UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
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December 14, 2004

Captain C. Schanz
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Naval Facilities Engineering Command
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San Diego, CA 92132-5190

Subject: FIVE YEAR REVIEW REPORT OU-1 AND OU-2, MARINE CORP AIR STATION, YUMA, ARIZONA

Dear Captain Schanz:

The U.S. Environmental Protection Agency (EPA) Region 9 has received the Final Five- Year Review for OU-1 and OU-2, Marine Corps Air Station, Yuma, dated August 2004. We have reviewed the aforementioned document. Based on this review, EPA agrees with the findings, conclusions and recommendations provided in the Report, and concurs with the Marine Corps that the remedies in place at Yuma Air Station are protective of human health and the environment under the current land use and exposure pathways.

If you have questions regarding this letter, please contact Martin Hausladen, Remedial Project Manager, at (415) 972-3007.

Sincerely,

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cc:
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Five-Year Review Report
Operable Units 1 and 2
Marine Corps Air Station
Yuma, Arizona

August 2004

Prepared by:

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Approved by: Date:

James J. Cooney

4 Nov 2004

James J. Cooney, Colonel, USMC
Commanding Officer
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EXECUTIVE SUMMARY

This report provides the results of the first Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year review conducted for Operable Unit 1 (OU-1) and at Marine Corps Air Station (MCAS) Yuma, Arizona. In addition, this report includes an update on the status of OU-2, which completed its first five-year review in November 2002. This review was conducted in accordance with the Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews (November 2001) and the United States Environmental Protection Agency (U.S. EPA) Comprehensive Five-Year Review Guidance (OSWER No. 9355.7-03B-P, June 2001). The purposes of this review are to evaluate the performance of the remedies implemented in OU-1 and OU-2 and to recommend actions for improvement if the remedies have not performed as designed.

This five-year review comprises document and data review, site inspections, station personnel interviews, regulatory comments review, and report development. Because the remedies do not currently result in site conditions suitable for unlimited use and unrestricted exposure (i.e., residential use) at the time of this five-year review and because the Record of Decision (ROD) for OU-1 was 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 scheduled completion date for this review is 16 November 2004, as dictated by the date when operation of the remediation system began, i.e., 16 November 1999.

OU-1 includes chlorinated hydrocarbon (CHC) groundwater plumes more than 10 ft below ground surface (bgs). The plumes are identified as Areas 1, 2, 3, and 6, with the largest plume in Area 1. The remedy for OU-1 as selected in the ROD signed 05 October 2000 consists of 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, and 3; and institutional controls in the form of restrictions on groundwater use for all sites.

The results of the review indicate that the intent of the remedy for OU-1 Areas 1, 2, and 3 (i.e., protection of human health and the environment) has been achieved as follows:

- 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. The system has reduced CHC concentrations to U.S. EPA maximum contaminant levels (MCLs) and contained any off-site migration of the plume in this area.
    - An AS/SVE system was installed in the Building 230 vicinity to remediate the groundwater in the most highly contaminated area of OU-1. The system has operated relatively continuously from November 1999 to present. The AS/SVE system has reduced the CHC Hot Spot in both size and magnitude (from a maximum of 260 µg/L in 1998 to a maximum of 62 µg/L in March 2004) such that the CHCs will not migrate off site at concentrations greater than MCLs.
- MNA was applied at all Areas to demonstrate the reduction of contaminant concentrations through natural processes and to ensure that the plumes are not migrating. Groundwater monitoring required for the MNA program was implemented through the long-term monitoring (LTM) plan for OU-1 at MCAS Yuma. Plumes will continue to be monitored until they decrease in concentrations below MCLs.
- Institutional controls are in place to restrict exposure to any contaminated groundwater at Areas 1, 2, and 3 through MCAS Yuma Station Order 5090 (issued on January 10,

2002). This order formally directs tenants and contractors to incorporate the land-use controls (LUCs) provided in the MCAS Yuma Master Plan and the Final Land Use Control Implementation Plan (LUCIP) into their existing land-use planning and management programs.

In general, all Areas of OU-1 are approaching or have met remedial action objectives (RAOs) within the five-year review period. Groundwater RAOs are to reach U.S. EPA MCLs. Groundwater monitoring is performed for OU-1 on a quarterly basis. The sampling indicates that all plumes are shrinking in size and concentration due to remedial actions, and none of the plumes are migrating off site. Area 6 achieved MCLs through implementation of MNA and was closed in October 2003 by the U.S. EPA, Arizona Department of Environmental Quality (ADEQ), and the Department of the Navy. Area 2 and Area 3 are also at MCLs through MNA and will be candidates for closure in the near future. MCLs were reached at the LEPA vicinity of the Area 1 plume with operation of the VCT system. The system was temporarily shut down pending confirmation of remedial goals. The AS/SVE system has reduced contamination significantly in the Area 1 Hot Spot such that groundwater modeling indicates that the plume will be reduced to MCLs through natural attenuation processes.

OU-2 includes contaminated soils to depths of 10 ft bgs. The first five-year review for OU-2 was completed in November 2002. CERCLA Areas of Concern (CAOCs) 1, 8A, and 10 were reviewed in the report. The remedy for the sites consists of institutional controls that protect the health of potential receptors by restricting future land use. This report contains an update on the status of OU-2 since completion of the last review so that both units may be evaluated on the same five-year review schedule.

Review of OU-2 status indicates that the remedy for CAOCs 1, 8A, and 10 is protective of human health and the environment. Institutional controls designed to protect potential receptors by restricting land use are implemented through the following methods:

- Institutional controls are in place to restrict exposures to contaminants in soil at CAOCs 1, 8A, and 10 through MCAS Yuma Station Order 5090 (issued on January 10, 2002). This order formally directed tenants and contractors to incorporate the land use controls provided in the MCAS Yuma Master Plan and the Final Land Use Control Implementation Plan into their existing land-use planning and management programs.
- The “modified declaration of environmental use restrictions” for CAOCs 1, 8A, and 10 have been proposed to satisfy the requirements specified in the OU-2 ROD for registration of the sites with the State of Arizona.
- The MCAS Yuma Environmental Department will continue 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 land use restrictions specified in the OU-2 ROD.

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

Five-Year Review Summary Form – Page 1

SITE IDENTIFICATION		
Site name: Marine Corps Air Station Yuma, Operable Units 1 and 2		
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:** 11/16/99	
Has site been put into reuse? YES ☑ NO		
REVIEW STATUS		
Lead agency: EPA State Tribe ☑ Other Federal Agency		
Author name: Naval Facilities Engineering Command		
Author title: Southwest Division	**Author affiliation:** U.S. DOD	
Review period: 11/16/1999 to 11/16/2004		
Date(s) of site inspection: 1/26/04 to 1/27/04		
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 (Update on OU-2)		
Triggering action: Actual RA Onsite Construction at OU #1 Actual RA Start at OU#____ Construction Completion Previous Five-Year Review Report Other (specify): _____		
Triggering action date: 11/16/1999		
Due date *(five years after triggering action date)*: 11/16/2004		

Five-Year Review Summary Form – Page 2

Issues:

1) A petroleum sheen to thin layer was discovered in an isolated well in Area 3. The petroleum contamination is confined to a single well and is being investigated to determine if further action is required. There is no evident source to the contamination, and it is not an immediate threat to human health due to institutional controls on groundwater use and its isolated location.

Recommendations and Follow-up Actions:

1) Continued monitoring to evaluate status of petroleum contamination in Area 3 well A3-MW-07. Investigate and remediate petroleum groundwater contamination if necessary.

Protectiveness Statement:

The remedy 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 as follows:

1) Institutional controls are in place to restrict exposure to groundwater associated with OU-1 and contaminated soils associated with OU-2. The institutional controls are expressed in MCAS Yuma Station Order 5090, MCAS Yuma Master Plan, and the Final Land Use Control Implementation Plan for MCAS Yuma.

2) Remedies consisting of an air sparge/soil vapor extraction system (AS/SVE), vertical circulation treatment (VCT) system, and monitored natural attenuation (MNA) were applied to reduce and contain contaminants of potential concern in groundwater at OU-1. The VCT system was applied at the leading edge of the Area 1 plume. Regular groundwater monitoring indicates that the contaminants of potential concern were contained and reduced to maximum contaminant levels (MCLs). Consequently, the VCT system was temporarily shut down. The AS/SVE system has operated in the Building 230 area and has contained and significantly reduced groundwater contamination in the area. Monitored natural attenuation (MNA) was applied to all areas to demonstrate that the contaminants of potential concern were reduced in concentration and extent by natural processes. A long-term monitoring plan is in place to assess the status of any remaining groundwater contamination.

3) The MCAS Yuma Environmental Department will continue to review and coordinate all plans for future activities, in consultation with U.S. EPA and ADEQ as necessary, to ensure continued compatibility with the land-use restrictions specified in the OU-1 and OU-2 RODs.

TABLE OF CONTENTS

Section Page

EXECUTIVE SUMMARY ES-1

FIVE-YEAR REVIEW SUMMARY FORM ES-3

ACRONYMS/ABBREVIATIONS v

1 INTRODUCTION 1-1

2 SITE CHRONOLOGY 2-1

3 BACKGROUND AND CURRENT STATUS 3-1

3.1 Background 3-1

3.1.1 Station History 3-1

3.1.2 Geology 3-3

3.1.3 Hydrogeology 3-4

3.1.4 Land and Resource Use 3-5

3.2 OU-1 Overview and Current Status 3-6

3.2.1 Area 1 3-6

3.2.2 Area 2 3-7

3.2.3 Area 3 3-7

3.2.4 Area 6 3-11

3.2.5 Response Actions for OU-1 3-11

3.3 OU-2 Overview and Current Status 3-17

3.3.1 Response Actions for OU-2 3-17

4 REMEDIAL ACTIONS 4-1

4.1 Remedy Selection 4-1

4.1.1 Remedial Action Objective 4-1

4.1.2 Criteria for Termination of Groundwater Containment/ Treatment System 4-3

4.2 OU-1 Selected Remedy 4-4

4.2.1 Area 1 4-4

4.2.2 Areas 2, 3, and 6 4-5

4.3 OU-2 Selected Remedy 4-6

4.4 Remedy Implementation 4-6

4.4.1 OU-2 4-6
4.4.2 OU-1 4-7
4.4.2.1 Area 1 4-7
4.4.2.2 Area 2 Plume 4-10
4.4.2.3 Area 3 Plume 4-11
4.4.2.4 Area 6 Plume 4-11
4.4.2.5 Long-Term Groundwater Monitoring Plan 4-11

4.5 Land-Use Control Implementation Plan 4-12

4.6 MCAS Yuma Master Plan 4-12

5 FIVE-YEAR REVIEW PROCESS 5-1

5.1 Administrative Components of the Five-Year Review Process 5-1

5.2 Community Notification and Involvement 5-1

5.3 Document Review 5-2

5.4 Data Review 5-3

5.5 Site Inspection 5-3

5.5.1 Area 1 5-4
5.5.2 Area 2 5-4
5.5.3 Area 3 5-4
5.5.4 OU-2 5-4

5.6 Interviews 5-5

6 TECHNICAL ASSESSMENT 6-1

6.1 Question A 6-1

6.2 Question B 6-3

6.2.1 Human-Health and Ecological Risk Assessments 6-3
6.2.2 Applicable or Relevant and Appropriate Requirements 6-4
6.2.3 Achievement of the RAO 6-4

6.3 Question C 6-4

7 ISSUES, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS 7-1

7.1 Issues 7-1

7.2 Recommendations and Follow-up Actions 7-1

8 PROTECTIVENESS STATEMENT 8-1

9 NEXT REVIEW 9-1

10 REFERENCES 10-1

APPENDICES

A DOCUMENTS REVIEWED

B DOCUMENTATION REGARDING REMEDY PERFORMANCE

B1 MCAS YUMA STATION ORDER 5090

B2 MCAS YUMA LUCIP

B3 SITE 6 CLOSURE CORRESPONDENCE

B4 VCT SYSTEM SHUTDOWN CORRESPONDENCE

B5 AS/SVE AND VCT SYSTEM DIAGRAMS

B6 FIVE YEAR REVIEW COMMUNITY NOTIFICATION BULLETIN

C SITE INSPECTION CHECKLISTS AND ASSOCIATED DOCUMENTATION

C1 FIVE YEAR REVIEW SITE INSPECTION CHECKLIST FOR AREA 1

C2 FIVE YEAR REVIEW SITE INSPECTION CHECKLIST FOR AREA 2

C3 FIVE YEAR REVIEW SITE INSPECTION CHECKLIST FOR AREA 3

C4 FIVE YEAR REVIEW SITE INSPECTION CHECKLIST FOR AREA 6

D INTERVIEW REPORTS

D1 INTERVIEW DOCUMENTATION FORM

D2 INTERVIEW RECORD FOR CAROL LEWIS (1/27/04)

D3 INTERVIEW RECORD FOR H. GIL GUILLORY (1/15/04)

D4 INTERVIEW RECORD FOR JOE BRITAIN (1/27/04)

D5 INTERVIEW RECORD FOR CHRIS KOST (1/27/04)

D6 INTERVIEW RECORD FOR JON COGER (1/27/04)

D7 INTERVIEW RECORD FOR ANGELA LIND (1/15/04)

D8 INTERVIEW RECORD FOR DON BOSCH (2/2/04)

