FINAL
CERCLA FIVE-YEAR REVIEW REPORT OPERABLE UNITS 1A, 1B NORTH, 1B SOUTH, AND 3 (INSTALLATION RESTORATION PROGRAM SITES 13S, 12, 3, AND 1)

FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

October 31, 2011

Prepared for:
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California

Prepared under:
Naval Facilities Engineering Command
Contract Number N62473-10-C-4409
Contract Task Order 0000
DCN: ECS-4409-0000-0101

CERCLA Five-Year Review Report

for

Operable Units 1A, 1B North, 1B South, and 3
(Installation Restoration Program Sites 13S, 12, 3, and 1)

Former Marine Corps Air Station Tustin, California

October 31, 2011

PREPARED FOR:

Base Realignment and Closure

Program Management Office West

San Diego, California

Approved by: James T. Callian

James T. Callian
BRAC Environmental Coordinator
Former Marine Corps Air Station Tustin

Date: 10/31/2011

(THIS PAGE LEFT INTENTIONALLY BLANK)

TABLE OF CONTENTS

APPROVAL PAGE.....i
ACRONYMS AND ABBREVIATIONS.....ix
EXECUTIVE SUMMARY.....xiii
SUMMARY FORM – FIVE-YEAR REVIEW.....xxi
1. INTRODUCTION.....1-1
1.1 BACKGROUND.....1-1
1.2 FIVE-YEAR REVIEW AUTHORITY AND GENERAL APPROACH.....1-4
2. SITE CHRONOLOGY.....2-1
3. BACKGROUND.....3-1
3.1 ENVIRONMENTAL SETTING.....3-1
3.1.1 Geology and Hydrogeology.....3-1
3.1.2 Surface Water Hydrology.....3-2
3.2 IRP-1.....3-2
3.2.1 Physical Characteristics.....3-2
3.2.2 Land and Resource Use.....3-3
3.2.3 Re-Use.....3-3
3.2.4 Site History.....3-3
3.2.5 Initial Response.....3-4
3.2.6 Basis for Taking Action.....3-4
3.2.6.1 Summary of Human Health Risk Assessment – IRP-1.....3-4
3.2.6.1.1 Summary of Exposure Assessment.....3-4
3.2.6.1.2 Summary of Site Risks Associated with Sediment and Surface Water.....3-5
3.2.6.1.3 Summary of Site Risks Associated with Groundwater.....3-6
3.2.6.2 Summary of Ecological Risk Assessment.....3-7
3.2.6.3 Basis for Taking Action.....3-7
3.3 IRP-3.....3-8
3.3.1 Physical Characteristics.....3-8
3.3.2 Land and Resource Use.....3-8
3.3.3 Re-Use.....3-8
3.3.4 Site History.....3-8
3.3.5 Initial Response.....3-9
3.3.6 Basis for Taking Action.....3-11
3.3.6.1 Summary of Human Health Risk Assessment (HHRA).....3-11
3.3.6.2 Summary of Ecological Risk.....3-13
3.3.6.3 Basis for Taking Action.....3-13
3.4 IRP-12.....3-13
3.4.1 Physical Characteristics.....3-13
3.4.2 Land and Resource Use.....3-13
3.4.3 Re-Use.....3-13
3.4.4 Site History.....3-14
3.4.5 Initial Response.....3-14
3.4.6 Basis for Taking Action.....3-17
3.4.6.1 Summary of Human Health Risk Assessment.....3-17
3.4.6.2 Summary of Ecological Risk.....3-20
3.4.6.3 Basis for Taking Action.....3-20
3.5 IRP-13S.....3-20
3.5.1 Physical Characteristics.....3-20
3.5.2 Land and Resource Use.....3-20
3.5.3 Re-Use.....3-20

3.5.4 Site History ... 3-21
3.5.5 Initial Response ... 3-21
3.5.6 Basis for Taking Action ... 3-23
3.5.6.1 Summary of HHRA ... 3-23
3.5.6.1.1 Residential Risk Under Current Conditions with Beneficial Use of Groundwater ... 3-23
3.5.6.1.2 Residential Risk Under Future Conditions with Beneficial Use of Groundwater ... 3-23
3.5.6.1.3 Residential Risk with No Beneficial Use of Groundwater ... 3-24
3.5.6.1.4 Summary ... 3-24
3.5.6.2 Summary of Ecological Risk ... 3-25
3.5.6.3 Basis for Taking Action ... 3-25

4. REMEDIAL ACTIONS ... 4-1

4.1 IRP-1 (OU-3) ... 4-1
4.1.1 Remedy Selection ... 4-1
4.1.2 Remedy Implementation ... 4-1
4.1.2.1 Monitoring ... 4-1
4.1.2.1.1 LFG Monitoring ... 4-2
4.1.2.1.2 Groundwater Monitoring and Sampling ... 4-2
4.1.2.1.3 Surface Water Sampling ... 4-2
4.1.2.2 Inspections ... 4-2
4.1.2.3 Reporting ... 4-3
4.1.3 Problems Encountered ... 4-3
4.2 IRP-3, -12, AND -13S (OU-1B SOUTH, OU-1B NORTH, AND OU-1A) ... 4-3
4.2.1 Remedy Selection ... 4-3
4.2.2 Remedy Implementation ... 4-4
4.2.2.1 Soil Hot Spot Excavation ... 4-4
4.2.2.2 Groundwater Extraction ... 4-5
4.2.2.3 Groundwater Treatment ... 4-7
4.2.2.4 Treated Groundwater Discharge ... 4-8
4.2.2.5 Performance Monitoring ... 4-9
4.2.2.6 Institutional Controls ... 4-9
4.2.2.7 Periodic Reviews ... 4-10
4.2.2.8 Operation and Maintenance ... 4-11
4.2.2.8.1 Extraction Well Shutdown Criteria ... 4-11
4.2.2.8.1.1 Hot Spot Extraction Wells ... 4-11
4.2.2.8.1.2 Hydraulic Containment Wells ... 4-12
4.2.3 Problems Encountered ... 4-12

5. PROGRESS SINCE THE LAST REVIEW ... 5-1

5.1 IRP-1 ... 5-1
5.1.1 First Five-Year Review Summary ... 5-1
5.1.2 Progress Since First Five-Year Review ... 5-1
5.2 IRP-3, -12, AND -13S ... 5-1

6. FIVE-YEAR REVIEW PROCESS ... 6-1

6.1 ADMINISTRATIVE COMPONENTS ... 6-1
6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT ... 6-2
6.3 DOCUMENT REVIEW ... 6-2
6.4 DATA REVIEW ... 6-3
6.4.1 IRP-1 ... 6-3
6.4.1.1 LFG Data ... 6-3
6.4.1.2 Surface Water Concentration data ... 6-3
6.4.1.3 Groundwater Level Data ... 6-3
6.4.1.4 Groundwater Concentration Data ... 6-4
6.4.1.5 IC Compliance Data ... 6-4
6.4.2 IRP-3, -12, and -13S ... 6-4

6.4.2.1 Groundwater Level Data 6-5
6.4.2.2 Groundwater Concentration Data 6-5
6.4.2.3 Hydraulic Containment and Hot Spot Mass Removal Data 6-5
6.4.2.4 Groundwater Treatment System Performance Data 6-6
6.4.2.5 Treated Groundwater Discharge Data 6-6
6.4.2.6 IC Compliance Data 6-6
6.5 SITE INSPECTIONS 6-7
6.6 INTERVIEWS 6-10

7. TECHNICAL ASSESSMENT 7-1

7.1 IRP-1 7-1
7.1.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents? 7-1
7.1.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid? 7-2
7.1.2.1 Exposure Assumptions 7-2
7.1.2.2 Toxicity Data and Effect on Health Risk 7-2
7.1.2.3 Cleanup Levels and RAOs 7-3
7.1.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy? 7-3
7.1.4 Technical Assessment Summary 7-3
7.2 IRP-3, -12, AND -13S 7-4
7.2.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents? 7-4
7.2.1.1 Capture Zone Analyses 7-5
7.2.1.2 Hot Spot Mass Removal 7-7
7.2.1.3 Performance of Institutional Controls 7-8
7.2.1.4 Question A Summary and Conclusion 7-9
7.2.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid? 7-9
7.2.2.1 Exposure Assumptions 7-9
7.2.2.2 Toxicity Data and Effect on Health Risk 7-9
7.2.2.2.1 Changes to Toxicity Criteria 7-9
7.2.2.2.2 Effects on Health Risk 7-10
7.2.2.2.2.1 Groundwater Exposure Routes 7-10
7.2.2.2.2.2 Vapor Intrusion Exposure Route 7-11
7.2.2.2.3 NCP Point of Departure Analysis 7-13
7.2.2.2.3.1 Exposure Factors 7-13
7.2.2.2.3.2 Uncertainty Factors 7-14
7.2.2.2.3.3 Technical Limitation Factors 7-15
7.2.2.2.3.4 NCP Point of Departure Conclusion 7-15
7.2.2.3 Cleanup Levels and RAOs 7-15
7.2.2.4 Question B Summary and Conclusion 7-16
7.2.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy? 7-17
7.2.4 Technical Assessment Summary 7-17

8. ISSUES 8-1

9. RECOMMENDATIONS AND FOLLOW-UP ACTIONS 9-1

9.1 IRP-1 9-1
9.2 IRP-3, -12, AND -13S 9-1

10. PROTECTIVENESS STATEMENT 10-1

10.1 IRP-1 10-1
10.2 IRP-3, -12, AND -13S 10-1

11. NEXT REVIEW 11-1

12. REFERENCES 12-1

TABLES

Table ES-1 Current Status of OU-1A, -1B North, -1B South, -3, and -4B.....xiv
Table 1-1 Current Status of OU-1A, -1B North, -1B South, -3, and -4B.....1-2
Table 2-1 Chronology of Response Actions.....2-1
Table 6-1 Details of Site Inspections.....6-7
Table 6-2 List of Interviewees - IRP-1, -3, -12, and -13S.....6-10

FIGURES

Figure 1 Former MCAS Tustin Location Map
Figure 2 IRP-1 (OU-3) Site Plan
Figure 3 IRP-3 (OU-1B South) Site Plan
Figure 4 IRP-13S and -12 (OU-1A/-1B North) Site Plan
Figure 5 Generalized Geologic Cross Section
Figure 6 IRP-1 (OU-3) First WBZ Groundwater Level Elevations - Second Quarter 2010
Figure 7 IRP-1 (OU-3) Second WBZ Groundwater Level Elevations - Second Quarter 2010
Figure 8 IRP-1 (OU-3) TPH and VOC Concentrations - 2006-2010, First WBZ
Figure 9 IRP-1 (OU-3) TPH and VOC Concentrations - 2006-2010, Second WBZ
Figure 10 IRP-1 (OU-3) Inorganic Concentrations - 2006-2010, First WBZ
Figure 11 IRP-1 (OU-3) Inorganic Concentrations - 2006-2010, Second WBZ
Figure 12 IRP-3 (OU-1B South) First WBZ Groundwater Level Elevations – Fourth Quarter 2010
Figure 13 IRP-3 (OU-1B South) Second WBZ Groundwater Level Elevations – Fourth Quarter 2010
Figure 14 IRP-12 and -13S (OU-1B North/OU-1A) First WBZ Groundwater Level Elevations - Fourth Quarter 2010
Figure 15 IRP-12 and -13S (OU-1B North/OU-1A) Second WBZ Groundwater Level Elevations - Fourth Quarter 2010
Figure 16 IRP-12 and -13S (OU-1B North/OU-1A) Third WBZ Groundwater Level Elevations - Fourth Quarter 2010
Figure 17a IRP-3, -12, and -13S (OU-1A/-1B) First & Second WBZ Groundwater VOC Plume Boundaries - 2004-2010 (1 of 2)
Figure 17b IRP-3, -12, and -13S (OU-1A/-1B) First & Second WBZ Groundwater VOC Plume Boundaries - 2004-2010 (2 of 2)
Figure 18 IRP-3 (OU-1B South) First WBZ Gradient Vector Map
Figure 19 IRP-3 (OU-1B South) Second WBZ Gradient Vector Map
Figure 20 IRP-12 (OU-1B North) First WBZ Gradient Vector Map
Figure 21 IRP-13S (OU-1A) First WBZ Gradient Vector Map
Figure 22 IRP-13S (OU-1A) Second WBZ Gradient Vector Map
Figure 23 IRP-3 (OU-1B South) Vapor Intrusion Risk Contours
Figure 24 IRP-12 (OU-1B North) and -13S (OU-1A) Vapor Intrusion Risk Contours

APPENDICES

Appendix A List of Documents Reviewed
Appendix B Land Use Controls Compliance Certificates
Appendix C Site Inspection Checklists
Appendix D Site Inspection Photographs
Appendix E Interview Documentation
Appendix F Vapor Intrusion Evaluation
Appendix G Responses to Comments

(THIS PAGE LEFT INTENTIONALLY BLANK)

ACRONYMS AND ABBREVIATIONS

ANL	Argonne National Laboratory
AOC	area of concern
AOPC	area of potential concern
ARAR	applicable or relevant and appropriate requirement
ARIC	area requiring institutional control
AS	aerial photograph, storage or possible temporary storage
AST	aboveground storage tank
BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
CAO	cleanup and abatement order
CAPE	Cape Environmental Management, Inc.
CAL/EPA	California Environmental Protection Agency
CDM	Camp, Dresser & McKee (CDM) Federal Programs
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEG	Certified Engineering Geologist
CFC	chlorofluorocarbon
C.F.R.	Code of Federal Regulations
CHG	Certified Hydrogeologist
CIWMB	California Integrated Waste Management Board
CO	carve-out
COC	chemical of concern
COPC	chemical of potential concern
CRUP	covenant to restrict use of property
CSF	cancer slope factor
DCA	dichloroethane
DCE	dichloroethene
DoN	Department of the Navy
DSD	disposal, storm drain
DSS	disposal, sanitary sewer
DTSC	Department of Toxic Substances Control
ECS	Enviro Compliance Solutions, Inc.
e.g.	for example
EPC	exposure point concentration
ERA	ecological risk assessment
ERRG	Engineering/Remediation Resources Group, Inc.
ESD	explanation of significant differences
ESI	expanded site inspection
FEAD	Facility Engineering Acquisition Division

FFSRA	Federal Facility Site Remediation Agreement
FOSET	Finding of Suitability for Early Transfer
FOSL	Finding of Suitability to Lease
FOST	Finding of Suitability for Transfer
Freon 112	1,1,2,2-tetrachloro-1,2-difluoroethane
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
FS	feasibility study
ft	feet
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
GSE	ground support equipment
H	helicopter
HDPE	high density polyethylene
HHRA	human-health risk assessment
HI	hazard index
HQ	hazard quotient
IAS	initial assessment study
IC	institutional control
i.e.	that is
IDL	instrument detection limit
I-RACR	interim remedial action completion report
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IRWD	Irvine Ranch Water District
IT	The IT Group
J&E	Johnson and Ettinger (vapor intrusion model)
JEG	Jacobs Engineering Group, Inc.
JMM	James M. Montgomery Consulting Engineers, Inc.
JP-5	jet propellant grade 5
LFG	landfill gas
LIFOC	Lease-in-Furtherance-of-Conveyance
LRA	Local Redevelopment Authority
LTA	lighter than air
LTMP	long term monitoring plan
LUC	land-use control
LUCCC	land-use control compliance certificate
LUCICP	land-use control implementation and compliance plan
LUC RD	land-use control remedial design
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCAF	Marine Corps Air Facility
MCAS	Marine Corps Air Station
MCL	maximum contaminant level in drinking water
MDA	miscellaneous, potential disposal area

Messrs.	plural form of "Mr."
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MPA	Mingled Plumes Area
MMS	miscellaneous, major spill
MT3D	mass transport - three dimensional (groundwater model)
MTBE	methyl *tert*-butyl ether
MSL	mean sea level
MWA	miscellaneous, wash area
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTCRA	non-time critical removal action
O&M	operation and maintenance
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District
OEHHA	Office of Environmental Health Hazard Assessment
OHM	OHM Remediation Services, Inc.
OMP	operation and maintenance plan
OPS	operating properly and successfully
OU	operable unit
O/W	oil/water (as in oil/water separators)
PAH	polycyclic aromatic hydrocarbon, also polynuclear aromatic hydrocarbon
PCAP	Petroleum Corrective Action Program
PCB	polychlorinated biphenyl
PE	licensed professional engineer
PG	registered professional geologist
PERF	project environmental review form
PHG	public health goal
PLC	programmable logic controller
PMO	Program Management Office
PTES	Pacific Treatment Environmental Services
QAPP	Quality Assurance Project Plan
QC	quality control
RAB	Restoration Advisory Board
RACR	remedial action completion report
RAO	remedial action objective
RAP	remedial action plan
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RFA	RCRA facility assessment
RfC	reference concentration

RfD	reference dose
RG	remediation goal
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
RWQCB	California Regional Water Quality Control Board, Santa Ana Region
§	section
SAP	Sampling and Analysis Plan
Shaw	Shaw Environmental, Inc.
SI	site investigation
SIM	selected ion monitoring
SPDP	special purpose discharge permit
SP/RP	Specific Plan/Reuse Plan
ST	storage, temporary
STD	storage, designated hazardous waste
TCA	trichloroethane
TCE	trichloroethene
TCP	trichloropropane
TCRA	time-critical removal action
TDS	total dissolved solids
TOW	treatment, oil/water separator
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
UCL	upper confidence limit
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride
VI	vapor intrusion
VEE	vacuum-enhanced extraction
VOC	volatile organic compound
WBZ	water-bearing zone

EXECUTIVE SUMMARY

This Report presents the results of the five-year review for four Sites located at former Marine Corps Air Station (MCAS) Tustin, California. The four Sites addressed in this Report are Operable Unit 1A (OU-1A), OU-1B North, OU-1B South, and OU-3. These are also referred to as Installation Restoration Program (IRP) Site 13S (IRP-13S), IRP-12, -3, and -1, respectively. This is the first five year review for OU-1A, -1B North, and -1B South, and is the second five year review for OU-3.

The purpose of the five-year review is to evaluate whether the remedies implemented at OU-1A, -1B North, -1B South, and -3 are functioning as intended by the respective Records of Decision (RODs)/Remedial Action Plans (RAPs) (Department of the Navy [DoN] 2001, 2004b, 2004c) and remain protective of human health and the environment.

Three additional Sites in OU-4B, termed "low concentration" Sites (IRP-11, -13W, and Miscellaneous, Major Spill [MMS]-04) are also discussed briefly in this Report. The selected remedy for these Sites is institutional controls (ICs). The remedy for MMS-04 was recently implemented with the completion of the Remedial Action Completion Report (RACR) in 2011. The RACR documented that concentrations of Site chemicals of concern (COCs) are below remediation goals (RGs); therefore, no further action (NFA) is warranted (AIS-TN&A JV 2011). The trigger date for the five-year reviews for IRP-11 and -13W was the ROD signature date; however, the selected remedies have not yet been fully implemented since the Remedial Design (RD) for these Sites is currently in preparation. Insufficient time has passed to adequately evaluate the selected remedies for these OU-4B low concentration Sites; therefore, they were not subjected to the comprehensive five-year review process described in this Report. They will be addressed in the next five-year review.

Authority for Conducting Five-Year Reviews

The DoN is the lead agency for conducting five-year reviews at former MCAS Tustin under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The DoN has conducted this five-year review pursuant to CERCLA Section (§) 121(c) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In addition, the DoN policy for conducting CERCLA five-year reviews (DoN 2011), and the United States Environmental Protection Agency's (U.S. EPA's) five-year review guidance (U.S. EPA 2001) were used in preparation of this Five-Year Review Report.

In accordance with the DoN policy for conducting CERCLA five-year reviews, the first site on an installation that triggers the five-year review triggers the five-year review clock for the entire installation. The Final ROD/RAP for IRP-1 was published in December 2001 (DoN 2001) and the selected remedy included remedial actions that had already been completed or begun earlier and were already underway; therefore, the triggering date for beginning the first five year review period for former MCAS Tustin was the date of the IRP-1 ROD/RAP (i.e. December 20, 2001). The first five-year review for IRP-1 was conducted in 2006 (Enviro Compliance Solutions, Inc. [ECS] 2006). In 2006, remedial action implementation had not yet begun at other IRP sites at former MCAS Tustin. Since 2007, remedial action has been implemented and is ongoing at IRP-3, -12, and -13S.

The second five-year review for IRP-1 is due on October 31, 2011, which is five years from the signature date of the first five-year review. In order to streamline and synchronize the

five-year reviews, the first five-year reviews for IRP-3, -12, and -13S were conducted concurrently with the second five-year review for IRP-1, and the results are presented in this combined Report. This approach is consistent with the Federal Facility Site Remediation Agreement (FFSRA) between the DoN and the State of California Environmental Protection Agency Department of Toxic Substances Control (DTSC) (DoN 1999), and is consistent with the DoN policy and U.S. EPA guidance.

Status of IRP Sites Addressed in the Five-Year Review

The current status of the sites addressed in this Five-Year Review Report is summarized in the following table.

Table ES-1 : Current Status of OU-1A, -1B North, -1B South, -3, and -4B

Site I.D.	Current Status
OU-1A, -1B North, and -1B South (IRP-13S, -12, and -3)	The selected remedy for groundwater at the three sites is hydraulic containment with hot spot mass removal (DoN 2004b,c). The ROD/RAPs also documented NFA for soil at these three Sites. Major remedy components include: • Two groundwater extraction and treatment systems (OU-1A/-1B North, and OU-1B South); • Groundwater monitoring; and • ICs. COCs identified for groundwater at OU-1A are: • trichloroethene (TCE) and • 1,2,3-trichloropropane (TCP). COCs identified for groundwater at OU-1B are: • TCE; • 1,1-dichloroethane (DCA); • 1,1-dichloroethene (DCE); • 1,1,2-trichloroethane (TCA); • 1,2-DCA; and • 1,2-DCE. Major documents/events include: • Remedy implementation in 2007; • OU-1A/-1B North system startup December 7, 2007; • OU-1B South system startup January 2, 2008; • Performance monitoring began during the first quarter 2008; • Operating Properly and Successfully (OPS) demonstration February 2010 (ECS 2010c); • U.S. EPA determination of OPS (U.S. EPA 2009c); • DTSC and California Regional Water Quality Control Board, Santa Ana Region (RWQCB) concurrence with OPS (DTSC 2010, RWQCB 2010a). Current ongoing activities include: • Operation and maintenance (O&M) of the remedy

Site I.D.	Current Status
	components; • Groundwater monitoring and reporting; • IC monitoring and reporting.
OU-3(IRP-1)	The selected remedy is containment (DoN 2001). Major remedy components include: • Containment of impacted groundwater utilizing the existing reinforced concrete containment wall along the west bank of Peters Canyon Channel; • Groundwater, surface water, and landfill gas (LFG) monitoring; and • ICs. The following COCs were identified for groundwater: • 1,1-DCA; • 1,1-DCE; • 1,2-dichlorobenzene; • 1,4-dichlorobenzene; • benzene; • chlorobenzene; • ethylbenzene; • TCE; • vinyl chloride (VC); • antimony; • arsenic; • cadmium; • manganese; • molybdenum; • thallium. Major documents/events include: • Remedy implementation beginning in 1986 (the ROD was signed in 2001 and the selected remedy incorporated pre-existing remedy components); • OPS demonstration (Pacific Treatment Environmental Services [PTES] and Tetra Tech, 2003); • Agency determination of OPS (U.S. EPA 2004), • DTSC and RWQCB concurrence with OPS (DTSC 2004, RWQCB 2003); • First five-year review (ECS 2006). Current ongoing activities include: • O&M of the remedy components; • Groundwater, surface water, and LFG monitoring and reporting; and • IC monitoring and reporting.

Site I.D.	Current Status
OU-4B (IRP-11, -13W, and MMS-04	These three Sites in OU-4B are termed "low concentration" Sites. The selected remedy for these Sites is ICs. The remedy for MMS-04 was completed in 2011; the agency concurred RACR documented that the terms of the Final ROD/RAP were met; the remedial action objectives (RAOs) and RG had been achieved, that Soil at the Site required NFA, and the Site was protective of human health and the environment (AIS-TN&A JV 2011). The trigger date for the five-year reviews for IRP-11 and -13W is the ROD signature date; however, the selected remedies have not yet been fully implemented since the RD for these Sites and are currently in preparation. Insufficient time has passed to adequately evaluate the selected remedies for these low concentration Sites; therefore, they were not subjected to the comprehensive five-year review process described in this Report. They will be addressed in the next five-year review.

Five-Year Review Process

In accordance with DoN policy and U.S. EPA guidance, the five-year review process at the four sites addressed in this Report consisted of the following components:

Community notification and involvement: In accordance with DoN policy, the primary vehicle for community participation is the Restoration Advisory Board (RAB) which consists of interested community members and stakeholders. The RAB for former MCAS Tustin is co-chaired by the DoN's Base Realignment and Closure (BRAC) Environmental Coordinator (BEC) Mr. James Callian, and a community leader, Mr. Don Zweifel. Notification of the five-year review process was provided to the RAB by email on March 3, 2011, and by means of a presentation at a RAB meeting on May 18, 2011. Notification was provided to the community at large through a newspaper advertisement. The email and RAB presentation notifications included invitations to participate and provide comments. Following completion of the five-year review, the Five-Year Review Report including community input will be made available to the stakeholders.

Document review: Numerous documents were reviewed for IRP-1, -3, -12, and -13S as part of this five-year review. The objective of the document review was to obtain relevant information that could be used as the basis for evaluating the performance of the remedies implemented at these sites. The types of documents reviewed included RODs, remedial investigation/feasibility study (RI/FS) reports, RD/remedial action work plans (RAWPs), RACRs and as-built drawings, the OPS Demonstration Reports for IRP-1, -3, -12, and -13S, and documents containing O&M and groundwater monitoring data and information.

Data review: The data reviewed for IRP-1, -3, -12, and -13S included inspection checklists to evaluate compliance with ICs, O&M data for IRP-3, -12, and -13S, surface water and LFG monitoring data for IRP-1, and groundwater monitoring data for all four sites.

Site Inspections: Site inspections were conducted for IRP-1, -3, -12, and -13S as part of this five-year review to provide information on the status of these Sites, and to visually confirm and document the conditions of the remedies, the Sites, and the surrounding areas. The first inspection event for IRP-1, -3, -12, and -13S was conducted on 16 February, 2011. This inspection was conducted by a team consisting of representatives from the DoN, BRAC Program Management Office (PMO) West, DTSC, and the California Regional Water

Quality Control Board, Santa Ana Region (RWQCB). Additional detailed inspections of the remedies at IRP-1, -3, -12, and -13S were conducted by the O&M contractor in April 2011.

Interviews: Interviews were conducted as part of this five-year review with various stakeholders to provide additional information about the status of IRP-1, -3, -12, and -13S. The interviewees included representatives from the DoN BRAC PMO West, regulatory agencies, City of Tustin, and a RAB member.

Protectiveness Determination: Technical assessments of the remedies at IRP-1, -3, -12, and -13S were conducted, and protectiveness statements were formulated for each site based on the data and document reviews, site inspections, interviews and technical assessment results. The technical assessments are summarized below.

Technical Assessment Summary

The technical assessment conducted as part of the five-year review process focused on responses to the following three key questions presented in the U.S. EPA guidance (U.S. EPA 2001):

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The results of the technical assessments are summarized below.

IRP-1:

Based on the monitoring data and documents reviewed, the site inspection, and interviews, the remedy for IRP-1 is functioning as intended by the ROD. Groundwater, surface water, and LFG monitoring data indicate that COCs at the Site are being effectively contained by the engineering components of the remedy, as designed. There was no evidence of any activities at the Site that are inconsistent with the land-use restrictions established in the Land-Use Control Implementation and Compliance Plan (LUCICP). The evaluation of the Applicable or Relevant and Appropriate Requirements (ARARs) which were documented in the ROD indicated that there were no significant changes to the standards/requirements identified as ARARs that could negatively affect the protectiveness of the remedy at the Site. Additionally, no newly promulgated standards were identified that could negatively affect the protectiveness of the remedy.

The remedy for IRP-1 is containment and includes ICs to prevent contact with impacted groundwater and wastes. COCs have not been reported in surface water samples in Peters Canyon Channel since the containment wall was originally installed in 1986. In the baseline human health risk assessment (HHRA), the groundwater risk driver was arsenic for cancer risk, and antimony, arsenic, cadmium, manganese, molybdenum, thallium, chlorobenzene, and 1,2-dichlorobenzene for non-cancer hazard index (HI). None of these COCs have updated toxicity criteria posted on the U.S. EPA Integrated Risk Information System (IRIS) website that post-date the IRP-1 ROD; therefore, the remedy remains protective relative to these COCs. There is no other information that calls into question the protectiveness of the remedy.

The responses to the three technical assessment questions for IRP-1 are summarized as follows:

IRP-1 - Technical Assessment Summary	
Question A: Is the remedy functioning as intended by the decision documents?	**Affirmative**
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?	**Affirmative**
Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	**Negative**

IRP-3, -12, and -13S: Based on the documents reviewed, the site inspection, and the interviews, the remedies for IRP-3, -12, and -13S (OU-1A/-1B) are functioning as intended by the RODs. The engineering components of the remedies are functioning as designed. Based on the documents reviewed and site inspections, there was no evidence of activity at IRP-3, -12, and -13S that is inconsistent with the land-use restrictions presented in the land-use controls remedial design (LUC RD). The evaluation of ARARs documented in the RODs indicated that there have been no significant changes to the standards or requirements identified as ARARs that could affect the protectiveness of the remedies at the sites. Additionally, no newly promulgated laws or regulations were identified that could negatively affect the protectiveness of the remedies.

The U.S. EPA published an updated oral cancer slope factor for 1,2,3-TCP, the primary risk driver at IRP-13S, since the signing of the IRP-13S (OU-1A) ROD (U.S. EPA 2009b). The updated criterion has not yet resulted in new enforceable groundwater standards that would constitute ARARs, but it may in the future. The RG of 0.5 micrograms per liter (µg/L) for 1,2,3-TCP in groundwater established in the ROD was based partly on risk considerations and partly on limitations of technology.

Toxicity criteria have also been updated for cis-1,2-DCE since the signing of the OU-1A and -1B RODs. This compound has been reported at low concentrations in groundwater at OU-1A and -1B South and is not a risk driver at either Site; therefore, the updated toxicity criteria do not affect the protectiveness of the remedy.

The primary contributor to total cancer risk in the baseline HHRA was exposure via inhalation of vapor from beneficial use of groundwater; therefore, ICs preventing beneficial use of groundwater were incorporated in the remedy. U.S. EPA guidance states that route-to-route extrapolation of toxicity values should not be done (U.S. EPA, 2009a); therefore, the updated oral cancer slope factor does not apply for evaluating inhalation exposures. Since the inhalation exposure route is the primary pathway of concern, and ICs are in place preventing beneficial use of groundwater, the updated toxicity criterion does not negatively affect the overall protectiveness of the remedy.

The baseline HHRA determined that the vapor intrusion (VI) pathway from groundwater to indoor air was not a significant contributor to total risk and the agency-concurred ROD concluded that no action was warranted for this exposure route. Nevertheless, VI risk was

re-evaluated as part of the five-year review because no ICs had been established that directly address the VI pathway. The results of the re-evaluation indicate that lifetime cancer risk for the VI pathway is either below the point of departure (10^{-6}), or within the NCP risk management range (10^{-6} to 10^{-4}), for the volatile organic compound (VOC) plumes in the first water bearing zone (WBZ) at IRP-3, -12, and -13S. The NCP point of departure analysis in Section 7.2.2.2.3 supports a risk management decision. Given the conservative nature of the exposure factors and uncertainty factors, and the technical limitation factors discussed in the analysis, accepting VI risks that are within the NCP risk management range is justified. The lifetime non-cancer HI is below 1 for all three sites. Since concentrations will decline as a result of the hot spot mass removal component of remediation, the overall conclusion is that the remedy continues to be protective for the VI exposure route at all three sites.

There is no other information that calls into question the protectiveness of the remedies.

The responses to the three technical assessment questions for IRP-3, -12, and -13S are summarized as follows:

IRP-3, -12, and -13S - Technical Assessment Summary	
Question A: Is the remedy functioning as intended by the decision documents?	**Affirmative**
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?	**Affirmative**
Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	**Negative**

Protectiveness Statements

Based on the technical assessments summarized above, the following protectiveness statements were made for the subject sites:

IRP-1: Based on the technical assessment, the remedy at IRP-1 is being implemented in accordance with the ROD (DoN 2001) and is protective of human health and the environment. Potential exposure to waste and groundwater contaminants at IRP-1 has been addressed through construction of engineering controls that isolate and contain the waste, through installation of access restrictions and warning signs, and through implementation of ICs. Long-term protectiveness of the remedial actions will be ensured by O&M activities that include inspection and maintenance of the reinforced concrete containment wall, groundwater monitoring, and long-term ICs that run with the land.

IRP-3, -12, and -13S:

Based on the technical assessment, the remedies at IRP-3, -12, and -13S are being implemented in accordance with the RODs (DoN 2004b, c) and are protective of human health and the environment. Groundwater hydraulic containment with hot spot mass removal is being implemented to attain groundwater RGs at the sites. Groundwater exposure pathways that might result in unacceptable risks to human receptors are being

controlled with ICs. The baseline HHRA determined that the VI pathway from groundwater to indoor air was not a significant contributor to total risk and the agency-concurred ROD concluded that no action was warranted for this exposure route. Nevertheless, VI risk was re-evaluated as part of the five-year review because no ICs had been established that directly address the VI pathway. The results of the re-evaluation demonstrate that the groundwater remedies are protective for the VI exposure pathway. The level of protectiveness of the groundwater remedies will increase over time with active groundwater hot spot mass removal.

Issues, Recommendations, and Follow-up Actions

No issues have been identified for IRP-1, -3, -12, and -13S that would prevent the respective remedies at these sites from being protective of human health and/or the environment either currently or in the future. However, consistent with the U.S. EPA guidance, recommendations have been made that pertain to O&M activities. These recommendations are fully described in Section 9 of this Report.

SUMMARY FORM

FIVE-YEAR REVIEW

FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Tustin Marine Corps Air Station		
U.S. EPA ID *(from WasteLAN)*: CA9170090022		
Site areas addressed in this five-year review: Installation Restoration Program (IRP) Site 1 (IRP-1)(Operable Unit [OU]-3), IRP-3 (OU-1B south), IRP-12 (OU-1B North), IRP-13S (OU-1A)		
Region: 9	**State:** CA	**City/County:** Tustin/Orange
SITE STATUS		
NPL status: ☐ Final ☐ Deleted ☒ Other (specify) Former MCAS Tustin is not an NPL site		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete		
Multiple OUs? ☒ YES ☐ NO	**Construction completion date:** N/A	
Has site been put into reuse? ☒ YES ☐ NO *(IRP-1 has been transferred; a portion of IRP-13S has been transferred; balance of areas remain under DoN control and/or Lease-in-Furtherance-of-Conveyance [LIFOC])*		
REVIEW STATUS		
Lease agency: ☐ U.S. EPA ☐ State ☐ Tribe ☒ Other Federal Agency Department of the Navy (DoN)		
Author name: DoN Base Realignment and Closure (BRAC) Program Management Office (PMO) West		
Author title:	**Author affiliation:**	
Review period: October 31, 2006 to October 31, 2011		
Date(s) of inspection:		
Type of review: ☒ Post-SARA ☒ Non-NPL Remedial Action Site ☐ Pre-SARA ☐ NPL State/Tribe-lead ☐ NPL-Removal only ☐ Regional Discretion		
Review number: ☒ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify)__ first (IRP Sites 3, 12, 13S); second (IRP-1)		
REVIEW STATUS - CONTINUED		
Triggering action (for the entire former MCAS Tustin): ☐ Actual Remedial Action Onsite Construction at OU #____ ☐ Construction Completion ☒ ROD for IRP-1 (remedy in progress as of ROD date) ☒ Previous Five-Year Review Report ☐ Other		
Triggering action date *(for the entire former MCAS Tustin)*: December 20, 2001 (date of ROD – IRP-1 remedy already in progress); October 31, 2006 (signature date of first five-year review for IRP-1)		
Due date *(five years after triggering action date)*: October 31, 2011 (five years from signature date of first five-year review for IRP-1)		

Five-Year Review Summary Form, cont'd

Issues:

No issues have been identified for IRP-1, -3, -12, and -13S that currently or in future would prevent the respective remedies at these sites from being protective of human health and the environment.

Recommendations and Follow-up Actions:

Since no issues have been identified for IRP-1, -3, -12, and -13S that currently prevent the remedies at these sites from being protective, or may do so in future, no recommendations or follow-up actions are required to ensure protectiveness of the remedies. However, consistent with DoN policy and United States Environmental Protection Agency (U.S. EPA) guidance, related to operation and maintenance (O&M) activities, including inspecting an older section of the wall adjacent to the steel-reinforced containment wall and properly destroying the landfill gas (LFG) probes at IRP-1; and evaluating measures to prevent surface water from inundating a well vault at IRP-3 have been made, and are fully described in Section 9 of this Report.

Protectiveness Statements:

IRP-1

Based on the technical assessment, the remedy at IRP-1 is being implemented in accordance with the ROD (DoN 2001) and is protective of human health and the environment. Potential exposure to waste and groundwater contaminants at IRP-1 has been addressed through construction of engineering controls that isolate and contain the waste, through installation of access restrictions and warning signs, and through implementation of ICs. Long-term protectiveness of the remedy is ensured by O&M activities that include inspection and maintenance of the steel-reinforced concrete containment wall, groundwater monitoring, and long-term ICs that run with the land.

IRP-3, -12, and -13S

Based on the technical assessment, the remedies at IRP-3, -12, and -13S are being implemented in accordance with the RODs (DoN 2004b, c) and are protective of human health and the environment. Groundwater hydraulic containment with hot spot mass removal is being implemented to achieve RGs at the Sites. Potential exposure pathways to groundwater that might result in unacceptable risks to human receptors are being controlled with ICs. The baseline HHRA determined that the VI pathway from groundwater to indoor air was not a significant contributor to total risk and the agency-concurred ROD concluded that no action was warranted for this exposure route. Nevertheless, VI risk was re-evaluated as part of the five-year review because no ICs had been established that directly address the VI pathway. The results of the re-evaluation demonstrate that the groundwater remedies are protective for the VI exposure pathway. The level of protectiveness of the groundwater remedies will increase over time with active groundwater hot spot mass removal, as appropriate, and natural attenuation processes.

1. Introduction

This Report presents the results of the five-year review for four Sites located at former Marine Corps Air Station (MCAS) Tustin, California. The four Sites addressed in this Report are Operable Unit 1A (OU-1A), OU-1B North, OU-1B South, and OU-3. These are also referred to as Installation Restoration Program (IRP) Site 13S (IRP-13S), and IRP-12, -3, and -1, respectively. This is the first five year review for OU-1A, -1B North, and -1B South, and is the second five year review for OU-3.

The purpose of the five-year review is to evaluate whether the remedies implemented at IRP-1, -3, -12, and -13S are functioning as intended by the respective Records of Decision (RODs)/Remedial Action Plans (RAPs) (Department of the Navy [DoN] 2001, 2004b, 2004c) and remain protective of human health and the environment.

Three additional Sites in OU-4B, termed "low concentration" Sites (IRP-11, -13W, and Miscellaneous Major Spill [MMS]-04) are also discussed briefly. The selected remedy for these Sites is institutional controls (ICs) with no active remedial action. The remedy for MMS-04 was completed in 2011; the agency concurred Remedial Action Completion Report (RACR) documented that the terms of the Final ROD/RAP were met; the remedial action objectives (RAOs) and remediation goal (RG) had been achieved, that Soil at the Site required no further action (NFA), and the Site was protective of human health and the environment (AIS-TN&A JV, 2011). The trigger date for the five-year reviews for IRP-11 and -13W is the ROD signature date; however, the selected remedies have not yet been fully implemented since the RD for these Sites is currently in preparation and an insufficient amount of time has passed to adequately evaluate the selected remedies for these low concentration Sites; therefore, they were not subjected to the comprehensive five-year review process described in this Report. They will be addressed in the next five-year review.

This Five-Year Review Report was prepared by Enviro Compliance Solutions, Inc. (ECS) on behalf of the DoN Base Realignment and Closure (BRAC) Program Management Office (PMO) West. The work was authorized by the DoN under Contract No. N62473-10-C-4409.

1.1 BACKGROUND

Former MCAS Tustin is located in southern California in Orange County, approximately 40 miles south of downtown Los Angeles and more than 100 miles north of the California-Mexico border (Figure 1). The locations of IRP-1, -3, -12, and -13S within former MCAS Tustin are shown on Figure 1. Individual site layouts are shown on Figures 2 through 4.

MCAS Tustin was initially established during World War II as a Navy lighter-than-air (LTA) facility to support air patrols off the southern California coast. The station was commissioned in the fall of 1942 upon completion of the construction of two blimp hangars (currently national historic landmarks), and served as an LTA facility until 1949, when it was decommissioned. The station was then used as an outlying field for other military operations in the area, primarily those of MCAS El Toro.

In 1951, MCAS Tustin was reactivated to support the Korean Conflict and was used solely for helicopter operations. The station was officially designated the "Santa Ana Marine Corps Air Facility (MCAF)." As the station expanded its operations, the name was changed in September 1969 to "MCAS (Helicopter [H]) Santa Ana." In 1978, the station name was changed to "MCAS (H) Tustin" to reflect its annexation by the city of Tustin. In 1986, the station was renamed "MCAS Tustin," and in October 1997, the station name was changed

to "MCAF Tustin." In 2000, the "MCAF Tustin" designation was dropped, and use of "MCAS Tustin" was officially restored.

To support its mission, operations at the station were expanded over the years to include more than 200 structures and various facilities, including a 3,000-foot-long runway, aircraft parking aprons, and numerous aircraft maintenance shops. Prior to its closure, MCAS Tustin occupied approximately 1,595 acres of land, of which approximately 212 acres was used for station housing and 1,383 acres was used for non-housing purposes. At the present time, all of the property at the station is developed, except for approximately 674 acres that was previously used for commercial farming. The land around former MCAS Tustin has residential, commercial/business, industrial, and recreational uses.

MCAS Tustin was initially included on the BRAC II list in 1991; further realignment and complete closure were ordered for the station under the BRAC III list (1993). Since 1993, the BRAC Cleanup Team (BCT) has coordinated cleanup and closure activities at former MCAS Tustin. The BCT consists of representatives from the DoN, United States Environmental Protection Agency (U.S. EPA), Department of Toxic Substances Control (DTSC), and California Regional Water Quality Control Board, Santa Ana Region (RWQCB). The DoN is the lead federal agency for environmental restoration at former MCAS Tustin. The BCT has been collectively managing and coordinating cleanup and closure activities at former MCAS Tustin since the BCT's inception.

MCAS Tustin was closed on July 2, 1999. Former MCAS Tustin is not listed on the National Priorities List (NPL). A Federal Facility Site Remediation Agreement (FFSRA) between the DoN and the DTSC was signed for former MCAS Tustin on 18 August 1999. The FFSRA defines the DoN's corrective action and response obligations under the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The DoN has transferred portions of former MCAS Tustin property under various conveyance documents to the city of Tustin, recognized as the Local Redevelopment Authority (LRA). Those areas requiring further investigation and/or response actions were retained by the DoN and are referred to as "carve-out" (CO) areas. The groundwater plumes at IRP-12 and -13S are within CO-5, and the groundwater plumes at IRP-3 are within CO-6 (Figure 2). The transfer documents for IRP-1, transferred to the City in 2004, contain provisions that are used to protect the integrity of groundwater extraction wells and remediation equipment, prevent inadvertent use of or exposure to contaminated groundwater, and allow the DoN, DoN contractors, and regulatory personnel access to install, operate, and maintain equipment and to monitor the remedial action. Transfer documents for other parcels to be transferred in the future will contain the same provisions.

A summary of the status of the IRP sites is presented in Table 1-1.

Table 1-1: Current Status of OU-1A, -1B North, -1B South, -3, and -4B

Site I.D.	Current Status
OU-1A, -1B North, and -1B South (IRP-13S, -12, and -3)	The selected remedy for groundwater at the three sites is hydraulic containment with hot spot mass removal (DoN 2004b, c). The ROD/RAPs also documented NFA for soil at these three Sites. Major remedy components include: • Two groundwater extraction and treatment systems (OU-

Site I.D.	Current Status
	1A/-1B North, and OU-1B South); • Groundwater monitoring; and • ICs. Chemicals of concern (COCs) identified for groundwater at OU-1A are: • trichloroethene (TCE) and • 1,2,3-trichloropropane (TCP). COCs identified for groundwater at OU-1B are: • TCE; • 1,1-dichloroethane (DCA); • 1,1-dichloroethene (DCE); • 1,1,2-trichloroethane (TCA); • 1,2-DCA; and • 1,2-DCE. Major documents/events include: • Remedy implementation in 2007; • OU-1A/-1B North system startup December 7, 2007; • OU-1B South system startup January 2, 2008; • Performance monitoring began during the first quarter 2008; • Operating Properly and Successfully (OPS) demonstration February 2010 (ECS 2010c); • U.S. EPA determination of OPS (U.S. EPA 2009c); • DTSC and RWQCB concurrence with OPS (DTSC 2010, RWQCB 2010a). Current ongoing activities include: • Operation and maintenance (O&M) of the remedy components; • Groundwater monitoring and reporting; • IC monitoring and reporting.
OU-3 (IRP-1)	The selected remedy is containment (DoN 2001). Major remedy components include: • Containment of impacted groundwater utilizing the existing reinforced concrete containment wall along the west bank of Peters Canyon Channel; • Groundwater, surface water, and landfill gas (LFG) monitoring; and • ICs. The following COCs were identified for groundwater: • 1,1-DCA; • 1,1-DCE; • 1,2-dichlorobenzene;

Site I.D.	Current Status
	• 1,4-dichlorobenzene; • benzene; • chlorobenzene; • ethylbenzene; • TCE; • vinyl chloride (VC); • antimony; • arsenic; • cadmium; • manganese; • molybdenum; • thallium. Major documents/events include: • Remedy implementation; • OPS demonstration (Pacific Treatment Environmental Services [PTES] and Tetra Tech 2003); • Agency determination of OPS (U.S. EPA 2004); • DTSC and RWQCB concurrence with OPS (DTSC 2004, RWQCB 2003); • First five-year review (ECS 2006). Current ongoing activities include: • O&M of the remedy components; • Groundwater, surface water, and LFG monitoring and reporting; and • IC monitoring and reporting.
OU-4B (IRP-11, -13W, and MMS-04	These three Sites in OU-4B are termed "low concentration" Sites. The selected remedy for these Sites is ICs. The remedy for MMS-04 was completed in 2011; the agency concurred RACR documented that the terms of the Final ROD/RAP were met; the RAOs and RG had been achieved, that Soil at the Site required NFA, and the Site was protective of human health and the environment (AIS-TN&A JV 2011). The trigger date for the five-year reviews for IRP-11 and -13W is the ROD signature date; however, the selected remedies have not yet been fully implemented since the RD for these Sites and are currently in preparation. Insufficient time has passed to adequately evaluate the selected remedies for these low concentration Sites; therefore, they were not subjected to the comprehensive five-year review process described in this Report. They will be addressed in the next five-year review.

1.2 FIVE-YEAR REVIEW AUTHORITY AND GENERAL APPROACH

The DoN has prepared this five-year review pursuant to DoN policy, and in accordance with CERCLA Section (§) 121(c) and the National Oil and Hazardous Substances Pollution

Contingency Plan (NCP). DoN and U.S. EPA five-year review guidance documents (DoN 2011, U.S. EPA 2001) were followed in preparation of this Five-Year Review Report.

CERCLA §121 states:

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

In addition, the NCP; Title 40 of the Code of Federal Regulations (C.F.R.) §300.430(f)(4)(ii) 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.*

Pursuant to CERCLA § 121(c) and the NCP, five-year reviews have been conducted at former MCAS Tustin to evaluate if the remedies at IRP-1, -3, -12, and -13S are now, or will be, protective of human health and the environment at the completion of remedial action.

In accordance with the DoN policy for conducting CERCLA five-year reviews, the first site on an installation that triggers the five-year review triggers the five-year review clock for the entire installation. The Final ROD for IRP-1 was signed on December 20, 2001 (DoN 2001). The selected remedy included remedial actions that had already been completed or begun earlier and were already underway; thus, the triggering date for beginning the first five-year review period for former MCAS Tustin was the date of the IRP-1 ROD, i.e. December 20, 2001. The first CERCLA five-year review for IRP-1 was conducted in 2006 (ECS 2006). At that time, remedial action implementation had not yet begun at other IRP sites on the installation. The signature date for the first five-year review was October 31, 2006. This date triggers the clock for the second five-year review period. Since that time, remedial action has been implemented at IRP-3, -12, and -13S, and is ongoing at these sites. The second five-year review for IRP-1, and the first five-year reviews for IRP-3, -12, and -13S are therefore due on October 31, 2011.

(THIS PAGE LEFT INTENTIONALLY BLANK)

2. Site Chronology

Table 2-1 lists important events and milestones pertinent to environmental response actions taken by the DoN for former MCAS Tustin.

Table 2-1: Chronology of Response Actions

Date	Investigation/ Activity	Objective	Summary of Findings
1983-1984	Initial assessment study	Identify and evaluate sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations.	Identified all sites as potentially contaminated and recommended IRP-1 through -14 for a confirmation study (Brown and Caldwell Consulting Engineers [Brown and Caldwell] 1985).
1985	RWQCB Cleanup and Abatement Order (CAO) for IRP-1	In May 1985, pursuant to California's Porter-Cologne Water Quality Control Act, the RWQCB issued CAO No. 85-74 in response to the seepage of petroleum (and other materials) into Peters Canyon Channel. The CAO ordered the U.S. Marine Corps to perform specific actions, including: • Submit a plan for cleanup of all fuel and contaminated groundwater and soil resulting from discharge of waste to the burn pits, • Submit a schedule for implementation of the necessary investigative remedial work, and • Submit monthly progress reports describing the status of work conducted to comply with the CAO.	The CAO was rescinded on May 31, 1996, after a determination by the RWQCB that MCAS Tustin had fulfilled the requirements of the CAO.

Date	Investigation/ Activity	Objective	Summary of Findings
1986-1987	Construction of reinforced concrete containment wall and French drain system along west side of Peters Canyon Channel at IRP-1	Prevent migration of Site groundwater contaminants to surface water within Peters Canyon Channel; provide a means of removing impacted groundwater from the area behind the containment wall, if needed (French drain).	Remedial action pursuant to CAO No. 85-74
1987-1988	Former Fuel Farm investigation	Identify contaminants of potential concern (COPCs) present in groundwater at IRP-16.	Three monitoring wells were installed and sampled. Several volatile organic compounds (VOCs), including TCA, DCA, and toluene, were reported in groundwater (James M. Montgomery Consulting Engineers, Inc. [JMM] 1988).
1990-1993	Site inspection	Evaluate nine sites (IRP-2, -3, -5, -7, -9, -12, -13, and -15) identified during the Initial Assessment Study (IAS).	Further evaluation of IRP-2 and IRP-8 was recommended. A remedial investigation/feasibility study (RI/FS) was recommended for IRP-3, -5, -7, -9, -12, and -13. NFA was recommended at IRP-15. Removal actions were not recommended for any sites (Jacobs Engineering Group [JEG] 1993a).
1992	Former Fuel Farm investigation	Identify COPCs present in soil and groundwater at IRP-16.	No VOCs were reported in groundwater. Elevated concentrations of total recoverable petroleum hydrocarbons (TRPH) were reported in soil (JEG 1993b).
1994-1995	Expanded site characterization	Determine background concentrations of COPCs in groundwater and establish baseline geochemistry at MCAS Tustin.	Installed and sampled more than 20 wells and more than 30 HydroPunch™ borings to establish baseline geochemistry (Argonne National Laboratory [ANL] 1994, 1995).

Date	Investigation/ Activity	Objective	Summary of Findings
1994-1995	Expanded site inspection (ESI)	Evaluate nine IRP sites and areas of concern (AOCs) (IRP-2, -6, -8, -9, -11, -15, MMS-03, -04, and -05), including soil and groundwater sampling, fate and transport analysis, baseline risk assessment, and screening risk assessment associated with future impacts on groundwater (due to potential leaching of COPCs in soil).	NFA was recommended for soil at IRP-8, -11, -15, MMS-03, -04, and -05. NFA was recommended for soil at IRP-2 and -9. Further evaluation was recommended for soil at IRP-6. NFA was recommended for groundwater at IRP-9, -15, and MMS-03. IRP-2, -6, -8, -11, MMS-04 and -05 were recommended for further evaluation in the remedial investigation (RI) station-wide groundwater program, based on the risk assessment and evaluation of COPCs in groundwater (Bechtel National, Inc. [BNI] 1997b).
1997	Final RCRA Facility Assessment (RFA) Report	Fifty of the 258 AOCs were investigated.	Twenty-seven AOCs were recommended for further action, including storage, temporary (ST)-72 and miscellaneous wash area (MWA)-18 (BNI 1997a).
1995-1997	OU1-1/OU-2 RI	Evaluate seven sites (IRP-3, -5, -12, -13E, -13W, -13S, and -16). Also perform station-wide groundwater study to evaluate impact of sources of contamination at 29 AOPCs identified under the RI, ESI, and RFA programs.	Non- time critical removal actions (NTCRAs) were recommended for 23 of the 29 areas of potential concern (AOPCs) (IRP-2, -5, -6, -8, -11, -13E, -13W, and -I6, and AOCs AD-04, AS-06, AS-08, AST-02, above ground storage tank (AST)-04, disposal, storm drain (DSD)-01, DSD-02, miscellaneous potential disposal area (MDA)-02, -04, -07, MMS-01, MWA-03, MMS-04, -05, and ST-67). A feasibility study (FS) was recommended for IRP-3 (which includes treatment, oil/water separator [TOW]-X3 and -X4), IRP-12, and -13S (ST-72 and MWA-18) (BNI 1997c).
1996	OU-3 RI/FS	Assess nature and extent of contamination at IRP-1 and evaluate remedial action.	Further action was recommended for IRP-1. Recommended remedial action *was* containment of waste left in place using an existing cover and containment wall for contaminated groundwater (BNI 1996, 1997a).

Date	Investigation/ Activity	Objective	Summary of Findings
1996	Removal action at IRP-16B	Excavate and treat petroleum-contaminated soil under a petroleum corrective action.	Approximately 15,000 tons of soil was excavated, of which 6,000 tons of contaminated soil was heated and used for backfill to restore the Site. Activities were completed in August 1996 (OHM Remediation Services, Inc. [OHM] 1997b).
1997	Removal action at IRP-2	Excavate and treat polycyclic aromatic hydrocarbons (PAH)-contaminated soil.	Approximately 569 tons of PAH-contaminated soil was excavated and treated. Activities were completed in June 1997 (OHM 1997a).
1997-1999	Removal action at IRP-9A and -9B	Excavate and treat PAH-contaminated soil.	Approximately 701 tons and 6,837 tons of soil were excavated and treated from IRP-9A and -9B, respectively, for a total of 7,538 tons. Activities were completed at IRP-9A in September 1997 and IRP-9B in December 1998 (OHM 1999).
1997	Removal action at IRP-13W	Excavate and treat total petroleum hydrocarbons (TPH) - and PAH-contaminated soil.	Approximately 4,000 tons of soil was removed, and site restoration activities (paving and fencing) were performed as part of a NTCRA at IRP-13W. Activities were completed in November 1997. Following this NTCRA, IRP-13W was recommended for NFA in the OU-1/OU-2 RI (BNI 1997c).
1997	Post-RI field program at IRP-12	Verify the distribution of TCE in soil at IRP-12.	Confirmed the data interpretations presented in the RI Report: additional TCE source areas were not identified at IRP-12, and the boundary of TCE-contaminated soil at IRP-12 was not modified (BNI 1997c).

Date	Investigation/ Activity	Objective	Summary of Findings
1998	Vacuum-enhanced extraction (VEE) pilot-scale tests for OU-1	Evaluate the effectiveness of a VEE system for groundwater extraction and treatment at OU-l.	VEE was demonstrated to produce a slight increase in the effectiveness of TCE mass removal and to achieve a slightly wider radius of influence in comparison with conventional extraction technology. Based on this finding, it was recommended that VEE be considered as an alternative in the OU-1 FS (BNI 1999a).
1999	OU-1 FS	Evaluate remedial alternatives for IRP-3, -12, and -13S.	Six remedial alternatives were evaluated: no action, natural attenuation, hydraulic containment, groundwater extraction, permeable iron wall, and VEE (BNI 1999a).
1999	BCT meeting 23 September 1999	Modify recommended action for six IRP sites and six AOCs.	Recommended a focused FS for IRP-5, -6, -8, -11, -13W, and -16, and AOCs disposal, sanitary sewer (DSS)-01, DSS-02, MDA-02, MMS-04, MMS-05, and ST-67 due to the presence of contaminants in shallow groundwater at concentrations exceeding regulatory Limits. These sites/AOCs were included in newly-designated OU-1A.
1999	Removal of TOW-X3 and -X4	Remove oil/water separators and TPH/TCE-contaminated soil.	Based on confirmation soil sampling results TOW-X3 and -X4 were considered potential sources of IRP-3 groundwater contamination. It was recommended that closure for these AOCs be conducted under the CERCLA program (International Technologies, Inc. [IT] 2000, OHM 2001).
1999-2001	Stationwide groundwater monitoring at IRP-1, -3, -6, -12, and -13S, mingled plumes area, and underground storage tank (UST) Site 222	Evaluate groundwater contamination and plume movement through RIs and FSs, RD, and remedial action phases for various OUs at MCAS Tustin.	Groundwater monitoring results supported interpretations of stationwide groundwater flow patterns, groundwater chemistry, and contaminant distributions developed from monitoring conducted during the RI and subsequent interim monitoring (BNI 1999a, 2000, 2001b, Bechtel Environmental, Inc.[BEI] 2003c).

Date	Investigation/ Activity	Objective	Summary of Findings
2000	ROD/RAP for OU-2	Select remedy for OU-2 sites and AOCs.	The selected remedy for the three IRP sites and nine AOCs that comprise OU-2 was no action.
2001	ROD/RAP for OU-3	Select remedy for IRP-1.	Selected remedial action consists of ICs; groundwater, surface water, and landfill gas monitoring; and inspection and maintenance of the existing containment wall and cover, French drain systems, monitoring wells, and security features (DoN 2001).
2001-2002	Time critical removal action (TCRA) at IRP-13S	Coordinate with petroleum corrective action being conducted for methyl *tert*-butyl ether (MTBE) plume migration at adjacent UST Site 222 OU-1 was divided into OU-1A and OU-1B to facilitate remedial action at IRP Sites 3 and 12.	In December 2001, installation of a groundwater extraction and treatment system including seven extraction wells and ten monitoring wells was completed at IRP-13S. (BNI 2001a). The purpose of the treatment system was to hydraulically contain VOC contamination within the then-current plume boundary at IRP-13S and to prevent or minimize cross-gradient migration of contaminants from IRP-13S that might occur as a result of the petroleum corrective action plan (PCAP) remediation being conducted at adjacent UST Site 222. Interim removal at IRP-13S began in January 2002. The TCRA system was incorporated into the final groundwater remedy for OU-1A; performance monitoring used to evaluate the effectiveness of the removal action, is ongoing as of 2011.
2001-2002	OU-1B FS	Evaluate remedial alternatives for IRP-3 and -12.	Nine remedial alternatives were evaluated: no action, monitored natural attenuation, hydraulic containment, aggressive groundwater extraction with off-site soil disposal, aggressive groundwater extraction with on-site soil treatment, permeable iron wall, VEE with off-site disposal, VEE with on-site soil treatment, and hydraulic containment with hot spot removal (BNI 2002).

Date	Investigation/ Activity	Objective	Summary of Findings
2003	OU-3 Operation and Maintenance Plan (OMP)	Establish detailed procedures and protocols for implementing the IRP-1 (OU-3) selected remedy	Specified types and frequency of inspections and monitoring (BEI 2003a).
2003	OPS Evaluation Report, OU-3 (IRP-1).	Establish whether OU-3 remedy was constructed as designed, is functioning as intended, and is protective of human health and the environment in accordance with the CERCLA OPS process.	OPS was demonstrated (PTES and Tetra Tech 2003), U.S, EPA made the OPS determination, and DTSC and RWQCB concurred with OPS (DTSC 2004, RWQCB 2003).
2003	OU-1A FS	Evaluate remedial alternatives for OU-1A (IRP-13S).	Nine remedial alternatives were evaluated: no action, monitored natural attenuation, hydraulic containment, aggressive groundwater extraction with off-site soil disposal, aggressive groundwater extraction with on-site soil treatment, permeable reaction wall, VEE with off-site disposal. VEE with on-site soil treatment, and hydraulic containment with hot spot removal (BEI 2003b).
2003-2004	OU-4 Technical Memorandum	Shallow groundwater investigation of selected sites.	Recommended IRP-5N, -5S(b), -8, -11 (Area A), -16, and MMS-04 (Areas A and C) for NFA; these Sites became OU-4A. Recommended IRP-5S(a), -6, -11 (Area B), -13W, MMS-04 (Area B), and Mingled Plumes Area (MPA) for further action; these Sites became OU-4B.
2004	OU-4A NFA ROD/RAP	Select NFA for OU-4A sites.	Issued NFA ROD/RAP to present the selected remedy of no action for the OU-4A sites.

Date	Investigation/ Activity	Objective	Summary of Findings
2004	Finding of Suitability to Transfer #6 (FOST#6) a portion of Carve-Out 5 (Parcel 20, and the Lansdowne Road Portion of Parcel 40) and Carve-Out 10 (portions of Parcels 28, 40, and 41)	Establish suitability of designated parcels prior to transferring title from the government to the City of Tustin in accordance with CERCLA and DoN requirements.	IRP-1 in CO 10 is suitable for transfer (DoN 2004a).
2004	OU-1A ROD/RAP	ROD and Selected Remedial Action Plan for OU-1A (IRP-13S).	The preferred remedy was documented in the OU-1A ROD/RAP: hydraulic containment with hot spot mass removal (Alternative 7) (DoN 2004b).
2004	OU-1B ROD/RAP	ROD and Selected Remedial Action Plan for OU-1B (IRP-3 and -12).	The preferred remedy was documented in the OU-1B ROD/RAP: hydraulic containment with hot spot removal (Alternative 7) (DoN 2004c).
2005	Remedial design (RD)/remedial action work plan (RAWP) for soil hot spot removal at IRP-3 and -12 (OU-1B)	Work plan for removing sources of contamination to groundwater.	Soil hot spot removal was part of the groundwater remedy selected in the ROD. Design consisted of excavation and removal of soil hot spots with offsite disposal. Excavations were to be backfilled with clean imported fill soil (Engineering/Remediation Resources Group, Inc. [ERRG] 2005).
2006	Soil hot spot removal at IRP-3 and -12 (OU-1B)	Implement RD/RAWP for soil hot spot removal.	Contaminated soil was removed per the RD/RAWP and replaced with clean backfill (ERRG 2006).
2006	CERCLA First Five Year Review for IRP-1 (OU-3).	Determine whether remedy for IRP Site1 remains protective of human health and the environment in accordance with the CERCLA five year review process.	The remedy was determined to be functioning properly and remains protective of human health and the environment (ECS 2006). DTSC concurred with the Report (DTSC 2006).

Date	Investigation/ Activity	Objective	Summary of Findings
2007	RD/RAWP for OU-1A/-1B (IRP-3, -12, and -13S).	Establish RD for groundwater remedy at IRP-3, -12, and -13S; prescribe construction and startup procedures.	Design incorporated operating TCRA system into OU-1A groundwater remedy; design also accounted for presence of adjacent UST Site 222 PCAP groundwater remedial system (ERRG 2007).
2007	Land-use control remedial design (LUC RD) for OU-1A/-1B (IRP-3, -12, and -13S).	Establish RD of land-use controls for groundwater remedy at IRP-3, -12, and -13S	Incorporated in RD document (ERRG 2007).
2007	Finding of Suitability for Early Transfer (FOSET) - portion of IRP-13S	To enable early transfer of a portion of IRP-13S to City of Tustin, and to memorialize ICs.	Parcel 24-1 in IRP-13S is suitable for transfer.
2008	Groundwater monitoring for OU-1A/-1B (IRP-3, -12, and -13S) remedy.	Routine groundwater monitoring in accordance with the RAWP.	Groundwater remedy performance monitoring with capture zone analysis in Annual Performance Evaluation Reports (ERRG 2008a, 2008b, ECS 2008b, 2010b)
2008	Interim RACR (Interim Remedial Action Completion Report [I-RACR]) for OU-1A/-1B (IRP-3, -12 and -13S).	Documents construction of the groundwater remedy as designed in the RD.	Groundwater remedy was constructed as designed (ERRG 2008c).
2009	OMP for OU-1A/-1B groundwater remedy (IRP-3, -12, and -13S).	Establish methods, procedures and protocols for operating, maintaining, and monitoring the groundwater remedy for OU-1A/-1B.	Prescribes system optimization procedures and decision logic (ERRG 2009).
2009	Groundwater monitoring for OU-1A/-1B (IRP-3, -12, and -13S) remedy.	Routine groundwater monitoring in accordance with the OMP.	Groundwater remedy performance monitoring with capture zone analysis in Annual Performance Evaluation Report (ECS 2010e)

Date	Investigation/ Activity	Objective	Summary of Findings
2010	OPS determination for OU-1A/-1B groundwater remedy (IRP-3, -12, and -13S).	Establish whether OU-1A/-1B groundwater remedy was constructed as designed, is functioning as intended, will eventually achieve RGs with continued operation, and is protective of human health and the environment, in accordance with the CERCLA OPS process.	OPS demonstration (ECS 2010c); U.S. EPA OPS designation (U.S. EPA 2009c); DTSC and RWQCB concurrence with OPS (DTSC 2010, RWQCB 2010a). FOST #6 (DoN 2004a)
2010	Groundwater monitoring for OU-1A/-1B (IRP-3, -12, and -13S) remedy.	Routine groundwater monitoring in accordance with the OMP.	Groundwater remedy performance monitoring with capture zone analysis in Annual Performance Evaluation Report (ECS 2011b)
2010	ROD/RAP for OU-4B	ROD and Selected Remedial Action Plan for OU-4B (IRP-5Sa, -6, -11, -13W, and MMS-04).	Established remedy of ICs for low concentration sites IRP-11, -13W, and MMS-04. Established remedy of in-situ bioremediation with ICs for moderation concentration sites IRP-5Sa, and -6.
2011	FOST #9 for parcels associated with OU-1A/-1B groundwater remedy (IRP-3, -12, and -13S).	Establish suitability of designated parcels prior to transferring title from the government to the City of Tustin in accordance with CERCLA and DoN requirements.	In preparation (DoN 2010b).
2011	Final Remedial Action Completion Report, Miscellaneous Major Spill (MMS) -04	Document the MMS-04 Site closeout.	Response action is complete and no further action is required for groundwater

3. Background

3.1 ENVIRONMENTAL SETTING

Former MCAS Tustin lies at the eastern edge of a broad coastal plain (an essentially planar, alluviated flatland) that is bounded on the east-northeast by the gentle slopes of Lomas de Santiago (along the foothills of the Santa Ana Mountains) and on the south by the San Joaquin Hills. The coastal plain slopes gently southwestward toward the Pacific Ocean. The ground surface at the former station is essentially flat, with an average elevation of approximately 54 feet above mean sea level (MSL). The ground surface slopes gradually from approximately 75 feet above MSL at the northern portion of the station to approximately 45 feet above MSL at the southern portion. The geology, hydrogeology, and surface water hydrology of former MCAS Tustin are briefly described below.

3.1.1 Geology and Hydrogeology

In the vicinity of former MCAS Tustin, the coastal plain overlies approximately 1,300 feet of unconsolidated sediments. Sediments from the ground surface to depths from approximately 90 feet to 150 feet below ground surface (bgs) consist of massive silt, clayey silt, clay, and silty clay deposits with laterally discontinuous lenses of sand and gravel. Groundwater within these sediments is referred to as the "shallow water bearing zone (WBZ)," and is of generally poor quality as discussed further below. It is not currently used for beneficial purposes.

A transmissive sand zone is encountered below approximately 150 feet bgs. Groundwater within this sand defines the top of the “regional aquifer" and has generally good quality. This groundwater is currently used for beneficial purposes.

Three WBZs comprise the shallow WBZ beneath former MCAS Tustin, These WBZs are identified in part by lithologic changes, and in part by the depth intervals at which they occur. The first WBZ occurs from approximately 5 to 30 feet bgs, the second WBZ occurs from approximately 30 to 60 feet bgs, and the third WBZ occurs from approximately 60 feet bgs to between 90 and 120 feet bgs. The boundaries between the WBZs vary from location to location, reflecting the heterogeneity of the sediments within each depth range. A generalized geologic cross section showing the shallow WBZs and underlying regional aquifer is shown on Figure 5.

Groundwater at former MCAS Tustin is first encountered at depths from approximately 5 to 15 feet bgs (30 to 60 feet above MSL). Hydraulic testing completed during the RI indicated that groundwater in the uppermost sand zone in the first WBZ is pressurized, indicating semiconfined conditions within the first WBZ. Groundwater within the second and third WBZs is also semiconfined (BNI 1996).

Groundwater within the first WBZ contains total dissolved solids (TDS) at elevated concentrations, averaging approximately 6,000 milligrams per liter (mg/L). Field data suggest that the first and second WBZs are hydraulically interconnected. However, TDS concentrations in the second WBZ are typically lower than those in the first WBZ and average approximately 2,400 mg/L. Field data also suggest that the third WBZ is separated hydraulically from the second WBZ. Limited field data show that the third WBZ has substantially better general water quality then the second WBZ. The underlying regional aquifer is hydraulically separated from the third WBZ by a fine-grained aquitard measuring roughly 30-feet in thickness (Figure 5).

Groundwater flow in the three WBZs has been monitored at former MCAS Tustin. Groundwater in the first and second WBZs generally flows in the same direction, from north to south across the station. In localized areas where the shallow WBZs intercept the land surface at Peters Canyon Channel, Barranca Channel, and Santa Ana-Santa Fe Channel, groundwater within the first WBZ discharges into these surface water drainages. Groundwater within the second and third WBZs does not recharge the surface drainages. Groundwater within the third WBZ generally flows toward the southwest.

3.1.2 Surface Water Hydrology

Former MCAS Tustin is located within the Irvine Groundwater Management Zone. Surface waters consist typically of small streams, flood channels, and water-storage reservoirs. Three man-made channels bound former MCAS Tustin: Barranca Channel to the south, Santa Ana-Santa Fe Channel to the north, and Peters Canyon Channel to the east. These unlined channels are incised approximately 10 to 20 feet below the surrounding land surface and permit flow between groundwater and surface water. These channels typically contain water year-round as a result of recharge from shallow groundwater.

Data obtained during the RI indicate that both Barranca and Peters Canyon Channels are "gaining" streams in the reach of former MCAS Tustin, while Santa Ana-Santa Fe Channel loses water in its western reach and gains water in its eastern reach.

Surface drainage at the station is controlled by local topography and by various manmade drainages. Surface runoff at former MCAS Tustin originates almost entirely from within the station, because surface runoff flowing toward the station from the north and northeast is intercepted by ditches running parallel to the Santa Fe Railroad tracks located along the northeast side of the station. Surface runoff as excess precipitation leaves the former station in two ways: through the underground storm drainage system or through open ditches and channels. Peters Canyon Channel and Barranca Channel receive surface runoff and storm drain discharge from former MCAS Tustin.

Surface water generally flows south and southwest, away from former MCAS Tustin. Along two boundaries of the station, however, Santa Ana-Santa Fe Channel and Barranca Channel carry flow southeast toward Peters Canyon Channel. Short ditches running along the Santa Fe Railroad tracks and along Warner Avenue and a culvert beneath Edinger Avenue carry flow northwest toward Peters Canyon Channel. Peters Canyon Channel receives runoff from Santa Ana-Santa Fe Channel on the northeast side of the former station, and merges with San Diego Creek approximately 1 mile southwest of the former station. Barranca Channel merges with San Diego Creek approximately 2 miles southwest of the former station. San Diego Creek empties into upper Newport Bay approximately 5 miles southwest of the former station.

3.2 IRP-1

3.2.1 Physical Characteristics

IRP-1 consists of the former Moffett Trenches and Crash Crew Burn Pits Site, and is also known as OU-3. The Site consists of former unlined, shallow landfill trenches and pits constructed to contain refuse from the installation and to burn flammable liquids for firefighter training exercises. Between 1997 and 1999 extensive road construction occurred at the Site. Prior to construction, a high-density polyethylene (HDPE) liner was installed over the landfill to prevent surface water from infiltrating through the landfill and contaminating groundwater below the Site. Up to 20 vertical feet of earthfill was placed on top of the liner over a majority of the Site to support the construction of the overlying Jamboree Road extension. Retaining walls, associated embankment slopes, and

southbound/northbound off ramps were constructed on the Site as a part of the road project. Road improvements also included a surface-water runoff collection system that collects and directs surface water to Peters Canyon Channel rather than allowing it to infiltrate the subsurface, and extensive slope landscaping on the east side of Jamboree Road.

3.2.2 Land and Resource Use

The boundaries of IRP-1 are illustrated on Figure 2. The majority of IRP-1 is now covered by Jamboree Road and its earthfill embankment slopes and retaining walls. To the east the Site is bordered by Peters Canyon Channel, with a reinforced concrete groundwater containment wall lining the west bank adjacent to the Site. To the west is generally level undeveloped land.

3.2.3 Re-Use

IRP-1 was transferred to the City of Tustin in 2004. The current designated land use is designated as "traffic circulation" and the majority of the Site is occupied by Jamboree Road. Planned re-use of adjacent property was researched by accessing the City of Tustin's Specific Plan/Reuse Plan (SP/RP) posted on their website at the following link:

http://www.tustinca.org/about/demographics/baseplan.html

As of June 29, 2011, the SP/RP indicated future development of currently-vacant land adjoining IRP-1 to the west is indicated as medium- to high-density residential use.

3.2.4 Site History

The landfill trenches, which reportedly contain approximately 5,000 cubic yards of material, were used from the late 1940s or early 1950s until about 1971. The trenches are suspected of containing a mixture of MCAS Tustin-generated municipal solid waste and industrial waste, the latter reportedly including paints, oils, solvents, and transformers. According to boring logs and trench logs, landfill materials consist of concrete, gravel, wood, glass, cobbles, metal, asphalt, and minor trash. The Crash Crew Burn Pits were used to burn flammable liquids for fire-fighting training exercises from about 1971 until 1983. Flammable liquids burned in the Crash Crew Bum Pits consisted primarily of jet propellant grade 5 (JP-5), as well as oils, solvents, lacquers, primers, and various chemicals. An estimated 250,000 to 350,000 gallons of liquid wastes was used for fire-fighting training at the burn pits. Further details regarding the Site history are provided in the Final ROD/RAP (DoN 2001).

The exact number and size of the trenches and pits are unknown because newer trenches and pits were constructed over older sections. The area encompassing the landfill trenches and burn pits has been estimated at approximately 600 by 250 feet based on aerial photographs and historical information.

In 1983, petroleum was reportedly observed seeping into Peters Canyon Channel. The petroleum was attributed to seepage from the landfill trenches and burn pits. Response actions were implemented beginning in 1983 to mitigate the petroleum impacts as discussed below in 3.2.5.

In May 1985, pursuant to California's Porter-Cologne Water Quality Control Act, the RWQCB Santa Ana Region issued CAO No. 85-74 for MCAS Tustin in response to the

seepage of petroleum (and other materials) into Peters Canyon Channel. The CAO ordered the U.S. Marine Corps to perform specific actions, including:

- Submit a plan for cleanup of all fuels and contaminated groundwater and soil resulting from discharge of waste to the burn pits;
- Submit a schedule for implementation of the necessary investigative remedial work; and
- Submit monthly progress reports describing the status of work conducted to comply with the CAO.

The CAO was rescinded on 31 May 1996, after a determination by the RWQCB Santa Ana Region that MCAS Tustin had fulfilled the requirements of the CAO.

3.2.5 Initial Response

Response actions taken at former MCAS Tustin are summarized in Table 2-1.

The principal response actions for IRP-1 included excavation and offsite disposal of contaminated soil in 1983. A steel-reinforced concrete containment wall was constructed along the west bank of the channel in 1986 to prevent seepage of contaminated groundwater into the channel. A "fishbone-style" French drain system and two associated sumps were installed in 1987, and periodic groundwater extraction was performed until approximately 1992. In addition, LFG monitoring probes and groundwater monitoring wells were installed in 2000.

The following major investigations were implemented:

- Initial site assessment during 1983 and 1984 (Brown and Caldwell 1985);
- Final site inspections from 1990 to 1993 (JEG 1993b);
- RI Report for OU-3 in 1996 (BNI 1996).

