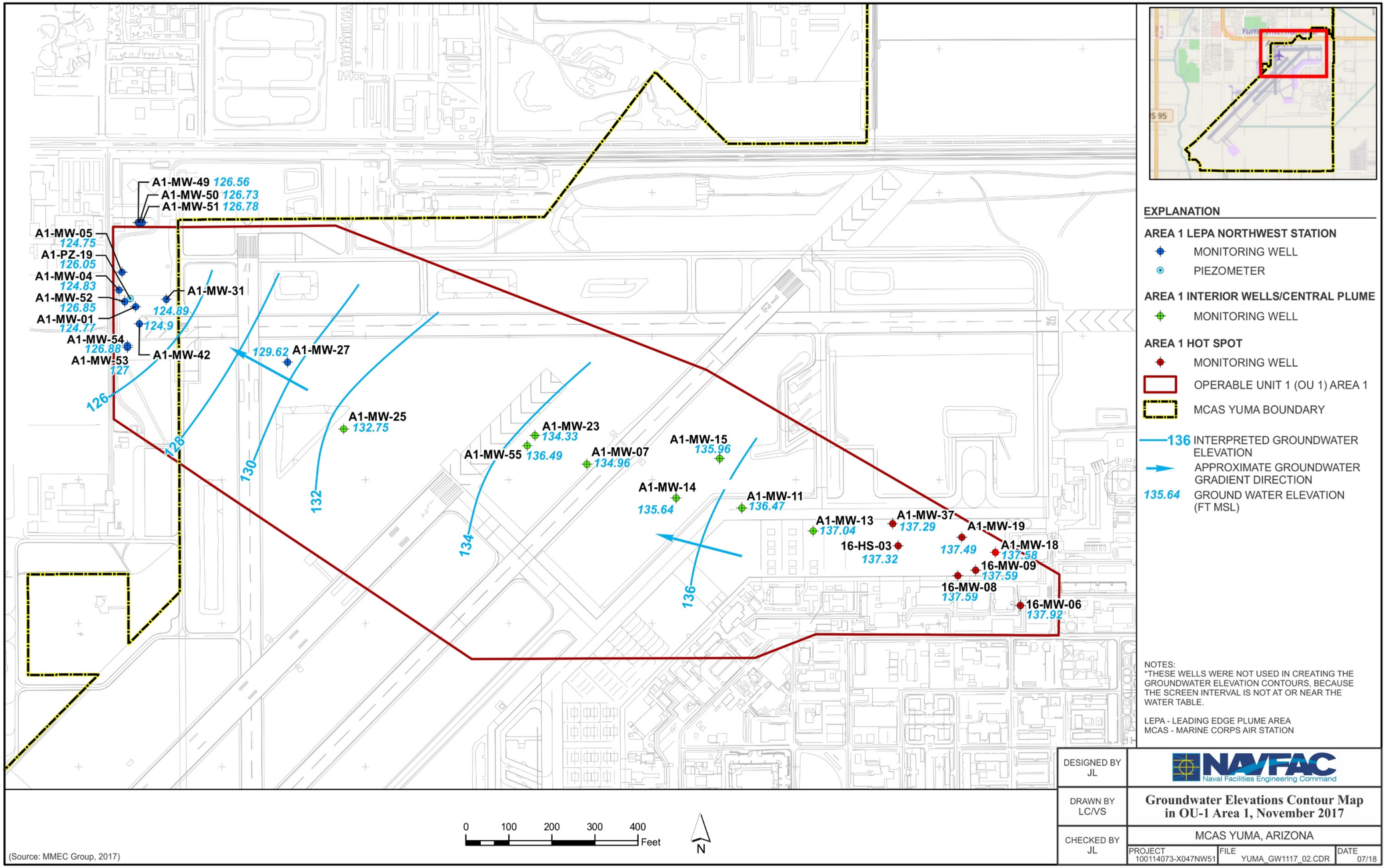

Figure 3-2. Groundwater Contour Map from the November 2017 Sampling Event

Underlying the upper fine-grained zone is the coarse gravel zone, which includes the basal gravel of the younger alluvium and the upper coarse gravel of the older alluvium. In addition to gravel, the coarse gravel zone contains interbeds of sand and fine-grained lithologies. The coarse gravel zone is the most permeable groundwater reservoir in the Yuma area and provides the primary groundwater supply source. The top of this zone is approximately 180 to more than 200 feet bgs, and it ranges in thickness from 0 to 100 feet. Water in this zone is saline (Olmsted et al., 1973).

The wedge zone underlies the coarse gravel zone and makes up most of the older alluvium stratigraphic unit. This zone may extend to 2,000 feet bgs. Lithologies in the wedge zone range from gravel to clay with generally coarser lithologies in the upper portion (Olmsted et al., 1973). The wedge zone contains water that is generally fresher than the water in the overlying coarse gravel zone (Olmsted et al., 1973).

3.3 Land and Resource Use

MCAS Yuma is comprised of 14 land use categories that are defined by specific uses or combinations of uses occurring in these areas, including: air operations, aircraft maintenance, training, general maintenance, weapons, supply, public safety, administration, medical/dental, bachelor quarters, family housing, community support, recreation and communications/utilities. The following is a brief description of each as provided by the MCAS Yuma Master Plan (KTUA, 2007):

Air Operations
Air operations include the airfield, taxiways, tow-ways, parking aprons, flight equipment testing facilities, and air operations logistical facilities.

Aircraft Maintenance
Aircraft maintenance includes facilities generally located along the flight line, such as hangars, wash racks, engine test cells, and aircraft parts repair shops.

Training
Training facilities include classrooms, lecture halls, educational workspaces/shops, and potentially specialized trainers and simulators.

General Maintenance
General maintenance includes facilities that provide varying levels of service to ground-based equipment and vehicles.

Weapons
Weapons facilities include a wide array of types, from the expansive area of the Combat Aircraft Loading Apron (CALA) to the confined area of an armory storeroom.

Supply
Supply refers primarily to warehouse-type facilities and storage lots that serve as staging areas for materials either being redistributed elsewhere on base or awaiting use by a particular unit. The supply land use also includes fueling storage and dispensing facilities.

Public Safety
Public safety facilities are used for the protection of physical assets and maintenance of order on an installation (e.g., police stations, fire stations, etc.).

Administration
Administration includes the facilities primarily composed of office spaces and other related functions to support all levels of command.

Medical/Dental
The medical/dental facilities are those designated for medical and dental services.

Bachelor Quarters
The bachelor quarters is almost entirely housing related, characterized by all types of barracks and the facilities that support them.

Family Housing
Family housing is comprised of on-base neighborhoods, including apartment-style and single family attached and detached homes.

Community Support
Community support facilities are those used by the base as a whole (e.g., library, exchange, recreation buildings, etc.).

Recreation
Recreational facilities may be considered a subset of the community support facilities, although they are usually characterized by outdoor facilities (e.g., playing courts, fields, parks, etc.)

Communications/Utilities
Communication and utilities facilities are used for the operation or oversight of the station's communications and utilities infrastructure (e.g., office space, equipment monitoring buildings, and the physical infrastructure).

Resource uses such as electrical, natural gas and water are operated and maintained by the Installation and Logistics Department. The following is a brief description of the source(s) and distribution of each resource as provided by the MCAS Yuma Master Plan (KTUA, 2007):

Electrical
Electricity is provided by Arizona Public Service and Western Area Power Administration and is fed to the MCAS Yuma substation located near the centrally located MCAS Yuma water tower. Five overhead circuits distribute the power to various station components.

Natural Gas

Natural gas is purchased through the Defense Fuel Support Contract Program, which allows the station to competitively purchase gas from various suppliers at reduced rates. Gas is metered near the station boundary, south of the Main Gate, and is delivered by Southwest Gas Corporation lines to the station distribution system.

Water

Surface water is obtained from the USBR, which transports surface water from the Colorado River to the station via canals maintained by the Yuma Mesa Irrigation and Drainage District. Surface water is taken from a branch canal at the eastern boundary of the station and transported to the station's water treatment facility.

Groundwater is obtained through one on-base production well located at the water treatment facility. A new well was installed in February 2008, adjacent to an old production well that had been failing and is now used as a back-up well. Both wells are upgradient from the known groundwater contamination of the station. The water produced from the well is analyzed for VOCs and other potential contaminants in accordance with ADEQ requirements. The new well is currently producing approximately 650,000 gallons per day and the water produced is run through the water treatment facility where it is blended with surface water prior to station distribution (Shepherd, 2010).

The nearest downgradient domestic well is approximately 0.8 mile from the MCAS Yuma boundary. The well (screened from 200 to 300 feet bgs) is registered with the Arizona Department of Water Resources (ADWR) under registration number 55-649396 and is located approximately 0.8 mile from the northwestern corner of the MCAS Yuma boundary (at the northern edge of the Yuma Golf and Country Club) and is downgradient of the LEPA of OU 1 Area 1. The well was installed in 1972, over 45 years ago, and the house on the property has since been connected to city water. There are no other permitted municipal or domestic wells within approximately 1 mile of OU 1 Area 1 that have the potential to be impacted by the OU 1 Area 1 groundwater plume (MMEC, 2018a).

The water treatment facility has three settling basins which have a total capacity of 7.5 million gallons of water. Water is processed via rapid sand filtration, clarification and disinfection with chlorine. Five electric pumps, with a total capacity of 6,500 gallons per minute (gpm), pump processed water into two elevated water storage tanks. The two tanks have a capacity of 500,000 gallons each. Water is distributed from the storage tanks through the station's water distribution network comprised of 6- to 16-inch-diameter pipes.

3.4 History of Contamination

During its approximately 80 years of operation, MCAS Yuma has generated industrial wastes such as used oil, fuels, solvents, paint residues, battery acid, pesticides, herbicides, and polychlorinated biphenyls (PCBs). In the early years, some of these wastes were disposed in landfills, burn pits, and other areas located throughout the facility. Construction and improvement activities also generated debris, which was disposed in undeveloped portions of the MCAS.

It is believed that chlorinated hydrocarbons (CHCs) were previously occasionally spilled on the ground surface during routine aircraft maintenance. It is also possible that tanks or drums of CHC solvents may have leaked onto the surface or into the subsurface. CHCs could then have migrated into the groundwater through infiltration and percolation.

Several training ranges were located at MCAS Yuma which have been closed. Possible munitions constituents (MC)- and munitions and explosives of concern (MEC)-contaminated soil may exist at these former range areas. The training facilities at MCAS Yuma included small arms ranges (MRP Sites 1, 2, and 4) and two firing-in butt ranges used to zero-in fixed aircraft guns (MRP Sites 5 and 6).

3.5 Initial Response

In 1985, the DON began evaluating its installations under the IRP (DON, 1992). Several studies were conducted at MCAS Yuma, including an Initial Assessment Study (Stearns, Conrad, Schmidt and Landau Associates, 1985a); the former Marine Wing Weapon Unit Site Characterization (Stearns, Conrad, Schmidt and Landau Associates, 1985b); a Confirmation Study, Verification Phase (Malcolm Pirnie, 1988); and a SI (Malcolm Pirnie, 1990). These early studies found the presence of various contaminants in soil and chlorinated solvents in groundwater underlying the MCAS, which led to its inclusion on U.S. EPA's NPL, or Superfund list, on February 21, 1990.

In 1990, following listing on the NPL, the DON entered into an FFA with U.S. EPA and ADEQ to establish a framework and schedule for implementing environmental investigations and appropriate cleanup actions. The Final FFA was signed in January 1992. The FFA team agreed to subdivide MCAS Yuma into three OUs (i.e., OU 1, 2, and 3). Areas with potential groundwater and soil contamination deeper than 10 feet bgs were designated as OU 1. OU 2 was designated for 18 CAOCs, titled CAOC 1 through CAOC 18, containing potential soil contamination shallower than 10 feet bgs. OU 3 was designated for sites that may be identified in the future, designated FFA Assessment Program sites. MRP Sites 1, 2, 3, 4, 5, and 6 were subsequently identified. The previous FYR discussed these sites as being in OU 3; however, the FFA was not formally amended to include the MRP sites in an OU.

A site investigation was performed for each OU. An RI was conducted at OU 1 to determine areas of groundwater contamination that required either evaluation of remedial action or NFA, as well as to assess the potential impacts of the contamination on human health and the environment (JEG, 1996b). An RI conducted for OU 2 investigated areas of soil contamination that required either evaluation of remedial action or NFA and included human health and ecological risk assessments to assess the potential impacts of the hazardous substances reported on both potential human and environmental receptors (JEG, 1996a).

MRP Sites 1, 2, 4, 5, and 6 were evaluated in a SI (Alliance Compliance, 2011). Based upon the results of the SI report, MRP Site 1 was subsequently evaluated in an RI (Pika-Pirnie, 2014). MRP Site 1 was split into MRP Site 1A and 1B. A time critical removal action (TCRA) was conducted at MRP Site 1B and that site received a finding of NFA. A non-time critical removal action (NTCRA) was planned at MRP Site 1A during the review process for this FYR. MRP Site 2 was evaluated in an Expanded SI (Pika-Pirnie, 2015) and received NFA after the Expanded SI.

MRP Site 5 was evaluated in an RI (Trevet, 2014b) and additional RI (Tetra Tech, 2017). MRP Sites 4 and 6 were addressed in a ROD (NAVFAC SW, 2017a). The remedial alternative implemented for both sites is ICs. MRP Site 3 was remediated in 2003 through the ADEQ Voluntary Remediation Program and received a finding of NFA.

3.6 Basis for Taking Action

The following subsections present a discussion of the RI findings and subsequent investigations performed for OU 1, OU 2, and MRP Sites 4 and 6, which provide the basis for taking action at each area.

3.6.1 Operable Unit 1. Based on the results of the OU l RI (JEG, 1996b), six areas of groundwater contamination were identified that exceeded maximum contaminant levels (MCLs) for drinking water established by the U.S. EPA. Four of the plume areas (Areas 1, 2, 3, and 6) that had CHC contamination were assigned to the DON's IRP under the CERCLA cleanup program. The two other areas of groundwater contamination, primarily containing fuel constituents, were assigned to the state of Arizona's LUST Program. These non-CERCLA areas were located in the Fuel Farm (Area 4) and the Motor Transportation Pool (Area 5) (BNI, 2002). After the RI, fuel constituents exceeding MCLs were identified at the Exchange Service Station (Subarea 5A), which was also investigated under the LUST Program (BNI, 2002). Because Areas 4 and 5 and Subarea 5A were part of the LUST Program and not associated with CERCLA, their inclusion in this FYR is not required. Therefore, these areas are not further discussed. Figure 3-3 shows the locations of OU 1 Areas 1, 2, 3, and 6 within MCAS Yuma and other general site characteristics (i.e., roads, fence lines, and buildings).

The OU 1 STRAP was conducted under the DON RA contract to evaluate the use of innovative in situ groundwater treatment technologies (JEG, 1996c). Based on the OU 1 RI (JEG, 1996b) and STRAP findings, remedial alternatives were evaluated for the CHC plumes in Areas 1, 2, 3, and 6 in the OU 1 FS (JEG, 1998a). In September 1998, a draft ROD for OU 1 was prepared, which documented the RA plan for OU 1, including selected and contingent RAs for groundwater impacted by CHCs (JEG, 1998b). In addition, the nature and extent of the CHC groundwater plumes were further investigated in several sampling phases (OHM Remediation Services Corp., 1996-1997; GEOFON, 2002).

The contaminants of concern (COCs) identified in the ROD for the OU 1 CHC groundwater plumes consisted of 1,1-dichloroethene (DCE), trichloroethene (TCE), and tetrachloroethene (PCE). These chemicals were present at levels exceeding U.S. EPA MCLs for drinking water (i.e., 7 µg/L for 1,1-DCE, 5 µg/L for TCE, and 5 µg/L for PCE). The following text provides detailed information regarding the location, source and extent of CHC contamination in OU 1 Area 1. Areas 2, 3 and 6 received NFA status prior to completion of the third FYR and are not discussed further in this document.

Area 1 Groundwater Plume. OU 1 Area 1 has been the largest CHC-contaminated groundwater plume, underlying an area of approximately 60 acres, and extending from the Building 230 area to the northwest station boundary (Figure 3-3). For reporting purposes, the plume is described by "region" based upon contaminant concentrations: the "Hot Spot" region of the Area 1 plume near Building 230; the interior/central area of the Area 1 plume near the northeast portion of the

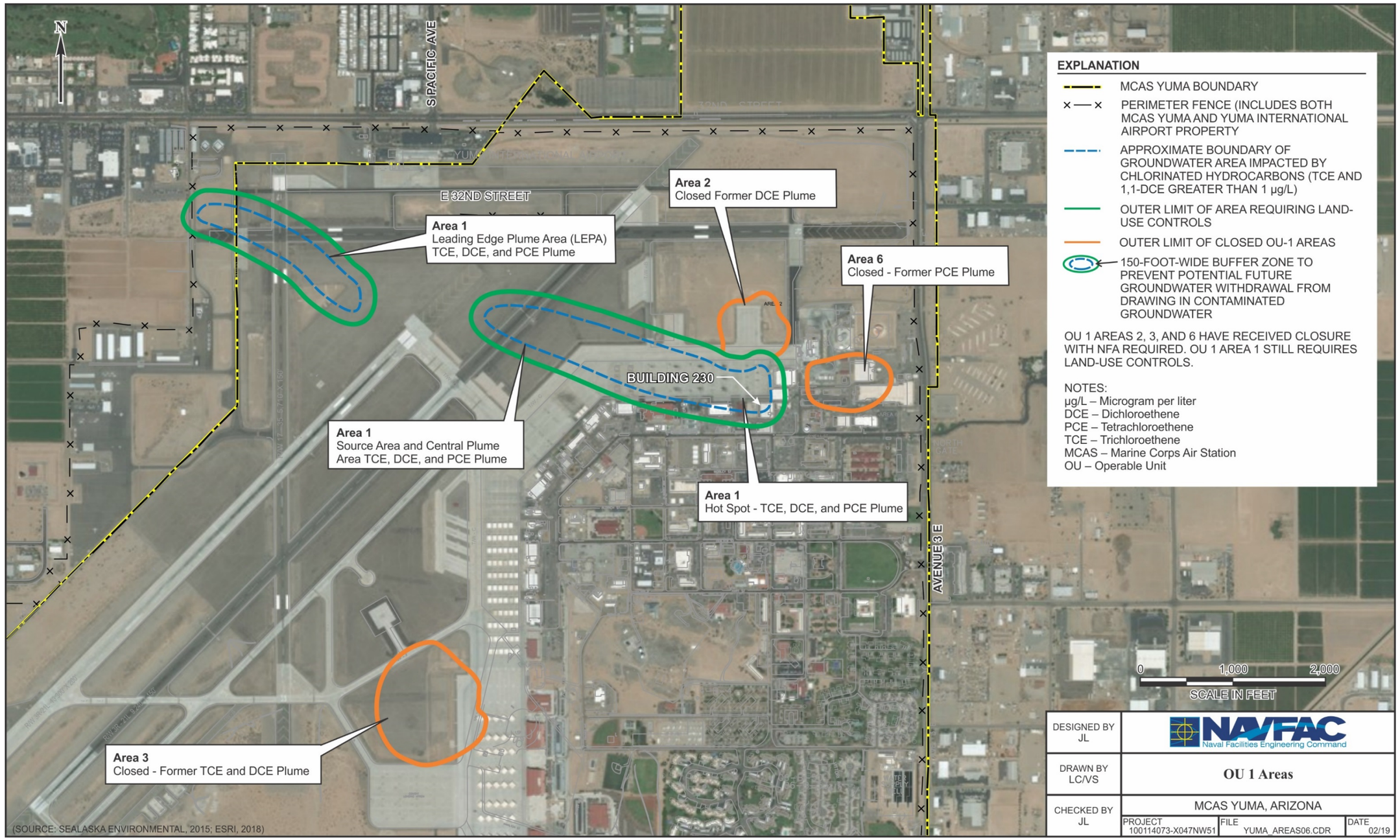

Figure 3-3. Location Map of OU 1 Areas

runway; and the LEPA near the northwest boundary of the station (Figure 3-3). The Hot Spot is the source of the Area 1 plume. The highest COC concentrations are detected in this region of the Area 1 plume, with CHC concentrations historically detected at greater than 200 µg/L.

Two USTs were removed from the vicinity of the building, and the surrounding area has been paved. TCE was detected in soils beneath one of the USTs, which collected discharges from the floor drain of the Building 230 paint shop. Four dry wells, located within 200 feet of the building, were also identified and likely collected water from the vicinity of the building, allowing the water to infiltrate into soil and potentially into groundwater. Although there is no conclusive evidence regarding the source of the Area 1 CHC plume, it appears to be related to activities associated with Building 230. After the RI, results of passive and active soil-gas and vadose zone sampling suggested that there was no remaining source of CHCs in the vadose zone of the Building 230 area (NAVFAC SW, 2000).

The Area 1 plume is limited to the upper portion of the unconfined aquifer; however, the plume appears to have a slight downward gradient from the Building 230 Hot Spot towards the LEPA (NAVFAC SW, 2000). Based on groundwater sampling performed between 1998 and 1999, the extent of the Hot Spot was approximately 1,000 feet long by 400 feet wide. The maximum concentrations of TCE and PCE decreased during this time as well (NAVFAC SW, 2000).

The subsurface lithology in the source area is relatively heterogeneous with sediment sizes including silts, fine to coarse sands, and gravels. Lithologic logging in the vicinity of Building 230 encountered several discontinuous clay lenses of a few inches up to 5 feet thick, which began approximately 30 feet bgs and were observed above and below the groundwater table (NAVFAC SW, 2000). The presence of these clay lenses may serve to limit vertical migration of contaminants in this area.

Additional groundwater sampling at the LEPA indicated concentrations of CHCs exceeding MCLs present to depths up to 180 feet bgs. Following the RI, CHCs were identified in groundwater beyond the western boundary of MCAS Yuma beneath property controlled by the Yuma Airport Authority. In September 1999, the horizontal and vertical extent of TCE- and DCE-impacted groundwater in the deep aquifer (30 to 190 feet below the groundwater table) had been fully delineated (OHM Remediation Services Corp., 1999a).

All of the chemicals identified in Area 1 during the RI and subsequent investigations prior to the ROD that exceeded their respective background levels (except for: metals considered essential human nutrients; non-site-related metals within naturally occurring background levels; and trihalomethanes historically detected in groundwater throughout the Yuma area) were evaluated as contaminants of potential concern (COPCs) in the HHRA. Table 3-1 lists the COPCs that exceeded MCLs and were major risk contributors in Area 1. The Area 1 risk assessment results for cancer (excess lifetime cancer risk [ELCR]) and noncancer (hazard index [HI]) were as follows:

- Residential exposure scenario based on 1995 OU 1 RI data (JEG, 1996b)
  - ELCR: 4.72×10^{-3}
  - Cancer risk driver(s): 1,1-DCE (93.2% of risk) and TCE (6.4% of risk)

- HI: 15.9
- Noncancer hazard driver(s): 1,1-DCE (19.5% of hazard) and TCE (78.6% of hazard)

- Residential exposure scenario based on August 1999 data (NAVFAC SW, 2000)
  - ELCR: 1.75×10^{-3}
  - Cancer risk driver(s): 1,1-DCE (91.4% of risk) and TCE (8.6% of risk)
  - HI: 2.7
  - Noncancer hazard driver(s): 1,1-DCE (40.7% of hazard) and TCE (59.3% of hazard)

The cancer risk associated with groundwater exposure from Area 1 contamination, for the hypothetical residential scenario from both datasets, exceeded the generally accepted range (10^{-6} to 10^{-4}). The HI exceeded the acceptable criterion of 1.0 in both datasets as well (NAVFAC SW, 2000).

Table 3-1. OU 1 Area 1 Historical Maximum Detected Concentrations of COPCs

Area 1 COPC	Maximum Reported Conc.[1]	Federal Primary Drinking Water Standards (MCLs)	Federal Maximum Contaminant Level Goals (MCLGs)	Arizona MCLs for Organic Chemicals	Arizona Numeric Aquifer Water Quality Standards (AWQS)	Required Cleanup Conc.[2]	Major Human Health Risk	Major Human Health Hazard
1,1-DCE	170	7	7	7	7	7	yes	yes
TCE	450	5	0	5	5	5	yes	yes
PCE	16	5	0	5	5	5	no	no

Based on summary information presented in Table 2-6 of the OU 1 ROD (NAVFAC SW, 2000).
All concentrations in micrograms per liter (µg/L).
[1] Maximum reported concentrations were based on information from the OU 1 RI (JEG, 1996b).
[2] Required cleanup concentrations based on the most conservative standards at the time of the investigation (i.e., MCLs based on Federal Drinking Water Standards).

3.6.2 Operable Unit 2. Based on the results of the RI conducted across the 18 CAOCs of OU 2, the FFA team agreed that 12 of the CAOCs required NFA. The six remaining CAOCs (i.e., CAOCs 1, 4, 7, 8, 9, and 10) required remedial actions (JEG, 1996a). The results of the ecological risk assessment conducted as part of the RI (JEG, 1996a) indicated that chemicals detected in the soil and surface water did not pose a significant risk to ecological receptors at MCAS Yuma. Except for migratory birds that were observed in the air over MCAS Yuma, no state or federally listed threatened or endangered species were known to be present at the MCAS. No critical habitats or habitats of endangered species were found to be affected by contaminants of potential ecological concern (COPECs) at OU 2.

The RI was finalized in 1996, before issuance of the U.S. EPA's *Risk Assessment Guidance for Superfund* (RAGS) (U.S. EPA, 1998). U.S. EPA RAGS indicates the exposure concentration should be the arithmetic average of the concentration that is contacted over the exposure period

rather than the maximum concentration. This approach is recommended because in most situations, assumption of long-term contact with the maximum concentration is not reasonable. Because of the uncertainty associated with any estimate of exposure concentration, the U.S. EPA states that the 95% upper confidence limit of the arithmetic average should be used as the exposure concentration. The RI used maximum detected concentrations to calculate risk and hazard. This approach likely resulted in overestimation of potential risks and hazards.

The FS conducted for the remaining six CAOCs (Uribe & Associates, 1996b) focused on RA for CAOCs 4, 7, and 9, where surface disposal of asbestos-bearing waste was confirmed. The FS developed a remedial approach that minimized potential health threats and would allow unrestricted use of the sites. Remediation to residential land use standards was completed in 1999 for CAOCs 4, 7, and 9 (GEOFON, 1999), which subsequently required NFA. The OU 2 CAOCs that have achieved NFA status are not discussed further in this review.

A discussion of the remaining OU 2 CAOCs (i.e., CAOCs 1, 8A, and 10), including site description, history of contamination, response actions, and the basis for taking RA, is provided below. The COCs of the remaining OU 2 CAOCs are PAHs and PCBs and do not represent a source of contamination for any of the OU 1 areas. Figure 3-4 shows the locations of OU 2 CAOCs 1, 8A. and 10 within MCAS Yuma and other general site characteristics (i.e., roads, fence lines, and buildings).

3.6.2.1 CERCLA Area of Concern 1. CAOC 1 consists of the pre-1960 flight line (tarmac, runways, aprons, and taxiways) and associated aircraft-maintenance hangar facilities. This site is located within the footprint of the existing flight line in the north-central portion of MCAS Yuma and occupies approximately 170 acres (Figure 3-4). In the 1940s, used oil was routinely drained from aircraft engines directly to the ground surface on which the aircraft were parked. In the 1950s, 1960s, and 1970s, waste oil was used for dust control around hangars, taxiways, and apron edges. The RI focused on the flight line areas where sources of contamination were expected to be found, such as aircraft and vehicle wash racks, oil/water separators, fuel storage bladder locations, dry wells, miscellaneous stained soil areas, and maintenance and storage yards (JEG, 1996a).

The results of the RI revealed the widespread detection of total recoverable petroleum hydrocarbons (TRPH) in surface soils and localized occurrences around the flight line. PAHs were also reported in localized surface soils. PCBs, formerly used as coolant for electric transformers, were reported at the northern edge of the flight line and existing wash rack. Solvents, containing VOCs and semi-volatile organic compounds (SVOCs), pesticides and metals, were reported in shallow soil samples throughout the flight line (Uribe & Associates, 1997b). The results of the investigation did not reveal significant soil contamination in the areas of the specific units included in the investigation (e.g., drywells, oil/water separators, wash racks, etc.). PAHs were the primary risk driver from exposure to CAOC 1 soils.

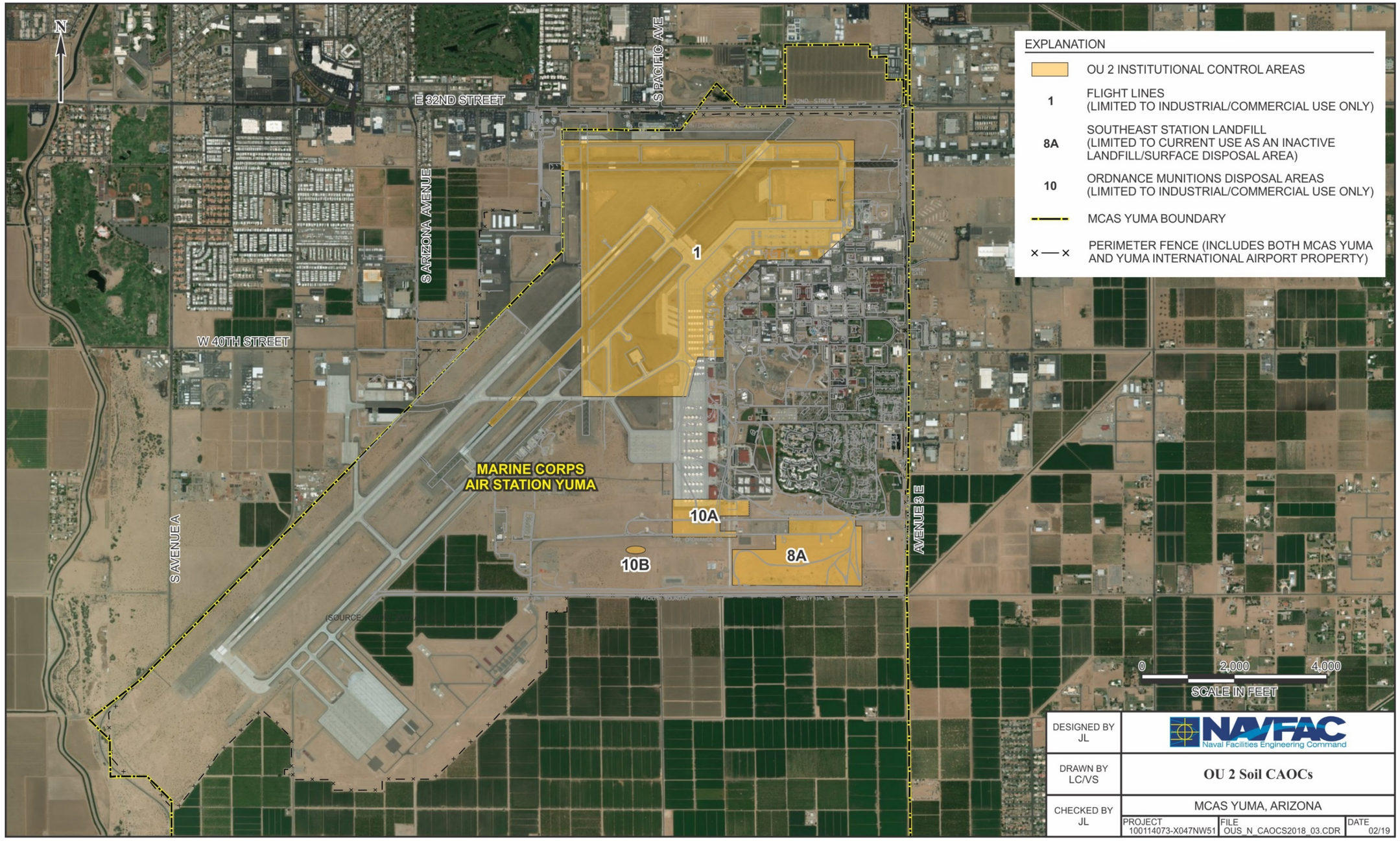

Figure 3-4. Location Map of OU 2 CERCLA Areas of Concern

Table 3-2. OU 2 CAOC 1 Maximum Detected Concentrations of COPCs

CAOC 1 COPC	Maximum Reported Conc.[1]	Residential Risk-Based Criteria		Industrial Risk-Based Criteria		TLV
		Cancer	Noncancer	Cancer	Noncancer	
VOCs						
2-Butanone	2.31	--	2,770	--	3,070	NA
Chloromethane	0.11	3.17	--	5.82	--	NA
Methylene Chloride	0.16	6.44	1,930	12	1,930	NA
Xylene	0.09	--	1,930	--	1,930	NA
SVOCs						
1-Methyl-2-Pyrrolidinone	0.16	NA	NA	NA	NA	NA
2-Cyclohexen-1-Ol	0.1	NA	NA	NA	NA	NA
2-Cyclohexen-1-One	0.095	NA	NA	NA	NA	NA
2-Methylnaphthalene	54	--	608	--	608	NA
2-Pentanone, 4-Hydroxy-4-Methyl	9.8	NA	NA	NA	NA	NA
7H-Benz(DE)Anthracen-7-One	1.7	NA	NA	NA	NA	NA
9,10-Anthracenedione	1.6	NA	NA	NA	NA	NA
Acenaphthene	0.034	--	55.6	--	55.6	NA
Acenaphthylene	0.045	NA	NA	NA	NA	NA
Anthracene	0.26	--	1.76	--	1.76	NA
Benzo(e) Pyrene	0.17	NA	NA	NA	NA	NA
Benzo(a) Anthracene	3.6	0.391	--	1.23	--	NA
Benzo(a) Pyrene	4.5	0.0391	--	0.123	--	NA
Benzo(b) Fluoranthene	10	0.391	--	1.23	--	NA
Benzo(g,h,i) Perylene	2	NA	NA	NA	NA	NA
Benzo(k) Fluoranthene	4.2	3.91	--	12.3	--	NA
Benzo(b) Naphtho(2,3-D) Furan	0.18	NA	NA	NA	NA	NA
Bis(2-Ethylhexyl) Phthalate	2.7	20.4	780	64.1	6,400	NA
Butyl Benzyl Phthalate	0.25	--	7,800	--	64,000	NA
Carbazole	0.77	14.3	--	44.9	--	NA
Chrysene	5.6	39.1	--	123	--	NA
Cyclopenta(def) Phenanthrenon	0.62	NA	NA	NA	NA	NA
Di-n-Octylphthalate	0.24	--	780	--	6,400	NA
Di-n-Butylphthalate	1.78	--	3,900	--	32,000	NA
Dibenzo(a,h) Antracene	0.97	0.0391	--	0.123	--	NA
Dibenzofuran	0.05	NA	NA	NA	NA	NA
Ethanone, 1-Oxiranyl	0.071	NA	NA	NA	NA	NA
Ethylene Glycol	170	--	78,000	--	100,000	NA
Fluoranthene	8.3	--	1,560	--	12,800	NA
Fluorene	0.044	--	47.6	--	47.6	NA
Hexanedioic Acid, Bis(2-Ethyl)	5.1	NA	NA	NA	NA	NA
Indeno (1,2,3-cd) Pyrene	2.5	0.391	--	1.23	--	NA
Naphthalene	70	--	124	--	124	NA
Phenanthrene	2.3	--	42	--	42	NA
Phenol	0.064	--	18,700	--	100,000	NA
Pyrene	8	--	1,170	--	9,600	NA
Total Petroleum Hydrocarbons						
Diesel	5,100	--	--	--	--	NA
Gasoline	48	--	--	--	--	NA
Total Petroleum Hydrocarbons	4,200	--	--	--	--	NA
Pesticides and PCBs						

Table 3-2 (continued). OU 2 CAOC 1 Maximum Detected Concentrations of COPCs

CAOC 1 COPC	Maximum Reported Conc.[1]	Residential Risk-Based Criteria		Industrial Risk-Based Criteria		TLV
		Cancer	Noncancer	Cancer	Noncancer	
4,4-DDD	0.21	0.935	--	2.63	--	NA
4,4-DDE	0.14	0.66	--	1.86	--	NA
4,4-DDT	0.026	0.66	15.6	1.86	113	NA
aldrin	0.000088	0.0132	0.973	0.0371	6.76	NA
aroclor 1254	0.02	0.0473	--	0.176	--	NA
aroclor 1260	0.39	0.0473	--	0.176	--	NA
dieldrin	0.014	0.014	1.56	0.0395	11.3	NA
endosulfan II	0.015	--	1.56	--	11.3	NA
endosulfan sulfate	0.013	--	1.56	--	11.3	NA
endrin	0.0067	--	9.37	--	67.6	NA
endrin aldehyde	0.0097	--	9.37	--	67.6	NA
endrin ketone	0.018	--	9.37	--	67.6	NA
heptachlor epoxide	0.0065	0.0247	0.406	0.0694	2.93	NA
alpha-benzene hexachloride	0.00027	0.0453	--	0.143	--	NA
alpha-chlordane	0.17	0.173	1.87	0.486	13.5	NA
delta-benzene hexachloride	0.0063	0.158	--	0.499	--	NA
gamma-chlordane	0.14	0.173	1.87	0.486	13.5	NA
methoxychlor	0.063	--	156	--	1,130	NA
Metals						
Aluminum	26,200	--	71,100	--	100,000	20,800
Arsenic	16	0.302	21.3	1.9	399	8.59
Barium	437	--	1,520	--	12,400	187
Beryllium	0.43	0.129	356	0.859	6,650	1.97
Cadmium	6.2	26.5	35.6	45.4	665	1.04
Chromium	32.2	--	71,100	--	100,000	49.2
Cobalt	16.6	--	4,540	--	29,600	12.2
Copper	47.1	--	2,630	--	49,200	15.4
Lead[2]	102	--	--	--	--	15.8
Manganese	727	--	136	--	1,180	319
Mercury	1.3	--	21	--	382	nd
Nickel	39.3	--	1,420	--	26,600	19.5
Selenium	0.59	--	356	--	6,650	2.26
Silver	42.1	--	356	--	6,650	1.15
Thallium	0.5	--	4.98	--	93.1	4.21
Vanadium	56.7	--	498	--	9,310	37.7
Zinc	101	--	21,300	--	100,000	37.9

Based on summary information presented in Tables 2-1 through 2-5 of the OU 2 ROD (Uribe & Associates, 1997b).
All concentrations in milligrams per kilogram (mg/kg).

TLV threshold limit value
-- indicates that this constituent did not have cancer and/or noncancer toxicity.
NA indicates that a TLV was not applicable for the constituent.
nd indicates that no data were obtained for the TLV calculations.
XX indicates that the maximum detected concentration of the constituent exceeded this criterion.

[1] Maximum reported concentrations were based on information from the OU 2 RI (JEG, 1996a).
[2] U.S. EPA Region IX residential and industrial soil screening levels for lead were 400 and 1,200 mg/kg at the time of the RI, respectively. Concentrations below these values were not considered to impact health.

All of the chemicals identified at CAOC 1 during the RI, including metals that exceeded their respective background levels (i.e., arsenic, beryllium, and cadmium), were evaluated as COPCs in the human-health risk assessment as industrial and residential land use scenarios. Table 3-2 lists the maximum detected concentrations of the COPCs, identifies the residential and industrial risk-based criteria used in the RI, and identifies the threshold limit values (TLVs) established for metals within the soils of CAOC 1. The CAOC 1 risk assessment used the maximum detected chemical concentrations to calculate risk and hazard. The CAOC 1 risk assessment results for cancer (i.e., ELCR) and noncancer risk (i.e., HI) were as follows:

- Residential exposure scenario
  - ELCR: 2.19×10^{-4}
  - Risk driver(s): PAHs, 83% of the cancer risk
- Industrial exposure scenario
  - ELCR: 6.48×10^{-5}
  - Cancer Risk driver(s): PAHs, 90% of the cancer risk
  - HI: 1.86
  - Noncancer Risk driver(s): metals

The cancer risk for the residential scenario exceeded the generally accepted range (10^{-6} to 10^{-4}), which precluded unrestricted exposure or residential land use. The RI used maximum detected concentrations which likely resulted in overestimation of potential risks and hazard. The cancer risk for the industrial scenario was within the acceptable range; therefore, no restrictions were needed for this land use. The HI exceeded the acceptable criterion of 1.0 (primarily attributed to metals); however, none of the individual target organs or organ systems HI values exceeded the criterion (JEG, 1996a).

3.6.2.2 CERCLA Area of Concern 8A. CAOC 8A is located in the southeastern portion of MCAS Yuma, between North Ordnance Road and the southern MCAS Yuma property line (Figure 3-4). It is the site of a former landfill and surface disposal area. The site is vacant land. South Ordnance Road runs through the site, and the area between North and South Ordnance Road is used as a laydown/storage area. During the RI, this area was investigated as part of the greater CAOC 8. CAOC 8 is a 68-acre area that was used primarily for the disposal of municipal wastes generated at MCAS Yuma from 1953 to 1961 (Uribe & Associates, 1997b). A portion of the area was also used for rubble disposal and as a borrow area for fill soil. The wastes were burned prior to disposal in 10 to 20 disposal pits. The waste streams potentially associated with this disposal area include vehicle- and fuel-related wastes, used oils, solvents, paints, thinners, pesticides, and herbicides. The disposal pits were backfilled and no longer provide an opportunity for direct human exposure to contaminated soil. The CAOC 8A landfill is inactive, and no disposal or other use is authorized for the area.

Drilling within the landfill was not performed during the RI because of potential hazards and difficult drilling conditions caused by buried construction debris. Therefore, the landfill investigation was directed at evaluating the exposure scenario for present site conditions and future (capped) conditions. The analytical results from the RI surface soil sampling and analysis

program indicated the presence of TRPH, PAHs, PCBs, solvents, pesticides and metals. These contaminants were generally found in the area assigned to CAOC 8A (i.e., south of North Ordnance Road). Low levels of TCE, PCE, xylenes and methane were also detected in soil gas samples. PCBs detected in surface soil were determined to be the major COPC posing a potential human health risk.

The HHRA subdivided CAOC 8, based on current and anticipated future land use, into CAOC 8A and CAOC 8B, and evaluated each separately. CAOC 8B is the MCAS Yuma residential housing area located between North Ordnance Road and Loesch Street. The assessment estimated the human-health risks at CAOC 8B for both the industrial and residential scenarios to be within the acceptable range (JEG, 1996a). Table 3-3 lists the maximum detected concentrations of the COPCs, identifies the residential and industrial risk-based criteria used in the RI, and identifies the TLVs established for metals within the soils of CAOC 8A. The CAOC 8A risk assessment used the maximum detected chemical concentrations to calculate risks. The results for cancer (ELCR) and noncancer (HI) were as follows:

- Residential exposure scenario (Uribe & Associates 1997b)
  - ELCR: 9.94×10^{-5}
  - HI: 0.35
  - Cancer risk drivers: PAHs and PCBs, with 74% of the cancer risk attributed to Aroclor-1254 (a PCB reported at three sampling locations)
  - Lead: detected at 659 mg/kg in surface soil, which exceeded the U.S. EPA Region 9 residential soil screening value of 400 mg/kg and caused lead to be identified as a potential residential health risk
- Industrial exposure scenario (Uribe & Associates 1997b)
  - ELCR: 3.02×10^{-5}
  - Cancer risk drivers: PAHs and PCBs
  - HI: 0.41

Because soil sample results were not available for the landfill contents, exposure to the landfill contents was not assessed for CAOC 8A. The cancer risk estimate for residential exposure at the site surface was at the high end of the generally acceptable range. Potential risk was driven by the maximum concentration of Aroclor-1254, which was detected at only three sampling locations. Exposure to surface soil did not pose an unacceptable level of risk under an industrial land use scenario. Based on this information and because risks associated with exposure to the landfill interior are not known, the U.S. EPA, ADEQ, DON, and MCAS Yuma made a risk management decision to restrict the use of CAOC 8A to the use in place at the time of the ROD (inactive landfill, roads, storage/laydown areas, and bunker storage areas) and to prohibit any land use that could potentially disturb the contents of the landfill (Uribe & Associates 1997b).

Table 3-3. OU 2 CAOC 8A Maximum Detected Concentrations of COPCs

CAOC 8A COPC	Maximum Reported Conc.[1]	Residential Risk-Based Criteria		Industrial Risk-Based Criteria		TLV
		Cancer	Noncancer	Cancer	Noncancer	
SVOCs						
1-Methyl-2-Pyrrolidinone	0.13	NA	NA	NA	NA	NA
Benzo(a) Anthracene	0.2	0.391	--	1.23	--	NA
Benzo(a) Pyrene	0.24	0.0391	--	0.123	--	NA
Benzo(b) Fluoranthene	0.42	0.391	--	1.23	--	NA
Benzo(g,h,i) Perylene	0.035	NA	NA	NA	NA	NA
Benzo(k) Fluoranthene	0.2	3.91	--	12.3	--	NA
Bis(2-Ethylhexyl) Phthalate	0.387	20.4	780	64.1	6,400	NA
Chrysene	0.27	39.1	--	123	--	NA
Di-n-Butylphthalate	4.038	--	3,900	--	32,000	NA
Fluoranthene	0.344	--	1,560	--	12,800	NA
Indeno (1,2,3-cd) Pyrene	0.074	0.391	--	1.23	--	NA
N-Nitrosodiphenylamine	0.049	58.2	--	183	--	NA
Phenanthrene	0.14	--	42	--	42	NA
Pyrene	0.344	--	1,170	--	9,600	NA
Total Petroleum Hydrocarbons						
Diesel	860	--	--	--	--	NA
Pesticides and PCBs						
4,4-DDD	0.00805	0.935	--	2.63	--	NA
4,4-DDE	0.0079	0.66	--	1.86	--	NA
4,4-DDT	0.0023	0.66	15.6	1.86	113	NA
aldrin	0.00248	0.0132	0.973	0.0371	6.76	NA
aroclor 1254	4.045	0.0473	--	0.176	--	NA
dieldrin	0.0695	0.014	1.56	0.0395	11.3	NA
endosulfan I	0.00136	--	1.56	--	11.3	NA
endosulfan II	0.0027	--	1.56	--	11.3	NA
endosulfan sulfate	0.00098	--	1.56	--	11.3	NA
endrin	0.04176	--	9.37	--	67.6	NA
endrin aldehyde	0.0174	--	9.37	--	67.6	NA
endrin ketone	0.01142	--	9.37	--	67.6	NA
alpha-chlordane	0.05873	0.173	1.87	0.486	13.5	NA
beta-benzene hexachloride	0.00041	0.158	--	0.499	--	NA
gamma-chlordane	0.00756	0.173	1.87	0.486	13.5	NA
gamma-benzene hexachloride (lindane)	0.00072	0.173	9.37	0.486	67.6	NA
Metals						
Aluminum	11,700	--	71,100	--	100,000	7,770
Antimony	8.5	--	28.4	--	532	6
Arsenic	4.7	0.302	21.3	1.9	399	9.68
Barium	160	--	1,520	--	12,400	133
Beryllium	0.14	0.129	356	0.859	6,650	0.28
Cadmium	1.2	26.5	35.6	45.4	665	0.8
Chromium	15.7	--	71,100	--	100,000	10.6
Chromium VI	0.22	4.07	356	6.97	6,650	nd
Cobalt	6.5	--	4,540	--	29,600	6.12
Copper	582	--	2,630	--	49,200	21.7
Lead[2]	659	--	--	--	--	8.79
Manganese	278	--	136	--	1,180	137

Table 3-3 (continued). OU 2 CAOC 8A Maximum Detected Concentrations of COPCs

CAOC 8A COPC	Maximum Reported Conc.[1]	Residential Risk-Based Criteria		Industrial Risk-Based Criteria		TLV
		Cancer	Noncancer	Cancer	Noncancer	
Mercury	0.17	--	21	--	382	nd
Nickel	14.9	--	1,420	--	26,600	6.7
Selenium	0.98	--	356	--	6,650	1.89
Silver	10.2	--	356	--	6,650	1.47
Thallium	0.5	--	4.98	--	93.1	6.76
Vanadium	28	--	498	--	9,310	22.6
Zinc	58.9	--	21,300	--	100,000	28.0

Based on summary information presented in Tables 2-1 through 2-5 of the OU 2 ROD (Uribe & Associates, 1997b).
All concentrations in milligrams per kilogram (mg/kg).
TLV threshold limit value
-- indicates that this constituent did not have cancer and/or noncancer toxicity.
NA indicates that a TLV was not applicable for the constituent.
nd indicates that no data were obtained for the TLV calculations.
XX indicates that the maximum detected concentration of the constituent exceeded this criterion.
[1] Maximum reported concentrations were based on information from the OU 2 RI (JEG, 1996a).
[2] U.S. EPA Region IX residential and industrial soil screening levels for lead were 400 and 1,200 mg/kg at the time of the RI, respectively. Concentrations below these values were not considered to impact health.

3.6.2.3 CERCLA Area of Concern 10. CAOC 10, consisting of subareas 10A and 10B (Figure 3-4), is located within the secured and existing Ordnance Distribution Facility (ODF) (CAOC 10A) and the fenced area adjacent to CAOC 8A (CAOC 10B) in the southeastern portion of MCAS Yuma. CAOC 10 was used during World War II as a shooting range for bomber gun crews. From the early 1950s to approximately 2010, ordnance materials were stored in the magazines around the central portion of the Ordnance Loop (North and South Ordnance Roads). The magazines have since been demolished. The area has also been used for surface tank and drum storage. Surface spills, including liquid residues from ordnance-mixing operations, have been reported within this area. Suspected waste associated with this area includes used oils, ordnance waste associated with nitroaromatics, fuel-related wastes, and metals.

The primary finding of the RI field sampling and analysis program was TRPH, PAHs in surface soil, and one lead result reported above the site background concentration. PAHs were detected in surface soil at four locations during the RI. The risk assessment results from CAOC 10 indicated the industrial and residential exposure scenarios had potential cancer risk within the generally accepted range; benzo(a)pyrene, a PAH, contributed 74% of the cancer risk for the residential exposure scenario. The risk assessment results for CAOC 10 were later revised with results from additional soil sampling for PAHs conducted in August 1996 (Uribe & Associates, 1996a) and February 1997 (Uribe & Associates, 1997a). The August 1996 sample results showed one to two orders of magnitude higher total PAH concentrations, which led to supplemental soil sampling to fully define the extent of PAHs in the soil areas then designated as CAOCs 10A and 10B (Uribe & Associates, 1997a). Initially, this second risk assessment used RBCs calculated during the RI with 1993 U.S. EPA-approved dermal exposure factors, instead of the promulgated 1996 dermal exposure factors.

Recalculating the RBCs using the dermal exposure factors valid for 1996 resulted in RBCs for PAHs that were identical to the 1996 U.S. EPA preliminary remediation goals. Using the recalculated RBC values and the maximum detected concentrations to estimate human health risk for CAOC 10 yielded the following results:

- Residential exposure scenario
  - ELCR: 2.9×10^{-4}
  - Risk driver(s): PAHs, greater than 74% of the cancer risk
- Industrial exposure scenario
  - ELCR: 7.0×10^{-5}
  - Cancer Risk driver(s): PAHs

The recalculated cancer risk for residential exposure exceeded the generally acceptable range, whereas the cancer risk for industrial exposure was in the middle of the range. For this reason, the risk for the site was considered potentially higher than acceptable for unrestricted exposure or residential land use, but acceptable for industrial land use. Table 3-4 lists the maximum detected concentrations of the COPCs, identifies the residential and industrial risk-based criteria used in the revised risk assessment (Uribe & Associates 1997a), and identifies the TLVs established for metals within the soils of CAOC 10.

Table 3-4. OU 2 CAOC 10 Maximum Detected Concentrations of COPCs

CAOC 10 COPC	Maximum Reported Conc.[1]	Residential Risk-Based Criteria		Industrial Risk-Based Criteria		TLV
		Cancer	Noncancer	Cancer	Noncancer	
SVOCs						
Acenaphthene	0.166	--	55.6	--	55.6	NA
Anthracene	0.388	--	1.76	--	1.76	NA
Benzo(a) Anthracene	2.718	0.391	--	1.23	--	NA
Benzo(a) Pyrene	2.197	0.0391	--	0.123	--	NA
Benzo(b) Fluoranthene	3.482	0.391	--	1.23	--	NA
Benzo(g,h,i) Perylene	0.322	NA	NA	NA	NA	NA
Carbazole	0.19	14.3	--	44.9	--	NA
Chrysene	2.873	39.1	--	123	--	NA
Di-n-Butylphthalate	3.359	--	3,900	--	32,000	NA
Fluoranthene	4.132	--	1,560	--	12,800	NA
Fluorene	0.044	--	47.6	--	47.6	NA
Indeno (1,2,3-cd) Pyrene	1.531	0.391	--	1.23	--	NA
Naphthalene	0.112	--	124	--	124	NA
Phenanthrene	1.746	--	42	--	42	NA
Pyrene	4.057	--	1,170	--	9,600	NA
Total Petroleum Hydrocarbons						
Total Petroleum Hydrocarbons	25	--	--	--	--	NA
Pesticides and PCBs						
4,4-DDE	0.002	0.66	--	1.86	--	NA
dieldrin	0.00079	0.014	1.56	0.0395	11.3	NA
endrin	0.00137	--	9.37	--	67.6	NA
beta-benzene hexachloride	0.00067	0.158	--	0.499	--	NA
Metals						

Table 3-4 (continued). OU 2 CAOC 10 Maximum Detected Concentrations of COPCs

Aluminum	5,290	--	71,100	--	100,000	6,310
Arsenic	3.9	0.302	21.3	1.9	399	8.99
Barium	85.3	--	1,520	--	12,400	184
Beryllium	0.67	0.129	356	0.859	6,650	0.28
Cadmium	1.7	26.5	35.6	45.4	665	1.64
Chromium	11.2	--	71,100	--	100,000	25.1
Cobalt	3.7	--	4,540	--	29,600	7.31
Copper	5.5	--	2,630	--	49,200	5.83
Lead[2]	31	--	--	--	--	6.79
Manganese	176	--	136	--	1,180	157
Nickel	6.8	--	1,420	--	26,600	9.83
Selenium	0.63	--	356	--	6,650	1.9
Silver	0.78	--	356	--	6,650	1.14
Vanadium	22.3	--	498	--	9,310	26.9
Zinc	157	--	21,300	--	100,000	30.2

Based on summary information presented in Tables 2-1 through 2-5 of the OU 2 ROD (Uribe & Associates, 1997b).
All concentrations in milligrams per kilogram (mg/kg).
TLV threshold limit value
-- indicates that this constituent did not have cancer and/or noncancer toxicity.
NA indicates that a TLV was not applicable for the constituent.
XX indicates that the maximum detected concentration of the constituent exceeded this criterion.
[1] Maximum reported concentrations were based on information from the OU 2 RI (JEG, 1996a).
[2] U.S. EPA Region IX residential and industrial soil screening levels for lead were 400 and 1,200 mg/kg at the time of the RI, respectively. Concentrations below these values were not considered to impact health.

3.6.3 Munitions Response Program Sites. Based on the SI results for MRP Sites 1, 2, 4, 5, and 6, the FFA team agreed that further action was needed for each of the sites. MRP Sites 1, 2, and 4 were formerly small arms ranges; therefore, the primary hazard at those sites is the potential for MC. MRP Sites 5 and 6 have the potential for MEC and MC because of the potential historical use of munitions with explosives at these sites, including 20-mm projectiles.

An RI was performed for MRP Site 1 (Pika-Pirnie, 2014) that indicated that site soil has been impacted by PAHs from skeet and metals (antimony, copper, and lead) from munitions at concentrations that pose a potentially unacceptable risk to the hypothetical future resident and ecological receptors. Further action was recommended, including conducting a FS to evaluate remedial alternatives for soil contamination. The site was subsequently split into MRP Sites 1A and 1B because of a (i.e., 2015) plan for a renewable energy project on a portion of the site, which was designated as 1B. The remainder of site was designated as MRP Site 1A. A time critical removal action was conducted on MRP Site 1B in 2015 in accordance with the approved work plan (Tetra Tech, 2015). Approximately 2.4 acres of the 2.9-acre site was excavated to 0.5 ft bgs (~ 3,060 cubic yards). A digital geophysical mapping (DGM) survey was also conducted to assess the presence of MEC at the site. No MEC was observed during excavation activities or during the DGM survey. In addition, there were no COC concentrations above soil cleanup levels in any of the post-excavation soil samples collected (Tetra Tech, 2015). U.S. EPA concurrence for NFA at Site 1B was obtained in August 2015 (U.S. EPA, 2015b).

An Expanded SI was conducted on MRP Site 2. Results indicated that MC does not pose a risk to human health or the environment. NFA was recommended for the site (Pika-Pirnie, 2015). U.S. EPA and ADEQ concurrence for NFA at Site 2 was obtained in September 2015 (U.S. EPA, 2015c; ADEQ, 2015).

MRP Site 5 was evaluated in an RI. RI results indicate that MC does not pose a risk to human health or the environment. A DGM survey was conducted and a portion of the resultant geophysical anomalies were investigated. No MEC or material potentially presenting an explosive hazard (MPPEH) was observed at the site (Trevet, 2014b). However, ADEQ requested an additional investigation of the remaining anomalies at the site.

The objective of the additional RI for MRP Site 5 was to complete the intrusive investigation of the DGM anomalies detected at the site during the initial RI and perform additional soil sampling for MC analysis. The additional RI completed the characterization of the nature and extent of MEC and MC present and assessed whether they pose an explosive safety hazard and/or risk to human health or the environment.

In order to complete site characterization for MEC/MPPEH, the following activities were performed as part of the additional RI:

- Excavation of the site to 16 inches bgs to remove the metallic debris observed at the surface during the previous RI;
- Screening and inspection of the excavated soil for MEC/MPPEH;
- DGM of the entire site after removal of the top 16 inches;
- Identification and removal of 100% of targets of interest (TOIs);
- Collection of soil samples from beneath TOIs for analysis of explosives and metals; and
- Backfill of the site.

During two mobilizations, a total of 124 targets were intrusively investigated and removed. MPPEH was encountered at one location at a depth of 6 inches below the excavated surface. The MPPEH was inspected and determined to be a 20-mm practice projectile that had been fired. The 20-mm practice projectile was comprised of solid metal and does not contain any explosives. The find was categorized as material documented as safe. Six locations contained small arms (expended .50-caliber bullets, which are not considered MEC) that were removed. All other locations contained metallic construction debris, grid corner nails, or blind seeds, all of which were removed. Approximately 332 pounds of scrap metal were removed during screening and target investigations and approximately 83 tons of concrete were removed from the site (Tetra Tech, 2017).

Soil samples were collected from beneath 10 of the removed targets, including the expended 20-mm practice round and small arms locations, for explosives and metals analysis, and from beneath two targets identified after the concrete pad was removed. No explosives were detected in any of the samples. Metals were detected in all samples, but none of the results were above

ADEQ residential soil remediation levels (SRLs). No metals were reported above background thresholds at the location of the expended 20-mm practice round or the six locations with small arms.

The findings of the additional RI, combined with historical results, indicate that metals in site soils at MRP Site 5 do not pose an unacceptable risk to human health or the environment. This conclusion is consistent with previous observations for MC in soil at the site. Explosives were not detected in any soil sample collected at MRP Site 5. The additional RI recommended NFA for MEC and MC at MRP Site 5 (Tetra Tech, 2017).

A No Action ROD was being prepared during the inspection and document review period for this FYR.

3.6.3.1 Munitions Response Site 4. MRP Site 4 is located at the northeastern end of the runway at MCAS Yuma (Figure 3-5). The majority of the approximately 240-acre site (approximately 198 acres) overlaps CAOC 1 in OU 2. The majority of MRP Site 4 (including the site area not overlapped by CAOC 1) is developed with the current runways, aprons, and associated airfield facilities. The site is relatively flat. The limited area not covered by runways, aprons, and airfield facilities is primarily covered by palliative.

The source of potential contaminants (i.e., MC) at MRP Site 4 is from ammunition when the site was used as a small arms range. According to the Archive Search Report, no fixed firing facilities were established at the former range. Munitions types used at the site consisted of cartridge, ball, and rifle (USACE, 2001). MC typically associated with munitions include antimony, arsenic, cadmium, copper, lead, and zinc. Results of the OU 2 RI for CAOC 1 indicated the presence of arsenic, cadmium, copper, lead, and zinc at concentrations above background as summarized in the OU 2 ROD.

An FS and proposed plan were prepared for MRP Site 4 following the SI, and the site was addressed in a ROD which identifies LUCs as the remedy. The ROD was signed by parties to the FFA in May 2017 (NAVFAC SW, 2017a).

3.6.3.2 Munitions Response Site 6. MRP Site 6 is located in the central portion of MCAS Yuma (Figure 3-5) and is approximately 1 acre in size. MRP Site 6 resides beneath 3 feet of clean imported fill and an approximately 18-inch-thick concrete apron that is part of a new hangar/apron complex constructed as part of the F-35 Joint Strike Fighter Wing stationed at MCAS Yuma in mid-2012.

The source of potential MEC at MRP Site 6 is from ammunition when the site was used as a range to zero-in fixed aircraft guns. Ammunition included .50-cal and 20-mm projectiles, which were the typical munitions for the types of military aircraft operated at MCAS Yuma at the time the firing-in butt was in use. Munitions debris was also observed during the SI. The source of potential MC at the site is munitions (if present). MC typically associated with munitions include antimony, arsenic, cadmium, copper, lead, and zinc, and nitroamine explosive constituents. Metals were not detected above background concentrations in the surface soil samples collected during the SI; however, the potential for subsurface MC cannot be ruled out.