E SUPPORTING PHOTOGRAPHS

FIGURES

Page

3-1 Regional Map 3-2

3-2 OU-1 Impacted Groundwater Areas and OU-2 Soil CAOCs 3-9

3-3 TCE and 1,1-DCE Status in Groundwater at OU-1, March 2004 3-13

3-4 Historical Sampling Results in Groundwater, Area 1- Hot Spot 3-14

3-5 Historical Sampling Results in Groundwater, Area 1- LEPA 3-15

TABLES

2-1 Chronology of Significant Events 2-2

4-1 Summary of Maximum Groundwater Concentrations Detected in March 2004 Monitoring Event 4-2

7-1 Issues 7-1

7-2 Recommendations and Follow-up Actions 7-2

ACRONYMS/ABBREVIATIONS

ACM	asbestos-containing material
ADEQ	Arizona Department of Environmental Quality
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	air sparge/soil vapor extraction
bgs	below ground surface
BNI	Bechtel National Incorporated
CALA	Combat Aircraft Loading Area
CAOC	CERCLA Area of Concern
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	contaminants of potential concern
DCA	dichloroethane
DCE	dichloroethene
DEUR	Declaration of Environmental Use Restrictions
DoD	Department of Defense
DON	Department of Navy
FFA	Federal Facility Agreement
FFAAP	Federal Facilities Agreement Assessment Program
FS	feasibility study
GAC	Granular Activated Carbon
gpm	gallons per minute
HBGL	health-based guidance level
IC	institutional controls
IR	Installation Restoration
IRP	Installation Restoration Project
LEPA	Leading Edge of the Plume Area
LTM	long-term monitoring
LUC	land-use control
LUCIP	Land Use Control Implementation Plan
MCAS	Marine Corps Air Station

MCL	maximum contaminant level
MNA	monitored natural attenuation
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OU	Operable Unit
PCE	tetrachloroethene
POTW	publicly owned treatment works
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
ROICC	Resident Officer in Charge of Construction
SARA	Superfund Amendments and Reauthorization Act
SRL	soil remediation level
STRAP	Source Treatment and Reduction Analysis Plan
SWDIV	Southwest Division
TCE	trichloroethene
U.S. EPA	United States Environmental Protection Agency
µg/L	microgram per liter
USC	United States Code
VOC	volatile organic compound
VCT	Vertical Circulation Treatment
VEMUR	Voluntary Environmental Mitigation Use Restriction

Section 1
INTRODUCTION

This report provides the results of the first Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year review conducted for Operable Unit 1 (OU-1) at Marine Corps Air Station (MCAS) Yuma, Arizona. In addition, the report includes an update on the status of OU-2, which completed its first five-year review in November 2002. An update on OU-2 is included so that both units may be evaluated on the same five-year review schedule. The purposes of this review are to evaluate the performance of the remedies implemented for OU-1 and OU-2 and to recommend actions for improvement if the remedies have not performed as designed. The report identifies the methods used in the review, key issues regarding the implementation and performance of the remedy, and gives recommendations on how the issues can be addressed. The triggering mechanism for this five-year review was the start of operation of the remediation system at OU-1 on 16 November 1999.

Consistent with Executive Order 12580, the Secretary of Defense is responsible for ensuring that five-year reviews are conducted at all qualifying Department of Defense (DoD) remediation sites. The United States Department of the Navy (DON) is authorized to conduct the five-year review pursuant to CERCLA Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 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.

The United States Environmental Protection Agency (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* [USC] § 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.

This five-year review was conducted November 2003 through March 2004 in accordance with the following guidance documents:

- DON. Navy/Marine Corps Policy for Conducting CERCLA Statutory Five-Year Reviews, November 2001.

- U.S. EPA Comprehensive Five-Year Review Guidance (OSWER No. 9355.7-03B-P), June 2001. (This document includes the report template used for preparing this Five-Year Review Report.)

The five-year review of the remedial actions taken for OU-1 and OU-2 is a statutory review because current site conditions are not suitable for unlimited use and unrestricted exposure (i.e., residential use) and because the record of decision (ROD) for OU-1 and OU-2 were signed after 17 October 1986, the effective date of the Superfund Amendments and Reauthorization Act (SARA).

The five-year review process involves several components detailed in this report including community notification, document review, data review, site inspection, and interviews of key personnel from the site. A technical assessment of the performance of the remedies selected for OU-1 and OU-2 is presented based on the standard questions required by five-year review guidance. Based on the review, any issues, recommendations, and follow-up actions are presented as well as an overall protectiveness statement.

Section 2
SITE CHRONOLOGY

This section summarizes events in the development of the Installation Restoration (IR) Program at MCAS Yuma with significance to the history of contaminant detection, characterization, and remediation at OU-1 and OU-2. Table 2-1 presents these events in chronological order. Events discussed in this review include the period of November 1999 through November 2004 for OU-1 and the period of December 2002 through November 2004 for OU-2.

Table 2-1 Chronology of Significant Events

Event	Date
Initial Assessment Study was conducted to investigate past disposal practices at MCAS Yuma (Stearns et al., 1985).	1985
MCAS Yuma was placed on Superfund National Priorities List.	02/1990
Site inspection was completed at MCAS Yuma.	06/1990
The Navy entered into a Federal Facilities Agreement with U.S. EPA and Arizona Department of Environmental Quality. Operable Units were established, along with a schedule and framework for implementing environmental investigations and appropriate cleanup activities.	01/1992
OU1 Remedial Investigation (JEG, 1996a) completed identifying six groundwater plumes as CAOCs.	11/1995
Source Treatment/Reduction Alternatives Plan (STRAP) developed to address contamination Hot Spots in LEPA and Building 230 Area (JEG, 1996b).	04/1996
OU1 Feasibility Study concluded (JEG, 1996a). The study identified and evaluated remediation options for the six groundwater plumes included under OU-1.	07/1996
Final ROD for OU-2 signed with institutional controls selected as the remedial action (UA, 1997).	12/1997
Draft ROD prepared finalizing remedial actions and allowing construction and operation of remedial systems for OU-1 (JEG, 1998).	09/1998
Full-scale AS/SVE system installed in Building 230 Area by OHM. The system consists of AS/SVE wells located in the Building 230 area of the Area 1 chlorinated hydrocarbon plume.	06/1999-11/1999
Full-scale AS/SVE system operation started in Building 230 part of the Area 1 plume.	11/1999
Full-scale VCT system installed in LEPA. The system consists of six clustered-circulation wells located in the leading edge of the Area 1 plume.	02/2000-06/2000
Full-scale VCT operations started in LEPA section of the Area 1 plume.	06/2000
Temporary AS/SVE systems installed in Areas 2 and 3 to remediate the small plumes in these areas.	09/2000
Final OU-1 ROD signed by DON, U.S. EPA, and ADEQ.	10/2000
MCAS Yuma Master Plan revised to include land use restrictions and recording of environmental use restrictions required in institutional controls for OU-1 and OU-2.	09/2001
MCAS Station Order 5090 implemented LUCs provided in Draft LUCIP.	01/2002
Wok Plan for Long Term Monitoring at OU-1 finished.	06/2002
Final Land-Use Implementation Plan for MCAS Yuma OU-1 and OU-2 finalized detailing institutional controls and monitoring (SWDIV, 2002b). The report formalizes the MCAS Yuma LUC agreement between DON, U.S. EPA, and ADEQ.	09/2002
OU-2 First Five-Year Review Completed (SWDIV, 2002a).	12/2002
VCT system at LEPA area shut down in concurrence with ADEQ and U.S. EPA.	05/2003
Area 6 receives no further action clean closure from ADEQ and U.S. EPA.	10/2003

Section 3
BACKGROUND AND CURRENT STATUS

This section describes the fundamental aspects of the station, 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 the OU-1 and OU-2 RODs, so that the performance of the remedy can be easily compared with the site conditions that the remedy was intended to address. Information provided by the OU-1 ROD regarding station history and site history has been updated in this section with information provided in the Remedial Action Reports, Semi-Annual Groundwater Monitoring Reports, and Final LUCIP (SWDIV, 2002b). The status of OU-2 is updated based on changes since the last five-year review (SWDIV, 2002a).

3.1 BACKGROUND

3.1.1 Station History

MCAS Yuma is a 4,791-acre area located in the city and county of Yuma, Arizona (Figure 3-1). The station is located at an average elevation of 180 feet above mean sea level, on the northern portion of Yuma Mesa, and is approximately 60 to 70 feet above and 4 miles east of the Colorado River. MCAS Yuma started as a county airfield in 1928. It was then leased to the U.S. Army Air Corps for pilot training and bomber crew training from 1941 to 1946. In July 1951, the U.S. Air Force reactivated the station as a Weapons Proficiency Center for fighter-inceptor units. The station was declared a permanent Air Force installation in 1954. MCAS Yuma was established in 1959 to provide services and materials to support the operations of the Marine Aircraft Wing and its subordinate units. In January 1959, MCAS Yuma and associated range facilities were transferred to the U.S. Navy. MCAS Yuma currently operates the airport facility as a joint military/civilian airport with Yuma County Airport Authority.

The Initial Assessment Study (Stearns et al., 1985) conducted at MCAS Yuma in 1985 identified the past disposal practices at MCAS Yuma and indicated the presence of various contaminants in the soil and chlorinated solvents in underlying groundwater. MCAS Yuma was placed on the Superfund National Priorities List (NPL) list in February 1990.

Three OUs were established to address CERCLA Areas of Concern (CAOCs) at the station under the auspices of the Federal Facility Agreement (FFA) signed in January 1992. OU-1 includes areas of contaminated soil and groundwater underlying the station at depths greater than 10 feet below ground surface (bgs), the common depth of building construction activities at MCAS Yuma. OU-2 consists of contaminated soils of the station from the ground surface to a depth of 10 feet bgs. A separate five-year review was completed for OU-2 in December 2002 (SWDIV, 2002a). OU-3 was established to include additional CAOCs that may be identified later on; however, no CERCLA sites have been identified since that time. Therefore, OU-3 has not been used at the station.

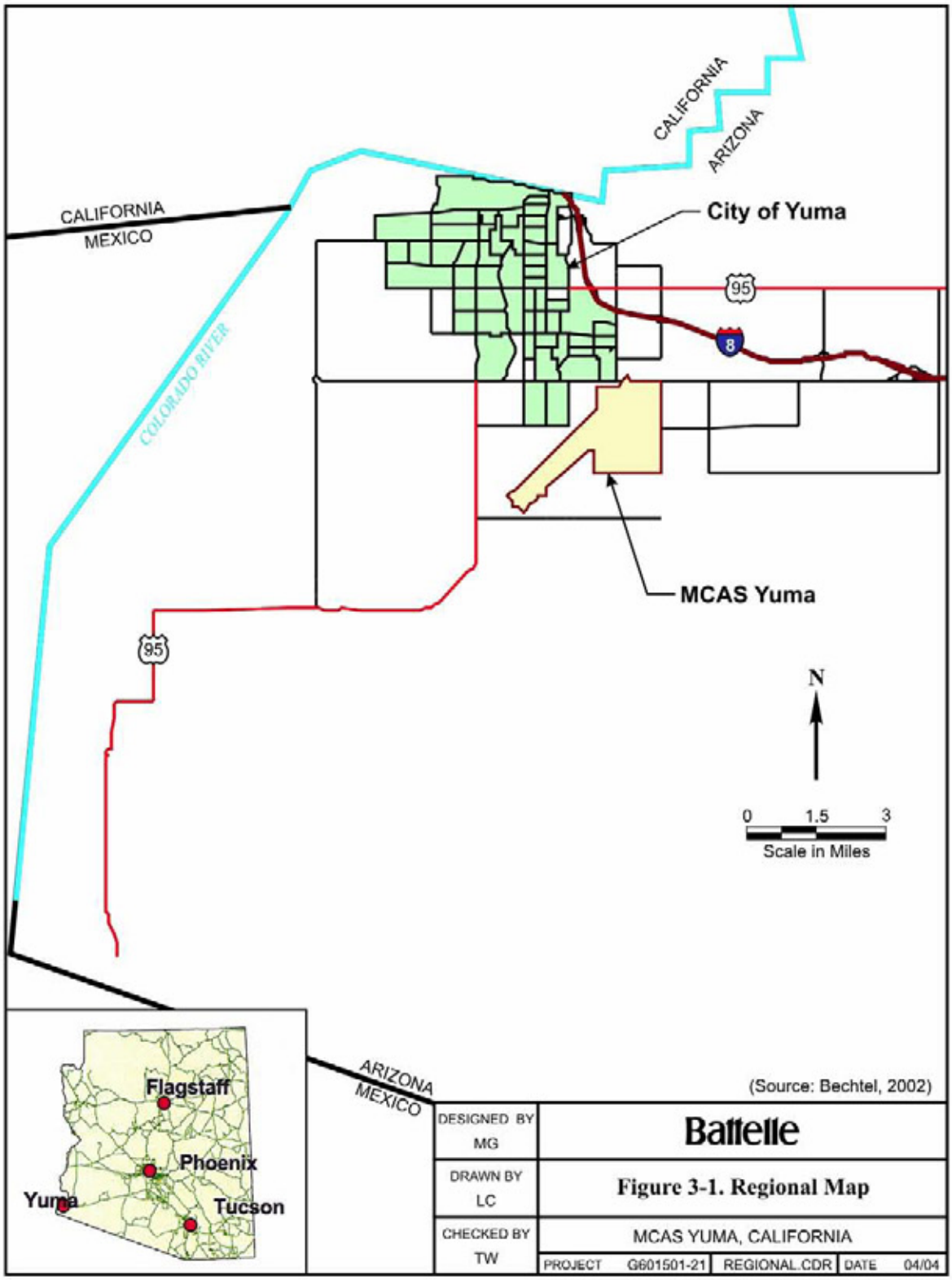

Figure 3-1. Regional Map

OU-1 may have been contaminated by disposal or releases of petroleum products, paints, solvents, metals, pesticides, and other process chemicals. The remedial investigation (RI) conducted for OU-1 identified six groundwater plumes identified as Areas 1-6. The Areas 1, 2, 3, and 6 plumes consisted of chlorinated hydrocarbon dissolved in the groundwater. Areas 4 and 5 were petroleum plumes covered under the State of Arizona underground storage tank program. Figure 3-2 shows the locations of the OU-1 Areas 1, 2, 3, and 6 within MCAS Yuma and general site characteristics (i.e., roads, fence lines, and buildings). The contaminated groundwater encompassed by OU-1 is located approximately 60 ft bgs, and there is no risk or hazard from exposure to the groundwater unless it is pumped from the aquifer. The soils included in the Unit are below excavation depths, preventing any potential exposure to soils. Site geology and hydrogeology has a significant effect on the fate and transport of OU-1 contamination and is summarized in sections 3.1.2 and 3.1.3.