Routine groundwater monitoring was implemented in 1997, and continued beyond the ROD milestone (DoN 2001) and into the long-term monitoring phase, which continues today.

As discussed in 3.2.1 above, construction of the Jamboree Road extension over the Site occurred in 1997 to 1999. The construction included placement of up to 20 vertical feet of earthfill, associated retaining walls, elevated ramps, road pavement, and slope landscaping. The road design incorporated surface runoff collection and drainage features designed to prevent or minimize infiltration of surface water into the underlying subgrade. The surface water collection system drains into the adjacent Peters Canyon Channel.

3.2.6 Basis for Taking Action

3.2.6.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT – IRP-1

3.2.6.1.1 Summary of Exposure Assessment

The human health risk assessment (HHRA) conducted for IRP-1 as part of the RI focused on COPCs identified in surface water and sediment in Peters Canyon Channel and shallow groundwater beneath the Site. No viable exposure pathways were identified for the contaminated subsurface soil and buried landfill materials beneath the Site.

For surface water and sediment, the receptor on which the risk estimates were based was a child of elementary to high school age ("older child") who spends 4 hours per week (2 hours per day on Saturday and Sunday) playing in Peters Canyon Channel adjacent to the Site for a period of 7 years. The estimates of groundwater risk assumed a residential scenario for children and adults. Residential adult risk estimates were based on exposure of a person from birth to the age of 30 years. Residential child exposure was assumed to be 6 years.

The exposure routes used in the risk assessment for surface water and sediment included ingestion, dermal contact, and inhalation. Although it was considered unlikely that anyone would install a private well to obtain water for home use (due to the high TDS content in excess of 10,000 mg/L, the low yield in the shallow WBZs, and the ready availability of public water), the potential risk presented by the COPCs in groundwater was estimated using exposure conditions associated with residential use of the groundwater (as tap water). The exposure routes used in the risk assessment for groundwater included ingestion, dermal contact, and inhalation. The chemicals evaluated in the risk assessment were those identified as COPCs in the RI Report. Risks were calculated using exposure-point concentrations based on the highest measured concentrations of COPCs.

Toxicity values used in the risk assessment were obtained from either the U.S. EPA or the DTSC because the DTSC recommends use of the more conservative toxicity criteria when conducting risk assessments in California. Similarly, the U.S. EPA requires the use of toxicity values developed by the U.S. EPA when conducting risk assessments at facilities that fall under the jurisdiction of the federal government (U.S. EPA 2003). Since the Site falls under the jurisdiction of both the U.S. EPA and the DTSC, the risk assessment was conducted using a “dual-tracking” approach. That is, the risk assessment was conducted following two parallel tracks, one that developed potential cancer risk estimates and noncancer hazard estimates using only toxicity values published by the U.S. EPA and a second that developed these estimates using only toxicity values published by the DTSC. Cancer risk and non-cancer hazard indices estimated using the “dual-tracking” approach are presented below.

3.2.6.1.2 Summary of Site Risks Associated with Sediment and Surface Water

The estimated lifetime cancer risk presented by the COPCs in the sediment and surface water to the child playing in Peters Canyon Channel at the exposure conditions assumed in the risk assessment was estimated to be 4.4×10^{-6} when based exclusively on U.S. EPA cancer slope factors (CSFs) and about 5×10^{-6} when based on California Environmental Protection Agency (Cal/EPA) CSFs substituted for cadmium, hexavalent chromium, nickel, benzo(a)pyrene, benzo(k)fluoranthene, and chrysene. The total cancer risk for surface water and sediment was within the generally acceptable range of 10^{-6} to 10^{-4} as defined in the NCP.

The total non-cancer hazard index (HI) for the COPCs in sediment and surface water was 0.052, which indicated that the COPC concentrations were not high enough in both media to cause systemic toxicity in a child exposed in the manner assumed in this risk assessment.

The exposure conditions used for the estimate of risk for sediment and surface water probably overestimated the actual risk. The risk estimate was based on the assumption that exposure could occur 2 hours per day, 104 days per year. In addition, because of similarities in both the type and magnitude of organic and inorganic contamination detected

in sediment and surface water samples both from locations upstream of the Site and from locations adjacent to and downstream of the Site, it was concluded that there was significant uncertainty as to whether the COPCs identified in the channel actually came from IRP-1.

3.2.6.1.3 Summary of Site Risks Associated with Groundwater

The total residential adult cancer risk for groundwater was estimated to be 2.5 x 10^{-3} for both the estimate based exclusively on U.S. EPA CSFs, and that based on a combination of U.S. EPA and Cal/EPA CSFs. The groundwater cancer risk for a resident child was estimated at 9.1 x 10^{-4}. Naturally-occurring arsenic accounted for 93 percent of the total cancer risk and 1,4-dichlorobenzene accounted for an additional 7 percent. The total cancer risk estimate for groundwater exceeded the NCP risk management range of 10^{-6} to 10^{-4} as defined in the NCP.

For the resident receptor, non-cancer risk estimates were those corresponding to the child resident. The non-cancer risk estimates for the child resident were higher than those for the adult resident. The HI for groundwater for a resident child was estimated to be 40. Arsenic and molybdenum accounted for 76 percent of the HI, and manganese, thallium (as thallic oxide), cadmium, antimony, chlorobenzene, and 1,2-dichlorobenzene accounted for an additional 24 percent. The estimated HI exceeded the NCP-defined threshold of 1, indicating that adverse effects could occur under the conditions assumed for the risk estimate.

The groundwater risk and hazard estimates were examined again in November 1998 to assess possible changes due to more current toxicity factors or to additional data from the groundwater monitoring program. Arsenic was the major risk driver and hazard driver and was used to indicate changes. The CSF for cancer risk due to arsenic was not revised by the U.S. EPA between 1995 and 1998, but the hazard factor increased by approximately 5 percent. The exposure-point concentration used for arsenic in the RI Report was 0.1 mg/L, but the July 1998 maximum reported concentration was 0.02 mg/L, The net result was that incremental groundwater cancer risk (U.S. EPA) dropped from 2.5 x 10^{-3} to about 6 x 10^{-4} and the HI dropped from 40 to about 22.

The risk assessment indicated that arsenic, manganese, molybdenum, thallium, and antimony were present in groundwater at concentrations that presented a relatively high cancer risk (arsenic) or a high HI (all five metals). Metals are naturally occurring substances. Therefore, when any metal is present at a concentration that presents a relatively high level of cancer risk or hazard, it was considered important to determine whether or not the concentrations found in soil or groundwater at the Site were typical of the regional values outside the Site. Available information suggested that the highest reported concentrations of arsenic and manganese in the groundwater were elevated. However, the highest reported concentrations of molybdenum and thallium in groundwater appeared to be within background (i.e., the concentrations of molybdenum and thallium were equal to or below the highest reported concentrations in upgradient wells that had not been affected by Marine Corps activities). Antimony concentrations were concluded to be likely representative of background concentrations as well.

As stated earlier, the probability of the contaminated groundwater being used as a drinking-water source was concluded to be extremely low for the following reasons:

- The shallow WBZs had naturally high TDS, which exceeded concentrations suitable for potable use; and yield was low.
- Tustin and other cities in the area do not use water from the shallow WBZs.
- If a drinking-water well were to be installed to obtain water from that zone, it would be by a private property owner; however, there is no usable land left for any development because Jamboree Road and the off-ramps nearly cover the entire Site.
- ICs such as the City of Tustin's well permit requirements and the Orange County Water District's well permit requirements preclude construction of water supply wells without written approval.

3.2.6.2 SUMMARY OF ECOLOGICAL RISK ASSESSMENT

The objective of the ecological risk assessment (ERA) was to assess the hazards of COPCs in sediment and surface water of Peters Canyon Channel to wildlife receptors by performing a screening-level assessment. No special-status species were identified as directly exposed; however, it was concluded that the American peregrine falcon (*Falco peregrinus anatum*) could be exposed indirectly by consuming prey (waterfowl) that might become contaminated by living on or near the channel.

The ERA considered the potential hazard presented by COPCs in sediment and surface water by ingestion. The COPC concentrations used for the ERA were based on the maximum values detected in the area. Ecological receptors at the Site included adult great blue herons and mallards. The receptors were assumed to consume all of their daily food and water from the channel adjacent to the Site.

The hazard quotient (HQ) values for cadmium (2), cobalt (5), zinc (13), hexavalent chromium (54), and bis(2ethylhexyl)phthalate (2) calculated for the mallard exceeded 1.0. The HQ values for cadmium (82), cobalt (3), and bis(2-ethylhexyl)phthalate (3) calculated for the great blue heron exceeded 1.0. These findings indicated a slight potential for an effect from sediments and surface water on mallards and great blue herons given a worst-case exposure scenario. It was considered unlikely that any mallard spends all of its time at IRP-1, and given the small size of the Site, it was considered highly unlikely that there is any effect to waterfowl at the population level. Similarly, it was considered unlikely that any great blue heron ingested all of its diet of fish from the short section of channel adjacent to IRP-1. Therefore, given the conservative nature of the risk assessment, it was concluded that there was little to no threat to waterfowl when considered at the population or individual animal level.

3.2.6.3 BASIS FOR TAKING ACTION

The HHRA concluded that risks associated with exposures to surface water and sediment in Peters Canyon Channel were within the NCP risk management range for cancer risk of 10^{-6} to 10^{-4}, and below the threshold HI of 1, but exceeded these criteria for risks associated with exposures from beneficial use of groundwater. Therefore, remedial action to address groundwater risks was deemed warranted.

COCs identified in the risk assessment as risk drivers were limited to specific chemicals in groundwater that included arsenic, manganese, molybdenum, thallium, antimony,

cadmium, chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene. Remedial action to prevent exposure to these chemicals in groundwater was warranted.

3.3 IRP-3

3.3.1 Physical Characteristics

IRP-3 is located in the central portion of the former MCAS Tustin property, north of Building 29 (Hangar No. 2), and is also referred to as OU-1B South (Figure 3). IRP-3 occupies approximately 1.4 acres and encompasses building 29A formerly used for chemical storage and painting operations that began in 1967. IRP-3 also includes the site of former UST-29A as well as eight AOCs (ST-48 through -52 and TOW-X3, -X4, and -X8).

3.3.2 Land and Resource Use

The layout of IRP-3 is illustrated on Figure 3 - Site Plan. IRP-3 is currently in the process of being transferred to the City of Tustin and is not presently used other than for operation, maintenance and monitoring of the groundwater remedy. To expedite the transfer process, a Lease-in-Furtherance-of-Conveyance (LIFOC) has been established between the City and the DoN.

3.3.3 Re-Use

IRP-3 is located in CO-6 and consists of undeveloped land and a portion of existing Hangar 29. According to the City of Tustin SP/RP, IRP-3 is designated for reuse as "general office" (commercial) use. No residences are planned at IRP-3.

3.3.4 Site History

The Marine Corps reportedly used four waste disposal areas, which could only be located approximately within the boundaries of IRP-3 (BNI 1997c). Other potential sources of subsurface contamination include two oil/water (O/W) separators (O/W-29A and -174) as well as a former fuel-oil UST (UST-29A).

Available information suggests that approximately 3,750 gallons of liquid wastes were released directly onto the ground outside storage and painting operation Buildings 174 and 265, respectively (BNI 1996). These liquid wastes included solvents, paint strippers, and battery acids. Wash-water used to remove waste material from the paint-stripping dip tank was also reportedly released directly onto the ground.

Building 174 was built in 1967 and used primarily for painting and welding operations. It also provided storage for batteries, hazardous materials, and miscellaneous equipment. AOC TOW-X3 includes O/W-174, a separator formerly located adjacent to the southeast corner of Building 174, which received solvent-contaminated discharges from a wash rack (BNI 1997c). O/W-174 was removed in 1999.

Building 265 was built in 1985 and was used to store hazardous materials, including lubricating oil, propellant, epoxy paint, polyurethane-based paints, enamel, paint thinners, corrosion-prevention compounds, lacquers, and solvents.

Building 29A was used to store empty boxes, although it originally housed a boiler that provided heat to Building 29. Fuel oil for the boiler was stored in UST 29A, formerly located west of Building 29A. UST 29A was installed in 1942 and had a storage capacity of 7,000 gallons (BNI 1997c), UST 29A was removed in August 1993. Residual petroleum

hydrocarbon contaminated soil associated with UST 29A was removed in 2004 and 2009 under the oversight of the RWQCB (ECS 2010d). The RWQCB granted regulatory NFA case closure for UST 29A in 2010 (RWQCB 2010b).

AOC TOW-X4 included O/W-29A, a separator formerly located on the north side of Building 29A. O/W-29A was removed in 1999. Residual TCE concentrations in soil were considered to be a potential continuing source of groundwater contamination, and were subsequently removed as a part of the CERCLA groundwater remedy for IRP-3 (DoN 2004c).

3.3.5 Initial Response

Response actions taken at former MCAS Tustin are summarized in Table 2-1.

In 1991, a site inspection, including a soil gas survey and shallow soil and groundwater investigations, was performed at IRP-3 (JEG 1993b). The results confirmed reported releases of hazardous constituents in the area. TCE and chloroform were reported in soil gas and groundwater samples collected across the Site. TCE was reported in groundwater samples at concentrations ranging from 10 to approximately 3,000 micrograms per liter (μg/L). TCE, TPH, bis(2-ethylhexyl) phthalate, pesticides, and polychlorinated biphenyls (PCBs) were reported in soils. Heavy metals including lead, cadmium, chromium, and zinc were also reported in soils but at concentrations near expected background values (JEG 1993b).

In 1995, BNI conducted an RI to further evaluate the nature and extent of soil and groundwater contamination at IRP-3 (BNI 1997c). TCE was the most frequently-reported and widely-distributed contaminant in soil and groundwater samples collected and analyzed in the RI. TCE contamination was attributed to sources such as historical surface spills and past waste disposal practices as well as the inactive O/W separators at AOCs TOW-X3 (O/W-174) and TOW-X4 (O/W-29A).

TCE and three of its degradation products including 1,1-DCA, 1,1-DCE, and 1,2-DCE were reported in shallow soils in several areas at IRP-3 (BNI 1997c, 1998). Other VOCs reported in soils included methylene chloride, acetone, methyl ethyl ketone, ethylbenzene, and total xylenes.

Maximum reported TCE concentrations, and the largest areal extent of TCE-contaminated soil, were found at depths from 7 to 13 feet bgs within saturated silts and clays in the upper portion of the first WBZ (BNI 1997c, 1998). In general, concentrations of TCE reported in soil at IRP-3 decreased with depth. TCE was reported at a maximum concentration of 2,679 micrograms per kilogram (μg/kg) in a soil sample collected from the saturated zone at 12 feet bgs in the vicinity of inactive separator O/W-29A. Reported TCE concentrations were less at 15 to 20 feet bgs, depths that are also generally within the saturated silts and silty sands of the first WBZ. TCE was reported in soil samples collected from 20 to 40 feet bgs, within the second WBZ, at concentrations of up to 1,539 μg/kg. Only trace concentrations of TCE were reported in soil samples taken from depths below about 40 feet bgs.

TPH-contaminated soils also containing elevated concentrations of metals and PAHs were reported in some areas at IRP-3 (BNI 1997c). TPH contamination was reported in shallow vadose-zone soils (typically shallower than 3 feet bgs) at concentrations of approximately 10 to 30 milligrams per kilogram (mg/kg). PAHs were also reported in soil samples, with

maximum concentrations reported in a sample collected at 7 feet bgs that was associated with a fuel-oil release from a pipeline connected to former UST-29A.

Other organic compounds reported in the upper one foot of soil included the solvent bis(2-chloroisopropyl) ether and two plasticizers, bis-(2-ethylhexyl) phthalate and butyl benzyl phthalate. Three phenolic compounds (phenol, 2-methyl phenol, and 4-methyl phenol) were also reported in upper vadose-zone soil samples.

Site-related metal contamination was limited to the upper 2 feet of soil (BNI 1997c). Lead, the most frequently reported metal, was reported in 25 percent of the shallow soil samples at concentrations exceeding the background concentration of 23.4 mg/kg. Lead was reported at a maximum concentration of 621 mg/kg. Other metals exceeding background concentrations and, therefore identified as COPCs for soil, included cadmium, chromium (total), hexavalent chromium, copper, silver, and zinc.

On the basis of sampling results obtained during the RI, TCE and three of its degradation products (1,2-DCE, 1,1-DCA, and 1,1-DCE) were identified as the primary COPCs for groundwater (BNI 1997b,c).

Four co-mingled VOC plumes originating from several TCE-contaminated soil areas were interpreted to exist in the first WBZ at IRP-3 (BNI 1997c, 1998). TCE was reported in groundwater samples from the first WBZ at concentrations ranging from 10 μg/L to 1,742 μg/L. TCE reported in groundwater at concentrations exceeding 5 μg/L was interpreted to extend approximately 1,000 feet in a south-southwest and north-northeast direction and approximately 600 feet in a west-northwest and south-southeast direction.

Two VOC plumes were interpreted to exist in the second WBZ, extending downgradient from separators O/W-29A and O/W-174 (BNI 1997c, 1998). TCE was reported in groundwater samples from both plumes at concentrations in excess of 1,000 μg/L. Based on RI data, TCE in these plumes was interpreted to extend laterally approximately 600 to 800 feet in a south-southwest direction, approximately 100 to 125 feet in a northwest-southeast direction, and vertically to depths of approximately 40 feet bgs, respectively.

A post-RI soil sampling program was conducted in 1997 to further evaluate the extent of TCE-contaminated soil in the saturated zone at IRP-3 (BNI 1997c). Two additional potential TCE source areas extending approximately 50 and 75 feet south (downgradient) from O/W-174 and O/W-29A, respectively, were identified in the uppermost saturated silts and clays of the first WBZ. Post-RI sampling results also indicated that TCE in the upper silts and clays of the first WBZ was slightly more extensive south of Building 514 than originally determined during the RI (BNI 1997c). Overall, the occurrence of TCE in saturated-zone soils at IRP-3 was found to parallel the general direction of groundwater flow (i.e., toward the south and southwest).

An FS was conducted for IRP-3 (OU-1B South) that included development and evaluation of remedial action alternatives for groundwater (BNI 2002). Computer modeling performed during the FS indicated that TCE remaining in soil at concentrations exceeding 400 μg/kg within the vadose zone could potentially act as a continuing source of contamination to groundwater, resulting in concentrations of TCE exceeding the maximum contaminant level (MCL). Based on soil sampling results obtained during the RI and post-RI soil sampling programs, four areas with TCE concentrations in soil exceeding 400 μg/kg were identified at IRP-3.

3.3.6 Basis for Taking Action

3.3.6.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT (HHRA)

Potential exposure pathways for COPCs in soil at IRP-3 included ingestion, inhalation, and dermal contact. Exposure pathways were identified based on site-specific information, physical properties of COPCs, and human receptors corresponding to future land use planned by the City of Tustin (BNI 1997c).

Toxicity values used in the risk assessment for IRP-3 were obtained from either the U.S. EPA or the DTSC, since DTSC recommends use of the more conservative toxicity criteria when conducting risk assessments in California. The risk assessment was conducted using a dual-tracking approach. The risk assessment was conducted following two parallel tracks, one that developed potential cancer risk estimates and noncancer hazard estimates using only toxicity values published by the U.S. EPA and a second that developed these estimates using only toxicity values published by the DTSC.

Human-health risks were calculated for IRP-3 both under conditions at the time of the RI, and under future conditions (i.e., after 30 years, when remediation of groundwater is assumed to be complete). Exposure point concentrations (EPCs) for VOCs in groundwater were developed by multiplying the current concentration (at the time of the RI) by a factor (a 90 percent reduction) that reflected the expected overall concentration decline within the plume at the completion of remediation. The factor was based on the reduction in the concentration of TCE predicted by groundwater modeling performed during the FS. TCE was considered to be a conservative cleanup indicator relative to other VOC risk drivers because it has a lower aqueous solubility and a greater tendency to adsorb to soil than other VOCs. Because groundwater cleanup was intended for VOCs, concentrations of other contaminants (e.g., semi-volatile organic compounds, pesticides, and metals) at the completion of groundwater cleanup were conservatively assumed to be the same as the initial concentrations used to evaluate current (RI) conditions in the baseline HHRA, i.e. no decline in non-VOC contamination concentrations was assumed.

In the RIs, VOCs were typically reported at low concentrations in the vadose zone. Maximum VOC concentrations were reported in soil samples collected from below the top of the water table beginning at approximately 12 feet bgs in a relatively thick, low permeability, silty clay layer known as the upper confining layer. Reported concentrations of VOCs typically diminished within this upper confining layer upwards towards the ground surface, and also downwards within the saturated zone towards the bottom of the sand layer in the second WBZ. Direct exposure to chemicals in the subsurface, therefore, would not occur unless excavation activities exposed contaminated soils at the surface.

VOC contamination originating at or near the surface at IRP-3 entered groundwater through the vadose zone in dissolved form. All VOC contamination associated with IRP-3 is confined to the first and second WBZs (BNI 1997c, 1998). There is no indication that VOCs from IRP-3 have impacted the third WBZ or the deeper regional aquifer (BNI 1997c). Currently, there is no complete exposure pathway to contaminated groundwater at IRP-3 because ICs are in place to prevent exposure.

The baseline HHRA concluded that the then-current total residential cancer risk (from soil and groundwater contaminants) for IRP-3 sitewide, TOW-X3, and TOW-X4, was 1.5×10^{-4}, 1.5×10^{-4}, and 1.6×10^{-4}, respectively. The cancer risks were primarily associated with exposure to 1,1-DCE and hexavalent chromium in groundwater. The non-cancer HI for each of these three areas was 8.4, 6.0, and 6.4 respectively. These HIs were principally

associated with thallium and chloroform in groundwater. For IRP-3 sitewide, manganese in soil was identified as an additional contributor to the HI.

The HHRA also considered future risks estimated after cleanup of VOCs in groundwater was projected to be complete (30 years following implementation of the selected groundwater remedy). In this future estimate, non-VOC contaminant concentrations were assumed to remain unchanged, unless soil was removed as a part of the groundwater remedy. In this case, non-VOC concentrations in areas of planned soil removal were eliminated from the analysis. The HHRA projected total future cancer risk for each of IRP-3 sitewide, TOW-X3, and TOW-X4, of 4×10^{-5} for the residential scenario. The reduction in risk was related principally to reduction of 1,1-DCE concentrations in groundwater. The HHRA projected total future non-cancer HIs for IRP-3 sitewide, TOW-X3, and TOW-X4, of 7.5, 4.6 and 4.6 respectively. At IRP-3, the principal risk driver was thallium in groundwater and manganese in soil. At TOW-X3 and TOW-X4 the principal risk driver was thallium in groundwater.

Based on the ROD, remediation of the IRP-3 groundwater plumes will be considered complete when RGs, represented by state and federal drinking water standards, are achieved throughout the plume. At the time of the baseline HHRA, the cancer risk associated with IRP-3 site-wide groundwater was estimated at 1.3×10^{-4} using U.S. EPA toxicity values, and 1.5×10^{-4} using DTSC toxicity values (DoN 2004c).

Following remediation, cancer risks in groundwater at IRP-3 including TOW-X3, and TOW-X4 were estimated to be reduced to 4×10^{-5}, within the NCP risk management range. Principal cancer risk drivers were related to 1,1-DCE and hexavalent chromium in groundwater. It should be noted that carcinogenic risk estimates that include 1,1-DCE and hexavalent chromium were considered overly conservative. As discussed in the FS Report, these projected risk estimates should not be taken as absolute indicators of risk because of inherent uncertainties associated with assumptions used in the analysis. Sources of uncertainty included:

- The assumption that groundwater VOCs degrade at the same rate as TCE,
- The use of a conservative model to quantify future TCE concentrations, and
- The assumption that all other COPCs remain unchanged throughout groundwater cleanup.
- Baseline non-cancer risks in groundwater at IRP-3 following remediation were determined to be equal to 4.5 (DoN 2004c). This HI was associated primarily with exposure to thallium in groundwater. Thallium was retained as a COPC in groundwater during the IRP-3 risk assessment on the basis of a statistical comparison of on-site concentrations to background concentrations. However, the total non-cancer risk at IRP-3 under current and future conditions was believed to be overly conservative due to the thallium contribution. The following reasons indicate why thallium in groundwater is not a site-related release.
- Thallium is a naturally-occurring metal in both soil and groundwater. It is not a common environmental contaminant, and its use would primarily be limited to application of rodent pesticides.
- There is no documentation or historical information indicating thallium was used at IRP-3, TOW-X3, or TOW-X4, or that pesticides containing thallium were applied at these locations.

- If concentrations of thallium in groundwater were due to a site-related release (i.e., not naturally occurring), then it would be expected that elevated thallium concentrations would be present in soil at IRP-3 and at the AOCs.
- Thallium was not reported in soil at IRP-3; however, it was retained as a groundwater COPC in the risk assessment, based solely on statistical evaluation of on-site and background groundwater data.
- Thallium was infrequently reported in the IRP-3 groundwater data (9 of 56 sampling data points, or 16 percent).
- Concentrations of thallium (0.0073 mg/L) reported in background monitoring wells located at perimeter areas of former MCAS Tustin were similar to the thallium groundwater EPC (0.0032 mg/L) used in the risk assessment.

3.3.6.2 SUMMARY OF ECOLOGICAL RISK

Habitat surveys were performed for IRP-3. It was concluded that no suitable wildlife habitats exist at the Site (DoN 2004c). Therefore, no ERA was performed for the Site.

3.3.6.3 BASIS FOR TAKING ACTION

Based on the results of the baseline HHRA, the DoN and BCT determined that remedial action was required to reduce the concentration of contaminants in groundwater at IRP-3. Remedial action was not required to reduce risks from soil (soil with elevated concentrations of VOCs was recommended for removal to prevent future impact to groundwater).

3.4 IRP-12

3.4.1 Physical Characteristics

IRP-12 occupies approximately 3.5 acres north of Building 28 in the northwestern portion of former MCAS Tustin, south of Valencia Avenue and east of Armstrong Avenue (Figure 4). IRP-12 includes two former buildings (Buildings 90 and 20B) and several former drum storage areas once used to manage hazardous wastes, including assorted unidentified solvents, motor oil, and hydraulic fluids. IRP Site12 is also the site of former UST-90 as well as eight AOCs (ST-21A, ST-21B, ST-21C, ST-21D, ST-2IE, ST-21F, designated hazardous waste storage area [STD]-1, and MDA-07) investigated during the RFA.

3.4.2 Land and Resource Use

The boundaries and layout of IRP-12 are illustrated on Figure 4 - Site Plan. IRP-12 is located within CO-5 which is retained by the DoN. A FOST is underway for a small portion (Reuse Parcels 16B and 17A) of IRP-12. The majority of IRP-12 includes undeveloped land and former MCAS Tustin buildings. To expedite the transfer process, a LIFOC has been established between the City and the DoN. The Final Finding of Suitability to Lease (FOSL) provides provisions for use of buildings within Carve Out (CO) 5.

3.4.3 Re-Use

IRP-12 is located in CO-5 and consists of undeveloped land. According to the City of Tustin SP/RP, IRP-12 is designated for reuse as park and open space. No residences are planned at IRP-12.

3.4.4 Site History

The area identified as IRP-12 was used primarily for materials storage and warehouse functions (BNI 1997c). Building 90, built in 1953 and renovated in 1989, was always a warehouse. Building 20B was built in 1943 and was used exclusively for storage. The following three subareas within IRP-12 were reportedly used for drum storage from the mid-1960s until 1975 and experienced leaks or releases as summarized below.

- Approximately 880 gallons of assorted organic liquids, including solvents, motor oil, and hydraulic fluids, reportedly leaked from drums within an approximately 250-square-foot area west of the northern corner of Building 90.
- Approximately 1,000 gallons of motor oil and hydraulic fluids reportedly leaked from storage containers within a 20,000-square-foot area northeast of Building 90.
- An estimated 660 to 800 gallons of motor oil and hydraulic fluids was released in a 500-square-foot area southeast of Building 20B.

A 500-gallon UST (UST-90), removed in 1993, was formerly located between Building 90 and Copeland Street. It was installed in 1953 and stored No. 2 fuel oil (similar to diesel fuel) for heating Building 90. Petroleum contamination was discovered both around the tank excavation zone and upgradient near Building 90 (BNI 2000). The DoN removed the contaminated soil associated with former UST-90 under a separate petroleum corrective action program.

ST-21A and ST-21B were inactive hazardous waste storage units that formerly held materials such as mercury, jet fuel, other distilled petroleum products, and cleaning compounds. ST-21C, ST-21D, ST-21B, and ST-21F were used to store recyclable wastes such as oil, jet fuel, and batteries. STD-1 (Building 248) was used to store hazardous wastes. MDA-07 was used as a washpad for aircraft.

3.4.5 Initial Response

Response actions taken at former MCAS Tustin are summarized in Table 2-1.

IRP-12 was recommended for a confirmation study based on the results of an initial assessment in which IRP-12 was first identified as a potentially contaminated area (BNI 1997c). Results of the initial assessment indicated limited surficial soil contamination was present, primarily TPH at reported concentrations ranging up to 730 mg/kg in an area just north of Building 90, in drainage ditch sediments east of Building 90, and in the area south of Building 20B (BNI 1997c). Pesticides reported in soil included the following chemicals:

- dichlorodiphenyltrichloroethane,
- dichlorodiphenyldichloroethene, and
- dichlorodiphenyldichloroethane.

Other organic compounds reported in soils included methylene chloride, acetone, and bis(2-ethylhexyl)phthalate at maximum concentrations of 68, 39, and 600 μg/kg, respectively. Heavy metals (arsenic, chromium, copper, lead, mercury, nickel, and zinc) were reported in shallow soil samples at concentrations near expected background values (BNI 1997c).

Selenium was reported in all groundwater samples collected during the site investigation (SI) at concentrations ranging from 80 to 380 µg/L. TCE was reported in one groundwater sample at a concentration of 1,000 µg/L (BNI 1997c).

In 1995, an RI was performed to confirm the findings of the initial assessment and to determine the nature and extent of soil and groundwater contamination at IRP-12 (BNI I997b). The major contaminants identified during the RI included TCE in soil and groundwater and TPH in soil. The presence of TCE in soil and groundwater was attributed to surface disposal of solvents as well as spills and leakage from solvent storage containers situated on the ground surface. It is believed that these releases occurred before the early 1980s.

TCE contamination was not linked to either former UST-90 or to any of the AOCs. Former UST-90, however, was shown to be the principal source of the TPH-contaminated soil discussed above (BNI 1997c).

TCE, the most frequently reported VOC in soil samples, was reported in shallow vadose zone soils (generally above 7 feet bgs) and in deeper saturated zone soils to a depth of approximately 24 feet bgs (BNI 1997c). The maximum areal extent of TCE and the greatest concentrations were generally reported in soil samples from 12 feet bgs. Common TCE degradation products, including 1,1-DCA, 1,1-DCE, 1,2-DCE, 1,2-DCA, and VC, were not reported in soil samples collected during the RI or during post-RI soil sampling programs.

Concentrations of TCE reported in soil were significantly lower in unsaturated vadose-zone soil samples (2 to 3 feet bgs) than in saturated zone samples (7 to 12 feet bgs) (BNI 1997c). TCE was reported in shallow vadose-zone soils at concentrations up to 200 µg/kg, and in soil samples collected at and below the water table at concentrations up to 6,629 µg/kg. TCE was reported in deeper saturated soil samples (17 to 24 feet bgs) at concentrations varying up to 346 µg/kg. TCE was not reported in soil samples collected from between 25 and 90 feet bgs.

Other VOCs that have been used as industrial solvents (chloroform, acetone, methyl chloride, and chlorofluorocarbons [CFCs]) were reported in soils at trace concentrations. TPH was reported in approximately 10 percent of the soil samples analyzed during the RI at concentrations between 11 and 722 mg/kg. Constituents indicative of petroleum, notably aromatic hydrocarbons, aliphatic hydrocarbons, and PAHs, were reported infrequently and at trace concentrations. The occurrence of TPH and related hydrocarbons at IRP-12 was generally restricted to the top 2 feet of soil. Two plasticizers, bis-(2-ethylhexyl)phthalate and butyl benzyl phthalate, were reported in the upper one foot of soil. PCBs were not reported in soil at IRP-12 (BNI 1997c).

Site-related metal contamination was also found generally in the upper portion of the vadose zone. Lead, selenium, and zinc above background concentrations were reported at 1 to 2 feet bgs. The presence of elevated concentrations of TPH in these surficial soils, together with reported releases of used motor oil, suggests that these metals are related to waste oil. Mercury was reported in six soil samples at concentrations slightly above background levels. Because of the reported storage of wastes containing mercury, the RI Report concluded that this metal was also probably a site-related contaminant in IRP-12 soil (BNI 1997c).

Based on data collected during the RI, VOCs (principally TCE) were reported in groundwater plumes in the first and second WBZs to a maximum depth of approximately 50 feet bgs (BNI 1997c). The RI identified two groundwater plumes at IRP-12; the western plume (Plume 12W) occurred only in the first WBZ, and the eastern plume (Plume 12E) occurred in both the first and second WBZs (Figure 4).

Plume 12W appeared to originate in the TCE source areas located north-northeast of Building 533 and to extend laterally approximately 450 feet in a south-southwest and north-northeast direction, following the predominant shallow groundwater flow direction in this area (BNI 1997c). The maximum width of Plume 12W was about 150 feet in a west-northwest and east-southeast direction. The downgradient extent of this plume appeared to be located near the former Copeland Street across from the southwestern end of Building 90. During the RI, a maximum TCE concentration of 3,900 µg/L was reported in a water grab sample from 21 feet bgs in a soil boring within the plume. Monitoring wells subsequently completed within the plume revealed maximum reported TCE concentrations in the range of 350 to 460 µg/L.

Plume 12E appeared to originate in TCE source areas located to the east and northeast of Building 20B and extended laterally approximately 1,800 feet in a north-south direction, with a maximum estimated width of approximately 400 feet (BNI 1997c). Although Plume 12E covered a greater area than Plume 12W, reported TCE concentrations were generally lower than at Plume 12W. TCE was reported at a maximum concentration of 1,051 µg/L in groundwater samples from the source area of Plume 12E; however, the maximum TCE concentration measured in the downgradient portion of this plume in the first WBZ was in the range of 80 to 90 µg/L in a monitoring well located approximately 250 feet downgradient from the source area (BNI 1997c). In the second WBZ, a single plume lay directly under the footprint of the first WBZ plume, extending approximately 650 feet southwards from the IRP-12 source area. A maximum TCE concentration of 58 µg/L was reported in the second WBZ at a depth of approximately 38 feet bgs (BNI 1997c). TCE was not reported in any groundwater samples collected below approximately 43 feet bgs at IRP-12.

Other VOCs reported in groundwater samples from one or both of the plumes included 1,2-DCA, 1,2-DCE, and 1,1,2-TCA. Two CFCs, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113) and 1,1,2,2-tetrachloro-1,2-difluoroethane (Freon 112), were reported at concentrations up to 900 µg/L. The distribution of the CFCs appears to coincide with Plume 12E, suggesting that these solvents were released with TCE (BNI 1997c).

Three heavy metals, including cadmium, chromium, and hexavalent chromium, were reported in groundwater samples at concentrations up to 5, 32, and 3 µg/L, respectively. The maximum reported concentration of each metal occurred in the first WBZ at approximately 25 feet bgs. Cadmium is a constituent of waste oils and paint pigment. Chromium (measured as either total or hexavalent chromium) can be found in waste oils, residuals from paint-stripping and metal-polishing operations, and chemicals used for industrial cleaning. The occurrence of cadmium and chromium in IRP-12 groundwater at depths coincident with TCE contamination suggested that both metals were related to waste releases from the drum storage areas (BNI 1997c).

Based on data obtained during the RI, TCE, 1,2-DCE, and 1,1,2-TCA were identified as COPCs for groundwater at IRP-12 (BNI I997c). A post-RI field program was performed in

1997 that verified the estimated distribution of TCE in soil, interpreted from data collected during the RI. No additional TCE source areas were identified (BNI 1998).

An FS was conducted for IRP-12 (OU-1B North) that included developing and evaluating remedial action alternatives for groundwater (BNI 2002). Computer modeling performed during this FS indicated that TCE remaining in soil at concentrations exceeding 400 μg/kg within the vadose zone and in the upper confining layers of the first WBZ would act as a continuing source of contamination to groundwater. Based on soil sampling results obtained during the RI and post-RI soil sampling programs, one area with TCE concentrations in soil exceeding 400 μg/kg was identified at IRP-12.

3.4.6 Basis for Taking Action

3.4.6.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

Exposure pathways for COPCs in soil at IRP-12 include ingestion, inhalation, and dermal contact. Exposure pathways were identified based on site-specific information, physical properties of COPCs, and human receptors corresponding to future land use planned by the city of Tustin (BNI 1997c).

Toxicity values used in the risk assessment for IRP-12 were obtained from either the U.S. EPA or the DTSC, since DTSC recommends use of the more conservative toxicity criteria when conducting risk assessments in California. The risk assessment was conducted using a dual-tracking approach. The risk assessment was conducted following two parallel tracks, one that developed potential cancer risk estimates and noncancer hazard estimates using only toxicity values published by the U.S. EPA and a second that developed these estimates using only toxicity values published by the DTSC.

Human-health risks were calculated for IRP-12 under conditions at the time of the RI, and under future conditions (i.e., after 30 years, when remediation of groundwater is assumed to be complete). EPCs for VOCs in groundwater were developed by multiplying the current concentration (at the time of the RI) by a factor (a 90 percent reduction) that reflected the expected overall concentration decline within the plume at the completion of remediation. The factor was based on the reduction in the concentration of TCE predicted by groundwater modeling performed during the FS. TCE is considered to be a conservative cleanup indicator relative to other VOC risk drivers because it has a lower aqueous solubility and a greater tendency to adsorb to soil than other VOCs. Because groundwater cleanup was intended for VOCs, concentrations of other contaminants (e.g., semi-volatile organic compounds, pesticides, and metals) were assumed to be the same as the concentrations used to evaluate current (RI) conditions in the baseline risk assessment.

In RI investigations, VOCs were typically reported at low concentrations in the vadose zone. Maximum VOC concentrations were reported in soil samples collected from below the top of the water table beginning at approximately 12 feet bgs in a relatively thick, low permeability, silty clay layer known as the upper confining layer. Reported concentrations of VOCs typically diminished from this upper confining layer upward within the vadose zone towards the ground surface, and downwards within the saturated zone towards the bottom of the sand layer in the second WBZ. Direct exposure to chemicals in the subsurface, therefore, would not occur unless excavation activities exposed contaminated soils at the surface.

VOC contamination originating at or near the surface at former MCAS Tustin entered groundwater through the vadose zone in dissolved form. Groundwater plumes containing TCE were shown to originate at IRP-12 (BNI 1997c). All VOC contamination associated with IRP-12 was confined to the first and second WBZs (BNI 1997c). There was no indication that VOCs from IRP-12 had impacted the third WBZ or the deeper regional aquifer (BNI 1997c). There were no complete exposure pathways to contaminated groundwater at the Site; groundwater from the first and second WBZs was not being used for any purpose. However, groundwater remained a potential future route of exposure because it could in theory be used for irrigation or domestic purposes in the future.

The baseline HHRA concluded that the then-current total residential cancer risk (from soil and groundwater contaminants) for IRP-12 sitewide, STD-1, and MDA-07, was 1.9×10^{-4}, 1.6×10^{-4}, and 2.0×10^{-4}, respectively. The cancer risks were primarily associated with exposure to hexavalent chromium, 1,2-DCA, chloroform, and 1,1,2-TCA in groundwater, and arsenic in soil. The non-cancer HI for each of these three areas was 29, 42, and 27 respectively. These HIs were principally associated with chloroform, selenium, antimony and 1,2-DCA in groundwater, and manganese in soil at IRP-12 sitewide and thallium in soil at STD-1.

The HHRA also considered future risks estimated after cleanup of VOCs in groundwater was projected to be complete (30 years following implementation of the selected groundwater remedy). In this future estimate, non-VOC contaminant concentrations were assumed to remain unchanged, unless soil was removed as a part of the groundwater remedy. In this case, non-VOC concentrations in areas of planned soil removal were eliminated from the analysis. The HHRA projected total future cancer risk for each of IRP-12 sitewide, STD-1, and MDA-07, of 8.9×10^{-5}, 6.2×10^{-5}, and 9.8×10^{-5}, respectively, for the residential scenario. The primary contributors to future risk included 1,2-DCA, chloroform, 1,1,2-TCA and hexavalent chromium in groundwater, and arsenic in soil. The HHRA projected total future non-cancer HIs for IRP-12 sitewide, STD-1, and MDA-07, of 9.9, 23 and 8.2 respectively. These HIs were primarily the result of exposure to selenium, antimony and chloroform in groundwater. Manganese in soil at IRP-12 sitewide, and thallium in soil at STD-1, also contributed to the HI for these sites.

Following remediation, cancer risks in groundwater at IRP-12 sitewide, STD-1, and MDA-07 were estimated to be 1.1×10^{-5} using U.S. EPA toxicity values, and 6.2×10^{-5} using DTSC toxicity values. The primary contributor to the groundwater cancer risk was hexavalent chromium. This risk value was considered overly conservative based on the following information presented in the RI Report (BNI 1997c, Section 4.2.3.2).

- Concentrations of hexavalent chromium reported in the RI groundwater data (seven samples, with one sampling result discounted due to elevated turbidity) were either not reported above the instrument detection limit (IDL) (three results) or essentially at the IDL, (four results). The analytical method (U.S. EPA Method 7196) for hexavalent chromium is highly sensitive to matrix interferences (e.g., presence of iron in groundwater), and values reported close to the IDL are difficult to resolve due to variation in the instrument signal-to-noise ratio. Because of these factors, the analytical method for hexavalent chromium is subject to high false positive rates and most, if not all, of the RI groundwater results for hexavalent chromium at IRP-12 were likely false positives (BNI 1997c).
- Other results reported in the RI groundwater data (BNI 1997c, Table 4.2-8) cast further suspicion on the analytical results for hexavalent chromium, not only at IRP-

l2 but also at IRP-3. For instance, regular and field duplicate samples collected from well I012MW08S had poor reproducibility in terms of the reported total chromium and hexavalent chromium sample concentrations. Additionally, in several cases hexavalent chromium was reported in samples where no total chromium was reported above detection limits.

Although considered a potential COPC in the RI, there was no documentation or historical information that chromium-containing materials, such as cleaning solutions or paints containing chromate, were potentially involved in a site-related release at IRP-12. Concentrations of total chromium reported in soil were within background's 99th percentile (39.2 mg/kg) (BNI 1997c). Total chromium concentrations reported in groundwater at IRP-12 (0.0052 to 0.0455 mg/L) were similar to those reported in background monitoring wells (99th percentile of 0.0106 mg/L) located at perimeter areas of former MCAS Tustin (BNI 1997b). If a site-related release involving chromium were to have impacted groundwater, it would be expected that elevated chromium levels would also be present in soil at IRP-12 sitewide and/or STD-1 and MDA-07.

The non-cancer risk at IRP-12 site-wide, STD-1, and MDA-07 for current and future conditions was also believed to be overestimated due to inclusion of selenium and antimony, two metals that occur naturally in both soil and groundwater. The risks due to these metals are considered to be overestimated for the following reasons (BNI 1997c):

- Antimony was reported infrequently in the IRP-12 groundwater data (8 of 55 samples [less than 15 percent]). This is consistent with infrequent occurrence in the background data (20 percent). Selenium was reported above detection limits in both IRP-12 and background groundwater samples with similar frequency (93 and 90 percent, respectively).
- Selenium and antimony both occur naturally in soil and groundwater. The RI Report (BNI 1997c, Volume V. page V-7) noted that background concentrations of selenium were randomly distributed in former MCAS Tustin groundwater due to local geochemical conditions (i.e., oxidation-reduction conditions) and were not attributable to station activities, including IRP-12.
- Selenium was used in the manufacturing of electronics (semiconductors), photovoltaic cells, glass-making, photographic toner, and as a steel additive. Antimony was used in semiconductors and metal alloys; as a hardening agent for lead products; and in enamel paints, glass, and pottery (minor use). There is no documentation or historical information that either of these metals, or products that could have potentially contained them, were involved in a site-related release at IRP-12 sitewide, and/or STD-1 and MDA-07.
- Selenium and antimony were retained as groundwater COPCs in the risk assessment, based solely on statistical evaluation of on-site and background data. Similar to hexavalent chromium, if a site-related release involving selenium and/or antimony were to have impacted groundwater, it would be expected that elevated levels of these metals would also be present in soil at IRP-12 sitewide, and/or STD-1 and MDA-07.

Finally, chloroform contributed to cancer and, in particular, non-cancer risk estimates at IRP-12 under future conditions. Although chloroform could have been used as a cleaning solvent or as a component of cleaning solvents used and subsequently released at the Site, it was infrequently reported in the on-site groundwater data (17 of 221 samples [less than 8 percent]). Also, chloroform was not reported above detection limits in soil samples

collected from IRP-12 site-wide, STD-1, or MDA-07. Chloroform was not a primary contaminant in terms of occurrence in the overall groundwater plume at IRP-12. There was some question as to whether it was a site-related groundwater contaminant, or a sampling or laboratory analytical artifact.

3.4.6.2 SUMMARY OF ECOLOGICAL RISK

Habitat surveys were performed for IRP-12. It was concluded that no suitable wildlife habitats exist at the Site (DoN 2004c). Therefore, no ERA was performed.

3.4.6.3 BASIS FOR TAKING ACTION

Based on the results of the baseline HHRA, the DoN and BCT determined that remedial action was required to reduce the concentration of contaminants in groundwater at IRP-12. Remedial action was not required to reduce risks from soil (soil with elevated concentrations of VOCs was recommended for removal to prevent future impact to groundwater).

3.5 IRP-13S

3.5.1 Physical Characteristics

IRP-13S includes ST-72 and MWA-18, and is also referred to as OU-1A.

IRP-13S is located in the northwest portion of the former MCAS Tustin property, along Armstrong Avenue just north of Valencia Avenue (adjacent to the former Severyns Road)(Figure 4). IRP-13S is generally level and occupies approximately 0.7 acre and is the source of the VOC-contaminated groundwater plume originating from ST-72 and MWA-18 (Figure 4). ST-72 and MWA-18 are separated by a distance of approximately 100 feet. ST-72 contained two buildings used for vehicle maintenance in the former ground support equipment (GSE) Yard. MWA-18 was a former washpad used for cleaning small generators and other field equipment.

3.5.2 Land and Resource Use

The boundaries and layout of IRP-13S are illustrated on Figure 4 - Site Plan. IRP-13S includes an early transfer parcel that consists of a multifamily residential development called Columbus Square was recently constructed (circa 2008) on the Site and adjoining areas. A FOST is underway for a portion of IRP-13S to support transfer of the property to the City of Tustin. To expedite the transfer process, a LIFOC has been established between the City and the DoN. Other than the residential development, IRP-13S is not presently used other than for operation, maintenance and monitoring of the groundwater remedy.

3.5.3 Re-Use

IRP-13S is located in CO-5 and consists of undeveloped land. According to the City of Tustin SP/RP, the northerly portion of IRP-13S is designated for reuse as a community park, and the southerly portion of IRP-13S is designated for reuse by the South Orange County Community College District. A portion of IRP-13S at its northeasterly extremity was transferred early under a Finding of Suitability for Early Transfer (FOSET). This early transfer parcel has been developed as a multifamily residential development called Columbus Square. An area requiring institutional controls (ARIC) was designated for IRP-13S that encompasses the entire footprint of the groundwater VOC plumes plus a surrounding buffer zone. The early transfer parcel lies partially within the ARIC; therefore,

the Columbus Square development is subject to ICs and the Columbus Square Homeowners Association is responsible for certifying compliance with the ICs in accordance with the LUC RD. The SP/RP indicates that no additional residences are planned within the boundary of the ARIC at IRP-13S.

3.5.4 Site History

Vehicle maintenance activities were formerly conducted at ST-72, located in the northern portion of IRP-13S. ST-72 consisted of the southern half of Building 16, the former Building 50, and the paved area surrounding the buildings. This area was part of the former GSE Yard constructed in 1942 (BNI 1997c). The southern half of Building 16 operated as a GSE maintenance garage from 1942 through 1993. From then on it housed administrative functions (BNI 1997c). A hoist lift with a below-grade waste oil collection sump was present at ST-72. Cleaning solvents were reportedly used at ST-72 as degreasers to wash down floors in the buildings, and waste solvent was likely released to storm drains or to the ground outside the building (BNI 1997c). By 1985, biodegradable soaps were being used for this purpose instead of solvents (BNI 1997c).

Building 50, located south of Building 16, was used as a vehicle lubrication facility within the former GSE Yard from the mid-1960s until the mid-1970s. Building 50 was demolished in 1982, and the area was then used as a parking lot before the station's closure. A steam-cleaning wash rack reportedly existed on the south side of the building (BNI 1997c). JEG reported that the sumps below the former lift were filled with sediment and appeared to be stained (BNI 1997c). However, no visible evidence of the sumps associated with former Building 50 was found in the RI, and no records were available to indicate whether the sumps had been excavated or left in place (BNI 1997c).

MWA-18 was an inactive washpad located west of Building 47 within the former GSE Yard that comprised the southern portion of IRP-13S. Installed in the 1940s, MWA-18 was used for washing small generators and other field equipment, and consisted of a concrete pad (50 by 56 feet) sloped to a drain. No oil/water separator was connected to MWA-18. JEG reported numerous cracks in the concrete pad and stated that its overall integrity appeared to be poor (BNI 1997c). During the RFA, wash water from equipment-cleaning activities several hundred feet north of MWA-18 was observed to drain across an asphalt-covered parking lot toward MWA-18 (BNI 1997a).

3.5.5 Initial Response

Response actions taken at former MCAS Tustin are summarized in Table 2-1.

As discussed above, the DoN performed an IAS during 1983 and 1984 to locate potentially contaminated sites at MCAS Tustin (Brown and Caldwell 1985). The report identified 14 potentially contaminated sites (IRP Sites 1 through 14) based on record searches and employee interviews. The report recommended sampling locations and analytical parameters to confirm the suspected contamination at the sites.

The potential for subsurface contamination at ST-72, included as part of IRP-13S, was first identified and was named as an area to be investigated under the RFA (BNI 1997a), The RFA conducted at ST-72 indicated that hazardous substances may have been stored, handled, disposed of, or released at this Site (BNI 1997a). Two RFA sampling visits were conducted at ST-72 in 1995 and 1996 that involved collection of limited field data to address the extent of soil and groundwater contamination. A screening-level risk

assessment and a preliminary analysis of contaminant fate and transport were also performed (BNI I997a). The screening-level risk assessment for ST-72 indicated that COPCs in groundwater presented unacceptable carcinogenic risk and adverse systemic effects (BNI 1997a).

The RFA sampling activities identified an extensive 1,2,3-TCP groundwater plume originating from ST-72 (BNI 1997a). On the basis of the RFA, the DoN determined that VOC contamination in the groundwater plume originating at ST-72 extended beyond the Site boundaries and would therefore be more appropriately managed under the CERCLA program.

An RI was conducted from 1995 through 1997 to evaluate seven sites, including IRP-13S (BNI 1997c). It consisted of a field investigation followed by an evaluation of the nature and extent of contamination, a fate and transport analysis, and a baseline HHRA. In addition, the RI included a station-wide groundwater study to evaluate the impact of COPCs present in soil and groundwater. The RI identified a TCE plume originating from MWA-18 co-located within the 1,2,3-TCP plume originating from ST-72. ST-72 and MWA-18 were therefore included with IRP-13S for CERCLA response actions (BNI 1997c).

In 1998, a limited deep HydroPunch™ investigation was conducted to evaluate potential mechanisms for migration of 1,2,3-TCP into the third WBZ at IRP-13S (BNI 1999b), Investigation results indicated that a localized lithologic discontinuity (an area with relatively coarser-grained materials), along with seasonal reversals of the vertical hydraulic gradients evident over several years of monitoring, provided a potential mechanism for limited migration of VOCs from the second to the third WBZ at that location. The investigation also confirmed that groundwater flow in the third WBZ was to the southwest, compared to a more southerly flow direction in the second and first WBZs.

OHM excavated impacted soil at MWA-I8 and ST-72 based on data from previous RFA sampling events. ST-72 was identified as the probable source of 1,2,3-TCP in groundwater based on limited soil sampling performed adjacent to Building 16 during the RI. ST-72 was subsequently split into ST-72A (Building 16) and ST-72B (Building 50). ST-72A (Building 16) consisted of a 40- by 47-foot concrete pad with a hydraulic lift. The DoN recommended ST-72A for NFA based on further soil sampling results that indicated no reportable concentrations of 1,2,3-TCP in soil (BNI 1997c).

In January 2002, a TCRA for 1,2,3-TCP in groundwater was begun at IRP-13S. The purpose of the TCRA was to establish hydraulic containment of groundwater contaminated with 1,2,3-TCP within the then-current plume boundaries in the first and second WBZs to prevent further vertical and/or horizontal migration until the final remedy was implemented, or until plume migration was stabilized (DoN 2004b). Results from quarterly groundwater monitoring conducted during summer 2002 indicated the TCRA system was effectively containing the VOC plumes (PTES 2003a). Operation of the TCRA groundwater treatment system was closely coordinated with remedial activities at the nearby UST Site 222, managed by the DoN under the PCAP.

The Final OU-1 FS Report was issued in 2003 (BEI 2003b). This report identified and screened nine remedial alternatives for IRP-13S. During 2001, while the FS Report was in preparation, it was determined that the proposed PCAP for the MTBE plume associated with adjacent UST Site 222 had the potential to cause westward or cross-gradient migration of the IRP-13S groundwater plume; therefore, OU-1 was separated into OU-1A (IRP-13S)

and OU-1B (IRP Sites 3 and 12). This allowed the DoN to coordinate the petroleum corrective action at UST Site 222 with the TCRA at IRP-13S, while proceeding to develop a separate remedy for IRP sites 3 and 12.

3.5.6 Basis for Taking Action

3.5.6.1 SUMMARY OF HHRA

As for IRP Sites 1, 3 and 12, toxicity values used in the risk assessment for IRP-13S were obtained from either the U.S. EPA or the DTSC, and the risk assessment was conducted using a dual-tracking approach. The risk assessment was conducted following two parallel tracks, one that developed potential cancer risk estimates and non-cancer hazard estimates using only toxicity values published by the U.S. EPA and a second that developed these estimates using only toxicity values published by the DTSC. DTSC recommends use of the more conservative toxicity criteria.

Three residential health risk characterization scenarios were conducted for IRP-13S as follows:

- Current1 conditions with beneficial use of groundwater (baseline case),
- Future conditions upon achievement of groundwater RGs (with beneficial use of groundwater), and
- Current conditions (with beneficial use of groundwater prevented by ICs).

Each of these scenarios is discussed in the following sections.

3.5.6.1.1 Residential Risk Under Current Conditions with Beneficial Use of Groundwater

In the baseline HHRA, total cancer and non-cancer risk estimates (using U.S. EPA criteria) for the IRP-13S source area exceeded the upper limit of the NCP risk management range for cancer risk (10^{-6} to 10^{-4}) and the non-cancer HI of 1.0 (which indicates the potential for development of adverse health effects). Total cancer risks at the source area were estimated to be 4.8×10^{-3} and were primarily associated with exposure to 1,2,3-TCP in groundwater using U.S. EPA risk factors. Results from the risk assessment indicated the calculated risk estimates within the source area using U.S. EPA and Cal/EPA slope factors were comparable. Therefore, risk estimates using U.S. EPA slope factors were used. Non-cancer HI calculated for a resident child at the source area was estimated to be 7.3 and was principally related to 1,2,3-TCP and selenium in groundwater.

Selenium was not identified as a site-related chemical at IRP-13S. Furthermore, the background threshold concentration for selenium in the first WBZ at former MCAS Tustin was 0.33 mg/L, while the EPC for selenium in groundwater at IRP-13S was 0.15 mg/L. This indicated that selenium concentrations in groundwater at IRP-13S did not exceed background concentrations and, therefore, the risks were related to selenium as a naturally-occurring chemical in groundwater at the Site.

3.5.6.1.2 Residential Risk Under Future Conditions with Beneficial Use of Groundwater

Upon achievement of RGs, the total future cancer risk estimated under the residential scenario at the source area was 4.0×10^{-4}. The principal cancer risk driver was 1,2,3-TCP

[1] Note that "Current" in this context refers to conditions at the time of the ROD.

in groundwater. This risk value represented an approximately 92 percent reduction of the risk estimate under baseline conditions. The non-cancer threshold value (HI) for a resident child under future conditions at the source area was estimated to be 3.7 and was associated with selenium in groundwater and manganese in soil. This represented an approximately 49 percent reduction in non-cancer risk from baseline conditions. The reduction in cancer and non-cancer risk was principally related to the removal of 1,2,3-TCP from groundwater.

Baseline and future risk assessment results were based on groundwater modeling that used conservative assumptions and were prepared for conservative residential scenarios in which the domestic use of groundwater (e.g., drinking, bathing, and other domestic uses) was assumed to occur over a period of 30 years. Domestic use of groundwater from the shallow WBZs is, in reality, unlikely due to the poor quality of the water (e.g., elevated concentrations of TDS, nitrates, and salinity). The actual risks posed to residents under future conditions were expected to be less than those calculated owing to factors such as the extent and effectiveness of natural attenuation.

3.5.6.1.3 Residential Risk with No Beneficial Use of Groundwater

An additional residential scenario using baseline chemical concentrations but assuming the existence of ICs to prevent beneficial use of groundwater was performed to evaluate the effectiveness of ICs and/or restrictions for reducing human health risk associated with residential occupancy of newly-constructed buildings at the Site. This scenario used all reported VOCs with EPCs calculated at a 95 percent upper confidence limit (UCL) of the mean value of their respective reported concentrations.

Total cancer and non-cancer risk estimates (using U.S. EPA criteria) for the source area fell within the NCP risk management range (10^{-6} to 10^{-4}) and did not exceed the non-cancer HI of 1.0. Total cancer risk at the source area was estimated to be 1.0×10^{-5} and was primarily associated with exposure to TCE and 1,2,3-TCP in soil vapor. Non-cancer HI calculated for a resident child at the source area was estimated to be 1.0. These results indicated that with ICs in place to prevent domestic use of groundwater, cancer risk was reduced by more than two orders of magnitude.

3.5.6.1.4 Summary

Cancer risk estimates were primarily associated with exposures to groundwater. Inhalation of groundwater vapors during household water use was the dominant risk pathway in the baseline risk assessment. Over 95 percent of the U.S. EPA cancer risk was attributable to the concentrations of 1,2,3-TCP in groundwater. Chemicals reported in soil contributed less than 1 percent of the total residential cancer risk.

Under a hypothetical residential scenario with baseline VOC concentrations and ICs to prevent beneficial use of groundwater, the maximum estimated total cancer risk was reduced by two orders of magnitude to 1×10^{-5}, within the NCP risk management range (10^{-6} to 10^{-4}). Therefore, ICs would be effective in protecting human health and would allow for the reuse of existing and newly constructed buildings within the IRP-13S Site boundary.

The main exposure pathway under the scenario with ICs was indoor vapor inhalation of TCE emanating from groundwater (63 percent), since direct exposure to 1,2,3-TCP from beneficial groundwater use would be prevented through ICs.

The HI for a hypothetical resident child exposed to soil and groundwater under baseline and future conditions exceeded the systemic toxicity threshold of 1.0, indicating a potential for the development of adverse health effects. The baseline HI, estimated at 7.3, was primarily associated with groundwater exposures to 1,2,3-TCP (38 percent) and selenium (26 percent).

3.5.6.2 SUMMARY OF ECOLOGICAL RISK

Habitat surveys were performed for IRP-13S. It was concluded that no suitable wildlife habitats exist at the Site (DoN 2004b). Therefore, no ERA was performed for the Site.

3.5.6.3 BASIS FOR TAKING ACTION

On the basis of results of the baseline HHRA, the DoN and BCT determined that remedial action was required to reduce concentrations of contaminants in groundwater at IRP-13S (OU-1A). Remedial action was not required to reduce risks from soil, since risks due to soil contamination made up less than one percent of the total cancer risk and were considered generally allowable per the NCP criteria. However, soil with elevated concentrations of VOCs was recommended for removal to prevent further contamination of groundwater.

Cancer risk estimates were primarily associated with exposures to groundwater. Inhalation of groundwater vapors during household water use was the dominant risk pathway, Over 95 percent of the U.S. EPA cancer risk was attributable to the concentrations of 1,2,3-TCP in groundwater.

Estimates of risk under a residential scenario with no beneficial use of groundwater (i.e., ICs to prevent groundwater use) were shown to reduce the risk to within NCP risk management range (10^{-6} to 10^{-4}). Under this scenario, the total cancer risk in the source area (area with the highest concentrations) was reduced to 1.0×10^{-5}; therefore, ICs would be an effective component of the remedy for protecting human health, and would allow for the reuse of existing and newly constructed buildings within the Site boundary prior to completion of other components of the remedy.

The main exposure pathway under the scenario with ICs was inhalation of 1,2,3-TCP vapors as a result of VI to indoor air from groundwater (63 percent), since direct exposure to 1,2,3-TCP from beneficial groundwater use would be prevented through ICs.

(THIS PAGE LEFT INTENTIONALLY BLANK)

4. Remedial Actions

This section summarizes the remedial actions for IRP-1, -3, -12, and -13S. It includes discussions on remedy selection, implementation, O&M and monitoring. Discussions are provided individually for each of the subject sites.

For each of the sites, the remedy selection process was done in accordance with CERCLA evaluation criteria based on requirements promulgated in the NCP. These evaluation criteria are stated in the NCP (40 C.F.R. § 300.430[f]), and are arranged in the following hierarchical manner: threshold criteria, primary balancing criteria, and modifying criteria.

Detailed discussions of the application of the selection criteria for each site are included in the respective RODs (DoN 2001, 2004b, 2004c).

4.1 IRP-1 (OU-3)

4.1.1 Remedy Selection

The remedy selection process for the response action at IRP-1 is documented in the Proposed Plan and in the agency-concurred ROD/RAP (DoN 2001). The selected remedy for IRP-1 consisted of continued containment of contaminated groundwater utilizing previously-installed remedy components, and restricted access to impacted media through previously-installed engineering controls, and ICs (DoN 2001). The major components of the selected remedy included:

- Containment of contaminated groundwater;
- Inspection and maintenance of the previously-installed steel-reinforced concrete containment wall, channel bed, landfill cover, and vegetation; groundwater and surface water monitoring;
- LFG monitoring for potential LFG generation from the former waste pits;
- Maintenance of the previously-installed French drain system, sumps, monitoring wells and security features such as fences, signs and locks; and
- ICs to prevent on–site activities that could result in exposures to buried waste, contaminated subsurface soil, or contaminated groundwater.

4.1.2 Remedy Implementation

The selected remedy was designed to stabilize or decrease COC concentrations, and prevent the migration of COCs and other chemicals beyond IRP-1 boundaries at concentrations exceeding RGs. To evaluate the effectiveness of the selected remedy, specific monitoring, inspection and reporting programs were adopted at IRP-1 (BEI 2003a). These are discussed below.

4.1.2.1 MONITORING

LFG, surface water and groundwater are monitored periodically according to an approved Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan ( ) contained in the OMP (BEI 2003a). The essential elements of each of these programs are summarized below.

4.1.2.1.1 LFG Monitoring

LFG probes were monitored monthly in 2000 and quarterly in 2001 and 2002. No methane was detected in any of the probes, and the California Integrated Waste Management Board (CIWMB) and County of Orange Health Care Agency (OCHCA) agreed to suspend LFG monitoring as of January 2003. Recently in 2010, quarterly LFG monitoring was restarted due to a response from OCHCA to a request by the DoN for agency concurrence to destroy the probes; the OCHCA noted the possibility of future development adjacent to OU-3. Again, no methane has been detected during the current 2010 and 2011 monitoring phase. LFG monitoring continues on an annual basis in accordance with a request from the OCHCA.

4.1.2.1.2 Groundwater Monitoring and Sampling

In accordance with the OMP (BEI 2003a), periodic groundwater sampling and monitoring included field measurements of groundwater levels and laboratory analyses of samples for:

- VOCs by U.S. EPA method 8260B.
- TPH by U.S. EPA method 8015M.
- Antimony, arsenic, cadmium, manganese molybdenum and thallium by U.S. EPA method 6010B.
- TDS by U.S. EPA method 160.1.
- Chloride, nitrate, phosphate and sulfate by U.S. EPA method 300.
- Alkalinity by U.S. EPA method 310.1.

Quarterly groundwater samples were collected from 1995 through 1996 as part of the RI (BNI 1996). Quarterly groundwater monitoring continued following the ROD. With BCT approval, the frequency of groundwater monitoring and sampling was reduced to semi-annual in 2003, and was further reduced to annual in 2007. Groundwater monitoring results are reported in PTES 2003b, Cape Environmental Management, Inc.(CAPE) 2005b, CAPE 2006a, CAPE 2007a, ECS 2008a, ECS 2010a, and ECS 2011a.

The two sumps connected to the French drain system were removed from the sampling schedule as of 2000, but are inspected and remain in good condition in the event they are needed in the future.

4.1.2.1.3 Surface Water Sampling

Surface water samples have been collected routinely from four sampling stations (1SW03, 04, 06 and 07) in accordance with the OMP (BEI 2003a), and have been analyzed for VOCs by U.S. EPA Method 8260B. Surface water sampling locations are shown on Figure 6.

4.1.2.2 INSPECTIONS

Inspections have been conducted at IRP-1 in accordance with the requirements of the LUCICP and OMP, and include inspection of the following:

- Landfill cover, drainage, vegetation, integrity of the steel-reinforced concrete containment wall, areas of excessive slope erosion, holes from burrowing animals, and excessive vegetation growth that could interfere with proper drainage.

- Site security to document any evidence of unauthorized access and vandalism, and that fencing is intact, warning signs are properly posted, locks are present and locked, and litter (if any) is removed.
- Integrity of ICs to confirm that unauthorized persons are not occupying IRP-1, that there are no new irrigation systems, that there are no unauthorized landscaping or planting activities, that there are no new wells installed, and that existing wells are secured and locked.

These observations are noted on field inspection forms, which are maintained on file at the ECS Tustin, California office and which are summarized in reports such as annual reports and this Report. Maintenance is performed as necessary.

4.1.2.3 REPORTING

The OMP (BEI 2003a) specifies routine and non-routine compliance reporting requirements for implementation of the remedy. Groundwater level contour maps are prepared for each reporting period. If groundwater or surface water sample data indicate that COCs are migrating beyond Site boundaries, then additional groundwater or surface water samples and splits must be collected and analyzed from wells or surface water stations where the COCs were reported. If these samples verify that COCs are migrating beyond IRP-1 boundaries, then the following reporting actions must be taken:

- Verbally notify the RWQCB and other regulatory agencies within 24 hours.
- Notify the RWQCB and other regulatory agencies in writing within 30 working days specifying actions taken or planned to mitigate the problem.
- Submit to the RWQCB and other regulatory agencies within 90 days a long-term monitoring plan (LTMP) to assess the probable causes for significant changes to water quality.

Compliance with these requirements was documented in the first Five-Year Review Report (ECS 2006), and is summarized in annual reports submitted to the BCT since the first Five-Year Review Report (CAPE 2006a, ECS 2008a, 2010a, 2011a, 2011c).

4.1.3 Problems Encountered

No significant problems have been reported to date for the IRP-1 remedy implementation. OPS was demonstrated in 2003 (PTES and Tetra Tech 2003). The OPS Determination was made by the U.S. EPA, and the BCT concurred with OPS in 2004 (U.S. EPA 2004, DTSC 2004, and RWQCB 2003).

4.2 IRP-3, -12, AND -13S (OU-1B SOUTH, OU-1B NORTH, AND OU-1A)

4.2.1 Remedy Selection

The remedy selection process for the response actions at IRP-3, -12, and -13S (OU-1B South, OU-1B North, and OU-1A) was documented in the RODs for OU-1A and OU-1B (DoN 2004b, c). The selected remedy was the same for all three sites; therefore, they are discussed together in this Report.

The remedy selection was based in part on the comparative analysis of remedial alternatives reported in the OU-1A FS and the OU-1B FS (BEI 2003b, BNI 2002). The comparative analysis evaluated the relative advantages and disadvantages of each

remedial alternative in relation to the nine evaluation criteria outlined in CERCLA Section 121(b). Computer-based groundwater modeling supported the analysis by assessing the effect of each alternative on VOC contamination. The modeling was used primarily to evaluate long-term effectiveness; short-term effectiveness (i.e., time to achieve RGs); and reduction of toxicity, mobility, or volume of contaminants. Modeling was performed using Vadose Zone Leaching Model, Modular Three-Dimensional Finite-Difference Groundwater Flow Model, and Modular Transport - Three Dimensions (MT3D) computer codes with supporting information taken primarily from the RI Report and subsequent groundwater monitoring reports.

The remedy the DoN selected for the three sites was Alternative 7 in each FS: hydraulic containment with hot spot removal. This selection was based on comparative analysis of the CERCLA criteria, the data and analyses in the RI and FS Reports, the administrative record for these sites, and an evaluation of comments submitted by interested parties during the public comment period.

4.2.2 Remedy Implementation

4.2.2.1 SOIL HOT SPOT EXCAVATION

Soil with elevated concentrations of TCE was removed from the vadose zone and upper confining layer of the first WBZ at IRP-3, -12, and -13S and was disposed off-site. Specific criteria for soil excavation and disposal were provided in the agency-concurred RD/RAWP (ERRG 2005, Shaw Environmental, Inc. [Shaw] 2005).

The rationale for removing the hot spot soils was to optimize the remedy by eliminating continual sources of low-level VOC contamination to groundwater in the first WBZ. The soils targeted for excavation were those portions of the vadose zone and upper confining layer of the first WBZ with TCE at concentrations exceeding 400 μg/kg. This value was chosen because modeling indicated that at this concentration or greater, the soil could act as a continuing source of contamination to groundwater. These targeted soils generally occurred at depths of approximately 3 to 15 feet bgs.

Soil removal at the IRP Sites 3 and 12 source areas was performed from July through October, 2005 (ERRG 2006). The work was conducted in accordance with an approved work plan (ERRG 2005).

Approximately 3,356 cubic yards of TCE-impacted soil exceeding 400 μg/kg was excavated, segregated, and stockpiled. Confirmation soil samples were collected from the sidewalls of the excavation and analyzed for VOCs. All reported concentrations of TCE for confirmation samples collected above the groundwater interface were below 400 μg/kg.

The stockpiles were sampled and analyzed, and 684 cubic yards of impacted soil with reported concentrations of TCE exceeding 100 μg/kg was transported and properly disposed at the Waste Management – Kettleman Hills facility as non-regulated waste. The remaining soil with reported concentrations of TCE less than 100 μg/kg was returned to the excavation as backfill. The backfilling of the excavation was augmented with clean imported fill soil as needed (ERRG 2006).

Soil removal at the IRP-13S source area was performed from January through March, 2005 (Shaw 2005). The work was conducted in accordance with the approved Work Plan (Shaw 2004).

Soil impacted with TCE exceeding a threshold concentration of 400 µg/kg was excavated from an area spanning approximately 140 feet in length, 50 feet in width, and up to 17 feet in depth (1 to 2 feet below top of groundwater). Confirmation soil samples were collected from the sidewalls of the excavation and analyzed for VOCs. All reported concentrations of TCE were below the threshold concentration of 400 µg/kg.

A total of 4,420 tons of soil with reported concentrations of TCE up to 7,200 µg/kg was transported and properly disposed offsite at the Clean Harbors – Buttonwillow facility as non-RCRA, California hazardous waste (Shaw 2005).

In addition, approximately 228,000 gallons of VOC-impacted groundwater was pumped from the excavation, treated through the nearby UST Site 222 PCAP groundwater treatment system, and discharged to the storm drain under the National Pollutant Discharge Elimination System (NPDES) discharge permit for that system.

The excavation was backfilled with clean imported fill soil (Shaw 2005).

4.2.2.2 GROUNDWATER EXTRACTION

Detailed design information on the IRP-3, -12, and -13S groundwater extraction systems is presented in the combined OU-1A/-1B RD (ERRG 2007). Details of the as-constructed extraction system installations are presented in the combined OU-1A/-1B I-RACR (ERRG 2008c).

The IRP Sites 3 and 12 (OU-1B South and OU-1B North) remedial systems utilize a total of 13 groundwater extraction wells as summarized in the following table:

Summary of Groundwater Extraction Wells			
No. of Extraction Wells	**Purpose**	**Screened Interval**	
		1st WBZ	**2nd WBZ**
OU-1B (South)			
3	HS	x	-
3	C	x	-
2	C	-	x
OU-1B (North)			
1	HS	x	-
2	C	x	-
1	C	-	x

C = hydraulic containment
HS = “hot spot” extraction

Well locations are shown on Figure 4. Extraction well construction details are presented in the I-RACR (ERRG 2008c).

As discussed in Section 3.5.4, a TCRA had been implemented at IRP-13S (OU-1A) beginning in 2001. The TCRA groundwater extraction and treatment system was installed in late 2001 and began operation in January 2002. The extraction system consisted of seven wells located along the alignment of the 1,2,3-TCP plume and screened in the first and second WBZs. The TCRA treatment system had a design flow rate of 35 gallons per minute (gpm) and consisted of the following components (CAPE 2005a, 2006b, 2007b):

- 5,000 gallon equalization tank;
- Bag filter; and
- Two – 2,000 pounds liquid phase granular activated carbon (GAC) vessels in series.

The treated effluent was discharged under RWQCB Order Numbers:

- R8-2002-0007, and amendments R8-2003-0085 and R8-2005-0110, General Groundwater Cleanup Permit for Discharges to Surface Waters of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Petroleum Hydrocarbons, Solvents and/or Petroleum Hydrocarbons mixed with Lead and/or Solvents; and
- R8-2006-0017, (NPDES No. CA8000404), Waste Discharge Requirements for the United States Department of the Navy, Former Marine Corps Air Station Tustin, Discharge to Peters Canyon Wash in the San Diego Creek/Newport Bay Watershed.

The primary objective of this interim measure was to mitigate the threat of uncontrolled horizontal and vertical migration of 1,2,3-TCP into the regional groundwater aquifer below OU-1A. Five of the seven TCRA extraction wells were incorporated into the groundwater extraction system for the final remedy (ERRG 2007).

The final IRP-13S (OU-1A) remedial system utilizes a total of 9 groundwater extraction wells, including 5 of the 7 pre-existing TCRA wells. The extraction wells are summarized in the following table:

Summary of Groundwater Extraction Wells			
No. of Extraction Wells	**Purpose**	**Screened Interval**	
		1st WBZ	**2nd WBZ**
OU-1A			
4	C (former TCRA wells)	x	x
1	HS (former TCRA well)	x	x
1	HS	x	-
1	C	x	-
1	HS	-	x
1	C	-	x

C = hydraulic containment
HS = "hot spot" extraction
TCRA = time critical removal action

Well locations are shown on Figure 4. Extraction well construction details are presented in the I-RACR (ERRG 2008c).

All extraction wells were originally equipped with 4-inch, 1/2-horsepower, three-phase electric submersible pumps[2]. All wells have pressure transducers to measure water levels, and paddlewheel flow meters to measure flow rate. Power to each pump is supplied from a variable frequency drive mounted within each well vault and controlled by a programmable logic controller (PLC) located within each vault.

Extracted groundwater is conveyed through 2-inch HDPE piping to a combined treatment plant for IRP Sites 12 and 13S, and to a separate stand-alone treatment plant for IRP-3. The 2-inch conveyance piping is contained within 4-inch HDPE secondary piping at specific locations detailed in the I-RACR (ERRG 2008c). Secondary containment was installed where extracted groundwater may contain TCE at a concentration greater than 500 µg/L.

Routine operation of the IRP Sites 12 and 13S (OU-1B North and OU-1A) remedial system commenced on December 7, 2007. Routine operation of the IRP-3 (OU-1B South) remedial system commenced on January 2, 2008. The groundwater extraction systems were initially operated and maintained in accordance with the RAWP that is part of the RD (ERRG 2007). Presently, O&M of the groundwater extraction systems is performed in accordance with the OMP (ERRG 2009).

The I-RACR (ERRG 2008c) documented that the groundwater extraction systems were installed as designed in the RD (ERRG 2007).

4.2.2.3 GROUNDWATER TREATMENT

Detailed information on the combined IRP Sites 12 and 13S (OU-1B North and OU-1A) groundwater treatment system, and the separate IRP-3 (OU-1B South) treatment system, is presented in the OU-1A/-1B RD (ERRG 2007). Details of the as-constructed treatment system installations are presented in the OU-1A/-1B I-RACR (ERRG 2008c).

The combined IRP Sites 12 and 13S treatment facility is located approximately 50 feet south of Armstrong Avenue (Figure 4). This combined facility is commonly referred to as the OU-1A/-1B treatment facility. The IRP-3 (OU-1B South) treatment facility is located approximately 250 feet north of intersection of Tustin Ranch Road and Warner Avenue (Figure 3).

