DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER
JOINT BASE SAN ANTONIO LACKLAND TEXAS

06 March 2014

MEMORANDUM FOR DISTRIBUTION

FROM: AFCEC/CIBW
2261 Hughes Avenue, Suite 155
JBSA Lackland TX 78236-9853

SUBJECT: Former Castle Air Force Base Final Five-Year Review Report

Attached is the Former Castle Air Force Base Final Five-Year Review Report for your information and records. This report addresses environmental remedies implemented and remedial actions performed at Castle for the period 2009 to the present. For questions or additional information, please contact the undersigned at (210) 395-8238 or Ms. Karen Kramer, MWH Americas, at (916) 418-8315.

STANLEY G. PEHL, REM
BRAC Environmental Coordinator

Attachment:
Former Castle AFB Final Five-Year Review Report

cc:
Admin Record (Gary Yuki)
AFCEC/CIBW, Attn: Joe Ebert (without atch.)
CNGS, Attn: Geoff Watkin

DISTRIBUTION:
CA DTSC, Attn: Theresa McGarry
CVRWQCB, Attn: Chris Cochrane
U.S. EPA Region IX, Attn: Nadia Hollan Burke
U.S. EPA Headquarters, Attn: Monica McEaddy (CD only)
CH2M HILL, Attn: Campbell McLeod

MWH
BUILDING A BETTER WORLD

6 March 2014

Mr. Joseph Ebert
AFCEC/CIBW
2261 Hughes Avenue, Suite 155
JBSA Lackland TX 78236-9853

SUBJECT: *Final* Five-Year Review, Fourth Five-Year Review Report
Former Castle Air Force Base, California
Contract FA8903-08-D-8777, Task Order 0144

Dear Mr. Ebert:

MWH is pleased to submit the *Final* Five-Year Review Report for the Former Castle Air Force Base, California.

Copies of this Five-Year Review have been sent directly to the EPA, DTSC, CVRWQCB, and CH2M-Hill as previously instructed.

MWH appreciates the opportunity to provide these services to the Air Force. Please contact me at (916) 418-8315 should you have any questions.

Sincerely,

MWH Americas, Inc.

Karen Kramer

Karen Kramer, PG
Project Manager

Enclosures

cc: S. Pehl (AFCEC, Castle BEC)
G. Watkin (AFCEC)
T. McGarry (CA DTSC)
C. Cochrane (CVRWQCB)
N. Hollan Burke (USEPA)
M. McEaddy (USEPA) (CD only)
C. McLeod (CH2M HILL)
Admin Record

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FINAL

FIVE-YEAR REVIEW

Fourth Five-Year Review Report

Former Castle Air Force Base,
California

Contract No. FA8903-08-D-8777
Task Order 0144

March 2014

U.S.AIR FORCE

MWH

Final

Five-Year Review

Fourth Five-Year Review Report

for

Former Castle Air Force Base

Atwater

Merced County, California

March 2014

Prepared for:
Air Force Civil Engineer Center
Joint Base San Antonio Lackland, Texas

Prepared by:
MWH Americas, Inc.
3321 Power Inn Road, Suite 300
Sacramento, California 95826

Approved by:

Connie M. Lotfi

CONNIE M. LOTFI, GS-15, DAF
Deputy Director
Installations Center of Excellence
Air Force Civil Engineer Center

Date:

5 March 2014

FINAL

FIVE-YEAR REVIEW REPORT
FORMER CASTLE AIR FORCE BASE, CALIFORNIA

March 2014

Contract FA8903-08-D-8777
Task Order 144

Prepared for:

Air Force Civil Engineer Center
Joint Base San Antonio Lackland, Texas

Prepared by:
MWH Americas, Inc.
Sacramento, California

MWH Americas, Inc. certifies that, to the best of its knowledge and belief, the technical data delivered herewith under contract FA8903-08-D-8777 is complete, accurate, and complies with all requirements of the contract.

Approved By: Karen Krane Date: 2-28-14
Task Order Manager

REGISTERED PROFESSIONAL ENGINEER
ERIC B. ROWNEY
No. C69144
Expires 6/30/14
CIVIL
STATE OF CALIFORNIA

Approved By: Eric B. Rowney Date: 2/28/14
Technical Lead

Note: This document is proprietary, revision-controlled, and is intended strictly for use by AFCEC in performing its environmental mission, including the release of this document to the public if necessary, and to applicable regulatory agencies, and by MWH and its subcontractors in support of specific contractual responsibilities.

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LIST OF ACRONYMS AND ABBREVIATIONS

μg/L	microgram(s) per liter
AFCEE	Air Force Center for Engineering and the Environment
AFCEC	Air Force Civil Engineer Center
AFRPA	Air Force Real Property Agency
Air Force	United States Air Force
AM	Atwater Municipal (Well)
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
B#	Building (number)
BCT	BRAC Cleanup Team
Berger	Louis Berger and Associates
bgs	below ground surface
BHHRA	baseline human health risk assessment
BoP	Federal Bureau of Prisons
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BRAC	Base Realignment and Closure
BV	bioventing
CAFB	Castle Air Force Base
Cal/EPA	California Environmental Protection Agency
CB	Comprehensive Basewide
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
COPC	contaminant of potential concern
1,2-DCA	1,2-dichloroethane
DA-#	Discharge Area-(number)
DBCP	1,2-dibromo-3-chloropropane

LIST OF ACRONYMS AND ABBREVIATIONS

DEHP	di(2-ethylhexyl) phthalate
DDE	1,1-*bis*(Chlorophenyl)-2,2-dichloroethene
DDT	1,1-*bis*(Chlorophenyl)-2,2,2-trichloroethane
DP-#	Disposal Pit-(number)
DTSC	Department of Toxic Substances Control
E&D	excavation and disposal
EPA	United States Environmental Protection Agency
ERA	ecological risk assessment
ETC-#	Earth Technology Corporation-(number)
EW	extraction well
FFS	Focused Feasibility Study
Freon 12	dichlorodifluoromethane
FTA-#	Fire Training Area-(number)
GAC	granular activated carbon
gpm	gallons per minute
HSZ	hydrostratigraphic zone
IAG	Interagency Agreement
IC	institutional control
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISCO	*in situ* chemical oxidation
Jacobs	Jacobs Engineering
LF-#	Landfill-(number)
LSS	Lower Subshallow (HSZ)
LTM	long-term (cap) maintenance and monitoring
LTEM	long-term ecological monitoring

LIST OF ACRONYMS AND ABBREVIATIONS

LTGSP	Long-Term Groundwater Sampling Program
MCL	maximum contaminant level
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MID	Merced Irrigation District
MOU	Memorandum of Understanding
MW	monitoring well
MWH	MWH Americas, Inc.
NCP	National Contingency Plan
NFA	no further action
ND	not detected
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PCE	tetrachloroethene
PFC	perfluorinated compounds
PRC	PRC Environmental Management
PW	production well
Q#/##	quarter/year
RAO	remedial action objective
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Level
RWQCB	Regional Water Quality Control Board

LIST OF ACRONYMS AND ABBREVIATIONS

SCADA	Supervisory Control and Data Acquisition
SCOU	Source Control Operable Unit
SLUC	State Land Use Covenant
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TBC	to be considered
TBV	threshold background value
TCE	trichloroethene
TDS	total dissolved solids
TEER	Technical and Economic Evaluation Report
USAF	United States Air Force
USS	Upper Subshallow (HSZ)
VOC	volatile organic compound
WPI	Waste Policy Institute
WQSA	water quality site assessment

EXECUTIVE SUMMARY

The United States Air Force (Air Force or USAF) has conducted the fourth five-year review of the Former Castle Air Force Base (Castle AFB or CAFB) environmental restoration program, located near the community of Atwater, in Merced County, California. The first five-year review was finalized in September 1999. The second five-year review was finalized in January 2004. The third five-year review was finalized in January 2009. Since the second five-year review (finalized in January 2004), all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) decisions and documentation have been completed, all remedial actions are in place or are completed, operating properly and successfully determinations were made for the groundwater and Landfill 4 (LF-4) remedial actions, all property was found suitable for transfer, and all property has been transferred. Castle AFB site and base-wide milestones achieved, both prior to and since the third five-year review, are listed in Table 2-1. This fourth five-year review covers data available between the third five-year review and that which is included in the 2012 Annual report (CH2M Hill, 2013b) and provides status updates for systems and field activities conducted in 2013. Analytical data collected in 2013 is not discussed in this fourth five-year review as the information has not been reported. Data collected during first and second quarters of 2013 will be included in the 2013 Semiannual LTGSP Report to be submitted in October 2013, and third and fourth quarter 2013 data will be included in the 2013 Annual LTGSP Report which is scheduled for submittal during the second quarter of 2014.

This five-year review addresses only those groundwater and vadose zone sites where actions resulted in hazardous substances, pollutants, or contaminants to remain above levels that allow for unlimited use and unrestricted exposure or where remedial actions will achieve unlimited use and unrestricted exposure but take longer than five years to complete. It addresses the remedies selected in the *Comprehensive Basewide Record of Decision – Part 1* (CB ROD – Part 1) and the *Comprehensive Basewide Record of Decision – Part 2* (CB ROD – Part 2) for two groundwater plumes with ongoing remedial actions (Main Base and Castle Vista Plumes), and the *Source Control Operable Unit Record of Decision Part 3* (SCOU ROD Part 3) for eleven SCOU sites (Earth Technology Corporation 10 [ETC-10]; ETC- 12; Fire Training Area 1 [FTA-1]; LF-3; LF-4, including Disposal Pit 5 [DP-5] and DP-6; and LF-5 including DP-8, DP-8A, and LF-5 Trenches).

The selected remedies for the Main Base and Castle Vista Plumes are outlined in the CB ROD – Part 1: pump-and-treat remediation for plume capture and cleanup to maximum contaminant levels (MCLs), and CB ROD – Part 2: institutional controls (ICs) to restrict groundwater use within plumes exceeding an MCL; wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells; and wellhead treatment to address groundwater contamination exceeding MCLs within the off-base confined hydrostratigraphic (HSZ) plume.

The selected remedy for ETC-10 is ICs and long-term ecological monitoring (LTEM) of the adjacent wetlands. The selected remedy for ETC-12 is LTEM of the adjacent wetlands. The selected remedy for FTA-1 is SVE with capping, BV, E&D, long-term cap maintenance and monitoring (LTM), ICs, and LTEM of the adjacent wetlands. The selected remedy for LF-3 is LTEM of the adjacent wetlands. The selected remedy for LF-4, including DP-5 and DP-6, is LTM and ICs. The selected remedy for LF-5, including DP-8, DP-8A, and LF-5 Trenches, is LTM, ICs, and LTEM of the adjacent wetlands.

Table ES-1 presents the Five-Year Review Summary Form and is located after the Executive Summary section. Results of this five-year review for the individual plumes/sites assessed are summarized below.

Main Base Plume: The remedial action implemented for the Main Base Plume is protective of human health and the environment. The remedy is functioning as intended by the decision documents (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, and all components of the remedy are being operated in a safe and proper manner and have been optimized to the extent practical. ICs to restrict use of groundwater exceeding MCLs are in place, are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy, and no other information has been identified that would affect protectiveness. Three potential issues were identified, two issues are related to capture of the northeast Shallow HSZ plume and wells going dry were identified in this five-year review. However, continued implementation of the LTGSP will be sufficient to address these potential issues. The third potential issue relates to the rebound concentrations in the OU-2 area where TCE concentrations are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009.

Follow-up actions based on issues and recommendations identified in the previous five-year review were completed.

Castle Vista Plume: The remedial action implemented for the Castle Vista Plume is protective of human health and the environment. The remedy is functioning as intended by the decision documents (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, and all components of the remedy are being operated in a safe and proper manner and have been optimized to the extent practical. ICs to restrict use of groundwater exceeding MCLs are in place, are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy, and no other information has been identified that would affect protectiveness.

The Castle Vista Plume wellhead system was shut down with agency concurrence for a long-term rebound study in 2010. Cis-1,2-DCE periodically recurs at levels exceeding the MCL in a very small area and the Air Force and regulatory agencies coordinate on implementation of rebound monitoring and system operation to address this issue. The system was restarted on 15 April 2013 due to cis-1,2-DCE exceeding restart criteria and operated through 20 June 2013, when it was shut down due to pump failure. The system was restarted again following repair of the pump in August 2013.

Earth Technology Corporation 10: The remedial actions implemented for ETC-10 are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted and ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/ Federal Bureau of Prisons (BoP) Memorandum of Understanding (MOU). Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-10 were last conducted in the spring of 2008, no impacts were noted in the 2008 survey. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance was statistically less in potentially impacted pools than in background pools. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-10 LTEM is not incorporated into this five-year review report. LTEM is recommended during the next year of sufficient rainfall.

Earth Technology Corporation 12: The remedial action implemented for ETC-12 is protective of human health and the environment. The remedy is functioning as designed (ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-12 were last conducted in the spring of 2008, no impacts were noted in the 2008 survey. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance was statistically less in potentially impacted pools than in background pools. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-12 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-12 LTEM is not incorporated into this five-year review report. LTEM is recommended during the next year of sufficient rainfall.

Fire Training Area 1: The remedial actions implemented for FTA-1 is protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active, and ecological monitoring conducted). The FTA-1 may have been impacted by the use of perfluorinated compound (PFC) used in fire-fighting foams. The Air Force is taking a programmatic approach at BRAC facilities with regard to potential emerging chemical contamination associated with PFCs. This Air Force-wide initiative will evaluate candidate sites for the potential presence of PFC compounds and will include sampling at the selected sites to determine if PFCs are present. FTA-1 is included in the Air Force assessment of such sites for PFCs. There are no other issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of FTA-1 were last conducted in the spring of 2008, no impacts were noted in the 2008 survey. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance was statistically less in potentially impacted pools than in background pools. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the FTA-1 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from FTA-1 LTEM is not incorporated into this five-year review report. LTEM is recommended during the next year of sufficient rainfall.

Because decreases in regional groundwater levels at Castle resulted in the wells in the FTA-1 area going dry, two new wells were installed during August 2013. Hydropunch™ samples collected during drilling activities showed TCE concentrations below the MCL at both locations. These wells were installed under a regulatory approved work plan. Sampling of the newly installed wells will be completed with scheduled LTGSP sampling and reported in the 2013 Annual LTGSP report.

Landfill 3: The remedial action implemented for LF-3 is protective of human health and the environment. The remedy is functioning as designed (ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-3 were last conducted in the spring of 2008, no impacts were noted in the 2008 survey. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance was statistically less in potentially impacted pools than in background pools. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-3 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-3 LTEM is not incorporated into this Five-Year Review Report. LTEM is recommended during the next year of sufficient rainfall.

Landfill 4: The remedial actions implemented for LF-4/DP-5/DP-6 are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place as part of the deed transferring the parcel containing LF-4 to Merced County and a State Land Use Covenant (SLUC) executed by Merced County and the State of California. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually.

Because decreases in regional groundwater levels at Castle resulted in the wells in the LF-4 area going dry, one new well was installed during August 2013. This well was installed under a regulatory approved work plan. Sampling of the newly installed wells will be completed with scheduled LTGSP sampling and reported in the 2013 Annual LTGSP report. Once data from the new background well at LF-4 are collected and the groundwater flow direction in this area is confirmed, the number and location of replacement downgradient wells at LF-4 will be determined.

Landfill 5: The remedial actions implemented for LF-5/DP-8/DP-8A/LF-5 Trenches are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active, and ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-5 were last conducted in the spring of 2008, no impacts were noted in the 2008 survey. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance was statistically less in potentially impacted pools than in background pools. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-5 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-5 LTEM is not incorporated into this five-year review report. LTEM is recommended during the next year of sufficient rainfall.

Because decreases in regional groundwater levels at Castle resulted in the wells in the LF-5 area going dry, three new wells were installed during August 2013. These wells were installed under a regulatory approved work plan. Sampling of the newly installed wells will be completed with scheduled LTGSP sampling and reported in the 2013 Annual LTGSP report.

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TABLE ES-1

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Castle Air Force Base		
EPA ID: CA3570024551		
Region: 9	**State:** CA	**City/County:** Atwater / Merced County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Air Force
Author name (Federal or State Project Manager): MWH Americas, Inc.
Author affiliation: MWH Americas, Inc.
Review period: December 2, 2008 – August 31, 2013
Date of site inspection: June 18, 2013
Type of review: Statutory
Review number: 4
Triggering action date: March 2009
Due date *(five years after triggering action date)*: Fourth Review – March 2014

Five-Year Review Summary Form
(continued)

The table below is for the purpose of the summary form and associated data entry and does not replace the two tables required in Section VIII and IX by the FYR guidance. Instead, data entry in this section should match information in Section VII and IX of the FYR report.

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): Groundwater	**Issue Category: Remedy Performance**			
	Issue - Main Base Plume: Capture of the northeast base plume area in the Shallow HSZ by the MW824/MW1037 wellhead treatment system. Capture of this portion of the plume is unlikely unless water levels rise such that pumping from the Shallow HSZ can resume.			
	Recommendation: The treatment system was shutdown in 2006 when water levels decreased such that pumping could not be sustained. Since 2006, the system has remained off line with regulatory agency concurrence and associated monitoring wells have been monitored in accordance with recommendations established in the annual LTGSP Reports (2007-2012). While the NEBP is not captured, monitoring results establish that the remaining NEBP area is very small, the contaminant concentrations have not indicated an increasing trend, and the limited area and levels of groundwater contamination have not migrated. Monitoring of the limited wells that are just above the MCL is appropriate and recommended until MCLs are achieved provided the contaminant concentrations do not show an increasing trend or the plume area does not migrate. Should monitoring under the LTGSP indicate an increasing contaminant trend or plume migration, the AF in consultation with the regulatory agencies, should evaluate if other action is warranted.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	Ongoing

<table>
<tr><td rowspan="3">OU(s): Groundwater</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue - Main Base Plume: Declining regional water levels have resulted in monitoring wells going dry.</td></tr>
<tr><td colspan="4">Recommendation: Each annual report contains an evaluation of dry wells to determine if they should be replaced. This evaluation process appears successful as evidenced by, development, approval, and implementation of work plans to replace dry wells at CAFB in 2013. It is recommended that this issue continue to be monitored and evaluated under the LTGSP.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Ongoing</td></tr>
</table>

<table>
<tr><td rowspan="3">OU(s): Groundwater</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue – OU-2: TCE rebound concentrations in the OU-2 area are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009.</td></tr>
<tr><td colspan="4">Recommendation: To improve and confirm plume capture and plume reduction, specifically, a) improve plume capture and contaminant mass removal by adding an extraction well from the existing well network (most likely a conversion of MW-948 to an extraction well), and b) confirm hydraulic control by installing a LSS monitoring well in the area of MW804A.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Summer 2014</td></tr>
</table>

<table>
<tr><td rowspan="3">OU(s): Groundwater</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue - Castle Vista Plume: Effectiveness of treatment system in attaining the remedial objective for the residual cis-1,2-DCE plume.</td></tr>
<tr><td colspan="4">Recommendation: It is recommended that the regulatory approved rebound study continue to be implemented to address recalcitrant contamination in the residual cis-1,2-DCE plume. This includes operation of the wellhead treatment system, as necessary, in consultation with the regulatory agencies. However, it is recommended that the cis-1,2-DCE cleanup level of 6 µg/L be evaluated in light of California's updated Public Health Goal of 100 µg/L and EPA's updated Regional Screening Level of 28 µg/L.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Ongoing (rebound study); Winter 2015 (cleanup level evaluation)</td></tr>
</table>

OU(s): Source Control	Issue Category: Remedy Performance			
	Issue - ETC-10: Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.			
	Recommendation: It is recommended that LTEM occur during the next year that sufficient rainfall occurs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	Winter 2014 or as soon as weather permits

OU(s): Source Control	Issue Category: Remedy Performance			
	Issue - ETC-12: Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.			
	Recommendation: It is recommended that LTEM occur during the next year that sufficient rainfall occurs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	Winter 2014 or as soon as weather permits

OU(s): Source Control	Issue Category: Remedy Performance
	Issue - FTA-1: Ground water monitoring well MW886 is dry and groundwater monitoring cannot be conducted at FTA-1.
	Recommendation: In August 2013, one groundwater well (MW1054) was installed approximately 100 feet downgradient of dry well MW886, and one groundwater well (MW1055) was installed adjacent to the FTA-1 cap. The location of MW1054 was selected as the nearest location downgradient of MW886 that is outside the Vernal Pool Preservation Area. A new well could not be drilled adjacent to MW886 because this well is located within a recently identified wetland. The location of MW1055 was selected to be closer to the FTA-1 cap and within the assumed boundary of the last known TCE MCL plume. Further details are presented in the Final Fire Training Area 1 Well Installation Work Plan (CH2M HILL, 2012c). It is recommended that monitoring continue under the LTGSP to determine if TCE at levels exceeding the MCL remain at FTA-1.

Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	No	Air Force	EPA/State	Ongoing

OU(s): Source Control	Issue Category: Remedy Performance			
	Issue - FTA-1: Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.			
	Recommendation: It is recommended that LTEM occur during the next year that sufficient rainfall occurs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	Winter 2014 or as soon as weather permits

OU(s): Source Control	Issue Category: Remedy Performance			
	Issue - FTA-1: Due to historical fire training activities, the area may have been impacted by the use of perfluorinated compounds (PFC) used in fire-fighting foam.			
	Recommendation: It is recommended that the Air Force perform their programmatic review to determine if PFCs are present at FTA-1.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	To be determined

OU(s): Source Control	Issue Category: Remedy Performance			
	Issue - LF-3: Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.			
	Recommendation: It is recommended that LTEM occur during the next year that sufficient rainfall occurs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Air Force	EPA/State	Winter 2014 or as soon as weather permits

<table>
<tr><td rowspan="3">OU(s): Source Control</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue - LF-4: Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.</td></tr>
<tr><td colspan="4">Recommendation: In August 2013, one groundwater well (MW1053) was installed to replace dry well MW888. Further details are presented in the Final Landfill 4 and Landfill 5 Well Installation Work Plan (CH2M HILL, 2012b). Downgradient detection compliance monitoring well MW847 became dry during 2012, it was previously dry only on a seasonal basis (only during Q4; CH2M HILL, 2013b). It is recommended to continue the landfill groundwater monitoring program to evaluate the newly installed well and monitor groundwater concentrations and flow directions prior to determining an appropriate location for the MW847 replacement well.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Summer 2014</td></tr>
</table>

<table>
<tr><td rowspan="3">OU(s): Source Control</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue - LF-5: Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.</td></tr>
<tr><td colspan="4">Recommendation: In August 2013, one groundwater well (MW1050) was installed to replace dry well MW360, and detection compliance monitoring wells MW1051 and MW1052 were installed to replace dry wells MW1004 and MW1005, respectively. Further details are presented in the Final Landfill 4 and Landfill 5 Well Installation Work Plan (CH2M HILL, 2012b). It is recommended to continue the landfill groundwater monitoring program to evaluate the newly installed wells.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Ongoing</td></tr>
</table>

<table>
<tr><td rowspan="3">OU(s): Source Control</td><td colspan="4">Issue Category: Remedy Performance</td></tr>
<tr><td colspan="4">Issue - LF-5: Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.</td></tr>
<tr><td colspan="4">Recommendation: It is recommended that LTEM occur during the next year that sufficient rainfall occurs.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Air Force</td><td>EPA/State</td><td>Winter 2014 or as soon as weather permits</td></tr>
</table>

Protectiveness Statement(s)
Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.

Location: Castle AFB	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Castle AFB Sitewide Protectiveness Statement: All remedial actions are in place or have been completed at the former Castle Air Force Base. The remedial actions implemented at the former Castle Air Force Base are protective of human health and the environment.		

Operable Unit: Comprehensive Basewide Groundwater Operable Unit	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: All remedial actions are in place or have been completed at the Comprehensive Basewide Groundwater Operable Unit. The remedial actions implemented at the Comprehensive Basewide Groundwater Operable Unit are protective of human health and the environment.		

Operable Unit: Source Control Operable Unit	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: All remedial actions are in place or have been completed at the Source Control Operable Unit. The remedial actions implemented at the Source Control Operable Unit are protective of human health and the environment.		

Operable Unit: Groundwater - Main Base	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial action implemented for the Main Base Plume is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner, and they have been optimized to the extent practical (OU-1 treatment plant and MW883/MW1021, MW941, and MW1009 wellhead treatment systems have been shut down). ICs to restrict use of groundwater exceeding MCLs are in place and are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness. A screening level assessment, as reported during the third five-year review report (Jacobs, 2009a), determined that the cancer risk associated with potential vapor intrusion from the current levels of groundwater contamination in the Shallow HSZ is less than 1x10-6.The technical assessment identified two potential issues, (1) capture of the northeast base plume area in the Shallow HSZ by the MW824/MW1037 wellhead treatment system and (2), declining groundwater levels that result in wells going dry. In both cases, continued implementation of the LTGSP will address these potential issues.

Operable Unit: Groundwater - Castle Vista	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial action implemented for the Castle Vista Plume is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner, and they have been optimized to the extent practical. ICs to restrict use of groundwater exceeding MCLs are in place and are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness. The technical assessment identified one potential issue, (1) effectiveness of treatment system in attaining the remedial objective for the residual cis-1,2-DCE plume. Continuation of the rebound study and an evaluation of the cleanup level will address this potential issue.

Operable Unit: Source Control - ETC-10	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial actions implemented for ETC-10 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedies are functioning as designed (access restricted and ecological monitoring) and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-10 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. The technical assessment identified one potential issue, (1) planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. This issue will be addressed by conducting LTEM during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

Operable Unit: Source Control - ETC-12	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial action implemented for ETC-12 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (ecological monitoring) and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-12 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. The technical assessment identified one potential issue, (1) planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. This issue will be addressed by conducting LTEM during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

Operable Unit: Source Control - FTA-1	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial actions implemented for FTA-1 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring, and ecological monitoring conducted). The FTA-1 may have been impacted by the use of PFCs used in fire-fighting foams. The Air Force is taking a programmatic approach at BRAC facilities with regard to potential emerging chemical contamination associated with PFCs. This Air Force-wide initiative will evaluate candidate sites for the potential presence of PFC compounds and will include sampling at the selected sites to determine if PFCs are present. FTA-1 is included in the Air Force assessment of such sites for PFCs. PFCs are being addressed as directed in the 17 September 2012 HQ UASF/A7C memo, Interim Guidance on Perfluorinated Compounds, implementing the 27 August 2012 Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations, which directs the Air Force to undertake a phased approach to identify, quantify, and mitigate, if necessary, potential releases of PFCs in groundwater, surface water, soil and/or sediment at its installations. Section 7.5.3 describes the steps the Air Force will take. After the Air Force investigation is complete, the protectiveness of the remedy should be re-evaluated in the next Five-Year Review. There are no other issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of FTA-1 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. The technical assessment identified three potential issues, (1) groundwater monitoring well MW886 was dry and groundwater monitoring could not be conducted, and (2) planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. These issues will be addressed by groundwater monitoring of wells MW1054 and MW1055, which were completed in August 2013, and conducting LTEM during the next year that has sufficient rainfall, (3) Due to historical fire training activities, the area may have been impacted by the use of PFCs used in fire-fighting foam.

Operable Unit: Source Control - LF-3	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial action implemented for LF-3 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (ecological monitoring) and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-3 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. The technical assessment identified one potential issue, (1) planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. This issue will be addressed by conducting LTEM during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

Operable Unit: Source Control - LF-4	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial actions implemented for LF-4/DP-5/DP-6 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring) and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place as part of the deed transferring the parcel containing LF-4 to Merced County, and a State Land Use Covenant executed by the Air Force and the State of California. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually. The technical assessment identified one potential issue, (1) groundwater monitoring wells MW888 and MW847 were dry and groundwater monitoring could not be conducted. This issue will be addressed by groundwater monitoring of well MW1053, which was completed in August 2013 as a replacement for MW888 and evaluation of data prior to determining a replacement well location for MW847.

Operable Unit: Source Control - LF-5	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*

Protectiveness Statement:
The remedial actions implemented for LF-5/DP-8/DP-8A/LF-5 Trenches is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring, and ecological monitoring conducted) and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-5 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. The technical assessment identified two potential issues, (1) groundwater monitoring well MW360 and compliance monitoring wells MW1004 and MW1005 were dry and groundwater monitoring could not be conducted, and (2) planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. These issues will be addressed by groundwater monitoring of wells MW1050, MW1051, and MW1052, which were completed in August 2013, and conducting LTEM during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

1 INTRODUCTION

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, five-year review reports identify issues found during the review, if any, and present recommendations to address them.

This five-year review has been prepared pursuant to Section 121 (c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP). CERCLA Section 121 (c) states:

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

The United States Environmental Protection Agency (EPA) interpreted this requirement further in the NCP. The Code of Federal Regulations, Title 40 (40 CFR) Section 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 initiation of the selected remedial action.*

Pursuant to Executive Order 12580, the Department of Defense is the delegated lead agency for CERCLA response actions for its facilities. Under authority of the Department of Defense, the Air Force Civil Engineer Center (AFCEC) is responsible for the five-year review of remedies implemented at the Former Castle AFB site. For National Priorities List federal facilities such as the former CAFB, the EPA retains final authority over whether the five-year review adequately addresses the protectiveness of remedies. EPA will either concur with the final Air Force protectiveness determination, or EPA may provide independent findings.

AFCEC retained MWH Americas, Inc. (MWH) to conduct the fourth five-year under AFCEC Contract Number FA8903-08-D-8777, Task Order No. 0144. The review was conducted from May through August 2013 and focuses on remedial actions taken pursuant to the Records of Decision (ROD) for groundwater and applicable source control operable unit (SCOU) sites at Castle AFB. This report, which documents the results of the review, has been prepared in accordance with the most recent EPA and AF guidance for conducting five-year reviews and preparing five-year review reports including: *Comprehensive Five-Year Review Guidance*; (USEPA, 2001), *Recommended Evaluation of Institutional Controls* (USEPA, 2011), *Clarifying the Use of Protectiveness Determinations* (USEPA, 2012a), *Assessing Protectiveness of Sites for Vapor Intrusion* (USEPA, 2012b), and *Air Force Real Property Agency Guidance for Five-Year Reviews* (AFRPA, 2007), and tailors the relevant parts of the guidance and supplements to the specific conditions at Castle AFB.

Two types of five-year reviews are defined in EPA guidance: statutory reviews and policy reviews. A statutory review is to be conducted for any site where the selected remedy, once ROD cleanup levels are attained, will not allow unlimited use and unrestricted exposure. A policy review is to be conducted for any site where no hazardous substances will remain above levels that allow unlimited use and unrestricted exposure after completion of the remedial action, but where the cleanup levels presented in the ROD will require five or more years to be attained. This five-year review of remedial actions at CAFB is a statutory review because the response actions completed at Fire Training Area 1 (FTA-1; capping), Landfill 4 (LF-4) and LF-5 (consolidation and capping), LF-3 (excavation and consolidation) and Earth Technology 10 (ETC-10; excavation and disposal) left hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure. The five-year review at ETC-12 is a statutory review because the response actions completed (long-term ecological monitoring) left contaminants of ecological concern that exceed levels allowing for unlimited use and unrestricted exposure. Five-year review of groundwater remedial actions is conducted because the actions will take longer than five years to achieve levels of hazardous substances, pollutants or contaminants that allow for unrestricted use and unlimited exposure.

This is the fourth five-year review for the Castle AFB site. The triggering action for the initial review was the start of construction of the Operable Unit 1 (OU-1) groundwater treatment system in March 1993. The initial five-year review for Castle AFB was completed in March 1998, and was submitted as final to the regulatory agencies on 12 November 1998 (Jacobs Engineering [Jacobs], 1998a). The EPA and State regulatory agencies (Department of Toxic Substances Control [DTSC] and Regional Water Quality Control Board [RWQCB]) provided their concurrence, included in the initial five-year review report, on 28 September 1999. The second five-year review was completed in September 2002, and, following an extended period of discussion, the final was issued on 23 January 2004 (Jacobs, 2004a). EPA provided concurrence for the second five-year review on 27 January 2004 (EPA, 2004; Administrative Record [AR]#2513). DTSC concurred with the second five-year review on behalf of the State on 8 March 2004 (DTSC, 2004; AR#2514). The third five-year review was finalized on 23 January 2009 (Jacobs, 2009a). EPA provided concurrence with the third five-year review on 11 March 2009 (EPA, 2009; AR#3018). DTSC concurred with the third five-year review on behalf of the State on 19 February 2009 (DTSC, 2009; AR#2994).

Public notification for the current five-year review was posted on 7 June 2013 in the Merced Sun-Star and is included as Appendix B.

1.1 SCOPE OF CURRENT FIVE-YEAR REVIEW

At present, there are only two OUs defined for CAFB: the Groundwater OU, which includes all identified contaminant plumes, and the SCOU, which includes all 233 identified vadose zone contamination sites. It is noted that the two initial groundwater treatment systems installed and operated at CAFB were designated OU-1 and OU-2. These systems were and remain part of the Groundwater OU.

Five RODs define the CERCLA response process for groundwater contamination and vadose zone contamination at CAFB (the two

Comprehensive Basewide RODs include remedies for the Groundwater OU and the three SCOU RODs include remedies for the SCOU sites):

- *Final Record of Decision, Comprehensive Basewide Program – Part 1 (Groundwater)* (CB ROD – Part 1) (USAF, 1997)
  - ♦ Addresses the six groundwater plumes identified during the CB Remedial Investigation (RI): Main Base, East Base, Landfill 1, Landfill 4, North Base, and Castle Vista Plumes.
  - ♦ This ROD supersedes the *Record of Decision – Interim, Operable Unit No. 1 (*OU-1 Interim ROD) (USAF, 1991) and the *Final Record of Decision for Operable Unit No. 2* (OU-2 ROD) (USAF, 1993).
- *Source Control Operable Unit Record of Decision – Part 1* (SCOU ROD – Part 1) (Waste Policy Institute [WPI], 2002)
  - ♦ Addresses 169 SCOU sites; 137 of which are identified as no further action (NFA) sites based on lack of contamination, risk management decisions, or completed removal actions; and 32 of which are CERCLA-exempt.
- *Source Control Operable Unit Record of Decision – Part 2* (SCOU ROD – Part 2) (Earth Tech, 2003a)
  - ♦ Addresses 53 SCOU sites: 21 with soil vapor extraction (SVE) as the selected remedy (one of these sites has excavation and disposal [E&D] as an additional component of the remedy); six with E&D as the selected remedy (two of these sites have bioventing [BV] as an additional component of the remedy); 14 identified as NFA sites based on lack of contamination or completed E&D; and 12 CERCLA-exempt sites.
- *Source Control Operable Unit Record of Decision Part 3* (SCOU ROD Part 3) (Jacobs, 2005a)
  - ♦ Addresses selected remedies for eight SCOU landfill sites (LF-4 including Disposal Pit 5 [DP-5] and DP-6; and LF-5 including DP-8, DP-8A, DP-9, and LF-5 Trenches) consisting of long-term cap maintenance and monitoring (LTM), and institutional controls (ICs). An NFA determination is made for DP-9. Also addresses the selected remedies for Earth Technology Corporation 8 (ETC-8; E&D), ETC-10 (ICs), and FTA-1 (SVE, BV, E&D, LTM, and ICs). Presents the remedies for ecological concerns at all SCOU sites: NFA at 225 sites, and long-term ecological monitoring (LTEM) at eight sites (ETC-10, ETC-12, FTA-1, LF-3, and LF-5 including associated sites DP-8, DP-8A, and LF-5 Trenches). The remedy for ecological concerns at FTA-1 includes E&D of approximately 150 cubic yards of soil outside of the existing cap that exceeds ecological remedial action objectives (RAOs).

- *Comprehensive Basewide Record of Decision – Part 2* (CB ROD – Part 2) (AFRPA, 2006a)
    - Addresses groundwater use restrictions (ICs) for areas overlying maximum contaminant level (MCL) plumes until CB ROD – Part 1 cleanup levels are achieved. Updates the groundwater remedy to include wellhead treatment within the plume and at Atwater municipal well 18 (AM18), if necessary, to address the MCL plume southwest of Castle AFB where capture is not practical because of AM18 pumping. Provides an overview of final remedies for all groundwater plumes (six) and SCOU sites (233).

This five-year review focuses on the ongoing Groundwater OU remedial actions at Castle AFB addressed by the CB ROD – Part 1 (pump-and-treat remediation for plume capture and cleanup to MCLs or monitoring) and CB ROD – Part 2 (ICs), and the eleven SCOU sites addressed by SCOU ROD Part 3 where hazardous substances, pollutants or contaminants exceed levels that allow for unlimited use and unrestricted exposure. Groundwater plumes addressed are the Main Base Plume (OU-2, Phase 3, and wellhead groundwater treatment systems; plume capture and cleanup) and the Castle Vista Plume (monitoring well 003 [MW003]/MW1046 wellhead treatment system; plume capture and cleanup). These plumes have been addressed in all three of the previous five-year reviews. The East Base, North Base, LF-4, and LF-1 plume areas identified in the CB ROD – Part 1 are not included in this five-year review because the remedies are complete and unrestricted use and unlimited exposure was achieved. SCOU sites addressed are ETC-10 (ICs and LTEM), ETC-12 (LTEM), FTA-1 (LTM, ICs, and LTEM), LF-3 (LTEM), LF-4 (ICs and LTM) and LF-5 (ICs, LTM, and LTEM). Associated sites also addressed herein are DP-5 and DP-6 at LF-4; and DP-8, DP-8A, and LF-5 Trenches at LF-5. This five-year review is the third to address ETC-10, FTA-1, LF-4, and LF-5; and the second to address ETC-12 and LF-3.

This five-year review does not provide technical assessments for SCOU sites at Castle AFB other than the 11 sites noted above. The remaining 222 SCOU sites are not evaluated for one of three reasons: (1) the site is designated as NFA in a SCOU ROD; (2) the site selected remedy was completed and levels that allow for unrestricted use and unlimited exposure were achieved, or (3) the site is a non-CERCLA or a CERCLA exclusion site. All SCOU sites, site linkages, selected remedies, ROD affiliation, and the rationale for technical assessment or exclusion from technical assessment in this five-year review are listed in Table 1-1. The ROD affiliation of all SCOU sites and the location of the majority of SCOU sites at CAFB are shown on Plate 1, plate provided in a plastic sleeve at end of this Report. Linear sites such as pipelines and two non-CERCLA stain sites (STA-34 and STA-35) with uncertain locations are not shown on Plate 1.

This five-year review was conducted by evaluating the status and performance of the ongoing groundwater remedial actions and the applicable LTM/LTEM/ICs for eleven SCOU sites, and determining whether those actions meet or demonstrate progress consistent with meeting the specific goals and objectives stated/anticipated in the applicable ROD. The assessment of protectiveness is based on the following three questions:

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

As stated in the guidance, these questions provide a framework for organizing and evaluating available data on the groundwater and SCOU site remedies, and to ensure that all relevant issues are considered when assessing protectiveness.

1.2 REPORT ORGANIZATION

The remainder of this five-year review is organized as follows:

- Section 2, Site Chronology, identifies the sequence and dates of major events in the CERCLA response process at CAFB, including key regulatory and remedial events for each of the 11 aforementioned sites.
- Section 3, Background, includes a description of the CAFB site, and briefly describes the geologic/hydrogeologic framework and contaminant distribution in groundwater and the vadose zone.
- Section 4, Remedial Actions, provides a brief description of the remedial actions and the decision documents for CAFB. The remedy selection process and implementation of the selected remedies for the groundwater plumes and SCOU sites evaluated in this five-year review are emphasized.
- Section 5, Progress Since Last Review, summarizes the major actions/accomplishments since the site's last five-year review.

- Section 6, Five-Year Review Process, briefly outlines those elements of the standard five-year review process conducted at CAFB, including a list of documents reviewed, evaluation of data collected during the past five years, site inspections, and personal interviews.
- Section 7, Technical Assessment, evaluates the protectiveness factors of each of the ongoing groundwater and SCOU site remedial actions (individual assessment for each identified contaminant plume and SCOU site).
- Section 8, Issues, summarizes any site-specific issues or concerns observed during the technical assessment review that may be impacting current or future protectiveness.
- Section 9, Recommendations and Follow-Up Actions, lists and describes any recommended actions or modifications to the existing actions that are necessary or appropriate to achieve and/or maintain protectiveness of the evaluated remedial actions.
- Section 10, Protectiveness Statements, provides a summary statement regarding the protectiveness of each of the evaluated groundwater and SCOU site remedial actions at CAFB.
- Section 11, Next Review, identifies the schedule for preparing the next and anticipated subsequent five-year review documents for CAFB.
- Section 12, References, lists all documents cited in the text.

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2 SITE CHRONOLOGY

This section presents a brief chronology, in table and figure format, of the major events directly related to the groundwater and vadose zone remedial actions at Castle AFB. Table 2-1 lists dates and events (major field activity, primary documents, removal actions, remedial actions, etc.) from the initial discovery of contaminated groundwater in 1978 through 2012. Figure 2-1 shows the primary CERCLA documents that have been and will be prepared for CAFB and the integration of the major operable units (vadose zone and groundwater) at CAFB. A full citation for all documents referenced in Table 2-1 and/or included on Figure 2-1 is provided in Section 12.

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3 BACKGROUND

3.1 PHYSICAL CHARACTERISTICS

The Former Castle AFB, now operating as Castle Airport, is located in central California within the San Joaquin Valley in Merced County, as shown on Figure 3-1. The site is approximately 6 miles northwest of Merced, near the communities of Winton (to the north and west) and Atwater (to the southwest). The former CAFB covered an area of 2,777 acres composed of runway and airfield operations, industrial areas, housing, recreational facilities, and several noncontiguous parcels of land located near the CAFB. The largest noncontiguous parcels are two former housing annexes (Castle Gardens and Castle Vista), totaling approximately 206 acres, located to the southwest of the former Base (Figure 3-1).

Land use within a 3-mile radius of CAFB is mixed urban and agricultural. Several small dairies, a large chicken ranch, row crops, and open pasture land are located immediately east of CAFB. Open pasture land is predominant to the south. An urbanized area (City of Atwater) bounds the site to the southwest. Orchards (primarily almonds) are predominant to the west, while in the north are mixed orchards and pasture land. There are several environmentally sensitive wetland areas within CAFB, mostly in the eastern and northern portions.

The subsurface at CAFB consists of a relatively thick vadose zone (approximately 60 to 70 feet) and an underlying sequence of lithologically distinct, but hydraulically connected, water-bearing or hydrostratigraphic zones (HSZs). The vadose zone typically consists of sand underlain by a few inches to several feet of hardpan that is underlain by laterally discontinuous alluvial sands, silts, gravels, and clays. Below the water table, five HSZs have been identified and designated, in descending order, as the Shallow, Upper Subshallow (USS), Lower Subshallow (LSS), Confined, and Deep HSZs. A generalized Base-wide conceptual model based on these HSZs is shown on Figure 3-2.

The Shallow HSZ is the uppermost water-bearing unit underlying CAFB and the surrounding area. This zone is unconfined, and extends from the water table (currently 70 to 80 feet below ground surface [bgs] and generally declining) to an average depth of about 95 feet bgs. In some areas, the Shallow HSZ extends to a maximum depth of 115 feet bgs. The lithology is mixed sands, silts, and gravels with minor amounts of clay. The basal layer of the Shallow HSZ appears to consist of sand- and gravel-filled relict stream channels. The saturated thickness of the Shallow HSZ averages from 20 to 25 feet, and ranges from about 5 to 45 feet.

The USS HSZ extends from the bottom of the Shallow HSZ to an average depth of 130 feet bgs, and a maximum depth of about 160 feet bgs. The lithology is heterogeneous, both laterally and vertically, consisting primarily of fine-grained flood plain deposits grading into medium-grained sands to the south of CAFB. The saturated thickness of the USS HSZ averages about 35 feet, with a maximum of about 65 feet.

The LSS HSZ extends from the base of the USS HSZ to an average depth of 220 feet bgs, and a maximum depth of about 245 feet bgs. The lithology is predominantly fine-grained sands, silts, and clays. A 10- to 25-foot-thick, gravel-bearing horizon occurs intermittently near the base of the zone. The saturated thickness of the LSS HSZ averages about 85 feet, with a maximum of about 115 feet.

The Confined HSZ extends from the base of the overlying LSS HSZ to an average depth of 350 feet bgs, and a maximum depth of about 370 feet bgs within the CAFB boundary. To the southwest, the base of the Confined HSZ dips downward to an average depth of about 400 feet bgs, and a maximum depth of perhaps 430 feet bgs. The zone is predominantly fine-grained, but also contains more continuous clean sands and gravels than does the overlying LSS HSZ. The North Merced Gravel, which occurs at the base of the zone, does not appear to be laterally continuous. Where present, this gravel comprises the majority of the clean sands and gravels in the Confined HSZ. The saturated thickness of the Confined HSZ ranges from about 125 to 185 feet.

The Deep HSZ underlies the Confined HSZ. The lithology and vertical extent of the Deep HSZ is not well defined.

3.2 LAND AND RESOURCE USE

Prior to establishment of the Merced Army Flying School at the site in 1941, the Base area was mixed agricultural and undeveloped land. While an active military base (1941-1995), land uses were those typical of military airfield operations: flight operations (fueling); fuel storage and transfer (tanks and pipelines); aircraft maintenance (solvents, hydraulic fluid, etc.); fire training (fuels, oils, and solvents); and general Base operations (industrial and domestic wastes).

The Base was listed on the EPA National Priorities List on 21 November 1987 and was decommissioned on 30 September 1995 under the authority of the Defense Authorization Amendments and Base Closure and Realignment Act of 1988 and the Defense Base Closure and Realignment Act of 1990. Subsequent to closure, the property was renamed Castle Airport (Jacobs, 2009c). From closure through 2006, portions of the property were transferred by deeds or Federal transfer documents or were subject to lease agreements. By the end of 2006, the Air Force had completed transfer of all property comprising former CAFB to several public and private entities; including the Federal Bureau of Prisons (BoP), Merced County, and the City of Atwater (CH2M HILL, 2012a).

Current and future land use at Castle Airport includes a civilian airport; educational, industrial, medical, and housing facilities; and a Federal prison. The land surrounding Castle Airport will likely remain a mix of urban and agricultural use for the foreseeable future.

The only significant resource use at Castle Airport is the pumping of groundwater for water supply. At present, there are three active water supply wells within the Castle Airport property: production well 10 (PW10; grid Q9; screened from 261 to 734 feet bgs), PW12 (grid R15; screened from 360 to 875 feet bgs) and AM21 (grid L14; screened from 360 to 670 feet bgs; Figure 3-3). All are completed in water-bearing zones beneath and/or upgradient of areas of known groundwater contamination at CAFB (Section 3.3; Figure 3-3). PW10 (primary) and PW12 (backup) supply water to all facilities and for all uses at Castle Airport except the Federal prison, which is supplied by AM21. PW10 and PW12 were installed by the Air Force; AM21 was installed by the City of Atwater. Castle Airport operates PW10 and PW12; together they have a maximum total production capacity of approximately 5,000 gallons per minute (gpm) and produce from the Confined and Deep HSZs (CH2M HILL, 2013b).

3.3 HISTORY OF CONTAMINATION

Numerous activities/facilities at the former CAFB generated soil and groundwater contaminants during all or a portion of active Base operations (1941-1995). Contamination at the former CAFB was first identified in 1978 when trichloroethene (TCE) was detected in groundwater samples from several on-Base production wells. Potential source areas and related contaminants at CAFB are as follows (Jacobs, 1997a):

- **Engine Maintenance Shops.** Buildings used for degreasing and repair of aircraft engines. Expected contaminants included volatile organic compounds (VOCs), primarily TCE and its degradation products; aromatic VOCs such as benzene, toluene, ethylbenzene, and total xylenes (BTEX); and other petroleum compounds and metals.
- **Washracks and Discharge Areas.** Washracks, typically associated with aircraft hangers and maintenance areas, were used for cleaning the outer surfaces of aircraft and other equipment. Discharge areas include locations where liquid wastes were released onto the ground surface. Expected contaminants included TCE and its degradation products and metals.
- **Landfills and Disposal Pits.** Areas used for the disposal of domestic, construction, and industrial wastes (solid and liquid). Expected contaminants included VOCs, BTEX, semivolatile organic compounds (SVOCs), chlorofluorohydrocarbons, and metals.
- **Storage Tanks and Tank Farms.** Aboveground and underground storage tanks used for storage of fuels and oils. Expected contaminants were petroleum hydrocarbons included in jet fuel, gasoline, diesel, heating oil, motor oil, and hydraulic fluid.
- **Utility Pipelines.** Fuel, domestic and industrial waste (sewer), and storm drain pipelines. Expected contaminants were VOCs and petroleum hydrocarbons.
- **Hazardous Waste Storage Sites and Solid Waste Management Units**. Hazardous waste storage sites included bermed, concrete-lined, or open areas used for the temporary storage of drummed (typical) wastes. Solid waste management units included silver recovery units, washrack tanks, grease traps, and oil/water separators. Expected contaminants were VOCs, SVOCs, BTEX, and other petroleum hydrocarbons, paints, pesticides, and metals.
- **Surface Release and Fire Training Areas.** Accidental spills during Base operations and purposeful releases of flammable liquids to the ground surface for fire training exercises. Expected contaminants included fuels, BTEX, and VOCs.

- **Miscellaneous.** Small sites, such as stains on concrete flightlines, that do not fall into any of the other categories. Expected contaminants for flightline stains were polyaromatic hydrocarbons and metals.

Site characterization investigations were initiated in 1981 under the Department of Defense Installation Restoration Program (IRP). The IRP investigations and the subsequent site characterization programs that followed have resulted in the installation of several hundred soil and soil vapor borings and in the installation of over 350 monitoring wells within, and in areas adjacent to, CAFB. The results of the separate groundwater and vadose zone investigations are presented in two comprehensive Remedial Investigation/Feasibility Study (RI/FS) reports, CB RI/FS–Part 1 for groundwater (Jacobs, 1996) and SCOU RI/FS for the vadose zone (Jacobs, 1997a).

3.4 REMOVAL ACTIONS

Several groundwater and vadose zone removal actions have been undertaken at CAFB to address groundwater, soil, or soil gas contamination. Groundwater removal actions were implemented at Discharge Area 4 (DA-4) and Wallace Road in 1991 and at Building 84 (B84) in 1993. E&D, consolidation and capping, and SVE removal actions were completed at numerous SCOU sites, all of which are listed in Table 2-1. The only SCOU sites with completed removal actions that have continuing selected remedy components (such as IC, LTEM, and LTM) are ETC-10 (IC and LTEM), FTA-1 (IC, LTEM, and LTM), LF-3 (LTEM), LF-4 (including DP-5 and DP-6) (IC and LTM), and LF-5 (including DP-8, DP-8A, and LF-5 Trenches) (IC, LTEM, and LTM). All removal actions were designed with input from, and implemented with the concurrence of, the Base Realignment and Closure (BRAC) Cleanup Team (BCT), including the EPA, DTSC, and RWQCB.

Because they are precursors to the groundwater remedial actions ultimately addressed in this five-year review as defined in the CB ROD – Part 1, brief descriptions of the three groundwater removal actions completed at CAFB and the actions defined by two preceding RODs (OU-1 Interim ROD [USAF, 1991] and OU-2 Final ROD [USAF, 1993]) are provided in Sections 3.4.1 through 3.4.4. The groundwater remedial actions and the SCOU sites with ongoing LTEM, LTM and ICs that are addressed in this five-year review are described in Section 4.

3.4.1 DA-4 Groundwater Removal Action

The DA-4 groundwater treatment system, located adjacent to the DA-4 site (grids K8 and L8 on Plate 1), consisted of one Shallow HSZ extraction well (DA4-2) and two, 2,000-pound liquid-phase granular activated carbon (GAC) vessels operated in series. The DA-4 system was implemented to address a "hot spot" area of groundwater contamination that had a maximum TCE concentration of approximately 2,000 micrograms per liter (μg/L) at the time of system startup. The extraction well was pumped at an average rate of 170 gpm. Treated groundwater was discharged to the Merced Irrigation District (MID) Casad Lateral Canal under a National Pollutant Discharge Elimination System (NPDES) permit. The system operated from July 1991 until it was decommissioned in May 1995. TCE concentrations in the system influent ranged from approximately 2,000 μg/L at startup, to 58 μg/L at shutdown. The system removed an estimated 414 pounds of TCE, and treated approximately 341 million gallons of groundwater. Extraction well DA4-2 was later integrated into the OU-2 system. The two, 2,000-pound GAC vessels were moved and incorporated into the OU-2 treatment plant.

3.4.2 Wallace Road Groundwater Removal Action

The Wallace Road groundwater treatment system, located along the western Base boundary south of the DA-4 site (grids M/N/P8 on Plate 1), consisted of four extraction wells and two 2,000-pound liquid-phase GAC vessels operated in series. The Wallace Road system was implemented to address a hot spot area of groundwater contamination that had a maximum TCE concentration of approximately 120 μg/L at the time of system startup. Three (WR1, WR2, and WR3) of the four extraction wells were screened across the Shallow and USS HSZs; the fourth extraction well (WR4) was screened only in the Shallow HSZ. The extraction wells were pumped at a combined average rate of about 450 gpm. Similar to the DA-4 system, treated groundwater was discharged to the MID Casad Lateral Canal under an NPDES permit. The system was in operation from December 1991 until April 1996, when it was taken offline to accommodate construction of the OU-2 groundwater treatment plant. TCE concentrations in the system influent ranged from approximately 120 μg/L at startup, to 42 μg/L at shutdown. The system removed an estimated 438 pounds of TCE, and treated approximately 969 million gallons of groundwater. The three extraction wells that were screened across the Shallow and USS HSZs were destroyed when the system was decommissioned; extraction well WR4 (Shallow HSZ) was not destroyed and was later incorporated into the OU-2 system. The two, 2,000-pound GAC vessels were incorporated into the OU-2 treatment plant, which was constructed in essentially the same location as the Wallace Road facility.

3.4.3 B84 Groundwater Removal Action

The B84 groundwater treatment system, located near SCOU sites B84, B54, and B51 (grid R11 on Plate 1), consisted of one Shallow HSZ extraction well (EW01) and two 10,000-pound liquid-phase GAC vessels operated in series. The B84 system was implemented to address a hot spot area of groundwater contamination which had a maximum TCE concentration of approximately 480 µg/L at the time of system startup. EW01 was pumped at an average rate of about 130 gpm. Treated groundwater was discharged to the sanitary sewer system. The system was in operation from January 1993 through May 1994, when it was taken offline to accommodate startup of the OU-1 system (July 1994). TCE concentration in the system influent ranged from a high of approximately 480 µg/L at startup, to about 130 µg/L at shutdown. The system removed an estimated 222 pounds of TCE, and treated approximately 116 million gallons of groundwater. EW01 was incorporated into the OU-1 system; components of the treatment plant were later used for the Phase 2 groundwater treatment system.

3.4.4 OU-1 and OU-2 Groundwater Remedial Actions

During the latter portion of initial RI field activities at CAFB (1990-1991), the Air Force divided CAFB into two groundwater OUs: OU-1 and OU-2. The Air Force defined these OUs in an attempt to segregate major groundwater contaminant plumes and their source areas. The general location and extent of OU-1 and OU-2 correspond to Main Plume Region 1 and Main Plume Region 2, which were the southeast and northwest portions of the single Main Base Plume Region shown on Plate 1.

An Interim OU-1 ROD was finalized in August of 1991 (USAF, 1991). The stated purpose of the OU-1 action was to remove contaminants from hot spots in the Shallow HSZ Main Base Plume.

Standards for groundwater cleanup were not established in the OU-1 Interim ROD, but were ultimately set as MCLs (5 µg/L for TCE) in the CB ROD – Part 1 (USAF, 1997). Standards for treated groundwater were originally set at MCLs in the OU-1 Interim ROD. However, prior to construction and operation of the OU-1 system, discharge standards were changed to values compatible with those subsequently included in the CB ROD – Part 1 (30-day median of 0.5 µg/L for TCE).

OU-1 groundwater treatment system construction began in March 1993, and the system was placed in service on 29 July 1994. The system originally consisted of four extraction wells and nine injection wells, all completed in the Shallow HSZ, with groundwater treatment by dual-stage air stripping (two air-stripping towers operated in series).

The OU-1 basis of design and rationale for well placement is documented in the *Final Basis of Design Report, Operable Unit No. 1, Castle Air Force Base, California* (PRC Environmental Management [PRC], 1992). The system was upgraded during the spring of 1996 to improve performance and treatment plant reliability. Major modifications included relocating control elements above ground and sealing the data highway and electrical conduits against water infiltration. The treatment plant pad was also upgraded to prevent future flooding. A fifth extraction well was installed in April 1996 to increase mass removal. Following these modifications, system capacity was approximately 425 gpm. The OU-1 extraction and injection well, conveyance system, and treatment plant locations are shown on Plate 1.

A ROD for OU-2 was finalized in November 1993 (USAF, 1993). The stated OU-2 groundwater treatment system objective was to remediate degraded groundwater in the OU-2 area, or that portion of the Main Base Plume as defined in 1992-1993 not covered by the OU-1 groundwater treatment system. Similar to OU-1, standards for treated groundwater, which were set at MCLs in the OU-2 Final ROD, were changed to values compatible with those subsequently included in the CB ROD – Part 1 (30-day median of 0.5 µg/L for TCE).

Construction of the OU-2 groundwater treatment system began in March 1995, and was completed by mid-November 1996. The system went online on

22 November 1996 and originally consisted of 15 extraction wells, 11 injection wells (2 of these were subsequently incorporated into the Phase 3 system; see Section 4.2), and 4 pairs of GAC vessels (operated in series). Of the 15 extraction wells, 9 are completed in the Shallow HSZ and 6 are completed in the USS HSZ. Five of the injection wells are completed in the Shallow HSZ, five in the USS HSZ, and one in the LSS HSZ (one USS HSZ and the LSS HSZ injection well are now part of Phase 3). The four GAC vessel pairs (all 2,000-pound vessels; one pair each from the DA-4 and Wallace Road systems) are connected in parallel, while each vessel pair is connected in series. System capacity at startup was approximately 2,200 gpm. The OU-2 extraction and injection well, conveyance system, and treatment plant locations are shown on Plate 1.

3.5 BASIS FOR TAKING ACTION

The Air Force has taken actions at CAFB because hazardous substances and petroleum products have been released on the Base that do not allow for unlimited and unrestricted use of the property. Contaminated media at CAFB are groundwater and soil. The basis for taking action in each is discussed separately in the following subsections.

3.5.1 Basis for Groundwater Action

Hazardous substances released to groundwater and identified as contaminants of concern (COCs) during the CB RI are in the following list. Groundwater COCs were those contaminants detected in groundwater at concentrations exceeding their respective MCLs or at concentrations that, with exposure, would result in a cancer risk greater than 1E-06 and/or a non-cancer hazard index equal to or greater than 1 (Jacobs, 1996). To identify COCs, monitoring wells were completed in all of the identified HSZs. There are, more numerous monitoring wells in the Shallow and USS HSZs than in the LSS and Confined HSZs; only one monitoring well, since destroyed, was completed in the Deep HSZ. Regular quarterly groundwater monitoring under the Long-Term Groundwater Sampling Program (LTGSP) was initiated at CAFB in 1993.

Contaminants of Concern in Groundwater

1,1-dichloroethene	carbon tetrachloride
1,2-dibromo-3-chloropropane	*cis*-1,2-dichloroethene
1,2-dibromoethane (ethylene dibromide)	chloroform
1,2-dichlorobenzene	di(2-ethylhexyl) phthalate
1,2-dichloroethane	hexachlorobutadiene
1,2-dichloropropane	tetrachloroethene
arsenic	trichloroethene
benzene	vinyl chloride
bromodichloromethane	

CB RI sampling and early LTGSP monitoring results indicated that the predominant groundwater contaminant at CAFB was TCE. It was detected in the Shallow, USS, LSS, and Confined HSZs both beneath and downgradient of the former Base. Free-phase TCE was not encountered during exploratory drilling, and concentrations were high enough to suggest its presence.

Based primarily on TCE distribution, six plume regions were identified (see Plate 1):

- Main Base Plume Region (initially subdivided into Region 1 and Region 2)
- East Base Plume Region
- North Base Plume Region
- Landfill 1 Plume Region
- Landfill 4 Plume Region
- Castle Vista Landfill B Plume Region (*cis*-1,2-dichloroethene [*cis*-1,2-DCE] plume identified by subsequent data gap sampling; hereafter, Castle Vista Plume Region).

TCE was the predominant contaminant identified during the CB RI sampling, and thus was the primary driver for subsequent remedial evaluations and decisions. However, several other organic compounds, as listed above, were detected in groundwater during the CB RI in the Castle Vista Plume Region. Although other organics were detected, most did not occur at concentrations above regulatory standards. The second quarter 1994 (Q2/94) TCE plume, outlined on Figures 3-4 (Shallow HSZ), 3-5 (USS HSZ), 3-6 (LSS HSZ), and 3-7 (Confined HSZ), generally encompassed these other organic compounds such that they would be addressed by TCE remediation activities.

Exceptions to this assumption included 1,2-dibromo-3-chloropropane (DBCP); di(2-ethylhexyl) phthalate (DEHP); benzene; and *cis*-1,2-DCE. DBCP is not believed to have originated from CAFB because it is an agricultural fumigant, and is commonly detected in groundwater throughout the area. DEHP was detected in an isolated plume at very low concentrations. Benzene concentrations that were detected in the deeper HSZs did not show extensive plumes. *cis*-1,2-DCE was detected and believed to be in an isolated and small plume at the time of the CB RI; however, data gap sampling indicated a much larger plume with higher concentrations downgradient of Castle Vista Landfill B. Further discussion regarding the aforementioned organic compounds is provided below.

DBCP was identified in a distinct plume in the western portion of the Base. The DBCP plume extended off of the Base property to the west. Although listed as a contaminant of potential concern (COPC), it is not considered a CAFB-derived contaminant.

DEHP was identified in a small plume in the North Base Plume Region. DEHP was not considered a significant issue because the isolated plume was small and reported concentrations were low.

The highest benzene concentrations were identified during the CB RI in the deep HSZs (LSS and Confined). The CB RI data did not indicate extensive plumes in the deep HSZs; however, subsequent site characterization and monitoring data did indicate that the TCE plumes in the LSS and Confined HSZs were large and encompassed the same area of high benzene concentrations that was detected during the CB RI. More recent monitoring data indicate that benzene plumes are no longer present. In 2006, benzene was not detected (ND) in any well, and in 2007, benzene was detected in only one well at a trace concentration of 0.32 µg/L. This detection occurred at shallow HSZ well MW100. Benzene was last detected above the MCL in the shallow HSZ at monitoring well JM11 in 2001; all subsequent samples from this monitoring well were ND for all VOCs. Benzene was last detected above the MCL in the LSS HSZ at MW863 in 1995, with a reported concentration of 5.4 µg/L. Benzene was last detected above the MCL in the Confined HSZ at wells MW929 and MW606 in 1995, with reported concentrations of 5.7 µg/L and 17 µg/L, respectively.

cis-1,2-DCE concentrations were detected and believed to be in an isolated and small plume at the time of the CB RI. The small plume was identified to the west of the small TCE plume at Castle Vista Landfill B. At the time of the CB RI, the *cis*-1,2-DCE plume was not considered a significant issue; however, a subsequent data gap sampling investigation indicated that a much larger plume with higher concentrations downgradient of Castle Vista Landfill B was present (Jacobs, 1999a). The gap sampling investigation also indicated that the *cis*-1,2-DCE plume encompassed both the Shallow and the USS HSZs.