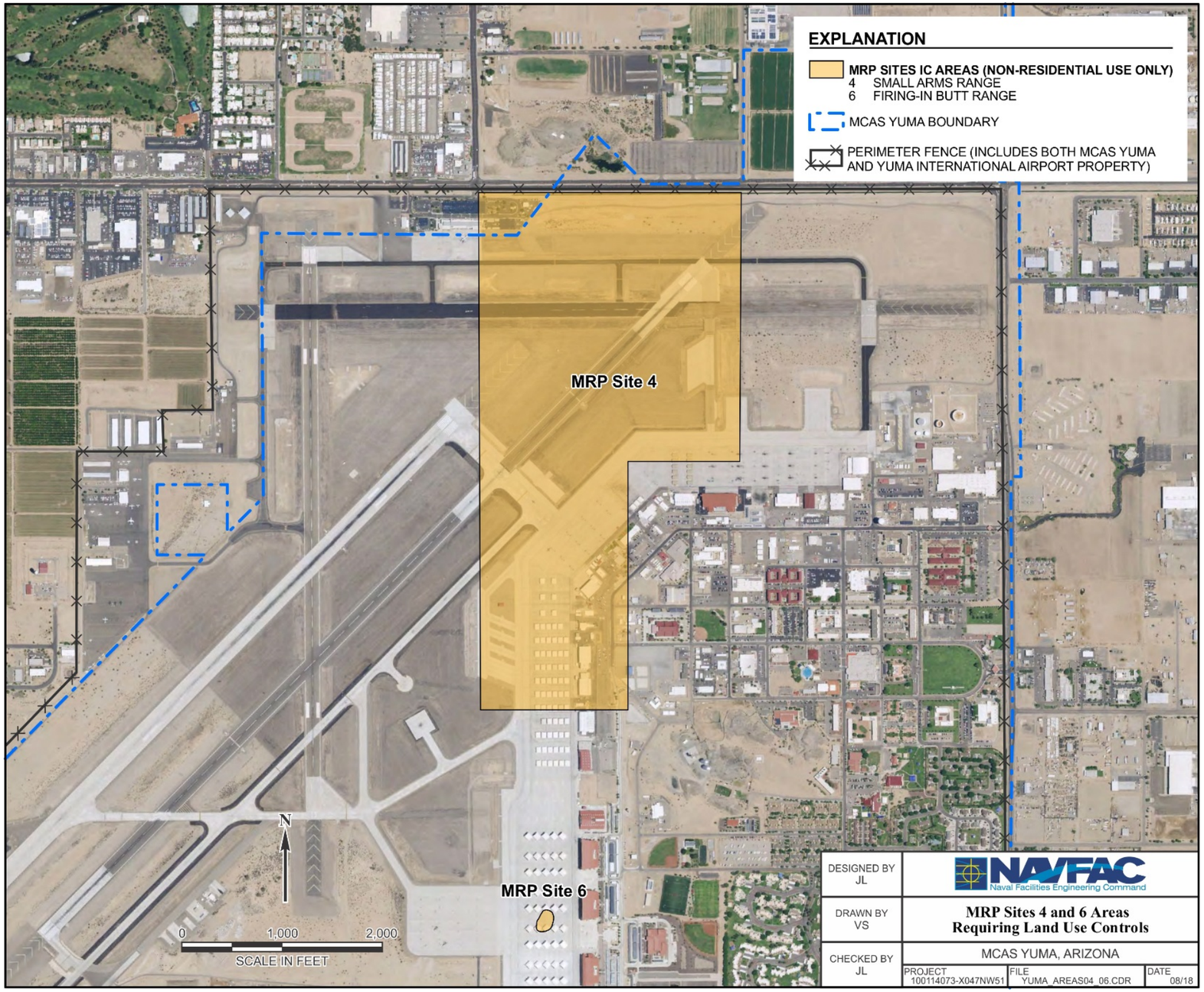

Figure 3-5. Location Map of MRP Sites 4 and 6 Areas of Concern

A surface sweep performed by MCAS Yuma Explosive Ordnance Disposal Group prior to military construction detected no MEC at the site. The range consisted of the firing-in butt, i.e., aircraft fired at the firing-in butt, not at the ground. However, the potential for subsurface MEC cannot be ruled out since the disposition of the earthen firing-in butt is unknown. It is unknown whether the firing-in butt was removed or graded. There were several earthen mounds at the site prior to construction of the hangar and apron, and it is unknown whether these were part of the firing-in butt. No MEC were observed when debris was removed from those mounds or when the mounds were spread over the site. However, DGM was not conducted at the site. Results of soil sampling (Table 3-5) conducted during the SI did not indicate concentrations of MC above site-specific background concentrations or above ADEQ residential and non-residential SRLs; however, the potential for MC cannot be ruled out if there is a potential for MEC to exist. Site soils have been covered with 3 feet of imported clean soil and up to 18 inches of concrete; therefore, any MEC or MC potentially present would be in subsurface soils. Potentially affected media includes subsurface soil between depths of 4.5 and approximately 8 feet below the concrete surface.

An FS and proposed plan were prepared for MRP Site 6 following the SI, and the site was addressed in a ROD which identifies LUCs as the remedy. The ROD was signed by parties to the FFA in May 2017 (NAVFAC SW, 2017a). MRP Site 6 has a remedy in place consisting of ICs.

Table 3-5. Comparison of Soil Munitions Constituents Concentrations to Screening Levels at Munitions Response Site 6[1]

Munitions Constituent (MC)	Maximum Concentration (mg/kg)	Residential			Non-Residential		
		Screening Level[1] (mg/kg)	Screening Ratio		Screening Level[1] (mg/kg)	Screening Ratio	
			Cancer Risk	Non-Cancer Hazard		Cancer Risk	Non-Cancer Hazard
Antimony	ND	31	NA	NA	470	NA	NA
Arsenic[2]	4.21	11.9	NC	NA	11.9	NC	NA
Cadmium	0.404	70	NA	0.01	980	NA	0.0004
Copper	31.1	3.100	NA	0.01	47.000	NA	0.001
Lead[3]	42.6	4000	NA	NA	800	NA	NA
Zinc	84	23.000	NA	0.004	350,000	NA	0.0002
Total Calculated Risk and Hazard			NA	0.02		NA	0.0013

Notes:
ND: not detected
NA: not applicable
NC: not calculated. The maximum detection is less than the background concentration.
1: Screening levels are USEPA January 2015 Regional Screening Levels, except for arsenic.
2. Screening level is installation-specific background level. Trevet. 2014. Final Soil Background Characterization Report.
3: Lead health risks are evaluated based on total estimated body burden and not by dose-response equations. However, the maximum lead detection was below the risk-based screening level. Therefore, potential health risk associated with exposure to lead was not evaluated further.

Data source: Alliance Compliance Group Joint Venture. 2011. Final Site Inspection Report. Munitions Response Sites 1, 2, 4, 5, & 6. Marine Corps Air Station Yuma. Yuma, Arizona.

4.0: REMEDIAL ACTIONS

This section presents the results of events identified in the chronology listed in Section 2 from the signing of the RODs to the present, which define the remedies for OU 1, OU 2, and MRP Sites 4 and 6. The section provides remedy selection, remedy implementation, and remedy performance, and identifies any changes to or problems associated with the components of the remedy. Table 4-1 summarizes all IR sites associated with OU 1, OU 2 and MRP Sites, including the type of site, current status, and past and present RAs.

Table 4-1. Summary of IR Sites Associated with OU 1, OU 2, and MRP Sites

Site ID	Operable Unit	Type of Site	Current Status (Active or Closed [Year Closed])	Remedial Actions Taken
Area 1	OU 1	Groundwater	Active	ICs, AS/SVE, VCT, MNA,
Area 2	OU 1	Groundwater	Closed [2006]	ICs, temporary AS/SVE, MNA
Area 3	OU 1	Groundwater	Closed [2006]	ICs, temporary AS/SVE, MNA
Area 6	OU 1	Groundwater	Closed [2003]	ICs, MNA
CAOC 1	OU 2	Soil	Active	ICs
CAOC 2	OU 2	Soil	Closed [1996]	NFA
CAOC 3	OU 2	Soil	Closed [1996]	NFA
CAOC 4	OU 2	Soil	Closed [1999]	Asbestos Remediation
CAOC 5	OU 2	Soil	Closed [1996]	NFA
CAOC 6	OU 2	Soil	Closed [1996]	NFA
CAOC 7	OU 2	Soil	Closed [1999]	Asbestos Remediation
CAOC 8A	OU 2	Soil	Active	ICs
CAOC 8B	OU 2	Soil	Closed [1996]	NFA
CAOC 9	OU 2	Soil	Closed [1999]	Asbestos Remediation
CAOC 10A	OU 2	Soil	Active	ICs
CAOC 10B	OU 2	Soil	Active	ICs
CAOC 11	OU 2	Soil	Closed [1996]	NFA
CAOC 12	OU 2	Soil	Closed [1996]	NFA
CAOC 13	OU 2	Soil	Closed [1996]	NFA
CAOC 14	OU 2	Soil	Closed [1996]	NFA
CAOC 15	OU 2	Soil	Closed [1996]	NFA
CAOC 16	OU 2	Soil	Closed [1996]	NFA
CAOC 17	OU 2	Soil	Closed [1996]	NFA
CAOC 18	OU 2	Soil	Closed [1996]	NFA
MRP Site 1A	NA	MRP	Active	NTCRA
MRP Site 1B	NA	MRP	Closed [2015]	Excavation, DGM
MRP Site 2	NA	MRP	Closed [2015]	NFA
MRP Site 3	NA	MRP	Closed [2003]	ADEQ Voluntary Remediation Program
MRP Site 4	NA	MRP	Active	ICs
MRP Site 5	NA	MRP	Closed [No Action ROD in preparation]	Excavation and screening of top 16-inches of soil; DGM and intrusive investigation of site below 16-inches; backfill of the site.
MRP Site 6	NA	MRP	Active	LUCs

4.1 Remedial Actions for Operable Unit 1 Area 1

This section presents the remedy, remedy implementation, and system O&M for OU 1 Area 1, and identifies any changes to or problems with the components of the remedy.

4.1.1 OU 1 Area 1 Remedy. This section describes the OU 1 Area 1 remedy in terms of the OU 1 remedial action objectives (RAOs), applicable or relevant and appropriate requirements (ARARs), selected remedy, and termination criteria.

4.1.1.1 OU 1 Area 1 Remedial Action Objective. RAOs for the OU-l Area 1 groundwater plume include containment of COC concentrations greater than the MCLs within the MCAS Yuma facility boundary and reduction of groundwater contamination to meet applicable drinking water standards. Groundwater RAOs were established to prevent future human exposure to unsafe levels of COCs. These RAOs were based on detailed analysis of chemical-specific ARARs and health risk-based criteria consistent with beneficial uses of the affected aquifer at the time of remediation and of the aquifer's projected use.

4.1.1.2 OU 1 Applicable or Relevant and Appropriate Requirements. The OU 1 ROD identifies federal drinking water standards as applicable or relevant and appropriate chemical-specific requirements for the remediation of OU 1 groundwater plumes. The U.S. EPA promulgated MCLs under the Safe Drinking Water Act (SDWA) to protect public health from contaminants that may be present in drinking water sources (40 CFR, Part 141). Although these requirements are applicable only at the tap for water provided directly to 25 or more people or that would be supplied to 15 or more service connections, they are relevant and appropriate because the State of Arizona designated all aquifers in the state as potential sources of drinking water (unless reclassification is obtained) (Arizona Revised Statutes [ARS] §§ 49-224B). Nonzero maximum containment level goals (MCLGs) also are relevant and appropriate to RAs required to meet drinking water standards. Federal MCLs and nonzero MCLGs therefore are chemical-specific ARARs for meeting RAOs.

State MCLs are the maximum permissible levels for treated groundwater delivered to users of water systems (§§ R18-4-205 and R18-4-211). They are applicable because the State of Arizona designated all aquifers in the state to be potential sources of drinking water (ARS §§ 49 through 224B). However, no state MCL equivalents, such as Aquifer Water Quality Standards (AWQSs) for the State of Arizona are more stringent than the federal MCLs or nonzero MCLGs.

Although none of the groundwater extraction and treatment alternatives transfer treated groundwater to a public water-supply agency, groundwater could be considered a potential future drinking water supply. If treated groundwater is to be used as a potable water supply, it will be considered an off-site, post-remedy activity and must comply with all legal drinking water requirements in existence at the time the water is used.

Portions of the Resource Conservation and Recovery Act (RCRA) groundwater protection standards contained in ARS Title 49 (Laws Relating to Environmental Quality) and Arizona Administrative Code (AAC) Title 18 are considered relevant and appropriate for the groundwater plumes being addressed by the OU l RAs because the hazardous constituents being addressed are

similar or identical to those found in RCRA hazardous waste. In addition to concentration limits for groundwater, a groundwater-quality monitoring program is required to demonstrate the effectiveness of a corrective action program (40 CFR 264.100).

Discharge by industrial users to a publicly owned treatment works (POTW) is considered an off-site activity that requires compliance with the substantive and procedural requirements of the federal pretreatment program (40 CFR Part 403). In general, the discharges could not cause either a violation of any requirement of the POTW's National Pollutant Discharge Elimination System permit or prevention of sewage sludge use or disposal.

The SDWA provided federal authority over injection wells (42 U.S.C. § 300f et seq.). The Federal Underground Injection Control Plan prohibits injection wells such as those located at OU l from causing a violation of primary MCLs in the receiving waters and adversely affecting human health (40 CFR § 144.12). The federal reinjection regulation states that contaminated groundwater that has been treated may be reinjected into the formation from which it was withdrawn if such reinjection was conducted pursuant to a CERCLA cleanup and was approved by the U.S. EPA (40 CFR § 144.13). These regulations were applicable to any OU l treated groundwater that was reinjected into the aquifer.

RCRA Section 3020 was also applicable to the OU l RAs. The RCRA states that the ban that prohibits the disposal of hazardous waste into a formation that contains an underground source of drinking water does not apply to the injection of contaminated groundwater into the aquifer if:

(1) such injection is part of a response action under CERCLA;

(2) such contaminated groundwater is treated to substantially reduce hazardous constituents before such injection; and

(3) such response action would, upon completion, be sufficient to protect human health and the environment (42 U.S.C. § 6939b).

Arizona's Aquifer Protection Permit Program would apply to the reinjection of treated groundwater (ARS § 49-243). Under this program, MCAS Yuma would implement best available demonstrated control technology, processes, operating methods, or other alternatives and include, where practicable, a technology permitting no discharge of pollutants. The facility must not cause or contribute to a violation of aquifer water quality standards at the applicable point of compliance (POC), or further degrade aquifer water quality with respect to a pollutant at the POC if the quality of the aquifer already violates the applicable aquifer water-quality standard for that pollutant.

4.1.1.3 OU 1 Area 1 Selected Remedy. The major components of the selected Area 1 remedy included the following:

- Contain and treat groundwater at the LEPA using a VCT system.
- Treat the groundwater at the Hot Spot in the vicinity of Building 230 with an AS/SVE system to reduce contaminant mass in the area and accelerate remediation time for the entire plume.

- Transport, regenerate, recycle, and/or dispose of spent granular activated carbon (GAC) units associated with the operation of the VCT and AS/SVE systems.
- Perform groundwater modeling to demonstrate that CHC concentrations will reach the base boundary equal to or less than MCLs. If so demonstrated, then perform MNA to verify CHC concentrations are approaching MCLs.
- Implement ICs to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with or adversely affect RAs.
- Implement an LTM plan, which includes MNA of COCs in the portions of Area 1 where active remediation (i.e., remedial system operations) was not taking place, and evaluate the results to determine the effectiveness of the selected remedies.
- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required ICs. The ICP documents all required institutional and engineering controls as well as details the procedures for any required monitoring programs. The ICP also documents procedures for the review of digging and building permits, establishes procedures for ensuring regular checks and balances are in place, includes provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provides for inspection and enforcement measures to ensure that the required ICs are correctly implemented and enforced. Additionally, the ICP establishes procedures that require the regulatory agencies to be notified in the event any major change in land use is proposed.
- Remediate all contaminated groundwater to MCLs for COCs (i.e., 7 µg/L for 1,1-DCE, 5 µg/L for TCE, and 5 µg/L for PCE).
- Terminate system operation (see Section 4.1.1.4).

Stipulations were provided in the OU 1 ROD for written concurrence to be obtained from the FFA team for any actions taken that were inconsistent with the prohibited groundwater use. Also, if the DON intended to excess the property, it must notify the ADEQ and U.S. EPA in advance of the execution of any transfer. The DON would again consult with the ADEQ and U.S. EPA in revisiting the existing land use classification and restrictions for the areas involved to determine if the foreseeable future land use would differ from the assumptions made at the time of the ROD. A reevaluation of the ICs would be performed if necessary at that time.

The MCAS Yuma Master Plan was required to be amended to (1) prohibit the use of groundwater from OU 1; (2) describe the risk to human health and the environment of contaminated groundwater use; and (3) reference the OU 1 ROD.

4.1.1.4 OU 1 Area 1 Termination Criteria. Criteria for termination of the groundwater containment/treatment systems for OU 1 Area 1 were defined in the ROD (Sections 2.13.1.4. and 2.13.2. of NAVFAC SW, 2000) and summarized below.

Selected monitoring wells located both upgradient and downgradient of the groundwater treatment systems would be monitored during the RA in accordance with the LTM plan. The DON would evaluate the results to verify that the remedial systems were effectively containing and treating the plume and, in the case of AS/SVE, to verify that the systems were effectively reducing contaminant mass in the treatment area. The groundwater containment/treatment systems will remain in operation until one of the following criteria is achieved:

(1) Representative groundwater concentrations measured in the designated wells upgradient and downgradient of the VCT system had achieved groundwater cleanup standards (MCLs).

(2) Remaining CHC concentrations in Area 1 groundwater would reach the station boundary at concentrations equal to or less than MCLs. This will require groundwater modeling results indicating that remaining contaminants above MCLs would reach the station boundary at concentrations equal to or less than MCLs followed by MNA to remedy the remaining CHCs. Modeling will be performed only after CHC concentrations upgradient and downgradient of the VCT system achieve the MCLs. After MCLs are achieved and the VCT system is temporarily shut down, if CHCs rebound to exceed the MCLs, modeling will be performed to determine whether CHCs would reach the station boundary at or below MCLs.

(3) The AS/SVE system no longer is removing mass (i.e., an asymptotic condition has been permanently reached) after system optimization. Modeling of the Hot Spot will be required to determine if CHC concentrations reach the station boundary at or below the MCLs in order to terminate operation of the VCT system.

The DON will demonstrate that one or more of the criteria above is being achieved through collection of groundwater samples from the monitoring wells designated in the LTM plan. When the monitoring data indicate that any of the above conditions have been met, the DON can propose a temporary shutdown of the remediation system. Shutdown is subject to U.S. EPA and ADEQ concurrence. The groundwater LTM program will continue for a period of up to 2 years. If it is demonstrated in this period that concentrations of CHCs in groundwater meet the cleanup standards, the parties may agree that the system can be shut down permanently.

If, during temporary shutdown of the remediation system, monitoring wells upgradient from the base boundary indicate a rebound in CHC concentrations to above MCLs, operation of the remediation system will be restarted. The DON could then attempt to demonstrate through groundwater modeling that remaining groundwater contaminants would reach the station boundary at concentrations equal to or less than MCLs. Groundwater modeling results will be subject to U.S. EPA and ADEQ concurrence. If demonstrated, the DON can propose permanent shutdown of the remediation system subject to U.S. EPA and ADEQ concurrence. MNA of the Area 1 plume would be implemented to confirm CHCs are approaching the MCLs. If MNA was not progressing adequately, the remediation system would resume operation as needed.
If it is determined that Criteria 1 and 2 could not be met, the DON will demonstrate that CHCs in groundwater have been removed to the extent technically and economically feasible as set forth in Criterion 3 above by analyzing the following:

(1) Whether the mass removal rate is approaching asymptotic levels after temporary shutdown periods and appropriate system optimization,

(2) The additional cost of continuing to operate the system to achieve concentrations approaching asymptotic mass levels, and

(3) Whether discontinuing the system would significantly prolong the time needed to achieve the groundwater cleanup standard.

Discontinuation of LTM as well as closure of Areas will require U.S. EPA and ADEQ concurrence. ICs for each area will be maintained until the individual areas meet the closure criteria with concurrence by U.S. EPA and ADEQ. After the closure of an individual area, the ICs for that area will no longer be required. FYRs will be required for all active areas undergoing remediation until cleanup standards (i.e., MCLs) are achieved.

4.1.2 OU 1 Area 1 Remedy Implementation. The following sections discuss implementation of the OU 1 Area 1 remedy, including the Area 1 containment and removal systems, OU 1 Area 1 LTM plan, MCAS Yuma Master Plan, and the LUCIP. The actions described below were taken post-ROD to implement the remedies selected for OU 1 Area 1 consisting of containment plus Hot Spot removal by AS/SVE.

4.1.2.1 Area 1 Containment and Removal Systems. Implementation of the OU 1 remedy began with the installation of the AS/SVE system in the Building 230 area of Area 1 in June 1999. The AS system was composed of 46 sparge wells, configured in five banks (i.e., Rows 29, 39, 49, 59, and 70 as shown in Figure 4-1), designed to inject air into the saturated zone to strip CHCs from groundwater. The SVE system was composed of 15 vapor recovery wells designed to create a vacuum in the vadose (or unsaturated) zone, capture the sparge air and soil vapor, and remove the stripped contaminants from the subsurface. The contaminated vapor stream is then treated above ground using a GAC system prior to discharge to the atmosphere.

A blower rated at 400 cubic feet per minute (cfm) was installed to deliver the injection air to the AS wells, while the SVE system used a separate blower, rated at 500 cfm, to recover vapors from the extraction wells. The injection and extraction blowers, the vapor treatment system, and associated equipment were contained in a treatment compound located west of Building 230. The operation of the AS/SVE system is described in detail in the addendum to the Final Operation and Maintenance (O&M) Manual (Battelle, 2004). Appendix B1 provides remedy-related documentation, and Appendix B2 provides a schematic diagram of the AS/SVE system.

The VCT system consists of four injection wells and four extraction wells located in the LEPA of OU 1 Area 1 (Figure 4-2). Submersible pumps in each extraction well are designed to extract groundwater at a flowrate of 30 to 40 gpm. The extracted groundwater is pumped through various holding tanks and bag filters before being treated with GAC to remove organic contaminants (e.g., 1,1-DCE, TCE, PCE, etc.). After the water passes through the GAC units, the treated water is pumped back into the aquifer through the four injection wells, each at a flowrate of 25 gpm. The target groundwater treatment flowrate is 100 gpm. The operation of the VCT system is described in detail in the *Final Operations and Maintenance Manual, Vertical Circulation Treatment System, Leading Edge Plume Area, Marine Corps Air Station, Yuma,*

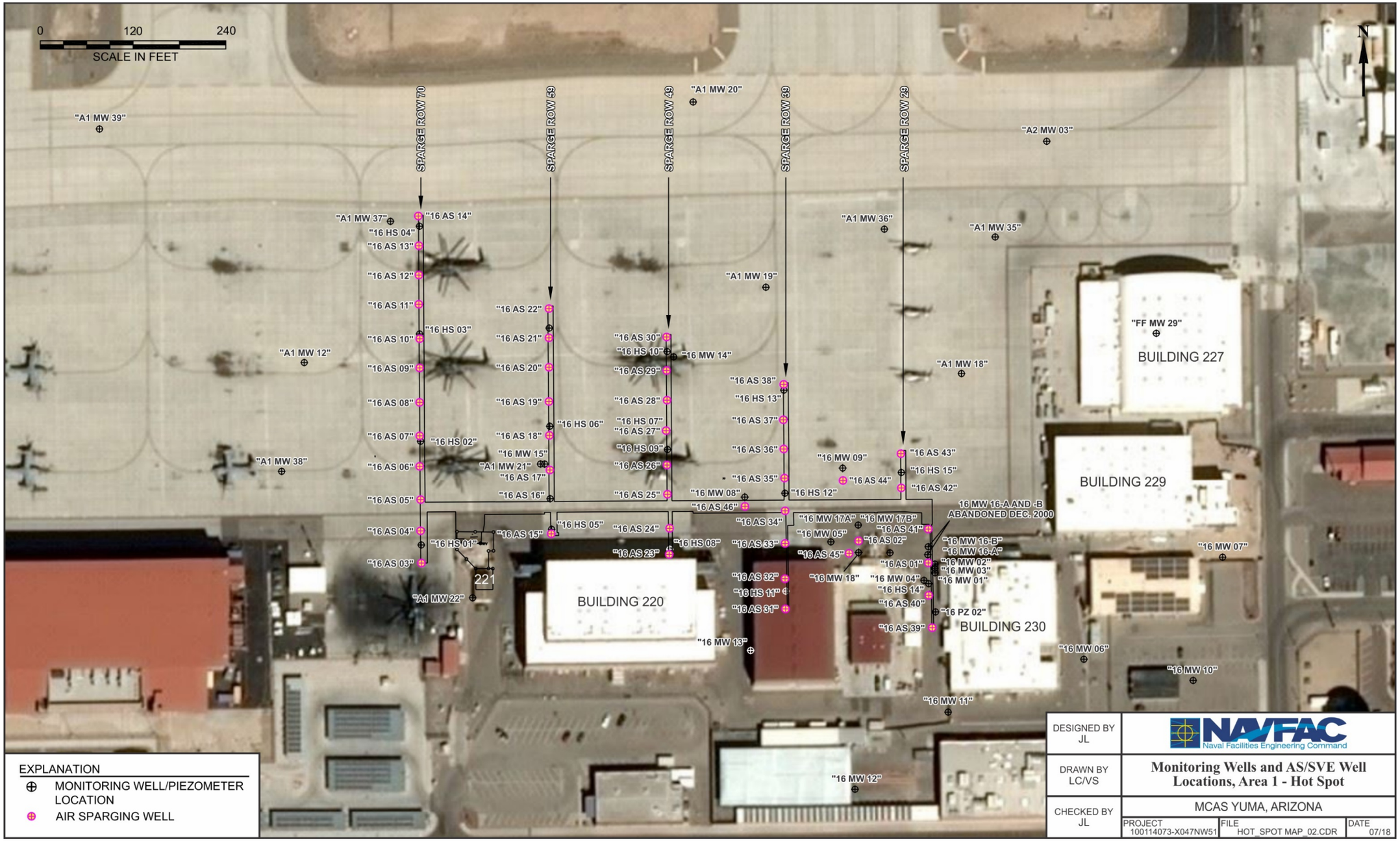

Figure 4-1. OU 1 Area 1 Hot Spot Monitoring Well and AS Well Map

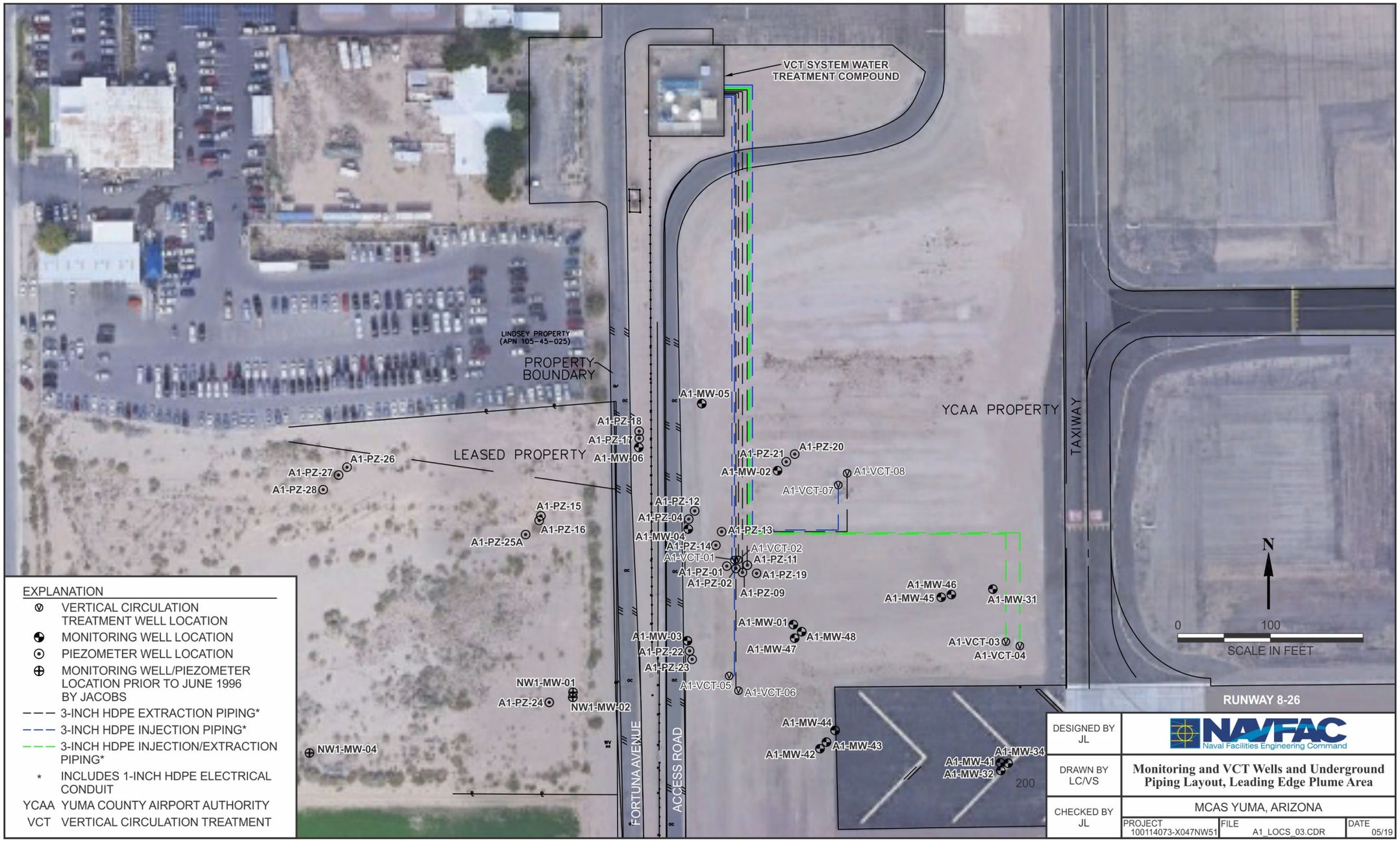

Figure 4-2. OU 1 Area 1 LEPA Monitoring Well and VCT Well Map

Arizona (Gutierrez Canales Engineering, PC [GCE], 2011). The system was in operation at the time of the FYR inspection as outlined in the Final O&M Manual; however, due to system downtime (maintenance, repairs, GAC backwashing, malfunctioning equipment, base operations, etc.), the average groundwater treatment rate since operation restarted in 2011 is below the target rate of 100 gpm. Appendix B3 provides a schematic diagram of the VCT system.

4.1.2.2 OU 1 Area 1 Long-Term Monitoring Plan. The OU 1 LTM plan was initiated in 1999 (OHM Remediation Services Corp., 1999b). An updated LTM sampling and analysis plan (SAP) was initiated in 2012 (GCE, 2013) and subsequent LTM SAP updates have been issued since that time based upon site characteristics and agreements with the regulatory agencies. The LTM SAP identifies the list of monitoring wells sampled, sampling frequency, and monitoring and sampling methods that are being used. The most recently approved LTM SAP available during this review period was finalized in April 2018 (Tetra Tech, 2018).

4.1.2.3 MCAS Yuma Master Plan. The MCAS Yuma Master Plan contains a detailed review of all physical conditions, resources, and tenant commands present at MCAS Yuma and the planned development of the station in the foreseeable future. It was developed to support the MCAS Yuma mission and implement the station's strategic plan. In order to control the areas of potential risk from exposure to groundwater contamination at OU 1 Area 1 and ensure that future land use would not result in unacceptable levels of risk to human health or the environment, restrictions (i.e., LUCs) are presented in the MCAS Yuma Master Plan. The MCAS Yuma Master Plan was revised in September 2001 (KTUA, 2001) and again in November 2007 (KTUA, 2007) to include the LUCs for OU 1 as identified in the Final OU 1 ROD (NAVFAC SW, 2000). Figure 3-3 (based on Figure 5-16 of the updated MCAS Yuma Master Plan [KTUA, 2007]) shows the locations of the OU 1 areas and the boundaries of the required ICs as defined by the Master plan and subsequent revisions.

4.1.2.4 Land Use Control Implementation Plan. The LUCIP was last updated in 2017 (NAVFAC SW, 2017b) to include a current figure set for OU 1.

As stated in the final LUCIP (NAVFAC SW, 2017b), the LUCs summarized below apply to OU 1 Area 1, which remains an active site. The other OU 1 areas have received NFA status.

- Restricted access to contaminated groundwater, including no unauthorized installation of groundwater wells or use of untreated contaminated groundwater for drinking water purposes until cleanup goals are met or FFA signatories agree that LUCs are no longer required.
- No use of property constituting a change in land use that presents unacceptable risks to human health or the environment or that would interfere with or adversely affect remedial actions.
- No use of property limiting access or reducing protection of the operational integrity of the AS/SVE system, VCT system, and monitoring wells.
- No use of property allowing the off-site migration of COCs at concentrations greater than MCLs; relevant MCLs are 5 µg/L for TCE; 5 µg/L for PCE; and 7 µg/L for 1,1-DCE.

Along with the LUCs summarized above, OU 1 Area 1 is surrounded by fencing which effectively limits access.

4.1.3 OU 1 Area 1 System Operations & Maintenance. This section presents the O&M activities associated with the remedial systems and the LTM program for OU 1 Area 1 including Area 1 AS/SVE System O&M; Area 1 VCT system O&M; Area 1 groundwater monitoring; Area 1 groundwater modeling; an Area 1 groundwater investigation for 1,4-dioxane and CHCs; and annual system operations and O&M costs.

4.1.3.1 Area 1 AS/SVE System O&M. The AS/SVE system began operation on November 16, 1999 and operated relatively continuously, except for maintenance and monitoring interruptions, until May 9, 2007, when the system was placed on temporary shutdown, with U.S. EPA concurrence. Before November 2002, the system was operated in a phased approach, whereby the sparged air was alternately directed into the different sparge rows of the well field. Typically, Rows 29, 39, and 59 (see Figure 4-1) were operated together, and Rows 49 and 70 were operated together for alternating 1-month periods. This injection pattern was used to increase the effectiveness of the system by allowing reestablishment of the natural groundwater gradient at the rows that were not operating, thus permitting groundwater to move through the well field. During the time period between November 2002 and the temporary system shutdown in May 2007, air injection was focused on the eastern portion of the site, where elevated contaminant concentrations persistently exceeded MCLs. Air was injected through Rows 29, 39, and 49 in an attempt to enhance CHC removal in the area. Soil vapor samples were periodically collected and analyzed by U.S. EPA method TO-14 prior to GAC treatment to monitor system performance, demonstrate air emission compliance, and calculate the cumulative CHC mass removed.

On August 16, 2006, the DON submitted a letter to U.S. EPA and ADEQ, proposing temporary shutdown of the AS/SVE system in Area 1 (NAVFAC SW, 2006a). The request was supported by a technical memorandum demonstrating that the AS/SVE system was no longer removing sufficient mass to justify continued operation (NAVFAC SW, 2006b). Further, the technical memorandum described how the temporary shutdown requirements of the ROD (NAVFAC SW, 2000) had been satisfied. Concurrence for shutdown of the Area 1 AS/SVE system was received from U.S. EPA on January 8, 2007 (Appendix B4). The Navy submitted a second letter to ADEQ, with the U.S. EPA concurrence attached, stating that ADEQ concurrence with temporary shutdown of the AS/SVE system would be assumed unless ADEQ responded otherwise within 10 days (NAVFAC SW, 2007). No response was received from ADEQ.

The AS/SVE system was temporarily shut down on May 9, 2007. However, rebound of contaminants in groundwater was eventually observed in the vicinity of the AS/SVE system. Therefore, the system was restarted in a pulsed injection pattern on July 15, 2013, to determine whether recovery of additional contaminant mass was feasible and whether system recovery would remain asymptotic. Injections were manually switched between Sparge Rows 29, 39, and 49, and Sparge Rows 59 and 70 each week until January 15, 2014. The AS/SVE system was temporarily shut down again on January 15, 2014, and currently remains off.

Based on soil vapor sampling results, approximately 79 pounds of COCs were removed from the subsurface between system startup in November 1999 and temporary shutdown in January 2014 (MMEC Group, 2018a). The total mass removal rate remained relatively consistent between January 2002 and May 2007. However, the mass removal rate increased after system startup in July 2013. This increase in CHC removal (compared to the 2007 data collected before system shutdown) likely is attributable to the CHC rebound observed in groundwater in the vicinity of the AS/SVE system that occurred since the system had been shut down. After AS/SVE system startup in July 2013, the mass removal rate steadily declined until system shutdown in January 2014. This situation likely is due to a reduction in contaminant concentrations in groundwater resulting from AS/SVE system operation. Groundwater concentration trends within the monitoring wells associated with the AS/SVE system continue to be monitored in accordance with the LTM plan, as stipulated in the ROD.

4.1.3.2 Area 1 VCT System O&M. The VCT system began operation on June 16, 2000 and operated relatively continuously except for routine maintenance and monitoring, such as replacement of filters and pumps. In September 2002, it was noted that injection well VCT-01 and extraction well VCT-06 were not operational due to a collapsed well casing and a faulty pump, respectively (see Figure 4-2). Consequently, the system was operated in three injection wells and three extraction wells from September 2002 to May 2003. Influent and effluent process water samples were collected during operation. Effluent sample results never exceeded established MCLs.

On February 24, 2003, the DON submitted a letter to U.S. EPA and ADEQ, proposing the temporary shutdown of the VCT system at the LEPA of Area 1. The request was supported by a technical memorandum describing how temporary shutdown requirements of the ROD had been satisfied for the VCT system at the LEPA (Battelle, 2003). Concurrence for the temporary shutdown of the VCT system was received from U.S. EPA on April 24, 2003, and from ADEQ on April 25, 2003 (Appendix B5). The VCT was temporarily shut down on May 6, 2003, following concurrence by U.S. EPA and ADEQ.

Analytical results from influent and effluent water samples were used to calculate CHC mass removal by the VCT system. In May 2003 at the time that the system was temporarily shut down, an estimated 10.7 lbs of total mass had been removed from approximately 136,591,000 gallons of extracted groundwater since system startup (Battelle, 2010).

On September 6, 2005, the DON submitted a letter to U.S. EPA, proposing permanent shutdown of the VCT system. The request was supported by a technical memorandum demonstrating that the COCs in groundwater in the vicinity of the VCT system had remained at or below MCLs for a period greater than 2 years and that remaining CHC concentrations would not migrate off-station above the MCLs as determined using a groundwater model (Battelle, 2005). The technical memorandum describes how the permanent shutdown requirements of the ROD (NAVFA SW, 2000) had been satisfied. Concurrence for shutdown of the VCT system was received from U.S. EPA on December 1, 2005 (Appendix B6). The system was permanently shut down in December 2005.

Due to COC rebound in groundwater in the vicinity of the VCT system, the system resumed operations in July 2011 and as of the date of the inspection for this FYR remains operational. Since system restart in July 2011, it has removed an estimated 2.6 lbs of COCs from approximately 273,457,000 gallons of extracted groundwater (MMEC Group, 2018a). Section 5.1.3 discusses activities associated with the Area 1 VCT system that have been performed since the last FYR.

4.1.3.3 Area 1 Groundwater Monitoring. Groundwater monitoring has been performed in Area 1 since commencement of the RAs. The LTM program is currently comprised of semi-annual monitoring events whereby select wells are monitored for standard water quality parameters and MNA parameters. During the monitoring events, groundwater samples are collected for laboratory analysis of CHC concentrations using U.S. EPA method 8260.

During the February 2012 compliance sampling event, 1,4-dioxane was analyzed in influent and effluent VCT samples. Based on the analytical results, the DON notified the U.S. EPA and ADEQ of the presence of 1,4-dioxane in groundwater at Area 1. The DON, U.S. EPA, and ADEQ agreed that the OU 1 Area 1 groundwater monitoring well network should be sampled for 1,4-dioxane. Hence, the LTM SAP was revised to include analysis for 1,4-dioxane in addition to the COCs established in the OU 1 ROD (NAVFAC SW, 2000) and was submitted to the regulatory agencies for review on March 27, 2012. After SAP approval, sampling for 1,4-dioxane within the OU 1 Area 1 groundwater monitoring well network began in May 2012. 1,4-dioxane results have been included in monitoring reports since inclusion of that compound in the monitoring program.

There currently is no MCL for 1,4-dioxane. The U.S. EPA Office of Water placed 1,4-dioxane on the drinking water contaminant candidate list (CCL) in 2009 (U.S. EPA, 2009b). The CCL is a list of contaminants currently not subject to any proposed or promulgated *National Primary Drinking Water Regulations* but that are known or anticipated to occur in public water systems and that may require future regulation under the SDWA. The U.S. EPA Regional Screening Level (RSL) for 1,4-dioxane in tap water is 0.46 µg/L (U.S. EPA, 2019). However, the RSL is a screening level rather than a cleanup level. The maximum concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4} (Trevet, 2016). 1,4-Dioxane concentrations do not exceed the U.S. EPA health advisory of 35 and 200 µg/L for carcinogenic or non-carcinogenic effects, respectively, anywhere within the plume. There are no drinking water wells within a mile downgradient of the site, and results of a risk assessment conducted for the 2014 groundwater study showed that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016).

Analysis for per- and polyfluorinated alkyl substances (PFAS) was initially conducted in a site-wide assessment conducted in November 2016 (MMEC Group, 2018b). There currently is no MCL for PFAS compounds. The screening level for the combined concentration of perfluorooctane sulfonate (PFOS) and perfluorooctanaoic acid (PFOA) is 0.07 µg/L, based on the U.S. EPA lifetime Health Advisories for public drinking water (U.S. EPA, 2016). PFOA and PFOS were analyzed in 27 wells in OU 1 Area 1 in 2016. PFOS and PFOA were detected in 20 and 24 of 27 wells, respectively. The lifetime Health Advisory of 0.07 µg/L for PFOA and PFOS combined was exceeded in 8 of the 27 wells. In 2017, PFOA and PFOS were analyzed in 2 hot

spot wells (16-MW-08 and 16-HS-03) in July and August. Well 16-MW-08 had exceedances of the lifetime Health Advisory in both the July and August 2017 samples with PFOA-PFOS combined concentrations of 0.086 and 0.085 µg/L, respectively (MMEC Group, 2018b).

Historical and current concentrations of 1,1-DCE, TCE, and PCE in the Hot Spot and LEPA areas are shown in Figure 4-3 and Figure 4-4, respectively. Figure 4-5 shows the November 2017/February 2018 sampling results for COCs at wells throughout Area 1, which were current at the time of the FYR inspection and document review period. Concentrations exceeding the MCL for each COC on the historical and current maps are highlighted in yellow. Figure 4-6 presents a contour map of 1,1-DCE concentrations at Area 1, with time-series contours based on semi-annual sampling event results from November 2015, 2016, and 2017. Similar time-series contours of TCE concentrations are presented in Figure 4-7. Contour maps were not prepared for PCE due to the consistent, below-MCL concentrations observed throughout the FYR period. Activities associated with LTM of Area 1 since the last FYR, including the current groundwater sampling schedule, are provided in Section 5.1.3.

4.1.3.4 Area 1 Groundwater Investigation for 1,4-Dioxane and CHCs. In May 2014, a groundwater investigation was initiated at OU 1 Area 1. The objectives of this investigation were to: 1) further delineate the lateral and vertical extent of 1,4-dioxane; 2) provide additional data to support the development of a groundwater fate and transport model to assess the potential for off-site migration of 1,4-dioxane; and 3) evaluate the potential human health risk associated with 1,4-dioxane. CHCs were included in this investigation to provide a complete and current assessment of site characteristics (Trevet, 2016).

The phased investigation included advancement of 30 cone penetrometer test (CPT) borings to depths of 80 to 90 ft bgs, followed by installation of 30 temporary wells to support 1,4-dioxane delineation efforts. 1,4-Dioxane was observed to correspond with the distribution of historic site COCs (i.e., CHCs) with detections observed from the Hot Spot Area to the LEPA. The highest 1,4-dioxane concentrations from temporary wells were observed in the LEPA with detections of 2.6 and 1.4 µg/L from wells A1-TMW-26 and A1-TMW-27, respectively, which exceeded the 2015 U.S. EPA RSL of 0.46 µg/L. One additional 1,4-dioxane detection in well A1-TMW-08 at a concentration of 0.47J µg/L exceeded the RSL value. TCE and 1,1-DCE were also observed in a limited number of temporary wells with concentrations well below their respective MCL values.

Seven new permanent groundwater monitoring wells were installed in October and November 2014 during the second phase of the groundwater investigation including wells A1-MW-49, A1-MW-50, A1-MW-51, A1-MW-52, A1- MW-53, A1-MW-54, and A1-MW-55. Sampling results from January and February 2015 identified the highest 1,4-dioxane concentrations near the Hot Spot Area in wells 16-HS-03 (54 µg/L) and 16-MW-09 (27 µg/L). A number of wells in the LEPA had 1,4-dioxane concentrations exceeding the 2015 U.S. EPA RSL of 0.46 µg/L with observed concentrations ranging from 0.85J to 5.2 µg/L. No historic COCs (e.g., 1,1-DCE, TCE, or PCE) exceeded their respective MCLs in the LEPA. Figure 4-8 presents a contour map of 1,4-dioxane concentrations at Area 1, with time-series contours based on semi-annual sampling event results from November 2015, 2016, and 2017.

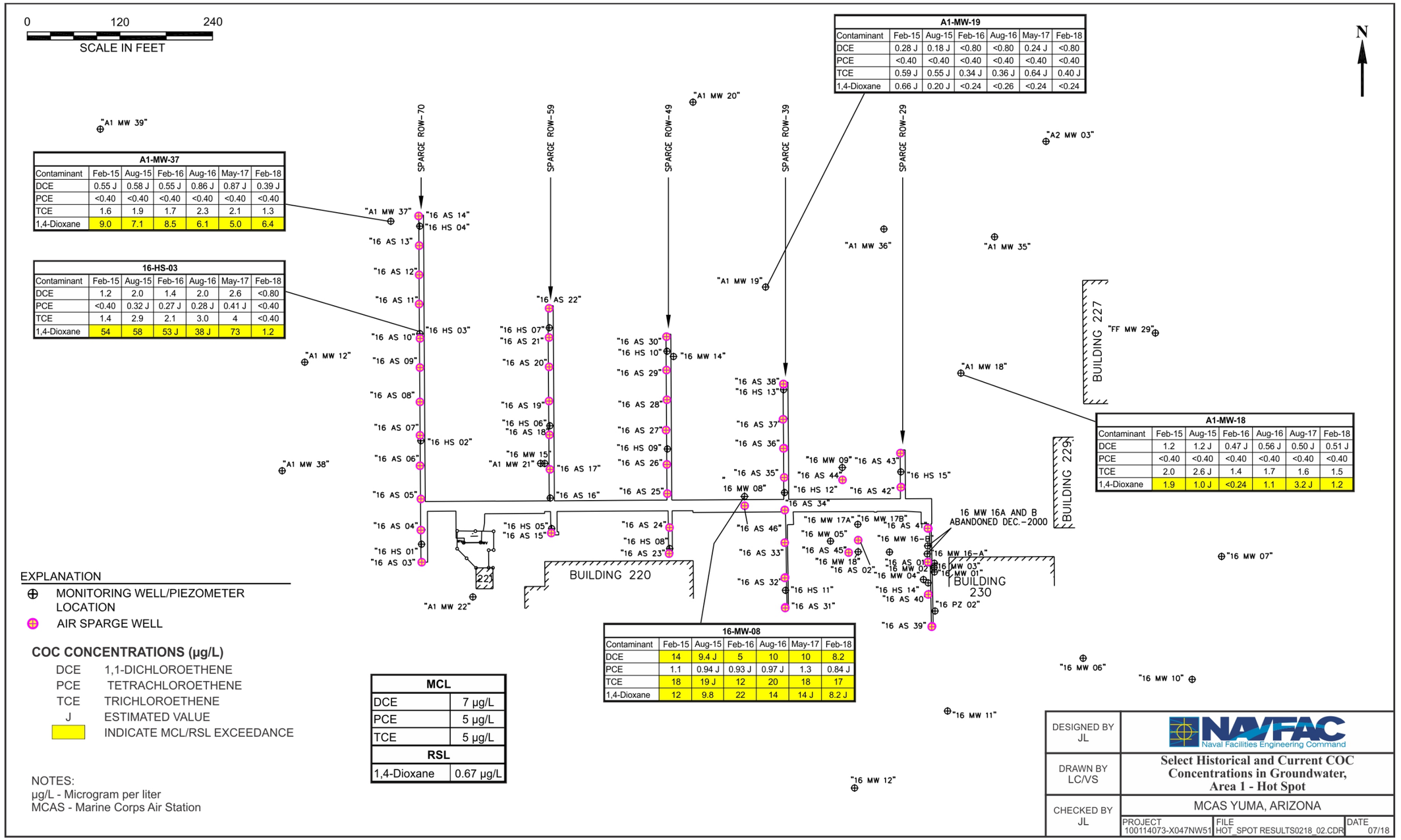

Figure 4-3. Historical Concentrations of 1,1-DCE, TCE, PCE and 1,4-Dioxane in the OU 1 Area 1 Hot Spot

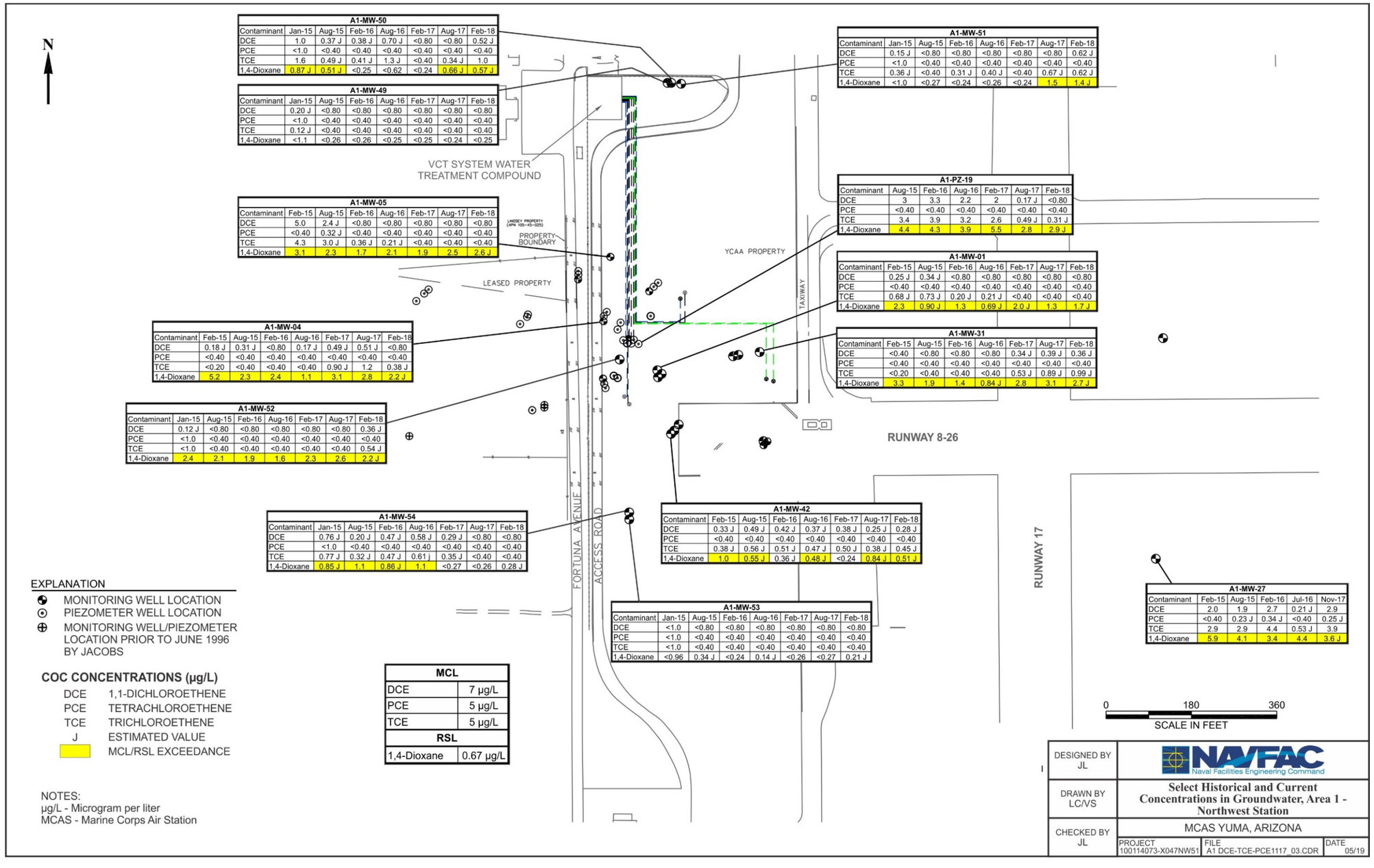

Figure 4-4. Historical Concentrations of 1,1-DCE, TCE, PCE and 1,4-Dioxane in the OU 1 Area 1 LEPA

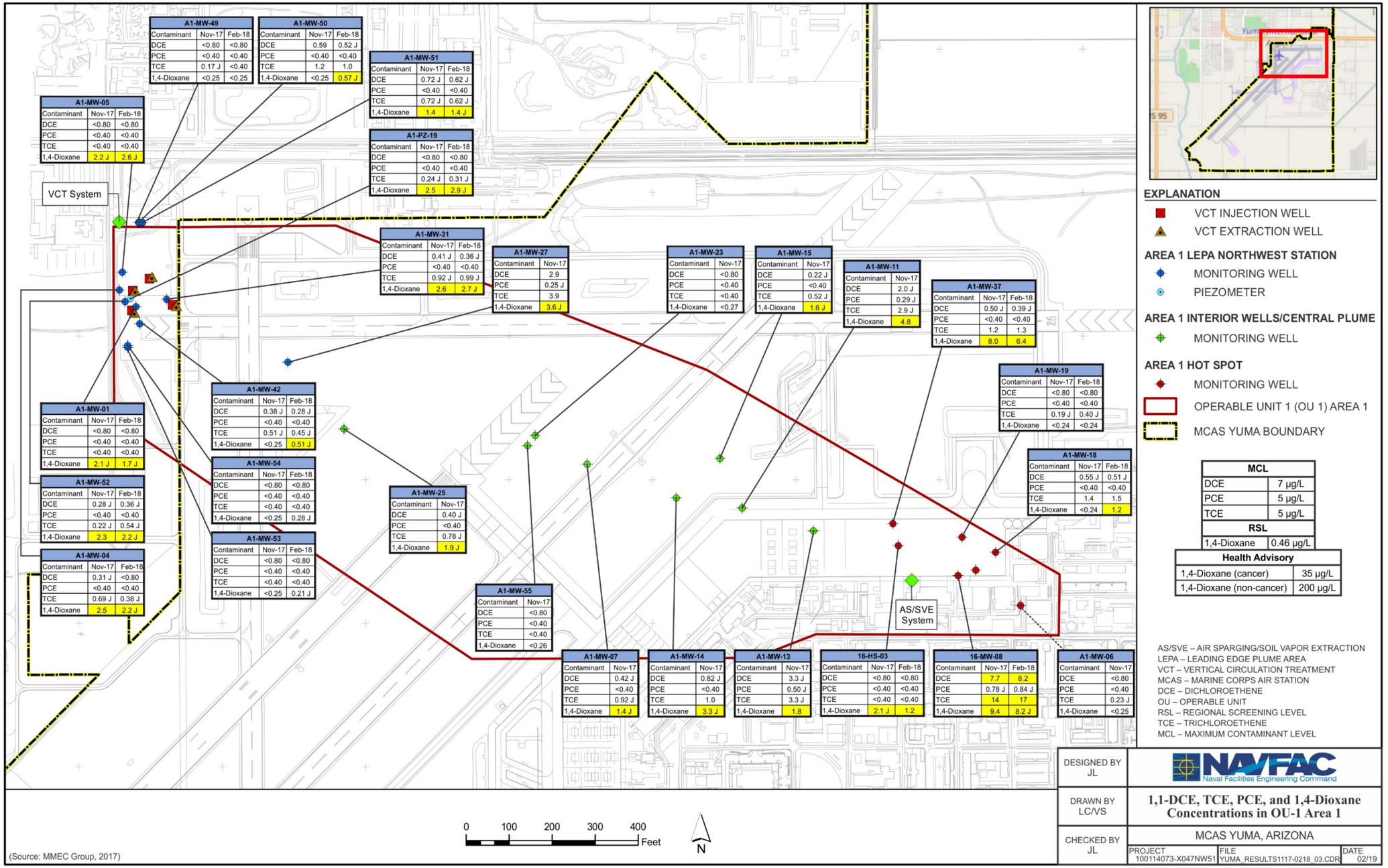

Figure 4-5. Current Concentrations of 1,1-DCE, TCE, PCE and 1,4-Dioxane in OU 1 Area 1

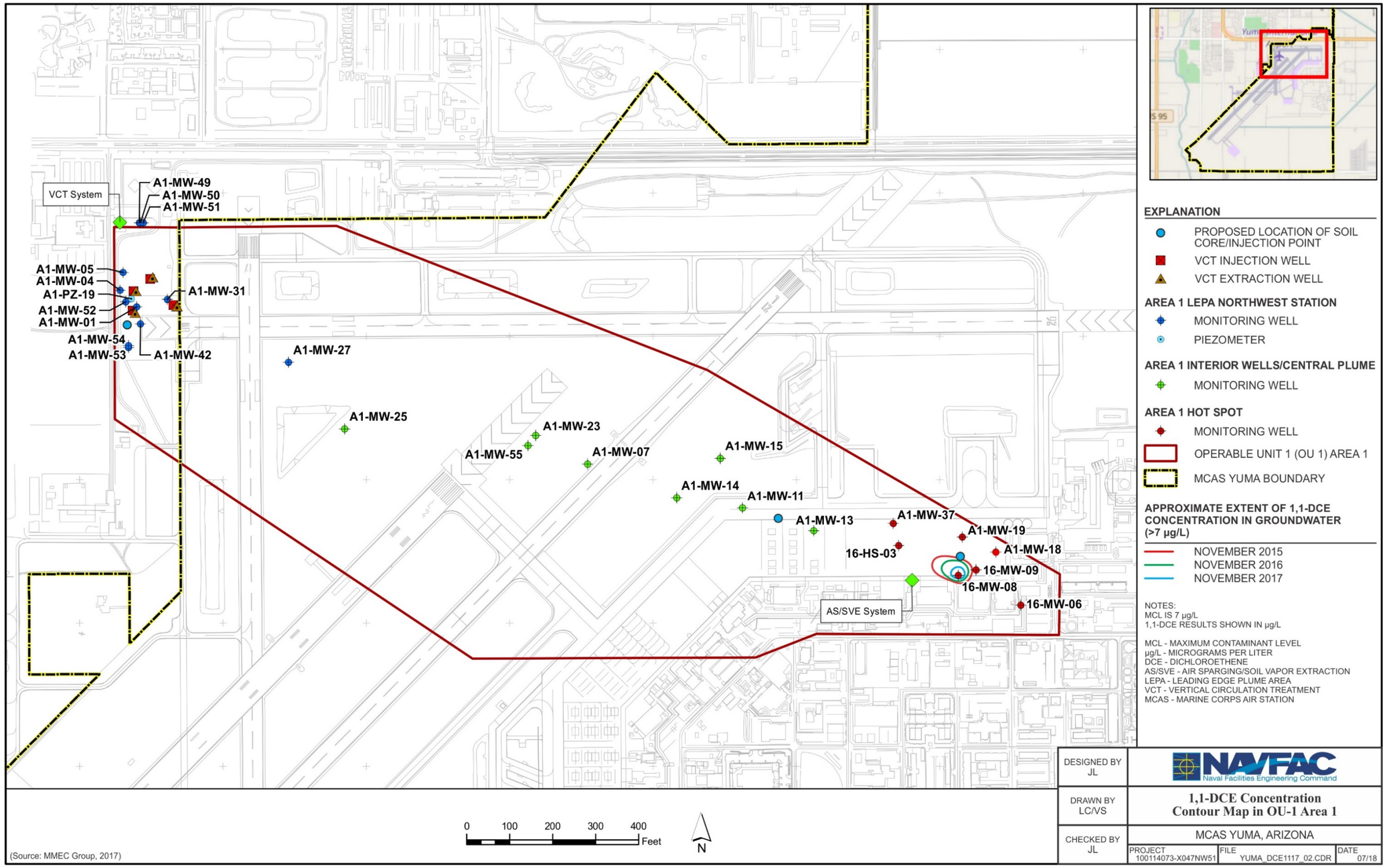

Figure 4-6. Current and Historical Contour Map of 1,1-DCE Concentrations in OU 1 Area 1

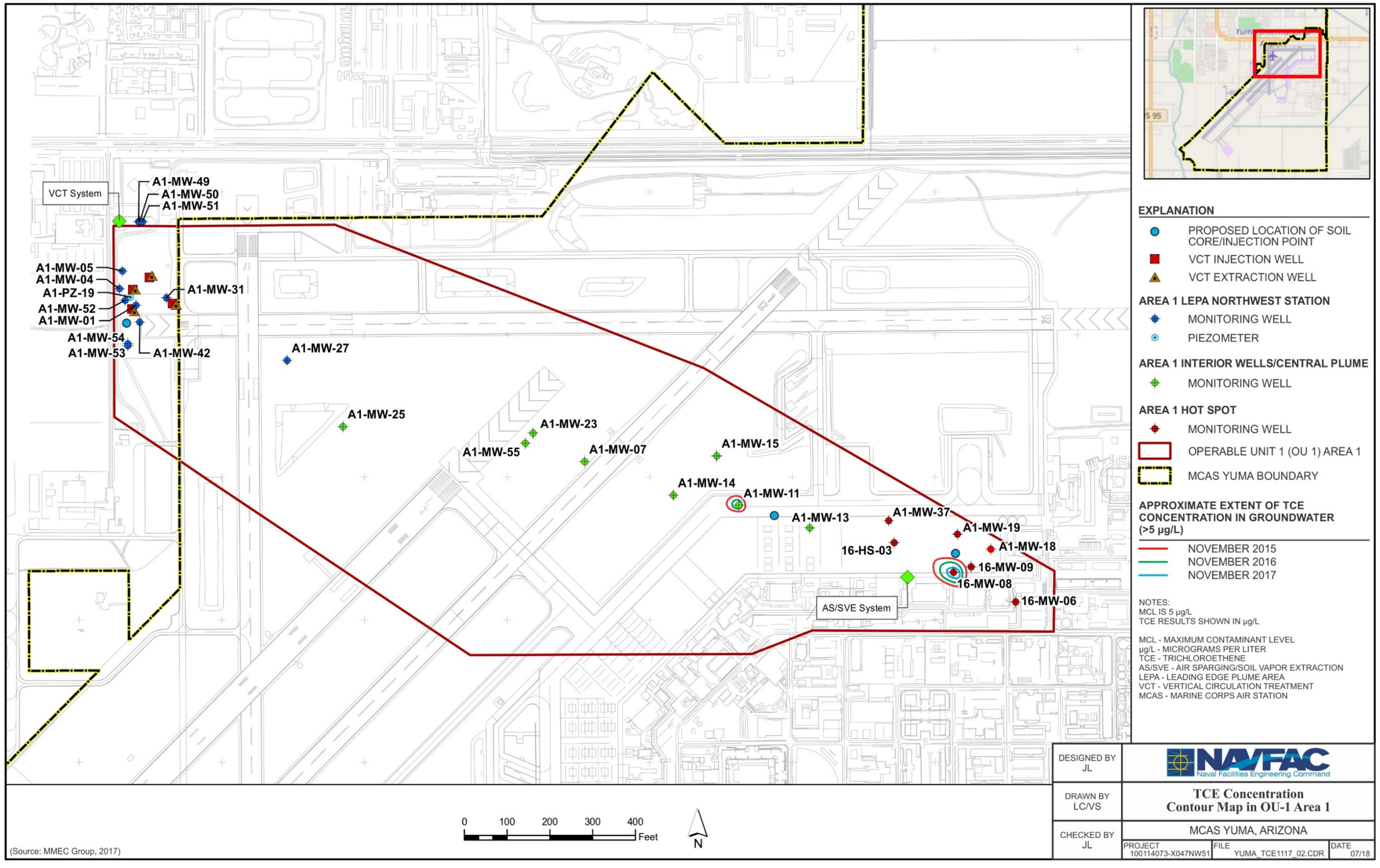

Figure 4-7. Current and Historical Contour Map of TCE Concentrations in OU 1 Area 1

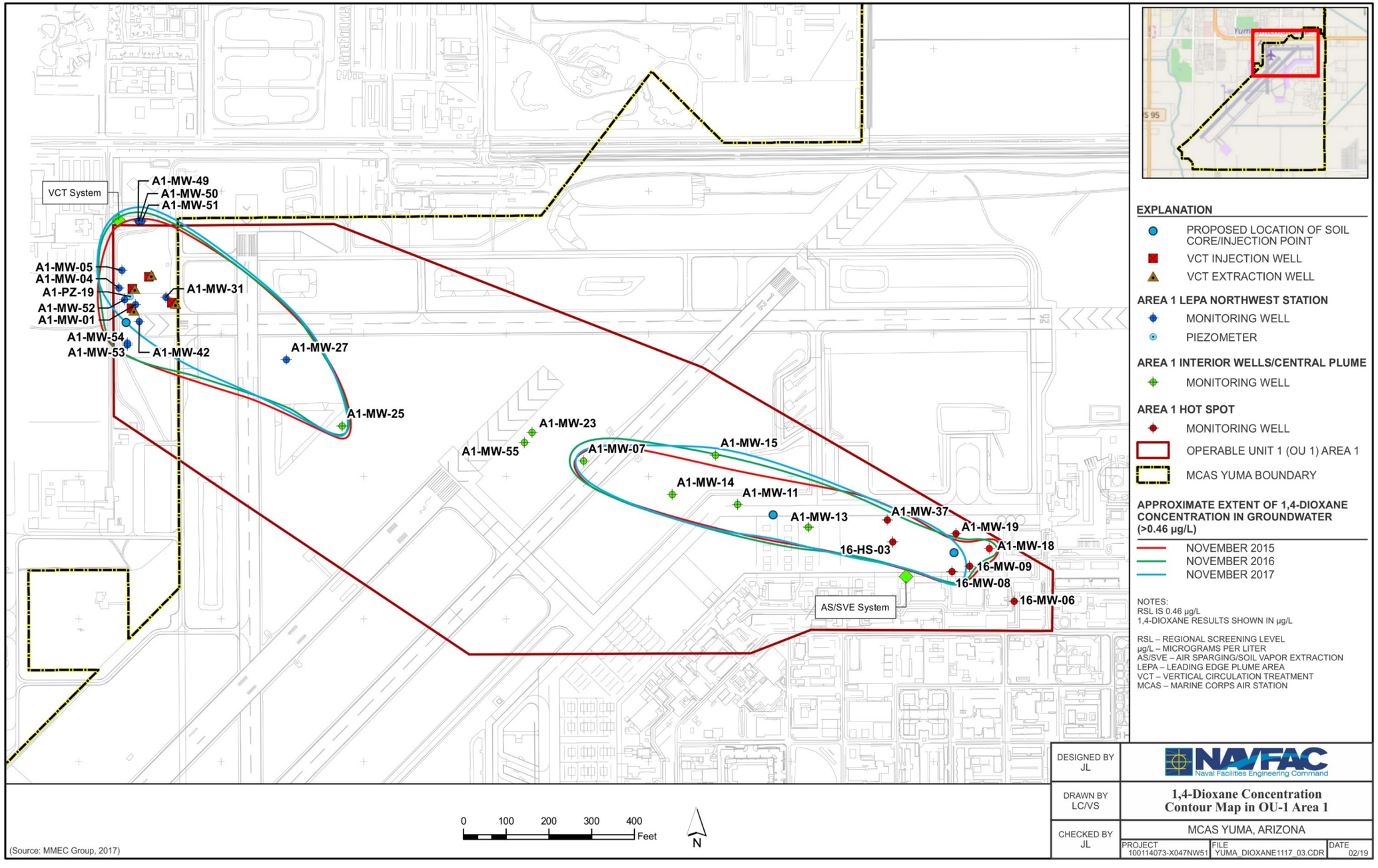

Figure 4-8. Current and Historical Contour Map of 1,4-Dioxane Concentrations in OU 1 Area 1

4.1.3.5 Area 1 Groundwater Modeling. Groundwater flow and transport modeling was performed as part of a supplemental groundwater investigation at OU-1 Area 1 (Trevet, 2016). The three-dimensional groundwater flow and transport model was developed to assist with evaluating the potential human health risk associated with the COCs and 1,4-dioxane. The model was also used to determine whether the dissolved-phase contaminant plume would migrate to the Site boundary at concentrations at or above the COCs' MCLs. Results of the modeling are included in Section 5.1.3.2.