Each treatment facility is built on a concrete containment pad and is enclosed within a steel building.

The primary components of each treatment system include:

[2] Extraction well IS72EX07D was subsequently fitted with a higher-capacity pump to increase the yield and capture zone dimensions.

- Control and alarm panel;
- Electrical panel with meter;
- 2,400 gallon influent tank;
- Feed pump;
- Cartridge filter;
- Three - 2,000-pound GAC vessels in series; and
- Totalizing flow meter.

At each facility, the subsurface piping conveys the extracted groundwater to a 2,400-gallon polyethylene influent equalization tank prior to treatment. A pressure transducer is installed within each influent tank to monitor water level in the tank. A transfer pump routes water from the influent tank through a cartridge filter to separate out any fine sediment or biological material suspended in the water. The water then passes through three 2,000-pound GAC vessels in series before flowing through a totalizing meter and being discharged into the sanitary sewer system.

Overall, the startup and shakedown process for both systems did not reveal any major issues (ERRG 2008c). Minor leaks were identified at a few well vault fittings and were promptly repaired. Once the systems were transitioned into full-time operation, the O&M phase of system operation was initiated in accordance with O&M procedures outlined in the RD/RAWP.

4.2.2.4 TREATED GROUNDWATER DISCHARGE

Disposal options for groundwater were evaluated in the FS for their effectiveness, implementability, and cost. Based on this initial evaluation, discharge to the storm drain was considered to be the most appropriate disposal option and was the selected disposal option in the ROD. However, the ROD incorporated flexibility to consider other disposal alternatives in the RD. Other disposal options evaluated in the FS were subsequently re-evaluated during the RD phase, and discharge to the sanitary sewer was ultimately selected since it enabled avoidance of costly treatment for nitrate and selenium that would have been required for discharge to the storm drain.

Both the OU-1A/-1B North and OU-1B South treatment systems currently discharge to the Irvine Ranch Water District (IRWD) sanitary sewer that, in turn, flows to a main trunk line operated by the Orange County Sanitation District (OCSD). The OU-1A/-1B North treated effluent is combined with treated effluent from the adjacent UST Site 222 PCAP groundwater treatment system, and the combined effluent flows through a single totalizing flow meter into the IRWD sewer. The PCAP system is not a CERCLA remedy and is not a part of this five-year review.

The OU-1B South treated effluent flows through a separate totalizing flow meter and has a separate dedicated discharge point into the IRWD sewer.

The IRWD sewer conveys effluent from various sources to the OCSD trunk line that routes combined flows from various sources to the OCSD sewage treatment plant in Fountain Valley. The following Special Purpose Discharge Permits (SPDP) issued by the OCSD contain substantive provisions including effluent discharge limits:

- SPDP No. 57-256 - OU-1A/-1B North treatment system (OCSD 2007a); and
- SPDP No. 57-270 - OU-1B South treatment system (OCSD 2007b).

The I-RACR documents that the treated groundwater discharge systems were installed as designed in the RD (ERRG 2008c).

4.2.2.5 PERFORMANCE MONITORING

Performance monitoring is used to optimize operation of the extraction system, track mass removal, verify containment of the IRP-3, -12, and -13S VOC plumes, and demonstrate successful treatment of the extracted groundwater before discharge. Monitoring includes water-level measurements as well as the collection and analysis of samples from wells within and outside the plume areas. Groundwater monitoring will continue until the shutdown criteria discussed below are met. Process streams within the treatment plant are also monitored to measure treatment efficiency and to demonstrate compliance with the discharge permit.

4.2.2.6 INSTITUTIONAL CONTROLS

ICs are a key component of the final groundwater remedies documented in the RODs (DoN 2004b,c). The RODs specified the following performance objectives for ICs:

- Prohibit installation of groundwater wells of any type and prevent exposure to VOC-contaminated groundwater without prior review and approval from the DoN, U.S. EPA, DTSC, and the RWQCB until remediation objectives have been achieved;
- Prohibit the installation of any well or other structure that has the potential to affect VOC plume migration; and
- Prohibit the alteration, disturbance or removal of groundwater extraction or monitoring wells, associated conveyance piping, and treatment equipment without the prior review and written approval from the DoN, U.S. EPA, DTSC, and the RWQCB.

The RD included LUC RD in Section 3.9 (ERRG 2007); including identification of:

- The areas requiring ICs;
- Specific land-use restrictions;
- The legal instruments by which the land-use restrictions will be implemented
- Specific responsibilities of the DoN and future landowners for inspection, monitoring, and enforcement of land-use restrictions.

The LUC RD identified the specific legal and administrative mechanisms that comprise the ICs. The long-term monitoring and maintenance of remediation systems, and inspections at the Site will use two separate legal instruments (discussed in Section 3.9 of the RD [ERRG 2007]):

- Restrictive covenants included in the Quitclaim Deed(s) from the Navy to the property recipient; and
- Restrictive covenants included in the "Covenant(s) to Restrict Use of Property" (CRUPs) between the Navy and the DTSC.

ICs (in the form of lease restrictions and security measures) are currently in place under a LIFOC for all parcels within CO-5 and CO-6 (except for Parcels 2 and 18 in CO-5 that are being retained by the DoN). ICs are also incorporated in the CRUP and Quitclaim Deed for the early transfer parcel (portion of IRP-13S). These ICs are as follows:

- Provisions preserving access to the property for Navy and regulatory personnel to conduct investigations, surveys, sampling, monitoring, and remedial actions.
- Provisions protecting the groundwater extraction and monitoring wells and associated piping and equipment. To prevent lessee personnel from mistaking remediation equipment for utilities infrastructure, all the system pull boxes and vaults are clearly marked as “US Navy Property” with appropriate contact signs.
- As described in the LIFOC, the lessee must complete a Project Environmental Review Form (PERF) for certain work proposed in the leased portion of the property. A PERF is submitted to the Navy for prior approval, and as appropriate to the rest of the BCT for concurrence.
- The treatment system buildings are locked, secured, and alarmed when the sites are not manned.
- The extraction well vault covers and high voltage pull boxes are protected with security locks (specialized locking bolts). Monitoring well caps are tagged and locked.
- No new water wells have been installed within any of the VOC plumes. No permit applications have been received or any permits issued by OCHCA or by IRWD for water supply wells or monitoring wells within CO-5 or CO-6.

The DoN is responsible for implementing, inspecting, reporting, and enforcing the LUC objectives in accordance with the LUC RD. Although the DoN may later transfer some of these responsibilities to another party by contract, property transfer agreement, or other means, the DoN retains ultimate responsibility for remedy integrity. Should any of the LUC objectives fail, the DoN must ensure that appropriate actions are taken to re-establish the protectiveness of the remedy, and may initiate legal action to either compel action by a third party and/or recover the DoN’s costs for mitigating any discovered LUC violations. The LUC shall be maintained until the concentrations of hazardous substances in groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use.

The DoN and DTSC have entered, and will enter, into CRUPs as provided in the Memorandum of Agreement between the DoN and the DTSC prior to transfer of property impacted by remaining groundwater contamination at IRP- 3, -12, and -13S. The CRUP incorporates land-use restrictions identified in the Final LUC RD and addresses the real property containing the groundwater plumes and associated buffer zones. The CRUP is recorded with the Orange County Recorder and runs with the land, continuing in perpetuity unless modified or terminated in accordance with applicable law.

4.2.2.7 PERIODIC REVIEWS

As required by DoN policy and by CERCLA Section I21(c), the DoN documents the following in a summary report (e.g. this Report) at least every 5 years:

- Whether the remedy is expected to remain protective, or to be protective at the completion of remedial action;

- Any deficiencies identified during the review, and
- Any recommended specific actions to correct any deficiencies.

If necessary, the Five-Year Review Report includes descriptions of follow-on actions needed to achieve, or to continue to assure, protectiveness along with a timetable for these actions.

4.2.2.8 OPERATION AND MAINTENANCE

An OMP was developed (ERRG 2009) that acknowledged the number and location of monitoring wells. It also outlined sampling and analysis methods, periods and sampling frequency for each well, and decision logic for optimizing the remedy (e.g., adding or removing wells, adjusting extraction well operation, changing sampling frequency or analytical parameters). The criteria for assessing the effectiveness of the remedial action and for eventual shutdown were also incorporated in the OMP.

4.2.2.8.1 Extraction Well Shutdown Criteria

RAOs include reducing concentrations of VOCs in groundwater to levels consistent with RGs, or until the plumes have stabilized, and preventing VOC migration beyond the current plume boundaries. As a part of the selected remedy, the DoN is operating hot spot groundwater extraction wells and hydraulic containment wells to meet these RAOs. The DoN is evaluating groundwater monitoring and system performance data to: I) optimize the performance of the hot spot wells in reducing VOC contaminant mass in the central portion of the plumes and to determine when they may be shut down; and 2) optimize and verify the performance of the hydraulic containment wells in containing VOCs within their present boundaries and determine when they may be shut down (i.e., when the VOC plumes are stable or shrinking without active remediation). Groundwater monitoring and system performance data are evaluated by the DoN and are reported to the BCT.

4.2.2.8.1.1 Hot Spot Extraction Wells

An evaluation of hot spot extraction wells is completed periodically to determine if monitoring data indicate that these wells are no longer efficiently removing VOC mass (i.e., if an asymptotic condition is reached based on concentration versus time trend analysis) or if a hot spot has statistically disappeared[3]. In these cases, the wells can be temporarily placed on standby and monitored for rebound in VOC concentrations. An "asymptotic condition" is defined as the point where the quantity of VOC mass removed over time has been reduced to a level at which continued reduction of VOCs is considered no longer technologically and/or economically feasible. After hot spot extraction wells are placed on standby, subsequent monitoring data will be evaluated and reported to the BCT. If monitoring data indicate a significant rebound in VOC concentrations in the hot spot portions of the plumes, the hot spot extraction wells will be restarted. Once asymptotic conditions for VOC mass removal are reached, the hot spot wells will be permanently shut down, subject to BCT concurrence.

[3] A "hot spot" is defined as an area within the plume in which COC concentrations exceed the geometric mean plus two standard deviations of all of the concentration data within the plume (ERRG 2009).

4.2.2.8.1.2 Hydraulic Containment Wells

For evaluation of the hydraulic containment system, the DoN can propose a temporary shutdown of the system if monitoring data indicate that either of the following conditions has been met:

- VOC concentrations in groundwater throughout the OU-1A/-1B plumes reach RGs; or
- Boundaries of the VOC plumes have stabilized or are shrinking.

Well shutdowns are subject to BCT concurrence. The groundwater monitoring program will continue for up to 2 years following temporary shutdown. If it is demonstrated in this period that VOCs in groundwater meet the RGs, the system operation may be shut down permanently.

If during temporary shutdown of the hydraulic containment system, data from monitoring wells within the boundaries of the plumes indicate that VOC concentrations are rebounding to levels exceeding the RGs, or plume boundaries are expanding, the containment system will be restarted.

The DoN may attempt to demonstrate through groundwater modeling that the boundaries of the plume are stable or shrinking without active remediation. In this case the DoN can then propose a permanent shutdown of the hydraulic containment system, subject to BCT concurrence. Groundwater monitoring would continue to confirm that VOCs are approaching RGs and that the remedy is still effective.

If the conditions stated above cannot be achieved, the DoN may choose to demonstrate that VOCs in groundwater have been removed to the extent technically and economically feasible by analyzing:

- Whether the total mass removal is approaching asymptotic levels after temporary shutdown periods and appropriate system optimization;
- The additional cost of continuing to operate the system at concentrations approaching asymptotic mass levels; and
- Whether discontinuing the system would significantly prolong the time to achieve RGs for groundwater.

4.2.3 Problems Encountered

No significant problems have been reported to date for the IRP-3, -12, and -13S remedy implementation. OPS was demonstrated in 2010 (ECS 2010c). The OPS Determination was made by the U.S. EPA (U.S. EPA 2009c), and the BCT concurred with OPS (RWQCB 2010a, DTSC 2010).

5. Progress Since the Last Review

5.1 IRP-1

The first five-year review for IRP-1 was conducted in 2006 (ECS 2006). The following subsections provide a summary of the findings and recommendations from the first Five-Year Review Report and developments since that review was completed.

5.1.1 First Five-Year Review Summary

The RAOs for IRP-1 are:

- Control or eliminate the discharge of contaminated groundwater into Peters Canyon Channel that potentially impacts human health or the environment, and preserve existing high-quality surface water.
- Prevent or mitigate the downward migration of contamination into deeper groundwater zones to preserve existing high-quality groundwater.
- Prevent or minimize exposures to on-site groundwater, buried wastes, and subsurface soils that have contamination above health-based levels.
- Implement appropriate remedial actions as necessary to facilitate rapid transfer and reuse of the OU-3 property.

The following conclusions were reported in the first Five-Year Review Report (ECS 2006):

- The Jamboree Road extension construction has mitigated potential surface water infiltration and exposure to subsurface contaminants by adding a HDPE liner, 20 feet of compacted fill, and concrete roadways above the original area of impact.
- The steel-reinforced concrete containment wall placed along the west bank of Peters Canyon Channel has mitigated seepage of impacted groundwater into this waterway.
- Subsurface contamination is contained within the original area of impact, and the extent of contaminated groundwater has not migrated or expanded.
- ICs are adequate to restrict Site access by unauthorized personnel.

5.1.2 Progress Since First Five-Year Review

At IRP-1 the following progress has occurred since the first five-year review:

- Groundwater, surface water, and LFG monitoring have continued;
- Surface water contaminants have not been reported since the last review;
- O&M has continued;
- Inspection, maintenance and monitoring of ICs have continued.

5.2 IRP-3, -12, AND -13S

This is the first five-year review for IRP-3, -12, and -13S.

(THIS PAGE LEFT INTENTIONALLY BLANK)

6. Five-Year Review Process

This Section discusses the activities performed during the five-year review process for IRP-1, -3, -12, and -13S. The DoN conducted five-year reviews at these sites in accordance with the following guidance documents:

- *Comprehensive Five-Year Review Guidance* (U.S. EPA 2001)
- *Department of Navy Policy for Conducting Five-Year Reviews Under the Installation Restoration Program* (DoN 2011)

The five-year review process at each of the five sites addressed in this Report consisted of the following:

- Administrative components;
- Community notifications and involvement;
- Document reviews;
- Data reviews;
- Site Inspections;
- Interviews; and
- Protectiveness determinations.

6.1 ADMINISTRATIVE COMPONENTS

The lead agency for this five-year review is the DoN; the five-year review team was led by Mr. Louie Cardinale, Professional Engineer (PE) as the DoN's Remedial Project Manager (RPM); and Mr. James Callian, Professional Geologist (PG), Certified Hydrogeologist (CHG), and Certified Engineering Geologist (CEG) as the BRAC Environmental Coordinator (BEC). Other members of the five-year review team included:

- ECS – technical experts such as civil/environmental engineers, geologists, hydrogeologists, and risk assessors.
- Camp, Dresser and McKee (CDM) Federal Programs Corporation – provides RAB meeting support.

During February and March 2011, the five-year review team established the review schedule for each of the four IRP sites addressed in this Report. The components of the five-year review included:

- Community notification and involvement;
- Review of relevant documents pertaining to IRP-1, -3, -12, and -13S;
- Review and evaluation of relevant data for IRP-1, -3, -12, and -13S;
- Inspection of IRP-1, -3, -12, and -13S;
- Interviews of knowledgeable persons; and
- Preparation of the Five-Year Review Report.

The schedule for five-year review of IRP-1, -3, -12, and -13S included issuance of the Draft Five-Year Review Report for comment on July 29, 2011, and submittal of the final report on October 31, 2011.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

In 1994, the RAB was established to provide interested parties from local communities a channel for participation in the environmental restoration process at former MCAS Tustin. Since 1994, there have been 94 RAB meetings. These RAB meetings occur on a routine basis and are scheduled in the evenings after normal working hours (6:30 to 9:00 p.m.) at the Tustin Senior Center. RAB meetings are open to the public and include representatives from the DoN, City of Tustin, regulatory agencies, and other interested parties. By sharing information from the regular meetings with the groups they represent, RAB members help increase awareness of the IRP process; in addition, members of the public can contact RAB members to obtain information or express concerns to be discussed at subsequent meetings.

Notification of the five-year review process was provided to the RAB by email on March 3, 2011, and by means of a presentation at a RAB meeting on May 18, 2011. Notification was provided to the community at large through a newspaper advertisement. The email and RAB presentation notifications included invitations to participate and provide comments. Community members were also interviewed during the five-year review process for IRP sites addressed in this Report to get their input about current Site conditions, problems, or any related concerns (see Section 6.6 for details).

Following completion of the five-year review, the Five-Year Review Report including community input will be placed in the information repository. A brief summary of the Report will be made available to the stakeholders. This summary will include short descriptions of the remedial actions at IRP-1, -3, -12, and -13S, and the results of the five-year review including the determinations of whether the remedies at the sites are protective of human health and the environment, or will be upon completion of the remedial actions. The summary will also provide the location of site information repository where the complete copy of the Report can be obtained, and will provide the date of the next five-year review.

A brief summary of the results of the five-year review will also be presented to the RAB members and interested community members in a RAB meeting.

6.3 DOCUMENT REVIEW

Numerous documents were reviewed for IRP-1, -3, -12, and -13S as part of the five-year reviews for these sites. The objective of the document review was to obtain relevant information and data that could be used as the basis for assessment of the performance of the remedies implemented at IRP-1, -3, -12, and -13S. The type of documents reviewed included the following:

- Documents containing the basis for the response actions including remedy decision documents such as RODs, RI/FS reports, toxicological and chemical characteristics databases, and federal and state statutory and regulatory requirements identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the remedy decision documents.
- Documents containing information about design and implementation of the remedy including RD/RAWPs and I-RACRs.

- Documents containing monitoring data and information that can be used to assess whether the remedial action continues to operate and function as designed. These documents included routine monitoring reports, and the OPS Report for OU-1A/-1B.

Documents cited in the report text are listed in Section 12 - References. A separate document review list organized by site for each of the four subject IRP Sites is presented in Appendix A.

6.4 DATA REVIEW

6.4.1 IRP-1

6.4.1.1 LFG DATA

As discussed in Section 4.1.2.1.1 LFG probes were monitored monthly in 2000 and quarterly in 2001 and 2002. Review of the data showed that no methane was detected in any of the probes. The CIWMB and OCHCA agreed to suspend LFG monitoring as of January 2003.

Recently in 2010, LFG monitoring was restarted due to a response from the OCHCA to a request by the DoN for agency concurrence to destroy the probes; the OCHCA noted the possibility of future development adjacent to OU-3.Review of these recent monitoring data again shows an absence of methane detected.

6.4.1.2 SURFACE WATER CONCENTRATION DATA

In the first five-year review (ECS 2006) previous surface water concentration data was pulled together from various sources into a common useable database. These sources included the RI (BNI 1996) and subsequent monitoring reports by DoN contractors. This database was incorporated in the first Five-Year Review Report (ECS 2006). The database has since been augmented with more recent monitoring data collected during the second five-year review period (CAPE 2006a, ECS 2008a, 2010a, 2011a, 2011c). All of the data reviewed indicated that since the implementation of the remedy, no site-related COCs have been detected in surface water samples.

6.4.1.3 GROUNDWATER LEVEL DATA

Water levels have been measured in Site monitoring wells dating back to the RI, and are currently routinely measured as a part of the ongoing long-term groundwater monitoring program. Results have been published in the first Five-Year Review Report (ECS 2006), and in routine groundwater monitoring reports listed in Appendix A. These data indicate that both the first and second WBZs have experienced seasonal water level fluctuations as recharge from upgradient sources ebbs and flows throughout the area.

Particular attention was paid in the data review to elevation differences between wells screened in the first WBZ and proximal wells screened in the second WBZ. Groundwater level differences between the first and second WBZs indicate that the clay aquitard between the two zones at this Site acts to hydraulically isolate the two WBZs and impede downward migration of Site COCs from the first to the second WBZ. Similarly, water level data also indicate that the aquitard between the second and third WBZs is generally effective in further impeding downward migration from the second to third WBZs. The data generally indicate that hydraulic separation between the WBZs has been a consistent factor through time and has been maintained during periods of groundwater level fluctuation.

Contoured water level elevations in the first and second WBZs obtained in May 2010 (the latest available) are shown on Figures 6 and 7, respectively.

6.4.1.4 GROUNDWATER CONCENTRATION DATA

As with historical surface water concentration data discussed above, groundwater data was also compiled into a database during the first five-year review to facilitate evaluation. This database has been augmented during the second five-year review period.

For the second five-year review, the criterion for judging effectiveness of hydraulic containment is whether concentrations of COCs did not exceed RGs in groundwater or surface water samples collected outside the original area of impact. If this criterion is met, then hydraulic containment would be demonstrated. The data review indicated that while COC concentrations occasionally exceeded RGs within the Site boundary, they did not routinely exceed RGs outside the Site boundary.

Concentrations of benzene, 1,1-DCA and VC occasionally exceeded RGs in groundwater samples collected from one well (I001BC50S), cadmium exceeded the RG in one well (I001MW52D), and manganese exceeded the RG in one well (I001BC52S). RGs were not routinely exceeded in groundwater samples collected from wells outside of the original area of impact, and were not exceeded in surface water samples collected within Santa Fe and Peters Canyon Channels through May 2010. These data indicated that containment wall was effective.

Groundwater organic and inorganic contaminant concentrations over the past five years for the first and second WBZs are shown on Figures 8 through 11.

6.4.1.5 IC COMPLIANCE DATA

Monitoring for compliance with ICs has been conducted at IRP-1 in accordance with the LUCICP (BEI 2003a). The data review indicated that site inspection checklists have been completed and submitted to DoN during the five-year review period. These checklists have been included with the annual monitoring reports for IRP-1 that have been submitted to the BCT. Land-use controls compliance certificates have been completed on an annual basis by the City of Tustin for the Jamboree Road overcrossing. Copies of these documents are provided in Appendix B.

A review of completed checklists indicates that no activities were conducted that are inconsistent with the land-use restrictions documented in the LUCICP. The data indicates that routine maintenance and repairs have been conducted as necessary during the review period.

6.4.2 IRP-3, -12, and -13S

Data for IRP Sites 3 (OU-1B South), 12 (OU-1B North), and 13S (OU-1A) were reviewed as a group since the remedies for these sites are identical and address groundwater as the only medium. Moreover, groundwater level and chemical data have been combined into a common database to facilitate review and evaluation.

The RD and OMP for the three sites are common documents (ERRG 2007, 2009). Data generated by operation and monitoring of the remedies are reported in quarterly data summary reports and annual performance evaluation reports (ECS 2010b, 2010e, 2011b). The LUC RD for the three sites is presented in the RD; therefore, the data review

concerning compliance with the LUC RD for the three sites is also discussed for the sites as a group.

6.4.2.1 GROUNDWATER LEVEL DATA

Water level data have been obtained in Site monitoring wells dating back to the RI, and are currently routinely obtained as a part of the ongoing long-term groundwater monitoring program. Results have been published in quarterly data summary reports and in annual performance evaluation reports (ECS 2010b, 2010e and 2011b). Reviews of these data indicate that the first and second WBZs experience seasonal fluctuations, with the third WBZ experiencing water level fluctuations to a lesser extent.

The data show that the general groundwater flow direction is to the south or southwest, and that local flow within the first and second WBZs is directed inwards, toward operating extraction wells. There are no operating extraction wells in the third WBZ.

Contoured water level elevations in the first and second WBZs for IRP Site 3 for October 2010 are shown on Figures 12 and 13, respectively. Contoured water level elevations in the first, second and third WBZs for IRP Sites 12 and 13S for October 2010 are shown on Figures 14 through 16, respectively.

6.4.2.2 GROUNDWATER CONCENTRATION DATA

Historical groundwater concentration data for the three IRP sites has been compiled into a database to facilitate evaluation. Graphic depictions of groundwater VOC plume footprints in each WBZ over time were constructed for IRP-3, -12, and -13S as a part of the five-year review and are shown on Figures 17a and 17b. The data review indicates that VOC concentrations have generally declined since the start of remediation, and plume footprints have remained relatively stable and not migrated beyond their previous boundaries since the start of remediation.

6.4.2.3 HYDRAULIC CONTAINMENT AND HOT SPOT MASS REMOVAL DATA

Data on hydraulic containment for the three IRP sites include groundwater level data and groundwater concentration data discussed above, as well as the results of capture analyses that have been performed on an annual basis for the last three years. Groundwater level and VOC concentration data are collected routinely at the three IRP sites and are reported in quarterly data summaries and in annual performance monitoring reports. The data are used to evaluate the effectiveness of hydraulic containment and to optimize operation of the groundwater extraction systems.

Results of capture analyses have been reported in the annual performance evaluation reports for OU-1A/-1B (ECS 2010b, 2010e and 2011b). The data review indicates that the VOC plumes have been adequately contained during the review period. Further discussion of this topic is provided in the Technical Assessment discussion in Section 7.2.1.1.

Hot spot mass removal data have also been routinely collected and include groundwater VOC concentration data as well as VOC concentrations in extraction well effluent and within the treatment system throughput as a whole. These data have been used to calculate the VOC mass removal for each of the IRP Sites. Review of these data indicates that hot spot mass has been removed at each hot spot area during the review period. Further discussion of this topic is provided in the Technical Assessment discussion in Section 7.2.1.2.

6.4.2.4 GROUNDWATER TREATMENT SYSTEM PERFORMANCE DATA

IRP-3, -12, and -13S utilize two separate groundwater treatment systems. Extracted groundwater from IRP- 12 and -13S is combined and treated in a common treatment system due to the proximity of these sites. Extracted groundwater from IRP-3 is treated by a separate dedicated system owing to its distance from the other two sites.

Groundwater treatment system performance data are routinely collected as a part of O&M. These data include VOC concentrations in system influent and effluent, as well as VOC concentrations between individual GAC vessels in the treatment process. Other system parameters that are routinely measured include flow rates and fluid pressures at various points in the system. These data are used to optimize the efficiency of the systems, and to schedule replacement of spent GAC. The data have been reported in the annual performance evaluation reports.

Treatment system performance data were reviewed for both systems. The review indicates that both treatment systems operated as designed during the review period, and that routine maintenance and repairs have been conducted as necessary during the review period.

6.4.2.5 TREATED GROUNDWATER DISCHARGE DATA

Both treatment systems discharge to IRWD sewer laterals that, in turn, discharge into OCSD main sewer trunk lines. The treated effluent is conveyed to the OCSD sewage treatment plant in Fountain Valley where it is treated further prior to recycling or discharge to the ocean.

Treated discharge data include chemical concentration data and flow rate data that are required for comparison with discharge limits in the following SPDPs:

- SPDP No. 57-256 - OU-1A/-1B North treatment system.
- SPDP No. 57-270 - OU-1B South treatment system.

Review of these data indicate that there have been no exceedences of the discharge limits.

6.4.2.6 IC COMPLIANCE DATA

Monitoring for compliance with ICs has been conducted at IRP-3, -12, and -13S in accordance with the LUC RD and OMP. The evaluation of compliance with the ICs based on this monitoring is presented in the sections below.

The ARICs at IRP-3, -12, and -13S are shown on Figure 9 of the OMP (ERRG 2009). The data review conducted as part of this five-year review indicated that site inspection checklists have been completed during the review period for the three sites in accordance with the requirements of the LUC RD and OMP. These inspection checklists are maintained at the O&M Contractor's offices. A review of completed checklists indicates that no activities were conducted that are inconsistent with the land-use restrictions documented in the LUC RD and OMP. The data also indicate that routine maintenance and repairs have been conducted as necessary during the review period.

Construction of a residential development known as Columbus Square commenced in 2005 within a portion of IRP-13S (OU-1A) (Early Transfer Parcel 24-1B). In accordance with the LUC RD, LUC Compliance Certificates have been completed by the Columbus Square

Homeowners Association on an annual basis. These documents were reviewed and indicated that there were no LUC violations recorded during the covered period. Copies of the LUC Compliance Certificates are provided in Appendix B.

6.5 SITE INSPECTIONS

Site inspections were conducted for IRP-1, -3, -12, and -13S as part of the five-year review to provide information about the status of these sites, and to visually confirm and document the conditions of the remedies, the sites, and the surrounding areas. The first inspection event included IRP Sites 1 and 3, and was conducted on 16 February, 2011. This inspection was conducted by a team consisting of representatives from the DoN, ECS, DTSC, and RWQCB.

Table 6-1 presents a list of participants for the 16 February Site inspection. During this inspection, representative features of the implemented remedies at IRP Sites 1 and 3 were inspected. These included selected groundwater monitoring and extraction wells, VOC treatment system components, the groundwater containment wall at IRP-1, and landfill cover components such as vegetation and drainage features at IRP-1.

Additional detailed inspections of the remedies at IRP-1, -3, -12, and -13S were conducted by ECS on the date listed in Table 6-1.

Table 6-1: Details of Site Inspections

Site	Inspection Date	Inspection Participants
IRP-1	16 February 2011	DoN • James Callian (BEC) • Content Arnold (Lead RPM) • Louie Cardinale (RPM) • Sean McGoey (RPM) • Scott Kehe (DoN Facilities Engineering Acquisition Division [FEAD]) Regulatory Agencies • Ram Peddada (RPM, DTSC) • Dave Murchison (DTSC) • John Broderick (RPM, RWQCB) DoN Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Dhananjay Rawal (Program Quality Control [QC] Manager) • Michael DeKlotz (O&M Field Supervisor)
IRP-1	11 April 2011	DON Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Rush Boynton (Geologist) • Michael DeKlotz (O&M Field

Site	Inspection Date	Inspection Participants
		Supervisor)
IRP-3	16 February 2011	DoN • James Callian (BEC) • Content Arnold (Lead RPM) • Louie Cardinale (RPM) • Sean McGoey (RPM) • Scott Kehe (FEAD) Regulatory Agencies • Ram Peddada (RPM, DTSC) • Dave Murchison (DTSC) • John Broderick (RPM, RWQCB) DoN Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Dhananjay Rawal (Program QC Manager) • Michael DeKlotz (O&M Field Supervisor)
IRP-3	11 April 2011	DON Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Rush Boynton (Geologist) • Michael DeKlotz (O&M Field Supervisor)
IRP-12	11 April 2011	DON Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Rush Boynton (Geologist) • Michael DeKlotz (O&M Field Supervisor)
IRP-13S	11 April 2011	DON Five-Year Review Contractor (ECS) • Michael Wolff (Project Manager) • Rush Boynton (Geologist) • Michael DeKlotz (O&M Field Supervisor)

Site inspections were conducted at IRP-1 to evaluate the condition of the remedy including fences and caution signs for access control, the integrity of the landfill cap, groundwater containment wall, and the condition of monitoring wells and features for storm water and erosion control such as slope landscaping and silt fences. The results of the inspection events at IRP-1 were compiled in an inspection checklist that is included in Appendix C.

The photographs taken during the inspection event on 16 February 2011 are presented in Appendix D.

The IRP-1 inspection indicated that the reinforced concrete containment wall is in good condition. The containment wall is constructed of reinforced shotcrete (also called gunite or spray-applied concrete) with widely-spaced elastomeric leak-preventing joint fillings. The older pre-existing concrete walls at the confluence of Peters Canyon and Santa Fe Channels at the north end of the containment wall are constructed of cast-in-place concrete and lack elastomeric joint fillings. The immediately adjacent section of the pre-existing concrete wall at the north end of the groundwater containment wall has a section that exhibits minor cracking, spalling of concrete and rusting of exposed rebar. This section of pre-existing wall is indicated on Figure 2 as part of the containment wall; however, it is clear from the difference in construction that this section of older wall pre-dates the remedy and was not intended to serve as a groundwater contaminant containment wall.

This older section of wall has been incorrectly indicated as part of the groundwater containment remedy going back to the RI Report (BNI 1996). The subsequent FS Report (BNI 1997b), ROD (DoN 2001), and OMP (BEI 2003a) all reflect the same erroneous interpretation of the containment wall configuration. In accordance with the U.S. EPA ROD Guidance (U.S. EPA 2011a), correcting this discrepancy would constitute a "minor" or "non-significant" change because it would not change the scope, performance or cost of the remedy. This type of change could be effected with a memorandum to the Site file. No explanation of significant differences (ESD) or ROD amendment would be required.

There was no visible seepage through the containment wall evident on the dates of the Site inspections. Overall, the containment wall appeared in very good condition with no structural cracks, bulges or visible seepage.

Minor erosion was observed on the graded slopes for the overlying Jamboree Road alignment at IRP-1, but there was no indication that erosion is a threat to the integrity of the landfill cover. No evidence of settlement, degradation, undercutting, obstruction, or excessive vegetation growth was observed during the inspection of the drainage system. The surface completions of the groundwater and LFG monitoring wells appeared in good condition. No evidence of activities was observed at IRP-1 that were inconsistent with land-use restrictions presented in the OMP.

It was noted that routine O&M of the monitoring systems and ICs at IRP-1 is ongoing. Interviews with O&M personnel indicated that small erosion gullies typically develop in the side slopes of the road embankment following rain events, and these are repaired promptly. In addition, sections of silt fencing have been replaced along the toe of the eastern perimeter slope as needed.

A Site inspection was also conducted at IRP-3 on 16 February 2001 to assess the condition of the groundwater remedy. The inspection included observation of groundwater monitoring and extraction well vaults, inspection of the treatment system building, and equipment condition and operation. The results of the inspection at IRP-3 were compiled in an inspection checklist which is included in Appendix C. The photographs taken during the inspection event are presented in Appendix D.

The inspections at IRP-3 indicated that components of the remedy including groundwater monitoring and extraction wells, and the groundwater treatment system are in good

condition and functioning as designed. Site conditions indicate that ICs are being properly implemented.

Site inspections were conducted for IRP-1, -3, -12, and -13S by ECS on 11 April, 2011. The inspections at these sites indicated that components of the remedy including groundwater monitoring and extraction wells, and the groundwater treatment system are in good condition and functioning as designed. Site conditions indicate that ICs are being properly implemented.

The results of the inspection events at IRP-3, -12, and -13S were compiled in one inspection checklist, which is included in Appendix C. The photographs taken during the inspection event on 11 April, 2011 are presented in Appendix D.

6.6 INTERVIEWS

Interviews were conducted as part of the five-year review with various stakeholders to provide additional information about the status of IRP-1, -3, -12, and -13S. A list of interviewees is presented in Table 6-3.

Table 6-2: List of Interviewees - IRP-1, -3, -12, and -13S

Interviewee Name	Title	Affiliation
James Callian	BEC/RAB Co-Chair	DoN BRAC PMO West
Content Arnold	Lead RPM	DoN BRAC PMO West
Louie Cardinale	RPM	DoN BRAC PMO West
James Ricks	RPM	U.S. EPA
John Broderick	RPM	RWQCB, Santa Ana Region
Ram Peddada	RPM	DTSC
Dana Ogdon	Asst. Community Development Director	City of Tustin
Matt West	Redevelopment Project Manager	City of Tustin
John Buchanan	Redevelopment Program Manager	City of Tustin
Christine Shingleton	Assistant City Manager	City of Tustin
Matthew Suarez	Campus Coordinator	South Orange County College District
Marsha Santry	Project Manager	Lennar Homes of California, Inc.

Detailed interview documentation for each interviewee is presented in Appendix E. The documentation includes the name of the interviewee, the relevant site or sites, date and time of the interview, contact information, and responses to interview questions. Specific interview results for the four IRP sites addressed in this Five-Year Review Report are discussed below.

Overall Performance/Impression of the Remedy

Mr. James Callian (BEC, DoN BRAC PMO West), Ms. Content Arnold (Lead RPM, DoN BRAC PMO West), and Mr. Louie Cardinale (RPM, DoN BRAC PMO West) indicated that the remedies implemented at IRP-1, -3, -12, and -13S are being implemented as presented in the respective RODs, and that no significant problems have been identified regarding the implemented remedies.

Mr. James Ricks of the U.S. EPA commented that "there are not any site conditions that would adversely impact the protectiveness of the remedies implemented at IRP-1, -3, -12, or -13S." Mr. Ricks further commented: "The U.S. Environmental Protection Agency has been and remains confident in the Navy's management of the remedies in place at IRP Sites 1, 3, 12, and 13S. The MCAS Tustin Project team continues to exercise appropriate due diligence ensuring protectiveness of the remedies at IRP Sites 1, 3, 12, and 13S."

Mr. Ram Peddada of the DTSC commented that "The Navy has done an excellent job in managing the remedies."

Mr. Matthew Suarez, RAB member and representative of the South Orange County Community College District, commented: "I have no suggestions; the Navy has handled restoration activities quite well."

All other respondents reported generally favorable impressions of the remedies; none reported negative impressions.

Community Concerns/Effects

None of the respondents indicated that they were aware of any community concerns regarding IRP-1, -3, -12, and -13S or their operation and administration. Ms. Christine Shingleton, City of Tustin Assistant City Manager, stated that to her knowledge, the City has not been contacted by concerned community members.

Problems Encountered during Remedy Construction

None of the respondents indicated that they were aware of any problems encountered during remedy construction at IRP-1, -3, -12, and -13S.

Problems Encountered during O&M

None of the respondents indicated that they were aware of any problems encountered during O&M activities at IRP-1, -3, -12, and -13S.

Effectiveness of Land-Use Controls

Mr. Peddada of DTSC recollected that there had been an issue with a monitoring well within the ARIC at IRP-13S that was accidentally damaged by an unknown party, and recollected that the damage was subsequently repaired. Ms. Santry of Lennar also mentioned the incident.

This incident indicates that the established process for reporting and responding to incidents established in the LUC RD was effective in this case.

None of the other respondents indicated that they were aware of any problems with the effectiveness of LUCs at IRP-1, -3, -12, and -13S.

Communication of Site Activities and Progress

All respondents were generally complimentary regarding the Navy's communication efforts. For example, Mr. Suarez commented: "The Navy has been very generous about handing out information at RAB meetings, and I have visited the Administrative Record File in Building 307 two or more times."

Other Comments/Suggestions/Recommendations

The following additional comments/suggestions/recommendations were made during the interviews:

Messrs. West, Ogdon and Buchanan of the City of Tustin stated that the City would like the Navy to continue their mandate to contain the plumes within Navy property boundaries.

Mr. Broderick of the RWQCB recommended that the Sites be tracked in RWQCB's GeoTracker website.

There were no other comments, suggestions or recommendations.

7. Technical Assessment

In accordance with DoN policy (DoN 2011) and U.S. EPA guidance on five-year reviews (U.S EPA 2001), the technical assessments conducted for this five-year review focused on responses to the following three key questions for each of the four subject IRP sites:

1) Question A: Is the remedy functioning as intended by the decision documents?
2) Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?
3) Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The responses to these questions are discussed for each of the IRP sites below.

7.1 IRP-1

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

The remedy at IRP-1 is functioning as intended by the ROD, as evidenced by results of monitoring data and document reviews, site inspections, and interviews; and on continuing O&M activities. The selected remedy was implemented to assure continued containment of impacted groundwater at the Site and to restrict access to contaminated media.

The major components of the remedy include ICs, groundwater and surface water monitoring, LFG monitoring, inspection and maintenance of the containment wall and cover, inspection of the channel bed, maintenance of monitoring wells and security features, and periodic reviews. Potential exposure routes to contaminated media are effectively cut off by the cover and containment wall and by site security features.

ICs were established to prevent contact with contaminated groundwater and to ensure the integrity of the remedy components. The ICs consist of land use restrictions that were incorporated in two separate legal instruments as provided in the Memorandum of Agreement between the DoN and DTSC. These are:

1. Restrictive covenants included in one or more "Quitclaim Deed(s)" from the DoN to the property recipient;
2. Restrictive covenants included in one or more CRUPs entered into by the DoN, DTSC, and RWQCB.

The LUCICP (Attachment F of the OMP) (BEI 2003a) set forth procedures for monitoring and maintaining the remedy, including the ICs. The land-use restrictions are being implemented in accordance with the LUCICP.

The performance of the ICs was evaluated in this five-year review by conducting site inspections and interviews with stakeholders, and by reviewing IC compliance certifications and inspection checklists. Since the entire Site area at IRP-1 was conveyed to the City of Tustin in 2004, the City completes the IC compliance checklist annually. IC compliance checklists are also prepared in accordance with OMP requirements by the O&M contractor. The data review, site inspection, and interviews revealed no evidence of any activities that were inconsistent with the land-use restrictions specified in the LUCICP.

The site inspections indicated that all engineering components of the remedy including the containment wall, cover, monitoring wells, access restrictions (fence and/or signs), and drainage features are in good overall condition and are operating and functioning as designed. No significant damage to any of the engineering features of the remedy was observed.

O&M activities continue to monitor the effectiveness of the remedy at IRP-1. These activities are designed and implemented to ensure that the remedy at IRP-1 remains protective of human health and the environment. The document and data reviews indicate the following:

- Many groundwater COCs are below their RGs;
- Water level monitoring consistently shows hydraulic separation between the first and second WBZs, indicating that downward migration of contaminants is prevented;
- Water quality monitoring indicates that downward migration of contaminants is prevented;
- No COCs have been reported in surface water samples from Peters Canyon Channel since the inception of surface water monitoring;
- No methane has been reported in the LFG probes since the inception of LFG monitoring;
- No seepage through, or breaches of, the containment wall have been reported; and
- Inspections of the channel bed have not revealed any evidence of channel bed erosion or other conditions that could call into question the integrity of the containment wall.

The response to Question A for IRP-1 is "affirmative."

7.1.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid?

7.1.2.1 EXPOSURE ASSUMPTIONS

The exposure assumptions considered during the remedy selection for IRP-1 are consistent with current Site conditions and remain unchanged. No changes to Site conditions have occurred that would negatively affect the remedy performance.

7.1.2.2 TOXICITY DATA AND EFFECT ON HEALTH RISK

The following COCs were identified in the ROD:

- 1,1-DCA;
- 1,1-DCE;
- 1,2-dichlorobenzene;
- 1,4-dichlorobenzene;
- benzene;
- chlorobenzene;
- ethylbenzene;
- TCE;
- vinyl chloride;
- antimony;
- arsenic;

- cadmium;
- manganese;
- molybdenum;
- thallium.

Of these COCs, the metals antimony, arsenic, cadmium, manganese, molybdenum, and thallium were identified in the ROD as potentially Site-related owing to the existence of elevated concentrations of these metals exceeding typical background concentrations in soil at the Site. However, it should also be noted that these metals occur naturally, are present in groundwater both on-site and off-site, including upgradient from the Site, and therefore may not be Site-related chemicals.

In the baseline HHRA, the groundwater risk driver was arsenic for cancer risk, and antimony, arsenic, cadmium, manganese, molybdenum, thallium, chlorobenzene, and 1,2-dichlorobenzene for non-cancer HI. None of these COCs have updated toxicity criteria posted on the U.S. EPA Integrated Risk Information System (IRIS) website that post-date the IRP-1 ROD; therefore, the remedy remains protective relative to these COCs.

7.1.2.3 CLEANUP LEVELS AND RAOS

The ARARs identified in the IRP-1 ROD (Don 2001) were evaluated to determine whether there have been any changes in these standards that may affect the protectiveness of the remedy at the Site. Based on the evaluation conducted for this five-year review, there have been no significant changes to the standards/requirements identified as ARARs in the IRP-1 ROD that could affect the protectiveness of the remedy. Additionally, no newly promulgated laws or regulations were identified that could negatively affect the protectiveness of the remedy at IRP-1.

The remedy at the Site is in place and the RAOs and RGs presented in the ROD are still applicable and appropriate.

The response to Question B for IRP-1 is: "affirmative."

7.1.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

The document and data reviews, site inspection and interviews identified no information that would call into question the protectiveness of the remedy implemented for IRP-1. In addition, there have been no technology developments, or advances in science that have come to light to call into question the protectiveness of the remedy.

The response to Question C for IRP-1 is: "negative."

7.1.4 Technical Assessment Summary

Based on the monitoring data and documents reviewed, the site inspection, and interviews, the remedy for IRP-1 is functioning as intended by the ROD. Groundwater, surface water, and LFG monitoring data indicate that COCs at the Site are being effectively contained by the engineering components of the remedy, as designed. There was no evidence of any activities at the Site that are inconsistent with the land-use restrictions established in the LUCICP. The evaluation of the ARARs which were documented in the ROD indicated that there were no significant changes to the standards/requirements identified as ARARs that could negatively affect the protectiveness of the remedy at the Site. Additionally, no newly

promulgated standards were identified that could negatively affect the protectiveness of the remedy.

The remedy for IRP-1 includes containment of groundwater contaminants through engineering controls, with ICs to prevent exposure to groundwater COCs. In the baseline HHRA, the groundwater risk driver was arsenic for cancer risk, and antimony, arsenic, cadmium, manganese, molybdenum, thallium, chlorobenzene, and 1,2-dichlorobenzene for non-cancer HI. None of these have updated toxicity criteria posted on the U.S. EPA IRIS website that post-date the IRP-1 ROD; therefore, the remedy remains protective relative to these COCs. There is no other information that calls into question the protectiveness of the remedy.

The responses to the three technical assessment questions for IRP-1 are summarized as follows.

IRP-1 - Technical Assessment Summary	
Question A: Is the remedy functioning as intended by the decision documents?	**Affirmative**
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?	**Affirmative**
Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	**Negative**

7.2 IRP-3, -12, AND -13S

7.2.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The hydraulic containment remedies for IRP-3, -12, and -13S (OU-1B South, OU-1B North and OU-1A, respectively) are functioning as intended by their respective RODs, as evidenced by results of groundwater monitoring data, capture zone analyses, document reviews, site inspections, interviews; and on continuing O&M activities.

The first and second WBZs are currently impacted by VOC plumes (areas of groundwater impacted by COCs at concentrations exceeding RGs) at IRP-3 and -13S, whereas only the first WBZ is currently impacted above RGs at IRP-12 (both WBZs were initially impacted, but COCs in the second WBZ have been reduced to below RGs since system startup).

Since the remedy at the three sites is hydraulic containment with hot spot mass removal, this five-year review focused on evaluating the sufficiency of hydraulic capture of the plumes and on the hot spot extraction wells in addressing hot spot mass removal, and site inspection and interviews to determine the performance of ICs in preventing contact with contaminated groundwater. Data and evaluations pertinent to these topics are presented in quarterly data summary reports and in annual performance evaluation reports for these Sites; a complete list of these documents is provided in Appendix A. The following subsections discuss capture analysis, hot spot mass removal, and performance of ICs for each site.

7.2.1.1 CAPTURE ZONE ANALYSES

Capture zone analyses have been performed as a part of the annual performance evaluations since the start of remediation and are presented in the annual performance evaluation reports for OU-1A/-1B for 2008, 2009 and 2010 (ECS 2010b, 2010e and 2011b).

The OMP specified that capture zone analysis by gradient vector mapping be utilized to evaluate capture (ERRG 2009). Prior to the OMP, capture zone analyses were performed using analytical capture zone calculations (ECS 2010b). In 2009, gradient vector mapping was used to evaluate capture; in addition, capture zone calculations were also used to confirm the gradient vector mapping results.

Both methods rely on groundwater elevation data measured at monitoring wells. The gradient vector mapping method is empirical, whereas the capture zone calculation method is theoretical. When both approaches indicate that the plumes and hot spots are captured under steady state pumping conditions, there is a higher level of confidence in the results than would be the case using either method alone. Each of these methods is discussed further below.

Groundwater gradient vector maps were prepared using water level data collected from monitoring and extraction wells within OU-1A/-1B during the fourth quarter of 2009 and fourth quarter of 2010. Groundwater contours and flow gradients were generated using Surfer® contouring software (Golden Software, Inc. version 9.5.785 2009). Water level elevations obtained from monitoring wells were input directly into Surfer®. Water levels measured in extraction wells were first adjusted based on evaluation of well efficiencies to provide estimated actual water levels in the respective WBZ outside the extraction wells for input into Surfer®.

Surfer® uses water level elevation data to generate three-dimensional representations of groundwater surfaces and gradient vectors (flow directions) for the first and second WBZs. Based on the configurations of these groundwater surfaces, the boundaries of capture zones are represented by groundwater divides where groundwater flows either towards, or away from, extraction wells. The locations of the capture zone boundaries based on the Surfer output for the fourth quarter 2010 data at IRP-3, -12, and -13S are shown on Figures 18 through 22.

The capture zone calculation method followed the approach given In the U.S. EPA guidance (U.S. EPA 2008). The equations and parameters used to calculate capture zones assume two-dimensional horizontal flow, and isotropic and homogeneous conditions in an aquifer of uniform thickness (Seaburn 1989, U.S. EPA 2008).

The following equations were used in the capture zone analysis:

$Qw/2\pi Ti =$	Distance (in feet) from the extraction well to the stagnation point downgradient of the extraction well where groundwater velocity is zero
$Qw/4Ti =$	Capture zone radius (in feet) cross-gradient from extraction well
$Qw/2Ti =$	Capture zone radius (in feet) upgradient of extraction well

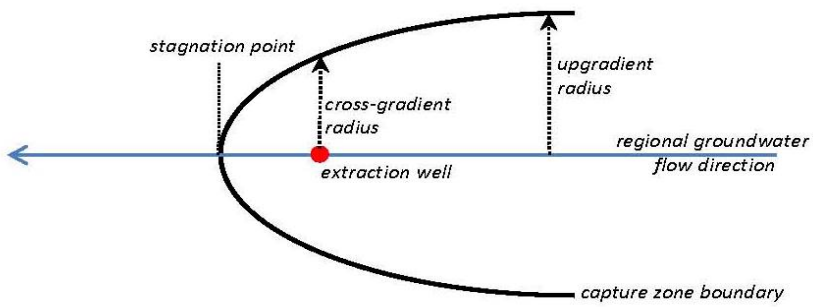
Where:

Qw = Extraction Rate (ft^3/day)

T = Transmissivity (ft^2/day)

i = Regional horizontal hydraulic gradient (ft/ft)

A schematic diagram illustrating the capture zone parameters is shown below:



For the computations, the regional horizontal hydraulic gradient (i) within former MCAS Tustin was 0.003 in the vicinity of OU-1A and OU-1B North and 0.004 in the vicinity of OU-1B South.

Transmissivity was computed using the following approximation (Driscoll 1986, p.1021):

T = 1,500(Q/s)

Where:

T = Transmissivity (gallons per day [gpd]/ft)

Q = Discharge rate (gpm)

s = Drawdown (ft)

Q/s = Specific capacity

This transmissivity value assumes ideal conditions where the drawdown adjacent to an extraction well is equivalent to the drawdown inside the extraction well (100 percent well efficiency). Under real conditions, extraction wells generally operate at less than 100 percent efficiency. For this analysis, transmissivity in the capture zone analysis was calculated using the following relationship.

T = 1,500(Q/s)/WE

Where:

WE = Well efficiency

Well efficiencies were evaluated by constructing distance-drawdown graphs using water levels measured in piezometers and monitoring wells near operating extraction wells. These graphs permit estimation of well efficiencies by comparing the measured water levels within the operating extraction wells with the projected groundwater elevations outside the operating extraction wells determined from the distance-drawdown graphs. The distance-drawdown graphs are included in the annual reports (ECS 2010b, 2010e, and 2011b).

The capture zone calculations in the 2008 Annual Performance Evaluation Report (ECS 2010b) showed that the VOC plumes in the first and second WBZs at IRP-3, -12, and -13S were adequately captured. The capture zone calculations in the 2009 and 2010 annual reports (ECS 2010e and 2011b) showed that the calculated capture zone dimensions were in general agreement with the gradient vector maps and tended to confirm the gradient vector map results which indicated that the VOC plumes were adequately captured in 2009 and 2010. In the Fourth Quarter of 2010, the width of the capture zone associated with hot spot extraction well I012EW03S at OU-1B North had apparently contracted due to seasonal groundwater fluctuation and did not completely capture the OU-1B North hot spot. This was noted in the 2010 Annual Performance Evaluation Report (ECS 2011b) and was subsequently corrected by increasing the flow rate from the extraction well. Maintenance of capture zones is a part of ongoing optimization of the remedy and it is the DoN's intent to continue such optimization as required to maintain capture. Graphical depictions of the calculated capture zones are included in the annual reports.

It should be noted that first WBZ TCE concentrations associated with one of the OU-4B low concentration sites mentioned in Section 1, IRP-13W, lie upgradient from the first WBZ VOC plume associated with IRP-13S. The IRP-13W TCE concentrations are low (on the order of 10 μg/L), are attenuating with time, and do not appear to be migrating towards IRP-13S; therefore, the presence of these low TCE concentrations at IRP-13W has no impact on the IRP-13S groundwater plume.

As another check on plume capture, the sizes and shapes of individual groundwater VOC plume boundaries (plume footprints) at different points in time were compared. If this comparison indicated that the plume sizes have either decreased or stabilized over time, then this would be another confirming indication of hydraulic containment. Figures 17a and 17b illustrate side-by-side comparisons of the VOC plume footprints beginning with the plumes as depicted at the RD stage (pre-remediation), as well as in the fourth quarters of 2008, 2009 and 2010.

The review of capture zone analyses, supplemented by plume footprint comparisons, indicates that the VOC plumes in the first and second WBZs at IRP-3, -12, and -13S were hydraulically contained as of the fourth quarter 2010.

7.2.1.2 HOT SPOT MASS REMOVAL

The groundwater remedies for IRP-3, -12, and -13S were designed to hydraulically contain the VOC plumes while removing mass from the hot spot areas so that the chemical driver for continued advective and dispersive transport of VOCs from hot spots to downgradient areas of lower concentration would be removed. In this way, natural attenuation would eventually take over and reduce VOC concentrations to RGs everywhere within the plumes while active hydraulic containment prevented overall enlargement of the plume boundaries.

The OMP defined a "hot spot" as an area of a VOC plume in which VOC concentrations of individual COCs (i.e. TCE at IRP Sites 3 and 12, and TCE and 1,2,3-TCP at IRP-13S) equal or exceed the geometric mean plus two standard deviations of their respective concentrations within the defined plume boundaries (ERRG 2009). Determination of the continuing presence of statistical hot spots within the VOC plumes is repeated on an annual basis and the results are reported in the annual performance evaluation reports.

Data that address hot spot mass removal include VOC concentrations in hot spot extraction well effluent, and flow rates from hot spot extraction wells over time. These data are published in the quarterly groundwater data summaries and annual performance reports.

Review of hot spot mass removal data indicate that mass removal within the hot spots is ongoing. The effectiveness of mass removal is eventually measured by the statistical "disappearance" of hot spots by application of the OMP hot spot criterion. Hot spot mass removal was also intended to shorten the overall life of the remedy. As of the fourth quarter of 2010, hot spots were still present but VOC concentration trends generally indicate that mass removal is having a beneficial effect on downgradient VOC concentrations.

7.2.1.3 PERFORMANCE OF INSTITUTIONAL CONTROLS

The LUC RD established ARICs at each IRP Site which encompass the VOC plumes and associated buffer zones. ICs were established within the ARICs to prevent contact with contaminated groundwater and to ensure the integrity of the remedy components until the RGs are achieved. The ICs consist of land use restrictions that were incorporated in two separate legal instruments as provided in the Memorandum of Agreement between the DoN and DTSC. These are:

1. Restrictive covenants to be included in one or more "Quitclaim Deed(s)" from the DoN to the property recipient;
2. Restrictive covenants to be included in one or more CRUPs entered into by the DoN, DTSC, and RWQCB.

The CRUP incorporates the land use restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The Quitclaim Deed(s) include similar land use restrictions in environmental restrictive covenants that run with the land and that are enforceable by the DoN against future transferees. Land use restrictions will also be included in FOSTs

A portion of IRP-13S was conveyed as an early transfer parcel pursuant to the FOSET process (Columbus Square development), and land use controls were incorporated in the Quitclaim Deed and CRUP associated with this early transfer. The remaining portion of IRP-13S, and all of IRP-3 and -12 have not yet been transferred; although portions of these Sites are under a LIFOC with the City of Tustin.

The performance of the ICs was evaluated in this five-year review by conducting site inspections and interviews with stakeholders, and by reviewing IC compliance certifications and inspection checklists (presented in Appendix B). Since a portion of IRP-13S was conveyed as an early transfer parcel pursuant to the FOSET process (Columbus Square development), the Columbus Square Homeowners Association completes the IC compliance checklist annually. IC compliance checklists are also prepared in accordance with OMP requirements by the O&M contractor. The data review, site inspection, and interviews revealed no evidence of any activities that were inconsistent with the land-use restrictions specified in the LUC RD.

Review of available IC compliance information from the sources mentioned above indicates that ICs continue to be effective in preventing contact with contaminated groundwater, and in protecting the integrity of the remedy components.

7.2.1.4 QUESTION A SUMMARY AND CONCLUSION

Results of this five-year review indicates that hydraulic containment of the VOC plumes has been effective, that hot spot mass removal has been effective, and that ICs designed to prevent contact with contaminated groundwater and to protect the integrity of the remedies have also been effective.

The remedies for IRP-3, -12, and -13S are therefore judged to be functioning as designed; therefore, the response to Question A (Is the remedy functioning as intended by the decision documents?) is: "affirmative."

7.2.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of Remedy Selection Still Valid?

7.2.2.1 EXPOSURE ASSUMPTIONS

The exposure assumptions considered during the remedy selection for IRP-3, -12, and -13S are consistent with current Site conditions and remain unchanged. No changes to Site conditions have occurred that would negatively affect the remedy performance.

7.2.2.2 TOXICITY DATA AND EFFECT ON HEALTH RISK

The following subsections present an evaluation of changes in toxicity criteria applicable to the risk drivers at IRP-3, -12, and -13S, and the effects of any such changes on human health risks. A re-evaluation of VI risk was performed to confirm the conclusion in the baseline risk assessments summarized in the respective RODs that VI risk did not warrant any action.

The following discussion leads to the overall conclusion that changes to toxicity data do not negatively affect the conclusions reached in the baseline health risk assessments, and that the remedies remain protective of human health.

7.2.2.2.1 Changes to Toxicity Criteria

No additional routes of exposure to chemicals in the subsurface at IRP-3, -12, or -13S have been identified since the implementation of the remedies. The previous baseline human health risk evaluation results were based on conservative assumptions that overestimated risks. Potential risks and hazards from other site contaminants, including potential chemical degradation byproducts of TCE, continue to be insignificant or inconsequential because of incomplete exposure pathways, or low concentrations.

There has been no change in the toxicity values for TCE. TCE is a risk driver for IRP-3, -12, and -13S. Toxicity criteria have been updated for 1,2,3-TCP since the signing of the IRP-13S (OU-1A) ROD. 1,2,3-TCP is a risk driver only at IRP-13S. The U.S. EPA published the following updated toxicity criteria for 1,2,3-TCP on their IRIS website in 2009 (U.S. EPA 2009b):

Oral CSF	30 per mg/kg-day
Oral reference dose (RfD)	4×10^{-3} mg/kg-day
Inhalation reference concentration (RfC)	3×10^{-4} mg/m^3

The oral CSF for 1,2,3-TCP is for the ingestion route and was based on a conservative analysis. According to U.S. EPA 2009b, the CSF was determined from results of laboratory

rat and mouse studies since no human studies have been completed. A strain of female mice was found in one study to have a much higher incidence of tumor development than all the other rats and mice in the studies. These other rats and mice had tumor development rates roughly an order of magnitude lower than the female mice. The oral CSF for human receptors was extrapolated from the female mice results since no human studies are available.

Toxicity criteria have also been updated for cis-1,2-DCE since the signing of the OU-1A and -1B RODs. This compound has been detected at low concentrations in groundwater at OU-1A and -1B South, but is not a risk driver at either Site. The U.S. EPA published the following updated toxicity criteria for cis-1,2-DCE on the IRIS website in 2010:

Oral CSF	Inadequate information to assess carcinogenic potential
Oral RfD	2×10^{-3} mg/kg-day
Inhalation RfC	Information reviewed but value not estimated

No other changes to toxicity criteria for Site COCs were identified in the review.

7.2.2.2.2 Effects on Health Risk

7.2.2.2.2.1 Groundwater Exposure Routes

As discussed above, ICs are in place to prevent contact with contaminated groundwater until RGs are achieved at IRP-3, -12, and -13S. As discussed in Section 7.2.2.2.1, the RG for 1,2,3-TCP was established in the ROD for IRP-13S at 0.5 µg/L based on consideration of the toxicity of 1,2,3-TCP, the practical quantitation limit of the commonly-used laboratory detection method, and the practical limitations of groundwater extraction in fine-grained WBZs. The lifetime cancer risk resulting from this RG estimated under the residential scenario at the source area was 4.0×10^{-4}. Incorporation of ICs to prevent beneficial use of groundwater was estimated to reduce the lifetime cancer risk at the source area to 1.0×10^{-5} (within the NCP risk management range) as discussed in Section 3.5.6.1.3. Based on these evaluations, the BCT made a risk management decision to adopt the RG of 0.5 µg/L and to incorporate ICs in the selected remedy in the ROD to prevent beneficial use of groundwater.

It should be noted that the ICs adopted by the DoN to prevent beneficial use of contaminated groundwater are in addition to ICs already enacted by the City of Tustin. The City Code requires a permit for any proposed well installation[4]. The permit approval process requires compliance with applicable California well standards[5].

[4] City Code: Article 4 - Health and Sanitation, Chapter 8 - Construction and Abandonment of Wells, §4802 - Permits.
[5] City Code: Article 4 - Health and Sanitation, Chapter 8 - Construction and Abandonment of Wells, §4804 - Standards.

The selected remedies reduce the lifetime cancer risk to a level within the NCP risk management range. This decision is justified in accordance with the NCP[6] for the following reasons:

- Exposure factors:
  - The overly conservative nature of the exposure factors built into the HHRA;
  - The risk contribution of naturally-occurring chemicals (those chemicals not related to site activities;
  - The decision to remove soil from the source areas despite risk from soil at the Sites being generally allowable and having received an NFA determination;
  - The decision to incorporate ICs to prevent beneficial use of groundwater;
  - Although risks under residential use (with ICs to prevent domestic groundwater use) estimated for areas over the VOC plumes is acceptable, the City of Tustin's SP/RP indicates that none of the areas overlying the VOC plumes will have future residential use;
  - The fact that concentrations of COCs in groundwater have decreased as a result of active extraction in the hot spot areas and due to natural attenuation throughout the plumes; and
  - The fact that plume sizes will diminish with time and eventually disappear.
- Factors limiting uncertainty:
  - The high degree of confidence in the data quality;
  - The level of conservatism in the predictive groundwater modeling;
  - The level of conservatism of the HHRA; and
  - The overlap between DoN-imposed ICs and City well permit requirements coupled with the fact that the groundwater in the shallow WBZs is not suitable and is unlikely to be used for beneficial uses.
- Technical limitation factors:
  - The practical quantitation limits of analytical methods.
  - The practical limitations of groundwater extraction from fine-grained aquifers for removal of COCs at low part-per-billion concentrations.

The adoption of an updated oral CSF for 1,2,3-TCP in 2009 by the U.S. EPA has the effect of incrementally raising the cancer risk due to ingestion of groundwater while at the same time lowering the cancer risk due to inhalation of vapor from beneficial use of groundwater. This is because along with the updated oral CSF, the U.S. EPA provided guidance that this value was not to be used in a route-to-route extrapolation, i.e. it is only for the ingestion route. There is no corresponding U.S. EPA value for the inhalation route. The baseline HHRA had originally utilized a route-to-route extrapolation for inhalation risk from beneficial use of groundwater (inhaling vapors while showering, etc.), and this route was determined to have the greatest contribution to risk in the baseline HHRA. Without this route-to-route extrapolation, the revised U.S. EPA cancer risk using the updated oral CSF from beneficial use of groundwater would therefore be lower than the baseline risk, under both baseline and future conditions.

7.2.2.2.2.2 Vapor Intrusion Exposure Route

The risks due to potential VI into indoor air were calculated in the baseline HHRAs for IRP-3, -12, and -13S. These risks were estimated to be either below the point of departure for cancer risk (10^{-6}), or within the NCP risk management range (10^{-6} to 10^{-4}). Since the risk

[6] See NCP 40CFR300.430(e)(2)(A).

estimates were determined through a conservative analysis, the BCT made a risk management decision not to incorporate ICs in the selected groundwater remedies that directly address VI exposure routes. In view of the recently-formulated toxicity criteria for 1,2,3-TCP, a re-evaluation of VI risk was performed as a part of the technical assessment for this five-year review. Appendix F presents the details of the VI evaluation. The results are summarized in the following paragraphs.

The VI risk driver at IRP Sites 3 and 12 is TCE, and at IRP-13S the VI risk drivers are TCE and 1,2,3-TCP. Since vinyl chloride is a daughter product from the dehalogenation of TCE and is highly toxic, this compound was also included in the VI evaluation. The evaluation therefore included assessment of potential intrusion of TCE and VC vapor into indoor air above the TCE groundwater plume in the first WBZ at IRP-3, assessment of potential intrusion of TCE vapor into indoor air above the TCE groundwater plume in the first WBZ at IRP-12 (VC was not reported), and potential intrusion of TCE, VC and 1,2,3-TCP vapor into indoor air above the first WBZ groundwater plume at IRP-13S. The Johnson and Ettinger (J&E) VI model was used as the analytical basis for the evaluation (J&E 1991). The J&E model has been updated and expanded into a family of models that are available for download from the DTSC website at: http://www.dtsc.ca.gov/AssessingRisk/JE_Models.cfm It should be noted that the DTSC versions of the J&E model include lookup tables that contain the most current DTSC toxicity criteria.

The evaluation employed site-specific soil lithology inputs, and used model default parameters for soil properties and building and ventilation inputs. The principal shortcoming of the J&E model for evaluating VI above groundwater VOC sources is its default assumption of a steady-state (infinite) source of groundwater VOC contamination. The model assumes that the groundwater concentration continues without degradation or decline over time. This input parameter is then used to calculate the lifetime cancer exposure risk as if the source never declined. This results in an overestimated VI risk for sites that have active groundwater remediation such as IRP-3, -12, and -13S.

As in the previous versions of the risk assessments for IRP-3, -12, and -13S, toxicity values used in the risk assessment were obtained from either the U.S. EPA or the DTSC because the DTSC recommends use of the more conservative value. The vapor intrusion risk evaluations were conducted using a dual-tracking approach. U.S. EPA-approved toxicity values were obtained from the Regional Screening Level (RSL) tables (U.S. EPA 2011c). DTSC-approved toxicity values were obtained from the 2009 version of the DTSC J&E model available for download at: (http://www.dtsc.ca.gov/AssessingRisk/JE_Models.cfm).

For each groundwater VOC plume, the evaluation was done on a point-by-point basis, i.e. the VI risk was determined above each data point in the plume. Groundwater concentrations reported from the fourth quarter 2010 monitoring event were used as inputs. The individual point source VI risks were then contoured to illustrate the spatial variation of interpreted VI risk over the area of each VOC plume.

The VI modeling for the TCE groundwater plume in the first WBZ at IRP-3 shows that, using fourth quarter 2010 groundwater concentrations (ECS 2011b), the lifetime[7] VI cancer risk is below the point of departure (10^{-6}) over the entire plume except at a localized area around the groundwater hot spot where it is estimated at 1.8×10^{-5}, which is within the NCP risk management range (10^{-6} to 10^{-4}) . It should be noted that the default assumption of

[7] Lifetime means 30 year exposure duration averaged over 70 years.

exposure averaged over a 70-year lifetime is extremely conservative because few people would actually experience this length of exposure. The VI cancer risk contours are shown on Figure 23. The VI modeling also shows that, using fourth quarter 2010 groundwater concentrations, the HI is below 1.

The VI modeling for the TCE groundwater plume in the first WBZ at IRP-12 shows that, using fourth quarter 2010 groundwater concentrations, the lifetime VI cancer risk is below the point of departure over the entire plume footprint. The VI cancer risk contours are shown on Figure 24. The VI modeling also shows that, using fourth quarter 2010 groundwater concentrations, the HI is below 1.

The VI modeling for the TCE and 1,2,3-TCP groundwater plumes in the first WBZ at IRP-13S shows that, using fourth quarter 2010 groundwater concentrations, the lifetime VI cancer risk is below 10^{-5} over the entire area of the plumes except for a localized area around the groundwater hot spot where it is 1.5×10^{-5}, within the NCP risk management range. The VI cancer risk contours are shown on Figure 24. The VI modeling also shows that, using fourth quarter 2010 groundwater concentrations, the HI is below 1.

7.2.2.2.3 NCP Point of Departure Analysis

Since the calculated VI lifetime cancer risks in areas above the groundwater hot spots at IRP-3 and -13S exceed the NCP point of departure (10^{-6}), but are within the NCP risk management range (10^{-6} to 10^{-4}), the NCP provides criteria for justifying risk management decisions that accept a level of risk above the point of departure[8]. In general, the factors that may justify these risk management decisions include exposure factors, uncertainty factors, and technical limitation factors. Each of these is discussed below.

7.2.2.2.3.1 Exposure Factors

The VI evaluation includes a presumption of residential exposure, despite the City re-use plans indicating no future residential use overlying VOC plume areas, as discussed in Section 7.2.2.2.2.1. Moreover, the VI risk model assumes that a residential receptor exposure is averaged over a default 70-year lifetime.

For the VOC hot spot areas in the first WBZ at IRP-3 and -13S, where lifetime VI cancer risk is within the NCP risk management range, the hot spot areas are being actively remediated. Groundwater modeling showed that concentrations are projected to decline to RGs over a 30-year period (BNI 2002, BEI 2003b). Since the risk assessment assumes a lifetime exposure averaged over 70 years (30 years exposure duration, 350 days per year), the actual VI risk will diminish over time as the hot spots are cleaned up. The J&E model uses an assumption of a steady-state groundwater contamination source; therefore, the hypothetical residential receptor would not in reality be exposed to VI from the maximum groundwater VOC concentrations over the entire exposure duration, but rather would be exposed to declining concentrations over time with the greatest rate of decline in the early years.

Groundwater contaminant concentrations for a wide variety of common groundwater contaminants have been shown to decline over time in a logarithmic fashion once the source or sources of contamination to groundwater have been removed (e.g. Tardiff and

[8] See NCP 40CFR300.430(e)(2)(A).

Katzman 2007). The ongoing mass removal from each hot spot will lead to long-term concentration declines.

7.2.2.2.3.2 Uncertainty Factors

The NCP preamble states (55 Federal Register 8717, March 8, 1990): *"Preliminary remediation goals for carcinogens are set at a 10^{-6} excess cancer risk as a point of departure, but may be revised to a different risk level within the acceptable risk range based on the consideration of appropriate factors including, but not limited to: exposure factors, uncertainty factors, and technical factors. Included under exposure factors are: the cumulative effect of multiple contaminants, the potential for human exposure from other pathways at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts of alternatives. Factors related to uncertainty may include: the reliability of alternatives, the weight of scientific evidence concerning exposures and individual and cumulative health effects, and the reliability of exposure data. Technical factors may include: detection/quantification limits for contaminants, technical limitations to remediation, the ability to monitor and control movement of contaminants, and background levels of contaminants. The final selection of the appropriate risk level is made when the remedy is selected based on the balancing of criteria..."*

The risk assessment process involves consideration of the uncertainty factors listed above, as well as other sources of uncertainty. Uncertainty is mitigated by introducing conservatism at each step of the evaluation. These conservative assumptions are additive, which results in a conservative estimation of risk. In the VI evaluation, conservative assumptions were used as inputs throughout the evaluation, as illustrated by the following:

- The assumption of residential exposure, although the City's SP/RP does not identify future residential land use in the affected areas;
- The default assumption in the J&E VI model that the VI exposure is averaged over a 70-year lifetime (applies to children and adults assumed to be in contact with vapors for 30 years, 350 days a year);
- The default assumption in the J&E VI model that the lifetime exposure to VI is from a steady-state groundwater contamination source (although VOC concentrations in groundwater decline over time due to active remediation and/or natural attenuation);
- The default assumption in the J&E model that the interior of a residence is under a perpetual state of negative pressure such that 100 percent of soil vapor is drawn into a residence through a continuous perimeter seam in the floor slab with no soil vapor escaping to outside air;
- The default assumption in the J&E model that indoor air is perfectly mixed with no floor-to-ceiling variation or room-to-room variation;
- The default assumption in the J&E model that there is no moisture barrier beneath the floor slab of a residence, although the City of Tustin requires installing "dampproofing"[9] (moisture barrier) beneath slabs (a moisture barrier would also

[9] The City of Tustin has a dampproofing requirement that applies to all new residential construction. According to the City website, the City Code has formally adopted the California Building Code, 2010 Edition in all respects except for specific itemized amendments. The itemized amendments are listed at the following link and do not address exceptions to dampproofing:
(http://library.municode.com/index.aspx?clientID=11307&stateID=5&statename=California)
The full text of the California Building Code 2010 Edition is available online at:
(http://www.archive.org/stream/gov.ca.bsc.title24.2010.part02.2/ca_2010_title24_02.2_djvu.txt)

minimize or prevent VI by constituting a vapor barrier and by eliminating the effect of the assumed perimeter seam in the floor slab).

By design, these uncertainty factors and the conservative assumptions used as inputs to models, result in an over-prediction (or upper-bound estimate) of vapor concentrations and therefore overestimate risk, to assure risk managers that the selected remedies are protective of human health and the environment. In making risk management decisions pursuant to CERCLA and the NCP, risk managers consider these uncertainty factors to qualitatively evaluate the modeled (overestimated) risk results in comparison to the actual risks potential receptors may be exposed to.

7.2.2.2.3.3 Technical Limitation Factors

When laboratory detection limits are elevated, chemicals present in groundwater samples could be reported as not detected, but actually be present at concentrations of concern. Elevated detection limits are not a concern for VI risk assessment calculations because quantification limits for the COCs in groundwater samples used in the risk assessment were sufficiently low, so that there is a high level of confidence that the distribution of the COCs is understood and that the VI risks are representative. Historic data for COCs with elevated detection limits were not included in the analysis.

The RG for 1,2,3-TCP in groundwater was established in the ROD at 0.5 µg/L in part because of technical limitations on the ability of active groundwater extraction technologies to achieve a concentration lower than this in fine-grained (clay-rich) soils at this Site, as stated above in Section 7.2.2.2.3.1. Therefore the limitations of current groundwater extraction technology impose a practical limit.

7.2.2.2.3.4 NCP Point of Departure Conclusion

Given the conservative nature of the exposure factors and uncertainty factors, and the technical limitation factors cited above, accepting VI risks that are within the NCP risk management range is justified.

7.2.2.3 CLEANUP LEVELS AND RAOS

The ARARs identified in respective RODs for IRP-3, -12, and -13S were evaluated as a part of this five-year review to determine if there have been any changes in these standards that may negatively affect the protectiveness of the remedies at these Sites. Based on the evaluation conducted for this five-year review, there have been no significant changes to the standards/requirements identified as ARARs in the respective RODs that could negatively affect the protectiveness of the remedies. Additionally, no newly promulgated laws or regulations were identified that could negatively affect the protectiveness of the remedies.

Section 1805.2 Dampproofing states: "Where hydrostatic pressure will not occur as determined by Section 1803.5.4, floors and walls for other than wood foundation systems shall be dampproofed in accordance with this section." Subsection 1805.2.1 Floors states: "Dampproofing materials for floors shall be installed between the floor and the base course required by Section 1805.4.1, except where a separate floor is provided above a concrete slab. Where installed beneath the slab, dampproofing shall consist of not less than 6-mil (0.006 inch; 0.152 mm) polyethylene with joints lapped not less than 6 inches (152 mm), or other approved methods or materials." The prescribed dampproofing therefore also constitutes a vapor barrier for all intents and purposes.

The risk driver in groundwater at IRP Sites 3 and 12 is TCE. The risk drivers in groundwater at IRP-13S are TCE and 1,2,3-TCP. The RG for TCE in groundwater is based on the MCL for TCE which is 5 µg/L; this water quality standard remains unchanged from the signing date of the ROD.

As of the signing date of the ROD for IRP-13S (OU-1A) there were no federal or California MCLs for 1,2,3-TCP. The RG for 1,2,3-TCP was established in the ROD for IRP-13S at 0.5 µg/L based on consideration of the toxicity of 1,2,3-TCP, the practical quantitation limit of the commonly used laboratory detection method (U. S. EPA Test Method 8260B), and the practical limitations on groundwater extraction in fine-grained matricies such as the shallow WBZs at these Sites.

The method detection limit for specific compounds in Method 8260B, including 1,2,3-TCP, may potentially be lowered by use of the selected ion monitoring (SIM) technique (U.S. EPA 2011b). However, the narrative description of the test method cautions that use of the SIM method may "provide a lesser degree of confidence in the compound identification unless multiple ions are monitored for each compound" (U.S. EPA 2011b). This problem may be further complicated by the presence of "large amounts of water-soluble materials, suspended solids or high boiling compounds" (U.S, EPA 2011b). Such compounds (e.g. TDS, nitrates, sulfates) are present in high concentrations in the shallow WBZs at the Site. In summary, although techniques exist for potentially achieving lower detection limits under favorable circumstances, 0.5 µg/L remains a practical quantitation limit given site-specific conditions.