As noted above, TCE was the predominant contaminant identified during the CB RI sampling. With the CB RI data, it was estimated that there was approximately 6,600 pounds of TCE in the groundwater. This number was estimated using the sum of the dissolved and solid mass, and the area inside of the 0.5 µg/L TCE contour. It was estimated that approximately 98 percent of the total TCE was contained within the Main Base Plume Region (Regions 1 and 2) (Jacobs, 1996). It was originally estimated that one of the three small plumes in the East Base Region (downgradient of B1762 and B1709) contained approximately 1.8 percent of the identified TCE mass; however, this was later incorporated into the Main Base Plume. The remaining plumes, East Base, North Base, Landfill 1, Landfill 4, and Castle Vista Plume Region, were estimated to contain approximately 0.2 percent of the total TCE mass in groundwater at CAFB.

3.5.2 Basis for Vadose Zone Action

The SCOU RI identified hazardous substances that had been released into the soil, and classified 42 hazardous substances as COCs at the site. The list of 42 COCs and the basis for their identification as a COC is included below. COCs were identified based on their potential to affect human health (baseline human health risk assessment [BHHRA] process—reported concentrations resulted in a cancer risk greater than 1×10^{-6}, a non-cancer hazard index equal to or greater than 1.0 or an estimated blood-lead concentration greater than 10 micrograms per deciliter [µg/dl]) or their potential to result in concentrations in groundwater exceeding the Federal or State MCLs (water quality site assessment [WQSA] process; Jacobs, 1997a).

Contaminants of Concern in Soil

1,1-*bis*(chlorophenyl)-2,2-dichloroethene (BHHRA)
1,1-*bis*(chlorophenyl)-2,2,2-trichloroethane (BHHRA)
1,2-dibromo-3-chloropropane (BHHRA)
1,2-dichloroethane (BHHRA)
1,2,2-trimethylbenzene (WQSA)
1,2,3-trichloropropane (BHHRA)
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (BHHRA)
1,4-dichlorobenzene (BHHRA)
2,4-dinitrotoluene (BHHRA)
antimony (BHHRA; WQSA)
arsenic (BHHRA)
benzene (WQSA)
benzo(a)anthracene (BHHRA; WQSA)
benzo(a)pyrene (BHHRA; WQSA)
benzo(b)fluoranthene (BHHRA; WQSA)
benzo(k)fluoranthene (BHHRA)
cadmium (BHHRA)
chloroform (WQSA)
chlordane(a) (BHHRA)
chlordane(g) (BHHRA)
chrysene (BHHRA; WQSA)
cis-1,2-dichloroethene (WQSA)
dibenz(a,h)anthracene (BHHRA)
dichlorodifluoromethane (WQSA)
dieldrin (BHHRA)
diesel (WQSA)
dioxins (BHHRA)
ethylbenzene (WQSA)
gasoline (WQSA)
heptachlor epoxide (BHHRA)
indeno(1,2,3-c,d)pyrene (BHHRA; WQSA)
jet fuel (primarily Jet Propulsion Fuel 4) (WQSA)
lead (BHHRA; WQSA)
methylene chloride (BHHRA)
naphthalene (WQSA)
polychlorinated biphenyls (BHHRA)
pyrene (WQSA)
tetrachloroethene (WQSA)
thallium (BHHRA)
toluene (WQSA)
trichloroethene (WQSA)
xylenes (WQSA)

Notes: 1,1-*bis*(Chlorophenyl)-2,2-dichloroethene is commonly known as DDE.
1,1-*bis*(Chlorophenyl)-2,2,2-trichloroethane is commonly known as DDT.

A summary presenting relevant information for all 233 SCOU sites, including the COCs and the basis for taking or not taking action, is provided in the CB RI/FS – Part 2 (Jacobs, 2002b). Additionally, brief site descriptions, including the COCs and the basis for taking action at the ETC-10, ETC-12, FTA-1, LF-3, LF-4 (including DP-5 and DP-6), and LF-5 (including DP8, DP-8A, and LF-5 Trenches) sites is included below. BHHRA COCs listed for a site may differ from those originally identified during the SCOU RI because they are based on the updated BHHRA (Jacobs, 2001a).

3.5.2.1 Earth Technology Corporation 10

ETC-10 was an active skeet-shooting range until 1995. ETC-10 is located in grid L16 (Figure 3-3), and wetlands are present to the north and south, as well as in the western portion of the site (Plate 1). The presence of clay pigeon shards and lead pellets was confirmed during a visual inspection of the site prior to the SCOU RI. Based on the ETC-10 site configuration, it was assumed that particulate deposits would most likely be distributed in a fan-shaped arc extending 300 to 500 feet radially from the shooting stand location.

Lead and polynuclear aromatic hydrocarbons (PAHs) derived from lead shot and clay pigeon shards were identified as COPC for this site. During the SCOU RI, a total of 19 soil samples were analyzed. One sample was collected from a soil boring, and the other eighteen samples were collected from various surface locations. The soil samples were analyzed for general metals with specific analyses for antimony, arsenic and lead. Subsequently, antimony, arsenic, and lead were identified as COCs based on potential human health risk, and antimony and lead were identified as WQSA COCs based on their potential to impact groundwater. A complete presentation of the RI activities and results for the ETC-10 site is provided in Section 7.8.4b of the SCOU RI/FS (Jacobs, 1997a). Subsequent investigative sampling conducted to assess ecological risk at ETC-10 identified the PAH benzo(a)pyrene as a COC based on potential human health risk.

Additionally, ETC-10 was identified as one of 25 SCOU sites with the potential to impact ecological habitat in the *Scoping and Phase I Ecological Risk Assessment* (ERA; Jacobs, 1995). The Phase I ERA also determined that at ETC-10, metals (primarily lead) contamination represented a potential risk to the majority of all target receptors. ETC-10 was not included in the subsequent

Phase II ERA activities because the potential for impact was clear. Following the Phase II ERA, the Air Force, EPA, and DTSC determined that additional contaminant characterization (soluble lead in wetlands soil) and biological survey data were needed to support remedy selection. These data sets were collected during March and June 2001, respectively, and the results were presented in the CB RI/FS – Part 2 (Jacobs, 2002b). Analytical results, including toxicity analyses and bioassays, from the March and June 2001 sampling activities indicated that contaminants within the wetlands at the ETC-10 site did present a potential adverse risk to ecological receptors. However, the biological survey results indicated that lead contamination had not, at that point in time, had an effect on the ecological health of the wetland communities.

3.5.2.2 Earth Technology Corporation 12

ETC-12, located in grid H15/16, was a former dump site that consisted of two noncontiguous sections, both of which contain wetlands. ETC-12 was identified as a dump site from the analysis of a 1958 aerial photograph (EPA, 1991). The area was subsequently investigated, upon which surface debris and disturbed ground confirmed the areas as a probable dump site (Jacobs, 1997a).

COPCs identified during the SCOU RI at ETC-12 were VOCs, SVOCs, and metals. Three soil samples and twenty-one shallow soil gas samples were collected at ETC-12; additionally, two surface soil samples were collected from the site-associated wetlands that were most likely to receive runoff from the site. The site soil samples were analyzed for SVOCs and metals, and the soil gas samples were analyzed for VOCs. The surface soil samples collected from the wetlands were analyzed for PAHs and metals. No SVOCs or PAHs were detected in the soil samples. VOCs were detected in several of the soil gas samples, but at very low concentrations. Several metals were detected in the surface and shallow soil samples at concentrations that exceeded threshold background values (TBVs) for aluminum, barium, beryllium, chromium, copper, lead, molybdenum, nickel, vanadium, and zinc. A complete summary of the RI activities and analytical results for the ETC-12 site is provided in Section 7.8.11 of the SCOU RI/FS (Jacobs, 1997a).

NFA was the selected remedy for human health and water quality risk at ETC-12, and was established in the SCOU ROD – Part 1 (WPI, 2002). ETC-12 was identified as one of 25 SCOU sites with the potential to impact ecological habitat in the *Scoping and Phase I Ecological Risk Assessment* (Jacobs, 1995). The Phase II ERA determined that soil contamination at ETC-12 represented a potential risk to several target ecological receptors (Jacobs, 1997b). Metals, specifically chromium, lead, and vanadium, were identified as potential risk factors at ETC-12. Following the Phase II ERA, the Air Force, EPA, and DTSC determined that biological survey data from the associated wetlands were needed to support remedy selection. These data sets were collected during June 2001, and the results are included in the CB RI/FS – Part 2 (Jacobs, 2002b). The biological survey results, including toxicity analyses and bioassays, indicated that metals contamination had not, at that point in time, affected the ecological health of the wetland communities associated with ETC-12.

3.5.2.3 Fire Training Area 1

FTA-1, located in grid L15 (Figure 3-3), was used for fire training exercises from 1955 through 1975. A 2,000-gallon storage tank was used for the weekly accumulation of fuel, waste oil, solvents, and other chemicals at the site. These stored materials were applied directly to soil pits and ignited. Other chemicals were stored in 55-gallon drums and were burned in an area adjacent to the soil pits. Several burn areas were identified from aerial photographs. The burn areas at FTA-1 were unlined with no surface fluid collection system. The land surface at FTA-1 is unpaved with the exception of the area surrounding B1888. Wetlands are located to the north, east, and west of the site.

VOCs, SVOCs, and fuels associated with the burn pits and other fire training activities were identified as the COPCs at the FTA-1 site. During the SCOU RI, 44 soil borings, 11 surface locations and 24 soil gas probes were sampled. Soil samples (total of 166) were analyzed for VOCs, SVOCs, petroleum hydrocarbons, dioxins/furans, metals, total organic carbon, and pH; soil gas samples (total of 103) were analyzed for VOCs. Arsenic; cadmium; lead; benzene; TCE; 1,2,3,4,6,7,8-heptachlorodibenzofuran; hexachlorinated dibenzo-p-dioxins; hexachlorinated dibenzofurans; octachlorodibenzo-p-dioxin; benzo(a)anthracene; benzo(a)fluoranthene; benzo(a)pyrene; and indeno(1,2,3-c,d)pyrene were identified as COCs based on potential human health risk (updated BHHRA COCs). In addition, arsenic; lead; zinc; fuels (gasoline, diesel, and jet fuel); TCE; benzene; toluene; xylenes; *cis*-1,2-DCE; isopropylbenzene; 1,2-dichloroethane (1,2-DCA); carbon tetrachloride; and chloroform were identified as WQSA COCs based on their potential to impact groundwater. Considering only the more common COCs, the maximum concentrations of TCE detected at the site were 360 milligrams per kilogram (mg/kg) in soil and 970 µg/L in soil gas, while the maximum concentrations of benzene detected at the site were 9.7 mg/kg in soil and 172 µg/L in soil gas. The maximum reported concentrations of fuels in soil were 5,400 mg/kg gasoline, 19,000 mg/kg diesel, and 5,900 mg/kg jet fuel. A complete presentation of RI activities/results for the FTA-1 site is provided in Section 7.5.1 of the SCOU RI/FS (Jacobs, 1997a).

In addition to risks to human health and water quality, FTA-1 was identified as one of the 25 SCOU sites with the potential to impact ecological habitat in the Scoping and Phase I (Jacobs, 1995). Results of the Phase II ERA (Jacobs, 1997b) indicated that sediments in both the wetlands northwest and east of FTA-1 represented a risk to several target ecological receptors. Following the Phase II ERA, the Air Force, EPA, and DTSC determined that additional contaminant characterization in the wetlands and biological survey data were necessary to support remedy selection. Contaminant characterization data was collected during March and June 2001, respectively, and the results are presented in the CB RI/FS – Part 2 (Jacobs, 2002b). Similar to the aforementioned SCOU sites, the biological survey results indicated that contamination had not, to that point in time, affected the ecological health of the wetland communities.

3.5.2.4 Landfill 3

LF-3, located in grid K/L 16 (Figure 3-3), is a former approximately 2-acre landfill that was operational from 1954 to 1956. During this time, general refuse and some chemical wastes were disposed in shallow trenches. The landfill was closed after only two years of use due to the existence of a hardpan layer at approximately 8 feet bgs, resulting in poor drainage (Jacobs, 1997a). A large wetland runs north-south through the western portion of the LF-3 site.

The COPCs identified at the site were VOCs, SVOCs, fuels, and metals. During the SCOU RI, nine surface soil/shallow soil gas locations, four soil borings, and two test pits were sampled. Low concentrations of VOCs and SVOCs were detected in soil samples, but no VOCs were detected in the shallow soil gas samples. Several metals were detected at concentrations exceeding TBVs, including a maximum reported concentration of lead of over 28,000 mg/kg. A complete presentation of the RI activities and sampling results for the LF-3 site is provided in Section 7.5.3 of the SCOU RI/FS (Jacobs, 1997a).

LF-3 was identified as one of the 25 SCOU sites with the potential to impact ecological habitat in the Scoping and Phase 1 ERA (Jacobs, 1995). The Phase II ERA (Jacobs, 1997b) determined that soil contamination at LF-3 represented a potential risk to several target receptors. The primary risk drivers were metals (predominantly lead) and PAHs. In 1999, a removal action was completed for the LF-3 site that included the excavation of all waste areas, followed by backfilling with clean soil. The removal action eliminated all of the sample locations that the Phase II ERA had indicated as representing an ecological risk. However, the Air Force, EPA, and DTSC determined that further characterization of the contamination in the wetlands and biological survey data from the wetlands were needed to support remedy selection. The additional contaminant characterization and biological survey data were collected during March and June 2001, respectively, and the results are presented in the CB RI/FS – Part 2 (Jacobs, 2002b). The biological survey results indicated that metals and PAH contamination had not, up to that point in time, affected the ecological health of the wetland communities. Analytical data, including toxicity analysis and bioassays, indicated that contaminants within the wetlands associated with LF-3 did represent a potential adverse risk to ecological receptors.

3.5.2.5 Landfill 4 (DP-5, DP-6)

LF-4, located in Grid G6 (Figure 3-3), was an approximately 14-acre at the former CAFB landfill utilized between 1957 and 1970. LF-4 was a trench-and-fill style landfill operation, containing approximately 26,000 cubic yards of municipal-type waste. Minor amounts of chemical wastes may have been disposed in LF-4. The northern one-third of the landfill (previously part of an agricultural field) was incorporated into LF-4 between 1957 and 1961. Twelve trenches in the southern two-thirds of the landfill were excavated to approximately 16 feet bgs prior to receiving waste materials. Disposal pits DP-5 and DP-6 were located at the southern end of LF-4 across one of the trenches. Former CAFB reportedly used DP-5 and DP-6 for the disposal of industrial wastes (including solvents, oils, and other miscellaneous chemicals) between 1954 and 1970.

COPCs identified at the site included VOCs, SVOCs, petroleum hydrocarbons, and metals potentially associated with any chemical wastes disposed at the site. During the SCOU RI and subsequent data gap investigation, seven soil borings, six surface locations, and sixty-three soil gas borings/probes were sampled. Soil samples (total of 27) were analyzed for VOCs, SVOCs, petroleum hydrocarbons, and metals; soil gas samples (total of approximately 100) were analyzed for VOCs. At the completion of the SCOU RI, 1,2-DCA in soil and dichlorodifluoromethane (Freon 12) in soil gas were identified as WQSA COCs based on potential to impact to groundwater. A complete presentation of RI activities and soil/soil gas sampling results for LF-4 and associated sites is provided in Section 7.6.3 of the SCOU RI/FS (Jacobs, 1997a). The more significant bases for action at LF-4 were landfill closure requirements and the subsequent designation of LF-4 as the primary consolidation landfill for CAFB. Following this designation, wastes from outlying trenches and other CAFB SCOU sites, primarily other landfills, were consolidated and capped at LF-4.

The scoping and Phase 1 ERA (Jacobs, 1995) did not identify LF-4 as a SCOU site with the potential to impact ecological habitat. The primary reason for this determination was the lack of any sensitive ecological habitat at, and in the vicinity of, LF-4.

3.5.2.6 Landfill 5 (DP-8, DP-8A, DP-9, LF-5 Trenches)

LF-5, located in grids E10-E12 and F10-F12 (Figure 3-3), is a CAFB landfill that was utilized between 1971 and 1977. The landfill was unlined and contained approximately 100,000 cubic yards of waste materials, primarily municipal wastes, construction wastes, and demolition debris. LF-5 contained 12 trenches (A through L; LF-5 trenches) and 5 disposal pits (DP-7, DP-8, DP-8A, DP-9, and DP-10). The trenches extended to a depth of approximately 15 feet bgs. Portions of the trenches and the disposal pits were reportedly used for the disposal of 55-gallon drums and uncontained liquid chemical wastes from CAFB operations. Wetlands are located within the LF-5 site, as well as south and east of the site.

COPCs identified at the site included VOCs, SVOCs, petroleum hydrocarbons, metals, and radioactivity potentially associated with any chemical wastes disposed at the site. During the SCOU RI and subsequent data gap investigation, 92 soil borings, 11 surface locations, and 179 soil gas probes/borings were sampled. Soil samples (total of 249) were analyzed for VOCs, SVOCs, dioxins/furans, petroleum hydrocarbons, metals, and radioactivity; soil gas samples (total of approximately 465) were analyzed for VOCs. At the completion of the SCOU RI and subsequent data gap investigation, diesel; 1,2-DCA; benzene; *cis*-1,2-DCE; Freon 12; p-isopropyltoluene; tetrachloroethene (PCE); TCE; vinyl chloride; and xylenes were identified as WQSA COCs based on potential to impact groundwater. No significant contamination was detected beneath DP-7 and DP-10, and they were subsequently eliminated from consideration for remedial action (NFA in SCOU ROD 1). A complete presentation of the RI activities and sampling results for LF-5 and associated sites is provided in Section 7.3.1 of the SCOU RI/FS (Jacobs, 1997a). The more significant bases for action at the LF-5 site were landfill closure requirements and the subsequent designation of LF-5 as the secondary or overflow consolidation landfill for CAFB. Following this designation, wastes from outlying trenches and other CAFB SCOU sites, primarily other landfills, were consolidated and capped at LF-5 when wastes to be consolidated exceeded the capacity of the area to be capped at LF-4.

LF-5, including DP-7, DP-8, DP-8A, DP-9, DP-10, and the LF-5 Trenches, was identified as one of twenty-five SCOU sites with the potential to impact ecological habitat in the Scoping and Phase I ERA (Jacobs, 1995). The Phase II ERA determined that metals contamination in wetlands soils at LF-5 represented a potential risk to a limited number of target receptors (Jacobs, 1997b). However, three of the sites associated with LF-5 (DP-7, DP-10, and DP-9) were not used for landfill disposal, and their selected remedies relative to human health and groundwater quality were established as NFA in the SCOU ROD Part 1 (DP-7 and DP-10) and the SCOU ROD Part 3 (DP-9). These disposal pits were subsequently excluded from further ecological evaluation due to the minimal contamination associated with them. Following the Phase II ERA, the Air Force, EPA, and DTSC determined that additional contaminant characterization (metals) and biological survey data were needed to support ecological remedy selection. Contaminant characterization and biological survey data were collected during March and June 2001, respectively, and the results presented in the CB RI/FS – Part 2 (Jacobs, 2002b). The biological survey results indicated that metals contamination had not, up to that point in time, affected the ecological health of the wetland communities. Analytical data, including toxicity analysis and bioassays, indicated that contaminants within the wetlands associated with LF-5, including DP-8, DP-8A, and the LF-5 Trenches, did represent a potential adverse risk to ecological receptors.

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4 REMOVAL/REMEDIAL ACTIONS

This section describes selection of remedies, removal action or remedial action implementation, and remedial system operation and maintenance (O&M) for the Main Base and Castle Vista groundwater plumes; and for ETC-10, ETC-12, FTA-1, LF-3, LF-4, and LF-5; at CAFB. These removal/remedial action discussions provide the basis for protectiveness evaluations that subsequently follow in Section 7.

4.1 GROUNDWATER REMEDIAL ACTIONS

This section describes the remedy selection processes and presents the final remedies for the Main Base and Castle Vista groundwater plumes at CAFB based on the CB ROD – Part 1 (USAF, 1997) and the CB ROD – Part 2 (AFRPA, 2006a). The implementation and operation of the ongoing groundwater remedial actions per the CB ROD – Part 1 and the CB ROD – Part 2 are then described.

The locations and historical contaminant concentrations of the Main Base groundwater plume is shown on Figures 3-4 through 3-7 (Q2/94 data for the Shallow, USS, LSS, and Confined HSZs, respectively). The locations and historical contaminant concentrations of the Castle Vista *cis*-1,2-DCE groundwater plume is shown on Figures 3-8 and 3-9 (Q1/97 data for the Shallow and USS HSZs, respectively).

4.1.1 Remedy Selection

The initial remedy selection process for identified groundwater plumes at CAFB is documented in Volume 3 of 3 (Groundwater Feasibility Study) of the CB RI/FS – Part 1 (Jacobs, 1996). The CB ROD – Part 1 (USAF, 1997) presented the selected remedy for each of the plumes. This ROD incorporated, and therefore superseded, both the OU-1 Interim ROD (USAF, 1991) and the OU-2 Final ROD (USAF, 1993). The remedy selection process and selected remedies are summarized on Figure 4-1.

Discharge standards for treated groundwater were established in the CB ROD – Part 1. These standards, as modified by the *Memorandum of Non-Significant Changes to Record of Decision for CB – Part 1 Groundwater – Final*, dated

9 December 1997, are listed in Table 4-1. The 30-day median concentration for discharge of the primary contaminant (TCE) and for most other VOCs is 0.5 µg/L (USAF, 1997). It is noted that the discharge limit in Table 4-1 for the constituent designated as "VOCs" represents the cumulative limit for all VOCs; all other limits are for the individual VOCs listed. The CB ROD – Part 2 (AFRPA, 2006a) presented the additional remedies for groundwater plumes, or portions of plumes, where contamination exceeding MCLs resulted in potential adverse groundwater risks that were not addressed by the CB ROD – Part 1 remedies.

4.1.2 Remedy Implementation

Groundwater remedies identified in the CB ROD – Part 1 and the CB ROD – Part 2 were already implemented or were implemented following finalization of the ROD in 1997 and 2006, respectively. Remedy implementation for the Main Base and Castle Vista plumes individual groundwater plumes is addressed in the following subsections.

4.1.2.1 CB ROD – Part 1 Main Base Plume Remedy Implementation

The CB ROD – Part 1 remedy for the Main Base Plume is plume capture and cleanup to MCLs. The primary COC for the Main Base Plume is TCE. The MCL for TCE at the time of the CB ROD – Part 1 was 5 µg/L, and that value remains in effect as of the date of this five-year review. Other VOCs have been detected at low concentrations in portions of the Main Base Plume (e.g., *cis*-1,2-DCE and PCE). However, they are consistently at much lower concentrations than TCE and occur within the TCE plume boundaries. Remedial technologies selected for the Main Base Plume (air stripping and liquid-phase GAC) are appropriate for TCE as well as for all other VOCs present. All Main Base Plume discussion and assessment focuses on the TCE plume as the most conservative and representative element of the plume.

The CB ROD – Part 1 established a three-phased approach for remediation of the Main Base Plume. As described previously in Section 3.4, three groundwater removal actions (DA-4, Wallace Road, and B84) and two groundwater remedial actions (OU-1 and OU-2) had been implemented prior to the ROD. Phase 1 of the Main Base Plume remedial action consisted of the existing OU-1 and OU-2 systems, operational since July 1994 and November 1996, respectively (see Section 3.4.4). Phases 2 and 3 of the Main

Base Plume remedial action began in September 1997 and May 2000, respectively. Phases 2 and 3 comprise the primary elements of the Main Base Plume remedial action. The approximate locations of the decommissioned groundwater removal actions (Table 2-1); and the OU-1, OU-2, and Phase 2/Phase 3 systems; are shown on Figure 4-2. The locations of major OU-1, OU-2, and Phase 2/Phase 3 treatment system components (treatment plants, extraction wells, injection wells, and conveyance pipelines) are shown on Figure 3-3.

The OU-1 groundwater treatment system was brought online in July 1994 to address an area of high TCE concentration (a "hot spot") within the Shallow HSZ Main Base Plume (Figure 3-4). The following monitoring wells define the TCE hot spot at OU-1: JM13 (grid Q10), MW516 (grid Q10), MW556 (grid R10), MW220 (grid S10), TW16 (grid R11), MW873 (grid R12), and MW310 (grid R13). The OU-1 groundwater treatment system was implemented to include five Shallow HSZ extraction wells, two air-stripping towers, and nine Shallow HSZ injection wells. System capacity at startup in 1994 was approximately 700 gpm. By the spring of 2003, TCE concentrations in the OU-1 area had been reduced to levels such that continued operation of the treatment system was not required to address the hot spot. With regulatory approval, the OU-1 treatment system was taken offline on 27 May 2003 and decommissioned in July 2011.

The OU-2 groundwater treatment system was brought online in November 1996 to address areas of high TCE concentration in the northern portion of the Main Base Plume. The OU-2 system was designed and implemented to address TCE concentrations both on- and off-Base, and in the Shallow and USS HSZs (see Figures 3-4 and 3-5). The OU-2 groundwater treatment system was implemented with 15 extraction wells (9 Shallow HSZ and 6 USS HSZ), 4 pairs of GAC vessels, and 11 injection wells (5 Shallow HSZ, 5 USS HSZ, and 1 LSS HSZ). System capacity at startup was over approximately 2,000 gpm. The following outlines overall OU-2 system operation during the reporting period:

- <u>2008:</u> During 2008 the OU-2 treatment system operated continuously extracting groundwater from the USS HSZ from the following extraction wells; EW06 at 70-80 gpm, EW11 at 100-110 gpm, EW12 at 110-120 gpm, and EW14 at 80-90 gpm. Treated water was injected into injection wells IW02, IW05, IW08, and IW09.

- 2009: During 2009 the OU-2 treatment system operated until October 30, 2009 when the system was shut down for a rebound study. During operation the system extracted groundwater from the USS HSZ from the following extraction wells; EW06 at 70-80 gpm (this well was shut off in February 2009 based on reduced TCE concentrations), EW11 at 100-110 gpm, EW12 at 110-120 gpm, and EW14 at 80-90 gpm. Treated water was injected into injection wells IW02, IW05, and IW09.

- 2010: During 2010 the OU-2 treatment system was offline until it was restarted on 28 December 2010, following a one-year rebound study. The system was restarted due to TCE concentrations in samples collected from three of the monitoring wells that increased to levels above the restart criteria established in the *Operable Unit 2 Rebound Study Work Plan* (CH2M HILL, 2009). The system was reconfigured from a pair of 20,000-pound GAC vessels to a pair of 2,000-pound vessels and groundwater was extracted from EW12. Treated water was injected into injection well IW02.

- 2011: During 2011 the OU-2 treatment system operated continuously extracting groundwater from the USS HSZ from the following extraction wells; EW11 at 70-80 gpm (this well was shut off in April 2011 for the remainder of the year) and EW12 at 60-70 gpm in January through March and 110-120 gpm in April through December. Treated water was injected into injection well IW02. In Q1/11, the OU-2 treatment system was operating at a reduced capacity (operating with one pair of 2,000-pound GAC vessels) and cycling between three weeks of pumping at EW12 and one week of pumping at EW11 as presented in the *Extraction, Injection, and Monitoring Plan for the OU-2 Groundwater System Re-start Technical Memorandum* (CH2M HILL, 2011b). Beginning in April 2011, extraction was modified to continue pumping on EW12, which has the greatest influence on MW804A, without switching to EW11. In addition, on April 12, 2011, a second pair of 2,000-pound GAC vessels was installed at the OU-2 groundwater treatment system to increase the flow rate from 70 to 120 gpm. Groundwater samples were collected from six monitoring wells (MW702A, MW804A, MW806A, MW902, MW947, and MW948) and three extraction wells (EW11, EW12, and EW14) in

January, April, August, and November 2011. Groundwater samples were also collected in January and April 2011 from one piezometer (PZ11), which is located northwest of MW804A (CH2M HILL, 2012a).

- 2012: During 2012 the OU-2 treatment system operated continuously extracting groundwater from the USS HSZ from the following extraction wells; EW11 at 105-115 gpm in May through October (this well was off in January through April and November through December) and EW12 at 110-120 gpm in January through April and 105-115 gpm in November through December (this well was off in May through October). Treated water was injected into injection well IW02 (CH2M HILL, 2013b).
- 2013: Based on the site visit on June 18, 2013 the OU-2 treatment system continues to extract groundwater from the USS HSZ from extraction wells EW12 and EW11. Treated water is injected into injection well IW02.

Phase 2 of the Main Base Plume remedial action was established to enhance the OU-1/OU-2 actions by addressing groundwater contamination in the deeper HSZs (USS, LSS and Confined). Specific objectives of the Phase 2 system were to eliminate the addition of TCE mass to the Confined HSZ; remediate TCE hot spots in the USS, LSS, and Confined HSZs; and to remediate a small residual hot spot in the Shallow HSZ. An additional objective of Phase 2 was the development of additional hydrogeological data for the USS, LSS, and Confined HSZs through a program of long-term pumping tests and tracer tests. Data from the long-term pumping and tracer tests were used in a *Technical and Economic Evaluation Report* (TEER; Jacobs, 1999c) to support Phase 3 design.

The Phase 2 groundwater treatment system was placed in operation in September 1997. The system was implemented with seven extraction wells (one in the Shallow HSZ; and two each in the USS, LSS, and Confined HSZs), two GAC vessel pairs, and seven injection wells (all in the LSS HSZ). System capacity at startup was approximately 1,300 gpm.

Phase 3 objectives were to assess results from the Phase 1 and Phase 2 operations, determine what additional system components would be required to meet ROD objectives, and implement any necessary actions. As noted previously, TEER results were used to support Phase 3. The expanded

Phase 3 system was brought online in May 2000. The major elements of the expansion included the replacement of the Phase 2 surge tank with a combination air stripper/surge tank (eliminated low concentrations of *cis*-1,2-DCE and other minor contaminants in influent which were causing excessive carbon usage), the addition of eight extraction wells and ten injection wells (eight new wells and two previously part of OU-2), and the addition of one pair of GAC vessels. Of the eight extraction wells, five were completed in the USS HSZ, two in the LSS HSZ, and one in the Confined HSZ. Six of the injection wells were completed in the Shallow HSZ and four in the USS HSZ (one USS HSZ and one LSS HSZ injection well were incorporated from OU-2). These additions brought the Phase 3 system up to a total of fifteen extraction wells, seventeen injection wells, and three pairs of GAC vessels. System capacity at startup was approximately 2,500 gpm. The following outlines Phase 3 system operation during the reporting period:

- <u>2008</u>: During 2008 the Phase 3 treatment system operated continuously extracting groundwater from the USS HSZ, LSS HSZ, and the CF HSZ from the following extraction wells; EW19 at 60-70 gpm, EW20 at 30-40 gpm, EW22 at 20-30 gpm (this well was shut off in August 2008 for the remainder of the year), EW31 at 70-80 gpm, EW32 at 70-80 gpm, EW34 at 180-190 gpm, EW36 at 180-190 gpm, and EW38 at 90-100 gpm. Treated water was injected into injection wells IW15 though IW18 and IW27 though IW31.

- <u>2009</u>: During 2009 the Phase 3 treatment system operated continuously extracting groundwater from the USS HSZ, LSS HSZ, and the CF HSZ from the following extraction wells; EW19 at 60-70 gpm; EW20 at 30-40 gpm; EW31 at 70-80 gpm (this well was shut off in November 2009 for the remainder of the year); EW32 at 70-80 gpm from January through October and at 80-90 gpm in November and December; EW34 at 160-170 gpm in January through March, 150-160 gpm in April through July and 140-150 gpm in August through December 180-190 gpm; EW36 at 180-190 gpm in January through May, 170-180 gpm in June through November, and 160-170 gpm in December; and EW38 at 90-100 gpm (this well was shut off in November 2009 for the remainder of the year). Treated water was injected into injection wells IW15 though IW17, IW27, and IW29 through IW31 throughout the year with the exception of IW18 and IW28which were taken offline in November 2009. In October 2009, modifications to the Phase 3 system were completed, whereby the system was reconfigured to bypass both the air stripper and the large 150-horsepower injection pumps. This bypass was completed because of the decrease of *cis*-1,2-DCE to well below the discharge limit of 0.5 µg/L, such that air stripper was no longer required and taken offline in November 2009.

- 2010: During 2010 the Phase 3 treatment system operated continuously extracting groundwater from the USS HSZ and LSS HSZ, from the following extraction wells; EW19 at 60-70 gpm in January through May, at 50-60 gpm from June through October and 70-80 gpm in November and December; EW20 at 30-40 gpm in January through August and 20-30gpm in September through December; EW32 at 80-90 gpm (this well was shut off in August 2010 for the remainder of the year); EW34 at 145-155 gpm in January through August and 130-140 gpm in September through December; and EW36 at 160-170 gpm in January through May, 150-160 gpm in June through August, and 130-140 gpm in September through December. Treated water was injected into injection wells IW15, IW16, IW27 and IW29 through IW31. The system was reconfigured on July 30, 2010 from 20,000-pound GAC vessels to a pair of 10,000-pound vessels, in preparation for the reduced flow resulting from the EW32 shutdown.

- 2011: During 2011 the Phase 3 treatment system operated continuously extracting groundwater from the USS HSZ and LSS HSZ, from the following extraction wells; EW19 at 70-80 gpm; EW20 at 20-30 gpm; EW34 at 130-140 gpm; and EW36 at 130-140 gpm. Treated water was injected into injection wells IW27, IW28, IW29, and IW31.

- 2012: During 2012 the Phase 3 treatment system operated continuously extracting groundwater from the USS HSZ and LSS HSZ, from the following extraction wells; EW19 at 70-80 gpm; EW20 at 20-30 gpm in January and March through August, at 10-15 gpm in October and November, and 45-55 gpm in December (this well was off in February and September; EW34 at 130-140 gpm in January and February, 120-

130 gpm in March through July, and 110-120 gpm in August through December; and EW36 at 130-140 gpm in January through February and 120-130 gpm in March through December. Treated water was injected into injection wells IW27, IW28, IW29, and IW31.

- 2013: Based on the site visit on June 18, 2013 the Phase 3 treatment system continues to extract groundwater from the USS HSZ and LSS HSZ from extraction wells EW19, EW20, EW34, and EW36. Treated water is injected into injection wells IW27, IW29, IW30, and IW31.

The Phase 3 system has been identified as the "final" system for the Main Base Plume Remediation. Since January of 2001, wellhead treatment systems have been installed on several monitoring wells within the Main Base Plume. The wellhead systems are completely independent of the Phase 3 groundwater treatment system; however, they are still defined as components of the Phase 3 system because the Phase 3 system is considered to be the final system of the Main Base Plume. To date, wellhead treatment systems have been installed and operated at wells MW883/MW1021, MW824/MW1037, MW941, MW951, and MW1009. These systems were installed to address the areas where increasing TCE concentrations have more recently been detected and which are outside of the hydraulic influence, or at least the near-term hydraulic influence, of the three main groundwater treatment systems. General system locations are shown on Figures 3-3 and 4-2.

TCE concentrations increased after remaining low for several years in the very northeast portion of the Main Base Plume. Wells MW883 and MW1021 (both Shallow HSZ) represent this area where increasing TCE concentrations have been more recently detected (Figure 3-3). Wellhead treatment was initiated at this location to hopefully reduce the remedial timeframe. A mobile, solar-powered GAC treatment system was operated at MW883 from January 2001 to January 2002. This system had a maximum pumping capacity of 10 gpm during daylight hours. To enhance groundwater treatment, MW1021 was drilled and completed, and a skid-mounted GAC treatment system of approximately 100-gpm capacity was installed and placed in operation in August 2002. At startup, the two-well system operated at a pumping rate of about 30 gpm, and the inlet TCE concentration was approximately 80 µg/L. In October 2004, following regulatory agency approval, the system was shut down due to declining pumping rates and low TCE concentration (8 gpm and approximately 8 μg/L, respectively).

The location of MW824 represents the downgradient portion of the northeast segment of the Main Base Plume addressed at MW883/MW1021. The basis and design of the wellhead treatment system are the same as for MW883/MW1021. The system was installed and placed in operation in August 2002. At startup, the system operated at a pumping rate of approximately 20 gpm, and the inlet TCE concentration was approximately 15 μg/L. By May 2005, the pumping rate had decreased to 5 gpm and the inlet TCE concentration to 8 μg/L. In June 2005, MW1037 was subsequently added to the system and the pumping rate and inlet TCE concentration increased slightly to 16 gpm and 12 μg/L, respectively. The sustainable pumping rate and the inlet TCE concentration continued a slow decline until the system was shut down in October 2006. The system was shut down when water levels in MW824 and MW1037 had decreased to such an extent that pumping could no longer be sustained. The inlet TCE concentration just prior to shutdown was approximately 5 μg/L. Since shutdown, water levels in the Shallow HSZ have remained low or declined further, and the system remains offline. Water levels have generally been declining in the Shallow HSZ since about 1999. Groundwater elevations in Q2/12 ranged approximately from 85 to 95 feet amsl in the Shallow HSZ, from 81 to 91 feet amsl in the USS HSZ, from 81 to 92 feet amsl in the LSS HSZ, and from 80 to 87 feet amsl in the Confined HSZ. Groundwater elevations in Q4/12 were approximately 3 to 6 feet lower in the Shallow HSZ, 3 to 10 feet lower in the USS HSZ, 1 to 5 feet lower in the LSS HSZ, and 3 to 10 feet lower in the Confined HSZ. The 2012 groundwater elevations represent an approximate decrease from 2011 of 2 to 3 feet in the three upper HSZs and 2.5 to 4 feet in the Confined HSZ.

MW941, MW951, and MW1009 (all Confined HSZ) are located off-base in the former Castle Gardens housing area in grids S8, U7, and U8, respectively (Figure 3-3). These three wells are in an area downgradient of CAFB where TCE concentrations in the Confined HSZ increased in the late 1990s. An additional factor driving wellhead treatment at MW941, MW951, and MW1009 was the detection of low levels of TCE in City of Atwater municipal water supply well AM18, beginning in the spring of 2001; and sporadic detections of low levels of TCE in Atwater municipal water supply wells AM16 and AM20. All three wells produce water from the Confined and the underlying Deep HSZ. City of Atwater municipal water supply well AM18 is located approximately 5,500 feet downgradient of the southwest boundary of CAFB in grid W5; AM16 is located about 3,000 feet downgradient of the southwest boundary of CAFB and about 3,000 feet north of AM18 in grid T6; and AM20 is located approximately 4,800 feet downgradient of the southwest boundary of CAFB and about 2,800 feet south-southeast of AM18 in grid AA7. The locations of AM16 and AM18 are shown on Figure 3-3 (see Figure 7-8 for the AM20 location).

To reduce contaminant mass and reduce potential contaminant impact on municipal water supply wells AM16 and AM18, and potentially AM20, the previously mentioned mobile, solar-powered GAC treatment system (formerly used at MW883) was placed in operation at MW941. Skid-mounted GAC treatment systems of approximately 100-gpm capacities were installed at MW951 and MW1009. The solar-powered system was placed in operation at MW941 in June 2002 and operated until it was shut down and removed, with regulatory agency approval, in May 2004. Inlet TCE concentration at the MW941 system ranged from about 11 µg/L at startup to about 7 µg/L just prior to shutdown. The MW951 system was placed in operation in July 2001 and currently remains in operation, with the injection of treated water at IW37. At startup, the system operated at a pumping rate of about 40 gpm, with inlet TCE concentrations of approximately 20 µg/L. The MW1009 system was placed in operation in January 2002 at a pumping rate of about 80 gpm and an inlet TCE concentration of approximately 18 µg/L. The CB ROD – Part 2 addressed groundwater contamination exceeding MCLs in the off-base Confined HSZ. Operations and status of the MW951 and MW1009 treatment systems after signing of the CB ROD – Part 2 is addressed in Section 4.1.2.3.

4.1.2.2 CB ROD – Part 1 Castle Vista Plume Remedy Implementation

The CB ROD – Part 1 remedy for the Castle Vista Plume is plume capture and cleanup to MCLs (the primary contaminant is *cis*-1,2-DCE). The State of California MCL for *cis*-1,2-DCE was 6 µg/L at the time of the CB ROD – Part 1 and has not changed as of the date of this five-year review.

The Castle Vista Plume groundwater remediation system consisted of a single groundwater treatment system located in the former Castle Vista housing area (Figures 3-3 and 4-2). Construction of the Castle Vista groundwater treatment system was completed in September 1997, and the system was placed in operation in October 1997. The Castle Vista system was designed to remediate the *cis*-1,2-DCE plume that exists in the Shallow and USS HSZs to the west and southwest of Castle Vista Landfill B. Atwater water supply well AM06 (Figure 3-9), which is screened in the USS and lower HSZs, was located immediately downgradient of the Castle Vista Plume. AM06 was sampled monthly as part of the LTGSP, beginning in June 1997. Samples from this well contained only low concentrations of *cis*-1,2-DCE, well below the MCL of 6 µg/L.

The original Castle Vista system consisted of seven extraction wells (six in the Shallow HSZ and one in the USS HSZ), eight injection wells (all completed in the Shallow HSZ), and a liquid-phase GAC treatment plant (two, 2,000-pound vessels). System capacity was approximately 550 gpm at startup. System flow through the treatment plant at startup was approximately 450 gpm and the inlet *cis*-1,2-DCE concentration was between 20 and 25 µg/L. Over time, contaminant concentrations were reduced in all of the extraction and plume monitoring wells, with the exception of MW003, located within the plume source area (Figure 3-3). In August 2003, following regulatory agency approval, the Castle Vista groundwater treatment system was shut down. As of July 2003, flow through the plant had decreased to about 60 gpm, with an inlet *cis*-1,2-DCE concentration at approximately 3.5 µg/L. Concurrent with the Castle Vista treatment plant shutdown, MW003 was converted to a low-capacity extraction well (GAC wellhead treatment system). At startup, the system operated at a pumping rate of approximately 13 gpm with an inlet *cis*-1,2-DCE concentration of approximately 10 µg/L. During subsequent rebound assessments, *cis*-1,2-DCE concentrations at MW003 were as high as 93 µg/L.

The wellhead system operated intermittently for the next seven years at one or more extraction wells (EW39, MW003, and MW1046). Water levels have generally been declining in the Shallow HSZ since about 1999. MW003 was removed from the LTGSP in Q3/10, as it had been dry since Q1/09 and no longer needed to fulfill monitoring objectives. MW003 was last sampled for TCE in October 2008, with a detection of 0.21 µg/L.

The *Castle Vista Vadose Zone/Groundwater Characterization Study Work Plan* (CH2M HILL, 2009b) was developed because of persistent detections of *cis*-1,2-DCE at concentrations greater than the ROD remediation goal of 6 µg/L in groundwater in wells EW39, MW003, and MW1045, and one-time detections of *cis*-1,2-DCE in Hydropunch™ groundwater samples collected from boreholes CVISCOSB05 (14 µg/L) and CVISCOSB06 (140 µg/L) in 2008 (Jacobs, 2009c). The work plan was implemented during late 2009 and early 2010, with the results presented in the *Castle Vista Vadose Zone/Groundwater Characterization Report* (CH2M HILL, 2010c). As part of the 2009 work plan implementation, two monitoring wells (MW1046 and MW1047) were installed to better delineate the existing plume and to serve as extraction wells, if necessary. Because *cis*-1,2-DCE concentrations in groundwater samples collected from MW1046 exceeded 6 µg/L, it was converted to an extraction well, and the capacity of the liquid-phase GAC treatment system was increased. The following outlines Castle Vista operation during the reporting period:

- 2008: During 2008 the Castle Vista system operated at MW003 at 3 gpm from January until 2 July 2008 when declining water levels precluded further pumping. This system was placed back in operation on 15 December 2008 with extraction from EW39 at 10-15 gpm. Treated water was injected into injection well IW23.
- 2009: During 2009 the Castle Vista system operated with extraction from EW39 at 10-15 gpm between January and October and at 5-10 gpm in November and December. Treated water was injected into injection well IW23.
- 2010: During 2010 the Castle Vista system operated with extraction from EW39 at 5-10 gpm in January and February, 15-25 gpm in March and April, and 10-15 gpm in May through July; and from MW1046 (which was brought on-line in May to increase extraction) at 5-10 gpm in May through July. Treated water was injected into injection well IW23. On August 17, 2010, the wellhead treatment system was shut down, for the remainder of the year, with agency concurrence for a long-term rebound study because *cis*-1,2-DCE concentrations had been below the MCL (6 µg/L) at both extraction wells (EW39 and MW1046) for at least three consecutive months (CH2M HILL, 2013b). Details of the shutdown and rebound study were presented in the *Startup Report for the Expanded Castle Vista Groundwater Extraction and Treatment System* (CH2M HILL, 2010e).

- 2011: During 2011 the Castle Vista system remained off-line, with the exception of March and April when the system extracted from EW39 at 10-15 gpm and MW1046 at 5-10 gpm.

- 2012: During 2012 the Castle Vista system remained off-line. Concentrations of *cis*-1,2-DCE at or above the MCL occurred only in a location in the Shallow HSZ centered on MW1046 and EW39 in the Castle Vista area during 2012; however, *cis*-1,2-DCE has most recently (end of Q4/12) been detected only in the Shallow HSZ and only at concentrations below the MCL of 6 µg/L (CH2M HILL, 2013b)

- 2013: In 2013 the Castle Vista system was restarted on April 15, 2013 due to *cis*-1,2-DCE exceeding restart criteria of 20 µg/L and the well was brought back on line at a low flow (5-6 gpm) and operated through June 20, 2013. The system was restarted in late August 2013 after fixing a pump. The system is operating on extraction well MW1046 and treated water is injected into injection well IW23.

Previously, the Castle Vista plume was much more extensive and extended to the west of the Castle Vista housing area, affecting the USS HSZ. This plume was remediated by the Castle Vista groundwater treatment system, and most of the extraction, injection, and monitoring wells associated with that system have since been decommissioned.

4.1.2.3 CB ROD – Part 2 Remedy Implementation

The CB ROD – Part 2 remedies for groundwater are:

- ICs to restrict groundwater use within plumes exceeding an MCL;

- Wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells; and

- Wellhead treatment to address groundwater contamination exceeding MCLs within the off-base Confined HSZ plume.

Implementation of the CB ROD – Part 2 remedies are discussed below.

ICs to restrict groundwater use within plumes exceeding an MCL: ICs (land use restrictions) were incorporated as a grantee covenant in the deed formally transferring the former CAFB to Merced County. Similar ICs were incorporated as a grantee covenant in the deed transferring portions of the former Castle Gardens and Castle Vista housing areas to private landowners. These covenants placed restrictions on the installation of wells, precluded disturbance of any existing groundwater remediation systems, and precluded activities that would limit access to any existing groundwater remediation system. In addition, the County of Merced, for applicable portions of the former CAFB, and the respective private landowners, for applicable portions of the Castle Gardens and Castle Vista housing areas, executed SLUC with the State of California that established prohibited activities in relation to groundwater uses and groundwater remediation systems. Groundwater use on the property transferred to the BoP was already restricted by terms of the Air Force/BoP Memorandum of Understanding (MOU). Following publication of the CB ROD – Part 2, the Air Force notified the City of Atwater, Merced County, and private landowners in the unincorporated portion of Merced County overlying a plume exceeding an MCL (off-base OU-2 plume area) that the groundwater should not be used for human consumption. The location and extent of off-base plumes exceeding any MCL within the off-base plumes are updated and documented each year in the LTGSP annual report. If monitoring results show that a plume exceeding an MCL has migrated, newly affected parcel owners are notified by the Air Force.

Wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells: Regular monitoring of contaminant concentration in public and domestic water supply wells downgradient of CAFB remains a component of the LTGSP. If a contaminant concentration in any drinking water well begins to exceed one half the MCL, the Air Force has agreed that, in consultation with the EPA, DTSC, and RWQCB, it will take immediate action, as necessary, to implement wellhead treatment or provide an alternative drinking water supply. In the past, the Air Force has provided an alternative water supply to three residences along Wallace Road, has installed replacement domestic wells at three residences along Wallace Road, and has installed and operated wellhead treatment systems on several domestic wells. Currently, the Air Force is maintaining a wellhead treatment system at downgradient domestic well D5766 (grid N4;

Figure 3-3). The pre-treatment TCE concentration detected in D5766 in April and October 2012 was 1.9 and 2.5 μg/L, respectively, below the MCL of 5 μg/L (CH2M HILL, 2013b).

Local (wellhead) treatment to address groundwater contamination exceeding MCLs within the off-base Confined HSZ plume: The Air Force has installed and operated three wellhead treatment systems in the off-base Confined HSZ plume (MW941, MW951, and MW1009) to address contaminant migration toward AM18. Based on declining TCE concentrations, two of the systems have been shut down (MW941 and MW1009). The MW951 system remains in operation. The inlet TCE concentration at the MW951 wellhead treatment system was sampled twice in 2012, and ranged from 3.9 in May to 5.6 μg/L in November (CH2M HILL, 2013b). MW1009 operated until February 2008 when it was shut down to assess potential TCE concentration rebound. As of May 2012, the inlet TCE concentration had decreased to 3.3 μg/L (CH2M HILL, 2013b). Periodic monitoring of TCE concentration at MW1009 continues under the LTGSP. Furthermore, the Air Force has agreed that, should AM18 become inoperative for an extended period, additional remedial actions to capture and clean up the off base Confined HSZ plume will be evaluated and may be implemented by the Air Force with regulatory agency review and approval. The operational status of AM18 is monitored through the LTGSP.

4.1.3 Main Base and Castle Vista Plume System Operation and Maintenance

All groundwater treatment plants and wellhead treatment systems at CAFB are operated in accordance with a comprehensive O&M plan (*Castle Groundwater Treatment Systems Operation and Maintenance Plan, Change 3 to Final*; Jacobs, 2006). This plan supersedes the previous O&M plans for the individual treatment plants and wellhead systems, but references considerable material from those documents.

O&M activities for each of the individual plants and treatment systems are extensive and are well beyond the scope of this document. O&M status is reported semiannually and provides the following:

- A performance summary (total gallons treated, average plant flow in gpm, estimated mass of contaminant removed, which extraction and injection wells were operational and, where applicable, carbon vessel configuration [identifies lead vessels in pairs]).

- Analytical results for plant effluent samples (minimum of monthly).
- Analytical results for any plant influent samples collected (per recommendations proposed in the LTGSP 2010 Semiannual Report [CH2M HILL, 2010d], influent samples are no longer collected on a monthly basis; treatment plant influents are only sampled to determine when a carbon changeout is required, following contaminant breakthrough; for wellhead systems consisting of a single extraction well, additional influent samples are collected semiannually).
- A summary of maintenance/upgrade work completed during the month.
- A summary of plant up time (percent of possible hours for month).
- A listing of system shutdowns and corrective actions implemented.
- A listing of equipment problems and upgrades.
- A listing of regular maintenance and/or upgrade work planned for the coming month.

The most critical pieces of information that are included in these semiannual reports are the analytical results for plant effluent (relates to discharge standards established in the CB ROD – Part 1). Effluent sample detections during the five-year review report period are summarized below:

- <u>2008</u>: For the OU-2 treatment plant, TCE was not detected in any of the combined effluent samples. 1,1-Dichloroethene was detected at a trace concentration (0.26 µg/L) in the May 2008 combined effluent sample; and boron and zinc were detected in the February 2008 (annual) combined effluent sample at concentrations slightly exceeding their discharge limits (0.39 milligrams per liter [mg/L] versus 0.072 mg/L for boron; 0.066 mg/L versus 0.037 mg/L for zinc). For the Phase 3 treatment plant, no VOCs were detected in the combined effluent samples for 2008. Inorganic analytes detected above discharge limits in the Phase 3 treatment plant combined effluent were calcium at 36 mg/L (discharge limit of 28 mg/L), chloride at 20 mg/L (discharge limit of 14 mg/L), chromium (total) at 0.0036 mg/L (discharge limit of 0.0022 mg/L), nitrogen (as nitrate and nitrite) at 6.6 mg/L (discharge limit of 3.2 mg/L) and total dissolved solids (TDS) at 290 mg/L (discharge limit of 258 mg/L). No organic compounds were detected at concentrations exceeding discharge limits in any of the wellhead treatment system final effluent samples during 2008 (that is, MW951, MW1009, and MW003). The only inorganic analytes detected above discharge limits in final effluent samples were: MW951 – potassium at 13 mg/L (discharge limit of 12 mg/L); MW1009 – potassium at 13 mg/L (discharge limit of 12 mg/L); and MW003 – boron at 0.11 mg/L (discharge limit of 0.084 mg/L; Jacobs, 2009c).

- 2009: For the OU-2 treatment plant, TCE was not detected in any of the combined effluent samples. 1,1-Dichloroethene was detected in the combined effluent samples collected in February (0.35 µg/L), March (0.35 µg/L), and September (0.58 µg/L) 2009. Although the September 1 sample exceeded the discharge standard of 0.5 µg/L, a confirmation sample collected on September 8 showed 1,1-dichloroethene was non-detect. One organic compound, nitrogen (as nitrate and nitrite), was detected in the February 2009 OU-2 treatment plant combined effluent sample at a concentration of 8.6 mg/L, which exceeded the discharge standard of 6.1 mg/L. For the Phase 3 treatment plant, chloroform and TCE were detected in the combined effluent samples in November and December 2009, respectively, at concentrations below discharge standards. Inorganic analytes detected above discharge standards in the Phase 3 treatment plant combined effluent were calcium at 36 mg/L (discharge standard of 28 mg/L), chloride at 18 mg/L (discharge standard of 14 mg/L), total chromium estimated at 0.0025 mg/L (discharge standard of 0.0022 mg/L), nitrogen (as nitrate and nitrite) at 6.3 mg/L (discharge standard of 3.2 mg/L), and TDS at 300 mg/L (discharge standard of 258 mg/L). *Cis*-1,2-DCE, chloroform, and toluene were detected at trace concentrations in one or more of the final effluent samples at MW951, but did not exceed discharge standards. Acetone was detected above the discharge standard (1 µg/L) at a concentration of 10 µg/L in the MW951 final effluent sample collected on August 3. The system was shut down on August 6 and the MW951 effluent resampled on August 10. Sample results showed all analytes were non-detect, and the system was restarted on August 11. The reason for the acetone exceedance is unknown. The only other discharge standard exceedance in the MW951 final effluent was potassium at 13 mg/L (discharge standard of 12 mg/L). At EW39, *cis*-1,2-DCE was detected in the final effluent sample at concentrations exceeding the discharge standard of 0.5 µg/L in February (1.7 µg/L), April (1 µg/L), and September (0.58 µg/L) 2009. *Cis*-1,2-DCE was also detected in the final effluent sample collected in December, but at a concentration less than the discharge standard. The system was shut down and the carbon changed out in each case. No inorganic analytes were detected above discharge standards in the final effluent sample at EW39 (CH2M HILL, 2010b).

- 2010: The OU-2 treatment plant was offline for a rebound study from October 30, 2009, until December 28, 2010, and thus no effluent sampling was conducted during 2010. For the Phase 3 treatment plant, chloroform and *cis*-1,2-DCE were detected at trace concentrations in one or more of the combined effluent samples at concentrations below discharge standards. TCE was detected in several combined effluent samples in January 2010 at concentrations exceeding the discharge standard. During early January, a combined effluent sample was collected in preparation for a carbon changeout and the results showed a TCE concentration of 0.66 µg/L, which exceeded the discharge standard of

0.5 µg/L. The system was immediately shut down. Following the carbon changeout of the lag vessel on January 25, TCE was again detected at a concentration (0.72 µg/L) exceeding the discharge standard, and the system was immediately shutdown. Two confirmation samples collected on January 28 and 29 also exceeded the discharge standard. The carbon was replaced again on February 5 and TCE was not detected in the effluent after the second changeout. It was determined that the effluent exceedances occurred because the subcontractor either failed to remove all of the used carbon from the lag vessel or failed to completely fill the lag vessel with new carbon. Corrective action procedures implemented as a result of the investigation include more rigorous inspection of carbon vessels during removal and filling. No other organic compounds exceeded discharge standards at the Phase 3 treatment plant during 2010. The only inorganic analyte detected above discharge standards in the combined effluent for the Phase 3 treatment plant was calcium at 36 mg/L (discharge standard of 28 mg/L). Chloroform and *cis*-1,2-DCE were detected at trace concentrations in one or more of the final effluent samples at MW951, but did not exceed discharge standards. The only discharge standard exceedances in the MW951 final effluent were molybdenum at 0.017 mg/L (discharge standard of 0.006 mg/L) and potassium at 13 mg/L (discharge standard of 12 mg/L). At the Castle Vista wellhead treatment system, acetone was detected in the final effluent sample at a concentration exceeding the discharge standard in June 2010 (1.9 µg/L versus 1 µg/L). No other organic compounds were detected in any of the Castle Vista wellhead treatment system final effluent samples, and boron was the only inorganic analyte detected above its discharge standard (0.1 mg/L versus 0.84 mg/L; CH2M HILL, 2011a).

- <u>2011</u>: VOC discharge standards were not exceeded in final effluent samples from the OU-2, Phase 3, or MW951 treatment systems during 2011. However, several inorganics exceeded discharge standards at one or more treatment systems, including calcium, chloride, nitrate, potassium, and TDS.
- <u>2012</u>: VOC discharge standards were not exceeded in final effluent samples from the OU-2, Phase 3, or MW951 treatment systems during 2012. However, inorganics that did exceed discharge standards included chloride and TDS at the Phase 3 treatment system (CH2M HILL, 2013b).

As indicated in the summaries above, the exceedance of certain inorganic discharge limits in treatment plant effluent is a regular occurrence at Castle. The exceedances reflect the differences in natural inorganic constituent levels for each of the HSZs and occur because of the mixing of water extracted from multiple HSZs and the subsequent injection of treated water into a single HSZ. The Air Force evaluated the feasibility of modifying the groundwater treatment systems to remove inorganic analytes and concluded that it was not cost-effective.

Results of this evaluation and a request for a waiver from inorganic discharge limits were presented to the regulatory agencies in 2002. The RWQCB responded that revised waste discharge requirements would be needed; however, RWQCB has not taken any action to date. Based on RWQCB and Air Force agreement, monitoring and reporting in regard to these inorganic discharges continues under the LTGSP (CH2M HILL, 2012a).

All wellhead treatment systems were sampled in accordance with the comprehensive O&M plan (Jacobs, 2006). A summary of the analytical results for CAFB treatment system influent samples during the five-year review report period are summarized below:

- <u>2008</u>: TCE was detected in the OU-2 treatment plant influent samples at concentrations ranging from 5.8 µg/L to 6.9 µg/L. TCE was detected in Phase 3 treatment plant influent samples at concentrations ranging from 7.6 µg/L to 12 µg/L during 2008. TCE was detected in influent samples at concentrations ranging from 4.7 µg/L to 7.6 µg/L at MW951. TCE concentrations in influent samples at MW1009 were 4.4 µg/L (January) and 3.9 µg/L (February), and TCE concentrations at MW1009 ranged from 3.1 µg/L to 4.4 µg/L during the initial four-month rebound period (the system remained off line for the remainder of 2008 to assess long-term rebound). *Cis*-1,2-DCE was detected in influent samples at concentrations ranging from 15 µg/L to 22 µg/L at MW003 while the system was operational. After the system was shut down because even low rates of pumping could not be sustained, the reported *cis*-1,2-DCE concentration at MW003 increased to 60 µg/L (Jacobs, 2009c).
- <u>2009</u>: TCE was detected in the OU-2 treatment plant influent samples at concentrations ranging from 6.1 to 7.2 µg/L. TCE was detected in Phase 3 treatment plant influent samples at concentrations ranging from 7.2 to 12 µg/L during 2009. TCE was detected in influent samples at concentrations ranging from 4.9 to 7.8 µg/L at MW951. At EW39, *cis*-1,2-DCE was detected in influent samples at concentrations ranging from 6.4 to 9.9 µg/L (CH2M HILL, 2010b).
- <u>2010</u>: The OU-2 treatment plant was offline for a rebound study from October 30, 2009, until December 28, 2010, and thus no influent sampling was conducted during 2010. TCE was detected in Phase 3 treatment plant influent samples at concentrations ranging from 3.3 to 12 µg/L during 2010. TCE was detected in influent samples at concentrations ranging from 1.1 to 8.0 µg/L at MW951. At the Castle Vista wellhead treatment system, *cis*-1,2-DCE was detected in samples

from EW39 at concentrations ranging from 2.8 to 10 µg/L, and from MW1046 at concentrations ranging from 1.4 to 2.0 µg/L (CH2M HILL, 2011a).

- 2011: For the OU-2 treatment plant, TCE was detected in the January OU-2 treatment plant influent sample at a concentration of 8 µg/L; no other OU-2 treatment plant influent samples were collected during 2011. For the Phase 3 treatment plant, TCE was detected in Phase 3 treatment plant influent samples at concentrations ranging from 5 to 9 µg/L during 2011. TCE was detected in the influent samples at concentrations ranging from 4.3 to 4.5 µg/L at the MW951 wellhead treatment system during 2011. At the Castle Vista wellhead treatment system, *cis*-1,2-DCE was detected in samples from EW39 at concentrations ranging from 3.9 to 12 µg/L and from MW1046 at concentrations ranging from 1.6 to 8.2 µg/L (CH2M HILL, 2012a).
- 2012: For the OU-2 treatment plant, TCE concentrations at extraction wells EW11 and EW12 ranged from 5.7 to 13 µg/L, and from 3.2 to 6.4 µg/L, respectively. For the Phase 3 treatment plant, TCE was detected at a concentration of 10 µg/L in the one Phase 3 treatment plant influent sample collected during 2012. TCE was detected in influent samples at concentrations ranging from 3.9 to 5.6 µg/L at MW951 (CH2M HILL, 2013b).

As TCE concentrations had reached asymptotic levels at the three operating USS HSZ OU-2 extraction wells (EW11, EW12, and EW14), the OU-2 treatment system was shut down on 30 October 2009 for a period of one year (with agency approval) to conduct a rebound study to gather data to determine how best to optimize operation of the system. A detailed discussion of the shutdown plan and rebound study was presented in the *Operable Unit 2 Rebound Study Work Plan* (CH2M HILL, 2009). The goals of the rebound study were to:

- Assess rebound of TCE concentrations in the absence of pumping to determine if there are areas with elevated TCE concentrations in the aquifer/soil matrix that are responsible for generating the low concentrations;
- Determine if there are wells or areas with significant rebound that would benefit from more focused groundwater extraction; and
- Assess groundwater gradients to determine potential plume migration rates and the potential for contaminant attenuation in the absence of pumping.

During shutdown, periodic groundwater sampling from designated wells indicated TCE concentrations had increased to levels above restart criteria established in the *Operable Unit 2 Rebound Study Work Plan* (CH2M HILL, 2009a), and the OU-2 system was re-started on 28 December 2010 (CH2M HILL, 2011a).