4.1.3.6 Annual System Operations/O&M Costs. Table 4-2 provides the annual system O&M costs since the previous FYR. The total cost values for each period reflect costs for O&M of the AS/SVE and VCT systems, groundwater monitoring, and preparation of the quarterly progress and groundwater monitoring reports. Costs for work performed beyond these parameters (including well decommissioning activities) are not included in Table 4-2.

Table 4-2. Annual System Operation and Maintenance Costs

Dates		Total Annual Costs[1]
From	To	
July 2015	June 2016	$616,000
July 2016	June 2017	$616,000
July 2017	June 2018	$616,000

[1] Total costs are rounded to the nearest $1,000.

4.2 Remedial Actions for Operable Unit 2

This section describes remedy selection, remedy implementation, and remedy performance for OU 2 and identifies any changes to or problems with the components of the remedy.

4.2.1 OU 2 Remedy. This section describes the OU 2 remedy in terms of the OU 2 RAO, ARARs, selected remedy, and 2014 ESD to the Final ROD for OU 2.

4.2.1.1 OU 2 Remedial Action Objective. The RAO for OU 2 CAOCs 1, 8A, and 10 is to minimize the potential for unacceptable human-health risk that could result from a change in land use (Uribe & Associates, 1996b). The RAO was determined as a result of the HHRA conducted for each site in the OU 2 RI (JEG, 1996a) and FS (Uribe & Associates, 1996b). The results indicated that potentially unacceptable cancer risk levels could result from residential land use and unrestricted exposure to surface and shallow subsurface soil at the three sites. However, the cancer risk for the current and anticipated future land use scenario, assuming industrial land use, was estimated to be within the U.S. EPA acceptable range.

4.2.1.2 OU 2 Applicable or Relevant and Appropriate Requirements. Arizona's Soil Remediation Standards are identified in the OU 2 ROD as relevant and appropriate chemical-specific requirements for the remediation of soil at CAOCs 1, 8A, and 10. These rules are relevant and appropriate, but not applicable because the RA is being conducted under federal law (e.g., CERCLA) and not as one of the State of Arizona's regulatory programs. For more information, see the OU 2 ROD (Uribe & Associates, 1997b) and the rules as summarized in ARS Title 49, §§ 151 and 152, and the AAC Title 18, Chapter 7, Article 2, Soil Remediation

Standards (§§ R18-7-201 through R18-7-209). These rules allow for soil remediation to one of the following three standards:

- Remediation to background levels;
- Remediation to health-based guidance levels (HBGLs) presented in Appendix A SRLs of AAC Title 18, Chapter 7, Article 2; or
- Remediation to levels derived from a site-specific risk assessment.

In addition, at sites where remediated soil does not meet residential standards or background levels, but rather industrial or site-specific standards, the rules previously required the submittal of a VEMUR. However, in July of 2000, subsequent to the signing of the OU 2 ROD, Arizona's Soil Remediation Standards were amended. The amended rules eliminated the VEMUR and replaced it with a DEUR as the appropriate document for recording a property's environmental land use restrictions with the State of Arizona (see Arizona Laws 2000, Chapter 225 amending ARS § 49-152 [Title 49, Chapter 1, Article 4]). The DEUR requires LUCs to be recorded as a covenant running with the land, which is not allowed by the federal policy. Because soil at CAOCs 1, 8A, and 10 meets industrial but not residential cleanup standards and because the VEMUR was determined to be relevant and appropriate in the OU 2 ROD (but was subsequently replaced by the DEUR), the DON proposed an ESD to amend the OU 2 ROD and eliminate the VEMUR/DEUR requirements (see Section 4.2.1.4 below).

4.2.1.3 OU 2 Selected Remedy. The selected remedy as defined in the ROD consists of ICs restricting land use at CAOC 1 and CAOC 10 to industrial/commercial use and at CAOC 8A to the current use (i.e., inactive landfill) and to prevent any activities that may disrupt or expose the landfill interior. The ICs are implemented through the MCAS Yuma Master Plan (former Base Master Plan), which references the OU 2 ROD. The ICs summarized below are identified in the ROD.

- Restrict land use at CAOCs 1 and 10 to industrial/commercial use.
- Restrict land use at CAOC 8A to current use and prevent any activities that may disrupt and expose the landfill interior.
- Provide a legal description of site boundaries and a site map for each site.
- Execute and record a VEMUR with the state of Arizona for each site.
    - The VEMUR would contain language clarifying that it was executed and recorded by the federal government "for itself only, and not as a covenant running with the land". In addition, it would clarify that:
        a. No interest in real property on behalf of the state of Arizona is created by the VEMUR or by any notice of cancellation of the VEMUR pursuant to ARS § 49-152, and
        b. The signature of an authorized representative of the ADEQ on the document acknowledges that the remediation of the property was conducted in accordance with the provisions of ARS § 49-152.

- Any future activities planned for the area must be coordinated with and reviewed by the MCAS Yuma Environmental Department, including official consultation with the DON, in consultation with U.S. EPA and ADEQ as necessary.

A change in land use from industrial to residential use would require reevaluation of the remedy for CAOCs 1 and 10. For CAOC 8A, a change in land use that would involve activities that may lead to disruption of the site surface and exposure of the landfill contents would require the reevaluation of the remedy for compatibility with the desired activity. The remedy could be changed pursuant to CERCLA §§ 120 and 121 and NCP § 300.430(f)(4)(iii), and further investigation could be undertaken to determine if remediation is required and if the ROD must be amended.

If the DON intended to excess the property to a nonfederal entity, it must notify the ADEQ and U.S. EPA in advance of the execution of any transfer. The DON would again consult with the ADEQ and U.S. EPA in revisiting the existing land use classification and restrictions for the CAOCs involved to determine if the foreseeable future land use would differ from the assumptions made at the time the original remedial action decision was made. A reevaluation of the ICs would be performed if necessary at that time.

4.2.1.4 2014 Explanation of Significant Differences to the Final ROD for OU 2. In August 2014, the *Final Explanation of Significant Differences to the Final Record of Decision for OU 2, Marine Corps Air Station Yuma, Arizona* was signed (NAVFAC SW, 2014a). The ESD documents the changes in the selected remedy outlined in the Final ROD for OU 2 (Uribe & Associates, 1997b). Specifically, it documents the elimination of the requirement to record VEMURs with the State of Arizona for active sites within OU 2. As outlined in the ESD, VEMURs no longer exist in the State of Arizona and the DON cannot comply with the DEUR language due to federal policy prohibiting against that language. Therefore, in consultation with the U.S. EPA and the ADEQ, the ESD was finalized to eliminate the requirement of submitting VEMURs (now DEURs) for CAOCs 1, 8A, and 10 from the Final OU 2 ROD.

The remedy for CAOCs 1, 8A, and 10 remains protective of human health and the environment without the submittal of VEMURs because the OU 2 ROD requirements for limiting exposure through implementation of ICs are being met through other processes. As required by the ROD, MCAS Yuma will continue to utilize the MCAS Yuma Master Plan to implement land-use restrictions. The MCAS Yuma Master Plan uses language approved by the U.S. EPA and ADEQ to provide notification to planners and project proponents regarding the locations of CAOCs 1, 8A, and 10, and the details of restrictions for these areas. The MCAS Yuma Master Plan also references the LUCIP, describes that the LUCIP provides specific land-use guidance for the management of station IR sites, and indicates the LUCIP's availability through the MCAS Yuma Environmental Department. In addition to the MCAS Yuma Master Plan, implementing processes described in the LUCIP are used to enforce the LUCs at CAOCs 1, 8A, and 10. The LUCIP describes implementation, monitoring, and reporting procedures (NAVFAC SW, 2014b).

The remedy for CAOCs 1, 8A, and 10 remains protective of human health and the environment in the event of future property transfer without the submittal of VEMURs because of notification requirements provided by the ROD and the LUCIP. As required by the ROD, if the DON plans

to excess the property to a non-federal entity, it will notify the ADEQ and U.S. EPA in advance of the execution of any such transfer and will advise the transferee that the property will be subject to a DEUR at the time of transfer. The DON will consult with the ADEQ and U.S. EPA in revisiting existing land-use classifications and restrictions for the CAOCs to determine if the foreseeable future land use after transfer is anticipated to differ from the assumptions made at the time the original RA decision was made. At that time, a re-evaluation of the appropriate institutional controls will be undertaken by the DON in consultation with the U.S. EPA and ADEQ. If the property is transferred to another federal agency, the DON will include a description of the restrictions in the transfer documents and advise the transferee of the obligation to document the restrictions in any future federal deed.

The LUCIP states that the DON must comply with CERCLA §120(h)(3) in the event of transfer or lease of real property that has LUCs to any non-federal entity. In transferring restricted-use property, CERCLA §120(h)(3)(A)(ii) requires the DON to covenant that all RA necessary to protect human health and the environment with respect to any hazardous substance remaining on the property has been taken before transfer and that any additional RA found to be necessary after the date of transfer will be conducted by the DON. When the selected remedy includes land-use restrictions, an element of the required covenant is the implementation of the land-use restrictions by the transferee through deed restrictions or DEURs. The site boundaries and the conditions, terms, and limitations of LUCs must be described in Findings of Suitability for Transfer and recorded in deeds. The DON retains the right to enter and inspect the property to ensure the viability of LUCs and to perform any additional remedial response actions. If the base is transferred in the future to a non-federal entity, the DON must place the restrictions in covenants that run with the land in accordance with applicable State laws so that subsequent transferees are as equally bound as the immediate transferee. Deeds for restricted-use property will contain requirements for subsequent owners to report annually to the DON and regulatory agencies on the viability of the LUCs. These requirements as well as requirements for notification of regulatory agencies in the event of federal-to-federal transfers are discussed in the 2001 DoD policy on LUCs associated with environmental restoration activities, included as an appendix to the updated 2014 LUCIP (NAVFAC SW, 2017b).

4.2.2 OU 2 Remedy Implementation. The following sections present the OU 2 remedy implementation, including the OU 2 RA report, MCAS Yuma Master Plan, and final LUCIP. The actions described below were taken post-ROD to implement the remedy selected for OU 2 of ICs for CAOCs 1, 8A, and 10.

4.2.2.1 OU 2 Remedial Action Report. The Final Remedial Action Report for OU 2 (GEOFON, 1999) included an information summary and ICs for CAOCs 1, 8A, and 10 in a recommended addendum to the MCAS Yuma Master Plan. A VEMUR application package containing a summary of pertinent site conditions and legal description of the site boundaries was included as a part of the addendum. A land survey of CAOCs 1, 8A, and 10 was used to produce the legal descriptions and site maps (Don Peterson Engineers, 1999).

4.2.2.2 MCAS Yuma Master Plan. The MCAS Yuma Master Plan contains a detailed review of all physical conditions, resources, and tenant commands present at MCAS Yuma and the planned development of the station in the foreseeable future. The MCAS Yuma Master Plan was

developed to support the MCAS Yuma mission and implement the station's strategic plan. In order to control the areas of potential risk from exposure to soil contamination at OU 2 CAOCs 1, 8A, and 10 and ensure that future land use would not result in unacceptable levels of risk to human health or the environment, the necessary restrictions were presented in a revision to the MCAS Yuma Master Plan. The MCAS Yuma Master Plan was revised in September 2001 (KTUA, 2001) and again in November 2007 (KTUA, 2007) to contain the ICs for OU 2 as identified in the ROD and provided in the Final Remedial Action Report for OU 2 (GEOFON, 1999). Figure 5-17 and Figure 5-18 of the updated MCAS Yuma Master Plan (KTUA, 2007) provide the locations of the OU 2 areas for which ICs apply and present the controls.

The MCAS Yuma Master Plan does not include a map of CAOC 8A showing the locations of the former disposal areas, as recommended in the ROD, or a map of the locations of PAHs in soil reported for CAOC 10 because the LUCs apply to the entire area of the site rather than just the former disposal areas or areas of PAHs. The site boundaries given for CAOCs 8A and 10 (as CAOCs 10A and 10B) in the MCAS Yuma Master Plan, for which the listed ICs apply, incorporate the corresponding areas of significance for both areas. Figure 3-4 shows the boundaries of the three CAOCs for which ICs are implemented as they appear in both the revised MCAS Yuma Master Plan (KTUA, 2007) and the Final LUCIP (NAVFAC SW, 2017b).

4.2.2.3 Land Use Control Implementation Plan. The original LUCIP was issued in September 2002 (NAVFAC SW, 2002a), was revised in 2014 (NAVFAC SW, 2014b) to address the 2009 FYR comments and again in 2017 (NAVFAC SW, 2017b) to incorporate MRP Sites 4 and 6. It describes implementation, monitoring, and reporting procedures and contains the following:

- description of the LUCs required by the OU 1, OU 2, and MRP Sites 4 and 6 RODs and the FFAAP AOC A VEMUR;
- current maps of MCAS Yuma showing the areas subject to the LUCs;
- listing of the LUC requirements and a designation of responsibility for meeting these requirements;
- descriptions of the mechanisms that will be used by the Navy and U.S. Marine Corps to meet the LUC requirements; and
- schedule and process for inspecting and reporting ongoing compliance with LUC requirements.

The LUCIP is to be used as a reference for installation personnel tasked with implementing and maintaining the LUC requirements.

4.3 Remedial Actions for MRP Sites 4 and 6

This section presents the remedy selection, the remedy implementation, and the remedy performance for MRP Sites 4 and 6 and identifies any changes to or problems with the components of the remedy.

4.3.1 MRP Sites 4 and 6 Remedy Selection. This section describes the purpose for remediation, the remedial alternatives developed and evaluated in the MRP Site 4 FS

(Trevet 2013a) and MRP Site 6 FS (Trevet, 2013b) against the nine CERCLA evaluation criteria for remedial alternatives, and the remedy selected in the ROD (NAVFAC SW, 2017a).

4.3.1.1 MRP Sites 4 and 6 Remedial Action Objective. The RAO for MC in soil at MRP Site 4 is to restrict land use to commercial/industrial use. The RAO for MC and MEC in soil at MRP Site 6 is to reduce potential explosive safety hazards associated with MEC and potential chemical hazards associated with MC by preventing interaction between receptors (people, plants, and animals) and MC and MEC in the subsurface (NAVFAC SW, 2017a).

4.3.1.2 MRP Sites 4 and 6 Applicable or Relevant and Appropriate Requirements. The State of Arizona identified ARS Title 49, DEUR, an action-specific ARAR for the implementation of ICs at MRP Sites 4 and 6. These rules are relevant and appropriate, but not applicable because the cited state statute addresses sites under state and county jurisdictions, and MCAS Yuma is currently, and will remain, a federal facility for the foreseeable future. However, the statute's substantive provisions are relevant and appropriate. In the event that the facility is transferred to a non-federal entity in the future, the DON will ensure that a use restriction is recorded as part of the transfer process, in consultation with U.S. EPA and ADEQ (NAVFAC SW, 2017a).

4.3.1.3 MRP Sites 4 and 6 Selected Remedy. Two remedial alternatives were developed and evaluated in the FS for MRP Site 4 and Site 6 to address the RAO for MCs in soil: no action and ICs. Taking public comment on the Proposed Plan into consideration, the ROD documented ICs, to restrict land use, as the preferred remedy (NAVFAC SW, 2017a).

MRP Site 4

The ICs would be implemented through the MCAS Yuma Master Plan (former Base Master Plan), which references the ROD (NAVFAC SW, 2017a). The ICs identified in the ROD are as follows:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.
- Construction activities such as above- or below-ground demolition work and above or below-ground construction of structures, including utility lines, must be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where MC might be encountered and will provide the requirements needed to perform site work.
- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.
- Requirements and procedures for notification if corrective action(s) are warranted.
- Identification of responsibilities for DON implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.
- Release of environmental restrictions when the project stakeholders (i.e., DON, U.S. EPA, and ADEQ) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.
- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

Monitoring the efficiency of the ICs is performed by conducting periodic inspections in the form of annual inspections and CERCLA statutory FYRs of the remedy. A LUCIP as part of the Remedial Design has been prepared as the land use component of the Remedial Design. Following signature of the ROD, DON prepared and submitted to U.S. EPA for review and approval a LUCIP (NAVFAC SW, 2017b) that contains implementation and maintenance actions, including periodic inspections. The FYRs will continue until the ICs have been released and terminated and potential MC-related risks no longer exist. The methods used in assessing the implementation and performance of the selected remedy, as well as the findings and conclusions of these evaluations are documented in this FYR Report, which provides a clear statement as to whether the selected remedy is being protective or is expected to become protective sometime in the future.

MRP Site 6

The LUCs alternative at MRP Site 6 minimizes exposure to the potential presence of MEC and MC. LUCs include engineering and institutional controls. ICs restrict site use to industrial/commercial and control access to MEC and MC potentially present in subsurface soils, have been implemented through the MCAS Yuma base planning process. Because MRP Site 6 is covered by 3 feet of clean imported soil overlain by an approximately 18-inch-thick concrete apron that is part of the aircraft hangar complex, engineering controls are effectively already in place. The LUC remedy for MRP Site 6 will maintain the cover over subsurface soils to physically limit potential exposure to MEC or MC.

The objectives and elements of the LUC alternative for MRP Site 6 include the following:

- Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marines/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.
- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.
- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

- Activities involving below-ground construction, such as utility lines, are to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where MEC and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.
- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.
- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement. Requirements and procedures for notification if corrective action(s) are warranted.
- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.
- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.
- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, Navy, U.S. EPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

4.3.2 MRP Sites 4 and 6 Remedy Implementation. The ROD for MRP Site 4 and 6 identified ICs for MRP Site 4 and LUCs for MRP Site 6. The following subsections describe the steps taken post-ROD to implement ICs for MRP Sites 4 and 6.

4.3.2.1 MCAS Yuma Master Plan. The MCAS Yuma Master Plan contains a detailed review of all physical conditions, resources, and tenant commands present at MCAS Yuma and the planned development of the station in the foreseeable future. The Master Plan was developed to support the MCAS Yuma mission and implement the station's strategic plan. In order to control the areas of potential risk from exposure to soil contamination at MRP Sites 4 and 6 and ensure that future land use would not result in unacceptable levels of risk to human health or the environment, the necessary restrictions will be presented in a revision to the MCAS Yuma Master Plan. Although, the MCAS Yuma Master Plan was revised in September 2001 (KTUA, 2001) and again in November 2007 (KTUA, 2007), there has been no update of the MCAS Mater Plan since the MRP Sites 4 and 6 ROD was finalized in 2016. MCAS Yuma Station Order 5090B formally directs tenants and MCAS Yuma departments to comply with land use controls (LUCs) provided in the MCAS Yuma Master Plan and the Final LUCIP. In addition, the base GIS, which is used to develop site plans, was updated to show the locations of MRP Sites 4 and 6 and the land use controls.

4.3.2.2 Land Use Control Implementation Plan. Monitoring the efficiency of the LUCs is performed by conducting periodic inspections in the form of annual inspections and CERCLA statutory FYRs of the remedy. Following the ROD signature, the DON prepared and submitted to U.S. EPA for review and approval a LUCIP (NAVFAC SW, 2017b) that contains implementation and maintenance actions, including periodic inspections. The FYRs will continue until the LUCs have been released and terminated and potential MEC- and MC-related risks no longer exist.

The original LUCIP was issued in September 2002 (NAVFAC SW, 2002a), was revised in 2014 to address the 2009 FYR comments and again in 2017 to incorporate MRP Sites 4 and 6 (NAVFAC SW, 2017b). It describes implementation, monitoring, and reporting procedures and contains the following:

- description of the LUCs required by the OU 1, OU 2, and MRP Sites 4 and 6 RODs;
- current maps of MCAS Yuma showing the areas subject to the LUCs;
- listing of the LUC requirements and a designation of responsibility for meeting these requirements;
- descriptions of the mechanisms that will be used by the DON to meet the LUC requirements; and
- schedule and process for inspecting and reporting ongoing compliance with LUC requirements.

The LUCIP is used as a reference for installation personnel tasked with implementing and maintaining the LUC requirements.

5.0: PROGRESS SINCE PREVIOUS FIVE-YEAR REVIEW

This section provides the protectiveness statements from the previous FYR, any recommendations and follow-up actions identified in the previous FYR, and the results of actions taken towards resolving any identified issues including whether the actions achieved the intended effect. The following subsections identify the progress for OU 1, OU 2, and MRP Sites 4 and 6 separately.

5.1 Progress for Operable Unit 1

The following provides the OU 1 protectiveness statement from the FYR dated June 2015 (NAVFAC SW, 2015), identifies recommended follow-up actions, and summarizes the results of actions taken.

5.1.1 OU 1 Protectiveness Statement from the 2015 Five-Year Review. The remedy at OU 1 Area 1 is currently and will continue to be protective of human health and the environment because of the implementation of remedial measures and control of exposure pathways that may result in unacceptable risks. The methods are summarized below:

(1) Remediation systems were installed and operated in the Area 1 plume. A VCT system was operated in the LEPA from June 2000 to May 2003 and again from July 2011 to present. The system has reduced COC concentrations to near MCLs and contained off-site migration of the plume in this area. An AS/SVE system was installed in the Building 230 area to remediate the groundwater in the most highly contaminated area of OU 1. The system has operated relatively continuously between November 1999 and May 2007 and again from July 2013 to January 2014. The AS/SVE system has reduced the COC "Hot Spot" in both size and magnitude, and groundwater modeling indicates that the COCs will not migrate offsite at concentrations exceeding the MCLs.

(2) MNA currently is being conducted at Area 1, the only OU 1 area still open. MNA has been demonstrated to reduce contaminant concentrations through natural processes, and MNA results for Area 1 indicate that COCs are not migrating off site at concentrations exceeding the MCLs. Groundwater monitoring required for the MNA program has been implemented through the LTM plan for OU 1 Area 1 at MCAS Yuma. The Area 1 plume will continue to be monitored to evaluate the progress of MNA until COC concentrations decrease to below the MCLs.

(3) ICs are in place to restrict exposure to contaminated groundwater at Area 1. They are provided in the MCAS Yuma Master Plan and implemented through the Final LUCIP. In addition, MCAS Yuma Station Order 5090B formally directs tenants and all MCAS Yuma departments to comply with the LUCs. If the DON plans to excess the property to a non-federal entity, it shall (1) notify the U.S. EPA and ADEQ of any plan to lease or transfer MCAS Yuma real property that has ICs to any non-federal entity, (2) notify the transferee or lessee of the prohibition on use of groundwater in the Area 1 plume as drinking water, and (3) include the restrictions in the transfer or lease.

The MCAS Yuma Environmental Department will continue to review and coordinate all plans for future activities at OU 1, in consultation with the U.S. EPA and ADEQ as necessary, to ensure application of the measures specified in the OU 1 ROD (NAVFAC SW, 2015).

5.1.2 Previous Issues, Recommendations and Follow-up Actions for OU 1. Table 5-1 lists the issues that were identified at OU 1 during the last FYR. Table 5-2 summarizes the recommendations and follow-up actions as stated in the last FYR (NAVFAC SW, 2015).

Table 5-1. Issues Identified during the Previous Five-Year Review

Issues	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
The cleanup goals for OU 1 Area 1 are the U.S. EPA MCLs, which are not risk-based. Achieving the MCLs may leave a greater risk than anticipated.	No	Yes
1,4-Dioxane has been detected in groundwater at OU 1 Area 1. There currently is no MCL for 1,4-dioxane. However, 1,4-dioxane concentrations exceed the U.S. EPA RSL. The existing groundwater treatment system does not treat 1,4-dioxane.	No	Yes

Table 5-2. Recommendations and Follow-up Actions from the Previous Five-Year Review

Recommendations/Follow-Up Actions	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
The MCL for 1,1-DCE is 7 µg/L, and the U.S. EPA RSL for tapwater is 280 µg/L. The MCL for PCE is 5 µg/L, and the RSL is 11 µg/L. The MCL for TCE is 5 µg/L, and the RSL is 0.49 µg/L. Therefore, the MCLs for the COCs 1,1-DCE and PCE are more protective than the risk-based RSLs, indicating that risk is even less than the upper boundary of the U.S. EPA's acceptable risk range. The MCL for TCE would yield a cancer risk within the middle of U.S. EPA's acceptable risk range; this level of risk would not require further remediation. Therefore, further evaluation of the risk associated with achieving the cleanup goals for OU 1 Area 1 (MCLs) does not appear to be necessary.	No	No
Because 1,4-dioxane has been detected in groundwater at OU 1 Area 1, the potential for risk related to 1,4-dioxane should be evaluated.	No	Yes

5.1.3 Actions Taken at OU 1 Since the Previous Five-Year Review. The following subsections identify the actions taken across all areas (Area 1) of OU 1 since the last FYR. The actions taken to address the recommendations given in Table 5-2 are provided below as well as other actions that have occurred at OU 1, which were not identified in the previous FYR.

5.1.3.1 Summary of Actions Taken in Response to Previous Five-Year Review Recommendations. Table 5-3 provides a summary of the actions taken to address the recommendations provided in the previous FYR (NAVFAC SW, 2015).

Table 5-3. Summary of Actions Taken in Response to Previous Five-Year Review Recommendations

Recommendations/ Follow-Up Actions	Party Responsible	Milestone Date	Actions Taken and Outcome	Date of Action
Because 1,4-dioxane has been detected in groundwater at OU 1 Area 1, the potential for risk related to 1,4-dioxane should be evaluated.	DON	Ongoing	Phase II groundwater investigation (see discussion in LTM subsection of Section 5.1.3.2. OU 1 Actions Taken)	October 2014 to January 2015
			Flow and transport modeling and HHRA (see discussion in Groundwater Modeling and HHRA subsection of Section 5.1.3.2. OU 1 Actions Taken)	2015
			1,4-Dioxane Pilot Study (see discussion in ISCO Treatment Pilot Study subsection of Section 5.1.3.2. OU 1 Actions Taken)	February 2016 to August 2017

5.1.3.2 OU 1 Actions Taken

LTM

In 2014, groundwater characterization was performed and a flow and transport model was developed to evaluate the lateral and vertical extent and migration potential of 1,4-dioxane in groundwater (see Section 4.1.3.4). Seven new permanent monitoring wells, A1-MW-49, A1-MW-50, A1-MW-51, A1-MW-52, A1-MW-53, A1-MW-54, and A1-MW-55, were installed between October 26 and November 17, 2014, as part of that effort (Trevet, 2016). These wells were added to the long-term groundwater monitoring program.

Addendum 4 to the Final SAP was finalized in October 2017 (MMEC Group, 2017a). Although the SAP was not finalized until October, the August 2017 sampling was conducted in accordance with the Addendum. In accordance with Addendum 4, and with regulatory concurrence, the sampling frequency was reduced from quarterly to semi-annually for 16 groundwater monitoring wells in the Hot Spot and Central Plume Areas. The sampling frequency for the remaining 12 groundwater monitoring wells in the LEPA Area was revised again in April 2018 from quarterly to semi-annual (Tetra Tech, 2018). Table 5-4 lists the revised groundwater monitoring schedule.

Groundwater Modeling and Human Health Risk Assessment

Groundwater flow and transport modeling was performed as part of a supplemental groundwater investigation at OU-1 Area 1 in 2015 (Trevet, 2016). The three-dimensional groundwater flow and transport model was developed to assist with evaluating the potential human health risk associated with the COCs and 1,4-dioxane at the Site. The model was also used to determine whether the dissolved-phase contaminant plume would migrate to the Site boundary at concentrations at or above the COCs' MCLs.

Using analytical data from August 2014, the transport model was run to simulate a period of 50 years from 2015 to 2065. Four scenarios were simulated: 1) the LEPA VCT recirculating wells shut off for 50 years representing natural attenuation; 2) the VCT recirculating wells operating for 10 years then shut off; 3) pumping rates of the VCT recirculating wells increase to twice the current rate for 50 years; and 4) pumping rates of the VCT recirculating wells increase to twice the current rate for 10 years then shut off.

Table 5-4. Revised Groundwater Monitoring Schedule for OU 1 Area 1

Subareas of OU 1 Area 1 Groundwater Contamination	Monitoring Well	Frequency of VOC Sampling		Annual Natural Attenuation Parameters[1]
		Semi Annual	Annual	
Area 1 "Hot Spot" Building 230 Area	A1-MW-18	X	X	X
	A1-MW-19	X	X	
	A1-MW-37	X	X	X
	16-MW-06	X	X	X
	16-MW-08	X	X	X
	16-MW-09	X	X	
	16-HS-03	X	X	X
Area 1 Interior Wells Central Plume Area	A1-MW-07	X	X	X
	A1-MW-11	X	X	
	A1-MW-13	X	X	
	A1-MW-14	X	X	X
	A1-MW-15	X	X	
	A1-MW-23	X	X	
	A1-MW-25	X	X	
	A1-MW-55	X	X	X
Area 1 "LEPA" Northwest Station Boundary Area	A1-PZ-19	X	X	
	A1-MW-01	X	X	X
	A1-MW-04	X	X	
	A1-MW-05	X	X	
	A1-MW-27	X	X	X
	A1-MW-31	X	X	
	A1-MW-42	X	X	
	A1-MW-49	X	X	X
	A1-MW-50	X	X	X
	A1-MW-51	X	X	X
	A1-MW-52	X	X	X
	A1-MW-53	X	X	X
	A1-MW-54	X	X	X

Sampling schedule derived from the Final SAP for OU-1 Area 1 (Tetra Tech, 2018).
[1] Natural attenuation parameters: chloride, ferrous iron, sulfate, nitrate, pH, dissolved oxygen, redox potential.

The simulation results are summarized below.

- Transport model results show that for all COCs in all simulation scenarios, modeled contaminant concentrations are practically the same in the Hot Spot Area and Central Plume Area because VCT operation only affects local flow conditions inside LEPA.
- For 1,4-dioxane, the modeled plume with concentration exceeding its 2019 U.S. EPA RSL (0.46 µg/L) would migrate beyond the boundary of OU-1 area for all four modeled scenarios.
- Modeled 1,4-dioxane plume disappears in year 2060 (i.e., modeled maximum 1,4- dioxane concentration is lower than its 0.46 µg/L) for all four scenarios.
- For Scenarios 2, 3, and 4, modeled 1,4-dioxane concentrations in LEPA are slightly lower during VCT operation period.
- For TCE simulations in all scenarios, the modeled TCE plume with concentrations exceeding its MCL (5.0 µg/L) would not migrate beyond the boundary of OU-1 Area 1 and the modeled maximum TCE concentration drops to its MCL in year 2025. The maximum concentration occurs in the Hot Spot Area and is not affected by VCT operation in the LEPA.
- For TCE simulations in Scenarios 2, 3, and 4, due to the VCT operation, the modeled TCE concentrations decrease faster and the modeled TCE plume shrinks faster in LEPA compared to Scenario 1. After 10 years of VCT operation, additional VCT operation is shown to make little difference since by then most TCE mass will have been removed.
- For 1,1-DCE simulations in all scenarios, the modeled 1,1-DCE plume with concentrations exceeding its MCL (7.0 µg/L) would not migrate beyond the boundary of OU-1 Area 1, and the modeled maximum 1,1-DCE concentration drops to its MCL of 7.0 µg/L in year 2021. The maximum concentration occurs in the Hot Spot Area and is not affected by VCT operation in the LEPA.
- For 1,1-DCE simulations in Scenarios 2, 3, and 4, due to the VCT operation, the modeled 1,1-DCE concentrations decrease slightly faster and the modeled 1,1-DCE plume shrinks slightly faster in LEPA in comparison to Scenario 1. After 10 years of VCT operation, additional VCT operation is shown to make little difference since most 1,1-DCE mass will have been removed.
- For all scenario simulations, TCE and 1,1-DCE migrations behave similarly and concentrations exceeding respective MCLs would not migrate beyond the boundary of OU 1 Area 1.

A HHRA was performed as part of the supplemental groundwater investigation at OU-1 Area 1 in 2015 (Trevet, 2016). The HHRA evaluated the risk to future on-site commercial/industrial workers hypothetically exposed to 1,4-dioxane in drinking water, hypothetical future residents on-site and current and future residents off-site. The exposure point concentrations for on-site exposures were taken from a data set generated over several years (2012-2015). The maximum detected concentrations from the three exposure areas (Hot Spot, Central Plume and LEPA) from

the years 2013, 2014, and 2015 were evaluated and showed decreasing risks over time. For the onsite hypothetical future scenarios, cancer risks from the Hot Spot were in the 10^{-4}range and risks from the Central Plume were in the 10^{-5} range. Cancer risks from the LEPA were $10^{-6}$for the future commercial/industrial worker hypothetically exposed to 1,4-dioxane in groundwater and 10^{-5} for the hypothetical future resident. Cancer risk for the off-site resident was estimated to be within the acceptable risk range of 10^{-5} and transitions to 10^{-6} around the year 2035, due to the modeled decreasing off-site concentration of 1,4-dioxane over time. The groundwater concentrations from 2015 from the three on-site exposure areas or any of the estimated off-site concentrations did not result in a hazard index greater than one.

ISCO Treatment Pilot Study

1,4-Dioxane is an emerging contaminant and has been identified as a commingled contaminant with the ROD-based COC plume (i.e., 1,1-DCE, TCE, and PCE) in groundwater at OU 1 Area 1. 1,4-Dioxane was added to the groundwater LTM program in May 2012; however, it is not currently a COC in the ROD for the site. There is currently no MCL for 1,4-dioxane so the U.S. EPA RSL of 0.46 µg/L has been used as the screening criterion. However, the RSL is a screening level, not a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is in the middle of the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Concentrations of 1,4-dioxane do not exceed the U.S. EPA health advisory anywhere within the plume. Results of modeling and risk assessment conducted for 1,4-dioxane at the site indicate that downgradient risk and hazard are within the U.S. EPA's acceptable risk range (Trevet, 2016).

In 2014, a groundwater characterization study was performed and a flow and transport model was prepared for OU 1 Area 1 to evaluate the lateral and vertical extent and migration potential of 1,4-dioxane in groundwater (Trevet, 2016). In addition to installing seven new wells as discussed above, 30 CPT borings were advanced to depth of 80 to 90 feet bgs and 30 groundwater grab samples were collected using direct push technology (DPT) in the vicinity of the CPT borings. Sampling results indicated that the 1,4-dioxane plume generally overlapped the COC plume, and the lateral extent of the 1,4-dioxane in groundwater was delineated (Trevet, 2016). The highest 1,4-dioxane concentrations were observed in the Hot Spot area of the site, and elevated concentrations above the U.S. EPA RSL were observed in the LEPA (see Section 4.1.3.4).

A groundwater treatment pilot study was conducted in 2016 and 2017 to evaluate the effectiveness of ISCO using sodium persulfate to reduce 1,4-dioxane concentrations in the groundwater in the Hot Spot area (MMEC Group, 2018b). Two rounds of ISCO injections were conducted in the Hot Spot area using DPT injection process to deliver PersulfOx™ as the oxidizing reagent. The first round of ISCO injection, performed in February 2016, consisted of introducing approximately 5,435 gallons of ISCO reagent at three treatment areas in the Hot Spot area. The results of the first round of ISCO injection were inconclusive based on available performance monitoring results not showing a decrease in 1,4-dioxane concentrations. Additionally, a significant change in geochemistry to more oxidizing conditions was observed. Site-specific factors that resulted in inconclusive evaluation of treatment effectiveness included:

1. The measured radius of influence (ROI) was smaller than the estimated treatment distance of 20 to 40 ft from injection points.

2. The decline in groundwater potentiometric surface elevations may have reduced the vertical extent of the treatment zone and resulted in a lack of measurable water in performance monitoring well 16-MW-09.

Based on the results from the first round of ISCO, a second round of injections was performed in the Hot Spot area in 2017. Approximately 4,089 gallons of ISCO reagent were introduced at two treatment areas in the Hot Spot area. Field parameter measurements (i.e., groundwater chemistry) following the second injection indicated that the ISCO treatment was effective in reducing 1,4-dioxane concentration in areas close to the injection points (5 to 7.5 feet), but not effective at greater distances.

The 1,4-Dioxane Pilot Study Report was finalized in October 2018 (MMEC, 2018b). The ISCO pilot study results are summarized as follows:

1. Significant reductions in 1,4-dioxane and OU 1 Area 1 COC (i.e., PCE, TCE, and 1,1-DCE) concentrations were observed during post-injection monitoring five months following the injection using 7% sodium persulfate (PersulfOx™) mixture in well 16-HS-03.
2. A ROI of 5 to 7.5 feet was achieved, indicating a treatment area smaller than the initial estimate of 25 feet.
3. A potential increase in bromate and hexavalent chromium concentrations was observed five months after the ISCO injection and will require monitoring in the future to evaluate if the condition is transitory.
4. Additionally, the post-ISCO injection monthly sampling events in July and August 2017 analyzed PFAS concentrations to address concerns that ISCO treatment could potentially mobilize PFAS in the subsurface. In comparison with the baseline PFAS concentrations in the same groundwater wells sampled in November 2016, no discernible effect on PFAS concentrations was observed following the ISCO reagent injections.
5. The results indicate that this treatment technology may not be effective for 1,4-dioxane at this site given site-specific characteristics.

AS/SVE System

The AS/SVE system was temporarily shut down in 2014 after running for six months (July 2013 to January 2014) after a significant decline in mass removal from the system and again reaching asymptotic conditions. It has been recommended for permanent shutdown; however, ADEQ noted that a review of the 1,4-dioxane pilot study results was needed before making a decision regarding the recommendation for permanent shutdown. In addition to COC concentrations being below MCLs, the groundwater level elevations have dropped below the top of the screen of the AS wells. In absence of significant groundwater level increases, the current screen depth of the AS wells relative to groundwater elevation does not justify operation of the AS/SVE system in the foreseeable future because injected air currently cannot be delivered to the saturated zone to strip CHCs from groundwater. If future operation is recommended, the

AS/SVE system will need to be modified to adjust the injection interval relative to the water table prior to resuming operation (MMEC Group, 2018a).

VCT System

Following a May 2003 shutdown of the VCT system when COC concentration in LEPA monitoring wells were below applicable MCLs, the system was restarted in July 2011 after COCs rebounded to concentrations above MCLs. With the exception of short-term shutdowns conducted to address system maintenance issues, the system has operated continuously since 2011. Since system restart in 2011, the VCT system has removed an estimated 2.6 pounds of total contaminant mass from the extracted groundwater (MMEC Group, 2018a). COC concentrations in the LEPA wells have not exceeded MCLs since August 2015. In addition, groundwater modeling (Trevet, 2016) indicates that COCs will not reach the base boundary at concentrations exceeding MCLs. Therefore, the current ROD requirements to request temporary shutdown of the VCT system have been met.

1,4-Dioxane has been identified at concentrations exceeding the U.S. EPA RSL of 0.46 µg/L in LEPA monitoring wells since 2012. As part of the 1,4-dioxane pilot study conducted in 2016 (MMEC Group, 2018b) the synthetic adsorbent media AMBERSORB 560™ was used to evaluate the treatment efficacy of removing 1,4-dioxane and site COCs from the VCT system influent groundwater in the LEPA. The AMBERSORB 560™ treatment included the following activities:

1. Retrofit the existing VCT system to process extracted groundwater through the synthetic adsorbent media unit, before processing groundwater through the GAC vessels, and then reinject the groundwater back into the aquifer.
2. Perform a four-month synthetic media pilot study to evaluate the effectiveness of the system to remove 1,4-dioxane and OU 1 Area 1 COCs from groundwater extracted by the existing VCT system.
3. Perform regular system performance checks and collect performance monitoring groundwater samples from the synthetic media treatment system influent and effluent during the four-month treatment study. Analyze the influent and effluent groundwater samples for OU 1 Area 1 COCs and 1,4-dioxane.

The system was evaluated using the following criteria:

1. Consistency in achieving 1,4-dioxane concentrations below the U.S. EPA tap water RSL of 0.46 µg/L in system effluent.
2. Reduction of site COC (PCE, TCE, 1,1-DCE) concentrations in the effluent to below their MCLs.
3. Effectiveness of onsite AMBERSORB 560™ regeneration and the effect, if any, on contaminant removal efficacy.

In addition to the system performance monitoring samples collected to assess treatment effectiveness, samples were also collected to evaluate AMBERSORB 560TM system contaminant loading and to optimize system operations, including AMBERSORB 560™ regeneration frequency.

Based on the assessment of the analytical results, the AMBERSORB 560™ pilot study demonstrated successful removal of 1,4-dioxane and the OU 1 Area 1 COCs (PCE, TCE, and 1,1-DCE). Results of post-treatment effluent groundwater sampling consistently showed that 1,4-dioxane concentrations were less than the laboratory instrument detection level of 0.084 µg/L. AMBERSORB 560™ system effluent samples had reported 1,4-dioxane and COC concentrations below project action limits, thus meeting treatment performance objectives. Additionally, steam regeneration of AMBERSORB 560™ was successful using cooling and capture of condensate, and steam venting to atmosphere to effectively regenerate the AMBERSORB 560™ treatment capacity after each contaminant loading cycle.

Because PFAS were detected in site groundwater during the initial site-wide assessment in November 2016, which occurred after completion of the AMBERSORB 560™ pilot study, PFAS analysis was not included in the pilot study evaluation of AMBERSORB 560™ treatment (MMEC, 2018b).

LUC Inspections
No LUC deficiencies were noted during quarterly LUC inspections at OU 1 Area 1 during this FYR reporting period. LUC inspections determined that land use at OU 1 Area 1 remains restricted to commercial and industrial use by MCAS Yuma and the Yuma County Airport Authority (MMEC Group, 2017c).

5.2 Progress for Operable Unit 2

This section provides the protectiveness statements from the previous FYR, the status of recommendations and follow-up actions from the previous FYR, and the results of implemented actions taken towards resolving the issues including whether they achieved the intended effect.

5.2.1 OU 2 Protectiveness Statement from the 2015 Five-Year Review. The remedy at OU 2 is currently and will continue to be protective of human health and the environment because exposure pathways that may result in unacceptable risks are being controlled.

5.2.2 Previous Issues, Recommendations and Follow-Up Actions for OU 2. Table 5-5 summarizes issues identified for OU 2 during the last FYR (NAVFAC SW, 2015). Table 5-6 summarizes the recommendations and follow-up actions as stated in the last FYR (NAVFAC SW, 2015).

Table 5-5. Issues Identified during the Previous Five-Year Review

Issues	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
Base personnel have indicated the desire to implement a land-use change for OU 2 CAOC 8A, which may make the current exposure assumptions for the site invalid. No military construction is funded at this time. However, there is limited available space on-base to expand. Therefore, it is reasonable to assume that the need to change the land use at OU 2 CAOC 8A will arise. As stated in the OU 2 ROD, if any changes in land use are planned at the area, the DON, in consultation with the U.S. EPA and ADEQ, will reevaluate the remedy at OU 2 CAOC 8A before the onset of any site activities.	No	Yes

Table 5-6. Recommendations and Follow-up Actions from the Previous Five-Year Review

Recommendations/Follow-Up Actions	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
Base personnel have indicated the possibility of a future land-use change for OU 2 CAOC 8A, and documentation of that land-use change is required because a change in land use involving any activities that may disrupt or expose the landfill interior will require a reevaluation of the remedy. Because the current dataset for the area is insufficient to evaluate the potential risk associated with future changes in land use, additional investigation will be needed before the remedy can be reevaluated. Thus, prior to the execution of any activities that may be construed as a land-use change at OU 2 CAOC 8A, further site investigations will be necessary to determine if remediation is required or if the ROD must be amended. As stipulated in the OU 2 ROD, all work pertaining to a change in land use for OU 2 CAOC 8A will be carried out in concert with the U.S. EPA and ADEQ.	No	Yes

5.2.3 Actions Taken at OU 2 Since the Previous Five-Year Review. The following subsections identify the actions taken across all of the CAOCs of OU 2 since the last FYR. The actions taken to address the recommendations given in Table 5-6 are provided below as well as other actions that have occurred at OU 2, which were not identified in previous FYRs.

5.2.3.1 Summary of Actions Taken in Response to Previous Five-Year Review Recommendations. Table 5-7 provides a summary of the actions taken to address the recommendations provided in the previous FYR (NAVFAC SW, 2015).

Table 5-7. Summary of Actions Taken in Response to Previous Five-Year Review Recommendations

Recommendations/ Follow-Up Actions	Party Responsible	Milestone Date	Actions Taken and Outcome	Date of Action
Base personnel have indicated the possibility of a future land-use change for OU-2 CAOC 8A, and documentation of that change is required. If a change in land use is needed for CAOC 8A, communication with the regulatory agencies will occur before the change as stipulated in the ROD.	DON	Not Applicable	No action has been taken because no Military Construction project is currently planned for the site and no Military Construction funding is programmed. Follow-up action will be carried out if a land-use change is proposed for OU 2 CAOC 8A.	Not Applicable

5.2.3.2 OU 2 Actions Taken

LUC Inspections

No LUC deficiencies were noted during quarterly LUC inspections at OU 2 CAOCs during this FYR reporting period. In the 2017 LUC Report (MMEC Group, 2017c) it was noted that site maintenance is planned for September 2017 to remove the debris and control a small erosional gully at OU2 CAOC 8A. Additionally, some signs posted on the perimeter fence at CAOC 8A were faded with no discernible information remaining.

5.3 Progress for Munitions Response Sites 4 and 6

This is the first FYR for MRP Sites 4 and 6; therefore, no protectiveness statements were provided in the previous FYR.

6.0: FIVE-YEAR REVIEW PROCESS

This section provides a description of the activities performed during the FYR process for MCAS Yuma OU 1, OU 2, and MRP Sites 4 and 6, as well as a summary of the findings of each step in the process when appropriate.

6.1 Administrative Components of the Five-Year Review Process

Responsibilities for this FYR were developed by the DON and the MCAS Yuma Environmental Department. Table 6-1 summarizes the people involved in the FYR process.

Table 6-1. Five-Year Review Participants

Name	Title	Organization
Angela Patterson	Remedial Project Manager	NAVFAC Southwest
Steve Rosansky	Project Manager	Battelle
Damon DeYoung	Principal Investigator	Battelle
Heather Rectanus	Environmental Engineer	Battelle
Anna Figueroa	IRP Manager	MCAS Yuma Environmental Department
Joseph Britain	Environmental Engineer	MCAS Yuma Environmental Department
David Rodriguez	Environmental Director	MCAS Yuma Environmental Department
Gregory McShane	Air Operations Manager	MCAS Yuma Air Operations
John Peterson	Project Manager	ADEQ
Steve Willis	Project Manager	UXO Pro, Inc.

The review team consisted of Damon DeYoung (Battelle) as the principal investigator for the review and Joseph Britain (MCAS Yuma Environmental Department) as the station contact responsible for arranging access to Environmental Department documents and to station resources and personnel. Components identified in advance with those responsible for the review included:

- Document review
- Data review
- Site inspection
- Local interviews, and
- FYR report development and review.

These activities later were modified to include U.S. EPA and ADEQ interview responses. The FYR, including site inspections and interviews, was conducted between February and May 2018.

6.2 Community Notification and Involvement

MCAS Yuma personnel and the greater Yuma, Arizona, community were informed of the start of the review in March 2018 in a public notice sent to base personnel and printed in the local area newspaper:

- *The Sun* (Yuma and regional paper) Friday through Sunday, March 23-25, 2018

The notice stated the purpose of the FYR at OU 1, OU 2, and MRP Sites 4 and 6 under CERCLA; described the remedy for contaminated groundwater at OU 1, and contaminated soils at OU 2 and MRP Sites 4 and 6; and identified the types of COCs present. The notice also identified the restriction of future groundwater and soil use as necessary to prevent unacceptable human-health risk that could result if the sites were allowed unlimited use/unrestricted use. The public notice is included in Appendix B7.

A second public notice is planned to notify the community of the findings upon completion of the FYR Report. The FYR Report for OU 1, OU 2, and MRP Sites 4 and 6 will also be made available at the Yuma County Public Library at the address below:

- Yuma County Public Library
  350 South Third Avenue
  Yuma, Arizona 85364-3897

The local community was not directly involved in the FYR process because ICs currently are implemented only within the station to limit groundwater use by station tenants. RAs have contained off-site plume migration. During the earlier phases of RI and remedy selection and evaluation, interested community representatives had the opportunity to provide input on the RA. The project was managed to allow exchange of information and partnership among the community, DON, U.S. EPA, and State of Arizona regulatory agencies through review and comments on technical documents relating to the ongoing environmental cleanup at MCAS Yuma. With RAs well under way at OU 1, OU 2, and MRP Sites 4 and 6, public interest in CERCLA proceedings has declined.

6.3 Document Review

This FYR consisted of a review of relevant documents issued before and since the construction of the remedial systems. Appendix A presents the list of all documents reviewed during this FYR. The documents reviewed included the OU 1, OU 2, and MRP RODs, the Final LUCIP, the MCAS Yuma Master Plan, technical memorandums, remediation progress reports, groundwater monitoring reports, discharge reports, monitoring well inspections required by the LUCIP, aerial photographs, and compliance documents maintained by the MCAS Yuma Environmental Department. Most documents focus on remediation system operation and groundwater monitoring. These reports summarize the AS/SVE and VCT systems O&M and emissions monitoring.

During the review process, no inconsistencies or issues were identified.

6.4 Data Review

The data review included examination of previous FYRs, groundwater monitoring information, pilot study reports, groundwater modeling reports, and LUC inspection reports to identify any changes to the protectiveness of the selected remedies for OU 1, OU 2, and MRP Sites 4 and 6. The most recent sampling data were used in a screening evaluation of potential change in human-health risk for the areas discussed in detail in Section 7.1.2 of this report.

Review of groundwater level surveys indicates that there were no major changes in hydraulic gradient direction or magnitude over the review period, although the water table continues to decline overall. It should be noted that the declining water table elevation has dropped below the top-of-screen elevations of the AS wells at OU 1, rendering them ineffective for sparging purposes. If the levels decrease below monitoring well screen intervals, the LTM program also will be ineffective. However, a number of wells are present at great enough depths to deem the LTM program effective for the foreseeable future. Water quality results also have shown only minor changes outside zones where the remediation systems have been applied. In general, the OU 1 plumes have not shown any significant movement or expansion that would indicate any significant changes in the performance of the groundwater treatment system.

Table 6-2 summarizes and compares the maximum detected concentration of COCs in Area 1 between the most recent sampling event (November 2017/February 2018) and the February 2014 sampling event (the results of which were reported in the last FYR).

Table 6-2. Summary of Maximum Groundwater Concentrations Detected in the February 2014 and November 2017/February 2018 Monitoring Events

OU 1 Area 1	Maximum Concentration in Groundwater (µg/L)					
	1,1-DCE		TCE		PCE	
	2014[a]	2017[b]	2014[a]	2017[b]	2014[a]	2017[b]
"Hot Spot"	5.6	7.7	15	14	0.71	0.78 J
Central/Interior	6.8	3.3 J	7.5	3.3 J	0.36	0.50 J
LEPA	5.7	2.9	4.4	3.9	<0.40	0.25 J
MCLs[c]	*7*		*5*		*5*	

[a] Groundwater monitoring data from February 2014 reported in the previous FYR (NAVFAC SW, 2015).
[b] Groundwater monitoring data from November 2017 (MMEC Group, 2018b).
[c] MCLs based on U.S. EPA National Primary Drinking Water Regulations (U.S. EPA, 2009a).

Figure 4-6 and Figure 4-7 illustrate the movement of the OU 1 COC plumes since the last FYR. (PCE is not mapped because the MCL has not been exceeded over the last 5 years). In November 2017 and February 2018, 1,1-DCE and TCE concentrations were below the MCLs in all but one monitoring well sampled quarterly across all of the OU 1 Area 1 (Figure 4-5). The one exceedance of 1,1-DCE (7.7 µg/L in November 2017 and 8.2 µg/L in February 2018) and TCE (14 µg/L in November 2017 and 17 µg/L in February 2018) was in Well 16-MW-08 which is located in the Hot Spot area.

Beginning in 2012, sampling for 1,4-dioxane began in the OU 1 Area 1 monitoring well network. In November 2017, 1,4-dioxane concentrations exceeded the tap water RSL (0.46 µg/L) in two of the six Hot Spot area wells; however, concentrations have been relatively stable since the

May 2014 sampling event. Concentrations of 1,4-dioxane exceeded the RSL in six of the eight central/interior plume wells and 9 of 13 LEPA wells. Concentrations of 1,4-dioxane have remained stable in the central/interior plume area and have indicated no discernible trend in the LEPA (Figure 4-3 and Figure 4-4). In February 2018, 1,4-dioxane concentrations exceed the tap water RSL in four of the five Hot Spot area wells and 9 of the 12 LEPA wells.

COCs continued to exhibit a decreasing trend or remained at low levels in OU 1 Area 1 groundwater monitoring wells in November 2017 and February 2018. 1,4-Dioxane concentrations also showed a decreasing trend in general or remained below RSL, with relatively stable trends compared with results from the previous reporting period.

6.5 Site Inspection

The purpose of the site inspections is to review and document current site conditions and evaluate visual evidence regarding the protectiveness of the remediation systems, monitoring equipment, and ICs. LUC inspection documents for OU 1, OU 2, and MRP Sites 4 and 6 were also reviewed. The U.S. EPA *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001) provides a site inspection checklist, as well as the report template used for the development of this report. The modified site inspection checklists completed during the site inspection for each area are provided in Appendix C.

The following sections summarize the site inspection findings at OU 1, OU 2, and MRP Sites 4 and 6.

6.5.1 OU 1 Site Inspection. Inspections at OU 1 Area 1 were conducted on May 9, 2018 by personnel from Battelle and the MCAS Yuma Environmental Department. The Area 1 plume extends across a large portion of the MCAS Yuma flight line area from the Building 230 area (Hot Spot) to the northwestern border of the station (LEPA). The site inspection for the Area 1 plume consisted of inspection of the active VCT system and general land use. The AS/SVE system was not in operation during the inspection because the system had been turned off since it had reached its shutdown criteria. The site is contained within the station, and much of Area 1 is located within the flight line area. No activity that would be considered inconsistent with industrial land use was noted at Area 1. Details on the Area 1 inspection are provided in Appendix C.

6.5.2 OU 2 Site Inspection. Inspections at OU 2 CAOCs 1, 8A, and 10 were conducted on May 9, 2018 by personnel from Battelle and the MCAS Yuma Environmental Department to document any changes since the last FYR. Inspection of the status of OU 2 CAOCs 1, 8A, and 10 indicated that there were no land use changes since the last FYR. All areas are located in restricted areas with fencing and secured gates. No activity that would be considered inconsistent with industrial land use was noted for CAOCs 1 and 10. No activity that would be considered inconsistent with the existing landfill was noted for CAOC 8A. During the CAOC 8A site inspection the erosional gully reported in 2017 (MMEC Group, 2017c) was not evident, however some signs still require replacement. Details on the OU 2 inspection are provided in Appendix C.

6.5.3 MRP Sites 4 and 6 Site Inspection. Inspections at MRP Site 4 and 6 were conducted on May 9, 2018 by personnel from Battelle and the MCAS Yuma Environmental Department to document any changes since the ROD. Inspection of the land-use status of MRP Site 4 and 6 indicated that there were no changes since the ROD was signed. No activity that would be considered inconsistent with industrial land use was noted at the areas. All areas are located in restricted areas with fencing and secured gates. Details on the MRP Sites 4 and 6 inspections are provided in Appendix C.

6.6 Interviews

Individuals responsible for or familiar with current activities at OU 1, OU 2, and MRP Sites 4 and 6 or with activities that took place since the last FYR were interviewed in May 2018 (Appendix D). An interview documentation form listing the name, title, and organization of the interviewee, along with the date and location where the interviews took place, is provided in Appendix D; the interview records documenting the interviews are provided in Appendix D.

All personnel interviewed noted no significant changes to site conditions or land use at the areas since the last FYR. A summary presentation of personnel interviews and regulatory agency comments is given below.

Angela Patterson, May 9, 2018
Angela Patterson is the NAVFAC Southwest Remedial Project Manager (RPM) for MCAS Yuma. Ms. Patterson directs OU 1 remediation activities for the Navy. The complete interview record for Ms. Patterson is provided in Appendix D.

- The VCT and AS/SVE systems have been effective in treating ROD COCs. Currently, the VCT is removing negligible COC mass and the AS/SVE system is temporarily shut down.
- An emerging contaminant (1,4-dioxane) has been detected and is not treated by the VCT. A pilot study is under way to evaluate treatment methods for 1,4-dioxane. AMBERSORB 560™ was tested at the LEPA and found to remove 1,4-dioxane to project action levels and also remove CHCs. However, removal of PFAS is not known. During this evaluation period, the VCT has been kept in operation. The PA/SI phase is in process for potential PFAS contamination at the Base. As such, the impact of PFAS is not yet known. It is anticipated for additional pilot study work to be conducted to evaluate approaches for emerging contaminant treatment.
- The Navy has requested permanent shutdown of the AS/SVE system, but the regulators requested that the system operation be only temporarily shut down and the results of the PFAS PA/SI be taken into account before permanent shutdown. In addition, a pilot study is currently under way to evaluate in situ treatment of 1,4-dioxane. Preliminary results indicate that ISCO can reduce 1,4-dioxane (as well as ROD COCs) within a small radius of influence (~5-7 ft). However, secondary impacts to groundwater were noted (hexavalent chromium and bromate levels were elevated). No decisions have been made with respect to treatment approaches for 1,4-dioxane.

- While 1,4-dioxane and PFAS do not have MCLs and are not in the ROD, the Navy is performing due diligence to understand the potential impact of these emerging contaminants and working towards addressing these potential concerns. These emerging contaminants may be added as COCs to the ROD pending the results of the investigations. The groundwater modeling study evaluated whether the 1,4-dioxane plume is co-located with the CHC plume. At the Hot Spot area, the plumes are collocated. At the LEPA, 1,4-dioxane is located in the deep aquifer at concentrations that would pose a potential risk within the U.S. EPA's acceptable risk range (Trevet, 2016).
- PFAS analysis has been added to the LTM on a semi-annual basis.
- NAVFAC SW understands that the Base has grown and would like to re-open the OU 2 ROD to allow using part the CAOC 8A landfill to support putting in a new gate. The regulators are OK with looking into re-opening the ROD to support the Base's request for a south gate. However, there is a functioning remedy already in place and the DoD policy is that once a remedy is in place and functioning, changes to the remedy are paid by whomever is requesting the change.
- In regard to PFAS, areas identified in the PA of potential concern will be further evaluated in an SI. Results of the PA/SI will be used to determine the need for future RI activities.

Dave Rodriguez, May 9, 2018

Mr. Rodriguez is the Director of the MCAS Yuma Environmental Department in charge of ensuring the LUCIP is followed and providing base access to environmental contractors performing monitoring and maintenance. The complete interview record for Mr. Rodriguez is provided in Appendix D.

- Base expansion has led to the desire to use the land where CAOC 8A is located. The Base would like to re-open the ROD and perform any necessary actions to allow for capping of the landfill and construction of a road over part of the landfill. This road would be for a new gate on the south side of the Base.

Joe Britain, May 9, 2018

Mr. Britain is an environmental engineer for the MCAS Yuma Environmental Department involved in engineering support and land use controls at the station. The complete interview record for Mr. Britain is provided in Appendix D.

- The Base has grown and is in need of using part of the landfill (CAOC 8A) to support putting in a new gate. This new gate would improve the security of the base by providing sufficient space to inspect trucks/commercial vehicles.

Anna Figueroa, May 9, 2018

Ms. Figueroa is the IRP manager the MCAS Yuma Environmental Department and is involved in reviewing environmental reports, ensuring the LUCIP is followed, and acts as a liaison with environmental contractors to provide access for site management activities. The complete interview record for Ms. Figueroa is provided in Appendix D.

- The Site Approval Request Process/Base Master Plan has been very effective in ensuring remedy protectiveness at sites with ICs.
- The Base would like to continue exploring how to re-open the OU2 ROD for CAOC 8A so that the landfill can be capped to allow for construction of a road and gate along the southern base boundary.