Since the signing of the ROD for IRP-13S, California's Office of Environmental Health Hazard Assessment (OEHHA) has adopted a final public health goal (PHG) for 1,2,3-TCP in drinking water systems of 0.0007µg/L (OEHHA 2009). There are still no federal or California MCLs in drinking water for 1,2,3-TCP. Based on the presently available information, the RG of 0.5µg/L for 1,2,3-TCP remains appropriate.

The remedies at the Sites are in place and the RAOs and RGs presented in the ROD are still applicable and appropriate.

7.2.2.4 QUESTION B SUMMARY AND CONCLUSION

Based on the evaluation conducted for this five-year review, there have been no significant changes to the standards/requirements identified as ARARs in the IRP-3, -12, and -13S RODs that could negatively affect the protectiveness of the remedies. Additionally, no newly promulgated regulations or enforceable standards were identified that could negatively affect the protectiveness of the remedies.

Toxicity criteria have been updated for 1,2,3-TCP since the signing of the IRP-13S (OU-1A) ROD. These new criteria have not yet resulted in new enforceable groundwater standards that would constitute ARARs, but they may in the future. The RG for 1,2,3-TCP in groundwater established in the ROD was based partly on risk considerations and partly on limitations of technology. If a new baseline HHRA were conducted based on current soil and groundwater COC concentrations, current toxicity criteria and U.S. EPA guidance for use of those criteria, it is likely that the total lifetime cancer risk under current and future unrestricted use would be lower than predicted in the original baseline HHRA for the following reasons:

- Cancer risk due to exposures from beneficial use of groundwater under current conditions would be lower due to lower current groundwater VOC concentrations than existed at the time of the baseline HHRA;
- Cancer risk due to exposures from beneficial use of groundwater under future conditions (upon achieving RGs) would be lower due to the net effect of elimination of route-to-route extrapolation of the revised oral CSF for 1,2,3-TCP discussed in Section 7.2.2.2.2.1.
- Soil with TCE contamination exceeding 400 μg/kg was removed from each source area and replaced with clean backfill, thereby eliminating the risk contribution from dermal contact with, and ingestion of, soil.

Given these factors, the weight of evidence indicates that the RG of 0.5μg/L for 1,2,3-TCP remains appropriate and protective.

The VI pathway to indoor air exposure route was re-evaluated as part of this five-year review because new toxicity criteria have been published for 1,2,3-TCP, and because no ICs were established that directly address the VI pathway. The results indicate that lifetime (30 years exposure duration, 350 days per year) cancer risk for the VI pathway is either below the point of departure, or within the NCP risk management range, for the IRP-3, -12, and -13S first WBZ VOC plumes. The NCP point of departure analysis in Section 7.2.2.2.3 supports a risk management decision. Given the conservative nature of the exposure factors and uncertainty factors, and the technical limitation factors cited above, accepting VI risks that are within the NCP risk management range is justified. The lifetime non-cancer HI is below 1 for all three sites. Since concentrations have declined and are expected to continue to decline as a result of the hot spot mass removal and natural attenuation components of the remedies, the overall conclusion is that the remedies continue to be protective for the VI exposure route at all three Sites.

The response to Question B for IRP-3, -12, and -13S is: "affirmative."

7.2.3 Question C: Has any other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

The document review, data review, site inspection and interviews have identified no other information that would call into question the protectiveness of the remedies implemented for IRP-3, -12, and/or -13S. In addition, there has been no technology development, or advances in science that have come to light that could call into question the protectiveness of the final remedies.

The response to Question C for IRP-3, -12, and -13S is "negative."

7.2.4 Technical Assessment Summary

Based on the monitoring data and documents reviewed, the site inspection, and the interviews, the remedies for IRP-3, -12, and -13S are functioning as intended by the respective RODs. Groundwater monitoring data and the capture analyses indicate that the COCs are being hydraulically contained by the extraction and treatment systems operating at the Sites and the concentrations of VOCs in the hot spots are being reduced by the hot-spot extraction wells. The engineering components of the remedies are functioning as designed to protect the integrity of the remedies; and there is no evidence of activity at the Sites that is inconsistent with the land-use restrictions presented in the LUC RD. The evaluation of ARARs documented in the RODs indicated that there were no significant

changes to the standards/requirements identified as ARARs in respective RODs that could negatively affect the protectiveness of the remedies at the Sites. Additionally, no newly promulgated laws or regulations were identified that could negatively affect the protectiveness of the remedies.

Updated toxicity criteria have been published for 1,2,3-TCP, the primary risk driver at IRP-13S. Evaluation of the effects of the updated criteria on health risk lead to the conclusion that health risk is not negatively affected and that the remedies remain protective of human health. VI risk was re-evaluated as part of the five-year review. Given the conservative nature of the exposure factors and uncertainty factors, and the technical limitation factors cited above, accepting VI risks that are within the NCP risk management range is justified. It was concluded that the remedies remain protective with respect to VI risk. There is no other information that calls into question the protectiveness of the remedies.

The responses to the three technical assessment questions for IRP-3, -12, and -13S are summarized as follows.

IRP-3, -12, and -13S - Technical Assessment Summary	
Question A: Is the remedy functioning as intended by the decision documents?	**Affirmative**
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?	**Affirmative**
Question C: Has any other information come to light that could call into question the protectiveness of the remedy?	**Negative**

8. Issues

No issues have been identified for IRP-1, -3, -12, and -13S that currently or in the future would prevent the respective remedies at these sites from being protective of human health and/or the environment.

(THIS PAGE LEFT INTENTIONALLY BLANK)

9. Recommendations and Follow-up Actions

9.1 IRP-1

No issues have been identified for IRP-1 that currently or in the future would prevent the remedy at the Site from being protective of human health and/or the environment; therefore, no follow-up actions are required to ensure protectiveness of the remedy for this Site. The following recommendations for follow-up action address the reinforced concrete containment wall:

- The reinforced concrete containment wall is in good condition, but the condition of the adjoining older wall at the north shows moderate concrete deterioration. Regular O&M inspections should include surveillance of the north end of the containment wall to confirm that the deterioration of the adjoining older wall does not affect the integrity of the containment wall over time.

- The discrepancy in the depiction of the containment wall as including a short section of the older pre-existing wall in Site documents including the RI and FS Reports, the ROD, and the OMP should be corrected as a "non-significant" or "minor" post-ROD change by documenting it in a memo to the file as prescribed in the U.S. EPA ROD Guidance (U.S. EPA 2011a).

The following recommendation addresses the LFG monitoring probes that are no longer needed:

- Monitoring should be discontinued and the probes should be properly sealed and destroyed in accordance with the State of California Well Standard Bulletins 74-81 and 74-90.

9.2 IRP-3, -12, AND -13S

No issues have been identified for IRP-3, -12, or -13S that currently or in the future would prevent the respective remedies at these Sites from being protective of human health and/or the environment; therefore, no follow-up actions are required to ensure protectiveness of the remedies for these Sites. The following recommendations are alternatives for follow-up action that could be considered to address the well vault inundation issue:

- Construct a berm to direct concentrated surface runoff falling from the hangar roof away from well vaults.

- Construct local berms surrounding each well vault subject to inundation.

- Extend the heights of the well vaults that are subject to inundation.

- Install automated or semi-automated sump pumps in well vaults subject to inundation.

(THIS PAGE LEFT INTENTIONALLY BLANK)

10. Protectiveness Statement

10.1 IRP-1

Based on the technical assessment presented in Section 7, the remedy at IRP-1 is being implemented in accordance with the ROD (DoN 2001) and is protective of human health and the environment. Potential exposure to waste and groundwater contaminants at IRP-1 has been addressed through construction of engineering controls that isolate and contain the waste, installation of access restrictions and warning signs, and implementation of ICs. The long-term protectiveness of the remedy is ensured by on-going O&M activities that include inspection and maintenance of the engineering controls, including the steel-reinforced concrete containment wall, groundwater monitoring, and ICs that run with the land.

10.2 IRP-3, -12, AND -13S

Based on the technical assessment, the remedies at IRP-3, -12, and -13S are being implemented in accordance with the RODs (DoN 2004b,c) and are protective of human health and the environment. Hydraulic containment with hot spot mass removal is being implemented to achieve the RGs for COCs in groundwater at these Sites. Potential exposure pathways to groundwater that might result in unacceptable risks to human receptors are being controlled with ICs. The baseline HHRA determined that the VI pathway from groundwater to indoor air was not a significant contributor to total risk and the agency-concurred ROD concluded that no action was warranted for this exposure route. Nevertheless, VI risk was re-evaluated as part of this five-year review because no ICs had been established that directly address the VI pathway. The results of the re-evaluation demonstrate that the groundwater remedies are protective for the VI exposure pathway. The level of protectiveness of the groundwater remedies will increase over time with active groundwater hot spot mass removal, and with the natural attenuation of COCs in groundwater through time.

(THIS PAGE LEFT INTENTIONALLY BLANK)

11. Next Review

The next five-year review for former MCAS Tustin will be required by October 31, 2016, five years from the signature date of the final version of this Report. This five-year review included the evaluation of available O&M data for IRP-1, -3, -12, and -13S ranging in duration from three years for IRP-3, -12, and -13S (OU-1A/-1B), to five years for IRP-1 (OU-3). The next five-year review will include evaluation of O&M data for a full five years for IRP-1, -3, -12, and -13S, as well as information for any additional CERCLA remedial actions that commence during the period.

An insufficient amount of time has passed to adequately evaluate the selected remedies for two OU-4B low concentration Sites (IRP-11 and -13W) in this review. The selected remedy for these Sites is ICs. The trigger date for the five-year reviews for IRP-11 and -13W is the ROD signature date; however, the selected remedies have not yet been fully implemented since the RD for these Sites is currently in preparation. These Sites will be addressed in the next five-year review.

The remedy, ICs, for OU-4B low concentration Site MMS-04, was completed in 2011; the agency concurred Final RACR documented that the terms of the Final ROD/RAP were met; the RAOs and RG for groundwater had been achieved, that Soil at the Site required NFA, and the Site was protective of human health and the environment (AIS-TN&A JV 2011). Therefore, no further Five Year Reviews are required for MMS-04.

(THIS PAGE LEFT INTENTIONALLY BLANK)

12. References

AIS-TN&A Joint Venture (AIS-TN&A JV). 2011. *Final Remedial Action Completion Report, Miscellaneous Major Spill (MMS)-04, Operable Unit 4B, Former Marine Corps Air Station Tustin, California.* June.

Argonne National Laboratory (ANL). 1994. *Draft Report: Geology, Hydrogeology, and Site History at the Marine Corps Air Station Tustin, California. Applied Geosciences and Environmental Management Section, Environmental Research Division.* August.

_____. 1995. *Final Report: Phase II Investigation for Expedited Site Characterization for Marine Corps Air Station Tustin, California. Applied Geosciences and Environmental Management Section, Environmental Research Division.* October.

Bechtel Environmental, Inc. (BEI), 2003a. *Final Operation and Maintenance Plan, Operable Unit 3, Marine Corps Air Station Tustin, Orange County California.* May.

_____. 2003b. *Final Feasibility Study Report for Operable Unit 1A, Former Marine Corps Air Station, Tustin, California.* August.

_____. 2003c. *Final 2001 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California.* December.

Bechtel National, Inc. (BNI). 1996. *Final Remedial Investigation Report for Operable Unit 3, Marine Corps Air Station, Tustin, California*. July.

_____. 1997a. *Draft Final RCRA Facility Assessment Report, Marine Corps Air Station, Tustin, California. Prepared for Southwest Division Naval Facilities Engineering Command.* April.

_____. 1997b. *Final Feasibility Study Report for Operable Unit 3, Former Marine Corps Air Station, Tustin, California.* September.

_____. 1997c. *Draft Final Remedial Investigation Report For Operable Units 1 and 2, Marine Corps Air Facility, Tustin, California. CTO 0049/1165. Bechtel National, Inc., San Diego, California.* November.

_____, 1998. *Draft Technical Memorandum: TCE-In-Soil Confirmation Sampling, Pilot-Scale Extraction Test, Bench-Scale Column Test, and Model Sensitivity Analysis, Marine Corps Air Facility Tustin, California. Prepared for Southwest Division Naval Facilities Engineering Command.* March

_____. 1999a. *Revised Draft Feasibility Study Report for Operable Unit 1, Marine Corps Air Facility Tustin, California. March.*

_____. 1999b. *Final Technical Memorandum: Limited Deep Hydropunch Investigation at IRP-13S, Marine Corps Air Facility, Tustin, California.* April.

_____. 1999c. *Draft Final Technical Memorandum: Pilot-Scale Vacuum-Enhanced Extraction Test. Marine Corps Air Facility Tustin, California.* June.

_____. 1999d. *Final 1998 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California.* December.

_____. 2000. *Final 1999 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California.* November.

_____. 2001a. *Final Work Plan, Time Critical Removal Action, Operable Unit 1A, Marine Corps Air Station, Tustin, California.* August.

_____. 2001b. *Final 2000 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California.* December.

_____. 2002. *Final Feasibility Study Report, Operable Unit 1B, Marine Corps Air Station, Tustin, California.* January.

Brown and Caldwell Consulting Engineers (Brown and Caldwell). 1985. *Initial Assessment Study of Marine Corps Air Station Tustin, California. NEESA 13-075. Prepared for Naval Energy and Environmental Support Activity.* September.

California Department of Toxic Substances Control (DTSC). 2004. *Letter Correspondence and Concurrence from DTSC to DoN on Final Operating Properly and Successfully Evaluation Report, Operable Unit 3, Former MCAS Tustin, California, November 2003*. June 17.

_____. 2006. *Letter Correspondence and Concurrence from DTSC to DoN on Final First Five-Year Review of Remedial Actions Implemented at Operable Unit 3 Former Marine Corps Air Station (MCAS) Tustin, California, October 2006.* November 9.

_____. 2010. *E-mail correspondence and Concurrence from Anantaramam (Ram) Peddada, Hazardous Substance Scientist of DTSC to James Callian, BEC Navy on Draft Final Operating Properly and Successfully Demonstration Groundwater Remedial Action Operable Units 1A (IRP-13S) and 1B (IRP-3 and IRP-12), Former MCAS Tustin, California, December 2009 and DTSC Letter dated January 5, 2010*. January 25.

California Office of Environmental Health Hazard Assessment (OEHHA). 2009. Announcement of Publication of the Final Public Health Goal for 1,2,3-Trichloropropane in Drinking Water. August 20. Available online at: http://oehha.ca.gov/water/phg/123tcp082009.html

California Regional Water Quality Control Board (RWQCB). 2003. *Comments on Draft Final Operating Properly and Successfully Demonstration, Groundwater Remedial Action, Operable Unit 3, Former Marine Corps Air Station Tustin.* Letter to Jerry Dunaway from John Broderick. August 22.

_____. 2010a. *Comments on Draft Final Operating Properly and Successfully Demonstration, Groundwater Remedial Action, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12), Former Marine Corps Air Station Tustin.* Letter to James Callian from John Broderick. February 2.

_____. 2010b. *Determination of No Further Action, Former Underground Storage Tank Release Site 29A, Former Marine Corps Air Station, Tustin, California.* March 10.

Cape Environmental Management, Inc. (CAPE). 2005a. *Final 2004 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California.* June.

_____. 2005b. *2004 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* July.

_____. 2006a. *2005 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* September.

_____. 2006b. *2005 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California.* September.

_____. 2007a. *2006 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California*. September.

_____. 2007b. *Final 2006 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California.* September.

Department of Navy (DoN). 1999. *Southwest Division, Naval Facilities Engineering Command (SWDIV). Federal Facility Site Remediation Agreement signed between the Department of the Navy and the State of California Environmental Protection Agency Department of Toxic Substances Control.* August 18.

_____. 2001. *Final Record of Decision/Remedial Action Plan, Operable Unit-3, Moffett Trenches and Crash Crew Burn Pits Site, Marine Corps Air Station, Tustin, California.* December.

_____. 2002*. Finding of Suitability to Lease (FOSL 3) for Carve-Out Areas 5, 6, 7, 8, 9, 10, and 11, Former Marine Corps Air Station, Tustin, California.* April 26.

_____. 2004a. *Finding of Suitability to Transfer (FOST #6) a Portion of Carve-Out 5 (Parcel 20, and the Lansdowne Road Portion of Parcel 40) and Carve-Out 10 (Portions of Parcels 28, 40, and 41), Former Marine Corps Air Station, Tustin, California*. September.

_____. 2004b. *Final Record of Decision/Remedial Action Plan, Operable Unit 1A, Former Marine Corps Air Station, Tustin, California.* October.

_____. 2004c. *Final Record of Decision/Remedial Action Plan, Operable Unit 1B, IRP-3 – Paint Stripper Disposal Area, IRP-12 – Drum Storage Area No. 2, Former Marine Corps Air Station, Tustin, California.* October.

_____. 2010a. *Final Record of Decision/Remedial Action Plan, Operable Unit 4B, IRP-5, -6, -11, -13W, MMS-04, and MPA, Former Marine Corps Air Station, Tustin, California.* March.

_____. 2010b. *Draft Finding of Suitability to Transfer #9 (FOST #9) for Parcels 1A, 1B, 2A, 16A, 16B, 17A, 19A, 19B, 22A, 40A, 40B, and Carve Out 6, Former Marine Corps Air Station, Tustin, California.* May.

_____ 2011. *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Five-Year Reviews.* June 7.

Driscoll, F. G (Driscoll). 1986. *Ground water and wells: Edward E. Johnson Co., St. Paul, Minnesota, 1089 p.*

Engineering/Remediation Resources Group (ERRG). 2005. *Final Remedial Design/Remedial Action Work Plan (RD/RAWP), Soil Hot Spot Removal at Operable Unit 1B, Installation Restoration Program Sites IRP-3 and IRP-12, Former MCAS Tustin, California.* July.

_____. 2006. *Final Soil Removal Report, Operable Unit 1B, Installation Restoration Program Sites 3 and 12, Former MCAS Tustin, California.* December.

_____. 2007. *Final (100% Design Submittal) Remedial Design, Hydraulic Containment With Hot Spot Removal, Operable Units 1A and 1B, Former Marine Corps Air Station, Tustin, California. Contract No. N68711-01D-6016, Delivery Order 001*. June.

_____. 2008a. *Final First Quarter 2008 Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and Operable Unit 1B (IRP-3 and IRP-12), Former Marine Corps Air Station, Tustin, California.* July.

_____. 2008b. *Final Second Quarter 2008 Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and Operable Unit 1B (IRP-3 and IRP-12), Former Marine Corps Air Station, Tustin, California.* October.

_____. 2008c. *Final Interim-Remedial Action Completion Report, Operable Units 1A and 1B Groundwater Remedy, Installation Restoration Program Sites 3, 12, and 13S, Former Marine Corps Air Station, Tustin, California*. December.

_____. 2009. *Final Operation and Maintenance Plan, Operable Units 1A and 1B Groundwater Remedy, Installation Restoration Program Sites 3, 12, and 13S, Former Marine Corps Air Station, Tustin, California.* September.

Enviro Compliance Solutions, Inc. (ECS). 2006. *First Five-Year Review of Remedial Actions Implemented at Operable Unit 3, Former Marine Corps Air Station, Tustin, California.* October.

_____. 2008a. *Final 2007 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* August.

_____. 2008b. *Final 2008 Third Quarter Groundwater Monitoring Data Summary, Operable Units 1A (IRP-13S) and Operable Unit 1B (IRP-3 and IRP-12), Former Marine Corps Air Station, Tustin, California.* December.

_____. 2010a. *Final 2008 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* January.

_____. 2010b. *Final 2008 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12); and Final 2007 Fourth Quarter Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and UST Site 222, Former Marine Corps Air Station, Tustin, California.* February.

_____. 2010c. *Final Operating Properly and Successfully Demonstration, Groundwater Remedial Action, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12), Former Marine Corps Air Station, Tustin, California*. February.

_____. 2010d. *Final Soil Removal Activities Closure Report, Former Underground Storage Tank (UST) Site 29A, Former Marine Corps Air Station, Tustin, California*. June.

_____. 2010e. *Final 2009 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12), Former Marine Corps Air Station, Tustin, California.* November.

_____. 2011a. *Final 2009 Annual Long-Term Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* February.

_____. 2011b. *Draft 2010 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12), Former Marine Corps Air Station, Tustin, California.* June.

_____. 2011c. *Final 2010 Annual Long-Term Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California.* July.

Environmental Quality Management, Inc. (EQM). 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings; report prepared for U.S. EPA Office of Emergency and Remedial Response. February 22. Available online at:* http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm

Golden Software Inc. 2009. Surfer contouring software version 9.5.785, 2009

International Technologies, Inc. (IT). 2000. *Final Memorandum Remedial Activities for Site TOW-X3*. November 14

Jacobs Engineering Group (JEG). 1993a. *Marine Corps Air Station Tustin, California, Underground Storage Tanks Preliminary Draft Monitoring Plan. In association with International Technology Corporation and CH2M Hill. 22* February.

_____. 1993b. *Marine Corps Air Station Tustin, California, Final Site Inspection Report. Prepared for Southwest Division Naval Facilities Engineering Command.* 12 March.

James M. Montgomery Consulting Engineers, Inc. (JMM). 1988. *MCAS Tustin Fuel Farm Area Remedial Investigation. Prepared for Western Division Naval Facilities Engineering Command.* July.

Johnson, P. C, and R. A. Ettinger (J&E). 1991. *Heuristic model for predicting the intrusion rate of contaminant vapors in buildings. Environ. Sci. Technol. 25: 1445-1452*.

OHM Remediation Services, Inc. (OHM). 1997a. *Final Supplemental Removal Action Work Plan for Soil Removal Actions at IRP-2 (Oil Disposal Areas) and IRP-9 (Hangar No. 1 Line Shacks).* April.

_____. 1997b. *Site Assessment /Closure Report, Former IRP-16B, Marine Corps Air Station (MCAS) Tustin, Tustin, California.* 10 September.

_____. 1999. *Draft Closure Repot, Soil Removal Actions at Sites IRP-9A (Hangar No. 1 Line Shacks, Subareas 1 and 2) and IRP-9B (Apron 1, Subareas 1 and 3), Marine Corps Air Facility, Tustin, California.* April

_____. 2001. *Final Memorandum Remedial Activities for Site TOW-X4.* June 22

Orange County Sanitation District (OCSD). 2007a. *Special Purpose Discharge Permit Number 57-256. Issued to DoD Navy BRAC PMO West - North - 15650 ½ Armstrong Avenue, Tustin, California 92782.* April 30.

_____. 2007b. *Special Purpose Discharge Permit Number 57-270. Issued to DoD Navy BRAC PMO West –South – 15951 ½ Tustin Ranch Road, Tustin, California 92782.* December 20.

Pacific Treatment Environmental Services (PTES). 2003a. *2002 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Station Tustin, California.* October.

_____. 2003b. *Draft Annual 2002 Groundwater Progress Monitoring Data Summary.* November.

PTES and Tetra Tech. 2003. *Final Operating Properly and Successfully, Evaluation Report, Operable Unit 3, Former Marine Corps Air Station Tustin, Tustin, California.* November.

Seaburn, Gerald, E (Seaburn). 1989. *The Capture-Zone Method for the Recovery System Design in Proceedings of the 1989 Georgia Water Resources Conferences, Institute of Natural Resources, University of Georgia, Athens, Georgia.* May

Shaw Environmental, Inc. (Shaw). 2004. *Final Work Plan, Soil Removal Action, Operable Unit 1A, Former MCAS Tustin, California.* May 14.

_____. 2005. Final Soil Removal Report, Operable Unit (OU) 1A, Former MCAS Tustin, California, Rev. 1. September 26.

Tardiff, M.F. and Katzman, D (Tardiff and Katzman). 2007. Estimating contaminant attenuation half-lives in alluvial groundwater systems. Journal of Environmental Monitoring; Royal Society of Chemistry. February.

United States Environmental Protection Agency (U.S. EPA). 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. Available online at http://www.epa.gov/superfund/pubs.htm. June.

_____. 2003. Human Health Toxicity Values in Superfund Risk Assessments. Memorandum from Office of Superfund Remediation and Technology Innovation to Superfund National Policy Managers, Region 1 – 10. December 5.

_____. 2004. Letter from U.S. EPA to DoN providing concurrence with IRP-1 (OU-3) OPS demonstration. March 18.

_____. 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, Final Project Report. U.S. EPA 600/R-08/003. January. Available online at: http://www.epa.gov/ada/download/reports/600R08003/600R08003.pdf

_____. 2009a. Risk Assessment Guide for Superfund; Vol. 1: Human Health Evaluation Manual; Part F, Supplemental Guidance for Inhalation Risk Assessment. Final. EPA-540-R-070-002 OSWER 9285.7-82. January. Available online at: http://www.epa.gov/oswer/riskassessment/ragsf/pdf/partf_200901_final.pdf

_____. 2009b. Toxicological Review of 1,2,3-Trichloropropane (CAS No. 96-18-4) In Support of Summary Information on the Integrated Risk Information System (IRIS). September. Available online at: http://www.epa.gov/iris/toxreviews/0200tr.pdf

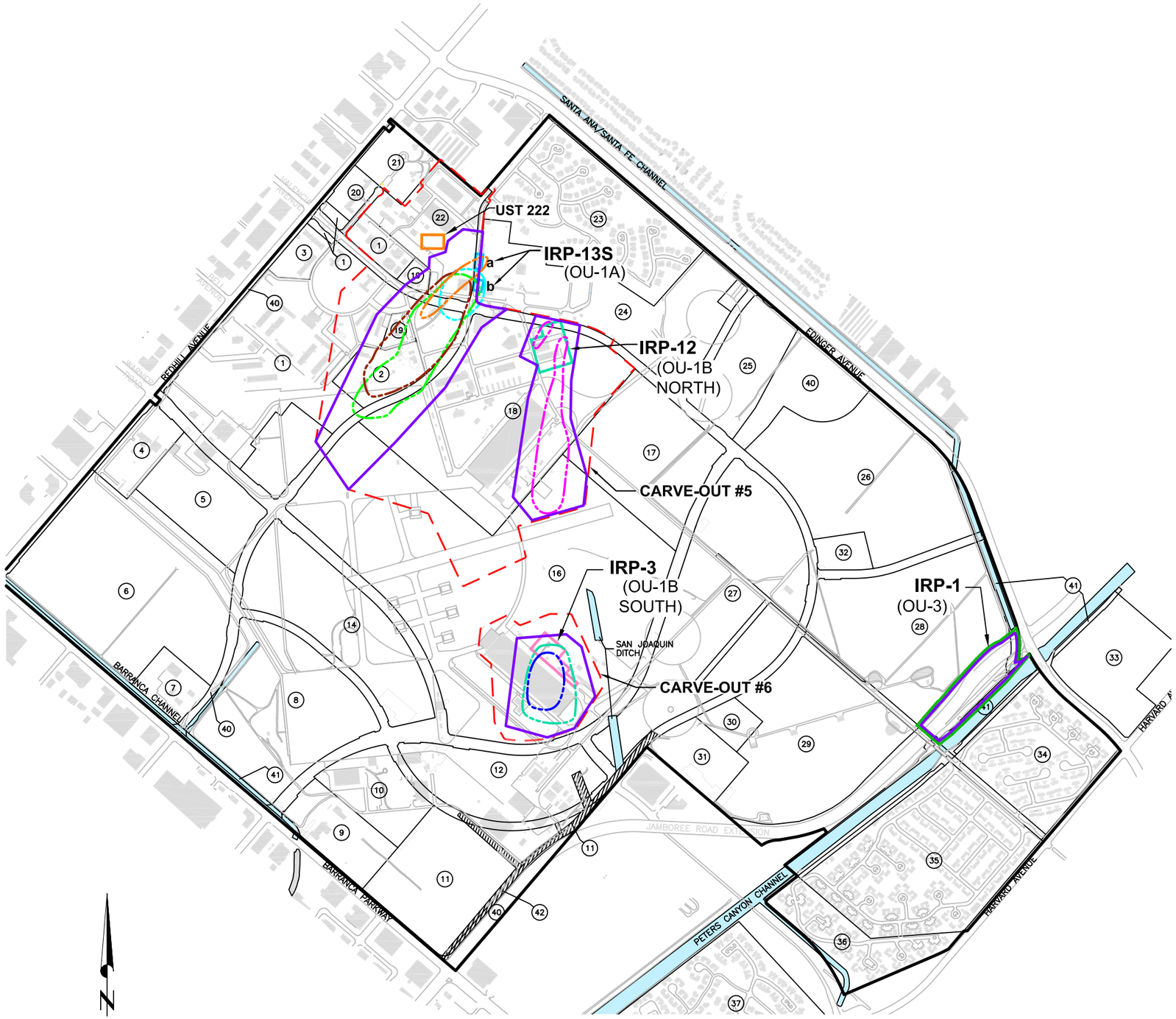
_____. 2009c. U.S. EPA concurrence with OPS for OU-1A/-1B; letter to DoN dated December 31.

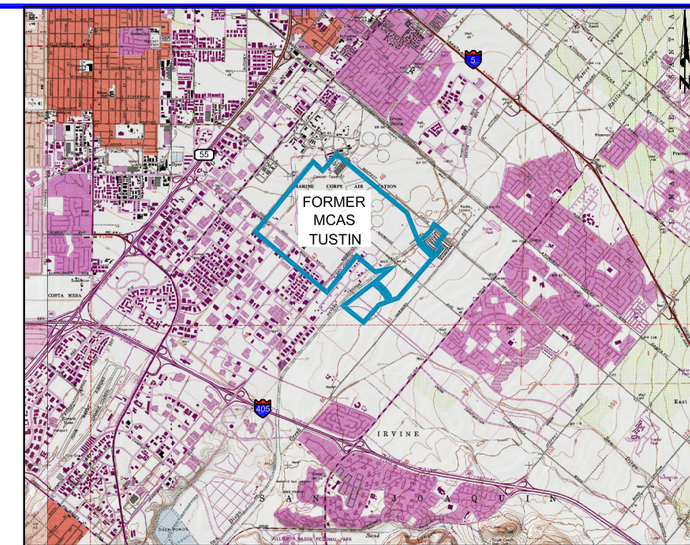
_____. 2011a. Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents. Available online at: http://www.epa.gov/superfund/policy/remedy/rods/index.htm

_____. 2011b. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW 846). Available online at: http://www.epa.gov/osw/hazard/testmethods/sw846/index.htm

_____. 2011c. Regional Screening Levels (Formerly PRGs). Available online at: http://www.epa.gov/region9/superfund/prg/

FIGURES





VICINITY MAP

0 .5 1 Mile

LEGEND:

- FORMER MCAS TUSTIN BOUNDARY
- ROAD OR PAVED AREA
- RAILROAD
- SURFACE CHANNEL
- BOX CULVERT CHANNEL
- BUILDING OR STRUCTURE
- (2) PARCEL NUMBER
- PARCEL BOUNDARY
- CARVE-OUT AREA
- CERCLA ARIC
- ARIC — AREA REQUIRING INSTITUTIONAL CONTROL
- a — TEMPORARY STORAGE AREA ST-72
- b — MISCELLANEOUS WASH AREA MWA-18
- CERCLA — COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT
- IRP — INSTALLATION RESTORATION PROGRAM
- OU — OPERABLE UNIT
- TCE — TRICHLOROETHENE
- TCP — TRICHLOROPROPANE
- PLUME OUTLINE_TCE_FIRST WBZ_OU-1A_4Q_2010
- PLUME OUTLINE_TCE_FIRST WBZ_OU-1B SOUTH_4Q_2010
- PLUME OUTLINE_TCE_FIRST WBZ_OU-1B_4Q_2010
- PLUME OUTLINE_TCE_SECOND WBZ_OU-1A_4Q_2010
- PLUME OUTLINE_TCE_SECOND WBZ_OU-1B SOUTH_4Q_2010
- PLUME OUTLINE_TCP_FIRST WBZ_OU-1A_4Q_2010
- PLUME OUTLINE_TCP_SECOND WBZ_OU-1A_4Q_2010

ENVIRONMENTAL RESTORATION LEGEND

IRP SITE	OPERABLE UNIT DESIGNATION	IRP SITE DESIGNATION
	OU-1A	IRP-13S
	OU-1B North	IRP-12
	OU-1B South	IRP-3
	UST 222	NONE
	OU-3	IRP-1

FIGURE 1

Base Realignment and Closure
Program Management Office West

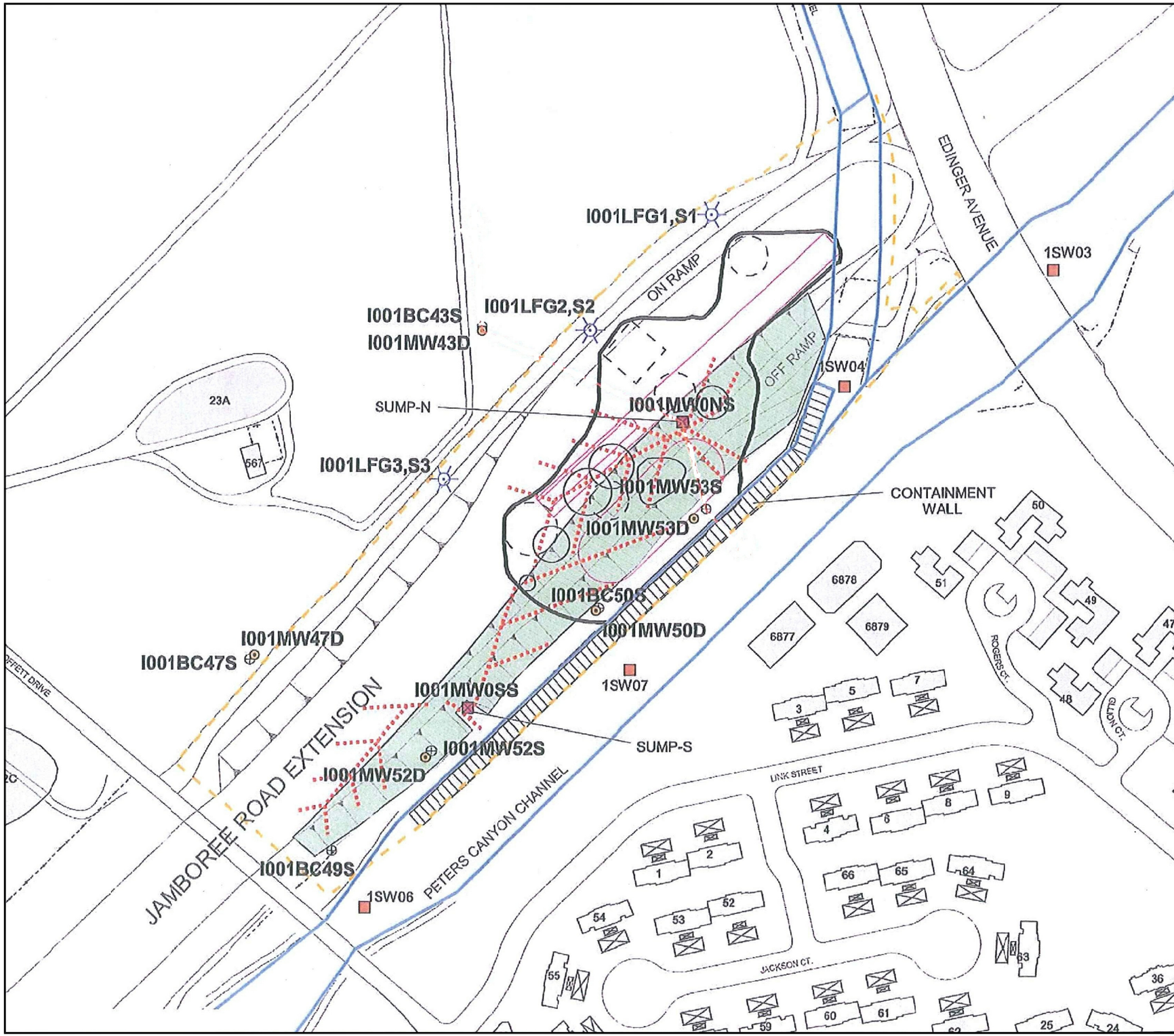
TUSTIN, CALIFORNIA

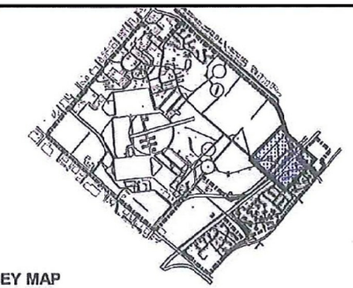
FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

FORMER MCAS TUSTIN LOCATION MAP

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296





KEY MAP
-NOT TO SCALE-

LEGEND

- LANDFILL GAS MONITORING PROBE LOCATION
- FIRST WATER-BEARING ZONE (WBZ) MONITORING WELL LOCATION
- SECOND WBZ MONITORING WELL LOCATION
- SURFACE WATER MONITORING LOCATION
- SUMP
- APPROXIMATE OU-3 SITE BOUNDARY
- EXISTING ROAD OR PAVED AREA
- DRAINAGE DITCH
- BUILDING OR STRUCTURE
- AREA COVERED WITH PLASTIC LINER
- FRENCH DRAIN (CURRENT)
- TRENCH (LANDFILL)
- AREA ASSOCIATED WITH HISTORIC DISPOSAL TRENCHES OR CRASH CREW BURN PITS
- PIT
- POSSIBLE PIT
- CONTAINMENT WALL

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

SOURCE: OPERATION AND MAINTENANCE PLAN (BEI 2003)

FIGURE 2

Base Realignment and Closure
Program Management Office West

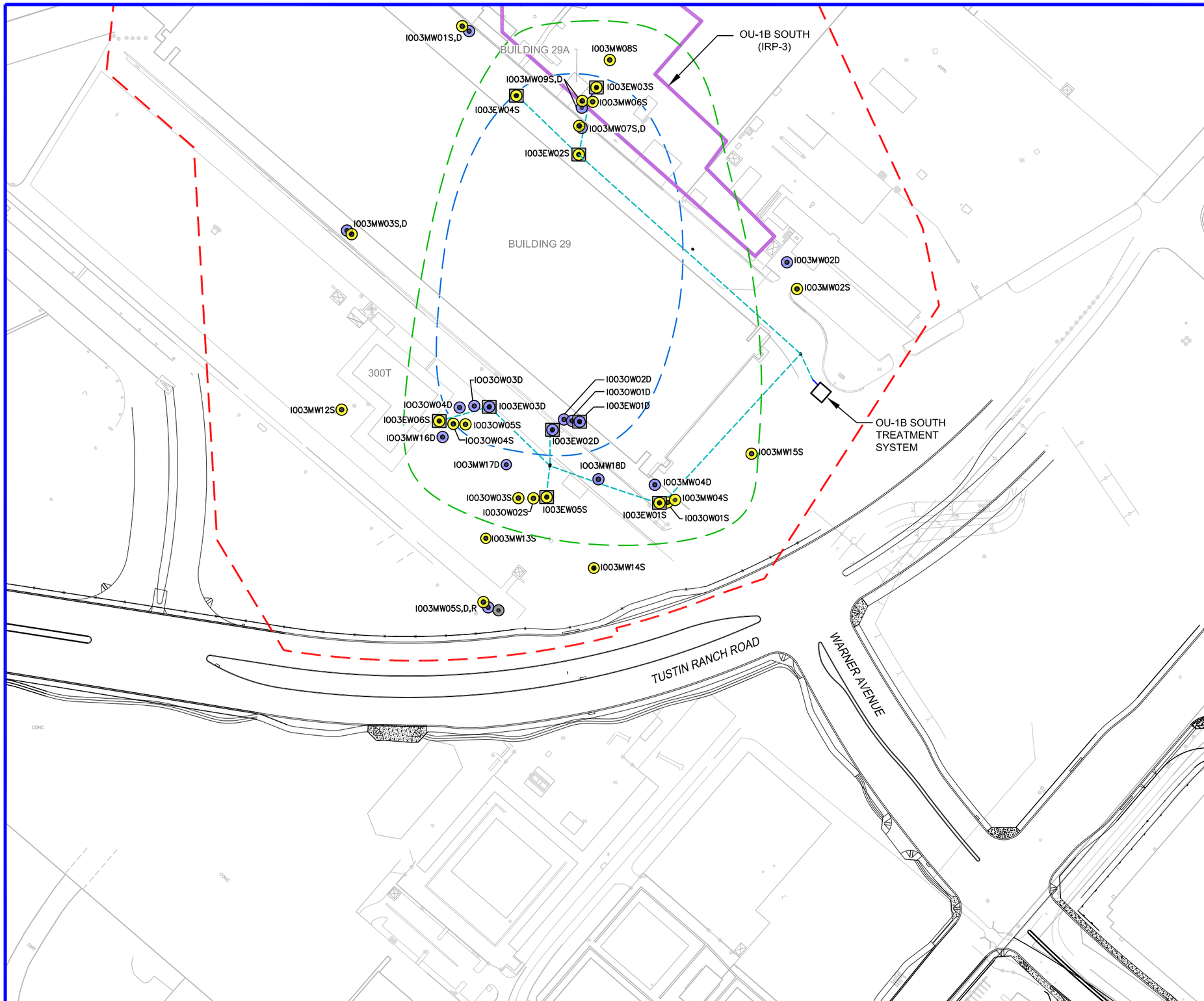
FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
SITE PLAN

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 2_IRP Site 1 (OU-3) Site Plan.dwg



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Monitoring Well (Second WBZ)
- Groundwater Monitoring Well (Third WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Carve-Out #6 Boundary
- Conveyance Piping (OU-1B South)
- Plume outline TCE First WBZ 4Q 2010
- Plume outline TCE Second WBZ 4Q 2010

WELL ID SUFFIX

S = First WBZ
D = Second WBZ
R = Third WBZ

ABBREVIATIONS

4Q = 4th Quarter
OU = Operable Unit
TCE = Trichloroethene
WBZ = Water Bearing Zone

N

0 80 160

APPROXIMATE SCALE IN FEET

FIGURE 3

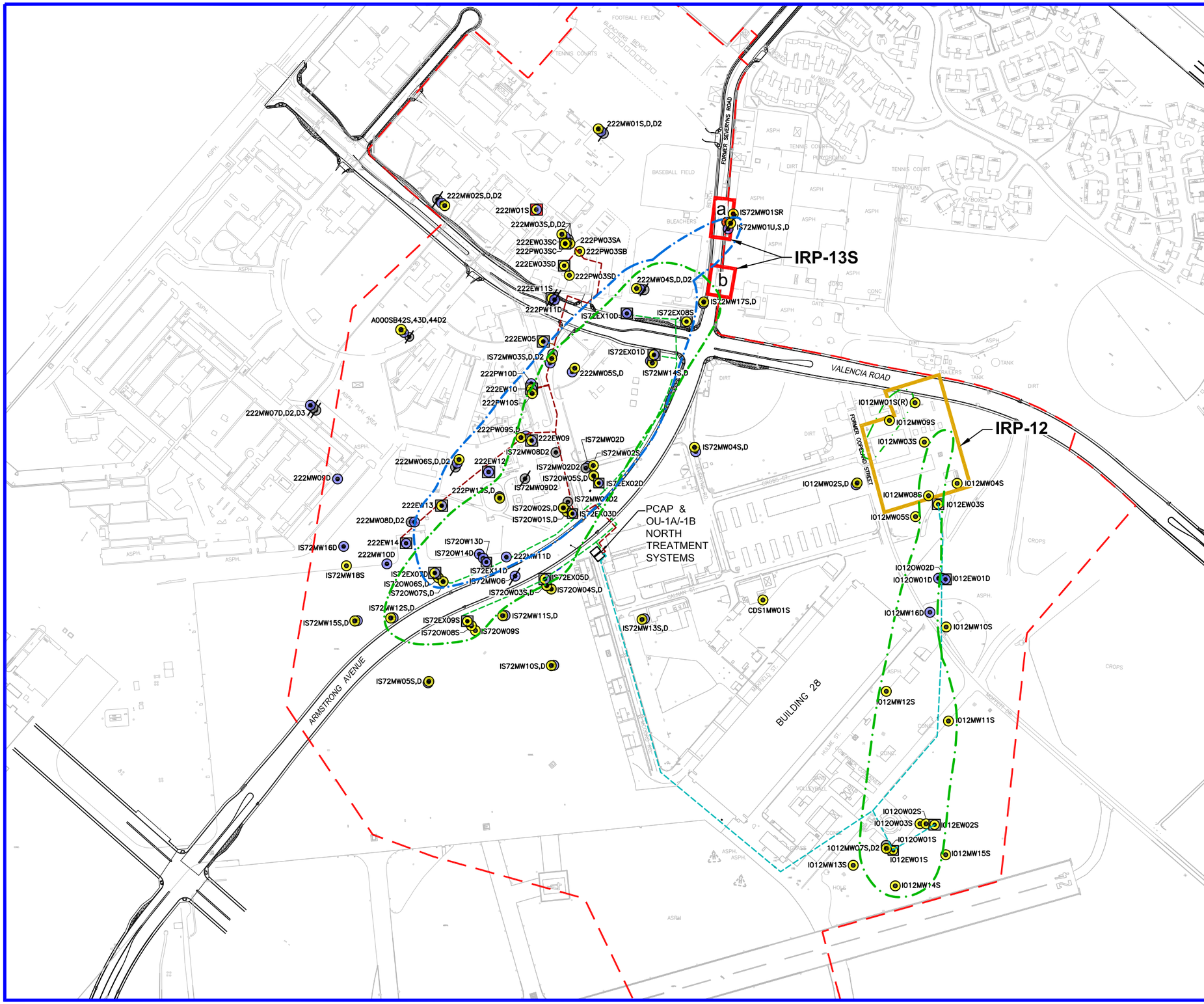
Base Realignment and Closure
Program Management Office West

FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) SITE PLAN

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND:

- Groundwater Monitoring Well (Upper Clay)
- Groundwater Monitoring Well (First WBZ)
- Groundwater Monitoring Well (Second WBZ)
- Groundwater Monitoring Well (Third WBZ)
- Infiltration Well (First & Second WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- Slash Through Well Symbol Indicates Properly Destroyed Well
- VOC Plume First WBZ 4Q 2010
- VOC Plume Second WBZ 4Q 2010
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary

WELL ID SUFFIX

U = Upper Clay
S, SA, SB, SC, SD, SR = First WBZ
D = Second WBZ
D2 = Third WBZ

ABBREVIATIONS

a = Temporary Storage Area ST-72
b = Miscellaneous Wash Area MWA-18
OU = Operable Unit
PCAP = Petroleum Corrective Action Program
WBZ = Water Bearing Zone

NOTE:

1. VOC Plume boundaries include 1,2,3-Trichloropropane and Trichloroethene

FIGURE 4

Base Realignment and Closure Program Management Office West

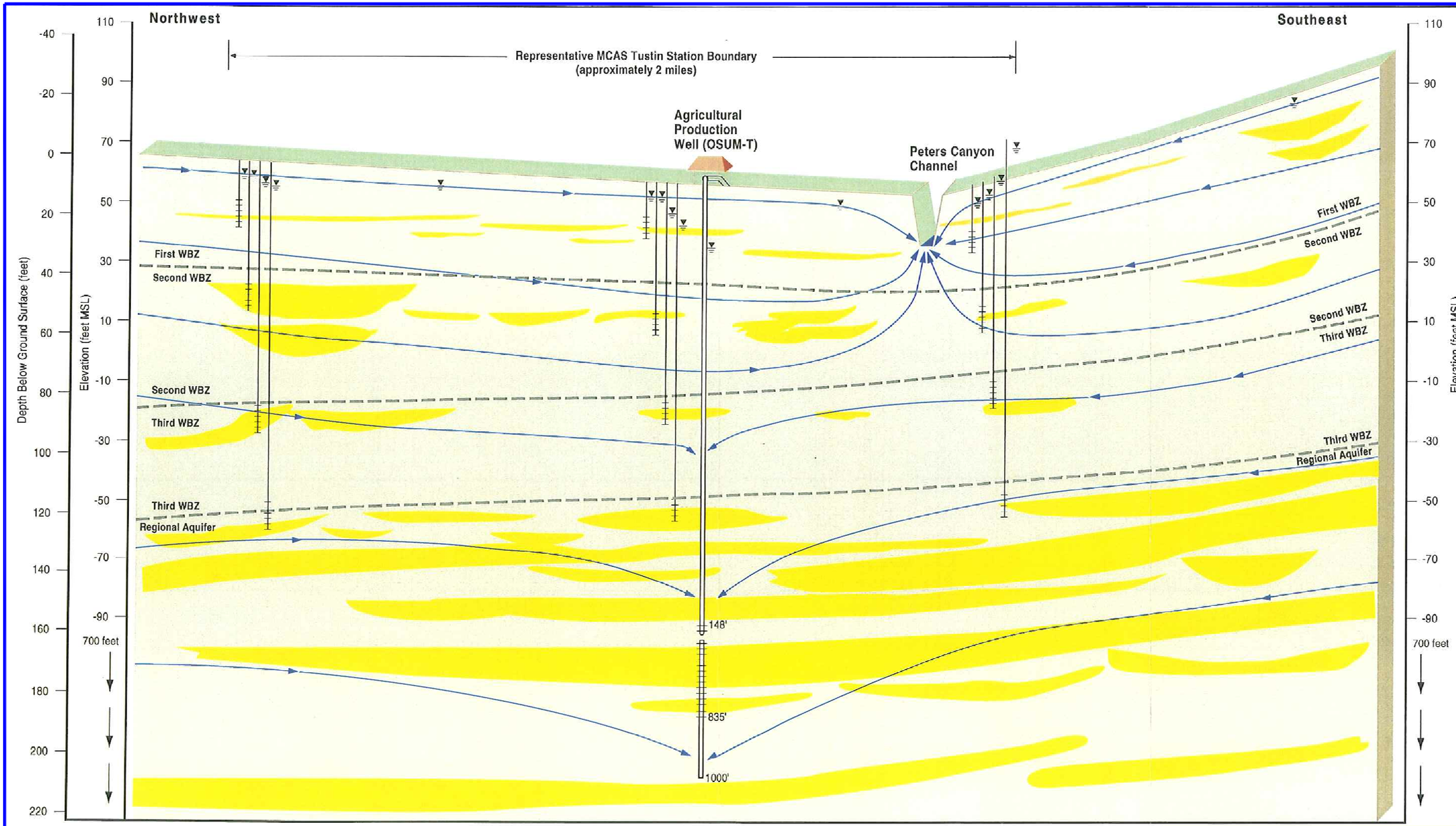
FORMER MARINE CORPS AIR STATION

TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW IRP-1, -3, -12, AND -13S

IRP-13S AND -12 (OU-1A/-1B NORTH) SITE PLAN

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



Legend

- Clayey Silt and Clay
- Silty Sand and Sand
- Water Level
- Groundwater Flow Direction
- Monitoring Well
- Production Well

Acronyms/Abbreviations:

MSL mean sea level
WBZ water-bearing zone

SOURCE: Department of Navy (DON 2004b)

FIGURE 5

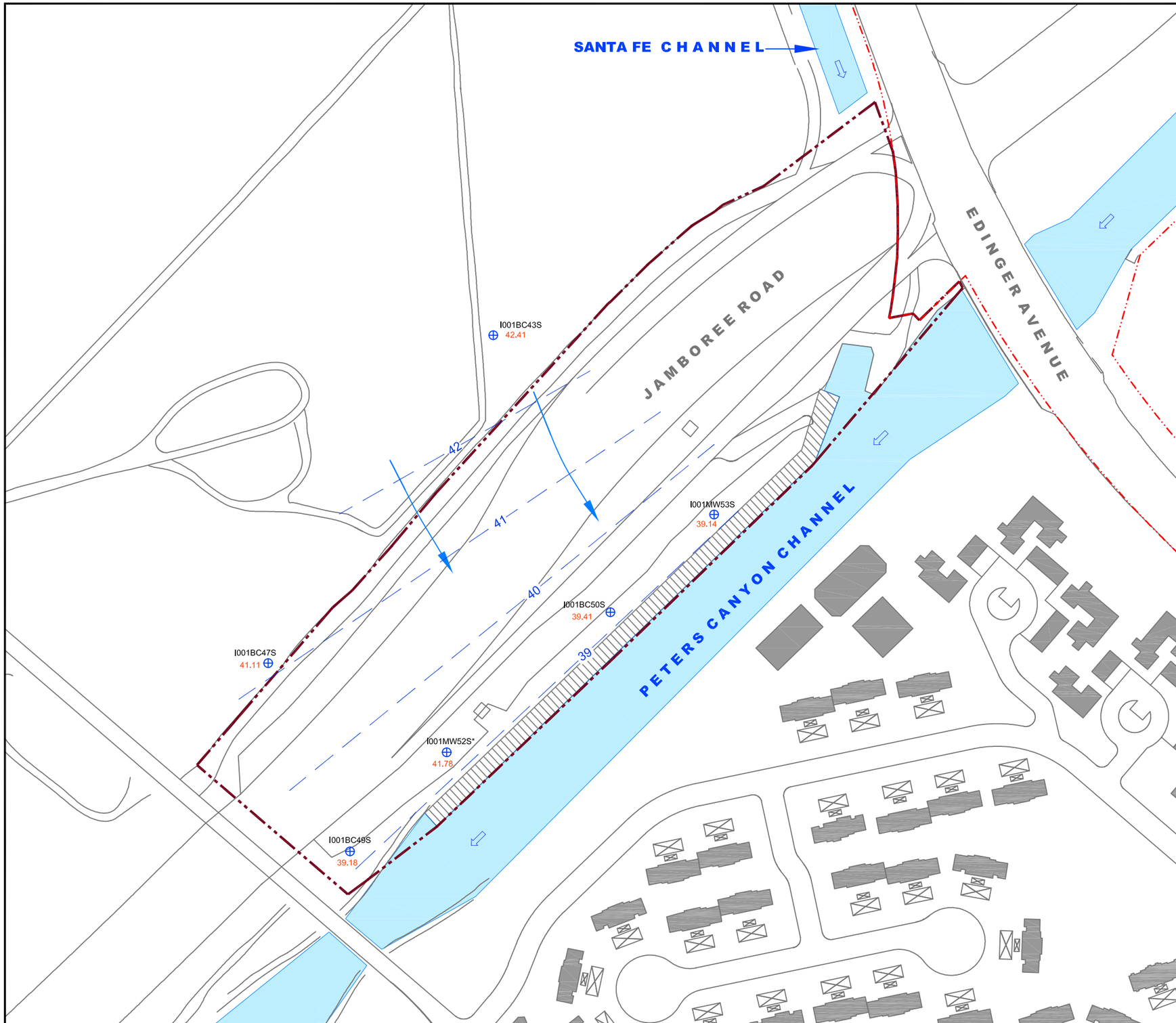
Base Realignment and Closure Program Management Office West

FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

GENERALIZED GEOLOGIC CROSS SECTION

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND

- WELLS INSTALLED IN THE 1st WATER-BEARING ZONE
- 42 — GROUNDWATER EQUIPOTENTIAL LINE IN FEET ABOVE MEAN SEA LEVEL (FT MSL); DASHED WHERE APPROXIMATE
- GENERALIZED GROUNDWATER FLOW DIRECTION (DIRECTION OF GROUNDWATER FLOW IS PERPENDICULAR TO WATER LEVEL CONTOURS)
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN
- I001MW53S — MONITORING WELL IDENTIFIER
- 39.14 — WATER LEVEL ELEVATION (Feet Mean Sea Level)
- * — THE WATER LEVEL ELEVATION AT I001MW52S REPRESENTS A LOCALIZED ANOMALY AND WAS NOT USED FOR CONTOURING

NOTE:

ALL WATER ELEVATION MEASUREMENTS WERE TAKEN ON MAY 26, 2010.

WELL ID SUFFIX:

S = First WBZ
D = Second WBZ

ABRREVIATIONS:

WBZ = Water Bearing Zone

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 6

Base Realignment and Closure
Program Management Office West

TUSTIN, CALIFORNIA

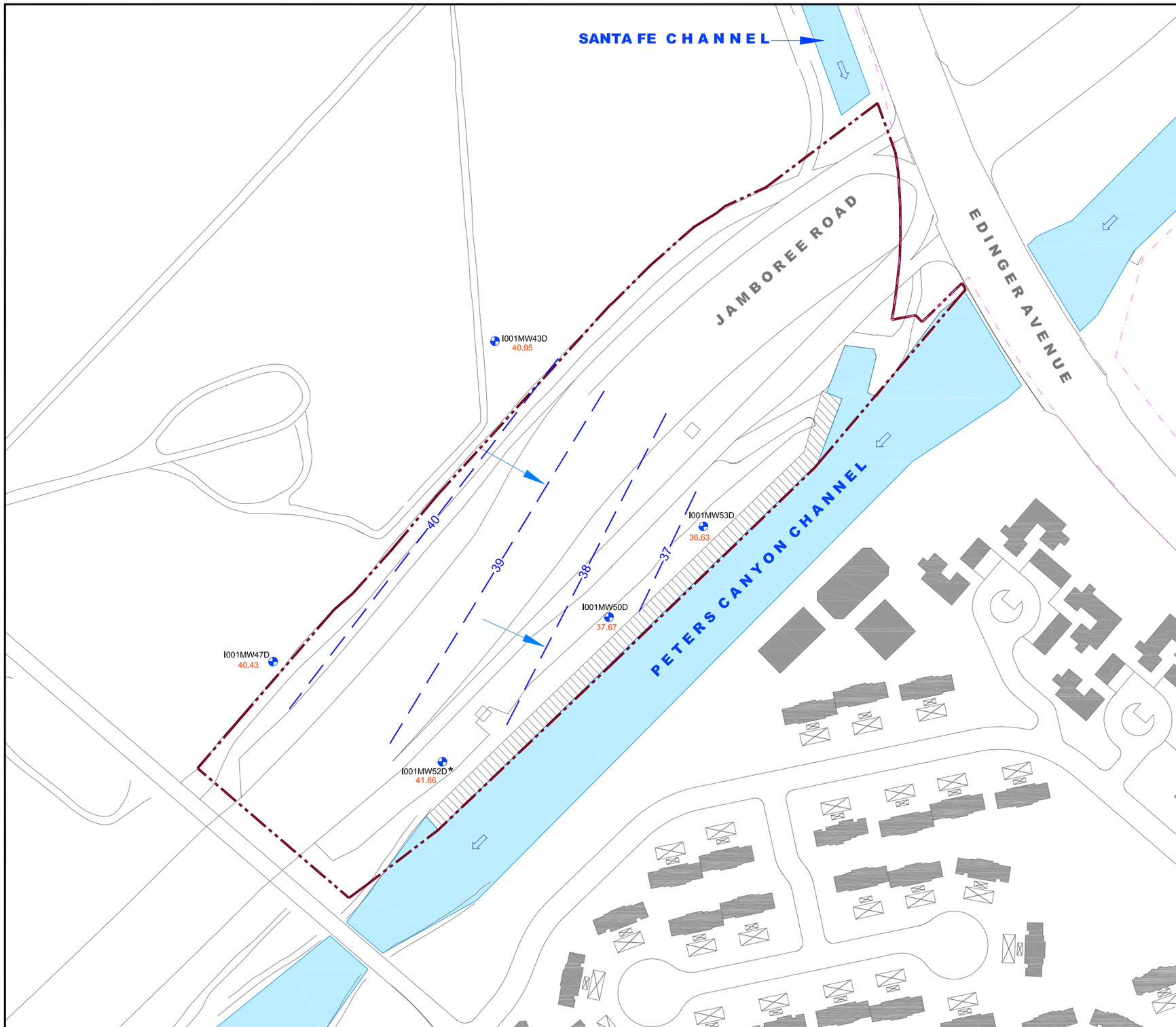
FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
FIRST WBZ GROUNDWATER LEVEL ELEVATIONS
SECOND QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 6_IRP SITE 1 (OU-3)_1WBZ_GWLE 4Q_10.dwg



LEGEND

- WELLS INSTALLED IN THE 2nd WATER-BEARING ZONE
- 41 — GROUNDWATER EQUIPOTENTIAL LINE IN FEET ABOVE MEAN SEA LEVEL (FT MSL); DASHED WHERE APPROXIMATE
- GENERALIZED GROUNDWATER FLOW DIRECTION (DIRECTION OF GROUNDWATER FLOW IS PERPENDICULAR TO WATER LEVEL CONTOURS)
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN
- I001MW53D — MONITORING WELL IDENTIFIER
- 36.63 — WATER LEVEL ELEVATION (Feet Mean Sea Level)
- * — THE WATER LEVEL ELEVATION AT I001MW52D REPRESENTS A LOCALIZED ANOMALY AND WAS NOT USED FOR CONTOURING

NOTE:

ALL WATER ELEVATION MEASUREMENTS WERE TAKEN ON MAY 26, 2010.

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 7

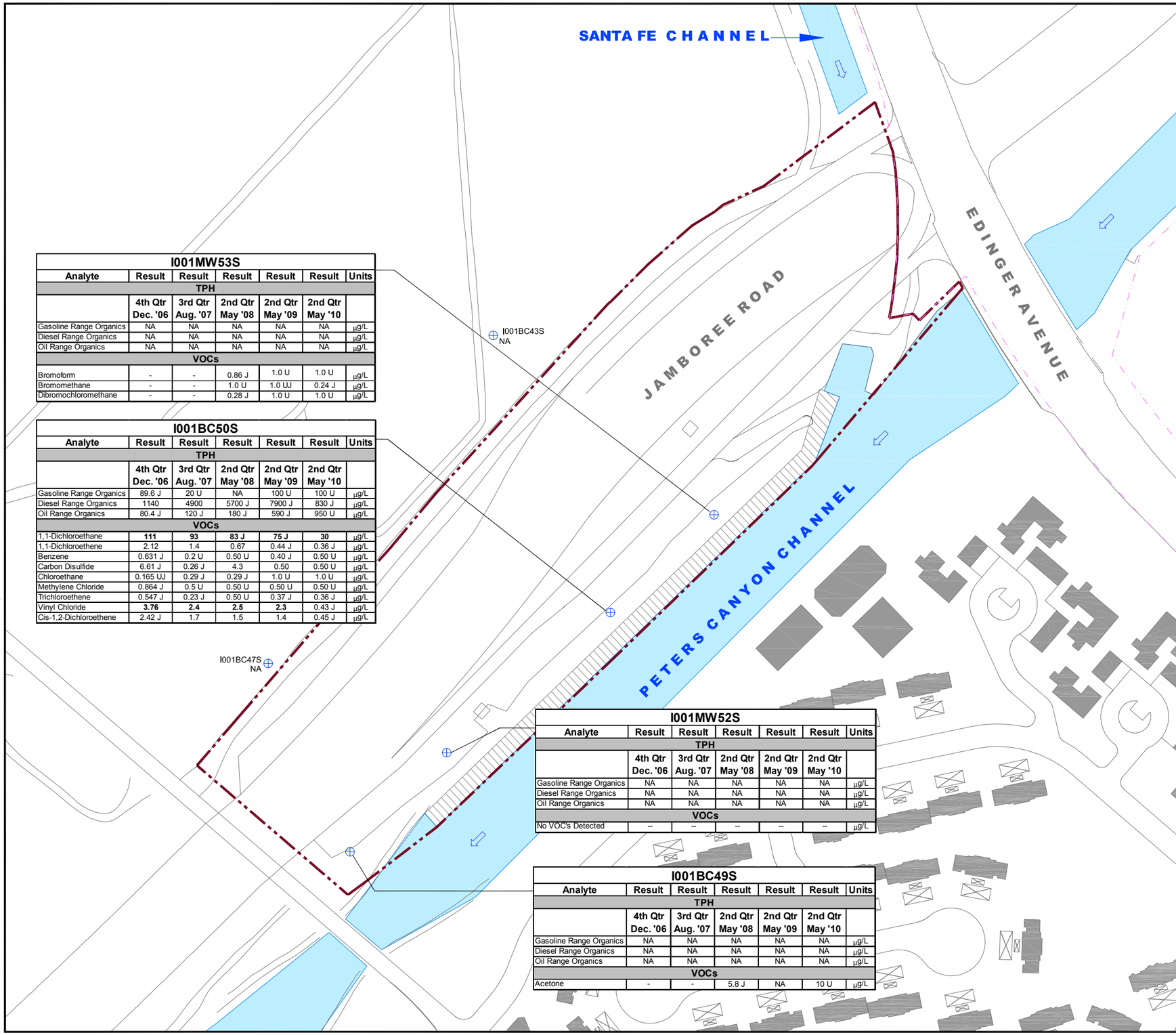
Base Realignment and Closure
Program Management Office West

FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S
IRP-1 (OU-3)
SECOND WBZ GROUNDWATER LEVEL ELEVATIONS
SECOND QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 7_IRP SITE 1 (OU-3)_2WBZ_GWLE 4Q_10.dwg



I001MW53S						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
Bromoform	-	-	0.86 J	1.0 U	1.0 U	µg/L
Bromomethane	-	-	1.0 U	1.0 UJ	0.24 J	µg/L
Dibromochloromethane	-	-	0.28 J	1.0 U	1.0 U	µg/L

I001BC50S						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	89.6 J	20 U	NA	100 U	100 U	µg/L
Diesel Range Organics	1140	4900	5700 J	7900 J	830 J	µg/L
Oil Range Organics	80.4 J	120 J	180 J	590 J	950 U	µg/L
VOCs						
1,1-Dichloroethane	**111**	**93**	**83 J**	**75 J**	**30**	µg/L
1,1-Dichloroethene	2.12	1.4	0.67	0.44 J	0.36 J	µg/L
Benzene	0.631 J	0.2 U	0.50 U	0.40 J	0.50 U	µg/L
Carbon Disulfide	6.61 J	0.26 J	4.3	0.50	0.50 U	µg/L
Chloroethane	0.165 UJ	0.29 J	0.29 J	1.0 U	1.0 U	µg/L
Methylene Chloride	0.864 J	0.5 U	0.50 U	0.50 U	0.50 U	µg/L
Trichloroethene	0.547 J	0.23 J	0.50 U	0.37 J	0.36 J	µg/L
Vinyl Chloride	**3.76**	**2.4**	**2.5**	**2.3**	0.43 J	µg/L
Cis-1,2-Dichloroethene	2.42 J	1.7	1.5	1.4	0.45 J	µg/L

I001MW52S						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
No VOC's Detected	--	--	--	--	--	µg/L

I001BC49S						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
Acetone	-	-	5.8 J	NA	10 U	µg/L

LEGEND

- WELLS INSTALLED IN THE 1st WATER-BEARING ZONE
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN

BOLD	RESULT ≥ REMEDIATION GOAL
J	ESTIMATED RESULT
NA	NOT ANALYZED
TPH	TOTAL PETROLEUM HYDROCARBONS
U	NOT REPORTED
VOCs	VOLATILE ORGANIC COMPOUNDS
µg/L	MICROGRAMS PER LITER
—	CONCENTRATIONS NOT REPORTED ABOVE THE REPORTING LIMIT

Monitoring Well Identifier

I001MW52S						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
No VOC's Detected	--	--	--	--	--	µg/L

Concentration data qualifier codes

Element

NOTES:

1. Prior year data shown for comparision.

WELL ID SUFFIX:

S = First WBZ
D = Second WBZ

ABRREVIATIONS:

WBZ = Water Bearing Zone

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 8

Base Realignment and Closure
Program Management Office West

TUSTIN, CALIFORNIA

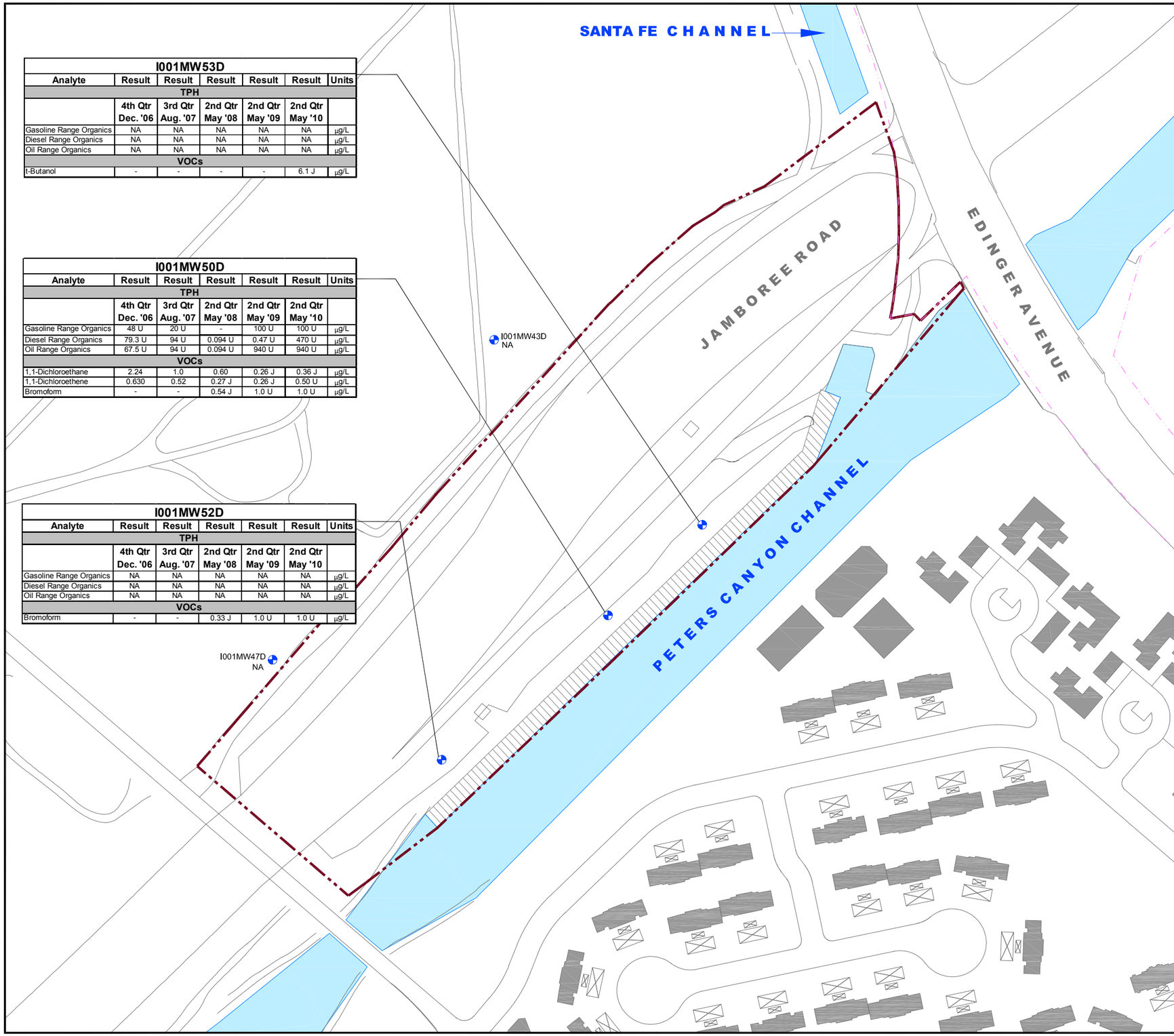
FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
TPH AND VOC CONCENTRATIONS - 2006-2010
FIRST WBZ

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 8_IRP SITE 1 (OU-3)_TPH & VOC CONC_06-10_1WBZ.dwg



I001MW53D						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
t-Butanol	-	-	-	-	6.1 J	µg/L

I001MW50D						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	48 U	20 U	-	100 U	100 U	µg/L
Diesel Range Organics	79.3 U	94 U	0.094 U	0.47 U	470 U	µg/L
Oil Range Organics	67.5 U	94 U	0.094 U	940 U	940 U	µg/L
VOCs						
1,1-Dichloroethane	2.24	1.0	0.60	0.26 J	0.36 J	µg/L
1,1-Dichloroethene	0.630	0.52	0.27 J	0.26 J	0.50 U	µg/L
Bromoform	-	-	0.54 J	1.0 U	1.0 U	µg/L

I001MW52D						
Analyte	Result	Result	Result	Result	Result	Units
TPH						
	4th Qtr Dec. '06	3rd Qtr Aug. '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Gasoline Range Organics	NA	NA	NA	NA	NA	µg/L
Diesel Range Organics	NA	NA	NA	NA	NA	µg/L
Oil Range Organics	NA	NA	NA	NA	NA	µg/L
VOCs						
Bromoform	-	-	0.33 J	1.0 U	1.0 U	µg/L

LEGEND

- WELLS INSTALLED IN THE 2nd WATER-BEARING ZONE
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN

BOLD	RESULT ≥ REMEDIATION GOAL
J	ESTIMATED RESULT
NA	NOT ANALYZED
TPH	TOTAL PETROLEUM HYDROCARBONS
U	NOT REPORTED
VOCs	VOLATILE ORGANIC COMPOUNDS
µg/L	MICROGRAMS PER LITER
—	CONCENTRATIONS NOT REPORTED ABOVE THE REPORTING LIMIT

Monitoring Well Identifier

Concentration and data qualifier codes

NOTES:

1. Prior year data shown for comparison.

WELL ID SUFFIX:

S = First WBZ
D = Second WBZ

ABRREVIATIONS:

WBZ = Water Bearing Zone

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 9

Base Realignment and Closure
Program Management Office West

TUSTIN, CALIFORNIA

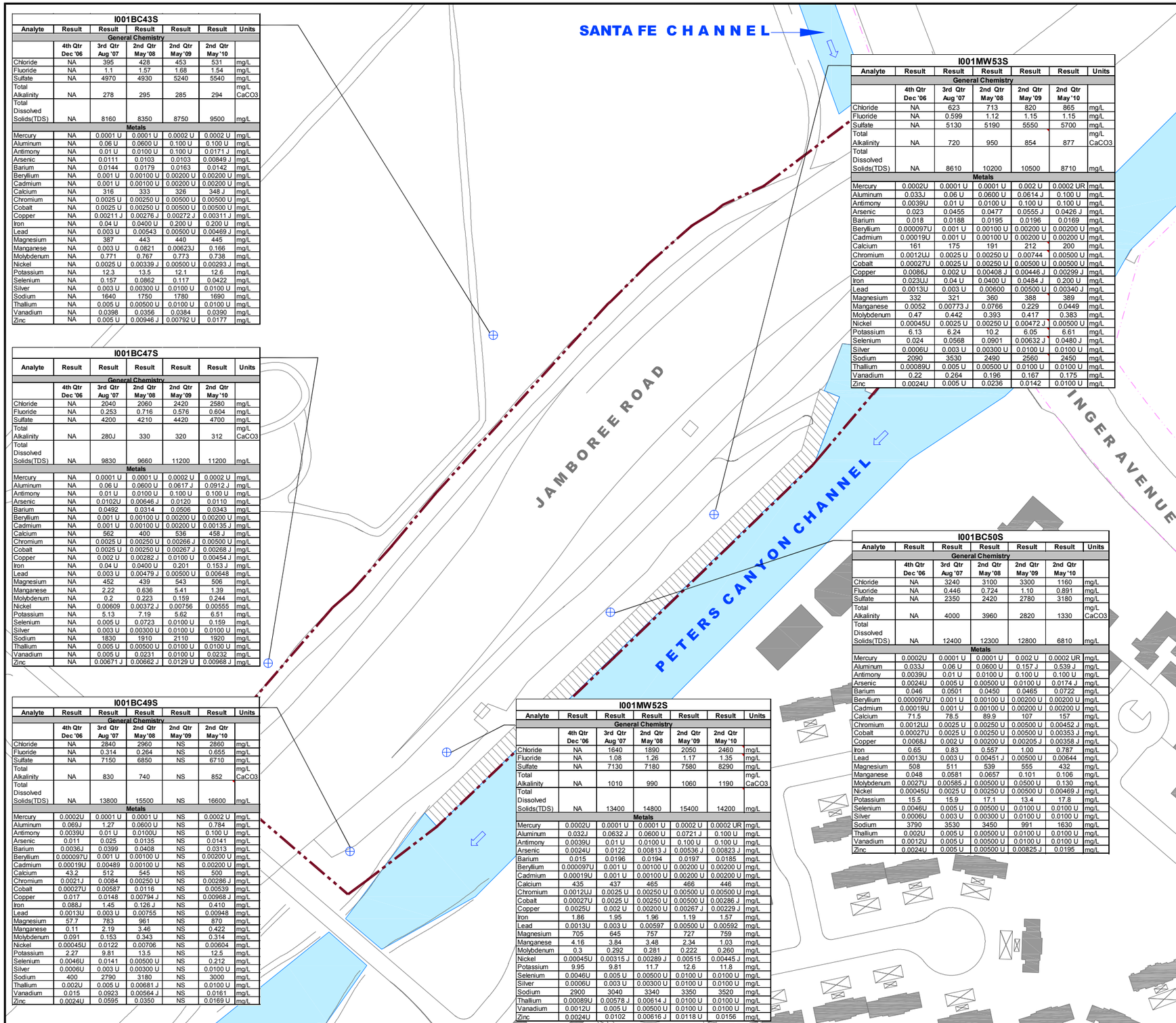
FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
TPH AND VOC CONCENTRATIONS - 2006-2010
SECOND WBZ