OU-2 initially consisted of surface disposal sites and disposal units within the upper 10 feet of soil underlying the station where disposal or releases of petroleum products, paints, solvents, metals, asbestos, pesticides, and other process chemicals may have occurred. The RI for OU-2 assessed the impact of hazardous substance releases on human health and the environment. Of a total of 18 CAOCs investigated, 12 CAOCs were recommended for no further action because they did not pose a threat to human health or the environment. The remaining six CAOCs (1, 4, 7, 8A, 9, and 10) were recommended for remedial actions to address any potential threat to human health from exposures to asbestos, metals, or organic compounds in the soil.

3.1.2 GEOLOGY

MCAS Yuma is on the northern portion of the Yuma Mesa, which is situated approximately 60 to 70 feet above the adjacent Colorado River valley. Yuma Mesa is separated from the Colorado River valley by a north-trending bluff approximately 5 miles west of MCAS Yuma. The climate is arid, and the land type is desert.

Sedimentary deposits on Yuma Mesa are predominantly fluvial (river) deposits with some eolian (windblown) deposits in the upper 180 to 200 feet. 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 MCAS Yuma are the "younger alluvium," which includes minor windblown sand, and the "older alluvium." The bottom of the older alluvium may extend more than 2,000 feet below the surface in some areas. These alluvial units appear to directly overlie pre-Tertiary bedrock at MCAS Yuma.

Granitic bedrock outcrops occur 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. Permeability of the Superstition Sand is rapid, and the available water capacity is low to moderate.

3.1.3 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.

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

Water quality in the upper zone is highly variable, probably as a result of the shallow depth to water (40 to 80 feet) and the presence of irrigated agriculture in the area. Groundwater in the upper fine-grained zone exists under unconfined conditions over much of Yuma Mesa. However, locally confined conditions associated with fine-grained lenses have been reported (Olmsted et al., 1973).

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 quality 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 below the surface. 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).

Groundwater generally occurs under unconfined conditions 40 to 60 ft beneath the station with the shallower groundwater located in the south-central portion of the station.

3.1.4 LAND AND RESOURCE USE

The MCAS Yuma facility is owned by the federal government and operated by the U.S. Marine Corps. The station provides services and materials to support the operations of the Marine Aircraft Wing and its subordinate units. MCAS Yuma also operates and maintains the joint military/civilian airport facility it shares with the Yuma County Airport Authority. Land use at the facility is considered primarily industrial in support of aircraft operations.

OU-1 includes groundwater Areas 1, 2, 3, and 6. Groundwater associated with OU-1 generally occurs under unconfined conditions 40 to 60 ft beneath the station with the shallower groundwater located in the south-central portion of the station. The primary source of drinking water in the Yuma area is from the surface water canals that direct water from the Colorado River. In the past, MCAS Yuma had one groundwater production well, located 2,000 feet upgradient of all the contaminant plumes. The well has been capped and is no longer in service. However, MCAS Yuma is currently considering placing this well back into service to improve drinking water quality on base. Groundwater modeling shows that no impact to the remedy would occur if this well is placed back into service. The nearest downgradient domestic wells are approximately 0.8-0.9 mile from the facility boundary. The nearest municipal well is approximately 0.7 mile upgradient of the facility. No wells are threatened by the OU-1 plumes. Currently, while there is no direct use or contact with groundwater at the site, the State of Arizona considers the water beneath Yuma as a potential source of drinking water supply.

OU-2 areas of interest include CAOCs 1, 8A, and 10. 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. CAOC 8A is located in the southeastern portion of MCAS Yuma, between North Ordnance Road and the southern MCAS Yuma property line. CAOC 8A is the site of a former landfill and surface disposal areas. The site is vacant land, except for ordnance and munitions storage bunkers on the portion of the site within the Ordnance Distribution Facility.

CAOC 10 is located within and south of the current ODF in the southeastern portion of MCAS Yuma. CAOC 10 was used during World War II as a shooting range for bomber gun crews. Since the early 1950s, ordnance materials have been stored in the magazines around the central portion of the Ordnance Loop (North and South Ordnance Roads). The area has also been used for surface tank and drum storage. CAOC 10 continued to be used for the storage and handling of ordnance as part of the station's ordnance distribution facility.

3.2 OU-1 OVERVIEW AND CURRENT STATUS

Four chlorinated hydrocarbon plumes (Areas 1, 2, 3, and 6) were identified as a current or future threat to public health, welfare, or the environment in the OU-1 RI. The contaminants of concern (COCs) in the OU-1 chlorinated hydrocarbon (CHC) groundwater plumes consist predominantly of 1,1-dichloroethene (1,1-DCE), trichloroethene (TCE), and tetrachloroethene (PCE) at levels exceeding the federal or State of Arizona maximum contaminant levels (MCLs). The applicable water quality criteria for potential sources of drinking water consist of Arizona Aquifer Water Quality Standards (7 micrograms per liter [µg/L] for 1,1-DCE, 5 µg/L for TCE, and 5 µg/L for PCE). Area 1 included the largest zone with the highest detected CHC concentrations. Areas 2, 3, and 6 consisted of relatively small, stable, and isolated CHC plumes. The Area 2 plume consists of an isolated area with 1,1-DCE near or above MCLs. In Areas 2 and 3, current groundwater monitoring data indicates CHC concentrations remaining below MCLs. Area 6 was closed after CHC concentrations were demonstrated to be below remedial goals.

Current remedial actions for OU-1 were chosen to contain and reduce the groundwater plumes. Based on the OU-1 ROD (SWDIV, 2000), the selected remedy consists of the following major components:

- Installing and operating a closed network of Vertical Circulation Treatment (VCT) wells at the Area 1 plume's leading edge at the station's northwest border, which are designed to contain off-base plume migration and treat the relatively low concentration of chlorinated hydrocarbons;
- Installing and operating an AS/SVE system to reduce contaminant concentrations in the Area 1 plume Hot Spot near Building 230;
- Monitoring groundwater throughout the duration of the remedial action, estimated to take between 10 and 20 years; and
- Implementing institutional controls throughout the duration of the remedial action to restrict the domestic use of contaminated groundwater. MCAS Yuma will implement these controls.

Institutional controls were implemented to prevent exposure to contaminants at the site, ensure the integrity of the remediation systems, and maintain the integrity of the monitoring wells. The Long-Term Groundwater Monitoring Plan for OU-1 (BNI, 2002) and Final Land-Use Control Implementation Plan (LUCIP) (SWDIV, 2002b) have been developed and implemented for these purposes. Areas 1, 2, 3 and 6 are described in more detail as follows.

3.2.1 Area 1

Area 1 is the largest plume in OU-1 and consists of TCE, 1,1-DCE, and PCE in groundwater. Area 1 includes groundwater contamination from Building 230 to the northwest station boundary. Area 1 includes three separate plumes: the Hot

Spot plume near Building 230, the Interior/Central plume located near the northeast portion of the runway, and the Leading Edge of the Plume Area (LEPA) area at the northwest boundary of the station (see Figure 3-2). A series of air sparge/soil vapor extraction (AS/SVE) wells have been operating in the Hot Spot area since 1999 to reduce contaminant concentrations. A VCT system was operated in the LEPA from 2000 to 2003 to contain and remediate the plume in this area. Monitored natural attenuation (MNA) has been conducted for the entire plume.

Figure 3-3 shows the current status of groundwater monitoring of Area 1 indicating that the plumes have been reduced significantly in size and concentration based on March 2004 sampling. In the Hot Spot area, maximum TCE concentrations have been reduced from 260 µg/L in 1998 to 62 µg/L in March 2004, and maximum 1,1-DCE concentrations have been reduced from 300 µg/L in 1998 to 20 µg/L in March 2004. CHC concentrations were reduced to less than MCLs in the LEPA area in all but well A1-PZ-19, which was slightly above MCLs at 6.3 µg/L for TCE and 7.5 µg/L for 1,1-DCE.

Monitoring suggests that the interior/central plume is stable, isolated, and at low levels. Monitoring also suggests that no portions of the plume are migrating, and the plume is shrinking substantially in areas where remediation systems have been applied.

Figure 3-4 shows historical sampling results for COCs in the Area 1 Hot Spot. Figure 3-5 shows historical sampling results for chemicals of concern in the LEPA. Both maps show that the concentrations of COCs are decreasing or stable.

3.2.2 Area 2

Area 2 is located northeast of the Flight Line along the easternmost taxiway, downgradient of the Fuel Farm area. The site was identified based on 1,1-DCE concentrations exceeding MCLs in a small, isolated area near well FF-MW-24 which is located north of Building 230. The footprint of the plume covers about 4 acres and is confined on-station (see Figure 3-2). No chlorinated hydrocarbons, which would indicate a source of contamination, were detected in the vadose soil at Area 2. The plume has been relatively stable for the past three years and does not appear to have significantly migrated. The concentrations of 1,1-DCE in FF-MW-24 have decreased over the past few years from 130 µg/L in June 1998 to less than 1 µg/L in March 2004.

3.2.3 AREA 3

Area 3 is located north of the Combat Aircraft Loading Area (CALA) near a former unlined fire training pit that was used from 1976 to 1985 to practice extinguishing various types of fires. The footprint of the plume covers about 10 acres and is confined on-station (see Figure 3-2). The Area 3 plume consists

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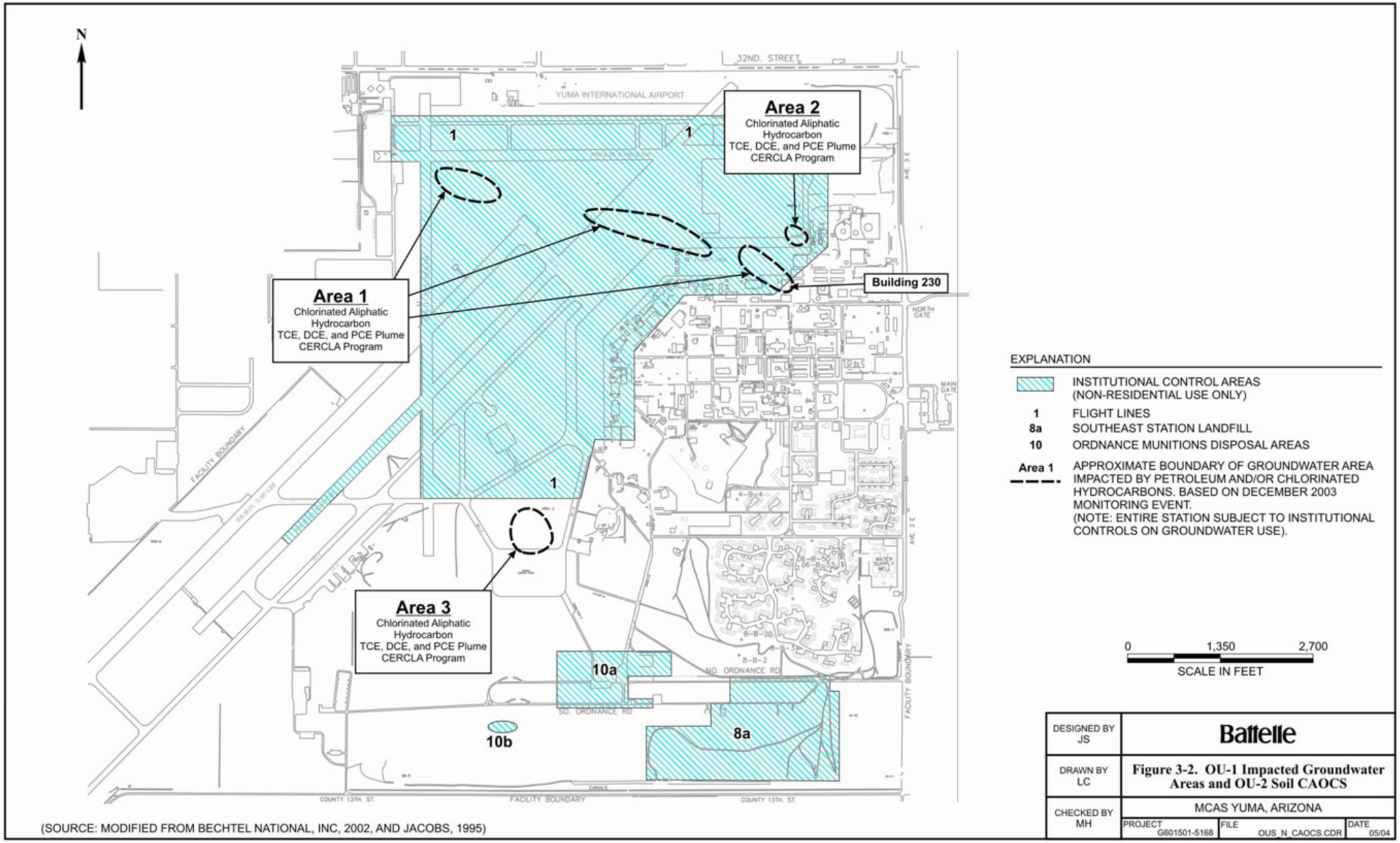

Figure 3-2. OU-1 Impacted Groundwater Areas and OU-2 Soil CAOCs

primarily of TCE and 1,1-DCE. Area 3 is located around well W-5 where TCE and 1,1-DCE were detected during groundwater monitoring events. The maximum concentrations of TCE and 1,1-DCE reported in the RI were 13 µg/L and 10.2 µg/L respectively, at monitoring well W-5. The CHC concentrations in Area 3 have been decreasing since the RI was prepared. Groundwater monitoring results show 1,1-DCE, TCE and PCE concentrations remaining below the MCLs since 1999 in all Area 3 wells. 1,1-DCE, TCE and PCE have been below detection in Area 3 wells in quarterly sampling from 2001 to March 2004. A petroleum sheen to thin layer has been observed in well A3-MW-07 in recent site activities. Investigation of the petroleum groundwater contamination is planned and the contamination will be subject to further remediation if necessary.