Greg McShane, May 9, 2018

Mr. McShane is the Air Operations Manager for MCAS Yuma. All flight line access requests require Air Operations coordination and approval. The complete interview record for Mr. McShane is provided in Appendix D.

- Monitoring at OU 1 has occurred quarterly and recently there has been a move to semi-annual monitoring. This change is helpful for the Air Field to minimize disturbance to flight line activities.
- OU 1, OU-2 CAOC 1, and MRP Sites 4 and 6 are located with the Air Field where access is restricted to flight line personnel who work in an industrial capacity. No residential access is permitted on the flight line.
- If changes in site conditions are being planned, Air Field personnel follow the LUCIP and work with Base personnel to adhere to the remedies at sites co-located on the Air Field.

Steve Willis, April 25, 2018

Mr. Willis is a Scientist at UXO Pro, Inc. and a technical consultant to ADEQ's Federal Projects Unit. In coordination with ADEQ, Mr. Willis has been involved with development of the MRP Sites 4 and 6 ROD, and reviewing environmental monitoring and maintenance reports for the sites involved in this FYR. The complete interview record for Mr. Willis is provided in Appendix D.

- ICs have been implemented and are effective within the MCAS boundary. Offsite groundwater contamination downgradient of the OU 1 Area 1 plume is unknown, but there does not appear to be any exposure to contaminated groundwater at this time.
- The active remediation systems in place for OU 1 (VCT and AS/SVE) have reduced ROD COC concentrations to below the MCLs over much of the plume area. Additional work is needed to reach the remedial goals in the Hot Spot source area. The VCT system in the LEPA continues to operate. The AS/SVE system in the Hot Spot area has been shut down and is unlikely to be re-started due to declining water levels and significant reductions in COC concentrations

- For MRP Sites 4 and 6, the remedies have effectively prohibited inappropriate use of the properties.
- Remedies have been effective, but I would like more assurance that contaminants have not migrated offsite downgradient of the OU-1 Area 1 plume.

John Peterson, April 30, 2018

Mr. Peterson is the ADEQ Project Manager for MCAS Yuma. Due to his short tenure with the environmental program at MCAS Yuma leading up to this FYR, Mr. Peterson has relied on the interview provided by the ADEQ technical consultant Steve Willis (provided above).

7.0: TECHNICAL ASSESSMENT

The technical assessments for OU 1, OU 2, and MRP Sites 4 and 6 are independently presented in the following subsections. They focus on answering the three key technical assessment questions presented in EPA's *Five-Year Review Guidance* (U.S. EPA, 2001).

7.1 Technical Assessment of Operable Unit 1

The technical assessment for OU 1 Area 1 presented in this section describes how each of the three key assessment questions was answered. The discussion presented here is a framework for the protectiveness determination that explains the conclusions of the review, based on the information presented in the previous section.

7.1.1 Question A: Is the Remedy for OU 1 Functioning as Intended by the Decision Documents?

Yes; a review of documents, site inspections, and interviews of station personnel indicates that the remedies for OU 1 are functioning to protect human health through implementation of the remedial systems and ICs on land and groundwater use. The subsections below provide further detail regarding the remedy efficacy.

7.1.1.1 AS/SVE Performance. The AS/SVE system for Area 1 operated relatively continuously in the Hot Spot area of Building 230 from November 1999 to May 2007 and again from July 2013 to January 2014. The system was designed to reduce CHC concentrations in the Hot Spot by injecting air into the subsurface in AS wells and recovering the vapors in the SVE wells. Since 1998, maximum TCE concentrations in the Hot Spot have been reduced from 290 µg/L in 1998 to 17 µg/L in February 2018 (see Figure 4-3 and Figure 4-5). Maximum 1,1-DCE concentrations have been reduced from 300 µg/L in 1998 to 8.2 µg/L in February 2018 (see Figure 4-3 and Figure 4-5). The system removed approximately 79 lb of volatile chemicals from the groundwater prior to temporary shutdown in May 2007. Concentrations of COCs in the system influent stream suggest that AS/SVE operations initially resulted in additional removal of COCs from the subsurface, but there was a significant decline in mass removal between system startup in July 2013 to its shutdown in January 2014. The overall size of the plume in the Hot Spot has also decreased substantially. This information suggests that the AS/SVE system has functioned as intended to remediate the groundwater plume in the Building 230 area. Consequently, temporary shutdown of the AS/SVE system was approved by U.S. EPA and ADEQ in 2014. In November 2017, groundwater elevations in the Hot Spot area wells ranged from 137.29 feet mean sea level (msl) to 137.92 feet msl, which are below the top of screen of the AS wells. In the absence of an increase in groundwater elevation, the current screen depth of the AS wells relative to groundwater elevation does not justify operation of the AS/SVE system because injected air cannot be delivered to the saturated zone to strip CHCs from groundwater. ADEQ and USEPA concurred with permanent shutdown of the AS/SVE system in 2019 in letters dated January 25 and 29, respectively.

7.1.1.2 VCT Performance. The VCT system operated relatively continuously in the LEPA area from June 2000 to May 2003. The system was designed to reduce CHC concentrations and contain the plume in the LEPA area by withdrawing contaminated groundwater and re-injecting treated water into the aquifer. Monitoring data indicated that CHC concentrations in the LEPA

were sustained below MCLs, so the system was shut down on May 6, 2003. Groundwater monitoring continued as part of the LTM program during the temporary shutdown period. Permanent shutdown of the VCT system was approved in December 2005 with concurrence from U.S. EPA and ADEQ, following two years of groundwater monitoring performed subsequent to approval of the 2003 temporary shutdown. Before system shutdown in December 2005, the VCT system had removed an estimated 10.7 lbs of total mass from about 136,591,000 gallons of extracted groundwater (Battelle, 2010).

Due to COC rebound in groundwater in the vicinity of the VCT system, the system resumed operations in July 2011 and currently remains operational. Since system restart in July 2011, the VCT system has removed an estimated 2.6 pounds of CHCs from approximately 273,457,000 gallons of extracted groundwater (MMEC Group, 2018a). Currently, COC concentrations in the LEPA have met their respective drinking water MCLs and demonstrate that the VCT system has met the performance objective of contaminant containment at the LEPA.

A 1,4-dioxane pilot study in 2016 assessed the efficacy of AMBERSORB 560™ in removing 1,4-dioxane and site COCs (i.e., PCE, TCE, and 1,1-DCE) from the VCT system influent groundwater (MMEC Group, 2018b). The study demonstrated successful removal of 1,4-dioxane and the OU 1 Area 1 COCs to concentrations below project action levels, thus meeting treatment performance objectives. Additionally, sorbent regeneration techniques showed positive results in regenerating AMBERSORB 560™.

7.1.1.3 Groundwater Modeling and Human Health Risk Assessment. Groundwater modeling performed in 2015 evaluated the fate and transport of 1,4-dioxane and COCs at OU 1 Area 1 (Trevet, 2016). The modeling report provided the following conclusions:

- For 1,4-dioxane, the modeled plume with concentration exceeding its 2019 USEPA RSL (0.46 µg/L) would migrate beyond the boundary of OU-1 area for all four modeled scenarios.
- For TCE simulations in all scenarios, the modeled TCE plume with concentrations exceeding the MCL (5.0 µg/L) would not migrate beyond the boundary of OU 1 Area 1. The modeled maximum TCE concentration, which occurs in the Hot Spot area and is not affected by operation of the VCT system in the LEPA, would decrease to the MCL in 2025.
- For 1,1-DCE simulations in all scenarios, the modeled plume with concentrations exceeding the MCL (7.0 µg/L) would not migrate beyond the boundary of OU 1 Area 1. The modeled maximum 1,1-DCE concentration, which occurs in the Hot Spot area and is not affected by operation of the VCT system in the LEPA, would decrease to the MCL of 7.0 µg/L in 2021.
- After a projected 10 years of additional VCT operation, further operation was shown to provide no additional mass removal for 1,1-DCE, and TCE.

According to the modeling report, the ROD COCs will not reach the base boundary at concentrations exceeding their respective MCLs. Additionally, ICs implemented as part of the RAOs prevent access to OU 1 groundwater. Thus, the remedy remains protective.

A HHRA was performed as part of the supplemental groundwater investigation at OU-1 Area 1 in 2015 (Trevet, 2016). The HHRA evaluated the risk to future on-site commercial/industrial workers hypothetically exposed to 1,4-dioxane in drinking water, hypothetical future residents on-site and current and future residents off-site. The exposure point concentrations for on-site exposures were taken from a data set generated over several years (2012-2015). The maximum detected concentrations from the three exposure areas (Hot Spot, Central Plume and LEPA) from the years 2013, 2014 and 2015 were evaluated and showed decreasing risks over time. For the onsite hypothetical future scenarios, cancer risks from the Hot Spot were in the 10^{-4}range and risks from the Central Plume were in the 10^{-5}range. Cancer risks from the LEPA were $10^{-6}$for the future commercial/industrial worker hypothetically exposed to 1,4-dioxane in groundwater and 10^{-5} for the hypothetical future resident. Cancer risk for the off-site resident was estimated to be within the acceptable risk range of 10^{-5} and transitions to 10^{-6}around the year 2035, due to the modeled decreasing off-site concentration of 1,4-dioxane over time. The groundwater concentrations from 2015 from the three on-site exposure areas or any of the estimated off-site concentrations did not result in a hazard index greater than one.

7.1.1.4 Monitored Natural Attenuation. MNA is a component of the selected remedy for 1 Area 1. The Area 1 plume has been monitored for COCs and MNA chemical indicators. Overall, monitoring has indicated that the COC plumes are decreasing in size and magnitude through natural processes. The OU 1 Area 1 plume concentrations are lower than the concentrations reported during the previous FYR (Table 6-2) and are substantially lower than concentrations 10 years ago (MMEC Group, 2018b). Overall, Area 1 continues to show reduction in COC concentrations, indicating natural attenuation has been effective (see Figure 4-3 and Figure 4-4).

1,4-Dioxane has been observed in several wells in the LEPA at concentrations exceeding the U.S. EPA RSL (0.46 µg/L) with screen-interval depths ranging from 50 to 250 ft bgs. The highest 1,4-dioxane concentrations in the LEPA have been observed in the deep piezometer A1-PZ-19 at a screen interval of 230 to 250 ft bgs, below the effective depth limit of the VCT system. However, ICs implemented as part of the RAOs prevent access to OU 1 groundwater and downgradient production wells have not been identified within 1 mile of the LEPA. Thus, the remedy remains protective.

7.1.1.5 Implementation of Institutional Control. ICs were selected for OU 1 Area 1. The MCAS Yuma Master Plan was updated in September 2001 (KTUA, 2001) with the ICs for Areas 1, 2, 3, and 6 in OU 1. The MCAS Yuma Master Plan has subsequently been revised since only Area 1 continues to require ICs (KTUA, 2007). The final LUCIP, issued in September 2002 (NAVFAC SW, 2002a), was developed to provide the details for implementing LUCs for OU 1, and included a description of the ICs and access and notification provisions. Since the original LUCIP was developed in 2002, it has been updated twice in 2014 and again in 2017 (NAVFAC SW, 2014 and NAVFAC SW, 2017b). The LUCs were also formally implemented for MCAS Yuma by Station Order 5090A, which directed tenants and contractors to incorporate the LUCs into existing land use planning and management systems. The MCAS Yuma Station Order 5090B was updated and signed in May 2014 (Appendix B1). ICs will be maintained for the OU 1 Area 1 groundwater plume area until it has met its closure criteria, as stated in the ROD and summarized in Section 4.1.1.4 of this report.

The final LUCIP also provides for ADEQ access to the sites, prior notification, and reevaluation of the remedy in the event a change to the land use is proposed. The final LUCIP states that ADEQ will be notified in advance if the property associated with these areas is identified as excess by MCAS Yuma and proposed for transfer out of federal ownership.

MCAS Yuma personnel and tenants do not have access to groundwater water resources. The only mechanism for exposure to groundwater is through extraction via groundwater wells. The MCAS Yuma dig permit approval process (which must proceed through the MCAS Yuma Environmental Department) successfully maintains control over the installation of any groundwater wells. No groundwater extraction wells, with the exception of the wells used for environmental remediation, have been installed in the areas within OU 1 Area 1.

MCAS Yuma Environmental Department personnel routinely visit the secured areas in the course of their regular duties.

7.1.1.6 Hot Spot Area Pilot Study – ISCO Treatment. Two rounds of ISCO injections were conducted February 2016 and June 2017 in the Hot Spot area using a DPT injection process to deliver PersulfOx™ as the oxidizing reagent to the treatment areas. The ISCO pilot study concluded:

1. A significant reduction in 1,4-dioxane and OU 1 Area 1 COC (PCE, TCE, and 1,1-DCE) concentrations during post-injection monitoring.
2. A ROI of 5 to 7.5 feet, which was significantly smaller than the initial estimate of 25 feet.
3. A potential increase in bromate and hexavalent chromium concentrations five months after the ISCO injection, requiring additional monitoring to evaluate if the condition is transitory.

7.1.2 Question B: Are the Exposure Assumptions, Toxicity Data, Clean-Up Levels, and Remedial Action Objectives Used at the Time of Remedy Selection Still Valid? Yes; the following sections present the information evaluated to answer this question on the basis of HHRA, federal and state regulations evaluated as potential ARARs for the RA, and achievement of the RAOs. Changes in exposure pathways, toxicity and other contaminant characteristics, and cleanup levels are discussed below, followed by discussion of expected progress toward meeting RAOs.

No state or federally listed threatened or endangered species are known to be present at MCAS Yuma. Also, no critical habitat or habitat of an endangered species is present. Given that the contaminated groundwater is about 60 feet bgs and most of the ground surface is used for MCAS activities, no significant impact to potential ecological receptors was identified during the RI and there is no apparent mechanism for ecological receptors to be exposed to contaminated groundwater. As such, there is no need to evaluate the protectiveness of the remedy with regard to ecological exposure assumptions, toxicity data, clean-up levels, and RAOs.

7.1.2.1 Changes in Standards. The U.S. EPA MCLs for 1,1-DCE, TCE, and PCE remain unchanged since the development of the OU 1 ROD as is shown in U.S. EPA's National Primary Drinking Water Regulations (U.S. EPA, 2009a).

There is no MCL for 1,4-dioxane. In the previous FYR (NAVFAC SW, 2015), concentrations of 1,4-dioxane in groundwater were compared to the U.S. EPA RSL for 1,4-dioxane in tap water, which was listed in the 2015 FYR report as 0.67 µg/L. The current residential tap water RSL for 1,4-dioxane is 0.46 µg/L (U.S. EPA, 2019). The difference in RSL values is due to the use of revised U.S. EPA-recommended default exposure factors for ingestion rate, surface area, body weight, and exposure duration that were released in February 2014 (U.S. EPA, 2014). In addition, the U.S. EPA 2018 Edition of the Drinking Water Standards and Health Advisories Tables provides a lifetime health advisory of 200 µg/L for non-carcinogenic effects and 35 µg/L for a 10^{-4} cancer risk (U.S. EPA, 2018). Concentrations of 1,4-dioxane in groundwater exceed the U.S. EPA RSL but not the U.S. EPA health advisory. In addition, ICs implemented as part of the RAOs prevent access to OU 1 groundwater. Thus, the remedy remains protective.

7.1.2.2 Changes in Toxicity and Other Contaminant Characteristics. Cancer slope factor and/or oral reference dose (RfD) have changed for the three COCs at OU 1 since the ROD was signed. A comparison of the toxicity values listed in the ROD to current toxicity criteria is provided in Table 7-1. Current toxicity criteria were selected according to the U.S. EPA (2003) Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53. Note that at the time of the signing of the OU 1 ROD, 1,1-DCE was considered a carcinogen and an oral slope factor was available for 1,1-DCE. Since that time however, U.S. EPA re-evaluated toxicity studies for 1,1-DCE and determined that there was not sufficient evidence to classify 1,1-DCE as a carcinogen. Accordingly, U.S. EPA withdrew the oral slope factor and that is the reason for the "NA" in Table 7-1.

Table 7-1. Summary of Toxicity Changes to the OU 1 COCs

OU 1 COC	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$			Oral Reference Dose (RfD) (mg/kg-day)		
	ROD Value[1]	Current Value	Source of Current Value[2]	ROD Value[1]	Current Value	Source of Current Value[2]
1,1-DCE	6.0×10^{-1}	NA	U.S. EPA IRIS	9.0×10^{-3}	5.0×10^{-2}	U.S. EPA IRIS
TCE	1.1×10^{-2}	4.6×10^{-2}	U.S. EPA IRIS	6.0×10^{-3}	5.0×10^{-4}	U.S. EPA IRIS
PCE	5.2×10^{-2}	2.1×10^{-3}	U.S. EPA IRIS	1.0×10^{-2}	6.0×10^{-3}	U.S. EPA IRIS

NA - not available
1. NAVFAC SW. 2000. Final Record of Decision for Operable Unit 1, Marine Corps Air Station Yuma, Arizona. July (signed 05 October).
2. U.S. EPA Integrated Risk Information System (IRIS) Accessed April 2018 [available on IRIS at https://cfpub.epa.gov/ncea/iris2/atoz.cfm].

The OU 1 baseline risk assessment evaluated potential carcinogenic risk and noncarcinogenic human health hazards using a risk-based concentration (RBC) approach, whereby maximum detected concentrations are compared to the chemical specific RBC. RBCs are chemical-specific concentrations in a medium (i.e., water) that correspond to a preestablished carcinogenic risk of 1×10^{-6} or a noncarcinogenic hazard quotient (HQ) of 1.0 for a defined set of reasonable maximum exposure (RME) assumptions. A carcinogenic risk of 1×10^{-6} implies that there is a one in a million chance that a person would get cancer during that person's lifetime. A noncarcinogenic HQ greater than 1.0 implies that there may be acute or chronic adverse noncancer health effects. Conservative exposure parameters representing RME conditions for residential use of groundwater as tap water, including drinking two liters of untreated contaminated water per day, every day for 30 years, and U.S. EPA-published toxicity values (U.S. EPA, 1992, 1995) were used in deriving the RBCs.

For this FYR, the current U.S. EPA RSLs (U.S. EPA, 2019) for tap water are compared to the OU 1 RBCs and current remediation goals designated in the ROD to assess the protective nature of the RA. Derivation of the RSLs is similar to the methodology used to derive the RBCs that were developed for use in the OU 1 risk assessment but the RSLs incorporate current toxicity (Table 7-1) and recommended default exposure factors (i.e., ingestion rate, surface area, body weight, and exposure duration) consistent with recent supplemental U.S. EPA guidance (U.S. EPA, 2014).

Comparisons of the RBCs and RSLs are shown in Table 7-2. Based on current toxicity values and, to a lesser degree, changes in exposure parameter assumptions, risk-based values for the COCs would be different today than they were when the ROD was signed. For 1,1-DCE, changes in toxicity have resulted in a single risk-based value for the noncarcinogenic endpoint which is higher than the noncarcinogenic RBC developed in the RI. For TCE, changes that have occurred with the toxicity values since calculation of the RBC for the RI have resulted in lower carcinogenic and noncarcinogenic risk-based values. For PCE, changes in toxicity values since the RI have resulted in a higher carcinogenic risk-based value, but a lower noncarcinogenic risk-based value.

Also provided in Table 7-2 are the MCLs for the COCs which were designated in the ROD as the cleanup goals. The MCLs for 1,1-DCE and PCE are lower than the current RSLs for residential use of groundwater as tap water. The MCL for TCE is higher than the RSL. For 1,1-DCE, only samples from monitoring well 16-MW-08 continue to exceed the MCL; however, all of the 1,1-DCE concentrations detected in groundwater monitoring wells are less than the current RSL. For PCE, all concentrations detected are below the MCL and the RSL. For TCE, concentrations detected continue to exceed the MCL and the current RSL. However, because the ICs in place at OU 1 prevent ingestion of groundwater, the RSLs do not require a modification of the remedial goal. As an ARAR, MCLs remain the remedial goal.

Table 7-2. Risk-Based Values for Groundwater and Comparison to Cleanup Levels and Current Groundwater Concentrations

COC	Carcinogenic Values		Noncarcinogenic Values		ROD Cleanup Goal[1]	Maximum Concentrations as Reported in the ROD[1]	Maximum Concentrations Reported between May 2017 and February 2018[3]
	ROD RBC[1]	Current RSL[2]	ROD RBC[1]	Current RSL[2]			
1,1-DCE	0.039	NA	55	280	7	170	7.7
TCE	1.5	0.49	36	2.8	5	450	14
PCE	0.83	11	61	41	5	16	0.84 J

1. Final ROD OU 1 (NAVFAC SW, 2000)
2. U.S. EPA RSL dated May 2019.
3. Draft Technical Memorandum for 1,4-Dioxane Pilot Study at OU 1 Area 1 (MMEC Group, 2018b).

7.1.2.3 Changes in Risk Assessment Methods. A HHRA was conducted in 2012 to assess the potential exposure to human receptors via the vapor intrusion (VI) pathway because VI exposure was not evaluated in the OU 1 RI risk assessment. Results of the VI assessment as reported in the Final Site Characterization Report, Data Gap Investigation Results, OU-1 Areas 1 and 3, and OU-2 CERCLA AOC 1, 8A, 8B, and 10 (Sealaska, 2013) indicated that noncancer hazards and cancer risks were below *de minimis* levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents and that the remedies for OU-1 remain protective (Sealaska, 2013).

The potential migration of subsurface VOCs into indoor air was assessed in the 2012 HHRA using the Johnson and Ettinger (J&E) model (Johnson and Ettinger, 1991) and a spreadsheet version ("SG-SCREEN" Version 3.1; February 2004) of the J&E model issued by U.S. EPA (2004). Since 2012, U.S. EPA has revised their spreadsheet for modeling subsurface VI and produced the J&E Model Spreadsheet Tool, Version 6.0. The revised spreadsheet tool implements the steady-state solution to vapor transport (infinite or non-diminishing source and steady-state vapor concentrations) described by J&E 1991 and allows the user to input a site-specific groundwater concentration and depth to groundwater. Version 6.0 of the model (updated September 2017) is consistent with the 2015 OSWER Vapor Intrusion Guidance (U.S. EPA, 2015a) and implements a number of updates to improve ease of use, transparency and interpretability and is available for download from https://www.epa.gov/vaporintrusion/epa-spreadsheet-modeling-subsurface-vapor-intrusion#background.

Risks and hazards based on a hypothetical residential use scenario were recalculated using the U.S. EPA J&E version 6.0 spreadsheet tool along with current inhalation toxicity values, 2012 soil gas concentrations, and the same input assumptions used in the 2012 HHRA. Current inhalation toxicity values are the same as those use in the 2012 HHRA VI assessment. Cancer risks and noncancer health hazards estimated using the version 6.0 J&E spreadsheet were the same as the results estimated using J&E version 3.1 reported in Sealaska, 2013 (i.e., noncancer hazards and cancer risks were below de minimis levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents). As such, the use of an updated risk

assessment tool for the VI pathway results in the same risk conclusions resulting from the 2012 HHRA (Sealaska, 2013) and the remedies for OU-1 remain protective.

7.1.2.4 New Contaminants and/or Contaminant Sources. 1,4-Dioxane and PFAS have been detected in groundwater across OU 1 Area 1 subsequent to the ROD. 1,4-Dioxane concentrations detected within OU 1 Area 1 do not exceed the U.S. EPA health advisory for carcinogenic or non-carcinogenic effects anywhere within the plume. However, 1,4-dioxane concentrations within OU 1 Area 1 exceed the tapwater RSL of 0.46 µg/L. If groundwater from OU 1 Area 1 LEPA were used for potable purposes, the maximum 1,4-dioxane concentration of 6.4 µg/L detected in November 2018 would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Modeling results show that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016). Therefore, there are no issues with regard to 1,4-dioxane at Area 1.

PFAS concentrations exceed the U.S. EPA lifetime health advisory levels within OU 1 Area 1, but are less than the U.S. EPA tapwater RSL of 0.4 µg/L (tapwater RSL calculated using U.S. EPA RSL Calculator; available at https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search). If groundwater from OU 1 Area 1 LEPA were used for potable purposes, the maximum PFAS concentration of 0.086 µg/L detected in July 2017 would result in noncancer hazard below EPA's goal of protection of a hazard index of 1. OU 1 Area 1 has an IC restricting against the use of groundwater so there is no excess hazard associated with the presence of PFAS in site groundwater. One well in the LEPA contained a combined PFOA/PFOS concentration essentially equivalent to the health advisory. There are no drinking water wells within a mile downgradient of the LEPA. Therefore, there are no issues with regard to PFAS at OU 1 Area 1.

7.1.2.5 Expected Progress Towards Meeting RAOs. The RAOs for the OU-l Area 1 groundwater plume are: (1) plume containment within the MCAS Yuma facility boundary, and (2) the reduction of groundwater contamination to meet applicable drinking water standards (U.S. EPA MCLs). The selected remedy (remediation activities) has successfully contained the CHC plume within the MCAS Yuma boundaries, and groundwater monitoring results have demonstrated reduction of CHC concentrations.

7.1.3 Question C: Has any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy? Yes; additional studies have been conducted on emerging contaminants including 1,4-dioxane and PFAS, which are not ROD COCs.

The current treatment technology for CHCs do not appear to be effective in treating 1,4-dioxane. Therefore, additional studies have been conducted to assess the performance of ISCO in the Hot Spot Area and AMBERSORB 560™ in the LEPA. Treatment technologies for PFAS have not been evaluated for OU 1.

Further delineation and treatment evaluations of these emerging contaminants are recommended.

7.2 Technical Assessment of Operable Unit 2

The technical assessment for OU 2 presented in this section describes how each of the three key assessment questions was answered for OU 2 CAOCs 1, 8A, and 10. The discussion presented here is a framework for the protectiveness determination that explains the conclusions of the review, based on the information presented in the previous section.

7.2.1 Question A: Is the Remedy for OU 2 Functioning as Intended by the Decision Documents? Yes; a review of documents, site inspections, and interviews of station personnel indicates that the remedy for OU 2 CAOCs 1, 8A, and 10 is functioning to protect human health through implementation of ICs on land use. The subsections below provide further detail regarding the remedy efficacy.

7.2.1.1 Remedial Action Performance. The selected remedy as defined in the ROD consisted of ICs restricting land use of CAOC 1 and CAOC 10 to industrial/commercial use and CAOC 8A to its current use as an inactive former landfill as well as prevent any activities that may disrupt and expose the landfill interior. The land surfaces are secured by fencing with locked gates and access to CAOCs 1, 8A, and 10 is restricted to MCAS Yuma Environmental Department personnel and MCAS Yuma security personnel. No station activity is currently proceeding at the CAOCs. These measures are functioning to protect human health.

7.2.1.2 Implementation of Institutional Controls. The MCAS Yuma Master Plan was updated in September 2001 (KTUA, 2001) with the ICs for CAOCs 1, 8A, and 10 of OU 2. The MCAS Yuma Master Plan has subsequently been revised (KTUA, 2007). The final LUCIP, updated in 2017 (NAVFAC SW, 2017b), provides the details for implementing LUCs for OU 2 and included a description of the ICs and access and notification provisions. The LUCs were also formally implemented for MCAS Yuma by Station Order 5090B, which directed tenants and contractors to incorporate the LUCs into existing land use planning and management systems. The MCAS Yuma Station Order 5090B was signed in May 2014 (Appendix B1).

The final LUCIP also provides for regulatory access to the sites, prior notification, and remedy reevaluation if a change to the land use is proposed. The final LUCIP states that the regulatory agencies will be notified in advance if the property associated with these areas is identified as excess by MCAS Yuma and proposed for transfer out of federal ownership.

7.2.2 Question B: Are the Exposure Assumptions, Toxicity Data, Clean-up Levels, and RAOs Used at the Time of Remedy Selection Still Valid? Yes; the following subsections present the information evaluated to answer this question on the basis of human health and ecological risk assessment, federal and state regulations evaluated as potential ARARs for the RA, and achievement of the RAO. Changes in exposure pathways, toxicity and other contaminant characteristics, and cleanup levels are discussed below, followed by discussion of expected progress toward meeting RAOs.

7.2.2.1 Changes in Standards. Arizona's Soil Remediation Standards are identified in the OU-2 ROD as chemical-specific ARARs for the remediation of soil at CAOCs 1, 8A, and 10. ARS Title 49, as implemented in AAC Title 18, Chapter 7, Article 2 (March 31, 2009), requires that

soil be remediated to either (1) background levels, (2) HBGLs, or (3) site-specific risk assessment-based levels. In 1997 the HBGLs were replaced with SRLs. The current SRLs listed in the March 31, 2009 version of Appendix A of AAC Title 18, Chapter 7, Article 2, are listed in Table 7-3, with a comparison of the HBGLs presented in the ROD. With the exception of naphthalene, the 2009 non-residential SRLs are consistently higher than the 1995 levels, indicating that the remedies remain protective as long as ICs remain in place to restrict land use.

Table 7-3. Comparison of Arizona Soil Remediation Standards for COCs at OU 2 CAOC 1, 8A, and 10

OU 2 COC	Cancer Group		Residential (mg/kg)		Non-Residential (mg/kg)	
	1995[a]	2009[b]	1995 HBGL[1]	2009 SRL[2]	1995 HBGL[1]	2009 SRL[2]
Acenaphthene	ND	nc	7,000	3,700	24,500	29,000
Acenaphthylene	D	NA	7,000	NA	24,500	NA
Anthracene	D	nc	35,000	22,000	122,500	240,000
Benz[a]anthracene	B2	ca	1.1	0.69	4.6	21
Benzo[a]pyrene	B2	ca	0.19	0.069	0.80	2.1
Benzo[b]fluoranthene	B2	ca	1.1	0.69	4.6	21
Benzo[k]fluoranthene	B2	ca	1.1	6.9	4.6	210
Chrysene	B2	ca	110	68	462.0	2,000
Dibenz[a,h]anthracene	B2	ca	0.11	0.069	0.46	2.1
Fluoranthene	D	nc	4,700	2,300	16,450	22,000
Fluorene	D	nc	4,700	2,700	16,450	26,000
Indeno[1,2,3-cd]pyrene	B2	ca	1.1	0.69	4.6	21
Naphthalene	D	nc	4,700	56	16,450	190
Polychlorinated biphenyls (high risk)	B2	ca, nc	0.18	0.25	0.76	7.4
Polychlorinated biphenyls (low risk)	ND	ca, nc	8.2	3.9	28.7	37
Pyrene	D	nc	3,500	2,300	12,250	29,000

1. Appendix A to Title 18, Chapter 7, Article 2; June 1995 Update. Health-based guidance levels (HBGL) as provided in Tables 2-8 of the OU 2 ROD (Uribe & Associates, 1997).
2. Soil remediation levels (SRLs) as obtained from Appendix A to ARS Title 18, Chapter 7, Article 2 updated March 31, 2009.
NA – not available
ND - no data available
Cancer Groups are as follows:
B2: Probable human carcinogen
D: Not classifiable as to human carcinogenicity
Ca: carcinogen
nc: noncarcinogen

7.2.2.2 Changes in Risk Assessment Methods. Similar to OU 1, the VI exposure pathway was not evaluated during the RI for OU 2 CAOCs 1 and 10. Therefore, a HHRA was conducted in 2012 to assess the potential exposure to human receptors via the VI pathway. Results of the VI assessment as reported in the Final Site Characterization Report (Sealaska, 2013) indicated that noncancer hazards and cancer risks were below *de minimis* levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents and that the remedies for OU-1 remain protective (Sealaska, 2013).

The potential migration of subsurface VOCs into indoor air was assessed in the 2012 HHRA using the J&E model (Johnson and Ettinger, 1991) and a spreadsheet version ("SG-SCREEN" Version 3.1; February 2004) of the J&E model issued by U.S. EPA (2004). Since 2012, U.S. EPA has revised its spreadsheet for modeling subsurface VI and produced the J&E Model Spreadsheet Tool, Version 6.0. The revised spreadsheet tool implements the steady-state solution to vapor transport (infinite or non-diminishing source and steady-state vapor concentrations) described by J&E (1991) and allows the user to input a site-specific groundwater concentration and depth to groundwater. Version 6.0 of the model (updated September 2017) is consistent with the 2015 OSWER Vapor Intrusion Guidance (U.S. EPA, 2015a) and implements a number of updates to improve ease of use, transparency and interpretability and is available for download from https://www.epa.gov/vaporintrusion/epa-spreadsheet-modeling-subsurface-vapor-intrusion#background.

Risks and hazards based on a hypothetical residential use scenario were recalculated using the U.S. EPA J&E version 6.0 spreadsheet tool along with current inhalation toxicity values, 2012 soil gas concentrations, and the same input assumptions used in the 2012 HHRA. Current inhalation toxicity values are the same as those use in the 2012 HHRA VI assessment. Cancer risks and noncancer health hazards estimated using the version 6.0 J&E spreadsheet were the same as the results estimated using J&E version 3.1 reported in Sealaska, 2013 (i.e., noncancer hazards and cancer risks were below de minimis levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents). As such, the use of an updated risk assessment tool for the VI pathway results in the same risk conclusions resulting from the 2012 HHRA (Sealaska, 2013) and the remedies for OU 2 CAOCs 1 and 10 remain protective.

7.2.2.3 Changes in Toxicity and Other Contaminant Characteristics. A toxicity evaluation was performed by comparing the RBCs that were developed for use in the human health screening evaluation in the RI and current 2019 U.S. EPA RSL for soil in an industrial exposure scenario for the OU 2 COPCs. In addition, a re-evaluation of the background characterization was performed based on the results of a 2013 soil background study for metals and PAHs to assess the distribution and concentrations of naturally occurring metals and non-naturally occurring, non-site-related anthropogenic levels of PAHs at MCAS Yuma in surface and subsurface soils (Trevet, 2014a).

7.2.2.3.1 Toxicity Evaluation. Derivation of the RBCs and RSLs is very similar; both sets of values are chemical-specific and based on a given set of exposure assumptions. For this particular evaluation, the exposure of interest is an industrial land use scenario. The RBCs and RSLs for carcinogenic compounds are calculated by inserting the appropriate exposure parameters and toxicity values into the chemical intake equation, and setting the target cancer risk, when all possible pathways are evaluated, equal to 1×10^{-6}. The target noncarcinogenic HI for the criteria is 1.0. Chemicals with both carcinogenic and noncarcinogenic health effects will have two sets of criteria. The algorithms and the description of the methodology used to calculate RBCs and RSLs are presented in Appendix P of the OU 2 RI (JEG, 1996a) and on U.S. EPA's website at https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide, respectively.

Table 7-4 provides a comparison of the RBCs listed in the ROD and the current 2019 U.S. EPA RSLs for an industrial land use scenario for each of the OU 2 COPCs. All of the 2019 RSLs are higher than the ROD RBCs primarily because of changes to toxicity values since the ROD was signed. Changes to toxicity values include lower carcinogenic PAH oral slope factors and discontinued use of route to route extrapolation of oral toxicity values in place of inhalation values for COPCs without specific inhalation toxicity values (primarily for the noncarcinogenic PAHs listed in Table 7-5). If RBCs were re-calculated today, values would be higher and the estimated cancer risks and noncancer health hazards would be lower, indicating that the remedies remain protective as long as ICs remain in place to restrict land use. Although the remedies remain protective, it is recommended that an updated screening level risk analysis be completed to estimate cancer risks and noncancer hazards for both residential and industrial use scenarios using current toxicity and risk assessment methodology to further assess the need for ICs at OU 2 CAOCs.

Table 7-4. Comparison of ROD RBC to Current RSL for the Commercial/Industrial Receptor

OU 2 COPC	ROD Industrial RBC[1] (mg/kg)		2019 Industrial RSL[2] (mg/kg)	
	Cancer	Noncancer	Cancer	Noncancer
Acenaphthene	--	55.6	--	45,000
Acenaphthylene	--	--	--	--
Anthracene	--	1.76	--	230,000
Benzo(e) Pyrene	--	--	--	--
Benzo(a) Anthracene	1.23	--	21	--
Benzo(a) Pyrene	0.123	--	2.1	220
Benzo(b) Fluoranthene	1.23	--	21	--
Benzo(g,h,i) Perylene	--	--	--	--
Benzo(k) Fluoranthene	12.3	--	210	--
Chrysene	123	--	2,100	--
Dibenzo(a,h) Anthracene	0.123	--	2.1	--
Fluoranthene	--	12,800	--	30,000
Fluorene	--	47.6	--	30,000
Indeno (1,2,3-cd) Pyrene	1.23	--	21	--
Naphthalene	--	124	17	590
Pyrene	--	9,600	--	23,000
Aroclor 1254	0.176	--	0.97	15

"--" indicates a value could not be derived because of the lack of toxicity values.
1. Risk-based criteria (RBC) obtained from the OU 2 ROD (Uribe & Associates, 1997).
2. Regional Screening Levels (RSLs) from U.S. EPA 2019.

7.2.2.3.2 Background Characterization. An evaluation of MCAS Yuma background data was previously presented in the OU 2 RI (JEG, 1996a). The RI background data were from both surface and subsurface soil samples, including samples obtained at depths greater than 10 feet bgs. During review of the SI Report for MRP Sites 1, 2, 4, 5, and 6 (Alliance Compliance, 2011), the U.S. EPA expressed concern that the background data set might not be comparable to the surface soil data collected from the MRP sites; hence the need for a background study. The

primary purpose of this background study for metals and PAHs is to assess the distribution and concentrations of naturally occurring metals and non-naturally occurring, non-site-related anthropogenic levels of PAHs at MCAS Yuma in surface and subsurface soils.

Table 7-5 shows a comparison of the background TLVs used during the OU 2 RI (JEG, 1996a) and the more recent background values calculated by Trevet (2014a). TLVs have increased for arsenic, barium, copper, manganese, nickel, vanadium, and zinc in CAOC 1, while TLVs have decreased for aluminum, antimony, beryllium, cadmium, chromium, cobalt, lead, selenium, silver, and thallium. TLVs for aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc have increased for CAOCs 8A and 10, while TLVs for antimony, cadmium, selenium, silver, and thallium have decreased. Although the remedies remain protective because of the ICs, it is recommended that an updated screening level risk analysis be completed to re-evaluate background contribution to cancer risks and noncancer hazards for both residential and industrial use scenarios to further assess the need for ICs at OU 2 CAOCs.

Table 7-5. Soil Background Threshold Limit Values for Metals at OU 2

OU 2 COPC	Threshold Limit Values (mg/kg)			
	CAOC 1 TLV[1]	CAOC 8A TLV[1]	CAOC 10 TLV[1]	2013 Current Background[2]
Aluminum	20,835	7,774	6,312	20,600
Antimony	7.0	6.0	7.1	0.46
Arsenic	8.6	9.8	9.0	15
Barium	187	133	184	555
Beryllium	2.0	0.28	0.28	0.90
Cadmium	1.0	0.80	1.64	0.49
Chromium	49	10.6	25	28
Cobalt	12	6.1	7.3	11
Copper	15	22	5.8	25
Lead	16	8.8	6.8	14
Manganese	319	137	157	527
Nickel	20	6.7	9.8	26
Selenium	2.3	1.9	1.9	0.45
Silver	1.2	1.6	1.1	0.10
Thallium	4.2	6.8	7.9	0.49
Vanadium	38	23	27	65
Zinc	38	28	30	56

1. Background concentrations obtained from the OU 2 RI Report (JEG, 1996a).
2. Background values for combined surface and subsurface samples from Trevet (2014a).

Because estimated risks associated with PAHs are what prompted the need for remedial action and implementation of ICs for CAOCs 1 and 10, it is recommended that the background PAH data provided in Trevet (2014a) be used in a forensic evaluation of site-related PAH data to determine if the site PAH detections exhibit an anthropogenic background signature or have a

different signature indicating a site-related source. Regardless whether the forensic evaluation is performed, the ICs remain protective.

7.2.2.4 Changes in Ecological Toxicity and Risk Assessment Methods. Screening level ecological risk assessments were conducted for the CAOCs at OU 2 and are provided in the RI for OU 2 (JEG, 1996a). All chemicals detected in the off-site laboratory analyses in soil 0 to 5 feet bgs were identified as a COPEC. COPEC maximum concentrations were compared to ecological soil toxicity criteria that represented chemical-specific concentrations in soil protective of valued receptors at MCAS Yuma. Ecological soil toxicity criteria were derived for each COPEC, assuming that the ecological receptor is exposed continuously for its entire lifetime and using ecological reference doses (ecoRfDs) for vertebrate species. Because the valued receptors identified for MCAS Yuma are vertebrates, ecological soil toxicity criteria were derived that were protective of vertebrate receptors (JEG, 1996a). The derivation of the toxicity criteria did not specifically address plants and invertebrates because:

- The plant community at MCAS Yuma is highly disturbed and consists mainly of small remnant communities or successional communities.
- There are no special status invertebrate species likely to be found at MCAS Yuma.

The process of developing soil toxicity criteria and the ecoRfDs selected for their development are provided in Appendix Q of the OU 2 RI (JEG, 1996a). Like the human health risk-based screening criteria (e.g., RSLs), ecological soil toxicity criteria that represent pollutant-specific concentrations in media that are protective of ecological receptors at MCAS Yuma are derived. Thus, they represent the concentration of a COPEC in soil that is unlikely to adversely impact terrestrial receptors at the site. The soil screening criteria derived for the RI were protective of direct exposure to terrestrial vertebrates. However, to protect higher level consumers like the burrowing owl, the potential bioaccumulation of COPECs was evaluated and taken into account when deriving criteria. Bioaccumulation potential has been integrated into the derivation of soil screening criteria at other sites by assessing a simplistic yet conservative pathway: soil to earthworms and earthworms to birds. Although simplistic, this pathway is realistic because at MCAS Yuma the only chemicals likely to bioaccumulate within tissues are those found in shallow soils.

Since the screening level risk assessments were performed in 1996, U.S. EPA, other state agencies, and other ecological researchers have been compiling toxicity information and developing soil screening levels for various types of ecological receptors. U.S. EPA now maintains the Ecotox Knowledgebase (ECOTOX), which is a comprehensive, publicly available knowledgebase providing single chemical environmental toxicity data on aquatic life, terrestrial plants and wildlife in addition to developing ecological soil screening level (SSL) documents for many of the soil contaminants that are frequently of ecological concern for plants and animals at hazardous waste sites. These documents are available at https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents.

In addition, the Environmental Sciences Division of Oak Ridge National Laboratory developed and compiled a comprehensive set of ecotoxicological screening benchmarks for surface water, sediment, and surface soil applicable to a range of aquatic organisms, soil invertebrates, and

terrestrial plants. These benchmarks, or updates are performed in collaboration with the Institute for Environmental Modeling at the University of Tennessee and URS | CH2M Oak Ridge LLC (UCOR), and are provided as a searchable database. Links to supporting technical reports from which the benchmarks were obtained are also provided. Benchmarks from many other national and international sources have been added to the database as well. The Ecological Benchmark Tool database is located in the Risk Assessment Information System at https://rais.ornl.gov/tools/eco_search.php.

The ecological risk assessments conducted for CAOCs 1, 8A and 10 identified several metals and organic compounds that exceeded the soil toxicity criteria. Table 7-6 provides a comparison of the current ecological SSLs developed by U.S. EPA for common inorganic and pesticide COPECs and the soil toxicity criteria developed for these COPECs for the screening level ecological risk assessments conducted in 1996. A screening level ecological assessment conducted today would most likely start with these U.S. EPA values. As shown in Table 7-6, many of the inorganic screening benchmarks are higher than the soil toxicity criteria, but the pesticide benchmarks are much lower.

Table 7-6. Ecological Soil Screening Levels

COPEC	Soil Toxicity Criteria (mg/kg)[1]	Current Soil Screening Benchmarks[2] (mg/kg)	
		U.S. EPA Eco-SSL Avian	U.S. EPA Eco-SSL Mammalian
Antimony	4.67	ND	0.27
Arsenic, Inorganic	10.5	43	46
Barium	244	ND	2000
Beryllium	7.2	ND	21
Cadmium	0.01	0.77	0.36
Cobalt	0.667	120	230
Copper	105	28	49
DDT	0.88	0.093	0.021
Dieldrin	0.24	0.022	0.0049
Lead	3.8	11	56
Manganese	519	4300	4000
Nickel	322	210	130
Selenium	4.75	1.2	0.63
Silver	6.83	4.2	14
Vanadium	37.3	7.8	280
Zinc	54.67	46	79

ND – not determined
1. Soil toxicity criteria as listed in the OU 2 RI (JEG, 1996a).
2. Current soil screening benchmarks obtained from the Risk Assessment Information System Ecological Benchmark Tool at https://rais.ornl.gov/tools/eco_search.php.

Although screening values differ today, the results of the thorough data evaluation conducted as part of the ecological risk assessments support that the remedies enacted at the CAOCs remain protective because only a small portion of the CAOCs could provide contact between receptors and potentially contaminated soil, the COPECs driving risk are fairly immobile, and the majority

of detected inorganic risk drivers were attributed to background; thus, it remains unlikely that vertebrate receptors would be significantly impacted from contact to COPECs remaining in the environment.

7.2.2.5 Expected Progress Towards Meeting RAOs. The RAO for OU 2 CAOCs 1, 8A, and 10 is to minimize the potential for unacceptable human-health risk that could result from a change in land use (Uribe & Associates, 1996b). The continued isolation of OU 2 CAOCs, by way of ICs, remains an effective means of meeting the RAO.

7.2.3 Question C: Has Any Other Information Come to Light That Could Call into Question the Protectiveness of the Remedy? No; no additional information has been found to suggest that the remedy selected for OU 2 CAOCs 1, 8A, and 10, as currently defined in the ROD (Uribe & Associates, 1997b), may not be protective. The selected remedy remains effective as long as ICs are maintained. While base personnel have indicated the possibility of a future land use change for OU 2 CAOC 8A, documentation of that land use change is needed; should a change in land use be needed for CAOC 8A, communication with the regulatory agencies, prior to the change, will occur as stipulated in the ROD.

7.3 Technical Assessment of Munitions Response Sites 4 and 6

The technical assessment for MRP Sites 4 and 6 presented in this section describes how each of the three key assessment questions was answered for MRP Sites 4 and 6. The discussion presented here is a framework for the protectiveness determination that explains the conclusions of the review, based on the information presented in the previous section.

7.3.1 Question A: Is the Remedy for MRP Sites 4 and 6 Functioning as Intended by the Decision Documents? Yes; a review of documents, site inspections, and interviews of station personnel indicates that the remedy for MRP Sites 4 and 6 is functioning to protect human health through implementation of ICs on land use. The subsections below provide further detail regarding the remedy efficacy with regard to RA performance and implementation of ICs.

7.3.1.1 Remedial Action Performance. The selected remedy as defined in the ROD consisted of ICs restricting land use of MRP Sites 4 and 6 to industrial/commercial use and control access to MC (and MEC at Site 6) potentially present in subsurface soils and will be implemented through the MCAS Yuma base planning process. No station activity is currently proceeding at the sites. These measures are functioning to protect human health.

7.3.1.2 Implementation of Institutional Controls. The final LUCIP, updated in 2017 (NAVFAC SW, 2017b) provides the details for implementing LUCs for MRP Sites 4 and 6, and included a description of the ICs. The LUCs were also formally implemented for MCAS Yuma by Station Order 5090B, which directed tenants and contractors to incorporate the LUCs into existing land use planning and management systems. The MCAS Yuma Station Order 5090B was signed in May 2014 (Appendix B1).

The final LUCIP also provides for regulatory access to the sites, prior notification, and remedy reevaluation if a change to the land use is proposed. The final LUCIP states that the regulatory

agencies will be notified in advance if the property associated with these areas is identified as excess by MCAS Yuma and proposed for transfer out of federal ownership.

7.3.2 Question B: Are the Exposure Assumptions, Toxicity Data, Clean-up Levels, and RAOs Used at the Time of Remedy Selection Still Valid? Yes; the following sections present the information evaluated to answer this question on the basis of human health and ecological risk assessment, federal and state regulations evaluated as potential ARARs for the RA, and achievement of the RAO. Changes in exposure pathways, toxicity and other contaminant characteristics, and cleanup levels are discussed below, followed by discussion of expected progress toward meeting RAOs.

For MRP Site 4 and Site 6, MC consist of metals that may have been released from small arms ammunition. MRP Site 4 is used as an airfield and overlaps CAOC 1. With agreement from the regulatory agencies, the Site Inspection (Alliance Compliance Group, 2011) conducted for MRP Site 4 did not include sampling because the site is primarily located within CAOC 1, which was the subject of an extensive RI in 1996 for OU 2. As documented in the OU 2 ROD (Uribe & Associates, 1997b), the OU 2 RI report concluded that soil contamination present from 0 to 10 feet bgs at CAOC 1 does not pose an unacceptable risk to human health or the environment if the site is restricted to commercial/industrial land use. The risks and hazards associated with metals concentrations at CAOC 1 were considered equivalent at MRP Site 4. Metals, which are the MC associated with MRP Site 4, were investigated in the CAOC 1 RI and are addressed by the CAOC 1 in-place remedy of ICs. As discussed in Section 7.2.2, the remedy remains protective as long as ICs remain in place to restrict land use.

The Site Investigation conducted in 2010 for MRP Site 6 did include collection of surface-soil samples. The samples were analyzed for six metals that are associated with munitions use (antimony, arsenic, cadmium, copper, lead, and zinc) and a nitroamine panel of 14 explosive constituents (components). Elements and chemicals associated with UXO or MEC are referred to as MC. No nitroamine explosive constituents were detected, and only arsenic was detected in soil at concentrations greater than U.S. EPA risk-based screening levels. Because a screening level risk assessment was performed for MRP Site 6, the focus of this section with regard to Question B is MRP Site 6; thus, changes in exposure pathways, toxicity and other contaminant characteristics, and cleanup levels are discussed for MRP Site 6, followed by discussion of expected progress toward meeting RAOs.

7.3.2.1 Toxicity Evaluation and other Characteristics. Residential and non-residential screening levels for antimony, cadmium, copper, lead, and zinc provided in the ROD were obtained from the U.S. EPA RSL table dated January 2015. Current RSLs (U.S. EPA, 2019) for these metals are the same as the values at the time of the ROD. Therefore, there are no changes in toxicity that would affect the protectiveness of the remedy.

For arsenic, the screening level of 11.9 mg/kg identified in the ROD (NAVFAC SW, 2017a) was the installation-specific background level for surface soil developed in the Final Soil Background Characterization Report (Trevet, 2014a). The background value of 11.9 mg/kg is the current installation-specific value for surface soil. Therefore, there are no changes in background that would affect the protectiveness of the remedy.

7.3.2.2 Expected Progress Towards Meeting RAOs. The RAO for MC in soil at MRP Site 4 is to restrict land use to commercial/industrial use. This objective has been achieved with measures that maintain and support the current commercial/industrial uses through continued implementation of ICs that are in place for CAOC 1 and has been expanded to incorporate the areas of MRP Site 4 outside of CAOC 1. ICs, including the MCAS Yuma Master Plan, site approval requests, and dig permits, are used to trigger safety notification to contractors or other construction workers, prior to performance of required subsurface construction activities at the site (such as underground utility installation or repair).

The RAO for MRP Site 6 is to reduce potential explosive safety hazards associated with MEC and potential chemical hazards associated with MC by preventing interaction between receptors and MC or intact MEC in the subsurface. LUCs consisting of a combination of engineering controls and ICs are used to meet the RAO. An engineering control to maintain a cover over subsurface soils serves to physically limit potential exposure to MEC and MC. ICs, such as the LUCIP, site approval requests, and dig permits, are used to trigger safety notification to contractors or other subsurface construction workers, prior to performance of required subsurface construction activities at the site (such as underground utility installation or repair), and to provide safety and reporting procedures in the unlikely event that MEC are encountered. ICs also instruct the base, contractors, or other subsurface construction workers on soil handling requirements should soil be removed from the site.

7.3.3 Question C: Has Any Other Information Come to Light That Could Call into Question the Protectiveness of the Remedy? No; no additional information has been found to suggest that the remedy selected for MRP Sites 4 and 6, as currently defined in the ROD (NAVFAC SW, 2017a), may not be protective. The selected remedies remain effective as long as ICs are maintained.

8.0: ISSUES

This section presents issues that have been raised since the previous FYR. Table 8-1 identifies the site operations, conditions, or activities that may currently prevent the remedy from being protective or may prevent it from being protective in the future.

Table 8-1. Issues Regarding Remedy Protectiveness

Issue Number	Issues	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
1	1,4-Dioxane has been included in the LTM program for OU 1 Area 1. Concentrations exceed U.S. EPA RSLs within the base boundary and at the furthest downgradient monitoring well at the LEPA. However, the RSL is a screening level, not a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is in the middle of the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Concentrations of 1,4-dioxane do not exceed the U.S. EPA health advisory anywhere within the plume. Results of modeling and a risk assessment conducted for 1,4-dioxane indicate that downgradient risk and hazard are acceptable. There are no known drinking water wells within 1 mile in the downgradient direction of the LEPA.	No	TBD
2	PFAS concentrations exceed the U.S. EPA lifetime health advisory levels within OU 1 Area 1, but are less than U.S. EPA RSL. However, Area 1 has an IC restricting against the use of groundwater so there is no excess risk or hazard associated with the presence of PFAS in site groundwater. One well in the LEPA contained a combined PFOA/PFOS concentration essentially equivalent to the health advisory. There are no drinking water wells within a mile downgradient of the LEPA. Therefore, there are no issues with regard to PFAS at Area 1. With regards to OU 1 PFAS issues, a base-wide PA was under way during the review period and the preliminary draft PA report was being reviewed by the Navy and Marine Corps during the site inspection and document review period for the FYR. Other potential areas of PFAS groundwater contamination on the Installation were identified and all areas were downgradient of the Installation's drinking water sources. However, it is currently unknown whether PFAS is present in groundwater at other areas of the installation (i.e., other than Area 1) at concentrations exceeding the health advisory level.	TBD	TBD
3	The MCAS Yuma Master Plan was last updated in 2007 prior to development of the MRP Sites 4 and 6 ROD. The ICs required at Sites 4 and 6 have not been incorporated into the Master Plan. The Master Plan is a conceptual document which is updated infrequently. The Base GIS system, which is used by the base planning department to develop site plans, has been updated to reflect the site boundaries and ICs, and MCAS Yuma Environmental staff reviews all site approval requests and all dig permits. Therefore, risk is unlikely. However, an amendment to the Master Plan is specified in the ROD and the current lack of amendment should be corrected.	No	Yes

Table 8-1 (continued). Issues Regarding Remedy Protectiveness

Issue Number	Issues	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
4	Base personnel have indicated the desire to implement a land-use change for OU-2 CAOC 8A, which may make the current exposure assumptions for the area invalid. No military construction is funded at this time. However, there is limited available space on-base to expand. Therefore, it is reasonable to assume that the need to change the land use at OU-2 CAOC 8A will arise. As stated in the OU-2 ROD, if any changes in land use are planned at the area, the DON, in consultation with the U.S. EPA and ADEQ, will reevaluate the remedy at OU-2 CAOC 8A before the onset of any site activities.	No	No

9.0: RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section presents the recommendations and follow-up actions identified as a result of the FYR process. Table 9-1 summarizes the recommendations.

Table 9-1. Recommendations and Follow-up Actions following the Five-Year Review

Issue Number	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes/No; Current and/or Future)
1	Evaluate technologies that treat and contain 1,4-dioxane using the results of pilot studies which should consider risk assessment results, cost and feasibility of treatment.	DON	U.S. EPA, ADEQ	Ongoing	TBD
2	The Area 1 remedy is protective of PFAS. Regarding the remainder of OU 1, complete the PA/SI that is currently under way and use the results to determine whether an RI for PFAS at other areas of OU 1 is necessary.	DON	U.S. EPA, ADEQ	Ongoing	TBD
3	Create an addendum to the Yuma Master Plan to incorporate ICs and LUCs for MRP Sites 4 and 6.	DON	U.S. EPA, ADEQ	December 2019	Yes, future
4	Base personnel have indicated the possibility of a future land-use change for OU 2 CAOC 8A, and documentation of that land-use change is required because a change in land use involving any activities that may disrupt or expose the landfill interior will require a reevaluation of the remedy. Because the current data set for the area is insufficient to evaluate the potential risk associated with future changes in land use, additional investigation will be needed before the remedy can be reevaluated. Thus, prior to the execution of any activities that may be construed as a land-use change at OU 2 CAOC 8A, further site investigations will be necessary to determine if remediation is required or if the ROD must be amended. As stipulated in the OU 2 ROD, all work pertaining to a change in land use for OU-2 CAOC 8A will be carried out in concert with the U.S. EPA and ADEQ. Because no military construction is currently planned or funded, the recommendation is to track the status of future use requests. The follow-up action is to engage the U.S. EPA and ADEQ when plans are developed for future land-use changes. The timing is to-be-determined because currently there are no plans or funding for land-use changes.	DON	U.S. EPA, ADEQ	TBD	No

Table 9-1 (continued). Recommendations and Follow-up Actions following the Five-Year Review

Issue Number	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes/No; Current and/or Future)
5	Replace damaged/illegible signage along the perimeter of OU 2 CAOC 8A in accordance with the LUCIP.	DON	U.S. EPA, ADEQ	December 2019	Yes, future

10.0: PROTECTIVENESS STATEMENTS

Protectiveness statements for OU 1, OU 2, and MRP Sites 4 and 6 are independently presented in the following subsections.

10.1 Protectiveness Statement for Operable Unit 1

The implemented remedy at OU 1 Area 1 is protective of human health and the environment with respect to the contaminants addressed in the OU 1 ROD (i.e., CHCs).

Because 1,4-dioxane and PFAS were not included as COCs in the OU 1 ROD, and because it has not yet been determined what remedial actions may be required for these constituents, the protectiveness determination for these constituents is deferred per U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Memorandum 9200.2-111 (U.S. EPA, 2012). If additional remedial actions are required to address these emerging contaminants, these requirements will be documented via the CERCLA process. The 1,4-dioxane pilot study report was in review with regulatory agencies during the site inspection and document review period for this FYR and discussions of appropriate treatment options are forthcoming.

1,4-Dioxane concentrations within OU 1 Area 1 exceed the RSL; however, the RSL is a screening level rather than a cleanup level. The maximum 1,4-dioxane concentration within the LEPA would result in a risk of 1.4×10^{-5}, which is within the U.S. EPA's acceptable risk range of 10^{-6} to 10^{-4}. Modeling results show that off-site risks would be within the U.S. EPA's acceptable risk range (Trevet, 2016). 1,4-Dioxane concentrations do not exceed the U.S. EPA Health Advisory for carcinogenic or non-carcinogenic effects anywhere within the plume.

PFAS concentrations exceed the U.S. EPA lifetime health advisory levels within OU 1 Area 1, but are less than the RSL. Area 1 has an IC restricting against the use of groundwater so there is no exposure and thus no potential health hazard associated with the presence of PFAS in site groundwater. One well in the LEPA contained a combined PFOA/PFOS concentration essentially equivalent to the health advisory level, but less than the RSL. There are no drinking water wells within a mile downgradient of the LEPA. Therefore, there are no issues with regard to PFAS at Area 1. With regards to the remainder of OU 1, a base-wide PA for PFAS was under way during the review period and the preliminary draft PA report was being reviewed by the Navy and Marine Corps during the FYR SI and document review period. Other potential areas of PFAS groundwater contamination on the installation were identified and all areas were downgradient of the Installation's drinking water sources. However, it is currently unknown whether PFAS is present in groundwater at other areas of the Installation (i.e., other than Area 1) at concentrations exceeding the health advisory level or RSL. A SI is anticipated to occur in 2019. The results of the PA/SI will be used to guide further investigations for PFAS contamination at MCAS Yuma. It is expected that these actions will be completed within 24 months, at which time a protectiveness determination of these emerging contaminants will be made.

10.2 Protectiveness Statement for Operable Unit 2

The implemented remedies at OU 2 are protective of human health and the environment.

ICs are in place to restrict exposure to contaminants in soil at CAOCs 1, 8A, and 10 through MCAS Yuma Station Order 5090B. This order formally directed tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan (KTUA, 2007) and the Final LUCIP (NAVFAC SW, 2017b) into their existing land use planning and management programs.

10.3 Protectiveness Statement for Munitions Response Sites 4 and 6

The implemented remedies at MRP Sites 4 and 6 are protective of human health and the environment.

ICs are in place to restrict exposure to contaminants in soil at MRP Sites 4 and 6 through MCAS Yuma Station Order 5090B. This order formally directed tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan (KTUA, 2007) and the Final LUCIP (NAVFAC SW, 2017b) into their existing land use planning and management programs.

11.0: NEXT REVIEW

The next FYR for MCAS Yuma OU 1, OU 2, and MRP Sites 4 and 6 will be due five years from the date on which this document is signed. Consecutive FYRs will be required as long as site groundwater and land conditions remain that do not allow for unlimited use and unrestricted exposure.

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Attachment 1

Response to Comments on the Draft Five-Year Review Report

ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

April 22, 2019
FPU 19-208

Ms. Angela Patterson
Naval Facilities Engineering Command Southwest
Environmental Core, Marine Corps
1220 Pacific Highway
San Diego, CA 92132-5190

Re: *Draft Five-Year Review Report, Operable Units 1, 2 and MRP Sites 4 and 6, Marine Corps Air Station Yuma, Yuma, Arizona, February 2019.*

Dear Ms. Patterson:

The Arizona Department of Environmental Quality (ADEQ) and our contractor UXO Pro, Inc. reviewed the above-referenced document. ADEQ comments are presented below.

General Comments:

1. ADEQ concurs with the following protectiveness determinations as stated in Section 10.0:
    - The implemented remedy at OU 1 Area 1 is protective of human health and the environment with respect to the contaminants addressed in the OU 1 ROD (i.e., CHCs).
    - Because emerging contaminants 1,4-dioxane and PFAS were not included as COCs in the OU 1 ROD, and because it has not yet been determined what remedial actions may be required for these constituents, the protectiveness determination for these constituents is deferred.
    - The implemented remedies at OU 2 are protective of human health and the environment.
    - The implemented remedies at MRP Sites 4 and 6 are protective of human health and the environment.

Specific Comments:

1. Page 3-16, Table 3-2. Please include a footnote to define "TLV". Note this comment also applies Tables 3-3 and 3-4.
2. Page 3-26, Table 3-5. Please include Munitions Response Site 6 in the table title.

3. Page 4-8, Figure 4-2. The "Water Treatment Compound" appears to be erroneously placed on the figure. Please review for accuracy. In addition, please identify this as the VCT system water treatment compound.
4. Page 4-12, last paragraph. Please revise the following sentence as indicated: *PFOS and ~~PFAS~~ PFOA were detected in 20 and 24 of 27 wells, respectively.*
5. Page 4-15, Figure 4-4. The "Water Treatment Compound" appears to be erroneously placed on the figure. Please review for accuracy. In addition, please identify this as the VCT system water treatment compound.
6. Page 5-3, Table 5-3. The column titled "Actions Taken and Outcome" only includes actions, but no outcomes. Please revise as appropriate.
7. Page 5-3, Section 5.1.3.2. Please revise the heading titles for consistency with actions described in Table 5-3. For example, the first action described in Table 5-3 is "Phase II Groundwater Investigation", but the first heading title is "LTM".
8. Page 5-10, Section 5.2.3.2.
    a. Please revise the MMEC Group reference from "2017x" to "2017c".
    b. The second sentence states *"maintenance is planned for September 2017 to remove the debris and control a small erosional gully at OU2 CAOC 8A. Additionally, some signs posted on the perimeter fence at CAOC 8A were faded with no discernible information remaining."* Please include a statement discussing whether this was addressed.