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 9_IRP SITE 1 (OU-3)_TPH & VOC CONC_06-10_2WBZ.dwg



I001BC43S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	395	428	453	531	mg/L
Fluoride	NA	1.1	1.57	1.68	1.54	mg/L
Sulfate	NA	4970	4930	5240	5540	mg/L
Total Alkalinity	NA	278	295	285	294	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	8160	8350	8750	9500	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.100 U	0.100 U	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.0171 J	mg/L
Arsenic	NA	0.0111	0.0103	0.0103	0.00849 J	mg/L
Barium	NA	0.0144	0.0179	0.0163	0.0142	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	316	333	326	348 J	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.00211 J	0.00276 J	0.00272 J	0.00311 J	mg/L
Iron	NA	0.04 U	0.0400 U	0.200 U	0.200 U	mg/L
Lead	NA	0.003 U	0.00543	0.00500 U	0.00469 J	mg/L
Magnesium	NA	387	443	440	445	mg/L
Manganese	NA	0.003 U	0.0821	0.00623J	0.166	mg/L
Molybdenum	NA	0.771	0.767	0.773	0.738	mg/L
Nickel	NA	0.0025 U	0.00339 J	0.00500 U	0.00293 J	mg/L
Potassium	NA	12.3	13.5	12.1	12.6	mg/L
Selenium	NA	0.157	0.0862	0.117	0.0422	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	1640	1750	1780	1690	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.0398	0.0356	0.0384	0.0390	mg/L
Zinc	NA	0.005 U	0.00946 J	0.00792 U	0.0177	mg/L

I001BC47S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	2040	2060	2420	2580	mg/L
Fluoride	NA	0.253	0.716	0.576	0.604	mg/L
Sulfate	NA	4200	4210	4420	4700	mg/L
Total Alkalinity	NA	280J	330	320	312	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	9830	9660	11200	11200	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.0617 J	0.0912 J	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.0102U	0.00646 J	0.0120	0.0110	mg/L
Barium	NA	0.0492	0.0314	0.0506	0.0343	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.001 U	0.00100 U	0.00200 U	0.00135 J	mg/L
Calcium	NA	562	400	536	458 J	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00266 J	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00267 J	0.00268 J	mg/L
Copper	NA	0.002 U	0.00282 J	0.0100 U	0.00454 J	mg/L
Iron	NA	0.04 U	0.0400 U	0.201	0.153 J	mg/L
Lead	NA	0.003 U	0.00479 J	0.00500 U	0.00648	mg/L
Magnesium	NA	452	439	543	506	mg/L
Manganese	NA	2.22	0.636	5.41	1.39	mg/L
Molybdenum	NA	0.2	0.223	0.159	0.244	mg/L
Nickel	NA	0.00609	0.00372 J	0.00756	0.00555	mg/L
Potassium	NA	5.13	7.19	5.62	6.51	mg/L
Selenium	NA	0.005 U	0.0723	0.0100 U	0.159	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	1830	1910	2110	1920	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.0231	0.0100 U	0.0232	mg/L
Zinc	NA	0.00671 J	0.00662 J	0.0129 U	0.00968 J	mg/L

I001BC49S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	2840	2960	NS	2860	mg/L
Fluoride	NA	0.314	0.264	NS	0.655	mg/L
Sulfate	NA	7150	6850	NS	6710	mg/L
Total Alkalinity	NA	830	740	NS	852	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	13800	15500	NS	16600	mg/L
Metals						
Mercury	0.0002U	0.0001 U	0.0001 U	NS	0.0002 U	mg/L
Aluminum	0.069J	1.27	0.0600 U	NS	0.784	mg/L
Antimony	0.0039U	0.01 U	0.0100U	NS	0.100 U	mg/L
Arsenic	0.011	0.025	0.0135	NS	0.0141	mg/L
Barium	0.0036J	0.0399	0.0408	NS	0.0313	mg/L
Beryllium	0.000097U	0.001 U	0.00100 U	NS	0.00200 U	mg/L
Cadmium	0.00019U	0.00489	0.00100 U	NS	0.00200 U	mg/L
Calcium	43.2	512	545	NS	500	mg/L
Chromium	0.0021J	0.0084	0.00250 U	NS	0.00286 J	mg/L
Cobalt	0.00027U	0.00587	0.0116	NS	0.00539	mg/L
Copper	0.017	0.0148	0.00794 J	NS	0.00968 J	mg/L
Iron	0.088J	1.45	0.126 J	NS	0.410	mg/L
Lead	0.0013U	0.003 U	0.00755	NS	0.00948	mg/L
Magnesium	57.7	783	961	NS	870	mg/L
Manganese	0.11	2.19	3.46	NS	0.422	mg/L
Molybdenum	0.091	0.153	0.343	NS	0.314	mg/L
Nickel	0.00045U	0.0122	0.00706	NS	0.00604	mg/L
Potassium	2.27	9.81	13.5	NS	12.5	mg/L
Selenium	0.0046U	0.0141	0.00500 U	NS	0.212	mg/L
Silver	0.0006U	0.003 U	0.00300 U	NS	0.0100 U	mg/L
Sodium	400	2790	3180	NS	3000	mg/L
Thallium	0.002U	0.005 U	0.00681 J	NS	0.0100 U	mg/L
Vanadium	0.015	0.0923	0.00564 J	NS	0.0161	mg/L
Zinc	0.0024U	0.0595	0.0350	NS	0.0169 U	mg/L

I001MW52S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	1640	1890	2050	2460	mg/L
Fluoride	NA	1.08	1.26	1.17	1.35	mg/L
Sulfate	NA	7130	7180	7580	8290	mg/L
Total Alkalinity	NA	1010	990	1060	1190	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	13400	14800	15400	14200	mg/L
Metals						
Mercury	0.0002U	0.0001 U	0.0001 U	0.0002 U	0.0002 UR	mg/L
Aluminum	0.032J	0.0632 J	0.0600 U	0.0721 J	0.100 U	mg/L
Antimony	0.0039U	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	0.0024U	0.0122	0.00813 J	0.00536 J	0.00823 J	mg/L
Barium	0.015	0.0196	0.0194	0.0197	0.0185	mg/L
Beryllium	0.000097U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	0.00019U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	435	437	465	466	446	mg/L
Chromium	0.0012UJ	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	0.00027U	0.0025 U	0.00250 U	0.00500 U	0.00286 J	mg/L
Copper	0.0025U	0.002 U	0.00200 U	0.00267 J	0.00229 J	mg/L
Iron	1.86	1.95	1.96	1.19	1.57	mg/L
Lead	0.0013U	0.003 U	0.00597	0.00500 U	0.00592	mg/L
Magnesium	705	645	757	727	759	mg/L
Manganese	4.16	3.84	3.48	2.34	1.03	mg/L
Molybdenum	0.3	0.292	0.281	0.222	0.260	mg/L
Nickel	0.00045U	0.00315 J	0.00289 J	0.00515	0.00445 J	mg/L
Potassium	9.95	9.81	11.7	12.6	11.8	mg/L
Selenium	0.0046U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Silver	0.0006U	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	2900	3040	3340	3350	3520	mg/L
Thallium	0.00089U	0.00578 J	0.00614 J	0.0100 U	0.0100 U	mg/L
Vanadium	0.0012U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	0.0024U	0.0102	0.00616 J	0.0118 U	0.0156	mg/L

I001MW53S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	623	713	820	865	mg/L
Fluoride	NA	0.599	1.12	1.15	1.15	mg/L
Sulfate	NA	5130	5190	5550	5700	mg/L
Total Alkalinity	NA	720	950	854	877	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	8610	10200	10500	8710	mg/L
Metals						
Mercury	0.0002U	0.0001 U	0.0001 U	0.002 U	0.0002 UR	mg/L
Aluminum	0.033J	0.06 U	0.0600 U	0.0614 J	0.100 U	mg/L
Antimony	0.0039U	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	0.023	0.0455	0.0477	0.0555 J	0.0426 J	mg/L
Barium	0.018	0.0188	0.0195	0.0196	0.0169	mg/L
Beryllium	0.000097U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	0.00019U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	161	175	191	212	200	mg/L
Chromium	0.0012UJ	0.0025 U	0.00250 U	0.00744	0.00500 U	mg/L
Cobalt	0.00027U	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	0.0086J	0.002 U	0.00408 J	0.00446 J	0.00299 J	mg/L
Iron	0.023UJ	0.04 U	0.0400 U	0.0484 J	0.200 U	mg/L
Lead	0.0013U	0.003 U	0.00600	0.00500 U	0.00340 J	mg/L
Magnesium	332	321	360	388	389	mg/L
Manganese	0.0052	0.00773 J	0.0766	0.229	0.0449	mg/L
Molybdenum	0.47	0.442	0.393	0.417	0.383	mg/L
Nickel	0.00045U	0.0025 U	0.00250 U	0.00472 J	0.00500 U	mg/L
Potassium	6.13	6.24	10.2	6.05	6.61	mg/L
Selenium	0.024	0.0568	0.0901	0.00632 J	0.0480 J	mg/L
Silver	0.0006U	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	2090	3530	2490	2560	2450	mg/L
Thallium	0.00089U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	0.22	0.264	0.196	0.167	0.175	mg/L
Zinc	0.0024U	0.005 U	0.0236	0.0142	0.0100 U	mg/L

I001BC50S

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	3240	3100	3300	1160	mg/L
Fluoride	NA	0.446	0.724	1.10	0.891	mg/L
Sulfate	NA	2350	2420	2780	3180	mg/L
Total Alkalinity	NA	4000	3960	2820	1330	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	12400	12300	12800	6810	mg/L
Metals						
Mercury	0.0002U	0.0001 U	0.0001 U	0.002 U	0.0002 UR	mg/L
Aluminum	0.033J	0.06 U	0.0600 U	0.157 J	0.539 J	mg/L
Antimony	0.0039U	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	0.0024U	0.005 U	0.00500 U	0.0100 U	0.0174 J	mg/L
Barium	0.046	0.0501	0.0450	0.0465	0.0722	mg/L
Beryllium	0.000097U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	0.00019U	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	71.5	78.5	89.9	107	157	mg/L
Chromium	0.0012UJ	0.0025 U	0.00250 U	0.00500 U	0.00452 J	mg/L
Cobalt	0.00027U	0.0025 U	0.00250 U	0.00500 U	0.00353 J	mg/L
Copper	0.0068J	0.002 U	0.00200 U	0.00205 J	0.00358 J	mg/L
Iron	0.65	0.83	0.557	1.00	0.787	mg/L
Lead	0.0013U	0.003 U	0.00451 J	0.00500 U	0.00644	mg/L
Magnesium	508	511	539	555	432	mg/L
Manganese	0.048	0.0581	0.0657	0.101	0.106	mg/L
Molybdenum	0.0027U	0.00585 J	0.00500 U	0.0500 U	0.130	mg/L
Nickel	0.00045U	0.0025 U	0.00250 U	0.00500 U	0.00469 J	mg/L
Potassium	15.5	15.9	17.1	13.4	17.8	mg/L
Selenium	0.0046U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Silver	0.0006U	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	3790	3530	3450	991	1630	mg/L
Thallium	0.002U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	0.0012U	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	0.0024U	0.005 U	0.00500 U	0.00825 J	0.0195	mg/L

LEGEND

- WELLS INSTALLED IN THE 1st WATER-BEARING ZONE
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN
- **BOLD** RESULT ≥ REMEDIATION GOAL
- J ESTIMATED RESULT
- NA NOT ANALYZED
- U NOT REPORTED
- UR QUALITY CONTROL INDICATES THE DATA IS NOT USABLE
- mg/L MILLIGRAMS PER LITER

Monitoring Well Identifier

Concentration data qualifier codes

Element

NOTES:

1. Prior year data shown for comparison.

WELL ID SUFFIX:

S = First WBZ
D = Second WBZ

ABRREVIATIONS:

WBZ = Water Bearing Zone

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 10

Base Realignment and Closure
Program Management Office West

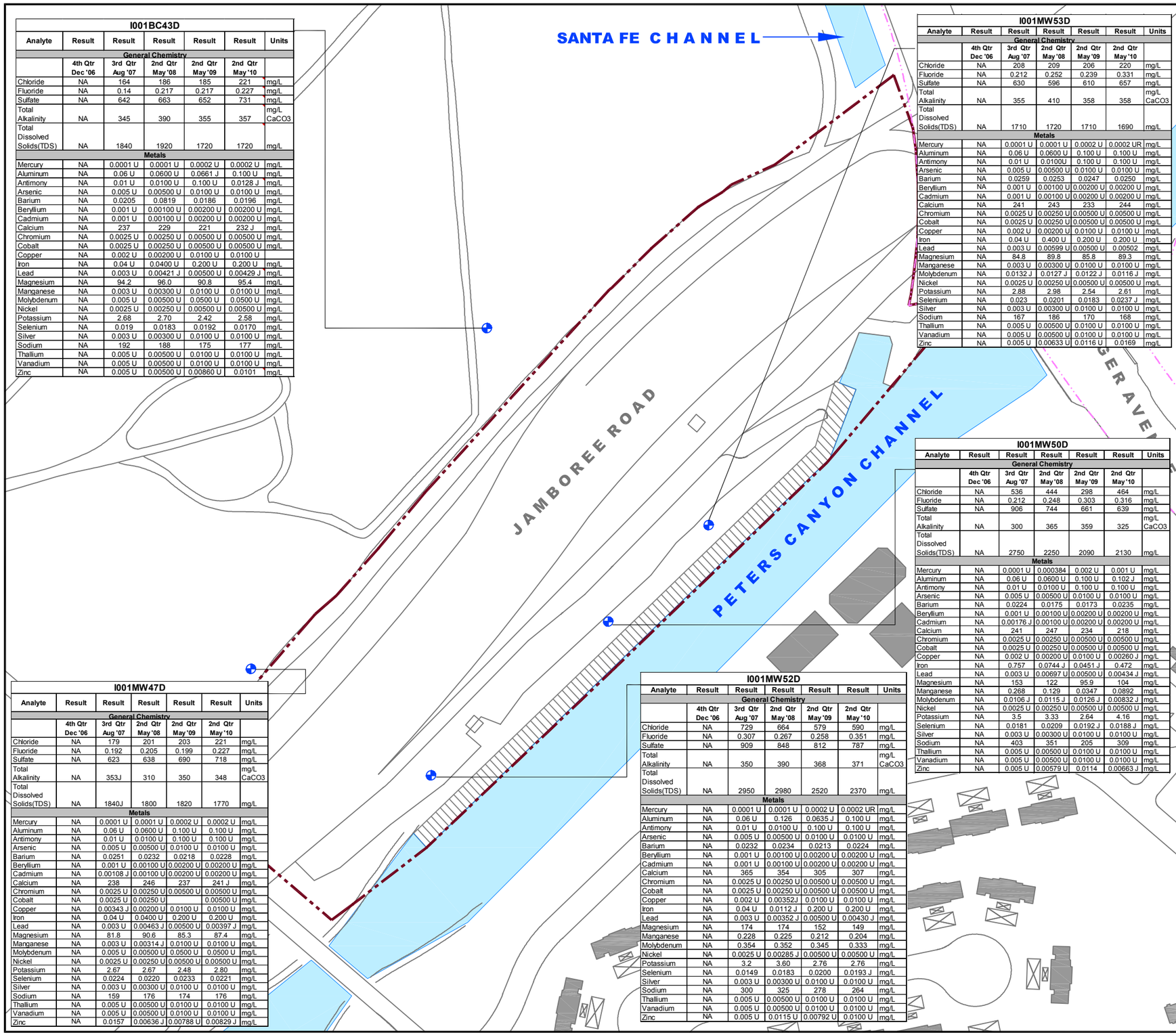
FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
INORGANIC CONCENTRATIONS - 2006-2010
FIRST WBZ

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 10 IRP SITE 1 (OU-3)_INORGANIC CONC- 06-10_1WBZ.dwg



I001BC43D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	164	186	185	221	mg/L
Fluoride	NA	0.14	0.217	0.217	0.227	mg/L
Sulfate	NA	642	663	652	731	mg/L
Total Alkalinity	NA	345	390	355	357	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	1840	1920	1720	1720	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.0661 J	0.100 U	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.0128 J	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0205	0.0819	0.0186	0.0196	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	237	229	221	232 J	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.002 U	0.00200 U	0.0100 U	0.0100 U	
Iron	NA	0.04 U	0.0400 U	0.200 U	0.200 U	mg/L
Lead	NA	0.003 U	0.00421 J	0.00500 U	0.00429 J	mg/L
Magnesium	NA	94.2	96.0	90.8	95.4	mg/L
Manganese	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Molybdenum	NA	0.005 U	0.00500 U	0.0500 U	0.0500 U	mg/L
Nickel	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Potassium	NA	2.68	2.70	2.42	2.58	mg/L
Selenium	NA	0.019	0.0183	0.0192	0.0170	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	192	188	175	177	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.005 U	0.00500 U	0.00860 U	0.0101	mg/L

I001MW53D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	208	209	206	220	mg/L
Fluoride	NA	0.212	0.252	0.239	0.331	mg/L
Sulfate	NA	630	596	610	657	mg/L
Total Alkalinity	NA	355	410	358	358	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	1710	1720	1710	1690	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 UR	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.100 U	0.100 U	mg/L
Antimony	NA	0.01 U	0.0100U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0259	0.0253	0.0247	0.0250	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	241	243	233	244	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.002 U	0.00200 U	0.0100 U	0.0100 U	mg/L
Iron	NA	0.04 U	0.400 U	0.200 U	0.200 U	mg/L
Lead	NA	0.003 U	0.00599 U	0.00500 U	0.00502	mg/L
Magnesium	NA	84.8	89.8	85.8	89.3	mg/L
Manganese	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Molybdenum	NA	0.0132 J	0.0127 J	0.0122 J	0.0116 J	mg/L
Nickel	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Potassium	NA	2.88	2.98	2.54	2.61	mg/L
Selenium	NA	0.023	0.0201	0.0183	0.0237 J	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	167	186	170	168	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.005 U	0.00633 U	0.0116 U	0.0169	mg/L

I001MW50D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	536	444	298	464	mg/L
Fluoride	NA	0.212	0.248	0.303	0.316	mg/L
Sulfate	NA	906	744	661	639	mg/L
Total Alkalinity	NA	300	365	359	325	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	2750	2250	2090	2130	mg/L
Metals						
Mercury	NA	0.0001 U	0.000384	0.002 U	0.001 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.100 U	0.102 J	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0224	0.0175	0.0173	0.0235	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.00176 J	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	241	247	234	218	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.002 U	0.00200 U	0.00200 J	0.00260 J	mg/L
Iron	NA	0.757	0.0744 J	0.0451 J	0.472	mg/L
Lead	NA	0.003 U	0.00697 U	0.00500 U	0.00434 J	mg/L
Magnesium	NA	153	122	95.9	104	mg/L
Manganese	NA	0.268	0.129	0.0347	0.0892	mg/L
Molybdenum	NA	0.0106 J	0.0115 J	0.0126 J	0.00832 J	mg/L
Nickel	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Potassium	NA	3.5	3.33	2.64	4.16	mg/L
Selenium	NA	0.0181	0.0209	0.0192 J	0.0188 J	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	403	351	205	309	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.005 U	0.00579 U	0.0114	0.00663 J	mg/L

I001MW47D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	179	201	203	221	mg/L
Fluoride	NA	0.192	0.205	0.199	0.227	mg/L
Sulfate	NA	623	638	690	718	mg/L
Total Alkalinity	NA	353J	310	350	348	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	1840J	1800	1820	1770	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.100 U	0.100 U	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0251	0.0232	0.0218	0.0228	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.00108 J	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	238	246	237	241 J	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U		0.00500 U	mg/L
Copper	NA	0.00343 J	0.00200 U	0.0100 U	0.0100 U	mg/L
Iron	NA	0.04 U	0.0400 U	0.200 U	0.200 U	mg/L
Lead	NA	0.003 U	0.00463 J	0.00500 U	0.00397 J	mg/L
Magnesium	NA	81.8	90.6	85.3	87.4	mg/L
Manganese	NA	0.003 U	0.00314 J	0.0100 U	0.0100 U	mg/L
Molybdenum	NA	0.005 U	0.00500 U	0.0500 U	0.0500 U	mg/L
Nickel	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Potassium	NA	2.67	2.67	2.48	2.80	mg/L
Selenium	NA	0.0224	0.0220	0.0233	0.0221	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	159	176	174	176	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.0157	0.00636 J	0.00788 U	0.00829 J	mg/L

I001MW52D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	729	664	579	590	mg/L
Fluoride	NA	0.307	0.267	0.258	0.351	mg/L
Sulfate	NA	909	848	812	787	mg/L
Total Alkalinity	NA	350	390	368	371	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	2950	2980	2520	2370	mg/L
Metals						
Mercury	NA	0.0001 U	0.0001 U	0.0002 U	0.0002 UR	mg/L
Aluminum	NA	0.06 U	0.126	0.0635 J	0.100 U	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0232	0.0234	0.0213	0.0224	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	365	354	305	307	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.002 U	0.00352J	0.0100 U	0.0100 U	mg/L
Iron	NA	0.04 U	0.0112 J	0.200 U	0.200 U	mg/L
Lead	NA	0.003 U	0.00352 J	0.00500 U	0.00430 J	mg/L
Magnesium	NA	174	174	152	149	mg/L
Manganese	NA	0.228	0.225	0.212	0.204	mg/L
Molybdenum	NA	0.354	0.352	0.345	0.333	mg/L
Nickel	NA	0.0025 U	0.00285 J	0.00500 U	0.00500 U	mg/L
Potassium	NA	3.2	3.60	2.76	2.76	mg/L
Selenium	NA	0.0149	0.0183	0.0200	0.0193 J	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	300	325	278	264	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.005 U	0.0115 U	0.00792 U	0.0100 U	mg/L

LEGEND

- WELLS INSTALLED IN THE 2nd WATER-BEARING ZONE
- SURFACE WATER FLOW DIRECTION (PETERS CANYON CHANNEL)
- ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- APPROXIMATE CHANNEL BOUNDARY
- CONTAINMENT WALL
- APPROXIMATE IRP SITE BOUNDARY AND AREA REQUIRING INSTITUTIONAL CONTROLS
- BOUNDARY FORMER MARINE CORPS AIR STATION, TUSTIN

BOLD	RESULT ≥ REMEDIATION GOAL
J	ESTIMATED RESULT
NA	NOT ANALYZED
U	NOT REPORTED
UR	QUALITY CONTROL INDICATES THE DATA IS NOT USABLE
mg/L	MILLIGRAMS PER LITER

Monitoring Well Identifier

I001MW50D

Analyte	Result	Result	Result	Result	Result	Units
General Chemistry						
	4th Qtr Dec '06	3rd Qtr Aug '07	2nd Qtr May '08	2nd Qtr May '09	2nd Qtr May '10	
Chloride	NA	536	444	298	464	mg/L
Fluoride	NA	0.212	0.248	0.303	0.316	mg/L
Sulfate	NA	906	744	661	639	mg/L
Total Alkalinity	NA	300	365	359	325	mg/L CaCO3
Total Dissolved Solids(TDS)	NA	2750	2250	2090	2130	mg/L
Metals						
Mercury	NA	0.0001 U	0.000384	0.002 U	0.001 U	mg/L
Aluminum	NA	0.06 U	0.0600 U	0.100 U	0.102 J	mg/L
Antimony	NA	0.01 U	0.0100 U	0.100 U	0.100 U	mg/L
Arsenic	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Barium	NA	0.0224	0.0175	0.0173	0.0235	mg/L
Beryllium	NA	0.001 U	0.00100 U	0.00200 U	0.00200 U	mg/L
Cadmium	NA	0.00176 J	0.00100 U	0.00200 U	0.00200 U	mg/L
Calcium	NA	241	247	234	218	mg/L
Chromium	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Cobalt	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Copper	NA	0.002 U	0.00200 U	0.0100 U	0.00260 J	mg/L
Iron	NA	0.757	0.0744 J	0.0451 J	0.472	mg/L
Lead	NA	0.003 U	0.00697 U	0.00500 U	0.00434 J	mg/L
Magnesium	NA	153	122	95.9	104	mg/L
Manganese	NA	0.268	0.129	0.0347	0.0892	mg/L
Molybdenum	NA	0.0106 J	0.0115 J	0.0126 J	0.00832 J	mg/L
Nickel	NA	0.0025 U	0.00250 U	0.00500 U	0.00500 U	mg/L
Potassium	NA	3.5	3.33	2.64	4.16	mg/L
Selenium	NA	0.0181	0.0209	0.0192 J	0.0188 J	mg/L
Silver	NA	0.003 U	0.00300 U	0.0100 U	0.0100 U	mg/L
Sodium	NA	403	351	205	309	mg/L
Thallium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Vanadium	NA	0.005 U	0.00500 U	0.0100 U	0.0100 U	mg/L
Zinc	NA	0.005 U	0.00579 U	0.0114	0.00663 J	mg/L

Element

Concentration and data qualifier codes

NOTES:

1. Prior year data shown for comparison.

WELL ID SUFFIX:

S = First WBZ
D = Second WBZ

ABRREVIATIONS:

WBZ = Water Bearing Zone

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

FIGURE 11

Base Realignment and Closure
Program Management Office West

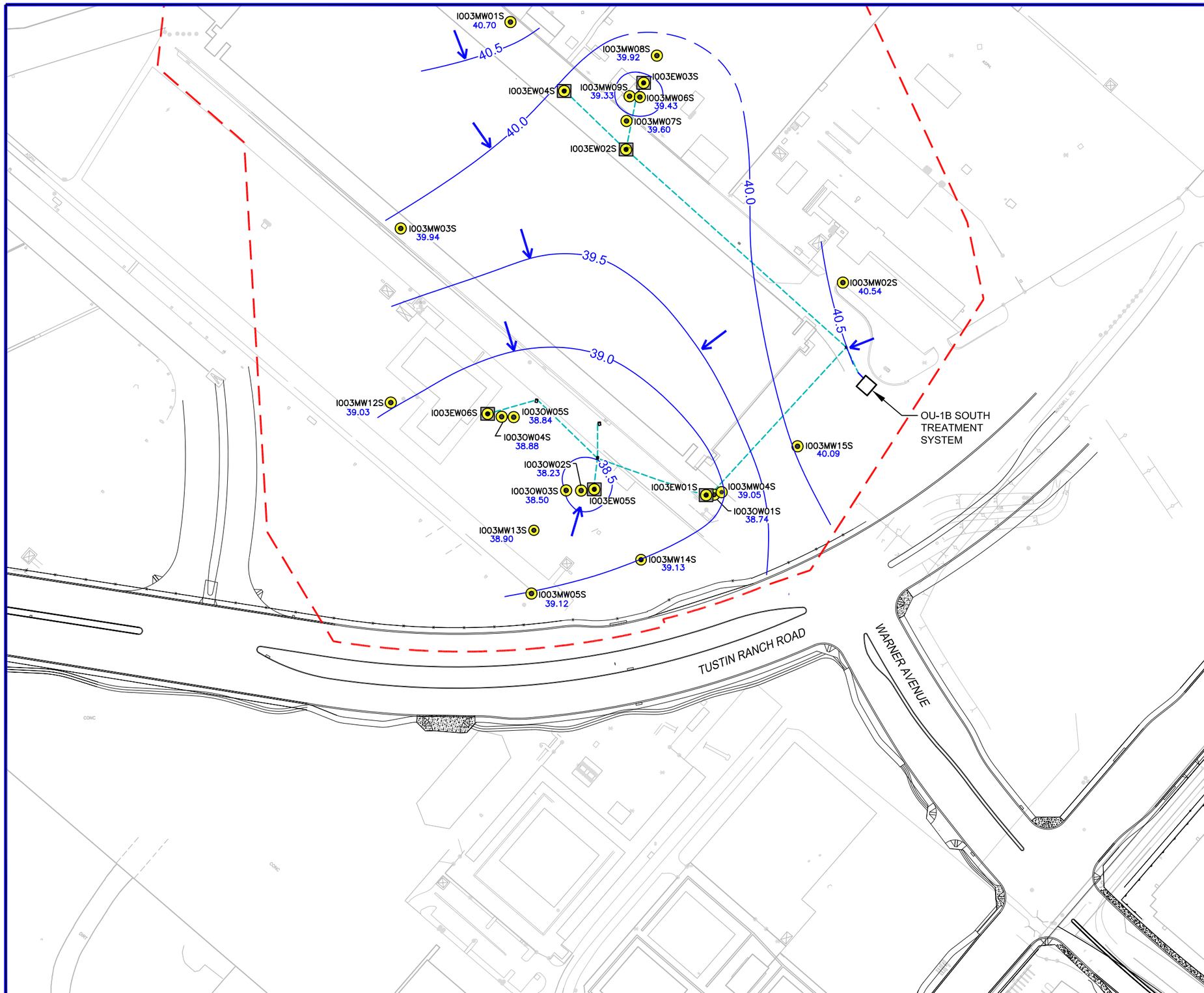
FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
INORGANIC CONCENTRATIONS 2006-2010
SECOND WBZ

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 11 IRP SITE 1 (OU-3)_INORGANIC CONC- 06-10_2\WBZ.dwg



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Extraction Well (First WBZ)
- OU-1B South Treatment Facility
- Conveyance Piping (OU-1B South)
- Carve-Out #6 Boundary
- 39 — Water Level Contour in Feet Above Mean Sea Level; Dashed Where Approximate
- Groundwater Flow Direction
- I003MW02S — Well ID
- 40.54 — Water Level Elevation in Feet Above Mean Sea Level

NOTES

Groundwater levels collected on October 28, 2010.

WELL ID SUFFIX

S = First WBZ

ABBREVIATIONS

OU = Operable Unit
WBZ = Water Bearing Zone

FIGURE 12

Base Realignment and Closure Program Management Office West

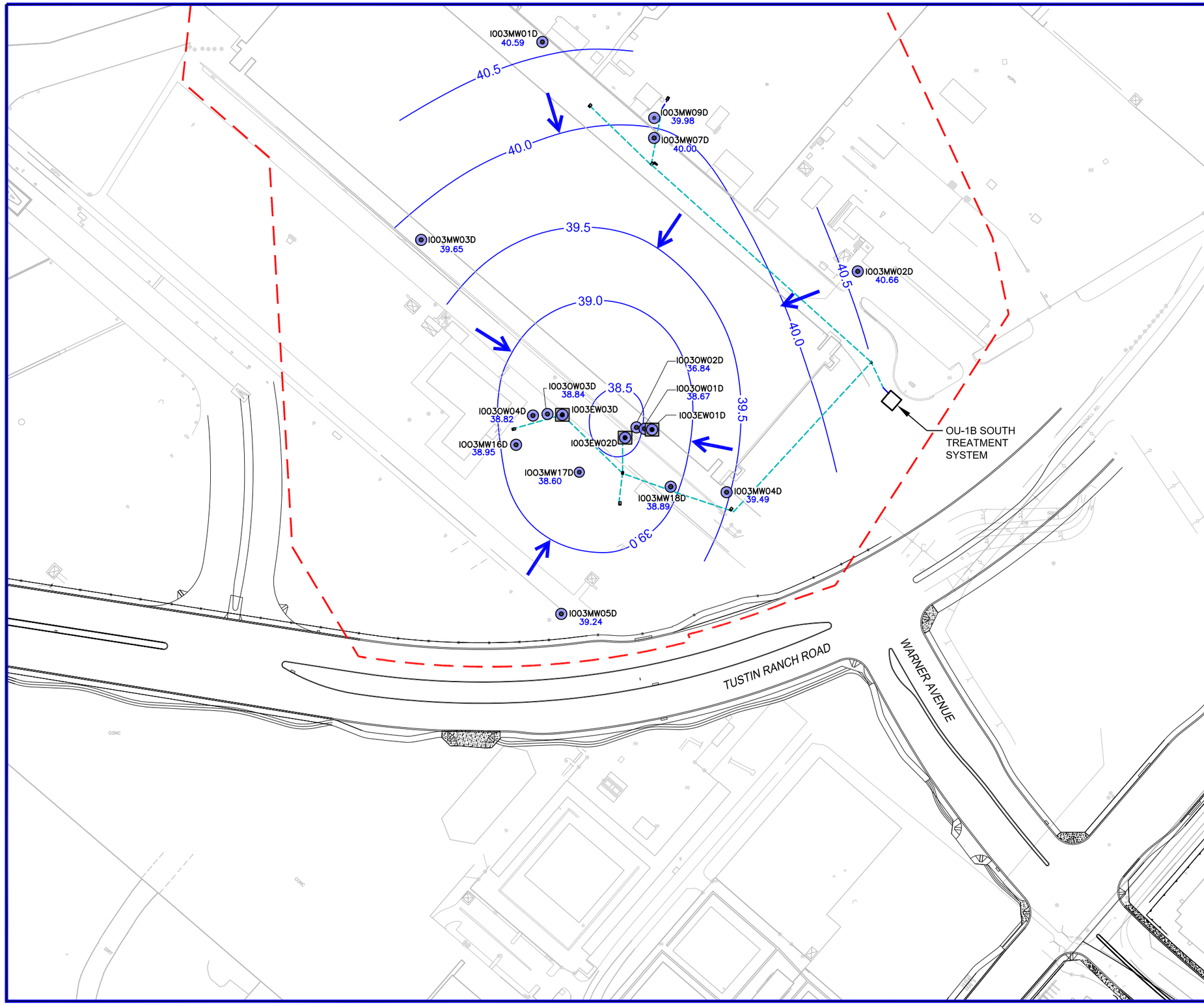
FORMER MARINE CORPS AIR STATION

TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) FIRST WBZ GROUNDWATER LEVEL ELEVATIONS FOURTH QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND:

- Groundwater Monitoring Well (Second WBZ)
- Groundwater Extraction Well (Second WBZ)
- OU-1B South Treatment Facility
- Conveyance Piping (OU-1B South)
- Carve-Out #6 Boundary
- 40 — Water Level Contour in Feet Above Mean Sea Level; Dashed Where Approximate
- Groundwater Flow Direction
- I003MW17D — Well ID
- 38.60 — Water Level Elevation in Feet Above Mean Sea Level

NOTES

1. Groundwater levels collected on October 28, 2010.
2. Extraction well I003EW01D is not part of the extraction network

WELL ID SUFFIX

D = Second WBZ

ABBREVIATIONS

OU = Operable Unit
WBZ = Water Bearing Zone

N

0 80 160

APPROXIMATE SCALE IN FEET

FIGURE 13

Base Realignment and Closure Program Management Office West

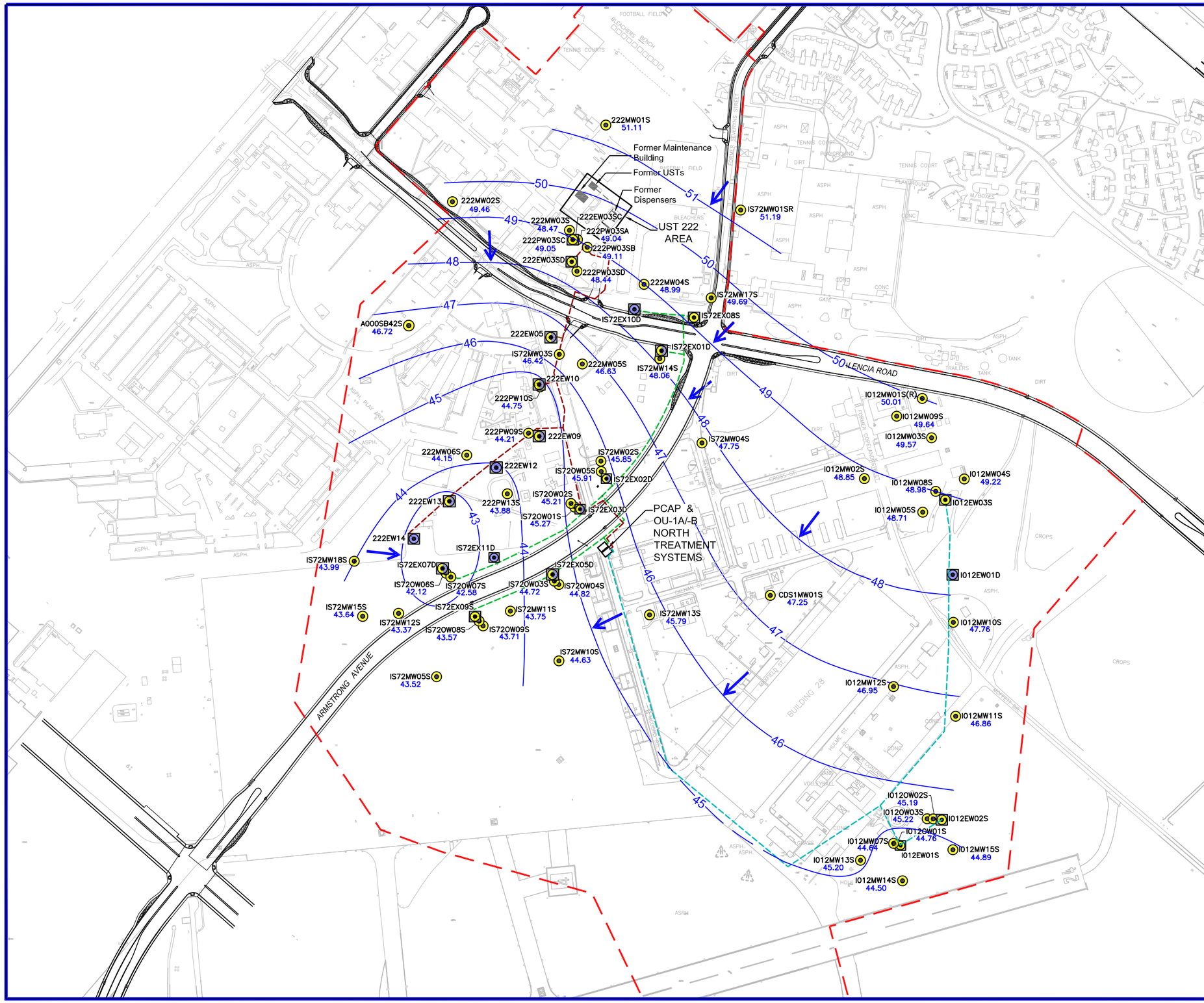
FORMER MARINE CORPS AIR STATION

TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) SECOND WBZ GROUNDWATER LEVEL ELEVATIONS
FOURTH QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- 50 — Water Level Contour in Feet Above Mean Sea Level; Dashed Where Approximate
- Groundwater Flow Direction
- I012MW04S ← Well ID
- 49.22 — Water Level Elevation in Feet Above Mean Sea Level

NOTES

1. Groundwater levels collected on October 28, 2010.
2. In June 2009, packers were placed in PCAP Extraction Wells 222EW05, -10, and -13 to separate the first and second WBZ. Groundwater is only extracted from the second WBZ in these wells.
3. Extraction Wells 222EW03SC and 222EW03SD are secured.

WELL ID SUFFIX

S, SA, SB, SC, SD, SR = First WBZ
D = Second WBZ

ABBREVIATIONS

OU = Operable Unit
PCAP = Petroleum Corrective Action Program
UST = Underground Storage Tank
WBZ = Water Bearing Zone

N

0 200 400

APPROXIMATE SCALE IN FEET

FIGURE 14

Base Realignment and Closure Program Management Office West

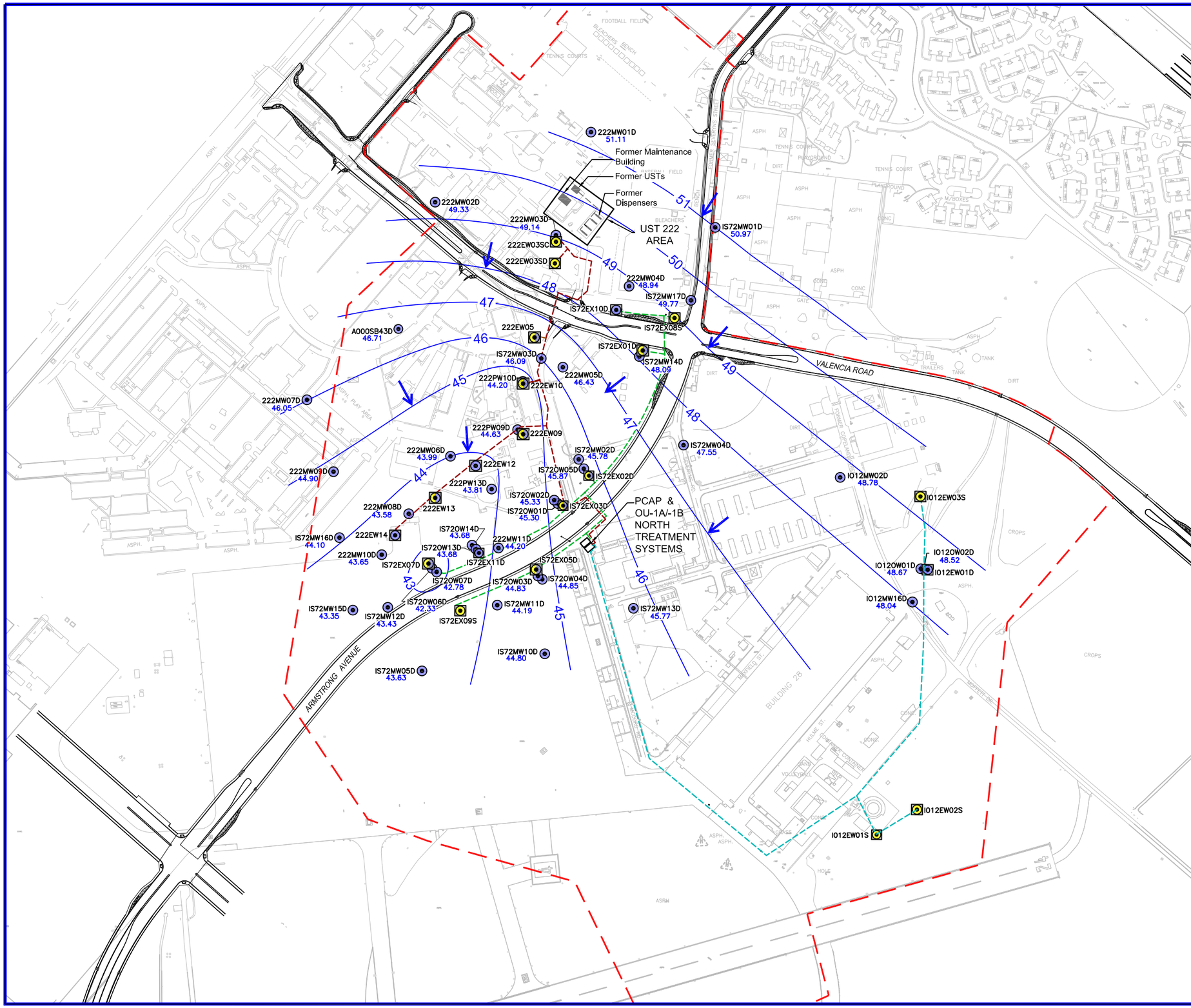
TUSTIN, CALIFORNIA

FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-12 AND -13S (OU-1B NORTH / OU-1A)
FIRST WBZ GROUNDWATER LEVEL ELEVATIONS - FOURTH QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND:

- Groundwater Monitoring Well (Second WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- 50 — Water Level Contour in Feet Above Mean Sea Level; Dashed Where Approximate
- Groundwater Flow Direction
- I012MW02D ← Well ID
- 48.78 Water Level Elevation in Feet Above Mean Sea Level

NOTES

1. Groundwater levels collected on October 28, 2010.
2. In June 2009, packers were placed in PCAP Extraction Wells 222EW05, -10, and -13 to separate the first and second WBZ. Groundwater is only extracted from the second WBZ in these wells.

WELL ID SUFFIX

SC, SD = First WBZ
D, SB = Second WBZ

ABBREVIATIONS

OU = Operable Unit
PCAP = Petroleum Corrective Action Program
UST = Underground Storage Tank
WBZ = Water Bearing Zone

N

0 200 400

APPROXIMATE SCALE IN FEET

FIGURE 15

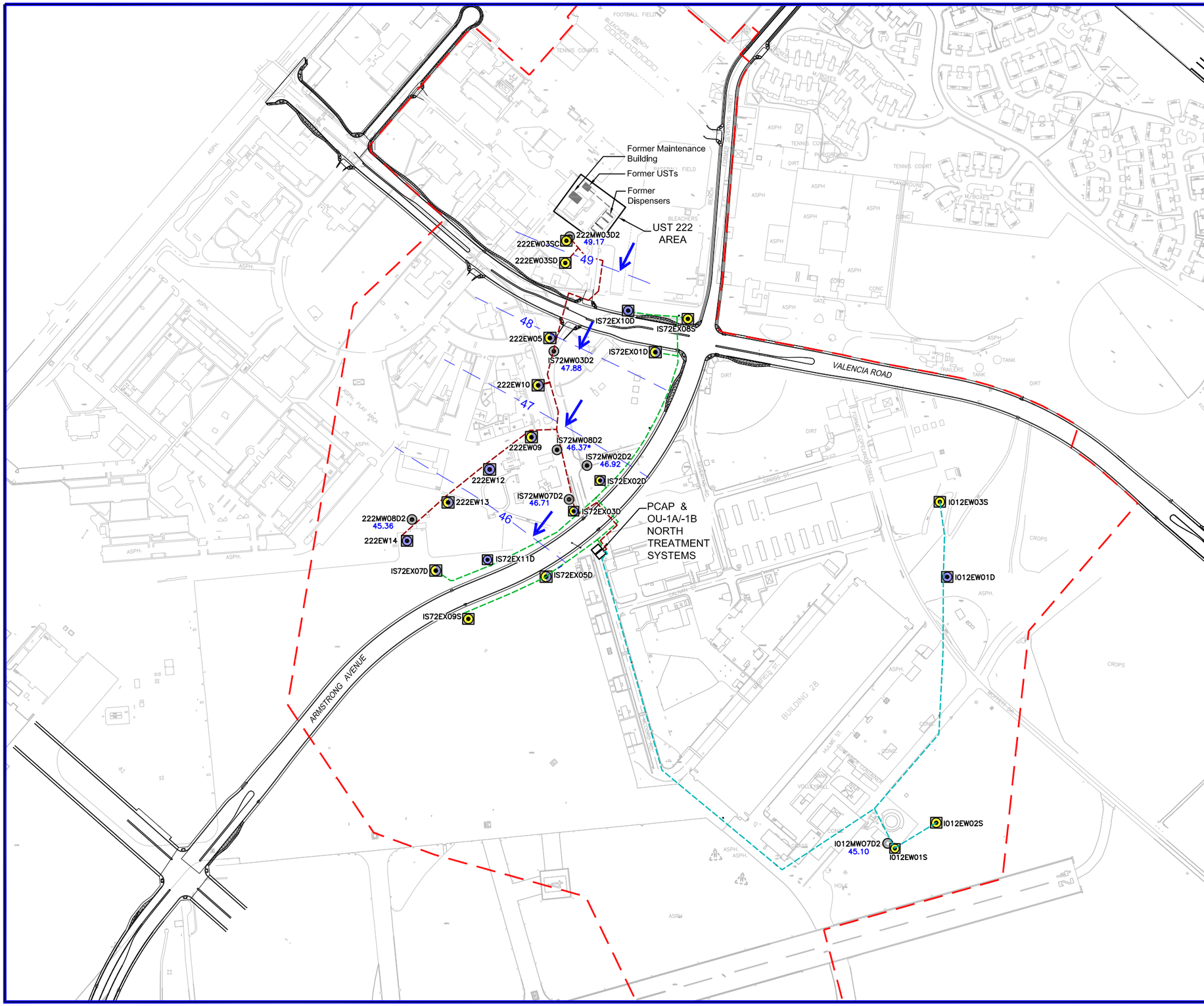
Base Realignment and Closure Program Management Office West

FORMER MARINE CORPS AIR STATION

TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S
IRP-12 AND -13S (OU-1B NORTH / OU-1A)
SECOND WBZ GROUNDWATER LEVEL ELEVATIONS - FOURTH QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296



LEGEND:

- Groundwater Monitoring Well (Third WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- 49 — Water Level Contour in Feet Above Mean Sea Level; Dashed Where Approximate
- Groundwater Flow Direction
- 222MW03D2 ← Well ID
- 49.17 — Water Level Elevation in Feet Above Mean Sea Level
- * — Not used for contouring

NOTES

1. Groundwater levels collected on October 28, 2010.

WELL ID SUFFIX

SC, SD= First WBZ
D = Second WBZ
D2 = Third WBZ

ABBREVIATIONS

OU = Operable Unit
PCAP = Petroleum Corrective Action Program
UST = Underground Storage Tank
WBZ = Water Bearing Zone

N

0 200 400

APPROXIMATE SCALE IN FEET

FIGURE 16

Base Realignment and Closure Program Management Office West

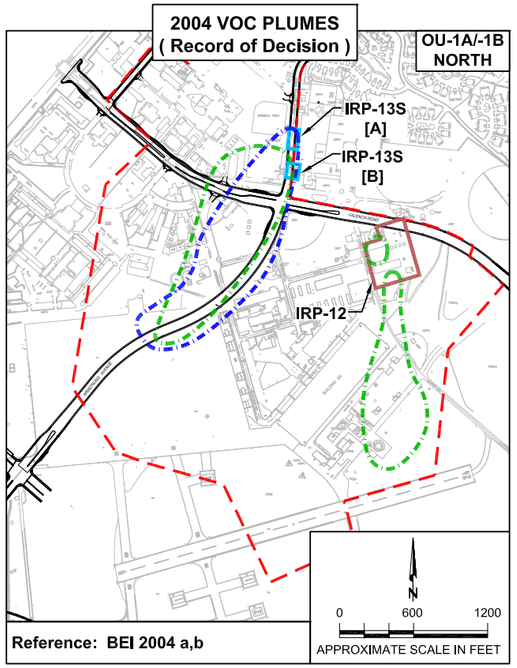
TUSTIN, CALIFORNIA

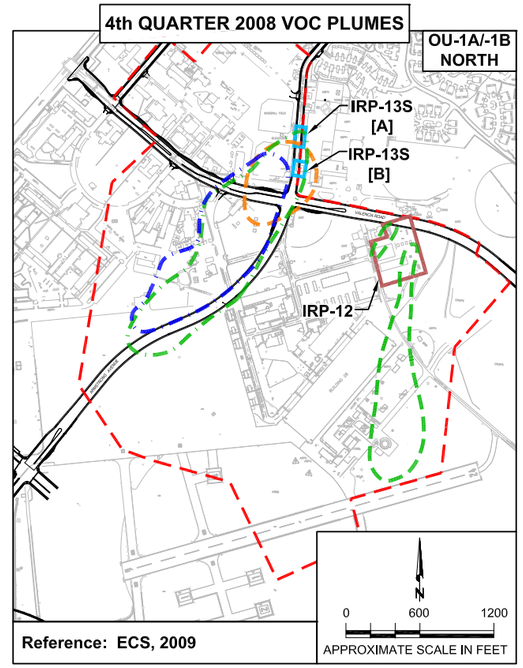
FORMER MARINE CORPS AIR STATION

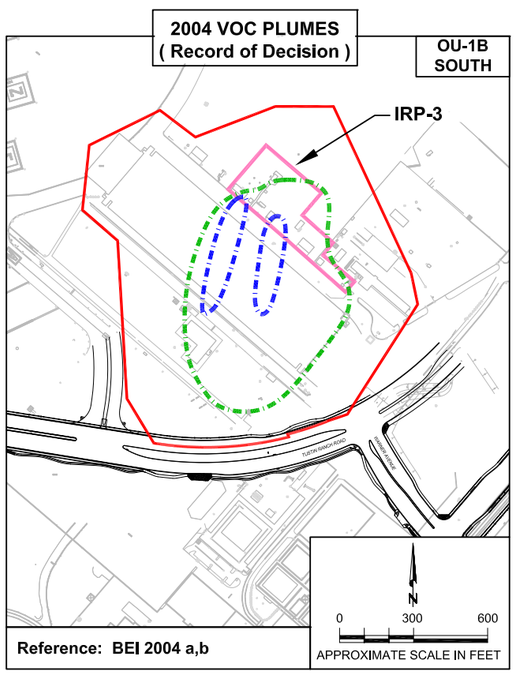
2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

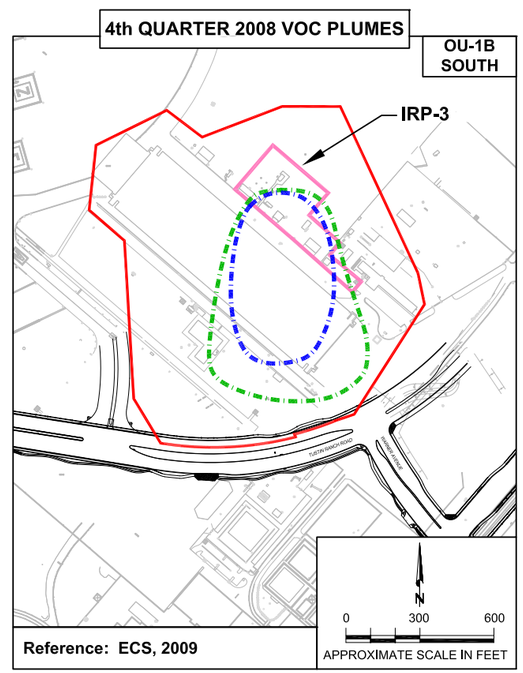
IRP-12 AND -13S (OU-1B NORTH / OU-1A)
THIRD WBZ GROUNDWATER LEVEL ELEVATIONS - FOURTH QUARTER 2010

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296









LEGEND:

- VOC PLUME (First WBZ)
- VOC PLUME (Second WBZ)
- CARVE-OUT # 5 BOUNDARY
- CARVE-OUT # 6 BOUNDARY

ABBREVIATIONS

BEI = Bechtel Environmental, Inc.
ECS = Enviro Compliance Solutions, Inc.
IRP = Installation Restoration Program
OU = Operable Unit
TCE = Trichloroethene
TCP = Trichloropropane
VOC = Volatile Organic Compounds

NOTES

1. Startup date for OU-1A / OU-1B North FInal Remedy System was December 2007
2. Startup date for OU-1B South System was January 2008
3. VOCs for OU-1A include TCE and 1,2,3-TCP
4. VOCs for OU-1B North and OU-1B South Include TCE

FIGURE 17A

Base Realignment and Closure
Program Management Office West

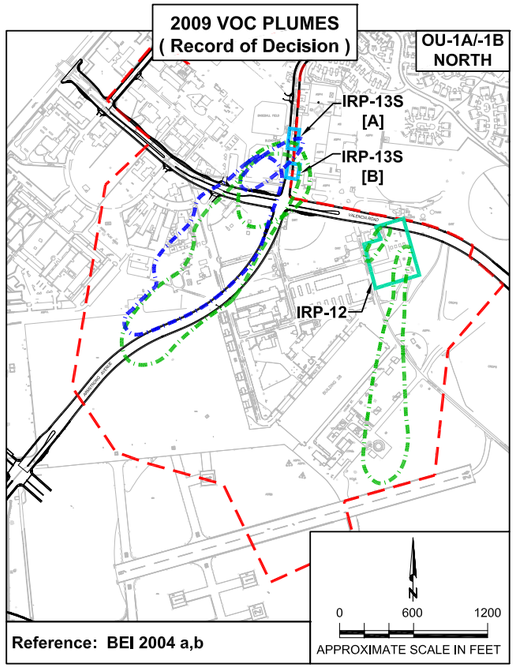
TUSTIN, CALIFORNIA

FORMER MARINE CORPS AIR STATION

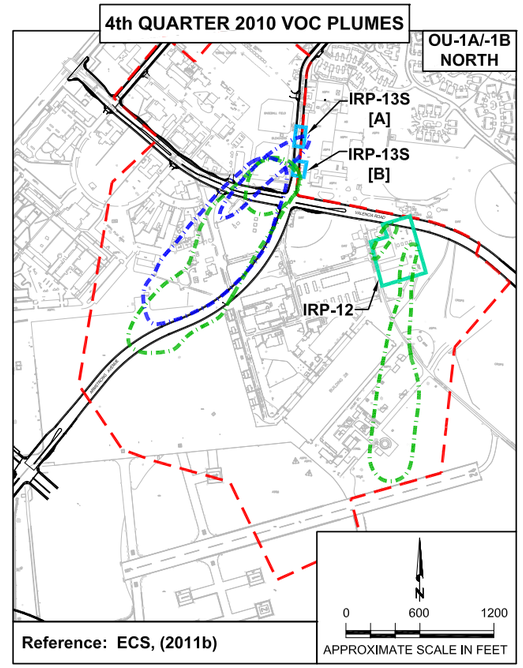
2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3, -12, AND -13S (OU-1A/-1B) FIRST & SECOND WBZ
GROUNDWATER VOC PLUME BOUNDARIES 2004-2010 (1 OF 2)

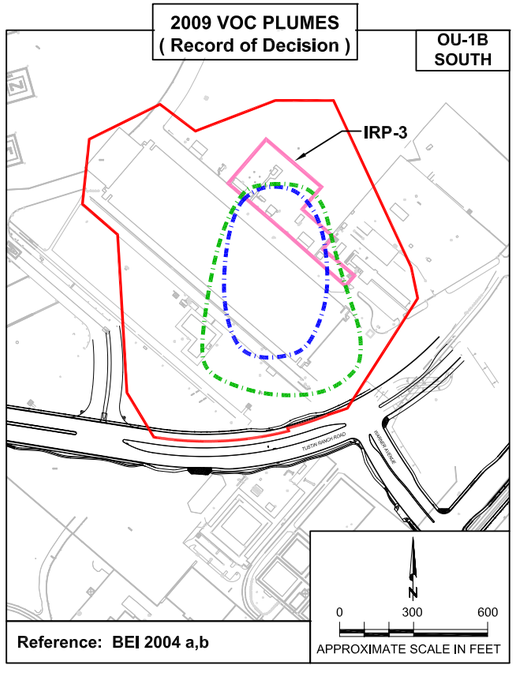
Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296



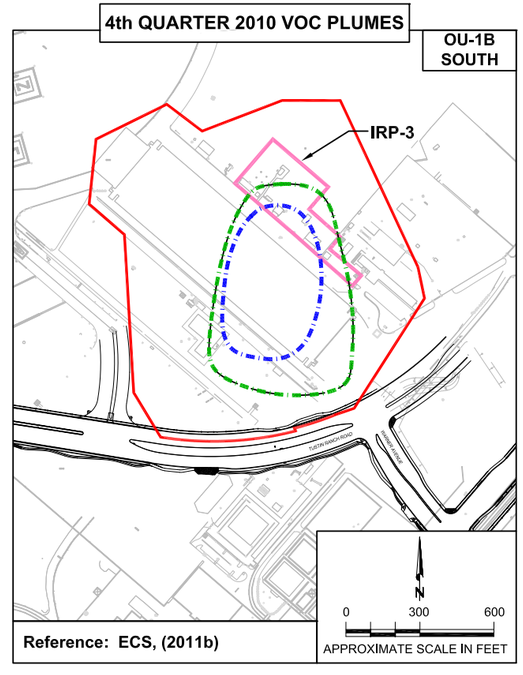
Reference: BEI 2004 a,b



Reference: ECS, (2011b)



Reference: BEI 2004 a,b



Reference: ECS, (2011b)

LEGEND:

- VOC PLUME (First WBZ)
- VOC PLUME (Second WBZ)
- CARVE-OUT # 5 BOUNDARY
- CARVE-OUT # 6 BOUNDARY

ABBREVIATIONS

BEI = Bechtel Environmental, Inc.
ECS = Enviro Compliance Solutions, Inc.
IRP = Installation Restoration Program
OU = Operable Unit
TCE = Trichloroethene
TCP = Trichloropropane
VOC = Volatile Organic Compounds

NOTES

1. Startup date for OU-1A / OU-1B North Final Remedy System was December 2007
2. Startup date for OU-1B South System was January 2008
3. VOCs for OU-1A include TCE and 1,2,3-TCP
4. VOCs for OU-1B North and OU-1B South include TCE

FIGURE 17B

Base Realignment and Closure Program Management Office West

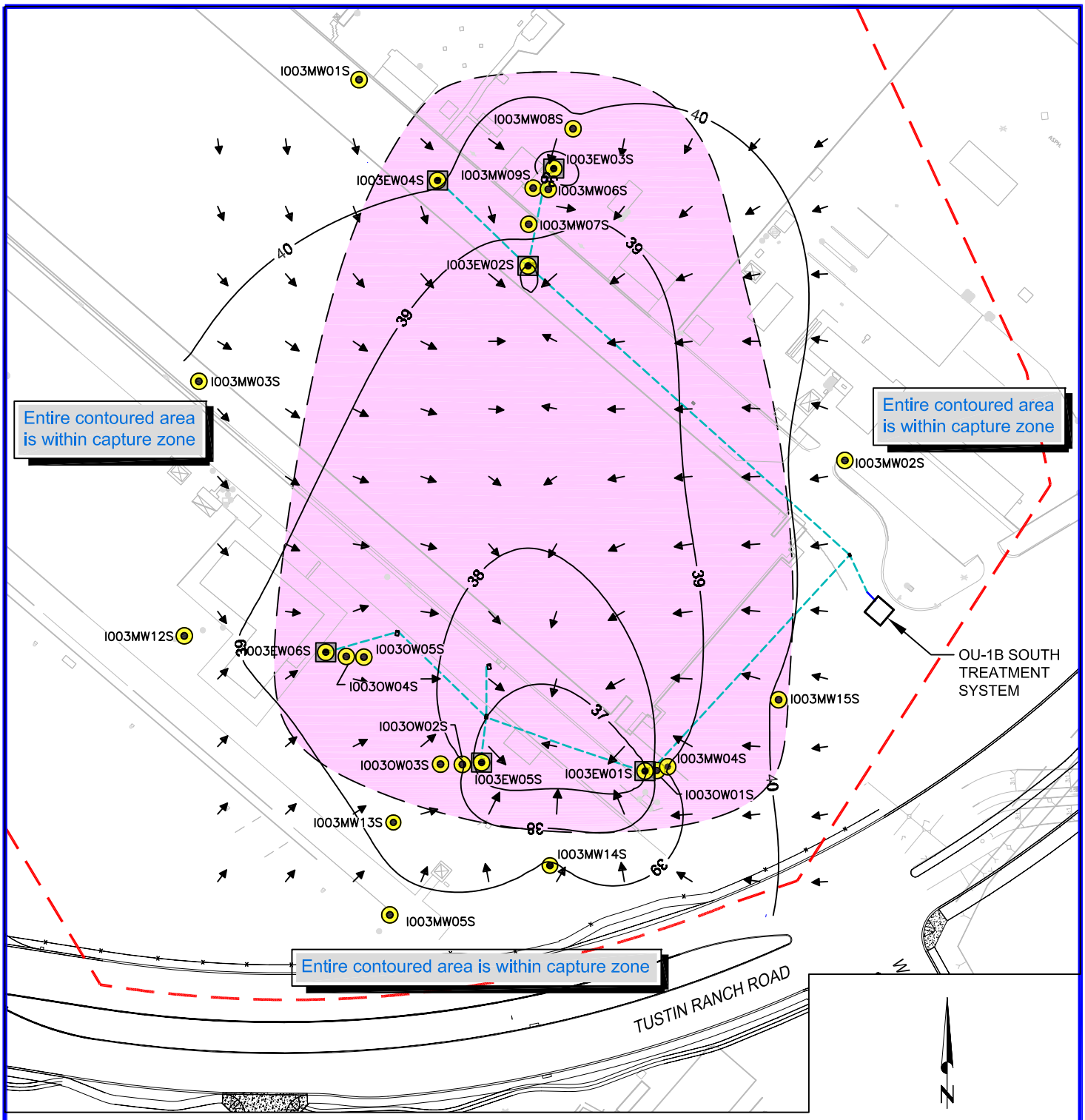
TUSTIN, CALIFORNIA

FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3, -12, AND -13S (OU-1A/-1B) FIRST & SECOND WBZ
GROUNDWATER VOC PLUME BOUNDARIES 2004-2010 (2 OF 2)

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Extraction Well (First WBZ)
- Carve-Out #6 Boundary
- Conveyance Piping (OU-1B South)
- 40 Groundwater Contour with Elevation in Feet Above Mean Sea Level
- Groundwater Flow Direction
- Extent of Trichloroethene in groundwater at concentrations > 5 ug/L (remediation goal) - fourth quarter 2010.

0 80 160

APPROXIMATE SCALE IN FEET

NOTE:

Groundwater gradient vectors generated by SURFER® Version 9.9.785

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

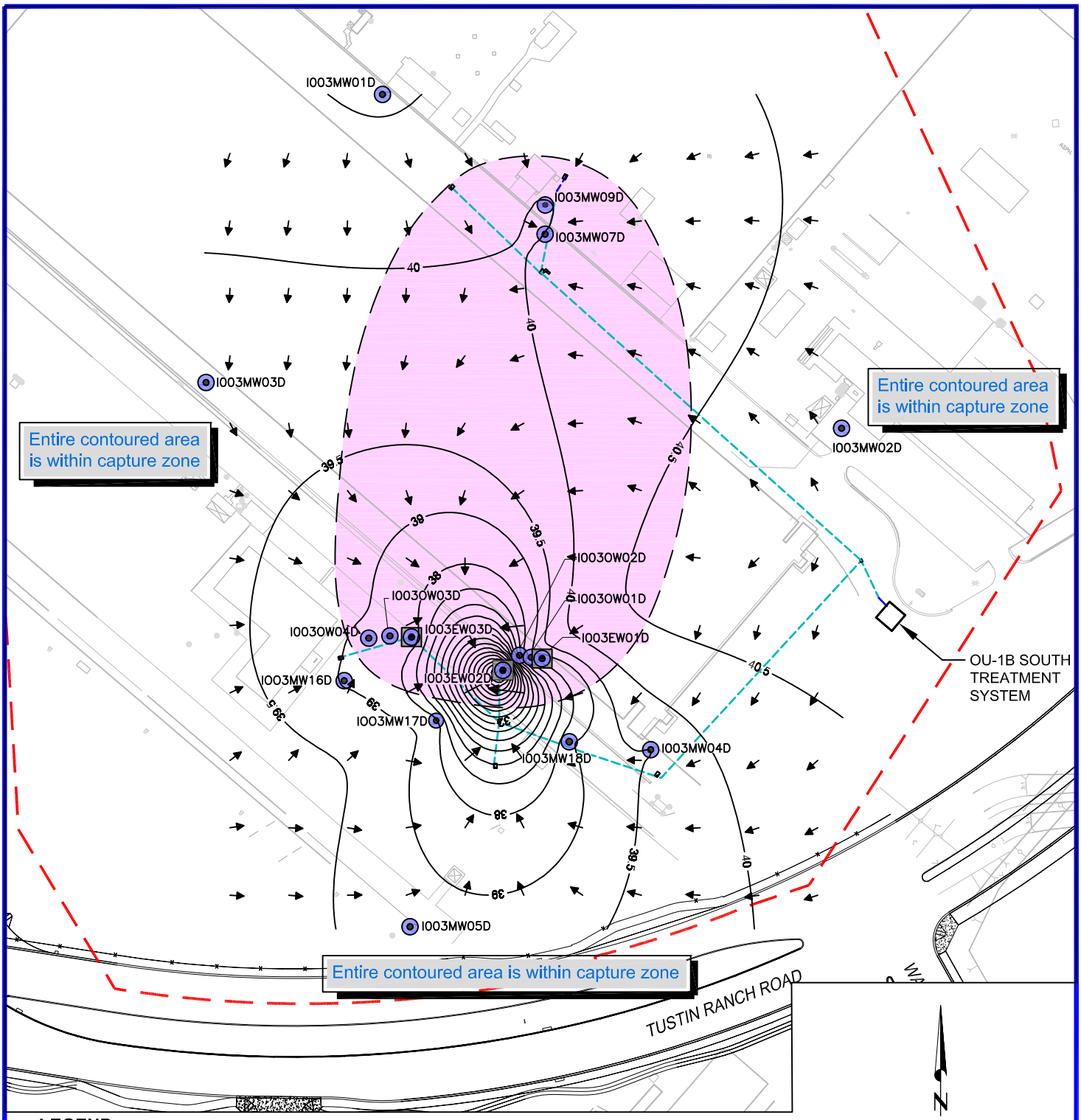
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) FIRST WBZ GRADIENT VECTOR MAP

Base Realignment and Closure Program Management Office West

FIGURE 18



LEGEND:

- Groundwater Monitoring Well (Second WBZ)
- Groundwater Extraction Well (Second WBZ)
- Carve-Out #6 Boundary
- Conveyance Piping (OU-1B South)
- 40 Groundwater Contour with Elevation in Feet Above Mean Sea Level
- Groundwater Flow Direction
- Extent of Trichloroethene in groundwater at concentrations > 5 ug/L (remediation goal) - fourth quarter 2010.

0 80 160

APPROXIMATE SCALE IN FEET

NOTE:

Groundwater gradient vectors generated by SURFER® Version 9.9.785

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

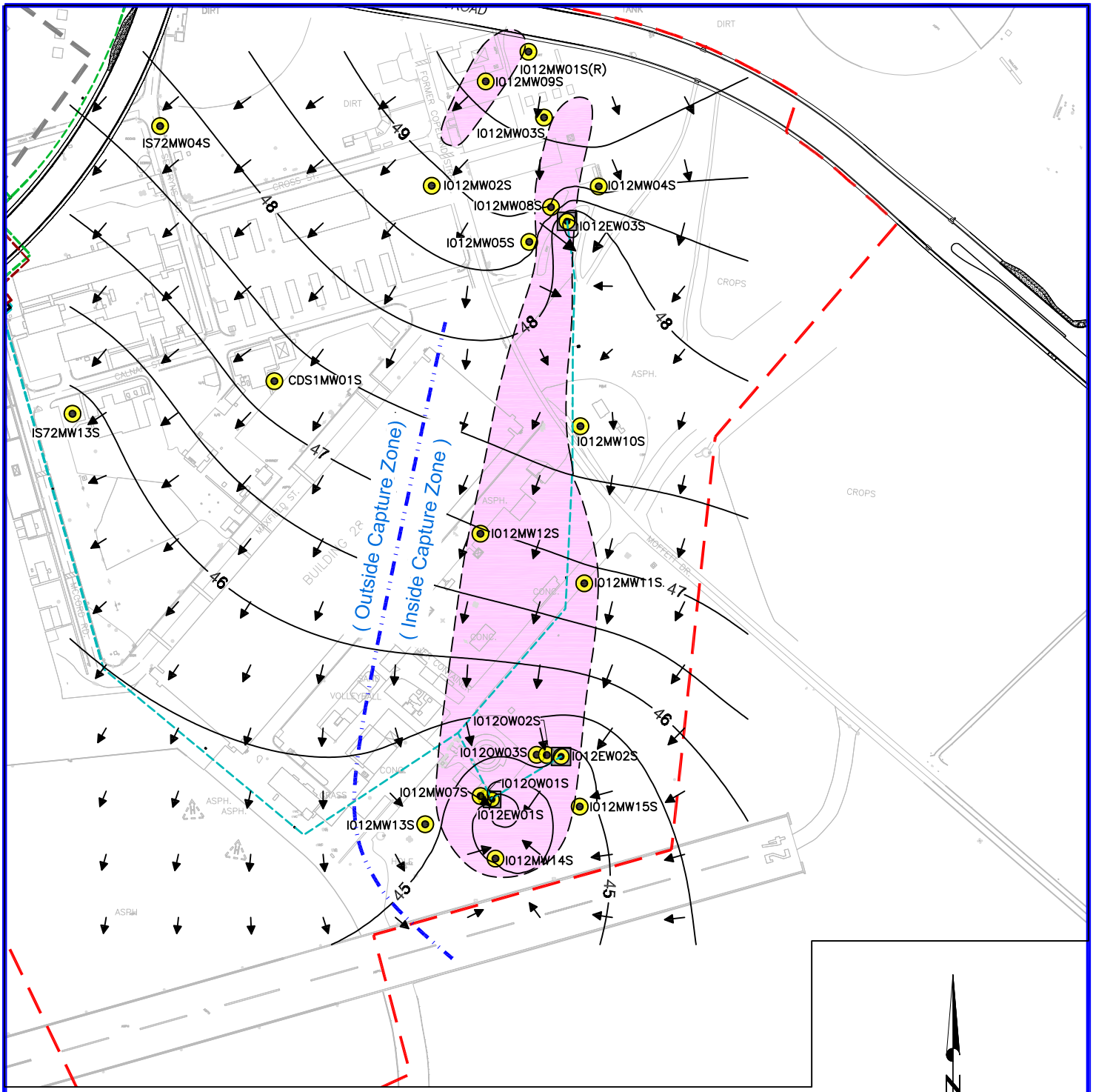
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) SECOND WBZ GRADIENT VECTOR MAP

Base Realignment and Closure Program Management Office West

FIGURE 19



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Extraction Well (First WBZ)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- Capture Zone Boundary
- 49 Groundwater Contour with Elevation in Feet Above Mean Sea Level
- Groundwater Flow Direction
- Extent of Trichloroethene in groundwater at concentrations > 5 ug/L (remediation goal) - fourth quarter 2010.