Based on quarterly groundwater samples collected during 2010, a rebound in TCE concentrations did occur; with concentrations in monitoring wells MW804A, MW806A, and MW948 increasing considerably. TCE concentrations in groundwater samples from the three extraction wells ranged between 4.4 and 9.9 µg/L during Q4/10. The TCE concentration in the sample collected from EW14 increased from 5.9 to 9.9 µg/L, which was the highest concentration at this well since Q3/04. TCE concentrations at the five monitoring wells that were selected to monitor any potential plume movement as part of the OU-2 rebound study (MW702A, MW902, MW947, MW1042, and MW1043) did not show any increases. The data from MW947 and MW702A strongly suggested that in the absence of pumping, the OU-2 TCE plume did not migrate to the west out of the area of influence of the OU-2 extraction wells. The *Extraction, Injection, and Monitoring Plan for the OU 2 Groundwater System Re-start Technical Memorandum* (CH2M Hill, 2011b) presented these results, and recommended a flexible pumping regime where one or more extraction wells may be offline at any given time. The *Extraction, Injection, and Monitoring Plan* was designed to be responsive to short-term changes in water levels and/or groundwater sampling data from monitoring wells and extraction wells, with specific restart criteria for all extraction wells based on TCE concentrations in extraction and monitoring wells. In 2012, TCE concentrations at MW804A, MW806A, and MW948 fluctuated up and down. TCE concentrations at MW804A had a high of 39 µg/L in Q2/13, but decreased to 27 µg/L in Q4/13. TCE concentrations at MW948 followed a similar pattern to MW804A, peaking at 40 µg/L in Q2/12 and decreasing to 37 µg/L in Q4/13, representing an overall increase from the 33 µg/L reported in Q4/11. TCE concentrations at MW806A decreased from 18 µg/L in Q4/11 to 12 µg/L in Q1/12 and then increased to 28 µg/L in Q4/12. While TCE concentrations at MW804A, MW806A, and MW948 have increased since the system was initially shut down in Q4/09, water level measurements collected since restart show that the OU-2 system is adequately controlling the entire MCL TCE plume; and TCE has not been detected above the reporting limit (0.5 µg/L) at any of the wells downgradient of MW804A, MW806A, and MW948 (PZ11, MW702A, MW902, MW947, MW1042, and MW1043), indicating that TCE has not migrated downgradient and that the current OU-2 system is sufficient to maintain capture of the plume.

The Castle Vista Plume wellhead treatment system, currently consisting of a small wellhead GAC treatment system at EW39 and MW1046. Following of long-term rebound study that was initiated on August 17, 2010, the Castle Vista system was restarted on April 15, 2013 due to cis-1,2-DCE exceeding restart criteria. Since February 2011, *cis*-1,2-DCE was detected in the influent samples at concentrations ranging from 3.9 to 12 µg/L at EW39, and at concentrations ranging from 1.6 to 9.2 µg/L at MW1046; but were below the MCL of 6 µg/L as of Q4/12 (CH2M HILL, 2013b). However, the Q1/13 result indicated that the cis-1,2-DCE concentration at MW1046 had increased to above 20 µg/L and it was necessary to resume extraction at MW1046.

4.2 VADOSE ZONE REMOVAL/REMEDIAL ACTIONS

This section describes the selection of final remedies and the implementation of removal and remedial actions at the following 11 CAFB SCOU sites: ETC-10, ETC-12, FTA-1, LF-3, LF-4 (DP-5 and DP-6), and LF-5 (DP-8, DP-8A, and LF-5 Trenches). Site locations are shown on Figure 3-3.

4.2.1 Remedy Selection

Final remedies for ETC-10, ETC-12, FTA-1, LF-3, LF-4 and its associated sites, and LF-5 and its associated sites, are presented in the SCOU ROD – Part 1 (WPI, 2002) and the SCOU ROD Part 3 (Jacobs, 2005a).

4.2.1.1 Earth Technology Corporation 10

The SCOU FS preferred alternative for ETC-10 was excavation and off-site disposal. The BCT later changed the preferred alternative (post-FS decision) to excavation and on-site disposal. An action memorandum was submitted in October 1996, and the removal action took place from 27 July 1997 through 10 August 1998. Approximately 5,050 cubic yards of contaminated soil was transported to and disposed in LF-5. The removal action closure report for ETC-10 was finalized in July 1999 (Jacobs, 1999b). At completion of the removal action, lead and benzo(a)pyrene concentrations in soil met occupational but not residential RAOs. As part of the CB RI/FS – Part 2 (Jacobs, 2002b), two focused feasibility studies (FFSs) were performed for ETC-10 to address post-removal action concerns. The ETC-10 FFS was performed to provide a CERCLA evaluation of alternatives to address residual lead in soil contamination. The ecological FFS, included in the CB RI/FS – Part 2 (Jacobs, 2002b), was performed to address concerns and evaluate alternatives regarding potential contamination of wetlands located within or near ETC-10 and other SCOU sites. The ETC-10 FFS preferred alternative was ICs to permanently control human access, with the exception of occasional access for scientific study and monitoring. The ecological FFS preferred alternative for ETC-10 was LTEM. The final remedy for ETC-10, established in the SCOU ROD Part 3 (Jacobs, 2005a), is ICs and LTEM.

4.2.1.2 Earth Technology Corporation 12

The selected remedy for human health and water quality risk at ETC-12 was established in the SCOU ROD – Part 1 (WPI, 2002) as NFA. However, the Scoping, Phase I, and Phase II ERAs (Jacobs, 1995; Jacobs, 1997b) and subsequent biological survey data (CB RI/FS – Part 2 [Jacobs, 2002b]) determined that soil contamination at ETC-12 represented a potential risk to several ecological receptors. The ecological FFS preferred alternative for ETC-12 was LTEM (Jacobs, 2002b). The final remedy for ecological risk at ETC-12, established in the SCOU ROD Part 3 (Jacobs, 2005a), is LTEM.

4.2.1.3 Fire Training Area 1

The SCOU FS preferred alternative was SVE for VOC contamination, and soil treatment (*ex situ* solidification and stabilization) for non-VOC contamination. An action memorandum was submitted in September 1995, and a removal action comprised of an SVE system and surface cap was implemented in 1996. The SVE system operated intermittently through August 2005.

In order to incorporate new site data and updated RAOs, and to further evaluate alternatives for non-VOC contamination, an FFS was performed for FTA-1 non-VOC contamination (Jacobs, 2002a). The FTA-1 FFS selected capping and ICs to ensure long-term cap integrity as the preferred alternative for non-VOC contamination. The FFS also concluded that the existing engineered cap would fulfill the requirements of the non-VOC capping preferred alternative. Similar to ETC-10, the ecological FFS identified LTEM as the preferred alternative to address concerns regarding the wetlands adjacent to FTA-1, and also noted the need to excavate and dispose of approximately 150 cubic yards of soil not under the existing cap that posed an ecological concern (Jacobs, 2002b). The final remedy for FTA-1, established in the SCOU ROD Part 3 (Jacobs, 2005a), is SVE, BV, LTM, ICs, E&D, and LTEM.

4.2.1.4 Landfill 3

The selected remedy for human health and water quality risk at LF-3 was established in the *SCOU ROD Part 1* (WPI, 2002) as NFA. However, the Scoping and Phase I and Phase II ERAs (Jacobs, 1995; Jacobs, 1997b) determined that soil contamination at LF-3 posed a potential risk to several ecological receptors. An E&D removal action, which started in late 1998 and was completed in September 1999, resulted in the removal of approximately 57,000 cubic yards of soil, waste, and construction debris from disposal trenches and surface disposal areas at LF-3. Almost all of the excavated material was transported to LF-5 for disposal; a small amount of hazardous material was profiled, manifested, and disposed at an off-site facility (Jacobs, 2000a). Subsequent characterization of contamination and biological surveys in adjacent wetlands indicated that contaminants within the wetlands associated with LF-3 represented a potential adverse risk to ecological receptors. The ecological FFS preferred alternative for LF-3 was LTEM (Jacobs, 2002b). The final remedy for ecological risk at LF-3, established in the SCOU ROD Part 3 (Jacobs, 2005a), is LTEM.

4.2.1.5 Landfill 4 (DP-5, DP-6)

The SCOU FS preferred alternative for LF-4 was landfill zoning (consolidation and capping in place), long-term maintenance and monitoring, and ICs. Following BCT post-FS decisions to consolidate waste from other CAFB landfills and sites at LF-4, the preferred alternative was revised to consolidation and capping with an engineered alternative to a Class III cap. Long-term maintenance and monitoring and ICs remained a part of the preferred alternative. An action memorandum was submitted in September 1997 and the LF-4 removal action, which included site preparation, excavation of waste from perimeter trenches, consolidation of LF-4 wastes and waste materials excavated from other authorized CAFB sites, confirmation sampling, backfilling excavated trenches, and cap installation, was initiated in October 1997 and completed in September 1999. Approximately 6,500 cubic yards of non-hazardous, non-designated waste was excavated from perimeter trenches at LF-4 and placed in the area to be capped. Approximately 240,000 cubic yards of waste material and contaminated soil meeting landfill acceptance criteria (non-hazardous and non-designated waste) was imported from other CAFB SCOU sites and placed in the area to be capped. The consolidated waste and soil was covered with an engineered alternative to a Class III cap. The caps (two separate areas were capped) consist of a gas collection layer, a low-permeability layer, a drainage layer, and a vegetative cover. The *Landfill 4 and Landfill 5 Closure Report* was finalized in May 2003 (Jacobs, 2003b). A post-closure long-term maintenance and monitoring program was initiated, following capping. The final remedy for LF-4 and its associated sites, established in the SCOU ROD Part 3 (Jacobs, 2005a), is LTM and ICs.

4.2.1.6 Landfill 5 (DP-8, DP-8A, LF-5 Trenches)

The SCOU FS preferred alternative for LF-5 was landfill zoning (consolidation and capping in place), long-term maintenance and monitoring, and ICs. Following BCT post-FS decisions to consolidate waste from other CAFB landfills and sites at LF-5, the preferred alternative was revised to consolidation and capping with an engineered alternative to a Class III cap. Long-term maintenance and monitoring and ICs remained a part of the preferred alternative. An action memorandum was submitted in October 1998 and the LF-5 removal action, which included site preparation, excavation of waste from perimeter trenches, consolidation of LF 5 wastes and waste materials excavated from other authorized CAFB sites, confirmation sampling, backfilling excavated trenches, and cap installation, was initiated in November 1998 and completed in September 1999. Approximately 19,000 cubic yards of non-hazardous, non-designated waste was excavated from perimeter trenches at LF-5 and placed in the area to be capped. Approximately 100,000 cubic yards of waste material and contaminated soil meeting landfill acceptance criteria (non-hazardous and non-designated wastes) was imported from other CAFB SCOU sites and placed in the area to be capped. The consolidated waste and soil was covered with an engineered alternative to a Class III cap. The cap consists of a gas collection layer, a low-permeability layer, a drainage layer, and a vegetative cover. The Landfill 4 and Landfill 5 Closure Report was finalized in May 2003 (Jacobs, 2003b). A post-closure, long-term maintenance and monitoring program was initiated following capping. Similar to ETC-10, ETC-12, FTA-1, and LF-3, the ecological FFS identified LTEM as the preferred alternative to address concerns regarding the wetlands adjacent to LF-5 (Jacobs, 2002b). The final remedy for LF-5 and its associated sites, established in the SCOU ROD Part 3 (Jacobs, 2005a), is LTM, ICs, and LTEM.

4.2.2 Remedy Implementation

This section describes removal and remedial actions implemented at ETC-10, ETC-12, FTA-1, LF-3, LF-4 and its associated sites, and LF-5 and its associated sites. All removal and remedial actions were designed with input from, and implemented with the concurrence of, the BCT.

4.2.2.1 Earth Technology Corporation 10

ETC-10 and its associated wetlands are located within the BoP United States Penitentiary, Atwater Complex, and public access is, and will for the foreseeable future, be prohibited. In addition, implementation of the selected remedy will not threaten sensitive ecological habitats. ICs are currently in place and implemented as follows:

1) The Air Force/BoP MOU precludes site alterations that would interfere with Interagency Agreement (IAG) or IRP activities without notification of EPA, DTSC, and the Air Force and approval of the Air Force;
2) The Air Force/BoP MOU establishes access for the Air Force and the BCT;
3) Other than access required pursuant to the IAG/IRP, the BoP's *Preservation Area Mitigation and Management Plan* (Louis Berger and Associates [Berger], 1998) restricts access to activities that are necessary for implementation of the plan; and
4) Elements of prison security (e.g., patrolled security fencing) restrict the potential for human exposure to site contamination.

ICs will be maintained at ETC-10 until soils are at levels that allow for unrestricted use and exposure. Given that there are no plans to remediate the soil, it is assumed that ICs will be maintained indefinitely. Modification or termination of ICs requires Air Force, EPA, and State of California approval.

LTEM, consisting of wetlands invertebrate (fairy shrimp) and plant surveys at selected vernal pools, was implemented in the spring of 2008 (surveys are to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted). A fairy shrimp survey and plant survey were last completed in February and March 2008, respectively, in order to confirm that site contaminants have not impacted wetland habitats, both potentially contaminated (within or downgradient of the site) and uncontaminated (upgradient or remote from any site) vernal pools were surveyed. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Results of the 2008 biological surveys are documented in Appendix A in the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a).

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was not conducted in 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-10 LTEM is not incorporated into this five-year review report. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

4.2.2.2 Earth Technology Corporation 12

LTEM, consisting of wetlands invertebrate (fairy shrimp) and plant surveys at selected vernal pools, was implemented in the spring of 2008 (surveys are to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted). A fairy shrimp survey and plant survey were last completed in February and March 2008, respectively, in order to confirm that site contaminants have not impacted wetland habitats, both potentially contaminated (within or downgradient of the site) and uncontaminated (upgradient or remote from any site) vernal pools were surveyed. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Results of the 2008 biological surveys are documented in Appendix A in the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a).

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-12 site was not conducted in 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-10 LTEM is not incorporated into this five-year review report. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

4.2.2.3 Fire Training Area 1

SVE/capping and E&D remedial actions have been completed; and IC, LTM, and LTEM remedies have been implemented. At the completion of the SVE remedial action, it was determined that a BV remedial action was not necessary. The SVE/capping remedial action, consisting of installation of a SVE treatment system and a cap to enhance SVE operation, was initially implemented at the FTA-1 site in 1996 as a removal action. The Class III engineered cap helped the SVE well network perform more effectively by eliminating inflow of surface air within the area of vapor extraction. In addition, the cap reduced the influence of rainfall on contaminant migration toward the groundwater and protected potential receptors from exposure to the metals and dioxin contamination in shallow soil at the site. The SVE system was started in November 1996 and operated on and off until August 2005. Over the nine years of operation, the SVE system removed 69,220 pounds of contaminants (fuels and VOCs) from the vadose zone. The SVE completion report for FTA-1 was finalized in May 2007 (MWH, 2007a).

The E&D remedial action, completed in September and October 2004, consisted of the excavation and off-site disposal of two areas of metals-impacted soils outside of the existing cap. A total of 21.4 cubic yards of impacted soil was removed. These soils had been determined to pose a risk to ecological receptors in the vicinity of FTA-1. The E&D removal action completion report was finalized in March 2005 (MWH, 2005a).

FTA-1 and its associated wetlands are located within the BoP United States Penitentiary, Atwater Complex and the BoPs wetlands preservation area, and public access is, and will for the foreseeable future, be prohibited. ICs are currently in place and implemented as follows:

1) The Air Force/BoP MOU precludes site alterations that would interfere with IAG or IRP activities without notification of EPA, DTSC, and the Air Force and approval of the Air Force;
2) The Air Force/BoP MOU establishes access for the Air Force and the BCT;

3) Other than access required pursuant to the IAG/IRP, the BoP's *Preservation Area Mitigation and Management Plan* (Berger, 1998) restricts access to activities that are necessary for implementation of the plan; and
4) Elements of prison security (e.g., patrolled security fencing) restrict the potential for human exposure to site contamination. In addition, implementation of the selected remedy will not threaten sensitive ecological habitats.

ICs will be maintained at FTA-1 until soils are at levels that allow for unrestricted use and exposure. Given that FTA-1 is capped and there are no plans to remediate the capped soil, it is assumed that ICs will be maintained indefinitely. Modification or termination of ICs requires Air Force, EPA, and State of California approval.

LTM for the engineered cap at FTA-1 was initiated in 1999 concurrent with implementation of the post-closure maintenance and monitoring program for LF-4 and LF-5 and in accordance with the *Closure and Post-Closure Maintenance Plan for Castle Airport Landfills* (Jacobs, 1997d). Although FTA-1 is not a landfill, maintenance and monitoring, including cap maintenance, drainage maintenance, erosion control, and rodent control was assumed to be appropriate for the FTA-1 cap. LTM activities at FTA-1 include quarterly to semiannual inspections of the cap, monitoring wells, drainage ditch elevations and condition (additional inspection after major rain events), site security, and roads, and completion of any necessary repairs. The Closure and Post-Closure Maintenance Plan – Update 2 (AFRPA, 2006) establishes inspection and monitoring requirements for semiannual activities, annual activities, and after major rain events. Reports documenting inspection results are prepared annually. Relevant to this five-year review, quarterly to semiannual inspections of the FTA-1 cap were performed from 2008 through 2012.

Groundwater monitoring, which is part of the remedy for FTA-1, was ongoing when declining regional water levels resulted in all FTA-1 monitoring wells going dry by 2009. Prior to the wells going dry, TCE was detected above the MCL in a single well (MW886) located downgradient of FTA-1. No groundwater monitoring occurred at FTA-1 during 2012 because all of the wells were dry. The remedy for FTA-1 specified in the SCOU ROD Part 3 (Jacobs, 2005) includes long-term groundwater monitoring that may be discontinued once the results demonstrate that water quality limits will not be exceeded. Because

MW886 went dry before TCE concentrations decreased below the MCL, replacement wells and additional monitoring are needed to satisfy SCOU ROD Part 3 requirements. A plan was proposed to address this issue, in the *Final Fire Training Area 1 Well Installation Work Plan* (CH2M HILL, 2012c). In accordance with the work plan, two groundwater wells were recently installed at FTA-1 in July 2013. One groundwater well (MW1054) was installed approximately 100 feet downgradient of dry well MW886, and one groundwater well (MW1055) was installed adjacent to the FTA-1 cap. The location of MW1054 was selected as the nearest location downgradient of MW886 that is outside the Vernal Pool Preservation Area. A new well could not be installed adjacent to MW886 because this well is located within a recently identified wetland. The location of MW1055 was selected to be closer to the FTA-1 cap and within the assumed boundary of the last known TCE MCL plume.

The 2009 inspection and maintenance information for FTA-1 indicated that the FTA-1 cap and all components had been maintained, that they did require some ongoing burrow baiting and maintenance, but were generally in good and stable condition and did not pose a threat to human health of the environment.

LTEM, consisting of wetlands invertebrate (fairy shrimp) and plant surveys at selected vernal pools, was implemented in the spring of 2008 (surveys are to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted). A fairy shrimp survey and plant survey were last completed in February and March 2008, respectively, in order to confirm that site contaminants have not impacted wetland habitats, both potentially contaminated (within or downgradient of the site) and uncontaminated (upgradient or remote from any site) vernal pools were surveyed. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Results of the 2008 biological surveys are documented in Appendix A in the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a).

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the FTA-1 site was not conducted in 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from FTA-1 LTEM is not incorporated into this five-year review report. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

4.2.2.4 Landfill 3

LTEM, consisting of wetlands invertebrate (fairy shrimp) and plant surveys at selected vernal pools, was implemented in the spring of 2008 (surveys are to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted). A fairy shrimp survey and plant survey were last completed in February and March 2008, respectively, in order to confirm that site contaminants have not impacted wetland habitats, both potentially contaminated (within or downgradient of the site) and uncontaminated (upgradient or remote from any site) vernal pools were surveyed. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Results of the 2008 biological surveys are documented in Appendix A in the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a).

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-3 site was not conducted in 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-3 LTEM is not incorporated into this five-year review report. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

4.2.2.5 Landfill 4 (DP-5 and DP-6)

ICs for LF-4, in the form of land use restrictions, were incorporated in the deed transferring the parcel containing LF-4 to Merced County; and a State Land Use Covenant has been executed by Merced County with the State of California. These controls establish land use for the LF-4 site as non-irrigated open space, and limit groundwater withdrawal and any construction or other site activities that would disturb the cap or any of the existing access control, drainage control, or monitoring facilities. ICs will be maintained at LF-4 until soils are at levels that allow for unrestricted use and exposure. Given that LF-4 is capped and there are no plans to remediate the capped soil/wastes, it is assumed that ICs will be maintained indefinitely. Modification or termination of ICs requires Air Force, EPA, and State of California approval.

LTM for LF-4 was initiated in 1999 and consisted of a post-closure monitoring and maintenance program for the caps, and a post-closure monitoring program for landfill gas and groundwater beneath the landfill. Landfill cap and groundwater monitoring features at LF-4 are shown on Figures 4-3 and 4-4, respectively. Cap monitoring and maintenance activities and landfill gas and groundwater monitoring are conducted in compliance with the approved *Closure and Post-Closure Maintenance Plan for Castle Airport Landfills* (Jacobs, 1997c) and the *Landfill 4 and Landfill 5 Closure and Post-Closure Maintenance Plan Update* (Jacobs, 2000b). Cap monitoring and maintenance activities for LF-4 consist of quarterly to semiannual inspections of the cap, landfill gas collection system, monitoring wells, drainage ditch elevations and condition (additional inspection after major rain events), settlement monuments, site security, roads, and completion of any necessary repairs. Reports documenting inspection results are prepared annually.

In September 2009, a technical memorandum was prepared, asking to reduce the monitoring frequency for the landfill gas perimeter probes and landfill cap gas vents for LF-4 at CAFB. The Air Force Center for Engineering and the Environment (AFCEE) requested regulatory concurrence on decreasing the monitoring, based on the minimal presence of methane at the gas perimeter probes and cap gas vents and resulting relatively low risk to public health, safety, or the environment in conjunction with adjacent land use. The technical memorandum requested reduction in the monitoring frequency of the landfill gas perimeter wells (referred to as probes in the annual landfill reports) and the landfill cap gas vents at LF-4 from quarterly to semiannually, and to eliminate monitoring from the landfill cap vents all together (CH2M HILL, 2010f). However, AFCEE only received concurrence on the monitoring frequency reduction, from quarterly to semiannually, as of 4 November 2010 (CH2M HILL, 2011a).

The landfill gas monitoring system consists of perimeter probes or gas wells and passive gas vents. The perimeter gas wells or probes are used to detect subsurface migration of landfill gas. The landfill gas collection system is monitored at the passive gas vents. Landfill gas monitoring is currently conducted semiannually.

The LF-4 post-closure groundwater monitoring program has been structured in accordance with post-closure monitoring requirements contained in California Code of Regulations (CCR), Title 27, Subchapter 3, Article 1 (27 CCR) and CFR Title 40, Part 258 (40 CFR 258). As specified in the regulations, the post-closure groundwater monitoring program at LF-4 consists of two components: (1) semiannual corrective action monitoring, which addresses contaminants already in groundwater that were derived from historical landfill releases (releases prior to capping); and (2) semiannual detection monitoring, which addresses any new releases from the landfill (releases subsequent to capping). If the corrective action or detection monitoring results indicate "measurably significant" evidence of a continuing or new release from LF-4, the Air Force will notify the regulatory agencies and implement retest/verification procedures. If resampling confirms measurably significant evidence of a continuing or new release, follow-up activities would include a detailed inspection/assessment of the cap and preparation of work plans and/or engineering feasibility studies to addressing potential corrective actions. The LF-4 post-closure groundwater monitoring program is conducted as an integrated part of the ongoing Castle LTGSP. Current results of the LF-4 post-closure groundwater monitoring program are presented in each LTGSP annual and semiannual report. At LF-4, corrective action monitoring was terminated in 2007 (all analytes less than MCLs or ND for minimum of a year), and all corrective action analytes were transferred to the detection monitoring program.

At LF-4, the detection monitoring program previously included five detection compliance monitoring wells (MW410, MW847, MW1001, MW1002, and MW1003) and one background monitoring well (MW888). However, as a result of continuing decreases in groundwater elevations at the former CAFB, four of the five LF-4 detection monitoring wells (MW410, MW1001, MW1002, and MW1003) and the background monitoring well (MW888) could no longer be sampled beginning in Q2/08 because they were either dry or contained insufficient water for sampling. In December 2009, MW1048 was installed to replace dry wells MW410 and MW1003 for detection monitoring of the northern cell of LF-4. In addition, existing well MW846 was brought back into the sampling program to replace dry wells MW1001 and MW1002 for detection monitoring of the southern cell of LF-4. Detection compliance monitoring well MW847 became dry during 2012; it was previously dry only on a seasonal basis (only during Q4; CH2M HILL, 2013b). In July 2013, one groundwater well (MW1053) was installed to replace dry well MW888, in accordance with the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b).

The 2008 and 2009 inspection and maintenance information for LF-4 indicated that the LF-4 cap and all components had been maintained, were in good and stable condition, and did not pose a threat to human health of the environment. Based on this information, an optimization request for reduction in the frequency of inspection and maintenance at LF-4 from quarterly/semiannually to annually was proposed in the *Final Technical Memorandum - Proposal for Optimization of the Post-Closure Care Inspection and Monitoring Requirements for Landfill 4, Landfill 5, and Fire Training Area 1* (MWH, 2009b). Following the July 2011 inspection, a fire damaged vegetation on the southern portion of the Cell #1 cap (approximately one-third of the cap was affected). During the December 2011 inspection, new vegetation was observed growing over the burned area. The fire did not affect the integrity of the cap and did not impact the protectiveness of the remedy. Currently, as of December 2012, inspection and monitoring requirements are established for semiannual activities, annual activities, and after major rain events.

4.2.2.6 Landfill 5 (DP-8, DP-8A, LF-5 Trenches)

LF-5 and its associated wetlands are located within the BoP United States Penitentiary, Atwater Complex and public access is, and will for the foreseeable future, be prohibited. ICs are currently in place and implemented as follows:

1) The Air Force/BoP MOU precludes site alterations that would interfere with IAG or IRP activities without notification of the EPA, DTSC, and the Air Force and approval of the Air Force;
2) The Air Force/BoP MOU establishes access for the Air Force and the BCT;
3) Other than access required pursuant to the IAG/IRP, the BoP's *Preservation Area Mitigation and Management Plan* (Berger, 1998) restricts access to activities that are necessary for implementation of the plan; and

4) Elements of prison security (e.g., patrolled security fencing) restrict the potential for human exposure to site contamination. In addition, implementation of the selected remedy will not threaten sensitive ecological habitats.

ICs will be maintained at LF-5 until soils are at levels that allow for unrestricted use and exposure. Given that LF-5 is capped and there are no plans to remediate the capped soil/wastes, it is assumed that ICs will be maintained indefinitely. Modification or termination of ICs requires Air Force, EPA, and State of California approval.

LTM for LF-5 was initiated in 1999, and consisted of a post-closure monitoring and maintenance program for the caps, and a post-closure monitoring program for landfill gas and groundwater beneath the landfill. Landfill cap and groundwater monitoring features at LF-5 are shown on Figures 4-5 and 4-6, respectively. Cap monitoring and maintenance activities and landfill gas and groundwater monitoring are conducted in compliance with the approved *Closure and Post-Closure Maintenance Plan for Castle Airport Landfills* (Jacobs, 1997c) and the *Landfill 4 and Landfill 5 Closure and Post-Closure Maintenance Plan Update* (Jacobs, 2000b). Cap monitoring and maintenance activities for LF-5 consist of quarterly to semiannual inspections of the cap, landfill gas collection system, monitoring wells, drainage ditch elevations and condition (additional inspection after major rain events), settlement monuments, site security, and roads, and completion of any necessary repairs. Reports documenting inspection results are prepared annually. Relevant to this five-year review, quarterly to semiannual inspections were performed from 2008 through 2012.

The landfill gas monitoring system consists of perimeter probes or gas wells and passive gas vents. The perimeter gas wells or probes are used to detect subsurface migration of landfill gas. The landfill gas collection system is monitored at the passive gas vents. Landfill gas monitoring is currently conducted semiannually.

The LF-5 post-closure groundwater monitoring program has been structured in accordance with post-closure monitoring requirements contained in CCR Title 27, Subchapter 3, Article 1 (27 CCR) and CFR Title 40, Part 258 (40 CFR 258). As specified in the regulations, the post-closure groundwater monitoring program at LF-5 consists of two components; semiannual corrective action monitoring, which addresses contaminants already in groundwater that were derived from historical landfill releases (releases prior to capping); and semiannual detection monitoring, which addresses any new releases from the landfill (releases subsequent to capping). If the corrective action or detection monitoring results indicate “measurably significant” evidence of continuing or a new release from LF-5, the Air Force will notify the regulatory agencies and implement retest/verification procedures. If resampling confirms measurably significant evidence of a continuing or new release, follow-up activities would include a detailed inspection/assessment of the cap and preparation of work plans and/or engineering feasibility studies to addressing potential corrective actions. The LF-5 post-closure groundwater monitoring program is conducted as an integrated part of the ongoing Castle LTGSP. Current results of the LF-5 post-closure groundwater monitoring program are presented in each LTGSP annual and semiannual report.

At LF-5, the detection monitoring program previously included three detection compliance monitoring wells (MW862R, MW1004, and MW1005) and one background monitoring well (MW360). As at LF-4, because of decreasing groundwater elevations, none of the four monitoring wells (MW360, MW862R, MW1004, and MW1005) could be sampled as of Q2/08. In October 2010, MW1049 was installed to replace the three dry detection compliance monitoring wells (MW862R, MW1004, and MW1005). At that time, it was believed that a single well would be sufficient until water levels recovered enough for the previous wells to be sampled. However, because water levels have not recovered, a need for additional wells was identified. In July 2013, one groundwater well (MW1050) was installed to replace dry well MW360, and detection compliance monitoring wells MW1051 and MW1052 were installed to replace dry wells MW1004 and MW1005, respectively, in accordance with the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b).

The 2008 and 2009 inspection and maintenance information for LF-5 indicated that the LF-5 cap and all components had been maintained, were in good and stable condition, and did not pose a threat to human health of the environment. Based on this information, an optimization request for reduction in the frequency of inspection and maintenance at LF-5 from quarterly/semiannually to annually was proposed in the *Final Technical Memorandum - Proposal for Optimization of* *the Post-Closure Care Inspection and Monitoring Requirements for Landfill 4, Landfill 5, and Fire Training Area 1* (MWH, 2009b). Currently, as of December 2012, inspection and monitoring requirements are established for semiannual activities, annual activities, and after major rain events.

LTEM, consisting of wetlands invertebrate (fairy shrimp) and plant surveys at selected vernal pools, was implemented in the spring of 2008 (surveys are to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted). A fairy shrimp survey and plant survey were last completed in February and March 2008, respectively, in order to confirm that site contaminants have not impacted wetland habitats, both potentially contaminated (within or downgradient of the site) and uncontaminated (upgradient or remote from any site) vernal pools were surveyed. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Results of the 2008 biological surveys are documented in the presented in Appendix A in the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a).

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-5 site was not conducted in 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-5 LTEM is not incorporated into this five-year review report. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

4.2.3 System Operation and Maintenance

There are no system O&M activities for ETC-10, ETC-12, or LF-3. LTM activities are ongoing at FTA-1, LF-4 (including DP-5 and DP-6), and LF-5 (including DP-8, DP-8A, and LF-5 Trenches), as described in Sections 4.2.2.3, 4.2.2.5 and 4.2.2.6.

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5 PROGRESS SINCE LAST REVIEW

This section describes the status of issues identified and recommendations presented in the previous five-year review.

5.1 MAIN BASE AND CASTLE VISTA REMEDIAL ACTIONS

Technical assessments in the third five-year review for groundwater treatment systems at CAFB (Jacobs, 2009a) indicated that the groundwater remedial actions at CAFB remained protective of human health and the environment. The groundwater remedial actions were either meeting requirements of the CB ROD – Part 1 (capture of the Main Base and Castle Vista Plumes) or were demonstrating adequate progress toward meeting long-term ROD objectives (cleanup to MCLs). Since completion of the previous five-year review, plume extent and contaminant concentrations have continued a general decline. The OU-1 and Castle Vista groundwater treatment systems and MW824/MW1037 and MW1009, MW883/MW1021 and MW941 wellhead treatment systems have been shut down with regulatory agency concurrence. The OU-2 and Phase 3 groundwater treatment plants and the MW951 wellhead treatment system continue to operate. The MW1046 wellhead treatment system was recently restarted in April 2013.

The Main Base Plume Protectiveness Statement from the third five-year review is as follows:

The remedial action implemented for the Main Base Plume is protective of human health and the environment. The remedy is functioning as designed (plume control and reduction), expected progress has been made towards achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner and have been optimized to the extent practical (OU-1 treatment plant and MW883/MW1021, MW941, and MW1009 wellhead treatment systems have been shut down). ICs to restrict use of groundwater exceeding MCLs are in place, are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness. A screening level assessment determined that the cancer risk associated with potential vapor intrusion from the current levels of groundwater contamination in the Shallow HSZ is less than $1x10^{-6}$.

The following issues and recommendations were presented for the identified plumes at CAFB in the third five-year review report. The current status of each issue/recommendation is summarized.

Main Base Plume issues:

- Issue #1: The lack of active Shallow HSZ pump-and-treat remediation and plume capture in the former OU-1 area where TCE concentrations have rebounded to above MCL levels was identified as a potential issue that could affect protectiveness of the Main Base Plume remedy in the future. The third five-year review report contained a recommendation that the Air Force perform an assessment of the feasibility of optimizing the existing remedy (pump-and-treat) or applying alternative technologies (e.g., *in-situ* chemical oxidation [ISCO]) to address the remaining contamination in the Shallow HSZ. The assessment was to be presented in the form of a Technical Memorandum appended to the 2009 or 2010 LTGSP Annual Report. If the Technical Memorandum recommended a change in the remedy and the regulatory agencies concurred, the Air Force would have prepared the necessary documentation (i.e., a ROD Amendment or an Explanation of Significant Difference) to change the remedy for this portion of the Main Base Plume.

  Status: This issue was addressed in the Revised Final Former CAFB LTGSP 2011 Semi-Annual Report (CH2M Hill, 2012d). As stated in the report, the OU-1 plume is captured (and has been captured since the OU-1 system was shut down) by the Phase 3 extraction wells located downgradient of the OU-1 plume in the underlying USS HSZ. This fact is supported by the Shallow HSZ capture zone maps (presented in LTGSP Annual and Semiannual Reports), which show the presence of a large hydraulic depression within and downgradient of the OU-1 TCE plume. Additionally, an in-situ, enhanced bioremediation study conducted in 2005 indicated a limited effective range for injection of Hydrogen-Releasing Compound (HRC) and the Air Force determined that further use of HRC was not cost effective (Jacobs, 2005d). Finally, the saturated thickness of the Shallow HSZ is too small to support active pumping. Groundwater monitoring, including evaluation of contaminant concentrations and plume capture in the former OU-1 area, continues under the LTGSP.

The follow up actions achieved the intended purpose.

- Issue #2: In response to concerns expressed by the regulatory agencies, it was recommended that a focused round of groundwater sampling for 1,4-dioxane be conducted. This compound, an emerging chemical of concern, has been detected at several sites in the Central Valley of California, but the groundwater at CAFB has never been tested for this chemical.

  Status: The Air Force conducted a special groundwater sampling event for 1,4-dioxane in March and April 2009, following, to the extent possible, the Groundwater Sampling Plan for 1,4-Dioxane Screening (Jacobs, 2009b). Groundwater samples were collected from ten monitoring wells, one irrigation well, and influent streams to four treatment plants. Two of the original candidate monitoring wells were dry (JM1 and JM15), so another monitoring well in the vicinity was sampled as a replacement (MW520). The samples were analyzed for 1,4-dioxane by EPA Method 8270C. 1,4-Dioxane was not detected in any of the groundwater samples (Jacobs, 2009d).

  The follow up actions achieved the intended purpose.

The Castle Vista Plume Protectiveness Statement from the third five-year review is as follows:

The remedial action implemented for the Castle Vista Plume is protective of human health and the environment. The remedy is functioning as designed (plume control and reduction), expected progress has been made towards achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner and have been optimized to the extent practical (Castle Vista treatment plant shut down). ICs to restrict use of groundwater exceeding MCLs are in place, are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

The following issues and recommendations were presented for the Castle Vista Plume in the third five-year review report. The current status of each issue/recommendation is summarized:

- Issue #1: Pump-and-treat remediation (i.e., the MW003 wellhead treatment system) was noted to be an ineffective technology for elimination of the small residual plume centered on MW003. The third five-year review report indicated that this was delaying ultimate closure of the Castle Vista Plume remedial action. The Air Force's recommended action was additional site characterization and an alternative remedial technology (ISCO).

  Status: The Air Force completed the Final Castle Vista ISCO Pilot Study Work Plan (AR #3002) in July 2008 and proceeded with implementation in the fall of 2008. Based on sampling results, additional investigation was warranted. As described in Section 4.1.2.2, the *Castle Vista Vadose Zone/Groundwater Characterization Study Work Plan* (CH2M HILL, 2009b) was implemented during late 2009 and early 2010, with the results presented in the *Castle Vista Vadose Zone/Groundwater Characterization Report* (CH2M HILL, 2010c). An SVE system was operated in the area from November 2009 to January 2010 to remove cis-1,2-DCE in the deep vadose zone but there was minimal mass recovery. As part of the 2009 work plan implementation, two monitoring wells (MW1046 and MW1047) were installed to better delineate the existing plume and to serve as extraction wells, if necessary. MW1046 was operated as an extraction well for a portion of 2010, along with EW39. However, the treatment system was turned off with regulatory concurrence in August 2010 for a long-term rebound study because *cis*-1,2-DCE concentrations had been below the MCL at both extraction wells for at least three consecutive months. The wellhead system operated for a short period in March and April 2011 with extraction from wells EW39 and MW1046. The wellhead system was restarted in April 2013 with extraction from MW1046 due to *cis*-1,2-DCE exceeding restart criteria.

The follow up action is achieving the intended purpose, this action is ongoing.

5.2 SCOU REMOVAL/REMEDIAL ACTIONS

The SCOU sites assessed in the previous five-year review were ETC-10, ETC-12, FTA-1, LF-3, LF-4 (DP-5 and DP-6), and LF-5 (DP-8, DP-8A, and LF-5 Trenches). The removal actions ongoing or completed at that time were found to be protective of human health and the environment. No issues were noted in the third five-year review report, although recommendations were presented for the identified SCOU sites. The Protectiveness Statement from the third five-year review and the current status of each recommendation is summarized below for each of the SCOU sites.

The Earth Technology Corporation 10 Protectiveness Statement from the third five-year review is as follows:

The remedial actions implemented for ETC-10 are protective of human health and the environment. The remedies are functioning as designed (access restricted and ecological monitoring conducted), there are no issues and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-10 were conducted in the spring of 2008. Results of the surveys show no evidence that fairy shrimp abundance, plant diversity or plant abundance is statistically less (95% confidence level) in potentially impacted pools than in background pools.

Earth Technology Corporation 10 recommendation:

- LTEM: The previous five-year review report recommended that one additional round of LTEM be conducted by the Air Force at an appropriate time during the next five years (a year with average or above winter precipitation) to further confirm that there are no ecological impacts.

  Status: LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient (a year with average or above winter precipitation) rainfall.

The follow up action has not achieved the intended purpose because drought-like conditions have prevented additional LTEM.

The Earth Technology Corporation 12 Protectiveness Statement from the third five-year review is as follows:

The remedial action implemented for ETC-12 is protective of human health and the environment. The remedy is functioning as designed (ecological monitoring conducted), there are no issues and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-12 were conducted in the spring of 2008. Results of the surveys show no evidence that fairy shrimp abundance, plant diversity or plant abundance is statistically less (95% confidence level) in potentially impacted pools than in background pools.

Earth Technology Corporation 12 recommendation:

- <u>LTEM</u>: The previous five-year review report recommended that one additional round of LTEM be conducted by the Air Force at an appropriate time during the next five years (a year with average or above winter precipitation) to further confirm that there are no ecological impacts.

  <u>Status</u>: LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-12 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient rainfall.

  The follow up action has not achieved the intended purpose because drought-like conditions have prevented additional LTEM.

The Fire Training Area 1 Protectiveness Statement from the third five-year review is as follows:

The remedial actions implemented for FTA-1 are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active and ecological monitoring conducted), there are no issues and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap, including reporting of any evidence of human access or alteration, is being conducted quarterly. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of FTA-1 were conducted in the spring of 2008. Results of the surveys show no evidence that fairy shrimp abundance, plant diversity or plant abundance is statistically less (95% confidence level) in potentially impacted pools than in background pools. Although not an issue for the FTA-1 remedies, continued sampling of the two monitoring wells at FTA-1 with recent TCE detections near or above the MCL is recommended.

FTA-1 recommendations:

- <u>TCE detections in two wells at the FTA-1 Site</u>: Two LTGSP monitoring wells near FTA-1 (MW320 [grid M15] and MW886 [grid M14]) had reported detections of TCE near or just above the MCL (Q1/07 and Q2/07). This was not viewed as a significant issue, but monitoring of the two wells was recommended to continue until TCE concentrations in both wells were below the MCL for two consecutive sampling events. If concentrations increase, it was recommended that appropriate actions be assessed with the regulatory agencies.

  <u>Status</u>: Per the *Long-Term Groundwater Sampling Program 2008 Annual Report* (Jacobs, 2009c), regular monitoring of these two wells was reinitiated as a part of FTA-1 closure monitoring. MW320 could not be sampled in Q1/08 or Q2/08 because the well was dry. Per the *Operations, Maintenance, and Monitoring 2009 Annual Report* (CH2M HILL, 2010b), MW886 and MW320 could not be sampled in Q2/09 because the wells were dry. Per the 2010 and 2011 *Operations, Maintenance, and Monitoring Annual Reports* (CH2M HILL, 2011a and 2012a), all FTA-1 monitoring wells had gone dry by 2009. The 2011 report recommended collecting additional groundwater data to close FTA-1. A Work Plan that included a replacement well for MW886 was finalized in October 2012 (CH2M Hill, 2012c) and implemented in August 2013.

The follow up action has not yet achieved the intended purpose because the monitoring wells went dry and there has not been sufficient sampling since the wells were replaced in August 2013.

- LTEM: The previous five-year review report recommended that one additional round of LTEM be conducted by the Air Force at an appropriate time during the next five years (a year with average or above winter precipitation) to further confirm that there are no ecological impacts.

  Status: LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the FTA-1 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient rainfall.

  The follow-up action has not achieved the intended purpose because drought-like conditions have prevented additional LTEM.

The Landfill 3 Protectiveness Statement from the third five-year review is as follows:

The remedial action implemented for LF-3 is protective of human health and the environment. The remedy is functioning as designed (ecological monitoring conducted), there are no issues and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-3 were conducted in the spring of 2008. Results of the surveys show no evidence that fairy shrimp abundance, plant diversity or plant abundance is statistically less (95% confidence level) in potentially impacted pools than in background pools.

Landfill 3 recommendation:

- LTEM: The previous five-year review report recommended that one additional round of LTEM be conducted by the Air Force at an appropriate time during the next five years (a year with average or above winter precipitation) to further confirm that there are no ecological impacts.

  Status: LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-3 site was planned but not conducted in

> 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient rainfall.
>
> The follow-up action has not achieved the intended purpose because drought-like conditions have prevented additional LTEM.

The Landfill 4 (DP-5, DP-6) Protectiveness Statement from the third five-year review is as follows:

The remedial actions implemented for LF-4/DP-5/DP-6 are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active), there are no issues and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place as part of the deed transferring the parcel containing LF-4 to Merced County and a State Land Use Covenant executed by the Air Force and the State of California. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted quarterly.

There were no recommendations for Landfill 4 in the third five-year review report.

The Landfill 5 (DP-8, DP-8A, LF-5 Trenches) Protectiveness Statement from the third five-year review is as follows:

The remedial actions implemented for LF-5/DP-8/DP-8A/LF-5 Trenches are protective of human health and the environment. The ongoing remedies are functioning as designed (access restricted, cap maintenance and monitoring active and ecological monitoring conducted), there are no issues and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted quarterly. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-5 were conducted in the spring of 2008. Results of the surveys show no evidence that fairy shrimp abundance, plant diversity or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools.

Landfill 5 recommendation:

- LTEM: The previous five-year review report recommended that one additional round of LTEM be conducted by the Air Force at an appropriate time during the next five years (a year with average or above winter precipitation) to further confirm that there are no ecological impacts.

  Status: LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-5 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient rainfall.

  The follow-up action has not achieved the intended purpose because drought-like conditions have prevented additional LTEM.

6 FIVE-YEAR REVIEW PROCESS

Executive Order 12580 authorized the Air Force to perform the initial and all subsequent five-year reviews for the CAFB site. The Air Force has and will handle all administrative components of the five-year review process, including community notification and involvement.

6.1 ADMINISTRATIVE COMPONENTS

The fourth five-year review team was led by Ms. Karen Kramer (Project Manager), and Mr. Eric Rowney (Project Technical Lead). The team was assisted by members of various Base consultants to the AFCEC. Stanley Pehl (the AFCEC Program Manager for Castle) provided oversight and technical direction. Input was also provided by the current Base contractor (CH2M HILL), the USEPA, the DTSC, and the Central Valley RWQCB.

The review schedule was established by the aforementioned review team and included the following components:

- Community involvement;
- Document review;
- Data review;
- Site inspection; and
- Interviews.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

On 6 June 2013, a public notice of the Castle Five-Year Review was provided to the *Merced Sun Star* to announce the initiation of a fourth five-year review at CAFB (the public notice is included in Appendix B). In the notice, the public was encouraged to contact Stanley Pehl, AFCEC, via telephone or e-mail if they had questions, comments, or suggestions concerning the ongoing remediation program at CAFB.

A second notice will be published in the same newspaper after finalization of this document. The Castle Restoration Advisory Board (RAB) has been adjourned and need not be notified. Copies of the final document will be made available in the Air Force online Administrative Record at http://afrpaar.lackland.af.mil/ar/.

6.3 DOCUMENT REVIEW

This fourth five-year review consisted of a review of relevant documents, including monitoring data and monitoring reports, applicable cleanup standards, select RI reports, annual RAO reports, technical memoranda, and RODs. In addition to the preceding, the following documents were reviewed for the fourth five-year review:

- *Long-Term Groundwater Sampling Program 2012 Semiannual Report* (CH2M HILL, 2013a);
- *Operations, Maintenance, and Monitoring 2012 Annual Report* (CH2M HILL, 2013b);
- *Operations, Maintenance, and Monitoring 2011 Annual Report* (CH2M HILL, 2012a);
- *Operations, Maintenance, and Monitoring 2010 Annual Report (CH2M HILL, 2011a);*
- *Operations, Maintenance, and Monitoring 2009 Annual Report* (CH2M HILL, 2010b);
- *Landfill Inspection and Monitoring Report for Landfill 4, Landfill 5, and Fire Training Area 1 – 2008 Annual Report* (MWH, 2009a);
- *Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b);
- *Fire Training Area 1 Well Installation Work Plan* (CH2M HILL, 2012c); and
- *Third Castle Airport Five-Year Review Report* (Jacobs, 2009a).

6.4 FIVE-YEAR REVIEW SITE INSPECTION

The site inspection was conducted by Mr. Eric Rowney of MWH on 18 June 2013. During this inspection, MWH viewed each active Remedial Action Site and completed each site inspection form. MWH also visited all of the treatment facilities. Additionally, MWH interviewed Ralph Scull, O&M Site Management Field Technician, regarding the sites that have active treatment.

A comprehensive 14-page site inspection form, provided in the EPA *Comprehensive Five-Year Review Guidance* (EPA, 2001), was used to direct the site inspection; the form itself was completed for the following sites: Main Base Plume site, Castle Vista Plume site, ETC-10, ETC-12, FTA-1, LF-3, LF-4, and LF-5. The completed site inspection forms are included in Appendix C. Site inspection photographic logs are also included in Appendix C.

During this site inspection, the following activities were also performed:

- On-site documents and records were verified;
- Access and ICs were inspected; and
- General site conditions were evaluated and photographed.

Generally, all sites appeared to be in good condition with regard to such features as monitoring wells, roads, and fencing. All required on-site documents requested were made available. Overall, no major concerns or issues were identified during the site inspection.

The following minor O&M issues and Site concerns were noted during the site inspection:

- Although there was evidence of historical graffiti on the fencing of several wells in the Main Base Plume Site, the graffiti has been painted over, and there is no evidence of impact on the system components.
- At the OU-2 treatment system:
    - EW11 had a broken grounding wire between a flange and the aboveground piping.
    - EW12 had a broken grounding wire between a flange and the aboveground piping.
    - Sample ports should be checked for readability, and re-stenciled as necessary while they can be read, as some are fading.
    - The PVC piping that is part of the treatment system at OU-2 should be monitored for degradation due to ultraviolet light exposure.
    - The OU-2 treatment system has several drips emanating from the flex hosing connections. These drips are not significant, but they should be fixed as some of the drips represent untreated water.
- At the Phase 3 treatment system:
    - At EW19, the electrical panel has corrosion on the 120-volt receptacle and the control panel.
    - At EW34, valve drips were noted on the bottom of the strainer.
    - At EW36, valve drips were noted on the bottom of the strainer.
    - At IW27, the valve is rusted and therefore the well is not used.
    - At IW28, there is a hole in the valve body, and therefore it is not used (IW30 is utilized instead of IW28).
    - Sample ports should be checked for readability, and re-stenciled as necessary while they can be read, as some are fading.

- The PVC piping that is part of the treatment system at MW951 and D5766 should be monitored for degradation due to ultraviolet light exposure.
- At FTA-1, burrowing animal holes were evident over the surface of the vegetative cover; however, the holes did not appear to have impacted the integrity of the landfill liner or adversely impacted the stability of the vegetative soil cover.
- At LF-4, it was noted that because of vegetative growth in the drainage ditches, the extent of vegetation in the drainage channels should be evaluated to determine if it is an obstruction to drainage flow off of and away from the landfill cap.
- At LF-5:
    - There are various depressions in the landfill surface. The observed direction of the depressions indicated that the landfill cap should be directing water off of and away from the landfill cap. It was noted that the depth and extent of depressions should be evaluated as part of the aerial survey.
    - Burrowing animal holes were evident over the surface of the vegetative cover; however, the holes did not appear to have impacted the integrity of the landfill liner or adversely impacted the stability of the vegetative soil cover.
    - It was noted that because of vegetative growth in the drainage ditches, the extent of vegetation in the drainage channels should be evaluated to determine if it is an obstruction to drainage flow off of and away from the landfill cap.
    - The culverts on the southeastern part of the Site that transfers drainage water from the landfill and off site are partially filled with rock. It appears that transfer and drainage of water can still take place; however, it was noted that these culverts should be cleaned out to maintain maximum capacity in the event of significant rain events.

6.5 INTERVIEWS

During June and July 2013, Ms. Diane Krueger of MWH conducted interviews with 10 individuals representing a cross-section of community, regulatory, and AFRPA involvement with the CAFB remediation program. Interviews were conducted over the phone and via email. The purpose of these interviews was to document the perceived status of the CAFB remediation program and to document successes and any problems with the implemented remedies. Each interview followed the set of standard questions recommended in Appendix C of EPA's *Comprehensive Five-Year Review Guidance* (EPA, 2001). General interviewee impressions of the project are included below. The reader is referred to Appendix D for the specific questions and responses for each interview in their entirety. Comments below are excerpted from those that appear in Appendix D.

The following individuals were interviewed:

- Nadia Hollan Burke, Remedial Project Manager and Environmental Engineer, EPA Region IX, San Francisco, California
- Theresa McGarry, Remedial Project Manager, DTSC, DTSC Sacramento Field Office, Sacramento, California
- Chris Cochrane, Engineering Geologist, Central Valley RWQCB, Rancho Cordova, California
- Marcus Pierce, Remedial Project Manager, Central Valley RWQCB, Rancho Cordova, California
- Campbell McLeod, Project Manager, CH2M Hill, Sacramento, California
- Daniel Chern, Staff Engineer/Field Manager, CH2M Hill, Sacramento, California
- Mark Hendrickson, Director, Merced County Department of Commerce, Aviation & Economic Development, Merced, California
- James Pichner, Assistant Airport Manager, Castle Airport, Atwater, California
- Randy McCarty, Facilities Manager, BoP United States Penitentiary, Atwater Complex, Atwater, California [Note: No Response]
- Russ Enos, Private Landowner, land adjacent to Castle Airport, Winton, California
- Leland Hancock, Private Landowner, Castle Gardens housing area, Discovery Bay, California

6.5.1 Summary of General Impressions of the Project

Overall, interviewees believe the project is moving along very well, that it has had few if any negative effects on the surrounding community, and they feel well informed about the Site activities and progress. Only one of the interviewees was aware of any events, incidents, or activities at the Site such as vandalism, trespassing, or emergency responses from local authorities. The interviewees are appreciative of the cleanup efforts and ongoing relationships with those responsible for the remediation work. There are regulatory agency concerns, however, that regional declines in groundwater levels have created the potential for residual contaminants in the vadose zone in some areas.

6.5.1.1 From Community Representatives

Community representatives, including private landowners, stated that the work is being conducted in a professional manner, the workers are courteous, and the ongoing activities seem to have no negative effects on the surrounding community. However, Mr. Hancock, a private landowner of the Castle Gardens housing area, had concerns because some equipment blocks the use of a residential garage. He also was under the impression that because the Sites were substantially cleaned up, the pumping and field work should be ending soon. Additionally, Mr. Enos, a private landowner of land adjacent to Castle Airport, had concerns because pumps, meters, and test wells are in his way; he has to dodge them with his tractors and equipment. He was also under the impression that because cleanup is almost finished, the equipment on his property should be removed soon. Mr. Hendrickson, Director of the Merced County Department of Commerce, Aviation & Economic Development did note that vandalism in the form of graffiti has occurred on fencing around some of the monitoring wells in recent months. These incidents were reported to the Merced County Sheriff's Department.

6.5.1.2 From Regulatory Representatives

Project regulators stated that they meet regularly with Air Force representatives to discuss the status of ongoing remedial activities; they receive updates on projects; and they feel well-informed about the Site activities. It was noted that there have not been any complaints, violations, or other incidents related to the Site, with the exception of minor releases of untreated groundwater, typically caused by mechanical or electrical failures in the groundwater extraction/treatment systems or by accidents. The interviewees state that the AF has addressed these minor releases promptly and reported them in a timely manner to the project regulatory team, along with the corrective actions that were implemented.

Mr. Pierce, Remedial Project Manager, Central Valley RWQCB, stated that due to a declining water table, there may be VOCs left behind in the vadose zone that could pose a future threat to water quality or to human health. He doesn't expect this to be a Base-wide problem, but noted that the AF should consider investigating residual VOC concentrations in a few of the former hotspots in the Shallow HSZ.

Ms. Burke, Remedial Project Manager and Environmental Engineer with EPA Region IX, noted that the efficiencies and performance of the remedial actions, as well as the adequacy of the monitoring well networks, have been impacted by regional declines in groundwater levels. She feels that many technical issues have surfaced with regards to whether the systems are operating and monitored optimally or appropriately, and that there also seems to be an increasing number of repairs needed to address spills and leaks due to the aging remedial treatment systems. Ms. Burke suggested that the AF review their strategy for achieving closure with the existing systems, monitoring network, and contracting mechanisms, or if changes are likely to be needed, including decision document modifications to address optimization needs, and an increased demand for O&M repairs should they be necessary to keep up with an older system and changing site conditions. She stated that Site conditions have changed over time, and the remedial decisions made in the past may no longer be appropriate for current conditions, and may need to be re-visited.

Ms. McGarry, Remedial Project Manager for DTSC, of the DTSC Sacramento Field Office, stated her concern that issues sometime arise due to the AF's use of performance-based contracts. Because of these types of contracts, contractors may resist regulatory requests when the work was not anticipated and not included in scopes of work. She provided the example of requests regarding O&M procedures, such as dry well replacement, which doesn't carry the same importance as achieving closure or other performance objectives.

6.5.1.3 From AFCEC Employees and Contractors

AFCEC employees and contractors stated that the project is going well and the remedy is functioning as expected/designed.

The Site contractors noted the following positive points:

- The groundwater and landfill remedies are successfully meeting the ROD requirements.
- The groundwater treatment systems are maintaining plume capture even after several extraction wells have been turned off.
- The groundwater treatment plants have been downsized and simplified; the changes continue to be protective but are more cost-effective, with system efficiency increased and energy costs decreased.

- The groundwater sampling program has been simplified and sampling time has been reduced.
- Value has been provided by capturing and remediating the MCL plume and re-injecting the treated groundwater.
- The reorganization of sampling events to the second and fourth quarters better aligns with high and low groundwater levels and better sampling weather.
- Reports have been revised to be more focused and concise.
- Replacements have included extraction well pumps and monitoring wells.

The Site contractors noted the following issues:

- Several leaks have occurred along the groundwater conveyance lines and at the treatment systems; however, they have been reported, and corrective actions were implemented in accordance with existing O&M plans. Repair of leaks are addressed when identified and repairs are made under the ongoing O&M and monitoring of the treatment systems. The volumes and concentrations were low and have not exceeded recordable quantities, and therefore do not represent a protectiveness issue.
- The Supervisory Control and Data Acquisition (SCADA) system is outdated, with obsolete software and worn out hardware.

6.5.2 Site-Specific Comments

6.5.2.1 Main Base Plume Site

No comments were received that pertain specifically to the Main Base Plume Site.

6.5.2.2 Castle Vista Plume Site

No comments were received that pertain specifically to the Castle Vista Plume Site.

6.5.2.3 ETC-10

No comments were received that pertain specifically to ETC-10.

6.5.2.4 ETC-12

No comments were received that pertain specifically to ETC-12.

6.5.2.5 FTA-1

No comments were received that pertain specifically to FTA-1.

6.5.2.6 LF-3

No comments were received that pertain specifically to LF-3.

6.5.2.7 LF-4

Mr. Enos, a private landowner of land adjacent to Castle Airport, pointed out problems with a pile of soil from LF-4 that abuts his property, which is covered with weeds and appears to draw squirrels and other nuisance animals.

6.5.2.8 LF-5

No comments were received that pertain specifically to LF-5.

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7 TECHNICAL ASSESSMENT

Separate technical assessments are provided for the two groundwater plume remedial actions and the eleven SCOU site remedial actions considered in this five-year review. Table 7-1 provides a summary of the technical assessment for each of the remedial actions.

7.1 MAIN BASE PLUME REMEDIAL ACTION

The CB ROD – Part 1 remedy for the Main Base Plume is:

- Plume capture and cleanup of the most restrictive contaminant (currently TCE) to MCL levels.

The CB ROD – Part 2 remedies for the Main Base Plume are:

- ICs to restrict groundwater use within plumes exceeding an MCL;
- Wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells; and
- Local (wellhead) treatment to address groundwater contamination exceeding MCLs within the off-base Confined HSZ plume.

The MCL for TCE at the time of the CB ROD – Part 1 was 5 µg/L; that value remains in effect as of the date of this five-year review. While other VOCs occur in the Main Base Plume (*cis*-1,2-DCE and PCE are the most common minor COCs), they are at much lower concentrations than TCE and currently do not occur outside the TCE plume boundaries at levels exceeding MCLs. For 2012 and the first two quarters of 2013, there were no VOCs exceeding MCL that were outside of the Main Base TCE plume boundary. For these reasons, this technical assessment addresses only TCE. Note that all discussion of the Main Base Plume in this section and subsequent sections refers to the plume as defined by the 5 µg/L or MCL plume boundary or contour and not the 0.5 µg/L plume contour, which is also shown on select figures.

The Main Base Plume groundwater remediation system consists of three separate groundwater treatment systems (OU-1 [shut down as of May 2003], OU-2, and Phase 3), and several independent wellhead treatment systems that are administratively identified with the Phase 3 system

(MW883/MW1021 [shut down as of August 2002], MW824/MW1037 [off-line as of October 2006], MW941 [shut down as of May 2004], MW951, and MW1009 [off-line as of February 2008]).

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

7.1.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of TCE plume reduction (plume extent and concentration), hydraulic control, and treatment system operation (cumulative amount of groundwater treated and contaminant mass removed). Information on current conditions is derived from plume and treatment system monitoring conducted under the LTGSP. The primary LTGSP documents used to support this five-year review are the *Operations, Maintenance, and Monitoring 2012 Annual Report* (CH2M HILL, 2013b), which includes the 2012 LTGSP report; and the *Long-Term Groundwater Sampling Program 2012 Semiannual Report* (CH2M HILL, 2013a). Based on a review of factors presented in this section, the remedy is functioning as intended by the decision documents for the Main Base Plume with early indicators of potential issues identified in Section 7.1.1.4.

7.1.1.1.1 Plume Reduction

Current (Q4/12) TCE plume configuration is shown on Figures 7-1 (Shallow HSZ), 7-2 (USS HSZ), 7-3 (LSS HSZ), and 7-4 (Confined HSZ). Comparison of the current TCE plume configurations with those from Q2/94 (Figures 3-4 through 3-7) shows that significant decreases in plume size and extent have occurred over 18 years as a result of the remedial action.

Areal extent of the Shallow HSZ Main Base Plume decreased approximately 93 percent from Q4/96 through Q4/12. Plume extent decreased approximately 11 percent from Q4/11 through Q4/12 (CH2M HILL, 2013a).

Areal extent of the USS HSZ Main Base Plume decreased approximately 76 percent from Q4/96 through Q4/12. Plume extent increased approximately 25 percent from Q4/11 through Q4/12; the increase was due to the Q4/12 Phase 3 area encompassing EW34, where TCE concentration increased from 3.9 µg/L (Q4/11) to 6.7 µg/L (Q4/12; CH2M HILL, 2013a).

Areal extent of the LSS HSZ Main Base Plume decreased approximately 66 percent from Q4/96 through Q4/12. Plume extent increased approximately 10 percent from Q4/11 through Q4/12; the increase was due to the Q4/12 plume area encompassing operating extraction well EW20 and adjacent monitoring well MW975, where TCE concentrations increased above the MCL in Q4/12 to 7.0 and 7.3 µg/L, respectively (CH2M HILL, 2013a).

Areal extent of the Confined HSZ Main Base Plume decreased approximately 95 percent from Q4/96 through Q4/12. However, plume extent increased approximately 39 percent from Q4/11 through Q4/12; the increase was due to operating extraction well MW951 and off-line extraction well EW23, whose TCE concentrations increased above the MCL in Q4/12 to 5.6 and 5.4 µg/L, respectively (CH2M HILL, 2013b). As of Q4/12, EW23 is the only location that exceeded the MCL in the on-base Confined HSZ. EW23 was shut off in Q2/06 with agency approval after three consecutive sampling events with TCE concentrations below the MCL and has since been monitored and evaluated for restart in the LTGSP reports. Since shutdown, TCE has not been sustained above the MCL and the maximum result since EW23 was turned off was 5.9 µg/L in Q1/09. The Q2/13 analytical result for TCE was 1.6 µg/L such that there currently is no on-base Confined HSZ plume that exceeds the TCE MCL. As stated in the 2012 Annual LTGSP report (CH2M HILL, 2013a), monitoring results since shutdown have not warranted EW23 restart. Monitoring and evaluation of EW23 and the on-base Confined HSZ continues under the LTGSP.

7.1.1.1.2 Plume Capture

Groundwater elevation contours for Q4/12 for the site HSZs are shown on Figures 7-6 through 7-9. Prior to groundwater remediation at CAFB, groundwater flow in all HSZs was essentially from east to west. Groundwater elevation contours from Q4/12 clearly show the effects of pumping for groundwater remediation in the Main Base Plume area. The most noticeable effects have been the development of groundwater depressions near or along the Base boundary in all four HSZs, and the development of groundwater mounds blocking off-Base flow in the Shallow and USS HSZs.

Estimated hydraulic capture zones and the Q4/12 MCL plume contours (5 µg/L plume contour for TCE) for the Main Base Plume are also shown on Figures 7-6 through 7-9. The hydraulic capture zones portrayed on these figures are the result of interpretation of groundwater elevation contours by a professional hydrogeologist.