3.2.4 AREA 6

Area 6 consisted of a small area south of the Central Receiving Warehouse (Bldg 328) where PCE was detected in monitoring well 317-MW-01 at concentrations slightly exceeding the MCL. All CHCs were less than detection limits in quarterly groundwater samples from 2001 to 2003. The area received clean closure from the Arizona Department of Environmental Quality (ADEQ) and U.S. EPA on October 21, 2003 (see Appendix B), and requires no further action.

3.2.5 Response Actions for OU-1

An FFA was signed by U.S. EPA, ADEQ, and the Navy in January 1992 to establish a framework and schedule for implementing environmental investigations and appropriate remedial actions. The FFA established the three OUs to address specific environmental issues at MCAS Yuma. This overall approach to MCAS Yuma's IR Program was designed to address source areas and achieve significant risk reduction to on-site personnel.

As expressed in the ROD, the selected remedies for each plume in OU-1 are described in this section. The remedial approach is to reduce the contaminant concentrations in groundwater to federal and state MCLs. The OU-1 groundwater contaminant plumes are primarily characterized by 1,1-DCE, PCE and TCE, but also contain other volatile organic compounds (VOCs). Aquifer cleanup levels for PCE, TCE, and 1,1-DCE were set in the ROD as the more stringent of the federal and state MCLs. The major components of the selected remedies included a VCT system at the LEPA of Area 1, an AS/SVE system at the Building 230 Hot Spot in Area 1, and MNA in all areas, and LTM for plumes that have not met remediation objectives. In addition, institutional controls were selected to control use of groundwater at the site. In the event that the remedial action objectives (RAOs) were not met, the selected contingent alternative was to extract groundwater and treat with air stripping and granular activated carbon (GAC).

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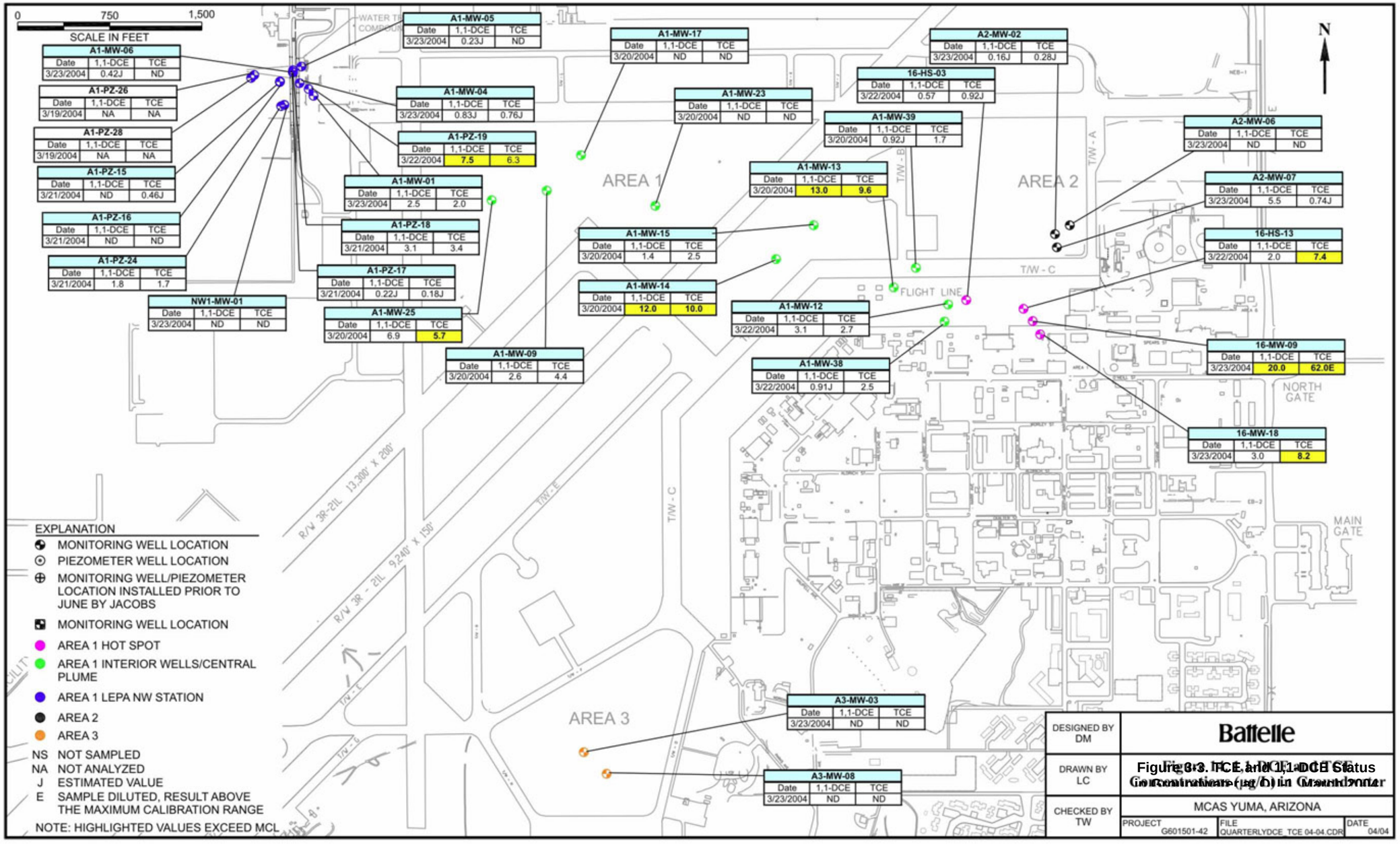