If you have any questions or need additional information, please contact me at 602-771-2234 or peterson.john@azdeq.gov.

Sincerely,

John Peterson

John Peterson
Project Manager
Federal Programs Unit

cc: Mark Ripperda, U.S. EPA Region IX (email)
Steve Willis, UXO Pro (email)

Response to Comments
Draft Five-Year Review Report, Operable Units 1, 2 and MRP Sites 4 and 6, Marine Corps Air Station Yuma, Arizona
Dated February 2019

Review Letter Date: 04/22/2019		**Review Organization: ADEQ**	**Reviewer: John Peterson**
Comment Number	**Page/Section Numbers**	**Reviewer's Comments**	**Response**
General Comments			
1.	Section 10.0	ADEQ concurs with the following protectiveness determinations as stated in Section 10.0: • The implemented remedy at OU 1 Area 1 is protective of human health and the environment with respect to the contaminants addressed in the OU 1 ROD (i.e., CHCs). • Because emerging contaminants 1,4-dioxane and PFAS were not included as COCs in the OU 1 ROD, and because it has not yet been determined what remedial actions may be required for these constituents, the protectiveness determination for these constituents is deferred. • The implemented remedies at OU 2 are protective of human health and the environment. • The implemented remedies at MRP Sites 4 and 6 are protective of human health and the environment.	Comment noted. No revision required.
Specific Comments			
1.	Page 3-16, Table 3-2; Page 3-20, Table 3-3; Page 3-22, Table 3-4	Page 3-16, Table 3-2. Please include a footnote to define "TLV". Note this comment also applies Tables 3-3 and 3-4.	Threshold limit value (TLV) has been defined in a footnote below each of the three referenced tables.
2.	Page 3-26, Table 3-5	Page 3-26, Table 3-5. Please include Munitions Response Site 6 in the table title.	The table title has been revised to state "Table 3-5. Comparison of Soil Munitions Constituents Concentrations to Screening Levels at Munitions Response Site 6."
3.	Page 4-8, Figure 4-2	Page 4-8, Figure 4-2. The "Water Treatment Compound" appears to be erroneously placed on the figure. Please review for accuracy. In addition, please identify this as the VCT system water treatment compound.	Figure 4-2 has been revised to include the location of the VCT system water treatment compound and labelled as such.
4.	Page 4-12, second to last paragraph of section 4.1.3.3.	Page 4-12, last paragraph. Please revise the following sentence as indicated: *PFOS and ~~PFAS~~ PFOA were detected in 20 and 24 of 27 wells, respectively*.	The referenced sentence has been revised to state: "PFOS and PFOA were detected in 20 and 24 of 27 wells, respectively."
5.	Page 4-15, Figure 4-4	Page 4-15, Figure 4-4. The "Water Treatment Compound" appears to be erroneously placed on the figure. Please review for	Figure 4-4 has been revised to include the location of the VCT system water treatment compound and labelled as such.

Response to Comments
Draft Five-Year Review Report, Operable Units 1, 2 and MRP Sites 4 and 6, Marine Corps Air Station Yuma, Arizona
Dated February 2019

Review Letter Date: 04/22/2019		Review Organization: ADEQ	Reviewer: John Peterson
Comment Number	**Page/Section Numbers**	**Reviewer's Comments**	**Response**
		accuracy. In addition, please identify this as the VCT system water treatment compound.	
6.	Page 5-3, Table 5-3	Page 5-3, Table 5-3. The column titled "Actions Taken and Outcome" only includes actions, but no outcomes. Please revise as appropriate.	The cells of the column have been revised to direct the reader to action-specific subsections of Section 5.1.3.2 OU 1 Actions Taken.
7.	Page 5-3, Sections 5.1.3.1 and 5.1.3.2.	Page 5-3, Section 5.1.3.2. Please revise the heading titles for consistency with actions described in Table 5-3. For example, the first action described in Table 5-3 is "Phase II Groundwater Investigation", but the first heading title is "LTM".	Section 5.1.3.1 provides a table (Table 5-3) that highlights the actions taken in response to recommendations from the previous five-year review. Section 5.1.3.2 provides a general discussion of all actions taken at OU-1 since the previous five-year review, some of which are not necessarily in response to previous recommendations (e.g., AS/SVE system operations). As such, not all of the subsection titles will be aligned with the response to recommendations table (Table 5-3). However, as listed in response to Comment #6 above, reference to action-specific subsections in Section 5.1.3.2. are provided for ease of cross-reference.
8.	Page 5-10, Section 5.2.3.2.	Page 5-10, Section 5.2.3.2. a. Please revise the MMEC Group reference from "2017x" to "2017c". b. The second sentence states *"maintenance is planned for September 2017 to remove the debris and control a small erosional gully at OU2 CAOC BA. Additionally, some signs posted on the perimeter fence at CAOC BA were faded with no discernible information remaining.* " Please include a statement discussing whether this was addressed.	a. The reference in the second sentence of the paragraph in Section 5.2.3.2. has been revised to list "(MMEC Group, 2017c)." b. Although not provided in Section 5.2.3.2., a discussion of the site inspection in association with the five-year review is provided in Section 6.5.2. The second-to-last sentence of the section states: "During the CAOC 8A site inspection the erosional gully reported in 2017 (MMEC Group,

Response to Comments
Draft Five-Year Review Report, Operable Units 1, 2 and MRP Sites 4 and 6, Marine Corps Air Station Yuma, Arizona
Dated February 2019

Review Letter Date: 04/22/2019		Review Organization: ADEQ	Reviewer: John Peterson
Comment Number	**Page/Section Numbers**	**Reviewer's Comments**	**Response**
			2017c) was not evident, however some signs still require replacement." A recommendation was added to Section 9.0 stating: "Replace damaged/illegible signage along the perimeter of OU 2 CAOC 8A in accordance with the LUCIP."

EPA Comments on the Draft Five Year Review for Marine Corps Air Station Yuma

Document Dated February 2019

PFAS Specific Comments

Based on quick scan, it does not appear that PFAS documents were included in the reference list. Please add any documents pertaining to sampling and analysis of PFAS (and dioxane) to this list.

EPA recommends that the PFAS and Dioxane information be moved from "Question C" to "Question B". It is more appropriate to include under Question B based on existing guidance, e.g., see Pages 3-7 and 4-5 of EPA, 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. June 2001.

OU-1

The document describes detections and MCL exceedances (predominantly historic) of chlorinated hydrocarbon in the discussions of OU-1. Vapor Intrusion is discussed later in the document (page 7-7), but it should be summarized early in the OU-1 discussions (e.g., page xi) so the reader is informed that this pathway has been evaluated and unacceptable risks to receptors via this pathway do not exist.

The statement on PDF page 4-2, Section 4.1.1.1 seems to limit the RAO to within the facility boundary but page 3-11 discusses a potential impact off base. Please clarify to text to demonstrate that the off-base impacts are to be considered protective as well, given the selected remedy if this is the case.

OU-2

There seems to be a discrepancy between the protectiveness statement on page xix ("protective") and the 5-year review summary form on page xviii (Affect future protectiveness=yes). Because the description of the remedy in the ROD contains directions on handling a potential future change in land use, we suggest changing page xviii, Affect Future Protectiveness, to "no".

MCAS Yuma Five-Year Review
FFRRO Comments
July 29, 2019

Review of MMRP sites by Doug Maddox

No comments regarding the MMRP sites. The main MMRP site is overlain with 3 feet of fill and a concrete pad, and LUCs seem to still be protective based on the report. The others are MC contamination (small arms/skeet and minimal explosives) and seem to be under control, although I am not an expert on current lead issues.

General Review by John Burchette

PFAS

They do have detections of PFAS exceeding the HA in 1 groundwater well (no one is consuming within a mile radius of this area and the area onsite already has LUCs). They will further evaluate PFAS as part of the PA that has been/or is being developed. We need to check whether we consulted with them on this site, but this sounds okay for the purpose of the 5-Year Review. If the toxicity or actions level for PFAS change (lower) in the future, this site may need to be revisited to ensure the remedy remains protective.

OU-1

The document describes detections and MCL exceedances (predominantly historic) of chlorinated hydrocarbon in the discussions of OU-1, but I didn't notice any discussion of the potential vapor intrusion pathway. It would be worthwhile to mention this early in the OU-1 discussions (e.g. pdf page 13) so the reader is informed that this pathway has been evaluated and unacceptable risks to receptors via this pathway do not exist. VI is discussed later in the document (~page 105), but it should be summarized earlier on.

Area 1 discussions pages 37 and 54

The statement on page 54, 4.1.1.1 seems to limit the RAO to within the facility boundary but page 37 discusses a potential impact off base. Please clarify to text to demonstrate that the off-base impacts are to be considered protective as well, given the selected remedy if this is the case.

OU-2

There seems to be a discrepancy between the protectiveness statement on PDF page 21 ("protective") and the 5-year review summary form on page 20 (Affect future protectiveness=yes). The RPM should consider whether page 21 should be updated to protective in the short-term since long-term plans seem to indicate a use for the property that would not be protective given the current selected remedy.

PFAS Review from Cal Baier-Anderson

Expectations for PFAS in Five-Year Reviews:

- Progress Since Last Review
- Data Review (summary of findings)
- Question B (changing exposure assumptions, emerging chemicals)
- Issues and Recommendations (next steps)
- Protectiveness

Overall, they did a nice job of incorporating PFAS into the FYR. Just a couple of comments.

PFAS Documents Referenced:

Based on quick scan, it does not appear that PFAS documents were included in the reference list. Please add any documents pertaining to sampling and analysis of PFAS (and dioxane) to this list.

Questions for FYRs:

Where was PFAS sampling summarized?

Executive summary xii, xiii

Issues/Recommendations xvii

Protectiveness Statements xix

Remedial Actions, Section 4.1.3.3 page 4-12

Progress since last review, Section 5.1.3.2 OU 1 Actions Taken, Page 5-7, 5-8

Technical Assessment, Section 7.1.3 Question C, page 7-8

Issues, Section 8.0, Table 8-1, page 8-1

Recommendations, Section 9.0, Table 9-1, page 9-1

Protectiveness Statements, Section 10.0, page 10-1

EPA RECOMMENDATION: See below.

Was PFAS included in Question B?

No. It was addressed under Question C.

EPA RECOMMENDATION: We recommend that the PFAS and Dioxane information be moved from "Question C" to "Question B". It is more appropriate to include under Question B based on existing guidance, e.g., see Pages 3-7 and 4-5 of EPA, 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. June 2001.

Were PFAS issues identified?

Yes. Nicely done.

Does PFAS contamination affect protectiveness?

Yes, protectiveness deferred for the PFAS (and dioxane) but they do note that GW is currently under institutional controls.

EPA RECOMMENDATION: None.

General Review by Dianna Young

The only comment I have that is not covered by other reviewers relates to Community Notification and Involvement (6.2). The report indicates that public notice was given at the start of the FYR with a second notice scheduled to go out at the completion of the report. The report notes that, with RA underway, public interest has declined. While there may not be interest expressed by individual community members, my question would be are there local officials who could have been interviewed? Except for an ADEQ consultant, the only individuals interviewed for the FYR were from MCAS Yuma and NAVFAC (6.6).

Response to Comments
Draft Five-Year Review for Marine Corps Air Station Yuma
Dated February 2019

Comment Number	Page/Section Numbers	Comment	Response
Specific Comments from EPA			
1.	PFAS Specific Comments	Based on quick scan, it does not appear that PFAS documents were included in the reference list. Please add any documents pertaining to sampling and analysis of PFAS (and dioxane) to this list. EPA recommends that the PFAS and Dioxane information be moved from "Question C" to "Question B". It is more appropriate to include under Question B based on existing guidance, e.g., see Pages 3-7 and 4-5 of EPA, 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. June 2001.	PFAS references have been added to the following pages: pg. xiii following discussion of the PFAS concentrations following ISCO. pg. 5-7 following the reference to the Final 1,4-Dioxane Pilot Study Report pg. 5-9 following PFAS reference in AMBERSORB treatment discussion. PFAS and 1,4 dioxane information has been moved from Question C to Question B as recommended.
2.	OU 1	The document describes detections and MCL exceedances (predominantly historic) of chlorinated hydrocarbon in the discussions of OU-1. Vapor Intrusion is discussed later in the document (page 7-7), but it should be summarized early in the OU-1 discussions (e.g., page xi) so the reader is informed that this pathway has been evaluated and unacceptable risks to receptors via this pathway do not exist. The statement on PDF page 4-2, Section 4.1.1.1 seems to limit the RAO to within the facility boundary but page 3-11 discusses a potential impact off base. Please clarify to text to demonstrate that the off-base impacts are to be considered protective as well, given the selected remedy if this is the case.	The following paragraph has been added to the executive summary for as requested: "A human health risk assessment (HHRA) conducted in 2012 evaluated potential exposure to human receptors via the vapor intrusion (VI) pathway because VI exposure was not assessed in the OU 1 RI risk assessment. Results of the VI assessment indicated that noncancer hazards and cancer risks were below de minimis levels for VI into indoor air from soil gas for both indoor workers and hypothetical future residents and that the remedies for OU-1 remain protective (Sealaska, 2013)." The statement on page 3-11 (Section 3.6.1, Basis for taking action at OU 1 Area 1) is correct in that CHC concentrations exceeding MCLs were observed in the LEPA and led to the incorporation of the VCT treatment system in the selected remedy in order to meet the RAO of "containment of the

Response to Comments
Draft Five-Year Review for Marine Corps Air Station Yuma
Dated February 2019

Comment Number	Page/Section Numbers	Comment	Response
			groundwater plume within the facility boundary." The actions taken have contained the CHC plume to within the base boundary as specified in Section 7.1 Question B.
3.	OU 2	There seems to be a discrepancy between the protectiveness statement on page xix ("protective") and the 5-year review summary form on page xviii (Affect future protectiveness=yes). Because the description of the remedy in the ROD contains directions on handling a potential future change in land use, we suggest changing page xviii, Affect Future Protectiveness, to "no".	The "Affect Future Protectiveness" has been changed as suggested to "No" for the referenced issue listed for OU 2 CAOC 8A in the Five-Year Review Summary Form. Corresponding changes have been made to sections 8.0 (Issues) and 9.0 (Recommendations).
Specific Comments from FERRO			
Review of MMRP sites by Doug Maddox			
1.		No comments regarding the MMRP sites. The main MMRP site is overlain with 3 feet of fill and a concrete pad, and LUCs seem to still be protective based on the report. The others are MC contamination (small arms/skeet and minimal explosives) and seem to be under control, although I am not an expert on current lead issues.	Comment noted.
General Review by John Burchette			
2.	PFAS	They do have detections of PFAS exceeding the HA in 1 groundwater well (no one is consuming within a mile radius of this area and the area onsite already has LUCs). They will further evaluate PFAS as part of the PA that has been/or is being developed. We need to check whether we consulted with them on this site, but this sounds okay for the purpose of the 5-Year Review. If the toxicity or actions level for PFAS change (lower) in the future, this site may need to be revisited to ensure the remedy remains protective.	Comment noted. The Navy is consulting with EPA and Arizona Dept. of Environmental Quality on all PFAS investigations.

Response to Comments
Draft Five-Year Review for Marine Corps Air Station Yuma
Dated February 2019

Comment Number	Page/Section Numbers	Comment	Response
3.	OU-1	The document describes detections and MCL exceedances (predominantly historic) of chlorinated hydrocarbon in the discussions of OU-1, but I didn't notice any discussion of the potential vapor intrusion pathway. It would be worthwhile to mention this early in the OU-1 discussions (e.g. pdf page 13) so the reader is informed that this pathway has been evaluated and unacceptable risks to receptors via this pathway do not exist. VI is discussed later in the document (~page 105), but it should be summarized earlier on.	See response #2 to "Specific Comments from EPA" above.
4.	Area 1 discussions pages 37 and 54	The statement on page 54, 4.1.1.1 seems to limit the RAO to within the facility boundary but page 37 discusses a potential impact off base. Please clarify to text to demonstrate that the off-base impacts are to be considered protective as well, given the selected remedy if this is the case.	See response #2 to "Specific Comments from EPA" above.
5.	OU-2	There seems to be a discrepancy between the protectiveness statement on PDF page 21 ("protective") and the 5-year review summary form on page 20 (Affect future protectiveness=yes). The RPM should consider whether page 21 should be updated to protective in the short-term since long-term plans seem to indicate a use for the property that would not be protective given the current selected remedy.	See response #3 to "Specific Comments from EPA" above.
PFAS Review from Cal Baier-Anderson			
6.		**Expectations for PFAS in Five-Year Reviews:** • Progress Since Last Review • Data Review (summary of findings) • Question B (changing exposure assumptions, emerging chemicals) • Issues and Recommendations (next steps)	See response #1 to "Specific Comments from EPA" above.

Response to Comments
Draft Five-Year Review for Marine Corps Air Station Yuma
Dated February 2019

Comment Number	Page/Section Numbers	Comment	Response
		• Protectiveness Overall, they did a nice job of incorporating PFAS into the FYR. Just a couple of comments.	
7.		**PFAS Documents Referenced:** Based on quick scan, it does not appear that PFAS documents were included in the reference list. Please add any documents pertaining to sampling and analysis of PFAS (and dioxane) to this list.	See response to Comment #1 at top.
8.		**Questions for FYRs:** **Where was PFAS sampling summarized?** Executive summary xii, xiii Issues/Recommendations xvii Protectiveness Statements xix Remedial Actions, Section 4.1.3.3 page 4-12 Progress since last review, Section 5.1.3.2 OU 1 Actions Taken, Page 5-7, 5-8 Technical Assessment, Section 7.1.3 Question C, page 7-8 Issues, Section 8.0, Table 8-1, page 8-1 Recommendations, Section 9.0, Table 9-1, page 9-1 Protectiveness Statements, Section 10.0, page 10-1 **EPA RECOMMENDATION:** See PFAS comments below.	Comment noted.
9.		**Was PFAS included in Question B?** No. It was addressed under Question C. **EPA RECOMMENDATION:** We recommend that the PFAS and dioxane information be moved from "Question C" to "Question B". It is more appropriate to include under Question B based on existing guidance, e.g., see Pages 3-7	See response #1 to "Specific Comments from EPA" above.

Response to Comments
Draft Five-Year Review for Marine Corps Air Station Yuma
Dated February 2019

Comment Number	Page/Section Numbers	Comment	Response
		and 4-5 of EPA, 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. June 2001.	
10.		**Were PFAS issues identified?** Yes. Nicely done.	Comment noted. Thanks.
11.		**Does PFAS contamination affect protectiveness?** Yes, protectiveness deferred for the PFAS (and dioxane) but they do note that GW is currently under institutional controls. **EPA RECOMMENDATION:** None.	Comment noted.
		General Review by Dianna Young	
12.		The only comment I have that is not covered by other reviewers relates to Community Notification and Involvement (6.2). The report indicates that public notice was given at the start of the FYR with a second notice scheduled to go out at the completion of the report. The report notes that, with RA underway, public interest has declined. While there may not be interest expressed by individual community members, my question would be are there local officials who could have been interviewed? Except for an ADEQ consultant, the only individuals interviewed for the FYR were from MCAS Yuma and NAVFAC (6.6).	The request for interview participation was submitted to the members of the FFA, including ADEQ and US EPA. Responses were received from ADEQ. Additionally, a public notice will be published following the completion of the Draft Final document, which will allow the public an opportunity to comment on the FYR Report prior to its finalization.

APPENDIX A:
DOCUMENTS REVIEWED
(in chronological order)

Document	Date	Author
MCAS Operable Unit 2 Final Remedial Investigation Report	26-Mar-96	JEG
MCAS Operable Unit 1 Final Remedial Investigation Report	4-Apr-96	JEG
Feasibility Study for Operable Unit 2	20-Dec-96	U & A
Operable Unit 1 Feasibility Study Report	25-Aug-98	JEG
Record of Decision for Operable Unit 2	29-Aug-97	U & A
MCAS Operable Unit 1 Final Feasibility Study Report	25-Aug-98	JEG
Record of Decision Operable Unit 1	Jul-00	BECHTEL
Remedial Action Report - Collaborative Review for Operable Unit 1, CERCLA Program Areas 1, 2, 3, and 6	21-Sep-00	OHM
MCAS Yuma Masterplan	Sep-01	KTUA
Land-Use Control Implementation Plan	23-Sep-02	BNI
MCAS Yuma Masterplan	Sept-07	KTUA
Five-Year Review Report (Nov 2004 - Nov 2009) for OU 1 and OU 2	1-Jun-10	Battelle
Site Inspection Report, Munitions Response Sites 1, 2, 4, 5, & 6	2011	Alliance
Site Characterization Report, Data Gap Investigation Results, OU 1 Areas 1 and 3, and OU-2 CERCLA AOC 1, 8A, 8B, and 10	Oct-13	Sealaska
Soil Background Characterization Report Marine Corps Air Station Yuma	Apr-14	Trevet
Station Order 5090B	25-May-14	SWDIV
Land Use Control Implementation Plan	19-Aug-14	SES
Explanation of Significant Differences to the Final ROD	28-Aug-14	SES
Final Remedial Investigation Report, Munitions Response Program Site, Unexploded Ordinance 5	Sep-14	Trevet
Draft Expanded Site Inspection for Munitions Response Program Site 2	5-Feb-15	Pika-Pirinie
Final Time Critical Removal Action Work Plan, Munitions Response Program Site 5	Apr-15	Tetra Tech
Five-Year Review Report (Nov 2009 - Nov 2014) for OU 1 and OU 2	Jun-15	Sealaska
Groundwater Investigation and Modeling Report at Operable Unit 1 Area 1	Jul-15	Trevet
Groundwater Investigation and Modeling Report at Operable Unit 1 Area 1	22-Mar-16	Trevet
Record of Decision Munitions Response Sites 4 and 6	Jun-16	MMEC
Final Additional Remedial Investigation Report, Munitions Response Program Site 5	Mar-17	Tetra Tech
Addendum 4 to the Final Sampling and Analysis Plan, Groundwater Long-Term Monitoring and System Operation	Oct-17	MMEC
Land Use Control Report for Operable Unit 1, Area 1, Operable Unit 2 CAOCs 1, 8A, and 10, and FFAAP AOC A	Sep-17	MMEC
Land Use Control Implementation Plan Operable Unit 1 (Area 1), Operable Unit 2 (CERCLA Areas of Concern 1, 8A, and 10), Federal Facilities Agreement Assessment Program Area of Concern A, and Munitions Response Program Sites 4 and 6	Oct-17	Tetra Tech
Semi-Annual Groundwater Long-Term Monitoring Report Operable Unit 1 Area 1	Feb-18	MMEC
Technical Memorandum for 1,4-Dioxane Pilot Study at OU 1 Area 1	May-18	MMEC
Annual Groundwater Long-Term Monitoring Report OU 1 Area 1	Aug-18	MMEC

APPENDIX B:
DOCUMENTATION REGARDING REMEDY PERFORMANCE

B1 - STATION ORDER

UNITED STATES MARINE CORPS
MARINE CORPS AIR STATION YUMA
BOX 99100
YUMA, ARIZONA 85369-9100

IN REPLY REFER TO
StaO 5090B
ENVL
25 May 14

STATION ORDER 5090B

From: Commanding Officer, Marine Corps Air Station Yuma
To: Distribution List

Subj: LAND USE CONTROLS FOR ENVIRONMENTAL CLEANUP AREAS AT MCAS YUMA

Ref: (a) MCO P5090.2A, Environmental Compliance and Protection Manual
(b) Record of Decision for Operable Unit 1, July 2000
(c) Record of Decision for Operable Unit 2, August 1997
(d) Land Use Control Implementation Plan

Encl: (1) Operable Unit 1 Land Use Control Map
(2) Operable Unit 2 Land Use Control Map

1. Cancellation. Station Order 5090A

2. Summary of Revision. Revisions are considerable and this document should be reviewed in its entirety.

3. Mission. To implement land use controls (LUCs) at environmental areas of concern necessary to protect human health and the environment.

4. Situation. The Navy and Marine Corps conduct environmental cleanups at MCAS Yuma under the Comprehensive Environmental Response, Compensation, and Liability Act. To facilitate these cleanups, implementing environmental LUCs is sometimes necessary. LUCs include physical, legal, or administrative mechanism restricting the use of, or limiting access to, environmental cleanup areas.

5. Execution

a. Commander's Intent

(1) Prevent unauthorized groundwater use.
(2) Prevent unauthorized land use.
(3) Protect environmental cleanup areas.
(4) Protect environmental cleanup facilities and equipment.

b. Concept of Operations

(1) MCAS Yuma shall incorporate, as applicable, all environmental cleanup area LUCs into its existing land use planning

and management systems. The system includes the site approval process for reviewing and approving all construction and land use changes.

(2) Land use that is inconsistent with the uses shown on enclosures (1) and (2) is prohibited without written concurrence from MCAS Yuma Environmental Dept., U.S. Environmental Protection Agency (EPA), and Arizona Department of Environmental Quality (ADEQ).

(3) Groundwater use from the designated contaminated groundwater plume is prohibited without written concurrence from MCAS Yuma Environmental Dept., EPA, and ADEQ.

(4) MCAS Yuma tenants and all MCAS Yuma departments shall cooperate fully with this order and are responsible for compliance with this order.

(5) MCAS Yuma tenants and all MCAS Yuma departments shall not damage or interfere with groundwater monitoring wells, remedial treatment systems, and/or sampling. Reasonable access to monitoring wells, remedial treatment systems, and sampling efforts will be permitted only for authorized MCAS Yuma personnel and contractors for sampling, operating, inspecting, and maintaining monitoring wells and remediation systems.

c. Subordinate Element Missions

(1) MCAS Yuma Environmental Director is responsible for the implementation of this order.

(2) MCAS Yuma Environmental Department is the point of contact for environmental LUCs matters for environmental cleanup areas to include compliance with this Order.

(3) MCAS Yuma tenants and all MCAS Yuma departments will comply with cleanup area LUCs.

d. Coordinating Instructions

(1) Enclosures (1) and (2) depict the MCAS Yuma cleanup areas and LUCs. References (b), (c), and (d) identifies and describes cleanup area LUCs.

6. Administrative and Logistics. This Order is issued under Distribution Statement A and is published electronically. It can be accessed online via the MCAS Yuma web page at https://www.mciwest.usmc.mil/inst/mcasy/env.

7. Command and Signal

a. Command. Requirements outlined in this Station Order are applicable to and shall be complied with by all tenant or permanently

Subj: LAND USE CONTROLS FOR ENVIRONMENTAL CLEANUP AREAS AT MCAS YUMA

assigned or temporarily assigned organization, organizations visiting or deployed to MCAS Yuma, as well as all MCAS Yuma departments.

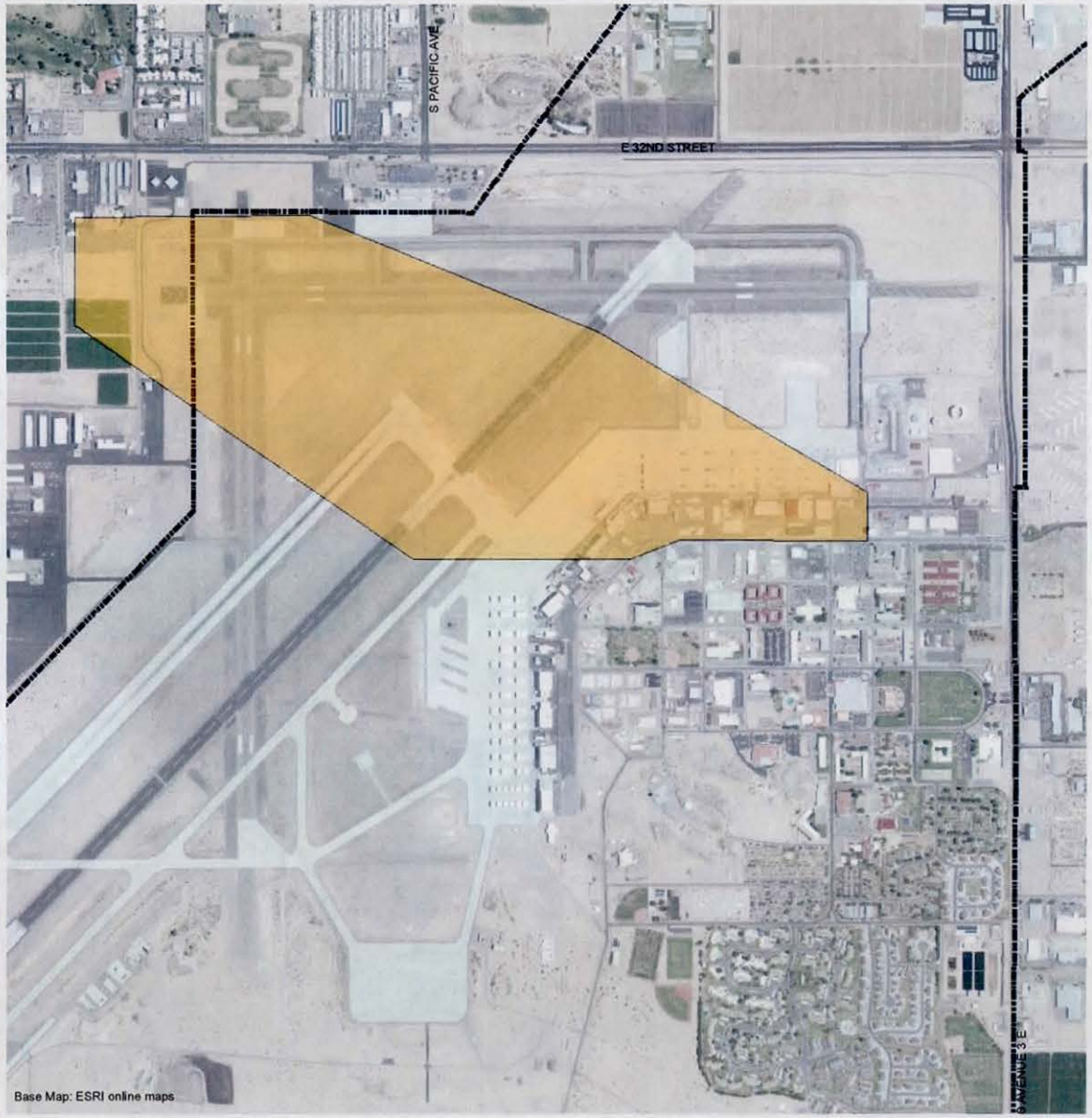
b. Signal. This Order is effective the date signed.

Robert C. Kuckuk

ROBERT C. KUCKUK

DISTRIBUTION: A

3



022H0429.mxd 3/4/2013 JP

LEGEND

BOUNDARIES FOR ENVIRONMENTAL AREAS OF INTEREST

OPERABLE UNIT 1, AREA 1 BOUNDARY

LAND USE CONTROLS / INSTITUTIONAL CONTROLS

Institutional Controls (ICs) will remain in place throughout the duration of the remedial actions to restrict the use of contaminated groundwater.

MCAS Yuma tenants will be made aware of the requirement to submit a REIR and/or site approval request for planned activities.

MCAS Yuma tenants and assigned organizations will be made aware of LUCs, and comply with all of the LUCs in force at MCAS Yuma. MCAS Yuma tenants and assigned organizations will not use contaminated groundwater underlying the designated plume areas for any purpose including (but not limited to) drinking water, irrigation, fire control, dust control, or any other activity.

MCAS Yuma tenants and assigned organizations will not damage or interfere in any way with groundwater monitoring wells, remedial treatment systems, other remediation system components, and/or sampling efforts. Access to monitoring wells, remedial treatment systems, and sampling efforts is permitted to regulatory agency personnel and individuals specifically contracted by the Navy and the MCAS Yuma Environmental Department to perform the activities related specifically to the use and maintenance of such wells, systems, and sampling efforts. Access to monitoring wells, remedial treatment systems, and sampling efforts is not permitted to other MCAS personnel unless specifically authorized by the MCAS Environmental Department. Access is required for equipment, including trucks, small loaders, and drill rigs. Alteration or destruction of monitoring wells or remedial treatment systems requires approval from the MCAS Yuma Environmental Department, USEPA, and ADEQ.

0 500 1,000 2,000 Feet

NOTES:

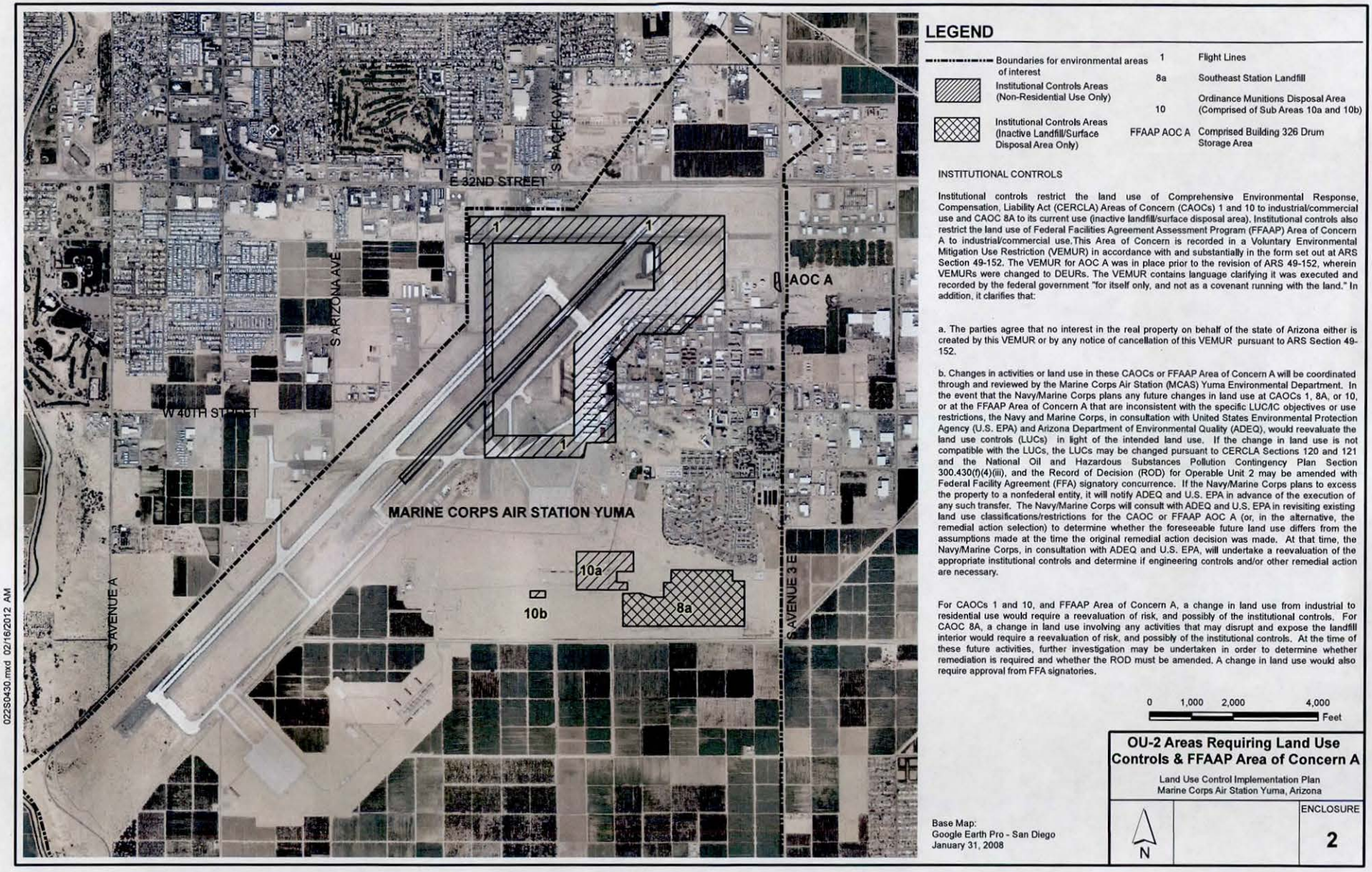
ADEQ - Arizona Department of Environmental Quality
MCAS - Marine Corps Air Station
U.S. EPA - United States Environmental Protection Agency

OU-1 Areas Requiring Land Use Controls

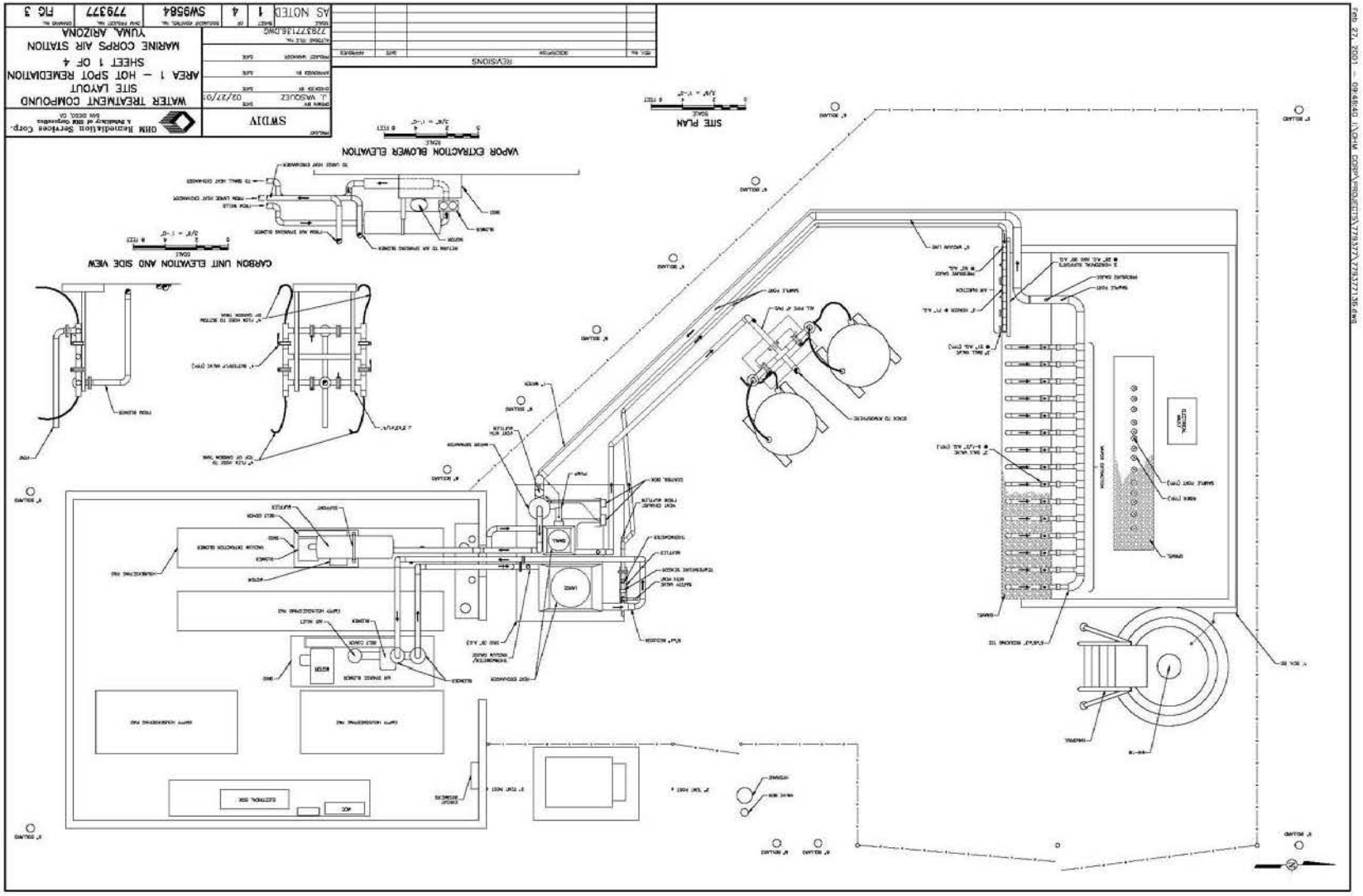
Land-Use Control Implementation Plan
Marine Corps Air Station Yuma, Arizona

N

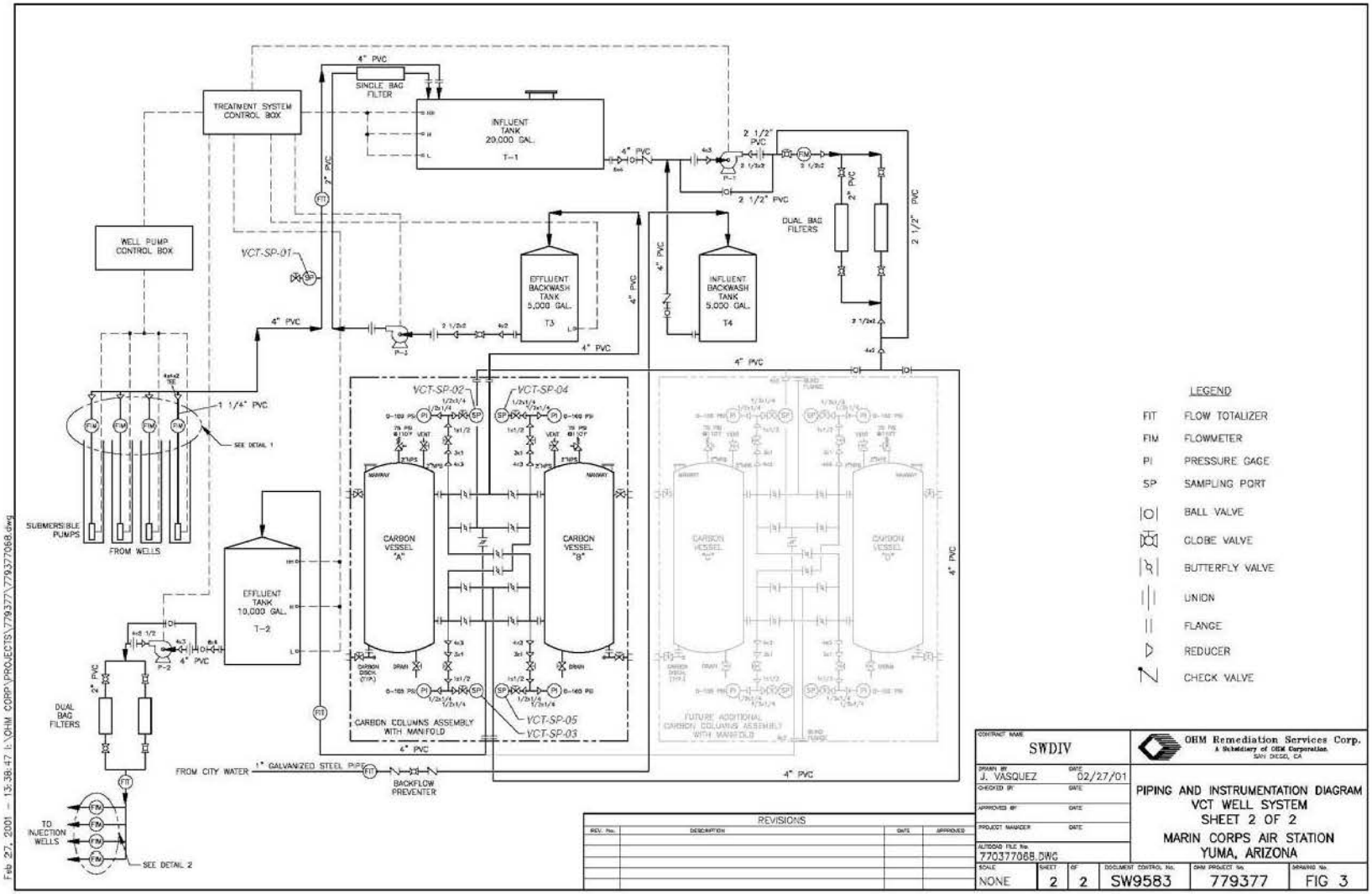
ENCLOSURE 1


E 32ND STREET
S PACIFIC AVE
S ARIZONA AVE
W 40TH STREET
S AVENUE A
S AVENUE 3 E
MARINE CORPS AIR STATION YUMA
AOC A
1
10a
10b
8a
022S0430.mxd 02/16/2012 AM
LEGEND
Boundaries for environmental areas of interest
Institutional Controls Areas (Non-Residential Use Only)
Institutional Controls Areas (Inactive Landfill/Surface Disposal Area Only)
1 Flight Lines
8a Southeast Station Landfill
10 Ordinance Munitions Disposal Area (Comprised of Sub Areas 10a and 10b)
FFAAP AOC A Comprised Building 326 Drum Storage Area
INSTITUTIONAL CONTROLS
Institutional controls restrict the land use of Comprehensive Environmental Response, Compensation, Liability Act (CERCLA) Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use and CAOC 8A to its current use (inactive landfill/surface disposal area). Institutional controls also restrict the land use of Federal Facilities Agreement Assessment Program (FFAAP) Area of Concern A to industrial/commercial use.This Area of Concern is recorded in a Voluntary Environmental Mitigation Use Restriction (VEMUR) in accordance with and substantially in the form set out at ARS Section 49-152. The VEMUR for AOC A was in place prior to the revision of ARS 49-152, wherein VEMURs were changed to DEURs. The VEMUR contains language clarifying it was executed and recorded by the federal government "for itself only, and not as a covenant running with the land." In addition, it clarifies that:
a. The parties agree that no interest in the real property on behalf of the state of Arizona either is created by this VEMUR or by any notice of cancellation of this VEMUR pursuant to ARS Section 49-152.
b. Changes in activities or land use in these CAOCs or FFAAP Area of Concern A will be coordinated through and reviewed by the Marine Corps Air Station (MCAS) Yuma Environmental Department. In the event that the Navy/Marine Corps plans any future changes in land use at CAOCs 1, 8A, or 10, or at the FFAAP Area of Concern A that are inconsistent with the specific LUC/IC objectives or use restrictions, the Navy and Marine Corps, in consultation with United States Environmental Protection Agency (U.S. EPA) and Arizona Department of Environmental Quality (ADEQ), would reevaluate the land use controls (LUCs) in light of the intended land use. If the change in land use is not compatible with the LUCs, the LUCs may be changed pursuant to CERCLA Sections 120 and 121 and the National Oil and Hazardous Substances Pollution Contingency Plan Section 300.430(f)(4)(iii), and the Record of Decision (ROD) for Operable Unit 2 may be amended with Federal Facility Agreement (FFA) signatory concurrence. If the Navy/Marine Corps plans to excess the property to a nonfederal entity, it will notify ADEQ and U.S. EPA in advance of the execution of any such transfer. The Navy/Marine Corps will consult with ADEQ and U.S. EPA in revisiting existing land use classifications/restrictions for the CAOC or FFAAP AOC A (or, in the alternative, the remedial action selection) to determine whether the foreseeable future land use differs from the assumptions made at the time the original remedial action decision was made. At that time, the Navy/Marine Corps, in consultation with ADEQ and U.S. EPA, will undertake a reevaluation of the appropriate institutional controls and determine if engineering controls and/or other remedial action are necessary.
For CAOCs 1 and 10, and FFAAP Area of Concern A, a change in land use from industrial to residential use would require a reevaluation of risk, and possibly of the institutional controls. For CAOC 8A, a change in land use involving any activities that may disrupt and expose the landfill interior would require a reevaluation of risk, and possibly of the institutional controls. At the time of these future activities, further investigation may be undertaken in order to determine whether remediation is required and whether the ROD must be amended. A change in land use would also require approval from FFA signatories.
0 1,000 2,000 4,000
Feet
OU-2 Areas Requiring Land Use Controls & FFAAP Area of Concern A
Land Use Control Implementation Plan
Marine Corps Air Station Yuma, Arizona
N
ENCLOSURE 2
Base Map:
Google Earth Pro - San Diego
January 31, 2008

B2 – AS/SVE DIAGRAM


WATER TREATMENT COMPOUND
SITE LAYOUT
AREA 1 – HOT SPOT REMEDIATION
SHEET 1 OF 4
MARINE CORPS AIR STATION
YUMA, ARIZONA
SITE PLAN
VAPOR EXTRACTION BLOWER ELEVATION
CARBON UNIT ELEVATION AND SIDE VIEW

B3 – VCT DIAGRAM


TREATMENT SYSTEM CONTROL BOX
SINGLE BAG FILTER
INFLUENT TANK 20,000 GAL. T-1
WELL PUMP CONTROL BOX
VCT-SP-01
EFFLUENT BACKWASH TANK 5,000 GAL. T3
INFLUENT BACKWASH TANK 5,000 GAL. T4
DUAL BAG FILTERS
SUBMERSIBLE PUMPS
FROM WELLS
SEE DETAIL 1
VCT-SP-02
VCT-SP-04
CARBON VESSEL "A"
CARBON VESSEL "B"
EFFLUENT TANK 10,000 GAL. T-2
CARBON COLUMNS ASSEMBLY WITH MANIFOLD
VCT-SP-05
VCT-SP-03
FUTURE ADDITIONAL CARBON COLUMNS ASSEMBLY WITH MANIFOLD
FROM CITY WATER
BACKFLOW PREVENTER
TO INJECTION WELLS
SEE DETAIL 2
LEGEND
FIT FLOW TOTALIZER
FIM FLOWMETER
PI PRESSURE GAGE
SP SAMPLING PORT
BALL VALVE
GLOBE VALVE
BUTTERFLY VALVE
UNION
FLANGE
REDUCER
CHECK VALVE
REVISIONS
SWDIV
OHM Remediation Services Corp.
J. VASQUEZ 02/27/01
PIPING AND INSTRUMENTATION DIAGRAM
VCT WELL SYSTEM
SHEET 2 OF 2
MARIN CORPS AIR STATION
YUMA, ARIZONA
770377068.DWG
NONE
SW9583
779377
FIG 3

B4 – AS/SVE TEMPORARY SHUT DOWN

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

11000
Ser OPCE.JDB/028
24 Jan 07

Ms. Cathy O'Connell
Arizona Department of Environmental Quality (ADEQ)
Federal Projects Unit, Superfund Programs Section, Waste Program Division
1110 West Washington Street
Phoenix, AZ 85007

SUBJECT: TECHNICAL MEMOS FOR THE REVISED LTM SCHEDULE AND THE SHUTDOWN OF THE HOT SPOT AS/SVE SYSTEM LOCATED AT THE MARINE CORPS AIR STATION (MCAS), YUMA ARIZONA

Dear Ms O'Connell:

The Department of the Navy proposed to diminish the sampling frequency of wells, reduce the number of wells being sampled, and temporarily shut down the Air Sparge/Soil Vapor Extraction System at Area 1, Operable Unit One (OU-1), MCAS Yuma, Arizona, in two separate technical memos sent to both ADEQ and U.S. Environmental Protection Agency (EPA) on 27 July and 16 August, 2006, respectively. These letters requested a response to the LTM schedule revision memo by 25 September, 2006, and a response to the Hot Spot temporary shutdown memo by 17 October, 2006, no response from ADEQ has been received. However, per enclosure (1), U.S. Environmental Protection Agency Region IX sent a concurrence letter.

This letter is to notify you that the Department of the Navy plans to proceed with the diminished sampling frequency of wells, reduced number of wells being sampled, and the temporary shut down of the Air Sparge/Soil Vapor Extraction System at Area 1 unless we receive a non-concurrence response from ADEQ within the next 10 days of receiving this correspondence. The Department of the Navy will assume ADEQ concurs with the recommendations in the memos otherwise.

If you have any questions please call me at (619) 532-1735.

Sincerely,

JUAN DIEZ DE BONILLA
Remedial Project Manager
By Direction

Enclosure:
1. U.S. EPA Region IX Concurrence Letter dated November 28, 2006

Copy to:
U.S. EPA Region IX (Mr. Martin Hausladen)
Environmental Department, MCAS Yuma AZ (Mr. Dan Nail)
Arizona Department of Environmental Quality (ADEQ) (Bob Peeples)
Battelle, Environmental Restoration Department (Chris Coonfare)

OPCE JAB
JC
OPCS.PO

JAN-08-2007 MON 10:05 AM U.S E.P.A FAX NO. 4159473520 P. 01/01

(619) 556-9160

November 28, 2006

NAVFAC Southwest
Central Area Focus Team
1220 Pacific Highway (Building 1)
San Diego, CA 92132

Attention: Juan Diez de Bonilla
Remedial Project Manager

Subject: Technical Memos for the revised LTM schedule and the shutdown of the Hot Spot AS/SVE system located at the MCAS, Yuma, Arizona.

Mr. Diez de Bonilla

The Environmental Protection Agency (EPA) has completed its review of the above mentioned Technical Memos regarding Operational Unit (OU) 1 located at the Marine Corps Air Station (MCAS), Yuma, Arizona. One memo discusses the reduction of the number of wells sampled in addition to the reduced frequency of sampling events, except for the "hot spot" area. The second memo discusses the temporary shut down of the Air Sparge/ Soil Vapor Extraction System. The EPA concurs with the recommendations presented in the Technical Memos.

If you should have any further questions, pleases call me at (415) 972-3007.

Sincerely,

Martin Hausladen
Environmental Protection Agency

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

5090
Ser ROPDE.AL/6240
August 16, 2006

Mr. Martin Hausladen
U.S. Environmental Protection Agency
Region 9 - Federal Facilities/Superfund Division
75 Hawthorne Street
San Francisco, CA 94105

Ms. Cathy O'Connell
Arizona Department of Environmental Quality
Federal Projects Unit, Superfund Program Section,
Waste Program Division
1110 West Washington Street
Phoenix, AZ 85007

Dear Environmental Project Managers:

SUBJECT: PROPOSED TEMPORARY SHUTDOWN OF THE AIR SPARGE/SOIL VAPOR EXTRACTION (AS/SVE) SYSTEM AT MARINE CORPS AIR STATION (MCAS) YUMA, ARIZONA

The Department of the Navy is proposing a temporary shutdown of the AS/SVE system at MCAS Yuma pursuant to the Record of Decision (ROD) for Operable Unit 1 (OU-1) dated July 2000. According to this ROD, the Department of the Navy can propose a temporary shutdown of the AS/SVE system when the system no longer removes mass (i.e., asymptotic condition is reached) or further removal of Chlorinated Hydrocarbons (CHC) is technically and economically unfeasible or Maximum Contaminant Levels (MCLs) are reached.

The enclosed Technical Memorandum demonstrates the AS/SVE system is no longer removing sufficient mass to justify continued operation of the system. Furthermore, only three of the numerous monitoring wells in the treatment zone have CHC concentrations that exceed (MCLs). In fact, one of the three monitoring wells barely exceeds MCLs. The highest concentration of CHCs in the other two wells is 33 µg/L. The Department of the Navy believes that these three wells will naturally attenuate to MCLs without continued operation of the AS/SVE system.

The Department of the Navy will continue to monitor the groundwater per the Long Term Monitoring Plan. If there is a significant rebound in CHC concentrations, the AS/SVE system will be restarted. However, the Department of the Navy will propose permanent shutdown of the AS/SVE system if no significant rebound occurs within two years.

The Department of the Navy is requesting your concurrence to the above-mentioned proposed temporary shutdown of the AS/SVE system in writing by October 17, 2006.

If you have any questions regarding this letter, please contact me at (619) 532-4228.

Sincerely,

ANGIE LIND
Remedial Project Manager
By direction of the Commanding Officer

Encl: (1) Technical Memorandum Groundwater Monitoring Schedule dated July 25, 2006

Copy to:
Mr. Ken Yargus, MCAS Yuma Environmental
Mr. Dan Nail, MCAS Yuma Installation Restoration Program Manager
Ms. Diane Silva, Admin Record

TECHNICAL MEMORANDUM

Temporary Shutdown of the Air Sparging/Soil Vapor Extraction System at the Hot Spot, Marine Corps Air Station Yuma, Arizona

Contract No. N68711-01-D-6009
Task Order No. 008
August 16, 2006

Introduction

This Technical Memorandum has been prepared to support the temporary shutdown of the Air Sparging/Soil Vapor Extraction (AS/SVE) system at the Area 1 Hot Spot, Operable Unit (OU) 1 at Marine Corps Air Station (MCAS) Yuma, Arizona. The rationale supporting the temporary shutdown of the AS/SVE system has been reviewed and approved previously by the United States Environmental Protection Agency (U.S. EPA) and the Arizona Department of Environmental Quality (ADEQ) with regard to the Vertical Circulation Treatment (VCT) system at the Leading Edge Plume Area (LEPA) of OU-1. Temporary shutdown of the AS/SVE system was discussed at a project review meeting attended by U.S. EPA, ADEQ, Naval Facilities Engineering Command (NAVFAC) Southwest, and Battelle on June 20, 2006.

Site Description

MCAS Yuma is an active facility located immediately southeast of the city of Yuma, Arizona. Previous activities at MCAS Yuma resulted in the release of volatile organic compounds (VOCs) to the groundwater in the vicinity of the flight line, near Building 230. This area is currently referred to as the Hot Spot. The plume of contaminated groundwater extends to the northwest from the Hot Spot. The Hot Spot is designated as a portion of Area 1 of OU-1. A final Record of Decision (ROD) for OU-1 was signed by the U.S. EPA and the ADEQ in September and October 2000, respectively. The remedial action objectives established for this effort are the Maximum Contaminant Levels (MCLs) based on the Safe Drinking Water Act (SDWA). The contaminants of concern (COCs) at the Hot Spot area are 1,1-Dichloroethylene (1,1-DCE), Perchloroethylene (PCE), and Trichloroethylene (TCE), with MCLs of 7 μg/L, 5 μg/L, and 5 μg/L, respectively.

System Description

An AS/SVE system was installed at the Hot Spot area to treat the contaminated groundwater in the subsurface northwest of Building 230. The AS system injects air into the saturated zone to strip VOCs from groundwater. The SVE system creates a vacuum in the vadose zone, capturing the sparge air and soil vapors and removing the stripped contaminants from the subsurface. The contaminated vapor stream is treated aboveground prior to discharge to the atmosphere. The injection of air into the subsurface also supports the reduction of COC concentrations via biodegradation.

The AS system consists of 43 sparge wells, operating in five banks (i.e., Rows 29, 39, 49, 59, and 70). A blower (rated at 400 cfm) is used to deliver the air to the wells. The SVE system uses a separate blower, rated at 500 cfm, to extract sparge air and soil vapors from 15 extraction wells. The extracted vapors are treated with granular activated carbon (GAC). The AS and SVE wells and injection/extraction manifolds are completed below the asphalt and concrete surface. The injection and extraction blowers, the vapor

treatment system, and associated equipment are contained in the treatment compound located to the west of Building 230. The layout of the AS/SVE system is included as Figure 1, a piping and instrumentation diagram is included as Figure 2, and a map showing the locations of the sparge well rows and the Hot Spot area monitoring wells is included as Figure 3.

System Operation

The operation of the AS/SVE system is described in detail in the revised O&M manual (TerraVac, 2003b). The AS/SVE system was modified and reconfigured in December 2002 (see Addendum to the revised O&M manual [TerraVac, 2003b]). The AS/SVE system began operation on November 16, 1999. Battelle took over operation on September 30, 2002.

From November 2002 through early January 2004, air injection focused on the eastern portion of the site where elevated contaminant concentrations were persistent; air injection through Rows 29, 39, and 49 continued as an attempt to enhance VOC removal in this area. Such focused operations resulted in significant reductions of TCE and DCE concentrations in Hot Spot area groundwater. On November 24 and 25, 2003, Rows 59 and 70 were opened and Rows 29, 39, and 49 were closed for two days to test the wells for injection during the upcoming quarter. The injection pattern was revised in January 2005 to focus on the eastern part of the site while still addressing the western section (i.e., rows 59 and 70 operating for one week of each month, and rows 29, 39, and 49 operating for three weeks of each month). The injection strategy at the Area 1 Hot Spot was further modified in early October 2005 to incorporate a daily pulsed injection pattern, with injection manually switched between rows 29, 39, and 49 and rows 59 and 70 three times each day. The purpose of this modification was to optimize the removal of VOCs from the groundwater by disrupting established flow paths of injected air in the saturated zone.

Data Review

Vapor samples have been collected at the SVE vapor treatment unit on a monthly basis throughout the operation of the Hot Spot AS/SVE system. These samples are analyzed for volatile organic compounds (VOCs) at a laboratory, using the TO-14 Method. The VOC concentrations and the system vapor discharge rate are used to calculate a mass removal rate. Cumulative vapor-phase mass removal (Figure 4) has remained stable for approximately four years.

Groundwater samples have been collected on a quarterly, semiannual, or annual basis at the Hot Spot since April 2000, in accordance with the Long-Term Monitoring Plan and subsequent revisions. The most recent samples were collected in June, 2006. Nine groundwater monitoring wells in the Area 1 Hot Spot were scheduled to be sampled. TCE was detected at concentrations exceeding the 5 μg/L MCL in three of the 9 monitoring wells sampled during this event: 16-MW-06 (5.9 μg/L), 16-MW-18 (15 μg/L), and 16-MW-09 (33 μg/L). 1,1-DCE was detected at concentrations exceeding the 7 μg/L MCL in two monitoring wells: 16-MW-18 (14 μg/L) and 16-MW-09 (7.2 μg/L).

Significant reductions of TCE and DCE concentrations have occurred at the Hot Spot following system optimization actions undertaken by the Navy since December, 2002, including repairs to the injection wells and modifications to the injection strategy. For example, TCE and DCE concentrations in well 16-MW-18 decreased from 73 and 18 μg/L in March 2003 to 15 and 14 μg/L, respectively, in June 2006. TCE and DCE concentrations in 16-MW-09 decreased from 230 and 55 μg/L in August 2002 to 33.0 and 7.2 μg/L, respectively, in June 2006. The current DCE and TCE concentrations are contoured on Figures 5 and 6, respectively. The DCE and TCE concentrations appear to have stabilized over recent quarters. Historical and recent DCE and TCE concentrations at the Hot Spot are shown on Figure 3.

Conclusions and Recommendations

Figure 7 provides the decision flow diagram for operation and shutdown of the VCT and AS/SVE remediation systems in Area 1. This decision flow diagram was developed in the ROD in 2000. As shown on Figure 7, when the AS/SVE system no longer removes mass (i.e., asymptotic condition is reached), and further removal is technically and economically unfeasible or MCLs are reached, the Navy can propose a temporary shutdown of the system operation with continued groundwater monitoring for up to two years. If rebound of the COC concentrations does not occur, the Navy will propose permanent shutdown of the AS/SVE system. If rebound to above the MCLs does occur in wells at the Hot Spot, the system will be restarted and operated until the MCLs are reached again. Once asymptotic conditions are permanently reached, AS/SVE operation will be discontinued.

Recent TO-14 analyses indicate low and stable concentrations of VOCs in the SVE off-gas. Groundwater results show that the operation of the AS/SVE system has resulted in significant reductions of TCE and DCE concentrations in Hot Spot groundwater, and that concentrations have stabilized. Furthermore, groundwater modeling has been performed to evaluate the potential for COCs to reach the MCAS Yuma facility boundary at concentrations equal to or exceeding the MCLs. The simulations discussed in the "Final Groundwater Modeling Report for OU-1 at MCAS Yuma, AZ" (Battelle, 2004) indicate that COCs will not reach the facility boundary at such levels. The simulations discussed in the modeling report were based upon COC concentrations significantly higher than the current levels, providing an additional level of conservatism given the current reduced concentrations. Therefore, because the requirements for temporary shutdown of the AS/SVE system as set forth in the decision flow diagram have been met, Battelle recommends temporary shutdown of the AS/SVE system.

Quarterly groundwater monitoring in the Hot Spot area is recommended during the temporary shutdown period. The Navy has submitted a Technical Memorandum proposing a revised LTM schedule that incorporates continued quarterly sampling at the Hot Spot. The groundwater monitoring data will be used to evaluate the amount of rebound in the COC concentrations. Monthly start-up testing should be conducted to ensure that the AS/SVE system remains in working order should continued operation be required.