Capture of the southern Shallow HSZ, northern and southern USS HSZ, and the LSS HSZ Main Base Plume is considered complete. The OU-2 area, including extraction wells EW11 and EW12, is being monitored and the wellhead treatment system operated based on the regulatory approved *Operable Unit 2 Rebound Study Work Plan* (CH2M Hill, 2009a). Although capture is not achieved during periods of system shutdown, rebound monitoring provides data to support evaluations, in consultation with the agencies, of whether the system should be restarted. Capture of the OU-2 plume area has been demonstrated during operation of the wellhead treatment system. However, the rebound concentrations are higher (as of 4Q/12 the maximum TCE concentrations in wells MW804A, MW806A and MW948 were 27 µg/L, 28 µg/L, and 37 µg/L, respectively) and the rebound duration has been longer than anticipated when the rebound study was initiated in 2009. Consideration of additional actions that may be necessary to improve the rate of contaminant mass removal and to confirm hydraulic control is appropriate. See the discussion of this issue and recommendations in Section 7.1.1.4, Early Indicators of Potential Issues. The wellhead treatment system at MW951 is capturing a portion of the off-Base plume segment within the Confined HSZ (capture of the off-base Confined HSZ plume area is not required by the remedy). The northeastern plume segment in the Shallow HSZ is not capable of being captured by the MW824/MW1037 wellhead treatment system unless water levels increase in this area and the system can resume operation. The system was shut down when water levels in MW824/MW1037 had decreased to such an extent that pumping could no longer be sustained. The inlet TCE concentration just prior to shutdown was approximately 5 µg/L. August 2007 concentrations were 6.9 µg/L for MW824 and 4 µg/L for MW1037. Since 2006, the system has remained off line with regulatory agency concurrence and associated monitoring wells have been monitored in accordance with recommendations established in the annual LTGSP Reports (2007-2012). The northeastern plume segment had only two wells in exceedance of the MCL in 2012 (MW1014, during annual sampling, and MW1015 in 4th quarter). Sampling in 2013 indicates that only MW1015 exceeds the MCL. There are no indications that concentrations exceeding the MCL are migrating downgradient. While the northeastern plume segment is not captured, monitoring results establish that the remaining plume area is very small, the contaminant concentrations have not indicated an increasing trend, and the limited area and levels of groundwater contamination have not migrated. In addition, if plume migration is indicated by monitoring, in accordance with the *Rebound Study Work Plan* (CH2M Hill, 2009a) the Air Force will either demonstrate that migrating contaminants will be captured by extraction wells EW11 and/or EW12 in the underlying USS HSZ or evaluate appropriate actions with the regulatory agencies.

7.1.1.1.3 Treatment System Operation

Treatment system operation for the Main Base Plume is summarized in terms of the number of extraction and injection wells (OU-1, OU-2, and Phase 2/3 only), and the cumulative gallons of groundwater treated and pounds of contaminant removed (all VOCs, but primarily TCE), as of system shutdown or the end of Q4/12 (December 2012; CH2M HILL, 2013a):

- The OU-1 treatment system went online in July 1994 (five extraction wells and nine injection wells) and was shut down in May 2003 (all extraction and injection wells offline). During its approximate eight years of operation, the system treated over 1.59 billion gallons of groundwater and removed 695 pounds of VOCs.
- The OU-2 system went online in November 1996 (fifteen extraction wells and eleven injection wells) and remains in operation (one operating extraction well [EW12], one injection well [IW02], and a GAC treatment plant with two pairs of 2,000-pound vessels). The OU-2 plant has treated approximately 5.26 billion gallons of groundwater and has removed about 857 pounds of TCE from startup through December 2012; the OU-2 plant treated approximately 55 million gallons of groundwater and removed about 2.4 pounds of TCE during 2012. No OU-2 treatment plant influent samples were collected during 2012; however, TCE concentrations at EW11 and EW12, which operated singly at different times during 2012, ranged from 3.2 to 13 µg/L.
- The Phase 2 treatment system went online in September 1997 (seven extraction wells and seven injection wells). The Phase 3 expansion went online in May 2000 (eight additional extraction wells and eight additional injection wells) and remains in operation (four operating extraction wells [EW19, EW20, EW34, and EW36], four injection wells [IW27, IW28, IW29, and IW31], and a GAC treatment plant with one pair of 10,000-pound vessels). The Phase 3 plant has treated approximately 7.8 billion gallons of groundwater and has removed about 1,246 pounds of TCE from startup through December 2012; the Phase 3 plant treated

approximately 170 million gallons of groundwater and removed about 12 pounds of TCE during 2012. The single Phase 3 treatment plant influent sample collected during 2012 contained TCE at 10 µg/L (July).

- The MW883/MW1021 wellhead system went online in January 2001 (solar wagon at MW883; MW883/MW1021 system online in August 2002), and was shut down in October 2004. During its approximate four years of operation, the system treated over 19.8 million gallons of groundwater and removed 4.5 pounds of VOCs.
- The MW941 wellhead system went online in June 2002 (solar wagon), and was shut down in May 2004. During its approximate two years of operation, the system treated over 2.8 million gallons of groundwater and removed 0.2 pounds of VOCs.
- The MW824/MW1037 wellhead system went online in August 2002 (MW824 only; MW1037 added in June 2005), and was shut down in October 2006 because of low water levels. During its approximate four years of operation, the system treated over 27.5 million gallons of groundwater and removed 2.75 pounds of VOCs.
- The MW951 wellhead system (wellhead GAC treatment system with injection of the treated water at IW37) went online in July 2001 and remains in operation. The MW951 system has treated approximately 332 million gallons of groundwater and has removed about 27.8 pounds of TCE from startup through December 2012; the MW951 system treated approximately 19.7 million gallons of groundwater and removed about 0.7 pounds of TCE during 2012. The MW951 wellhead treatment system influent was sampled twice in 2012 and TCE concentrations ranged from 3.9 (May) to 5.6 µg/L (November).
- The MW1009 wellhead system went online in January 2002, and was shut down in February 2008. During approximately six years of operation, the system treated over 138 million gallons of groundwater and removed 10 pounds of VOCs.
- The entire Main Base Plume remedial system (not counting the prior groundwater removal actions; see Sections 3.4.1, 3.4.2 and 3.4.3) has treated approximately 14.8 billion gallons of groundwater and removed 2,816 pounds of TCE through the end of 2012. This represents more than 100 percent of the estimated total mass prior to system operation (2,500 pounds). Because a fraction of the mass removed by the Main Base Plume remedial system is likely drawn from outside the 5-µg/L plume boundary, the percent of total mass removed from the portion of the plume within the cleanup objective boundary is likely overestimated (CH2M HILL, 2013a).

7.1.1.1.4 CB ROD – Part 2 Remedies

ICs to restrict groundwater use within plumes exceeding an MCL: As noted in Section 4.1.2.3, ICs, in the form of land use restrictions, were incorporated as a grantee covenant in the deed formally transferring the majority of the former CAFB to Merced County. Similar ICs were incorporated as a grantee covenant in the deeds transferring a portion of the former CAFB to the Merced Union School District (the deed was recorded on 12 March 2007, Merced County Recorder's document #2007-016027), transferring Veteran's Park to the City of Atwater (the deed was recorded on 2 February 2007, Merced County Recorder's document #2007-008545), and transferring portions of the former Castle Gardens housing area to private landowners (the deeds were recorded on 19 February 1998, Merced County Recorder's document #5400, and 19 January 2007, Merced County Recorder's document #2007-003735). These covenants placed restrictions on the installation of wells, precluded disturbance of any existing groundwater remediation systems, and precluded activities that would limit access to any existing groundwater remediation system. In addition, with the exception of the School District, each of these transferees executed SLUCs with the State of California that established prohibited activities in relation to groundwater uses and groundwater remediation systems.

Groundwater use on the property transferred to the BoP is restricted by terms of the Air Force/BoP MOU which remains in effect. Following publication of the CB ROD – Part 2, the Air Force notified the City of Atwater, Merced County, and private landowners in the unincorporated portion of Merced County overlying a plume exceeding an MCL (off-base OU-2 plume area) that the groundwater should not be used for human consumption. The location and extent of off-base plumes exceeding any MCL within the off-base plumes are updated and documented each year in the LTGSP annual report. If monitoring results show that a plume exceeding an MCL has migrated, newly affected parcel owners are notified by the Air Force. Finally, a review is made on an annual basis to assure that new wells have not been installed in areas overlying a groundwater plume exceeding an MCL.

The County of Merced (County) conducts an annual inspection of the property to determine if any SLUC restrictions have been violated. The annual SLUC report is submitted to the Air Force, DTSC and the RWQCB. For this five-year review, the County's annual SLUC reports for 2009, 2010, and 2012 (*County of Merced Annual Report Regarding Covenant Requirement for Former Castle Air Force Base Property* [Merced County, 2010, 2012, 2013]) were reviewed and are summarized as follows. The County conducted annual inspections on 20 January 2010 (inspection for 2009), 10 January 2011 (inspection for 2010), and 8 February 2013 (inspection for 2012). No violations were noted regarding any activity that would interfere with the groundwater remedy or affect groundwater. The County verified that the Division of Environmental Health has not issued any well permits for construction or destruction of groundwater wells. The County checked with the Planning and Community Development Department and determined that no plans have been approved and none are in process and there are no land uses or construction in violation of the SLUC restrictions.

The Air Force verified property ownership status with the County Recorder's Office. Merced County Redevelopment Agency transferred property to Big Creek Timber-Atwater, LLC (the deed was recorded on 31 May 2007, Merced County Recorder's document #2007-031852) and all appropriate covenants were recorded with the property transfer. Merced County transferred property to Castle Air Museum Foundation (the deed was recorded on 4 October 2007, Merced County Recorder's document #2007-054467) and all appropriate covenants were recorded with the property transfer. Merced County transferred property to Bloss Memorial Health Care District (the deed was recorded on 3 April 2008, Merced County Recorder's document #2008-017771) and all appropriate covenants were recorded with the property transfer. Merced County Redevelopment Agency transferred property to Noah Williams (the deed was recorded on 13 January 2009, Merced County Recorder's document #2009-002275), and all appropriate covenants were recorded with the property transfer. Merced County Redevelopment Agency transferred property to BHMH, LLC (the deed was recorded on 1 December 2010, Merced County Recorder's document #2010-047032), and all appropriate covenants were recorded with the property transfer. Merced County transferred property to West Coast Gas Company, Inc. (the deed was recorded on 5 September 2013, Merced County Recorder's document #2013-032352) and all appropriate covenants were recorded with the property transfer. During 2012 no property ownership changes took place. The Air Force independently confirms compliance with ICs on an annual basis. IC compliance is verified by Air Force inspection and the compliance evaluation information, including checklists, is included in the groundwater monitoring report and annual OM&M reports.

The annual Operations, Maintenance, and Monitoring Reports provide a remedy protectiveness evaluation on an annual basis. The annual reports for 2009 (CH2M Hill, 2010b), 2010 (CH2M Hill, 2011a), 2011 (CH2M Hill, 2012a) and 2012 (CH2M Hill, 2013a) indicate no new groundwater wells were installed on the former base property or within the then current off-base plume areas. Monitoring results indicate the extent of the plumes exceeding MCL have not migrated and no new parcel owners have been affected. For the continued protection of drinking water supply wells one private residence water supply well (D5766) was provided with wellhead treatment during 2009, 2010, 2011, and 2012. The municipal, domestic and irrigation well monitoring network was evaluated and is determined to be sufficient (i.e., the municipal, domestic and irrigation wells have been adequately identified under the LTGSP and monitored in accordance with the LTGSP sampling decision tree; in many cases the Air Force has retained monitoring of municipal and domestic wells even though monitoring results and the well locations in relation to current plume conditions don't necessarily warrant continued monitoring.)

The Air Force conducts site inspections and maintains regular communications with the BoP to insure site conditions have not changed. Within the BoP property no groundwater wells have been constructed and there have been no changes to the land use that would impact the remedial actions. No violations to IC restrictions were noted.

A Five-Year Review site inspection was performed by the Air Force and MWH to confirm and document the conditions of the remedy. The site inspection was performed on 18 June 2013, the inspection determined that no groundwater wells have been constructed and there have been no changes to the land use that would impact the remedial actions. No violations to IC or SLUC restrictions were noted.

The ICs and SLUCs have been properly implemented and are effective and no issues have been identified.

<u>Wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells</u>: If a

contaminant concentration in any drinking water well begins to exceed one-half the MCL, the Air Force, in consultation with the EPA, DTSC, and RWQCB, will take immediate action, as necessary, to implement wellhead treatment or provide an alternative drinking water supply. Currently, the Air Force is maintaining a wellhead treatment system at domestic well D5766 (grid N4; Figure 3-3). No other public or private drinking water supply wells require remedial action based on the CB Part 2 ROD criteria. Results for 2012 sampling of Castle production wells and off-site domestic or irrigation wells were generally consistent with previous years. TCE concentrations at AM16 and AM18 remained below the reporting limit throughout 2012 and were non-detect at the end of the year (Q4/12 sample). No VOCs were detected in the following domestic, irrigation, and production wells: D4460, D4472, D4480, D5472, D5682, and D5766-E. TCE was detected in the following wells: D5480, D5482, D5486, D5489, D5502B, D5511, D5766, D5766-PE, 15266, and Strawberry. The highest TCE concentration was found in the influent at domestic well D5766 in Q4/12 (2.5 µg/L). Average 2012 influent TCE concentration at the D5766 wellhead treatment unit is slightly higher than the average concentration reported in 2011 (2 µg/L) and the wellhead treatment system at D5766 remains in operation. Other VOCs were detected at trace levels at AM16, AM18, and D5766-PE (CH2M HILL, 2013a).

<u>Local (wellhead) treatment to address groundwater contamination exceeding MCLs within the off-base Confined HSZ plume</u>: In accordance with the CB Part 2 ROD remedy, local wellhead treatment is implemented in consultation with the agencies to remove contaminant mass and/or reduce potential impact on municipal water supply wells in the area. The Air Force has installed and operated three wellhead treatment systems in the off-base Confined HSZ plume area (MW941, MW951, and MW1009) to remove contaminant mass and/or reduce contaminant impact on municipal wells, particularly AM18. Since these actions have been implemented, the TCE concentrations at AM18 (0.37 µg/L, Q3/2012) and upgradient guard well MW1010 (1.5 µg/L, Q2/2012) have decreased significantly. Based on declining TCE concentrations, two of the systems have been shut down with agency concurrence (MW941 in Q2/04 and MW1009 in Q1/06). The MW951 system remains in operation. The TCE concentration at MW951 in Q2/12 was 3.9 µg/L. The maximum TCE concentration remaining in the off-base Confined HSZ plume area is at MW1008,

where in Q2/12 and Q2/13, the TCE concentration was 12 µg/L, a decrease from a maximum of 26 µg/L in Q4/06. Based on these results, remedy implementation for the off-base Confined HSZ plume has been effective in meeting the CB ROD Part 2 RAO of preventing exposure to groundwater from a Castle AFB plume containing chemicals of concern above the MCL. Based on the CB Part 2 ROD remedies, wellhead treatment or an alternative water supply would be evaluated in consultation with the agencies if a water supply well (such as AM18) begins to exceed one-half the MCL In addition, the CB Part 2 ROD requires the Air Force to evaluate and, if appropriate, implement additional remedial action should AM18 become inoperative for an extended period. The City of Atwater currently has no plans to shut down AM18; and if the well were to become inoperable due to pump failure or other problems, it would quickly be repaired and placed back in service. The off-base confined plume area and operational status of AM18 continues to be monitored through the LTGSP.

7.1.1.2 System Operations/Operation and Maintenance

As outlined in Section 4.1.3, the groundwater treatment systems comprising the Main Base Plume remedial system are operated in accordance with an approved O&M plan. Monthly status reports document a high percentage of uptime for all treatment systems, which maintain the documented effectiveness of the remedial system. Treatment plant effluents consistently meet discharge requirements. No organic compounds exceeded discharge standards during 2012 (CH2M HILL, 2013a).

As outlined in Section 4.1.3, the exceedance of certain inorganic discharge limits in Main Base treatment plant effluent has been a regular occurrence throughout the remedial action at Castle. The exceedances reflect the differences in inorganic background levels for each of the HSZs and occur because of the mixing of water extracted from multiple HSZs and the subsequent injection of treated water into a single HSZ. These exceedances have been a regular occurrence throughout the remedial action and have been monitored in accordance with the LTGSP (CH2M HILL, 2012a) and coordinated with the regulatory agencies. These inorganic discharge limit exceedances do not represent a protectiveness issue.

No discharge standards were exceeded for inorganics at the OU-2 treatment system or MW951 wellhead treatment system during 2012. Discharge standards for chloride and TDS were slightly exceeded at the Phase 3 treatment system during 2012 (CH2M HILL, 2013a).

As outlined in Section 6.4, a few minor O&M issues were noted during the site inspection. None of the observed issues impact the operations or effectiveness of the remedial systems. As the remedial systems age, there are increased O&M requirements that need to be addressed for the systems. These issues are addressed under the normal implementation of the O&M and monitoring plans and the items noted in Section 6.4 are not issues that affect protectiveness.

As noted in Section 6.5.1.2, the regulatory agencies indicated a concern that there are increased requirements for O&M due to aging remedial treatment systems. There have been leaks in the conveyance lines and at the treatment systems. All releases have been recorded and corrective actions were implemented in accordance with existing O&M plans. Repairs of leaks are addressed when identified and repairs are made under the ongoing O&M and monitoring of the treatment systems. The volumes and concentrations did not exceed recordable quantities, therefore there is no impact to protectiveness. These O&M issues are addressed as needed by the Air Force and do not represent a protectiveness issue.

7.1.1.3 Opportunities for Optimization

Remedial process optimization is a continuing component of remedial system operation (proactive plume management) and the LTGSP. Numerous actions that increased efficiency and/or reduced costs have already been, and continue to be, implemented. Significant examples include:

- Rescheduling LTGSP annual and semiannual sampling events to the second and fourth quarters, respectively, to correlate with the semiannual groundwater elevation surveys and to increase sampling efficiency by avoiding the severest weather conditions (regulatory agency approval for this rescheduling received during August 26, 2009 meeting; CH2M HILL, 2010a);
- Switching from dedicated pumps and the millipurge method to passive diffusion bags and/or HydraSleeves®, to significantly reduce sampling costs and eliminate the need to dispose of purge water, beginning in Q4/09 (regulatory agency approval for these replacements received during August 26, 2009 meeting; CH2M HILL, 2010a);

- Shutting off extraction wells that are no longer needed for plume capture and where TCE concentrations are less than the MCL;
- Eliminating sampling of monitoring wells no longer needed for plume definition;
- Sizing pumps for the most efficient use of electrical power;
- Developing and implementing a modified carbon change-out procedure to reduce overall carbon usage;
- Installing a pre-treatment air stripper at the Phase 3 treatment plant to remove *cis*-1,2-DCE and other contaminants, thereby reducing the frequency of carbon change-outs;
- Bypassing the Phase 3 groundwater treatment system air stripper and injection pumps as of October 2009, since *cis*-1,2-DCE influent concentrations have decreased below the discharge limit of 0.5 µg/L (regulatory agency approval for this reconfiguration received during August 26, 2009 meeting; CH2M HILL, 2010a); and
- Negotiating reduced quality control requirements for monitoring well sampling as the LTGSP has matured.

In addition, some routine activities conducted as a part of the LTGSP and proactive plume management result in cost savings and continual optimization of the remedial process. These include:

- Use of a decision tree to optimize sample collection frequency at all monitoring wells;
- Use of groundwater flow/transport modeling to help assess future remedial system performance and the results of potential changes to the remedial system; and
- Intermittent adjustments to extraction well pumping rates to maintain capture while minimizing pumping (and thereby treatment) of clean groundwater.

7.1.1.4 Early Indicators of Potential Issues

Three potential issues are noted. First, capture of the northeastern plume segment (flightline area) in the Shallow HSZ by the MW824/MW1037 wellhead treatment system is unlikely unless water levels increase and the system is turned back on. Monitoring and evaluation of the northeastern plume segment continue under the LTGSP.

In the OU-2 area, the rebound concentrations are higher (as of 4Q/12 the maximum TCE concentrations in wells MW804A, MW806A and MW948 were 27 µg/L, 28 µg/L, and 37 µg/L, respectively) and the rebound duration longer than anticipated when the rebound study was initiated in 2009. Consideration of additional actions that may be necessary to improve the rate of contaminant mass removal and to confirm hydraulic control is appropriate. To address this issue, it is recommended to improve and confirm plume capture and plume reduction, specifically, a) improve plume capture and contaminant mass removal by adding an extraction well from the existing well network (most likely a conversion of MW-948 to an extraction well), and b) confirm hydraulic control by installing a LSS monitoring well in the area of MW804A.

Finally, due to declining regional water levels, many of the groundwater wells in the Shallow HSZ have gone dry over the last several years and can no longer be sampled. In nearly every case, TCE concentrations were below the MCL before the wells went dry and thus, no plume was present.

Of the 53 dry wells identified in the 2012 Annual Report, only six went dry with TCE concentrations above the MCL (EW13, JE2, JM5, JM13, MW824, and MW886). With the exception of JM13, which had a final TCE concentration of 41 µg/L, the final TCE concentrations in these wells only slightly exceeded the MCL, ranging from 5.5 to 7.1 µg/L. The remaining 47 dry wells all had TCE concentrations below the MCL and are not critical for defining MCL plume boundaries and thus, data from these wells are not required to determine plume capture. Of the six wells that had TCE concentrations above the MCL prior to going dry, only MW886 is considered critical for evaluating plume capture and this well was recently replaced. JM5 and JM13 were replaced with existing adjacent wells JM6 and JM14, respectively, in 2008 when they went dry. JE2 is located in the upgradient portion of the OU-1 plume and is not critical for demonstrating plume capture because downgradient wells MW1038 and MW1039 are also located within the OU-1 plume and had higher concentrations. MW824, which is located along the downgradient edge of the northeast plume segment, is not critical because crossgradient well MW1018 is considered sufficient to define the downgradient edge of this small plume, which consists of only two wells with TCE concentrations slightly above the MCL (concentrations between 6 and 7 µg/L). Finally, EW13 does not warrant replacement because the exceedance of the MCL was very slight (5.5 µg/L), the mass was small, and no other nearby wells exceeded the MCL. Furthermore, TCE concentrations at downgradient wells MW704, MW943, and MW950 have been below the MCL since at least Q1/02 (1 year before EW13 was first shut down and 6 years before it went dry), indicating that the MCL plume was small and did not migrate.

Dry wells are identified in each annual report and their monitoring objectives are evaluated to determine if the well should be replaced. Of the 53 dry wells identified in the 2012 Annual Report, 11 wells were determined to warrant replacement. Ten of these wells are located at LF-4 and LF-5, and required replacement to remain compliant with the long-term detection monitoring program at these two sites. Only MW886 was replaced because it had TCE concentrations above the MCL prior to it going dry. With the completion of drilling efforts 2013, all of the wells requiring replacement have been replaced with the exception of downgradient LF-4 well MW847. Replacement of this well has been postponed until sufficient groundwater elevation data can be collected from the newly installed wells to determine the optimum location of the MW847 replacement well. Based on the limited number of wells that went dry with concentrations exceeding the MCL, the potential for future groundwater impacts at levels exceeding the MCL as a result of residual VOCs in the deep vadose zone is very minimal and not considered a protectiveness issue.

7.1.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs in Section 7.1.1.1.4.

Access control (security fencing) is in place at all aboveground system facilities (treatment plants, extraction wells, injection wells, and wellhead treatment systems). Locking caps and protective casings minimize the potential for vandalism and adequately protect the public from exposure to contaminants at individual monitoring wells. As noted in Section 6.4, there was evidence of graffiti on the fencing of several wells in the Main Base Plume Site, the graffiti has been painted over, and there is no evidence of impact on the system components.

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

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for the Main Base Plume.

7.1.2.1 Changes in Standards and To Be Considered Guidelines

The standard identified for groundwater cleanup of the Main Base Plume in the CB ROD – Part 1 was MCLs. For the Main Base Plume, the primary contaminant is TCE; *cis*-1,2-DCE and PCE are minor contaminants. California drinking water standards for these three contaminants have not changed since the CB ROD – Part 1 was signed and implemented: they remain at 5 µg/L for TCE, 6 µg/L for *cis*-1,2-DCE and 5 µg/L for PCE. A review of applicable or relevant and appropriate requirements (ARARs) and to be considered guidelines (TBCs) indicates that no new standards have been promulgated since the CB ROD – Part 1 and the CB ROD – Part 2 that would call into question the protectiveness of the current remedy.

7.1.2.2 Changes in Exposure Pathways

There have been no changes to exposure parameters, potential exposure pathways or site/land use conditions since the last five-year review. LTGSP results have not identified any new or additional contaminants within the Main Base Plume since implementation of the remedy. The primary contaminant remains TCE, while *cis*-1,2-DCE and PCE remain the most common minor contaminants and continue to occur only within the boundaries of the TCE plume. As described in Section 7.1.1.1.4, additional IC's and notification procedures have been implemented to prevent on-Site and off-Site exposures to groundwater containing contaminant concentrations in excess of MCLs or other applicable standards.

7.1.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been changes in toxicity values since remedy selection. Most notably, the USEPA issued its final health assessment for TCE to the Integrated Risk Information System (IRIS) database in September 2011, along with revised toxicity values for TCE. The revised toxicity values for TCE are more restrictive than those used at the time of remedy selection. Based on the revised toxicity values for TCE, the tap water screening level corresponding to a hazard quotient (HQ) of 1 is 2.6 µg/L; and tap water screening levels corresponding to the acceptable carcinogenic risk range of 1E-6 to 1E-04 are 0.44 to 44 µg/L. The TCE MCL corresponds to an HQ of 2 and a cancer risk of 1E-5. However, representative noncancer hazard and cancer risks will be less than these values when cleanup levels are achieved because the large majority of the plume areas will be much less than the MCL concentrations (as demonstrated by the reduction in plume areas depicted in the Section 7.1.1.2). Therefore, based on restrictions that remain in place until MCLs are achieved, the remedy remains protective.

The USEPA also published its Final Health Assessment for Tetrachloroethylene (PCE) in February 2012, along with revised toxicity values for PCE in the IRIS Database. The revised oral cancer slope factor for PCE is less restrictive than the value used at the time of remedy selection, while the oral chronic reference dose (RfD) is more restrictive that the value used at the time of remedy selection. Based on the revised toxicity values for PCE, the tap water screening level corresponding to an HQ of 1 is 35 µg/L; and tap water screening levels corresponding to the acceptable carcinogenic risk range of 1E-6 to 1E-04 are 20 to 2,000 µg/L. The PCE MCL corresponds to an HQ of 0.1 and a cancer risk of 2E-7. The most current concentrations of PCE in groundwater samples collected from the Main Base Plume in 2012 ranged from non-detect to 0.91J µg/L. Based on the above, and the fact that PCE only occurs within the boundaries of the TCE plume, the remedy is protective.

In September of 2010, the USEPA published a new oral chronic RfD for cis-1,2-DCE that is more restrictive than the value used at the time of remedy selection. Based on the revised toxicity values for cis-1,2-DCE, the tap water screening level corresponding to an HQ of 1 is 28 µg/L. The California drinking water standard for cis-1,2-DCE corresponds to an HQ of 0.2. The most current concentrations of cis-1,2-DCE in groundwater samples collected from the Main Base Plume in 2012 ranged from non-detect to 0.36J µg/L. Based on the above, and the fact that cis-1,2-DCE only occurs within the boundaries of the TCE plume, the remedy is protective.

7.1.2.4 Changes in Risk Assessment Methods

A groundwater BHHRA was conducted as part of the CB RI/FS – Part 1 and was updated as part of the CB RI/FS – Part 2. The same methods were used to calculate cancer risk and non-cancer hazard in both the original and the updated CB RI/FS – Part 1 BHHRA.

The 2009 Five-Year Review included an evaluation of potential risks associated with vapor intrusion of TCE from groundwater to indoor air, to address this potential exposure pathway. The vapor intrusion evaluation utilized DTSC's version of the Johnson and Ettinger vapor intrusion model, Cal-EPA toxicity values, and a TCE concentration in groundwater of 25 µg/L; and calculated cancer risk and noncancer hazard estimates assuming sand as a default soil type and silt as the site-specific soil type. Cancer risk estimates for default and site-specific soil types were 1.1E06 and 2.2E-07, respectively; while noncancer HQ estimates for default and site-specific soil types were 0.0021 and 0.00043, respectively. Utilizing USEPA's revised toxicity values for TCE, with the original TCE concentration in groundwater of 25 µg/L and previous model input parameters, results in cancer risk estimates for default and site-specific soil types of 2E06 and 4E-07, respectively; while noncancer HQ estimates for default and site-specific soil types are 0.63 and 0.13, respectively. These updated cancer risk estimates are within, or below the USEPA's acceptable cancer risk range of 1E-06 to 1E-04, and the updated noncancer hazard estimates are below the acceptable HQ of 1.

The most current concentrations of TCE in groundwater samples collected from the Main Base Plume in 2012 ranged from 3.2 to 13 µg/L. Utilizing USEPA's revised toxicity values for TCE, with the upper end of TCE concentrations measured in groundwater in 2012 (i.e., 13 µg/L) and previous model input parameters, results in cancer risk estimates for default and site-specific soil types of 1E06 and 2E-07, respectively; while noncancer HQ estimates for default and site-specific soil types are 0.33 and 0.066, respectively. These updated cancer risk estimates do not exceed the point of departure risk management criteria for cancer risk of 1E06 or HQ of 1. Therefore, no significant vapor intrusion concerns are anticipated at current concentrations of TCE in groundwater within the Main Base Plume.

There are no additional changes in risk assessment methods that would affect the protectiveness of the remedy.

7.1.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.1.1.1 documents significant progress toward meeting the RAO for the Main Base Plume of cleanup to MCLs, both in terms of plume reduction (7.1.1.1.1) and removal of VOC mass from groundwater (7.1.1.1.3). ICs are in place to prevent inadvertent use of contaminated groundwater, and procedures are in place to minimize impact to municipal and domestic water supply wells.

7.1.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this Review Report and a review of recent LTGSP annual and semiannual reports, no data or other information are identified that could call into question the protectiveness of the remedy for the Main Base Plume.

7.2 CASTLE VISTA PLUME REMEDIAL ACTION

The CB ROD – Part 1 remedy for the Castle Vista Plume is:

- Plume capture and cleanup to MCLs.

The CB ROD – Part 2 remedies for the Castle Vista Plume are:

- ICs to restrict groundwater use within plumes exceeding an MCL; and
- Wellhead treatment or provision of an alternative drinking water supply to protect against adverse impacts to public and private drinking water wells.

The principal contaminant in the Castle Vista Plume is *cis*-1,2-DCE. The MCL (State) for *cis*-1,2-DCE was 6 μg/L at the time of the CB ROD – Part 1 and has not been changed as of the date of this five-year review. While TCE and PCE have also been detected in the Castle Vista Plume, they are always at much lower concentrations than *cis*-1,2-DCE and, without exception, occur inside the *cis*-1,2-DCE plume boundaries. For these reasons, this technical assessment addresses only *cis*-1,2-DCE.

The main component of the Castle Vista Plume groundwater remediation system, the Castle Vista groundwater treatment plant, was shut down with regulatory agency concurrence in August 2003. A wellhead treatment system at MW003 (grid U4) operated from treatment plant shutdown until July 2008, when it was shut down due to low water level in the well. Although MW003 has been dry since Q1/09, the wellhead system in the vicinity of MW003 operated intermittently through 2010 and a brief period in 2011 at extraction wells EW39 and MW1046. The wellhead treatment system was shutdown in April 2011 and remained offline through the end of 2012. The Castle Vista system was restarted on April 15, 2013 due to cis-1,2-DCE exceeding restart criteria. The system operated through June 20, 2013 and was restarted again in late August 2013 after a pump was fixed.

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

7.2.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of *cis*-1,2-DCE plume reduction (plume extent and concentration), hydraulic control and treatment system operation (cumulative amount of groundwater treated and contaminant mass removed). Information on current conditions (data through Q4/12) is derived from plume and treatment system monitoring conducted under the LTGSP. The primary LTGSP documents used to support this five-year review are the *Operations, Maintenance, and Monitoring 2012 Annual Report* (CH2M HILL, 2013b), which includes the 2012 LTGSP report; and the *Long-Term Groundwater Sampling Program 2012 Semiannual Report* (CH2M HILL, 2013a). Based on plume reduction and *cis*-1,2-DCE sampling results provided in the *Operations, Maintenance, and Monitoring 2012 Annual Report* (CH2M HILL, 2013b), the Castle Vista Plume is being successfully remediated .

During the period that the Castle Vista groundwater treatment system was in operation (October 1997 through August 2003), there were 17 monitoring wells, 6 extraction wells (including MW003) and 8 injection wells completed in the Shallow HSZ. There were 9 monitoring wells and 1 extraction well completed within the USS HSZ both inside and surrounding the Castle Vista Plume. MW003 (grid U4) was added to the groundwater treatment system in June 2000 at an initial pumping rate of about 13 gpm. However, the pumping rate decreased over time as water levels declined, and MW003 was shut down in May 2002. During July 2002, a new Shallow HSZ extraction well (EW39; grid

U4) was installed adjacent to MW003. This well came online in early August 2002 and began pumping at about 80 gpm. Because of continuing reductions in plume size and concentration, EW39 was taken offline when the Castle Vista groundwater treatment plant was shut down in August 2003.

At the same time, a small-capacity wellhead treatment system was installed at MW003 and pumping was reinitiated at a rate of about 7 gpm. The MW003 wellhead treatment system operated, with some interruptions for rebound testing, until July 2008 when it was shut down due to low water levels in the well. The pumping rate for the MW003 wellhead treatment system ranged from about 7 gpm at startup to less than 1 gpm just prior to shutdown.

The Castle Vista Plume remedial system was restarted in December 2008, using EW39 as the extraction well (Jacobs, 2009c). In May 2010, extraction well MW1046 was brought online and added to the Castle Vista wellhead system (CH2M HILL, 2010c).

On 17 August 2010, the Castle Vista wellhead treatment system was shut down with agency concurrence for a long-term rebound study because *cis*-1,2-DCE concentrations had been below the MCL (6 μg/L) at both extraction wells (EW39 and MW1046) for at least three consecutive months. Details of the shutdown and rebound study were presented in the *Startup Report for the Expanded Castle Vista Groundwater Extraction and Treatment System* (CH2M HILL, 2010e). The wellhead system was offline through the end of 2012 with the exception of a brief period in Q1/11 (CH2M HILL, 2012a), and restarted in April 2013.

7.2.1.1.1 Plume Reduction

Current (Q4/12) *cis*-1,2-DCE plume configuration for the Shallow HSZ is shown on Figure 7-5. A figure is not presented for current *cis*-1,2-DCE plume configuration in the USS HSZ because the plume in the USS HSZ was eliminated by Castle Vista groundwater treatment plant operation. Comparison of the current (Q4/12) Shallow HSZ *cis*-1,2-DCE plume configuration (Figure 7-5) with that from Q1/97 (Figure 3-8) shows that the Shallow HSZ plume has nearly been eliminated over the 15-year period as a result of the remedial action. All that remains at present (Q4/12) is a small plume in the immediate vicinity of wells EW39, MW1046, MW1045, and MW1047. The highest current *cis*-1,2-DCE concentration in this residual plume is 3.7 µg/L at EW39. Because all downgradient portions of the Shallow HSZ plume had been eliminated by 2002 or earlier (the first Shallow HSZ extraction well was taken offline in October 1999), the Castle Vista groundwater treatment plant was shut down, with regulatory agency approval, in August 2003.

7.2.1.1.2 Plume Capture

As noted in Section 4.1.2.2, well MW003 extracted groundwater at 3 gpm from January until 2 July 2008 when declining water levels precluded further pumping. The system was placed back in operation on 15 December 2008 using well EW39, which pumped at 10 to 15 gpm through October 2009, at 5 to 10 gpm from November 2009 through February 2010, at 15 to 25 gpm from March 2010 through April 2010, and at 10 to 15 gpm from May 2010 through July 2010. MW1046 also pumped at 5 to 10 gpm from May 2010 through July 2010. On August 17, 2010, the wellhead treatment system was shut down with agency concurrence for a long-term rebound study because cis-1,2-DCE concentrations had been below the MCL at both extraction wells (EW39 and MW1046) for at least three consecutive months (CH2M HILL, 2013b).

There is limited data with which to demonstrate hydraulic capture based on information presented in the 2009 and 2010 LTGSP reports. For example, the 4Q/09 figure for hydraulic containment shows that only three wells (excluding the pumping well) had water level measurements. However, the cis-12,-DCE MCL was only exceeded at EW39. The target capture zone, therefore, was limited to that location and extraction from that well was sufficient to capture the plume.

In February 2011, *cis*-1,2-DCE concentrations at EW39 and MW1046 were 12 µg/L (decreased from 19 µg/L in Q4/10) and 8.2 µg/L (increased from 4.3 µg/L in Q4/10), respectively. Both concentrations of *cis*-1,2-DCE were greater than the MCL, but less than the 20 µg/L criterion established in the *Startup Report for the Expanded Castle Vista Groundwater Extraction and Treatment System* (CH2M HILL, 2010e) for evaluating whether the system should be restarted. Results from February 2011 showed a slight increase in *cis*-1,2-DCE at downgradient wells MW936 (0.54 µg/L) and PZ14B (0.72 µg/L). Based on these results, the Castle Vista wellhead system was temporarily restarted on March 9, 2011 to determine the impact of extraction on *cis*-1,2-DCE concentrations. April

2011 results showed a significant reduction in *cis*-1,2-DCE concentrations in EW39 (3.9 µg/L) and MW1046 (3.4 µg/L). Therefore, on April 4, 2011, the Castle Vista wellhead system was shut down and the rebound study resumed (CH2M HILL, 2013b).

During 2012, samples were collected quarterly from EW39, MW936, MW1045, MW1046, and PZ14B. *cis*-1,2-DCE concentrations rebounded at MW1046 from 1.6 µg/L in Q4/11 to 9.2 µg/L in Q1/12, but have since decreased. *cis*-1,2-DCE concentrations were below the MCL of 6 µg/L during the last two quarters of 2012 and ended the year at 3.5 µg/L (Q4/12). *cis*-1,2-DCE concentrations at EW39 decreased slightly during 2012, and remained below the MCL with the exception of one result in Q4/12. The regularly scheduled Q4/12 sample collected at EW39 on 20 October 2012 showed an increased *cis*-1,2-DCE concentration of 7.9 µg/L. However, the *cis*-1,2-DCE concentration detected in the confirmation sample collected less than one month later on 19 November 2012 was only 3.7 µg/L. The second Q4/12 sample is more consistent with previously collected samples. *cis*-1,2-DCE concentrations at the remaining three wells were consistent with or lower than those detected in 2011 (CH2M HILL, 2013b). Given the lack of pumping and lack of an MCL plume at the end of 2012, plume capture for that period is not relevant.

The Castle Vista system was restarted on April 15, 2013 due to cis-1,2-DCE exceeding restart criteria. The system operated through June 20, 2013 and was restarted again in late August 2013 after a pump was fixed. Plume capture for the 2013 operating period will be discussed in future LTGSP reports.

7.2.1.1.3 Treatment System Operation

Treatment system operation for the Castle Vista Plume is summarized in terms of the number of extraction and injection wells and the cumulative gallons of groundwater treated and pounds of contaminant removed (all VOCs, but primarily *cis*-1,2-DCE) as August 2013:

- The Castle Vista treatment system went online in October 1997 (six extraction wells [MW003 added later] and eight injection wells) and was shut down in August 2003. During its approximate 6 years of operation, the system treated over 952 million gallons of groundwater and removed 37.7 pounds of VOCs.

- A wellhead system at MW003 went online in August 2003 and operated until July 2008, when it was shut down due to low water levels in the well. During its approximate 5 years of operation, the system treated over 8.6 million gallons of groundwater and removed about 1 pound of VOCs.
- The wellhead system was restarted in December 2008 with extraction from wells EW39 and MW1046. This system operated until August 2010, when it was shut down with agency concurrence for a long-term rebound study because *cis*-1,2-DCE concentrations had been below the MCL (6 µg/L) at both extraction wells for at least 3 consecutive months. During its operation through 2010, the system treated over 25 million gallons of groundwater and removed about 2 pounds of VOCs.
- The wellhead system operated for a short period in March and April 2011 with extraction from wells EW39 and MW1046.
- The wellhead system was restarted in April 2013 due to *cis*-1,2-DCE exceeding restart criteria.

7.2.1.1.4 CB ROD – Part 2 Remedies

<u>ICs to restrict groundwater use within plumes exceeding an MCL</u>: ICs (land use restrictions) were incorporated as a grantee covenant in the deed transferring affected portions of the Castle Vista housing area to private landowners. This covenant placed restrictions on the installation of wells, precluded disturbance of any existing groundwater remediation systems, and precluded activities that would limit access to any existing groundwater remediation system. Deeds were recorded on 30 June 1998, Merced County Recorders document #23298, 30 July 2998, Merced County Recorders document #27247, 12 August 1998, Merced County Recorders document #28667, 7 October 2002, Merced County Recorders document #2002-049703, 29 January 2007, Merced County Recorders document #2007-006705. In addition, in 2007 the private landowners, for applicable portions of the Castle Vista housing areas, executed a SLUC with the State of California that established prohibited activities in relation to groundwater uses and groundwater remediation systems. The SLUC for Parcel J2b2 (Castle Vista area) was recorded on 29 January 2007, Merced County Recorder's document #2007-006706. There have been no subsequent transfers of the restricted property.

The location and extent of off-base plumes exceeding any MCL within the off-base plumes are updated and documented each year in the LTGSP annual report. If monitoring results show that a plume exceeding an MCL has migrated, newly affected parcel owners are notified by the Air Force.

The annual Operations, Maintenance, and Monitoring Reports provide remedy protectiveness evaluation based on then current conditions. The annual reports for 2009 (CH2M Hill, 2010b), 2010 (CH2M Hill, 2011a), 2011 (CH2M Hill, 2012a) and 2012 (CH2M Hill, 2013b) indicate no new groundwater wells were installed within the then current off-base plume areas. Monitoring results indicate the extent of the plumes exceeding MCL have not migrated and there were no newly affected parcel owners.

A Five-Year Review site inspection was performed by the Air Force and MWH to confirm and document the conditions of the remedy. The site inspection was performed on 18 June 2013 and determined no groundwater wells have been constructed and there have been no changes to the land use that would impact the remedial actions. No violations to IC or SLUC restrictions were noted.

The ICs and SLUCs have been properly implemented and are effective and no issues have been identified.

<u>Wellhead treatment or provision of an alternate drinking water supply to protect against adverse impacts to public and private drinking water wells</u>: The residual Castle Vista Plume is within the City of Atwater where individual domestic water supply wells are prohibited by City regulations. Because the plume in the USS HSZ has been eliminated and the plume in the shallow HSZ is small, it is very unlikely that *cis*-1,2-DCE concentration will increase at AM06 at any time in the future. In addition, AM06 was shut down by the City of Atwater in September 2006. There are no plans to resume use of this well, although a replacement well is planned (CH2M HILL, 2013b). If the *cis*-1,2-DCE concentration at AM06 (or its replacement) exceeds one-half the MCL prior to completion of the remedial action, the Air Force, in consultation with the EPA, DTSC, and RWQCB, will take immediate action, as necessary, to implement wellhead treatment or provide an alternative drinking water supply to ensure that drinking water is not distributed to the public at concentrations exceeding the MCL.

7.2.1.2 System Operations/Operation and Maintenance

As outlined in Section 4.1.3, the MW003 wellhead treatment system was operated in accordance with an approved O&M plan. Monthly status reports documented a high percentage of uptime for the system through August 2010, which maintained the documented effectiveness of the remedial system. Treatment plant effluent consistently met discharge requirements, and there were only a few minor releases of untreated groundwater.

7.2.1.3 Opportunities for Optimization

The wellhead treatment system at MW003 was a small, low capacity single well system and there were no realistic opportunities for optimization while it was in operation.

7.2.1.4 Early Indicators of Potential Issues

Cis-1,2-DCE concentrations in the Castle Vista area are above the MCL. If concentrations remain above the MCL the Air Force will evaluate system performance and recommend necessary actions to achieve the MCL. No potential issues are noted.

7.2.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs in Section 7.2.1.1.4.

Access control (security fencing) is in place at all aboveground system facilities (MW003 wellhead treatment system). All remaining extraction, injection, and monitoring wells associated with the Castle Vista Plume are located in locked below-ground vaults or have locking caps and protective casings to assure adequate protection of the public from exposure to contaminants.

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

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for the Castle Vista Plume, with the exceptions noted below.

7.2.2.1 Changes in Standards and To Be Considered Guidelines

The standard identified for groundwater cleanup of the Castle Vista Plume in the CB ROD – Part 1 was MCLs. The primary contaminant is *cis*-1,2-DCE, while TCE and PCE are minor contaminants. The California drinking water standards or MCLs for *cis*-1,2-DCE (6 μg/L), TCE (5 μg/L), and PCE (5 μg/L) have not changed since the CB ROD – Part 1 was signed and implemented. A review of ARARs and TBCs indicates that no new standards have been promulgated or proposed since the CB ROD – Part 1 or the CB ROD – Part 2 that would call into question the protectiveness of the current remedy.

7.2.2.2 Changes in Exposure Pathways

There have been no changes to exposure parameters, potential exposure pathways or site/land use conditions since the last five-year review. The most likely exposure pathway, City of Atwater water supply well AM06, was shut down by the City of Atwater in September 2006, and there are no plans to resume its use as a water supply source although a replacement well is planned (CH2M HILL, 2013b). LTGSP results have not identified any new or additional contaminants within the Castle Vista Plume since implementation of the remedy. The primary contaminant remains *cis*-1,2-DCE. As described in Section 7.2.1.1.4, additional IC's and notification procedures have been implemented to prevent onsite and offsite exposures to groundwater containing contaminant concentrations in excess of MCLs or other applicable standards.

7.2.2.3 Changes in Toxicity and Other Contaminant Characteristics

Cleanup levels for the Castle Vista Plume are MCLs. There have been no changes to MCLs for *cis*-1,2-DCE or PCE since publication of the CB ROD – Part 1. There have been changes in toxicity values since remedy selection. Most notably, the USEPA issued its final health assessment for TCE to the Integrated Risk Information System (IRIS) database in September 2011, along with revised toxicity values for TCE. The revised toxicity values for TCE are more restrictive than those used at the time of remedy selection. Based on the revised toxicity values for TCE, the tap water screening level corresponding to a hazard quotient (HQ) of 1 is 2.6 µg/L; and tap water screening levels corresponding to the acceptable carcinogenic risk range of 1E-6 to 1E-04 are 0.44 to 44 µg/L. The TCE MCL corresponds to an HQ of 2 and a cancer risk of 1E-5. However, representative noncancer hazard and cancer risks will be less than these values when cleanup levels are achieved because the large majority of the plume areas will be much less than the MCL concentrations (as demonstrated by the reduction in plume areas depicted in the Section 7.1.1.2). Therefore, based on restrictions that remain in place until MCLs are achieved, the remedy remains protective. The USEPA also published its Final Health

Assessment for Tetrachloroethylene (PCE) in February 2012, along with revised toxicity values for PCE in the IRIS Database. The revised oral cancer slope factor for PCE is less restrictive than the value used at the time of remedy selection, while the oral chronic reference dose (RfD) is more restrictive that the value used at the time of remedy selection. Based on the revised toxicity values for PCE, the tap water screening level corresponding to an HQ of 1 is 35 µg/L; and tap water screening levels corresponding to the acceptable carcinogenic risk range of 1E-6 to 1E-04 are 20 to 2,000 µg/L. The PCE MCL corresponds to an HQ of 0.1 and a cancer risk of 2E-7. The current concentrations of PCE in the Castle Vista Plume are below, or only slightly above, the MCL of 5 µg/L. Based on the above, and the fact that PCE only occurs within the boundaries of the *cis*-1,2-DCE plume, the remedy is protective.

In September of 2010, the USEPA published a new oral chronic RfD for *cis*-1,2-DCE that is more restrictive than the value used at the time of remedy selection. Based on the revised toxicity values for *cis*-1,2-DCE, the tap water screening level corresponding to an HQ of 1 is 28 µg/L. The California drinking water standard for *cis*-1,2-DCE corresponds to an HQ of 0.2. Castle Vista Plume extraction wells MW003 and MW1046 were shut down in August 2010, and remained off-line through April 15, 2013. In February of 2013 and April of 2013, *cis*-1,2-DCE concentrations in groundwater samples collected from MW1046 were 27 µg/L and 29 µg/L, respectively, and exceeded the extraction and treatment system start-up criterion of 20 µg/L. As a result, the groundwater extraction and treatment system for the Castle Vista Plume was restarted in April 2013.

The groundwater standard for *cis*-1,2-DCE at Castle AFB is based on the current California MCL for *cis*-1,2-DCE of 6 µg/L. However, the California Office of Health Hazard Assessment (OEHHA) recently established a new Public Health Goal (PHG) for *cis*-1,2-DCE of 100 µg/L (OEHHA, 2006). The new PHG for *cis*-1,2-DCE is based on a lowest-observed-adverse-effect-level (LOAEL) from a 90-day oral gavage study in rats that was published in 1990, and the application of a 3,000-fold uncertainty factor to the LOAEL. The current California MCL is based on an acute inhalation study in rats that was published in 1978, and the application of an uncertainty factor of 10,000. In establishing the new PHG for *cis*-1,2-DCE of 100 µg/L, the OEHHA reported that the 1990 study used a more appropriate exposure route, is of longer duration, and is far more comprehensive in the analysis and investigation of toxicological endpoints than the earlier, acute inhalation study. Both the federal Maximum Contaminant Level Goal (MCLG) and the federal MCL for *cis*-1,2-DCE are 70 µg/L. Based on operation of the treatment system in accordance with an agency-approved rebound monitoring plan and the restrictions that remain in place until the MCL is achieved, the remedy remains protective at levels that the EPA and State have determined are protective of public health.

7.2.2.4 Changes in Risk Assessment Methods

A groundwater BHHRA was conducted as part of the CB RI/FS–Part 1 and was updated as part of the CB RI/FS – Part 2. The same methods were used to calculate cancer risk and non-cancer hazard in both the original and the updated CB RI/FS – Part 1 BHHRA. There are no changes in risk assessment methods that would affect the protectiveness of the remedy.

7.2.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.2.1.1 documents that there has been significant progress toward meeting the RAO for the Castle Vista Plume of cleanup to MCLs. The *cis*-1,2-DCE plume in the USS HSZ has been eliminated and only a small residual plume in the original source area remains in the Shallow HSZ. The small residual plume is being addressed through continued extraction at MW1046.

7.2.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this Review Report and a review of recent LTGSP annual and semiannual reports, no data or other information are identified that could call into question the protectiveness of the remedy for the Castle Vista Plume.

7.3 EARTH TECHNOLOGY CORPORATION 10

The SCOU ROD Part 3 remedy for ETC-10 is:

- ICs and LTEM.

As described in Section 4.2.2.1, an E&D removal action has been completed, and IC and LTEM remedies have been implemented.

7.3.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.3.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of the effectiveness of ICs and the results of LTEM. Information on the effectiveness of ICs is based on the nature of the controls in place and current site conditions as observed during a recent site inspection. The results of LTEM are based on the wetlands invertebrate (fairy shrimp) and plant surveys conducted in the vicinity of ETC-10 in February and March 2008, respectively. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.3.1.1.1 Institutional Controls

ETC-10 is currently located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site altering activities within the prison parcel, including ETC-10, without notification of the EPA, DTSC, and the Air Force and the approval of such activities by the Air Force. No requests for site altering activities have been received to date by the Air Force for ETC-10 or its vicinity. Further, no evidence of any regular site use, construction, or other site-altering activities were observed within the ETC-10 site during a site inspection by MWH personnel on 18 June 2013. The ICs have been properly implemented and are effective and no issues have been identified.

7.3.1.1.2 Long-Term Ecological Monitoring

Per the SCOU ROD Part 3, LTEM at ETC-10, consisting of wetlands invertebrate (fairy shrimp) and plant (flora) surveys at selected vernal pools, is to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted based on measurement criteria established in the SCOU ROD Part 3.

A survey of vernal pools potentially impacted by residual soil contamination at ETC-10 and not-impacted background pools was last conducted in spring 2008. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Survey procedures and results were presented in Appendix A of the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a). Results of the surveys indicated that, at a 95 percent confidence level and based on the Wilcoxon-Mann-Whitney tests, there was no evidence that fairy shrimp abundance, plant diversity, or plant abundance (percent plant coverage) in the potentially impacted pools was statistically less than in the reference pools. Given those results, it was reasonable to state that there have been no identifiable effects from residual soil contamination at ETC-10 on vernal pool fairy shrimp or plants. Based on weather conditions and limitations on the areas included in the 2008 LTEM event, EPA requested that another round of monitoring be conducted prior to concluding that LTEM could be terminated.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, results from ETC-10 LTEM are not available for evaluation in this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.3.1.2 System Operations/Operation and Maintenance

There are no operating remedial systems in place at ETC-10.

7.3.1.3 Opportunities for Optimization

There are no opportunities for optimization at ETC-10 given that there are no operating remedial systems.

7.3.1.4 Early Indicators of Potential Issues

There are no potential issues identified for the ETC-10 remedial action.

7.3.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs and access control measures in Section 7.3.1.1.1.

ETC-10 is currently located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site altering activities within the prison parcel, including ETC-10, without notification of the EPA, DTSC, and the Air Force and the approval of such activities by the Air Force.

7.3.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for ETC-10, with the exceptions noted below.

7.3.2.1 Changes in Standards and To Be Considered Guidelines

ARARs and TBCs related to site soil contamination are relevant to the IC and LTEM remedies addressed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the COCs evaluated in the FS. The COCs identified for soil at the site are antimony, arsenic, benzo(a)pyrene and lead. Changes to TBCs for some of these COCs have occurred since the time of remedy selection. The USEPA's May 13, 2013 Regional Screening Level (RSL) for antimony in residential soil is 31 mg/kg, in comparison to the RAO for antimony in soil (residential scenario) of 280 mg/kg that was included in the SCOU RI/FS Part 2. The current USEPA RSL for arsenic in residential soil is 0.71 mg/kg, only slightly lower than the risk-based RAO for arsenic in soil (residential scenario) of 1 mg/kg that was included in the SCOU RI/FS Part 2. It should be noted, however, that the RAO for arsenic in soil published in the SCOU ROD Part 3 is 9.9 mg/kg, based on the threshold background value (TBV) for arsenic. The current USEPA for RSL for benzo(a)pyene in residential soil is 0.020 mg/kg, in comparison to the risk-based RAO for benzo(a)pyene in soil (residential scenario) of 0.089 mg/kg that was included in the SCOU RI/FS Part 2.

Because concentrations of antimony, arsenic and benzo(a)pyrene in soil at ETC-10 exceed both the previous risk-based RAOs and the current TBCs, and the contaminated soil was removed as part of the remedial action, potential changes to TBCs for these COCs have no material impact on the protectiveness of the remedy. In addition, the following qualitative RAO was selected for the site and is still applicable: "Prevent use of the ETC-10 site that would result in potential human exposure to contaminated soils at ETC-10 under residential use conditions." Based on the ICs described in Section 7.3.1.1.1, this RAO is being met.

At the time of remedy selection, the USEPA's PRGs for lead in residential soil and industrial soil were adopted as the human health RAO for lead in soil of 400 mg/kg and the proposed soil cleanup level for lead of 750 mg/kg, respectively. As noted above, the USEPA's PRGs were superseded by USEPA RSLs. The May 2013 RSLs for lead in residential soil and industrial soil are 400 mg/kg and 800 mg/kg, respectively. Because current TBCs for lead in soil are equal to, or greater than, TBCs that were considered at the time or remedy selection, they have no impact on the protectiveness of the remedy.

7.3.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at ETC-10. Exposure pathways of concern, and those addressed by the SCOU ROD Part 3 remedies, are human exposure to residual soil contamination and vernal pool fairy shrimp and flora exposure to contaminants from past and present soil contamination at the site.

7.3.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no significant changes to toxicity values or other contaminant characteristics for site COCs, with the exception of arsenic and lead. In 2012, the USEPA established a relative bioavailability (RBA) of 60 percent for arsenic in soil relative to arsenic in water to account for differences in absorption between the readily soluble forms of the chemical ingested with water and the chemical ingested with site media (USEPA, 2012b). Because previous human health risk and noncancer HQ estimates were calculated without the RBA of 60 percent, they were over-estimated by approximately 40 percent.

In 2007, the California Office of Health Hazard Assessment (OEHHA) performed a new toxicity evaluation for lead that replaced the 10 µg/dl threshold blood-lead concentration with a source-specific "benchmark change" of 1 µg/dl. This change resulted in a new version of DTSC's lead risk assessment spreadsheet (LeadSpread 8; DTSC, 2011), as described in the following subsection.

7.3.2.4 Changes in Risk Assessment Methods

The only significant change in risk assessment methods related to the site involves lead. The HHRA for the site used DTSC's blood-lead biokinetic model (DTSC, 2000) to quantify risks for hypothetical future residential exposures to site soil. The DTSC's 2000 version of the blood-lead model assumed that increases in blood-lead concentrations up to 10 µg/dl in a residential child exposed to lead in soil are acceptable. In 2011, however, the DTSC released a new version of its lead risk assessment spreadsheet (LeadSpread 8) that is more restrictive. Section 2.8.5.4 of the SCOU ROD Part 3 stated, "The blood-lead estimate for the child residential exposure scenario based on the UCL^{95} concentration of 330 mg/kg was 8.8 µg/dl, less than the child protective level of 10 µg/dl." However, if the 95 percent UCL on the mean concentration for lead of 330 mg/kg is input to LeadSpread 8, an incremental 90^{th} percentile blood-lead concentration of 4.3 µg/dl is calculated, which exceeds the new incremental blood-lead threshold of 1 µg/dl.

Although an evaluation of risks associated with lead in soil using LeadSpread 8 is inconsistent with the conclusions of the HHRA relative to lead, the current remedy excludes development of the site for future residential land use and, therefore, is protective.

7.3.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.3.1.1 documents that objectives of the IC and LTEM remedies for ETC-10 are being achieved. Site access is controlled and there has been no identifiable human access or use of the site during the period of this five-year review. The first ecological monitoring event was performed in early 2008 as required and identified no effects from residual soil contamination at ETC-10 on vernal pool fairy shrimp or plants.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-10 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-10 LTEM is not incorporated into this five-year review report. LTEM is planned during the next year that has sufficient rainfall.

7.3.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this five-year review report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for ETC-10.

7.4 EARTH TECHNOLOGY CORPORATION 12

The SCOU ROD Part 3 remedy for ETC-12 is:

- LTEM.

As described in Section 4.2.2.2, the LTEM remedy has been implemented.

7.4.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.4.1.1 Remedial Action Performance

Per the SCOU ROD Part 3, LTEM at ETC-12, consisting of wetlands invertebrate (fairy shrimp) and plant (flora) surveys at selected vernal pools, is to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted. A survey of vernal pools potentially impacted by residual soil contamination at ETC-12 and not-impacted background pools was last conducted in spring 2008. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Survey procedures and results were presented in Appendix A of the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a). Results of the surveys indicated that, at a 95 percent confidence level and based on the Wilcoxon-Mann-Whitney tests, there was no evidence that fairy shrimp abundance, plant diversity, or plant abundance (percent plant coverage) in the potentially impacted pools was statistically less than in the reference pools. Given those results, it was reasonable to state that there have been no identifiable effects from residual soil contamination at ETC-12 on vernal pool fairy shrimp or plants. Based on weather conditions and limitations on the areas included in the 2008 LTEM event, EPA requested that another round of monitoring be conducted prior to concluding that LTEM could be terminated.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-12 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, results from ETC-12 LTEM are not available for evaluation in this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.4.1.2 System Operations/Operation and Maintenance

There are no operating remedial systems in place at ETC-12.

7.4.1.3 Opportunities for Optimization

There are no opportunities for optimization at ETC-12 given that there are no operating remedial systems.

7.4.1.4 Early Indicators of Potential Issues

There are no potential issues identified for the ETC-12 remedial action.

7.4.1.5 Implementation of Institutional Controls and Other Measures

ICs are not part of the remedy for ETC-12. No measures other than LTEM are required or have been implemented at ETC-12.

7.4.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for ETC-12, with the exceptions noted below.

7.4.2.1 Changes in Standards and To Be Considered Guidelines

ARARs and TBCs related to residual soil contamination at ETC-12 are relevant to the LTEM remedy addressed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the contaminants of ecological concern (COECs) that were evaluated in the FS. A baseline HHRA was not performed for ETC-12 in either the SCOU RI or in the CB HHERA. As a result, no COCs were identified for this site. Consequently, USEPA RSLs for soil are not applicable to this site. The COECs identified for soil at the site are chromium, lead and vanadium. Ecological TBCs for soil are currently unavailable for these metals.

7.4.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at ETC-12. The exposure pathway of concern, and that addressed by the SCOU ROD Part 3 remedy, are vernal pool fairy shrimp and flora exposure to contaminants from past and present soil contamination at the site.

7.4.2.3 Changes in Toxicity and Other Contaminant Characteristics

No changes to toxicity values used to evaluate ecological hazards for site COECs have occurred since the remedy was implemented.

7.4.2.4 Changes in Risk Assessment Methods

No significant changes to the methods used to evaluate ecological hazards for site COECs have occurred since the remedy was implemented.

7.4.2.5 Expected Progress toward Meeting Remedial Action Objectives

Information presented in Section 7.4.1.1 documents that objectives of the LTEM remedy for ETC-12 are being achieved. The first ecological monitoring event was performed in early 2008 as required.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the ETC-12 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from ETC-12 LTEM is not incorporated into this five-year review report. LTEM is planned during the next year that has sufficient rainfall.

7.4.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this Review Report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for ETC-12.

7.5 FIRE TRAINING AREA 1

The SCOU ROD Part 3 remedy for FTA-1 is:

- SVE, BV, LTM, ICs, E&D, and LTEM.

As described in Section 4.2.2.3, SVE/capping and E&D remedial actions have been completed; a BV remedial action was not necessary; and IC, LTM, and LTEM remedies have been implemented.

7.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.5.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of the effectiveness of ICs, and the results of LTM and LTEM. Information on the effectiveness of ICs is based on the nature of the controls in place, site conditions reported for the annual evaluation of site activities and conditions, and site conditions observed during a recent site inspection. The results of LTM are based on the cap inspection and monitoring conducted quarterly to semiannually for FTA-1, and a recent site inspection. Groundwater monitoring is also part of the LTM at FTA-1 per the SCOU ROD Part 3. The results of LTEM are based on the wetlands invertebrate (fairy shrimp) and plant surveys conducted in the vicinity of FTA-1 in February and March 2008, respectively. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.5.1.1.1 Institutional Controls

FTA-1 is currently located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site-altering activities within the prison parcel, including FTA-1, without notification of the EPA, DTSC and the Air Force and the approval of such activities by the Air Force. No requests for site-altering activities have been received to date by the Air Force for FTA-1 or its vicinity.

In accordance with the *Closure and Post-Closure Maintenance Plan – Update 2* (AFRPA, 2006b), annual monitoring is conducted to identify any activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with the effectiveness of the ICs. An IC checklist is completed during the inspection and included in the annual Operations, Maintenance, and Monitoring Reports. The annual reports for 2009 (CH2M Hill, 2010b), 2010 (CH2M Hill, 2011a), 2011 (CH2M Hill, 2012a) and 2012 (CH2M Hill, 2013b) indicate there were no issues with the annual IC evaluation during the fourth five-year review period. Further, no evidence of any irregular site use, construction or other site altering activities was observed within the FTA-1 site during a site inspection by MWH personnel on 18 June 2013.