Figure 3-3. TCE and 1,1-DCE Status in Groundwater at OU-1, March 2004

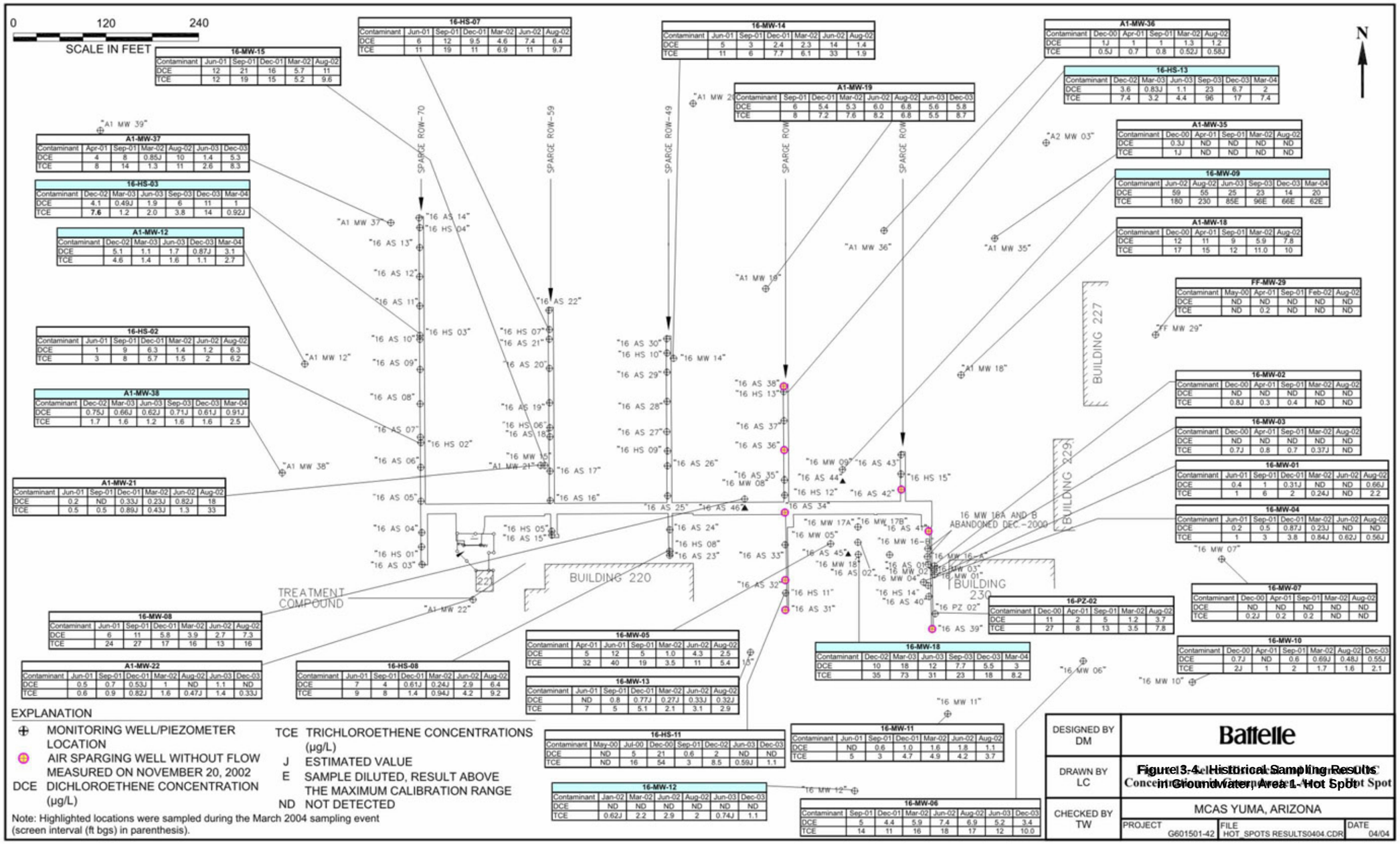

Figure 3-4. Historical Sampling Results in Groundwater, Area 1- Hot Spot

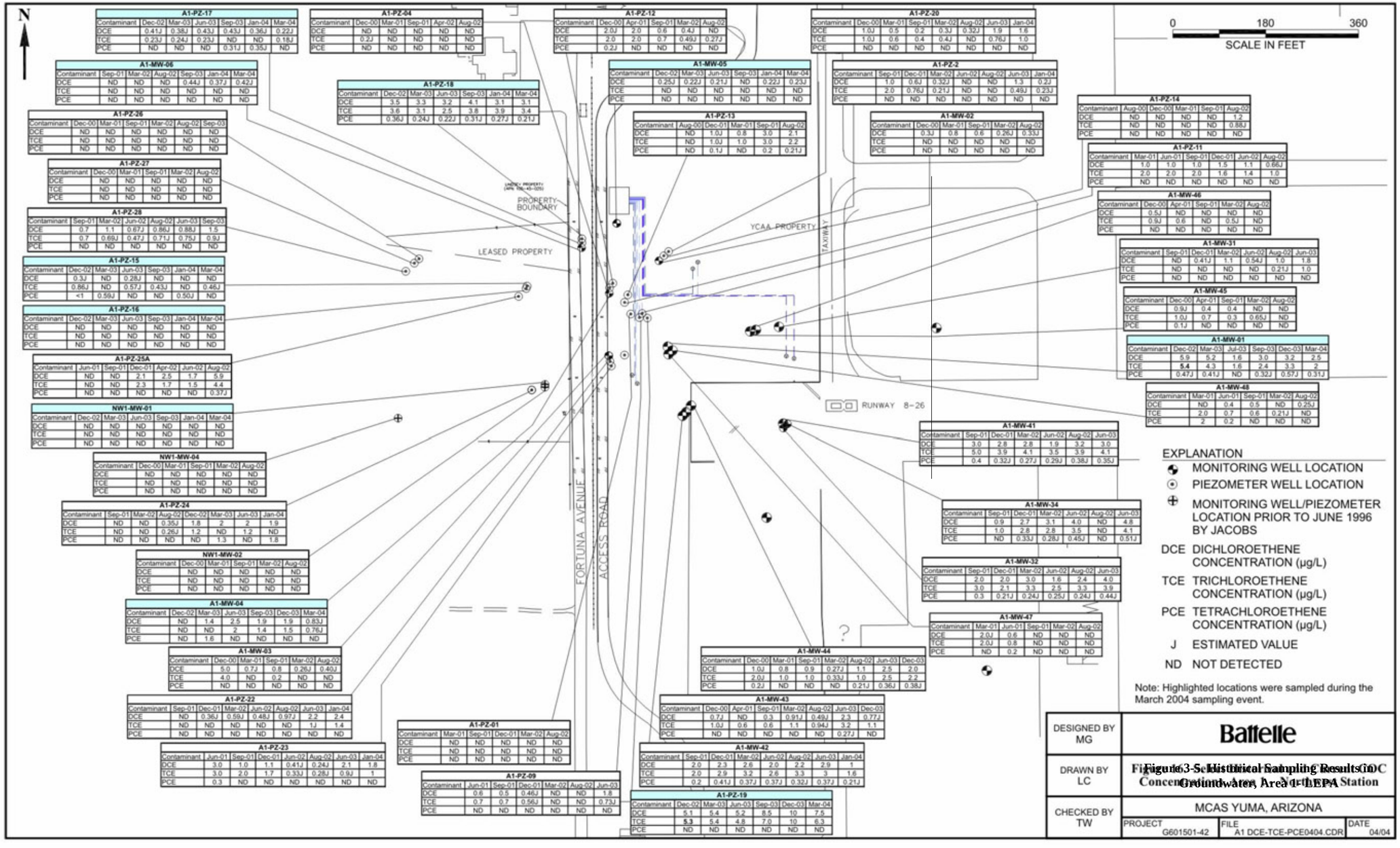

Figure 3-5. Historical Sampling Results in Groundwater, Area 1- LEPA

3.3 OU-2 OVERVIEW AND CURRENT STATUS

The impact on human health and the environment by hazardous substance releases to the soil were evaluated in the RI for OU-2 (JEG, 1996a). A total of 18 CAOCs investigated, and six CAOCs (1, 4, 7, 8A, 9, and 10) were recommended for remedial action to address a potential threat to human health from exposure to asbestos, metals, or organic compounds in the soil. Remediation of CAOCs 4, 7, and 9 was completed 07 June 1999 with the removal of remaining Asbestos-Containing Material (ACM).

The remedy selected for CAOCs 1, 8A, and 10 consists of institutional controls that protect the health of potential receptors by restricting future land use. Because this remedy leaves site conditions that do not allow for unlimited use and unrestricted exposure, a five-year review was prepared for these CAOCs of OU-2 (SWDIV, 2002b). In the five-year review, it was concluded that the land use controls in place for OU-2 were protective of human health and the environment. CAOCs 1, 8A, and 10 are currently subject to land use restrictions as dictated in the MCAS Yuma Master Plan and LUCIP.

3.3.1 Response Actions for OU-2

The feasibility study (FS) and supplemental soil sampling program conducted for OU-2 indicated that exposure to soil conditions at CAOCs 1, 8A, and 10 did not present an unacceptable risk to human health so long as controls were put in place to restrict current and future land-use to the industrial land-use scenario. Response actions for OU-2 CAOCs 1, 8A, and 10 since this finding have included the following:

- A Proposed Plan was issued to the public in March 1997, proposing institutional controls to restrict land use at the sites to current industrial uses.
- The OU-2 ROD outlined institutional controls that would be implemented as the preferred remedy for CAOCs 1, 8A, and 10 at MCAS Yuma by modification of the MCAS Yuma Master Plan. Access to CAOC 8A was summarily restricted by fencing.
- The institutional controls were immediately implemented in limiting access to CAOC 8A and incorporating the controls into the existing review process used by the MCAS Yuma Environmental Department for review of land-use proposals, dig permits, and construction plans for station property that may involve environmental sites.

Issues raised in the first five-year review for OU-2 were addressed in the review process. MCAS Yuma's Master Plan was updated in January 2002 to include a map of all IR sites with LUCs as identified in the ROD. The Plan was sent to all tenants to ensure application of the institutional controls. In addition, access to CAOC 8A was restricted by fencing and locking all gates that access the area. Signs were posted on the locked gates stating that access is restricted and to contact the Environmental office. Only the Environmental Office and Base security have a key to the locked gates. The Broken Gate Saddle Club cannot

access CAOC 8A through the south end gate. The south end gate is locked and only the Environmental Office and Base Security have a key to the gate. MCAS Yuma has decided to select a different site to construct the MWSS-371 parking lot so the construction will not abut with CAOC 8A.

Section 4
REMEDIAL ACTIONS

This section discusses the results of events identified in the Section 2 chronology that define the remedy for OU-1 and OU-2, from the implementation of the selected remedy to the time of this review. The section discusses remedy selection, remedy implementation, and remedy performance, and identifies any changes to or problems with the components of the remedy.

4.1 REMEDY SELECTION

This section describes the purpose for remediation, the remedial alternatives developed and evaluated in the OU-1 FS (JEG, 1998) and OU-2 FS (UA, 1996) against CERCLA evaluation criteria for remedial alternatives, and the remedy selected in the OU-1 and OU-2 RODs (SWDIV, 2000; UA, 1997).

4.1.1 Remedial Action Objective

RAOs for all of the OU-1 groundwater CHC plumes include containment of all the plumes within the facility boundary and reducing groundwater contamination to meet applicable drinking water standards. Groundwater from the aquifer shall be monitored until cleanup goals (MCLs) are achieved as agreed upon by the Navy, MCAS Yuma, U.S. EPA, and ADEQ. The RAO was determined as a final result of the human-health risk assessments conducted for each site in the RI and FS. The results indicated that potentially unacceptable risk and hazard levels could result from residential use of groundwater with the highest detected contamination levels.

All aquifers in the State of Arizona are classified for drinking water protected use. As such, the water beneath Yuma is subject to Arizona Aquifer Water Quality Standards. The primary source of drinking water in the Yuma area is from the surface water canals that direct water from the Colorado River.

Groundwater cleanup levels were established to ensure that any person exposed in the future will not be subject to unsafe levels of COC. These cleanup levels were based on a detailed analysis of chemical-specific applicable or relevant and appropriate requirement (ARAR) and health risk-based criteria that are consistent with the present and projected beneficial uses of the affected aquifer.

Because the groundwater at Yuma is a potential source of drinking water, MCLs are the ARARs for the groundwater in the aquifer. MCLs are the maximum permissible level for treated groundwater delivered to any user of a water system as expressed by the U.S. EPA and/or the state of Arizona. The lower of the permissible levels between federal or Arizona Water Quality Standards are relevant and appropriate since the state of Arizona has designated all aquifers in the state as a potential source of drinking water. As described above, MCLs were established as the cleanup levels for groundwater remedial actions under the OU-1 ROD. The main chemicals of interest at OU-1 are TCE, 1,1-DCE, and PCE. The MCLs are 7 µg/L for 1,1-DCE, 5 µg/L for TCE, and 5 µg/L for PCE. Table 4-1 summarizes maximum groundwater concentrations for OU-1.

Table 4-1. Summary of Maximum Groundwater Concentrations Detected in March 2004 Monitoring Event

Area		Maximum Concentration in Groundwater (µg/L)- March 2004		
		1,1-DCE	TCE	PCE
1	(Bldg 230 Area)	20	62	2.4
	(Central/Interior)	13	10	<1
	(LEPA)	7.5	6.3	<1
2		5.5	<1	<1
3		<1	<1	<1
*MCLs**		*7*	*5*	*5*

* maximum contaminant levels based on lower of federal or state of Arizona ARARs.

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 (UA, 1996). The RAO was determined as a final result of the human-health risk assessments conducted for each site in the RI and FS. The results indicated that potentially unacceptable cancer risk levels could result from residential land use and exposure to surface and shallow subsurface soil at the three sites. However, the cancer risk for the current and anticipated future land-use scenario, as areas of industrial land use, was estimated to be within the U.S. EPA acceptable range.

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 allow for soil remediation to background levels, remediation to health-based guidance levels (HBGLs) presented in Appendix A (Soil Remediation Levels [SRLs]) of Ariz. Admin. Code tit. 18, ch. 7, art. 2, or remediation to levels derived from a site-specific risk assessment.

4.1.2 Criteria for Termination of Groundwater Containment/ Treatment Systems and Monitoring and Natural Attenuation

Criteria for termination of the groundwater containment/treatment system for OU-1 were defined in the ROD (SWDIV, 2000) and are summarized as follows:

Selected monitoring wells located both upgradient and downgradient of the groundwater treatment systems will be monitored during the remedial action in accordance with the long-term groundwater monitoring plans. The Navy will

evaluate the results to verify that the remedial systems are effectively containing and treating the plume, and in the case of AS/SVE, to verify that the systems are effectively reducing contaminant mass in the treatment area.

The groundwater containment/treatment systems will be operated until one of the following conditions is reached:

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

(2) Remaining CHC concentrations in groundwater will reach the Base boundary at concentrations equal to or less than MCLs. (This would require groundwater modeling results indicating remaining contaminants above MCLs will reach the Base boundary at concentrations equal to or less than MCLs followed by MNA to remedy the remaining VOCs). Modeling will be performed only after CHC concentrations upgradient and downgradient of the VCT system reach MCLs. After MCLs have been attained and the VCT system has been temporarily shut down, if CHCs rebound above MCLs, modeling would be performed to determine whether CHCs would reach the MCAS Yuma Facility boundary above or below MCLs.

(3) The AS/SVE system is no longer removing mass (i.e., asymptotic condition is permanently reached) after system optimization. Modeling of the Hot Spot would also be required, indicating CHCs would reach the facility boundary equal to or below MCLs to terminate operation of the VCT well system.

The Navy will demonstrate the above conditions through collection of groundwater samples from the monitoring wells designated in the Long-Term Monitoring (LTM) Plan (BNI, 2002). When the monitoring data show that any of the above conditions have been met, the Navy can propose a temporary shutdown of the remediation system. Shutdown will be subject to U.S. EPA and ADEQ concurrence. The groundwater LTM program will continue for a period of up to two years. If it is demonstrated in this period that the representative groundwater concentrations of CHCs meet the groundwater cleanup standards, the parties agree that the system operation will be shut down permanently.

If, during temporary shutdown of the remediation system, monitoring wells upgradient from the Base boundary show a rebound in VOC concentrations to above MCLs, operation of the remediation system will be restarted. The Navy can then attempt to demonstrate through groundwater modeling that remaining groundwater contaminants will reach the Base boundary at concentrations equal to or less than MCLs. Groundwater modeling will be subject to U.S. EPA and ADEQ concurrence. If this is demonstrated, the Navy can then propose a 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 VOCs are approaching MCLs. If MNA is not progressing adequately, the remediation system will be operated as needed.

If it is determined that criteria 1 and 2 cannot be met, the Navy will demonstrate that VOCs in groundwater have been removed to the extent technically and economically feasible as set forth in item 3, 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 at concentrations approaching asymptotic mass levels; and

(3) Whether discontinuing the system will significantly prolong the time to attain the groundwater cleanup standard.

The criteria for closure at Areas 2, 3, and 6 include demonstration that MCLs have been met at the sites through at least two years of quarterly groundwater monitoring as specified in the LTM plan. If monitoring indicates that MCLs have not been met in accordance with these criteria, the groundwater monitoring will continue until MCLs have been achieved. When monitoring indicates that VOC concentrations have decreased to MCLs, the LTM program will continue for a minimum of two additional years. If there is no significant rebound in VOC concentrations above MCLs, the Navy can propose that the LTM program be terminated. Closure of LTM requires U.S. EPA and ADEQ approval.

4.2 OU-1 SELECTED REMEDY

The proposed remedies for OU-1 were selected to achieve remediation objectives. The RAO is to remediate all contaminated groundwater to MCLs. The final remedy involves innovative technologies such as VCT wells for the Area 1 plume leading edge containment/treatment system, and AS/SVE for the Hot Spot treatment. MNA and institutional controls were also selected for all sites to prevent exposure to groundwater. Remedies for each Area are described as follows:

4.2.1 Area 1

The selected remedy for Area 1 as identified in the OU-1 ROD consists of the following major components:

- Implement a groundwater containment/treatment system at the leading edge of the Area 1 plume to prevent further off-site migration;
- 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;
- Transport, regenerate, recycle, and/or dispose of the spent GAC units;
- Perform groundwater modeling in an attempt to demonstrate that VOC concentrations will reach the Base boundary equal to or less than MCLs. If so demonstrated, then MNA will be performed to verify VOCs are approaching MCLs;

- 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 interfere with or adversely affect remedial actions; and
- Implement an LTM plan to monitor groundwater concentrations and contaminant movement in the Areas 1, 2, 3, and 6 plumes and evaluate the results to determine the effectiveness of the remedies;
- Implement an institutional control plan to facilitate training and education of personnel involved with the enforcement of the required institutional controls;
- Remediate all contaminated groundwater to MCLs;
- Terminate system operations.

In the event that the VCT wells are ineffective in treating the contaminant plume and preventing it from migrating off-Base, the selected contingent alternative was to extract the contaminated groundwater and treat it with air stripping and GAC. The treated groundwater would either be discharged to the city of Yuma publicly owned treatment works (POTW), or recharged back into the aquifer via on-site reinjection wells.

4.2.2 Areas 2, 3, and 6

Areas 2, 3, and 6 consist of relatively small, stable plumes of chlorinated hydrocarbons. The major components of the selected remedy for the Areas 2, 3, and 6 plumes as identified in the OU-1 ROD are:

- Implementing institutional controls on MCAS Yuma;
- Maintaining an LTM plan that includes periodic monitoring of selected COCs in groundwater monitoring wells, as specified in the OU-1 LTM plan; and
- Closure criteria.