FIGURES

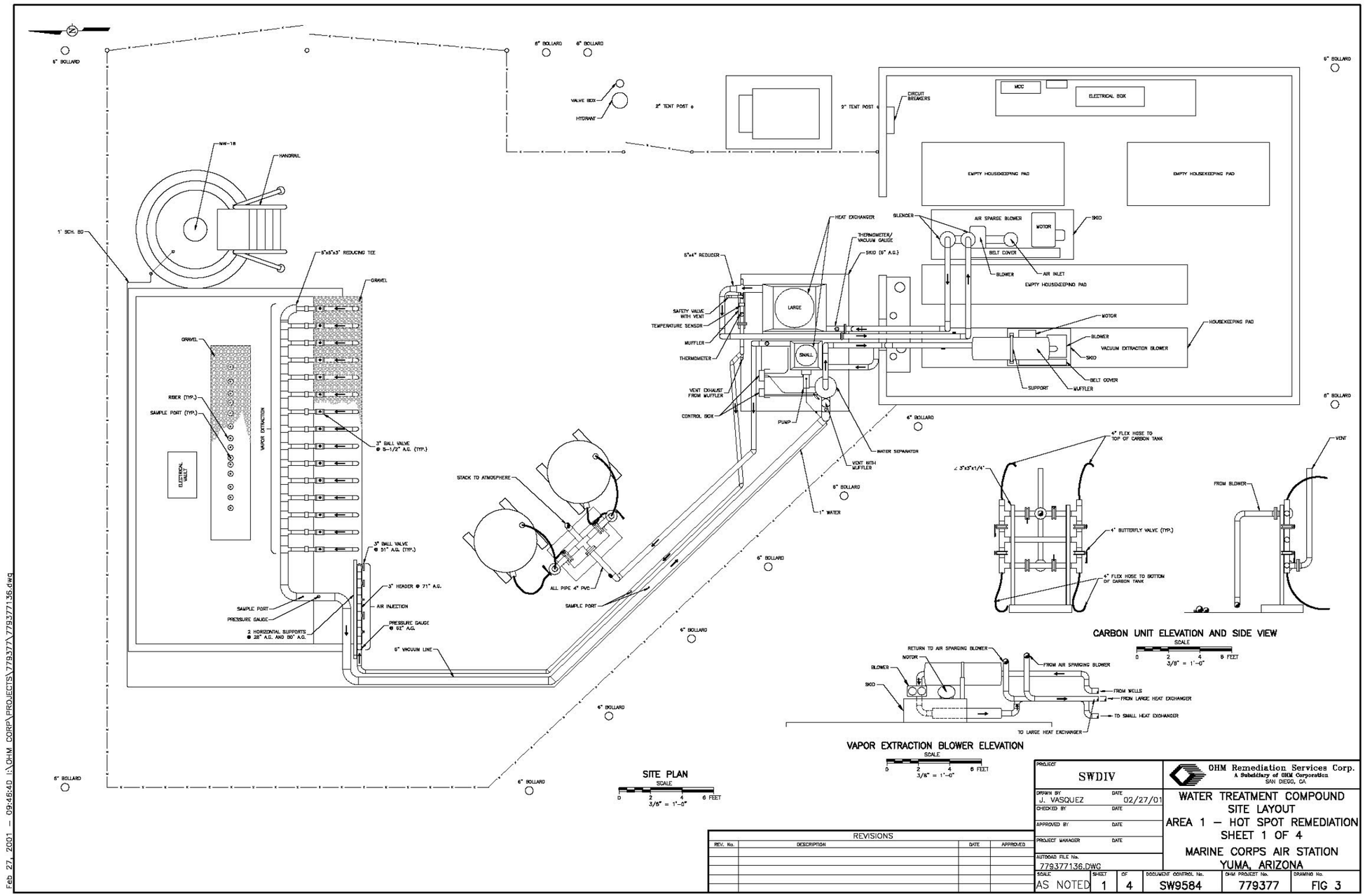


Figure 1. AS/SVE System Layout

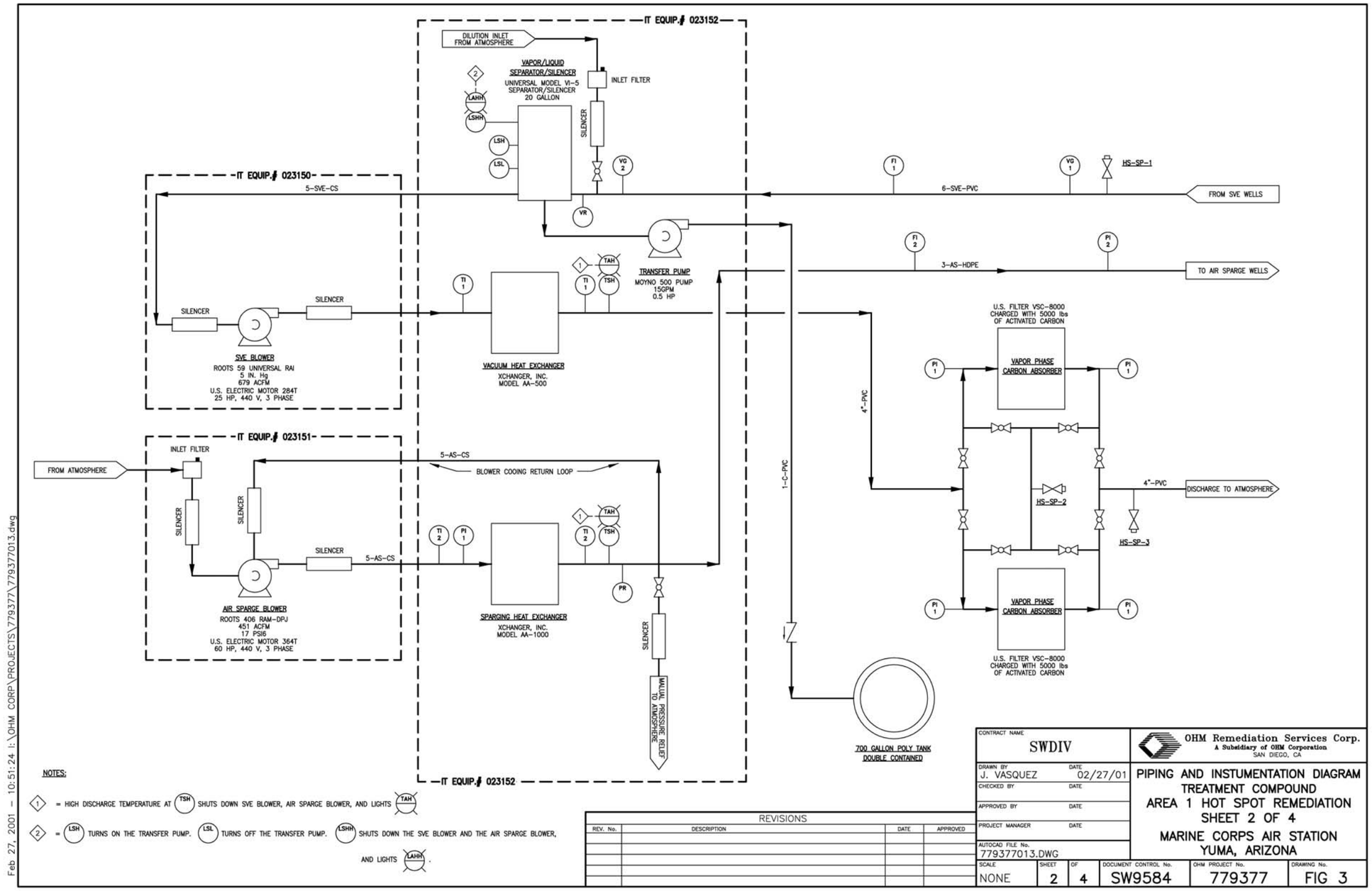


Figure 2. AS/SVE Piping and Instrumentation Diagram

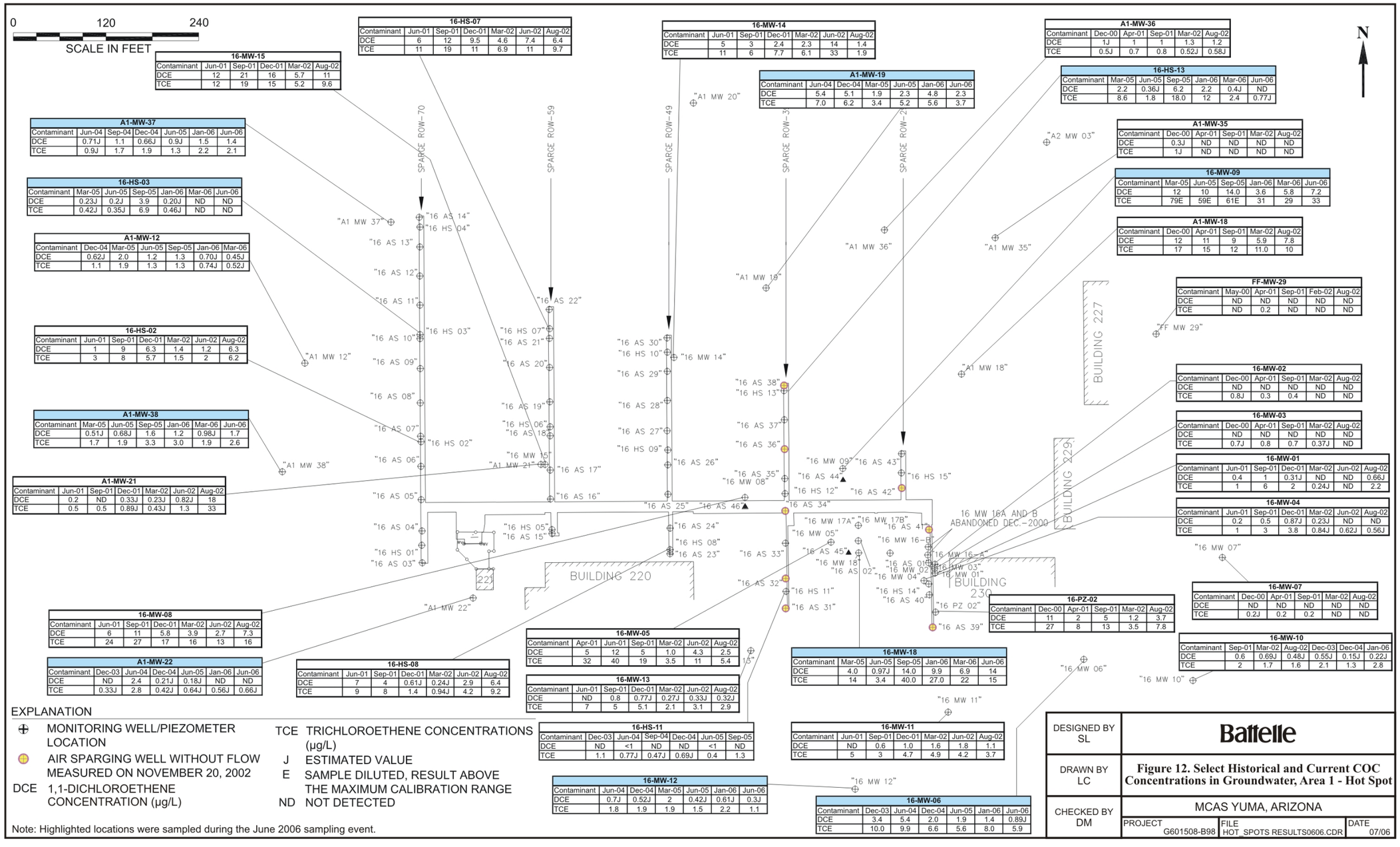


Figure 3. Locations of Hot Spot AS and Monitoring Wells, with Historical and Current DCE and TCE Concentrations

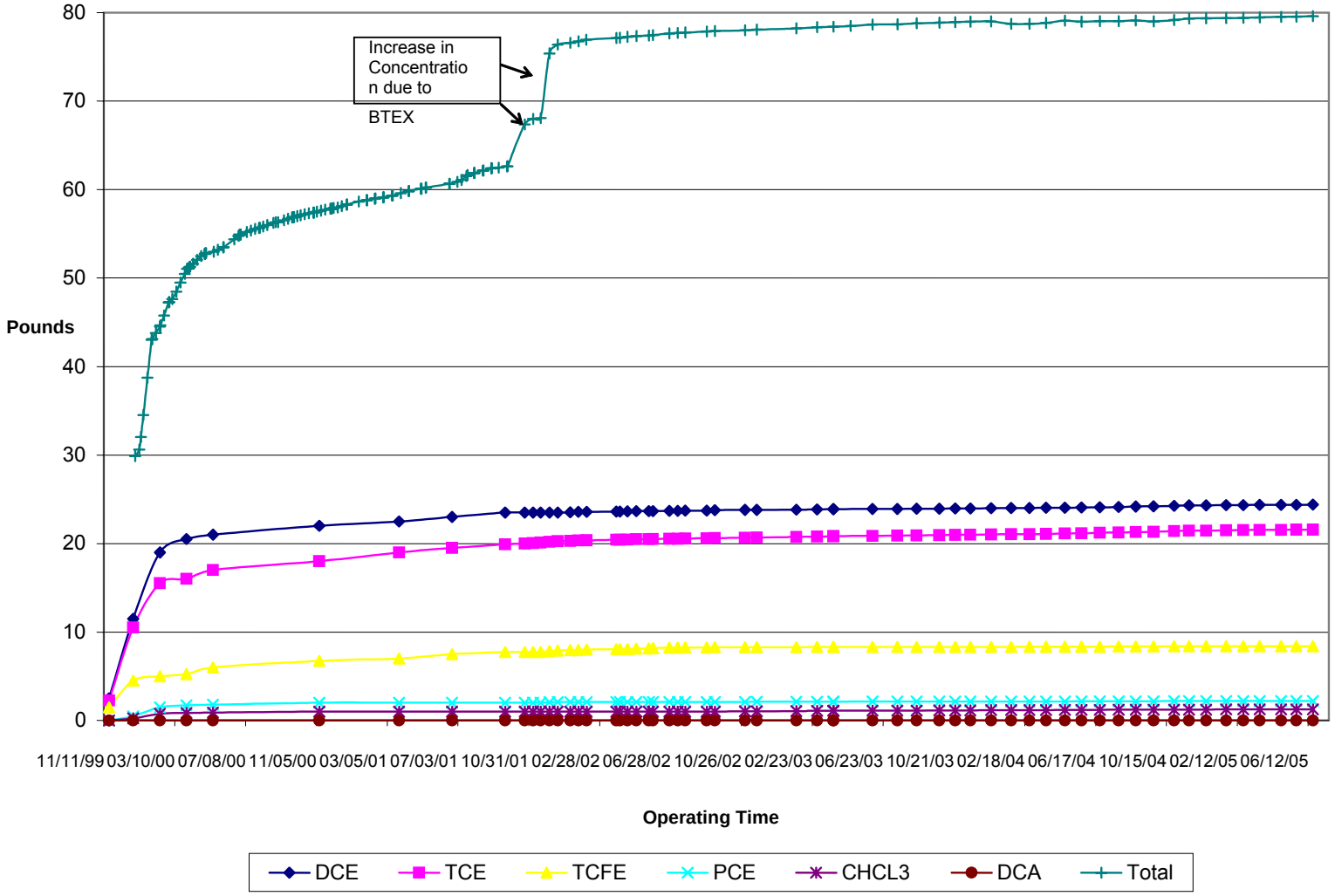


Figure 4. Cumulative Mass Removal by the SVE System

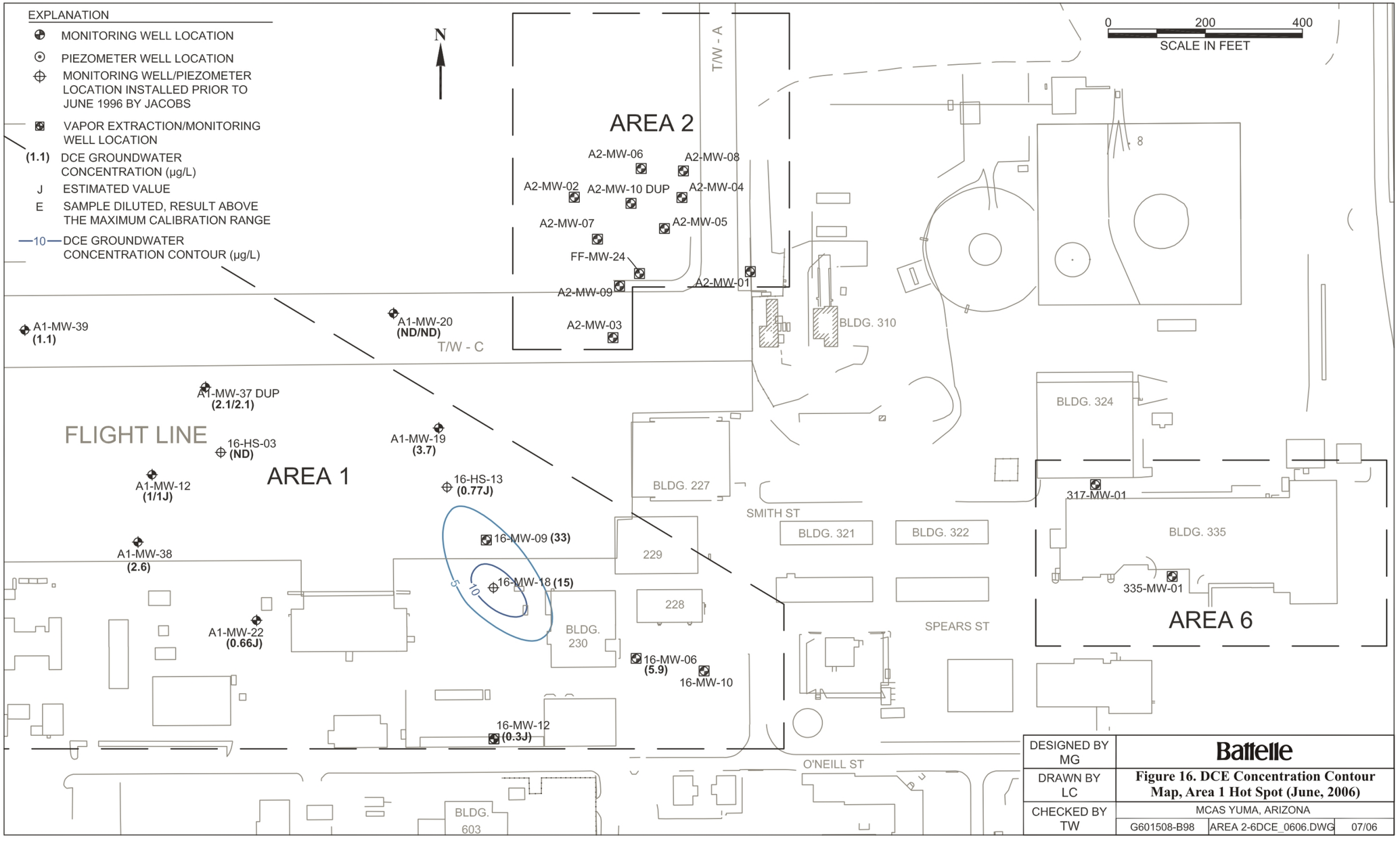


Figure 5. DCE Concentration Contour Map, June 2006

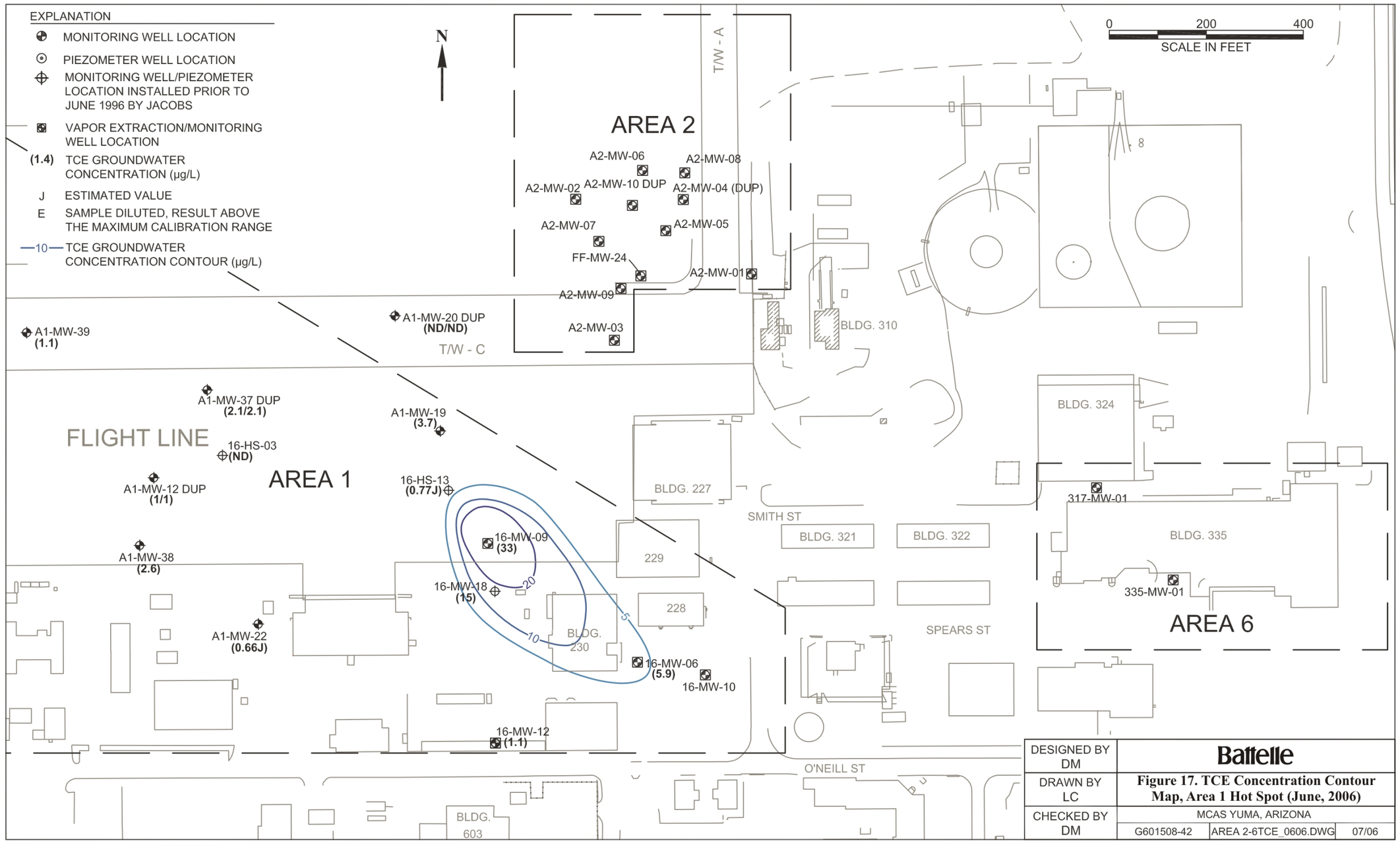


Figure 6. TCE Concentration Contour Map, June 2006

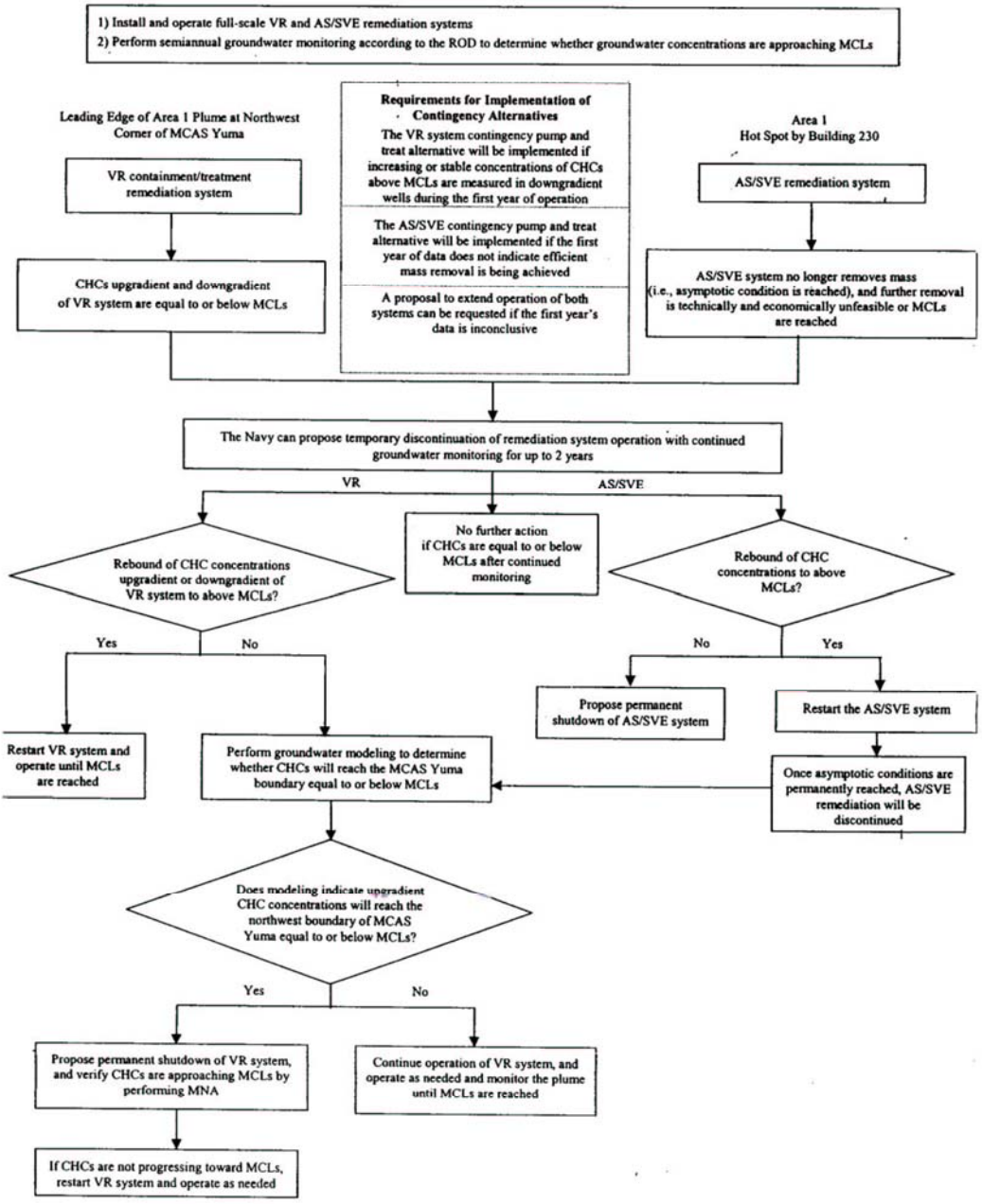


Figure 7. Decision Flow Diagram for Operation at Shutdown of VCT and AS/SVE Remediation Systems, Area 1

B5 – VCT TEMPORARY SHUT DOWN

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

11000
Ser OPCE.JDB/028
24 Jan 07

Ms. Cathy O'Connell
Arizona Department of Environmental Quality (ADEQ)
Federal Projects Unit, Superfund Programs Section, Waste Program Division
1110 West Washington Street
Phoenix, AZ 85007

SUBJECT: TECHNICAL MEMOS FOR THE REVISED LTM SCHEDULE AND THE SHUTDOWN OF THE HOT SPOT AS/SVE SYSTEM LOCATED AT THE MARINE CORPS AIR STATION (MCAS), YUMA ARIZONA

Dear Ms O'Connell:

The Department of the Navy proposed to diminish the sampling frequency of wells, reduce the number of wells being sampled, and temporarily shut down the Air Sparge/Soil Vapor Extraction System at Area 1, Operable Unit One (OU-1), MCAS Yuma, Arizona, in two separate technical memos sent to both ADEQ and U.S. Environmental Protection Agency (EPA) on 27 July and 16 August, 2006, respectively. These letters requested a response to the LTM schedule revision memo by 25 September, 2006, and a response to the Hot Spot temporary shutdown memo by 17 October, 2006, no response from ADEQ has been received. However, per enclosure (1), U.S. Environmental Protection Agency Region IX sent a concurrence letter.

This letter is to notify you that the Department of the Navy plans to proceed with the diminished sampling frequency of wells, reduced number of wells being sampled, and the temporary shut down of the Air Sparge/Soil Vapor Extraction System at Area 1 unless we receive a non-concurrence response from ADEQ within the next 10 days of receiving this correspondence. The Department of the Navy will assume ADEQ concurs with the recommendations in the memos otherwise.

5090
Ser 5DEN.AL/3047
May 8, 2003

- Groundwater monitoring will continue as prescribed in the Long Term Monitoring (LTM) plan for a minimum of two years to determine if a rebound in contaminant concentrations occurs. As suggested by your letter, monitoring wells A1-PZ-19, A1-PZ-28, A1-PZ-15, A1-PZ-17, A1-PZ-22, A1-MW-01, A1-MW-06, and A1-PZ-26 will be monitored. The LTM plan will be amended to include all of the above-mentioned monitoring wells in the groundwater monitoring schedule. The results will be discussed in the quarterly, semi-annual, and annual progress and groundwater monitoring reports.

- The VR system will be restarted if there is a rebound in chlorinated hydrocarbons concentrations above Maximum Contaminant Levels (MCL) in VR monitoring wells.

If additional information is needed, please call me at (619) 532-4228. Thank you for your attention to this matter.

Sincerely,

Angie Lind
Remedial Project Manager
By direction of the Commander

Copy to:
Mr. Martin Hausladen, EPA Region 9, San Francisco, CA
Mr. Herbert "Gil" Guillory, MCAS Yuma, AZ
Ms. Carol Lewis, MCAS Yuma, AZ
Diane Silva, Southwest Division Admin Record (2 copies)

April 24, 2003

MEMORANDUM FOR THE RECORD

From: Mr. Martin Hausladen, U.S. Environmental Protection Agency
Region 9 – Federal Facilities/Superfund Division
75 Hawthorne Street, San Francisco, CA 94105

To: Angie Lind, RPM, Southwestdiv Naval Facilities Engineering Command

SUBJECT: PROPOSED TEMPORARY SHUT DOWN OF VERTICAL RECIRCULATION TREATMENT/CONTAINMENT (VR) SYSTEM AT THE LEADING EDGE OF THE AREA 1 PLUME (LEPA)

Ref (a): Southwestdiv Naval Facilities Engineering Command ltr 5090
Ser 5DEN.AL/3018 of 24 Feb 03

Reference (a) requested EPA concurrence to temporarily shut down the VR system for a period of two years with the following conditions:

- The Navy will continue to monitor the groundwater per the LTM plan
- The VR system will be restarted if there is rebound in CHC concentrations above MCLs in VR monitoring wells

After reviewing reference (a), EPA concurs with the recommendation to temporarily shutdown the VR system.

Sincerely,

MARTIN HAUSLADEN

Copy to: Frank Smaila, ADEQ, Phoenix, AZ (w/o enclosure)
Carol Lewis, MCAS Yuma, AZ
Herbert "Gil" Guillory, MCAS Yuma, AZ
Diane Silva, Southwest Division Admin Record

TECHNICAL MEMORANDUM
Temporary Discontinuation of the Vertical Circulation Treatment System at the Leading Edge Plume Area Marine Corps Air Station, Yuma, Arizona Contract No. N68711-01-D-6009 Task Order No. 001

Introduction

Battelle has been contracted by the Naval Facilities Engineering Command (NAVFAC), Southwest Division (SWDIV) under Task Order 001, Remedial Action Operations (RAO)/Long Term Monitoring (LTM) for Operable Unit (OU) 1 at Marine Corps Air Station (MCAS), Yuma, Arizona. This task order includes the operation and maintenance (O&M) of the Vertical Circulation Treatment (VCT) system at the Area 1 Leading Edge Plume Area (LEPA), the O&M of the Air Sparging/Soil Vapor Extraction (AS/SVE) system at Area 1 Hot Spot, and the collection of groundwater samples in accordance with the Long Term Monitoring (LTM) Plan. The groundwater samples collected under the LTM portion of this task order are used to evaluate the VCT and AS/SVE systems. A data review of LEPA system wells is being addressed in this Technical Memorandum.

Site Description

MCAS Yuma is an active facility located immediately southeast of the city of Yuma, Arizona. Previous activities at MCAS Yuma resulted in the release of volatile organic compounds (VOCs) to the groundwater in the vicinity of the flight line, near Building 230. This area is currently referred to as the Hot Spot. The plume of contaminated groundwater extends to the northwest from the Hot Spot. The Leading Edge Plume Area (LEPA) is located downgradient from the Hot Spot, adjacent to the Yuma Airport. The Hot Spot and LEPA are designated as Area 1 of OU-1. A final Record of Decision (ROD) for OU-1 was signed by the United States Environmental Protection Agency (U.S. EPA) and the Arizona Department of Environmental Quality (ADEQ) in September and October 2000, respectively. The remedial action objectives established for this effort are the Maximum Contaminant Levels (MCLs) based on the Safe Drinking Water Act (SDWA). The contaminants of concern (COCs) in the LEPA area are 1,1-Dichloroethylene (1,1-DCE), Perchloroethylene (PCE), and Trichloroethylene (TCE), and the MCLs are 7 µg/L, 5 µg/L, and 5 µg/L, respectively.

System Description

The full-scale VCT system was installed in June 2000 to provide containment and treatment of relatively low concentrations of chlorinated hydrocarbons in the groundwater at the Northwest Station boundary. The VCT system uses submersible pumps to extract groundwater from four extraction wells. The extracted groundwater enters the aboveground treatment compound, where it is pumped through various holding tanks and bag filters before being treated with granular activated carbon (GAC). After the water has passed through the GAC units, the treated water is pumped back into the aquifer through four injection wells. Figure 1 provides a schematic of the VCT system. The following paragraphs provide a detailed description of the process flow and control logic for the VCT system located in the LEPA.

Contaminated groundwater is extracted from the four VCT wells simultaneously using four 40-gallon-per-minute (gpm) electric submersible pumps. The pumps transfer the untreated groundwater at a maximum rate of 160 gpm through high-density polyethylene (HDPE) piping to the water treatment compound. The water treatment compound processes the contaminated groundwater at a maximum rate of 200 gpm. The GAC-treated groundwater is then transferred through HDPE piping and discharged into

four injection wells. The process and instrumentation diagram and details of the system are presented in Figure 2.

The remediation well field consists of four extraction wells (VCT-02, VCT-04, VCT-06 and VCT-08) and four injection wells (VCT-01, VCT-03, VCT-05, and VCT-07). Figure 3 presents the locations of the extraction and injection wells at LEPA.

VCT-02 and VCT-04 are 6-inch production wells installed to 145 feet below ground surface with two different screen intervals. The lower screen extends from 130 to 140 feet below ground surface; the upper screen extends from 40 to 70 feet below ground surface. A 40-gpm Grundfos submersible pump with a 2-horsepower (hp), 230-volt, 3-phase Grundfos electric motor is installed in the lower screened section of VCT-02. A 60-gpm Grundfos submersible pump with a 5-hp, 460-volt, 3-phase Franklin electric motor is installed in the lower screened section of VCT-04. The 60-gpm pump is normally operated at 40 gpm. The 2-hp pump is controlled by a variable speed Grundfos Red-Flo VFD controller. The 5-hp pump is controlled by a variable speed Baldor adjustable speed drive controller. All the pump controllers are located in enclosures at the treatment compound. TAM inflatable packers are installed above the pumps to limit the extraction to the lower screened interval.

VCT-06 and VCT-08 are 6-inch production wells installed to 145 feet below ground surface. The screened interval extends from 130 to 140 feet below ground surface. One each 5-hp, 60-gpm Grundfos electric submersible pump is installed in the screened section of VCT-06 and VCT-08. The 60-gpm pump is normally operated at 40-gpm. A variable speed Baldor adjustable speed drive controller controls the pumps which are located in enclosures at the treatment compound.

VCT-01 and VCT-03 are 6-inch production wells installed to 105 feet below ground surface, with two screen intervals. The lower screen extends from 90 to 100 feet below ground surface, the upper screen extends from 40 to 70 feet below ground surface. The wells are currently used for injection. VCT-01 is located close to VCT-02 and VCT-03 is located close to VCT-04 to produce groundwater circulation.

VCT-05 and VCT-07 are 6-inch production wells installed to 115 feet below ground surface. The screened interval extends from 100 to 110 feet below ground surface, with a 10-foot stainless steel prepack with 0.020-inch slots and No. 2/12 Monterey sand. Each well has a 5-foot stainless steel silt trap. VCT-05 is located close to VCT-06 and VCT-07 is located close to VCT-08 to produce groundwater circulation.

Five 3-inch extraction pipes (one spare) are manifolded on the east side of the treatment compound. Once aboveground, each pipe transitions to Schedule 80 PVC piping. Each pipe has a separate Signet 5090 analog flowmeter used to adjust the extraction rate from each extraction well. The readouts for all the system flowmeters are installed in panels at the treatment compound. All panels (including pump controllers, flowmeter readouts, and interface control panel) are located on the east side of the treatment compound. After the manifold, the total influent flow from the extraction wells is routed through a totalizing Signet 5500 analog digital flowmeter. This flowmeter is used to track the total gallons of groundwater extracted by the system. The contaminated influent groundwater then enters Tank 1 (T-1). This tank holds the untreated influent groundwater to allow settlement of any sediment and provides system surge capacity so that system maintenance, carbon backwashing, and carbon changeouts can be performed without shutting down the well extraction pumps

The untreated groundwater is pumped from T-1 via Pump 1 (P-1) (see Figure 2). P-1 is a 200-gpm, 65-pound-per-square-inch-gauge (psig) Aurora Model 341A transfer pump. The water is pumped from T-1 through a Signet 5100 digital flowmeter. This flowmeter is used to adjust the P-1 pump rate. The water

then flows through a dual-bag filter system, followed by the liquid-phase GAC adsorbers, and then into Tank 2 (T-2).

The GAC treatment system consists of two Waterlink/Barneby Sutcliff LD-180 adsorbers, holding 5000 pounds of GAC each. T-2 contains treated groundwater and provides surge capacity. The clean treated water is pumped from T-2 using Pump 2 (P-2). The water is pumped through a dual-bag filter system with 100-micron filter elements, through a flowmeter, and enters the injection manifold.

The purpose of the backwash system is to maximize GAC efficiency by removing any sediment or precipitates that accumulate on the GAC bed. In addition, the backwash fluffs the GAC beds, thus ensuring that all GAC particles are exposed to groundwater contaminants. The GAC is currently being backwashed on a biweekly basis.

Data Review

The LEPA VCT system is currently operating at a total influent and effluent rate of approximately 120 gpm. The system is operating with 3-extraction and 3-injection wells on-line. Extraction well VCT-06 and injection well VCT-01 are not operational. Inspection of well VCT-01 during October 2001 VCT well redevelopment indicated a collapsed well casing and a stuck down-hole packer assembly and drop pipe. The motor at VCT -06, currently not operational, was previously replaced under warranty by Franklin Motor and, therefore, further repairs are no longer warranted. Franklin motor further stated that the damage to the pump is caused by the water at the site, possibly due to the activities of sulfate-reducing bacteria. The cost to repair the pump would be greater than the cost to replace it. Given a review of the data presented during the October 23, 2002 project review meeting, there is no current plan to replace VCT-01 or the damaged pump and motor. Extraction well VCT-04 was temporarily not operable (October 7, 2002). The pump and motor were replaced on October 15, 2002 and the well was placed back in service. VCT-08 also was temporarily out of service (December 30, 2002); the pump and motor were replaced on January 6, 2003.

Groundwater samples have been collected on a quarterly, semiannual, or annual basis at the site since April 2000. A total of 48 groundwater monitoring wells were used in this document to evaluate the contaminants of concern (COC) concentrations in LEPA and the area downgradient (northwest) of the intersection of Runways 17 and 8-26 (see Figure 4 for well locations). Table 1 provides the historical and current analytical results. A graphical representation of these concentrations in each monitoring well is provided in Figure 5 (Figure 5-A presents graphs of wells which have never exceeded MCLs, and Figure 5-B represents graphs of wells which have exceeded MCLs).

Data from the historical and most recent monitoring events, conducted in December 2002, show that concentrations of 1,1-DCE, TCE, and PCE have never exceeded MCLs in the following 35 of the 48 monitoring wells:

➢ A1-MW-44	A1-MW-45	A1-MW-46	A1-MW-47	A1-MW-48
➢ A1-PZ-01	A1-PZ-02	A1-PZ-04	A1-PZ-07	A1-PZ-08
➢ A1-PZ-11	A1-PZ-12	A1-PZ-13	A1-PZ-14	A1-PZ-16
➢ A1-PZ-18	A1-PZ-20	A1-PZ-24	A1-PZ-25A	A1-PZ-26
➢ A1-PZ-27	A1-PZ-28	A1-MW-02	A1-MW-03	A1-MW-04
➢ A1-MW-05	A1-MW-06	A1-MW-28	A1-MW-29A	A1-MW-30
➢ A1-MW-33	A1-MW-43	NW-MW-01	NW-MW-02	NW-MW-04

Further, PCE has never exceeded its MCL in any of the 48 monitoring wells during any monitoring events. 1,1-DCE and TCE concentrations have exceeded their respective MCLs in 11 of the 48 wells historically but have been below their MCLs during the last four to ten monitoring events. In 2 of the 48 monitoring wells, A1-PZ-19 and A1-MW-01, TCE concentrations have been measured slightly above the MCL (i.e., 5.1 to 5.3 μg/L) during the last three sampling events. Detections of 1,1-DCE and TCE with regard to their MCLs and trends in these 13 monitoring wells are discussed below:

A1-PZ-09 (Screened from 130 to 140 ft bgs)

In April 2000, the 1,1-DCE concentration at this well was reported at 8.0 μg/L, exceeding the MCL of 7 μg/L. This is the only measured concentration exceeding the MCL for 1,1-DCE at this well in a total of 10 monitoring events. The TCE concentration also was reported above its MCL in this well in April 2000 (6 μg/L) and at its MCL in December 2000 (5.0 μg/L), The 1,1-DCE and TCE concentrations have been well below their MCLs in the six subsequent sampling events. All COCs have been below detection since March 2002. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-PZ-17 (Screened from 100 to 110 ft bgs)

The MCLs for 1,1-DCE and TCE were exceeded in only one (December 2000) of the ten monitoring events. Concentrations have been decreasing in this well since December 2000 and are currently at 0.41 μg/L and 0.23 μg/L, respectively.

A1-PZ-21 (Screened from130 to 140 ft bgs)

The 1,1-DCE concentration was measured at its MCL of 7 μg/L during the August 2000 monitoring event. This level has decreased since and this COC was not detected during the last two monitoring events (June and August 2002). TCE was exceeded only in August 2000 (6.0 μg/L) and its concentration has decreased since then. TCE was not detected during the June 2002 or August 2002 monitoring events. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-PZ-22 (Screened from 100 to 110 ft bgs)

The 1,1-DCE concentration exceeded the MCL during the August 2000 (15 μg/L), September 2000 (8 μg/L), and December 2000 (8.0 μg/L) monitoring events. This COC has been below the MCL, ranging from less than detection to 4 μg/L, since April 2001. TCE also exceeded the MCL during August 2000 (12.0 μg/L), September 2000 (6.0 μg/L), and December 2000 (7.0 μg/L), however, it has not been detected since September 2001. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-PZ-23 (Screened from130 to 140 ft bgs)

1,1-DCE exceeded its MCL during the August 2000 monitoring event (9.0 μg/L). The concentration has been steadily decreasing since September 2000 and was measured at 0.25 μg/L in August 2002. The TCE MCL was exceeded in the first four of the ten monitoring events at concentrations of 6.0 μg/L (April 2000), 9.0 μg/L (August 2000), 7.0 μg/L (September 2000), and 6.0 μg/L (December 2000). However, the TCE concentration has been decreasing since August 2000 and was measured at 0.26 μg/L in August 2002. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-MW-31 (Screened from 50 to 80 ft bgs)

TCE exceeded the MCL in this monitoring well only during the April 2000 monitoring event. In all subsequent monitoring events, TCE concentrations have been less than 5 µg/L with six of those monitoring events at levels less than the detection limit. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-MW-32 (Screened from 100 to 110 ft bgs)

Only TCE exceeded the MCL in April 2000 and December 2000 at concentrations of 6.0 µg/L; and the concentration in March 2001 was at the 5.0 µg/L MCL. However, concentrations have been below MCL in the subsequent seven monitoring events. In August 2002, the TCE concentration was 3.3 µg/L. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-MW-42 (Screened from 48.5 to 78.5 ft bgs)

The TCE MCL was exceeded once in this well, with a concentration of 6.0 µg/L reported in December 2000. During the other seven monitoring events in which this well was sampled (August 2000 to August 2002) no MCLs were exceeded. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-PZ-15 (Screened from 130 to 140 ft bgs)

The 1,1-DCE MCL was exceeded in April 2001 (9.0 µg/L), September 2001 (10 µg/L), and February 2002 (12 µg/L). The TCE concentration was at its MCL in December 2000 (5.0 µg/L), and exceeded its MCL in April 2001 (7.0 µg/L) and September 2001 (9.0 µg/L). Concentrations have been declining since the February 2002 and are currently at 0.30 µg/L (1,1-DCE) and 0.9 µg/L (TCE).

A1-MW-34 (Screened from 130 to 140 ft bgs)

The MCL for TCE was exceeded in this well during the August and December 2000 and June 2001 sampling events (7.0, 8.0, and 7.0 µg/L, respectively). The 1,1-DCE MCL has not been exceeded. The MCL for TCE has been less than the MCL since September 2001. This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-MW-41 (Screened from 49 to 79 ft bgs)

The TCE concentration exceeded its MCL in January 2000 (6.0 µg/L) and during the September 2001 sampling event, TCE was measured at 5.0 µg/L. In all other quarterly monitoring events since January 2000, concentrations were less than 5.0 µg/L. Results from the most recent monitoring event reported a TCE concentration of 3.9 µg/L (August 2002). This well is scheduled to be sampled on a semiannual basis and, therefore, was not sampled during the quarterly monitoring event in December 2002.

A1-PZ-19 (Screened from 230 to 250 ft bgs)

The MCL for 1,1-DCE has not been exceeded in this well. TCE concentrations of 5.1 µg/L (June and August 2002) and 5.3 µg/L (December 2002) were reported for the last three monitoring events.

A1-MW-01 (Screened from 53 to 78 ft bgs)

The MCLs for 1,1-DCE and TCE were exceeded in this well from April 2000 to March 2002. However, results from 2002 monitoring events show concentrations below the MCL for 1,1-DCE and TCE concentrations at or near the MCL. The average TCE concentration (a duplicate sample was collected) for the December 2002 monitoring event was 5.2 µg/L (reported concentrations of 5.4 and 5.0 µg/L).

Conclusions and Recommendations

Figure 6 provides the decision flow diagram for operation and shutdown of VCT and AS/SVE remediation systems in Area 1. This decision flow diagram was developed in the ROD in 2000. As shown on Figure 6, when the concentrations of the COCs (or chlorinated hydrocarbons [CHCs] as noted on the diagram) upgradient and downgradient of the VCT system have reached the levels equal to or below the respective MCLs, the Navy can propose a temporary shutdown of the system operation with continued groundwater monitoring for up to two years. If rebound to above the MCLs occurs in wells located either upgradient or downgradient of the system, the system will be restarted and operated until the MCLs are reached again. If rebound of the COC concentrations does not occur, groundwater modeling will be performed to determine whether COCs will reach the MCAS Yuma boundary at levels equal to or below the MCLs.

The review of the COC concentrations in 48 upgradient or downgradient monitoring wells indicates that, except in two wells (i.e., A1-MW-01 screened from 53 to 78 bgs and A1-PZ-19 screened from 230 to 250 bgs), the COC concentrations have reached the levels equal to or below the MCLs. In A1-MW-01 and A1-PZ-19, TCE has been detected at 5.1 to 5.3 µg/L, slightly above its MCL, since June 2002. Historically, A1-MW-01 has experienced significant DCE and TCE reductions, i.e., from as high as 37 µg/L of DCE and 15 µg/L of TCE, to levels below the respective MCLs. The slightly above- and below-the-MCL-concentrations of TCE detected in June, August, and December 2002 may indicate that the system has reached an asymptotic state.

In A1-PZ-19, TCE concentrations were 6.0 µg/L in July 1999, reduced to below its MCL till June 2002, and increased to 5.1−5.3 µg/L afterwards. The exact reasons for these minor concentration variations are not known. The cross sections A-A' and B-B' at the Northwest Station (see Figure 7) revealed that the geology at A1-PZ-19 consists of silty sands interlayered with clay lenses at the depths from 230 to 250 bgs. This natural heterogeneity could be one of the factors causing the concentration variations observed in A1-PZ-19.

By design, the VCT system treats contaminated groundwater in the "shallower" aquifer where most of the contamination was present. The VCT system extracts groundwater from 130 to 140 ft bgs and reinjects the treated water to 40-70 ft bgs. As such, the treatment system was not designed to treat the localized area at A1-PZ-19 at depths from 230 to 250 bgs. Therefore, even if it continues to operate, the system may not reduce TCE concentrations in A1-PZ-19. Because of the low permeability of the geologic materials in this area, the TCE plume is moving very slowly and the principal mechanisms for the TCE reduction would be such naturally attenuating processes as dispersion, sorption, and biological degradation. As such, the most effective approach to deal with the TCE in A1-PZ-19 would be continually monitoring its concentrations and evaluating the effects of the natural attenuating processes.

Because the requirements for temporary discontinuation of remediation system operation, as set in the decision flow diagram, have been met, Battelle recommends that the VCT system be temporarily shutdown with continued groundwater monitoring.

TABLE

Table 1. 1,1-DCE, PCE, and TCE Concentrations

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)					
			1,1-DCE (7 µg/L)		PCE (5 µg/L)		TCE (5 µg/L)	
A1-MW-44	LEPA	04/00	1.0	J	0.2	J	2.0	J
A1-MW-44	LEPA	08/00	1.0	J	ND		1.0	J
A1-MW-44	LEPA	12/00	1.0	J	0.2	J	2.0	J
A1-MW-44	LEPA	09/01	0.9	J	ND		1.0	J
A1-MW-44	LEPA	03/28/02	0.27	J	ND		0.33	J
A1-MW-44	LEPA	08/09/02	1.1		0.21	J	1.0	
A1-MW-45	LEPA	04/00	0.8	J	ND		1.0	J
A1-MW-45	LEPA	08/00	0.9	J	ND		1.0	J
A1-MW-45	LEPA	12/00	0.9	J	0.1	J	1.0	J
A1-MW-45	LEPA	09/01	0.4	J	ND		0.3	J
A1-MW-45	LEPA	03/27/02	ND		ND		0.65	J
A1-MW-45	LEPA	08/07/02	ND		ND		ND	
A1-MW-46	LEPA	04/00	2.0	J	ND		2.0	
A1-MW-46	LEPA	08/00	1.0	J	ND		2.0	J
A1-MW-46	LEPA	12/00	0.6	J	ND		0.9	J
A1-MW-46	LEPA	09/01	ND		ND		ND	
A1-MW-46	LEPA	03/26/02	ND		ND		0.5	J
A1-MW-46	LEPA	08/07/02	ND		ND		ND	
A1-MW-47	LEPA	12/00	2.0		0.9	J	3.0	
A1-MW-47	LEPA	03/01	2.0	J	ND		2.0	J
A1-MW-47	LEPA	06/01	0.6	J	0.2	J	0.8	J
A1-MW-47	LEPA	09/01	ND		ND		ND	
A1-MW-47	LEPA	03/16/02	ND		ND		ND	
A1-MW-47	LEPA	08/07/02	ND		ND		ND	
A1-MW-47 DUP	LEPA	03/16/02	ND		ND		ND	
A1-MW-48	LEPA	08/00	1.0	J	0.5	J	2.0	J
A1-MW-48	LEPA	12/00	3.0		2.0	J	3.0	
A1-MW-48	LEPA	06/01	0.4	J	0.2	J	0.7	J
A1-MW-48	LEPA	09/01	0.5	J	ND		0.6	J
A1-MW-48	LEPA	03/27/02	ND		ND		0.21	J
A1-MW-48	LEPA	08/08/02	0.25	J	ND		ND	
A1-PZ-01	LEPA	01/00	ND		ND		ND	
A1-PZ-01	LEPA	04/00	ND		ND		ND	
A1-PZ-01	LEPA	08/00	ND		ND		ND	
A1-PZ-01	LEPA	12/00	ND		ND		0.2	J
A1-PZ-01	LEPA	03/01	ND		ND		ND	
A1-PZ-01	LEPA	09/01	ND		ND		ND	
A1-PZ-01	LEPA	03/11/02	ND		ND		ND	
A1-PZ-01	LEPA	08/06/02	ND		ND		ND	
A1-PZ-01 DUP	LEPA	03/12/02	ND		ND		ND	
A1-PZ-02	LEPA	02/00	0.3	J	ND		0.7	J
A1-PZ-02	LEPA	04/00	0.2	J	ND		0.3	J
A1-PZ-02	LEPA	08/00	2.0		ND		3.0	
A1-PZ-04	LEPA	01/00	ND		ND		0.5	J
A1-PZ-04	LEPA	04/00	ND		ND		0.5	J
A1-PZ-04	LEPA	08/00	ND		ND		ND	
A1-PZ-04	LEPA	12/00	ND		ND		0.2	J
A1-PZ-04	LEPA	03/01	ND		ND		ND	

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)					
			1,1-DCE (7 µg/L)		PCE (5 µg/L)		TCE (5 µg/L)	
A1-PZ-04	LEPA	09/01	ND		ND		ND	
A1-PZ-04	LEPA	04/02/02	ND		ND		ND	
A1-PZ-04	LEPA	08/07/02	ND		ND		ND	
A1-PZ-07	LEPA	01/00	ND		ND		0.3	J
A1-PZ-07	LEPA	09/00	ND		ND		ND	
A1-PZ-08	LEPA	01/00	ND		ND		ND	
A1-PZ-08	LEPA	12/00	ND		ND		0.4	J
A1-PZ-09	LEPA	01/00	ND		ND		ND	
A1-PZ-09	LEPA	04/00	**8.0**		0.6	J	**6.0**	
A1-PZ-09	LEPA	08/00	2.0	J	ND		2.0	J
A1-PZ-09	LEPA	12/00	6.0		0.4	J	**5.0**	
A1-PZ-09	LEPA	04/01	0.5	J	ND		ND	
A1-PZ-09	LEPA	09/01	0.5	J	ND		0.7	J
A1-PZ-09	LEPA	12/18/01	0.46	J	ND		0.56	J
A1-PZ-09	LEPA	03/28/02	ND		ND		ND	
A1-PZ-09	LEPA	06/10/02	ND		ND		ND	
A1-PZ-09	LEPA	08/08/02	ND		ND		ND	
A1-PZ-11	LEPA	01/00	2.0	J	ND		2.0	J
A1-PZ-11	LEPA	04/00	4.0		0.3	J	4.0	
A1-PZ-11	LEPA	08/00	ND		ND		ND	
A1-PZ-11	LEPA	12/00	2.0	J	0.1	J	2.0	
A1-PZ-11	LEPA	03/01	1.0	J	ND		2.0	J
A1-PZ-11	LEPA	06/01	1.0	J	ND		2.0	J
A1-PZ-11	LEPA	09/01	1.0	J	ND		ND	
A1-PZ-11	LEPA	12/18/01	1.5		ND		1.6	
A1-PZ-11	LEPA	06/11/02	1.1		ND		1.4	
A1-PZ-11	LEPA	08/08/02	0.66	J	ND		1.0	
A1-PZ-12	LEPA	01/00	ND		ND		0.5	J
A1-PZ-12	LEPA	04/00	0.7	J	ND		0.8	J
A1-PZ-12	LEPA	08/00	0.8	J	ND		0.8	J
A1-PZ-12	LEPA	12/00	2.0	J	0.2	J	2.0	
A1-PZ-12	LEPA	04/01	2.0	J	ND		2.0	J
A1-PZ-12	LEPA	09/01	0.6	J	ND		0.7	J
A1-PZ-12	LEPA	03/28/02	0.4	J	ND		0.49	J
A1-PZ-12	LEPA	08/08/02	ND		ND		0.27	J
A1-PZ-13	LEPA	01/00	ND		ND		ND	
A1-PZ-13	LEPA	04/00	0.9	J	ND		0.8	J
A1-PZ-13	LEPA	08/00	ND		ND		ND	
A1-PZ-13	LEPA	12/00	1.0	J	0.1	J	1.0	J
A1-PZ-13	LEPA	03/01	0.8	J	ND		1.0	J
A1-PZ-13	LEPA	09/01	3.0		0.2	J	3.0	
A1-PZ-13	LEPA	08/08/02	2.1		0.21	J	2.2	
A1-PZ-14	LEPA	01/00	0.3	J	ND		0.7	J
A1-PZ-14	LEPA	04/00	0.3	J	ND		0.4	J
A1-PZ-14	LEPA	08/00	ND		ND		ND	
A1-PZ-14	LEPA	12/00	ND		ND		ND	
A1-PZ-14	LEPA	03/01	ND		ND		ND	
A1-PZ-14	LEPA	09/01	ND		ND		ND	
A1-PZ-14	LEPA	08/07/02	1.2		ND		0.88	J
A1-PZ-15	LEPA	04/00	3.0		0.2	J	2.0	

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-PZ-15	LEPA	08/00	4.0	ND	4.0
A1-PZ-15	LEPA	12/00	6.0	0.4 J	**5.0**
A1-PZ-15	LEPA	04/01	**9.0**	0.7 J	**7.0**
A1-PZ-15	LEPA	06/01	3.0	0.3 J	3.0
A1-PZ-15	LEPA	09/01	**10**	0.6 J	**9.0**
A1-PZ-15	LEPA	02/06/02	**12**	0.4 J	4.7
A1-PZ-15	LEPA	02/11/02	**12**	0.4	4.7
A1-PZ-15	LEPA	04/02/02	3.4	ND	3.3
A1-PZ-15	LEPA	06/11/02	1.4	0.23 J	2.4
A1-PZ-15	LEPA	06/11/02	1.4	0.24 J	2.5
A1-PZ-15	LEPA	08/09/02	0.76 J	0.21 J	1.5
A1-PZ-15	LEPA	12/07/02	0.30 J	ND	0.9 J
A1-PZ-16	LEPA	04/00	ND	ND	ND
A1-PZ-16	LEPA	08/00	ND	ND	ND
A1-PZ-16	LEPA	12/00	ND	ND	ND
A1-PZ-16	LEPA	03/01	ND	ND	ND
A1-PZ-16	LEPA	06/01	ND	ND	ND
A1-PZ-16	LEPA	09/01	ND	ND	ND
A1-PZ-16	LEPA	12/19/01	ND	ND	0.22 J
A1-PZ-16	LEPA	04/02/02	ND	ND	ND
A1-PZ-16	LEPA	06/10/02	ND	ND	ND
A1-PZ-16	LEPA	08/07/02	ND	ND	ND
A1-PZ-16	LEPA	12/07/02	ND	ND	ND
A1-PZ-17	LEPA	04/00	0.3 J	ND	0.7 J
A1-PZ-17	LEPA	08/00	4.0	ND	3.0
A1-PZ-17	LEPA	12/00	**8.0**	0.3 J	**6.0**
A1-PZ-17	LEPA	04/01	5.0	0.2 J	4.0
A1-PZ-17	LEPA	06/01	3.0	0.2 J	2.0
A1-PZ-17	LEPA	09/01	1.0 J	ND	1.0 J
A1-PZ-17	LEPA	12/20/01	0.5 J	ND	0.42 J
A1-PZ-17	LEPA	03/28/02	0.69 J	ND	0.43 J
A1-PZ-17	LEPA	06/11/02	0.48 J	ND	0.35 J
A1-PZ-17	LEPA	08/08/02	0.42 J	ND	0.36 J
A1-PZ-17	LEPA	12/07/02	0.41 J	ND	0.23 J
A1-PZ-18	LEPA	01/00	3.0	ND	3.0
A1-PZ-18	LEPA	08/00	1.0 J	ND	1.0 J
A1-PZ-18	LEPA	12/00	4.0	0.3 J	3.0
A1-PZ-18	LEPA	04/01	2.0 J	ND	2.0 J
A1-PZ-18	LEPA	06/01	3.0	0.3 J	2.0
A1-PZ-18	LEPA	09/01	1.0 J	1.0 J	ND
A1-PZ-18	LEPA	12/19/01	1.8	0.25 J	1.8
A1-PZ-18	LEPA	03/28/02	2.3	0.23 J	1.9
A1-PZ-18	LEPA	06/11/02	2.5	0.31 J	2.6
A1-PZ-18	LEPA	08/08/02	4.4	0.52 J	4.5
A1-PZ-18	LEPA	12/07/02	3.5	0.36 J	3.6
A1-PZ-19	LEPA	04/00	ND	ND	ND
A1-PZ-19	LEPA	08/00	3.0	ND	3.0 J
A1-PZ-19	LEPA	12/00	3.0	ND	3.0
A1-PZ-19	LEPA	03/01	3.0	ND	3.0
A1-PZ-19	LEPA	06/01	2.0	ND	3.0

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-PZ-19	LEPA	09/01	1.0 J	ND	1.0 J
A1-PZ-19	LEPA	12/20/01	4.1	ND	4.6
A1-PZ-19	LEPA	06/11/02	5.1	ND	**5.1**
A1-PZ-19	LEPA	08/08/02	5.5	ND	**5.1**
A1-PZ-19	LEPA	12/05/02	5.1	ND	**5.3**
A1-PZ-20	LEPA	02/00	ND	ND	0.3 J
A1-PZ-20	LEPA	04/00	0.9 J	ND	0.7 J
A1-PZ-20	LEPA	08/00	0.7 J	ND	0.8 J
A1-PZ-20	LEPA	12/00	1.0 J	ND	1.0 J
A1-PZ-20	LEPA	03/01	0.5 J	ND	0.6 J
A1-PZ-20	LEPA	09/01	0.2 J	0.4 J	ND
A1-PZ-20	LEPA	03/27/02	0.3 J	ND	0.4 J
A1-PZ-20	LEPA	08/07/02	0.32 J	ND	ND
A1-PZ-21	LEPA	04/00	2.0	ND	3.0
A1-PZ-21	LEPA	08/00	**7.0**	ND	**6.0**
A1-PZ-21	LEPA	09/00	4.0	0.2 J	4.0
A1-PZ-21	LEPA	12/00	5.0	0.3 J	**5.0**
A1-PZ-21	LEPA	03/01	3.0	ND	3.0
A1-PZ-21	LEPA	06/01	2.0	0.2 J	3.0
A1-PZ-21	LEPA	09/01	1.0 J	ND	2.0 J
A1-PZ-21	LEPA	12/19/01	0.6 J	ND	0.76 J
A1-PZ-21	LEPA	03/29/02	0.32 J	ND	0.21 J
A1-PZ-21	LEPA	06/11/02	ND	ND	ND
A1-PZ-21	LEPA	08/08/02	ND	ND	ND
A1-PZ-22	LEPA	02/00	2.0 J	ND	1.0 J
A1-PZ-22	LEPA	04/00	3.0	ND	3.0
A1-PZ-22	LEPA	08/00	**15**	1.0 J	**12**
A1-PZ-22	LEPA	09/00	**8.0**	0.5 J	**6.0**
A1-PZ-22	LEPA	12/00	**8.0**	0.8 J	**7.0**
A1-PZ-22	LEPA	04/01	4.0	ND	3.0
A1-PZ-22	LEPA	09/01	ND	ND	ND
A1-PZ-22	LEPA	12/18/01	0.38 J	ND	ND
A1-PZ-22	LEPA	03/09/02	0.59 J	ND	ND
A1-PZ-22	LEPA	06/10/02	0.48 J	ND	ND
A1-PZ-22	LEPA	08/06/02	0.97 J	ND	ND
A1-PZ-22 DUP	LEPA	12/18/01	0.36 J	ND	ND
A1-PZ-23	LEPA	04/00	6.0	0.5 J	**6.0**
A1-PZ-23	LEPA	08/00	**9.0**	0.8 J	**9.0**
A1-PZ-23	LEPA	09/00	**7.0**	0.7 J	**7.0**
A1-PZ-23	LEPA	12/00	6.0	0.8 J	**6.0**
A1-PZ-23	LEPA	04/01	4.0	0.4 J	4.0
A1-PZ-23	LEPA	06/01	3.0	0.3 J	3.0
A1-PZ-23	LEPA	09/01	1.0 J	ND	2.0 J
A1-PZ-23	LEPA	12/20/01	1.1	ND	1.7
A1-PZ-23	LEPA	06/11/02	0.32 J	ND	0.28 J
A1-PZ-23	LEPA	06/11/02	0.41 J	ND	0.33 J
A1-PZ-23	LEPA	08/09/02	0.24 J	ND	0.28 J
A1-PZ-23 -DUP	LEPA	08/09/02	0.25 J	ND	0.26 J
A1-PZ-25A	LEPA	08/00	2.0 J	ND	2.0 J
A1-PZ-25A	LEPA	12/00	5.0	0.5 J	4.0