The ICs have been properly implemented and are effective and no issues have been identified.

7.5.1.1.2 Long-Term Monitoring

Quarterly inspections of the FTA-1 cap were performed from 2008 through Q1/09 (February/March 2009). Semiannual inspections of the FTA-1 cap were performed from Q2/09 (May 2009) through 2012. The results of these inspections are as follows:

<u>2008</u>: Access road in good condition; fencing and gates in good condition; no evidence of vandalism or unauthorized access; cap overall in good condition, with usual number of animal burrows observed, so filling of burrows and erosion areas completed in fall 2008 but with little effect, and thus baiting of burrows was started December; cap mowed in April; SVE wells in fair condition with sun exposure damage observed, but since the SVE system is no longer in service, no repairs are planned; dismantling and removal of piping system on cap completed during 2008; periphery of cap in good condition; no trash or evidence of unauthorized dumping (MWH, 2009a).

<u>2009</u>: Access roads, fencing, and gates in good condition; no evidence of vandalism or unauthorized access; rodent activity still present, but greatly reduced since baiting activities began in Q4/08; small animal burrows baited through Q2/09; filling of rodent holes (each quarter) and re-seeding (first and

second quarters); cap mowed in May; substantial rutting by vehicles during well abandonment and piping removal activities, but repaired prior to start of rainy season; cap periphery in good condition; erosion and rodent burrows observed beneath perimeter fence; no trash or debris in the area (CH2M HILL, 2010b).

2010: Access roads, fencing, and gates in good condition; no evidence of vandalism or unauthorized access; numerous animal burrows observed and filled during both semiannual inspections, with baiting discontinued because of the potential for impacting burrowing owls and raptors; cap mowed in May; some vegetation noted and treated with weed/grass killer in drainage channel during June inspection, although vegetative growth did not seem to impede functionality of drainage channel; cap periphery in good condition; rodent burrows observed beneath perimeter fence; debris observed in drainage channel and removed during June inspection; no trash or evidence of unauthorized dumping observed during December inspection (CH2M HILL, 2011a).

2011: Access roads, fencing, and gates in good condition; no evidence of vandalism or unauthorized access; numerous animal burrows observed and filled during both semiannual inspections; cap mowed in May; monitoring wells in good condition; cap periphery in good condition; rodent burrows observed beneath perimeter fence; no trash or debris in the area (CH2M HILL, 2012a).

2012: Access roads, fencing, and gates in good condition; no evidence of vandalism or unauthorized access; numerous animal burrows observed but no indication the geosynthetic cap material was affected; cap mowed in May; monitoring wells in good condition; cap periphery in good condition; no trash or debris in the area (CH2M Hill, 2013b).

The burrowing animal holes noted in the FTA-1 vegetative cover during the Site Inspection (Section 6.4) are consistent with similar observations noted above for the regular monitoring inspections completed at FTA-1. The animal burrows are subject to normal inspection and maintenance activities under the O&M Plan and are not an issue that affects protectiveness.

As discussed in detail in Section 4.2.2.3, groundwater monitoring well MW886 has been planned for sampling as part of FTA-1 closure monitoring, but has been dry since 2008. Two replacement wells, one to replace MW886 and one located within the assumed boundary of the last known TCE MCL plume, were installed in August 2013. Results from the new wells will be presented in future LTGSP reports.

7.5.1.1.3 Long-Term Ecological Monitoring

Per the SCOU ROD Part 3, LTEM at FTA-1, consisting of wetlands invertebrate (fairy shrimp) and plant (flora) surveys at selected vernal pools, is to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted. A survey of vernal pools potentially impacted by residual soil contamination at FTA-1 and not-impacted background pools was last conducted in spring 2008. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Survey procedures and results were presented in Appendix A of the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a). Results of the surveys indicated that, at a 95 percent confidence level and based on the Wilcoxon-Mann-Whitney tests, there was no evidence that fairy shrimp abundance, plant diversity, or plant abundance (percent plant coverage) in the potentially impacted pools was statistically less than in the reference pools. Given those results, it was reasonable to state that there have been no identifiable effects from residual soil contamination at FTA-1 on vernal pool fairy shrimp or plants. Based on weather conditions and limitations on the areas included in the 2008 LTEM event, EPA requested that another round of monitoring be conducted prior to concluding that LTEM could be terminated.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the FTA-1 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, results from FTA-1 LTEM are not available for evaluation in this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.5.1.2 System Operations/Operation and Maintenance

There are no operating remedial systems in place at FTA-1. Maintenance of the FTA-1 cap is discussed in Section 7.5.1.1.2.

7.5.1.3 Opportunities for Optimization

There are no opportunities for optimization at FTA-1 given that there are no operating remedial systems.

7.5.1.4 Early Indicators of Potential Issues

Groundwater monitoring at FTA-1 is affected by the decline in the regional groundwater levels, dry wells are identified in the annual monitoring reports and the monitoring objectives are evaluated to determine if the dry wells should be replaced. A basewide discussion of declining regional groundwater levels and an evaluation of dry wells is provided in Section 7.1.1.4.

There are no other potential issues identified for the FTA-1 remedial action.

7.5.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs and access control measures in Section 7.5.1.1.1.

FTA-1 is currently located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site-altering activities within the prison parcel, including FTA-1, without notification of the EPA, DTSC and the Air Force and the approval of such activities by the Air Force.

7.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for FTA-1, with the exceptions noted below.

7.5.2.1 Changes in Standards and To Be Considered Guidelines

The SVE/capping and E&D actions at FTA-1 were completed as removal/remedial actions. ARARs and TBCs are relevant to the IC, LTM, and

LTEM remedies addressed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the COCs that were evaluated in the FS. The COCs identified for soil at the site include arsenic, benzo(a)pyrene, cadmium, lead, and dioxins. Changes to TBCs for some of these COCs have occurred since the time of remedy selection. The current USEPA RSL for arsenic in residential soil is 0.71 mg/kg, only slightly lower than the risk-based RAO for arsenic in soil (residential scenario) of 1 mg/kg that was included in the SCOU RI/FS Part 2. It should be noted, however, that the RAO for arsenic in soil published in the SCOU ROD Part 3 is 9.9 mg/kg, based on the threshold background value (TBV) for arsenic. The current USEPA RSL for benzo(a)pyene in residential soil is 0.020 mg/kg, in comparison to the risk-based RAO for benzo(a)pyene in soil (residential scenario) of 0.089 mg/kg that was included in the SCOU RI/FS Part 2. The current USEPA RSL for cadmium in residential soil is 70 mg/kg, in comparison to the risk-based RAO for cadmium in soil (residential scenario) of 4.4 mg/kg that was included in the SCOU RI/FS Part 2. The current USEPA RSL for 2,3,7,8-tetrachlorodibenzo-p-dioxins (TCDD) in residential soil is 4.5E-06 mg/kg, in comparison to the risk-based RAO for 2,3,7,8-TCD in soil (residential scenario) of 1.0E-02 mg/kg that was included in the SCOU RI/FS Part 2.

At the time of remedy selection, the USEPA's PRGs for lead in residential soil and industrial soil were adopted as the human health RAO for lead in soil of 400 mg/kg and the proposed soil cleanup level for lead of 750 mg/kg, respectively. As noted above, the USEPA's PRGs were superseded by USEPA RSLs. The May 2013 RSLs for lead in residential soil and industrial soil are 400 mg/kg and 800 mg/kg, respectively. Because current TBCs for lead in soil are equal to, or greater than, TBCs that were considered at the time or remedy selection, they have no impact on the protectiveness of the remedy.

7.5.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at FTA-1. The exposure pathways of concern, and those addressed by the SCOU ROD Part 3 remedies, are human exposure to residual soil contamination under the cap and vernal pool fairy shrimp and flora exposure to contaminants from former soil contamination at the site. The potential exposure pathway of vapor intrusion to future buildings from residual shallow VOCs that may be present at FTA-1 is not an issue because human use of the site is restricted by ICs in the Air Force/BoP MOU and, in addition, human use or building on the site is precluded since the site is within the BoP Vernal Pool Preservation Area.

7.5.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no changes to toxicity values or other contaminant characteristics for site COCs, with the exception of arsenic and lead. In 2012, the USEPA established a relative bioavailability (RBA) of 60 percent for arsenic in soil relative to arsenic in water to account for differences in absorption between the readily soluble forms of the chemical ingested with water and the chemical ingested with site media (USEPA, 2012b). Because previous human health risk and noncancer HQ estimates were calculated without the RBA of 60 percent, they were over-estimated by approximately 40 percent.

In 2007, the California Office of Health Hazard Assessment (OEHHA) performed a new toxicity evaluation for lead that replaced the 10 µg/dl threshold blood-lead concentration with a source-specific “benchmark change” of 1 µg/dl. This change resulted in a new version of DTSC’s lead risk assessment spreadsheet (LeadSpread 8; DTSC, 2011), as described in the following subsection.

7.5.2.4 Changes in Risk Assessment Methods

The only significant change in risk assessment methods related to the site involves lead. The HHRA for the site used DTSC’s blood-lead biokinetic model (DTSC, 2000) to quantify risks for hypothetical future residential exposures to site soil. The DTSC’s 2000 version of the blood-lead model assumed that increases in blood-lead concentrations up to 10 µg/dl in a residential child exposed to lead in soil are acceptable. In 2011, however, the DTSC released a new version of its lead risk assessment spreadsheet (LeadSpread 8) that is more restrictive. In LeadSpread 8, a soil-lead concentration of 77 mg/kg corresponds to an incremental increase in blood-lead concentration in a residential child equal to 1 µg/dl. The concentration of lead that was evaluated in the SCOU RI/FS Part 2 (i.e., equal to 51.6 mg/kg) is below the acceptable soil-lead threshold of 77 mg/kg.

7.5.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.5.1.1 documents that the objectives of the IC, LTM, and LTEM remedies for FTA-1 are being achieved. Site access is controlled, and there has been no identifiable human access or use of the site during the period of this five-year review. Cap monitoring and maintenance is being performed quarterly to semiannually, and there have been no significant issues with the cap. The first ecological monitoring event was performed in early 2008 as required.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the FTA-1 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from FTA-1 LTEM is not incorporated into this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.5.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Due to historical fire training activities at FTA-1, the area may have been impacted by the use of PFCs used in fire-fighting foams. The Air Force is taking a programmatic approach at BRAC facilities with regard to potential emerging chemical contamination associated with PFCs. This Air Force-wide initiative will evaluate candidate sites for the potential presence of PFC compounds and will include sampling at the selected sites to determine if PFCs are present. FTA-1 is included in the Air Force assessment of such sites for PFCs. PFCs are being addressed as directed in the 17 September 2012 HQ UASF/A7C memo, Interim Guidance on Perfluorinated Compounds, implementing the 27 August 2012 Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations, which directs the Air Force to undertake a phased approach to identify, quantify, and mitigate, if necessary, potential releases of PFCs in groundwater, surface water, soil and/or sediment at its installations. Step 1 is to confirm if PFC releases have occurred, Step 2 is to delineate the extent of any confirmed releases, and Step 3 is to mitigate human exposures on a case-specific basis if required. AFCEC awarded a contract in December 2013 to execute Step 1 at all BRAC bases. Appropriate notifications, discussions, and documentation will facilitate this effort. Implementation of the Air Force's PFC initiative in regard to Castle AFB and Site FTA-1 is included as an issue and recommendation in Sections 8 and 9, respectively.

Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the annual IC evaluations, the recent site inspection, and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for FTA-1.

7.6 LANDFILL 3 REMEDIAL ACTION

The SCOU ROD Part 3 remedy for LF-3 is:

- LTEM.

As described in Section 4.2.2.4, an E&D removal action has been completed and the LTEM remedy has been implemented.

7.6.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.6.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of the results of LTEM. Per the SCOU ROD Part 3, LTEM at LF-3, consisting of wetlands invertebrate (fairy shrimp) and plant (flora) surveys at selected vernal pools, is to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted. A survey of vernal pools potentially impacted by residual soil contamination at LF-3 and not-impacted background pools was last conducted in spring 2008. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Survey procedures and results were presented in Appendix A of the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a). Results of the surveys indicated that, at a 95 percent confidence level and based on the Wilcoxon-Mann-Whitney tests, there was no evidence that fairy shrimp abundance, plant diversity, or plant abundance (percent plant coverage) in the potentially impacted pools was statistically less than in the reference pools. Given those results, it was reasonable to state that there have been no identifiable effects from residual soil contamination at LF-3 on vernal pool fairy shrimp or plants. Based on weather conditions and limitations on the areas included in the 2008 LTEM event, EPA requested that another round of monitoring be conducted prior to concluding that LTEM could be terminated.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-3 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, results from LF-3 LTEM are not available for evaluation in this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.6.1.2 System Operations/Operation and Maintenance

There are no operating remedial systems in place at LF-3.

7.6.1.3 Opportunities for Optimization

There are no opportunities for optimization at LF-3 given that there are no operating remedial systems.

7.6.1.4 Early Indicators of Potential Issues

There are no potential issues identified for the LF-3 remedial action.

7.6.1.5 Implementation of Institutional Controls and Other Measures

ICs are not part of the remedy for LF-3. No measures other than LTEM are required or have been implemented at LF-3.

7.6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-3, with the exceptions noted below.

7.6.2.1 Changes in Standards and To Be Considered Guidelines

ARARs and TBCs related to residual soil contamination at LF-3 are relevant to the LTEM remedy addressed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the

COCs evaluated in the FS. The COCs identified for soil at the site are arsenic, PAHs including benzo(a)pyrene, and lead. Changes to TBCs for these COCs have occurred since the time of remedy selection. The current USEPA RSL for arsenic in residential soil is 0.71 mg/kg, only slightly lower than the risk-based RAO for arsenic in soil (residential scenario) of 1 mg/kg that was included in the SCOU RI/FS Part 2. It should be noted, however, that the RAO for arsenic in soil published in the SCOU ROD Part 3 is 9.9 mg/kg, based on the threshold background value (TBV) for arsenic. The current USEPA for RSL for benzo(a)pyene in residential soil is 0.020 mg/kg, in comparison to the risk-based RAO for benzo(a)pyene in soil (residential scenario) of 0.089 mg/kg that was included in the SCOU RI/FS Part 2.

Because concentrations of arsenic and benzo(a)pyrene in soil at LF-3 exceed both the previous risk-based RAOs and the current TBCs, and the contaminated soil was consolidated and capped as part of the remedial action, potential changes to TBCs for these COCs have no material impact on the protectiveness of the remedy.

At the time of remedy selection, the USEPA's PRGs for lead in residential soil and industrial soil were adopted as the human health RAO for lead in soil of 400 mg/kg and the proposed soil cleanup level for lead of 750 mg/kg, respectively. As noted above, the USEPA's PRGs were superseded by USEPA RSLs. The May 2013 RSLs for lead in residential soil and industrial soil are 400 mg/kg and 800 mg/kg, respectively. Because current TBCs for lead in soil are equal to, or greater than, TBCs that were considered at the time or remedy selection, they have no impact on the protectiveness of the remedy.

7.6.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at LF-3. The exposure pathway of concern, and that addressed by the SCOU ROD Part 3 remedy, are vernal pool fairy shrimp and flora exposure to contaminants from past and present soil contamination at the site.

However, ARARs have not been established for the contaminants detected in soil at the site or for the COCs evaluated in the FS. The COCs identified for soil at the site are arsenic, PAHs including benzo(a)pyrene, and lead. Changes to TBCs for these COCs have occurred since the time of remedy selection. The current USEPA RSL for arsenic in residential soil is 0.71 mg/kg, only slightly lower than the risk-based RAO for arsenic in soil (residential scenario) of 1 mg/kg that was included in the SCOU RI/FS Part 2. It should be noted, however, that the RAO for arsenic in soil published in the SCOU ROD Part 3 is 9.9 mg/kg, based on the threshold background value (TBV) for arsenic. The current USEPA for RSL for benzo(a)pyene in residential soil is 0.020 mg/kg, in comparison to the risk-based RAO for benzo(a)pyene in soil (residential scenario) of 0.089 mg/kg that was included in the SCOU RI/FS Part 2.

Because concentrations of arsenic and benzo(a)pyrene in soil at LF-3 exceed both the previous risk-based RAOs and the current TBCs, and the contaminated soil was consolidated and capped as part of the remedial action, potential changes to TBCs for these COCs have no material impact on the protectiveness of the remedy.

At the time of remedy selection, the USEPA's PRGs for lead in residential soil and industrial soil were adopted as the human health RAO for lead in soil of 400 mg/kg and the proposed soil cleanup level for lead of 750 mg/kg, respectively. As noted above, the USEPA's PRGs were superseded by USEPA RSLs. The May 2013 RSLs for lead in residential soil and industrial soil are 400 mg/kg and 800 mg/kg, respectively. Because current TBCs for lead in soil are equal to, or greater than, TBCs that were considered at the time or remedy selection, they have no impact on the protectiveness of the remedy.

7.6.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no changes to toxicity values or other contaminant characteristics for site COCs since the remedy was implemented, with the exception of arsenic and lead. In 2012, the USEPA established a relative bioavailability (RBA) of 60% for arsenic in soil relative to arsenic in water to account for differences in absorption between the readily soluble forms of the chemical ingested with water and the chemical ingested with site media (USEPA, 2012b). Because previous human health risk and noncancer HQ estimates were calculated without the RBA of 60 percent, they were over-estimated by approximately 40 percent.

In 2007, the California Office of Health Hazard Assessment (OEHHA) performed a new toxicity evaluation for lead that replaced the 10 µg/dl threshold blood-lead concentration with a source-specific “benchmark change” of 1 µg/dl. This change resulted in a new version of DTSC’s lead risk assessment spreadsheet (LeadSpread 8; DTSC, 2011), as described in the following subsection.

7.6.2.4 Changes in Risk Assessment Methods

The only significant change in risk assessment methods related to the site involves lead. The HHRA for the site used DTSC’s blood-lead biokinetic model (DTSC, 2000) to quantify risks for hypothetical future residential exposures to site soil. The DTSC’s 2000 version of the blood-lead model assumed that increases in blood-lead concentrations up to 10 µg/dl in a residential child exposed to lead in soil are acceptable. In 2011, however, the DTSC released a new version of its lead risk assessment spreadsheet (LeadSpread 8) that is more restrictive. In LeadSpread 8, a soil-lead concentration of 77 mg/kg corresponds to an incremental increase in blood-lead concentration in a residential child equal to 1 µg/dl. The concentration of lead that was evaluated in the SCOU RI/FS Part 2 (i.e., equal to 29,000 mg/kg) is well above the currently acceptable soil-lead threshold of 77 mg/kg.

7.6.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.6.1.1 documents that objectives of the LTEM remedy for LF-3 are being achieved. The first ecological monitoring event was performed in early 2008 as required.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-3 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-3 LTEM is not incorporated into this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.6.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this five-year review report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for LF-3.

7.7 LANDFILL 4 REMEDIAL ACTION (INCLUDING DP-5 AND DP-6)

The SCOU ROD Part 3 remedy for LF-4 is:

- ICs and LTM.

As described in Section 4.2.2.5, a consolidation and capping removal action has been completed, and IC and LTM remedies have been implemented.

7.7.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.7.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of the effectiveness of ICs and the results of LTM. Information on the effectiveness of ICs is based on the nature of the controls in place, site conditions reported for the annual evaluation of site activities and conditions, and site conditions observed during a recent site inspection. The results of LTM are based on the cap inspection and monitoring conducted quarterly to semiannually for LF-4, the results of post-closure groundwater monitoring conducted as part of the LTGSP, and a recent site inspection.

7.7.1.1.1 Institutional Controls

Land use restrictions for LF-4 were incorporated in the deed transferring the parcel containing LF-4 to Merced County (deed recorded 8 January 2007, Merced County Recorders document #2007-001242), and a State Land Use Covenant has been executed by Merced County with the State of California (deed recorded 8 January 2007, Merced County Recorders document #2007-001241). These controls limit site use to non-irrigated open space and preclude any groundwater withdrawal or other activity that would disturb the closed landfill, including the cap, access roads and security fencing, drainage features, and monitoring probes/wells.

In accordance with the *Closure and Post-Closure Maintenance Plan – Update 2* (AFRPA, 2006b), annual monitoring is conducted to identify any activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with the effectiveness of the ICs. An IC checklist is completed during the inspection and is included in the annual Operations, Maintenance, and Monitoring Reports. The annual reports for 2009 (CH2M Hill, 2010b), 2010 (CH2M Hill, 2011a), 2011 (CH2M Hill, 2012a) and 2012 (CH2M Hill, 2013b) indicate there were no issues with the annual IC evaluation of LF-4 during this five-year review period. Furthermore, no evidence of any irregular site use, construction, or other site-altering activities were observed within LF-4 during a site inspection by MWH personnel on 18 June 2013.

The ICs have been properly implemented and are effective and no issues have been identified.

7.7.1.1.2 Long-Term Maintenance and Monitoring

Quarterly inspections of the LF-4 caps were performed from 2008 through Q1/09 (February/March 2009). Semiannual inspections of the LF-4 caps were performed from Q2/09 (May 2009) through 2012. The results of these inspections are as follows:

<u>2008</u>: Access road in good condition, but with excessive vegetation observed over roadways; main access gate bent but works well, with remaining fencing in good condition; no evidence of vandalism or unauthorized access; settlement monuments and gas vents in good condition; no water or flow issues at gas vents Cell #1 Center or Cell #2 North, as were observed in 2007; caps overall in good condition, but cracking in southwest side of Cell #1 observed in 2007 has not changed, but does not create a problem with drainage or erosion, so was not filled; caps mowed in April; drainage channel regrading conducted in September, with 900 feet of Cell #1 west channel cobbles removed, bottom regraded, and cobbles replaced to remove vegetation overgrowth and sediment buildup; also, new drainage culvert installed at south end of west drainage channel of Cell #1; monitoring probes and wells in good condition; periphery of both caps in good condition; no trash or evidence of unauthorized dumping (MWH, 2009a).

<u>2009</u>: An herbicide (Roundup) was sprayed to control excessive vegetation in the road; no evidence of vandalism or unauthorized access; settlement monuments

and gas vents in good condition, a subsurface inspection of a slight settlement was conducted near the center vent of cell #1, the liner was found to be in good condition and a small tear in the well collar, considered to be from initial construction was patched with silicone rubber; vegetative cover in good condition; caps mowed in May; volunteer trees noted in portions of drainage channels and removed in 2012 after the rainy season; monitoring probes and wells in good condition and an audit by the Merced County Environmental Health Department, resulted in installation of gas tight caps with ball valves; periphery of both caps in good condition with no evidence of animal intrusion on the cap; minor trash and debris along fencing removed. An aerial survey was completed on December 12, 2009. In general, there has been non-uniform settlement. However, one pattern has emerged, where areas of settlement have occurred over underlying waste trenches. Ponding resulting from settlement is possible and will be further evaluated in the field. However, it does not appear that any substantial differential settlement, or the displacement of one point on the surface with respect to another caused by settlement, may have resulted in damage to the underlying geosynthetic materials. One area has experienced a drop of about 1.2 feet in 20 feet horizontally. A review of the settlement between 1999 and 2009 and between 1999 and 2004 revealed that, in general, the primary settlement occurred during the first 5 years. Subsequent settlement has been minor since 2004. Additionally, settlement over underlying trenches has developed a preferential pathway for storm water. The resulting swales are heavily vegetated, but will be further evaluated for erosion potential, and if necessary, will be treated with fiber rolls, rolled erosion control materials, or other appropriate erosion control measures.

2010: Access road in good condition; several bent fence posts noted during June inspection, on west side near area between Cells #1 and #2, but fence is still functional; during November inspection, signs of burrowing animals along perimeter fence to west of Cell #1 observed, and the burrows were backfilled with soil; no evidence of vandalism or unauthorized access; settlement monuments should be re-labeled, and methane warning stickers on the gas vents are fading; vegetative cover overall in good condition; excessive animal burrowing near LF4SVE-B filled with soils to prevent erosion; during June inspection, several surface depressions at Cell #1 observed, consistent with depressions noted in 2009 during the 5-yearly settlement monitoring, thus the surface depressions will be monitored for erosion potential, and if necessary, will be treated with appropriate erosion control measures; caps mowed in May; application of grass/weed killer in May to control vegetation growth in swales; in March, drainage channel near southwestern corner of Cell #1 overflowed, so drainage ditch along southern end of Cell #1 expanded from the southwestern corner eastward about 30 feet and to a 6-foot bottom width and a 4-foot depth from ground surface; also, culvert under perimeter road along west side of LF-4 was capped to prevent water from discharging to western fence line; monitoring probes and wells in good condition; grass/weed killer used on vegetation near vapor wells and LF-4 drainage ditch; periphery of both caps in good condition; no trash or evidence of unauthorized dumping (CH2M HILL, 2011a).

2011: Access road in good condition; bullet holes were noted on a sign, but the holes do not interfere with the function of the sign; settlement monuments and gas vents labeled and in good condition; labels were re-marked with a paint pen; signs of burrowing animals along the perimeter fence of Cell #1 observed, and the burrows were backfilled with soil during each semiannual inspection; cap mowed in May; following July inspection, fire damaged vegetation on southern portion of Cell #1 cap (approximately one-third of the cap affected); during December inspection, new vegetation was observed growing over burned area; during December inspection, several surface depressions at Cell #1 observed, consistent with depressions noted in 2009 during five-yearly settlement monitoring and during 2010 cap inspections; in the spring, surface water observed to be diverting from the drainage channel and running into the neighboring orchard to the west of Cell #1, so the drainage channel was expanded, deepened, and re-graded to promote directional flow; no drainage issues observed during December inspection; monitoring probes and wells in good condition; periphery of both caps in good condition; no trash or evidence of unauthorized dumping (CH2M HILL, 2012a).

2012: Access road, fencing and gates in good condition; signs of burrowing animals along the perimeter fence of Cell #1 were observed and backfilled with soil; additional bullet holes were noted on a sign, but the holes do not interfere with the function of the sign; several surface depressions at Cell #1 were observed during the May and December inspections, consistent with depressions noted in 2009 during the 5-year settlement monitoring and during the 2010 cap inspections; no erosion control measures were necessary in 2012; no other issues with the cap or vegetative cover were noted; entire cap mowed in May; no drainage issues noted in 2012; monitoring probes and wells in good condition; periphery of both caps in good condition; no trash or evidence of unauthorized dumping (CH2M Hill, 2013b).

The vegetative growth in the drainage ditches noted at LF-4 during the Site Inspection (Section 6.4) is consistent with similar observations noted above for the regular monitoring inspections completed at LF-4. The drainage channels are regularly evaluated to confirm adequate drainage flow and necessary repairs are undertaken as part of implementing the O&M Plan. The site inspection observations were not noted as issues that affects protectiveness.

Semiannual post-closure groundwater level measurements and groundwater monitoring for LF-4 (detection monitoring) was performed from 2008 through 2012 where possible. Corrective action monitoring was eliminated at LF-4 in Q2/07 (Jacobs, 2009c). To address the issue of declining water levels, beginning in Q2/10 existing monitoring well MW846 was used as a replacement for downgradient wells MW1001 and MW1002, while newly installed monitoring well MW1048 was used as a replacement for downgradient well MW410 Monitoring (CH2M HILL, 2010b). In July 2013, one groundwater well (MW1053) was installed to replace dry well MW888, in accordance with the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). The significant results of these monitoring events are as follows:

<u>2008</u>: No evidence of a release from the caps warranting action, during the first half of the year; all LF-4 detection monitoring wells were dry in Q4, and thus no evaluation was possible for the second half of the year (Jacobs, 2008b; Jacobs, 2008c).

<u>2009</u>: Only one detection monitoring well (MW847) was sampled in Q2, all others were dry. In Q4 all wells were dry. All detection monitoring parameters were below their concentration limits at monitoring well MW847 in Q2/09 (CH2M HILL, 2010b).

<u>2010</u>: Due to decreasing water levels, all of the LF-4 detection monitoring wells have gone dry; therefore, wells MW846 and MW1048 were added to the program in 2010. Although a few detection monitoring parameters detected in 2010

exceeded the concentration limits established for the detection monitoring wells that are now dry, the Air Force does not consider this "measurably significant" evidence of a release from the landfill (CH2M HILL, 2011a).

2011: Groundwater monitoring was postponed during 2011 pending revision of the monitoring plan (CH2M HILL, 2012a).

2012: Two detection monitoring wells (MW846 and MW1048) were sampled in 2012; all other LF-4 detection and upgradient monitoring wells were dry. At MW846, antimony, barium, bicarbonate, calcium, dichlorodifluormethane, lead, and zinc were all detected at above their respective concentration limits. At MW1048, antimony and DBCP were detected above their respective concentration limits. The Air Force believes these data do not represent "measurably significant" evidence of a release because (1) DBCP is not an Air Force contaminant, and its presence results from the surrounding agricultural operations, (2) dichlorodifluoromethane was detected at MW846 at an estimated concentration that only slightly exceeded its concentration limit, and it has been previously detected at MW846 at concentrations as high as 6.2 micrograms per liter (µg/L), and (3) antimony, barium, bicarbonate, calcium, lead, and zinc are naturally occurring constituents, the elevated concentrations of which likely represent upgradient conditions. During future monitoring events, data from the newly proposed upgradient background well at LF-4 will be used to evaluate whether any exceedance of constituents in downgradient compliance wells is the result of a new landfill release (CH2M HILL, 2013a; CH2M Hill 2013b).

As discussed in Section 4.2.2.5, four of the five LF-4 detection monitoring wells (MW410, MW1001, MW1002, and MW1003) and the background monitoring well (MW888) have gone dry. To address the issue of declining water levels, in December 2009, MW1048 was installed to replace dry wells MW410 and MW1003 for detection monitoring of the northern cell of LF-4. Existing well MW846 was brought back into the sampling program to replace dry wells MW1001 and MW1002 for detection monitoring of the southern cell of LF-4. In July 2013, one groundwater well (MW1053) was installed to replace dry well MW888. Results from the new wells will be presented in future LTGSP reports.

7.7.1.2 Systems Operations/Operations and Maintenance

There are no operating remedial systems in place at LF-4. Maintenance of the LF-4 caps is discussed in Section 7.7.1.1.2.

7.7.1.3 Opportunities for Optimization

There are no opportunities for optimization at LF-4 given that there are no operating remedial systems.

7.7.1.4 Early Indicators of Potential Issues

Groundwater monitoring at LF-4 is affected by the decline in the regional groundwater levels, dry wells are identified in the annual monitoring reports and the monitoring objectives are evaluated to determine if the dry wells should be replaced. A basewide discussion of declining regional groundwater levels and an evaluation of dry wells is provided in Section 7.1.1.4.

There are no other potential issues identified for the LF-4 remedial action.

7.7.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs and access control measures in Section 7.7.1.1.1.

Land use restrictions for LF-4 were incorporated in the deed transferring the parcel containing LF-4 to Merced County, and a State Land Use Covenant has been executed by Merced County with the State of California. These controls limit site use to non-irrigated open space and preclude any groundwater withdrawal or other activity that would disturb the closed landfill, including the cap, access roads and security fencing, drainage features, and monitoring probes/wells.

7.7.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-4, with the exceptions noted below.

7.7.2.1 Changes in Standards and To Be Considered Guidelines

ARARs and TBCs related to site soil contamination are relevant to the IC and LTM remedies assessed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the COCs that were evaluated in the FS. The primary COCs identified for soil at the site include arsenic and cadmium. Changes to TBCs for these COCs have occurred since the time of remedy selection. The current USEPA RSL for arsenic in residential soil is 0.71 mg/kg, only slightly lower than the risk-based RAO for arsenic in soil (residential scenario) of 1 mg/kg that was included in the SCOU RI/FS Part 2. It should be noted, however, that the RAO for arsenic in soil published in the SCOU ROD Part 3 is 9.9 mg/kg, based on the threshold background value (TBV) for arsenic. The current USEPA RSL for cadmium in residential soil is 70 mg/kg, in comparison to the risk-based RAO for cadmium in soil (residential scenario) of 4.4 mg/kg that was included in the SCOU RI/FS Part 2.

7.7.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at LF-4. The exposure pathways of concern, and those addressed by the SCOU ROD Part 3 remedies, are human exposure to residual soil contamination under the caps and groundwater contamination by leachate from the capped waste. The potential exposure pathway of vapor intrusion to future buildings from residual shallow VOCs that may be present at LF-4 is not an issue because human use of the site is restricted by ICs that were incorporated in the deed transferring the parcel containing LF-4 to Merced County and in the State Land Use Covenant that has been executed by Merced County with the State of California.

7.7.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no significant changes to toxicity values or other contaminant characteristics for site COCs since the remedy was implemented, with the exception of arsenic. In 2012, the USEPA established a relative bioavailability (RBA) of 60 percent for arsenic in soil relative to arsenic in water to account for differences in absorption between the readily soluble forms of the chemical ingested with water and the chemical ingested with site media (USEPA, 2012b). Because previous human health risk and noncancer HQ estimates were calculated without the RBA of 60 percent, they were over-estimated by approximately 40 percent.

7.7.2.4 Changes in Risk Assessment Methods

There have been no significant changes in risk assessment methods related to site COCs since the remedy was implemented.

7.7.2.5 Expected Progress Toward Meeting Remedial Action Objectives

Information presented in Section 7.7.1.1 documents that objectives of the IC and LTM remedies for LF-4 are being achieved. Site access is controlled and there has been no identifiable human access or use of the site during the period of this five-year review. Cap monitoring and maintenance is being performed quarterly to semiannually, and there have been no significant issues with the caps.

7.7.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the post-closure groundwater monitoring program, the annual IC evaluations, and the recent site inspection, no data or other information are identified that could call into question the protectiveness of the remedy for LF-4.

7.8 LANDFILL 5 REMEDIAL ACTION (INCLUDING DP-8, DP-8A, LF-5 TRENCHES)

The SCOU ROD Part 3 remedy for LF-5 is:

- ICs, LTM, and LTEM.

As described in Section 4.2.2.6, a consolidation and capping removal action has been completed; and IC, LTM, and LTEM remedies have been implemented.

7.8.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

7.8.1.1 Remedial Action Performance

Remedial action performance is assessed in terms of the effectiveness of ICs and the results of LTM and LTEM. Information on the effectiveness of ICs is based on the nature of the controls in place, site conditions reported for the annual evaluation of site activities and conditions, and site conditions observed during a recent site inspection. The results of LTM are based on cap inspection and monitoring conducted quarterly to semiannually for LF-5, the results of post-closure groundwater monitoring conducted as part of the LTGSP, and a recent site inspection. The results of LTEM are based on the wetlands invertebrate (fairy shrimp) and plant surveys conducted in the vicinity of LF-5 in February and March 2008, respectively. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.8.1.1.1 Institutional Controls

LF-5 is located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site-altering activities within the prison parcel, including LF-5, without notification of the EPA, DTSC, and the Air Force and the approval of such activities by the Air Force. No requests for site-altering activities have been received to date by the Air Force for LF-5 or its vicinity.

In accordance with the *Closure and Post-Closure Maintenance Plan – Update 2* (AFRPA, 2006b), annual monitoring is conducted to identify any activity that is inconsistent with the IC objective or use restrictions, or any action that may interfere with the effectiveness of the ICs. An IC checklist is completed during the inspection and is included in the annual Operations, Maintenance, and Monitoring Reports. The annual reports for 2009 (CH2M Hill, 2010b), 2010 (CH2M Hill, 2011a), 2011 (CH2M Hill, 2012a) and 2012 (CH2M Hill, 2013b) indicate there were no issues with the annual IC evaluation of LF-5 during the period covered by this five-year review. Further, no evidence of any regular site use, construction, or other-site altering activities was observed within LF-5 during a site inspection conducted by MWH personnel on 18 June 2013.

The ICs have been properly implemented and are effective and no issues have been identified.

7.8.1.1.2 Long-Term Maintenance and Monitoring

Quarterly inspections of the LF-5 cap were performed from 2008 through Q1/09 (February/March 2009). Semiannual inspections of the LF-5 cap were performed from Q2/09 (May 2009) through 2012. The results of these inspections are as follows:

2008: Access road in good condition, but with excessive vegetation observed over roadways; fencing and gates in good condition; no evidence of vandalism or unauthorized access; settlement monuments and gas vents in good condition; cap overall in good condition; cap mowed in April; drainage channel regrading conducted in September, with 410 feet of southwestern channel cobbles removed, bottom regraded, and cobbles replaced to remove vegetation overgrowth and sediment buildup; also, two new drainage culverts installed at southwest end of south drainage channel; monitoring probes and wells in good condition; periphery of both caps in good condition; no trash or evidence of unauthorized dumping (MWH, 2009a).

2009: An herbicide (Roundup) was sprayed to control excessive vegetation in the road; no evidence of vandalism or unauthorized access; settlement monuments and gas vents in good condition; vegetative cover in good condition; caps mowed in May; drainage was noted as slow but sufficient to allow standing water to run off; monitoring probes and wells in good condition and an audit by the Merced County Environmental Health Department, resulted in installation of gas tight caps with ball valves; periphery of both caps in good condition; minor trash and debris along fencing removed. An Aerial survey was completed on December 12, 2009. In general, there has been non-uniform settlement. One pattern has emerged, where areas of settlement have occurred over underlying waste trenches. However, it does not appear that any substantial differential settlement, or the displacement of one point on the surface with respect to another caused by settlement, may have resulted in damage to the underlying geosynthetic materials. One area has experienced a drop of about 1.2 feet over 20 feet horizontally. Additionally, settlement over underlying trenches has developed a preferential pathway for storm water. These settlement areas or swales were inspected and found to be heavily vegetated, with no evidence of erosion past or present. The iso-settlement contours were inspected, and no evidence of soil mounding was found downgradient of the swales. The resulting swales will be evaluated for erosion potential each year, and if necessary, will be treated with fiber rolls, rolled erosion control materials, or other appropriate erosion control measures. A review of the settlement between 1999 and 2009 and between 1999 and 2004 revealed that, in general, the primary settlement occurred during the first 5 years. Subsequent settlement has been relatively minor since 2004 (CH2M HILL, 2010b).

2010: Access road in good condition; fencing and gates in good condition, however, evidence of burrowing animals along the perimeter fence on northeast, western and southern sides of the landfill during June and December inspections observed, so these areas were repaired as necessary; no evidence of vandalism or unauthorized access; settlement monuments and gas vents in good condition, but faded labels noted in June, and in December, monuments and gas vents were adequately labeled; cap in good condition, but animal burrowing activities observed at various locations on the cap; also, during June and December inspections, several surface depressions were observed, consistent with those observed in 2009 during 5-yearly settlement monitoring, so these surface depressions will be monitored for erosion potential, and if necessary, treated with appropriate erosion control measures; cap mowed in May; vegetation in drainage swales noted, and treated with grass/weed killer during June, although vegetation did not seem to impede functioning of drainage channel; monitoring probes and wells in good condition; squirrel holes observed at base of probes LF5SVE-A and LF5SVE-C during June inspection, with holes filled following inspection event; cap periphery in good condition; no trash or evidence of unauthorized dumping (CH2M HILL, 2011a).

2011: Access road in good condition; fencing and gates in good condition; animal burrowing activities observed at various locations on cap; large area of dead grass (approximately 2,000 square feet) observed by south vent, but was allowed to reseed naturally; during both inspections, several surface depressions observed, appearing consistent with those observed in 2009 during the five-yearly settlement monitoring and during the 2010 cap inspections; settlement monuments and gas vents in good condition; cap mowed in May; drainage channel observed to have vegetative growth; monitoring probes and wells in good condition; probes re-labeled during December inspection; cap periphery in good condition; many animal burrows observed along perimeter fence on northeast, western, and southern sides of landfill during the July and December inspections, and were filled with soil following inspections; no trash or evidence of unauthorized dumping (CH2M HILL, 2012a).

<u>2012</u>: Access road, fencing and gates in good condition; animal burrows were found along the perimeter fence on the northeastern, western, and southern sides of the landfill during the May and December inspections and were repaired as necessary, no evidence of vandalism or unauthorized access; settlement monuments and gas vents in good condition; animal burrowing activities occur at various locations on the cap although there was no indication the geosynthetic cap material was affected and no geosynthetic fragments were observed in the spoils pile created by the animals; a subcontractor was brought in to repair numerous burrows in mid-January 2012 – burrows were filled with cobble and compacted with dirt; during May and December inspections, several surface depressions were observed, which are consistent with those observed in 2009 during the 5-year settlement monitoring and during 2010 cap inspections; entire cap mowed in May; no drainage issues observed; monitoring probes and wells in good condition; cap periphery in good condition with exception of animal burrows; no trash or evidence of unauthorized dumping (CH2M Hill, 2013b).

The monitoring and maintenance issues noted at LF-5 during the Site Inspection (Section 6.4) are consistent with similar observations noted above for the regular monitoring inspections completed at LF-5. The landfill cap and drainage systems are regularly evaluated to confirm adequate cap integrity and drainage flow and necessary repairs are undertaken as part of implementing the O&M Plan. The site inspection observations were not noted as issues that affects protectiveness.

Semiannual post-closure groundwater level measurements and groundwater monitoring for LF-5 (corrective action and detection monitoring) was performed from 2008 through 2012 where possible. The significant results of these monitoring events are as follows:

<u>2008</u>: All LF-5 detection monitoring wells were dry. Only two corrective action monitoring wells (MW848 and MW878) were sampled in Q4, as the others were dry. Due to the limited data available, no evaluation was possible (Jacobs, 2009b; Jacobs, 2009c).

2009: The only LF-5 corrective action monitoring wells sampled in either Q2/09 or Q4/09 were MW352, MW848, and MW878. All other LF-5 corrective action and upgradient monitoring wells were dry during both sampling events. Chromium (0.56 mg/L) and nickel (0.69 mg/L) were detected at concentrations above tolerance limits at MW352 during the Q4/09 sampling event. Although these detections represent about a 5- to 10-fold increase in concentrations from Q2/09, they are within the range of concentrations that have been previously detected at this and other wells in the area. Thus, these detections do not represent “measurably significant” evidence of a recent release from LF-5, and further action at this site is unwarranted at this time (CH2M HILL, 2010b)

2010: Due to declining water levels, all of the detection monitoring wells and all but three corrective action wells (MW352, MW848, and MW878) have been dry or have had insufficient water for sampling since at least Q4/08. A new detection monitoring well (MW1049) was installed and sampled in December 2010. Installation of this well was originally planned for December 2009, but the work was delayed because of U.S. Fish and Wildlife concerns about potential habitat impacts. Detection monitoring parameters detected in Q4/10 did not exceed concentration limits, and corrective action parameters detected in Q2/10 and Q4/10 do not warrant active remediation (CH2M HILL, 2011a).

2011: Groundwater monitoring was postponed during 2011 pending revision of the monitoring plan (CH2M HILL, 2012a).

2012: LF-5 corrective action monitoring wells MW352, MW848, MW878, and MW1049 were sampled in Q2/12 and Q4/12. None of the sample results exceeded tolerance limits for corrective action parameters. LF-5 detection monitoring well MW1049 was sampled in Q2/12 and cobalt was the only parameter that exceeded its concentration limit at LF-5 (0.028 mg/L versus 0.019 mg/L). The Air Force believes that these data do not represent "measurably significant" evidence of a release because cobalt is a naturally occurring constituent, the elevated concentration of which likely represents upgradient conditions. During future monitoring events, data from a newly proposed upgradient background well at LF-5 will be used to evaluate whether any exceedance of constituents in downgradient compliance wells is the result of a new landfill release (CH2M HILL, 2013a).

As discussed in detail in Section 4.2.2.6, three detection compliance monitoring wells (MW862R, MW1004, and MW1005) and one background monitoring well (MW360) have gone dry. To address the issue of declining water levels, in October 2010, MW1049 was installed to replace the dry detection compliance monitoring wells and in July 2013, monitoring well (MW1050) was installed to replace the dry background monitoring well, detection compliance monitoring wells MW1051 and MW1052 were installed to replace dry compliance monitoring wells. All wells were installed in accordance with the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). Results from the new wells will be presented in future LTGSP reports.

7.8.1.1.3 Long-Term Ecological Monitoring

Per the SCOU ROD Part 3, LTEM at LF-5, consisting of wetlands invertebrate (fairy shrimp) and plant (flora) surveys at selected vernal pools, is to be conducted every five years for up to 30 years unless the Air Force and the regulatory agencies agree during that period that further monitoring is not warranted. A survey of vernal pools potentially impacted by residual soil contamination at LF-5 and not-impacted background pools was last conducted in spring 2008. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Survey procedures and results were presented in Appendix A of the *Third Five-Year Review Report for Castle Airport* (Jacobs, 2009a). Results of the surveys indicated that, at a 95 percent confidence level and based on the Wilcoxon-Mann-Whitney tests, there was no evidence that fairy shrimp abundance, plant diversity, or plant abundance (percent plant coverage) in the potentially impacted pools was statistically less than in the reference pools. Given those results, it was reasonable to state that there have been no identifiable effects from residual soil contamination at LF-5 on vernal pool fairy shrimp or plants. Based on weather conditions and limitations on the areas included in the 2008 LTEM event, EPA requested that another round of monitoring be conducted prior to concluding that LTEM could be terminated.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-5 site was not planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, results from LF-5 LTEM are not available for evaluation in this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.8.1.2 Systems Operations/Operations and Maintenance

There are no operating remedial systems in place at LF-5. Maintenance of the LF-5 cap is discussed in Section 7.8.1.1.2.

7.8.1.3 Opportunities for Optimization

There are no opportunities for optimization at LF-5 given that there are no operating remedial systems.

7.8.1.4 Early Indicators of Potential Issues

Groundwater monitoring at LF-5 is affected by the decline in the regional groundwater levels, dry wells are identified in the annual monitoring reports and the monitoring objectives are evaluated to determine if the dry wells should be replaced. A basewide discussion of declining regional groundwater levels and an evaluation of dry wells is provided in Section 7.1.1.4.

There are no other potential issues identified for the LF-5 remedial action.

7.8.1.5 Implementation of Institutional Controls and Other Measures

See discussion of ICs and access control measures in Section 7.8.1.1.1.

LF-5 is located within the BoP United States Penitentiary, Atwater Complex; and public access is, and will for the foreseeable future, be prohibited and controlled by prison security (fencing and guard patrols). In addition, the Air Force/BoP MOU precludes any site-altering activities within the prison parcel, including LF-5, without notification of the EPA, DTSC, and the Air Force and the approval of such activities by the Air Force.

7.8.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup levels, and the Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Based on a review of factors presented in this section, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-5, with the exceptions noted below.

7.8.2.1 Changes in Standards and To Be Considered Guidelines

ARARs and TBCs related to site soil contamination are relevant to the IC and LTM remedies assessed herein. However, chemical-specific ARARs have not been established for the contaminants detected in soil at the site or for the COCs that were evaluated in the FS. The primary risk driver identified for soil at the site was cadmium. However, cadmium was associated with a single detection of 4.63 mg/kg that was determined not to represent site contamination. Consequently, no COCs were identified for LF-5 soil in the SCOU ROD Part 3.

7.8.2.2 Changes in Exposure Pathways

There have been no changes in the potential exposure pathways at LF-5. The exposure pathways of concern, and those addressed by the SCOU ROD Part 3 remedies, are human exposure to residual soil contamination under the cap and groundwater contamination by leachate from the capped waste. The potential exposure pathway of vapor intrusion to future buildings from residual shallow VOCs that may be present at LF-5 is not an issue because human use of the site is restricted by ICs that were incorporated in the Air Force/BoP MOU. The potential exposure pathway of vapor intrusion to future buildings adjacent to LF-5 is also not an issue. The Atwater prison was constructed in the central portion of the BoP parcel. The remainder of the parcel, including LF-5 and vicinity, constitutes a buffer area for the prison and is to remain open space. LF-5 is located along the northern boundary (fenceline) of the BoP parcel, but, given the nature of the facility, no buildings will ever be considered or allowed to be built near the fence defining prison property – either inside or outside the fence. In addition, the Federal-to-Federal transfer letter requires the BoP to consult with the Air Force and the regulatory agencies if they plan to construct or operate any type of facility at or adjacent to LF-5.

7.8.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no significant changes to toxicity values or other contaminant characteristics for site COCs since the remedy was implemented.

7.8.2.4 Changes in Risk Assessment Methods

There have been no significant changes in risk assessment methods related to site COCs since the remedy was implemented.

7.8.2.5 Expected Progress Toward Meeting Removal Action Objectives

Information presented in Section 7.8.1.1 documents that objectives for the IC and LTM remedies for LF-5 are being achieved. Site access is controlled, and there has been no identifiable human access or use of the site during the period of this five-year review. Cap monitoring and maintenance is being performed quarterly to semiannually, and there have been no significant issues with the cap. The first ecological monitoring event was performed in early 2008 as required.

LTEM of invertebrates and plants at wetlands possibly impacted by contaminants from the LF-5 site was planned but not conducted in 2012 and 2013 as a result of drought-like conditions. Subsequently, an ecological monitoring report with results from LF-5 LTEM is not incorporated into this five-year review report. LTEM is planned during the next year that has sufficient rainfall. It should be noted that since the 2008 survey there have been no substantive changes to the land use that would impact the vernal pools and therefore the conclusions of the 2008 survey remain valid.

7.8.3 Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the post-closure groundwater monitoring program, the annual IC evaluations, the recent site inspection, and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for LF-5.

8 ISSUES

This section discusses remedial action issues that have been identified as part of the Five-Year Review. Table 8-1 summarizes these issues and identifies if the issue affects the current or future protectiveness of the remedy.

8.1 MAIN BASE PLUME REMEDIAL ACTION

Three potential issues have been identified for the Main Base Plume Remedial Action. First is the issue of capture of the northeast base plume area in the Shallow HSZ by the MW824/MW1037 wellhead treatment system. Capture of this portion of the plume is unlikely unless water levels rise such that pumping from the Shallow HSZ can resume.

Second is the potential issue of declining regional water levels that has resulted in monitoring wells going dry, as described in Section 7.1.1.4.

Third is the rebound concentrations in the OU-2 area where TCE concentrations are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009.

8.2 CASTLE VISTA PLUME REMEDIAL ACTION

The issue noted in the previous five-year review (discussed in Section 5) regarding effectiveness of treatment system in attaining the remedial objective for the residual *cis*-1,2-DCE plume continues for this five-year review.

8.3 EARTH TECHNOLOGY CORPORATION 10 REMEDIAL ACTION

ICs are in place and functioning. However, as noted in Section 7.3.1.1, despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The 5-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey, there have been no substantive changes to the land use that would impact the vernal pools and therefore, the conclusions of the 2008 survey remain valid.

8.4 EARTH TECHNOLOGY CORPORATION 12 REMEDIAL ACTION

As noted in Section 7.4.1.1, despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The 5-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey, there have been no substantive changes to the land use that would impact the vernal pools and therefore, the conclusions of the 2008 survey remain valid.

8.5 FIRE TRAINING AREA 1 REMEDIAL ACTION

Ground water monitoring well MW886 is dry and groundwater monitoring cannot be conducted at FTA-1.

As noted in Section 7.5.1.1.3, despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The 5-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey, there have been no substantive changes to the land use that would impact the vernal pools and therefore, the conclusions of the 2008 survey remain valid.

As noted in Section 7.5.3, due to historic fire training activities there is the potential for PFCs to be present at the site. The potential presence of this emerging contaminant will be evaluated under a programmatic Air Force-wide initiative to conduct sampling at BRAC facilities to determine if PFCs are present. FTA-1 is included in the Air Force assessment of such sites for PFCs.

8.6 LANDFILL 3 REMEDIAL ACTION

As noted in Section 7.6.1.1, despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The 5-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. Since the 2008 survey, there have been no substantive changes to the land use that would impact the vernal pools and therefore, the conclusions of the 2008 survey remain valid.

8.7 LANDFILL 4 (DP-5, DP-6) REMEDIAL ACTION

Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.

8.8 LANDFILL 5 (DP-8, DP-8A, LF-5 TRENCHES) REMEDIAL ACTION

Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.

As noted in Section 7.8.1.1.3, despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The 5-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 survey concluded there was no evidence that site contaminants had impacted the wetland habitats. It should be noted that since the 2008 survey, there have been no substantive changes to the land use that would impact the vernal pools and therefore, the conclusions of the 2008 survey remain valid.

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9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section discusses the recommendations and follow-up actions that have been identified as part of the five-year review. Table 9-1 summarizes these recommendations and follow-up actions and identifies the responsible party, oversight agency, milestone date and indicates if the recommendations and follow-up actions affect the current or future protectiveness of the remedy.

9.1 MAIN BASE PLUME REMEDIAL ACTION

Issue: Capture of the Northeast Base Plume Area - The MW824/MW1037 system that was used to capture and treat the northeast base plume was shut down in October 2006 when water levels had decreased to such an extent that pumping could no longer be sustained (Jacobs, 2007). August 2007 concentrations were 6.9 µg/L for MW824 and 4 µg/L for MW1037. Since 2006, the system has remained off line with regulatory agency concurrence and associated monitoring wells have been monitored in accordance with recommendations established in the annual LTGSP Reports (2007-2012). While the NEBP is not captured, monitoring results establish that the remaining NEBP area is very small, the contaminant concentrations have not indicated an increasing trend, and the limited area and concentrations of groundwater contamination have not migrated. Monitoring of the limited wells that are just above the MCL is appropriate and recommended until MCLs are achieved provided the contaminant concentrations do not show an increasing trend or the plume area does not migrate. Should monitoring under the LTGSP indicate an increasing contaminant trend or plume migration, the AF in consultation with the regulatory agencies, should evaluate if other action is warranted.

Issue: Declining Water Levels Resulting in Dry Groundwater Wells – As noted in Section 7.1.1.4, each annual report contains an evaluation of dry wells to determine if they should be replaced. This evaluation process appears successful as evidenced by, development, approval, and implementation of work plans to replace dry wells at CAFB in 2013. It is recommended that this issue continue to be monitored and evaluated under the LTGSP.

Issue: Higher TCE Concentrations and Longer Duration of Rebound in OU-2 – As noted in Section 7.1.1.4, in OU-2, in the area of MW804A, MW806A and

MW948, the rebound concentrations of TCE are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009. To address this issue, it is recommended to improve and confirm plume capture and plume reduction, specifically, a) improve plume capture and contaminant mass removal by adding an extraction well from the existing well network (most likely a conversion of MW-948 to an extraction well), and b) confirm hydraulic control by installing a LSS monitoring well in the area of MW804A.

9.2 CASTLE VISTA PLUME REMEDIAL ACTION

Issue: Pump and Treat Effectiveness - It is recommended that the regulatory approved rebound study continue to be implemented to address recalcitrant contamination in the residual cis-1,2-DCE plume. This includes operation of the wellhead treatment system, as necessary, in consultation with the regulatory agencies. However, it is recommended that the cis-1,2-DCE cleanup level of 6 µg/L be evaluated in light of California's updated Public Health Goal of 100 µg/L and EPA's updated Regional Screening Level of 28 µg/L.

9.3 EARTH TECHNOLOGY CORPORATION 10 REMEDIAL ACTION

Issue: LTEM - As noted in Section 8.3, the five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved due to drought-like conditions in 2012 and 2013. It is recommended that LTEM occur during the next year that sufficient rainfall occurs.

9.4 EARTH TECHNOLOGY CORPORATION 12 REMEDIAL ACTION

Issue: LTEM - As noted in Section 8.4, the five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved due to drought-like conditions in 2012 and 2013. It is recommended that LTEM occur during the next year that sufficient rainfall occurs.

9.5 FIRE TRAINING AREA 1 REMEDIAL ACTION

Issue: Dry Ground Water Well - In August 2013, one groundwater well (MW1054) was installed approximately 100 feet downgradient of dry well MW886, and one groundwater well (MW1055) was installed adjacent to the FTA-1 cap. The location of MW1054 was selected as the nearest location downgradient of MW886 that is outside the Vernal Pool Preservation Area. A new well could not be drilled adjacent to MW886 because this well is located within a recently identified wetland. The location of MW1055 was selected to be closer to the FTA-1 cap and within the assumed boundary of the last known TCE MCL plume. Further details are presented in the *Final Fire Training Area 1 Well Installation Work Plan* (CH2M HILL, 2012c). It is recommended that monitoring continue under the LTGSP to determine if TCE at levels exceeding the MCL remain at FTA-1.

Issue: LTEM - As noted in Section 8.5, the five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved due to drought-like conditions in 2012 and 2013. It is recommended that LTEM occur during the next year that sufficient rainfall occurs.

Issue: Potential presence of PFCs – As noted in Section 7.5.3, due to historical fire training activities there is the potential for PFCs to be present at the site. It is recommended that the Air Force perform their programmatic review at FTA-1 to determine if PFCs are present.

9.6 LANDFILL 3 REMEDIAL ACTION

Issue: LTEM - As noted in Section 8.6, the five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved due to drought-like conditions in 2012 and 2013. It is recommended that LTEM occur during the next year that sufficient rainfall occurs.

9.7 LANDFILL 4 (DP-5, DP-6) REMEDIAL ACTION

Issue: Dry Ground Water Wells - In August 2013, one groundwater well (MW1053) was installed to replace dry well MW888. Further details are presented in the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). Downgradient detection compliance monitoring well MW847 became dry during 2012, it was previously dry only on a seasonal basis (only during Q4; CH2M HILL, 2013b). It is recommended to continue the LTGSP to evaluate the newly installed well and monitor groundwater concentrations and flow directions prior to determining an appropriate location for the MW847 replacement well.

9.8 LANDFILL 5 (DP-8, DP-8A, LF-5 TRENCHES) REMEDIAL ACTION

Issue: Dry Ground Water Wells - In August 2013, one groundwater well (MW1050) was installed to replace dry well MW360, and detection compliance monitoring wells MW1051 and MW1052 were installed to replace dry wells MW1004 and MW1005, respectively. Further details are presented in the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). It is recommended to continue the LTGSP to evaluate the newly installed wells.

Issue: LTEM - As noted in Section 8.8, the five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved due to drought-like conditions in 2012 and 2013. It is recommended that LTEM occur during the next year that sufficient rainfall occurs.

10 PROTECTIVENESS STATEMENTS

The remedial actions implemented for the Comprehensive Basewide Groundwater Operable Unit are protective of human health and the environment. The remedial actions implemented for the Source Control Operable Unit are protective of human health and the environment. All remedial actions are in place or have been completed at the former CAFB. The remedial actions implemented at the former CAFB are protective of human health and the environment.

10.1 MAIN BASE PLUME REMEDIAL ACTION

The remedial action implemented for the Main Base Plume is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner, and they have been optimized to the extent practical (OU-1 treatment plant and MW883/MW1021, MW941, and MW1009 wellhead treatment systems have been shut down). ICs to restrict use of groundwater exceeding MCLs are in place and are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness. A screening level assessment, as reported during the third five-year review report (Jacobs, 2009a), determined that the cancer risk associated with potential vapor intrusion from the current levels of groundwater contamination in the Shallow HSZ is less than $1x10^{-6}$.

The technical assessment identified three potential issues, (1) capture of the northeast base plume area in the Shallow HSZ by the MW824/MW1037 wellhead treatment system and (2), declining groundwater levels that result in wells going dry. In both cases, continued implementation of the LTGSP will address these potential issues. And, (3) the rebound concentrations in the OU-2 area where TCE concentrations are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009.

10.2 CASTLE VISTA PLUME REMEDIAL ACTION

The remedial action implemented for the Castle Vista Plume is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (plume control and reduction), expected progress has been made toward achieving MCL cleanup levels, all components of the remedy are being operated in a safe and proper manner, and they have been optimized to the extent practical. ICs to restrict use of groundwater exceeding MCLs are in place and are effective, and regular IC monitoring is being conducted. There have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness. The technical assessment identified one potential issue, effectiveness of treatment system in attaining the remedial objective for the residual cis-1,2-DCE plume. Continuation of the rebound study and an evaluation of the cleanup level will address this potential issue.

10.3 EARTH TECHNOLOGY CORPORATION 10 REMEDIAL ACTION

The remedial action implemented for ETC-10 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedies are functioning as designed (access restricted and ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-10 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. Planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. As recommended in Section 9, LTEM is recommended during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

10.4 EARTH TECHNOLOGY CORPORATION 12 REMEDIAL ACTION

The remedial action implemented for ETC-12 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of ETC-12 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. Planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. As recommended in Section 9, LTEM is recommended during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

10.5 FIRE TRAINING AREA 1 REMEDIAL ACTION

The remedial actions implemented for FTA-1 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring, and ecological monitoring conducted). The FTA-1 may have been impacted by the use of PFCs used in fire-fighting foams. The Air Force is taking a programmatic approach at BRAC facilities with regard to potential emerging chemical contamination associated with PFCs. This Air Force-wide initiative will evaluate candidate sites for the potential presence of PFC compounds and will include sampling at the selected sites to determine if PFCs are present. FTA-1 is included in the Air Force assessment of such sites for PFCs. PFCs are being addressed as directed in the 17 September 2012 HQ UASF/A7C memo, Interim Guidance on Perfluorinated Compounds, implementing the 27 August 2012 Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations, which directs the Air Force to undertake a phased approach to identify, quantify, and mitigate, if necessary, potential releases of PFCs in groundwater, surface water, soil and/or sediment at its installations. Section 7.5.3 describes the steps the Air Force will take. After the Air Force investigation for PFCs is complete, the protectiveness of the remedy should be re-evaluated in the next five-year review. There are no other issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of FTA-1 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. Planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. As recommended in Section 9, LTEM is recommended during the next year that has sufficient rainfall.

10.6 LANDFILL 3 REMEDIAL ACTION

The remedial action implemented for LF-3 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The remedy is functioning as designed (ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-3 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. Planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. As recommended in Section 9, LTEM is recommended during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

10.7 LANDFILL 4 (DP-5, DP-6) REMEDIAL ACTION

The remedial actions implemented for LF-4/DP-5/DP-6 is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place as part of the deed transferring the parcel containing LF-4 to Merced County, and a State Land Use Covenant executed by the Air Force and the State of California. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually.

10.8 LANDFILL 5 (DP-8, DP-8A, LF-5 TRENCHES) REMEDIAL ACTION

The remedial actions implemented for LF-5/DP-8/DP-8A/LF-5 Trenches is protective of human health and the environment. The remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks. The ongoing remedies are functioning as designed (access restricted, active cap maintenance and monitoring, and ecological monitoring conducted), there are no issues, and no other information has been identified that would affect protectiveness. ICs to restrict site access and alteration are in place and maintained as part of the Air Force/BoP MOU. Maintenance and monitoring of the cap and its ancillary facilities, including reporting of any evidence of human access or alteration, is being conducted semiannually. Ecological surveys of background (not impacted) and potentially impacted vernal pools at and in the vicinity of LF-5 were conducted in the spring of 2008. Results of the surveys showed no evidence that fairy shrimp abundance, plant diversity, or plant abundance is statistically less (95 percent confidence level) in potentially impacted pools than in background pools. Planned LTEM during this five-year review period could not be conducted due to insufficient rainfall. As recommended in Section 9, LTEM is recommended during the next year that has sufficient rainfall. Since the 2008 survey, there have been no changes in criteria, standards, or methods which affect the protectiveness of the remedy and no other information has been identified that would affect protectiveness.

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11 NEXT REVIEW

The first five-year review for CAFB was finalized in September 1999. The second five-year review was finalized in January 2004. The third five-year review was finalized in January 2009. EPA provided concurrence on the third five-year review on 11 March 2009. Where EPA has a concurrence role, such as for five-year reviews at NPL sites that are led by other federal agencies, the trigger for subsequent reviews corresponds to EPA's concurrence signature date of the preceding five-year review report. In accordance with EPA guidance *Correction to the Memorandum "Program Priorities for Federal Facility Five Year Reviews"* (EPA, 2012c), all five-year reviews for the former CAFB will now be conducted at 5-year intervals based on EPA's concurrence date for the third five-year review. Therefore, this five-year review is scheduled to be completed by 11 March 2014 and the next five-year review will be completed by 11 March 2019.