4.3 OU-2 SELECTED REMEDY

The selected remedy as defined in the ROD consisted of institutional controls restricting land use of CAOC 1 and CAOC 10 to industrial/commercial use and CAOC 8A to the current status as an inactive landfill. The institutional controls would be implemented through the MCAS Yuma Master Plan (former Base Master Plan), which will reference the OU-2 ROD. The institutional controls identified in the ROD are as follows:

- Restrict land use at CAOCs 1 and 10 to industrial/commercial use.
- Restrict land use at CAOC 8A to current status (inactive landfill).
- Provide a legal description of site boundaries and a site map for each site.

- Execute and record a Voluntary Environmental Mitigation Use Restriction (VEMUR) with the state of Arizona for each site.
- 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.

4.4 REMEDY IMPLEMENTATION

The remedies for OU-1 and OU-2 were implemented on separate schedules because of the differing nature of the units. The first five-year review for OU-2 was completed in December 2002. This report includes an update on remedy implementation at OU-2 and complete description of remedy implementation at OU-1 so that the units may be reviewed on the same schedule.

4.4.1 OU-2

The selected remedy for OU-2 CAOCs 1, 8A, and 10 has been fully implemented and remedial action is complete. Land Use Controls (LUC) were formalized and fully implemented with the Land Use Control Implementation Plan (LUCIP), and with MCAS Yuma's Base Master Plan and Station Order 5090. Land Use Controls are defined as both institutional controls (IC) and Engineering Controls. Maps and legal descriptions of CAOCs 1, 8A, and 10 are contained both in the Base Master Plan and the LUCIP. In lieu of a VEMUR a modified Declaration of Environmental Use Restrictions (DEURs) was provided in the final LUCIP. In keeping with the LUCIP, MCAS Yuma's Environmental department reviews and approves all building or dig permits to ensure land use is restricted to industrial/commercial use at CAOCs 1 and 10 and as an inactive landfill at CAOC 8A. Engineering controls such as fencing, locked gates, and signage have been erected and maintained to restrict access to CAOC 8A. Only MCAS Environmental Department and Base security have an access key to CAOC 8A. The final LUCIP stipulates that ADEQ will be informed of any future plans to transfer properties to non-federal ownership whereupon properties with environmental use restrictions could be formally registered with the state.

4.4.2 OU-1

Implementation of the remedy for OU-1 started with operation of the AS/SVE system in the Building 230 area on November 16, 1999. Several remedial actions were taken at the OU-1 sites over the five-year review period and are discussed in detail as follows:

The AS/SVE system at the Area/Hot Spot has operated relatively continuously since startup. Implementation of the VCT system in the LEPA area began June 15, 2000. The VCT system was shut down in May 2003 with ADEQ and U.S. EPA approval after monitoring demonstrated CHC levels below MCLs. MNA was

applied at all sites through quarterly sampling of monitoring wells for contaminant concentrations and MNA indicators to track plume status. Land-use restrictions for Areas 1, 2, 3, and 6 were implemented per LUCIP. The Land-Use Control Implementation Plan (BNI, 2002) establishes engineering and institutional controls at OU-1 and OU-2 sites and establishes procedures to management and enforcement of these controls.

The systems were installed, operated, and monitored by OHM from June 1999 to September 2000. GEOFON was responsible for OU-1 environmental activities from October 2000 to September 2001. Terra Vac assumed responsibility for OU-1 RAO from October 2001 to September 2002. Battelle was contracted to perform environmental activities for October 2002 through June 2004. There is a daily operation and maintenance (O&M) presence at the site and the AS/SVE and VCT systems are inspected on a weekly basis, at the very least, during operation. System O&M activities are described in quarterly reports summarizing operation details, monitoring parameters, and any issues related to the remedial systems. Groundwater sampling is performed quarterly for OU-1. The environmental monitoring aspects were formalized in the LTM monitoring plan (BNI, 2002). This plan outlines groundwater monitoring, system O&M, and reporting necessary to meet CERCLA requirements for OU-1.

The AS/SVE system was optimized in fall 2002 to focus on eastern portions of the Hot Spot where concentrations exceeded MCLs, reducing the amount of O&M needed for the AS/SVE system. The VCT system was shut down in May 2003. Overall, there were no unanticipated expenses.

The following sections discuss in detail the steps taken in implementation of remedial actions for OU-1 Areas 1, 2, 3, and 6 at MCAS Yuma.

4.4.2.1 AREA 1

As discussed in previous sections, the primary remedies for the Area 1 plume included a series of AS/SVE wells at the Hot Spot, VCT wells in the LEPA area, and MNA. Implementation of the remediation systems is described in detail below.

VCT System

The VCT system was installed to treat and contain the impacted groundwater at the LEPA. The primary objective of the VCT system was to provide containment and treatment of relatively low concentrations of chlorinated hydrocarbons in the groundwater at the Northwest Station boundary. The constituents of potential concern in this area are 1,1-DCE, TCE, and PCE. The VCT system consists of four injection wells and four extraction wells located in the LEPA area. Submersible pumps in each well extract groundwater at a flowrate of 30-40 gal/min (gpm). The extracted groundwater is pumped through various holding tanks and bag filters before being treated with GAC. The GAC removes organic

chemicals from the groundwater. After the water has passed through the GAC units, the treated water is pumped back into the aquifer through four injection wells, each at a flowrate of 40 gpm. The operation of the VCT system is described in detail in the revised O&M Manual (Battelle, 2004). A schematic diagram of the VCT system is included in Appendix B.

The VCT system began operation on June 16, 2000. The system operated relatively continuously except for 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. Consequently, the system was operated using only three injection wells and three extraction wells from September 2002 to May 6, 2003 (when the system was temporarily shut down). The only other system interruptions were associated with O&M. VCT process water samples were collected during VCT system operation. MCLs were never exceeded in the effluent samples. Because groundwater monitoring results indicated that VOC groundwater concentrations in the LEPA area were consistently below MCLs, the VCT system was shut down on May 6, 2003 with concurrence by ADEQ and U.S. EPA.

The analytical results from the total influent samples were used to calculate VOC mass removal from the groundwater. Contaminant mass removal by the VCT system was calculated from the process water sampling results. As of May 2003 (when the system was temporarily shut down), an estimated 10.710 lbs of total mass has been removed from the 136,591,146 gallons of extracted groundwater since system startup.

AS/SVE System

The AS/SVE system was installed to treat the Area 1 Hot Spot northwest of Building 230. The primary objective of the AS/SVE system was to reduce groundwater contaminant concentrations to MCLs. Contaminants of potential concern (COPCs) in the area are 1,1-DCE, TCE, and PCE. The system design also includes provisions for a contingency groundwater extraction system if the AS/SVE system is ineffective in remediating chlorinated hydrocarbons within an acceptable period of time. 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 above ground prior to discharge to the atmosphere.

The AS system consists of 43 sparge wells, operating in five banks (i.e., Rows 29, 39, 49, 59, and 70) as shown in Appendix B. A blower (rated at 400 cubic feet per minute [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 GAC. 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. A diagram of the system is included in Appendix B. The operation of the AS/SVE system is described in detail in the revised O&M Manual (Battelle, 2004).

The AS/SVE system began operation on November 16, 1999 and has operated relatively continuously except for maintenance and monitoring interruptions. 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 were operated together and rows 49 and 70 were operated together for alternate one-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 allowing groundwater to move through the well field. Since November 2002, air injection has focused on the eastern portion of the site where elevated contaminant concentrations were persistent; air injection through Rows 29, 39, and 49 has continued as an attempt to enhance VOC removal in this area.

The system air injection pattern was also temporarily modified in fall 2002 to cool the air from the SVE wells before it was directed through the carbon filter. However, this configuration resulted in vacuum loss across the carbon treatment units, so the system was returned to its original design in December 2002. Otherwise, there have been no major modifications to the AS/SVE system.

TO-14 samples were periodically collected prior to the GAC treatment to monitor system performance, demonstrate air emission compliance, and calculate the cumulative VOC mass removed. Based on the sampling, about 79 lbs of contaminants of concern (COCs) have been removed from the subsurface since the system startup. The total mass removal rate has remained relatively consistent since January 2002. Two step increases were observed on October 24 and December 5, 2001; these increases were attributed to the detection of some benzene and xylenes. Contaminant mass removed by the system has generally declined overall. Mass removal rates have not exceeded 0.5 lb/month since 2001.

MNA was also selected as the remedy for the overall Area 1 plume in areas where active remediation was not applied. The program entailed monitoring of wells at the site for contaminant concentrations and other chemical indicators of natural attenuation. The plan was detailed in the *Evaluation of Remediation by Natural Attenuation for Groundwater at Areas 1, 2, 3, and 6 (Operable Unit 1)* (Parsons, 1997); *Long-Term Groundwater Monitoring Plan in Support of the Remedial Action Plan CERCLA Program Groundwater Monitoring Areas 1, 2, 3, and 6* (OHM, 1999), and *Work Plan For Long-Term Groundwater Monitoring*

Operable Unit-1 (Areas 1, 2, 3, 6, and Sub-Area 5A) (BNI, 2002). MNA activities for Area 1 were integrated into groundwater monitoring events. Monitoring was performed on a quarterly basis from March 1998 to present.

Groundwater Fate and Transport Modeling

Groundwater fate and transport modeling was updated for the Area 1 plume to evaluate the effects of the remediation systems on the behavior of the plumes. Models were prepared for the Area 1 plume (BNI, 2002; Battelle, 2003) to assess the effects of the VCT and AS/SVE systems on the behavior of the groundwater plumes. An eight-layer flow model was prepared that simulates the geologic and hydrologic conditions at the site. Natural attenuation processes were included in the model as shown by site-specific monitoring and sampling data. In general, the models confirmed historical monitoring results which show that the plumes are slow moving and decreasing in size and magnitude. The modeling demonstrated that the plumes would not migrate off site at concentrations greater than MCLs.

4.4.2.2 AREA 2 PLUME

The Area 2 plume consists of an isolated zone of mainly 1,1-DCE in the groundwater at low concentrations near the MCL. MNA was selected as the remedy for the Area 2 plume. The program entailed monitoring of wells at the site for contaminant concentrations and other chemical indicators of natural attenuation. The plan was detailed in the *Evaluation of Remediation by Natural Attenuation for Groundwater at Areas 1, 2, 3, and 6 (Operable Unit 1)* (Parsons, 1997); *Long-Term Groundwater Monitoring Plan in Support of the Remedial Action Plan CERCLA Program Groundwater Monitoring Areas 1, 2, 3, and 6* (OHM, 1999); and *Work Plan For Long-Term Groundwater Monitoring Operable Unit-1 (Areas 1, 2, 3, 6, and Sub-Area 5A)* (BNI, 2002). MNA activities for Area 2 were integrated into groundwater monitoring events. Monitoring was performed on a quarterly basis from March 1998 to present. In addition to the MNA activities, a small temporary AS/SVE system was installed in the Area 2 plume in September 2000, but was deemed unnecessary due to the low CHC concentrations.

4.4.2.3 AREA 3 PLUME

The Area 3 plume consists of TCE and 1,1-DCE in the groundwater at low concentrations near MCLs. MNA was selected as the remedy for the Area 3 plume. The MNA program entailed monitoring of wells at the site for contaminant concentrations and other chemical indicators of natural attenuation. The plan was detailed in the *Evaluation of Remediation by Natural Attenuation for Groundwater at Areas 1, 2, 3, and 6 (Operable Unit 1)* (Parsons, 1997); *Long-Term Groundwater Monitoring Plan in Support of the Remedial Action Plan CERCLA Program Groundwater Monitoring Areas 1, 2, 3, and 6* (OHM, 1999); and *Work Plan For Long-Term Groundwater Monitoring Operable Unit-1 (Areas*

1, 2, 3, 6, and Sub-Area 5A) (BNI, 2002). The MNA activities for Area 3 were integrated into groundwater monitoring events. Monitoring was performed on a quarterly basis from March 1998 to present. In addition to the MNA activities, a small temporary AS/SVE system was installed in the Area 3 plume in September 2000, but was deemed unnecessary due to the low CHC concentrations.

4.4.2.4 AREA 6 PLUME

MNA was selected as the remedy for the Area 6 plume. The MNA program entailed monitoring of wells at the site for contaminant concentrations and other chemical indicators of natural attenuation. The plan was detailed in the *Evaluation of Remediation by Natural Attenuation for Groundwater at Areas 1, 2, 3, and 6 (Operable Unit 1)* (Parsons, 1997); *Long-Term Groundwater Monitoring Plan in Support of the Remedial Action Plan CERCLA Program Groundwater Monitoring Areas 1, 2, 3, and 6* (OHM, 1999); and *Work Plan For Long-Term Groundwater Monitoring Operable Unit-1 (Areas 1, 2, 3, 6, and Sub-Area 5A)* (BNI, 2002). The MNA activities for Area 6 were integrated into regular groundwater monitoring events. Monitoring was performed on a basis from March 1998 to October 2003 when Site 6 was granted no further action closure by ADEQ and U.S. EPA because monitoring indicated CHC concentrations were below MCLs for the past three years.