N

0 175 350

APPROXIMATE SCALE IN FEET

NOTE:

Groundwater gradient vectors generated by SURFER® Version 9.9.785

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

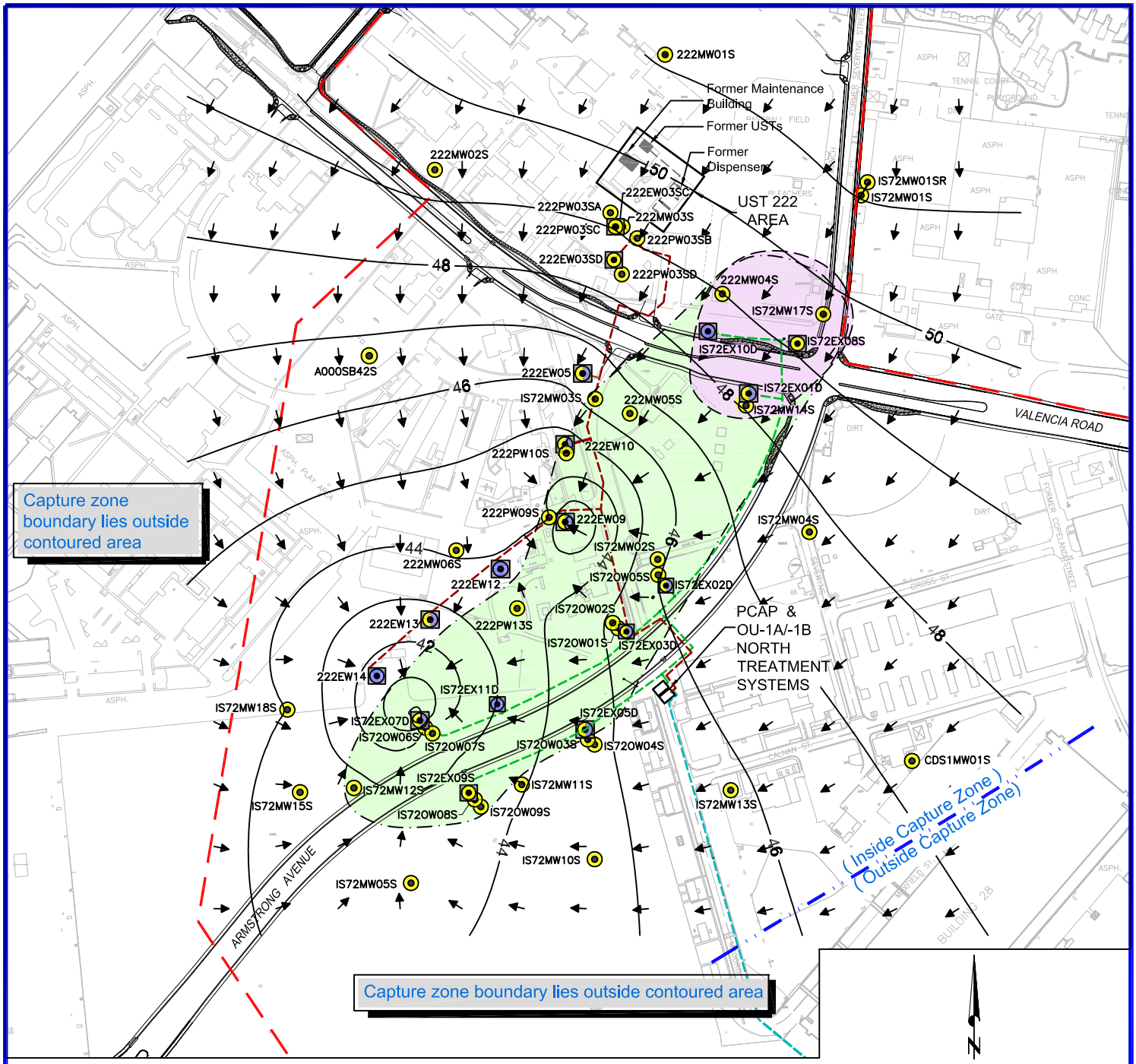
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-12 (OU-1B NORTH) FIRST WBZ GRADIENT VECTOR MAP

Base Realignment and Closure Program Management Office West

FIGURE 20



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Groundwater Extraction Well (First WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- Extent of Trichloroethene in groundwater at concentrations > 5 ug/L (remediation goal) - fourth quarter 2010.
- Extent of 1,2,3-Trichloropropane in groundwater at concentrations > 0.5 ug/L (remediation goal) - fourth quarter 2010.
- 49 Groundwater Contour with Elevation in Feet Above Mean Sea Level
- Groundwater Flow Direction
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- Capture Zone Boundary

0 200 400

APPROXIMATE SCALE IN FEET

ABBREVIATIONS:

PCAP = Petroleum Corrective Action Program
UST = Underground Storage Tank

NOTE:

Groundwater gradient vectors generated by SURFER® Version 9.9.785

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

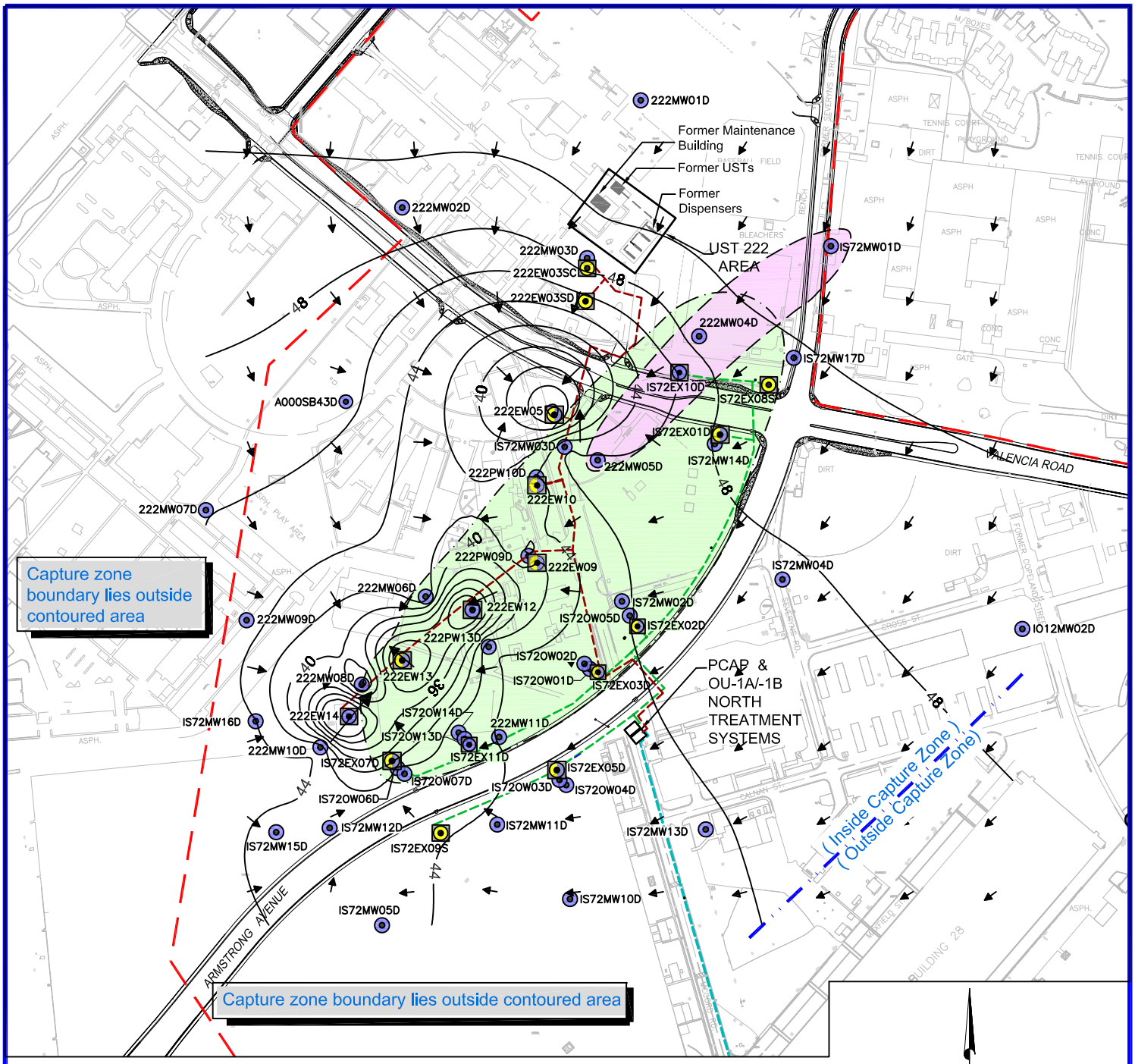
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-13S (OU-1A) FIRST WBZ GRADIENT VECTOR MAP

Base Realignment and Closure Program Management Office West

FIGURE 21



LEGEND:

- Groundwater Monitoring Well (Second WBZ)
- Groundwater Extraction Well (Second WBZ)
- Groundwater Extraction Well (First & Second WBZ)
- 48 — Groundwater Contour with Elevation in Feet Above Mean Sea Level
- Groundwater Flow Direction
- Extent of Trichloroethene in groundwater at concentrations > 5 ug/L (remediation goal) - fourth quarter 2010.
- Extent of 1,2,3-Trichloropropane in groundwater at concentrations > 0.5 ug/L (remediation goal) - fourth quarter 2010.
- Conveyance Piping (PCAP)
- Conveyance Piping (OU-1A)
- Conveyance Piping (OU-1B North)
- Carve-Out #5 Boundary
- Capture Zone Boundary

N

0 200 400

APPROXIMATE SCALE IN FEET

ABBREVIATIONS:

PCAP = Petroleum Corrective Action Program
UST = Underground Storage Tank

NOTE:

Groundwater gradient vectors generated by SURFER® Version 9.9.785

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

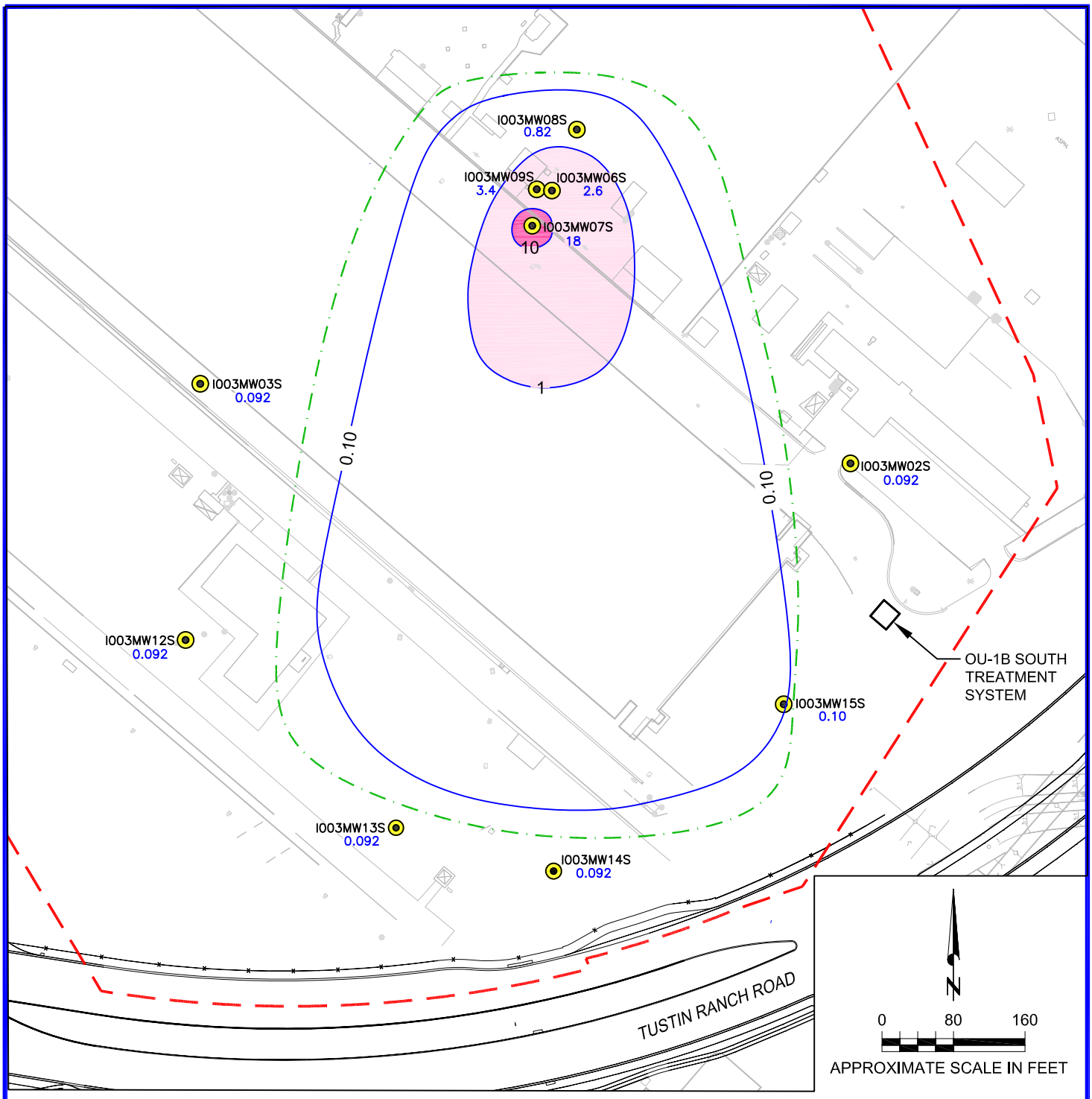
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-13S (OU-1A) SECOND WBZ GRADIENT VECTOR MAP

Base Realignment and Closure Program Management Office West

FIGURE 22



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Carve-Out #6 Boundary
- 1 — Vapor Intrusion Risk Contour with Lifetime VI cancer risk (x 10^{-6})
- 18 — Lifetime VI cancer risk
- Area of 10^{-5} Risk Range
- Area of 10^{-6} Risk Range
- TCE Groundwater Plume (First WBZ)

ABBREVIATIONS

TCE = Trichloroethene
VI = Vapor Intrusion
VC = Vinyl Chloride
WBZ = Water Bearing Water Zone

Note:

1. Lifetime VI cancer risk determined using current Cal / EPA toxicity values for TCE and VC. (See Appendix F).

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Sulte B
Tustln, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

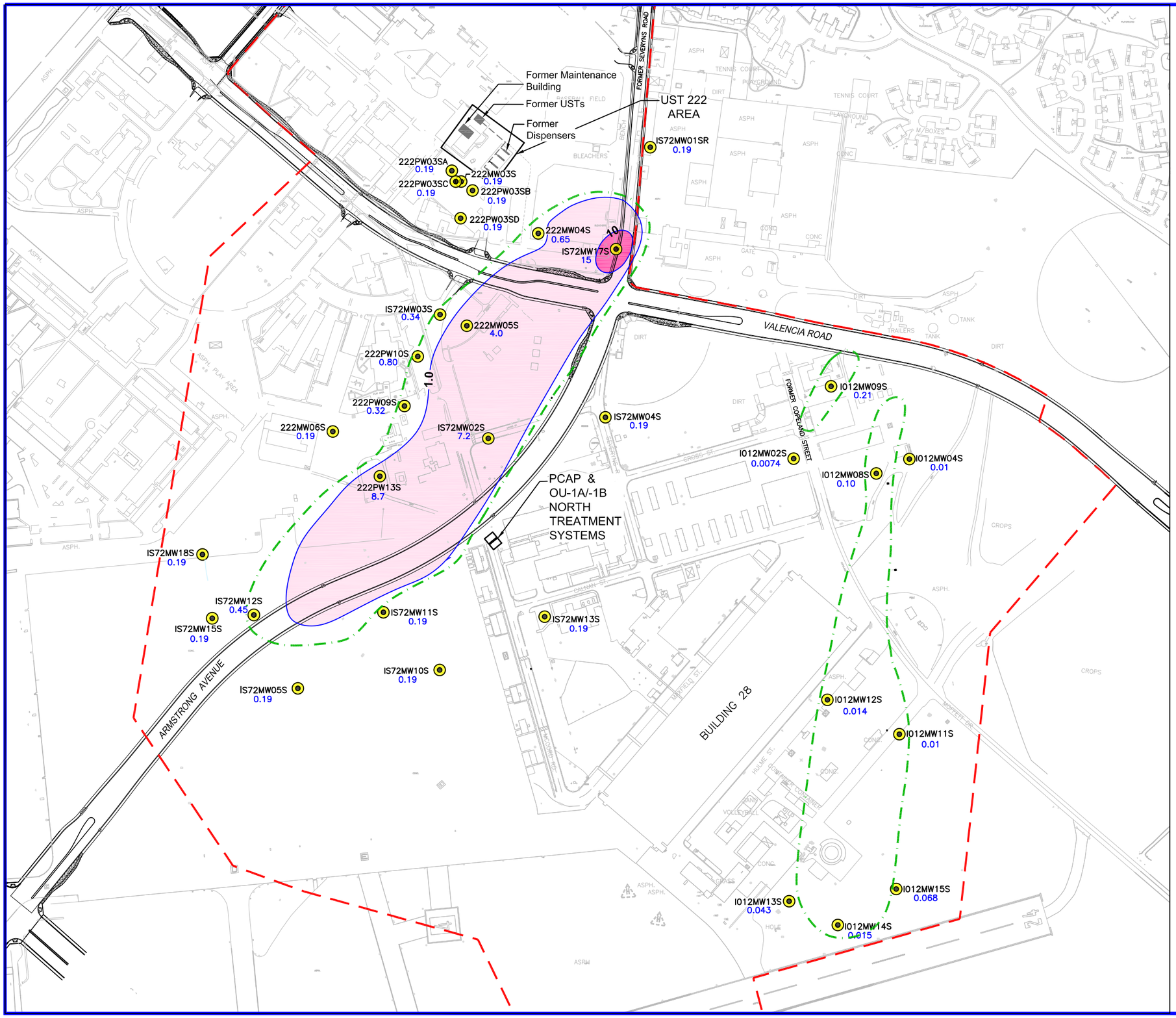
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) VAPOR INTRUSION RISK CONTOURS

Base Realignment and Closure
Program Management Office West

FIGURE 23



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Carve-Out #5 Boundary
- 1 — Vapor Intrusion Risk Contour with Lifetime VI cancer risk (x 10^{-6})
- 15 — Lifetime VI cancer risk
- Area of 10^{-5} Risk Range
- Area of 10^{-6} Risk Range
- TCE and 1,2,3-TCP Groundwater Plume (First WBZ)

ABBREVIATIONS

TCE = Trichloroethene
TCP = Trichloropropane
VI = Vapor Intrusion
VC = Vinly Chloride

Note:

1. Lifetime VI cancer risk determined using current Cal/EPA toxicity values for TCE, 1,2,3-TCP, and VC. (See Appendix F).

N

0 175 350

APPROXIMATE SCALE IN FEET

FIGURE 24

Base Realignment and Closure Program Management Office West

TUSTIN, CALIFORNIA

FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-12 (OU-1B NORTH) AND -13S (OU-1A) VAPOR INTRUSION RISK CONTOURS

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

APPENDIX A

LIST OF DOCUMENTS REVIEWED

IRP Site 1 (OU-3)
Investigation Documents
Brown and Caldwell (BC), 1985. Initial Assessment Study of Marine Corps Air Station Tustin, California. Prepared for Naval Energy and Environmental Support Activity. September.
Jacobs Engineering Group (JEG), 1993. Marine Corps Air Station Tustin, California, Final Site Inspection Report. Prepared for Southwest Division Naval Facilities Engineering Command. 12 March.
Bechtel National, Inc. (BNI), 1996. Final Remedial Investigation Report for Operable Unit 3, Marine Corps Air Station, Tustin, California. July.
Feasibility Study
BNI, 1997. Final Feasibility Study Report for Operable Unit 3, Former Marine Corps Air Station, Tustin, California. September.
Risk Assessment
BNI, 1996. Final Remedial Investigation Report for Operable Unit 3, Marine Corps Air Station, Tustin, California. Appendix G. July.
Decision Documents
Department of the Navy (DoN), 2001. Final Record of Decision/Remedial Action Plan, Operable Unit-3, Moffett Trenches and Crash Crew Burn Pits Site, Marine Corps Air Station, Tustin, California. December.
Remedial Design Documents
n/a
Remedial Implementation Documents
Bechtel Environmental, Inc. (BEI), 2003. Final Operation and Maintenance Plan, Operable Unit 3, Marine Corps Air Station Tustin, Orange County California. May.
Performance Monitoring Documents
BNI, 1999. Final 1998 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
_____, 2000. Final 1999 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. November.
_____, 2001. Final 2000 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
BEI, 2003. Final 2001 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
Enviro Compliance Solutions, Inc. (ECS), 2008. Final 2007 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California. August.
_____, 2010. Final 2008 Annual Groundwater Progress Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California. January.
_____, 2011. Final 2009 Annual Long-Term Monitoring Report, Operable Unit 3

(OU-3), Former Marine Corps Air Station, Tustin, California. February.
_____, 2011. Final 2010 Annual Long-Term Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California. July.
Performance Review Documents
ECS, 2006. First Five-Year Review of Remedial Actions Implemented at Operable Unit 3, Former Marine Corps Air Station, Tustin, California. October.
Compliance Documents
Site inspection checklists (various)
Guidance Documents
DoN, 2004. Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Statutory Five-year Reviews. May.
United States Environmental Protection Agency (U.S. EPA), 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. Available online at http://www.epa.gov/superfund/pubs.htm. June.
Other Documents
DoN, 2002. Finding of Suitability to Lease (FOSL 3) for Carve-Out Areas 5, 6, 7, 8, 9, 10, and 11, Former Marine Corps Air Station, Tustin, California. April 26.
DoN, 2004. Finding of Suitability to Transfer (FOST 6) a Portion of Carve-Out 5 (Parcel 20, and the Lansdowne Road Portion of Parcel 40) and Carve-Out 10 (Portions of Parcels 28, 40, and 41), Former Marine Corps Air Station, Tustin, California. September.
IRP Sites 3 (OU-1B South), 12 (OU-1B North) and 13S (OU-1A)
Investigation Documents
Brown and Caldwell (BC), 1985. Initial Assessment Study of Marine Corps Air Station Tustin, California. Prepared for Naval Energy and Environmental Support Activity, July.
Jacobs Engineering Group (JEG), 1993. Marine Corps Air Station Tustin, California, Final Site Inspection Report. Prepared for Southwest Division Naval Facilities Engineering Command. 12 March.
BNI, 1997. Draft Final Remedial Investigation Report For Operable Units 1 and 2, Marine Corps Air Facility, Tustin, California. CTO 0049/1165. Bechtel National, Inc., San Diego, California. November.
_____, 1999. Final Technical Memorandum: Limited Deep Hydropunch Investigation at IRP-13S, Marine Corps Air Facility, Tustin, California. April.
Feasibility Studies
Bechtel National, Inc. (BNI), 1999a. Revised Draft Feasibility Study Report for Operable Unit 1, Marine Corps Air Facility Tustin, California. March.
BNI, 2002. Final Feasibility Study Report, Operable Unit 1B, Marine Corps Air Station, Tustin, California. January.

BEI, 2003. Final Feasibility Study Report for Operable Unit 1A, Former Marine Corps Air Station, Tustin, California. August.
Risk Assessments
BNI, 2002. Final Feasibility Study Report, Operable Unit 1B, Marine Corps Air Station, Tustin, California. Appendix F. January.
BEI, 2003. Final Feasibility Study Report for Operable Unit 1A, Former Marine Corps Air Station, Tustin, California. Appendix F. August.
Decision Documents
DoN, 2004. Final Record of Decision/Remedial Action Plan, Operable Unit 1A, Former Marine Corps Air Station, Tustin, California. October.
_____, 2004. Final Record of Decision/Remedial Action Plan, Operable Unit 1B, IRP-3 – Paint Stripper Disposal Area, IRP-12 – Drum Storage Area No. 2, Former Marine Corps Air Station, Tustin, California. October.
Remedial Design Documents
Bechtel National, Inc. (BNI), 2001a. Final Work Plan, Time Critical Removal Action, Operable Unit 1A, Marine Corps Air Station, Tustin, California. August.
Shaw Environmental, Inc. (Shaw), 2004. Final Work Plan, Soil Removal Action, Operable Unit 1A, Former MCAS Tustin, California. May 14.
Engineering/Remediation Resources Group (ERRG), 2005. Final Remedial Design/Remedial Action Work Plan (RD/RAWP), Soil Hot Spot Removal at Operable Unit 1B, Installation Restoration Program Sites IRP-3 and IRP-12, Former MCAS Tustin, California. July.
_____, 2007. Final (100% Design Submittal) Remedial Design, Hydraulic Containment With Hot Spot Removal, Operable Units 1A and 1B, Former Marine Corps Air Station, Tustin, California. Contract No. N68711-01D-6016, Delivery Order 001. June.
Remedial Implementation Documents
Shaw, 2005. Final Soil Removal Report, Operable Unit (OU) 1A, Former MCAS Tustin, California, Rev. 1. September 26.
ERRG, 2006. Final Soil Removal Report, Operable Unit 1B, Installation Restoration Program Sites 3 and 12, Former MCAS Tustin, California. December.
_____, 2008. Final Interim-Remedial Action Completion Report, Operable Units 1A and 1B Groundwater Remedy, Installation Restoration Program Sites 3, 12, and 13S, Former Marine Corps Air Station, Tustin, California. December.
_____, 2009. Final Operation and Maintenance Plan, Operable Units 1A and 1B Groundwater Remedy, Installation Restoration Program Sites 3, 12, and 13S, Former Marine Corps Air Station, Tustin, California. September.
Performance Monitoring and Evaluation Documents
BNI, 1999. Final 1998 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
_____, 2000. Final 1999 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. November.

_____, 2001. Final 2000 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
BEI, 2003c. Final 2001 Annual Basewide Groundwater Monitoring Plan, Former Marine Corps Air Facility Tustin, California. December.
Pacific Treatment Environmental Services (PTES), 2003. 2002 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Station Tustin, California. October.
Cape Environmental Management, Inc. (CAPE), 2005. Final 2004 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California. June.
_____, 2006. 2005 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California. September.
_____, 2007. Final 2006 Annual Time-Critical Removal Action Performance Evaluation Report, Operable Unit OU-1A, Former Marine Corps Air Facility Tustin, California. September.
Engineering/Remediation Resources Group (ERRG), 2008. Final First Quarter 2008 Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and Operable Unit 1B (IRP-3 and IRP-12), Former Marine Corps Air Station, Tustin, California. July.
_____, 2008. Final Second Quarter 2008 Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and Operable Unit 1B (IRP-3 and IRP-12), Former Marine Corps Air Station, Tustin, California. October.
Enviro Compliance Solutions, Inc. (ECS), 2010. Final 2008 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12); and Final 2007 Fourth Quarter Groundwater Monitoring Data Summary, Operable Unit 1A (IRP-13S) and UST Site 222, Former Marine Corps Air Station, Tustin, California. February.
_____, 2010. Final 2009 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12Former Marine Corps Air Station, Tustin, California. November.
_____, 2011. Final 2009 Annual Long-Term Monitoring Report, Operable Unit 3 (OU-3), Former Marine Corps Air Station, Tustin, California. February.
_____, 2011. Draft 2010 Annual Performance Evaluation, Groundwater Remedy, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12 Former Marine Corps Air Station, Tustin, California. June.
Performance Review Documents
ECS, 2010. Final Operating Properly and Successfully Demonstration, Groundwater Remedial Action, Operable Units 1A (IRP-13S) and 1B (IRP-3 and -12), Former Marine Corps Air Station, Tustin, California. February.
Compliance Documents
Enviro Compliance Solutions, Inc. (ECS), 2010c. Final Soil Removal Activities Closure Report, Former Underground Storage Tank (UST) Site 29A, Former Marine Corps Air Station, Tustin, California. June.

International Technologies, Inc. (IT), 2000. Final Memorandum Remedial Activities for Site TOW-X3. November 14.
Jacobs Engineering Group (JEG), 1993. Marine Corps Air Station Tustin, California, Underground Storage Tanks Preliminary Draft Monitoring Plan. In association with International Technology Corporation and CH2M Hill. 22 February.
James M. Montgomery Consulting Engineers, Inc. (JMM), 1988. MCAS Tustin Fuel Farm Area Remedial Investigation. Prepared for Western Division Naval Facilities Engineering Command. July
Columbus Square Homeowners Association 2010 Land-Use Controls Compliance Certificate (Appendix B of this report)
Guidance Documents
DoN, 2004. Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Statutory Five-year Reviews. May.
United States Environmental Protection Agency (U.S. EPA), 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. Available online at http://www.epa.gov/superfund/pubs.htm. June.
Effluent Discharge Permits
Orange County Sanitation District (OCSD), 2007. Special Purpose Discharge Permit Number 57-256. Issued to DoD Navy BRAC PMO West - North - 15650 ½ Armstrong Avenue, Tustin, California 92782. April 30.
_____, 2007. Special Purpose Discharge Permit Number 57-270. Issued to DoD Navy BRAC PMO West –South – 15951 ½ Tustin Ranch Road, Tustin, California 92782. December 21.
Other: Capture Zone Evaluation
Seaburn, Gerald, E., 1989. The Capture-Zone Method for the Recovery System Design in Proceedings of the 1989 Georgia Water Resources Conferences, Institute of Natural Resources, University of Georgia, Athens, GA. May
U.S. EPA, 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, Final Project Report. U.S. EPA 600/R-08/003. January. Available online at: http://www.epa.gov/ada/download/reports/600R08003/600R08003.pdf
Driscoll, F. G., 1986. Ground water and wells: Edward E. Johnson Co., St. Paul, Minnesota, 1089 p.
Other: Vapor Intrusion Evaluation
Environmental Quality Management, Inc. (EQM), 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings; report prepared for U.S. EPA Office of Emergency and Remedial Response. February 22. Available online at: http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm
Johnson, P. C, and R. A. Ettinger, 1991. Heuristic model for predicting the intrusion rate of contaminant vapors in buildings. Environ. Sci. Technol. 25: 1445-1452.

Other: Groundwater Contaminant Attenuation
Tardiff, M.F. and Katzman, D., 2007. Estimating contaminant attenuation half-lives in alluvial groundwater systems. Journal of Environmental Monitoring; Royal Society of Chemistry. February.
Other: Toxicity of 1,2,3-Trichloropropane
United States Environmental Protection Agency (U.S. EPA), 2009. Toxicological Review of 1,2,3-Trichloropropane (CAS No. 96-18-4) In Support of Summary Information on the Integrated Risk Information System (IRIS). September. Available online at http://www.epa.gov/iris/toxreviews/0200tr.pdf
Basewide and Other Documents
Argonne National Laboratory (ANL), 1994. Draft Report: Geology, Hydrogeology, and Site History at the Marine Corps Air Station Tustin, California. Applied Geosciences and Environmental Management Section, Environmental Research Division. August.
_____, 1995. Final Report: Phase II Investigation for Expedited Site Characterization for Marine Corps Air Station Tustin, California. Applied Geosciences and Environmental Management Section, Environmental Research Division. October.
Bechtel National, Inc. (BNI), 1998. Draft Technical Memorandum: TCE-In-Soil Confirmation Sampling, Pilot-Scale Extraction Test, Bench-Scale Column Test, and Model Sensitivity Analysis, Marine Corps Air Facility Tustin, California. Prepared for Southwest Division Naval Facilities Engineering Command. March
_____, 1999. Draft Final Technical Memorandum: Pilot-Scale Vacuum-Enhanced Extraction Test. Marine Corps Air Facility Tustin, California. June.
Department of Navy (DoN), 1999. Southwest Division, Naval Facilities Engineering Command (SWDIV). Federal Facility Site Remediation Agreement signed between the Department of the Navy and the State of California Environmental Protection Agency Department of Toxic Substances Control. August 18.
DoN, 2010. Draft Finding of Suitability to Transfer #9 (FOST 9) for Parcels 1A, 1B, 2A, 16A, 16B, 17A, 19A, 19B, 22A, 40A, 40B, and Carve Out 6, Former Marine Corps Air Station, Tustin, California. May.
OHM Remediation Services, Inc. (OHM), 1997. Final Supplemental Removal Action Work Plan for Soil Removal Actions at IRP-2 (Oil Disposal Areas) and IRP-9 (Hangar No. 1 Line Shacks). April.
_____, 1997. Site Assessment /Closure Report, Former IRP-16B, Marine Corps Air Station (MCAS) Tustin, Tustin, California. 10 September.
_____, 1999. Draft Closure Repot, Soil Removal Actions at Sites IRP-9A (Hanger No. 1 Line Shacks, Subareas 1 and 2) and IRP-9B (Apron 1, Subareas 1 and 3), Marine Corps Air Facility, Tustin, California. April
_____, 2001. Final Memorandum Remedial Activities for Site TOW-X4. June 22

APPENDIX B

LAND USE CONTROLS COMPLIANCE CERTIFICATES

COPY

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) NO

If for an annual inspection, this evaluation covers the period from through 1/16/2008 through 5/20/2009

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) ~~No activities that could expose groundwater~~ within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) ~~No altering, disturbing, or removing groundwater~~ monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

COPY

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

For the Board of Directors

Jan Ch, JDN Ceraole 5/19/2009

Signature 949-448-6000 Date

Notes:

a A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

b Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

c A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

(CC)

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) NO

If for an annual inspection, this evaluation covers the period from through 1/16/2008 through 5/20/2009

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

COPY

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

For the Board of Directors

Jon Cenok, JON Cenok 5/19/2009

Signature Date

949-448-6000

Notes:

a A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

b Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

c A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Attachment 2
Land Use Controls Compliance Certificate
Carve Out 5
Operable Unit (OU) 1A and 1B; Installation Restoration Program (IRP) Sites 13S and 12
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: United States Navy

This evaluation is the final Navy certification just prior to site conveyance (yes or no) No____

If for an annual inspection, this evaluation covers the period from through January 1, 2008 to December 31, 2008

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	■	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	■	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	■	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	■	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	■	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	■	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	■	☐	☐

Comments:

Exhibit A (continued)
Land Use Controls Compliance Certificate
Carve Out 5
Operable Unit (OU) 1A and 1B; Installation Restoration Program (IRP) Sites 13S and 12
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature

5/21/09
Date

Notes:

a A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __" and the Quitclaim Deed.

b A property owner may seek a variance or termination of restrictions on the property contained in the state "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __."

c A property owner may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3348

Attachment 2
Land Use Controls Compliance Certificate
Carve Out 6
Operable Unit (OU) 1B; Installation Restoration Program (IRP) Site 3
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: United States Navy

This evaluation is the final Navy certification just prior to site conveyance (yes or no) No____

If for an annual inspection, this evaluation covers the period from through January 1, 2008 to December 31, 2008

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	■	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	■	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	■	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	■	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	■	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	■	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	■	☐	☐

Comments:

Exhibit A (continued)
Land Use Controls Compliance Certificate
Carve Out 6
Operable Unit (OU) 1B; Installation Restoration Program (IRP) Site 3
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature

5/21/09
Date

Notes:

a A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __" and the Quitclaim Deed.

b A property owner may seek a variance or termination of restrictions on the property contained in the state "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __."

c A property owner may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3348

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) NO

If for an annual inspection, this evaluation covers the period from through 5/21/2009 to 12/31/2009

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature

1/15/2010
Date

Notes:

[a] A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property - Former Marine Corps Air Station - Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

[b] Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property - Former Marine Corps Air Station - Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

[c] A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Exhibit E
Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) NO

If for an annual inspection, this evaluation covers the period from through 5/21/2009 to 12/31/2009

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

Exhibit E (continued)
Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature

1/15/2010
Date

Notes:

[a] A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

[b] Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

[c] A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Exhibit E
Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) NO

If for an annual inspection, this evaluation covers the period from through 1/1/2010 to 12/31/2010

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan City of Tustin "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

Exhibit E (continued)
Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1A
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

On Behalf of the Board,

Signature: Jon Cerwick, Merit Property Mgt. Date: 1/14/2011

949-448-6080

Notes:

a. A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

b. Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1A" and the Quitclaim Deed.

c. A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: Columbus Square Community Association

This evaluation is the final Navy certification just prior to site conveyance (yes or no) No

If for an annual inspection, this evaluation covers the period from through 1/1/2010 to 12/31/2010

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	☒	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	☒	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	☒	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	☒	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	☒	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	☒	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	☒	☐	☐

Comments:

Land Use Controls Compliance Certificate
Early Transfer Parcel 24-1B
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

On Behalf of the Board,

Signature JON Cernok, Merit Property Mgt 949-448-6080 Date 1/14/2011

Notes:

a. A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

b. Future property owner(s) may apply for a written variance from the restrictions in accordance with the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Early Transfer Parcel ETP 24-1B" and the Quitclaim Deed.

c. A property owner(s) may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Attachment 2
Land Use Controls Compliance Certificate
Carve Out 5
Operable Unit (OU) 1A and 1B; Installation Restoration Program (IRP) Sites 13S and 12
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: **United States Navy**

This evaluation is the final Navy certification just prior to site conveyance (yes or no) **No**

If for an annual inspection, this evaluation covers the period from through **January 1, 2010 to December 31, 2010**

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	■	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	■	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	■	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	■	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	■	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	■	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	■	☐	☐

Comments:

Exhibit A (continued)
Land Use Controls Compliance Certificate
Carve Out 5
Operable Unit (OU) 1A and 1B; Installation Restoration Program (IRP) Sites 13S and 12
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature _____ Date 1/12/11

Notes:

a A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __" and the Quitclaim Deed.

b A property owner may seek a variance or termination of restrictions on the property contained in the state "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __."

c A property owner may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3348

Attachment 2
Land Use Controls Compliance Certificate
Carve Out 6
Operable Unit (OU) 1B; Installation Restoration Program (IRP) Site 3
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

Property Owner[a]: **United States Navy**

This evaluation is the final Navy certification just prior to site conveyance (yes or no) **No**

If for an annual inspection, this evaluation covers the period from through **January 1, 2010 to December 31, 2010**

Checklist

	In Compliance	Non-Compliance	See Comment
1) No installation of new groundwater wells of any type within the area requiring institutional controls.[b,c]	■	☐	☐
2) No activities that could expose groundwater within the area requiring institutional controls.[b,c]	■	☐	☐
3) No groundwater use for any purpose (including, but not limited to, human consumption, irrigation, heating/cooling purposes, and other industrial processes).[b,c]	■	☐	☐
4) No altering, disturbing, or removing groundwater monitoring wells and associated equipment within the area requiring institutional controls.[b,c]	■	☐	☐
5) No installation of structure or improvement that has the potential to affect plume migration within the area requiring institutional controls.[b,c]	■	☐	☐
6) No construction and/or operation within the area requiring institutional controls that interfere with ongoing monitoring or assessment work, or the final remedy being conducted by Department of the Navy, or the Federal, State, or local regulatory agencies.[b,c]	■	☐	☐
7) Parcel use consistent with Specific Plan/Reuse Plan. City of Tustin. "Draft MCAS Tustin Specific Plan/ Reuse Plan" (original July 1996, errata September 1998).	■	☐	☐

Comments:

Exhibit A (continued)
Land Use Controls Compliance Certificate
Carve Out 6
Operable Unit (OU) 1B; Installation Restoration Program (IRP) Site 3
Former Marine Corps Air Station Tustin
EPA I.D. Number: CA9170090022

I, the undersigned, hereby certify that the above-described land use restrictions have been complied with for the period noted. Alternately, any known deficiencies and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiencies.

Signature _____ Date 1/12/11

Notes:

[a] A Homeowners Association may submit this form on behalf of all Property Owners, whose property is subject to the "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __" and the Quitclaim Deed.

[b] A property owner may seek a variance or termination of restrictions on the property contained in the state "Covenant to Restrict Use of Property – Former Marine Corps Air Station – Parcel __."

[c] A property owner may seek a variance or termination of restrictions on the property contained in the Quitclaim Deed pursuant to the variance and termination provisions in that document.

Mail completed form(s) to the DON, U.S. Environmental Protection Agency (EPA), Department of Toxic Substances Control (DTSC), and Regional Water Quality Control Board (RWQCB) by January 15th of each calendar year.

Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

Department of Toxic Substances Control
Office of Military Facilities
5796 Corporate Avenue
Cypress, CA 90630

U.S. Environmental Protection Agency
Superfund (SDF 8-1) Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Santa Ana Regional Water Quality
Control Board
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3348

Table 5-2
Institutional Controls Annual Field Inspection Log (for Transferee use)

Land-Use Restriction Checklist: **Provide descriptions and comments on separate pieces of paper and attach.**

Inspected by: DOUG ANDERSON
CITY OF TUSTIN
300 CENTENNIAL WAY, TUSTIN, CA 92807
(name, affiliation, address, and telephone number)

Date: 1/5/09

1. Structures in the area containing the containment remedy:

   Is the area containing the containment remedy being used as a residence, hospital for humans, a school for persons under 21 years of age, a day care center for children, or any permanently occupied human habitation other than those used for industrial purposes? YES / NO (circle one). If yes, describe.

   Has there been any construction of facilities or structures, or appurtenances on the surface of the area containing the containment remedy since the last inspection? YES / NO (circle one).

   If yes, was prior written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, was construction conducted in accordance with the approved plan?

2. Land-disturbing activities and potential for damaging the geotextile liner (excavations greater than 5 feet below ground surface):

   Is there evidence of land-disturbing activity on the surface of the area containing the containment remedy? YES / NO (circle one). If yes, what was the depth of the excavation? _____ feet.

   If the excavation was greater than 5 feet below ground surface:

   (a) Was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one).

   (b) Was the excavation undertaken in accordance with any and all applicable conditions of approval? YES / NO (circle one).

   (c) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (d) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____. At what depth below land surface was it encountered? _____. Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

3. Land-disturbing activities and potential for damaging the geotextile liner (shallow excavations to a depth not greater than 5 feet below the ground surface, or to the geotextile liner, whichever is closer to the ground surface):

   If the excavation was to a depth not greater than 5 feet below the ground surface:

   (a) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (b) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____. At what depth below ground surface was it encountered? _____. Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

Exhibit D
Institutional Controls Annual
Field Inspection Log

Table 5-2 (continued)

4. Irrigation and landscaping activities:

Is there evidence of irrigation, landscaping, or planting activities within the area of the containment remedy? YES / NO (circle one).

If yes, was an irrigation and landscaping plan submitted, reviewed, and approved in writing by the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity prior to conducting this activity? YES / NO (circle one). Describe.

If yes, were the irrigation, landscaping, and planting activities conducted in accordance with the approved plan? YES

5. Groundwater extraction:

Has any groundwater been extracted within the area of the containment remedy? YES / NO (circle one).

Are there any new groundwater wells installed within the area of the containment remedy since the last inspection? YES / NO (circle one).

If yes, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

If yes, were the wells installed in accordance with any applicable conditions of approval?

6. Monitoring equipment:

Have any of the following items located within the area of the containment remedy been removed or damaged: French drain system, sumps, monitoring wells and associated monitoring equipment, survey monuments, landfill gas probes, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

If yes, were they removed or managed in accordance with any applicable conditions of approval?

7. Adjacent monitoring equipment:

Have any of the following items located adjacent to the area of the containment remedy been removed or damaged: monitoring wells and associated monitoring equipment, survey monuments, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

If yes, were they removed or managed in accordance with any applicable conditions of approval?

I hereby certify that the information contained in this report is true and accurate based upon information and belief following a reasonable inquiry.

Name: CHRISTINE SHINGLETON

Signature: C Shingleton

Title: ASSISTANT CITY MANAGER

Date: 1-5-09

Acronyms/Abbreviations:

DON – Department of the Navy
DTSC – (California Environmental Protection Agency) Department of Toxic Substances Control
RWQCB – (California) Regional Water Quality Control Board

Exhibit D
Institutional Controls Annual
Field Inspection Log

Table 5-2
Institutional Controls Annual Field Inspection Log (for Transferee use)

Land-Use Restriction Checklist: **Provide descriptions and comments on separate pieces of paper and attach.**

Inspected by: DOUG ANDERSON Date: 1/7/2010
CITY OF TUSTIN
300 CONTENNIAL WAY, TUSTIN, CA 92780
(name, affiliation, address, and telephone number)

1. Structures in the area containing the containment remedy:

   Is the area containing the containment remedy being used as a residence, hospital for humans, a school for persons under 21 years of age, a day care center for children, or any permanently occupied human habitation other than those used for industrial purposes? YES / NO (circle one). If yes, describe.

   Has there been any construction of facilities or structures, or appurtenances on the surface of the area containing the containment remedy since the last inspection? YES / NO (circle one).

   If yes, was prior written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, was construction conducted in accordance with the approved plan?

2. Land-disturbing activities and potential for damaging the geotextile liner (excavations greater than 5 feet below ground surface):

   Is there evidence of land-disturbing activity on the surface of the area containing the containment remedy? YES / NO (circle one). If yes, what was the depth of the excavation? _____ feet.

   If the excavation was greater than 5 feet below ground surface:

   (a) Was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one).

   (b) Was the excavation undertaken in accordance with any and all applicable conditions of approval? YES / NO (circle one).

   (c) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (d) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____. At what depth below land surface was it encountered? _____ Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

3. Land-disturbing activities and potential for damaging the geotextile liner (shallow excavations to a depth not greater than 5 feet below the ground surface, or to the geotextile liner, whichever is closer to the ground surface):

   If the excavation was to a depth not greater than 5 feet below the ground surface:

   (a) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (b) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____. At what depth below ground surface was it encountered? _____. Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

Exhibit D
Institutional Controls Annual
Field Inspection Log

Table 5-2 (continued)

4. Irrigation and landscaping activities:

   Is there evidence of irrigation, landscaping, or planting activities within the area of the containment remedy? YES / NO (circle one).

   If yes, was an irrigation and landscaping plan submitted, reviewed, and approved in writing by the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity prior to conducting this activity? YES / NO (circle one). Describe.

   If yes, were the irrigation, landscaping, and planting activities conducted in accordance with the approved plan? YES

5. Groundwater extraction:

   Has any groundwater been extracted within the area of the containment remedy? YES / NO (circle one).

   Are there any new groundwater wells installed within the area of the containment remedy since the last inspection? YES / NO (circle one).

   If yes, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were the wells installed in accordance with any applicable conditions of approval?

6. Monitoring equipment:

   Have any of the following items located within the area of the containment remedy been removed or damaged: French drain system, sumps, monitoring wells and associated monitoring equipment, survey monuments, landfill gas probes, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

   If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were they removed or managed in accordance with any applicable conditions of approval?

7. Adjacent monitoring equipment:

   Have any of the following items located adjacent to the area of the containment remedy been removed or damaged: monitoring wells and associated monitoring equipment, survey monuments, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

   If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were they removed or managed in accordance with any applicable conditions of approval?

I hereby certify that the information contained in this report is true and accurate based upon information and belief following a reasonable inquiry.

Name: Christine Shingleton

Signature: Christine Shingleton

Title: Assistant City Manager

Date: 1-11-10

Acronyms/Abbreviations:

DON – Department of the Navy
DTSC – (California Environmental Protection Agency) Department of Toxic Substances Control
RWQCB – (California) Regional Water Quality Control Board

Exhibit D
Institutional Controls Annual Field Inspection Log

Table 5-2
Institutional Controls Annual Field Inspection Log (for Transferee use)

Land-Use Restriction Checklist: **Provide descriptions and comments on separate pieces of paper and attach.**

Inspected by: Doug Anderson
City of Tustin
300 Centennial Way, Tustin, CA 92807

Date: 1/7/2011

(name, affiliation, address, and telephone number)

1. Structures in the area containing the containment remedy:

   Is the area containing the containment remedy being used as a residence, hospital for humans, a school for persons under 21 years of age, a day care center for children, or any permanently occupied human habitation other than those used for industrial purposes? YES / NO (circle one). If yes, describe.

   Has there been any construction of facilities or structures, or appurtenances on the surface of the area containing the containment remedy since the last inspection? YES / NO (circle one).

   If yes, was prior written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, was construction conducted in accordance with the approved plan?

2. Land-disturbing activities and potential for damaging the geotextile liner (excavations greater than 5 feet below ground surface):

   Is there evidence of land-disturbing activity on the surface of the area containing the containment remedy? YES / NO (circle one). If yes, what was the depth of the excavation? _____ feet.

   If the excavation was greater than 5 feet below ground surface:

   (a) Was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one).

   (b) Was the excavation undertaken in accordance with any and all applicable conditions of approval? YES / NO (circle one).

   (c) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (d) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____ At what depth below land surface was it encountered? _____ Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

3. Land-disturbing activities and potential for damaging the geotextile liner (shallow excavations to a depth not greater than 5 feet below the ground surface, or to the geotextile liner, whichever is closer to the ground surface):

   If the excavation was to a depth not greater than 5 feet below the ground surface:

   (a) Were necessary measures taken to locate the depth of the geotextile liner prior to the excavation to prevent damage to the geotextile liner? YES / NO (circle one).

   (b) Was the geotextile liner or waste encountered in the course of any excavation? YES / NO (circle one). If yes, when did it occur (date, time)? _____ At what depth below ground surface was it encountered? _____ Was the excavation stopped immediately? YES / NO (circle one). Were the DON, DTSC, and RWQCB notified by the party responsible for the excavation? YES / NO (circle one). If yes, describe how and when the notifications occurred.

Exhibit D
Institutional Controls Annual
Field Inspection Log

Table 5-2 (continued)

4. Irrigation and landscaping activities:

   Is there evidence of irrigation, landscaping, or planting activities within the area of the containment remedy? YES / NO (circle one).

   If yes, was an irrigation and landscaping plan submitted, reviewed, and approved in writing by the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity prior to conducting this activity? YES / NO (circle one). Describe.

   If yes, were the irrigation, landscaping, and planting activities conducted in accordance with the approved plan? yes

5. Groundwater extraction:

   Has any groundwater been extracted within the area of the containment remedy? YES / NO (circle one).

   Are there any new groundwater wells installed within the area of the containment remedy since the last inspection? YES / NO (circle one).

   If yes, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were the wells installed in accordance with any applicable conditions of approval?

6. Monitoring equipment:

   Have any of the following items located within the area of the containment remedy been removed or damaged: French drain system, sumps, monitoring wells and associated monitoring equipment, survey monuments, landfill gas probes, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

   If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were they removed or managed in accordance with any applicable conditions of approval?

7. Adjacent monitoring equipment:

   Have any of the following items located adjacent to the area of the containment remedy been removed or damaged: monitoring wells and associated monitoring equipment, survey monuments, signs describing use restrictions, fencing, or other related equipment? YES / NO (circle one).

   If they were removed or damaged, was prior review and written approval obtained from the DON, DTSC, RWQCB, and other regulatory agencies that have jurisdiction over the proposed activity? YES / NO (circle one). Describe.

   If yes, were they removed or managed in accordance with any applicable conditions of approval?

I hereby certify that the information contained in this report is true and accurate based upon information and belief following a reasonable inquiry.

Name: CHRISTINE SHINGLETON

Signature: Christine Shingleton

Title: ASSISTANT CITY MANAGER

Date: 1-10-2011

Acronyms/Abbreviations:

DON – Department of the Navy
DTSC – (California Environmental Protection Agency) Department of Toxic Substances Control
RWQCB – (California) Regional Water Quality Control Board

Exhibit D
Institutional Controls Annual Field Inspection Log

APPENDIX C

SITE INSPECTION CHECKLISTS

CERCLA FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site name: Former MCAS Tustin – IRP Site 1 (OU-3)	**Date of inspection:** 4-11-11
Location and Region: Tustin, CA	**EPA ID:**
Agency, office, or company leading the five-year review: NAVY	**Weather/temperature:** Clear/60's

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other _____
- ☐ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. SITE INTERVIEWS (Check all that apply)

1. **O&M site manager** N/A – _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

2. **O&M staff** N/A _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   Agency N/A
   Contact _____ _____ _____ _____
   Name Title Date Phone no.
   Problems; suggestions; G Report attached _____

   Agency _____
   Contact _____ _____ _____ _____
   Name Title Date Phone no.
   Problems; suggestions; G Report attached _____

4. **Other site interviews** (optional) ☐ Report attached. N/A.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

☒ O&M manual	☒ Readily available	☐ Up to date	☐ N/A
☒ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☐ Up to date	☐ N/A

Remarks As-built drawings are not part of O&M Manual. Available at El Toro Library

2. Site-Specific Health and Safety Plan ☒ Readily available ☐ Up to date ☐ N/A
Contingency plan/emergency response plan ☒ Readily available ☐ Up to date ☐ N/A
Remarks

3. O&M and OSHA Training Records ☒ Readily available ☐ Up to date ☐ N/A
Remarks

4. Permits and Service Agreements

Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
Other permits	☐ Readily available	☐ Up to date	☒ N/A

Remarks

5. Gas Generation Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6. Settlement Monument Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

7. Groundwater Monitoring Records ☒ Readily available ☐ Up to date ☐ N/A
Remarks

8. Leachate Extraction Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. Discharge Compliance Records

Air ☐ Readily available ☐ Up to date ☒ N/A

Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A

Remarks_____

10. Daily Access/Security Logs ☒ Readily available ☐ Up to date ☐ N/A

Remarks:

Site is inspected on a quarterly basis, or after significant rain events (>2")

IV. O&M COSTS

1. O&M Organization

☐ State in-house ☐ Contractor for State

☐ PRP in-house ☐ Contractor for PRP

☐ Federal Facility in-house ☐ Contractor for Federal Facility

Other_____

2. O&M Cost Records

☐ Readily available ☐ Up to date

☒ Funding mechanism/agreement in place

Original O&M cost estimate N/A ☐ Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons:

N/A

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ **Applicable** ☐ **N/A**

A. Fencing

1. Fencing damaged ☐ Location shown on site map ☐ Gates secured ☒ N/A ☐

Remarks

B. Other Access Restrictions

1. Signs and other security measures ☒ Location shown on site map ☐ N/A

Remarks Signs posted at optimal locations around the perimeter of the site.

C. Institutional Controls (ICs)

1. Implementation and enforcement

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by) Self-reporting

Frequency annually

Responsible party/agency Navy

Contact Jim Callian (Name) BEC (Title) N/A (Date) 619-532-0952 (Phone no.)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. Land use changes on site ☒ N/A
Remarks

3. Land use changes off site ☒ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1. Roads damaged ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident
Areal extent _____ Depth _____
Remarks

2. Cracks ☐ Location shown on site map ☒ Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____

3. Erosion ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks Erosion/inspections performed quarterly

4. Holes ☐ Location shown on site map ☒ Holes not evident
Areal extent_____ Depth_____
Remarks Hole (rodents, etc.) are backfilled as part of quarterly inspections

5. Vegetative Cover ☐ Grass ☒ Cover properly established ☒ No signs of stress
G Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. Alternative Cover (armored rock, concrete, etc.) ☐ N/A
Remarks Containment wall along eastern boundary has minor structural cracks. No visible leakage to surface water.

7. Bulges ☐ Location shown on site map ☒ Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. Wet Areas/Water Damage ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____

9. Slope Instability ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. Flows Bypass Bench ☐ Location shown on site map ☒ N/A or okay
Remarks

2. Bench Breached ☐ Location shown on site map ☒ N/A or okay
Remarks

3. Bench Overtopped ☐ Location shown on site map ☒ N/A or okay
Remarks

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. Settlement ☐ Location shown on site map ☐ No evidence of settlement
Areal extent Depth
Remarks

2. Material Degradation ☐ Location shown on site map ☐ No evidence of degradation
Material type Areal extent
Remarks

3. Erosion ☐ Location shown on site map ☐ No evidence of erosion
Areal extent Depth
Remarks

4. Undercutting ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent Depth
Remarks

5. Obstructions Type ☐ No obstructions
☐ Location shown on site map Areal extent
Size
Remarks

6. ~~Excessive Vegetative Growth~~ Type_____

☐ ~~No evidence of excessive growth~~

☐ ~~Vegetation in channels does not obstruct flow~~ RB

☐ ~~Location shown on site map~~ ~~Areal extent~~ _____

Remarks_____

D. Cover Penetrations ☒ Applicable ☐ N/A

1. Gas Vents ☐ Active ☐ Passive

☐ Properly secured/locked G Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance

☒ N/A

Remarks_____

2. Gas Monitoring Probes

☐ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks Monitored quarterly

3. Monitoring Wells (within surface area of landfill)

☐ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks Sampled quarterly

4. Leachate Extraction Wells

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A

Remarks_____

5. Settlement Monuments ☐ Located ☐ Routinely surveyed ☒ N/A

Remarks_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. Gas Treatment Facilities

☐ ~~Flaring~~ RB ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ ~~Needs Maintenance~~

Remarks_____

2. Gas Collection Wells, Manifolds and Piping

☐ Good condition ☐ Needs Maintenance

Remarks_____

3. Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs Maintenance ☐ N/A

Remarks_____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. Outlet Pipes Inspected ☐ Functioning ☐ N/A

Remarks_____

2. Outlet Rock Inspected ☐ Functioning ☐ N/A

Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. Siltation Areal extent_____ Depth_____ ☐ N/A

☐ Siltation not evident

Remarks_____

2. Erosion Areal extent_____ Depth_____

☐ Erosion not evident

Remarks_____

3. Outlet Works ☐ Functioning ☐ N/A

Remarks_____

4. Dam ☐ Functioning ☐ N/A

Remarks_____

H. Retaining Walls ☐ Applicable ☒ N/A

1. Deformations ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement_____ Vertical displacement_____

Rotational displacement_____

Remarks_____

2. Degradation ☐ Location shown on site map ☐ Degradation not evident
Remarks

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. Siltation ☐ Location shown on site map ☒ Siltation not evident
Areal extent Depth
Remarks

2. Vegetative Growth ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent Type
Remarks

3. Erosion ☐ Location shown on site map ☒ Erosion not evident
Areal extent Depth
Remarks

4. Discharge Structure ☒ Functioning ☐ N/A
Remarks

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. Settlement ☐ Location shown on site map ☐ Settlement not evident
Areal extent Depth
Remarks

2. Performance Monitoring Type of monitoring
☐ Performance not monitored
Frequency ☐ Evidence of breaching
Head differential
Remarks

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. Pumps, Wellhead Plumbing, and Electrical
☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks

2. Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances

☐ Good condition ☐ Needs Maintenance

Remarks _____

3. Spare Parts and Equipment

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks _____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. Collection Structures, Pumps, and Electrical

☐ Good condition ☐ Needs Maintenance

Remarks _____

2. Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances

☐ Good condition ☐ Needs Maintenance

Remarks _____

3. Spare Parts and Equipment

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks _____

C. Treatment System ☐ Applicable ☒ N/A

1. Treatment Train (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters _____

☐ Additive (e.g., chelation agent, flocculent) _____

☐ Others _____

☐ Good condition ☐ Needs Maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually _____

☐ Quantity of surface water treated annually _____

Remarks _____

2. Electrical Enclosures and Panels (properly rated and functional)

☐ N/A ☐ Good condition ☐ Needs Maintenance

Remarks

3. Tanks, Vaults, Storage Vessels

☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

Remarks

4. Discharge Structure and Appurtenances

☐ N/A ☐ Good condition ☐ Needs Maintenance

Remarks

5. Treatment Building(s)

☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks

6. Monitoring Wells (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks

D. Monitoring Data

1. Monitoring Data

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:

☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. Monitoring Wells (natural attenuation remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☒ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks Sampled Annually

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy for IRP Site 1 (OU-3) is hydraulic containment with institutional controls. The groundwater, surface water, LFG monitoring data, and results of the physical inspections indicate the containment remedy is effective.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

- The quarterly inspections appear adequate for the site.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

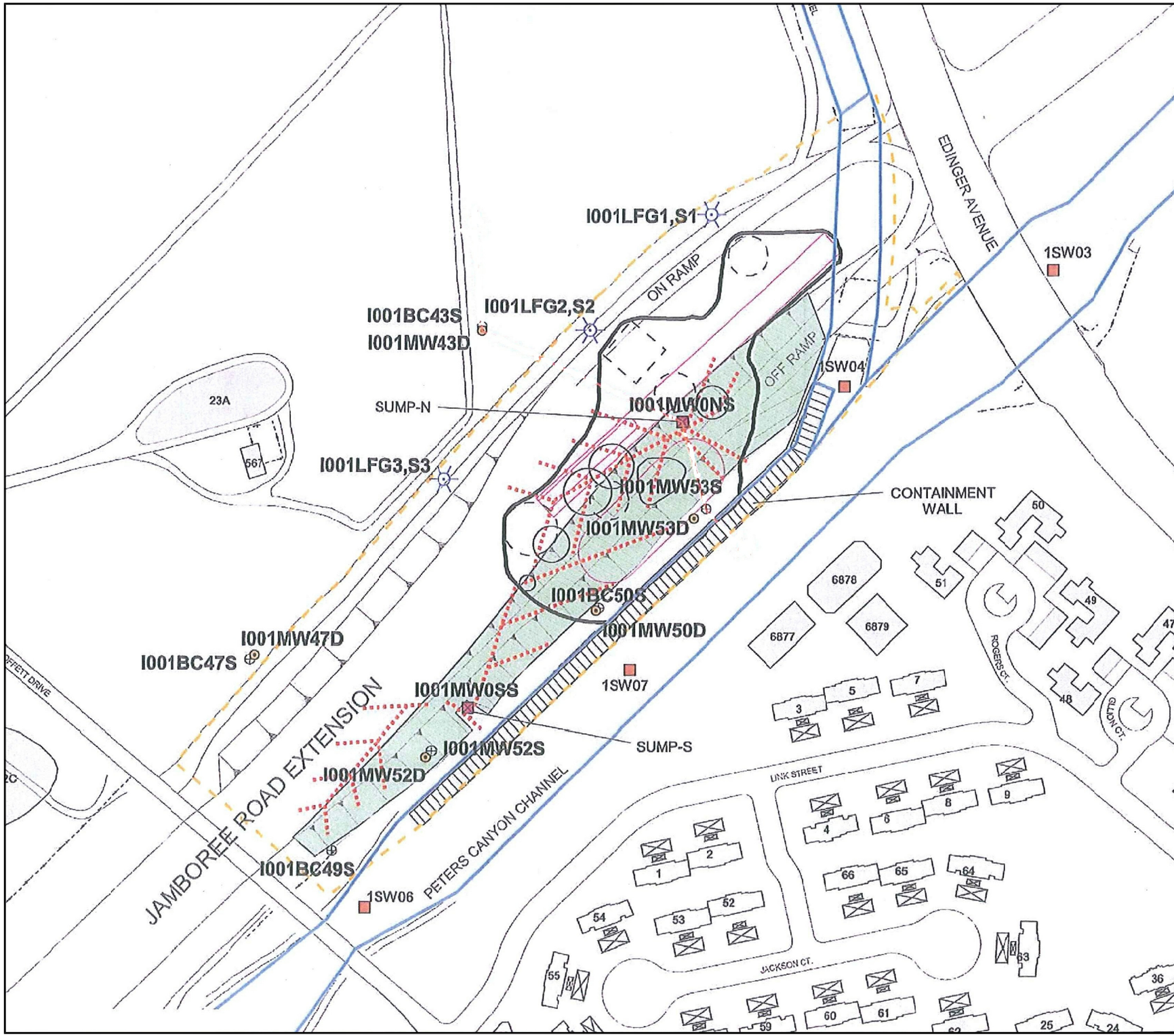
- Repairs to containment wall will increase costs to the O&M program when implemented

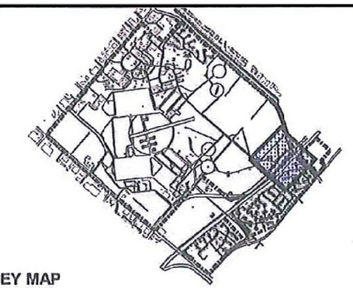
D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
The annual monitoring and quarterly inspections are adequate for the site.

CERCLA FIVE-YEAR REVIEW SITE INSPECTION
INSPECTION TEAM

1. Michael Wolff, PG, CEG
2. Rush Boynton, PG
3. Mike Deklotz





KEY MAP
-NOT TO SCALE-

LEGEND

- LANDFILL GAS MONITORING PROBE LOCATION
- FIRST WATER-BEARING ZONE (WBZ) MONITORING WELL LOCATION
- SECOND WBZ MONITORING WELL LOCATION
- SURFACE WATER MONITORING LOCATION
- SUMP
- APPROXIMATE OU-3 SITE BOUNDARY
- EXISTING ROAD OR PAVED AREA
- DRAINAGE DITCH
- BUILDING OR STRUCTURE
- AREA COVERED WITH PLASTIC LINER
- FRENCH DRAIN (CURRENT)
- TRENCH (LANDFILL)
- AREA ASSOCIATED WITH HISTORIC DISPOSAL TRENCHES OR CRASH CREW BURN PITS
- PIT
- POSSIBLE PIT
- CONTAINMENT WALL

N

GRAPHIC SCALE

80 0 20 40 80

SCALE: 1" = 80'

DRAWING MAY BE REDUCED
CHECK GRAPHIC SCALE BEFORE USING

SOURCE: OPERATION AND MAINTENANCE PLAN (BEI 2003)

FIGURE 2

Base Realignment and Closure
Program Management Office West

FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-1 (OU-3)
SITE PLAN

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
PHONE No.: 714 - 259 - 0295
FAX No.: 714 - 259 - 0296

\\ECSSVR\Company\08 - CAD_DRAWINGS\2011 5 YEAR REVIEW\OU-3 FIGURES\FIG 2_IRP Site 1 (OU-3) Site Plan.dwg

CERCLA FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site name: Former MCAS Tustin – IRP Sites 3, 12 and 13S	**Date of inspection:** 4/11/2011
Location and Region: Tustin, CA.	**EPA ID:**
Agency, office, or company leading the five-year review: Navy	**Weather/temperature:** clear/60s

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other hot spot mass removal
- ☐ Monitored natural attenuation
- ☒ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. SITE INTERVIEWS (Check all that apply)

1. **O&M site manager** Mike Deklotz (Name) Supv. Tech. (Title) 4/11/2011 (Date)

   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. 714-259-0295

   Problems, suggestions; ☐ Report attached All systems functioning correctly as of date of inspection; suggested correcting well vault inundation issue at OU-3 South (IRP Site 3)

2. **O&M staff** n/a (Name) _____ (Title) _____ (Date)

   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____

   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   Agency n/a
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone no.)
   Problems; suggestions; G Report attached _____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone no.)
   Problems; suggestions; G Report attached _____

4. **Other site interviews** (optional) ☐ Report attached. N/A

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

☒ O&M manual	☒ Readily available	☐ Up to date	☐ N/A
☒ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☐ Up to date	☐ N/A

Remarks As-built drawings on file at information repository

2. Site-Specific Health and Safety Plan ☒ Readily available ☐ Up to date ☐ N/A
Contingency plan/emergency response plan ☒ Readily available ☐ Up to date ☐ N/A
Remarks

3. O&M and OSHA Training Records ☒ Readily available ☐ Up to date ☐ N/A
Remarks

4. Permits and Service Agreements

Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
Effluent discharge	☒ Readily available	☐ Up to date	☐ N/A
Waste disposal, POTW	☐ Readily available	☐ Up to date	☐ N/A
Other permits	☐ Readily available	☐ Up to date	☐ N/A

Remarks OCSD Special Purpose Discharge Permits (2)

5. Gas Generation Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6. Settlement Monument Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

7. Groundwater Monitoring Records ☒ Readily available ☐ Up to date ☐ N/A
Remarks

8. Leachate Extraction Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. Discharge Compliance Records

Air ☐ Readily available ☐ Up to date ☒ N/A

Water (effluent) ☒ Readily available ☐ Up to date ☐ N/A

Remarks _____

10. Daily Access/Security Logs ☐ Readily available ☐ Up to date ☒ N/A

Remarks:

IV. O&M COSTS

1. O&M Organization

☐ State in-house ☐ Contractor for State

☐ PRP in-house ☐ Contractor for PRP

☐ Federal Facility in-house ☒ Contractor for Federal Facility

Other _____

2. O&M Cost Records

☐ Readily available ☐ Up to date

☒ Funding mechanism/agreement in place

Original O&M cost estimate n/a ☐ Breakdown attached

Total annual cost by year for review period if available n/a

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons:

n/a

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ **Applicable** ☐ **N/A**

A. Fencing

1. Fencing damaged ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks

B. Other Access Restrictions

1. Signs and other security measures ☐ Location shown on site map ☐ N/A

Remarks signage around perimeter fence and on treatment buildings (2)

C. Institutional Controls (ICs)

1. Implementation and enforcement

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by) Self-reporting + LUC compliance cert.

Frequency quarterly / annually

Responsible party/agency DoN

Contact James Callian — Base Env. Coord. — 619-532-0952

Name — Title — Date — Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

2. Adequacy ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks

D. General

1. Vandalism/trespassing ☐ Location shown on site map ☒ No vandalism evident

Remarks

2. Land use changes on site ☐ N/A

Remarks residential development constructed - portion of IPP Site 13S (OU-1A)

3. Land use changes off site ☐ N/A

Remarks residential/commercial developments off site in vicinity of IPP Site 3 (OU-1B South)

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks

B. Other Site Conditions

Remarks undeveloped other than (2) above

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface n/a

1. Settlement (Low spots) ☐ Location shown on site map ☐ Settlement not evident

Areal extent _____ Depth _____

Remarks

2. Cracks n/a ☐ Location shown on site map ☐ Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____

3. Erosion n/a ☐ Location shown on site map ☐ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. Holes n/a ☐ Location shown on site map ☐ Holes not evident
Areal extent_____ Depth_____
Remarks_____

5. Vegetative Cover ☐ Grass n/a ☐ Cover properly established ☐ No signs of stress
G Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. Alternative Cover (armored rock, concrete, etc.) ☒ N/A
Remarks_____

7. Bulges n/a ☐ Location shown on site map ☐ Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. Wet Areas/Water Damage ☐ Wet areas/water damage not evident n/a
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____

9. Slope Instability n/a ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. Flows Bypass Bench n/a ☐ Location shown on site map ☐ N/A or okay
Remarks

2. Bench Breached n/a ☐ Location shown on site map ☐ N/A or okay
Remarks

3. Bench Overtopped n/a ☐ Location shown on site map ☐ N/A or okay
Remarks

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. Settlement n/a ☐ Location shown on site map ☐ No evidence of settlement
Areal extent Depth
Remarks

2. Material Degradation n/a ☐ Location shown on site map ☐ No evidence of degradation
Material type Areal extent
Remarks

3. Erosion n/a ☐ Location shown on site map ☐ No evidence of erosion
Areal extent Depth
Remarks

4. Undercutting n/a ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent Depth
Remarks

5. Obstructions n/a Type ☐ No obstructions
☐ Location shown on site map Areal extent
Size
Remarks

6. Excessive Vegetative Growth n/a Type_____

☐ No evidence of excessive growth

☐ Vegetation in channels does not obstruct flow

☐ Location shown on site map Areal extent_____

Remarks_____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. Gas Vents n/a ☐ Active ☐ Passive

☐ Properly secured/locked G Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance

☐ N/A

Remarks_____

2. Gas Monitoring Probes n/a

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks_____

3. Monitoring Wells (within surface area of landfill)

☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks_____

4. Leachate Extraction Wells n/a

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks_____

5. Settlement Monuments n/a ☐ Located ☐ Routinely surveyed ☐ N/A

Remarks_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. Gas Treatment Facilities

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs Maintenance

Remarks_____

2. Gas Collection Wells, Manifolds and Piping n/a
☐ Good condition ☐ Needs Maintenance
Remarks

3. Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings) n/a
☐ Good condition ☐ Needs Maintenance ☐ N/A
Remarks

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. Outlet Pipes Inspected ☐ Functioning ☐ N/A
Remarks

2. Outlet Rock Inspected ☐ Functioning ☒ N/A
Remarks

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. Siltation Areal extent _____ Depth _____ ☒ N/A
☐ Siltation not evident
Remarks

2. Erosion n/a Areal extent _____ Depth _____
☐ Erosion not evident
Remarks

3. Outlet Works ☐ Functioning ☒ N/A
Remarks

4. Dam ☐ Functioning ☒ N/A
Remarks

H. Retaining Walls ☐ Applicable ☒ N/A

1. Deformations ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement _____ Vertical displacement _____
Rotational displacement _____
Remarks

2. Degradation n/a ☐ Location shown on site map ☐ Degradation not evident
Remarks

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. Siltation ☐ Location shown on site map ☐ Siltation not evident
Areal extent Depth
Remarks

2. Vegetative Growth ☐ Location shown on site map ☒ N/A
☐ Vegetation does not impede flow
Areal extent Type
Remarks

3. Erosion n/a ☐ Location shown on site map ☐ Erosion not evident
Areal extent Depth
Remarks

4. Discharge Structure ☐ Functioning ☒ N/A
Remarks

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. Settlement ☐ Location shown on site map ☐ Settlement not evident
Areal extent Depth
Remarks

2. Performance Monitoring Type of monitoring
☐ Performance not monitored
Frequency ☐ Evidence of breaching
Head differential
Remarks

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. Pumps, Wellhead Plumbing, and Electrical
☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks

2. Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances

☒ Good condition ☐ Needs Maintenance

Remarks

3. Spare Parts and Equipment

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. Collection Structures, Pumps, and Electrical

☐ Good condition ☐ Needs Maintenance

Remarks

2. Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances

n/a ☐ Good condition ☐ Needs Maintenance

Remarks

3. Spare Parts and Equipment n/a

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks

C. Treatment System ☒ Applicable ☐ N/A

1. Treatment Train (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☒ Carbon adsorbers

☒ Filters bag filters

☐ Additive (e.g., chelation agent, flocculent) n/a

☐ Others

☒ Good condition ☐ Needs Maintenance

☒ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☒ Equipment properly identified

☒ Quantity of groundwater treated annually in annual reports

☐ Quantity of surface water treated annually n/a

Remarks all systems in good condition

2. Electrical Enclosures and Panels (properly rated and functional)

☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks

3. Tanks, Vaults, Storage Vessels

☐ N/A ☐ Good condition ☐ Proper secondary containment ☒ Needs Maintenance

Remarks extraction well vaults at IRP Site 3 (OU-1B South) are subject to flooding during heavy rainfall

4. Discharge Structure and Appurtenances

☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks

5. Treatment Building(s)

☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks

6. Monitoring Wells (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☐ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks

D. Monitoring Data

1. Monitoring Data

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:

☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. Monitoring Wells (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Remedies at IRP Sites 3, 12 and 13S consist of groundwater hydraulic containment with hot spot mass removal. IRP Sites 12 and 13S use a combined treatment system. IRP Site 3 uses a separate treatment system. All systems appear in good condition. Remedies appear to be effective and functioning as designed

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O&M is performed pursuant to the Final OMP. O&M appears to be adequate relative to the scope as defined by the OMP.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

None noted

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
Optimization measures are routinely identified for consideration and are reported in the annual performance evaluation reports

SITE INSPECTION ROSTER

1. Michael Wolff, PG ECS, Inc.
2. Rush Boynton, PG ECS, Inc.
3. Mike DeKlotz ECS, Inc.

APPENDIX D

SITE INSPECTION PHOTOGRAPHS

PHOTO 1: IRP Site 1 – View from south to north along perimeter on west side showing perimeter fence with locked gate.

PHOTO 2: IRP Site 1 – Close-up of access restriction sign in conformance with LUCICP.

PHOTO 3: IRP Site 1 – View from south to north on east perimeter showing perimeter fence at left, and sloping reinforced concrete containment wall on west side of Peters Canyon Channel.

PHOTO 4: IRP Site 1 – View from south to north on east perimeter showing perimeter fence at right, and landscaped earthfill slope for overlying Jamboree Road. Note silt fence at toe of slope.

PHOTO 5: IRP Site 1 – French drain sump with locked steel cover on east side of earthfill embankment for Jamboree Road.

PHOTO 6: IRP Site 1 – Typical flush surface completion for groundwater monitoring well (I003MW53S) – east side of earthfill embankment for Jamboree Road.

PHOTO 7: IRP Site 1 – View from north to south showing reinforced concrete containment wall along west bank of Peters Canyon Channel. Note smooth, good condition of concrete containment wall relative to the cracked condition of the pre-existing concrete wall in foreground.

PHOTO 8: IRP Site 3 – Close-up of treatment system building.

PHOTO 9: IRP Site 3 – Interior of treatment system building. GAC vessels at left; manifold at right.

PHOTO 10: IRP Site 3 – – Interior of treatment system building. Equalization tank at left; electrical panels at right.

PHOTO 11: IRP Site 3 – Extraction well vault on northeast side of hangar. This area is subject to inundation during heavy rains caused by runoff from the hangar roof.

PHOTO 12: IRP Site 3 – Northeast side of hangar. Note gutterless lean-to roofs that create ponding of runoff on the ground in the vicinity of extraction well vaults during heavy rains.

PHOTO 13: IRP Site 3 – Southwest side of hangar with extraction well and monitoring well vaults in foreground.

PHOTO 14: IRP Site 3 – Ongoing weed abatement activities in progress.

PHOTO 15: IRP Site 12 – View looking north from south end of OU-1B North TCE plume. Monitoring well in foreground is I012MW14S.

PHOTO 16: IRP Site 12 – View looking south from IRP Site 12 towards IRP Site 3.

PHOTO 17: IRP Site 13S – View looking south from north end of TCE/1,2,3-TCP groundwater plumes. New development at left is Columbus Square.

PHOTO 18: IRP Site 13S – Close-up of reinstalled monitoring well IS72MW01SR in Columbus Square residential development shown in Photo 17.

PHOTO 19: IRP Site 13S – View looking north with Columbus Square residential development in background. Hot spot monitoring well IS72MW17S is located within the silt fence rectangle in foreground.

PHOTO 20: IRP Site 13S – Combined IRP Sites 12 and 13S treatment system building showing fencing and signage.

PHOTO 21: IRP Site 13S – Interior of combined IRP Sites 12 and 13S treatment system building showing influent equalization tank.

PHOTO 22: IRP Site 13S – Interior of combined IRP Sites 12 and 13S treatment system building showing GAC vessels. Note good housekeeping practices.

PHOTO 23: IRP Site 13S – Interior of combined IRP Sites 12 and 13S treatment system building showing main and subsidiary control panels.

PHOTO 24: IRP Site 13S – Interior of combined IRP Sites 12 and 13S treatment system building showing manifolding.

PHOTO 25: IRP Site 13S – Exterior of combined IRP Sites 12 and 13S treatment system building showing signage.

PHOTO 26: IRP Site 13S - View southwest along Armstrong Avenue down the spine of the 1,2,3-TCP plume.