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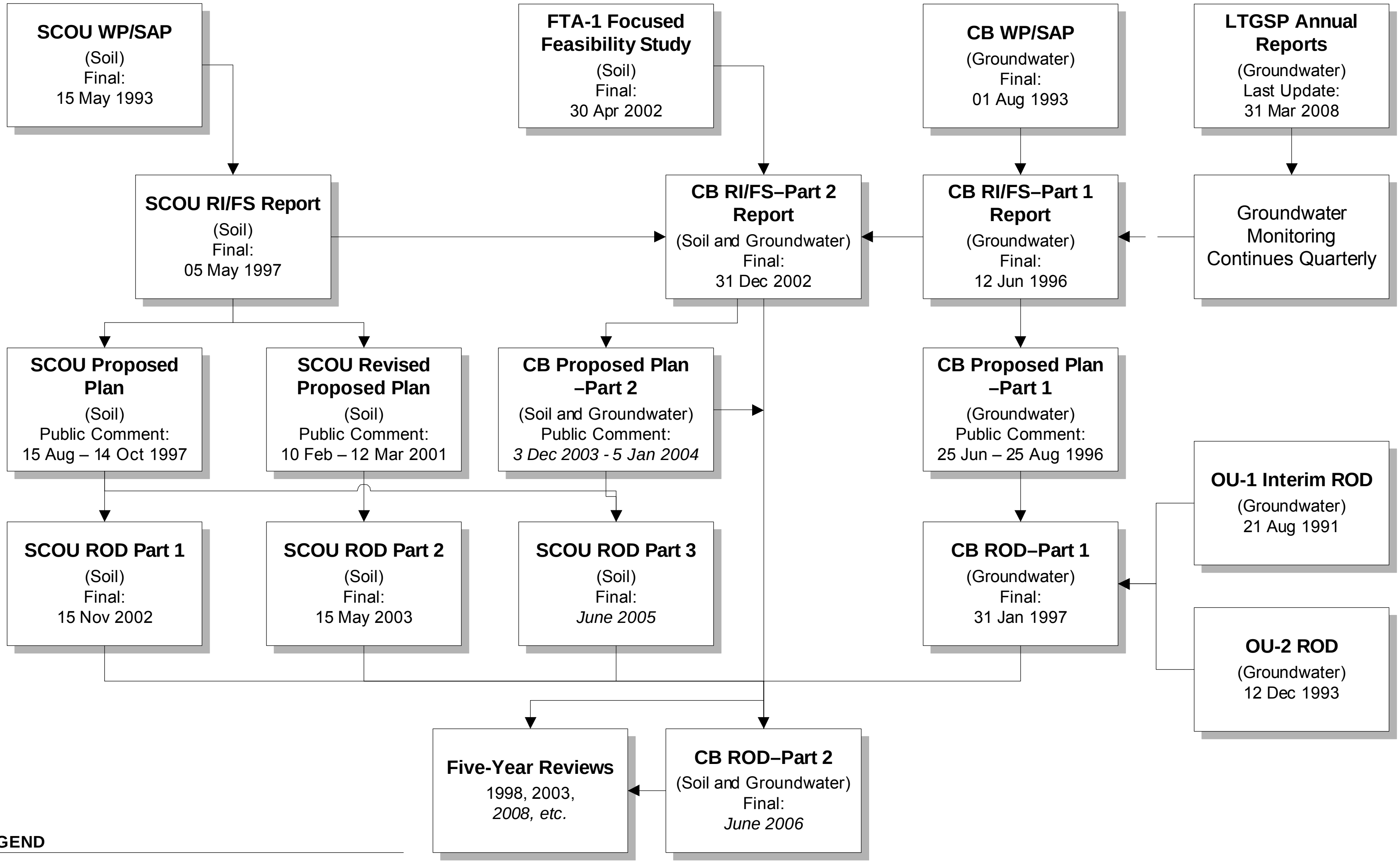
FIGURES

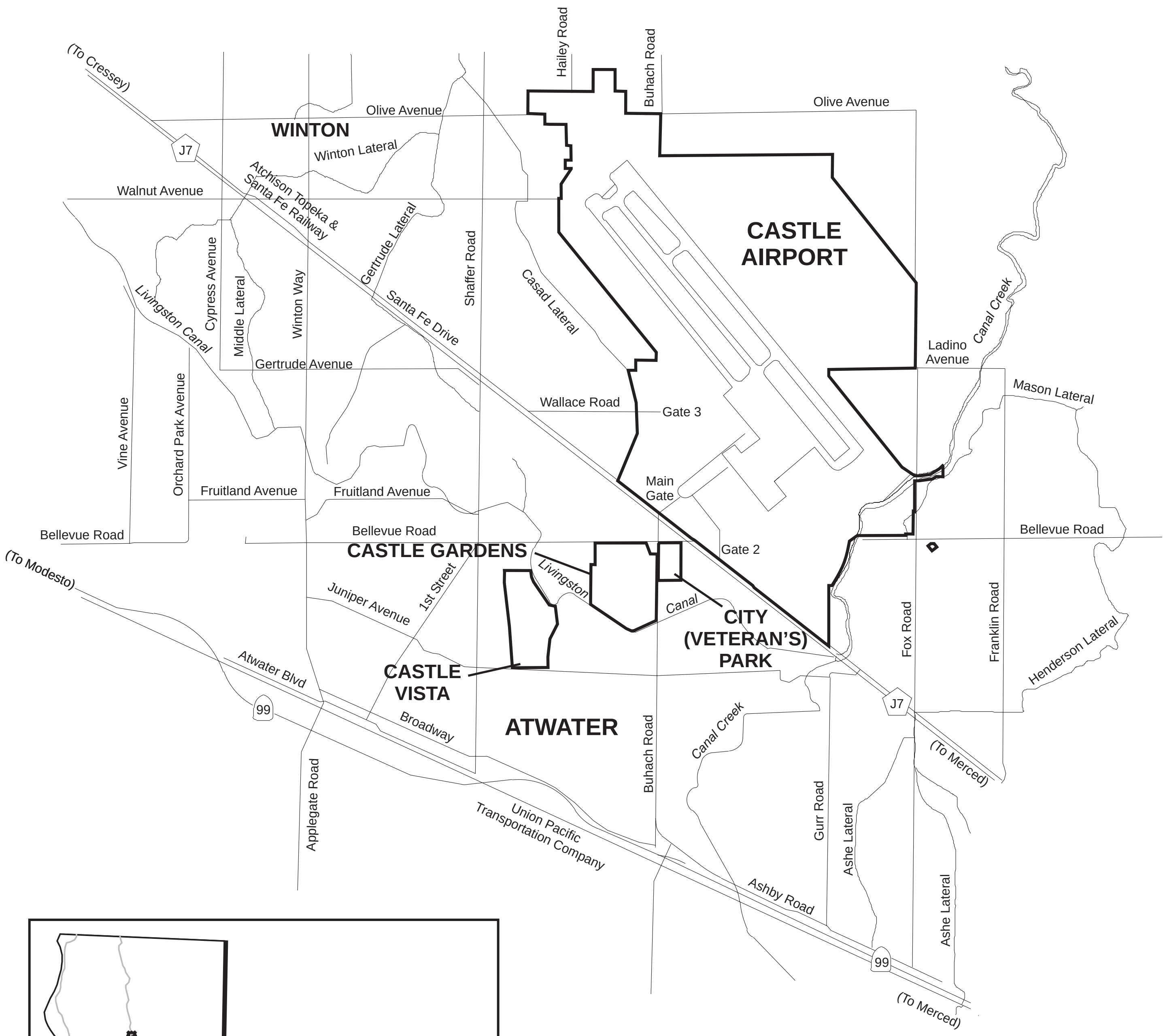


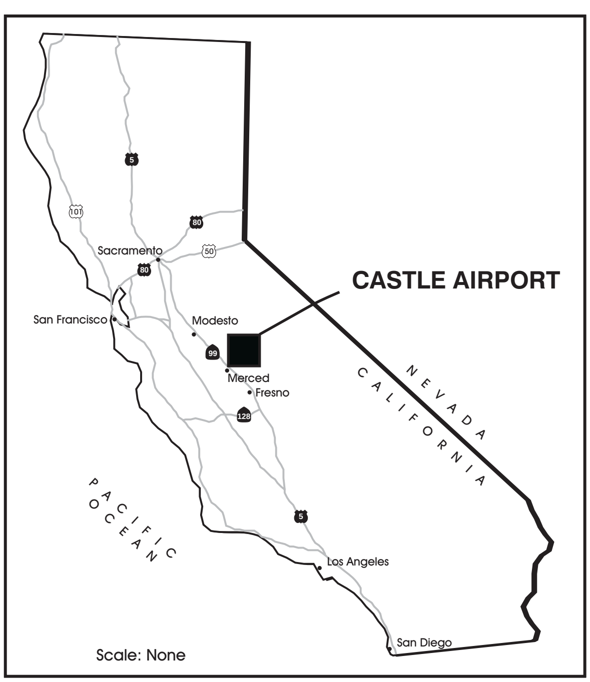
LEGEND

CB	comprehensive basewide
FTA	fire training area
LTGSP	long-term groundwater sampling program
OU	operable unit
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SAP	sampling and analysis plan
SCOU	source control operable unit
WP	work plan

Primary CERCLA Documents and Integration of Operable Units at the Former Castle Air Force Base

Five-Year Review
Castle Airport



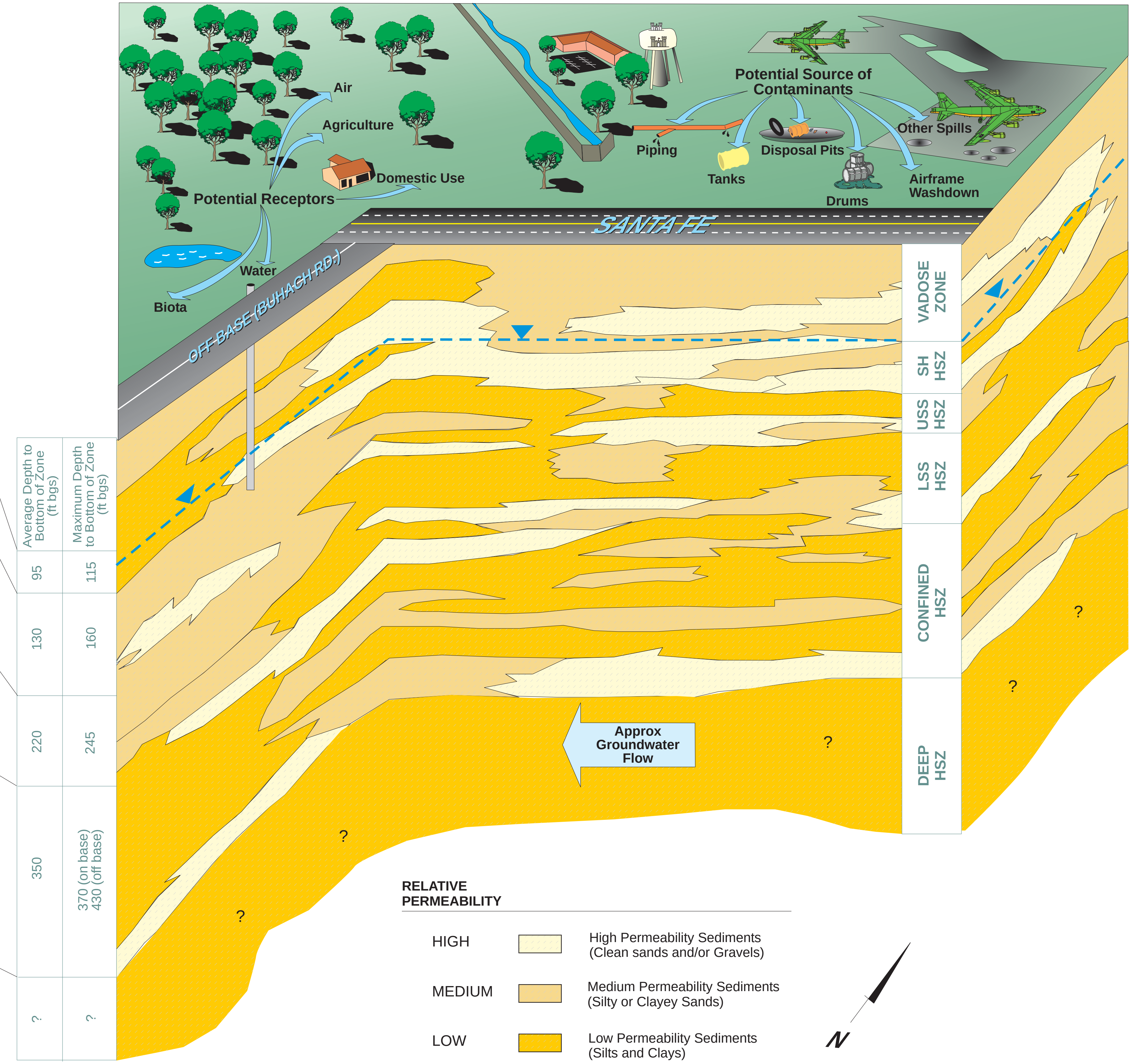


Former Castle Air Force Base Vicinity Map

Five-Year Review
Castle Airport

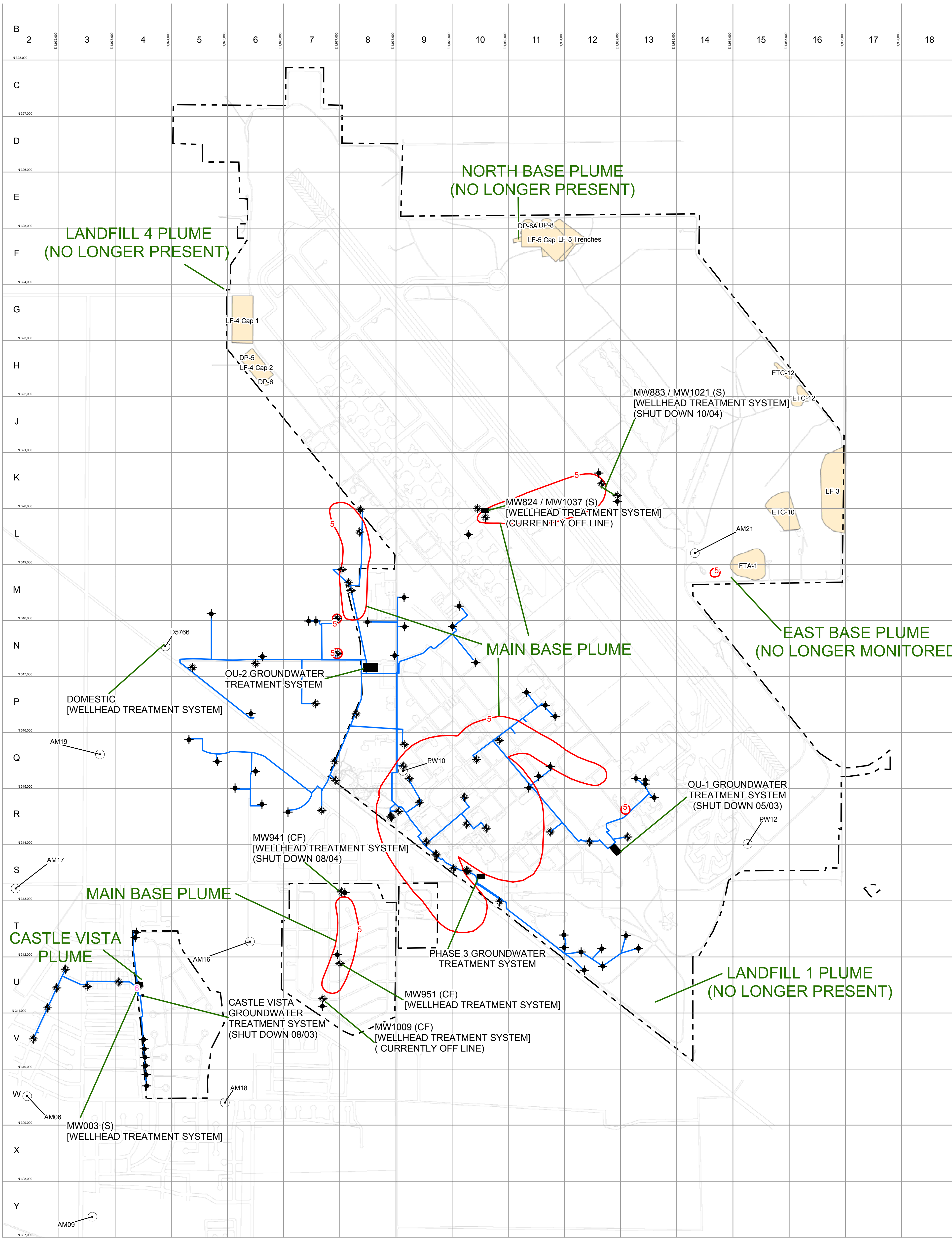
FIGURE 3-1

Geologic Age: Period	Geologic Age: Epoch	Stratigraphic Name	Typical Geologic Characteristics of Predominant Water Bearing Sections	Possible Depositional Models	HSZ
Quaternary	Pleistocene	Modesto and Riverbank Formation	Gravel bearing sediments mostly beneath the Main Base Plume, based on isolith plots. The gravel bearing sediments trend in a northwest-southeast direction. These gravels pinch-out to the north and east beneath the runway, and to the southwest of Castle Air Force Base. The gravel bearing zone is mostly bordered by flood plain deposits at the pinch-out boundaries. Maximum thickness of the gravel bearing zone is in excess of 40 feet.	Braided channel deposits surrounded by flood plain deposits. Braided system exhibits shallow channelization with fairly uniform thickness. Top and bottom of gravel bearing zones are gradational with overlying and underlying sands. This information is suggestive of a transgressive-regressive aggradational fluvial-alluvial sequence likely caused by abrupt climatic change (i.e. glacial melting and precipitation with rapid increase in transport energy).	Shallow (SH)
Quaternary	Pleistocene	Turlock Lake Formation	Consisting of mostly fine sands, grading to medium-grained sands to the southwest. Beneath Castle Air Force Base, the water bearing zones are mostly in discontinuous sand lenses ranging in thickness from 5 to 10 feet. To the southwest, the interval between 120 and 155 feet bgs consists mostly of medium-grained sands. Based on a lithofacies plot of sand percentage, the sands appear to trend in a northwest-southeast direction.	Sinuous to meandering channel system surrounded by flood plain deposits. Flood plain sediments exhibit sequences of interbedded thin laminae of fine-grained sand and silt alternating with whitish mottled fine-grained sediments containing root casts and organic carbon residues. This suggests overbank deposits formed during flood stages with concurrent ephemeral shallow lake deposition in flood plain areas. The wet season is followed by a dry season with soil horizon formation and growth of short grasses.	Upper Subshallow (USS)
			Consists mostly of sands, gravelly sands, and sandy gravels. In the central portion of the Main Base Plume, there is a large nongravel bearing area bordered by gravel bearing sediments to the north, south, and west. The extent of this nongravel bearing zone to the east and southeast is not known. The trend of the LSS HSZ appears to be generally northwest-southeast.	Braided channel system bordered by flood plain deposits. May have been formed in similar scenario as the gravel bearing sediments in the Shallow HSZ.	Lower Subshallow (LSS)
			North Merced Gravel Appears to consist of a thin (maximum thickness of about 40 feet), widespread gravel bearing zone. This zone has been encountered at numerous locations throughout Castle Airport. The zone appears to pinch out to the east and west as indicated by the Confined HSZ isolith map.	Braided channel system bordered by flood plain deposits. May have been formed in similar scenario as the gravel bearing sediments in the Shallow HSZ.	Confined
Tertiary	Pliocene	Laguna Formation	Continental deposits	Insufficient data.	Deep



Generalized Basewide Conceptual Model

Five-Year Review
Castle Airport



LEGEND

- MCL Contour for TCE (Q4 2007; all HSZs)
- MCL Contour for cis-1,2-DCE (Q4 2007; Shallow HSZ only)
- Groundwater Conveyance System
- Groundwater Treatment System
- SCOU Site Included in Five-Year Review
- Extraction Well
- Injection Well
- Atwater Municipal Well (AM)/Production Well (PW)/Domestic Well

B	Building
CF	Confined Hydrostratigraphic Zone
DA	Discharge Area
DP	Disposal Pit
LF	Landfill
MCL	Maximum Contaminant Level
OU	Operable Unit
S	Shallow Hydrostratigraphic Zone
SCOU	Source Control Operable Unit
ST	Structure

N
W E
S

0 1,700
Scale in Feet
1:20,400

Long-Term Soil and Groundwater Remedial Actions

Five-Year Review
Castle Airport

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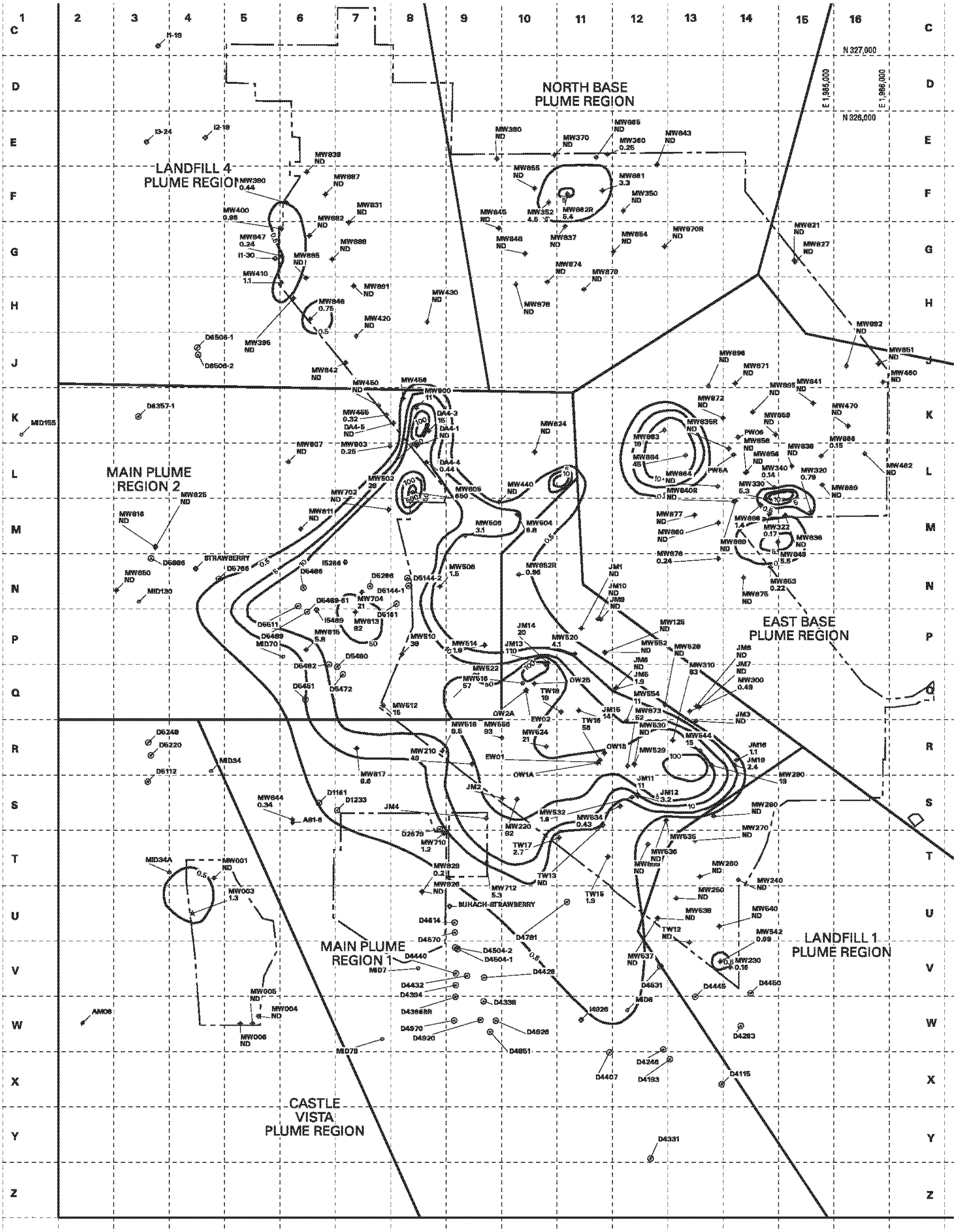
Figure 3-3



LEGEND

MW001	Monitoring well	
D4740	Domestic well	
PW15	Production well	
I1-01	Irrigation well-private	
MID1	Irrigation well-public	
EW01	Extraction well	
JI6	Injection well	
AM11	Municipal well	
PZ03	Piezometer	

Property boundary

50 Isoconcentration contour of TCE in $\mu g/L$

MW875 6.4 Well location with TCE concentration in $\mu g/L$

Notes:
Dry wells and wells with insufficient water for sampling not shown on map.

Hydropunch data used for contouring not shown on map.

N

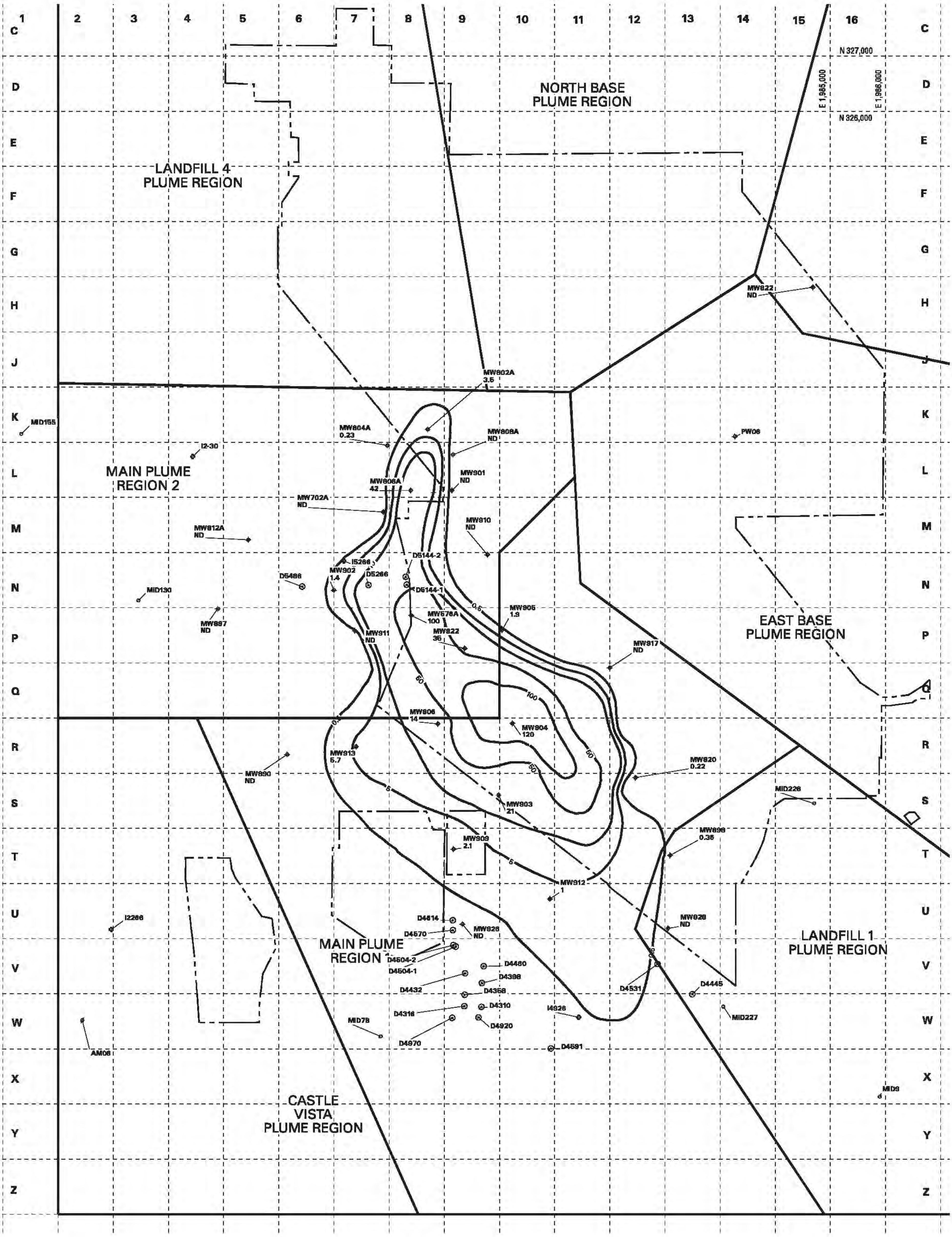
0 1700

Scale in Feet
1:20400

TCE Plume Delineation Map, Second Quarter 1994
Shallow Hydrostratigraphic Zone

Five-Year Review
Castle Airport

Figure 3-4



LEGEND

MW001	Monitoring well	Property boundary
D4740	Domestic well	Isoconcentration contour of TCE in $\mu g/L$
PW15	Production well	
I1-01	Irrigation well-private	
MID1	Irrigation well-public	
EW01	Extraction well	Well location with TCE concentration in $\mu g/L$
JI6	Injection well	
AM11	Municipal well	
PZ03	Piezometer	

Note:
Hydropunch data used for contouring not shown on map.

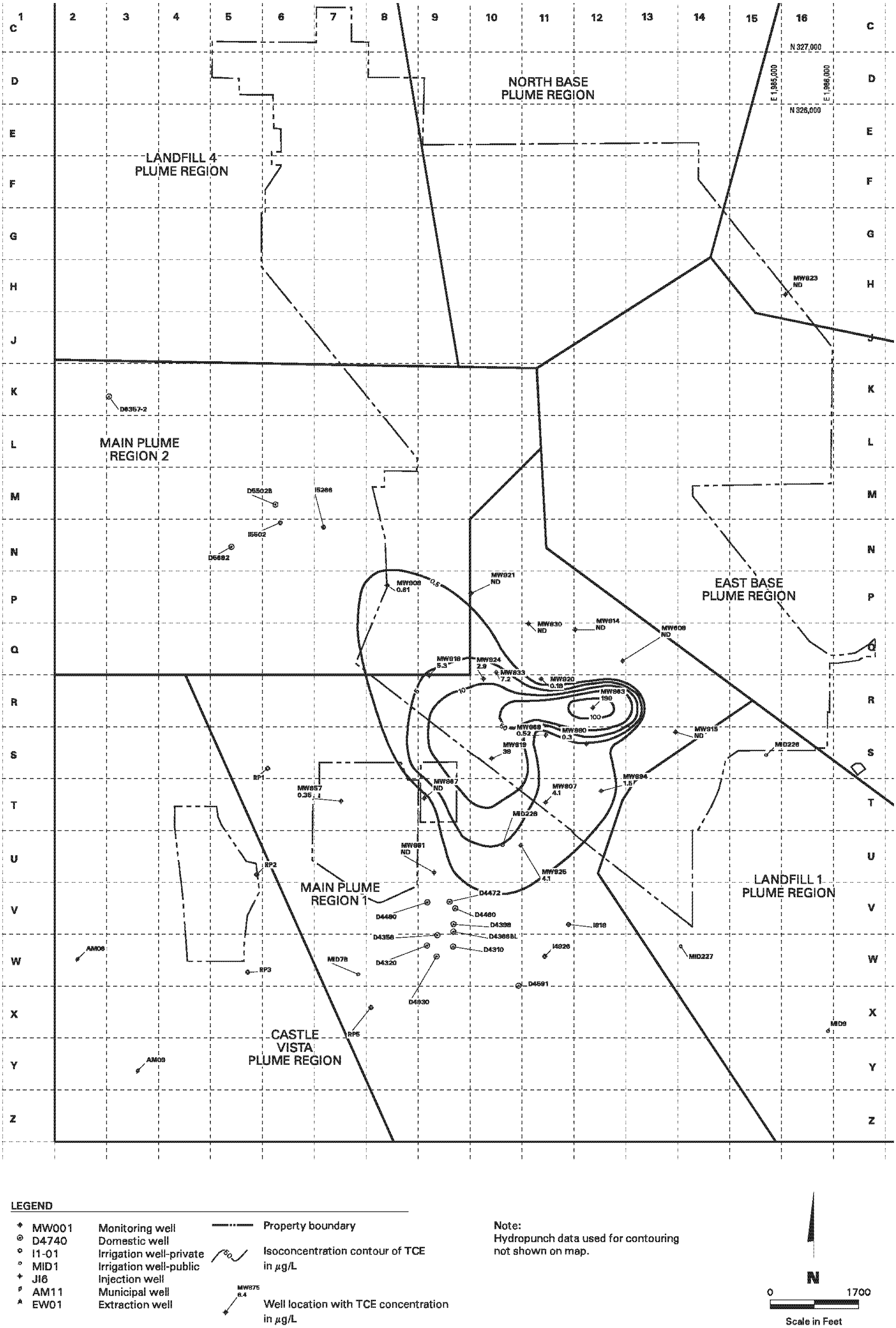
N

0 1700

Scale in Feet
1:20400

TCE Plume Delineation Map, Second Quarter 1994
Upper Subshallow Hydrostratigraphic Zone

Five-Year Review
Castle Airport



TCE Plume Delineation Map, Second Quarter 1994
Lower Subshallow Hydrostratigraphic Zone

Five-Year Review
Castle Airport

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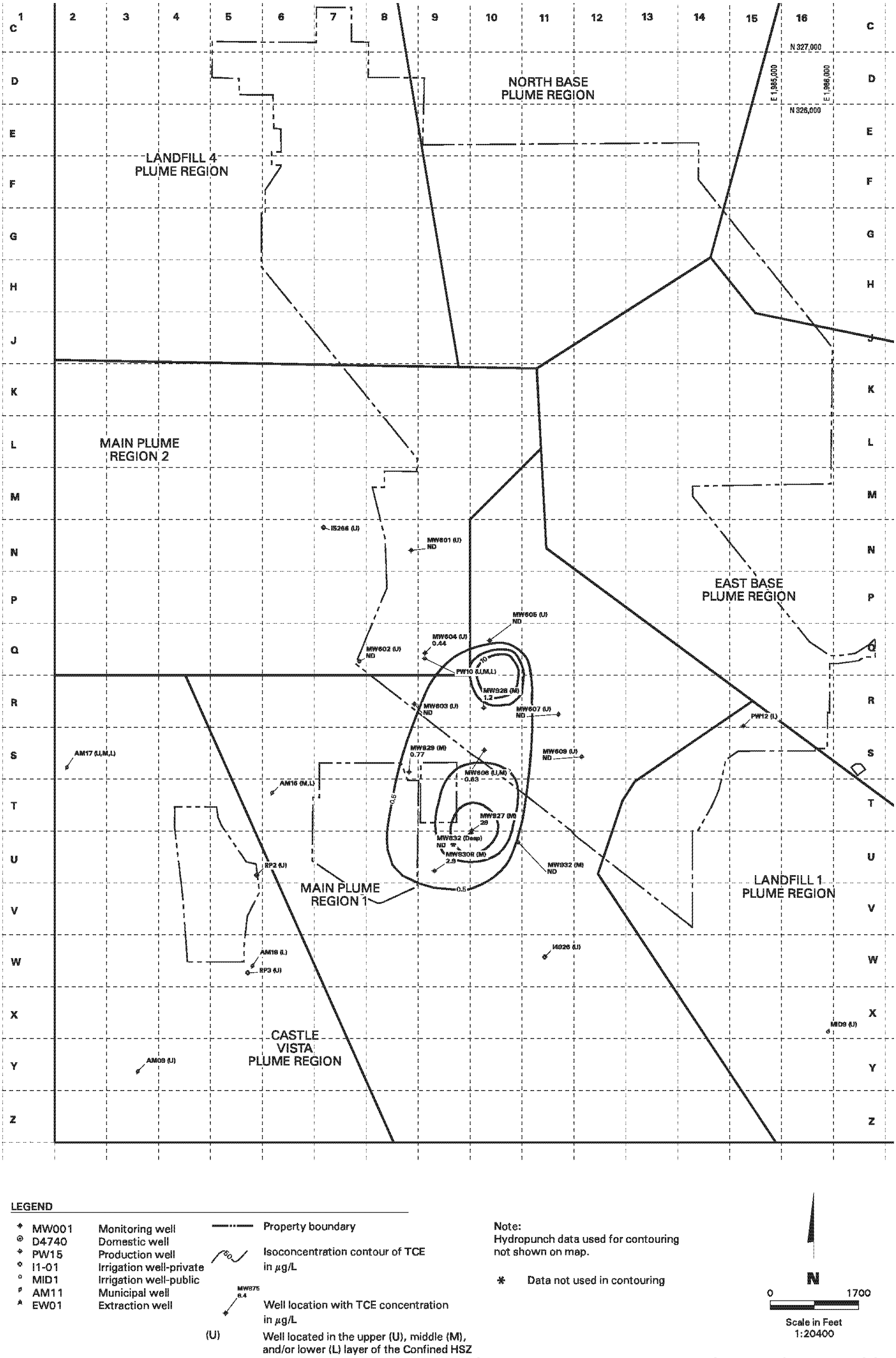
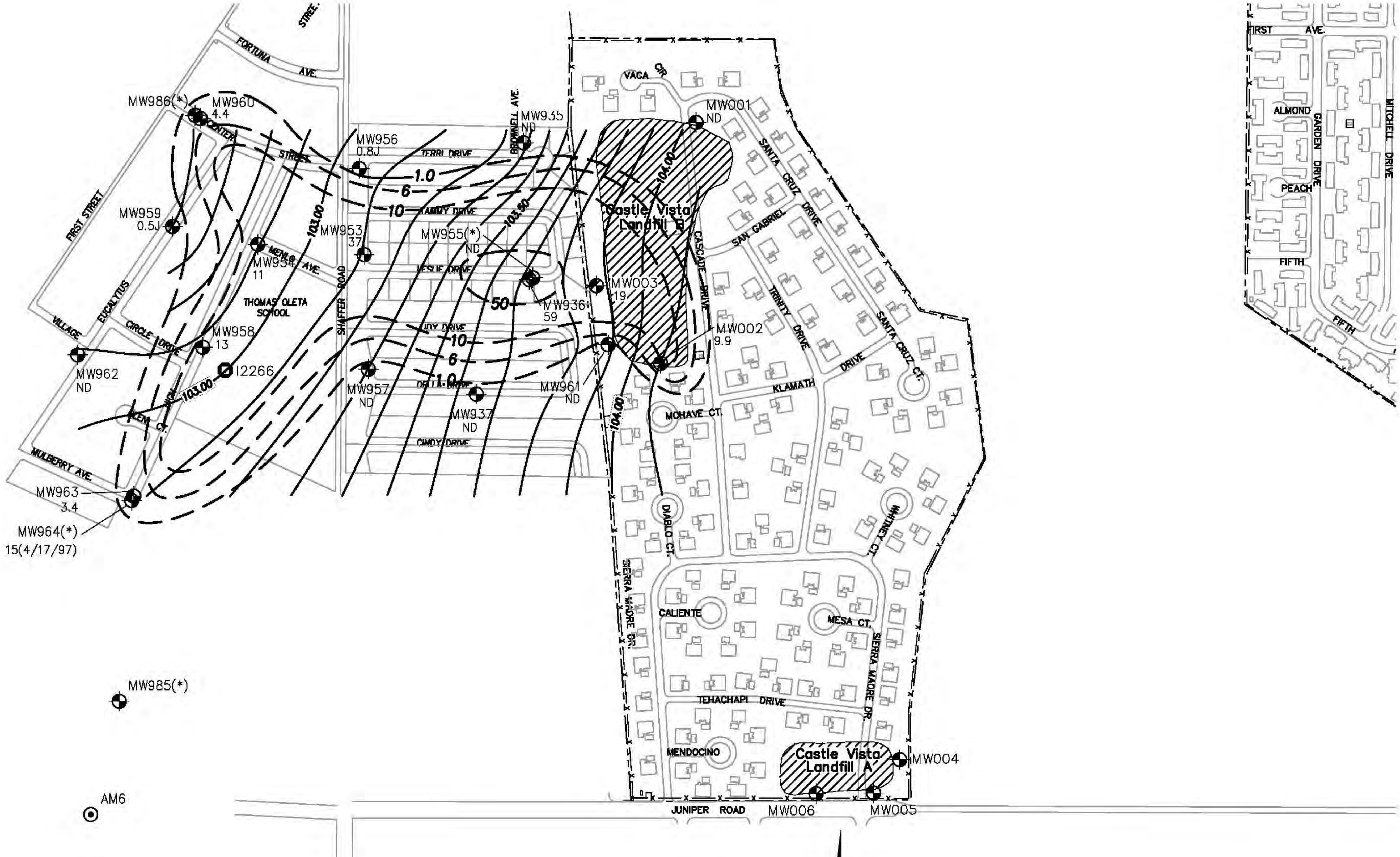
Figure 3-6



TCE Plume Delineation Map, Second Quarter 1994
Confined Hydrostratigraphic Zone



LEGEND

—x— Fence Line	**-104.00-** Groundwater Elevation Contours in Feet Above Mean Sea Level Contour Interval = 0.10 Feet	ND Not Detected Above Reporting Limits
Monitoring Well Location		J Estimated Value Due to Trace Concentration on Quality Control Deficiency
Municipal Well Location	— — *cis*-1,2-DCE Isoconcentration Contours (inferred)	(*) Upper Subshallow HSZ Monitoring Well
Irrigation Well Location	19 *cis*-1,2-DCE concentrations in ug/L	

N

100 0 100 200 300 400
Scale In Feet
1:4800

Groundwater Elevation Contours and *cis*-1,2-DCE Plume Delineation Map First Quarter 1997 Shallow Hydrostratigraphic Zone

Five-Year Review
Castle Airport

6/6/01 Xv
6/02/08 Xv
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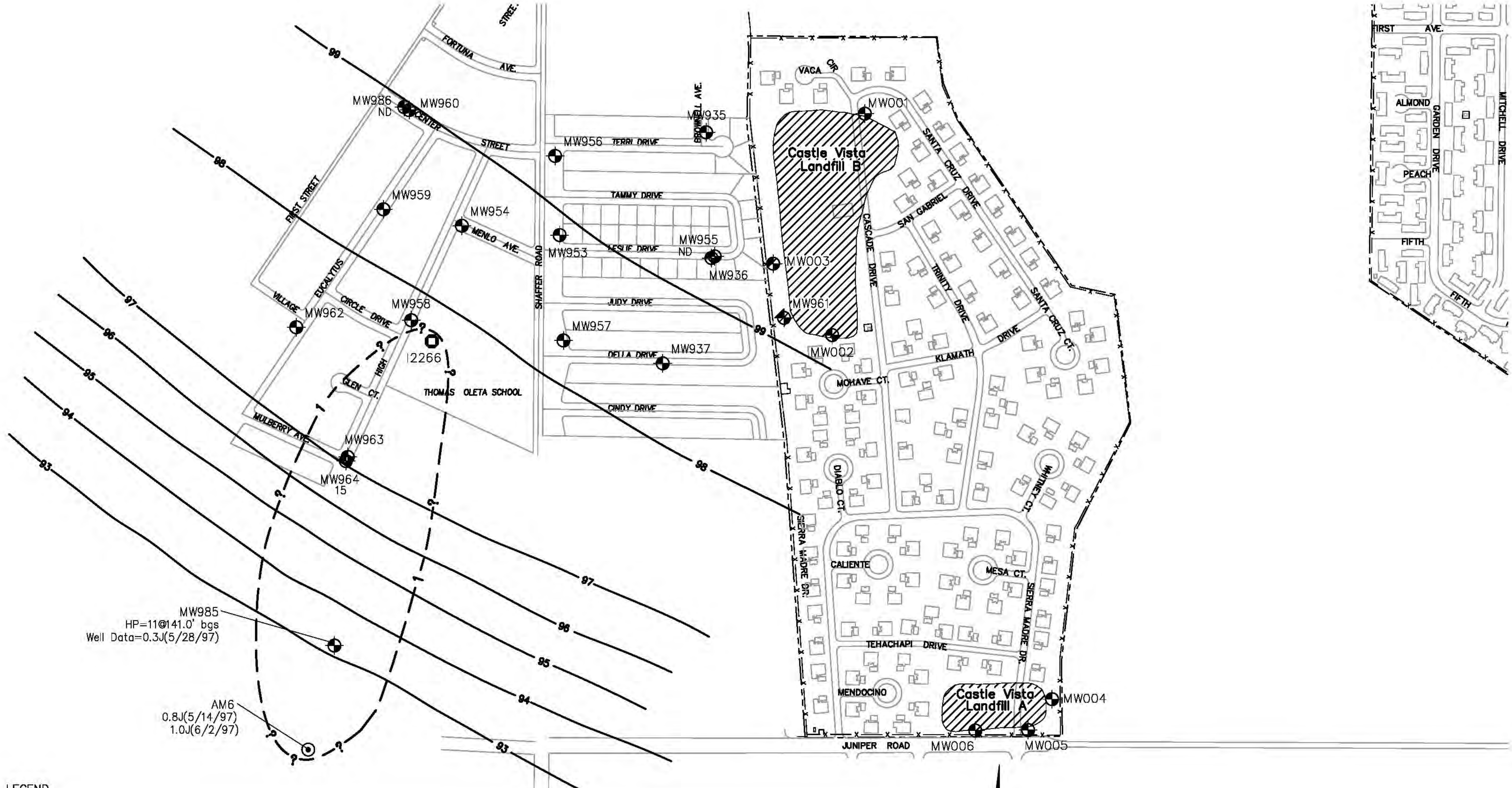
FIGURE 3-8



LEGEND

—x— Fence Line	
Monitoring Well Location	
Municipal Well Location	
Irrigation Well Location	
— 93 —	Groundwater Elevation Contours in Feet Above Mean Sea Level Contour Interval = 1 Foot
— —	*cis*-1,2-DCE Isoconcentration Contours (inferred)
15	*cis*-1,2-DCE concentrations in ug/L
ND	Not Detected Above Reporting Limits
J	Estimated Value Due to Trace Concentration on Quality Control Deficiency

N

100 0 100 200 300 400
Scale In Feet
1:4800

Groundwater Elevation Contours and *cis*-1,2-DCE Plume Delineation Map First Quarter 1997 Upper Subshallow Hydrostratigraphic Zone

Five-Year Review
Castle Airport

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6/02/08 Xv
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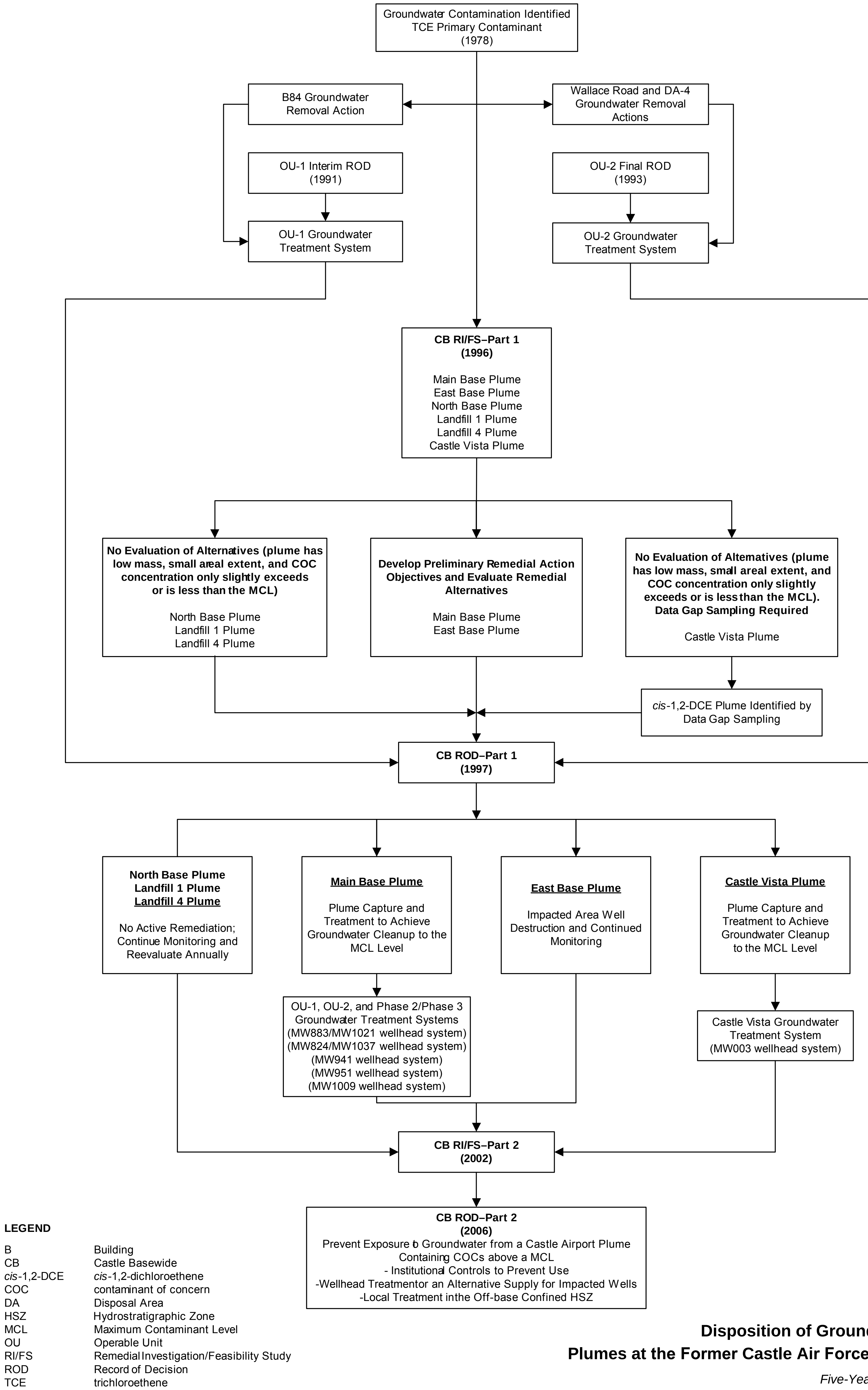
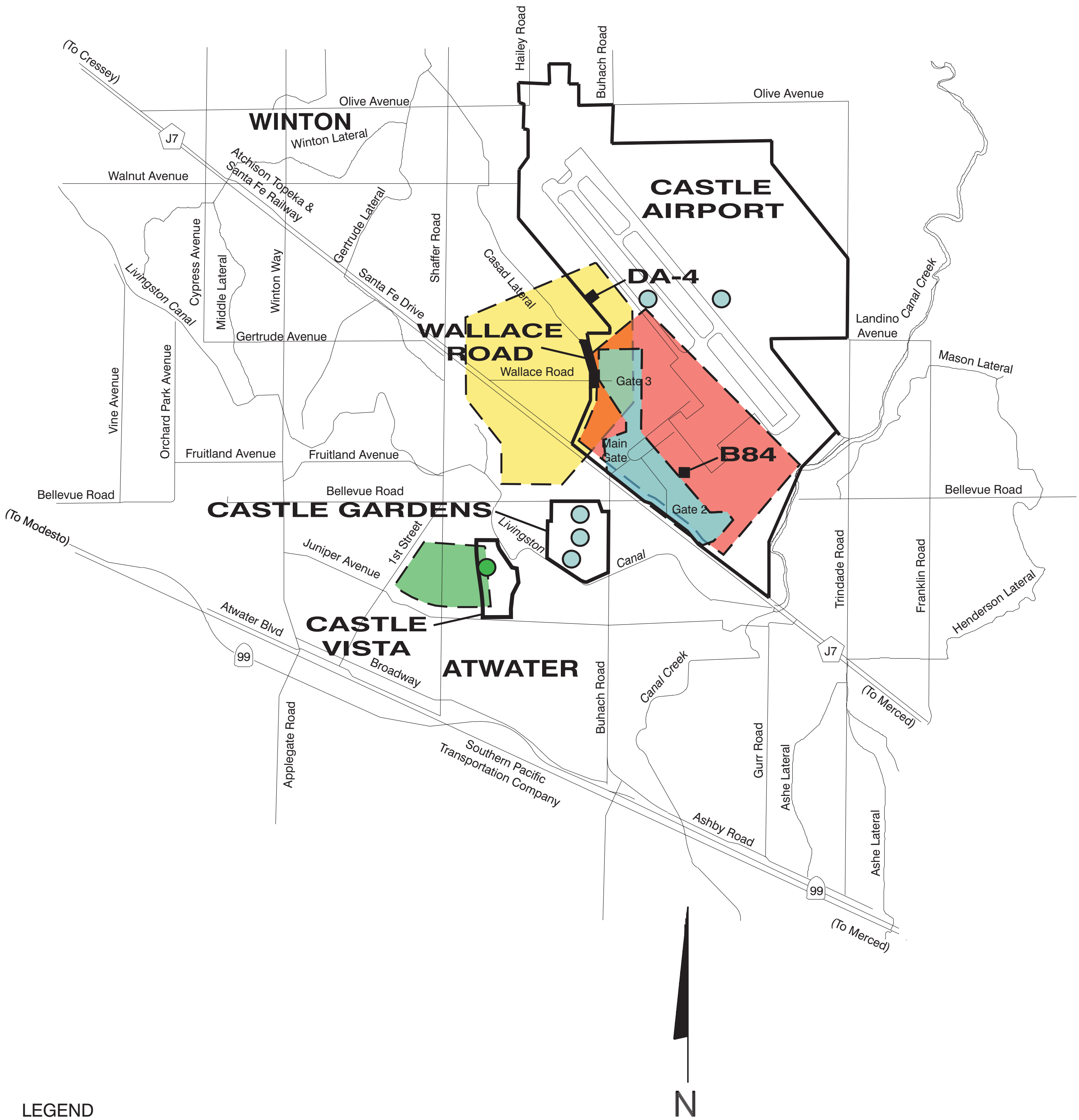
FIGURE 3-9



Disposition of Groundwater Plumes at the Former Castle Air Force Base

Five-Year Review
Castle Airport



LEGEND

OU-1 Groundwater Treatment System

OU-2 Groundwater Treatment System

Phase 3 and Wellhead Groundwater Treatment Systems

Castle Vista Groundwater Treatment System

0 .75 1.5

Scale In Miles
1: 64,000

Groundwater Treatment Systems

Five-Year Review
Castle Airport

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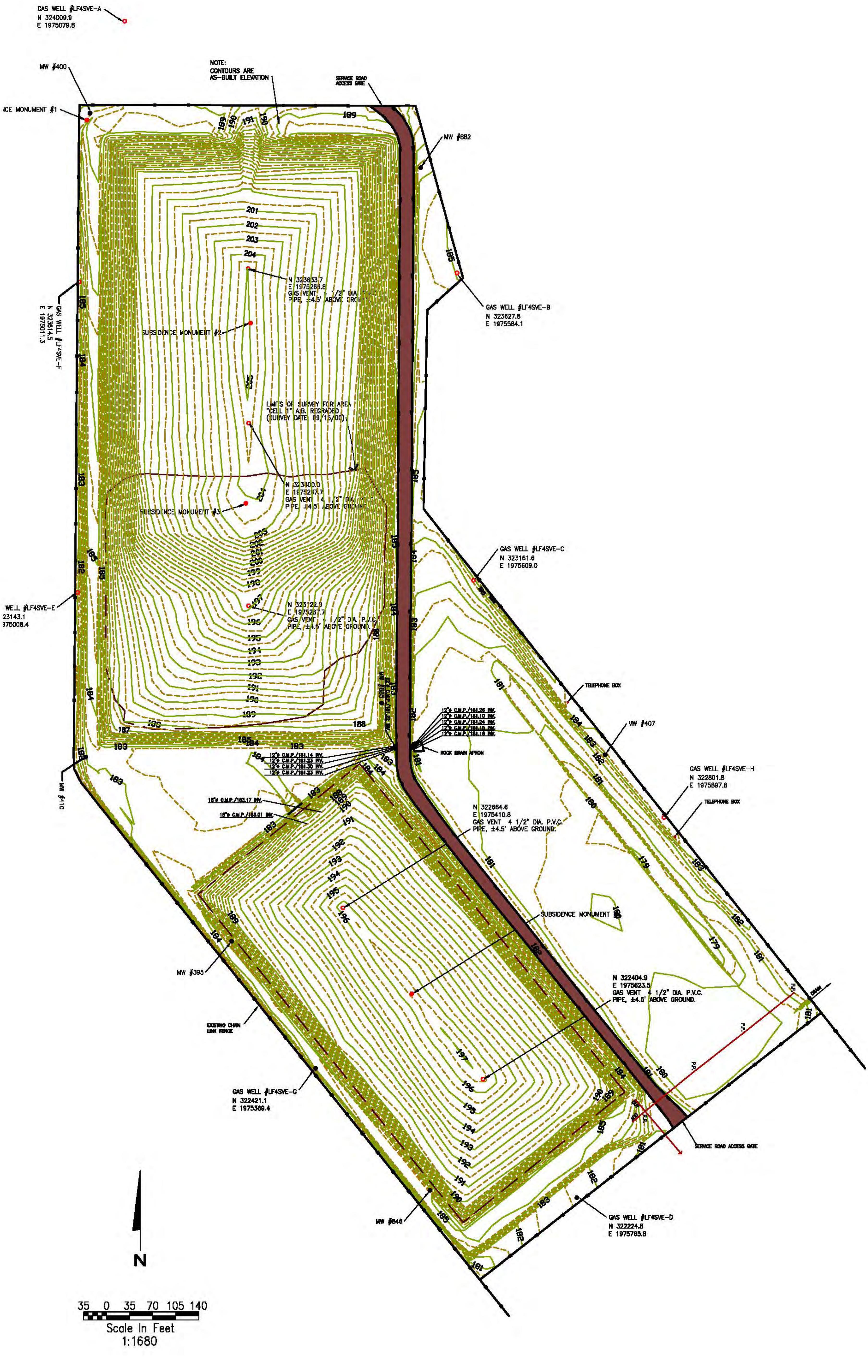
06/02/08 Xv

FIGURE 4-2



Landfill 4 Surface Features
Five-Year Review
Castle Airport

11/2/00 pr
06/03/08Xv
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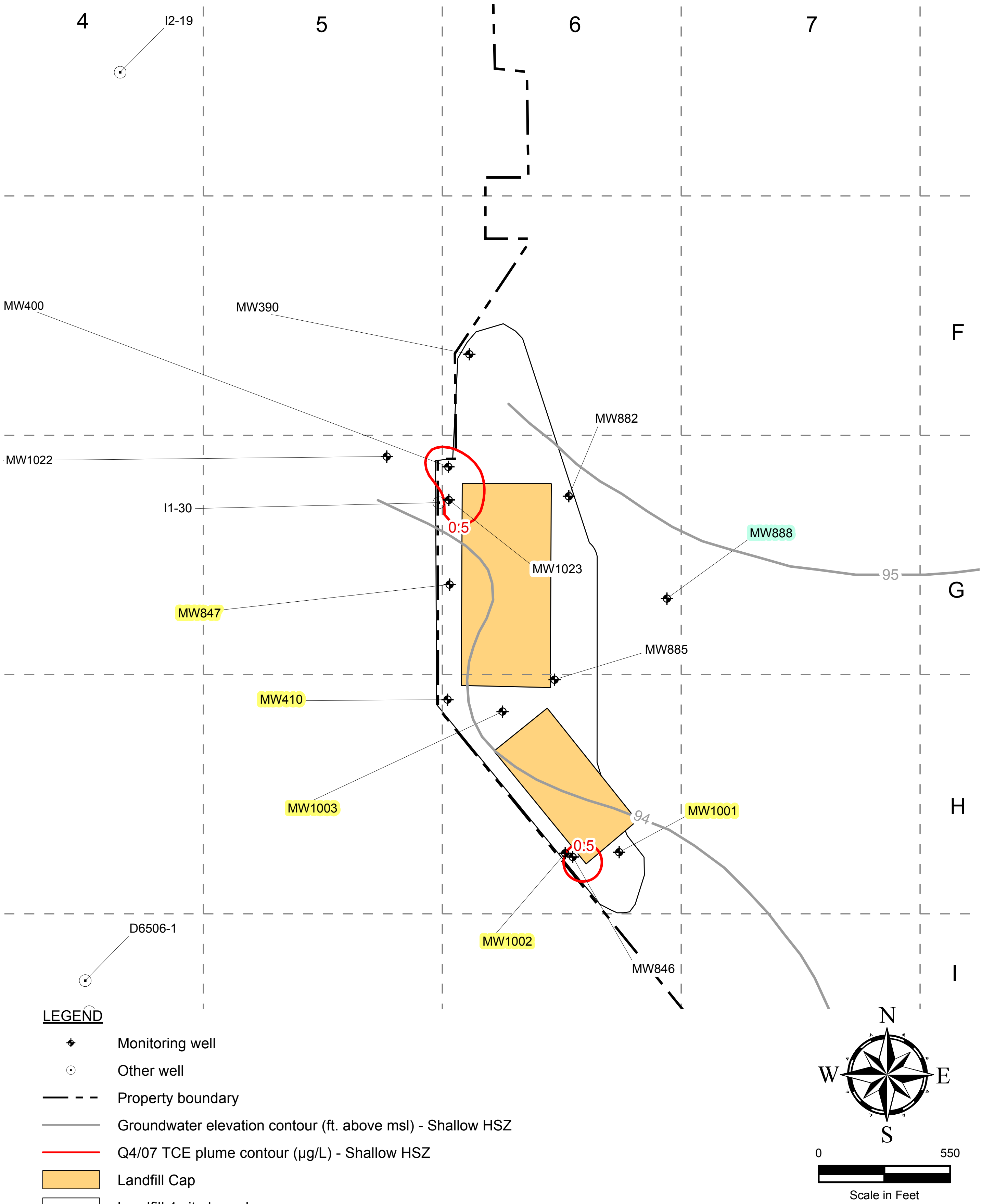
Job No. 05-Z010-01
FIGURE 4-3