4.4.2.5 LONG-TERM GROUNDWATER MONITORING PLAN

The Long-Term Groundwater Monitoring Plan was finalized in June 2002 (Bechtel, 2002). The objective of the plan was to select monitoring wells necessary to assess the status of the groundwater plumes. Many of the wells at MCAS Yuma were installed for site characterization, RI, and FS studies. Consequently, many wells have demonstrated nondetection and offer no meaningful information on plume status. The LTM monitoring plan evaluated the well layout and identified wells necessary to track contamination. The plan calls for sampling in 31 wells on a quarterly basis and 63 wells on a semiannual basis. The sampling results are described in quarterly progress and groundwater reports. These reports are reviewed by the MCAS Yuma Environmental Department and regulators. If any significant changes in plume status are detected, additional wells may be sampled. Most of the wells are clustered in the Building 230 area, where contamination levels were highest, and the LEPA area, where there was a possibility for off-site migration.

4.5 LAND-USE CONTROL IMPLEMENTATION PLAN

Institutional controls were chosen to restrict the use of groundwater for all areas of OU-1 and land for OU-2 CAOCs 1, 8A, and 10. The controls were integrated into the Final LUCIP issued in September 2002 (SWDIV, 2002b). The Final LUCIP addressed all DON, U.S. EPA, and ADEQ comments on the Draft (Revision 1) LUCIP that was issued on 20 December 2001. Concurrence on the Final LUCIP has been received on all comments with the exception of one ADEQ

comment on the “modified DEURs (Declaration of Environmental Use Restrictions)” (former VEMURs).

MCAS Yuma Station Order 5090 was issued 10 January 2002 informing station tenants of the land-use restrictions for OU-1 and OU-2 and implementing the other LUCs provided in the Draft LUCIP (see Appendix B2). The Draft (Revision 1) LUCIP was originally issued as an addendum to the Master Plan to provide steps for implementation and monitoring of institutional controls at OU-1, OU-2, and Federal Facilities Agreement Assessment Program (FFAAP) AOC A. The document also contained complete VEMUR application packages for Areas 1, 2, 3, and 6.

4.6 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 groundwater contamination from OU-1 and ensure that future groundwater 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 of 1998 was revised in September 2001 to contain the institutional controls for OU-1 and OU-2, as identified in the ROD and specified in the Master Plan. Figures 5-17 and 5-19 of the revised MCAS Yuma Master Plan provide the locations of the OU-1 and OU-2 site areas for the institutional controls that would apply, as well as a list of the controls.

Section 5
FIVE-YEAR REVIEW PROCESS

This section provides a description of the activities performed during the five-year review process for MCAS Yuma OU-1 and a summary of the findings of each step in the process, when appropriate. In addition, an update on the status of OU-2 since its first five-year review is provided.

5.1 ADMINISTRATIVE COMPONENTS OF THE FIVE-YEAR REVIEW PROCESS

Responsibilities for the OU-1 five-year review were developed by the Navy and the MCAS Yuma Environmental Department. The following list summarizes the people involved in the review:

Name	Title	Organization
Angie Lind	Lead Remedial Project Manager	Navy, SWDIV
Don Bosch	Remedial Project Manager	Navy, SWDIV
Abe Chen	Contract Manager	Battelle
Phil Jagucki	Contract Task Order Leader	Battelle
Herbert “Gil” Guillory	Environmental Director	MCAS Yuma Environmental Department
Carol Lewis	IRP Manager	MCAS Yuma Environmental Department

The review team was identified at that time as Phil Jagucki (Battelle) as the primary investigator for the review and Carol Lewis (MCAS Yuma) as the station contact responsible for arranging access to Environmental Department documents and station resources and personnel. Components identified in advance with those responsible for the review included document review, data review, site inspection, local interviews, and five-year review report development and review. The site inspections and most of the interviews were conducted on January 26-27, 2004. The five-year review itself was conducted from November 2003 to March 2004.

5.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

MCAS Yuma personnel and the greater Yuma, Arizona, community were informed of the start of the review in November 2003 in a public notice printed in area newspapers:

The Sun (Yuma and regional newspaper)	Sunday, November 30, 2003
The Cactus Comet (MCAS Yuma newspaper)	Thursday, November 27, 2003

The notice stated the purpose of the five-year review at OU-1 under CERCLA, described the remedy for contaminated groundwater at Areas 1, 2, 3, and 6, and identified the types of COCs present. The restriction of future groundwater use

was identified as necessary to prevent unacceptable human-health risk that could result if the sites were used for residential purposes. The notice stated that the institutional controls for OU-1 were implemented through the Base Master Plan issued September 2001. The public notice is included in Appendix B.

A second public notice and a fact sheet are planned to notify the community of the findings upon completion of the Five-Year Review Report. In addition, the fact sheet will be sent to regulatory agency personnel and those community representatives who indicated interest in prior mailings concerning environmental restoration activities at MCAS Yuma. The Five-Year Review Report for OU-1 will be made available at the Yuma County Public Library, 350 South Third Avenue, Yuma, Arizona 85364-3897.

Other than the public notice the local community was not directly involved in the five-year review, because institutional controls are currently implemented only within the station to limit groundwater use by station tenants. Remedial actions have contained off-site plume migration. During the earlier phases of site RI and remedy selection and evaluation, interested community representatives had the opportunity to provide input on the remedial action. The project was managed to allow exchange of information and partnership among the community, Navy, U.S. EPA, and State of Arizona regulatory agencies by reviewing and commenting on technical documents relating to the ongoing environmental cleanup at MCAS Yuma. With remedial activities well under way at OU-1 and OU-2, public interest in CERCLA proceedings has declined.

5.3 DOCUMENT REVIEW

This five-year review for OU-1 consisted of a review of relevant documents issued prior to and since the construction of the remedial systems (see Appendix A). The documents reviewed included the RI report, the FS reports, Technical Memorandums, Remediation Progress reports, groundwater monitoring reports, aerial photographs, and compliance documents maintained by the MCAS Yuma Environmental Department.

In this review period, most documents have focused on remediation system operation and groundwater monitoring. These reports summarize the AS/SVE and VCT systems O&M and emissions monitoring. In addition to the system monitoring, quarterly groundwater monitoring results are presented. Analysis of all the data documenting trends and movement toward remediation goals is provided.

Other major documents prepared in the review period include the Land Use Control Implementation Plan (SWDIV, 2002b) and the Final Long Term Groundwater Monitoring Work Plan (BNI, 2002).

5.4 DATA REVIEW

The data review included examination of groundwater monitoring information, risk assessment information, and regulatory standards to identify any changes to the protectiveness of the selected remedies. The most recent sampling data was used in a screening evaluation of potential change in human-health risk for the Areas which is discussed in detail in Section 6.2.1 of this report.

Other chemicals detected in the groundwater during the past five years of monitoring include 1,2-DCA, which was detected exceeding the MCL of 5 µg/L in two wells at Area 2. However, the contaminant has not been detected in wells at Area 2 in subsequent sampling events. A sheen to thin layer (0.01 to 0.12 inches thick) of free petroleum contamination was detected at Area 3 in well A3-MW-07. No petroleum contamination was present in any nearby wells. The contamination appeared to be associated with mostly diesel fuel contamination the fire training activities. Plans are under way to investigate the source and nature of the petroleum contamination at Area 3.

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. Water quality parameters have also shown only minor changes outside of the zones where the remediation systems were applied. In general, the plumes have not shown any significant movement or expansion that would indicate any significant changes in the groundwater system.

Overall, contaminant concentrations have declined at OU-1. Table 4-1 summarizes the maximum detected concentration of COCs at Areas 1, 2, and 3 in the March 2004 sampling event. All CHC concentrations were below MCLs at Area 3. Chemical concentrations were near MCLs for Area 2, the Area 1 LEPA, and the Area 1 Central/Interior plume. The only chemicals detected at levels significantly higher than their MCLs were 1,1-DCE and TCE in the Building 230 area.

5.5 SITE INSPECTION

Inspections at OU-1 Areas 1, 2, and 3 were conducted on January 26-27, 2004, by personnel from Battelle and MCAS Yuma Environmental Department. OU-2 CAOCs 1, 8A, and 10 were also inspected for any changes since the last five-year review. The purpose of the site inspections was to review and document current site conditions at the Areas and evaluate visual evidence regarding the protectiveness of the remediation systems, monitoring equipment, and institutional controls. This effort included examining the condition, operation, and precision of the AS/SVE and VCT system equipment. It also included inspection of the monitoring wells used to assess the groundwater plumes and review of monitoring documents concerning OU-1. In addition to the site inspections performed for this report, the Marine Corps Headquarters completed an environmental compliance audit in December 2003. The purpose of the audit

was to review all environmental factors for the station. The only discrepancy noted in the outbrief regarded technical assistance grants availability. Otherwise the audit found that MCAS Yuma complies with CERCLA, SARA, and NCP laws.

The U.S. EPA Comprehensive Five-Year Review Guidance (OSWER 9355.7-03B-P) provides a site inspection checklist as well as the report template used for the development of this report. The modified site inspection checklists (the lists were changed slightly to focus on groundwater) completed during the site inspection for each Area are provided to document site conditions in Appendix C. Site photographs are included in Appendix E.

5.5.1 Area 1

The site inspection for the Area 1 Plume consisted of inspection of the AS/SVE system, the VCT system, monitoring wells associated with the area, and general land use. The AS/SVE system was operating during the inspection. The system was in working condition, properly labeled, properly secured, with adequate O&M. The VCT system was in working condition and properly labeled. Monitoring wells were in good condition. The site is mostly contained within the Station, and much of Area 1 is located within the airstrip 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 C1.

5.5.2 Area 2

Inspection of the Area 2 plume consisted of inspection of the wells used to monitor the plume and examination of land use in the area. All wells were in working order and properly secured. The site is located near the northeast boundary of the runway. Land use in the area was industrial with no groundwater extraction present. Details on the Area 2 inspection are provided in Appendix C2.

5.5.3 Area 3

Inspection of the Area 3 plume consisted of examination of monitoring wells and appraisal of land use in the area. Inspection of the Area 3 plume consisted of inspection of the wells used to monitor the plume and examination of land use in the area. All wells were in working order and properly secured. Land use in the area was industrial with no groundwater extraction present. Details on the Area 3 inspection are provided in Appendix C3.

5.5.4 OU-2

Inspection of the status of OU-2 CAOCs 1, 8A, and 10 indicated that there were no land use changes since the last five-year review. 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. There were no

new construction projects at the OU-2 CAOCs. A more detailed review of OU-2 is provided in the first five-year review (SWDIV, 2002a).

5.6 INTERVIEWS

MCAS Yuma personnel responsible for or familiar with current activities at OU-1 and OU-2 or with activities that took place over the past five years, were interviewed between January 26, 2004 and February 2, 2004 (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 D1; the interview records documenting the interviews are provided in Appendices D2 through D8.

None of the personnel interviewed knew of any significant changes to site conditions or land use at the Areas over the last five years. A summary presentation of additional observations made during the review's site inspections, personnel interviews, and regulatory agency comments is given below.

Carol Lewis, 27 January 2004

Carol Lewis is the Installation Restoration Project (IRP) manager for MCAS Yuma Environmental Department in charge of coordinating environmental activities for OU-1. The complete interview record for Ms. Lewis is provided in Appendix D2.

- Concentrations of COCs are generally declining across the site due to implementation of remedial actions. Area 6 was given no further action status, Areas 2 and 3 are approaching closure, the VCT system was temporarily shut down, and the AS/SVE system has been successful in the Building 230 Hot Spot.
- LUCIP specifies review of any new land or groundwater use for the station. Dig permits are effective in monitoring land use changes.
- O&M was addressed by routine maintenance and contractor presence on site.

H. Gil Guillory, 15 January 2004

Mr. Guillory was the director of the MCAS Yuma Environmental Department from October 2001 to early January 2004. The complete interview record for Mr. Guillory is provided in Appendix D3.

- The remedies for OU-1 are proceeding in the right direction in reducing CHCs to RAO objectives. State of the art remediation systems have been constructed and operated to address groundwater contamination.
- MCAS Yuma has taken an aggressive stance on institutional controls through review of excavation permits and construction plans for the entire station.
- The remedies have been optimized by the current contractor. Minor leaks and repairs are corrected through routine maintenance.

Joe Britain, 27 January 2004

Joe Britain is an environmental engineer and acting director of the MCAS Yuma Environmental Department. Mr. Britain was mainly involved in engineering support and land use controls at the station. The complete interview record for Mr. Britain is provided in Appendix D4.

- Land use controls were accounted for in any new construction through review by the MCAS Yuma Environmental Department.
- No indication of groundwater use in the area; any new wells would be discussed with the Environmental Department and ADEQ.

Chris Kost, 27 January 2004

Mr. Kost is an environmental protection specialist at the MCAS Yuma Environmental Department. Mr. Kost worked with OHM and IT during OU-1 remediation construction projects. The complete interview record for Mr. Kost is provided in Appendix D5.

- The remedies for OU-1 have been optimized recently by the current contractor and are working as planned.
- Some issues on high TDS in groundwater, condensation in the AS/SVE system, and electrical shorts had to be overcome during initial construction and O&M. The systems are working correctly now through routine maintenance.
- A petroleum sheen was found in Area 3.

Jon Coger, 27 January 2004

Mr. Coger is the Resident Officer in Charge of Construction (ROICC) at MCAS Yuma and supervises construction projects at the station. The complete interview record for Mr. Coger is provided in Appendix D6.

- The remedies are generally working as planned through monitoring of plumes, VCT system, and AS/SVE system.
- New development may impact existing groundwater monitoring wells, but is addressed in the LUCIP. Dig permits are required for any excavation and reviewed by the Environmental Department.