APPENDIX E

INTERVIEW DOCUMENTATION

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): **Mr. James Callian**	**Title:** **BRAC Environmental Coordinator**	**Organization:** **BRAC PMO**
Telephone: (619) 532-0952 **Fax No:** **E-Mail Address: james.callian@navy.mil**		**Mailing Address:** **1455 Frazee Rd. Suite 900** **San Diego, CA 92108**
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date: 07/15/2011** / **Time:**
Type: ☐ Telephone ☐ Visit √ Other		**Interview Location:**

Contact Made By:

Name: James Callian	**Title: BRAC Environmental Coordinator**	**Organization: BRAC PMO WEST**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   Yes. As the Navy's BRAC Environmental Coordinator, one of my responsibilities is to serve as the Co-Chairman of the RAB. I am responsible for hosting regularly scheduled RAB meetings where the Navy provides information to and solicits feedback from interested members of the public on the environmental restoration activities being conducted by the Navy at MCAS Tustin. The Navy distributes and posts RAB meeting announcements and agendas, RAB meeting minutes, and other documents and information on the BRAC PMO website (http://www.bracpmo.navy.mil). Key documents are also provided for public review at the Administrative Record File and the Information repository.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   Not at this time.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   No.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): Content Arnold	**Title:** Lead Remedial Project Manager	**Organization:** BRAC PMO West
Telephone: 619.532.0790 **Fax No.:** **E-Mail Address:** content.arnold@navy.mil		**Mailing Address:** 7030 Trabuco Rd. Bldg 307 Irvine, CA 92618
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** July 6, 2011 / **Time:** 1500
Type: ☐Telephone ☐ Visit X Other		**Interview Location:**

Contact Made By:

Name:	**Title:**	**Organization:**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***
   I am the Navy's Lead Remedial Project Manager. The Navy has been proactive in providing the community with technical information related to the environmental clean-up efforts at Former MCAS Tustin. As noted above, information is provided on the BRAC PMO Website (http://www.bracpmo.navy.mil), at community RAB Meetings, and at the Administrative Record File/Information Repository. The RAB continues to meet on a regular basis throughout the year. Agendas and meeting minutes are also available at the BRAC PMO website.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   No.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***
   No specific community concerns regarding the protectiveness of the remedies have been expressed. RAB Meetings continue to be a forum for RAB and Community members to ask questions pertaining to the environmental restoration program.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***
   No.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): Rene "Louie" Cardinale	**Title:** Remedial Project Manager	**Organization:** BRAC PMO West
Telephone: 619.532.0979 **Fax No.:** **E-Mail Address:** rene.cardinale@navy.mil		**Mailing Address:** 7030 Trabuco Rd. Bldg 307 Irvine, CA 92618
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** July 7, 2011 / **Time:** 1530
Type: ☐Telephone ☐ Visit X Other		**Interview Location:**

Contact Made By:

Name:	**Title:**	**Organization:**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   I am the Navy Remedial Project Manager overseeing the Sites covered by this Five-Year Review. Information, in the form of reports regarding the remedies in place at the subject Sites are readily available at the Administrative Record File/Information Repository. The Navy provides the community with technical information, primarily in the form of presentations, related to the environmental clean-up efforts at Former MCAS Tustin at Restoration Advisory Board (RAB) meetings. Additional information can be accessed on the BRAC PMO Website (http://www.bracpmo.navy.mil). The RAB continues to meet on a regular basis throughout the year. Agendas and meeting minutes are also available at the BRAC PMO website.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   No.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   No.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): James Ricks	**Title:** Project Manager	**Organization:** U.S. Environmental Protection Agency
Telephone: (415) 972-3023 **Fax No.:** (415) 947-3520 **E-Mail Address:** ricks.james@epa.gov		**Mailing Address:** U.S. Environmental Protection Agency Region IX 75 Hawthorne Street San Francisco, California 94105-390
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** 15 July 2011 / **Time:**
Type: ☐Telephone ☐ Visit √ Other		**Interview Location:** Office
Contact Made By:		
Name: James Callian	**Title:** BEC	**Organization:**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   Access primarily via Project Managers Meetings and BRAC PMO Website.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   None: there are not any site conditions that would adversely impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   None

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***
   None

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   The U.S. Environmental Protection Agency has been and remains confident in the Navy's management of the remedies in place at IRP Sites 1, 3, 12, and 13S. The MCAS Tustin Project team continues to exercise appropriate due diligence ensuring protectiveness of the remedies at IRP Sites 1, 3, 12, and 13S.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): **Mr. John Broderick**	**Title:** **Remedial Project Manager**	**Organization:** **California Regional Water Quality Control Board, Santa Ana Region**
Telephone: (951) 782-4494 **Fax No: (951) 781-6288** **E-Mail Address:jbroderick@waterboards.ca.gov**		**Mailing Address:** **3737 Main Street Suite 500** **Riverside, CA 92501**
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date: 6/13/2011** / **Time:**
Type: √Telephone ☐ Visit ☐ Other		**Interview Location:**

Contact Made By:

Name: James Callian	**Title: BRAC Environmental Coordinator**	**Organization: BRAC PMO WEST**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   Yes.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   No.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   Track projects on RWQCB's GeoTracker website.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): Anantaramam Peddada	**Title:** Project Manager	**Organization:** Department of Toxic Substances Control
Telephone: (714) 484-5418 **Fax No:** 714 484 5437 **E-Mail Address:** Apeddada@dtsc.ca.gov		**Mailing Address:** 5796 Corporate Avenue Cypress, CA 90630
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** 6/9/2011 **Time:**
Type: ☐Telephone ☐ Visit √ Other		**Interview Location:**

Contact Made By:

Name: James Callian	**Title:** BRAC Environmental Coordinator	**Organization:** BRAC PMO WEST

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   As a Project Manager for Former MCAS Tustin I have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S. I also attended RAB meetings where this information was presented.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process); that required a response from your office? If so, please provide details of the events and results of the responses.***

   As I remember, one of the monitoring wells was damaged at IRP-13S (now Lennar property). It was not repaired for a long time; eventually however, the well was repaired.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   No. The Navy has done an excellent job in managing the remedies.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name): Mr. Matt West (Primary Contact) Mr. Dana Ogdon Mr. John Buchanan	**Title:** Redevelopment Project Manager Assistant Community Development Director Redevelopment Program Manager	**Organization:** City of Tustin City of Tustin City of Tustin
Telephone: (714) 573-3116 **Fax No.:** **E-Mail Address:** mwest@tustinca.org		**Mailing Address:** 275 Centennial Tustin, CA 92780
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** June 15, 2011 / **Time:** 2:30
Type: Telephone √ Visit Other		**Interview Location:** City of Tustin Offices

Contact Made By:

Name: James Callian	**Title:** BRAC Environmental Coordinator	**Organization:** BRAC PMO

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   Yes, primarily from the BRAC website, EnviroStor, and at RAB meetings.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process)? If so, please provide details.***

   No.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   The City would like the Navy to continue their mandate to contain the plumes within Navy property boundaries.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: Former MCAS Tustin		**EPA ID No.:** CA9170090022
Individual Contacted (Name):Christine Shingleton	**Title: Assistant City Manager**	**Organization: City of Tustin**
Telephone: **Fax No.:** **E-Mail Address:**		**Mailing Address:** **300 Centennial Way, Tustin, CA 92780**
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date: July 6, 2011** / **Time:11:00**
Type: xTelephone ☐ Visit ☐ Other		**Interview Location: telephone interview**

Contact Made By:

Name: James Callian (notes taken by M. Wolff, ECS)	**Title: BRAC Environmental Coordinator**	**Organization: BRAC PMO**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***
   Yes - Ms. Singleton accesses information through hard copy documents available at the City. Assigned staff attends RAB meetings.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***
   No.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process)? If so, please provide details.***
   No - Ms. Shingleton believes that all work has been in conformance with the PERF process.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No - City has not been contacted by concerned community members to Ms. Shingleton's knowledge.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***
   No.

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: **Former MCAS Tustin**		**EPA ID No.:** **CA9170090022**
Individual Contacted (Name): **Marsha Santry**	**Title:** **Project manager**	**Organization:** **Lennar Homes of California, Inc.**
Telephone: (949)349-8214 **Fax No.:** (949) 349-0394 **E-Mail Address:** marsha.santry@lennar.com		**Mailing Address:** 25 Enterprise, Suite 300 Aliso Viejo, CA 92656
Subject: Five-Year Review for IRP Sites 1, 3, 12, and 13S		**Date:** July 25, 2011 **Time:** 11:13 a.m.
Type: ☐Telephone ☐ Visit ☐ Other		**Interview Location:** Lennar office
Contact Made By:		
Name: James Callian	**Title:** BRAC Env. Coordinator	**Organization:** United States Navy

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?*** *Documents are mailed to us upon publication.*

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?*** *No.*

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process)? If so, please provide details.*** *No. However In 2009, in coordination with the Navy and other regulatory agencies, a work plan was created, approved & implemented to install a replacement monitoring well and deconstruct the original monitoring well.*

4. ***

5. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.*** *No.*

6. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.*** *No.*

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: **Former MCAS Tustin**		**EPA ID No.:** **CA9170090022**
Individual Contacted (Name): **Marsha Santry**	**Title:** **Project manager**	**Organization:** **Lennar Homes of California, Inc.**

INTERVIEW RECORD

FIVE-YEAR REVIEW – INSTALLATION RESTORATION PROGRAM (IRP) SITES 1, 3, 12, AND 13S

FORMER MARINE CORPS AIR STATION (MCAS) TUSTIN, CALIFORNIA

Site Name: **Former MCAS Tustin**		**EPA ID No.:** **CA9170090022**
Individual Contacted (Name): Mr. Matthew Suarez	**Title:** Campus Coordinator Advanced Technology & Education Park Irvine Valley College	**Organization:** South Orange County Community College District
Telephone: (949) 282-2726 **Fax No.:** **E-Mail Address:** msuarez@socccd.edu		**Mailing Address:** Advanced Technology & Education Park Irvine Valley College South Orange County Community College District 15445 Lansdowne Road, Tustin, CA 92782
Subject: **Five-Year Review for IRP Sites 1, 3, 12, and 13S**		**Date:** **June 3, 2011**	**Time:** **16:30**
Type: √Telephone ☐ Visit ☐ Other		**Interview Location:**

Contact Made By:

Name: James Callian	**Title: MCAS Tustin, BRAC Environmental Coordinator**	**Organization: Navy BRAC PMO**

Summary of Interview:

1. ***Do you have access to information on the remedies in place at IRP Sites 1, 3, 12, and 13S; and do you access that information (e.g., at the BRAC PMO Website, Information Repository, Administrative Record File, or at Restoration Advisory Board [RAB] Meetings)?***

   The Navy has been very generous about handing out information at RAB meetings, and I have visited the Administrative Record File in Building 307 two or more times.

2. ***Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedies implemented at IRP Sites 1, 3, 12, or 13S?***

   No, not at all.

3. ***To the best of your knowledge, have there been any violations of the land use controls at IRP Sites 1, 3, 12, and/or 13S; with the exception of previously approved activities (e.g., those approved under the Project Environmental Review Form [PERF] process)? If so, please provide details.***

   No, everything is appropriate; ECS has been very diligent about checking pumps and wells, etc.

4. ***Are you aware of any community concerns regarding the protectiveness of the remedies at IRP Sites 1, 3, 12, and/or 13S? If so, please provide details.***

   No, not at all, from time to time, we have community members that have asked about the remedies but no one has ever raised any concerns regarding the remedies.

5. ***Do you have any comments, suggestions, or recommendations regarding management of the remedies in place at IRP Sites 1, 3, 12, and 13S? If so, please provide details.***

   I have no suggestions; the Navy has handled restoration activities quite well.

APPENDIX F

VAPOR INTRUSION EVALUATION

APPENDIX F

VAPOR INTRUSION EVALUATION

Introduction

Dr. Heriberto Robles, Ph. D., D.A.B.T. of Enviro-Tox Services, Inc. (ETSI) was retained by Enviro Compliance Solutions, Inc. (ECS) to (1) assess whether the toxicity values for trichloroethylene (TCE) and 1,2,3-trichloropropane (1,2,3-TCP) have changed since the time of the baseline human-health risk assessments (HHRAs) for IRP Sites 1, 3, 12 and 13S; and, (2) to conduct a Screening-Level Vapor Intrusion Risk Evaluation for current and future residential buildings located on IRP Site 3 (OU-1B South), IRP Site 12 (OU-1B North) and IRP Site 13S (OU-1A). This memorandum summarizes the result of the evaluation.

5-Year Toxicological Review

At the request of ECS, the toxicological review was conducted only for TCE, 1,2,3-TCP, and vinyl chloride. It should be noted that the California Environmental Protection Agency (Cal/EPA) recommends that the methodology recommended in the United States Environmental Protection Agency's (U.S. EPA's) Risk Assessment Guidance for Superfund (Part F) (U.S. EPA 2009a) be now used to estimate cancer risks and health hazards for volatile organic compounds (VOCs) via the inhalation pathway. This guidance recommends using toxicity factors known as inhalation unit risks (IUR) and reference concentrations (RfC) for VOCs where such values are available. The 2001 and 2002 risk assessments for the Tustin facility used cancer slope factors and reference doses to estimate inhalation cancer risks and non-cancer hazards resulting from exposure to VOCs via the inhalation pathway. This approach is now considered obsolete by both the U.S. EPA and Cal/EPA. As a result of this regulatory change, inhalation slope factors and inhalation reference doses (RfDs) are no longer published by regulatory agencies. Thus, inhalation slope factors and reference doses for TCE and 1,2,3-TCP have not been revised in this document. Instead, IUR and RfC for both chemicals are presented here.

1,2,3-Trichloropropane

According to the U.S. EPA (2007) and Cal/EPA (2009b) 1,2,3-TCP is likely to be carcinogenic to humans. There is compelling evidence that 1,2,3-TCP can cause tumors in laboratory animals exposed to high doses and concentrations.

The toxicological properties of 1,2,3-TCP have been evaluated in laboratory animals exposed to the chemical through the oral and inhalation pathways. However, there are no reports of cancer in humans associated with exposure to 1,2,3-TCP. Thus, an IUR has not been derived for 1,2,3-TCP. Data on the carcinogenicity of the compound via the inhalation route is unavailable, and route-to-route extrapolation was not possible due to the lack of an adequate physiologically based pharmacokinetic model. However, it is anticipated that an IUR will be developed for 1,2,3-TCP in the foreseeable future because the chemical could be carcinogenic to humans by the inhalation route.

- The U.S. EPA slope factor for lifetime oral exposure to 1,2,3-TCP is 30 per milligrams per kilogram per day (mg/kg-d).
- The Office of Environmental Health Hazard Assessment (OEHHA) [Cal/EPA 2009b] slope factor for lifetime oral exposure to 1,2,3-TCP is 25 per mg/kg-d.
- The current chronic oral RfD for 1,2,3-TCP is 4E-03 mg/kg-d (U.S. EPA 2010).
- The current chronic RfC for 1,2,3-TCP is 3E-04 milligrams per cubic meter (mg/m^3) [U.S. EPA 2010].

Trichloroethylene

The toxicological properties of TCE in humans and animals have been extensively studied. Recent toxicological information developed for TCE has prompted the U.S. EPA to reassess its

toxicity values for TCE. According to Cal/EPA (2009a), the U.S. EPA is revising its TCE risk assessment. In the U.S. EPA's draft Risk Assessment for TCE, an oral RfD of 3E-04 mg/kg-d was developed based on critical effects in the liver, kidney, and developing fetus. An inhalation RfC of 4E-02 mg/m^3 was developed based on critical effects in the central nervous system, liver, and endocrine system. In addition, several cancer slope factors were developed, with most between 2E-02 and 4E-01 per mg/kg-d. Once the revised TCE risk assessment is completed, it is expected that the U.S. EPA will seek comments and advice from the National Academy of Science, the U.S. EPA Science Advisory Board, and the public prior to publishing the TCE risk assessment report in its final form.

- According to the U.S. EPA (2009b) and Cal/EPA (2009a) TCE is probably carcinogenic to humans.
- The current oral slope factor published by Cal/EPA is 5.9E-03 per mg/kg-d.
- The current inhalation IUR published by Cal/EPA is 2E-06 per micrograms per cubic meter (µg/m^3).
- There is no RfD or RfC for TCE published by the U.S. EPA or Cal/EPA (U.S. EPA 2010).

Screening-Level Vapor Intrusion Risk Evaluation

Risk characterization involves estimating the magnitude of the potential adverse health effects that could occur as a result of chronic, long-term exposure to man-made chemicals identified at a site.

Active groundwater remediation systems are operating at the three IRP sites. It is anticipated that these remediation systems will reduce chemical concentrations down to remedial goals (RGs) within 30 years. In the meantime, the Navy is interested in knowing whether existing concentrations of TCE and 1,2,3-TCP in groundwater could pose a potential vapor intrusion health risk to future onsite residents. Thus, ETSI used the risk assessment methods in the U.S. EPA's vapor intrusion risk evaluation manual (U.S. EPA 2002) to determine if the TCE and 1,2,3-TCP detected in groundwater – given their residual concentrations, locations, soil physical characteristics, weather conditions, etc. – could potentially migrate up to the surface (where human receptors may be exposed).

It should be noted that degradation of TCE could result in the temporary production of vinyl chloride (Dragun J. 1998). This chemical transformation is of importance because vinyl chloride is known to be more toxic than TCE. Since vinyl chloride was detected in groundwater at OU-1A and OU-1B South wells, vinyl chloride was included in this screening evaluation.

Screening-level models were used to predict indoor air concentrations that may result from TCE, 1,2,3-TCP and vinyl chloride that may be offgassing from shallow groundwater under the site. The estimated vapor flux and indoor air concentrations were then used to estimate potential health risks that may result from residential exposure to TCE, 1,2,3-TCP and vinyl chloride vapors. For purposes of this evaluation, ETSI assumed that TCE, 1,2,3-TCP and vinyl chloride detected in groundwater can volatilize and impact soil gas in the vadose zone. Chemical vapors in soil gas can then escape to ambient indoor air.

The potential migration of VOC vapors into indoor air was estimated using the Johnson and Ettinger (JE) model (1991; GW-SCREEN, Department of Toxic Substances Control [DTSC]) Version 2.0-last modified 02/04/2009). The GW-SCREEN model was modified to incorporate DTSC toxicity values; two distinct soil layer lithology; and California-specific building ventilation rates. A copy of the JE model used in the evaluation is included in Attachment A. The estimated chemical vapor flux and ambient concentrations were then used to estimate potential health risks and hazards that may result from exposure to estimated indoor air chemical concentrations.

The building parameters used in the JE model were as follows:

Building Size	1,000 by 1,000 cm
Ceiling Height	305 cm (10 feet [ft]) (Note that current default residential ceiling height is 8 ft; however, the version of the JE model used for the VI evaluation in the baseline HHRA did not include ceiling height as a parameter; therefore, for consistency, an equivalent ceiling height was back-calculated, and this was determined to be 10ft.)
Indoor Air Exchange Rate	0.5 exchanges/hour

ECS provided information on site-specific soil lithology based on review of 44 boring logs for IRP Site 3, 29 boring logs for IRP Site 12, and 57 boring logs for IRP Site 13S. This lithologic data show that the three sites are characterized by two soil layers above the groundwater table. The layer directly above groundwater (Layer B) is clay, and the overlying layer (Layer A) is a silt-clay mixture. These model inputs have the Natural Resources Conservation Service (NRCS) soil symbols C (clay) and SIC (silt-clay mixture). The layer thicknesses used in the models were as follows:

- IRP Site 3 Layer A (SIC) 60.96 centimeters (cm), Layer B (C) 91.44 cm
- IRP Site 12 Layer A (SIC) 121.92 cm, Layer B (C) 121.92 cm
- IRP Site 13S Layer A (soil type SIC) 152.4 cm, Layer B (soil type C) 91.44 cm

The JE model was run using default soil physical parameters for the lithologies reported above. The table below lists the soil physical parameters assumed in this screening risk evaluation.

Parameter	Value Used in this Screening Risk Evaluation
Soil Density (grams per cubic centimeter [g/cm^3])	1.41
Soil Porosity (unitless)	0.468
Soil Moisture Content (cm^3/cm^3)	0.215
Air-Filled Porosity (cm^3/cm^3)	0.253

ECS also provided well-specific groundwater temperatures that were used as model inputs.

The indoor air chemical concentrations estimated to result from the volatilization of TCE, 1,2,3-TCP and vinyl chloride from groundwater could be considered to represent a “worst-case” estimate. In the calculations it was assumed that single chemical compounds are volatilizing, traveling alone through the vadose zone and escaping to indoor air. In reality, all chemicals detected at the site are competing with each other for available soil-pore space. It is well known that chemical volatilization and migration is limited by the vapor saturation in the vadose zone.

Potential health risks and hazards associated with the estimated indoor TCE, 1,2,3-TCP and vinyl chloride concentrations were estimated using equations, toxicity values and methods established by the U.S. EPA and Cal/EPA. Current regulatory guidance requires risk assessments to be conservative in nature and to overestimate any potential risks. Therefore, actual risks associated with conditions evaluated in this screening risk evaluation are likely to be lower than those

described herein. The estimated incremental cancer risks and health hazards are summarized below.

The DTSC recommends use of the more conservative toxicity criteria (DTSC or U.S. EPA) when conducting risk assessments in California. DTSC's toxicity values have been developed by, and are available from, the DTSC's OEHHA (http://www.oehha.org). The U.S. EPA risk assessment guidance, however, indicates that toxicity values developed by the U.S. EPA Office of Solid Waste and Emergency Response be used at sites that fall under the jurisdiction of the federal government (U.S. EPA 2003). Since the sites evaluated here fall under the jurisdiction of both, the U.S. EPA and the DTSC, the vapor intrusion risk evaluation for these sites were conducted using a "dual-tracking" approach. That is, the risk evaluations were conducted following two parallel tracks, one that developed potential cancer risk estimates and noncancer hazard estimates using only U.S. EPA's recommended hierarchy of toxicity values and a second that developed these estimates using only DTSC toxicity values. U.S. EPA-approved toxicity values were obtained from the regional screening level (RSL) tables (U.S. EPA 2011). DTSC-approved toxicity values were obtained from the 2009 version of the DTSC JE model (http://www.dtsc.ca.gov/AssessingRisk/ JE_Models.cfm).

Given the variable chemical composition and concentrations found in all the monitoring wells (Table F-1), the groundwater chemical concentrations were not pooled and averaged to obtain a "site wide" groundwater TCE, 1,2,3-TCP or vinyl chloride concentration. Instead, it was assumed that TCE, 1,2,3-TCP and vinyl chloride vapors could migrate vertically and impact a residence located directly above the area where those chemicals were detected. For this risk evaluation, potential vapor emissions and associated health risks and hazards were estimated separately for each groundwater monitoring well.

The JE model used in the evaluation contains a module for estimating potential doses as well as cancer risks and health hazards associated with a given chemical dose. For this assessment, a groundwater chemical concentration of one microgram per liter (µg/L) was used as the groundwater chemical concentration. The estimated cancer risk per unit chemical concentration for each chemical and operating unit were used as the "risk per unit concentration" factor for the operating unit. The "risk per unit concentration" factors were then used to estimate potential cancer risks associated with chemicals detected at each monitoring well. "Hazard quotients per unit concentration" factors were also estimated for each VOC detected in the groundwater monitoring wells. These "hazard quotients per unit concentration" factors were used to estimate hazard quotients associated with chemical concentrations at the various monitoring wells at the site. Cancer risk and hazard quotients per unit concentrations were estimated using only toxicity values published by the U.S. EPA or toxicity values published only by Cal/EPA.

Cancer risk and hazard quotients per unit concentrations estimated for TCE, 1,2,3-TCP and vinyl chloride detected in groundwater at OU-1A (IRP Site 13S), OU-1B North (IRP Site 12) and OU-1B South (IRP Site 3) are presented in Tables F-2 through F-7. If a chemical was not detected in any of the site wells, the chemical was not included in the evaluation. However, if a chemical was detected in at least one well from one of the site, the chemical was included in the evaluation and non-detected values were included as if the chemical had been detected at a concentration equal to one-half its detection limit. Spreadsheets used to calculate risk and hazard unit factors are included in Attachment A.

Cancer risks associated with each monitoring well were obtained by multiplying the chemical concentration detected in each monitoring well by the chemical's "cancer risk per unit concentration". The total cancer risk per monitoring well was obtained by adding the cancer risk estimated for each chemical. Cancer risks estimated for OU-1A, OU-1B North and OU-1B South are presented in Tables F-8 through F-15. Figures F-1 and F-2 present the iso-risk contours estimated for each site.

Hazard quotients (HQs or noncancer hazards) associated with each monitoring well, were obtained by multiplying the chemical concentration detected in each monitoring well by the chemical's "hazard quotient per unit concentration" factor. The hazard quotient per monitoring

well was obtained by adding the hazard quotient estimated for each chemical. As stated above, it was assumed that vapors released from each monitoring well would enter a single residence and would not mix with vapors released from other monitoring wells. In other words, single value "site-wide" health risk and hazard estimates were not calculated. Instead, "single-point" health risk and hazards were calculated for each monitoring well at OU-1A, OU-1B North and OU-1B South. Hazard quotients estimated for OU-1A, OU-1B North and OU-1B South are presented in Tables F-10 through F-15.

According to the U.S. EPA (1989), if the HQ for a combination of chemicals is less than unity (1.0), there is no concern for potential chronic adverse health effects from the chemical exposures. The HQs estimated are all well below 1.0. Therefore, it can be concluded that noncancer hazards from exposure to chemical-affected indoor air is not associated with a concern for potential chronic adverse health effects.

Summary of Findings

California and federal health and environmental protection agencies have conducted comprehensive evaluation of the scientific literature regarding the toxicological properties of TCE and 1,2,3-TCP. Based on the results of their toxicological reviews, toxicological parameters have been modified since the baseline HHRAs. Updated toxicological values are discussed and presented in this Appendix. Results of the screening risk evaluation indicate that clayey soils found at the site at depths above the groundwater table (5 ft below ground surface [bgs] at IRP Site 3, and 8 ft bgs at IRP Sites 12 and 13S) are attenuating the migration of chemical vapors to the surface.

Incremental cancer risks estimated to result from exposure to TCE, 1,2,3-TCP and vinyl chloride in indoor air were calculated for each groundwater monitoring point with data for the fourth quarter 2010. The results are summarized below and are shown in Tables F-8 through F-15:

- IRP Site 3 (OU-1B South) - Incremental cancer risk[1] ranged from a low of 9.2E-08 to a high of 1.8E-05. The high value is coincident with the groundwater TCE hot spot.
- IRP Site 12 (OU-1B North) - Incremental cancer risk[2] ranged from a low of 4.3E-09 to a high of 2.1E-07. All values are below the point of departure (1E-06).
- IRP Site 13S (OU-1A) - Incremental cancer risk[3] ranged from a low of 1.9E-07 to a high of 1.5E-05. The high value is coincident with the groundwater TCE and 1,2,3-TCP hot spot.

All incremental cancer risk values are either below the point of departure (10^{-6}), or within the Risk Management Range as defined by the U.S. EPA (10^{-6} to 10^{-4}). In addition, the HQs estimated are all well below 1.0. Therefore, it can be concluded that noncancer hazards from exposure to chemical-affected indoor air is not associated with a concern for potential chronic adverse health effects.

---

[1] Calculated using Cal/EPA toxicity criteria.
[2] Calculated using Cal/EPA toxicity criteria.
[3] Calculated using Cal/EPA toxicity criteria.

Attachments

Table F-1 – Groundwater Analytical Summary for OU-1A, OU-1B North and OU-1B South

Table F-2 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1A, Estimated Using USEPA Toxicity Values

Table F-3 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1A, Estimated Using Cal-EPA Toxicity Values

Table F-4 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1B North, Estimated Using USEPA Toxicity Values

Table F-5 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1B North, Estimated Using Cal-EPA Toxicity Values

Table F-6 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1B South, Estimated Using USEPA Toxicity Values

Table F-7 – Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1B South, Estimated Using Cal-EPA Toxicity Values

Table F-8 – Incremental Cancer Risks per Monitoring Well for OU-1A, Estimated Using USEPA Toxicity Values

Table F-9 – Incremental Cancer Risks per Monitoring Well for OU-1A, Estimated Using Cal-EPA Toxicity Values

Table F-10 – Health Hazards per Monitoring Well for OU-1A, Estimated Using USEPA Toxicity Values

Table F-11 – Health Hazards per Monitoring Well for OU-1A, Estimated Using Cal-EPA Toxicity Values

Table F-12 – Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B North, Estimated Using U.S. EPA Toxicity Values

Table F-13 – Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B North, Estimated Using Cal-EPA Toxicity Values

Table F-14 – Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B South, Estimated Using U.S. EPA Toxicity Values

Table F-15 – Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B South, Estimated Using Cal-EPA Toxicity Values

Figure F-1 – IRP Site 3 (OU-1B South) Vapor Intrusion Risk Contours

Figure F-2 – IRP Sites 12 (OU-1B North) and 13S (OU-1A) Vapor Intrusion Risk Contours

Attachment A – Model Input/Output Spreadsheets

References

California Environmental Protection Agency (Cal/EPA) 2009a. *Public Health Goal for Trichloroethylene in Drinking Water. Prepared by Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment.* July.

_____ 2009b. *Public Health Goal for 1,2,3-Trichloropropane in Drinking Water. Prepared by Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment.* August.

_____ 2011. *Department of Toxic Substances Control. Toxicity Criteria Database. On-line database:* http://www.oehha.ca.gov/risk/chemicalDB/index.asp. April.

Dragun, J. 1998. *The Soil Chemistry of Hazardous Materials, Second Edition. Amherst Scientific Publishers. Amherst, Massachusetts.*

Johnson, P. C. and R. A. Ettinger (JE) 1991. *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings. Environmental Science and Technology 25:1445-1452*.

U.S. Environmental Protection Agency (U.S. EPA) 1989. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. Washington, D.C.*

_____ 2002. *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). EPA 530-02-004.* November.

_____ 2003. *Human Health Toxicity Values in Superfund Risk Assessments. Memorandum from Office of Superfund Remediation and Technology Innovation to Superfund National Policy Managers, Region 1 – 10*. December 5.

_____ 2007. *Draft Toxicological Review of 1,2,3-Trichloropropane (CAS No. 96-18-4), In Support of Summary Information on the Integrated Risk Information System (IRIS). NCEA-S-1669.* October.

_____ 2009a. *Risk Assessment Guide for Superfund; Vol. 1: Human Health Evaluation Manual; Part F, Supplemental Guidance for Inhalation Risk Assessment. Final*. January.

_____ 2009b. *External Review Draft Toxicological Review of Trichloroethylene (CAS No. 79-01-6), In Support of Summary Information on the Integrated Risk Information System (IRIS). EPA/635/R-09/011A.* October.

---------- 2010. *Integrated Risk Information System (IRIS) Database, Trichloroethylene Quickview (CASRN 79-01-6).* Available online at:

http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showQuickView&substance_nmbr=0199

_____ 2011. Region 9. Regional Screening Levels. On-line Database: www.epa.gov/region09/superfund/prg/index.html. June.

Acronyms and Abbreviations

bgs	below ground surface
C	clay
Cal/EPA	California Environmental Protection Agency
cm	centimeter
cm^3	cubic centimeter
DTSC	Department of Toxic Substances Control
ECS	Enviro Compliance Solutions, Inc.
ETSI	Enviro-Tox Services, Inc.
ft	feet
g/cm^3	grams per cubic centimeter
HHRA	human-health risk assessment
HQ	hazard quotient
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
JE	Johnson and Ettinger (vapor intrusion model)
$\mu g/m^3$	micrograms per cubic meter
µg/L	micrograms per liter
mg/m^3	milligrams per cubic meter
mg/kg-d	milligrams per kilogram per day
NRCS	Natural Resources Conservation Service
OEHHA	Office of Environmental Health Hazard Assessment
RfC	reference concentration
RfD	reference dose
RG	remediation goal
RSL	regional screening level
SIC	silt-clay mixture
TCE	trichloroethylene
TCP	trichloropropane
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Table F-1

Groundwater Analytical Summary for OU-1A, OU-1B North and OU-1B South

OU-1A 1st WBZ				OU-1B North 1st WBZ		OU-1B South 1st WBZ		
Well No.	TCE (µg/L)	1,2,3 TCP (µg/L)	Vinyl Chloride (µg/L)	Well No.	TCE (µg/L)	Well No.	TCE (µg/L)	Vinyl Chloride (µg/L)
222MW03S	<1.0	<0.50	<1.0	I012MW02S	4.7	I003MW02S	<1.0	<1.0
222MW04S	7	1.4	<1.0	I012MW08S	66	I003MW03S	<1.0	<1.0
222MW05S	3.1	10	<1.0	I012MW09S	130	I003MW06S	1600	0.2
222MW06S	<1.0	<0.50	<1.0	I012MW11S	6.3	I003MW07S	11000	0.21
222PW03SA	<1.0	<0.50	<1.0	I012MW12S	9.1	I003MW08S	240	2.4
222PW03SB	<1.0	<0.50	<1.0	I012MW13S	2.7	I003MW09S	2100	<1.0
222PW03SC	<1.0	<0.50	<1.0	I012MW14S	9.2	I003MW12S	<1.0	<1.0
222PW03SD	<1.0	<0.50	<1.0	I012MW15S	4.3	I003MW13S	<1.0	<1.0
222PW09S	<1.0	0.59	<1.0	--	--	I003MW14S	0.52	<1.0
222PW10S	<1.0	1.8	<1.0	--	--	I003MW15S	5	<1.0
222PW13S	<1.0	22	<1.0	--	--	--	--	--
IS72MW01SR	2.3	<0.50	<1.0	--	--	--	--	--
IS72MW02S	2	18	<1.0	--	--	--	--	--
IS72MW03S	0.21	0.62	<1.0	--	--	--	--	--
IS72MW04S	0.44	<0.50	<1.0	--	--	--	--	--
IS72MW05S	<1.0	<0.50	<1.0	--	--	--	--	--
IS72MW10S	<1.0	<0.50	<1.0	--	--	--	--	--
IS72MW11S	<1.0	<0.50	<1.0	--	--	--	--	--
IS72MW12S	<1.0	0.92	<1.0	--	--	--	--	--
IS72MW13S	0.62	<0.50	<1.0	--	--	--	--	--
IS72MW15S	<1.0	<0.50	<1.0	--	--	--	--	--
IS72MW17S	1000	34	0.35	--	--	--	--	--
IS72MW18S	<1.0	<0.50	<1.0	--	--	--	--	--

Notes:

The groundwater analytical data presented in this table are the results from the 2010 fourth quarter sampling event.

TCE = trichloroethylene

TCP = trichloropropane

µg/L = micrograms per liter

WBZ = water bearing zone

Table F-2

Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1A Estimated Using USEPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.58E-09	NA
1,2,3-Trichloropropane	96184	1.0	4.8E-04	NA	1.53E-03
Vinyl chloride	75014	1.0	5.7E-03	1.03E-08	5.46E-05

Notes:

CAS = Chemical Abstracts Service

NA = Not applicable or not available

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-3

Incremental Cancer Risks and Health Quotient Per Unit Concentration Factors for OU-1A Estimated Using Cal-EPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.58E-09	3.07E-06
1,2,3-Trichloropropane	96184	1.0	4.8E-04	3.93E-07	1.53E-03
Vinyl chloride	75014	1.0	5.7E-03	1.82E-07	5.46E-05

Notes:

CAS = Chemical Abstracts Service

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-4

Incremental Cancer Risks and Health Quotient per Unit Concentration Factors for OU-1B North Estimated Using USEPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.58E-09	NA
1,2,3-Trichloropropane	96184	1.0	4.8E-04	NA	1.53E-03

Notes:

CAS = Chemical Abstracts Service

NA = Not applicable or not available

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-5

Incremental Cancer Risks and Health Quotients per Unit Concentration Factors for OU-1B North Estimated Using Cal-EPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.58E-09	3.07E-06
1,2,3-Trichloropropane	96184	1.0	4.8E-04	3.92E-07	1.53E-03

Notes:

CAS = Chemical Abstracts Service

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-6

Incremental Cancer Risks and Health Quotients per Unit Concentration Factors for OU-1B South Estimated Using USEPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.59E-09	NA
1,2,3-Trichloropropane	96184	1.0	5.0E-04	NA	1.59E-03
Vinyl chloride	75014	1.0	5.7E-03	1.03E-08	5.48E-05

Notes:

CAS = Chemical Abstracts Service

NA = Not applicable or not available

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-7

Incremental Cancer Risks and Health Quotients per Unit Concentration Factors for OU-1B South Estimated Using Cal-EPA Toxicity Values

Chemical of Potential Concern (COPC)	CAS Number	Exposure to Indoor Air			
		Groundwater Chemical Concentration (µg/L)	Indoor Chemical Concentration (µg/m^3)	Cancer Risk (unitless)	Hazard Index (unitless)
Trichloroethylene	79016	1.0	1.9E-03	1.59E-09	3.09E-06
1,2,3-Trichloropropane	96184	1.0	5.0E-04	4.09E-07	1.59E-03
Vinyl chloride	75014	1.0	5.7E-03	1.83E-07	5.48E-05

Notes:

CAS = Chemical Abstracts Service

µg/L = micrograms per liter

µg/m^3 = micrograms per cubic meter

Table F-8

Incremental Cancer Risks per Monitoring Well for OU-1A
Estimated Using USEPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	1,2,3-Trichloropropane (1,2,3-TCP) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	1,2,3-TCP Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk Attributed to TCE (unitless)	Estimated Cancer Risk Attributed to 1,2,3-TCP (unitless)	Estimated Cancer Risk Attributed to VC (unitless)	Total Estimated Cancer Risk for Monitoring Well (unitless)
222MW03S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222MW04S	7	1.4	<1.0	7	1.4	0.5	1.1E-08	0.0E+00	5.1E-09	1.6E-08
222MW05S	3.1	10	<1.0	3.1	10	0.5	4.9E-09	0.0E+00	5.1E-09	1.0E-08
222MW06S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW03SA	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW03SB	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW03SC	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW03SD	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW09S	<1.0	0.59	<1.0	0.5	0.59	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW10S	<1.0	1.8	<1.0	0.5	1.8	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
222PW13S	<1.0	22	<1.0	0.5	22	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW01SR	2.3	<0.50	<1.0	2.3	0.25	0.5	3.6E-09	0.0E+00	5.1E-09	8.8E-09
IS72MW02S	2	18	<1.0	2	18	0.5	3.2E-09	0.0E+00	5.1E-09	8.3E-09
IS72MW03S	0.21	0.62	<1.0	0.21	0.62	0.5	3.3E-10	0.0E+00	5.1E-09	5.5E-09
IS72MW04S	0.44	<0.50	<1.0	0.44	0.25	0.5	7.0E-10	0.0E+00	5.1E-09	5.8E-09
IS72MW05S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW10S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW11S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW12S	<1.0	0.92	<1.0	0.5	0.92	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW13S	0.62	<0.50	<1.0	0.62	0.25	0.5	9.8E-10	0.0E+00	5.1E-09	6.1E-09
IS72MW15S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09
IS72MW17S	1000	34	0.35	1000	34	0.35	1.6E-06	0.0E+00	3.6E-09	1.6E-06
IS72MW18S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	0.0E+00	5.1E-09	5.9E-09

Notes:
µg/L = micrograms per liter

Table F-9

Incremental Cancer Risks per Monitoring Well for OU-1A
Estimated Using Cal-EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	1,2,3-Trichloropropane (1,2,3-TCP) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	1,2,3-TCP Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk Attributed to TCE (unitless)	Estimated Cancer Risk Attributed to 1,2,3-TCP (unitless)	Estimated Cancer Risk Attributed to VC (unitless)	Total Estimated Cancer Risk for Monitoring Well (unitless)
222MW03S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222MW04S	7	1.4	<1.0	7	1.4	0.5	1.1E-08	5.5E-07	9.1E-08	6.5E-07
222MW05S	3.1	10	<1.0	3.1	10	0.5	4.9E-09	3.9E-06	9.1E-08	4.0E-06
222MW06S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222PW03SA	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222PW03SB	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222PW03SC	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222PW03SD	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
222PW09S	<1.0	0.59	<1.0	0.5	0.59	0.5	7.9E-10	2.3E-07	9.1E-08	3.2E-07
222PW10S	<1.0	1.8	<1.0	0.5	1.8	0.5	7.9E-10	7.1E-07	9.1E-08	8.0E-07
222PW13S	<1.0	22	<1.0	0.5	22	0.5	7.9E-10	8.6E-06	9.1E-08	8.7E-06
IS72MW01SR	2.3	<0.50	<1.0	2.3	0.25	0.5	3.6E-09	9.8E-08	9.1E-08	1.9E-07
IS72MW02S	2	18	<1.0	2	18	0.5	3.2E-09	7.1E-06	9.1E-08	7.2E-06
IS72MW03S	0.21	0.62	<1.0	0.21	0.62	0.5	3.3E-10	2.4E-07	9.1E-08	3.4E-07
IS72MW04S	0.44	<0.50	<1.0	0.44	0.25	0.5	7.0E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW05S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW10S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW11S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW12S	<1.0	0.92	<1.0	0.5	0.92	0.5	7.9E-10	3.6E-07	9.1E-08	4.5E-07
IS72MW13S	0.62	<0.50	<1.0	0.62	0.25	0.5	9.8E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW15S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07
IS72MW17S	1000	34	0.35	1000	34	0.35	1.6E-06	1.3E-05	6.4E-08	1.5E-05
IS72MW18S	<1.0	<0.50	<1.0	0.5	0.25	0.5	7.9E-10	9.8E-08	9.1E-08	1.9E-07

Notes:
µg/L = micrograms per liter

Table F-10

Health Hazards per Monitoring Well for OU-1A
Estimated Using USEPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	1,2,3-Trichloropropane (1,2,3-TCP) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	1,2,3-TCP Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Hazard Quotient Attributed to TCE (unitless)	Estimated Hazard Quotient Attributed to 1,2,3-TCP (unitless)	Estimated Hazard Quotient Attributed to VC (unitless)	Total Estimated Hazard Quotient for Monitoring Well (unitless)
222MW03S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222MW04S	7	1.4	<1.0	7	1.4	0.5	0.0E+00	2.1E-03	2.7E-05	2.2E-03
222MW05S	3.1	10	<1.0	3.1	10	0.5	0.0E+00	1.5E-02	2.7E-05	1.5E-02
222MW06S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222PW03SA	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222PW03SB	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222PW03SC	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222PW03SD	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
222PW09S	<1.0	0.59	<1.0	0.5	0.59	0.5	0.0E+00	9.0E-04	2.7E-05	9.3E-04
222PW10S	<1.0	1.8	<1.0	0.5	1.8	0.5	0.0E+00	2.8E-03	2.7E-05	2.8E-03
222PW13S	<1.0	22	<1.0	0.5	22	0.5	0.0E+00	3.4E-02	2.7E-05	3.4E-02
IS72MW01SR	2.3	<0.50	<1.0	2.3	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW02S	2	18	<1.0	2	18	0.5	0.0E+00	2.8E-02	2.7E-05	2.8E-02
IS72MW03S	0.21	0.62	<1.0	0.21	0.62	0.5	0.0E+00	9.5E-04	2.7E-05	9.7E-04
IS72MW04S	0.44	<0.50	<1.0	0.44	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW05S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW10S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW11S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW12S	<1.0	0.92	<1.0	0.5	0.92	0.5	0.0E+00	1.4E-03	2.7E-05	1.4E-03
IS72MW13S	0.62	<0.50	<1.0	0.62	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW15S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04
IS72MW17S	1000	34	0.35	1000	34	0.35	0.0E+00	5.2E-02	1.9E-05	5.2E-02
IS72MW18S	<1.0	<0.50	<1.0	0.5	0.25	0.5	0.0E+00	3.8E-04	2.7E-05	4.1E-04

Notes:
µg/L = micrograms per liter

Table F-11

Health Hazards per Monitoring Well for OU-1A
Estimated Using Cal-EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	1,2,3-Trichloropropane (1,2,3-TCP) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	1,2,3-TCP Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Hazard Quotient Attributed to TCE (unitless)	Estimated Hazard Quotient Attributed to 1,2,3-TCP (unitless)	Estimated Hazard Quotient Attributed to VC (unitless)	Total Estimated Hazard Quotient for Monitoring Well (unitless)
222MW03S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222MW04S	7	1.4	<1.0	7	1.4	0.5	2.2E-05	2.1E-03	2.7E-05	2.2E-03
222MW05S	3.1	10	<1.0	3.1	10	0.5	9.5E-06	1.5E-02	2.7E-05	1.5E-02
222MW06S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222PW03SA	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222PW03SB	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222PW03SC	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222PW03SD	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
222PW09S	<1.0	0.59	<1.0	0.5	0.59	0.5	1.5E-06	9.0E-04	2.7E-05	9.3E-04
222PW10S	<1.0	1.8	<1.0	0.5	1.8	0.5	1.5E-06	2.8E-03	2.7E-05	2.8E-03
222PW13S	<1.0	22	<1.0	0.5	22	0.5	1.5E-06	3.4E-02	2.7E-05	3.4E-02
IS72MW01SR	2.3	<0.50	<1.0	2.3	0.25	0.5	7.1E-06	3.8E-04	2.7E-05	4.2E-04
IS72MW02S	2	18	<1.0	2	18	0.5	6.1E-06	2.8E-02	2.7E-05	2.8E-02
IS72MW03S	0.21	0.62	<1.0	0.21	0.62	0.5	6.5E-07	9.5E-04	2.7E-05	9.8E-04
IS72MW04S	0.44	<0.50	<1.0	0.44	0.25	0.5	1.4E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW05S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW10S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW11S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW12S	<1.0	0.92	<1.0	0.5	0.92	0.5	1.5E-06	1.4E-03	2.7E-05	1.4E-03
IS72MW13S	0.62	<0.50	<1.0	0.62	0.25	0.5	1.9E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW15S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04
IS72MW17S	1000	34	0.35	1000	34	0.35	3.1E-03	5.2E-02	1.9E-05	5.5E-02
IS72MW18S	<1.0	<0.50	<1.0	0.5	0.25	0.5	1.5E-06	3.8E-04	2.7E-05	4.1E-04

Notes:
µg/L = micrograms per liter

Table F-12

Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B North

Estimated Using U.S. EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk for Monitoring Well (unitless)	Estimated Hazard Quotient for Monitoring Well (unitless)
I012MW02S	4.7	4.7	7.4E-09	0.0E+00
I012MW08S	66	66	1.0E-07	0.0E+00
I012MW09S	130	130	2.1E-07	0.0E+00
I012MW11S	6.3	6.3	1.0E-08	0.0E+00
I012MW12S	9.1	9.1	1.4E-08	0.0E+00
I012MW13S	2.7	2.7	4.3E-09	0.0E+00
I012MW14S	9.2	9.2	1.5E-08	0.0E+00
I012MW15S	4.3	4.3	6.8E-09	0.0E+00

Notes:
µg/L = micrograms per liter

Table F-13

Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B North

Estimated Using Cal-EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk for Monitoring Well (unitless)	Estimated Hazard Quotient for Monitoring Well (unitless)
I012MW02S	4.7	4.7	7.4E-09	1.4E-05
I012MW08S	66	66	1.0E-07	2.0E-04
I012MW09S	130	130	2.1E-07	4.0E-04
I012MW11S	6.3	6.3	1.0E-08	1.9E-05
I012MW12S	9.1	9.1	1.4E-08	2.8E-05
I012MW13S	2.7	2.7	4.3E-09	8.3E-06
I012MW14S	9.2	9.2	1.5E-08	2.8E-05
I012MW15S	4.3	4.3	6.8E-09	1.3E-05

Notes:
µg/L = micrograms per liter

Table F-14

Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B South
Estimated Using U.S. EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk Attributed to TCE (unitless)	Estimated Cancer Risk Attributed to VC (unitless)	Estimated Cancer Risk for Monitoring Well (unitless)	Estimated Hazard Quotient Attributed to TCE (unitless)	Estimated Hazard Quotient Attributed to VC (unitless)	Estimated Hazard Quotient for Monitoring Well (unitless)
I003MW02S	<1.0	<1.0	0.5	0.5	7.9E-10	5.17E-09	6.0E-09	0.0E+00	2.7E-05	2.7E-05
I003MW03S	<1.0	<1.0	0.5	0.5	7.9E-10	5.17E-09	6.0E-09	0.0E+00	2.7E-05	2.7E-05
I003MW06S	1600	0.2	1600	0.2	2.5E-06	2.07E-09	2.5E-06	0.0E+00	1.1E-05	1.1E-05
I003MW07S	11000	0.21	11000	0.21	1.7E-05	2.17E-09	1.7E-05	0.0E+00	1.2E-05	1.2E-05
I003MW08S	240	2.4	240	2.4	3.8E-07	2.48E-08	4.1E-07	0.0E+00	1.3E-04	1.3E-04
I003MW09S	2100	<1.0	2100	0.5	3.3E-06	5.17E-09	3.3E-06	0.0E+00	2.7E-05	2.7E-05
I003MW12S	<1.0	<1.0	0.5	0.5	7.9E-10	5.17E-09	6.0E-09	0.0E+00	2.7E-05	2.7E-05
I003MW13S	<1.0	<1.0	0.5	0.5	7.9E-10	5.17E-09	6.0E-09	0.0E+00	2.7E-05	2.7E-05
I003MW14S	0.52	<1.0	0.52	0.5	8.3E-10	5.17E-09	6.0E-09	0.0E+00	2.7E-05	2.7E-05
I003MW15S	5	<1.0	5	0.5	7.9E-09	5.17E-09	1.3E-08	0.0E+00	2.7E-05	2.7E-05

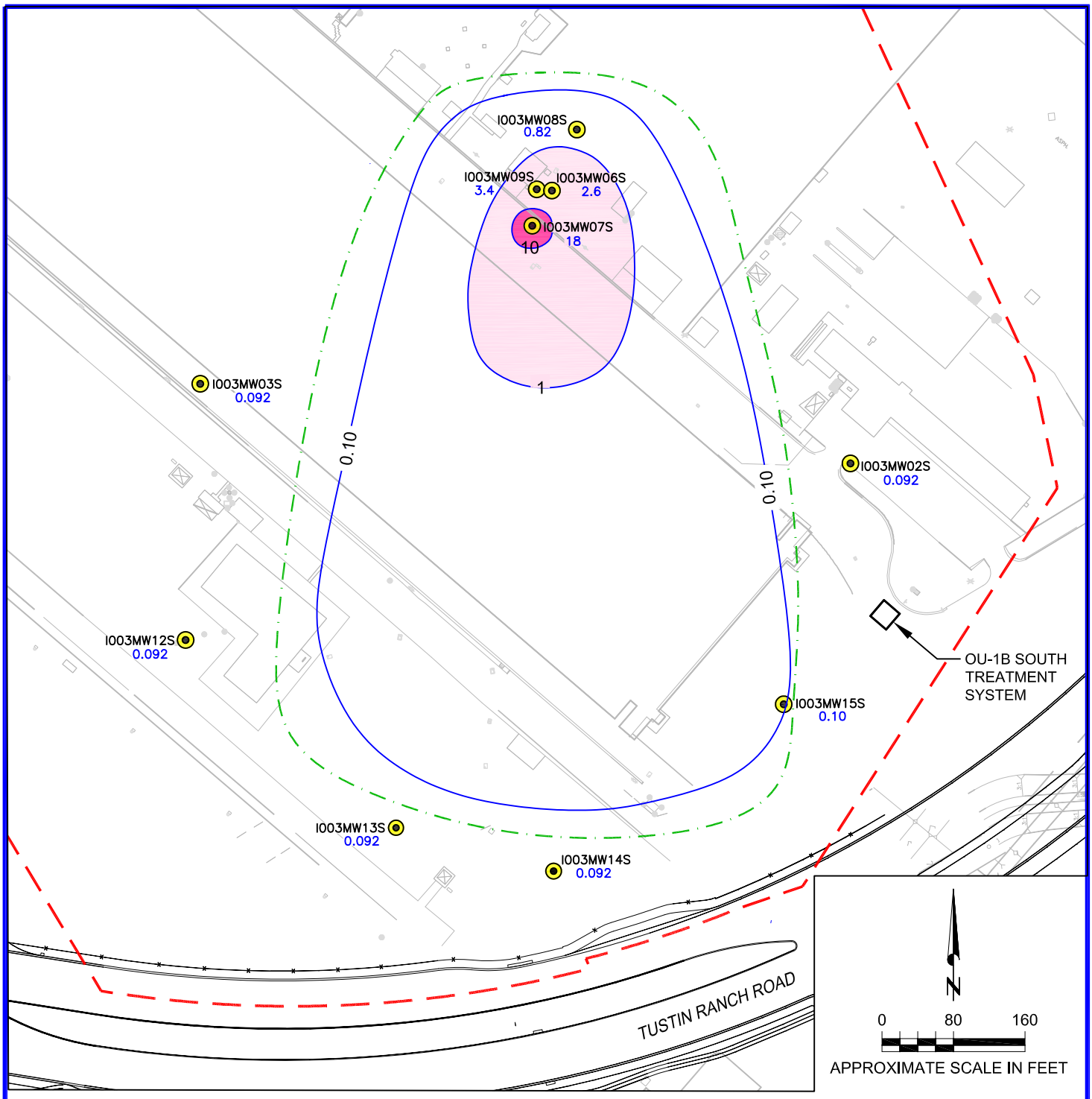
Notes:
µg/L = micrograms per liter

Table F-15

Incremental Cancer Risks and Health Hazards per Monitoring Well for OU-1B South Estimated Using Cal-EPA Toxicity Values

Monitoring Well Number	Trichloroethylene (TCE) Detected in Groundwater in 2011 (µg/L)	Vinyl Chloride (VC) Detected in Groundwater in 2011 (µg/L)	TCE Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	VC Concentration in Groundwater Used in the Vapor Intrusion Calculations (µg/L)	Estimated Cancer Risk Attributed to TCE (unitless)	Estimated Cancer Risk Attributed to VC (unitless)	Estimated Cancer Risk (unitless)	Estimated Hazard Quotient Attributed to TCE (unitless)	Estimated Hazard Quotient Attributed to VC (unitless)	Estimated Hazard Quotient (unitless)
I003MW02S	<1.0	<1.0	0.5	0.5	7.9E-10	9.16E-08	9.2E-08	1.5E-06	2.7E-05	2.9E-05
I003MW03S	<1.0	<1.0	0.5	0.5	7.9E-10	9.16E-08	9.2E-08	1.5E-06	2.7E-05	2.9E-05
I003MW06S	1600	0.2	1600	0.2	2.5E-06	3.66E-08	2.6E-06	4.9E-03	1.1E-05	5.0E-03
I003MW07S	11000	0.21	11000	0.21	1.7E-05	3.85E-08	1.8E-05	3.4E-02	1.2E-05	3.4E-02
I003MW08S	240	2.4	240	2.4	3.8E-07	4.40E-07	8.2E-07	7.4E-04	1.3E-04	8.7E-04
I003MW09S	2100	<1.0	2100	0.5	3.3E-06	9.16E-08	3.4E-06	6.5E-03	2.7E-05	6.5E-03
I003MW12S	<1.0	<1.0	0.5	0.5	7.9E-10	9.16E-08	9.2E-08	1.5E-06	2.7E-05	2.9E-05
I003MW13S	<1.0	<1.0	0.5	0.5	7.9E-10	9.16E-08	9.2E-08	1.5E-06	2.7E-05	2.9E-05
I003MW14S	0.52	<1.0	0.52	0.5	8.3E-10	9.16E-08	9.2E-08	1.6E-06	2.7E-05	2.9E-05
I003MW15S	5	<1.0	5	0.5	7.9E-09	9.16E-08	1.0E-07	1.5E-05	2.7E-05	4.3E-05

Notes:
µg/L = micrograms per liter



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Carve-Out #6 Boundary
- 1 — Vapor Intrusion Risk Contour with Lifetime VI cancer risk (x 10^{-6})
- 18 — Lifetime VI cancer risk
- Area of 10^{-5} Risk Range
- Area of 10^{-6} Risk Range
- TCE Groundwater Plume (First WBZ)

ABBREVIATIONS

TCE = Trichloroethene
VI = Vapor Intrusion
VC = Vinyl Chloride
WBZ = Water Bearing Zone

Note:

1. Lifetime VI cancer risk determined using current Cal / EPA toxicity values for TCE and VC.

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Sulte B
Tustln, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

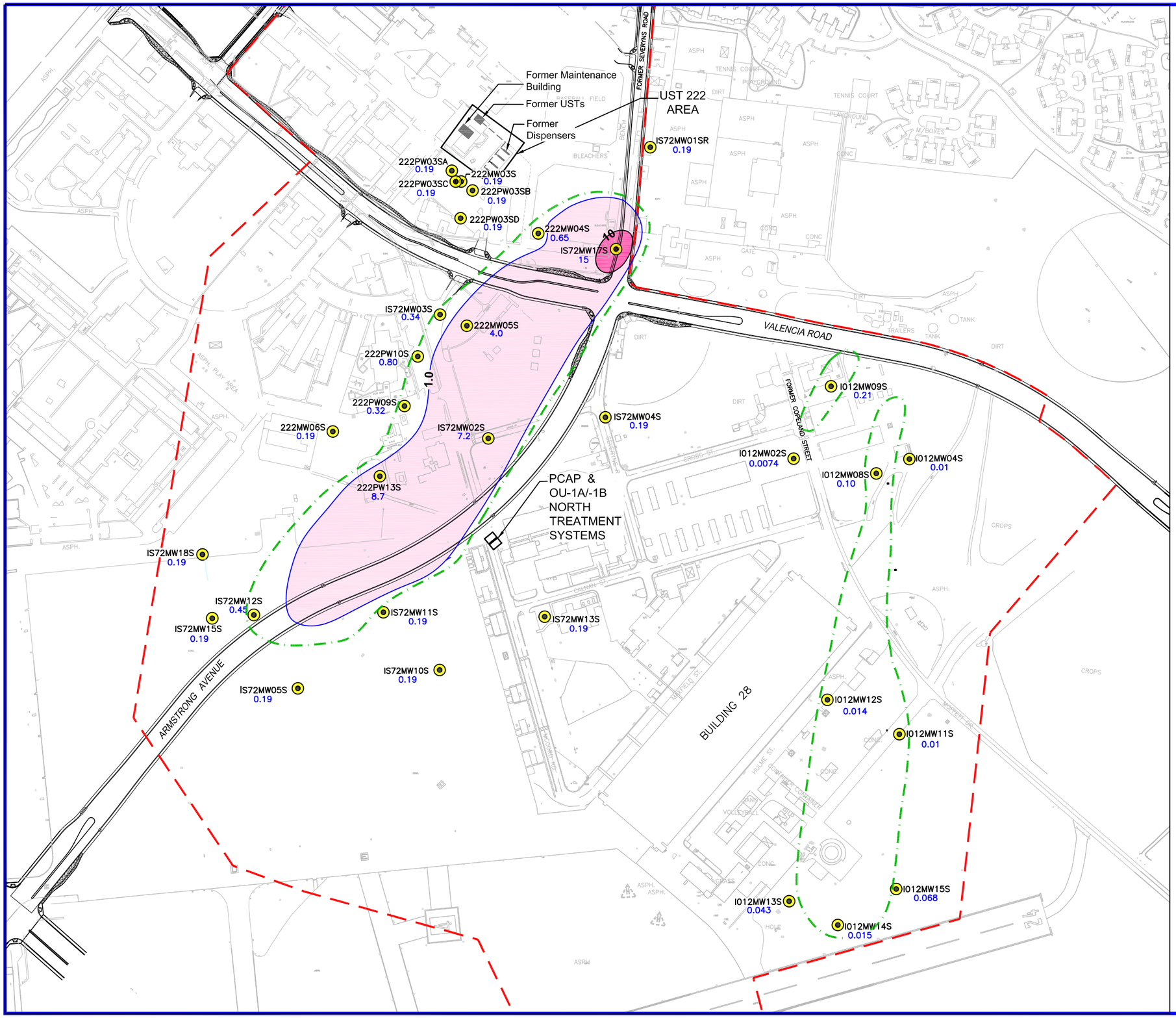
FORMER MARINE CORPS AIR STATION TUSTIN, CALIFORNIA

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-3 (OU-1B SOUTH) VAPOR INTRUSION RISK CONTOURS

Base Realignment and Closure
Program Management Office West

FIGURE
F-1



LEGEND:

- Groundwater Monitoring Well (First WBZ)
- Carve-Out #5 Boundary
- Vapor Intrusion Risk Contour with Lifetime VI cancer risk (x 10^{-6})
- 15 Lifetime VI cancer risk
- Area of 10^{-5} Risk Range
- Area of 10^{-6} Risk Range
- TCE and 1,2,3-TCP Groundwater Plume (First WBZ)

ABBREVIATIONS

TCE = Trichloroethene
TCP = Trichloropropane
VI = Vapor Intrusion
VC = Vinly Chloride

Note:

1. Lifetime VI cancer risk determined using current Cal/EPA toxicity values for TCE, 1,2,3-TCP, and VC.

N

0 175 350

APPROXIMATE SCALE IN FEET

FIGURE F-2

Base Realignment and Closure Program Management Office West

TUSTIN, CALIFORNIA

FORMER MARINE CORPS AIR STATION

2011 CERCLA FIVE - YEAR REVIEW
IRP-1, -3, -12, AND -13S

IRP-12 (OU-1B NORTH) AND -13S (OU-1A) VAPOR INTRUSION RISK CONTOURS

Enviro Compliance Solutions, Inc.
1571 Parkway Loop, Suite B
Tustin, CA 92780
Phone No.: 714-259-0295
Fax No.: 714-259-0296

APPENDIX F

ATTACHMENT A
MODEL INPUT/OUTPUT SPREADSHEETS

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	NA
96184	1.00E+00	1,2,3-Trichloropropane	NA	1.5E-03
75014	1.00E+00	Vinyl chloride (chloroethene)	1.0E-08	5.5E-05

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	243.84	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
		1.00E-08	C	1.399	0.473	0.216

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	152.4	91.44	243.840
Density (g/cm3)	1.38	1.43	1.399
Porosity (unitless)	0.481	0.459	0.473
Moisture (cm3/cm	0.216	0.215	0.216

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	0.0E+00
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	0.0E+00	3.0E-04
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.84E-03	1.99E-05	5.53E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.46E-03	1.36E-04	3.56E-04
5.08E+04	1.00E+06	5.00E-03	15	4,838	2.63E-02	1.08E+00	1.80E-04	5.15E-03	2.21E-05	6.14E-05

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
228.84	15	4.05E+02	1.25	8.33E+01	3.84E-03	5.00E+03	7.16E+18	4.75E-06	1.92E-03	2.0E-06	NA
228.84	15	1.59E+01	1.25	8.33E+01	3.46E-03	5.00E+03	7.96E+20	3.01E-05	4.78E-04	NA	3.0E-04
228.84	15	1.08E+03	1.25	8.33E+01	5.15E-03	5.00E+03	1.13E+14	5.27E-06	5.69E-03	4.4E-06	1.0E-01

RESULTS SHEET

OU-1A/1B North Incremental Intrusion Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	NA	Trichloroethylene
NA	1.5E-03	1,2,3-Trichloropropane
1.0E-08	5.5E-05	Vinyl chloride (chloroethene)

MESSAGE SUMMARY BELOW:

END

OU-1A.1B North Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	3.1E-06
96184	1.00E+00	1,2,3-Trichloropropane	3.9E-07	1.5E-03
75014	1.00E+00	Vinyl chloride (chloroethene)	1.8E-07	5.5E-05

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	243.84	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
		1.00E-08	C	1.399	0.473	0.216

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350
Used to calculate risk-based groundwater concentration.					

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	152.4	91.44	243.840
Density (g/cm3)	1.38	1.43	1.399
Porosity (unitless)	0.481	0.459	0.473
Moisture (cm3/cm3	0.216	0.215	0.216

CHEMICAL PROPERTIES SHEET

OU-1A.1B North Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	2.0E-03	3.0E-04
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	7.8E-05	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

OU-1A.1B North Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.257	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.84E-03	1.99E-05	5.53E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.46E-03	1.36E-04	3.56E-04
5.08E+04	1.00E+06	5.00E-03	15	4,838	2.63E-02	1.08E+00	1.80E-04	5.15E-03	2.21E-05	6.14E-05

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
228.84	15	4.05E+02	1.25	8.33E+01	3.84E-03	5.00E+03	7.16E+18	4.75E-06	1.92E-03	2.0E-06	6.0E-01
228.84	15	1.59E+01	1.25	8.33E+01	3.46E-03	5.00E+03	7.96E+20	3.01E-05	4.78E-04	2.0E-03	3.0E-04
228.84	15	1.08E+03	1.25	8.33E+01	5.15E-03	5.00E+03	1.13E+14	5.27E-06	5.69E-03	7.8E-05	1.0E-01

END

RESULTS SHEET

OU-1A.1B North Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	3.1E-06	Trichloroethylene
3.9E-07	1.5E-03	1,2,3-Trichloropropane
1.8E-07	5.5E-05	Vinyl chloride (chloroethene)

MESSAGE SUMMARY BELOW:

END

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (U.S. EPA Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	NA
96184	1.00E+00	1,2,3-Trichloropropane	NA	1.5E-03

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	243.84	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type _____ Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^v (g/cm^3)	ENTER Vadose zone soil total porosity, n^v (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^v (cm^3/cm^3)
		1.00E-08	C	1.405	0.470	0.216

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	121.92	121.92	243.840
Density (g/cm3)	1.38	1.43	1.405
Porosity (unitless)	0.481	0.459	0.470
Moisture (cm3/cm3	0.216	0.215	0.216

CHEMICAL PROPERTIES SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (U.S. EPA Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	0.0E+00
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	0.0E+00	3.0E-04

END

INTERMEDIATE CALCULATIONS SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (U.S. EPA Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
228.84	0.255	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.255	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.75E-03	1.99E-05	5.53E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.39E-03	1.36E-04	3.56E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
228.84	15	4.05E+02	1.25	8.33E+01	3.75E-03	5.00E+03	1.92E+19	4.74E-06	1.92E-03	2.0E-06	NA
228.84	15	1.59E+01	1.25	8.33E+01	3.39E-03	5.00E+03	2.37E+21	3.00E-05	4.77E-04	NA	3.0E-04

END

RESULTS SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (U.S. EPA Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	NA	Trichloroethylene
NA	1.5E-03	1,2,3-Trichloropropane

MESSAGE SUMMARY BELOW:

END

DATA ENTRY SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (DTSC Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	3.1E-06
96184	1.00E+00	1,2,3-Trichloropropane	3.9E-07	1.5E-03

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	243.84	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type	ENTER Vadose zone soil dry bulk density, ρ_b^v (g/cm^3)	ENTER Vadose zone soil total porosity, n^v (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^v (cm^3/cm^3)
		1.00E-08	C	1.405	0.470	0.216

Lookup Soil

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	121.92	121.92	243.840
Density (g/cm3)	1.38	1.43	1.405
Porosity (unitless)	0.481	0.459	0.470
Moisture (cm3/cm3	0.216	0.215	0.216

CHEMICAL PROPERTIES SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (DTSC Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	2.0E-03	3.0E-04

END

INTERMEDIATE CALCULATIONS SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (DTSC Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
228.84	0.255	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
228.84	0.255	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.75E-03	1.99E-05	5.53E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.39E-03	1.36E-04	3.56E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
228.84	15	4.05E+02	1.25	8.33E+01	3.75E-03	5.00E+03	1.92E+19	4.74E-06	1.92E-03	2.0E-06	6.0E-01
228.84	15	1.59E+01	1.25	8.33E+01	3.39E-03	5.00E+03	2.37E+21	3.00E-05	4.77E-04	2.0E-03	3.0E-04

END

RESULTS SHEET

OU-1A/1B North Incremental Risk - TCE/1,2,3-TCP (DTSC Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	3.1E-06	Trichloroethylene
3.9E-07	1.5E-03	1,2,3-Trichloropropane

MESSAGE SUMMARY BELOW:

END

DATA ENTRY SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	NA
96184	1.00E+00	1,2,3-Trichloropropane	NA	1.6E-03
75014	1.00E+00	Vinyl chloride (chloroethene)	1.0E-08	5.5E-05

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	152.4	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type _____ Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
		1.00E-08	C	1.410	0.468	0.215

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350
Used to calculate risk-based groundwater concentration.					

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	60.96	91.44	152.400
Density (g/cm3)	1.38	1.43	1.410
Porosity (unitless)	0.481	0.459	0.468
Moisture (cm3/cm3	0.216	0.215	0.215

CHEMICAL PROPERTIES SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	0.0E+00
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	0.0E+00	3.0E-04
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.69E-03	1.99E-05	3.34E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.33E-03	1.36E-04	2.23E-04
5.08E+04	1.00E+06	5.00E-03	15	4,838	2.63E-02	1.08E+00	1.80E-04	4.95E-03	2.21E-05	3.71E-05

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
137.4	15	4.05E+02	1.25	8.33E+01	3.69E-03	5.00E+03	4.34E+19	4.77E-06	1.93E-03	2.0E-06	NA
137.4	15	1.59E+01	1.25	8.33E+01	3.33E-03	5.00E+03	5.81E+21	3.13E-05	4.98E-04	NA	3.0E-04
137.4	15	1.08E+03	1.25	8.33E+01	4.95E-03	5.00E+03	4.34E+14	5.29E-06	5.72E-03	4.4E-06	1.0E-01

END

RESULTS SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (U.S. EPA Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	NA	Trichloroethylene
NA	1.6E-03	1,2,3-Trichloropropane
1.0E-08	5.5E-05	Vinyl chloride (chloroethene)

MESSAGE SUMMARY BELOW:

END

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 1 of 4

GW-SCREEN
Version 3.0; 04/03

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 2/4/09)

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
79016	1.00E+00	Trichloroethylene	1.6E-09	3.1E-06
96184	1.00E+00	1,2,3-Trichloropropane	4.1E-07	1.6E-03
75014	1.00E+00	Vinyl chloride (chloroethene)	1.8E-07	5.5E-05

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	152.4	C	24.2	5.0

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type _____ Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
		1.00E-08	C	1.410	0.468	0.215

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350
Used to calculate risk-based groundwater concentration.					