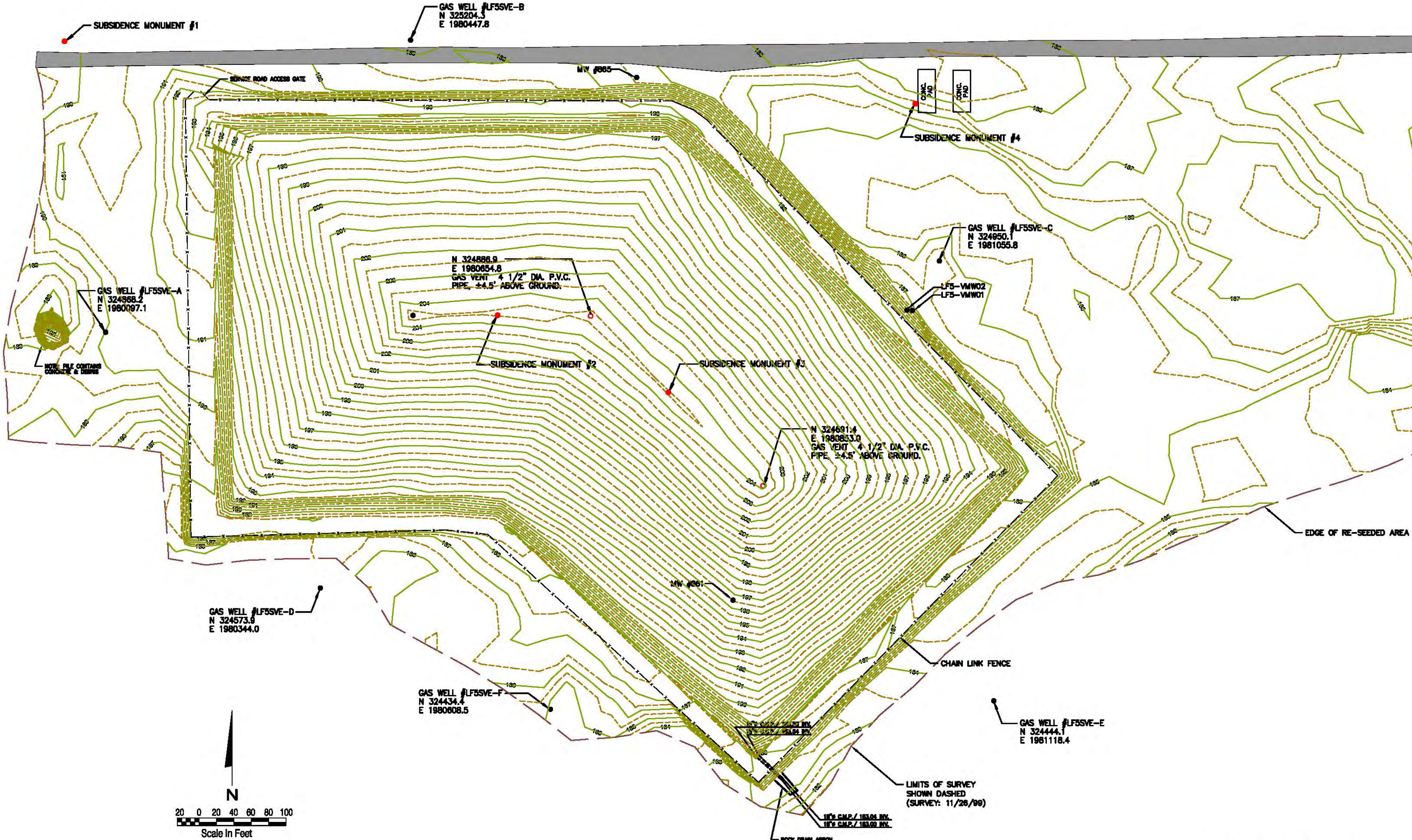


LEGEND

- Monitoring well
- Other well
- Property boundary
- Groundwater elevation contour (ft. above msl) - Shallow HSZ
- Q4/07 TCE plume contour (µg/L) - Shallow HSZ
- Landfill Cap
- Landfill 4 site boundary
- MW888 Background monitoring well
- MW410 Detection compliance monitoring well

Landfill 4 Post-Closure Groundwater Monitoring Plan

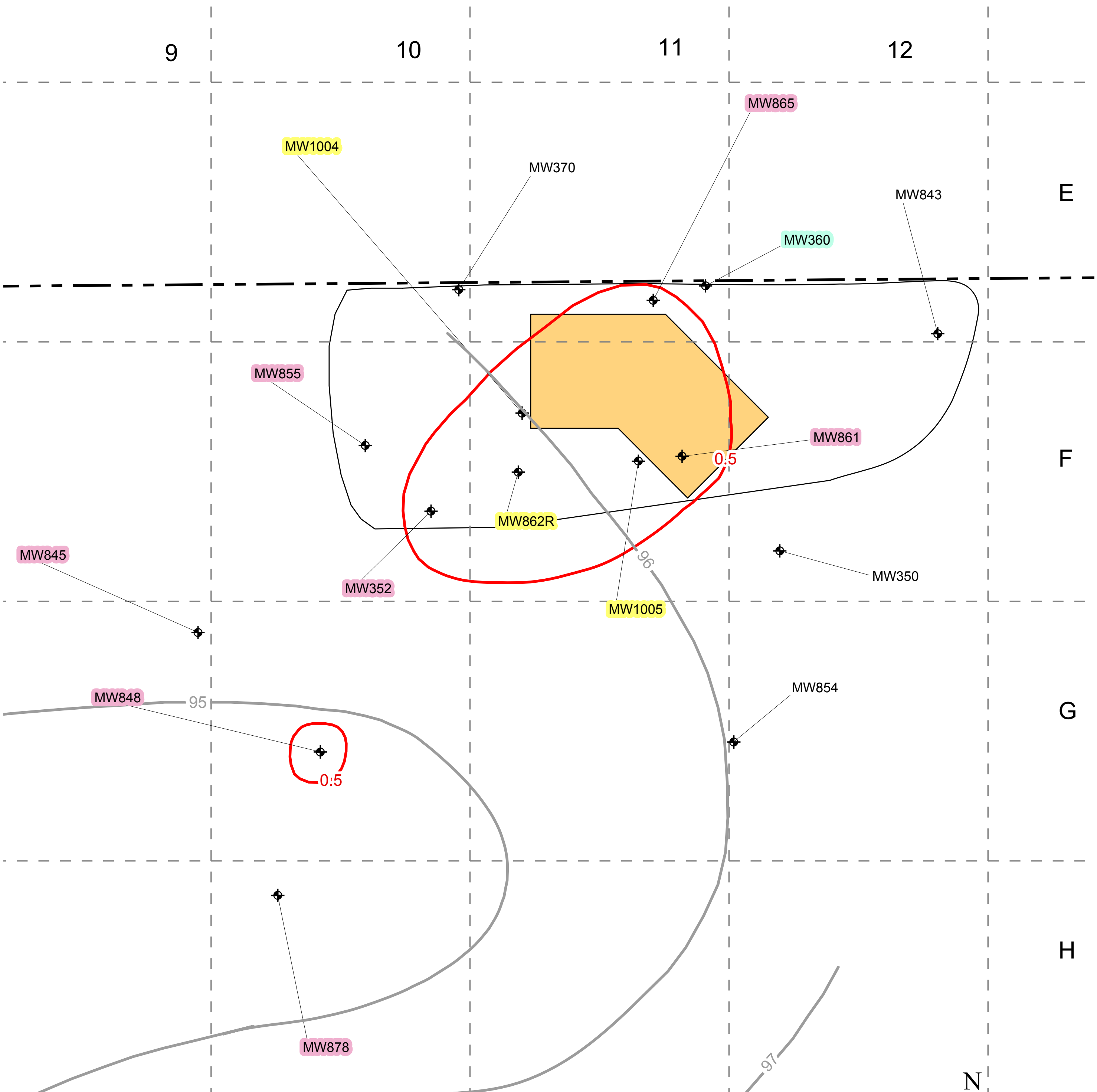
Five-Year Review
Castle Airport



Landfill 5 Surface Features

Five-Year Review

Castle Airport



LEGEND

- Monitoring well
- Other well
- Property boundary
- Groundwater elevation contour (ft. above msl) - Shallow HSZ
- Q4/07 TCE plume contour (µg/L) - Shallow HSZ
- Landfill Cap
- Landfill 5 site boundary
- MW360 Background monitoring well
- MW1004 Detection and corrective action compliance monitoring well
- MW855 Corrective action compliance monitoring well

N W E S

0 550

Scale in Feet
1:6,600

Landfill 5 Post-Closure Groundwater Monitoring Plan

Five-Year Review
Castle Airport

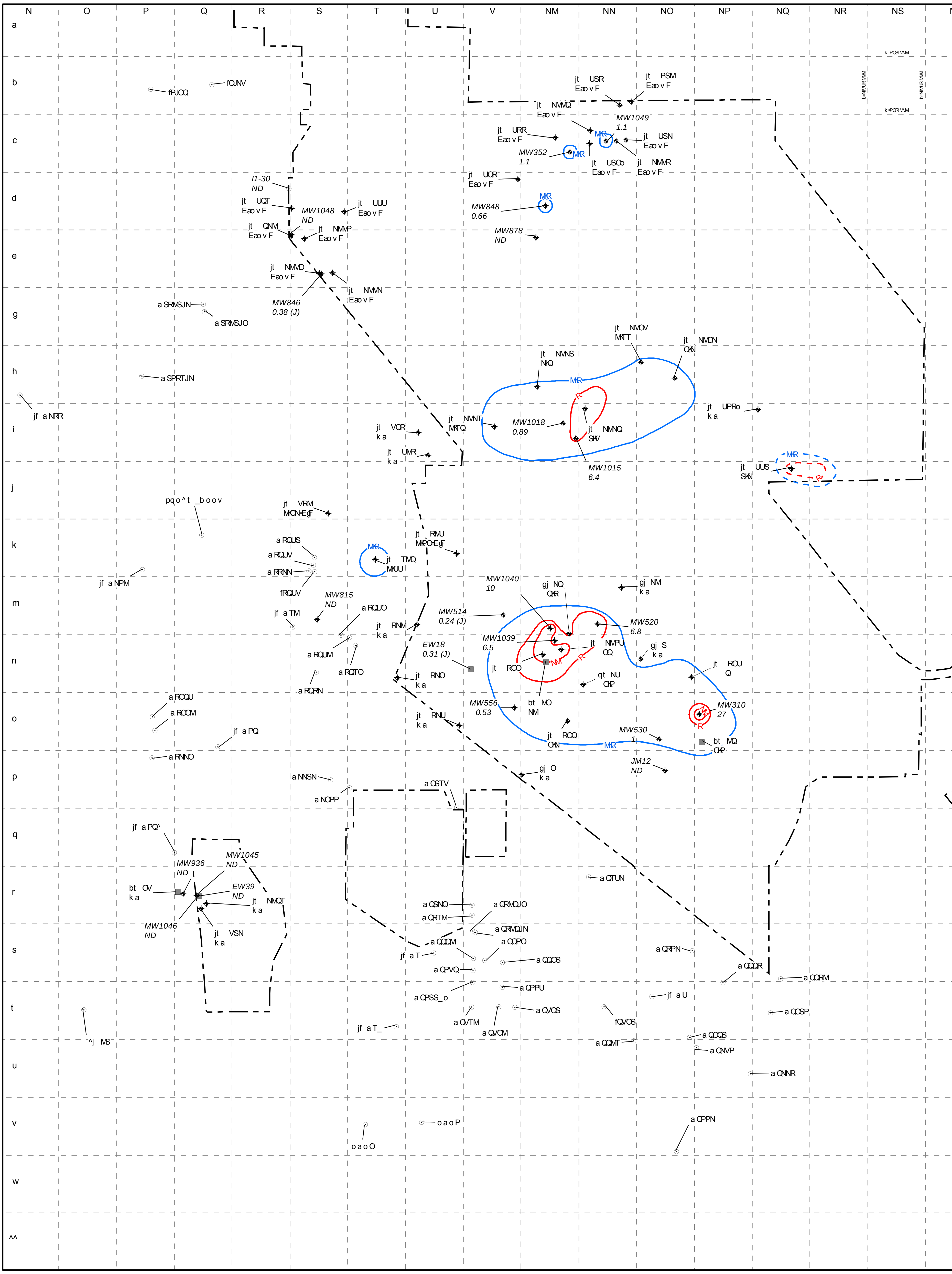


FIGURE 7-1
TCE Plume Delineation Map, Fourth Quarter 2012
Shallow Hydrostratigraphic Zone
Former Castle AFB, Atwater, California

CH2MHILL

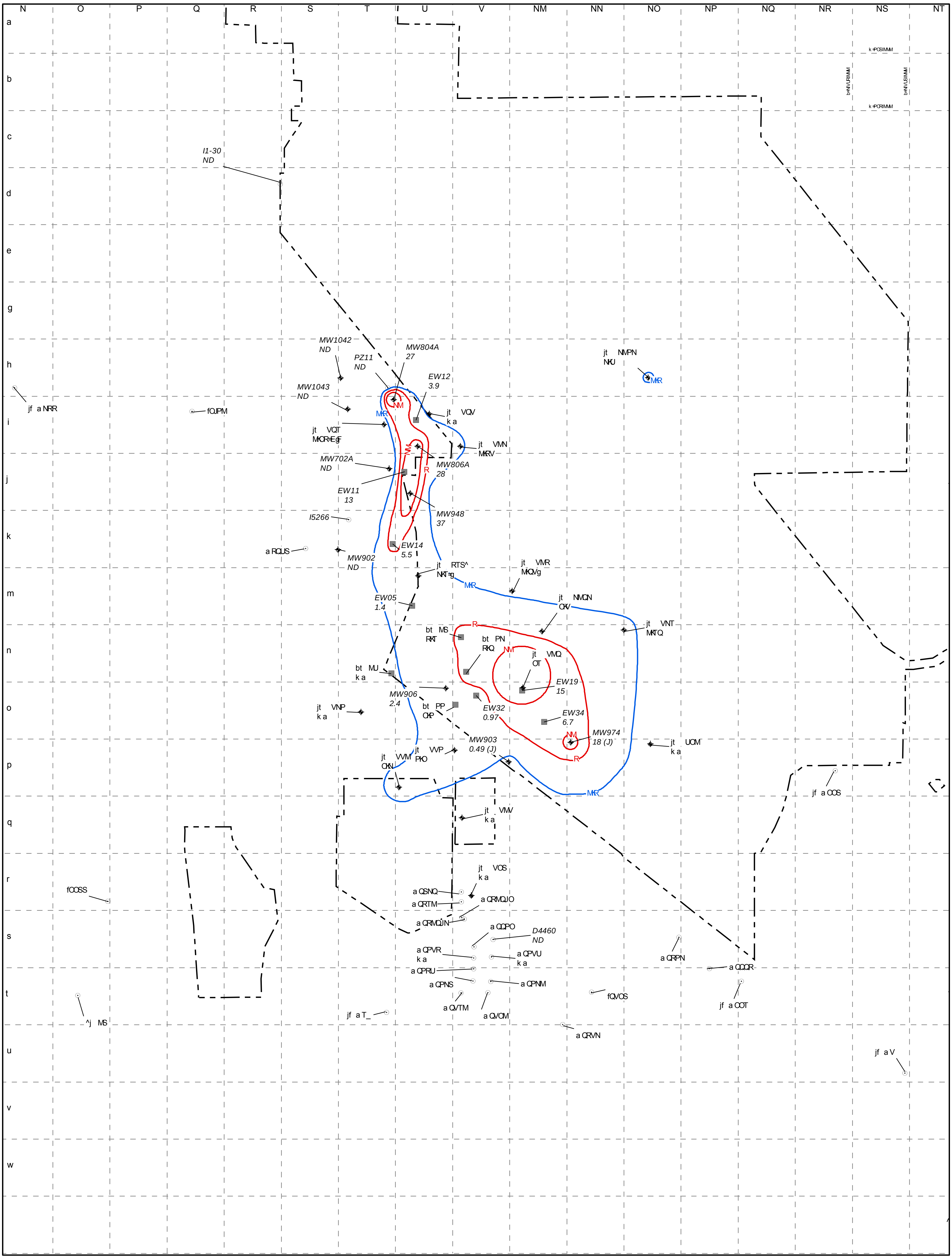


FIGURE 7-2
TCE Plume Delineation Map, Fourth Quarter 2012
Upper Subshallow Hydrostratigraphic Zone

Former Castle AFB, Atwater, California

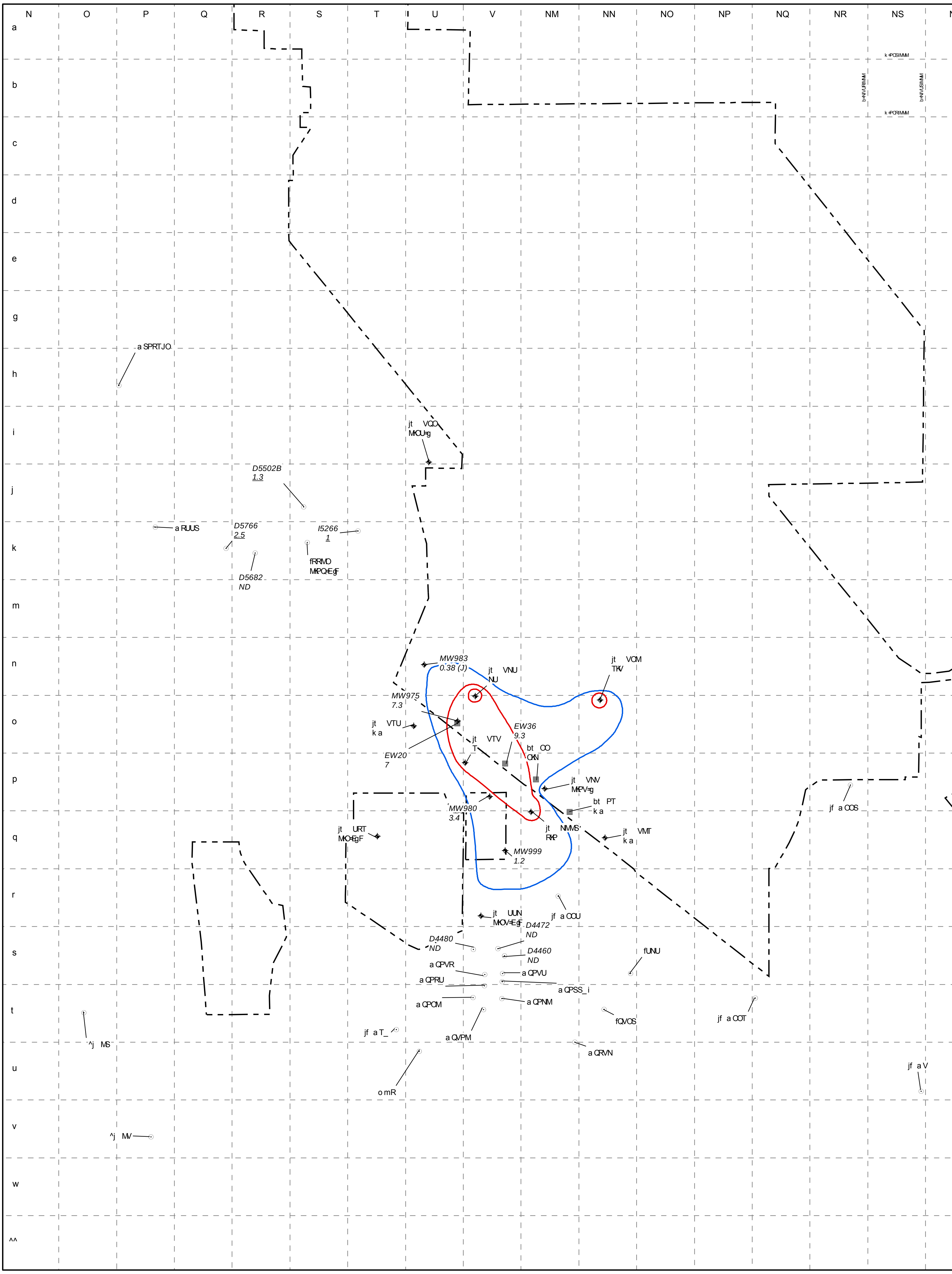


FIGURE 7-3
TCE Plume Delineation Map, Fourth Quarter 2012
Lower Subshallow Hydrostratigraphic Zone
Former Castle AFB, Atwater, California

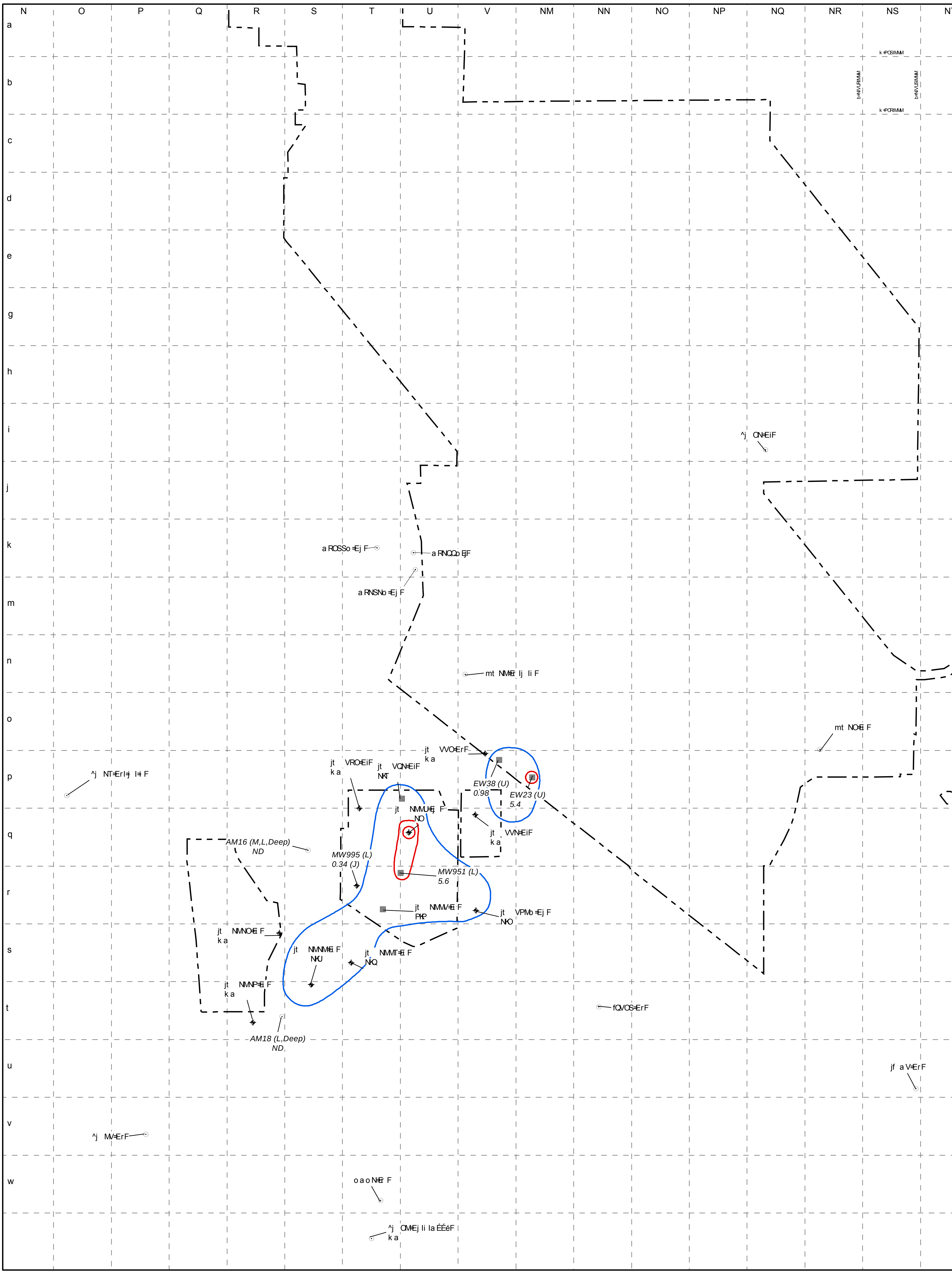
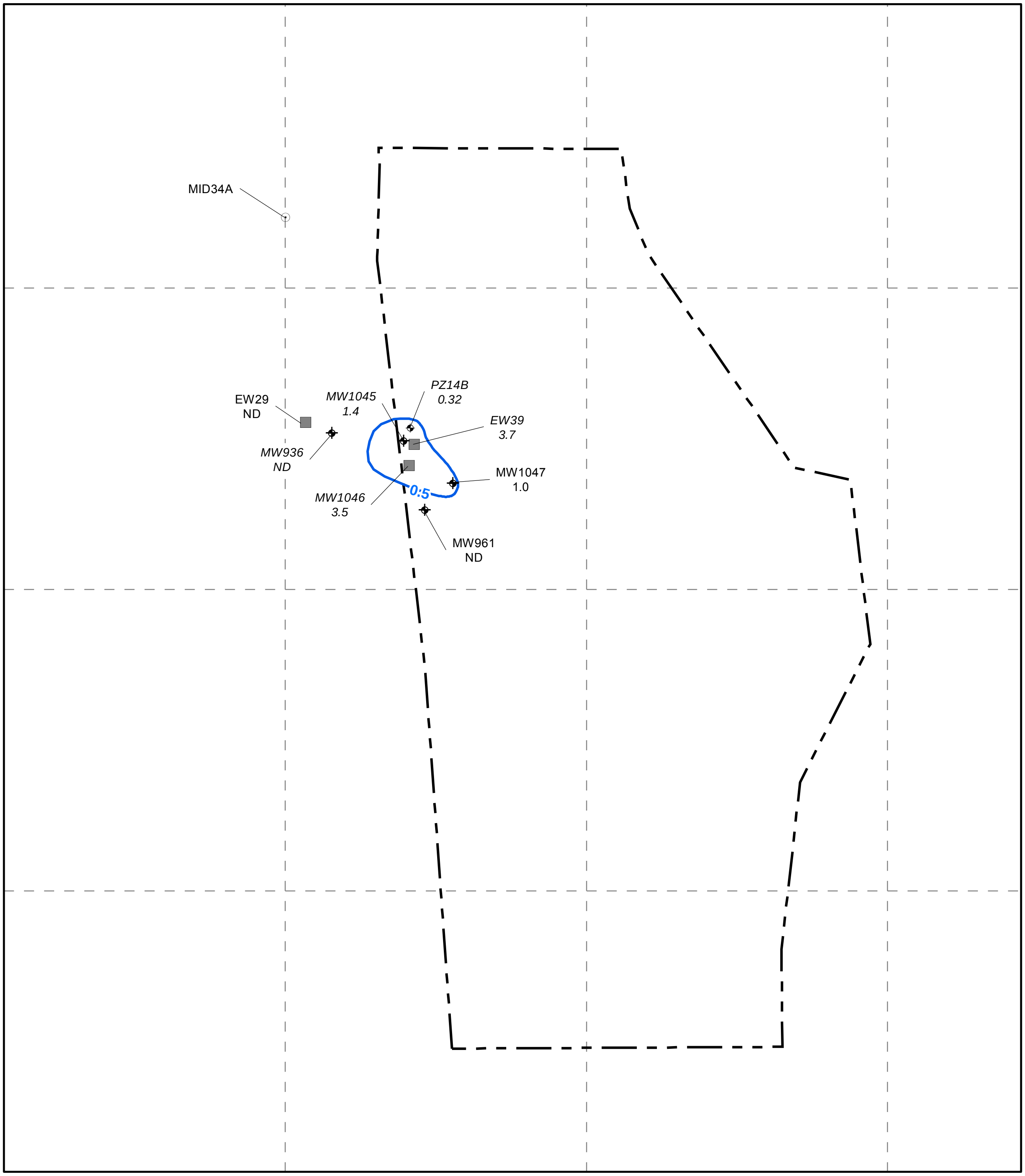


FIGURE 7-4
TCE Plume Delineation Map, Fourth Quarter 2012
Confined Hydrostratigraphic Zone

Former Castle AFB, Atwater, California

CH2MHILL



LEGEND

- Extraction well
- Injection well
- Monitoring well
- Other well
- Property boundary
- cis-1,2-DCE isoconcentration (0.5 µg/L)

(J) Estimated value due to trace concentration or quality control deficiency

Note:
Data in *italics* represent sample results from current quarter

Monitoring, extraction, and injection wells not in sampling program are not shown on map.

N

0 250 500
Feet

FIGURE 7-5
Castle Vista cis-1,2-DCE Plume Delineation Map, Fourth Quarter 2012 Shallow Hydrostratigraphic Zone
LTGSP 2012 Annual Report
Former Castle AFB, Atwater, California

CH2MHILL

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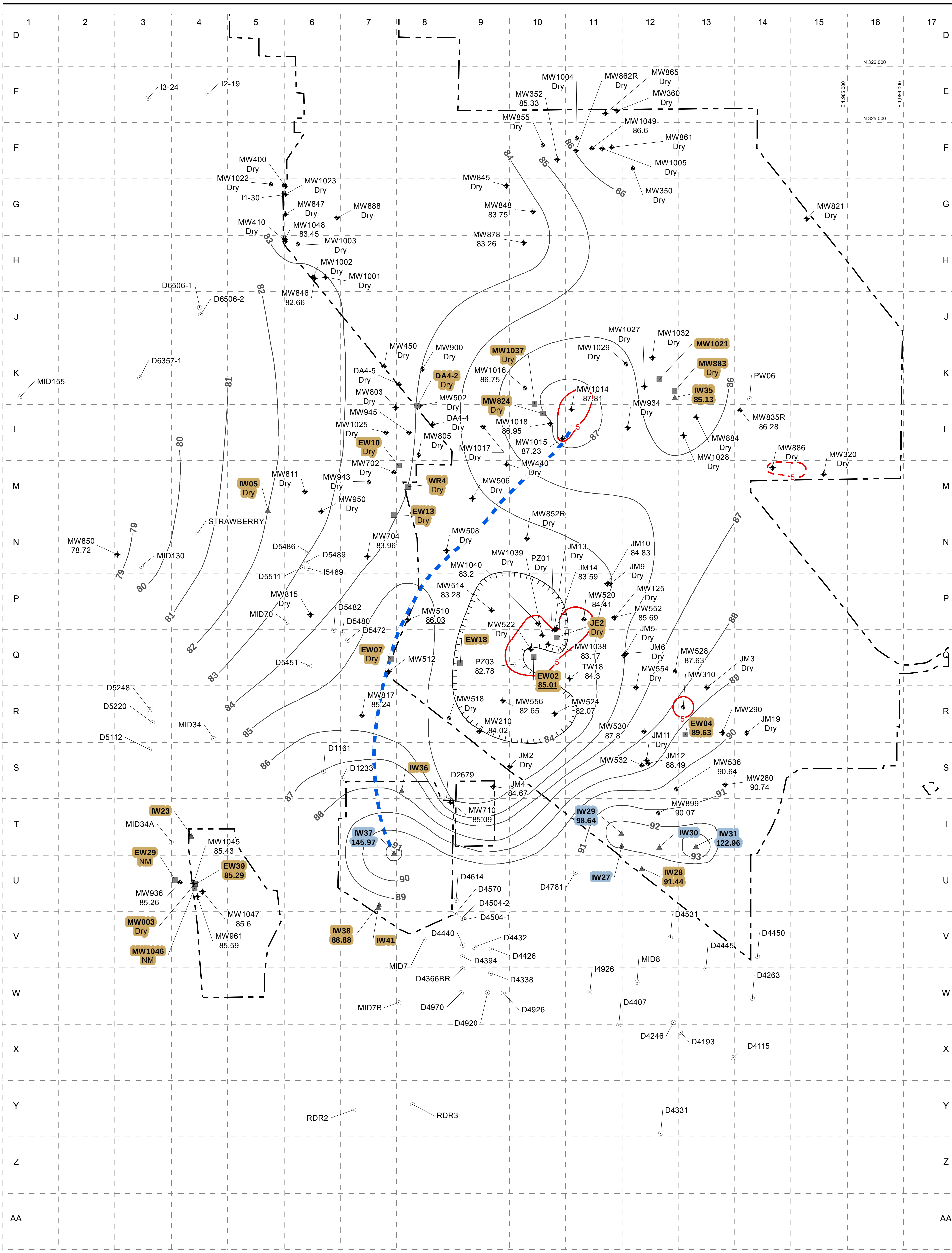

LEGEND

- Extraction well
- Injection well
- Monitoring well
- Other well
- 5 µg/L TCE isoconcentration contour
- Groundwater elevation (ft above msl)
- Groundwater depression
- Estimated zone of capture
- Property boundary

MW510
86.03 Data not used in contouring
(J) Estimated value due to trace concentration or quality control deficiency
(DRY) No water in well or insufficient water for sampling
(NM) Not measured

Note:

EW39 Extraction well -online

IW23 Injection well - online

EW29 Extraction / injection well - offline

Wells with no data presented are not checked for water levels and may be dry.

MW886 is dry and the TCE concentration and plume (dashed) are based on data from the last sample collected (Q1/08).

N

0 850 1,700
Feet

FIGURE 7-6
Estimated Plume Capture, Fourth Quarter 2012
Shallow Hydrostratigraphic Zone
LTGSP 2012 Annual Report
Former Castle AFB, Atwater, California

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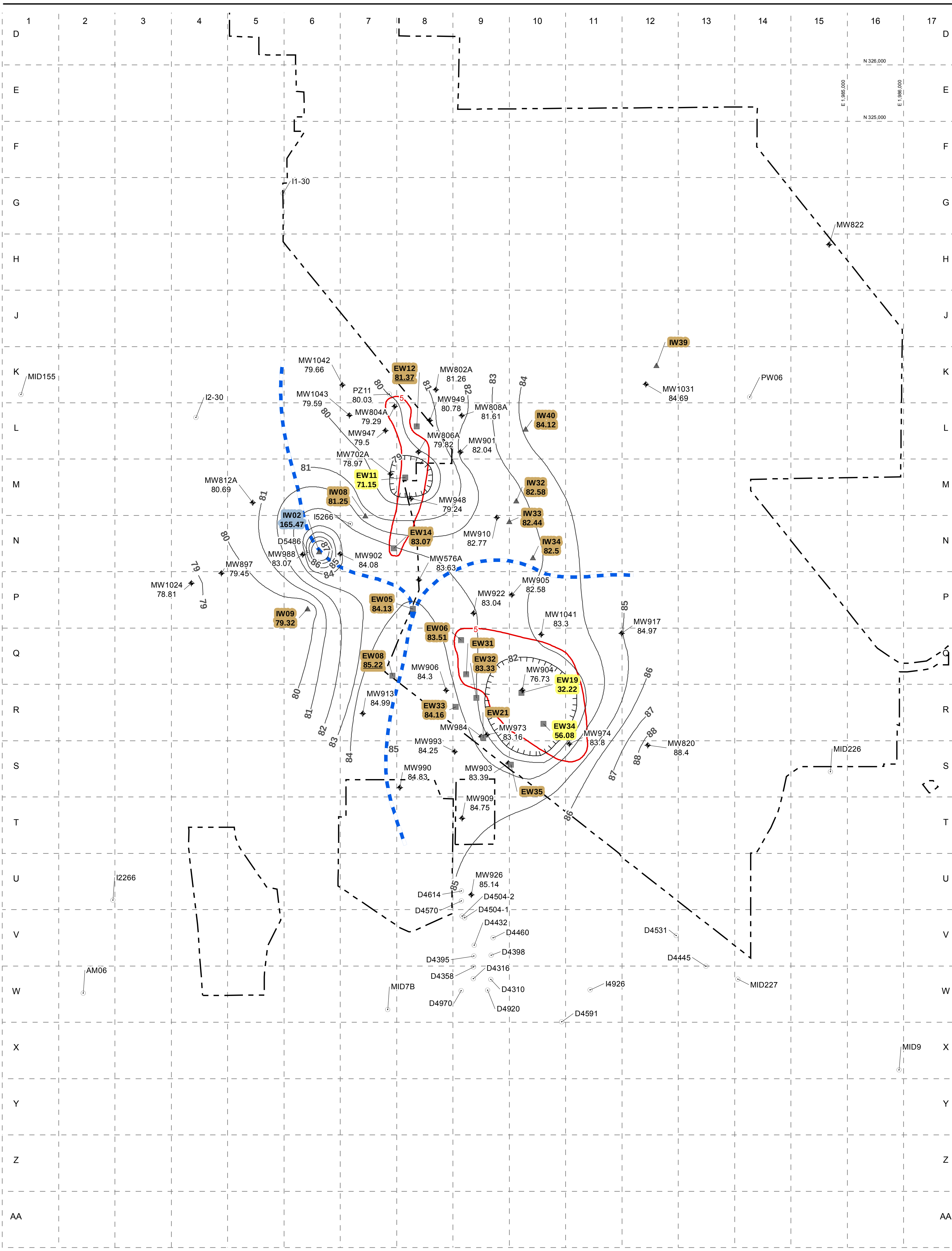

LEGEND

- Extraction well
- Injection well
- Monitoring well
- Other well
- 5 µg/L TCE isoconcentration contour
- Groundwater elevation (ft above msl)
- Groundwater depression
- Estimated zone of capture
- Property boundary

EW12
81.37 Data not used in contouring

(J) Estimated value due to trace concentration or quality control deficiency

Note:

EW39 Extraction well - online

IW23 Injection well - online

EW29 Extraction / injection well - offline

Wells with no data presented are not checked for water levels.

N

0 850 1,700

Feet

FIGURE 7-7

Estimated Plume Capture, Fourth Quarter 2012

Upper Subshallow Hydrostratigraphic Zone

LTGSP 2012 Annual Report

Former Castle AFB, Atwater, California

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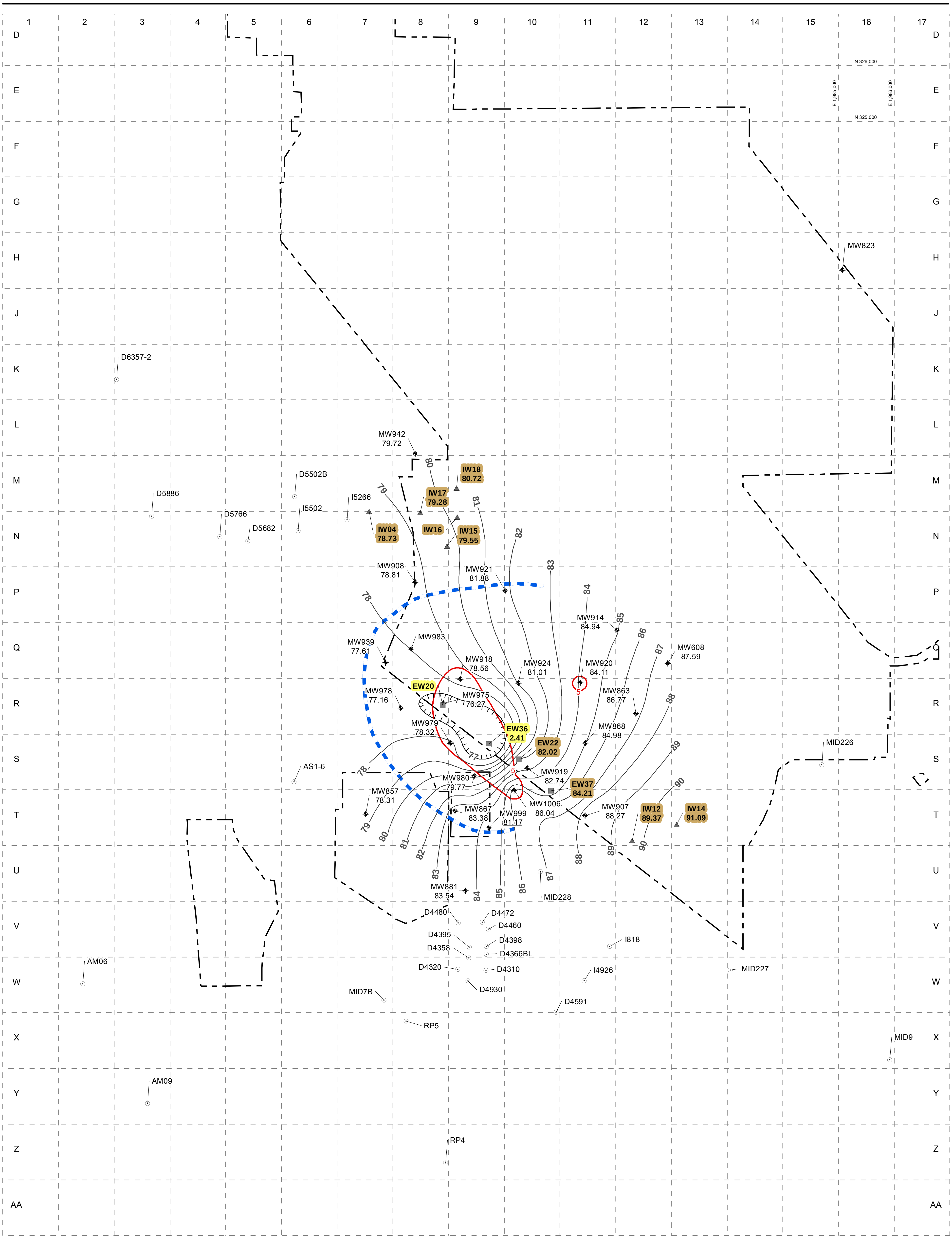
CH2MHILL



LEGEND

- Extraction well
- Injection well
- Monitoring well
- Other well
- 5 µg/L TCE isoconcentration contour
- Groundwater elevation (ft above msl)
- Groundwater depression
- Estimated zone of capture
- Property boundary

MW999
81.17 Data not used in contouring

(J) Estimated value due to trace concentration or quality control deficiency

NM Not measured

Note:

EW39 Extraction well - online

IW23 Injection well - online

EW29 Extraction / injection well - offline

Wells with no data presented are not checked for water levels.

N

0 850 1,700
Feet

FIGURE 7-8
Estimated Plume Capture, Fourth Quarter 2012
Lower Subshallow Hydrostratigraphic Zone
LTGSP 2012 Annual Report
Former Castle AFB, Atwater, California

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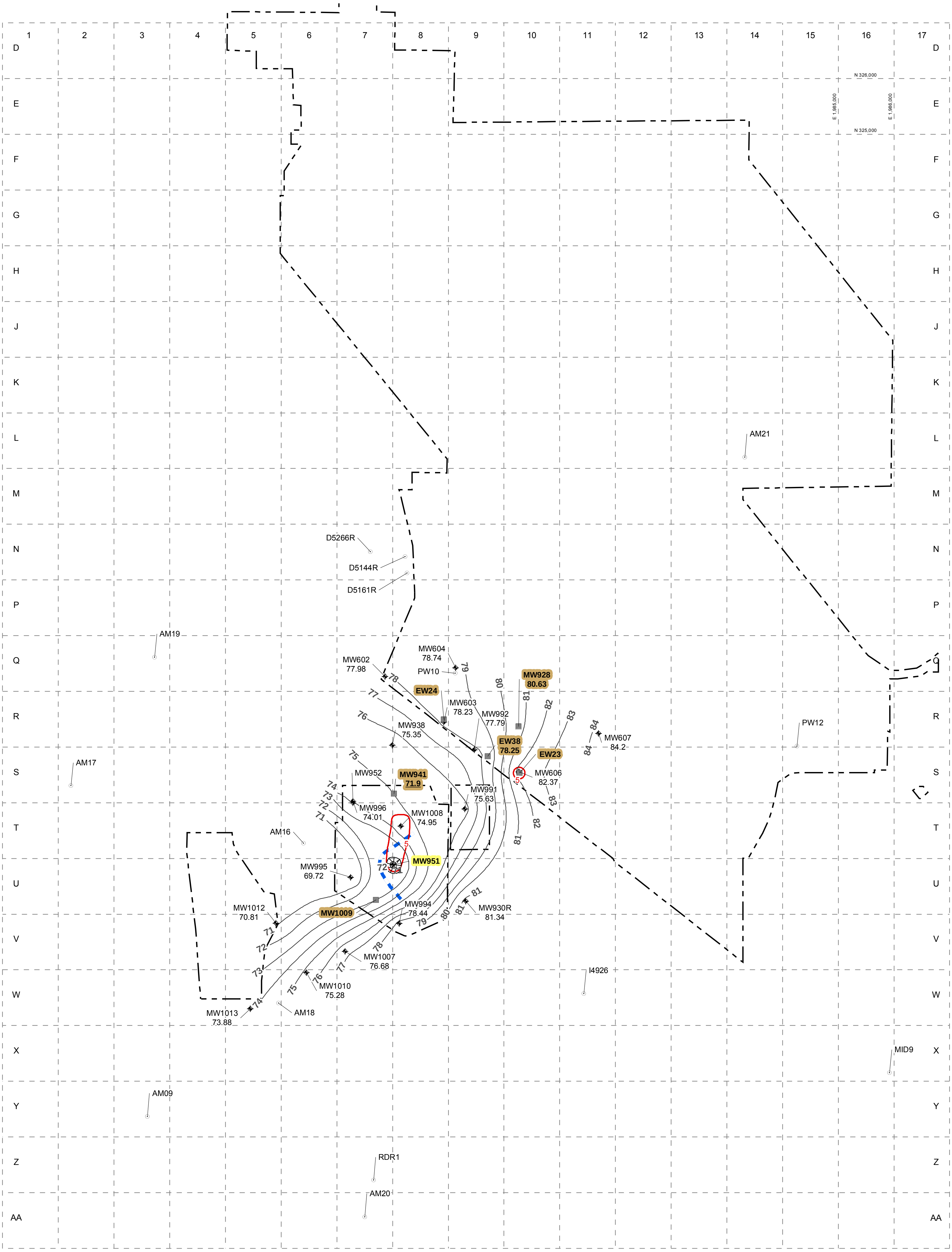
CH2MHILL



LEGEND

- Extraction well
- Injection well
- Monitoring well
- Other well
- 5 µg/L TCE isoconcentration contour
- Groundwater elevation (ft above msl)
- Groundwater depression
- Estimated zone of capture
- Property boundary

MW941
71.9 Data not used in contouring

(J) Estimated value due to trace concentration or quality control deficiency

Note:

EW39 Extraction well - online

IW23 Injection well - online

EW29 Extraction / injection well - offline

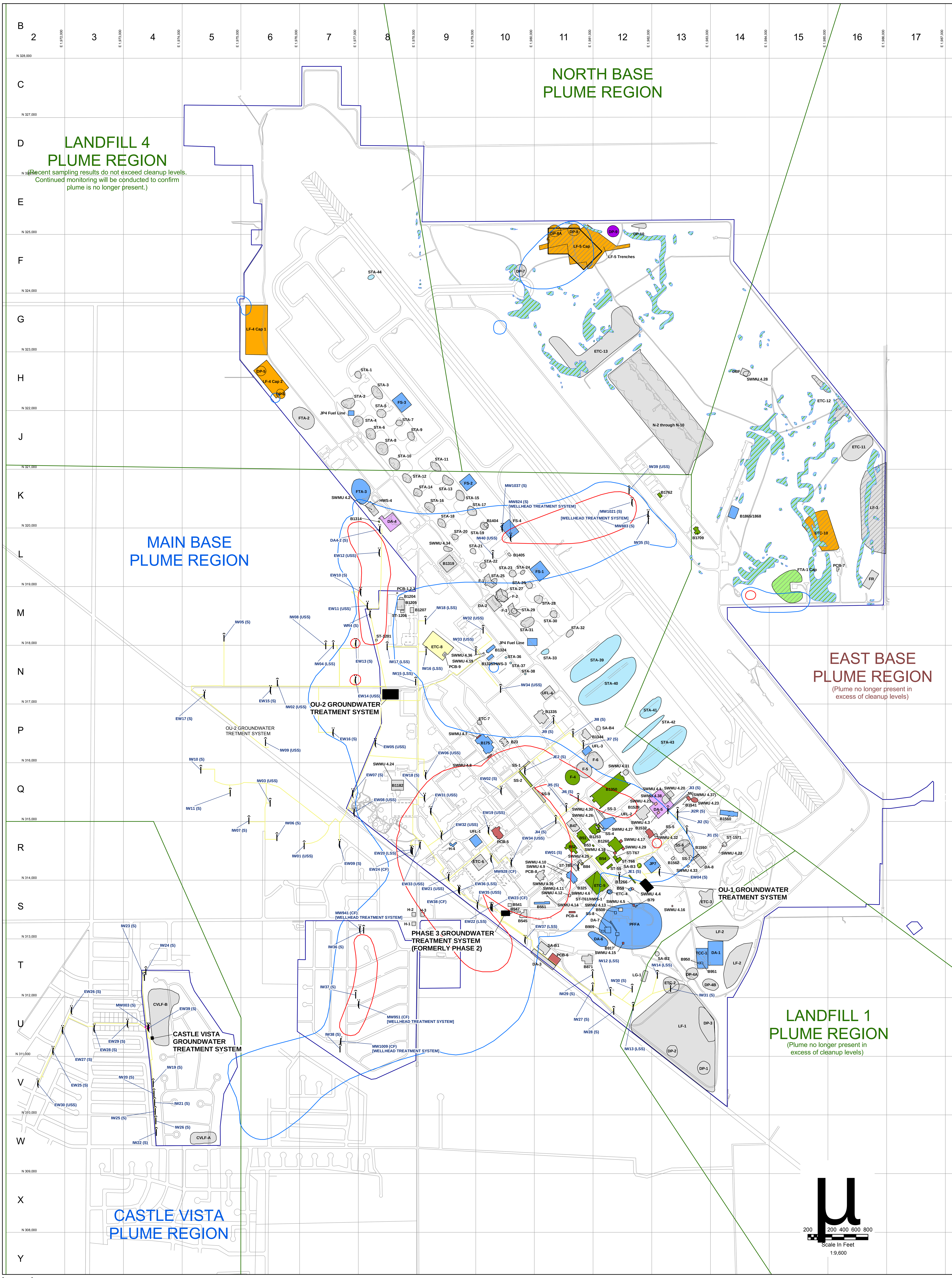
Wells with no data presented are not checked for water levels.

N

0 850 1,700
Feet

FIGURE 7-9
Estimated Plume Capture, Fourth Quarter 2012
Confined Hydrostratigraphic Zone
LTGSP 2012 Annual Report
Former Castle AFB, Atwater, California

CH2MHILL



Legend

- Base Boundary
- MCL Contour for cis-1,2-DCE (6 µg/L) (Q4 2007; Shallow HSZ only)
- MCL Contour for TCE (5 µg/L) (Q4 2007; All HSZs)
- MCL Contour for TCE (0.5 µg/L) (Q4 2007; All HSZs)
- Groundwater Conveyance System
- Groundwater Treatment System
- Extraction Well
- Injection Well
- Wetlands

ROD, Remedy

- Plume — CB-1, IC&M
- Plume — CB-1, P&T
- Plume — CB-1, WD&M
- SCOU-1, NFA
- SCOU-1, PHO
- SCOU-2, CERCLA Exclusion
- SCOU-2, E&D
- SCOU-2, E&D/SVE
- SCOU-2, NFA
- SCOU-2, SVE
- SCOU-3, BV/E&D/IC/LTM/SVE
- SCOU-3, IC/LTM
- SCOU-3, E&D
- SCOU-3, IC
- SCOU-3, LTEM
- SCOU-3, NFA

BV	Bioventing
CB	Comprehensive Basewide
CB-1	CB ROD - Part 1
CF	Confined HSZ
E&D	Excavation and Disposal
HSZ	Hydrostratigraphic Zone
IC	Institutional Controls
IC&M	Institutional Controls and Monitoring
LSS	Lower Subshallow HSZ
LTEM	Long-Term Ecological Monitoring
LTM	Long-Term Cap Monitoring
NFA	No Further Action
P&T	Pump and Treat
PHO	Petroleum Hydrocarbon Only
ROD	Record of Decision
S	Shallow HSZ
SCOU	Source Control Operable Unit
SCOU-1	SCOU ROD Part 1
SCOU-2	SCOU ROD Part 2
SCOU-3	SCOU ROD Part 3
SVE	Soil Vapor Extraction
USS	Upper Subshallow HSZ
WD&M	Well Destruction and Monitoring

SCOU ROD 1 (169 Sites)

NFA						PHO	
B23	DA-8	H-2	SA-B4	STA-13	SWMU 4.9	B59	H-4
B47	DBF	H-3	SDS *	STA-14	SWMU 4.10	B79	JP4 Fuel Line
B84	DP-1	HWS-4	SS-1	STA-15	SWMU 4.11	B175	JP7
B541	DP-2	IWL *	SS-3	STA-16	SWMU 4.12	B325	PFFA
B545	DP-3	LF-1	SS-5	STA-17	SWMU 4.13	B508	SS-8
B547	DP-4A/4B	LF-2	SS-6	STA-18	SWMU 4.19	B551	ST-T61/HWS-1
B871	DP-7	LF-3	SS-7	STA-19	SWMU 4.20	B909	UFL-1
B1182	DP-10	LG-1	SS-9	STA-20	SWMU 4.24	B917	UFL-2
B1204	ETC-2	N-2	ST-1201	STA-21	SWMU 4.25	B950	UFL-3
B1205	ETC-3	N-3	ST-1206	STA-22	SWMU 4.26	B951	
B1207	ETC-6	N-4	ST-1571	STA-23	SWMU 4.27	B1324	
B1319	ETC-7	N-5	STA-1	STA-24	SWMU 4.28	B1325/HWS-3	
B1335	ETC-11	N-6	STA-2	STA-25	SWMU 4.30	B1560	
B1344	ETC-12	N-7	STA-3	STA-26	SWMU 4.31	B1865/1868	
B1404	ETC-13	N-8	STA-4	STA-27	SWMU 4.32	DA-1/TCC-1	
B1405	F-1	N-9	STA-5	STA-28	SWMU 4.33	DA-6	
B1529	F-2	N-10	STA-6	STA-29	SWMU 4.34	DA-7	
B1550	F-3	PCB-1,2,3	STA-7	STA-30	SWMU 4.35	ETC-4	
B1562	F-5	PCB-7	STA-8	STA-31	SWMU 4.36	FS-1	
CVLF-A	F-6	PCB-8	STA-9	STA-32	SWMU 4.37 *	FS-2	
CVLF-B	FR	PCB-9	STA-10	ST-T85	SWMU 4.38	FS-3	
DA-2	FTA-2	SA-B1	STA-11	SWMU 4.1	UFL-4	FS-4	
DA-3	H-1	SA-B2	STA-12	SWMU 4.2		FTA-3	

SCOU ROD 2 (53 Sites)

CERCLA Exclusion	E&D	SVE
STA-33	SWMU 4.3(+BV)	B51
STA-34 **	SWMU 4.4	B52
STA-35 **	SWMU 4.6	B53
STA-36	SWMU 4.16	B54
STA-37	SWMU 4.21(+BV)	B1253
STA-38	SWMU 4.22	B1260
STA-39		B1266
STA-40	**NFA**	B1314
STA-41	B1532	B1350
STA-42	B1541	B1709
STA-43	PCB-4	B1762
STA-44	PCB-5	ETC-5
	PCB-6	F-4
	SWMU 4.5	SA-B3
	SWMU 4.7	SS-2
	SWMU 4.8	SS-4
	SWMU 4.14	ST-55
	SWMU 4.15	ST-T66
	SWMU 4.17	ST-T67
	SWMU 4.18	**E&D/SVE**
	SWMU 4.23	DA-4
	SWMU 4.29	DA-5(+BV)

SCOU ROD 3 (11 Sites; all 233 Sites for Ecological Risk)

IC/LTM	NFA (Ecological)
DP-5	ALL SCOU SITES NOT LISTED BELOW
DP-6	**LTEM**
DP-8	DP-8
DP-8A	DP-8A
LF-4	ETC-10
LF-5	ETC-12
LF-5 Trenches	FTA-1
NFA	LF-3
DP-9	LF-5
IC	LF-5 Trenches
ETC-10	
E&D	
ETC-8	
BV/E&D/IC/LTM/SVE	
FTA-1	

* Basewide sites not shown on map
** Location unknown

Notes:

Basewide Sites (IWL, JP4 Pipeline and SDS) not shown - All are SCOU ROD Part 1 NFA.