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-PZ-25A	LEPA	04/01	ND	ND	ND
A1-PZ-25A	LEPA	06/01	4.0	0.4 J	3.0
A1-PZ-25A	LEPA	09/01	3.0	0.3 J	2.0
A1-PZ-25A	LEPA	12/21/01	2.1	ND	2.3
A1-PZ-25A	LEPA	04/02/02	2.5	ND	1.7
A1-PZ-25A	LEPA	06/11/02	1.7	ND	1.5
A1-PZ-25A	LEPA	08/08/02	5.9	0.37 J	4.4
A1-PZ-27	LEPA	01/00	ND	ND	ND
A1-PZ-27	LEPA	08/00	ND	ND	ND
A1-PZ-27	LEPA	12/00	ND	ND	ND
A1-PZ-27	LEPA	03/01	ND	ND	ND
A1-PZ-27	LEPA	09/01	ND	ND	ND
A1-PZ-27	LEPA	03/09/02	ND	ND	ND
A1-PZ-27	LEPA	08/06/02	ND	ND	ND
A1-PZ-28	LEPA	01/00	1.0 J	ND	ND
A1-PZ-28	LEPA	08/00	0.6 J	ND	0.7 J
A1-PZ-28	LEPA	12/00	1.0 J	ND	1.0 J
A1-PZ-28	LEPA	03/01	0.9 J	ND	0.9 J
A1-PZ-28	LEPA	09/01	0.7 J	ND	0.7 J
A1-PZ-28	LEPA	03/11/02	1.1	ND	0.69 J
A1-PZ-28	LEPA	06/10/02	0.67 J	ND	0.47 J
A1-PZ-28	LEPA	08/07/02	0.86 J	ND	0.71 J
A1-MW-01	Area 1	04/00	**16**	ND	**12**
A1-MW-01	Area 1	08/00	**17**	0.8 J	**15**
A1-MW-01	Area 1	09/00	**13**	0.4 J	**10**
A1-MW-01	Area 1	12/00	**16**	0.7 J	**14**
A1-MW-01	Area 1	04/01	**20**	0.9 J	**15**
A1-MW-01	Area 1	06/01	**16**	1.0 J	**13**
A1-MW-01	Area 1	09/01	**17**	0.9 J	**13**
A1-MW-01	Area 1	02/06/02	**37**	1.0	**11**
A1-MW-01	Area 1	02/11/02	**37**	1.0	**11**
A1-MW-01	Area 1	03/09/02	**16**	0.92 J	**13**
A1-MW-01	Area 1	06/10/02	3.90	0.45 J	3.20
A1-MW-01	Area 1	08/05/02	5.1	0.50 J	**5.0**
A1-MW-01	Area 1	12/06/02	5.9	0.47 J	**5.4**
A1-MW-01 DUP	Area 1	12/06/02	5.4	0.43 J	**5**
A1-MW-02	Area 1	01/00	0.6 J	ND	0.2 J
A1-MW-02	Area 1	08/00	ND	ND	ND
A1-MW-02	Area 1	12/00	0.3 J	ND	ND
A1-MW-02	Area 1	03/01	0.8 J	ND	ND
A1-MW-02	Area 1	09/01	0.6 J	ND	ND
A1-MW-02	Area 1	03/12/02	0.47 J	ND	ND
A1-MW-02	Area 1	08/05/02	0.33 J	ND	ND
A1-MW-03	Area 1	01/00	ND	ND	ND
A1-MW-03	Area 1	04/00	3.0	ND	3.0
A1-MW-03	Area 1	08/00	ND	ND	ND
A1-MW-03	Area 1	12/00	5.0 `	ND	4.0
A1-MW-03	Area 1	03/01	0.7 J	ND	ND
A1-MW-03	Area 1	09/01	0.8 J	ND	0.2 J
A1-MW-03	Area 1	03/12/02	0.26 J	ND	ND

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-MW-03	Area 1	08/05/02	0.40 J	ND	ND
A1-MW-04	Area 1	01/00	ND	ND	0.2 J
A1-MW-04	Area 1	08/00	ND	ND	ND
A1-MW-04	Area 1	12/00	ND	ND	ND
A1-MW-04	Area 1	03/01	ND	ND	ND
A1-MW-04	Area 1	09/01	ND	ND	ND
A1-MW-04	Area 1	03/11/02	ND	ND	ND
A1-MW-04	Area 1	08/05/02	ND	ND	ND
A1-MW-04	Area 1	12/05/02	ND	ND	ND
A1-MW-05	Area 1	01/00	ND	ND	0.4 J
A1-MW-05	Area 1	04/00	ND	ND	0.3 J
A1-MW-05	Area 1	08/00	ND	ND	ND
A1-MW-05	Area 1	12/00	ND	ND	ND
A1-MW-05	Area 1	04/01	ND	ND	ND
A1-MW-05	Area 1	09/01	0.4 J	ND	ND
A1-MW-05	Area 1	03/09/02	0.44 J	ND	ND
A1-MW-05	Area 1	08/05/02	0.37 J	ND	ND
A1-MW-05	Area 1	12/05/02	0.25 J	ND	ND
A1-MW-06	Area 1	01/00	ND	ND	ND
A1-MW-06	Area 1	08/00	ND	ND	ND
A1-MW-06	Area 1	12/00	ND	ND	ND
A1-MW-06	Area 1	03/01	ND	ND	ND
A1-MW-06	Area 1	09/01	ND	ND	ND
A1-MW-06	Area 1	03/12/02	ND	ND	ND
A1-MW-06	Area 1	08/05/02	ND	ND	ND
A1-MW-24	Area 1	03/11/02	0.62 J	ND	1.1
A1-MW-24	Area 1	08/13/02	0.29 J	ND	0.67 J
A1-MW-24 DUP	Area 1	03/11/02	0.44 J	ND	0.96 J
A1-MW-26	Area 1	03/12/02	ND	ND	0.38 J
A1-MW-26	Area 1	08/13/02	ND	ND	0.21 J
A1-MW-28	Area 1	03/12/02	ND	ND	0.31 J
A1-MW-28	Area 1	08/13/02	0.38 J	ND	0.45 J
A1-MW-29A	Area 1	03/16/02	0.84 J	ND	0.78 J
A1-MW-29A	Area 1	08/14/02	1.8	ND	1.9
A1-MW-29A DUP	Area 1	08/14/02	2.2	ND	2.2
A1-MW-30	Area 1	03/12/02	ND	ND	ND
A1-MW-30	Area 1	08/14/02	ND	ND	ND
A1-MW-31	Area 1	04/00	6.0	0.5 J	**6.0**
A1-MW-31	Area 1	08/00	3.0	ND	**5.0**
A1-MW-31	Area 1	12/00	1.0 J	ND	0.2 J
A1-MW-31	Area 1	03/01	0.9 J	ND	ND
A1-MW-31	Area 1	06/01	ND	ND	ND
A1-MW-31	Area 1	09/01	ND	ND	ND
A1-MW-31	Area 1	12/17/01	0.41 J	ND	ND
A1-MW-31	Area 1	03/11/02	1.1	ND	ND
A1-MW-31	Area 1	06/07/02	0.54 J	ND	ND
A1-MW-31	Area 1	08/06/02	1.0	ND	0.21 J
A1-MW-32	Area 1	04/00	5.0	0.6 J	**6.0**
A1-MW-32	Area 1	08/00	1.0 J	ND	2.0 J
A1-MW-32	Area 1	12/00	5.0	0.5 J	**6.0**

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-MW-32	Area 1	03/01	4.0	0.4 J	5.0
A1-MW-32	Area 1	06/01	2.0	0.3 J	3.0
A1-MW-32	Area 1	09/01	2.0	0.3 J	3.0
A1-MW-32	Area 1	12/18/01	2.0	0.21 J	2.1
A1-MW-32	Area 1	03/09/02	3.0	0.24 J	3.3
A1-MW-32	Area 1	06/07/02	2.7	0.25 J	3.0
A1-MW-32	Area 1	06/13/02	1.6	0.25 J	2.5
A1-MW-32	Area 1	08/07/02	2.4	0.24 J	3.3
A1-MW-32 DUP	Area 1	08/07/02	2.4	0.27 J	2.9
A1-MW-33	Area 1	03/11/02	1.4	ND	1.5
A1-MW-33	Area 1	08/14/02	0.70 J	ND	0.89 J
A1-MW-33 DUP	Area 1	03/11/02	1.4	ND	1.5
A1-MW-34	Area 1	03/00	3.0	ND	4.0
A1-MW-34	Area 1	08/00	5.0	0.5 J	**7.0**
A1-MW-34	Area 1	12/00	6.0	0.6 J	**8.0**
A1-MW-34	Area 1	06/01	5.0	0.6 J	**7.0**
A1-MW-34	Area 1	09/01	0.9 J	ND	1.0 J
A1-MW-34	Area 1	12/17/01	2.7	0.33 J	2.8
A1-MW-34	Area 1	03/09/02	3.1	0.28 J	2.8
A1-MW-34	Area 1	06/07/02	4.0	0.45 J	3.7
A1-MW-34	Area 1	08/09/02	4.5	0.54 J	4.0
A1-MW-41	Area 1	01/00	5.0	0.6 J	**6.0**
A1-MW-41	Area 1	04/00	4.0 J	0.3 J	4.0 J
A1-MW-41	Area 1	08/00	2.0 J	ND	2.0
A1-MW-41	Area 1	12/00	2.0	0.2 J	2.0
A1-MW-41	Area 1	06/01	3.0	0.4 J	3.0
A1-MW-41	Area 1	09/01	3.0	0.4 J	**5.0**
A1-MW-41	Area 1	12/16/01	2.8	0.32 J	3.9
A1-MW-41	Area 1	03/09/02	2.8	0.27 J	4.1
A1-MW-41	Area 1	06/07/02	1.9	0.29 J	3.5
A1-MW-41	Area 1	06/07/02	2.3	0.33 J	3.8
A1-MW-41	Area 1	08/09/02	3.2	0.38 J	3.9
A1-MW-42	Area 1	08/00	3.0	ND	3.0
A1-MW-42	Area 1	12/00	6.0	0.8 J	**6.0**
A1-MW-42	Area 1	06/01	3.0	0.4 J	4.0
A1-MW-42	Area 1	09/01	2.0 J	0.2 J	2.0
A1-MW-42	Area 1	12/18/01	2.3	0.41 J	2.9
A1-MW-42	Area 1	03/09/02	2.6	0.37 J	3.2
A1-MW-42	Area 1	06/07/02	2.0	0.37 J	2.6
A1-MW-42	Area 1	08/07/02	2.2	0.32 J	3.3
A1-MW-43	Area 1	04/00	1.0 J	ND	1.0 J
A1-MW-43	Area 1	08/00	ND	ND	0.8 J
A1-MW-43	Area 1	12/00	0.7 J	ND	1.0 J
A1-MW-43	Area 1	09/01	0.3 J	ND	0.6 J
A1-MW-43	Area 1	03/09/02	0.91 J	ND	1.1
A1-MW-43	Area 1	08/07/02	0.49 J	ND	0.94 J
NW1-MW-01	Area 1	01/00	ND	ND	ND
NW1-MW-01	Area 1	03/00	ND	ND	ND
NW1-MW-01	Area 1	12/00	ND	ND	ND
NW1-MW-01	Area 1	09/01	ND	ND	ND

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
NW1-MW-01	Area 1	03/07/02	ND	ND	ND
NW1-MW-01	Area 1	08/06/02	ND	ND	ND
NW1-MW-01	Area 1	12/07/02	ND	ND	ND
NW1-MW-02	Area 1	01/00	ND	ND	ND
NW1-MW-02	Area 1	03/00	ND	ND	ND
NW1-MW-02	Area 1	12/00	ND	ND	ND
NW1-MW-02	Area 1	09/01	ND	ND	ND
NW1-MW-02	Area 1	03/08/02	ND	ND	ND
NW1-MW-02	Area 1	08/06/02	ND	ND	ND
NW1-MW-04	Area 1	01/00	ND	1.0 J	ND
NW1-MW-04	Area 1	03/00	ND	ND	ND
NW1-MW-04	Area 1	12/00	ND	ND	ND
NW1-MW-04	Area 1	09/01	ND	ND	ND
NW1-MW-04	Area 1	03/08/02	ND	ND	ND
NW1-MW-04	Area 1	08/06/02	ND	ND	ND

J: estimated value, below detection limit.
ND: not detected.
MCL: maximum contaminant level.
Shaded cells: concentration above MCL.

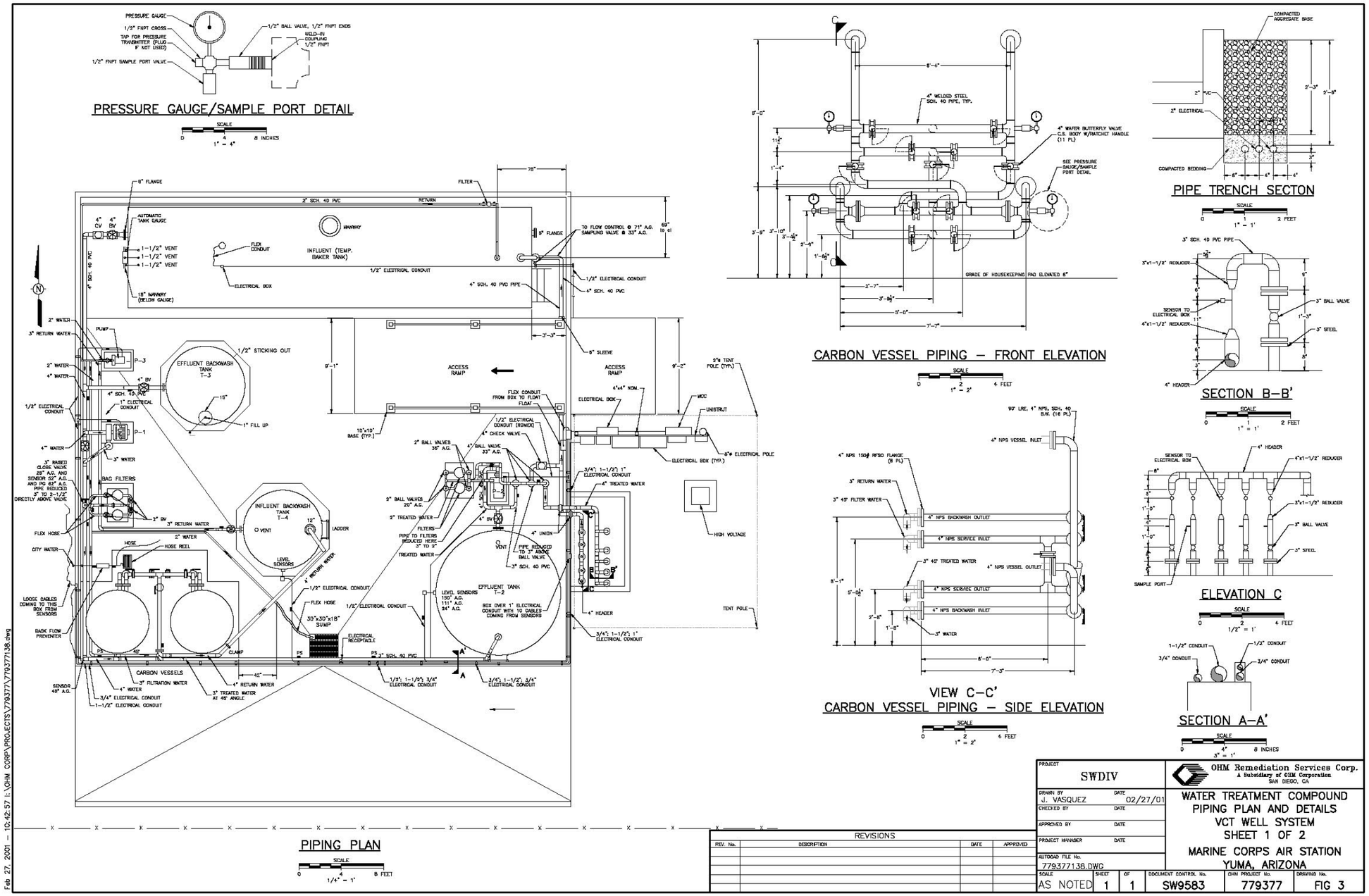


Figure 1. VCT System Schematic

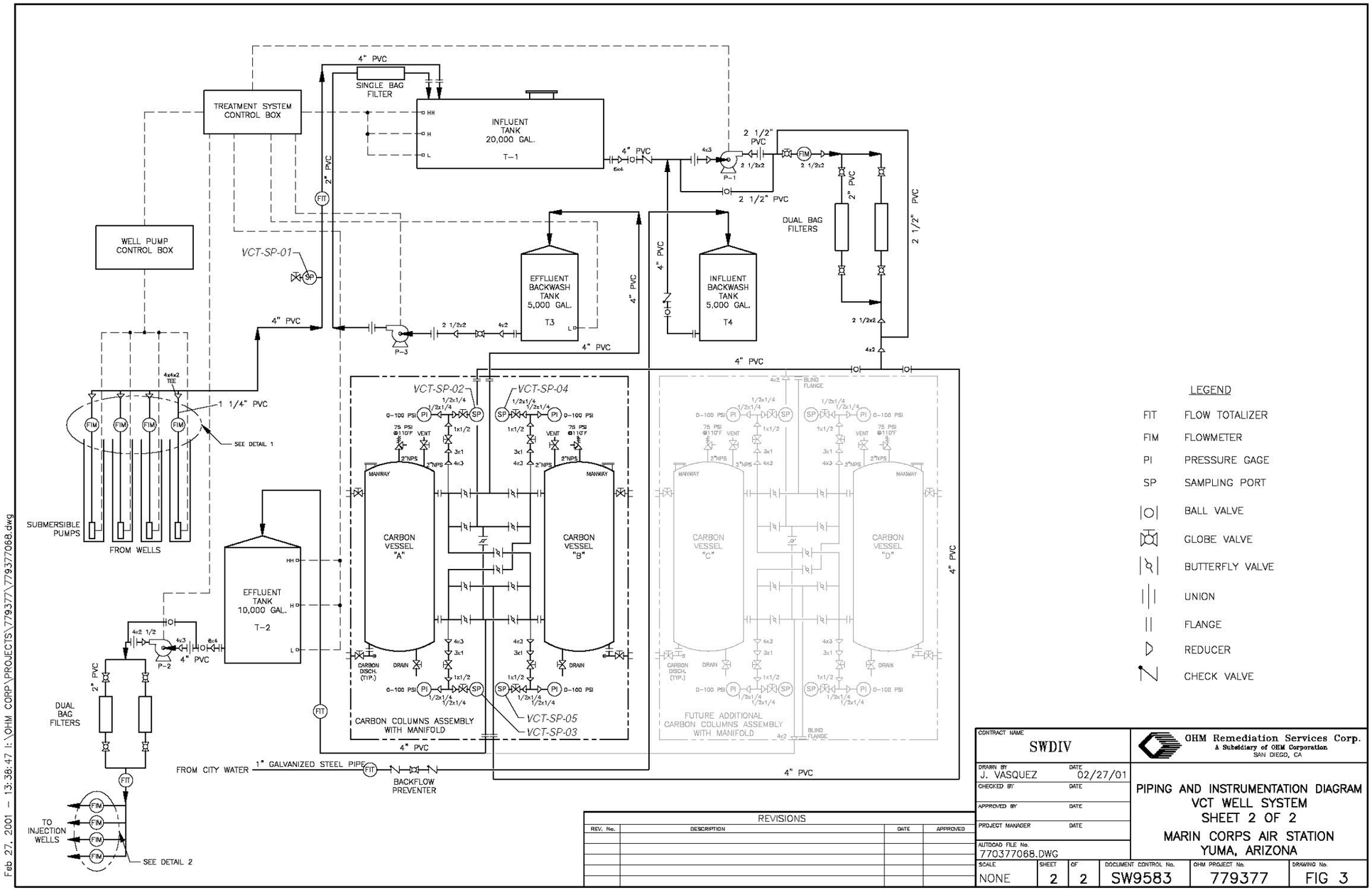


Figure 2. VCT System Piping and Instrumentation Diagram

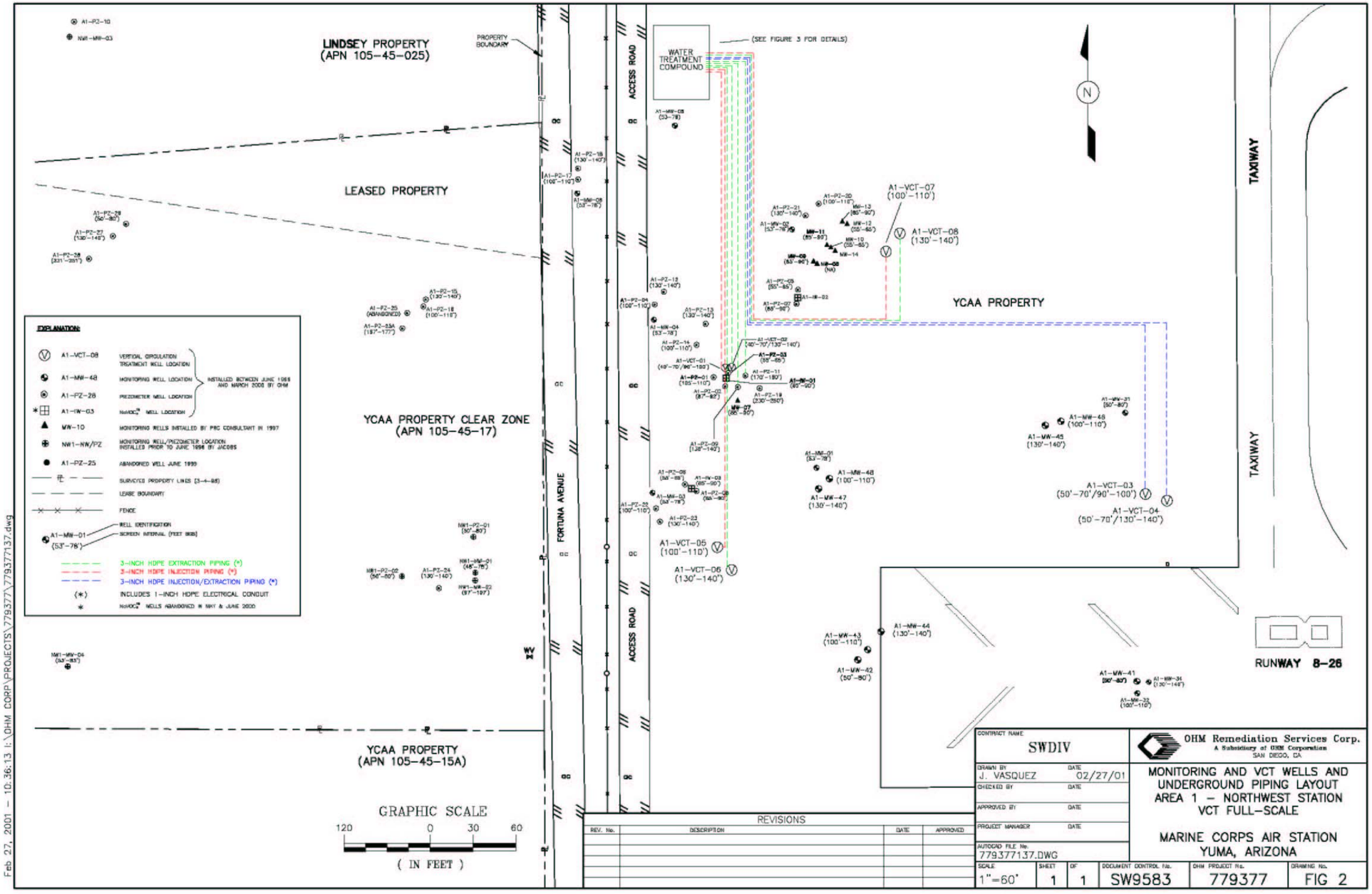


Figure 3. VCT Injection and Extraction Well Locations

B6 – VCT PERMANENT SHUT DOWN

From: Lind, Angela Y CIV NAVFAC SW [angela.lind@navy.mil]
Sent: Monday, December 05, 2005 6:53 AM
To: Magnificentmoose@aol.com
Cc: Coonfare, Christopher T; Cathy O'Connell (E-mail); Dan Nail (E-mail)
Subject: RE: FW: permanent shutdown of vCT
Signed By: There are problems with the signature. Click the signature button for details.
Martin,

Thanks for the quick response. I will forward the attached to my contractor Battelle, so that they can work up some drawings showing the current plume configuration and so that they can revisit our proposed LTM optimization plan.

I'll be on leave during Christmas. Let's get together after the 1st of the year. By then, my contract and hopefully ADEQ, will have enough time to look into our original request and your below suggestions.

Angie Lind
angela.lind@navy.mil
Remedial Project Mgr (MCAS Yuma/NAF El Centro)
Southwest Division, NAVFACENGCOM Code ROPDE.AL
1220 Pacific Highway
San Diego, CA 92132-5190
tel: (619) 532-4228
Mobile: (619) 726-5668
fax: (619) 532-1195

-----Original Message-----
From: Magnificentmoose@aol.com [mailto:Magnificentmoose@aol.com]
Sent: Thursday, December 01, 2005 10:53
To: Lind, Angela Y CIV NAVFAC SW
Subject: Re: FW: permanent shutdown of vCT

Hi Angie:
As we have discussed, I have reviewed the two letters you provided regarding the permanent shut-down of the VCT and the abandonment of the wells at the site. In general I have no problems with the shutdown of the system. Your modeling seems to indicate that the plume has been captured or remediated up gradient of the system and the monitoring shows little or no contamination. However, since the plan is to go to MNA I do have issues with the plugging of the monitoring wells. Since the system was to be in operation for many years it is prudent to plan on a long-term monitoring program to demonstrate effectiveness since waste is still in place in some wells, though at low levels. Due to the requirement of the 5-Year Review, the Marines/Navy will need to provide evidence that the remedy is effective and leaving the monitoring wells, or a subset of the wells, in place will be more cost effective than having to reinstall monitoring wells or provide hydro-punch data when requested. I would suggest you provide a map of the current plume configuration to help understand changes in geometry of the plume. Additionally, please consider providing a list of wells which can remain open and monitored to prove that the remedy is working. It is acceptable to me to plug wells that no longer provide critical data.
I would like to schedule a review meeting in San Diego to review the current state of Yuma, perhaps the week before Christmas of right after the first of the year. Additionally, please be advised that I would like a response from the State prior to any action at the site.
I you have questions regarding the EPA position, please feel free to contact me At (415) 972-3007 at any time.

Martin

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

5090
Ser OPDE.AL/5293
September 6, 2005

Mr. Martin Hausladen
Federal Facilities and Site Cleanup Branch
Environmental Protection Agency Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Mr. Hausladen:

SUBJECT: PROPOSED PERMANENT SHUTDOWN OF THE VERTICAL RECIRCULATION (VR) TREATMENT/CONTAINMENT SYSTEM AT THE LEADING EDGE OF THE PLUME AREA (LEPA) 1

The Department of the Navy is proposing permanent shutdown of the VR system at the Leading Edge of the Plume Area 1 at Marine Corps Air Station (MCAS) Yuma pursuant to the Record of Decision (ROD) for Operable Unit 1 (OU-1) dated July 2000. According to the ROD, the Department of the Navy can propose permanent shutdown of the VR system if the following conditions have been met:

- Continued monitoring after temporary shutdown of the VR system demonstrates that concentrations of Chlorinated Hydrocarbons (CHCs) continue to meet groundwater cleanup standards for a period of up to two years after temporary shutdown of the VR system.

- Groundwater modeling has demonstrated that remaining CHC concentrations will not migrate off MCAS Yuma's base boundary above groundwater cleanup standards.

Both the review of CHCs concentrations per the attached technical memorandum dated August 2005 and the Revised Final Groundwater Modeling Report for OU-1 at MCAS Yuma dated February 2004 demonstrate that the Department of the Navy has met the above permanent closure criteria. Therefore, the Department of the Navy is requesting your concurrence to permanently shutdown the VR system.

If you have any questions please call me at (619) 532-4228.

Sincerely,

ANGELA LIND
Remedial Project Manager
By direction of the Commanding Officer

Enclosure: 1. Permanent Discontinuation of the VCT System Tech Memo dtd Aug 05

Copy to:
Ms. Cathy O'Connell, ADEQ, Phoenix, AZ
Mr. Dan Nail, Environmental Department, MCAS Yuma AZ

TECHNICAL MEMORANDUM
Permanent Discontinuation of the Vertical Circulation Treatment System at the Leading Edge Plume Area Marine Corps Air Station, Yuma, Arizona Contract No. N68711-01-D-6009 Task Order No. 008 August 16, 2005

Introduction

Battelle has been contracted by the Naval Facilities Engineering Command (NAVFAC), Southwest Division (SWDIV) under Task Orders 001 and 008, Remedial Action Operations (RAO)/Long Term Monitoring (LTM) for Operable Unit (OU) 1 at Marine Corps Air Station (MCAS), Yuma, Arizona. These task orders include the operation and maintenance (O&M) of the Vertical Circulation Treatment (VCT) system at the Area 1 Leading Edge Plume Area (LEPA), the O&M of the Air Sparging/Soil Vapor Extraction (AS/SVE) system at Area 1 Hot Spot, and the collection of groundwater samples in accordance with the Long Term Monitoring (LTM) Plan.

The VCT system began operation on June 16, 2000. Battelle took over the system operation on September 30, 2002. A technical memorandum proposing a temporary shutdown of the VCT system was submitted to the U.S. EPA and the ADEQ on February 24, 2003. A review of the analytical results from LTM showed that, after two and a half years of system operations, the chlorinated hydrocarbon concentrations in all but two monitoring wells (A1-PZ-19 and A1-MW-01) had reached MCLs. TCE concentrations detected in those monitoring wells were only slightly above MCLs (5.1 to 5.3 µg/L, respectively). Based on concurrence from the U.S. EPA and ADEQ received on April 24 and 25, 2003, respectively, the VCT system was temporarily shut down on May 6, 2003.

In accordance with the temporary shutdown notification letter to ADEQ submitted May 8, 2003, the Navy has performed a monthly system inspection to ensure that the VCT system is fully functional. The Navy has continued to perform LTM in the vicinity of the LEPA to monitor for rebound of dissolved COCs in groundwater. In the two years since the shutdown of the VCT system, rebound of COC concentrations has not occurred. This Technical Memorandum presents a data review of LTM results in the LEPA area to support permanent shutdown of the VCT system.

Site Description

MCAS Yuma is an active facility located immediately southeast of the city of Yuma, Arizona. Previous activities at MCAS Yuma resulted in the release of volatile organic compounds (VOCs) to the groundwater in the vicinity of the flight line, near Building 230. This area is currently referred to as the Hot Spot. The plume of contaminated groundwater extends to the northwest from the Hot Spot. The Leading Edge Plume Area (LEPA) is located downgradient from the Hot Spot, adjacent to the Yuma Airport. The Hot Spot and LEPA are designated as Area 1 of OU-1. A final Record of Decision (ROD) for OU-1 was signed by the United States Environmental Protection Agency (U.S. EPA) and the Arizona Department of Environmental Quality (ADEQ) in September and October 2000, respectively. The remedial action objectives established for this effort are the Maximum Contaminant Levels (MCLs) based on the Safe Drinking Water Act (SDWA). The contaminants of concern (COCs) in the LEPA area are 1,1-Dichloroethylene (1,1-DCE), Perchloroethylene (PCE), and Trichloroethylene (TCE), and the MCLs are 7 µg/L, 5 µg/L, and 5 µg/L, respectively.

System Description

The full-scale VCT system was installed in June 2000 to provide containment and treatment of relatively low concentrations of chlorinated hydrocarbons in the groundwater at the Northwest Station boundary. The VCT system uses submersible pumps to extract groundwater from four extraction wells. The extracted groundwater enters the aboveground treatment compound, where it is pumped through various holding tanks and bag filters before being treated with granular activated carbon (GAC). After the water has passed through the GAC units, the treated water is pumped back into the aquifer through four injection wells. Figure 1 provides a schematic of the VCT system. The following paragraphs provide a detailed description of the process flow and control logic for the VCT system located in the LEPA.

Contaminated groundwater is extracted from the four VCT wells simultaneously using four 40-gallon-per-minute (gpm) electric submersible pumps. The pumps transfer the untreated groundwater at a maximum rate of 160 gpm through high-density polyethylene (HDPE) piping to the water treatment compound. The water treatment compound processes the contaminated groundwater at a maximum rate of 200 gpm. The GAC-treated groundwater is then transferred through HDPE piping and discharged into four injection wells. The process and instrumentation diagram and details of the system are presented in Figure 2.

The remediation well field consists of four extraction wells (VCT-02, VCT-04, VCT-06 and VCT-08) and four injection wells (VCT-01, VCT-03, VCT-05, and VCT-07). Figure 3 presents the locations of the extraction and injection wells at LEPA.

VCT-02 and VCT-04 are 6-inch production wells installed to 145 feet below ground surface with two different screen intervals. The lower screen extends from 130 to 140 feet below ground surface; the upper screen extends from 40 to 70 feet below ground surface. A 40-gpm Grundfos submersible pump with a 2-horsepower (hp), 230-volt, 3-phase Grundfos electric motor is installed in the lower screened section of VCT-02. A 60-gpm Grundfos submersible pump with a 5-hp, 460-volt, 3-phase Franklin electric motor is installed in the lower screened section of VCT-04. The 60-gpm pump is normally operated at 40 gpm. The 2-hp pump is controlled by a variable speed Grundfos Red-Flo VFD controller. The 5-hp pump is controlled by a variable speed Baldor adjustable speed drive controller. All the pump controllers are located in enclosures at the treatment compound. TAM inflatable packers are installed above the pumps to limit the extraction to the lower screened interval.

VCT-06 and VCT-08 are 6-inch production wells installed to 145 feet below ground surface. The screened interval extends from 130 to 140 feet below ground surface. One each 5-hp, 60-gpm Grundfos electric submersible pump is installed in the screened section of VCT-06 and VCT-08. The 60-gpm pump is normally operated at 40-gpm. A variable speed Baldor adjustable speed drive controller controls the pumps which are located in enclosures at the treatment compound.

VCT-01 and VCT-03 are 6-inch production wells installed to 105 feet below ground surface, with two screen intervals. The lower screen extends from 90 to 100 feet below ground surface, the upper screen extends from 40 to 70 feet below ground surface. The wells are currently used for injection. VCT-01 is located close to VCT-02 and VCT-03 is located close to VCT-04 to produce groundwater circulation.

VCT-05 and VCT-07 are 6-inch production wells installed to 115 feet below ground surface. The screened interval extends from 100 to 110 feet below ground surface, with a 10-foot stainless steel prepack with 0.020-inch slots and No. 2/12 Monterey sand. Each well has a 5-foot stainless steel silt trap. VCT-05 is located close to VCT-06 and VCT-07 is located close to VCT-08 to produce groundwater circulation.

Five 3-inch extraction pipes (one spare) are manifolded on the east side of the treatment compound. Once aboveground, each pipe transitions to Schedule 80 PVC piping. Each pipe has a separate Signet 5090 analog flowmeter used to adjust the extraction rate from each extraction well. The readouts for all the system flowmeters are installed in panels at the treatment compound. All panels (including pump controllers, flowmeter readouts, and interface control panel) are located on the east side of the treatment compound. After the manifold, the total influent flow from the extraction wells is routed through a totalizing Signet 5500 analog digital flowmeter. This flowmeter is used to track the total gallons of groundwater extracted by the system. The contaminated influent groundwater then enters Tank 1 (T-1). This tank holds the untreated influent groundwater to allow settlement of any sediment and provides system surge capacity so that system maintenance, carbon backwashing, and carbon changeouts can be performed without shutting down the well extraction pumps

The untreated groundwater is pumped from T-1 via Pump 1 (P-1) (see Figure 2). P-1 is a 200-gpm, 65-pound-per-square-inch-gauge (psig) Aurora Model 341A transfer pump. The water is pumped from T-1 through a Signet 5100 digital flowmeter. This flowmeter is used to adjust the P-1 pump rate. The water then flows through a dual-bag filter system, followed by the liquid-phase GAC adsorbers, and then into Tank 2 (T-2).

The GAC treatment system consists of two Waterlink/Barneby Sutcliff LD-180 adsorbers, holding 5000 pounds of GAC each. T-2 contains treated groundwater and provides surge capacity. The clean treated water is pumped from T-2 using Pump 2 (P-2). The water is pumped through a dual-bag filter system with 100-micron filter elements, through a flowmeter, and enters the injection manifold.

The purpose of the backwash system is to maximize GAC efficiency by removing any sediment or precipitates that accumulate on the GAC bed. In addition, the backwash fluffs the GAC beds, thus ensuring that all GAC particles are exposed to groundwater contaminants.

The LEPA VCT system has been in temporary shutdown status since May 6, 2003. Since that time, the system has been turned on one day each month to test the components and make sure the system could be returned to service if necessary.

Data Review

Groundwater samples have been collected on a quarterly, semiannual, or annual basis at the site since April 2000. Samples collected since March 2003, two months prior to the shutdown of the VCT system in May 2003, will be used in this document to evaluate the contaminants of concern (COC) concentrations in the LEPA and the area downgradient (northwest) of the intersection of Runways 17 and 8-26 (see Figures 4 and 5 for well locations). Table 1 provides the historical and current analytical results. The LEPA wells monitored during these events correspond to the revised LTM plan, as per the Technical Memorandum dated December 1, 2003. Thirty monitoring wells are listed in Table 1.

Data from the June 2003 through June 2005 period show that concentrations of 1,1-DCE, TCE, and PCE did not exceed MCLs in the following 28 of the 30 monitoring wells:

A1-MW-04	A1-MW-05	NW1-MW-01	A1-PZ-15	A1-PZ-16
A1-PZ-17	A1-PZ-18	A1-PZ-24	A1-PZ-26	A1-MW-06
A1-PZ-28	A1-MW-31	A1-MW-33	A1-MW-42	A1-MW-43
A1-MW-44	A1-PZ-09	A1-PZ-20	A1-PZ-21	A1-PZ-22
A1-PZ-23	A1-MW-28	A1-MW-29A	A1-MW-30	A1-MW-32
A1-MW-34	A1-MW-41	A1-MW01		

Further, PCE has never exceeded its MCL in any of the 30 monitoring wells during any monitoring events throughout this period. 1,1-DCE and TCE concentrations have exceeded their respective MCLs in only 2 of the 30 wells. However, these 2 wells (A1-PZ-19 and A1-MW-27) are not within the treatment zone of the VCT system. Monitoring well A1-MW-27 is located 1,200 feet southeast of the VCT system (near the Central Plume Area) and monitoring well A1-PZ-19 is screened at 230 to 250 ft bgs which is below the treatment zone of the VCT system. Detections of 1,1-DCE and TCE with regard to their MCLs and trends in these 2 monitoring wells since June 2003 are discussed below:

A1-MW-27 (Screened from 80 to 90 ft bgs)

The MCL for 1,1-DCE was exceeded in each of the two annual sampling events conducted at this well since the VCT system was shut down (10, 9.1, and 7.7 µg/L in the January 2004, January 2004 duplicate, and December 2004 samples, respectively). The MCL for TCE also was exceeded in each of these sampling events (9.9, 8.9, and 9.3 µg/L in the January 2004, January 2004 duplicate, and December 2004 samples, respectively).

A1-PZ-19 (Screened from 230 to 250 ft bgs)

The MCL for 1,1-DCE was exceeded in this well in four out of twelve samples (including duplicates) collected during the period from June 2003 through June 2005, with concentrations averaging 6.6 µg/L during this period. TCE concentrations exceeding the MCL were detected in 10 out of 12 samples (including duplicates) collected during this period, with concentrations averaging 6.4 µg/L. When this well was first developed in July 1999, the concentrations of DCE and TCE were both at 6 µg/L. Thus the concentrations of DCE and TCE have remained relatively stable within this well with minor fluctuations both between 4 and 10 µg/L.

Conclusions and Recommendations

Figure 6 provides the decision flow diagram for operation and shutdown of VCT and AS/SVE remediation systems in Area 1. This decision flow diagram was developed in the ROD in 2000. As shown on Figure 6, when the concentrations of the COCs (or chlorinated hydrocarbons [CHCs] as noted on the diagram) upgradient and downgradient of the VCT system have reached the levels equal to or below the respective MCLs, the Navy can propose a temporary shutdown of the system operation with continued groundwater monitoring for up to two years. If rebound to above the MCLs occurs in wells located either upgradient or downgradient of the system, the system will be restarted and operated until the MCLs are reached again. If rebound of the COC concentrations does not occur, groundwater modeling will be performed to determine whether COCs will reach the MCAS Yuma boundary at levels equal to or below the MCLs.

The review of the COC concentrations in 30 LEPA monitoring wells indicates that, except in two wells (i.e., A1-MW-27 screened from 80 to 90 ft bgs and A1-PZ-19 screened from 230 to 250 bgs), the COC concentrations have reached and remained at levels equal to or below the MCLs during this period.

In A1-MW-27, concentrations of 1,1-DCE and TCE exceeded their respective MCLs in each of the two annual sampling events conducted at this well since the VCT system was shut down. However, this well is actually located adjacent to the Central Plume Area (Figure 5), which is 1,200 feet southeast of the VCT system. Hence, this well is located outside the treatment zone of the VCT system. Furthermore, the *Final Groundwater Modeling Report for OU-1* demonstrates that DCE or TCE will not migrate beyond MCAS Yuma boundary above MCLs (Battelle, 2004). In view of these two factors, this well should have no influence on the decision to permanently shut down the VCT system.

In A1-PZ-19, 1,1-DCE and TCE concentrations fluctuated between 4 and 10 µg/L during this period. The exact reasons for these minor concentration variations are not known. The geology at A1-PZ-19 consists of silty sands interlayered with clay lenses at the depths from 230 to 250 bgs. This natural heterogeneity could be one of the factors causing the concentration variations observed in A1-PZ-19. By design, the VCT system treats contaminated groundwater in the "shallower" aquifer where most of the contamination was present. The VCT system extracts groundwater from 130 to 140 ft bgs and reinjects the treated water to 40-70 ft bgs. As such, the treatment system was not designed to treat the localized area at A1-PZ-19 at depths from 230 to 250 bgs. Therefore, even if the VCT system continues to operate, the system may not reduce TCE concentrations in A1-PZ-19. Because of the low permeability of the geologic materials in this area, the TCE plume is moving very slowly and the principal mechanisms for the TCE reduction would be such naturally attenuating processes as dispersion, sorption, and biological degradation. As such, the most effective approach to deal with the TCE in A1-PZ-19 is continued monitoring and evaluation of the contaminant concentrations and natural attenuation processes.

Throughout the two-year temporary shutdown period, the LTM effort has demonstrated that COC concentrations in the target treatment zone at the LEPA have remained below MCLs, and rebound has not occurred. According to the decision flow diagram, no further action is required if the COC concentrations are at or below the MCLs after continued monitoring. Furthermore, groundwater modeling has been performed to evaluate the potential for COCs to reach the MCAS Yuma facility boundary at concentrations equal to or exceeding the MCLs. The simulations discussed in the "Final Groundwater Modeling Report for OU-1 at MCAS Yuma, AZ" (Battelle, 2004) indicate that COCs will not reach the facility boundary at such levels. Therefore, because the requirements for permanent shutdown of the VCT system as set forth in the decision flow diagram have been met, Battelle recommends that the VCT system be turned off permanently.

Table 1. 1,1-DCE, PCE, and TCE Concentrations

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-MW-04	LEPA	Mar-03	1.4	< 1	1.6
A1-MW-04	LEPA	Jun-03	2.5	< 1	2
A1-MW-04	LEPA	Sep-03	1.9	< 1	1.4
A1-MW-04	LEPA	Dec-03	1.9	< 1	1.5
A1-MW-04	LEPA	Mar-04	0.83 J	< 1	0.76 J
A1-MW-04	LEPA	Jun-04	0.67 J	< 1	0.39 J
A1-MW-04	LEPA	Sep-04	0.79 J	< 1	0.69 J
A1-MW-04	LEPA	Dec-04	0.35 J	< 1	0.19 J
A1-MW-04	LEPA	Mar-05	0.47 J	< 1	0.2 J
A1-MW-04	LEPA	Jun-05	0.35 J	< 1	< 1
A1-MW-05	LEPA	Mar-03	0.22 J	< 1	< 1
A1-MW-05	LEPA	Jun-03	0.21 J	< 1	< 1
A1-MW-05	LEPA	Sep-03	< 1	< 1	< 1
A1-MW-05	LEPA	Jan-04	0.22 J	< 1	< 1
A1-MW-05	LEPA	Mar-04	0.23 J	< 1	< 1
A1-MW-05	LEPA	Jun-04	0.34 J	< 1	< 1
A1-MW-05	LEPA	Sep-04	0.61 J	< 1	0.43 J
A1-MW-05	LEPA	Dec-04	0.17 J	< 1	< 1
A1-MW-05	LEPA	Mar-05	0.25 J	< 1	< 1
A1-MW-05	LEPA	Jun-05	0.22 J	< 1	< 1
A1-MW-01	LEPA	Mar-03	5.2	0.41 J	4.3
A1-MW-01	LEPA	Jun-03	1.6	< 1	1.6
A1-MW-01	LEPA	Sep-03	3	0.32 J	2.4
A1-MW-01	LEPA	Dec-03	3.2	0.57 J	3.3
A1-MW-01	LEPA	Mar-04	2.5	0.31 J	2
A1-MW-01	LEPA	Jun-04	3.9	0.38 J	3.2
A1-MW-01	LEPA	Sep-04	3.2	0.20 J	2.9
A1-MW-01	LEPA	Jan-05	1.9	0.24 J	2.2
A1-MW-01	LEPA	Mar-05	2.8	0.25 J	2.6
A1-MW-01	LEPA	Jun-05	4.5	0.41 J	4.3
NW1-MW-01	LEPA	Mar-03	< 1	< 1	< 1
NW1-MW-01	LEPA	Jun-03	< 1	< 1	< 1
NW1-MW-01	LEPA	Sep-03	< 1	< 1	< 1
NW1-MW-01	LEPA	Jan-04	< 1	< 1	< 1
NW1-MW-01	LEPA	Mar-04	< 1	< 1	< 1
NW1-MW-01	LEPA	Jun-04	< 1	< 1	< 1
NW1-MW-01	LEPA	Sep-04	< 1	< 1	< 1
NW1-MW-01	LEPA	Dec-04	< 1	< 1	< 1
NW1-MW-01	LEPA	Mar-05	< 1	< 1	< 1
NW1-MW-01	LEPA	Jun-05	< 1	< 1	< 1
A1-PZ-19	LEPA	Mar-03	5.4	< 1	5.4
A1-PZ-19 DUP	LEPA	Mar-03	5.7	< 1	5.6
A1-PZ-19	LEPA	Jun-03	5.2	< 1	4.8
A1-PZ-19 DUP	LEPA	Jun-03	5.2	< 1	5.1
A1-PZ-19	LEPA	Sep-03	8.5	< 1	7.7
A1-PZ-19	LEPA	Dec-03	10	< 1	8.8
A1-PZ-19 DUP	LEPA	Dec-03	10	< 1	10
A1-PZ-19	LEPA	Mar-04	7.9	< 1	6.5

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-PZ-19 DUP	LEPA	Mar-04	6.4	< 1	5.3
A1-PZ-19	LEPA	Jun-04	6.3	< 1	5
A1-PZ-19	LEPA	Sep-04	4.1	< 1	4.2
A1-PZ-19	LEPA	Jan-05	4	< 1	5.3
A1-PZ-19	LEPA	Mar-05	6.8	< 1	6.6
A1-PZ-19	LEPA	Jun-05	5.7	< 1	6.2
A1-PZ-15	LEPA	Mar-03	< 1	< 1	0.59 J
A1-PZ-15	LEPA	Jun-03	0.28 J	< 1	0.57 J
A1-PZ-15	LEPA	Sep-03	< 1	< 1	0.43 J
A1-PZ-15	LEPA	Jan-04	< 1	< 1	0.5 J
A1-PZ-15	LEPA	Mar-04	< 1	< 1	0.46 J
A1-PZ-15	LEPA	Jun-04	< 1	< 1	0.42 J
A1-PZ-15	LEPA	Sep-04	< 1	< 1	0.39 J
A1-PZ-15	LEPA	Dec-04	< 1	< 1	0.31 J
A1-PZ-15	LEPA	Mar-05	< 1	< 1	0.27 J
A1-PZ-15	LEPA	Jun-05	0.15 J	< 1	0.42 J
A1-PZ-16	LEPA	Mar-03	< 1	< 1	< 1
A1-PZ-16	LEPA	Jun-03	< 1	< 1	< 1
A1-PZ-16	LEPA	Sep-03	< 1	< 1	< 1
A1-PZ-16	LEPA	Jan-04	< 1	< 1	< 1
A1-PZ-16	LEPA	Mar-04	< 1	< 1	< 1
A1-PZ-16	LEPA	Jun-04	< 1	< 1	< 1
A1-PZ-16	LEPA	Sep-04	< 1	< 1	< 1
A1-PZ-16	LEPA	Dec-04	< 1	< 1	< 1
A1-PZ-16	LEPA	Mar-05	< 1	< 1	< 1
A1-PZ-16	LEPA	Jun-05	< 1	< 1	< 1
A1-PZ-17	LEPA	Mar-03	0.38 J	< 1	ND
A1-PZ-17	LEPA	Jun-03	0.43 J	< 1	0.23 J
A1-PZ-17	LEPA	Sep-03	0.43 J	< 1	0.31 J
A1-PZ-17	LEPA	Jan-04	0.36 J	< 1	0.35 J
A1-PZ-17	LEPA	Mar-04	0.22 J	< 1	0.18 J
A1-PZ-17	LEPA	Jun-04	0.37 J	< 1	0.28 J
A1-PZ-17	LEPA	Sep-04	1.3	< 1	1
A1-PZ-17	LEPA	Jan-05	0.75 J	< 1	0.88 J
A1-PZ-17	LEPA	Mar-05	0.93 J	< 1	0.76 J
A1-PZ-17	LEPA	Jun-05	0.62 J	< 1	0.73
A1-PZ-18	LEPA	Mar-03	3.3	0.24 J	3.1
A1-PZ-18	LEPA	Jun-03	3.2	0.22 J	2.5
A1-PZ-18	LEPA	Sep-03	4.1	0.31 J	3.8
A1-PZ-18	LEPA	Jan-04	3.1	0.27 J	3.9
A1-PZ-18	LEPA	Mar-04	3.1	0.21 J	3.4
A1-PZ-18	LEPA	Jun-04	3.5	< 1	2.5
A1-PZ-18	LEPA	Sep-04	2.5	0.22 J	2.9
A1-PZ-18	LEPA	Jan-05	1.6	< 1	2.2
A1-PZ-18 DUP	LEPA	Jan-05	1.5	< 1	2.3
A1-PZ-18	LEPA	Mar-05	2.1	< 1	2.2
A1-PZ-18	LEPA	Jun-05	1.6	< 1	2.0
A1-PZ-24	LEPA	Mar-03	2	< 1	1.3
A1-PZ-24	LEPA	Jun-03	2	< 1	1.2
A1-PZ-24	LEPA	Jan-04	1.9	< 1	1.8

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-PZ-24	LEPA	Mar-04	1.8	0.18 J	1.7
A1-PZ-24	LEPA	Jun-04	1.7	0.20 J	1.3
A1-PZ-24	LEPA	Sep-04	0.79 J	< 1	0.75 J
A1-PZ-24	LEPA	Jan-05	0.64 J	< 1	0.79 J
A1-PZ-24	LEPA	Mar-05	0.99 J	< 1	0.88 J
A1-PZ-24	LEPA	Jun-05	0.92 J	< 1	1.0
A1-PZ-26	LEPA	Sep-03	< 1	< 1	< 1
A1-PZ-26	LEPA	Dec-03	< 1	< 1	< 1
A1-PZ-26	LEPA	Jun-04	< 1	< 1	< 1
A1-PZ-26	LEPA	Sep-04	< 1	< 1	< 1
A1-PZ-26	LEPA	Jan-05	< 1	< 1	< 1
A1-PZ-26	LEPA	Mar-05	< 1	< 1	< 1
A1-PZ-26	LEPA	Jun-05	< 1	< 1	< 1
A1-MW-06	LEPA	Sep-03	0.44 J	< 1	< 1
A1-MW-06	LEPA	Jan-04	0.37 J	< 1	< 1
A1-MW-06	LEPA	Mar-04	0.42 J	< 1	< 1
A1-MW-06	LEPA	Jun-04	0.47 J	< 1	< 1
A1-MW-06	LEPA	Sep-04	0.23 J	< 1	< 1
A1-MW-06	LEPA	Jan-05	< 1	< 1	< 1
A1-MW-06	LEPA	Mar-05	< 1	< 1	< 1
A1-MW-06	LEPA	Jun-05	< 1	< 1	< 1
A1-PZ-28	LEPA	Jun-03	0.88 J	< 1	0.75 J
A1-PZ-28	LEPA	Sep-03	1.5 J	< 1	0.9 J
A1-PZ-28	LEPA	Dec-03	1.4 J	< 1	1.3
A1-PZ-28	LEPA	Jun-04	1.6	< 1	0.74 J
A1-PZ-28	LEPA	Sep-04	1.2	< 1	0.8 J
A1-PZ-28	LEPA	Dec-04	1.6	< 1	0.95 J
A1-PZ-28	LEPA	Mar-05	1.6	< 1	0.83 J
A1-PZ-28	LEPA	Jun-05	1.9	< 1	1.4
A1-MW-31	Area 1	Jun-03	1.8	< 1	1
A1-MW-31	Area 1	Dec-03	2.8	< 1	2
A1-MW-31	Area 1	Jun-04	2.5	< 1	1.5
A1-MW-31	Area 1	Dec-04	1.2	< 1	0.98 J
A1-MW-31	Area 1	Jun-04	1.3	< 1	1.6
A1-MW-33	Area 1	Jun-03	0.77 J	< 1	0.93 J
A1-MW-33	Area 1	Jan-04	0.95 J	< 1	1.2
A1-MW-33	Area 1	Jun-04	1.3	< 1	1.1
A1-MW-33	Area 1	Dec-04	0.49 J	< 1	0.79 J
A1-MW-33	Area 1	Jun-05	0.52 J	< 1	0.43 J
A1-MW-42	Area 1	Jun-03	2.9	0.37 J	3
A1-MW-42	Area 1	Dec-03	1	0.21 J	1.6
A1-MW-42	Area 1	Jun-04	1.5	0.19 J	1.9
A1-MW-42	Area 1	Dec-04	1.1	0.19 J	1.5
A1-MW-42	Area 1	Jun-05	1.4	0.2 J	1.7
A1-MW-43	Area 1	Jun-03	2.3	0.27 J	3.2
A1-MW-43	Area 1	Dec-03	0.77 J	< 1	1.1
A1-MW-43	Area 1	Jun-04	2.4	< 1	2.2
A1-MW-43	Area 1	Dec-04	1.5	0.24 J	2
A1-MW-43	Area 1	Jun-05	1.0	0.22 J	1.4

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

Well ID Number	Well Location	Date Sampled	Contaminants of Concern (MCL)		
			1,1-DCE (7 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
A1-MW-44	LEPA	Jun-03	2.5	0.36 J	2.5
A1-MW-44	LEPA	Dec-03	2	0.38 J	2.2
A1-MW-44	LEPA	Jun-04	4	0.50 J	2.8
A1-MW-44	LEPA	Dec-04	2.1	0.33 J	2.2
A1-MW-44 DUP	LEPA	Dec-04	2.0	0.31 J	2.0
A1-MW-44	LEPA	Jun-05	1.8	0.33 J	2.1
A1-PZ-09	LEPA	Jun-03	1.8	< 1	0.73 J
A1-PZ-09 DUP	LEPA	Jun-03	1.7	< 1	0.65 J
A1-PZ-09	LEPA	Jan-04	1.2	< 1	0.67 J
A1-PZ-09	LEPA	Jun-04	1.3	< 1	0.56 J
A1-PZ-09	LEPA	Jan-05	0.55 J	< 1	0.42 J
A1-PZ-09	LEPA	Jun-05	2.3	< 1	2.5
A1-PZ-09 DUP	LEPA	Jun-05	2.4	< 1	2.6
A1-PZ-20	LEPA	Jun-03	1.9	< 1	0.76 J
A1-PZ-20	LEPA	Jan-04	1.6	< 1	1
A1-PZ-20	LEPA	Jun-04	1.6	< 1	0.91 J
A1-PZ-20	LEPA	Jan-05	0.53 J	< 1	0.63 J
A1-PZ-20	LEPA	Jun-05	0.8 J	< 1	0.85 J
A1-PZ-21	LEPA	Jun-03	1.3	< 1	0.49 J
A1-PZ-21	LEPA	Sep-03	1.1	< 1	0.73 J
A1-PZ-21	LEPA	Jan-04	0.2 J	< 1	0.23 J
A1-PZ-21	LEPA	Jun-04	0.38 J	< 1	0.35 J
A1-PZ-21	LEPA	Jan-05	< 1	< 1	0.24 J
A1-PZ-21	LEPA	Jun-05	0.19 J	< 1	0.37 J
A1-PZ-22	LEPA	Jun-03	2.2	< 1	1 J
A1-PZ-22	LEPA	Jan-04	2.4	< 1	1.4
A1-PZ-22 DUP	LEPA	Jan-04	2.1	< 1	1.1
A1-PZ-22	LEPA	Jun-04	2.3	< 1	1.1
A1-PZ-22	LEPA	Jan-05	0.71 J	< 1	0.74 J
A1-PZ-22	LEPA	Jun-05	1.1	< 1	0.99 J
A1-PZ-23	LEPA	Jun-03	2.1	< 1	0.9 J
A1-PZ-23	LEPA	Jan-04	1.8	< 1	1
A1-PZ-23	LEPA	Jun-04	2.2	< 1	1
A1-PZ-23	LEPA	Dec-04	1.3	< 1	0.83 J
A1-PZ-23	LEPA	Jun-05	1.1	< 1	0.77 J
A1-PZ-23 DUP	LEPA	Jun-05	1.1	< 1	0.82 J
A1-MW-27	LEPA	Jan-04	[redacted]	0.80 J	[redacted]
A1-MW-27 DUP	LEPA	Jan-04	[redacted]	0.74 J	[redacted]
A1-MW-27	LEPA	Dec-04	[redacted]	0.61 J	[redacted]
A1-MW-28	LEPA	Jan-04	0.77 J	< 1	0.74 J
A1-MW-28	LEPA	Dec-04	0.57 J	< 1	0.52 J
A1-MW-29A	LEPA	Jan-04	1.7	< 1	1.7
A1-MW-29A	LEPA	Dec-04	2.1	< 1	2.6
A1-MW-30	LEPA	Jan-04	< 1	< 1	< 1
A1-MW-30	LEPA	Dec-04	< 1	< 1	< 1
A1-MW-32	LEPA	Jun-03	4	0.44 J	3.9
A1-MW-34	LEPA	Jun-03	4.8	0.51 J	4.1
A1-MW-41	LEPA	Jun-03	3	0.35 J	4.1

J: estimated value, below detection limit.

Table 1. 1,1-DCE, PCE, and TCE Concentrations (Continued)

ND: not detected.
MCL: maximum contaminant level.
Shaded cells: concentration above MCL.