END

Soil Physical Properties by Layer

	Layers		Total
	A	B	
Soil Classification	SIC	C	
Thickness (cm)	60.96	91.44	152.400
Density (g/cm3)	1.38	1.43	1.410
Porosity (unitless)	0.481	0.459	0.468
Moisture (cm3/cm3	0.216	0.215	0.215

CHEMICAL PROPERTIES SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 2 of 4

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	6.0E-01
7.10E-02	7.90E-06	4.08E-04	25	9,171	430.00	652.00	2.20E+01	1.75E+03	2.0E-03	3.0E-04
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	7.8E-05	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 3 of 4

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000
137.4	0.252	#N/A	#N/A	#N/A	1.00E-08	81.52	0.459	0.047	0.412	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.08E+04	1.00E+06	5.00E-03	15	8,380	9.89E-03	4.05E-01	1.80E-04	3.69E-03	1.99E-05	3.34E-05
5.08E+04	1.00E+06	5.00E-03	15	10,917	3.88E-04	1.59E-02	1.80E-04	3.33E-03	1.36E-04	2.23E-04
5.08E+04	1.00E+06	5.00E-03	15	4,838	2.63E-02	1.08E+00	1.80E-04	4.95E-03	2.21E-05	3.71E-05

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
137.4	15	4.05E+02	1.25	8.33E+01	3.69E-03	5.00E+03	4.34E+19	4.77E-06	1.93E-03	2.0E-06	6.0E-01
137.4	15	1.59E+01	1.25	8.33E+01	3.33E-03	5.00E+03	5.81E+21	3.13E-05	4.98E-04	2.0E-03	3.0E-04
137.4	15	1.08E+03	1.25	8.33E+01	4.95E-03	5.00E+03	4.34E+14	5.29E-06	5.72E-03	7.8E-05	1.0E-01

END

RESULTS SHEET

OU-1B South Incremental Risk - TCE/1,2,3-TCP/VC (DTSC Criteria) - Sheet 4 of 4

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA
NA	NA	NA	1.75E+06	NA
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Chemical
1.6E-09	3.1E-06	Trichloroethylene
4.1E-07	1.6E-03	1,2,3-Trichloropropane
1.8E-07	5.5E-05	Vinyl chloride (chloroethene)

MESSAGE SUMMARY BELOW:

END

LOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CalEPA Toxicity Criteria in bold (last updated 2/4/09 DTSC/HERD)

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Molecular weight, MW (g/mol)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	**4.2E-05**	**4.0E-02**	1.54E+02
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	**3.4E-04**	7.0E-04	4.10E+02
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	**3.1E-04**	1.1E-03	2.91E+02
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01	7.41E+01
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	**4.6E-03**	1.8E-04	3.81E+02
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	**3.1E+01**	5.81E+01
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	**5.3E-06**	**3.0E-01**	1.19E+02
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	**1.1E-05**	3.5E-03	2.37E+02
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	**2.9E-05**	**3.0E-02**	7.81E+01
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	**5.0E+00**	1.33E+02
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02	3.46E+02
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	**9.7E-05**	0.0E+00	3.18E+02
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	**5.0E-03**	9.49E+01
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	**1.8E-06**	9.0E-02	5.05E+01
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	**3.0E-03**	2.70E+01
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02	1.74E+02
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	6.45E+01
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	**7.8E-05**	1.0E-01	6.25E+01
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02	4.11E+01
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	**2.7E-06**	**9.0E-03**	4.41E+01
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	**1.0E-06**	**4.0E-01**	8.49E+01
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01	7.61E+01
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	**8.8E-05**	**3.0E-02**	4.41E+01
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02	2.53E+02
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	**3.7E-05**	7.0E-02	1.64E+02
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01	7.85E+01
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	**1.6E-06**	**7.0E-01**	9.90E+01
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	**7.0E-02**	9.69E+01
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01	8.65E+01
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01	1.37E+02
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01	1.21E+02
76131	1,1,2-Trichloro-1,2,2-trifluoroethar	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01	1.87E+02
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	**1.2E-03**	1.8E-03	3.73E+02
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04	2.73E+02
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00	7.41E+01
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	**1.0E-05**	4.0E-03	1.13E+02
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00	7.21E+01
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	**1.6E-05**	1.4E-02	1.33E+02
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	**2.0E-06**	**0.0E+00**	1.31E+02
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00	7.41E+01
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	**5.8E-05**	**1.4E-02**	1.68E+02
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02	8.91E+01

80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01	1.00E+02
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01	1.54E+02
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01	1.66E+02
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	3.5E-03	2.61E+02
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.2E-03	1.37E+02
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03	1.28E+02
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	1.4E-02	1.42E+02
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01	1.54E+02
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01	1.06E+02
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01	1.47E+02
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02	1.29E+02
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03	1.20E+02
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	0.0E+00	3.0E-04	1.47E+02
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01	8.61E+01
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01	1.14E+02
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01	1.34E+02
98828	Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.16E+00	25	425.56	631.10	10,335	0.0E+00	4.0E-01	1.20E+02
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01	1.20E+02
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03	1.23E+02
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00	1.06E+02
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	9.0E-01	1.04E+02
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	1.0E-03	1.27E+02
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01	1.06E+02
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01	1.20E+02
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01	1.34E+02
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	1.0E-01	1.06E+02
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	1.1E-05	8.0E-01	1.47E+02
106934	1,2-Dibromoethane (ethylene dibr	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	7.1E-05	8.0E-04	1.88E+02
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	1.7E-04	2.0E-03	5.41E+01
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05	5.61E+01
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.1E-05	4.0E-01	9.90E+01
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	2.9E-04	2.0E-03	5.31E+01
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01	8.61E+01
108101	Methylisobutylketone (4-methyl-2-	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00	1.00E+02
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01	1.06E+02
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03	1.20E+02
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00	9.82E+01
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	3.0E-01	9.21E+01
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	1.0E+00	1.13E+02
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E-01	9.26E+01
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03	6.81E+01
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	7.0E-01	8.62E+01
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	7.1E-04	0.0E+00	1.43E+02
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02	4.07E+02
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	5.1E-04	2.8E-03	2.85E+02
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03	1.81E+02
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	7.01E+01
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.7E-05	7.0E-02	2.08E+02
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04	6.71E+01
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03	8.85E+01
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	3.5E-02	1.66E+02
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01	2.02E+02
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02	1.68E+02
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01	1.34E+02
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00	8.81E+01
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	3.5E-02	9.69E+01
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02	9.69E+01
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	1.1E-04	0.0E+00	2.52E+02
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	1.1E-05	0.0E+00	2.28E+02
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04	3.65E+02
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	7.7E-04	0.0E+00	2.91E+02
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01	1.47E+02
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	1.6E-05	2.0E-02	1.11E+02
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01	1.68E+02
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	2.6E-07	3.0E+00	8.82E+01
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-05	2.01E+02

APPENDIX G

RESPONSES TO COMMENTS

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

Comment No.	Section/ Page No.	Comment	Response
Reviewer: Anantaramam Peddada - Cover Letter General Comments			
1	Cover Letter - general comment	The purpose of a 5-year review, according to United States Environmental Protection Agency (U.S. EPA) guidance, is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. The National Contingency Plan (NCP) generally defines protectiveness by the risk range and the hazard index, or HI. As part of the 5-year review process, a technical assessment is conducted. The assessment focuses on the responses to the following questions: • Is the remedy functioning as intended by the decision documents? • Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? • Has any other information come to light that could call into question the protectiveness of the remedy? Based on the technical assessment conducted for IRP-1 (OU-3), DTSC concurs with the Navy's protectiveness statement that the remedy is being implemented in accordance with the record of decision (ROD) and is protective of human health and the environment.	The Department of Navy (DoN) acknowledges the California Department of Toxic Substances Control's (DTSC's) concurrence on the Installation Restoration Program (IRP-1) (Operable Unit [OU]-3) protectiveness determination and that this remedy is being implemented in accordance with the Final Record of Decision (ROD).
2	Cover Letter - general comment	Based on the technical assessment conducted for IRP-3, -12, and -13S, DTSC concurs that the remedies are being implemented in accordance with the RODs. DTSC also concurs that under *current conditions* the remedies are protective of human health and the environment. It's important to note that DTSC's concurrence is based on indications in the Draft Report, that other than the residential development in a portion of IRP-13S; IRP-3, -12, and -13S are "...not presently used other than for operation, maintenance and monitoring of the groundwater remedy."	The DoN acknowledges DTSC's concurrence that the Remedies for IRP-3, IRP-12, and IRP-13S are being implemented in accordance with their respective Final RODs. The DoN also acknowledges DTSC's concurrence on the protectiveness determination for IRP-1 and IRP-12; however, it's noted that DTSC's concurrence on the protectiveness determination for IRP-3 and IRP-13S is limited to current site conditions (i.e., non-residential use). As stated in DTSC's comment, residential use is limited to the

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		The Draft Report goes on to state that "No issues have been identified for IRP-1, -3, -12, and -13S that would prevent the respective remedies at these sites from being protective of human health and/or the environment either currently or in the future." DTSC concurs with the Navy's statement for IRP-1 and -12; however, we believe that issues have been identified for IRP-3 and -13S that would prevent the remedies at these sites from being protective of human health and/or the environment in the *future.* One of DTSC's issues is with the vapor intrusion (VI) pathway from groundwater to indoor air (for IRP-3 and -13S). While institutional controls (ICs) preventing the use of groundwater were incorporated in the remedies, no ICs were established that directly address the VI pathway. During DTSC's review of the Draft Finding of Suitability to Transfer (FOST) # 9, DTSC had many discussions with the Navy regarding the VI pathway from groundwater to indoor air. In an email dated March 10, 2011, Mr. Callian stated that "The Navy will further evaluate potential risks to residents that DTSC has raised through the vapor intrusion pathway during the 5-year review..." While DTSC is pleased that the VI risk was re-evaluated, DTSC has concerns with how the evaluation was conducted and the conclusions that were drawn. DTSC believes the Navy has underestimated the risk. Please refer to Attachment B for further details.	agency concurred Finding of Suitability for Early Transfer (FOSET) property which includes a portion of IRP-13S. At this time, no other buildings are currently in use within the respective IRP-3 and -13S Area Requiring Institutional Controls (ARICs). However, Hangar 28, which is within the northeast corner of the IRP-12 ARIC, is occasionally used on a short term basis for blimp storage/activities and for other DoN uses. The 2002 Final Finding of Suitability to Lease (FOSL) documents the suitability for leasing CO-5 and CO-6, subject to the conditions, notifications, and restrictions set forth in the FOSL. A LIFOC has been established between the City and the DoN for CO-6 and all CO-5 Parcels with the exception of Parcels 2 and 18. Interim land-use restrictions are administratively handled through the LIFOC. For completeness, Sections 3.2.3, 3.3.3 and 3.4.2 has been revised to reflect this information. Using all information available at the time the Draft Five-Year Review Report was issued, the protectiveness statements are valid. New toxicity data for trichloroethene (TCE) was released on September 28, 2011; and will require additional evaluation. Consistent with the 2011 Navy Five-Year Review Policy, insufficient time is available to confirm the protectiveness determination for IRP-3 and -13S in light of the September 28, 2011 new TCE toxicity criteria. As such, this Five Year Review Report will be completed on time and efforts will be taken to complete the aforementioned evaluation. An IRP-3 and -13S Five-Year Review Addendum with the final protectiveness determination shall be completed within one year of October 31, 2011. Responses to comments (RTCs) concerning IRP-3 and IRP-13S future risk associated with the VI pathway are addressed below. The DoN's re-evaluation of VI risk on a point-by-point basis using volatile organic compound (VOC) results from individual monitoring wells resulted in risk estimates ranging from 4.3×10^{-9} to 1.8×10^{-5}. The maximum estimated risks are within the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) risk management range (10^{-6} to 10^{-4}) for IRP-3 (maximum 1.8×10^{-5}) and -13S (maximum 1.5×10^{-5}). These estimates are similar in

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			magnitude to those presented in DTSC's re-evaluation presented in Attachment B to the comments (maximum values in the 10^{-5} range). The baseline risk assessments that were the basis for the Feasibility Studies (FSs) and RODs for IRP-3 and -13S also produced risk estimates that were within the NCP risk management range, and were accepted by DTSC when the agency concurred with these documents, and concurred with the original risk management decisions for IRP-3 and -13S.
3	Cover Letter - general comment	According to the Draft Report and Draft FOST # 9 dated May 2010, IRP-3 and several other parcels within IRP-13S are currently in the process of being transferred to the City of Tustin. DTSC understands that there are currently no receptors occupying buildings at these sites being proposed for transfer under FOST # 9 and therefore, the exposure pathway for VI to indoor air is incomplete. However, if the existing buildings become occupied or buildings are constructed and occupied in the near future, DTSC believes the VI pathway to indoor air would be a risk at IRP-3 and -13S. In order to alleviate the risk, DTSC believes that some type of IC is necessary that addresses the VI pathway in order to provide for the protection of human health.	On October 14, 2011 DTSC issued a 25-page comment letter on the Draft Five-Year Review Report, approximately 1.5 months after the requested comment date. On September 28, 2011, U.S. EPA released new TCE toxicity criteria. Based on available information at the time this Draft Five-Year Review Report was prepared; the remedies at IRP-1, -3, -12 and -13S were determined to be protective of human health and the environment. Consistent with the 2011 Navy Five-Year Review Policy, this Five Year Review Report will be completed and signed on time and an IRP-3 and -13S Five-Year Review Addendum containing the evaluation of the new TCE criteria and the final protectiveness determination will be completed within one year of October 31, 2011.
4	Cover Letter - general comment	On September 28, 2011 new information came to light that could call into question the protectiveness of the remedy. U.S. EPA released new toxicity criteria for trichloroethene (TCE) and the reference concentration and inhalation unit risk (IUR) factor values are more conservative than the Office of Environmental Health Hazard Assessment's (OEHHA's) toxicity criteria. Until now, U.S. EPA/IRIS did not have toxicity values for TCE, and the Navy was using the toxicity values from OEHHA's database. The IUR factor for TCE, used to evaluate the potential cancer risk, is only 2-fold more conservative than the current OEHHA IUR. However, the IRIS inhalation reference concentration (RfC) for TCE is 300-fold more conservative than the current RfC (OEHHA value) being used at the sites. DTSC's main concern is for the adverse non-cancer effects associated with TCE (and 1,2,3-TCP) exposure by the inhalation route, and in particular the construction worker/trench scenario at such time redevelopment occurs at IRP-3 and the parcels within IRP-	As stated in the Response to Comment #2 above, an evaluation of the new TCE toxicity criteria will be prepared for IRP-3 and -13S and presented in an Addendum.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		13S that are currently in the process of being transferred to the City of Tustin. Given the IRIS RfC is 300-fold more conservative, the non-cancer effects associated with TCE exposure will likely drive risk assessments. DTSC believes the Navy should address the new IRIS toxicity criteria values for TCE in the 5-year review, and if that is not planned, an explanation should be provided.	
5	Cover Letter - general comment	DTSC appreciates the opportunity to comment on the Draft Report and we look forward to the Navy's responses. DTSC would appreciate Navy responses to all of DTSC's comments, both in this cover letter, as well as Attachments A through C. DTSC also understands that the Navy would like to sign off on the Draft Report by the end of October as a matter of policy and in light of recent interpretations of when 5-year reviews should be completed, however, DTSC also believes that the issues discussed in its comments create a reasonable basis to readjust that date by a short time in an effort to resolve the concerns that DTSC has raised in regard to the protectiveness of the remedy.	On October 14, 2011; DTSC issued a 25-page comment letter on the Draft Five-Year Review Report, approximately 1.5 months after the requested comment date. On September 28, 2011, U.S. EPA released new TCE toxicity criteria. RTCs to DTSC comments are provided herein. On September 28, 2011, U.S. EPA released new TCE toxicity criteria after the Draft Five Year Review Report had been submitted to the Base Realignment and Closure (BRAC) Cleanup Team (BCT) for review. Based on available information at the time when this Draft Five-Year Review Report was prepared; the remedies at IRP-1, -3, -12 and -13S were determined to be protective of human health and the environment. DTSC concurs with the protectiveness determinations for IRP-1 and -12, and concurs with the protective determination for IRP-3 and -13S under current conditions. However, DTSC has also requested that the Navy address these new TCE toxicity criteria for IRP-3 and -13S within this Five-Year Review. In response to the new TCE toxicity criteria, time does NOT allow for a rigorous evaluation. As such, an evaluation of the new TCE toxicity criteria will be prepared for IRP-3 and -13S and presented in an Addendum.
Attachment A: Reviewer - Anantaramam Peddada - General Comments			
1	Attachment A General comment	Three Sites in OU-4B (Installation Restoration Program (IRP) Sites 11, and 13W, and Miscellaneous, Major Spill [MMS]-04) are briefly discussed in this Draft Report. The Draft Report states that 'insufficient time has passed to adequately evaluate the selected remedies for these OU-4B low concentration Sites; therefore, they were not subjected to the comprehensive five-year review process described in the Report. They will be addressed in the next five-year review." If, according to the United States Environmental Protection Agency's (U.S. EPA's) *Comprehensive*	OU-4B Sites IRP-11, -13W, and MMS-04 were discussed in this Five-Year Report because the ROD for these sites has already been signed, and DoN policy requires a five-year review be completed for remedies that do not require a remedial action-construction phase (e.g. remedies only implementing ICs) within five years of the ROD signature date. DoN policy also requires coordinating all five-year reviews at an installation so that they are completed simultaneously. Since the next scheduled five-year-review at former MCAS Tustin will occur more than five years from

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		Five-Year Review Guidance, a 5-year review is not required at this time for the OU-4B Sites, DTSC recommends removing them from this Draft Report. However, if information/data from these OU-4B Sites has a direct bearing on IRP Sites 1, 3, 12, or 13S, that information/data should be discussed in this Draft Report.	the ROD signature dates for IRP-11 and -13W, these Sites will be acknowledged in the current Report in order to synchronize the five-year review schedule for all the sites at former MCAS Tustin. As noted in Section 11, "The remedy, ICs, for OU-4B low concentration Site MMS-04, was completed in 2011; the agency concurred RACR documented that the terms of the Final ROD/RAP were met; the RAOs and RG had been achieved, that Soil at the Site required NFA, and the Site was protective of human health and the environment (AIS-TN&A JV 2011)." Therefore, no further Five-Year Reviews are required for MMS-04. For completeness, Section 11 will be updated to add the aforementioned sentence. The OU-4B sites do not have a direct bearing on the protectiveness determination for IRP-1. -3, -12, or -13S.
2	General comment	Subsequent to the record of decision (ROD) being signed in 2004, the United States Environmental Protection Agency (U.S. EPA) revised the toxicity criteria for 1,2,3-Trichloropropane (1,2,3-TCP) in 2009. The oral cancer slope factor (CSF) was revised and increased 15 fold from 2 per mg/kg-day to 30 per mg/kg-day. The updated criterion has not yet resulted in new enforceable groundwater standards or maximum contaminant levels (MCLs), but it may in the future. Therefore, this information should be included as a requirement to be considered (TBC) or at a minimum new information that has come to light that could call into question the protectiveness of the remedy.	This information is addressed in the Report in Sections 7.2.2.2 through 7.2.2.4. Specifically, the Report states in Section 7.2.2.4 (p. 7-16): *"Toxicity criteria have been updated for 1,2,3-TCP since the signing of the IRP-13S (OU-1A) ROD. These new criteria have not yet resulted in new enforceable groundwater standards that would constitute ARARs, but they may in the future. The RG for 1,2,3-TCP in groundwater established in the ROD was based partly on risk considerations and partly on limitations of technology. If a new baseline HHRA were conducted based on current soil and groundwater COC concentrations, current toxicity criteria and U.S. EPA guidance for use of those criteria, it is likely that the total lifetime cancer risk under current and future unrestricted use would be lower than predicted in the original baseline HHRA for the following reasons:* • *Cancer risk due to exposures from beneficial use of groundwater under current conditions would be lower due to lower current groundwater VOC concentrations than existed at the time of the baseline HHRA;* • *Cancer risk due to exposures from beneficial use of groundwater under future conditions (upon achieving RGs) would be lower due to the net effect of elimination of route-*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			to-route extrapolation of the revised oral CSF for 1,2,3-TCP discussed in Section 7.2.2.2.2.1. • *Soil with TCE contamination exceeding 400 µg/kg was removed from each source area and replaced with clean backfill, thereby eliminating the risk contribution from dermal contact with, and ingestion of, soil.* *Given these factors, the weight of evidence indicates that the RG of 0.5 µg/L for 1,2,3-TCP remains appropriate and protective."* Section 7.2.3 states: "The document review, data review, site inspection and interviews have identified no *other* information [emphasis added] that would call into question the protectiveness of the remedies implemented for IRP-3, -12, and/or -13S." No changes were made in the Final Five-Year Review Report in response to this comment.
3	General comment	At the time the Remedial Investigation/Feasibility Study (RI/FS) was conducted, no inhalation slope factor for 1,2,3-TCP was available in IRIS, and a route-to-route extrapolation was performed to estimate the inhalation risk for 1,2,3-TCP. As previously done in the RI/FS, DTSC performed a route-to-route extrapolation using the revised toxicity criteria to estimate the inhalation risk. Based on the revised oral CSF and the revised inhalation unit risk (IUR) (doing a route-to-route extrapolation of the oral CSF), DTSC believes that once the remedial goal (RG) established in the 2004 ROD has been met for 1,2,3-TCP, a revised human health risk assessment (HHRA) will need to be conducted for the use of groundwater. The revised HHRA will need to use the most current toxicity criteria (at the time of the HHRA) to establish the potential cancer risks for the site conditions at that time, and to potentially support the maintenance of institutional controls (ICs) prohibiting the use of groundwater.	Five-Year Reviews will continue to be performed until remedial action is complete. Consistent with this Review, toxicity data will continue be evaluated to ensure that the remedy continues to be protective.
4	General comment	Based on the information provided in the Draft Report, it appears that the Restoration Advisory Board (RAB) was notified of the 5-year review process. Was the "community at large" notified regarding the availability of the Draft Report?	Yes. In addition to the notification to the RAB, a public notice was mailed to 180 residents on the RAB mailing list to inform them of the upcoming RAB meeting that would discuss the Five-Year Review, and a newspaper advertisement as noted in the second paragraph

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			of Section 6.2. was also published.
5	General comment	The Draft Report discusses the reuse status of all the sites. It would be helpful to have this information depicted in a new or existing figure.	As noted, Draft Five-Year Review Report discusses the reuse status of all of the sites. For easy identification, each site has its own separate section dedicated to this topic. No changes were made in the Final Five-Year Review Report in response to this comment.
6	General comment	In various sections of the Report there are discussions about the IRP-1 containment wall. Specifically, it's stated on page 6-9 that "...an older section of the wall has been incorrectly indicated as part of the groundwater containment remedy going back to the RI Report..." Later in the Report, on page 9-1, there is a recommendation to correct the "...discrepancy in the depiction of the containment wall..." An existing structure could be a part of the remedy if that existing structure serves a purpose, therefore, DTSC would not recommend eliminating the older preexisting wall from the remedy without further understanding of the rationale. Why wasn't this issue bought up in the first 5-year review or during the 5-year review site inspection on February 16th of this year?	The issue was not recognized in the first five-year-review nor at the site inspection because the distinction between the adjoining sections of wall is subtle based on physical inspection. The older section was built using cast-in-place concrete while the newer section was built using spray-applied concrete (gunite). The gunite wall has fewer construction joints and is inherently superior for groundwater containment. The older section is located at the north end of the wall and is upgradient and cross-gradient from the area of groundwater impact. Based on the detailed evaluation performed in this Five-Year Review, it appears that previous document figures incorrectly identified this older section of wall as part of the containment wall configuration. Please note that both the RWQCB and U.S. EPA, concur with the recommended "minor" change approach to administratively document this discrepancy.
7	General comment	The area requiring institutional controls (ARIC) is shown on the figures for IRP-1. Why aren't the ARICs shown on the figures for IRP Sites 3, 12, and 13S?	The conceptual ARICs for IRP-3, -12, and -13S as documented in Finding of Suitability for Transfer (FOST) #9, are shown on Figure 1.
8	General comment	Although IRP-13W is not included in this 5-year review, the groundwater plume associated with IRP-13W is commingled with the IRP-13S groundwater plume. Please provide a discussion in the 5-year review that addresses any impacts associated with the IRP-13W groundwater plume being commingled with the IRP-13S groundwater plume. A figure, if appropriate, would also be helpful.	IRP-13W is included in this Five-Year Review Report but an evaluation was not completed (see General Comment #1). The following discussion has been inserted in the text in Section 7.2.1.1: *"It should be noted that first WBZ TCE concentrations associated with one of the OU-4B low concentration sites mentioned in Section 1, IRP-13W, lie upgradient from the first WBZ VOC plume associated with IRP-13S. The IRP-13W TCE concentrations are low (on the order of 10 ug/L), are attenuating with time, and do not appear to be migrating towards IRP-13S; therefore, the presence of these low TCE concentrations at IRP-13W has no impact on the IRP-13S groundwater plume."*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			It should be noted that there is an agency-concurred ROD for IRP-13W with ICs as the remedy.
Attachment A: Reviewer - Anantaramam Peddada - Specific Comments			
1	Page xi	Acronyms and Abbreviations - a. OCHCA: Please change to "Orange County Health Care Agency". b. OEHHA: Please change to "Office of Environmental Health Hazard Assessment". c. PERF: Please change "evaluation" to "environmental".	The corrections have been incorporated.
2	Page xiv Executive Summary	The first full sentence is not consistent with the corresponding reference on page12-3. Please note that the Department of Toxic Substances Control (DTSC) is not part of the Department of Health Services (DHS). Please correct the inconsistency.	The correction has been incorporated.
3	Page xiv Table ES-1	The second to the last bullet item says Base Realignment and Closure (BRAC) Cleanup Team (BCT) concurrence with OPS, but only a DTSC reference is listed. Did the RWQCB also concur? If yes, please add the RWQCB reference. If no, please explain the use of "BCT" concurrence rather than simply "DTSC" concurrence.	The RWQCB did concur with OPS for OU-1A/-1B. The table has been revised to reflect that the DTSC and RWQCB (rather than the BCT) concurred with OPS, and to include the RWQCB reference.
4	Page xv	OU-3 (IRP-1) – Similar to page xiv, please include a date for remedy implementation. Also similar to page xiv, please include a bullet for BCT concurrence with OPS, and include the appropriate reference(s).	The RWQCB did concur with OPS for IRP-1. The table has been revised to reflect that the DTSC and RWQCB (rather than the BCT) concurred with OPS, and to include the RWQCB reference.
5	Pages 1-2 through 1-4, Table 1-1	Please refer to Specific Comments 3 and 4 above.	The table has been revised to reflect that the DTSC and RWQCB (rather than the BCT) concurred with OPS, and to include the RWQCB reference. In addition, Table 2-1 was revised for conformance.
6	Pages 2-1 through 2-10, Table 2-1	Please include the Finding of Suitability for Early Transfer (FOSET) for IRP-13S and the Finding of Suitability for Transfer (FOST) for	Table 2-1 has been revised to include the FOSET for IRP-13S and the FOST for IRP-1.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		OU-3.	
7	Page 2-9, Table 2-1	Reference ECS 2010c – Shouldn't this be "ECS 2010d"?	The correction has been incorporated.
8	Page 3-8, Section 3.3.1	Physical Characteristics – Please identify, on Figure 3, the buildings referenced in this paragraph.	The text has been modified to delete references to buildings that no longer exist. Figure 3 has been modified to label existing building 29A.
9	Page 3-13, Section 3.4.1	Physical Characteristics – Please identify, on Figure 4, the buildings and street referenced in this paragraph.	The text has been modified to refer to the existing streets shown on Figure 4.
10	Page 3-13, Section 3.4.2	Land and Resource Use – Is IRP-12 being proposed for transfer under FOST #9?	FOST #9 Figure 5 depicts the property proposed for transfer in conjunction with this FOST which includes a small portion of IRP-12 (Parcels 16B and 17A). The text of Section 3.4.2 has been revised to read: *"The boundaries and layout of IRP-12 are illustrated on Figure 4 - Site Plan. IRP-12 is located within CO-5 which is retained by the DoN. A FOST is underway for a small portion (Reuse Parcels 16B and 17A) of IRP-12. The majority of IRP-12 includes undeveloped land and former MCAS Tustin buildings. To expedite the transfer process, a LIFOC has been established between the City and the DoN. The Final Finding of Suitability to Lease (FOSL) provides provisions for use of buildings within Carve Out (CO) 5."*
11	Page 3-20, Section 3.5.1	Physical Characteristics – Please identify, on Figure 4, the buildings and the streets referenced in this paragraph.	Reference to former buildings has been deleted from the text, and Figure 4 has been modified to identify former Severyns Road. The text of the first paragraph, second sentence has been revised to read: *"IRP-13S is located in the northwest portion of the former MCAS Tustin property, along Armstrong Avenue just north of Valencia Avenue (adjacent to the former Severyns Road)(Figure 4)."*
12	Page 3-20, Section 3.5.2	Land and Resource Use – Why doesn't it also say that a portion of IRP-13S is currently in the process of being transferred to the City of Tustin, like was done for IRP Sites 3 and 12?	Section 3.5.2 has been revised to read: *"The boundaries and layout of IRP-13S are illustrated on Figure 4 - Site Plan. IRP-13S includes an early transfer parcel that consists of a multifamily residential development called Columbus Square was recently constructed (circa 2008) on the Site and adjoining areas. A FOST is underway*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			for a portion of IRP-13S to support transfer of the property to the City of Tustin. To expedite the transfer process, a LIFOC has been established between the City and the DoN. Other than the residential development, IRP-13S is not presently used other than for operation, maintenance and monitoring of the groundwater remedy."
13	Page 3-24, Section 3.5.6.1.4,	Summary - In the 2nd paragraph, please include the actual risk number, not just the range. In the 3rd paragraph, please explain to which scenario you are referring and in the last line of the 3rd paragraph, please insert "beneficial" prior to "groundwater".	The text of the second and third paragraphs have been revised to read: *"Under a hypothetical residential scenario with baseline VOC concentrations and ICs to prevent beneficial use of groundwater, the maximum estimated total cancer risk was reduced by two orders of magnitude to 1 x 10^{-5}, within the NCP risk management range (10^{-6} to 10^{-4}). Therefore, ICs would be effective in protecting human health and would allow for the reuse of existing and newly constructed buildings within the IRP-13S Site boundary.* *The main exposure pathway under the scenario with ICs was indoor vapor inhalation of 1,2,3-TCP emanating from groundwater (63 percent), since direct exposure to 1,2,3-TCP from beneficial groundwater use would be prevented through ICs."*
14	Page 3-25, Section 3.5.6.3	Basis for Taking Action – In the 4th paragraph, first line, please explain to which scenario you are referring. Also, shouldn't "1,2,3-TCP" be "TCE"? In the last line, please insert "beneficial" prior to "groundwater".	At IRP-13S, the risk driver is 1,2,3-TCP. The text has been revised to replace "TCE" with "1,2,3-TCP" and insert "beneficial" prior to "groundwater".
15	Page 4-3, Section 4.1.2.3	Reporting – In the last paragraph, please explain why some of the references for the annual reports appear to be missing.	Section 12 has been revised to incorporate all applicable references, and citations have been added in the text.
16	Page 4-3, Section 4.1.3	Problems Encountered – Please include the reference for the U.S. EPA OPS Determination. The last sentence says the BCT concurred with OPS, but only a DTSC reference is listed. Did the RWQCB also concur? If yes, please add the RWQCB reference. If no, please explain the use of "BCT" concurrence rather than simply "DTSC" concurrence.	The text has been revised to incorporate the reference for the U.S. EPA OPS Determination, and the RWQCB reference has been added.
17	Page 4-4, Section 4.2.2.1	Soil Hot Spot Excavation – Paragraphs 4 and 5 seem to contradict one another. Please provide further explanation.	Paragraph 4 refers to results of confirmation samples collected from the sidewalls of the excavation following removal of the excavated soil. These samples were of soil that remained in place. Paragraph

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			5 refers to results of samples collected from the stockpiled soil that had been removed from the excavation. There is no contradiction between the paragraphs.
18	Pages 4-8 through 4-10, Section 4.2.2.6	Institutional Controls – Why isn't the land use covenant(s) for the early transfer parcel associated with IRP-13S discussed in this section?	The text of the fourth paragraph has been revised to read: "*ICs (in the form of lease restrictions and security measures) are currently in place under a LIFOC for all parcels within CO-5 and CO-6 (except for Parcels 2 and 18 in CO-5 that are being retained by the DoN). ICs are also incorporated in the CRUP and Quitclaim Deed for the early transfer parcel (portion of IRP-13S). These ICs are as follows:...*"
19	Page 4-9, Section 4.2.2.6	Institutional Controls – Page 4-9, Section 4.2.2.6, Institutional Controls – It says that institutional controls (ICs) are currently in place under a Lease-in-Furtherance-of-Conveyance (LIFOC) for all parcels within CO-5 (except for Parcels 2 and 18), and CO-6. Why aren't ICs in place for Parcels 2 and 18? Why don't Sections 3.3.2, 3.4.2, and 3.5.2 mention the LIFOC? Sections 3.3.2, 3.4.2, and 3.5.2 basically say that IRP-3, -12, and -13S (except for the residential development) are currently in the process of being transferred to the City of Tustin and are not presently used other than for operation, maintenance and monitoring of the groundwater remedy. If this is the case, what is the purpose of the LIFOC?	Parcels 2 and 18 in CO-5 have been retained by the Navy and do not yet have ICs related to a LIFOC. Section 4.2.2.6, paragraph 4 has been revised to read: "*ICs (in the form of lease restrictions and security measures) are currently in place under a LIFOC for all parcels within CO-5 and CO-6 (except for Parcels 2 and 18 in CO-5 that are being retained by the DoN). ICs are also incorporated in the CRUP and Quitclaim Deed for the early transfer parcel (portion of IRP-13S)...*" Section 3.3.2 has been revised to read: *" The layout of IRP-3 is illustrated on Figure 3 - Site Plan. IRP-3 is currently in the process of being transferred to the City of Tustin and is not presently used other than for operation, maintenance and monitoring of the groundwater remedy. To expedite the transfer process, a Lease-in-Furtherance-of-Conveyance (LIFOC) has been established between the City and the DoN."* The text in Sections 3.4.2, and 3.5.2 has been revised to add: *"To expedite the transfer process, a LIFOC has been established between the City and the DoN."*
20	Page 4-9, Section 4.2.2.6	Institutional Controls, 12th Bullet – If the RWQCB is a signatory to the PERFs, please include them in this bullet.	The PERFs are submitted to the DoN, and subsequently to the rest of the BCT for concurrence. The RWQCB occasionally defers to DTSC; therefore, the RWQCB does not always sign the PERFs. The third bullet under ICs in Section 4.2.2.6 has been revised to read: "*The Lessee must complete a Project Environmental Review Form (PERF) for any work proposed in the leased portion of the*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			property. A PERF is submitted to the Navy for prior approval, and subsequently to the rest of the BCT for concurrence."
21	Page 4-10, Section 4.2.2.6	Institutional Controls – In the 2nd paragraph why isn't IRP-13S mentioned?	The text has been revised to include IRP-13S.
22	Page 4-11, Section 4.2.2.8.1.1	Hot Spot Extraction Wells - DTSC disagrees with the use of the term "asymptotic" when used to describe groundwater contaminant behavior. An asymptote is a characteristic of a curve defined by a specific equation, which can be shown to approach, but never reach, a particular value over an infinite range of the curve. No such equation or curve has been demonstrated for this, or indeed any, groundwater contaminant system. If concentrations exist above the agreed upon cleanup goal and the existing remedy is failing to reduce those concentrations satisfactorily, then the Navy should propose other means of achieving the remedy. The existing remedy should remain in operation until a new remedy is proposed and approved.	"Asymptotic" is a term that was specifically defined in the Final Operation and Maintenance Plan (OMP), a document that was reviewed and concurred with by DTSC. Moreover, use of the term "asymptotic condition" in the Five-Year Review Report is also defined in Section 4.2.2.8.1.1 as meaning "the point where the quantity of VOC mass removed over time has been reduced to a level at which continued reduction of VOCs is considered no longer technologically and/or economically feasible." The definition of technological and/or economic feasibility is based on Cal. Code Regs. Title 22 Section 66264.94(c) which is a groundwater ARAR. The definition of "asymptotic" is consistent with the use of the term as defined in the OMP. To use a different term would be inconsistent with the Final OMP, and might introduce confusion.
23	Page 4-11	Please include a reference for the "hot spot" definition listed at the bottom of the page.	This term was defined in the Final OMP prepared by ERRG. A reference citation has been added to the footnote.
24	Page 4-12, Paragraph 1 and Associated Bullets	DTSC disagrees that a decline in mass removal rates justifies a shutdown, if the remedial goals have not been met. If system operations become economically inefficient the Navy should propose other remedial actions to achieve the cleanup goals.	The exit strategy for hot spot extraction wells is set forth in the agency concurred Final OMP. The text referred to in this comment restates the agency-concurred exit strategy.
25	Page 4-12, Section 4.2.3	Problems Encountered – The last sentence says the BCT concurred with OPS, but only a DTSC reference is listed. Did the RWQCB also concur? If yes, please add the RWQCB reference. If no, please explain the use of "BCT" concurrence rather than simply "DTSC" concurrence.	The RWQCB reference has been added.
26	Page 6-3, Section 6.4.1.2	Surface Water Concentration Data – Please explain why some of the references for the monitoring data appear to be missing.	The text has been revised to include all references.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

27	Page 6-4, Section 6.4.1.5	IC Compliance Data – It is noted that the annual Land Use Controls Compliance Certificates (LUCCCs) have been completed on an annual basis by the City of Tustin and that copies are provided in Appendix B. However, only the 2011 LUCCC is included in Appendix B. Please include all of the previous years in Appendix B.	LUC Compliance Certificates for 2008, 2009, and 2010 for IRP-1 have been added in Appendix B. The 2006 and 2007 LUC Compliance Certificates will be provided in an addendum.
28	Page 6-6, Section 6.4.2.6	IC Compliance Data, 2nd Paragraph – Please include the site inspection checklists in Appendix B.	Site inspection checklists have been added in Appendix B.
29	Page 6-6, Section 6.4.2.6	IC Compliance Data, 3rd Paragraph – What is meant by "recently constructed"? Please include a date.	The Columbus Square project commenced in 2005 and is being completed in phases. The text of the first sentence in the third paragraph has been revised to read: "*Construction of a residential development known as Columbus Square commenced in 2005 within a portion of IRP-13S (Early Transfer Parcel 24-1B)."*
30	Pages 6-6 and 6-7, Section 6.4.2.6	IC Compliance Data – It is noted that the LUCCCs have been completed by the Columbus Square Homeowners Association on an annual basis and that copies are provided in Appendix B. However, only the LUCCC covering the period 2010 is included in Appendix B. Please include all of the LUCCCs in Appendix B.	LUC Compliance Certificates for Columbus Square Homeowners Association for 2008, 2009, and 2010 have been added in Appendix B. The remaining LUC Compliance Certificates from previous years will be provided in an addendum.
31	Pages 6-7 through 6-10, Section 6.5	Site Inspections – Please provide an explanation, in the Report, as to why no regulators or Navy personnel were present for site inspections at IRP Sites 12 and 13S.	Site inspections were specifically coordinated with DTSC and coincided with the February 16, 2011 MCAS Tustin BCT Meeting to ensure agency participation. However, due to DTSC's schedule constraints and other competing priorities the agency representatives opted to just see IRP-1 and one of the three hydraulic containment treatment systems (i.e. IRP-3). No changes were made in the Final Five-Year Review Report in response to this comment.
32	Pages 7-7 and 7-8, Section 7.2.1.3	Performance of Institutional Controls – Are the first 2 paragraphs supposed to relate to IRP-3, -12, and the portion of -13S that have not yet transferred? If so, the tenses are incorrect. Additionally, In the first full paragraph on page 7-8 please change "identical" to "similar". It would be helpful, in the paragraph which talks about the portion of IRP-13S that was conveyed as an early transfer parcel,	Section 7.2.1.3, paragraphs 1, 2, 3, and a portion of 4 of have been revised to read: *"The LUC RD establishes ARICs at each IRP Site which encompass the VOC plumes and associated buffer zones. ICs are established within the ARICs to prevent contact with contaminated groundwater and to ensure the integrity of the remedy components*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		to discuss the deed(s) and land use covenant(s) associated with that portion. In the second to the last paragraph of this section, please include all of the IC compliance certifications and inspection checklists in Appendix B and include a reference.	*until the RGs are achieved. The ICs consist of land use restrictions incorporated in two separate legal instruments as provided in the Memorandum of Agreement between the DoN and DTSC. These are:* *1. Restrictive covenants to be included in one or more "Quitclaim Deed(s)" from the DoN to the property recipient;* *2. Restrictive covenants to be included in one or more CRUPs entered into by the DoN, DTSC, and RWQCB.* *The CRUP incorporates the land use restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The Quitclaim Deed(s) include similar land use restrictions in environmental restrictive covenants that run with the land and that are enforceable by the DoN against future transferees. Land use restrictions are also included in FOSTs.* *A portion of IRP-13S was conveyed as an early transfer parcel pursuant to the FOSET process (Columbus Square development), and land use controls were incorporated in the Quitclaim Deed and CRUP associated with this early transfer. The remaining portion of IRP-13S, and all of IRP-3 and -12 have not yet been transferred; although portions of these Sites are under a LIFOC with the City of Tustin.* *The performance of the ICs was evaluated during this five-year review by conducting site inspections and interviews with stakeholders, and by reviewing IC compliance certifications and inspection checklists (presented in Appendix B)..."*
33	Page 7-13, Section 7.2.2.2.3.2	Uncertainty Factors – DTSC doesn't believe that the uncertainty factors listed in this section are appropriate to support the conclusion in Section 7.2.2.2.3.4.	Section 7.2.2.2.3.2 has been revised to clarify the uncertainty issue. The revised text reads: "The NCP preamble states (55 Federal Register 8717, March 8, 1990): *'Preliminary remediation goals for carcinogens are set at a 10^{-6} excess cancer risk as a point of departure, but may be revised to a different risk level within the acceptable risk range based on the consideration of appropriate factors including, but not limited to: exposure factors, uncertainty factors, and technical factors.*

			Included under exposure factors are: the cumulative effect of multiple contaminants, the potential for human exposure from other pathways at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts of alternatives. Factors related to uncertainty may include: the reliability of alternatives, the weight of scientific evidence concerning exposures and individual and cumulative health effects, and the reliability of exposure data. Technical factors may include: detection/quantification limits for contaminants, technical limitations to remediation, the ability to monitor and control movement of contaminants, and background levels of contaminants. The final selection of the appropriate risk level is made when the remedy is selected based on the balancing of criteria...' *"The risk assessment process involves consideration of the uncertainty factors listed above, as well as other sources of uncertainty. Uncertainty is mitigated by introducing conservatism at each step of the evaluation. These conservative assumptions are additive, which results in a conservative estimation of risk. In the VI evaluation, conservative assumptions were used as inputs throughout the evaluation, as illustrated by the following:* • *The assumption of residential exposure, although the City's SP/RP does not identify future residential land use in the affected areas;* • *The default assumption in the J&E VI model that the VI exposure is averaged over a 70-year lifetime (applies to children and adults assumed to be in contact with vapors for 30 years, 350 days a year);* • *The default assumption in the J&E VI model that the lifetime exposure to VI is from a steady-state groundwater contamination source (although VOC concentrations in groundwater decline over time due to active remediation and/or natural attenuation);* • *The default assumption in the J&E model that the interior of a residence is under a perpetual state of negative pressure such that 100 percent of soil vapor is drawn into a residence through a continuous perimeter seam in the floor slab with no soil vapor escaping to outside air;*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

			• *The default assumption in the J&E model that indoor air is perfectly mixed with no floor-to-ceiling variation or room-to-room variation;* • *The default assumption in the J&E model that there is no moisture barrier beneath the floor slab of a residence, although the City of Tustin requires installing "dampproofing" (moisture barrier) beneath slabs (a moisture barrier would also minimize or prevent VI by constituting a vapor barrier and by eliminating the effect of the assumed perimeter seam in the floor slab).* *By design, these uncertainty factors and the conservative assumptions used as inputs to models, result in an over-prediction (or upper-bound estimate) of vapor concentrations and therefore overestimate risk, to assure risk managers that the selected remedies are protective of human health and the environment. In making risk management decisions pursuant to CERCLA and the NCP, risk managers consider these uncertainty factors to qualitatively evaluate the modeled (overestimated) risk results in comparison to the actual risks potential receptors may be exposed to."*
34	Page 7-13 and 7-14, Section 7.2.2.2.3.2	Uncertainty Factors, Last Bullet – Please note that according to DTSC's Vapor Intrusion Mitigation Advisory (DTSC 2009), a vapor barrier alone is not an acceptable vapor intrusion mitigation system since it does not completely eliminate vapor intrusion due to the likelihood of punctures, perforations, tears, and incomplete seals.	The purpose of the section is to identify sources of conservatism in the VI risk assessment, and that the presence of the moisture barrier required by the City will act to reduce the amount of VI that might otherwise occur.
35	Page 7-16, Section 7.2.2.4	Question B Summary and Conclusion – In the 2nd bullet, please change "7.2.2.2.3.1" to "7.2.2.2.2.1".	The text has been corrected.
36	Page 9-1, Section 9.1	IRP-1, 2nd bullet - DTSC does not concur with this recommendation. See General Comment #5 above.	Refer to the response to Attachment A - General Comment #6 above.
37	Page 9-1, Section 9.1	IRP-1, 3rd bullet – It is noted in Section 4.1.2.1.1, that "LFG monitoring continues on an annual basis in accordance with a request from the OCHCA." This request was made because OCHCA noted the possibility of future development adjacent to	No.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		OU-3. Section 6.4.1.1 includes similar information about the LFG monitoring. Does the OCHCA concur with discontinuing the LFG monitoring?	
38	Figure 1	It is difficult to distinguish some of the parcel boundary lines. Please ensure all parcel boundary lines are noted in black.	The figure has been revised to improve clarity.
39	Figures 23 and 24 and Figures F-1 and F-2	The legend is incomplete for these figures. Please update the legend. There are also some wells that don't appear to have any data associated with them, but they are included in the figures. Please provide an explanation for those wells and update the figures as needed.	The legends have been revised for completeness, and wells with no data have been deleted from the figures.
40	Appendix B	OU-3 Annual Field Inspection Log, 3(a) – Why is “NO” circled?	Based on the other responses to this Field Inspection Log, it appears that this “NO” was circled in error. This will be confirmed by contacting a responsible person at the City of Tustin.
41	Appendix C	Site Inspection Checklists, CERCLA Five-Year Review Site Inspection Checklist, IRP Site 1 (OU-3) – Why aren’t all the boxes filled out in Section 1? It also says a site map is attached. Where is the site map? In Section V (page 4 of 14), why is there a “G” after “Fencing damaged”?	For Section 1, The EPA number box was not filled in because IRP-1 does not have an individual EPA Number distinct from the EPA Number for the MCAS Tustin installation. “Navy” has been added to the box indicating who is leading the Five-Year Review. A site map of IRP-1 has been added to the checklist. In Section V, the "G" has been replaced by a check box (unchecked).
42	Appendix C	Site Inspection Checklists, CERCLA Five-Year Review Site Inspection Checklist, IRP Sites 3, 12 and 13S, Page 11 of 14 – Why isn’t the “Sampling/maintenance log displayed and up to date” box checked?	Sampling and Maintenance Logs are maintained by the O&M contractor and kept in their office files, rather than at the Sites. These were reviewed separately at the office. In addition, the Navy is updated bi-weekly via electronic updates and system performance records are published annually.
Attachment A: Reviewer - Anantaramam Peddada - Editorial Comments			
1	Page xiii, Executive Summary	Please change the last full sentence on the page to read, “The second five year review for IRP-1 is due on October 31, 2011, which is five years from the signature date of the first five-year review.”	The requested change has been made.
2	Page xv, Table ES-1	In Column 2, Row 2, please insert a bullet before “IC monitoring	The requested correction has been made.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		and reporting".	
3	Page xxi, Summary Form	Please insert a comma after "October 31" and 2011.	The requested correction has been made.
4	Page 1-1, Introduction, 2nd Paragraph	Please delete "either" in the last line.	The requested correction has been made.
5	Page 1-2, Section 1.1, Background, 2nd full paragraph	Please change "United States Environmental Protection Agency's (U.S. EPA's)" to singular.	The requested correction has been made.
6	Page 3-13, Section 3.3.6.3	Basis for Taking Action – Please insert a period at the end of the paragraph.	The requested correction has been made.
7	Page 3-23, Section 3.5.6.1	Summary of HHRA – In line 4, please insert a hyphen between "non" and "cancer".	The requested correction has been made.
Attachment B: Reviewer - Kimberly Day, Ph.D. - Human and Ecological Risk Office (HERO) - General Comments			
1	Executive Summary and Section 7.2.2.2	Toxicity Data and Effect on Health Risk - On page xviii, the Navy states that *"The RG of 0.5 micrograms per liter (ug/L) for 1,2,3- trichloropropane (TCP) in groundwater established in the ROD was based partly on risk considerations and partly on limitations of technology, and was conservative."* We do not agree that 0.5 ug/L is currently *"conservative"* in light of the revised oral cancer slope factor for 1,2,3-TCP (U.S. EPA IRIS). HERO recommends that the Navy revise this statement to clarify that the RG was conservative based on the toxicity criteria available at the time of the ROD or remove the words *"was conservative."*	The text has been revised in Section 7.2.2.4 and the Executive Summary to remove the words *"was conservative".*
2	Sections 3.2.6.1.1–	Toxicity Criteria Hierarchy - The report states that *"DTSC requires the preferential use of its toxicity values when*	The text has been revised in Sections 3.2.6.1.1, 3.3.6.1, 3.4.6.1, and Appendix F to read: *"Toxicity values used in the risk*

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

	IRP-1; 3.3.6.1,–IRP-3; 3,4.6.1–IRP-12; 3.5.6.1–IRP-13S; and Appendix F	*conducting risk assessments in California."* Please note that DTSC recommends that the more health protective toxicity criteria between California/OEHHA and U.S. EPA/IRIS are used, and not to only use the California toxicity criteria. Please revise the text in Sections 3.2.6.1.1–IRP-1, 3.3.6.1.–IRP-3, 3.4.6.1–IRP-12, 3,5,6.1–IRP-13S, and Appendix F to accurately reflect DTSC's recommendation.	*assessment were obtained from either the U.S. EPA or the DTSC because the DTSC recommends use of the more conservative toxicity criteria when conducting risk assessments in California."*
3	General Comment	Risk Management Range and Point of Departure. *"Generally acceptable range of 10^{-6} to 10^{-4}"* is used frequently throughout this 5-year review report. HERO disagrees with the use of *"generally acceptable range of 10-^{6} to 10^{-4}"* and requests that this terminology be removed from the report. The actual level of acceptable risk is a site-specific risk management decision, with 1 x 10^{-6} as the point of departure for making such decisions. Clear justification must be provided for risk management decisions which result in residual risk levels greater than 1 x 10^{-6}. HERO defers to the project manager for risk management decisions.	The DoN concurs that the level of acceptable risk is a site-specific risk management decision. The DoN also notes that the NCP preamble specifically states at 55 FR 8716, March 8, 1990: *"CERCLA section 121 does direct, among other requirements, that remedies protect human health and the environment, be permanent to the maximum extent practicable and be cost-effective. Remedies at Superfund sites comply with these statutory mandates when the amount of exposure is reduced so that the risk posed by contaminants is very small, i.e., at an acceptable level. EPA's risk range of 10^{-4} to 10^{-6} represents EPA's opinion on what are generally acceptable levels."* The NCP thus supports the use of this terminology and it is also consistent with the terminology in the agency-concurred Final RODs. No text revisions have been made.
4	Section 3.2.6.2	Summary of Ecological Risk Assessment. In this section, the third paragraph states, *"The hazard quotient (HQ) values for cadmium, cobalt, zinc, hexavalent chromium, and bis(2-ethylhexyl)phthalate calculated for the mallard slightly exceeded 1.0. The HQ values for cadmium, cobalt, and bis(2-ethylhexyl)phthalate) calculated for the great blue heron slightly exceeded 1.0."* Please include in this report the exact HQ value for these two receptors. This is a stand-alone document and all relevant information should be presented clearly and transparently.	The text in Section 3.2.6.2 has been revised to read: *"The hazard quotient (HQ) values for cadmium (2), cobalt (5), zinc (13), hexavalent chromium (54), and bis(2ethylhexyl)phthalate (2) calculated for the mallard exceeded 1.0. The HQ values for cadmium (82), cobalt (3), and bis(2-ethylhexyl)phthalate (3) calculated for the great blue heron exceeded 1.0."*
5	Section 3.2.6.3	Basis for Taking Action. The first paragraph of this section states, *"The HHRA concluded that risks associated with exposures to surface water and sediment in Peters Canyon*	The text has been revised to reflect the correction.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		Channel were below the risk management range for cancer risk..." HERO disagrees with this sentence. The reported cancer risks listed in Section 3,2.6.1.2 are estimated to be 4.4E-06 (U.S. EPA/IRIS) and 5E-06 (Cal/OEHHA). These estimated risks are within the risk management range. Please revise the sentence and remove the word *"below" and* replace with the word *"within".*	
6	Vapor Intrusion (Main Text and Appendix F – Vapor Intrusion Evaluation)	a. *Subsection 7.2.2.2.2.2– Vapor Intrusion Exposure Route.* HERO appreciates and acknowledges that the Navy used DTSC's modified version of the Johnson and Ettinger (J&E) Model. Please note that the toxicity criteria listed in the lookup table was last updated in February 4, 2009. The inhalation unit risk (IUR) listed in the lookup tables for 1,2,3-TCP is 2,0E-03 $(pg/m^3)^{-1}$ and is calculated using route to route extrapolation of the oral cancer slope factor listed in the 2008 RSL Table, 7.0 per mg/kg-day (U.S. EPA's Health Effects Assessment Summary Tables - HEAST). The IUR was derived using an oral cancer slope factor that is no longer appropriate since U.S. EPA revised the oral cancer slope factor in September 2009. <u>HERO recommends that a route to route extrapolation be conducted using the revised oral cancer slope factor of 30 per mg/kg-day, for an IUR for 1,2,3-TCP of 8.6E-03 $(ug/m^3)^{-1}$</u>. By using the IUR of 2.0E-03 $(ug/m^3)^{-}$' HERO feels that the risk from the vapor intrusion pathway is underestimated. While U.S. EPA no longer recommends route to route extrapolation between the oral and inhalation exposure pathways, HERO/DTSC recommends such extrapolation be conducted, particularly for organic compounds in which systemic effects are known to occur. According to the USEPA Toxicological Review of 1,2,3-Trichloropropane (2009), while an inhalation unit risk factor was not derived due to lack of data on the carcinogenicity of 1,2,3-TCP via the inhalation route, the document states that "1,2,3-trichloropropane is likely to be carcinogenic to humans by the inhalation route since the compound is well-absorbed, and induces tumors at sites other than the portal of entry in oral studies." The oral studies show that ingestion of 1,2,3- TCP	Response a.: The DoN acknowledges HERO's comprehensive explanation of its position regarding route-to-route extrapolation. HERO's recommendation to perform a route-to-route extrapolation for assessing inhalation risk for 1,2,3-TCP is a part of the Final Report by virtue of these RTCs. It should be noted that the Report will not be a part of the administrative record in accordance with DoN policy because it is not a primary document; however, it will be a public document in the Post-Decision File. The DoN's position on use of route-to-route extrapolation is as follows: The RGs for 1,2,3-TCP at IRP-13S were established in the Final ROD based on a risk management decision on estimated risks at 10^{-4}. The departure from the CERCLA Preliminary Remediation Goals (PRGs) at 10^{-6} to the RGs was justified based upon uncertainties and technical factors addressed in the Final ROD and supporting documents (see NCP at 40 CFR Section 300.430[e][2][i] as further clarified in "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," OSWER DIRECTIVE 9355.0-30 [April 22, 1991]). The DTSC HERO risk assessor performed a "route-to-route" extrapolation using a revised oral cancer slope factor for 1,2,3-TCP and requested that it be incorporated into the DoN's risk assessment evaluations conducted during the course of this Five Year Review. The U.S. EPA recommended against using such route-to-route extrapolations because of the lack of sufficient data, as stated in U.S. EPA's Toxicological Review of 1,2,3-Trichloropropane (U.S. EPA, IRIS 2009). Given the scientific uncertainties documented in U.S. EPA's position, the DoN does not agree that a route-to-route extrapolation is consistent with the NCP nor that modification of RGs are warranted (see discussion of

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		causes tumors at multiple sites in rats and mice, including the alimentary system, pancreas, kidney, liver, and uterine/cervical tumors in females. While no chronic inhalation studies have been conducted, two 13-week inhalation studies in rats showed increased liver weights, hepatocellular hypertrophy, and peribronchial lymphoid hyperplasia. Based on 1) the mechanism of action, namely mutagenicity via reactive metabolites; 2) multiple, distant tumor sites following ingestion; and 3) pre-neoplastic liver changes following inhalation, evaluation of the cancer risks associated with inhalation exposures is entirely justified.	factors relating to uncertainty in the risk management range discussed in the NCP preamble at 55 Fed. Reg. 8717 [March 8, 1990]).
		Please note that HERO is in the process of updating the lookup table in DTSC's modified version of the J&E Model on our website and it should be updated by October 31, 2011. The IUR for 1,2,3-TCP in the lookup table will reflect a route to route extrapolation of the revised oral cancer slope factor of 30 per mg/kg-day, for an IUR for 1,2,3-TCP of 8.6E-03 $(ug/m^3)^{-1}$. HERO acknowledges that portal-of-entry effects are expected following 1,2,3-TCP exposure via inhalation and a first-pass effect is expected following oral exposure. Thus, toxicokinetic and toxicodynamic differences between the two routes of exposure contribute to the uncertainty associated with route extrapolation for a quantitative assessment. These uncertainties should be described in the characterization of the inhalation cancer risk. From review of the best science that is available at this time, HERO recommends that a route to route extrapolation be conducted using the revised oral cancer slope factor of 30 per mg/kg-day, for an IUR for 1,2,3-TCP of 8.6E-03 $(ug/m^3)^{-1}$, At this time, HERO requests our position be placed on the administrative record.	Response a (cont.) The DoN cannot justify the use of toxicity values that have not yet been published, even if they will be in the near future. As stated in response to cover letter General Comment #5 above, given the new TCE toxicity criteria for TCE posted in IRIS on September 28, 2011; the DoN will re-evaluate VI risk for IRP-3 and -13S. The results and conclusions regarding protectiveness will be reported in a Five-Year Review Report Addendum to be submitted by October 31, 2012.
		b. <u>For information only.</u> Please note, an alternative method would be to use the IUR of a structurally similar chemical such as 1,3-dibromo-3-chloropropane (DBCP) to estimate the inhalation risk for 1,2,3-TCP. The IUR for DBCP listed in the June 2011 U.S. EPA RSL Table is 6.0E-	Response b.: Comment noted.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		03 (ug/m^3)$^{-1}$ (PPVRT). Please note that that IUR for a structurally similar chemical and the IUR using route to route extrapolation of the update oral cancer slope factor result in very similar toxicity criteria values. c. Appendix F. HERO reviewed Appendix F and the J&E spreadsheets included in Attachment A. We have the following comments: i. HERO recommends that the Navy use the most conservative IUR value and re-calculate the risk from the vapor intrusion pathway. HERO re-calculated the risk from the vapor intrusion pathway using the following criteria: 1. A IUR for 1,2,3-TCP of 8.6E-03 (ug/rn^3)$^{-1}$; 2. 8-foot ceiling height; 3. an indoor air exchange rate of 0.5 exchanges per hour; 4. a building size of 1000 cm x 1000 cm; and 5. the same soil parameters the Navy used for its re-evaluation and that are listed in Appendix F (DTSC's geologist concurs with the soil parameters used by the Navy for the re-evaluation). Please note for HERO's re-evaluation we only used the monitoring wells listed in Table F-1 and did not include the extraction wells also included in Table F-1. In an email from James Callian to Jennifer Rich dated September 23, 2011, Mr. Callian stated that "VOC data from extraction wells are obtained for the purposes of system optimization only. These data are not (and cannot) be used to represent what is in the subsurface...". DTSC's geologist concurs with the Navy, thus, HERO did not include the extraction wells in our re-evaluation. HERO requests that the Navy please explain why seven extraction wells were included in the Navy's re-	Response c(i).: The DoN will re-evaluate VI risks for these two sites and will employ the same dual-tracking approach previously used. Response (c)i (cont.): The risk estimated from extraction well data should not have been included in the Draft Five-Year Review Report. As concurred upon by DTSC, these results have been deleted from the Appendix F tables and from Figures 23, 24, F-1, and F-2.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		evaluation for OU-1A; why three extraction wells were included in the Navy's re-evaluation for OU-1B North; and why six extraction wells were included in the Navy's re-evaluation for OU-1B South.	
		ii. *Results of HERO's Re-Evaluation.* The results of HERO's re-evaluation using the parameters listed above (i) are presented in the attached tables, Table 1 (OU-1A), Table 2 (OU-1B North), and Table 3 (OU-1B South). Please note, HERO used the same approach as the Navy presented in Appendix F by calculating the cancer risks associated with each monitoring well by multiplying the chemical concentration detected in each monitoring well by the chemical's "cancer risk per unit concentration".	Response (c)ii: Please Note: DTSC Tables 1, 2, and 3 are attached for reference at the end of this response to comments document.
		1. OU-1A (Table 1). For OU-1A/IRP Site 13S, HERO estimates that the total incremental cancer risk ranges from 8.7E-05 to 7.6E-07, when using an 8-foot high ceiling and a IUR for 1,2,3-TCP of 8.6E-03 $(ug/m^3)^{-1}$. The total incremental cancer risk reported in the Five-Year Review Report ranged from 1.5E-05 to 1.9E-07. 2. OU-1B North (Table 2), For OU-1B North/1RP Site 12, HERO estimates that the total incremental cancer risk ranges from 3.1E-07 to 6.5E-09, below the point of departure for risk management decisions, when using an 8-foot high ceiling instead of a 10-foot high ceiling. The total incremental cancer risk reported in the Five-Year Review Report ranged from 2.1E-07 to 4.3E-09. 3. OU-1B South (Table 3). For OU-1B South/1RP Site 3, HERO estimates that the total incremental cancer risk ranges from 2.6E-05 to 1.4E-07, when using an 8-foot high ceiling instead of a 10-foot high ceiling. The total incremental cancer risk reported in the Five-Year Review Report ranged from 1.8E05 to 9.2E-08.	Response (c)ii (cont.): The DoN notes that HERO's maximum estimated risk is within the same order of magnitude as the DoN's maximum estimated risk, i.e. 8.7 x 10^{-5} (HERO) versus 1.5 x 10^{-5} (DoN) at IRP-13S, and 2.6 x 10^{-5} (HERO) versus 1.8 x 10^{-5} (DoN) at IRP-3..These results are within the NCP risk management range. As noted in the response to Cover Letter Comment #2, the baseline risk assessments that were the basis for the FS and RODs for IRP-3 and -13S, resulted in risk estimates that were within the NCP risk management range, and that were considered acceptable by DTSC when the agency concurred with those documents.
		iii. The report states that *"the GW-SCREEN model was*	

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		modified to incorporate DTSC toxicity values; two distinct soil layer lithology; and California-specific building ventilation rates. A copy of the JE model used in the evaluation is included in Attachment A." For transparency, please include a table with the building size, ceiling height, and exact indoor air exchange rate used. From our review, it appears that the Navy used a building size of 1000 cm x 1000 cm with a 10-foot high ceiling, and an indoor air exchange rate of 0.5 exchanges per hour for the residential scenario. Please note that for the residential scenario, DTSC recommends a building size of 1000 cm x 1000 cm with an **8- foot high ceiling,** and an indoor air exchange rate of 0.5 exchanges per hour. Eight feet is considered a standard residential ceiling height and the report does not provide justification for using a nonstandard ceiling height. HERO recommends that an 8-foot ceiling height be used.	Response (c)iii: A table with specific values used has been added to Appendix F. Response (c)iii (cont.): The DoN concurs that the 8-foot ceiling height is the current default residential building parameter.
		iv. In Appendix F, page 6, the text states, *"It should be noted that this risk evaluation was based on site-specific groundwater chemical data as well as conservative (health-protective) assumptions, estimates, models and parameters. For example, it was assumed that TCE, 1,2,3-TCP, and vinyl chloride will volatilize from groundwater, migrate through soil pore space and impact indoor air. In reality, 1,2,3-TCP and vinyl chloride are not likely to volatilize and migrate in significant quantities into soil gas. This conclusion is based on soil gas analytical data collected by CH2MHill at the nearby 1RP Site 13W and 1RP Site 13S Sites next to, and within, Carve-Out 5 at the former Marine Corps Air Station (CH2MHILL 2005). At that location, CH2MHILL collected 19 soil gas samples at various depths. The samples were analyzed for VOCs using U.S. EPA Methods 8260B SIM and TO-*	Response (c)iv: Appendix F has been revised to delete reference to the CH2M Hill report.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		15. Neither 1,2,3-TCP nor vinyl chloride were detected in any of the soil gas samples collected," HERO requested a copy of the CH2MHILL soil gas investigation report on September 8, 2011, and the Navy provided HERO with a copy of the report on September 9, 2011. HERO only briefly reviewed the report. HERO does not concur with the conclusion stated in the text cited above. Furthermore, the use of this CH2MHILL soil gas investigation report in the vapor intrusion evaluation (Appendix F) is inappropriate for the following reasons: 1. The soil gas samples do not appear to have been collected above the current location of the TCE and 1,2,3-TCP groundwater plumes, but to the northeast of the co-mingled groundwater plumes. While 1,2,3-TCP and vinyl chloride were non-detect in the sampled area, the sampled area does not appear to be representative of current site conditions and use of this data is inappropriate. Furthermore, TCE and other VOCs were detected in the soil gas samples. Even though these samples were not collected above the current co-mingled plumes, the detection of TCE and other VOCs suggests that they may be detected if soil gas samples were collected above the current groundwater plumes. 2. Drawing the conclusion that 1,2,3-TCP is not likely to volatilize and migrate in significant quantities into soil gas because it was not detected in the collected soil gas samples is an inaccurate statement since these samples do not appear to have been collected above the current groundwater plumes. 3. The argument made by the Navy is based on non-detects for vinyl chloride and 1,2,3-TCP in the collected soil gas samples, yet other VOCs including	

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		TCE were detected and the Navy fails to discuss these in their reasoning. 4. This investigation occurred over six years ago and does not appear to provide data that is representative of current site conditions. v. Please note the state of the science for vapor intrusion is to evaluate multiple lines of evidence, i.e., evaluate soil gas and groundwater. The re-evaluation only used groundwater data to re-evaluate the potential risk from the vapor intrusion pathway at each site. vi, DTSC's vapor intrusion guidance recommends multiple soil gas sampling events, one in the summer and one in the winter to account for weather effects.. d. *Subsection 7.2,2.2.3.2 – Uncertainty Factors.* The last bullet under the Uncertainty Factors section states "... a *moisture barrier would also minimize or prevent VI by constituting a vapor barrier...".* Please note, according to DTSC's Vapor Intrusion Mitigation Advisory (DTSC 2009) a vapor barrier alone is not an acceptable vapor intrusion mitigation system since it does not completely eliminate vapor intrusion due to the likelihood of punctures, perforations, tears, and incomplete seals. HERO defers to DTSC's engineer regarding vapor intrusion mitigation. e. Page 7-16.- The conclusion drawn from the re-evaluation of the vapor intrusion to indoor air pathway states that *"The results indicate that lifetime (70 years, 350 days per year) cancer risk for the VI pathway is either below the point of departure, or within the risk management range, for the 1RP-3, -12, and -13S first WBZ VOC plumes. The NCP point of departure analysis in Section 7.2.2.2.4 supports a risk management decision. Given the conservative nature of the exposure factors and uncertainty factors, and the technical limitation factors cited above, accepting VI risks that are within the risk management range is justified."*	Response (c)v.: The DoN notes that the baseline risk assessment, feasibility study, and decision documents were based on a very thorough and comprehensive remedial investigation (RI) that was concurred with by the agencies. In light of the new toxicity criteria for TCE posted to IRIS, the DoN proposes to re-evaluate VI risk and report the results in a Five-Year Review Report Addendum as noted in the response to Cover Letter Comment #4 above. Response (d): The purpose of the section is to identify sources of conservatism in the VI risk assessment, and that the presence of the moisture barrier required by the City will act to reduce the amount of VI that might otherwise occur.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		i. Please note the reference to Section 7.2.2.2.4, NCP Point of Departure Analysis, should be Section 7.2.2.2.3. There is no Section 7.2.2.2.4. Please correct the text in the Executive Summary, page xix, and the main text page 7-16.	Response (e)i.: The section reference has been corrected.
		ii. The reference to 70 years should be 30 years. The J&E Model uses 70 years as the averaging time for carcinogens, while the exposure duration is 30 years, 350 days per year. Note *"70 years, 350 days per year"* is listed several times in the main text (e.g., page 7-13 and 7-16). Please review the text and revise the reference of 70 years as the exposure duration to 30 years.	Response (e)ii.: The text has been corrected.
		iii. HERO does not completely concur with the Navy's conclusion. While the Navy has outlined justification as to why *"accepting VI risks that are within the risk management range are justified"* (e.g., page 7-16 and Executive Summary), the estimated incremental cancer risks associated with vapor intrusion are only based on groundwater data and the lack of soil gas data is a concern to HERO. Please note that the current path forward for DTSC regarding assessing the vapor intrusion pathway is to have multiple lines of evidence, (i.e., evaluate soil gas and groundwater), when deciding on the path forward at a site. HERO is only aware of one soil gas sampling event at IRP-13S. Please note that both the DTSC and the U.S. EPA guidance documents for subsurface vapor intrusion to indoor air recommend the use of soil gas data since soil gas data provides a direct measurement of the contaminants, Please include a discussion on the lack of soil gas data, the uncertainties of not having soil gas data, and how the lack of soil gas data affects the conclusion that *"accepting VI risks that are within the risk*	Response (e)iii.: In light of the new toxicity criteria for TCE, the DoN proposes to re-evaluate VI risk and report the results in a Five-Year Review Report Addendum as also noted in the response to Cover Letter Comment #4 above.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		management range are justified.".	
Attachment B: Reviewer - Kimberly Day, Ph.D. - HERO - Specific Comments			
1		Please remove the alignment text formatting of "justify". When the text is "justified' it makes it difficult for the reviewer to read the report since space(s) are placed between the first and last letters of words.	The Draft Five-Year Review Report format justification is a stylistic preference. This justified format was used to provide a professional, orderly, and consistent document design.
2	7-16	The second bullet statement on page 7-16 references a discussion on the elimination of *"route-to-route extrapolation of the revised oral CSF for 1,2,3-TCP"* in *"Section 7.2.2.2.3.1."* Please note that discussion regarding the elimination of route-to-route extrapolation is in Section 7.2.2.2.2.1. Please revise the text.	The text has been corrected.
3	Figures 23, 24, F-1 and F-2	a. The Legend for these figures lists "Vapor Intrusion Risk Contour with Lifetime VI cancer risk ($x10^{-6}$)" and "Lifetime VI cancer risk ($x10^{-6}$)". Please clarify the difference between these two on the figures. b. For transparency, on both figures please distinguish and identify the areas where the cancer risk is in the 10^{-6} range and in the 10^{-5} range. c. What do the numbers in blue listed under the monitoring wells and within the contour line represent?	Response (a): *"Vapor Intrusion Risk Contour with Lifetime VI cancer risk ($x10^{-6}$)"* refers to the contour line symbol, and "*Lifetime VI cancer risk ($x10^{-6}$)"* refers to the number posted next to each data point. Response (b): The figures have been revised to clarify these areas. Response (c): These numbers represent the *Lifetime VI cancer risk ($x10^{-6}$)* as stated in the legend.
4	Appendix F Attachment A	Please add page numbers to the J&E spreadsheets. Also, please label the J&E spreadsheets so the reviewer can easily tell which spreadsheet is associated with which site area and with either the U.S. EPA or the DTSC toxicity criteria.	The spreadsheets have been numbered and annotated to enhance clarity.
5		Please be consistent in how Cal/EPA is written throughout the main text and in Appendix F. Cal/EPA is listed as *"Cal/EPA"* and *"Cal-EPA".* Please note the acronyms and abbreviations page lists it as *"Cal/EPA."*	The text and Appendix F have been revised for consistency with the acronym list.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

6	Appendix F Table F-1	Please include under *"Notes"* that the groundwater analytical data presented in this table are the results from the 2010 fourth quarter sampling event. Also please define *"All"* under *"Notes". "All"* is listed as the last line under each chemical column heading.	The table has been revised to add the requested note and delete "All."
Attachment C: Reviewer - David Murchison, P.G. - Geological Services Unit (GSU) - Comments			
1		GSU notes that OU-1 B North includes two dissolved plumes in the 1st WBZ. These plumes have been designated 12W and 12E for the western and eastern plumes, respectively. Figure 20 shows the groundwater gradients in and around these plumes, and indicates that plume 12W is outside the capture zone of the remedy. GSU notes that the Navy plans to optimize the remedial system to extend the capture zone. The report should include language discussing the need to extend the capture zone, and the intention to do so by optimization.	This circumstance was noted in the 2010 Annual Performance Evaluation Report and was subsequently corrected by increasing the extraction rate at I012EW03S as part of the ongoing operation and optimization of the remedy. Recent monitoring data suggest that the capture zone of I012EW03S has been restored to its prior extent. The following text has been added in Section 7.2.1.1: *"In the Fourth Quarter of 2010, the width of the capture zone associated with hot spot extraction well I012EW03S at OU-1B North had apparently contracted due to seasonal groundwater fluctuation and did not completely capture the OU-1B North hot spot. This was noted in the 2010 Annual Performance Evaluation Report (ECS 2011b) and was subsequently corrected by increasing the flow rate from the extraction well. Maintenance of capture zones is a part of ongoing optimization of the remedy and it is the DoN's intent to continue such optimization as required to maintain capture."*
2	Section 9.2 page 9-1	The report notes that various well vaults at OU-1 (IRP-3) are subject to flooding during heavy rain events. The report recommends installing berms, raising the walls of the well vaults and installation of sump pumps to correct this problem. GSU generally concurs with these recommendations, and requests that the proposed berms be built before the 2011-2012 rainy season.	The DoN will evaluate options to determine the most effective solution to this issue.
3		GSU notes that the soil lithologies proposed for the Johnson and Ettinger (J&E) model discussed in Appendix F are based on the USCS soil classification, rather than the agricultural soil types anticipated in the J&E model. The Navy provided GSU with a large number of boring logs, showing their analysis of the soil types at the site. For purposes of this 5-	The DoN acknowledges GSU's concurrence.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		year review, GSU finds the proposed soil types acceptable.	
4	Appendix F	GSU notes that Appendix F cites a report titled "Soil Gas Investigation of Portions of Installation Restoration Program Sites 13W and 13S within Carve-Out 5 at Former Marine Corps Air Station Tustin, California" dated December 2005, by CH2M HILL, prepared for Moffet Meadows Partners LLC. GSU notes that this report does not relate directly to the IRP-13S plume discussed in the 5-year review report, since all the soil gas samples were taken outside the area of the dissolved plume, and is therefore not relevant to the calculation of risk in the area of the plume. The Navy should remove the report from the 5-Year Review.	The Report has been revised to delete reference to the CH2M Hill report.
5		GSU is concerned that the groundwater contamination data, well locations, and capture zone analysis for OU-1B South might lead a reviewer to conclude that high concentrations of TCE and low concentrations of vinyl chloride (VC) in the 1st WBZ may extend south of the hot spot at 1003MWO7S (11000 ug/L TCE, 0.21 ug/L VC) and under Building 29 (Hangar) to the south. a. Since the extraction well 1003EWO2S, which contains 1100 ug/L TCE and 0.77 ug/L VC, is very close to the building, and no other well is available for a considerable distance downgradient, there is no direct evidence that high concentrations of TCE are absent under the hangar. GSU notes that extraction wells are not reliable indicators of conditions in a aquifer, and should not be relied upon to reflect on contaminant concentrations. Therefore only the monitoring well data can be viewed as representative of conditions in the subsurface. b. The Navy has performed detailed capture zone analysis for the plume, but this data is not presented in the 5-Year Review report. That capture zone analysis may show that all the hot-spot TCE is captured by the extraction well, and that the capture zone extends under the hangar.	Please refer to specific responses below. Response (a): The DoN concurs that only monitoring well data should be relied upon as representative of conditions in the subsurface. Response (b): The capture analysis referenced in the Report does show that the capture zone of I003EW02S extends a considerable distance beneath the hangar and therefore should be effective for limiting the southerly extent of the hotspot associated with the first WBZ TCE groundwater

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

		c. The Navy should discuss the possibility of high TCE concentrations under the hangar, and whether indoor air risk inside the hangar is acceptable. All the supporting data and analysis should be included in the discussion. D. Since this area may be transferred under FOST #9 in the near future, the Navy should demonstrate that risk in a hypothetical building of conventional construction would also be acceptable in the current hangar area.	plume. Responses (c and d): The possibility of high TCE concentrations beneath the hangar is accounted for in the VI risk evaluation presented in the Report, as well as in the HERO re-evaluation of VI risk provided in another section of these DTSC comments. In both evaluations, the lifetime VI cancer risk under a residential scenario has an estimated maximum value in the 10^{-5} range, which is within the range for risk management decisions. This maximum value is associated with the highest TCE groundwater concentration in the first WBZ in the hot spot area. Therefore, if this highest concentration existed beneath the hangar, the associated VI risk under a residential scenario (more conservative than a hangar) would still be within the NCP risk management range. Please note that the DoN is proposing to re-evaluate VI risk in light of new TCE toxicity criteria posted in IRIS on September 28, 2011, and mentioned in the response to cover letter Comment #4 above and the responses to several of HERO's comments as well. The proposed re-evaluation will help to further confirm these issues.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

DTSC Risk Tables 1, 2, and 3:

Table 1. Incremental Cancer Risk per Monitoring Well for OU-1A Using Cal-EPA Toxicity Values for the Vapor Intrusion Pathway Only

	TCE		1,2,3-TCP		Vinyl Chloride		Total Estimated Cancer Risk for Monitoring Well w/ Cal-EPA Tox Values		[1]Total Estimated Cancer Risk for Monitoring Well w/ USEPA Tox Values
Well#	*GW Conc. ug/L	Risk	*GW Conc. ug/L	Risk	*GW Conc. ug/L	Risk			
222MW03S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222MW04S	7	1.68E-08	1.4	3.50E-06	0.50	1.35E-07	3.7E-06		1.6E-08
222MW05S	3.1	7.44E-09	10	2.50E-05	0.50	1.35E-07	**2.5E-05**		1.0E-08
222MW06S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222PW03SA	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222PW03SB	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222PW03SC	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222PW03SD	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
222PW09S	0.5	1.20E-09	0.59	1.48E-06	0.50	1.35E-07	1.6E-06		5.9E-09
222PW10S	0.5	1.20E-09	1.8	4.50E-06	0.50	1.35E-07	4.6E-06		5.9E-09
222PW13S	0.5	1.20E-09	22	5.50E-05	0.50	1.35E-07	**5.5E-05**		5.9E-09
IS72MW01SR	2.3	5.52E-09	0.25	6.25E-07	0.50	1.35E-07	7.7E-07		8.8E-09
IS72MW02S	2	4.80E-09	18	4.50E-05	0.50	1.35E-07	**4.5E-05**		8.3E-09
IS72MW03S	0.21	5.04E-10	0.62	1.55E-06	0.50	1.35E-07	1.7E-06		5.5E-09
IS72MW04S	0.44	1.06E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.8E-09
IS72MW05S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
IS72MW10S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
IS72MW11S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
IS72MW12S	0.5	1.20E-09	0.92	2.30E-06	0.50	1.35E-07	2.4E-06		5.9E-09
IS72MW13S	0.62	1.49E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		6.1E-09
IS72MW15S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09
IS72MW17S	1000	2.40E-06	34	8.50E-05	0.35	9.45E-08	**8.7E-05**		1.6E-06
IS72MW18S	0.5	1.20E-09	0.25	6.25E-07	0.50	1.35E-07	7.6E-07		5.9E-09

Notes:

*The groundwater (GW) concentration used in the re-calculation of risks associated with vapor intrusion to indoor air pathway. These are the same groundwater concentrations the Navy used in Appendix F of the Five Year Review Document.

TCE = trichloroethylene

1,2,3-TCP = 1,2,3-trichloropropane

ND = Chemical Not Detected in this well

[1]The estimated cancer risk for each monitoring well using US EPA toxicity criteria values as reported in Tables F-8, F-12, and F-14.

HERO included this column for risk management for comparison purposes only.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: Department of Toxic Substances Control, Letter from Anantaramam Peddada Dated: October 14, 2011

Table 2. Incremental Cancer Risk per Monitoring Well for OU-1B North Using Cal-EPA Toxicity Values for the Vapor Intrusion Pathway Only

Well#	TCE *GW Conc. ug/L	TCE Risk	1,2,3-TCP *GW Conc. ug/L	1,2,3-TCP Risk	Vinyl Chloride *GW Conc. ug/L	Vinyl Chloride Risk	Total Estimated Cancer Risk for Monitoring Well w/ Cal-EPA Tox Values	[1]Total Estimated Cancer Risk for Monitoring Well w/ USEPA Tox Values
I012MW02S	4.7	1.13E-08	ND	-	ND	-	1.1E-08	7.4E-09
I012MW08S	66	1.58E-07	ND	-	ND	-	1.6E-07	1.0E-07
I012MW09S	130	3.12E-07	ND	-	ND	-	3.1E-07	2.1E-07
I012MW11S	6.3	1.51E-08	ND	-	ND	-	1.5E-08	1.0E-08
I012MW12S	9.1	2.18E-08	ND	-	ND	-	2.2E-08	1.4E-08
I012MW13S	2.7	6.48E-09	ND	-	ND	-	6.5E-09	4.3E-09
I012MW14S	9.2	2.21E-08	ND	-	ND	-	2.2E-08	1.5E-08
I012MW15S	4.3	1.03E-08	ND	-	ND	-	1.0E-08	6.8E-09

Table 3. Incremental Cancer Risk per Monitoring Well for OU-1B South Using Cal-EPA Toxicity Values for the Vapor Intrusion Pathway Only

Well#	TCE *GW Conc. ug/L	TCE Risk	1,2,3-TCP *GW Conc. ug/L	1,2,3-TCP Risk	Vinyl Chloride *GW Conc. ug/L	Vinyl Chloride Risk	Total Estimated Cancer Risk for Monitoring Well w/ Cal-EPA Tox Values	[1]Total Estimated Cancer Risk for Monitoring Well w/ USEPA Tox Values
I003MW02S	0.5	1.2E-09	ND	-	0.5	1.35E-07	1.4E-07	6.0E-09
I003MW03S	0.5	1.2E-09	ND	-	0.5	1.35E-07	1.4E-07	6.0E-09
I003MW06S	1600	3.84E-06	ND	-	0.2	5.40E-08	3.9E-06	2.5E-06
I003MW07S	11000	2.64E-05	ND	-	0.21	5.67E-08	**2.6E-05**	1.7E-05
I003MW08S	240	5.76E-07	ND	-	0.24	6.48E-08	6.4E-07	4.1E-07
I003MW09S	2100	5.04E-06	ND	-	0.5	1.35E-07	5.2E-06	3.3E-06
I003MW12S	0.5	1.2E-09	ND	-	0.5	1.35E-07	1.4E-07	6.0E-09
I003MW13S	0.5	1.2E-09	ND	-	0.5	1.35E-07	1.4E-07	6.0E-09
I003MW14S	0.52	1.25E-09	ND	-	0.5	1.35E-07	1.4E-07	6.0E-09
I003MW15S	5	1.20E-08	ND	-	0.5	1.35E-07	1.5E-07	1.3E-08

Notes:

*The groundwater (GW) concentration used in the re-calculation of risks associated with vapor intrusion to indoor air pathway. These are the same groundwater concentrations the Navy used in Appendix F of the Five Year Review Document.

TCE = trichloroethylene

1,2,3-TCP = 1,2,3-trichloropropane

ND = Chemical Not Detected in this well

[1]The estimated cancer risk for each monitoring well using US EPA toxicity criteria values as reported in Tables F-8, F-12, and F-14. HERO included this column for risk management for comparison purposes only.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: John Broderick, Land Disposal and DoD Section, Regional Water Quality Control Board, Santa Ana Region.
Dated: August 17, 2011

Comment No.	Section / Page No.	Comment	Response
General Comments			
1.		We have completed our review of above-referenced document, dated July 2011, which we received on August 2, 2011. This report presents the results of the five-year review for four sites. The purpose of five-year review is to evaluate whether the implemented remedies are functioning as intended and remain protective of human health and the environment. The remedies for all four sites were found to functioning as intended and to be protective of human health and environment. We have no comments on this five-year review document.	Thank you for your review and concurrence of this document.

Document Title:

Draft CERCLA Five-Year Review, Operable Units 1A, 1B North, 1B South, and 3 (Installation Restoration Program Sites 13S, 12, 3, and 1), Former MCAS Tustin, California (July 2011)

Reviewer: James Ricks, Remedial Project Manager, United States Environmental Protection Agency, Region IX,
Dated: October 28, 2011

Comment No.	Section / Page No.	Comment	Response
General Comments			
1.		E-Mail: Pursuant to our telephone discussion on 27 October 2011, this e-mail confirms U.S. EPA's concurrence with the Navy's protectiveness determination on the subject five year review report. .	Thank you for your review and concurrence of this document.