Angie Lind, 15 January 2004

Angie Lind is the Naval Facilities Engineering Command (NAVFAC) Lead Remedial Project Manager for MCAS Yuma. Ms. Lind directs OU-1 remediation activities for the Navy. The complete interview record for Ms. Lind is provided in Appendix D7.

- Progress on the remediation of OU-1 has been better than expected. The VCT system has reduced CHCs to MCLs in the LEPA area. MNA has

been effective as a remedy for Areas 2, 3, and 6. The AS/SVE system has recently been optimized to focus on the remaining Hot Spot.

- O&M is handled by the contractor and reviewed by NAVFAC and MCAS Yuma Environmental Department. Minor issues on the breakage of belts are addressed in hot summer months.
- Groundwater use is restricted on site. Drinking water comes from the Colorado River through the surface water treatment plant.

Don Bosch, 2 February 2004

Don Bosch is a NAVFAC Remedial Project Manager for MCAS Yuma. Mr. Bosch has been involved in recent CERCLA compliance activities at the Station for the Navy. The complete interview record for Mr. Bosch is provided in Appendix D8.

- The remedial action at the station is nearing completion based on declining concentrations demonstrated by routine groundwater monitoring, system operation, and groundwater modeling.
- Monitoring shows decreasing trends and plume containment. Results have been confirmed through groundwater modeling.
- The AS/SVE system was optimized with phase change by the current contractor.

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Section 6
TECHNICAL ASSESSMENT

The technical assessment for OU-1 and OU-2 presented in this section describes how each of the three key assessment questions was answered for OU-1 Areas 1, 2, and 3 and OU-2 CAOC 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.

6.1 QUESTION A

Are the remedies 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 and OU-2 are functioning to protect human health through implementation of remedial systems and institutional controls on land and groundwater use. The OU-1 remediation systems consist of an AS/SVE and VCT system for Area 1. MNA and institutional controls were selected for OU-1 Areas 1, 2, and 3. Institutional controls were applied as the remedy for OU-2 CAOC 1, 8A, and 10.

For OU-1, the AS/SVE system has operated relatively continuously in the Building 230 area since November 1999. The VCT system operated relatively continuously in the LEPA area from June 2000 to May 2003. The required institutional controls were implemented by DON and the Marine Corps with the signing of the OU-1 ROD in October 2000 and the formal inclusion of the LUCs for OU-1 in the 2001 MCAS Yuma Master Plan, the 2002 Final LUCIP, and the 2002 MCAS Yuma Station Order 5090.

The AS/SVE system was constructed from June-November 1999 and system operation was started November 16, 1999, operating relatively continuously up to the present. The system was designed to reduce CHC concentrations in the Building 230 area by injecting air into the subsurface in air sparge wells and recovering the vapors in the soil vapor extraction wells. A total of 43 air sparge wells were installed in the Hot Spot of the CHC plume. Since 1998, maximum TCE concentrations in the Building 230 area have been reduced from 290 µg/L in 1998 to 62 µg/L in March 2004. Maximum 1,1-DCE concentrations have been reduced from 300 µg/L in 1998 to 20 µg/L in March 2004. The system has removed approximately 79 lbs of volatile chemicals from the groundwater. The overall size of the plume in the Building 230 area has also decreased substantially. This information suggests that the AS/SVE system has functioned as intended in remediation of the groundwater plume in the Building 230 area.

The VCT system was constructed from February 2000 to June 2000. The system started operation in June 2000 and was stopped on May 6, 2003 after CHC concentrations were reduced below MCLs. The system was designed to reduce CHC concentrations and contain the plume in the LEPA area by withdrawing contaminated groundwater and reinjecting clean water into the aquifer. Monitoring data indicated that CHC concentrations in the LEPA area

were sustained below MCLs so the system was shut down on May 6, 2003. Monitoring of the groundwater continues as part of the LTM during this temporary shutdown period. The VCT has functioned as intended in containing and treating groundwater contamination in the LEPA area.

Groundwater modeling was performed to ensure that the remediation systems selected for the Area 1 plume would work as intended and prevent any migration of the Area 1 plume (BNI, 2002; Battelle, 2003). The movement and behavior of the plume was simulated with groundwater flow and transport models in light of the effects of the remediation systems. The model suggested that the LEPA plume would not migrate and would be reduced to below MCLs by approximately 2003. This was confirmed by groundwater monitoring which evidenced that the LEPA plume was reduced to MCLs in the most recent sampling events. The model also showed that the reductions in plume concentrations at the Building 230 area caused by the AS/SVE system would limit plume expansion. Future simulations indicated that the plume would not migrate off-site and would be reduced to MCLs by approximately 2020.

MNA was the selected remedy for Areas 1, 2, 3, and 6. The plumes were monitored for contaminants and MNA chemical indicators. Overall, the monitoring indicated that the plumes are decreasing in size and magnitude through natural processes. There was no indication of significant plume migration. The Area 6 plume was given a no further action closure. Consequently, the remedy for Areas 2, 3, and 6 has worked as intended.

Institutional controls were selected for all Areas to limit use of groundwater from OU-1 and land use for OU-2. The MCAS Yuma Master Plan was updated in September 2001 with the institutional controls for Areas 1, 2, 3, and 6 in OU-1 and CAOC 1, 8A, and 10 in OU-2. The Final LUCIP, issued in September 2002, was subsequently developed to provide the details for implementing LUCs for OU-1 and OU-2 and included a description of the institutional controls and access and notification provisions. The LUCs were also formally implemented for MCAS Yuma by Station Order 5090, which directed tenants and contractors to incorporate the LUCs into existing land-use planning and management systems. The MCAS Yuma Station Order 5090 was signed in January 2002 (see Appendix B2).

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 the 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.

6.2 QUESTION B

Are the exposure assumptions, toxicity data, cleanup levels, and RAO used at the time of remedy selection still valid? Yes.

The following subsections discuss the information evaluated in answering this question on the basis of human-health and ecological risk assessment, federal and state regulations evaluated as potential ARARs for the remedial action, and achievement of the RAO.

6.2.1 Human-Health and Ecological Risk Assessments

Toxicity factors for COCs, contaminant characteristics, and standardized risk assessment methodologies used in prior risk assessments for the Areas were evaluated for changes over the last five years. The following summarizes findings of the human-health and ecological risk reevaluation:

- No new human-health or ecological routes of exposure or receptors have been identified. No changes in previously identified receptors or exposure routes have occurred that could affect the protectiveness of the remedy.
- No new ecological risks or receptors or impacts due to natural disasters have been identified for OU-1, OU-2, or MCAS Yuma in general. No threatened or endangered species have been identified for these Areas.
- Regulatory agency comments on the Draft LUCIP did not indicate that changes with regard to the evaluation of human-health risk had been identified or needed to be addressed at this time.
- The Final LUCIP provides an institutional control program that requires that ADEQ and U.S. EPA be informed in advance of any proposed changes in land use for the sites and that the effectiveness of the existing ICs and the remedy as a whole be reevaluated at that time.
- No indicators of change in land use at Areas 1, 2, and 3 or CAOC 1, 8A, and 10 have been identified as a result of interviews, site visits, or document reviews.

A review of potential human-health risk for exposure to groundwater and soil at the Areas was conducted in order to determine the need for a more extensive evaluation. The human-health risk assessments performed for the RODs for OU-1 and OU-2 used U.S. EPA exposure factors, cancer slope factors, and reference doses to estimate the risk from drinking groundwater (oral route) from the site for residential groundwater-use scenarios. Review of these values indicated that only the chronic reference dose for 1,1-DCE has been revised by the U.S. EPA within the five-year review period. The chronic reference dose for 1,1-DCE was revised from 0.009 mg/kg-day to 0.05 mg/kg-day effective August 13, 2002. This new chronic reference dose is higher than the previous value, which means that 1,1-DCE is not considered as hazardous as previously provided. Consequently, the new

toxicity value would suggest a lower contribution to the hazard index than previously calculated. In addition, the concentrations of all COCs in OU-1 have been declining. No risk factors have changed that would affect the protectiveness of the selected remedies. A more detailed human-health risk assessment is not warranted at this time.

6.2.2 Applicable or Relevant and Appropriate Requirements

No new ARARs have been identified for the OU-1 or OU-2 based on review of the federal and state regulations initially evaluated for OU-1 in the FS (JEG, 1998) and ROD (SWDIV, 2000). In addition, no new ARARs for institutional controls were identified based on a review of other regulations, requirements, and guidance currently considered by DON during the five-year review process.

ADEQ's comments on the Draft (Revision 1) LUCIP indicated that no additional regulations would need to be considered, apart from meeting the requirements of Ariz. Rev. Stat. §§ 49-151 and 49-152 for recording for each site environmental use restrictions in DEURs. The Navy believes that the proposed "modified DEURs" in the Final LUCIP satisfy the requirements in the OU-2 ROD for the execution and recordation of LUCs with the state of Arizona and meet the substantive intent of A.R.S 49-152(E). The language in the "modified DEURs" was developed to reflect the fact that they were not "a covenant running with the land" and that "no interest in real property" was being created (see Section 4.1.2 for more information). These "modified DEURs" are needed to provide for registration of the LUCs with the state of Arizona without compromising the Navy's other responsibilities under CERCLA and federal property law.

6.2.3 Achievement of RAOs

The RAOs were selected to protect potential receptors from health risks that could arise from a change in land or groundwater use. RAOs for OU-1 were to reduce CHC concentrations in the groundwater to MCLs and to restrict groundwater use through LUCs. LUCs consisted of institutional controls preventing the use of groundwater originating from OU-1. MCLs for the chemicals at OU-1 have not changed since the ROD was signed in October 2000. The MCL remains 7 µg/L for 1,1-DCE, 5 µg/L for TCE, and 5 µg/L for PCE. The RAO for OU-2 was to restrict land use through institutional controls. The RAOs are still valid for OU-1 and OU-2.

6.3 QUESTION C

Has any other information come to light that could call into question the protectiveness of the remedies? No.

No additional information has been found that suggests that the remedial systems for OU-1 Areas 1, 2, and 3 as currently defined in the ROD (SWDIV, 2000) may not be protective as the selected remedy, so long as groundwater is not used from the sites where RAOs have not been achieved. No additional

information has been found that suggests that the remedies for OU-2 CAOCs 1, 8A, and 10 may not be protective as the selected remedy, so long as institutional controls are maintained as currently defined in the ROD (SWDIV, 1997).

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Section 7
ISSUES, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS

This section discusses issues, recommendations, and follow-up actions in tabular form.

7.1 ISSUES

Table 7-1 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 7-1. Issues

Issues	Affects Current Protectiveness (Yes/No)	Affects Future Protectiveness (Yes/No)
A petroleum sheen to thin layer was observed in well A3-MW-07 in Area 3. The contamination was first noticed on December 28, 2001 and confirmed in subsequent events. Analysis of the substance indicates that it is mostly diesel contamination that may be related to the materials used in the fire training area. There is no evident source to the contamination, and petroleum hydrocarbon chemicals are not present in surrounding wells. The contamination is isolated and not an immediate threat to human health due to institutional controls on groundwater use.	No	No

7.2 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 7-2 summarizes the recommendations made to address the issues identified for OU-1 Areas 1, 2, 3, and 6 in Table 7-1.

Table 7-2. Recommendations and Follow-up Actions

Issue No.	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Yes/No)	
					Current	Future
1	Investigate the petroleum hydrocarbon contamination found at Area 3 to evaluate its potential impact on groundwater in Area 3. Continued monitoring and remediation of the contamination if necessary.	SWDIV	DON	Review signing date	No	No

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Section 8
PROTECTIVENESS STATEMENT

The remedy at OU-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. These methods are being applied as follows:

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. The system has reduced CHC concentrations to near MCLs and contained any 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 from November 1999 to present. The AS/SVE system has reduced the CHC Hot Spot in both size and magnitude such that the COCs will not migrate off site at concentrations greater than MCLs.
2) MNA will be applied at all Areas to demonstrate the reduction of contaminant concentrations through natural processes and ensure that the plumes are not migrating. Groundwater monitoring required for the MNA program will be implemented through the LTM plan for OU-1 at MCAS Yuma. Plumes will continue to be monitored until they decrease in concentrations below MCLs.
3) Institutional controls are in place to restrict exposure to any contaminated groundwater at Areas 1, 2, and 3 through MCAS Yuma Station Order 5090 (issued on January 10, 2002). This order formally directs tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan and the Final LUCIP into their existing land-use planning and management programs.
4) The MCAS Yuma Environmental Department will continue to review dig/building permits at Areas 1, 2, and 3.

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 as follows:

5) Institutional controls are in place to restrict exposure to contaminants in soil at CAOCs 1, 8A, and 10 through MCAS Yuma Station Order 5090 (issued on January 10, 2002). This order formally directed tenants and contractors to incorporate the LUCs provided in the MCAS Yuma Master Plan and the Final LUCIP into their existing land-use planning and management programs.
6) The “modified DEURs” for CAOCs 1, 8A, and 10 have been proposed to satisfy the requirements specified in the OU-2 ROD for registration of the sites with the state of Arizona.

The MCAS Yuma Environmental Department will continue to review dig/building permits.

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Section 9
NEXT REVIEW

The next five-year review for MCAS Yuma OU-1 and OU-2 will be due five years (2009) from the date on which this document is signed. Consecutive five-year reviews will be required as long as site groundwater conditions remain that do not allow for unlimited use and unrestricted exposure.