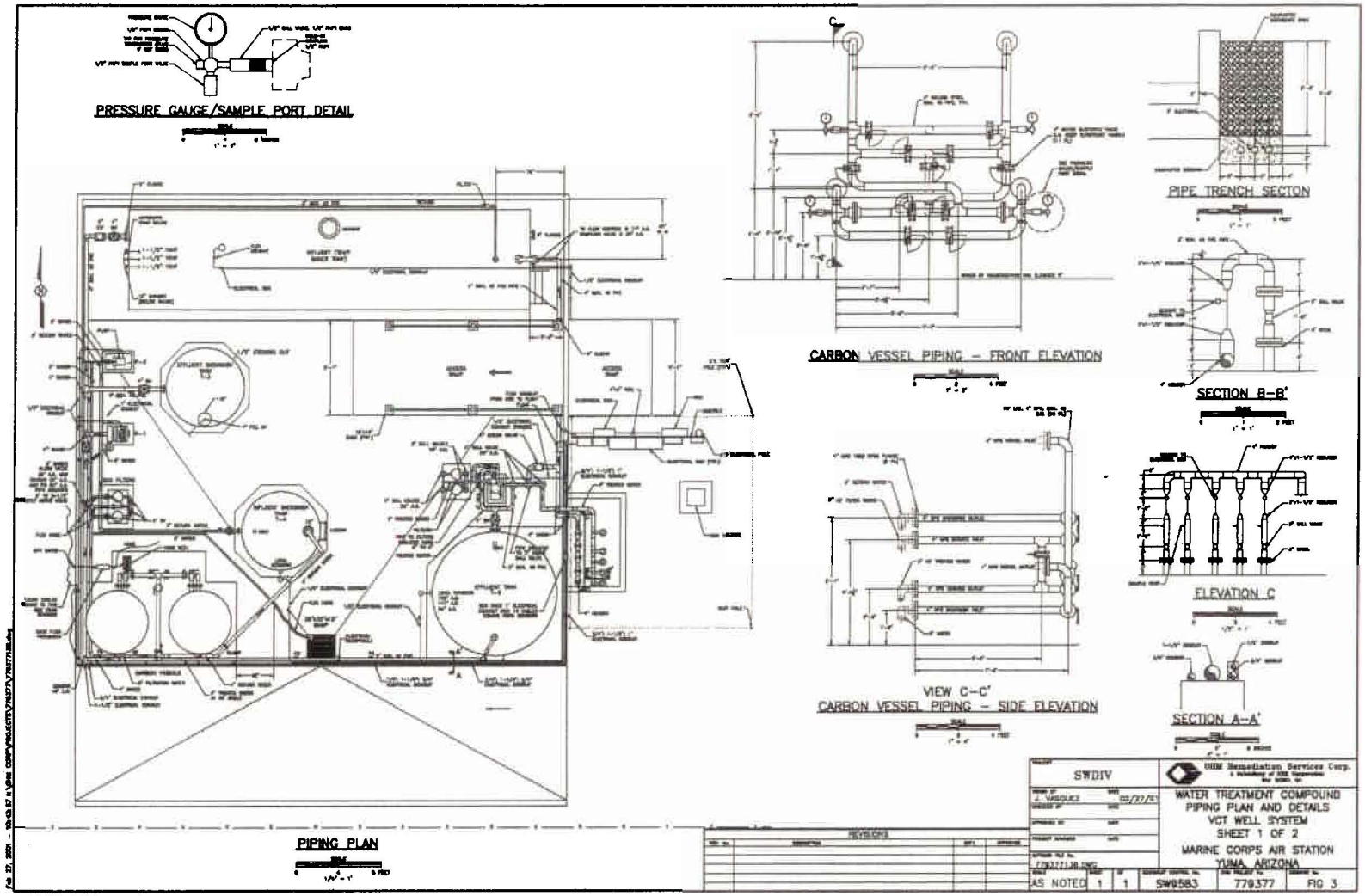


Figure 1. VCT System Schematic

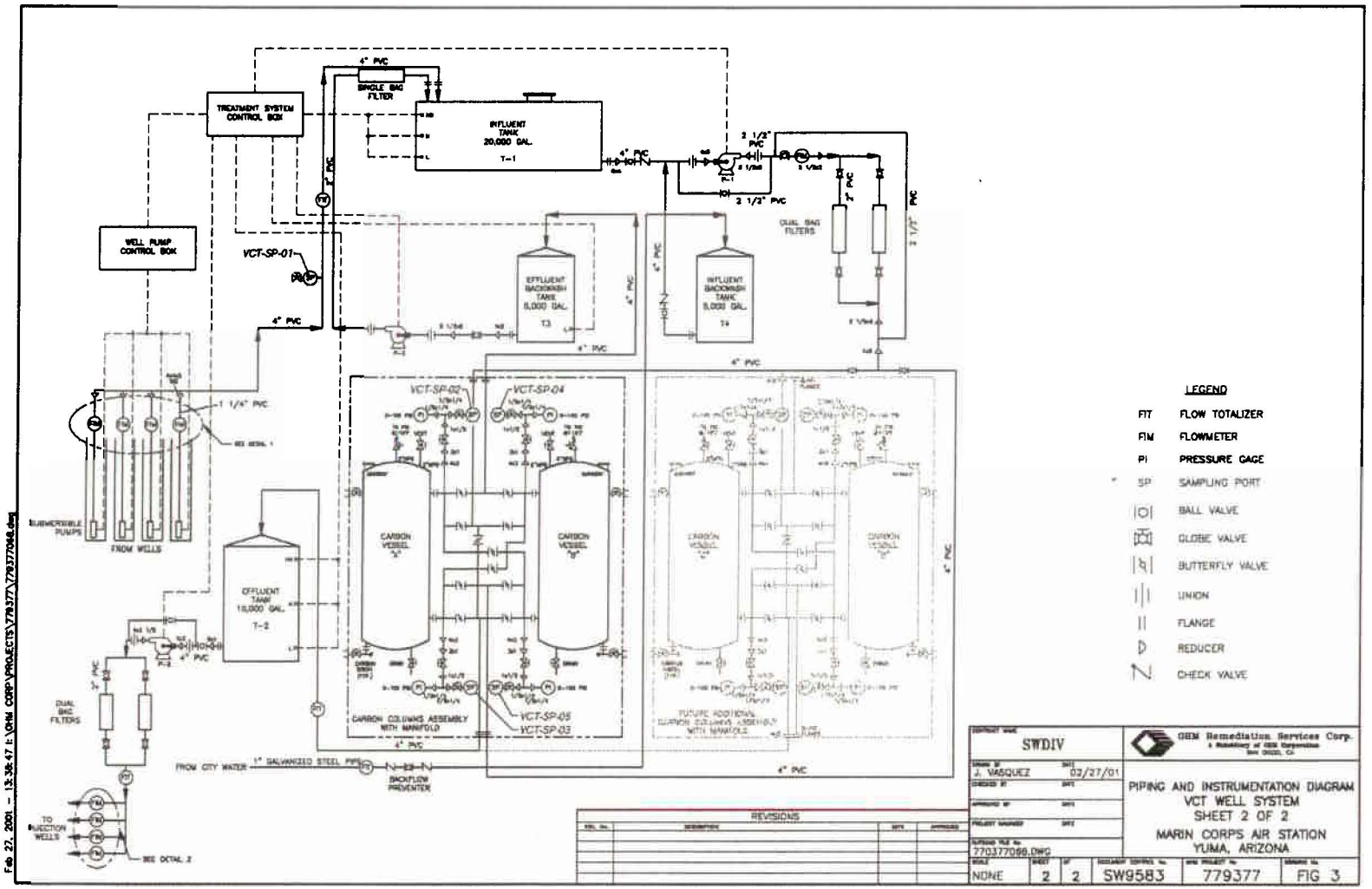


Figure 2. VCT System Piping and Instrumentation Diagram

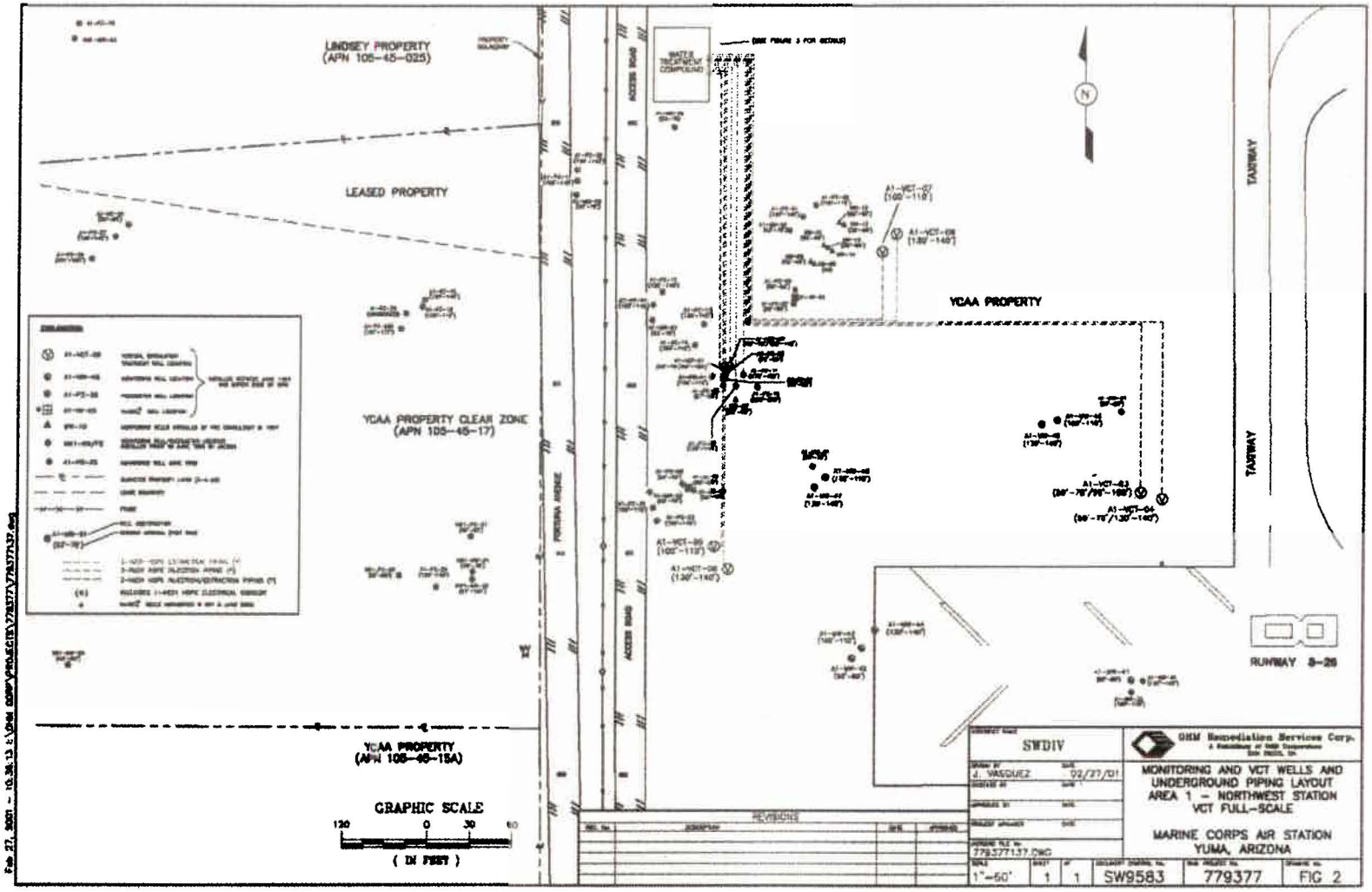


Figure 3. VCT Injection and Extraction Well Locations

B7 – PUBLIC NOTICE

AFFP
Marine Corps Air Station (MCAS

Affidavit of Publication

STATE OF ARIZONA }
COUNTY OF YUMA } SS

Lisa Reilly or Kelsey Bistodeau, being duly sworn, says:

That she is Publisher or Business Manager of the Yuma Sun, a daily newspaper of general circulation, printed and published in Yuma, Yuma County, Arizona; that the publication, a copy of which is attached hereto, was published in the said newspaper on the following dates:

March 23, 2018, March 24, 2018, March 25, 2018

That said newspaper was regularly issued and circulated on those dates.
SIGNED:

Kelsey Bistodeau

Publisher or Business Manager

Subscribed to and sworn to me this 25th day of March 2018.

Virgen P. Perez

Virgen P Perez, Notary, Yuma County, Arizona

My commission expires: May 10, 2021

VIRGEN P PEREZ
NOTARY PUBLIC, ARIZONA
YUMA COUNTY
My Commission Expires
May 10, 2021

00025542 00144875 6144580517

Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

PUBLIC NOTICE
CERCLA FIVE-YEAR REVIEW BEGUN FOR OPERABLE UNIT 1, GROUNDWATER CLEANUP, OPERABLE UNIT 2, SURFACE SOIL, AND MUNITIONS RESPONSE PROGRAM SITES 4 AND 6 MARINE CORPS AIR STATION YUMA, ARIZONA

Marine Corps Air Station (MCAS) Yuma has begun a five-year review of environmental cleanup actions (remedies) taken under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the MCAS Yuma Environmental Restoration Program to protect human health and the environment. CERCLA requires a review every five years for remedies that leave any contaminants within a cleanup site above levels allowing unrestricted use. The five-year review will look at the remedies for two CERCLA Operable Units (OUs) and two Munitions Response Program (MRP) sites at MCAS Yuma. The OU-1 remedy includes active remediation and monitoring to clean up groundwater that has been affected by the release of chlorinated solvents from historical base operations. The OU-2 remedy restricts and controls the use of two MCAS industrial areas and an inactive landfill due to contaminants in surface soil. The remedies for MRP Sites 4 and 6 restrict and control the site use. These remedies were selected in agreement with the U.S. Environmental Protection Agency and State regulatory agency, and based upon comments from the public. This review seeks to confirm that the remedies continue to protect human health and the environment.

The U.S. Environmental Protection Agency (EPA) signed the Record of Decision (ROD) for the OU-2 remedies on 2 December 1997, and the OU-1 ROD on 5 October 2000. The first five-year review for OU-2 was completed in December 2002, five years after the signing of the ROD. The first review for OU-1 was completed in November 2004, five years after the remedies discussed in the ROD were in place. The second scheduled review date for OU-2 (December 2007) was moved up to November 2004 so that both OUs would be on the same five-year cycle. The third review for OU-2 and the second five year-review for OU-1 was finalized in June 2010. The fourth review for OU-2 and the third review for OU-1 was completed in June 2015. The ROD for MRP Sites 4 and 6 was signed 25 May 2017 and this will be the first review for the MRP sites.

This review will not reconsider the remedies agreed upon in these RODs. It will re-evaluate each remedy's performance and recommend improvements if the remedy is not performing as designed.

FOR MORE INFORMATION
The report's findings will be provided to the public when it is completed. The full report will also be available at the Yuma County Public Library at the below address. Citizens with questions about the CERCLA Five-Year Review may contact Mr. Lee Saunders with the below contact information.

Yuma County Public Library
350 South Third Avenue
Yuma, AZ 85364
(928) 782-1871

Mr. Lee Saunders
Public Affairs Officer
NAVFAC Southwest
1220 Pacific Highway
San Diego, CA 92132
(619) 532-3100
lee.saunders@navy.mil

Daily March 23, 24, 25, 2018 - 00144875

APPENDIX C:
SITE INSPECTION CHECKLISTS AND ASSOCIATED DOCUMENTATION

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma MRP Site 4	**Date of inspection**: 09 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~90ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:

☐ O&M Manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built Drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance Logs	☐ Readily available	☐ Up to date	☒ N/A

2. **Plans**:

☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☒ Readily available	☒ Up to date	☐ N/A

3. **Training**:

☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A

4. **Records:**

☐ Groundwater Monitoring	☐ Readily available	☐ Up to date	☒ N/A

☐ Discharge Compliance				
☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	

IV. O&M COSTS

1. O&M Organization
   - ☐ State in-house
   - ☐ PRP in-house
   - ☐ Federal Facility in-house
   - ☐ Other:
   - ☐ Contractor for State
   - ☐ Contractor for PRP
   - ☒ Contractor for Federal Facility

2. O&M Costs
   - ☐ Readily Available — ☐ Up to date
   - ☐ Funding mechanism/agreement in place — ☐ Up to date
   - Original O&M cost estimate: $8,000 per year (2013 dollars) — ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☒ No

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
2. Gate(s) damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
3. Gate(s) secured?	☒ Yes ☐ No	☐ Location shown on site map	☐ N/A	

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures — ☐ Location shown on site map ☐ N/A

   Remarks: Signs identify the environmental site

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring: Physical Inspection and Site Walk
Frequency: Quarterly
Responsible party/agency: MCAS Yuma Environmental Department and O&M Contractor
Contact

Name	Title	Date

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A
Other problems or suggestions:	☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism/trespassing evident
2. Land use changes on-site ☐ Applicable ☒ N/A

3. Land use changes off-site	☐ Applicable	☒ N/A		
VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)				
A. Roads				
1. Roads damaged?	☐ Yes ☒ No	☒ Location shown on site map	☐ N/A	
2. Roads adequate for the site?	☒ Yes ☐ No	☒ Location shown on site map	☐ N/A	
B. Other Site Conditions	☒ N/A			
VII. LANDFILL COVERS				
☐ Applicable	☒ N/A			
VIII. VERTICAL BARRIER WALLS				
☐ Applicable	☒ N/A			
IX. GROUNDWATER/SURFACE WATER REMEDIES				
☐ Applicable	☒ N/A			
X. OVERALL OBSERVATIONS				
A. Implementation of the Remedy				
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). ICs are in place to minimize exposure to munitions constituents in subsurface soils. The site is within the active flight line area and unlimited use/unrestricted exposure is effectively mitigated by secured fencing.				
B. Adequacy of O&M				
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. LUC inspections are performed routinely to confirm ICs are being met. These inspections are adequate for the remedy.				
C. Early Indicators of Potential Remedy Problems				
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues found.				
D. Opportunities for Optimization				
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The current activities of LUC inspections are adequate for the remedy.				

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma MRP Site 6	**Date of inspection**: 09 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~85ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:

☐ O&M Manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built Drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance Logs	☐ Readily available	☐ Up to date	☒ N/A

2. **Plans**:

☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☒ Readily available	☒ Up to date	☐ N/A

3. **Training**:

☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A

4. **Records:**

☐ Groundwater Monitoring	☐ Readily available	☐ Up to date	☒ N/A

☐ Discharge Compliance				
☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	

IV. O&M COSTS

1. O&M Organization
   - ☐ State in-house
   - ☐ PRP in-house
   - ☐ Federal Facility in-house
   - ☐ Other:
   - ☐ Contractor for State
   - ☐ Contractor for PRP
   - ☒ Contractor for Federal Facility

2. O&M Costs
   - ☐ Readily Available — ☐ Up to date
   - ☐ Funding mechanism/agreement in place — ☐ Up to date
   - Original O&M cost estimate: $8,000 per year (2013 dollars) — ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☒ No

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
2. Gate(s) damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
3. Gate(s) secured?	☒ Yes ☐ No	☐ Location shown on site map	☐ N/A	

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures — ☐ Location shown on site map ☐ N/A

   Remarks: Signs identify the environmental site

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring: Physical Inspection and Site Walk
Frequency: Quarterly
Responsible party/agency: MCAS Yuma Environmental Department and O&M Contractor
Contact

Name	Title	Date

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A
Other problems or suggestions:	☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing	☐ Location shown on site map	☒ No vandalism/trespassing evident	
2. Land use changes on-site	☐ Applicable	☒ N/A	

3. Land use changes off-site	☐ Applicable ☒ N/A
VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)	
A. Roads	
1. Roads damaged?	☐ Yes ☒ No ☒ Location shown on site map ☐ N/A
2. Roads adequate for the site?	☒ Yes ☐ No ☒ Location shown on site map ☐ N/A
B. Other Site Conditions	☒ N/A
VII. LANDFILL COVERS	
	☐ Applicable ☒ N/A
VIII. VERTICAL BARRIER WALLS	
	☐ Applicable ☒ N/A
IX. GROUNDWATER/SURFACE WATER REMEDIES	
	☐ Applicable ☒ N/A
X. OVERALL OBSERVATIONS	
A. Implementation of the Remedy	
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). ICs are in place to prevent exposure to subsurface materials beneath the concrete cover and 3 feet of clean fill. No apparent disruptions to the concrete parking apron were observed.	
B. Adequacy of O&M	
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. LUC inspections are performed to confirm concrete cover and ICs are maintained. These inspections are adequate for the remedy.	
C. Early Indicators of Potential Remedy Problems	
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues found.	
D. Opportunities for Optimization	
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The current activities of LUC inspections are adequate for the remedy.	

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma OU-1, Area 1	**Date of inspection**: 10 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~85ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☒ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:			
☒ O&M Manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built Drawings	☒ Readily available	☒ Up to date	☐ N/A
☒ Maintenance Logs	☒ Readily available	☒ Up to date	☐ N/A
2. **Plans**:			
☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☐ Readily available	☒ Up to date	☐ N/A
3. **Training**:			
☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A
4. **Records:**			
☒ Groundwater Monitoring	☒ Readily available	☒ Up to date	☐ N/A

☐ Discharge Compliance			
☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A

IV. O&M COSTS

1. O&M Organization

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other:

2. O&M Costs

☐ Readily Available ☐ Up to date
☒ Funding mechanism/agreement in place ☐ Up to date
Original O&M cost estimate: $370,000 annually ☐ Breakdown attached

Total annual costs by year for review period if available

From:	Enter Date	To:	Enter Date	Enter Cost	☐ Breakdown attached
	Date		Date	Total Cost	
From:	Enter Date	To:	Enter Date	Enter Cost	☐ Breakdown attached
	Date		Date	Total Cost	
From:	Enter Date	To:	Enter Date	Enter Cost	☐ Breakdown attached
	Date		Date	Total Cost	
From:	Enter Date	To:	Enter Date	Enter Cost	☐ Breakdown attached
	Date		Date	Total Cost	
From:	Enter Date	To:	Enter Date	Enter Cost	☐ Breakdown attached
	Date		Date	Total Cost	

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☐ No

Describe unusual costs: Click here to enter text.

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes	☒ No	☐ Location shown on site map	☐ N/A
2. Gate(s) damaged?	☐ Yes	☒ No	☐ Location shown on site map	☐ N/A
3. Gate(s) secured?	☒ Yes	☐ No	☐ Location shown on site map	☐ N/A

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures ☐ Location shown on site map ☐ N/A

Remarks: Signs identify the airfield as a restricted area.

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced	☒ Yes	☐ No	☐ N/A
Type of monitoring	Physical Inspection and Site Walk		
Frequency	Quarterly		
Responsible party/agency	MCAS Yuma Environmental Department and O&M Contractor		
Contact			
Name	Title	Date	
Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A
Other problems or suggestions:	☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism/trespassing evident
2. Land use changes on-site ☐ Applicable ☒ N/A
3. Land use changes off-site ☐ Applicable ☒ N/A

VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)

A. Roads

1. Roads damaged? ☐ Yes ☒ No ☒ Location shown on site map ☐ N/A
2. Roads adequate for the site? ☒ Yes ☐ No ☒ Location shown on site map ☐ N/A

B. Other Site Conditions ☒ N/A

VII. LANDFILL COVERS

☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS

☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES

☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. Pumps, Wellhead Plumbing, and Electrical

☐ Good condition ☒ All required wells functioning properly ☐ Maintenance Required ☐ N/A

Remarks: VCT system is operational and functioning as intended. AS/SVE system is in temporary shutdown status and will require rehabilitation if additional operation is needed.

2. Extraction System Pipelines, Valves, and Other Appurtenances

☒ Good condition ☐ Maintenance Required ☐ N/A

3. Spare Parts and Equipment

☐ Readily Available ☐ Good Condition ☐ Upgrades Required ☐ Needs to be provided ☒ N/A

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. Treatment Train (Check applicable components)

☐ Metals Removal ☐ Oil/Water Separation ☐ Bioremediation
☐ Air Stripping ☒ Carbon Adsorbers
☐ Filters:
☐ Additive (e.g., chelation agent, flocculent, etc.):
☐ Others:
☒ Good Condition ☐ Maintenance Required
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up-to-date
☒ Equipment properly identified

2. Electrical Enclosures and Panels ☒ Properly rated and functional ☐ N/A

☒ Good condition ☐ Maintenance Required

3. Tanks, Vaults, Storage Vessels ☐ N/A

☒ Good Condition ☐ Maintenance Required ☒ Proper secondary containment

4. Discharge Structure and Appurtenances ☐ N/A

☒ Good condition ☐ Maintenance Required ☐ N/A

5. Treatment Building(s) ☐ N/A

☒ Good condition ☐ Maintenance Required ☒ Chemicals and equipment properly stored

6. Monitoring Wells (Pump and Treatment Remedy)

☒ Properly Secured/Locked ☒ All Required Wells Located ☒ Routinely Sampled
☒ Good Condition ☐ Maintenance Required ☐ N/A

D. Monitored Natural Attenuation ☒ Applicable ☐ N/A

1. Monitoring Wells (Natural Attenuation Remedy)

☒ Properly Secured/Locked ☒ All Required Wells Located ☒ Routinely Sampled
☒ Good Condition ☐ Maintenance Required ☐ N/A

E. Monitoring Data ☒ Applicable ☐ N/A

1. Monitoring data quality:

Routinely submitted on time? ☒ Yes ☐ No
Is of acceptable quality? ☒ Yes ☐ No

2. Monitoring data suggests:

Groundwater plume is effectively contained? ☒ Yes ☐ No
Contaminant concentrations are declining? ☒ Yes ☐ No

Remarks: RAOs are being met for the ROD COCs. Emerging Contaminants (1,4-dioxane and PFAS) require further evaluation.

X. OVERALL OBSERVATIONS

A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The VCT system has prevented off-base migration of ROD COCs at concentrations exceeding MCLs. The AS/SVE system has treated the ROD COCs in the Hot Spot area. Natural attenuation has reduced the concentrations of ROD COCs throughout the plume area.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. Treatment systems may require optimization to treat emerging contaminants (e.g., 1,4-dioxane and PFAS).
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. None identified
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Treatment systems may require optimization to treat emerging contaminants (e.g., 1,4-dioxane and PFAS).

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma OU-2, CAOC 1	**Date of inspection**: 09 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~90ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:			
☐ O&M Manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built Drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance Logs	☐ Readily available	☐ Up to date	☒ N/A
2. **Plans**:			
☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☒ Readily available	☒ Up to date	☐ N/A
3. **Training**:			
☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A
4. **Records:**			
☐ Groundwater Monitoring	☐ Readily available	☐ Up to date	☒ N/A

☐ Discharge Compliance				
☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	

IV. O&M COSTS

1. O&M Organization
   - ☐ State in-house
   - ☐ PRP in-house
   - ☐ Federal Facility in-house
   - ☐ Other:
   - ☐ Contractor for State
   - ☐ Contractor for PRP
   - ☒ Contractor for Federal Facility

2. O&M Costs
   - ☐ Readily Available — ☐ Up to date
   - ☐ Funding mechanism/agreement in place — ☐ Up to date
   - Original O&M cost estimate: None specified in the ROD — ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☒ No

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
2. Gate(s) damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
3. Gate(s) secured?	☒ Yes ☐ No	☐ Location shown on site map	☐ N/A	

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures ☐ Location shown on site map ☐ N/A

   Remarks: Signs identify the airfield as a restricted area.

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring: Physical Inspection and Site Walk
Frequency: Quarterly
Responsible party/agency: MCAS Yuma Environmental Department and O&M Contractor
Contact

Name	Title	Date

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A
Other problems or suggestions:	☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing	☐ Location shown on site map	☒ No vandalism/trespassing evident	
2. Land use changes on-site	☐ Applicable	☒ N/A	

3. Land use changes off-site	☐ Applicable	☒ N/A		
VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)				
A. Roads				
1. Roads damaged?	☐ Yes ☒ No	☒ Location shown on site map	☐ N/A	
2. Roads adequate for the site?	☒ Yes ☐ No	☒ Location shown on site map	☐ N/A	
B. Other Site Conditions	☒ N/A			
VII. LANDFILL COVERS				
☐ Applicable	☒ N/A			
VIII. VERTICAL BARRIER WALLS				
☐ Applicable	☒ N/A			
IX. GROUNDWATER/SURFACE WATER REMEDIES				
☐ Applicable	☒ N/A			
X. OVERALL OBSERVATIONS				
A. Implementation of the Remedy				
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). ICs are in place to maintain industrial/commercial land use. The site is within the active flight line area and unlimited use/unrestricted exposure is effectively mitigated by secured fencing. The LUCIP and Base Master Plan support the IC requirements of the ROD.				
B. Adequacy of O&M				
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. LUC inspections are performed routinely to confirm ICs are being met. These inspections are adequate for the remedy.				
C. Early Indicators of Potential Remedy Problems				
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues found.				
D. Opportunities for Optimization				
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The current activities of LUC inspections are adequate for the remedy.				

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma OU-2, CAOC 8A	**Date of inspection**: 09 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~90ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:			
☐ O&M Manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built Drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance Logs	☐ Readily available	☐ Up to date	☒ N/A
2. **Plans**:			
☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☒ Readily available	☒ Up to date	☐ N/A
3. **Training**:			
☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A
4. **Records:**			
☐ Groundwater Monitoring	☐ Readily available	☐ Up to date	☒ N/A

☐ Discharge Compliance				
☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	

IV. O&M COSTS

1. O&M Organization

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other:

2. O&M Costs

☐ Readily Available ☐ Up to date
☐ Funding mechanism/agreement in place ☐ Up to date
Original O&M cost estimate: None specified in the ROD ☐ Breakdown attached

Total annual costs by year for review period if available

From:	Enter Date (Date)	To:	Enter Date (Date)	Enter Cost (Total Cost)	☐ Breakdown attached	
From:	Enter Date (Date)	To:	Enter Date (Date)	Enter Cost (Total Cost)	☐ Breakdown attached	
From:	Enter Date (Date)	To:	Enter Date (Date)	Enter Cost (Total Cost)	☐ Breakdown attached	
From:	Enter Date (Date)	To:	Enter Date (Date)	Enter Cost (Total Cost)	☐ Breakdown attached	
From:	Enter Date (Date)	To:	Enter Date (Date)	Enter Cost (Total Cost)	☐ Breakdown attached	

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☒ No

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
2. Gate(s) damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
3. Gate(s) secured?	☒ Yes ☐ No	☐ Location shown on site map	☐ N/A	

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures ☐ Location shown on site map ☐ N/A

Remarks: Signs identify the environmental site. A few signs are faded with no discernible information available.

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented		☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced		☐ Yes	☒ No	☐ N/A
Type of monitoring	Physical Inspection and Site Walk			
Frequency	Quarterly			
Responsible party/agency	MCAS Yuma Environmental Department and O&M Contractor			
Contact	Name	Title	Date	
Reporting is up-to-date		☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency		☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met		☒ Yes	☐ No	☐ N/A
Violations have been reported		☐ Yes	☒ No	☐ N/A
Other problems or suggestions:		☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism/trespassing evident
2. Land use changes on-site ☐ Applicable ☒ N/A
3. Land use changes off-site ☐ Applicable ☒ N/A

VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)

A. Roads

1. Roads damaged? ☐ Yes ☒ No ☒ Location shown on site map ☐ N/A
2. Roads adequate for the site? ☒ Yes ☐ No ☒ Location shown on site map ☐ N/A

B. Other Site Conditions ☒ N/A

VII. LANDFILL COVERS

☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS

☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES

☐ Applicable ☒ N/A

X. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
ICs are in place to prevent exposure to landfill materials. The site is secured by a perimeter fence with signage.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
LUC inspections are performed routinely to confirm ICs are being met. These inspections are adequate for the remedy. A few signs are faded and information is not discernible. Damaged/illegible signs should be replaced.

C. Early Indicators of Potential Remedy Problems
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues found.
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The current activities of LUC inspections are adequate for the remedy.

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: MCAS Yuma OU-2 CAOC 10	**Date of inspection**: 09 May 2018
Location and Region: MCAS Yuma, Yuma County, AZ	**EPAID**: AZ0971590062 (MCAS Yuma)
Agency, office, or company leading the five-year review: Naval Facilities Engineering Command Southwest	**Weather/temperature**: Clear skies, warm temperature ~90ºF

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **MCAS Yuma Environmental Department**

David Rodriguez	Environmental Director	09 May 2018
Name	Title	Date

Meeting: ☐ at site. ☒ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

2. **MCAS Yuma Environmental Department**

Joseph Britain	Environmental Engineer	09 May 2018
Name	Title	Date

Meeting: ☒ at site. ☐ at office. ☐ by phone/email.

Site status, adjacent activities, problems, suggestions: ☒ Report attached

See interview form

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**:			
☐ O&M Manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built Drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance Logs	☐ Readily available	☐ Up to date	☒ N/A
2. **Plans**:			
☒ Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	☐ N/A
☒ Contingency Plan/Emergency Response Plan	☒ Readily available	☒ Up to date	☐ N/A
3. **Training**:			
☒ O&M and OSHA Training Records	☒ Readily available	☒ Up to date	☐ N/A
4. **Records:**			
☐ Groundwater Monitoring	☐ Readily available	☐ Up to date	☒ N/A

☐ Discharge Compliance				
☐ Air	☐ Readily available	☐ Up to date	☒ N/A	
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A	

IV. O&M COSTS

1. O&M Organization
   - ☐ State in-house
   - ☐ PRP in-house
   - ☐ Federal Facility in-house
   - ☐ Other:
   - ☐ Contractor for State
   - ☐ Contractor for PRP
   - ☒ Contractor for Federal Facility

2. O&M Costs
   - ☐ Readily Available — ☐ Up to date
   - ☐ Funding mechanism/agreement in place — ☐ Up to date
   - Original O&M cost estimate: None specified in the ROD — ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period ☐ Yes ☒ No

V. ACCESS AND INSTITUTIONAL CONTROLS (reduced to potentially applicable elements)

A. Fencing and Gates

1. Fencing damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
2. Gate(s) damaged?	☐ Yes ☒ No	☐ Location shown on site map	☐ N/A	
3. Gate(s) secured?	☒ Yes ☐ No	☐ Location shown on site map	☐ N/A	

Remarks: Access gates are electronically controlled for airfield security purposes.

B. Other Access Restrictions

1. Signs and other security measures ☐ Location shown on site map ☐ N/A

   Remarks: Signs identify the environmental site.

C. Institutional Controls (ICs)

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs are not being fully enforced	☐ Yes	☒ No	☐ N/A

Type of monitoring: Physical Inspection and Site Walk
Frequency: Quarterly
Responsible party/agency: MCAS Yuma Environmental Department and O&M Contractor
Contact

Name	Title	Date

Reporting is up-to-date	☒ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	☒ Yes	☐ No	☐ N/A
Specific requirements in the applicable Record of Decision, Decision Document or Deed have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☒ No	☐ N/A
Other problems or suggestions:	☐ Report Attached		

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism/trespassing evident
2. Land use changes on-site ☐ Applicable ☒ N/A

3. Land use changes off-site	☐ Applicable	☒ N/A		
VI. GENERAL SITE CONDITIONS (APPLICABLE TO ALL CAOCs)				
A. Roads				
1. Roads damaged?	☐ Yes ☒ No	☒ Location shown on site map	☐ N/A	
2. Roads adequate for the site?	☒ Yes ☐ No	☒ Location shown on site map	☐ N/A	
B. Other Site Conditions	☒ N/A			
VII. LANDFILL COVERS				
☐ Applicable	☒ N/A			
VIII. VERTICAL BARRIER WALLS				
☐ Applicable	☒ N/A			
IX. GROUNDWATER/SURFACE WATER REMEDIES				
☐ Applicable	☒ N/A			
X. OVERALL OBSERVATIONS				
A. Implementation of the Remedy				
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). ICs are in place to maintain industrial/commercial land use. The LUCIP and Base Master Plan support the IC requirements of the ROD.				
B. Adequacy of O&M				
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. LUC inspections are performed routinely to confirm ICs are being met. These inspections are adequate for the remedy.				
C. Early Indicators of Potential Remedy Problems				
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues found.				
D. Opportunities for Optimization				
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The current activities of LUC inspections are adequate for the remedy.				

APPENDIX D:
INTERVIEW REPORTS

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 1 Interview – Navy and Marine Corps Personnel
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**Angela Patterson**
Title:	**RPM**
Organization:	**NAVFAC SW**
Contact Made by:	**Damon DeYoung**
Method of Interview:	**In-Person**
Date:	**5/9/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munitions Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Superior Familiarity

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2. What is your level of familiarity with implementation of the remedies at these OUs and MRP Sites, and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Superior Familiarity

---

3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

   Response: Review all reports (pre-draft through final version) associated with the remedies. All reports are kept in the Administrative Record at NAVFAC SW. In addition, help the Base in reviewing dig permits or any construction request to ensure the ICs are met at the OUs/Sites.

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4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

- Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

  Response: Effective in treating ROD COCs. Currently, the VCT is removing negligible COC mass. An emerging contaminant (1,4-dioxane) has been detected and is not treated by the VCT. A Pilot Study is underway to evaluate treatment methods for 1,4-dioxane. Ambersorb was tested at the Base boundary. It removes 1,4-dioxane to project action levels and also removes chlorinated VOCs. However, removal of PFAS is not known. During this evaluation period, the VCT has been kept in operation. The PA/SI phase is in process for potential PFAS contamination at the Base. As such, the impact of PFAS is not yet known. It is anticipated for additional pilot study work to be conducted to evaluate approaches for emerging contaminant treatment.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: The AS/SVE system has been effective in treating the ROD COCs. The Navy has requested permanent shutdown of the system, but the regulators requested that the system operation be only temporarily shutdown and the results of the PFAS PA/SI be taken into account before permanent shutdown. In addition, a Pilot Study is underway to evaluate in situ treatment of 1,4-dioxane. Preliminary results indicate that ISCO can reduce 1,4-dioxane (as well as ROD COCs) within a small radius of influence (~5-7 ft). However, secondary impacts to groundwater were noted (hexavalent chromium and bromate levels were elevated). No decisions have been made with respect to treatment approaches for 1,4-dioxane.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: No comments to add on GAC, since the SVE system is in Temporary Shutdown status.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: The groundwater modeling study completed since the last FYR shows that the COCs will attenuate prior to reaching the site boundary. As such, the intent of the ROD has been met for the COCs, and the Navy has met their obligation. However, it is noted that emerging contaminants have been found (1,4-dioxane) and are being investigated (PFAS). While the emerging contaminants do not have MCLs and are not in the ROD, the Navy is performing due diligence to understand the potential impact of the emerging contaminants and working towards addressing these potential concerns. These

emerging contaminants may be added as COCs to the ROD pending the results of the investigations. The modeling study also evaluated whether the 1,4-dioxane plume is co-located with the CVOC plume. At the Hot Spot area, the plumes are co-located. At the VCT, 1,4-dioxane is located in the deep aquifer at a level of acceptable risk to the EPA. Off-base wells are in the process of being located and sampled to see if 1,4-dioxane is present.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: ICs are effective in restricting access throughout the Sites on the Base. For OU1, the Sites are located in the Air Field which is a restricted area. Down gradient and offsite, there isn't a receptor within a mile of the Base.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

  Response: LTM has been conducted quarterly and is transitioning to semi-annually. In each report (semi-annual and annual), the effectiveness of the remedy is evaluated and discussed. In addition, PFAS were added to the LTM on a semi-annual basis. Also, the locations of the current monitoring wells are situated where PFAS releases may have occurred in OU1.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

  Response: The ICP, known as the Land Use Control Implementation Plan (LUCIP) at MCAS Yuma, is very effective in ensuring ICs are adhered to.

- Remediate all contaminated groundwater to MCLs.

Response: All ROD COCs have been actively treated to asymptotic levels and modeling predicts that Monitored Natural Attenuation (MNA) will treat the ROD COCs to MCL levels with in the Site boundaries.

- Terminate system operation.

Response: As noted above, the Hot Spot treatment system is in temporary shutdown. If the system were re-started, the system would need to be retrofitted because the declining groundwater level makes the AS/SVE no longer effective.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

- Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: The LUCIP and Master Plan ensure the ICs are followed.

- Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: Fencing and signage is provided and restricts access. NAVFAC SW understands that the Base has grown and would like to re-open the OU2 ROD to allow using part of the CAOC 8a landfill to support putting in a new gate. The regulators are OK with looking into re-opening the ROD to support the Base's request for a south gate. However, there is a functioning remedy already in place and the DOD policy is that once a remedy is in place and functioning, changes to the remedy are paid by whomever is requesting the change.

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6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

Response: Effective as Site 4 is within the foot print of the Air Field.

- Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: The requirements/procedures are provided in the LUCIP.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: NAVFAC SW understands the responsibilities associated with the restrictions and helps the Base enforce the restrictions.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

  Response: Although the Base Master Plan has not been updated since the signing of the Site 4 ROD, Site 4 overlaps OU2 CAOC 1 where LUCs effectively mitigate changes to the current land use (i.e., active military air field).

- Release of environmental restrictions when the project stakeholders (i.e., Department of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: Not applicable to date.

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

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7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

- Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

  Response: The LUCIP ensures that the Site Approval Request Process is followed. In regards to PFAS, burn pits are located within the footprint of MRP Site 6. If the PA/SI identifies any areas of concern, those areas will be evaluated.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: Site 6 is within the foot print of the Air Field and as such residential use is not allowed.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

  Response: No changes have occurred since the ROD.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

  Response: No excavations have been performed.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: The requirements/procedures are provided in the LUCIP.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: NAVFAC SW understands the responsibilities associated with the restrictions and helps the Base enforce the restrictions.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

  Response: Although the Base Master Plan has not been updated since the signing of the Site 6 ROD, Site 6 overlaps OU2 CAOC 1 where LUCs effectively mitigate changes to the current land use (i.e., active military air field).

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: Not applicable to date.

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8. Are you aware of any violations of the institutional controls established for OU 1, OU 2, MRP Site 4, and/or MRP Site 6 that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater, etc.)?

   Response: No.

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9. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes. The reports are received and reviewed by NAVFAC SW.

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

    Response: Yes.

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11. Do you know of any significant operation and maintenance difficulties with the OU 1 groundwater treatment systems (e.g., Area 1 Hot Spot Air Sparge/Soil Vapor Extraction, Area 1 Leading Edge Plume Area Vertical Recirculation)?

    Response: As noted above, the Hot Spot treatment system is temporarily shutdown. If the system were to be re-started, maintenance would be required. The VCT is in operation and receives regular O&M.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

Response: No community concerns. When public meetings are held, the EPA does not often attend and the state is represented by a contractor.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

Response: No.

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14. To the best of your knowledge since June 2015, have there been any changes in future planned site use that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: No changes to date. But, the Base is actively looking to re-open the OU2 ROD for CAOC 8a to help with updating the remedy for the landfill. Area 10 may have a hanger constructed on it but that is in the preliminary planning phase and would still be industrial use.

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 1 Interview – Navy and Marine Corps Personnel
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**Anna Figueroa**
Title:	**Installation Restoration Program Manager**
Organization:	**MCAS Yuma Environmental Department**
Contact Made by:	**Damon DeYoung**
Method of Interview:	**In-Person**
Date:	**5/9/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munitions Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Above Average Familiarity

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2. What is your level of familiarity with implementation of the remedies at these OUs and MRP Sites, and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Above Average Familiarity

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3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

   Response: Contributes to remedy implementation through ensuring the LUCIP is followed and provides base access to the environmental contractors performing monitoring and maintenance.

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4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

- Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

  Response: Effective for the COCs in the ROD.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: Has been effective for the COCs in the ROD. Currently, the system is shutdown.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: None.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: None.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: ICs are in place and effective.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

  Response: LTM is being done.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event

any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

Response: The LUCIP ensures the Master Plan is used during review of any potential construction.

- Remediate all contaminated groundwater to MCLs.

Response: None.

- Terminate system operation.

Response: None.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

- Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: ICs are in place and effective.

- Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: ICs are in place.

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6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

Response: Site 4 is located on the Air Field. There is no residential use.

- Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

  Response: None.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: None.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: None.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

  Response: None.

- Release of environmental restrictions when the project stakeholders (i.e., Department of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: None.

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

  Response: None.

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7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

   - Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

     Response: None.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: Located on the Air Field. No residential use is allowed.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

  Response: None.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

  Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

  Response: Understood and EOD would be contacted if needed.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: None.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: None.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

  Response: None.

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

Response: None.

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8. Are you aware of any violations of the institutional controls established for OU 1, OU 2, MRP Site 4, and/or MRP Site 6 that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater, etc.)?

Response: No.

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9. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

Response: Yes.

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

Response: Yes.

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11. Do you know of any significant operation and maintenance difficulties with the OU 1 groundwater treatment systems (e.g., Area 1 Hot Spot Air Sparge/Soil Vapor Extraction, Area 1 Leading Edge Plume Area Vertical Recirculation)?

Response: It is known that the Hot Spot treatment is temporarily shutdown and maintenance would be needed in order to turn it back on. The VCT receives routine O&M.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

Response: No concerns known.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

Response: None.

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14. To the best of your knowledge since June 2015, have there been any changes in future planned site use that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: The Base would like to continue exploring how to re-open the OU2 ROD for CAOC 8A so that the landfill can be capped to allow for construction of a road and gate along the southern base boundary.

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 1 Interview – Navy and Marine Corps Personnel
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**David Rodriguez**
Title:	**Environmental Director**
Organization:	**MCAS Yuma Environmental Department**
Contact Made by:	**Damon DeYoung**
Method of Interview:	**In-Person**
Date:	**5/9/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munitions Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Above Average Familiarity

---

2. What is your level of familiarity with implementation of the remedies at these OUs and MRP Sites, and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Above Average Familiarity

---

3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

   Response: MCAS Yuma Environmental contributes to remedy implementation through ensuring the LUCIP is followed and provides base access to the environmental contractors performing monitoring and maintenance activities.

---

4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

- Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

  Response: Effective for the COCs in the ROD. It is known that 1,4-dioxane is not treated by the VCT and studies are underway to evaluate treatment options.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: Has been effective for the COCs in the ROD. Currently, the system is shutdown. It is known that 1,4-dioxane is not treated by the AS/SVE system and studies are underway to evaluate treatment options.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: None.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: None.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: ICs are in place and effective.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

  Response: LTM is being performed.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required

institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

Response: The LUCIP is used to ensure the Master Plan is used during review of any potential construction.

- Remediate all contaminated groundwater to MCLs.

Response: None.

- Terminate system operation.

Response: None.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

- Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: ICs are in place and effective.

- Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: ICs are in place – but Base expansion has led to the desire to use the land where CAOC 8A is located. The Base would like to re-open the ROD and perform any necessary actions to allow for capping of the landfill and construction of a road over part of the landfill. This road would be for a new gate on the south side of the Base.

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6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

Response: Site 4 is located on the Air Field. No residential use is allowed.

- Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers

prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

Response: The requirements are understood and provided in the LUCIP.

- Requirements and procedures for notification if corrective action(s) is warranted.

Response: The requirements are understood and provided in the LUCIP.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

Response: The requirements are understood and provided in the LUCIP.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

Response: Not applicable – no changes in site conditions/use are planned.

- Release of environmental restrictions when the project stakeholders (i.e., Department of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

Response: Not applicable – no changes in site conditions/use are planned.

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

Response: Not applicable – no changes in site conditions/use are planned.

7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

- Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine

Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

Response: The LUCIP ensures that the Site Approval Request Process is followed.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: The site is within the active Air Field. No residential use is allowed.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

  Response: No changes have occurred to the site since the concrete was installed.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

  Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

  Response: Understood and EOD would be contacted if needed.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: Understood. The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training

individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

Response: The Site Approval Request Process/Base Master Plan has been very effective in ensuring protectiveness.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

Response: None.

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

Response: None.

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8. Are you aware of any violations of the institutional controls established for OU 1, OU 2, MRP Site 4, and/or MRP Site 6 that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater, etc.)?

Response: None within last 5 years.

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9. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

Response: Yes.

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

Response: Yes.

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11. Do you know of any significant operation and maintenance difficulties with the OU 1 groundwater treatment systems (e.g., Area 1 Hot Spot Air Sparge/Soil Vapor Extraction, Area 1 Leading Edge Plume Area Vertical Recirculation)?

Response: It is known that the Hot Spot treatment is temporaily shutdown and maintenance would be needed in order to turn it back on. The VCT receives routine O&M.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

Response: No concerns known.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

Response: None.

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14. To the best of your knowledge since June 2015, have there been any changes in future planned site use that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: The Base would like to continue exploring how to re-open the OU2 ROD for CAOC 8A so that the landfill can be capped to allow for construction of a road at the southern base boundary.

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 1 Interview – Navy and Marine Corps Personnel
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**Greg McShane**
Title:	**Air Operations Manager**
Organization:	**MCAS Yuma**
Contact Made by:	**Damon DeYoung**
Method of Interview:	**In-Person**
Date:	**5/9/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munitions Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Average Familiarity

   Familiarity with RODs for all OUs/Sites where the RODs are associated with the Air Field.

2. What is your level of familiarity with implementation of the remedies at these OUs and MRP Sites, and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Above Average Familiarity

3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

   Response: Works with Contractors for the last 8-9 years to provide access to the Air Field to support monitoring and maintenance of remedies within the foot print of the Air Field.

4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

- Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

  Response: None.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: None.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: None.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: None.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: Access is restricted to OU-1 as the remedy is taking place within the Air Field boundaries.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

  Response: Monitoring has occurred quarterly and recently there has been a move to semi-annual monitoring. This change is helpful for the Air Field to minimize disturbance to flight line activities.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish

procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

Response: Well aware of the LUCIP and works with Base personal for any potential construction activities.

- Remediate all contaminated groundwater to MCLs.

  Response: None.

- Terminate system operation.

  Response: None.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

   - Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

     Response: As with OU-1, OU-2 is co-located with the Air Field where access is restricted to flight line personal who work in an industrial capacity.

   - Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

     Response: Aware of CAOC 8A, the land use controls and the base's wish to install a South Gate which would necessitate changes to the CAOC 8A ICs.

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6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

   - Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

     Response: Site 4 is co-located with the Air Field and no residential access is permitted on the flight line.

   - Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan.

These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

Response: As noted above, if construction activities are being planned, Air Field personnel follow the LUCIP and work with Base personnel to adhere to the remedies at sites co-located on the Air Field.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

  Response: As noted above, if changes in site conditions are being planned, Air Field personal follow the LUCIP and work with Base personal to adhere to the remedies at sites co-located on the Air Field.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: As noted above, if changes in site conditions are being planned, Air Field personal follow the LUCIP and work with Base personal to adhere to the remedies at Sites co-located on the Air Field.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: None.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

  Response: Site 4 is co-located with the Air Field and no residential use is permitted on the flight line. There are no changes to the current land use planned.

- Release of environmental restrictions when the project stakeholders (i.e., Department of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: Not applicable – no changes in site conditions/use planned.

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

Response: Not applicable – no changes in site conditions/use planned.

7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

- Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

  Response: This restriction is known.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: Site 6 is co-located with the Air Field and no residential access is permitted on the flight line.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

  Response: None.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

  Response: As noted above, if changes in site conditions are being planned, Air Field personal follow the LUCIP and work with Base personal to adhere to the remedies at sites co-located on the Air Field.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: As noted above, if changes in site conditions are being planned, Air Field personal follow the LUCIP and work with Base personal to adhere to the remedies at sites co-located on the Air Field.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

Response: None.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: None.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: None.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

  Response: None.

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: Not applicable.

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8. Are you aware of any violations of the institutional controls established for OU 1, OU 2, MRP Site 4, and/or MRP Site 6 that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater, etc.)?

   Response: Aware of none.

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9. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes.

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

    Response: Yes, regular monitoring has occurred.

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11. Do you know of any significant operation and maintenance difficulties with the OU 1 groundwater treatment systems (e.g., Area 1 Hot Spot Air Sparge/Soil Vapor Extraction, Area 1 Leading Edge Plume Area Vertical Recirculation)?

Response: Aware that the Hot Spot treatment has be temporarily stopped and maintenance has been needed at the VCT.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

Response: Aware of none.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

Response: No.

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14. To the best of your knowledge since June 2015, have there been any changes in future planned site use that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: No.

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 1 Interview – Navy and Marine Corps Personnel
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**Joseph Britain**
Title:	**Environmental Engineer**
Organization:	**MCAS Yuma Environmental Department**
Contact Made by:	**Damon DeYoung**
Method of Interview:	**In-Person**
Date:	**5/9/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munitions Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Above Average Familiarity

2. What is your level of familiarity with implementation of the remedies at these OUs and MRP Sites, and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Above Average Familiarity

3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

   Response: Contribute to review of reports, dig permits - any aspect of the review process for ensuring the ICs are observed at the OUs/Sites.

4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

   - Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

Response: Effective in treating ROD COCs. An emerging contaminant (1,4-dioxane) has been detected and is not treated by the VCT. The impact of PFAS is not yet known.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: Effective and system operation is temporarily stopped pending the PFAS investigation.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: None.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: None.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: ICs are effective in restricting access throughout the Sites on the Base. For OU1, the Sites are located in the Air Field which is a restricted area.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

  Response: LTM has been conducted quarterly and is transitioning to semi-annually.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP

will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

Response: LUCIP is very effective in ensuring ICs are adhered to.

- Remediate all contaminated groundwater to MCLs.

Response: None.

- Terminate system operation.

Response: None.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

- Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: The LUCIP ensures the ICs are followed.

- Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: Fencing and signage is provided and restricts access. It should be noted that the Base has grown and is in need of using part of the landfill to support putting in a new gate. This new gate would improve the security of the base by providing sufficient space to inspect trucks/commercial vehicles.

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6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

Response: Effective as Site 4 is within the foot print of the Air Field.

- Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: None.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: None.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

  Response: Site 4 is within the foot print of the Air Field and as such residential use is not allowed.

- Release of environmental restrictions when the project stakeholders (i.e., Department of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: None.

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

  Response: None.

7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

   - Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine

Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: Site 6 is within the foot print of the Air Field and as such residential use is not allowed.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

  Response: None.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: The LUCIP ensures that the Site Approval Request Process is followed per the Base Master Plan.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

  Response: None.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: None.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training

individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

Response: None.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

  Response: Site 6 is within the foot print of the Air Field and as such residential use is not allowed.

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: None.

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8. Are you aware of any violations of the institutional controls established for OU 1, OU 2, MRP Site 4, and/or MRP Site 6 that could impact the protectiveness of this component of the remedies (e.g., unauthorized excavation, unauthorized use of groundwater, etc.)?

   Response: No.

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9. To the best of your knowledge, are regular inspections of the institutional controls remedy components being conducted and documented?

   Response: Yes.

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

    Response: Yes.

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11. Do you know of any significant operation and maintenance difficulties with the OU 1 groundwater treatment systems (e.g., Area 1 Hot Spot Air Sparge/Soil Vapor Extraction, Area 1 Leading Edge Plume Area Vertical Recirculation)?

    Response: As noted above, the Hot Spot treatment system is temporarily shutdown. If the system were to be re-started, maintenance would be required. The VCT is in operation and receives regular O&M.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

    Response: No community concerns.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

Response: No.

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14. To the best of your knowledge since June 2015, have there been any changes in future planned site use that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: No changes to date. But, the Base is actively looking to re-open the ROD for CAOC 8a to help with updating the remedy for the landfill.

INTERVIEW RECORD FOR 2019 FIVE-YEAR REVIEW
June 2015 through April 2018
Type 2 Interview – Regulatory Agency
Marine Corps Air Station Yuma
Yuma, Arizona

Individual Contacted:	**Steve Willis**
Title:	**Sr. Scientist**
Organization:	**UXO Pro, Inc.**
Contact Made by:	**John Peterson, ADEQ Project Manager**
Method of Interview:	**Email**
Date:	**4/25/2018**

Summary of Communication

You are not obligated to answer every question. If you are not familiar with the topic of a question, or have no information or opinion to offer, please indicate "none" after "Response." Otherwise, please choose an applicable response and enter any additional comments you may have in the spaces provided.

1. What is your level of familiarity with the Record of Decision (ROD) documents for: Operable Unit (OU) 1; OU 2; and Munition Response Program (MRP) Sites 4 and 6 at Marine Corps Air Station (MCAS) Yuma.

   Response: Above Average Familiarity

   As consultant to ADEQ's Federal Projects Unit, I have reviewed the OU1 and OU2 RODs, and was involved in the development of the final ROD for MRP Sites 4 and 6.

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2. What is your level of familiarity with implementation of the remedies at these OUs, MRP Sites, and areas of concern (AOCs), and the monitoring and maintenance that have taken place since the remedies were implemented.

   Response: Above Average Familiarity

   I have regularly reviewed the periodic monitoring and maintenance reports for OU-1 and OU-2 sites since 2013, and provided input for the selected remedies at MRP Site 4 and 6.

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3. Please describe your involvement with regard to review and comment on remedy implementation including monitoring and maintenance since June 2015.

Response: I have provided technical review and comment on all OU1 Area 1 monitoring and maintenance reports, as well as the OU-1 Area 1 1,4-dioxane pilot test work plan and MRP Sites 4 and 6 Proposed Plan and ROD.

4. What is your overall impression of the on-going effectiveness of the components of the OU-1 remedy? For reference, the primary remedy components are:

- Implement a groundwater containment/treatment system at the leading edge of the plume of Area 1 (LEPA) to prevent further off-site migration.

  Response: The containment system has worked as planned to reduce the ROD COCs to below remedial goals at the base boundary.

- Treat the groundwater Area 1 Hot Spot in the vicinity of Building 230 to reduce contaminant mass in this area and accelerate remediation time for the entire plume.

  Response: The AS/VE system has significantly reduced the ROD COC concentrations in the Hot Spot source area, likely contributing to a reduction in downgradient concentrations and accelerating the remedial timeframe.

- Transport, regenerate, recycle, and/or dispose of the spent granular activated carbon units.

  Response: Spent GAC has been appropriately addressed.

- Perform groundwater modeling in an attempt to demonstrate that volatile organic compound (VOC) concentrations will reach the base boundary equal to or less than maximum contaminant levels (MCLs). If so demonstrated, then monitored natural attenuation (MNA) will be performed to verify VOCs are approaching MCLs.

  Response: Groundwater modeling was completed in March 2016 and accepted by ADEQ.

- Implement institutional controls to restrict access to contaminated groundwater. Amend the MCAS Yuma Master Plan to reflect groundwater access and use restrictions, including contamination that has moved off MCAS Yuma, and establish mechanisms to control changes that would not interfere with, or adversely affect remedial actions.

  Response: Institutional Controls have been implemented and are effective within the MCAS boundary. Offsite groundwater contamination downgradient of the OU 1 Area 1 plume is unknown, but there does not appear to be any exposure to contaminated groundwater at this time.

- Implement a long-term monitoring (LTM) plan to monitor groundwater concentrations and contaminant movement in the Area 1 plume and evaluate the results to determine the effectiveness of the selected remedy

Response: LTM has been implemented, and results are evaluated in Annual and Semi-Annual reports.

- Implement an institutional control plan (ICP) to facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detail the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for assuring regular checks and balances are in place, include provisions for annual review (and updates as necessary) of the MCAS Yuma Master Plan, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed. The LTM plan may be an attachment to the ICP.

  Response: The basewide Land Use Control Implementation Plan (LUCIP) has been updated as required.

- Remediate all contaminated groundwater to MCLs.

  Response: The active remediation systems in place (VCT and AS/VE) have reduced ROD COC concentrations to below the MCLs over much of the plume area. Additional work is needed to reach the remedial goals in the Hot Spot source area.

- Terminate system operation.

  Response: The VCT system in the Leading Edge Plume Area continues to operate. The AS/VE system in the Hot Spot area has been shut down and is unlikely to be re-started due to declining water levels and significant reductions in COC concentrations.

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5. What is your overall impression of the on-going effectiveness of the components of the OU 2 remedy? For reference, the primary remedy components are:

   - Implement institutional controls to restrict the land use of CERCLA Areas of Concern (CAOCs) 1 and 10 to industrial/commercial use. The institutional controls will be implemented through the MCAS Yuma Master Plan.

     Response: The ICs have been effective in restricting land use to industrial/commercial use.

   - Implement institutional controls to restrict the land use of CAOC 8A to current use (i.e., closed/inactive landfill). The institutional controls will be implemented through the MCAS Yuma Master Plan.

Response: The ICs have been effective in restricting land use of CAOC 8A to its current use.

6. What is your overall impression of the on-going effectiveness of the components of the MRP Site 4 remedy? For reference, the primary remedy components are:

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

  Response: The remedy has met the requirements of restricting land use.

- Construction activities such as above- or below-ground demolition work and above- or below-ground construction of structures, including utility lines, to be managed through the MCAS Yuma Site Approval Request Process and/or the Base Master Plan. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions constituents (MC) might be encountered and will provide the requirements needed to perform site work.

  Response: The LUCIP has been updated as required. I don't know if the Base Master Plan has been updated to include MRP Site 4. I am unaware of any non-compliance issues.

- Requirements and procedures for notification of changes in conditions of surface or subsurface soils that could potentially endanger the public or the environment.

  Response: The LUCIP has been appropriately updated. I am unaware of any non-compliance issues.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: The LUCIP has been appropriately updated. I am unaware of any non-compliance issues.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as monitoring for significant erosion and training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: Responsibilities are clearly stated in the LUCIP and Base Master Plan.

- Amendment of the Base Master Plan to prohibit unrestricted use (i.e., residential use) of MRP Site 4.

  Response: The LUCIP has been updated to include MRP Site 4. I'm unaware whether the Base Master Plan has been amended to add MRP Site 4.

- Release of environmental restrictions when the project stakeholders (i.e., Department

of the Navy [DON], U.S. Environmental Protection Agency [USEPA], and Arizona Department of Environmental Quality [ADEQ]) agree that the potential presence of MC has been sufficiently reduced, and thus protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

Response: N/A

- Environmental restrictions that would be binding upon occupants and users of the site and that would be incorporated into documents such as leases and statements of work (i.e., for construction activities).

Response: I am unaware of any completed leases or statements of work.

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7. What is your overall impression of the on-going effectiveness of the components of the MRP Site 6 remedy? For reference, the primary remedy components are:

- Prohibit intrusive activities such as digging or any other activity in the subsurface below the Portland cement and 3 feet of import fill that could result in explosive safety risks. However, intrusive subsurface activities may occur, provided that the Marine Corps/DON approve such intrusive subsurface activities before they are commenced and provided that these activities are undertaken with oversight by qualified personnel who are trained in explosives safety measures.

Response: The MRP 6 remedy has effectively prohibited activities that could result in explosive safety risks.

- Prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds.

Response: The MRP 6 remedy has been effective in prohibiting development and inappropriate use of the property.

- Maintain the concrete apron and the 3 feet of import fill soil layer to limit ecological impact.

Response: I am unaware of any maintenance issues with the concrete apron covering MRP Site 6.

- Construction activities involving below-ground construction, such as utility lines, to be managed through the MCAS Yuma dig permit process or, for large projects, the Site Approval Request Process. These processes will provide notification to engineers and construction/utility workers prior to intrusive construction activities where munitions and explosives of concern (MEC) and MC in subsurface soils might be encountered and will provide the requirements needed to perform site work.

Response: The LUCIP has been updated as required. I am unaware of any non-compliance issues at MRP Site 6.

- Requirements and procedures for notification of changes in conditions of the cover (the concrete apron and 3 feet of soil) that could potentially endanger the public or the environment.

  Response: I am unaware of any land use changes at MRP Site 6 that could potentially endanger the public or the environment.

- Oversight by unexploded ordnance (UXO) personnel required for excavations deeper than 3 feet below the import fill placed beneath the Portland cement.

  Response: I am unaware of any intrusive activities at MRP Site 6.

- Requirements and procedures for notification if corrective action(s) is warranted.

  Response: Requirements and procedures are outlined in the LUCIP. I am unaware of any recent corrective actions at MRP Site 6.

- Identification of responsibilities for the Marine Corps and Navy for implementation, monitoring, reporting, and enforcement of environmental restrictions, such as training individuals to recognize occurrences that would require notification under the elements of the environmental restrictions.

  Response: Responsibilities are outlined in the LUCIP and Base Master Plan.

- Amendment of the Base Master Plan to provide notice of the restriction of MRP Site 6 to industrial/commercial use.

  Response: I am unaware of any amendments to the Base Master Plan to address restrictions at MRP Site 6.

- Release of environmental restrictions when the project stakeholders (i.e., Marine Corps, DON, USEPA, and ADEQ) agree that the potential presence of MEC and MC has been sufficiently reduced and, thus, protection of human health and the environment from the types of uses that were formerly prohibited are no longer necessary.

  Response: N/A

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8. Do you feel well informed about the remediation activities and progress towards meeting remediation goals at MCAS Yuma? Please elaborate.

   Response: Yes, although MCAS has been slow to release results of the 1,4-dioxane pilot test.

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9. To the best of your knowledge since June 2015, have there been any new scientific findings that relate to the potential site risks that might call into question the protectiveness of the remedies for the sites being evaluated in this five-year review?

Response: No

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10. To the best of your knowledge, has the on-going environmental monitoring being performed at these sites been sufficiently thorough and frequent to meet the goals of the RODs? Have the monitoring data been timely and of acceptable quality?

    Response: The ongoing monitoring has been sufficiently thorough. Data has met quality criteria and has been regularly reported in Annual and Semi-Annual reports.

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11. What is your overall impression of the on-going effectiveness of the institutional controls components of the remedies for the sites being evaluated in this five-year review?

    Response: The institutional controls have been very effective in prohibiting exposure to contaminated media.

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12. Are you aware of any community concerns regarding the implementation of the remedies for OU 1, OU 2, MRP Site 4, and/or MRP Site 6? If so, please provide details.

    Response: No.

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13. Do you have any additional comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at MCAS Yuma?

    Response: Remedies have been effective, but I would like more assurance that contaminants have not migrated offsite downgradient of the OU-1 Area 1 plume.