Soil and Groundwater Remedial Actions at the Former Castle Air Force Base

Five-Year Review
Castle Airport

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PLATE 1

TABLES

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
1	B23	SS049	P10		NFA	SCOU-1	Site is NFA (no action was required)
2	B47	SS050	R11		NFA	SCOU-1	Site is NFA (no action was required)
3	B51	SS051	R11	B51 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
4	B52	SS052	R11	B51 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
5	B53	SS053	R12	B51 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
6	B54	SS054	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
7	B59	SS056	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
8	B79	SS060	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
9	B84	SS061	R11	ST-T85, SWMU 4.25	NFA	SCOU-1	Site is NFA (no action was required)
10	B175	SS063	P10	SWMU 4.7; 4.8	PHO	SCOU-1	Non-CERCLA Site
11	B325	SS064	R11	SWMU 4.9, 4.10, 4.11, 4.35	PHO	SCOU-1	Non-CERCLA Site
12	B508	SS065	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
13	B541	SS066	S10		NFA	SCOU-1	Site is NFA (no action was required)
14	B545	SS067	S10	B547	NFA	SCOU-1	Site is NFA (no action was required)
15	B547	SS068	S10	B545	NFA	SCOU-1	Site is NFA (no action was required)
16	B551	SS069	S11	SWMU 4.14	PHO	SCOU-1	Non-CERCLA Site
17	B871	SS070	T11		NFA	SCOU-1	Site is NFA (E&D removal action completed)
18	B909	SS071	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
19	B917	SS072	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
20	B950	SS102	T13	DA-1/TCC-1; B951	PHO	SCOU-1	Non-CERCLA Site
21	B951	SS103	T13	DA-1/TCC-1; B950	PHO	SCOU-1	Non-CERCLA Site
22	B1182	SS073	Q8	SWMU 4.24	NFA	SCOU-1	Site is NFA (no action was required)
23	B1204	SS109	M8	B1205	NFA	SCOU-1	Site is NFA (no action was required)
24	B1205	SS075	M8	B1204, ST-1206	NFA	SCOU-1	Site is NFA (no action was required)
25	B1207	SS077	M8		NFA	SCOU-1	Site is NFA (no action was required)
26	B1253	SS078	R12	B51 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
27	B1260	SS079	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
28	B1266	SS080	S12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
29	B1314	SS110	K8	DA-4	SVE/E&D	SCOU-2	Site is NFA (SVE/E&D remedial action completed)
30	B1319	SS111	L9	SWMU 4.34	NFA	SCOU-1	Site is NFA (no action was required)
31	B1324	SS081	N10	SWMU 4.19, 4.36	PHO	SCOU-1	Non-CERCLA Site
32	B1325/HWS-3	SS082	N10	STA-36; STA-37	PHO	SCOU-1	Non-CERCLA Site
33	B1335	SS083	P11		NFA	SCOU-1	Site is NFA (no action was required)
34	B1344	SS085	P11		NFA	SCOU-1	Site is NFA (E&D removal action completed)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
35	B1350	SS086	Q12	SWMU 4.31	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
36	B1404	SS113	L10	STA-19	NFA	SCOU-1	Site is NFA (no action was required)
37	B1405	SS114	L10		NFA	SCOU-1	Site is NFA (no action was required)
38	B1529	SS087	Q12	DA-5 Group	NFA	SCOU-1	Site is NFA (no action was required)
39	B1532	SS088	R12	SWMU 4.32	NFA	SCOU-2	Site is NFA (no action was required)
40	B1541	SS089	Q13	SWMU 4.23	NFA	SCOU-2	Site is NFA (E&D removal action completed)
41	B1550	SS090	R13	DA-8; SS-6; SS-7	NFA	SCOU-1	Site is NFA (SVE removal action completed)
42	B1560	SS091	Q14		PHO	SCOU-1	Non-CERCLA Site
43	B1562	SS092	R13		NFA	SCOU-1	Site is NFA (no action was required)
44	B1709	SS116	L13		SVE	SCOU-2	Site is NFA (SVE remedial action completed)
45	B1762	SS117	K13		SVE	SCOU-2	Site is NFA (SVE remedial action completed)
46	B1865/1868	SS105	K14		PHO	SCOU-1	Non-CERCLA Site
47	CVLF-A	LF034	W5		NFA	SCOU-1	Site is NFA (E&D removal action completed)
48	CVLF-B	LF034	U4		NFA	SCOU-1	Site is NFA (E&D/SVE removal action completed)
49	DA-1/TCC-1	SD009	T13	B950; B951	PHO	SCOU-1	Non-CERCLA Site
50	DA-2	SD010	M10		NFA	SCOU-1	Site is NFA (E&D removal action completed)
51	DA-3	SD011	T11	SA-B1	NFA	SCOU-1	Site is NFA (E&D removal action completed)
52	DA-4	SD012	K8	B1314	SVE/E&D	SCOU-2	Site is NFA (SVE/E&D remedial action completed)
53	DA-5	SD013	Q13	B1529, and SWMUs 4.1, 4.20, 4.21, 4.3 and 4.38	SVE/E&D/BV	SCOU-2	Site is NFA (SVE remedial action completed; no E&D and BV); ICs placed on the site due to non-CERCLA residual contaminants
54	DA-6	SD014	T12		PHO	SCOU-1	Non-CERCLA Site
55	DA-7	SD015	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
56	DA-8	SD016	R13	B1550, SS-6, SS-7 and SWMU 4.33	NFA	SCOU-1	Site is NFA (SVE removal action completed)
57	DBF	SS115	H14	SWMU 4.28	NFA	SCOU-1	Site is NFA (no action was required)
58	DP-1	DP099	V13	LF-1	NFA	SCOU-1	Site is NFA (E&D removal action completed)
59	DP-2	DP100	U13	LF-1	NFA	SCOU-1	Site is NFA (no action was required)
60	DP-3	DP101	U13	LF-1	NFA	SCOU-1	Site is NFA (E&D removal action completed)
61	DP-4A/4B	DP028	T13/1		NFA	SCOU-1	Site is NFA (no action was required)
62	**DP-5**	**DP106**	**H6**	**LF-4**	**LTM/IC**	**SCOU-3**	**Site included in technical evaluation (LTM and ICs)**
63	**DP-6**	**DP107**	**H6**	**LF-4**	**LTM/IC**	**SCOU-3**	**Site included in technical evaluation (LTM and ICs)**
64	DP-7	DP094	F10	LF-5	NFA	SCOU-1	Site is NFA (no action was required)
65	**DP-8**	**DP095**	**E11**	**LF-5**	**LTM/IC/LTEM**	**SCOU-3**	**Site included in technical evaluation (LTM, ICs and LTEM)**
66	**DP-8A**	**DP096**	**E11**	**LF-5**	**LTM/IC/LTEM**	**SCOU-3**	**Site included in technical evaluation (LTM, ICs and LTEM)**
67	DP-9	DP097	E12	LF-5	NFA	SCOU-3	Site is NFA (no action was required)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
68	DP-10	DP098	G12	LF-5	NFA	SCOU-1	Site is NFA (no action was required)
69	ETC-2	SS182	T13		NFA	SCOU-1	Site is NFA (E&D removal action completed)
70	ETC-3	SS183	S13		NFA	SCOU-1	Site is NFA (no action was required)
71	ETC-4	SS184	S12	ST-T61/HWS-1	PHO	SCOU-1	Non-CERCLA Site
72	ETC-5	SS185	S12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
73	ETC-6	SS186	R10		NFA	SCOU-1	Site is NFA (no action was required)
74	ETC-7	SS187	P9		NFA	SCOU-1	Site is NFA (no action was required)
75	ETC-8	SS188	N9		E&D	SCOU-3	Site is NFA (E&D remedial action completed)
76	**ETC-10**	**SS189**	**L16**		**IC/LTEM**	**SCOU-3**	**Site included in technical evaluation (ICs and LTEM)**
77	ETC-11	WP190	J16		NFA	SCOU-1	Site is NFA (no action was required)
78	**ETC-12**	**WP191**	**H15**	**ETC-13**	**NFA/LTEM**	**SCOU-1/SCOU-3**	**Site included in technical evaluation (LTEM)**
79	ETC-13	WP192	G12	ETC-12	NFA	SCOU-1	Site is NFA (no action was required)
80	F-1	SS166	L10	F1/2/3	NFA	SCOU-1	Site is NFA (no action was required)
81	F-2	SS167	M10	F1/2/3	NFA	SCOU-1	Site is NFA (no action was required)
82	F-3	SS168	M10	F1/2/3	NFA	SCOU-1	Site is NFA (no action was required)
83	F-4	SS169	Q11	F-5, F-6	SVE	SCOU-2	Site is NFA (SVE pilot test sufficient for closure)
84	F-5	SS170	Q11	F4/5/6	NFA	SCOU-1	Site is NFA (no action was required)
85	F-6	SS171	P12	F4/5/6	NFA	SCOU-1	Site is NFA (no action was required)
86	FR	SS104	L16		NFA	SCOU-1	Site is NFA (E&D removal action completed)
87	FS-1	SS017	L11	STA-24	PHO	SCOU-1	Non-CERCLA Site
88	FS-2	SS018	K9		PHO	SCOU-1	Non-CERCLA Site
89	FS-3	SS112	H8		PHO	SCOU-1	Non-CERCLA Site
90	FS-4	SS019	L10		PHO	SCOU-1	Non-CERCLA Site
91	**FTA-1**	**FT001**	**L15**		**SVE/BV/LTM/ IC/E&D/LTEM**	**SCOU-3**	**SVE and E&D remedial actions complete; BV not necessary; site included in technical evaluation for LTM, ICs and LTEM**
92	FTA-2	FT002	J7		NFA	SCOU-1	Site is NFA (no action was required)
93	FTA-3	FT003	K8		PHO	SCOU-1	Non-CERCLA Site
94	H-1				NFA	SCOU-1	Site is NFA (no action was required)
95	H-2				NFA	SCOU-1	Site is NFA (no action was required)
96	H-3				NFA	SCOU-1	Site is NFA (no action was required)
97	H-4		R10	UFL-1	PHO	SCOU-1	Non-CERCLA Site
98	HWS-4	SS108	K8	SWMU 4.2	NFA	SCOU-1	Site is NFA (no action was required)
99	IWL	ST044	BWS	SWMU 4.37	NFA	SCOU-1	Site is NFA (no action was required)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
100	JP4 Fuel Line	ST035	H7, M		PHO	SCOU-1	Non-CERCLA Site
101	JP7				PHO	SCOU-1	Non-CERCLA Site
102	LF-1	LF004	U13	DP-1, DP-2 and DP-3	NFA	SCOU-1	Site is NFA (E&D removal action completed)
103	LF-2	LF005	S14/T		NFA	SCOU-1	Site is NFA (E&D removal action completed)
104	**LF-3**	**LF006**	**K16**		**NFA/LTEM**	**SCOU-1/SCOU-3**	**Site included in technical evaluation (LTEM)**
105	**LF-4**	**LF007**	**G6**	**DP-5 and DP-6**	**LTM/IC**	**SCOU-3**	**Site included in technical evaluation (LTM and ICs)**
106	**LF-5**	**LF008**	**E&F 1**	**DP-7, DP-8, DP-8A, DP-9 and DP-10**	**LTM/IC/LTEM**	**SCOU-3**	**Site included in technical evaluation (LTM, ICs and LTEM)**
107	**LF-5 Trenches**		**F11/1**	**LF-5**	**LTM/IC/LTEM**	**SCOU-3**	**Site included in technical evaluation (LTM, ICs and LTEM)**
108	LG-1	WP172			NFA	SCOU-1	Site is NFA (no action was required)
109-117	N-2 through N-10	SD137-SD181			NFA	SCOU-1	Site is NFA (no action was required)
118	PCB-1,2,3	SS022	M8	HWS-6	NFA	SCOU-1	Site is NFA (no action was required)
119	PCB-4	SS023	S11		NFA	SCOU-2	Site is NFA (E&D removal action completed)
120	PCB-5	SS024	R10		NFA	SCOU-2	Site is NFA (E&D removal action completed)
121	PCB-6	SS025	T11		NFA	SCOU-2	Site is NFA (no action was required)
122	PCB-7	SS026	L16		NFA	SCOU-1	Site is NFA (no action was required)
123	PCB-8	SS027	R11		NFA	SCOU-1	Site is NFA (no action was required)
124	PCB-9	SS048	N9		NFA	SCOU-1	Site is NFA (E&D removal action completed)
125	PFFA	SS033	S12	PFFA Group	PHO	SCOU-1	Non-CERCLA Site
126	SA-B1	SS162	T11	DA-3	NFA	SCOU-1	Site is NFA (no action was required)
127	SA-B2	SS163	T13	SA B Group	NFA	SCOU-1	Site is NFA (no action was required)
128	SA-B3	SS164	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
129	SA-B4	SS165	P12	SA B Group	NFA	SCOU-1	Site is NFA (no action was required)
130	SDS	SD045	BWS		NFA	SCOU-1	Site is NFA (no action was required)
131	SS-1	WP036	Q10		NFA	SCOU-1	Site is NFA (no action was required)
132	SS-2	WP037	Q10		SVE	SCOU-2	Site is NFA (SVE remedial action completed)
133	SS-3	WP038	Q12		NFA	SCOU-1	Site is NFA (no action was required)
134	SS-4	WP039	R12		SVE	SCOU-2	Site is NFA (SVE remedial action completed; B51/B54 Group)
135	SS-5	WP040	R13		NFA	SCOU-1	Site is NFA (no action was required)
136	SS-6	WP041	R13	DA-8; SS-7; B1550	NFA	SCOU-1	Site is NFA (SVE removal action completed)
137	SS-7	WP042	R13	B1550; DA-8; SS-6	NFA	SCOU-1	Site is NFA (SVE removal action completed)
138	SS-8	WP043	S12	PFFA	PHO	SCOU-1	Non-CERCLA Site
139	SS-9		Q11		NFA	SCOU-1	Site is NFA (no action was required)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
140	ST-1201		M8		NFA	SCOU-1	Site is NFA (no action was required)
141	ST-1206		M8	B1205	NFA	SCOU-1	Site is NFA (no action was required)
142	ST-1571	SS093	R14	SWMU 4.22	NFA	SCOU-1	Site is NFA (no action was required)
143	ST-55	SS055	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
144	STA-1	SS118	H8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
145	STA-2	SS119	H7	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
146	STA-3	SS120	H8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
147	STA-4	SS121	J7	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
148	STA-5	SS122	J8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
149	STA-6	SS123	J8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
150	STA-7	SS124	J8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
151	STA-8	SS125	J8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
152	STA-9	SS126	J9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
153	STA-10	SS127	J8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
154	STA-11	SS128	J9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
155	STA-12	SS129	K8	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
156	STA-13	SS130	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
157	STA-14	SS131	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
158	STA-15	SS132	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
159	STA-16	SS133	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
160	STA-17	SS134	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
161	STA-18	SS135	K9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
162	STA-19	SS136	K10	B1404	NFA	SCOU-1	Site is NFA (no action was required)
163	STA-20	SS137	L9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
164	STA-21	SS138	L9	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
165	STA-22	SS139	L10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
166	STA-23	SS140	L10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
167	STA-24	SS141	L10	FS-1	NFA	SCOU-1	Site is NFA (no action was required)
168	STA-25	SS142	L10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
169	STA-26	SS143	L10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
170	STA-27	SS144	M10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
171	STA-28	SS145	M11	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
172	STA-29	SS146	M10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
173	STA-30	SS147	M11	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
174	STA-31	SS148	M10	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
175	STA-32	SS149	M11	STA-11/41	NFA	SCOU-1	Site is NFA (no action was required)
176	STA-33	SS150	N11	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
177	STA-34	SS151	MB	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
178	STA-35	SS152	MB	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
179	STA-36	SS153	N10	B1325	Exclusion	SCOU-2	CERCLA Exclusion Site
180	STA-37	SS154	N10	B1325	Exclusion	SCOU-2	CERCLA Exclusion Site
181	STA-38	SS155	N10	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
182	STA-39	SS156	N12	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
183	STA-40	SS157	N12	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
184	STA-41	SS158	P12	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
185	STA-42	SS159	P12	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
186	STA-43	SS160	P13	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
187	STA-44	SS161	F8	STA-11/41	Exclusion	SCOU-2	CERCLA Exclusion Site
188	ST-T66	ST058	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
189	ST-T67	SS059	R12	B54 Group	SVE	SCOU-2	Site is NFA (SVE remedial action completed)
190	ST-T85	SS062	R11	B84	NFA	SCOU-1	Site is NFA (no action was required)
191	ST-T61/HWS-1	SS057	S12	ETC-4	PHO	SCOU-1	Non-CERCLA Site
192	SWMU 4.1	SD193	Q13	DA-5	NFA	SCOU-1	Site is NFA (no action was required)
193	SWMU 4.2	SD194	K8	HWS-4	NFA	SCOU-1	Site is NFA (no action was required)
194	SWMU 4.3	SD195	Q13	DA-5	E&D/BV	SCOU-2	Site is NFA (E&D remedial action completed; BV not necessary)
195	SWMU 4.4	SD196	S12	PFFA Group	E&D	SCOU-2	Site is NFA (E&D remedial action completed)
196	SWMU 4.5	SD197	S12	PFFA Group	NFA	SCOU-2	Site is NFA (E&D removal action completed)
197	SWMU 4.6	SD198	S12	ETC-5	E&D	SCOU-2	Site is NFA (E&D remedial action completed)
198	SWMU 4.7	SD199	P10	B175	NFA	SCOU-2	Site is NFA (E&D removal action completed)
199	SWMU 4.8	SD200	P10	B175	NFA	SCOU-2	Site is NFA (E&D removal action completed)
200	SWMU 4.9	SD201	R11	B325	NFA	SCOU-1	Site is NFA (no action was required)
201	SWMU 4.10	SD202	R11	B325	NFA	SCOU-1	Site is NFA (no action was required)
202	SWMU 4.11	SD203	R11	B325	NFA	SCOU-1	Site is NFA (no action was required)
203	SWMU 4.12	SD204	S12		NFA	SCOU-1	Site is NFA (no action was required)
204	SWMU 4.13	SD205	S12	PFFA Group	NFA	SCOU-1	Site is NFA (no action was required)
205	SWMU 4.14	SD206	S11	B551	NFA	SCOU-2	Site is NFA (E&D removal action completed)
206	SWMU 4.15	SD207	S12	PFFA Group	NFA	SCOU-2	Site is NFA (no action was required)
207	SWMU 4.16	SD208	S13		E&D	SCOU-2	Site is NFA (E&D remedial action completed)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion
208	SWMU 4.17	SD209	R12	B54 Group	NFA	SCOU-2	Site is NFA (no action was required)
209	SWMU 4.18	SD210	R12	B54 Group	NFA	SCOU-2	Site is NFA (no action was required)
210	SWMU 4.19	SD211	N10	B1324	NFA	SCOU-1	Site is NFA (no action was required)
211	SWMU 4.20	SD212	Q13	DA-5	NFA	SCOU-1	Site is NFA (no action was required)
212	SWMU 4.21	SD213	Q12	DA-5	E&D/BV	SCOU-2	Site is NFA (E&D remedial action completed; SVE/BV not necessary)
213	SWMU 4.22	SD214	R14	ST-1571	E&D	SCOU-2	Site is NFA (E&D remedial action completed)
214	SWMU 4.23	SD215	Q13	B1541	NFA	SCOU-2	Site is NFA (E&D removal action completed)
215	SWMU 4.24	SD216	Q8	B1182	NFA	SCOU-1	Site is NFA (no action was required)
216	SWMU 4.25	SD217	Q8	B84	NFA	SCOU-1	Site is NFA (no action was required)
217	SWMU 4.26	SD218	R12	B51 Group	NFA	SCOU-1	Site is NFA (no action was required)
218	SWMU 4.27	SD219	R12	B51 Group	NFA	SCOU-1	Site is NFA (no action was required)
219	SWMU 4.28	SD220	H14	DBF	NFA	SCOU-1	Site is NFA (no action was required)
220	SWMU 4.29	SD221	R12	B54 Group	NFA	SCOU-2	Site is NFA (no action was required)
221	SWMU 4.30	SD222	R12	B51 Group	NFA	SCOU-1	Site is NFA (no action was required)
222	SWMU 4.31	SD223	Q12	B1350	NFA	SCOU-1	Site is NFA (no action was required)
223	SWMU 4.32	SD224	R12	B1532	NFA	SCOU-1	Site is NFA (no action was required)
224	SWMU 4.33	SD225	R13	DA-8	NFA	SCOU-1	Site is NFA (no action was required)
225	SWMU 4.34	SD226	L9	B1319	NFA	SCOU-1	Site is NFA (no action was required)
226	SWMU 4.35	SD227	R11	B325	NFA	SCOU-1	Site is NFA (no action was required)
227	SWMU 4.36	SD228	N10	B1324	NFA	SCOU-1	Site is NFA (no action was required)
228	SWMU 4.37	SD229	BWS	IWL	NFA	SCOU-1	Site is NFA (no action was required)
229	SWMU 4.38	SD230	Q13	DA-5	NFA	SCOU-1	Site is NFA (no action was required)
230	UFL-1	SS020	R10	H-4	PHO	SCOU-1	Non-CERCLA Site
231	UFL-2	SS021	R12		PHO	SCOU-1	Non-CERCLA Site
232	UFL-3	SS046	P11		PHO	SCOU-1	Non-CERCLA Site
233	UFL-4	SS047	N11		NFA	SCOU-1	Site is NFA (no action was required)

Table 1-1
SCOU Sites and Rationale for Exclusion from Technical Evaluation
(Bold Sites Included in Technical Evaluation)

	Site	IRP Number	Grid Location	Linked Sites or Group	Selected Remedy or Preferred Alternative	ROD	Rationale for Exclusion

Notes

The terminology "Non-CERCLA Site" is applied to petroleum hydrocarbon-contaminated sites which are not covered under CERCLA, but are addressed under state regulations. The terminology "CERCLA Exclusion Site" is applied to certain runway stain sites (those not previously designated NFA), as contamination from aircraft engine exhaust is specifically excluded from consideration under CERCLA.
The East Base, North Base, LF-4 and LF-1 groundwater remedies are complete and unrestricted use and unlimited exposure was achieved.

BV	bioventing
C&C	consolidation and capping
CB	comprehensive basewide
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
E&D	excavation and disposal
IC	institutional controls
LTM	long-term maintenance and monitoring
LTEM	long-term ecological monitoring
NFA	no further action
PHO	petroleum hydrocarbon only
ROD	record of decision
SCOU	source control operable unit
SVE	soil vapor extraction

Sites

B	Building	HWS	Hazardous Waste Storage Area
HWS	Hazardous Waste Storage Area	IWL	Industrial Waste Line
CVLFA	Castle Vista Landfill A	JP	Jet Propulsion
CVLFB	Castle Vista Landfill B	LF	Landfill
DA	Disposal Area	PCB	Polychlorinated Biphenyls
DBF	Detonation and Burn Facility	PFFA	Petroleum Fuel Farm Area
DP	Disposal Pit	SA	Storage Area
ETC	Earth Technology Corporation Site	SDS	Storm Drain System
F	Aircraft Maintenance Hangar	SS	Sanitary Sewer
FR	Firing Range	ST	Structure
FS	Fuel Spill	STA	Stain
FTA	Fire Training Area	SWMU	Solid Waste Management Unit
H	Gasoline Station	UFL	Underground Fuel Leak

Site Groups

B54	B54, B1260, B1266, ETC-5, SA-B3, ST-55, ST-T66, ST-T67, SWMU 4.17, SWMU 4.18, SWMU 4.29
B51	B51, B52, B53, B1253, SWMU 4.26, SWMU 4.27, SWMU 4.30
PFFA	B59, B79, B508, B909, B917, DA-7, PFFA, SWMU 4.4, SWMU 4.5, SWMU 4.13, SWMU 4.15

Table 2-1
Chronology of Site Events

Date	Action/Event/Document	Comments/Reference
1978	First evidence of TCE contamination in groundwater	
1981-1986	IRP field investigations	
March 1984	RWQCB issues Cleanup and Abatement Order Number 84-027	
August 1984	New base water-supply well installed (PW10)	
August 1987	Base listed on EPA NPL	
May 1988	Second new base water-supply well installed (PW12)	
1988-1994	Series of groundwater field investigations, culminating in the CB RI–Part 1	
1989	Base water-supply line extended along Wallace Road to provide potable water to three residences near the base boundary	
July 1989	Castle Air Force Base Federal Facility Agreement signed by the Air Force, EPA and the California Environmental Protection Agency	
1991-1995	DA-4 groundwater removal action system operation	
August 1991	OU-1 Interim ROD	USAF, 1991
1991-1996	Wallace Road groundwater removal action system operation	
1993-1994	B84 groundwater removal action system operation	
January 1993	Start of quarterly groundwater sampling under the LTGSP	
March 1993	OU-1 groundwater treatment plant–start construction (basis for five-year review schedule)	
May 1993	SCOU Work Plan/Sampling and Analysis Plan	Jacobs, 1993a
1993-1996	SCOU RI field investigations	
August 1993	CB Work Plan/Sampling and Analysis Plan	Jacobs, 1993b
1993-1994	CB RI field investigations	
December 1993	OU-2 ROD	USAF, 1993
July 1994	OU-1 groundwater treatment plant - start operation	
1995-date	Wellhead treatment at selected domestic wells downgradient of base (install at ½ MCL; remove after three events <PQL)	
Sept. 1995 - Oct. 1996	B871 Removal Action	
Sept. 1995	Start of DA-4 Removal Action (SVE and E&D)	
Sept. 1995	Start of FTA-1 Removal Action (capping and SVE)	
June 1996	CB RI/FS–Part 1	Jacobs, 1996
June 1996	CB Proposed Plan –Part 1	USAF, 1996
Oct. 1996 - July 1999	ETC-10 Removal Action (E&D)	Jacobs, 1999b
November 1996	OU-2 groundwater treatment plant - start operation	
January 1997	CB ROD–Part 1	USAF, 1997
Jan. 1997 - Aug. 1998	DA-8 Removal Action	
May 1997	SCOU RI/FS	Jacobs, 1997a
August 1997	SCOU Proposed Plan	WPI, 1997
September 1997	Phase 2 groundwater treatment plant - start operation	

Table 2-1
Chronology of Site Events

Date	Action/Event/Document	Comments/Reference
Sept. 1997 - May 1999	CVLF-A Removal Action	
Sept. 1997 - May 1999	LF-2 Removal Action	
Sept. 1997 - Sept. 2000	CVLF-B Removal Action	
Sept. 1997 - May 2003	LF-4 Removal Action (removal action completed in September 1999; final closure report in May 2003; additional remedy of LTM and ICs recommended for SCOU ROD Part 3)	Jacobs, 2003b
October 1997	Castle Vista groundwater treatment plant - start operation	
Feb. 1998 - Sept. 1998	PCB-9 Removal Action	
Oct. 1998 - Aug. 2000	LF-1 Removal Action	
Oct. 1998 - Aug. 2000	LF-3 Removal Action	Jacobs, 2000a
Oct. 1998 - May 2003	LF-5 Removal Action (removal action completed in September 1999; final closure report in May 2003; additional remedy of LTM and ICs recommended for SCOU ROD Part 3)	Jacobs, 2003b
November 1998	Initial Five-Year Review for Castle Airport	Jacobs, 1998a
July 1999	SCOU Data Gap Investigation Report	Jacobs, 1999a
Aug. 1999 - Aug 2000	FR Removal Action	
May 2000	Phase 3 groundwater treatment plant (expansion of the Phase 2 plant) - start operation	
May 2000 - Dec. 2000	B1344 Removal Action	
May 2000 - Dec. 2000	DA-3 Removal Action	
May 2000 - Dec. 2000	ETC-2 Removal Action	
May 2000 - Dec. 2000	ETC-8 Removal Action (initial)	
Nov. 2000	B1709 SVE Decision Study (START process)	
Nov. 2000	F-4 SVE Decision Study (START process)	
Nov. 2000	SS-2 SVE Decision Study (START process)	
January 2001	MW883 wellhead treatment system (solar wagon) - start operation	
February 2001	SCOU Revised Proposed Plan	Earth Tech, 2001
March 2001	Landfill 1 Plume monitoring terminated	
May 2001	B51/B54 Group Removal Action (start SVE operation)	
June 2001	B1350 Removal Action (start SVE operation)	
June 2001	B1762 Removal Action (start SVE operation)	
June 2001	DA-5 Removal Action (start SVE operation)	
July 2001	MW951 wellhead treatment system - start operation	
January 2002	MW1009 wellhead treatment system - start operation	
January 2002	MW883 wellhead treatment system (solar wagon) shut down	
April 2002	FTA-1 Focused Feasibility Study (non-VOC remedy of capping, LTM and ICs recommended for SCOU ROD Part 3)	Jacobs, 2002a
June 2002	MW941 wellhead treatment system (solar wagon) - start operation	
August 2002	MW883/MW1021 wellhead treatment system - start operation	
August 2002	MW824 wellhead treatment system - start operation	

Table 2-1
Chronology of Site Events

Date	Action/Event/Document	Comments/Reference
September 2002	SCOU ROD Part 1	WPI, 2002
December 2002	PCB-4 Removal Action (excavation and disposal)	
December 2002	PCB-5 Removal Action (excavation and disposal)	
December 2002	CB RI/FS–Part 2	Jacobs, 2002b
May 2003	SCOU ROD Part 2	Earth Tech, 2003a
May 2003	OU-1 groundwater treatment plant shut down	
August 2003	Castle Vista groundwater treatment plant shut down	
August 2003	MW003 wellhead treatment system - start operation	
September 2003 (1)	Hangar F-4 SVE pilot test complete; final closure report issued and approved	Earth Tech, 2003b
October 2003 (1)	B1709 SVE Removal/Remedial Action complete; final closure report issued and approved	Earth Tech, 2003c
October 2003 (1)	B1762 SVE Removal/Remedial Action complete; final closure report issued and approved	Earth Tech, 2003d
December 2003 (1)	CB Proposed Plan – Part 2	Jacobs, 2003a
December 2003 (1)	East Base Plume monitoring terminated	
January 2004	Second Five-Year Review for Castle Airport	Jacobs, 2004a
Site Events Since Second Five-Year Review		
March 2004	OPS determination for the Main Base Plume, Castle Vista Plume, Landfill 1 Plume, Landfill 4 Plume, B51/B54 Group, B1350, DA-5 and LF-4 (EPA milestone)	Jacobs, 2004e
May 2004	MW941 wellhead treatment system (solar wagon) shut down	
May 2004	SWMUs 4.16, 4.22, 4.4 and 4.6 Remedial Actions complete (all risk-based closures; no additional E&D); final closure report issued and approved	Jacobs, 2004b
October 2004	MW883/MW1021 wellhead treatment system shut down	
October 2004	SS-2 SVE Remedial Action complete; final closure report issued and approved	Earth Tech, 2004
October 2004	B1350 SVE Removal/Remedial Action complete; final closure report issued and approved	MWH, 2004a
March 2005	FTA-1 ecological soil E&D completed and approved	MWH, 2005a
June 2005	MW1037 added to the MW824 wellhead treatment system	
June 2005	SCOU ROD Part 3 (presented remedies for LF-4/DP-5/DP-6 [ICs and LTM]; LF-5/DP-8/DP-8A; Landfill 5 Trenches [ICs, LTM, and LTEM]; DP-9 [NFA]; ETC-8 [E&D]; ETC-10 [ICs and LTEM]; FTA-1 [SVE, BV, E&D, ICs, LTM, and LTEM); ETC-12 [LTEM]; and LF-3 [LTEM] Selected remedy for ecological risk at all SCOU sites other than those listed above (total of 225 sites) was NFA	Jacobs, 2005a
November 2005	DA-4/B1314 SVE and E&D Removal/Remedial Action complete; final closure report issued and approved	Earth Tech, 2005
June 2006	B51/B54 Group SVE Removal/Remedial Action complete; final closure report issued and approved (includes sites B51; B52; B53; B54; B1253; B1260; B1266; ETC-5; SA-B3; ST-55; ST-T66; ST-T67; SS-4)	MWH, 2006a

Table 2-1
Chronology of Site Events

Date	Action/Event/Document	Comments/Reference
June 2006	CB ROD–Part 2 (summarized previous RODs, updated groundwater remedy to incorporate wellhead treatment where plume capture impractical and established groundwater use restrictions (ICs) for parcels overlying MCL plumes	AFRPA, 2006a
April 2006	ETC-8 E&D Remedial Action complete; final closure report issued and approved	Jacobs, 2006a
September 2006	DA-5 SVE Removal/Remedial Action complete (E&D and BV not required); final closure report issued and approved (includes sites B1529 and SWMUs 4.1, 4.20, 4.21, 4.3 and 4.38)	MWH, 2006b
September 2006	SWMUs 4.3 and 4.21 E&D Remedial Action complete (BV not required); final closure report issued and approved (SWMUs associated with DA-5 – see above listing)	MWH, 2006c
September 2006	Basewide Construction Complete (EPA milestone)	
October 2006	MW824/MW1037 wellhead treatment system taken offline due to declining water levels	
December 2006	Landfill 4 Plume monitoring terminated	Jacobs, 2007a
December 2006	Castle Airport property transfer to Merced County complete on 19 December	
May 2007	FTA-1 SVE and E&D Removal/Remedial Action complete (BV not required); final closure report issued and approved	MWH, 2007a
November 2007	Sitewide Ready for Anticipated Use (EPA milestone)	
December 2007	North Base Plume monitoring terminated	Jacobs, 2008
February 2008	MW1009 wellhead treatment system taken offline for rebound evaluation	
February 2008	First five-year ecological monitoring for vernal pool invertebrates (fairy shrimp) completed	
April 2008	First five-year ecological monitoring for vernal pool flora completed	
January 2009	Third Five-Year Review for Castle Airport	Jacobs, 2009a
	Site Events Since Third Five-Year Review	
2009	Groundwater sampling for 1.4-dioxane	Jacobs, 2009d
October 2009	OU-2 treatment system shut down for rebound study	
August 2010	Castle Vista wellhead system shut down for rebound study	CH2M HILL, 2010c
September 2010	Monthly sampling of treatment system influents eliminated	CH2M HILL, 2010d
2010	LF-4 and LF-5 replacement well (MW1048 and MW1049) installation	CH2M Hill, 2011c
December 2010	OU-2 treatment system restarted, following one-year rebound study	CH2M HILL, 2012a
March 2011	Department of Toxic Substances Control approval of request for reduction in sampling frequency for landfill gas perimeter wells and landfill cap gas vents at LF-4 and LF-5	
April 2011	Restart/shutdown of Castle Vista wellhead treatment system	
July 2000	OU-1 GWTP Decommissioning	
October 2011	Revised Draft Closure and Post-Closure Maintenance Plan Update 3 submitted for LF-4 and LF-5	CH2M HILL, 2012a

Table 2-1
Chronology of Site Events

Date	Action/Event/Document	Comments/Reference

Notes

(1) Although these actions/reports/documents were finalized before the second five-year review was complete (final report issued), they were not available or noted as final in the second five-year review report because of the document preparation process.

Dates for removal actions are from publication of the final action memorandum to publication of the final closure report.

AFRPA	Air Force Real Property Agency	MCL	maximum contaminant level
B#	Building #	NPL	National Priority List
BV	bioventing	OPS	operating properly and successfully
CB	Comprehensive Basewide	OU	operable unit
CVLF- #	Castle Vista Landfill - #	PCB- #	Polychlorinated Biphenyl - #
DA- #	Discharge Area - #	PQL	practical quantitation limit
DP- #	Disposal Pit - #	PW	production well
E&D	excavation and disposal	RI	remedial investigation
EPA	U.S. Environmental Protection Agency	RI/FS	remedial investigation/feasibility study
ETC- #	Earth Technology Corporation - #	ROD	Record of Decision
FR	Firing Range	RWQCB	California Regional Water Quality Control Board
F- #	Aircraft Hanger F- #	SA- #	Storage Area - #
FTA- #	Fire Training Area - #	SCOU	Source Control Operable Unit
IC	institutional controls	SS- #	Sanitary Sewer - #
IRP	Installation Restoration Program	ST- #	Structure - #
LF- #	Landfill- #	START	SVE Turn On and Remediation Test
LTEM	long-term ecological monitoring	SVE	soil vapor extraction
LTGSP	Long-Term Groundwater Sampling Program	SWMU	Solid Waste Management Unit
LTM	long-term (cap) maintenance and monitoring	TCE	trichloroethene

Table 4-1
Treated Groundwater Discharge Standards

	Standards for Discharge[1]	
Constituent	**30-Day Median (µg/L)**	**Daily Maximum (µg/L)**
Acetone	1	-
Benzene	0.5	1
Bromoform	0.5	1
Carbon tetrachloride	0.5	0.5
Chloroethane	0.5	1
Chloroform	0.5	1
Chloromethane	0.5	1
Chlorobenzene	0.5	1
Dibromochloropropane	0.35	5
Di(2-ethylhexyl)phthalate	0.5	1
Dichlorobenzene (ortho)	0.5	1
Dichlorobenzene (para)	0.5	1
Dichlorodifluoromethane	0.5	1
1,1-DCE	0.5	1
1,2-DCE (*cis*)	0.5	1
1,2-DCE (*trans*)	0.5	1
1,1-DCA	0.5	1
1,2-DCA	0.5	0.5
1,2-dichloropropane	0.5	1
Ethylbenzene	0.5	29
Ethylene dibromide	0.14	0.5
Methylene chloride	0.5	1
Tetrachloroethene	0.5	1
Toluene	0.5	42
Trichlorofluoromethane	0.54	1
Trichloroethene	0.5	1
Volatile Organic Compounds[3]	1	5
Xylenes (total)	0.5	17
TPH (gas)	50	50
TPH (diesel)	50	100
Iron	-	300[2]
Manganese	-	50[2]
Nitrates	-	10 mg/L as Nitrogen[2]
Other constituents	All other constituents must be within background concentrations in the receiving water at the point of discharge. If this is not technically feasible, discharge standards may be established.	

Notes

1 For discharge into the contaminated regions of an aquifer, in lieu of the standards in this table, treated water cannot be discharged at concentrations that exceed the specified aquifer clean-up level or the actual concentrations in the aquifer at the point of discharge, whichever is lower. For constituents where no aquifer clean-up level has been specified, treated water cannot be discharged at constituent concentrations that exceed those of the receiving water.

2 Or 95 percent upper threshold limit background at point of discharge, if higher.

3 Cumulative limit for all volatile organic compounds.

General Note: All contaminants of concern will be included in routine long-term groundwater monitoring; other constituents will be sampled according to the approved Long-Term Groundwater Sampling Program sampling plan.

Source: United States Air Force, 1997. Final Record of Decision for Comprehensive Basewide – Part 1, Castle Air Force Base, Merced County, California, as modified by memorandum of non-significant changes to record of decision, 9 December 1997.

µg/L micrograms per liter
mg/L milligrams per liter
TPH total petroleum hydrocarbons

TABLE 7-1. Technical Assessment

<table>
<tr><th colspan="2">Groundwater Operable Unit - Main Base</th></tr>
<tr><td>Question A: Is the remedy functioning as intended by the decision documents?
a. Are or will performance standards be met?
b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk?
c. Are access and/or institutional controls needed to prevent exposure in place?
d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks?
e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?</td><td>Based on a review of factors presented in Section 7.1.1, the remedy is functioning as intended by the decision documents for the Main Base Plume.
a. Yes
b. No
c. Yes
d. Yes
e. Yes</td></tr>
<tr><td>Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy?
b. Are there changes in land use or the anticipated land use on or near the site?
c. Have new human health or ecological exposure pathways or receptors been identified?
d. Have new contaminants or contaminant sources been identified?
e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents?
f. Are there changes in the physical site condition?
g. Are there changes in the toxicity factors for contaminants of concern?</td><td>Based on a review of factors presented in Section 7.1.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for the Main Base Plume.
a. No
b. No
c. No
d. No
e. No
f. No
g. Yes, however the section establishes that the current remedy is protective.</td></tr>
<tr><td>Question C: Has any other information come to light that could call into question the protectiveness of the remedy?
a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action?
b. Has the site been subject to natural disasters?</td><td>Based on information provided in this Review Report and a review of recent LTGSP annual and semiannual reports, no data or other information are identified that could call into question the protectiveness of the remedy for the Main Base Plume.
a. Yes
b. No</td></tr>
<tr><th colspan="2">Groundwater Operable Unit - Castle Vista</th></tr>
<tr><td>Question A: Is the remedy functioning as intended by the decision documents?
a. Are or will performance standards be met?
b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk?
c. Are access and/or institutional controls needed to prevent exposure in place?
d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks?
e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?</td><td>Based on a review of factors presented in Section 7.2.1, the remedy is functioning as intended by the decision documents for the Castle Vista Plume.
a. Yes
b. No
c. Yes
d. Yes
e. Yes</td></tr>
</table>

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.2.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for the Castle Vista Plume. a. No b. No c. No d. No e. No f. No g. Yes, however the section establishes that the current remedy is protective.
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report and a review of recent LTGSP annual and semiannual reports, no data or other information are identified that could call into question the protectiveness of the remedy for the Castle Vista Plume. a. Yes b. No
Source Control Operable Unit - ETC-10	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.3.1, the remedy is functioning as intended by the decision documents for ETC-10. a. Yes b. No c. Yes d. Yes e. Not applicable

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.3.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for ETC-10. a. Yes, however the section establishes that the current remedy is protective. b. No c. No d. No e. No f. No g. Yes, however the section establishes that the current remedy is protective.
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for ETC-10. a. Yes b. No
Source Control Operable Unit - ETC-12	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.4.1, the remedy is functioning as intended by the decision documents for ETC-12. a. Yes b. No c. Yes d. Yes e. Not applicable

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.4.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for ETC-12. a. No b. No c. No d. No e. No f. No g. No
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for ETC-12. a. Yes b. No
Source Control Operable Unit - FTA-1	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.5.1, the remedy is functioning as intended by the decision documents for FTA-1. a. Yes b. No c. Yes d. Yes e. Yes

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.5.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for FTA-1. a. Yes, however the section establishes that the current remedy is protective. b. No c. No d. No e. No f. No g. Yes, however the section establishes that the current remedy is protective.
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Due to historical fire training activities at FTA-1, the area may have been impacted by the use of PFCs used in fire-fighting foams. The Air Force is taking a programmatic approach at BRAC facilities with regard to potential emerging chemical contamination associated with PFCs. This Air Force-wide initiative will evaluate candidate sites for the potential presence of PFC compounds. FTA-1 is included in the Air Force assessment of such sites for PFCs. The Air Force initiative will include sampling at the selected sites to determine if PFCs are present. After the Air Force investigation is complete, the protectiveness of the remedy should be re-evaluated in the next Five-Year Review. Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the annual IC evaluations, the recent site inspection, and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for FTA-1. a. Yes b. No

TABLE 7-1. Technical Assessment

Source Control Operable Unit - LF-3	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.6.1, the remedy is functioning as intended by the decision documents for LF-3. a. Yes b. No c. Yes d. Yes e. Not applicable
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.6.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-3. a. Yes, however the section establishes that the current remedy is protective. b. No c. No d. No e. No f. No g. Yes, however the section establishes that the current remedy is protective.
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report, including the results of the recent site inspection and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for LF-3. a. Yes b. No
Source Control Operable Unit - LF-4	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.7.1, the remedy is functioning as intended by the decision documents for LF-4. a. Yes b. No c. Yes d. Yes e. Yes

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.7.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-4. a. Yes, however the section establishes that the current remedy is protective. b. No c. No d. No e. No f. No g. Yes, however the section establishes that the current remedy is protective.
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the post-closure groundwater monitoring program, the annual IC evaluations, and the recent site inspection, no data or other information are identified that could call into question the protectiveness of the remedy for LF-4. a. Yes b. No
Source Control Operable Unit - LF-5	
Question A: Is the remedy functioning as intended by the decision documents? a. Are or will performance standards be met? b. Are there problems with the remedy that could ultimately lead to the remedy not being protective or suggest protectiveness is at risk? c. Are access and/or institutional controls needed to prevent exposure in place? d. Have necessary actions been implemented to ensure there are no exposure pathways that could result in unacceptable risks? e. Will maintenance activities, as implemented, maintain the effectiveness of response actions?	Based on a review of factors presented in Section 7.8.1, the remedy is functioning as intended by the decision documents for LF-5. a. Yes b. No c. Yes d. Yes e. Yes

TABLE 7-1. Technical Assessment

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid? a. Are there changes in ARARs identified in the ROD, newly promulgated standards, and/or changes in TBCs identified in the ROD, that could call into question the protectiveness of the remedy? b. Are there changes in land use or the anticipated land use on or near the site? c. Have new human health or ecological exposure pathways or receptors been identified? d. Have new contaminants or contaminant sources been identified? e. Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents? f. Are there changes in the physical site condition? g. Are there changes in the toxicity factors for contaminants of concern?	Based on a review of factors presented in Section 7.8.2, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for LF-5. a. No b. No c. No d. No e. No f. No g. No
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? a. Have ecological risks been adequately addressed at the site, and/or is there a plan to address them through a future action? b. Has the site been subject to natural disasters?	Based on information provided in this Review Report, including the results of the cap maintenance and monitoring program, the post-closure groundwater monitoring program, the annual IC evaluations, the recent site inspection, and the ecological monitoring program, no data or other information are identified that could call into question the protectiveness of the remedy for LF-5. a. Yes b. No

TABLE 8-1. Issues

Issues	Affects Protectiveness (Y/N)	
	Current	**Future**
1: Groundwater OU - Main Base - Capture of the northeast base plume area in the Shallow HSZ by the MW824/MW1037 wellhead treatment system. Capture of this portion of the plume is unlikely unless water levels rise such that pumping from the Shallow HSZ can resume.	N	N
2: Groundwater OU - Main Base - Declining regional water levels have resulted in monitoring wells going dry.	N	N
3: Groundwater OU - Main Base – TCE rebound concentrations in the OU-2 area are higher and the rebound duration longer than anticipated when the rebound study was initiated in 2009.	N	N
4: Groundwater OU - Castle Vista - Effectiveness of treatment system in attaining the remedial objective for the residual *cis*-1,2-DCE plume.	N	N
5: Source Control OU - ETC-10 - Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.	N	N
6: Source Control OU - ETC-12 - Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.	N	N
7: Source Control OU - FTA-1 - Ground water monitoring well MW886 is dry and groundwater monitoring cannot be conducted at FTA-1.	N	N
8: Source Control OU - FTA-1 - Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.	N	N
9: Source Control OU - FTA-1 – Due to historical fire training activities, the area may have been impacted by the use of PFCs used in fire-fighting foam.	N	N
10: Source Control OU - LF-3 - Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.	N	N
11: Source Control OU - LF-4 - Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.	N	N
12: Source Control OU - LF-5 - Ground water monitoring wells are going dry, impacting the ability to perform the landfill groundwater detection monitoring program.	N	N
13: Source Control OU - LF-5 - Despite plans to conduct LTEM first in 2012 and then in 2013, there were insufficient conditions due to low rainfall. The five-year frequency of LTEM specified in the SCOU ROD Part 3 was not achieved. The 2008 LTEM survey concluded that there were no identifiable effects.	N	N

TABLE 9-1. Recommendations and Follow-up Actions

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness (Y/N)	
				Current	Future
1: Groundwater OU - Main Base - The treatment system was shutdown in 2006 when water levels decreased such that pumping could not be sustained. Since 2006, the system has remained off line with regulatory agency concurrence and associated monitoring wells have been monitored in accordance with recommendations established in the annual LTGSP Reports (2007-2012). While the NEBP is not captured, monitoring results establish that the remaining NEBP area is very small, the contaminant concentrations have not indicated an increasing trend, and the limited area and concentrations of groundwater contamination have not migrated. Monitoring of the limited wells that are just above the MCL is appropriate and recommended until MCLs are achieved provided the contaminant concentrations do not show an increasing trend or the plume area does not migrate. Should monitoring under the LTGSP indicate an increasing contaminant trend or plume migration, the AF in consultation with the regulatory agencies, should evaluate if other action is warranted.	Air Force	EPA/State	Ongoing	N	N
2: Groundwater OU - Main Base - Each annual report contains an evaluation of dry wells to determine if they should be replaced. This evaluation process appears successful as evidenced by, development, approval, and implementation of work plans to replace dry wells at CAFB in 2013. It is recommended that this issue continue to be monitored and evaluated under the LTGSP.	Air Force	EPA/State	Ongoing	N	N
3: Groundwater OU - Main Base – to improve and confirm plume capture and plume reduction, specifically, a) improve plume capture and contaminant mass removal by adding an extraction well from the existing well network (most likely a conversion of MW-948 to an extraction well), and b) confirm hydraulic control by installing a LSS monitoring well in the area of MW804A.	Air Force	EPA/State	Summer 2014	N	N

TABLE 9-1. Recommendations and Follow-up Actions

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness (Y/N)	
				Current	Future
4: Groundwater OU - Castle Vista - It is recommended that the regulatory approved rebound study continue to be implemented to address recalcitrant contamination in the residual cis-1,2-DCE plume. This includes operation of the wellhead treatment system, as necessary, in consultation with the regulatory agencies. However, it is recommended that the cis-1,2-DCE cleanup level of 6 µg/L be evaluated in light of California's updated Public Health Goal of 100 µg/L and EPA's updated Regional Screening Level of 28 µg/L.	Air Force	EPA/State	Ongoing (rebound study); Winter 2015 (cleanup level evaluation)	N	N
5: Source Control OU - ETC-10 - It is recommended that LTEM occur during the next year that sufficient rainfall occurs.	Air Force	EPA/State	Winter 2014 or as soon as weather permits	N	N
6: Source Control OU - ETC-12 - It is recommended that LTEM occur during the next year that sufficient rainfall occurs.	Air Force	EPA/State	Winter 2014 or as soon as weather permits	N	N
7: Source Control OU - FTA-1 - In August 2013, one groundwater well (MW1054) was installed approximately 100 feet downgradient of dry well MW886, and one groundwater well (MW1055) was installed adjacent to the FTA-1 cap. The location of MW1054 was selected as the nearest location downgradient of MW886 that is outside the Vernal Pool Preservation Area. A new well could not be drilled adjacent to MW886 because this well is located within a recently identified wetland. The location of MW1055 was selected to be closer to the FTA-1 cap and within the assumed boundary of the last known TCE MCL plume. Further details are presented in the *Final Fire Training Area 1 Well Installation Work Plan* (CH2M HILL, 2012c). It is recommended that monitoring continue under the LTGSP to determine if TCE at levels exceeding the MCL remain at FTA-1.	Air Force	EPA/State	Ongoing	N	N

TABLE 9-1. Recommendations and Follow-up Actions

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness (Y/N)	
				Current	Future
8: Source Control OU - FTA-1 - It is recommended that LTEM occur during the next year that sufficient rainfall occurs.	Air Force	EPA/State	Winter 2014 or as soon as weather permits	N	N
9: Source Control OU - FTA-1 – There is the potential for PFCs to be present at the site due to historical fire training activities. It is recommended that the Air Force perform their programmatic review to determine if PFCs are present at FTA-1.	Air Force	EPA/State	TBD	N	N
10: Source Control OU - LF-3 - It is recommended that LTEM occur during the next year that sufficient rainfall occurs.	Air Force	EPA/State	Winter 2014 or as soon as weather permits	N	N
11: Source Control OU - LF-4 - In August 2013, one groundwater well (MW1053) was installed to replace dry well MW888. Further details are presented in the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). Downgradient detection compliance monitoring well MW847 became dry during 2012, it was previously dry only on a seasonal basis (only during Q4; CH2M HILL, 2013b). It is recommended to continue the landfill groundwater monitoring program to evaluate the newly installed well and monitor groundwater concentrations and flow directions prior to determining an appropriate location for the MW847 replacement well.	Air Force	EPA/State	Summer 2014	N	N
12: Source Control OU - LF-5 - In August 2013, one groundwater well (MW1050) was installed to replace dry well MW360, and detection compliance monitoring wells MW1051 and MW1052 were installed to replace dry wells MW1004 and MW1005, respectively. Further details are presented in the *Final Landfill 4 and Landfill 5 Well Installation Work Plan* (CH2M HILL, 2012b). It is recommended to continue the landfill groundwater monitoring program to evaluate the newly installed wells.	Air Force	EPA/State	Ongoing	N	N

TABLE 9-1. Recommendations and Follow-up Actions

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-Up Action: Affects Protectiveness (Y/N)	
				Current	Future
13: Source Control OU - LF-5 - It is recommended that LTEM occur during the next year that sufficient rainfall occurs.	Air Force	EPA/State	Winter 2014 or as soon as weather permits	N	N

APPENDIX A

RESPONSES TO AGENCY COMMENTS

COMMENTS ON THE DRAFT FINAL FIVE-YEAR REVIEW

RESPONSES TO COMMENTS ON THE DRAFT FINAL FIVE-YEAR REVIEW, FOURTH FIVE-YEAR REVIEW REPORT, FORMER CASTLE AIR FORCE BASE, CALIFORNIA

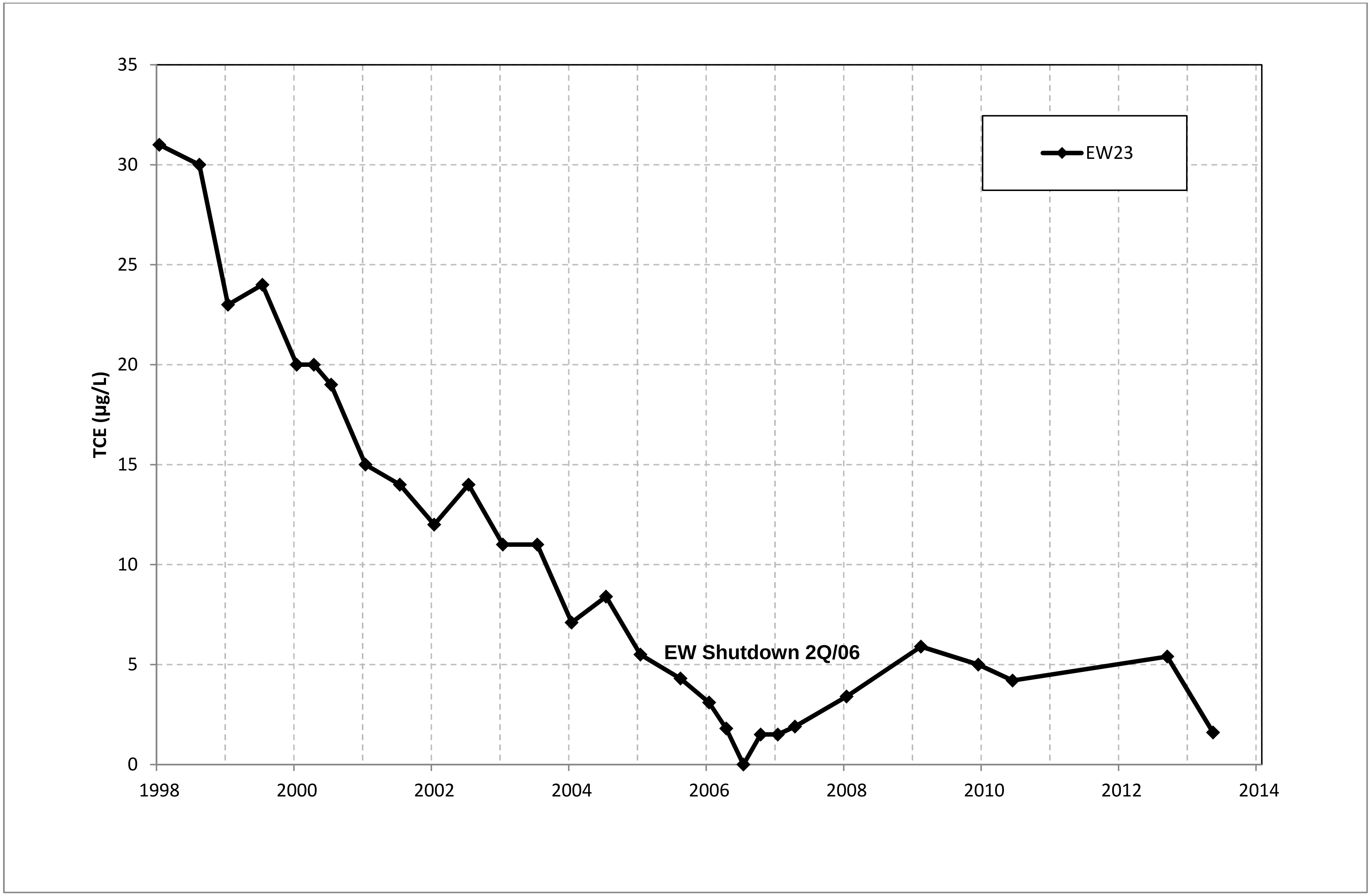
Comment Number	Section	Comment	Response
COMBINED US EPA AND STATE OF CALIFORNIA COMMENTS (DATED 24 FEBRUARY 2014)			
General Comments			
1	Section 7 Technical Assessment, Section 7.1 Main Base Plume, Section 7.1.1 Question A, Section 7.1.1.1.4 CB ROD-Part 2 Remedies, Appendix A Response to Comments Responses to Agency Comments on the Draft, Appendix A General Comment 3 and Specific Comment Numbers 7 and 8	The AF responses and revisions to the FYR partially address EPA's concern regarding the Main Base Plume Capture evaluation in Section 7, Technical Assessment. The agency's concern regarding the delineation of the TCE plume and capture at depth are not addressed. Section 7.1.1.1 Plume Capture describes the status of capture for the various Hydrostratigraphic Zones, both on and off-base, and is supplemented by Figures 7-6 through 7-9. The report does not state that capture is complete for the Confined Hydrostratigraphic Zone (HSZ), and Figure 7-9 does not display an estimated zone of capture at the 5 µg/L TCE isoconcentration contour, near MW 606.	The 5 µg/L isoconcentration contour for the on-base Confined Hydrostratigraphic Zone (HSZ) shown on Figure 7-9 is based on data for EW23 which is collocated with MW606. Based on data through 4Q2012, EW23 (5.4 µg/L) was the only on-base well that exceeded the MCL for TCE in the Confined HSZ. MW606 had no monitoring objective so it was removed from the LTGSP in 3Q1999 (see LTGSP reports). EW23 was shut off in 2Q2006 with agency approval after three consecutive sampling events with TCE concentrations below the MCL and has since been monitored and evaluated for restart in the LTGSP reports. The 2Q2013 analytical result for TCE was 1.6 µg/L. As stated in 2012 Annual LTGSP report, results have not warranted EW23 restart (see response to EPA General Comment 6 on the 2012 Annual Report, shutdown and restart criteria are discussed in the comment response). Since shutdown, TCE has not been sustained above the MCL and the maximum result since EW23 was turned off was 5.9 µg/L in 1Q09. Time series data for EW23 is attached. The following text has been added to the last paragraph of Section 7.1.1.1.1: "As of Q4/12, EW23 is the only location that exceeded the MCL in the on-base Confined HSZ. EW23 was shut off in Q2/06 with agency approval after three consecutive sampling events with TCE concentrations below the MCL and has since been monitored and evaluated for restart in the LTGSP reports. Since shutdown, TCE has not been sustained above the MCL and the maximum result since EW23 was turned off was 5.9 µg/L in Q1/09. The Q2/13 analytical result for TCE was 1.6 µg/L such that there currently is no on-base Confined HSZ plume that exceeds the TCE MCL. As stated in the 2012 Annual LTGSP report (CH2M HILL, 2013a), monitoring results since shutdown have not warranted EW23 restart. Monitoring and evaluation of EW23 and the on-base Confined HSZ continues under the LTGSP."

Comment Number	Section	Comment	Response
1 (cont'd)		Regarding the off-base plume that requires well head treatment to address groundwater contamination exceeding MCLs within the Confined HSZ, the report indicates that MW951 is capturing a portion of the off-Base plume segment, however does not clearly state whether all of the wells above MCLs are being satisfactorily addressed by wellhead treatment. Based on Figure 7-9, it appears that MW1008 is above MCLs, but not influenced by capture. The text on Page 7-10 does not mention the TCE levels for this well. While capture is not required, the report should confirm that the wellhead treatment objectives reduce the concentrations below MCLs are being achieved for all wells above MCLs, to ensure additional monitoring or wellhead treatment is not necessary.	TCE sample results for MW951, MW1008, and AM-18 have been added to the local well treatment portion of Section 7.1.1.1.4 and further explanation has been provided on how implementation of the CB ROD Part 2 remedy continues to achieve the CB ROD Part 2 RAO. The CB Part 2 remedy for the off base confined HSZ does not specify that all wells above the MCL be addressed by wellhead treatment. The off base confined remedy requires that local wellhead treatment remove contaminant mass and/or reduce potential impact on municipal water supply wells in the area (e.g., AM18) (CB ROD Part 2 Section 2.12.3). The CB ROD Part 2 RAO is to prevent exposure to groundwater from a Castle AFB plume containing chemicals of concern above the MCL (CB ROD Part 2 Section 2.8). Results of current implementation as reported in the LTGSP reports and FYR indicate the remedy has been effective in reducing the concentration at AM18 and within the off-base confined plume area such that achieving the RAO has been maintained. The monitoring results and achieving the RAO establish that additional monitoring or wellhead treatment is not necessary for achieving the RAO. As established by the CB RI/FS Part 2 and the CB ROD Part 2, capture of the off-base confined HSZ plume area is impractical due to the influence of municipal well pumping. Based on the CB Part 2 ROD remedies, wellhead treatment or an alternative water supply would be evaluated in consultation with the agencies if a water supply well (such as AM18) begins to exceed one-half the MCL.

Comment Number	Section	Comment	Response
1 (cont'd)		Further, the primary LTGSP documents used to support this five-year review (2012 LTGSP report) have not adequately addressed regulatory concerns regarding whether the plume is sufficiently delineated in the Confined HSZ, which is necessary to determine if the remedy is functioning as intended (on-base capture as well as off-base wellhead treatment). As indicated in agency comments on these documents, there is not enough data to demonstrate capture in the OU2 plume to the west and at depth. Analysis of the well network suggests no well exists in the area close enough to the west or at a reasonable depth below the wells of concern to provide this data. Rebound has occurred in the OU2 plume as a result of the pulsed operation of extraction wells, and while this was conducted under approved work plans, the agencies did not expect the rebound observed, and it is clear there is not capture during down times.	Notwithstanding the identified regulatory concerns and associated information to be included in the 2013 Annual LTGSP Report, please see the responses above in regard to on-base capture and off-base wellhead treatment. The Q2/13 TCE concentration was 1.6 µg/L at EW23, the only Confined HSZ well where TCE (5.4 µg/L) exceeded the MCL in 4Q/12. Implementation of the off base Confined HSZ remedy continues to accomplish mass removal, maintain reduced TCE concentrations at municipal well AM-18, and achieve the CB ROD Part 2 RAO. The following text has been added to Section 7.1.1.4 to address OU-2: "In the OU-2 area, the rebound concentrations are higher (as of 4Q/12 the maximum TCE concentrations in wells MW804A, MW806A and MW948 were 27 µg/L, 28 µg/L, and 37 µg/L, respectively) and the rebound duration longer than anticipated when the rebound study was initiated in 2009. Consideration of additional actions that may be necessary to improve the rate of contaminant mass removal and to confirm hydraulic control is appropriate. To address this issue, it is recommended to improve and confirm plume capture and plume reduction, specifically, a) improve plume capture and contaminant mass removal by adding an extraction well from the existing well network (most likely a conversion of MW-948 to an extraction well), and b) confirm hydraulic control by installing a LSS monitoring well in the area of MW804A." Additionally, the Executive Summary, Sections 8, 9, 10, and Tables ES-1, 8-1, and 9-1 have been updated to add this issue and recommendation.

Comment Number	Section	Comment	Response
1 (cont'd)		On 18 Feb 2014, the AF provided additional information to support the response to agency comments on the 2012 LTGSP and 2013 Semiannual LTGSP associated with the above issues. The regulatory agencies are still undergoing review of this information, and it is expected that the issues will be on-going through the next Annual Report review cycle. However, to the extent that the AF adds information regarding the status of these issues Final FYR, it would be much appreciated. At a minimum, an issue should be added to the Final FYR Section 7.1.1.4, Early Indicators of Potential Issues, and Section 8, Issues, etc., identifying the regulatory data gap concerns regarding the Confined HSZ contaminant extent both on and off base, and the need for confirmation of the adequacy of the associated treatment requirements. The AF should include in the recommendations how they will address these on-going concerns (such as provide additional information in the LTGSP for review and revision, etc. and address any data gaps, if necessary.) The EPA also believes that while the remedial actions are currently protective, these issues regarding the adequacy of plume delineation and capture affect long-term protectiveness.	The Air Force agrees that there will be continued resolution of regulatory concerns and comments in the 2013 LTGSP Annual Report. Due to the continuing resolution of these concerns and comments, and the development of the 2013 LTGSP Annual Report on a later schedule than the Five Year Review Report, the Air Force is unable to incorporate all of the information that will be presented in the LTGSP report. Hopefully, the additional information provided in these responses to comments will assist the regulatory agencies with their review. An issue and recommendation has been added to Section 7.1.1.4 to address contaminant capture and hydraulic control in the OU-2 area. Pending further resolution of agency comments, however, the on-base and off-base Confined HSZ is not currently considered a data gap issue by the Air Force. Based on the information presented above for EW23 in regard to the on-base confined and for implementation of the CB ROD Part 2 remedy in regard to the off base confined, a Confined HSZ issue has not been identified.
2	Section 7.1.1.1.4 CB ROD-Part 2 Remedies, and Response to Specific Comment Number 4	The AF has provided additional information in Section 7 that addresses this comment. However, page 7-7 to 7-8 indicates that the AF is still performing research to determine if there were any property ownership changes in 2011 and 2013, and that additional information will be included in the Final FYR. Because the AF verifies IC compliance annually, and has not seen any indication of problems, this is not appear to be a protectiveness issue in the short-term. However, protectiveness in the long-term could be an issue until this information can be verified. Please ensure the update to the Final document includes as much information as possible to verify compliance of all of the ICs and protectiveness so that this does not need to be added as an issue.	All IC compliance information has been compiled and is included in the Final FYR.

Comment Number	Section	Comment	Response
3	Response to General Comment Number 4	The AF has added the information EPA requested, and included it as Issue #8. However, the AF concludes the issue does not impact protectiveness. While EPA agrees that this issue does not present a current exposure concern, and the FTA-1 remedy is protective in the short-term, in the long-term, confirmation of the absence of the contaminant is still needed to confirm there are no soil and/or groundwater risks. Until the assessment is completed, EPA deems this a long-term protectiveness issue.	Sampling for PFCs has been identified as an issue and recommendation, and the Air Force agrees that confirmation of the presence or absence of PFC contaminants is needed. However, without data for evaluation of PFC presence and associated risk, there is not sufficient basis to conclude that there is long-term protectiveness issue. This would appear to be consistent with OSWER 9200.2-111.
Minor Issues/Typographical Concerns			
4a	Table of Contents and Five-Year Review Summary Form, and Response to Comments introduction	The Five-Year Review Summary Form was added to the document after the Executive Summary, however was not listed in the Table of Contents as a separate document, and presents different page numbers.	The Five-Year Review Summary Form has been revised to add “Table ES-1” in the heading. The Summary Form (Table ES-1) will be located directly following the Executive Summary. The Table of Contents has been revised to include the Summary Form.
4b	Five-Year Review Summary Form	Only issues that affect protectiveness need to be on the Summary Form, and issues should be listed only at the OU-wide level, not broken down into Sites. Further the sitewide protectiveness determination is missing from the form. The site specific issues should be consolidated at the OU-wide level, and a sitewide level summary provided.	The Summary Form has been revised. The site-specific issues have been consolidated at the OU-wide level. The Site-wide protectiveness determination has been added to the Summary Form.
4c	Section 7.6.2.2, Page 7-47, Changes in Exposure Pathways	Second sentence "The" is incomplete. Is there critical text missing, or does this need to be deleted?	The second sentence has been corrected to read as follows: “The exposure pathway of concern, and that addressed by the SCOU ROD Part 3 remedy, are vernal pool fairy shrimp and flora exposure to contaminants from past and present soil contamination at the site.”


EW23
TCE (µg/L)
EW Shutdown 2Q/06
35
30
25
20
15
10
5
0
1998
2000
2002
2004
2006
2008
2010
2012
2014

EW23 TCE DATA TABLE

Date	TCE (µg/L)	
1/1/1998	31	
8/1/1998	30	
1/1/1999	23	
7/1/1999	24	
1/1/2000	20	
4/1/2000	20	
7/1/2000	19	
1/1/2001	15	
7/1/2001	14	
1/1/2002	12	
7/1/2002	14	
1/1/2003	11	
7/1/2003	11	
1/1/2004	7.1	
7/1/2004	8.4	
1/1/2005	5.5	
8/1/2005	4.3	
1/1/2006	3.1	
4/1/2006	1.8	
7/1/2006	0	EW shutoff 2Q2006
10/1/2006	1.5	
1/1/2007	1.5	
4/1/2007	1.9	
1/1/2008	3.4	
2/1/2009	5.9	
12/1/2009	5	
6/1/2010	4.2	
9/1/2012	5.4	
5/30/2013	1.6	

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COMMENTS ON THE
DRAFT FIVE-YEAR REVIEW

RESPONSES TO COMMENTS ON THE DRAFT FIVE-YEAR REVIEW, FOURTH FIVE-YEAR REVIEW REPORT, FORMER CASTLE AIR FORCE BASE, CALIFORNIA

Comment Number	Section	Page	Paragraph	Comment	Response
COMBINED US EPA AND STATE OF CALIFORNIA COMMENTS (DATED 11 DECEMBER 2013)					
The ***Draft Five-Year Review, Fourth Five-Year Review Report, Former Castle Air Force Base, California,*** dated September 24, 2013 (the Review) does not include all of the summary and evaluation elements listed in the *Comprehensive Five-Year Review Guidance, June 2001* (EPA Guidance). Further, "Five-Year Review Summary Form Template" (December 2011) and shown in Appendix E of the EPA Guidance is not included. The Review should be revised to add summary information at the OU and site-wide level, clarify the analysis supporting the determination of protectiveness , and more clearly lay out and carry forward the issues as scenarios that need to be addressed and the evaluation of whether or not they impact protectiveness. See General and Specific comments below for further details. AF Response: The Five-Year Review Summary Form has been completed and incorporated into the Draft Final Five Year Review Report. Responses to the General and Specific comments are provided below.					
General Comments					
1	5			**Section 5 Progress Since Last Review:** This section does not clearly indicate the protectiveness statements from the last review, or clearly state if the follow-up actions achieved the intended purpose. Please add the verbatum information from the previous review.	The text in Section 5 has been revised to include the protectiveness statements verbatim from the 2009 Five-Year Review and to provide the status of any recommended actions. A statement has been added regarding whether the actions achieved the intended purpose.
2	6			**Section 6 Five-Year Review Process:** There are several issues identified in Section 6 that do not appear to be considered in Section 7 Technical Assessment. For example, several items affecting O&M and effectiveness of ICs are identified and discussed in the Section 6.4, Site Inspection, and 6.5 Interviews, but to not appear to be discussed and included in the technical assessment, Question A, or identified as issues and evaluated for whether they affect protectiveness in Section 8.	The O&M items and site concerns identified in Sections 6.4 and 6.5 are now addressed in the Section 7 Technical Assessments. For the Main Base Plume, a statement has been added to the System Operations/Operation and Maintenance section under Question A of the Technical Assessment (Section 7.1.1.2) to indicate that the O&M items identified in Section 6.4 are items subject to normal implementation of the respective O&M Plans and are not issues that affect protectiveness. Section 7.1.1.4 was updated to add that graffiti at the well enclosures (identified in Section 6.4) has occurred but there have been no negative impacts to the wells or the integrity of the enclosures. The maintenance and monitoring issues identified in Section 6.4 for FTA-1, LF-4 and LF-5 have been addressed in Sections

Comment Number	Section	Page	Paragraph	Comment	Response
					7.5.1.1.2, 7.7.1.1.2, and 7.8.1.1.2, respectively. The need for increased O&M requirements for aging systems noted by EPA during Interviews (Section 6.5.1.2) has also been noted in Section 7.1.1.2. The dry well replacement issue raised by EPA and DTSC in Section 6.5.1.2 is addressed for the Main Base Plume (Section 7.1.1.4). The status of dry wells at FTA-1, LF-4 and LF-5 has been added to Sections 7.5.1.1.2, 7.7.1.1.2, and 7.8.1.1.2, respectively, and the declining regional water level has been addressed as an Early Indicator or Potential issues for each of the sites.
3				**Section 7 Technical Assessment, Question A:** It does not appear that the remedial action performance discussed in Question A includes potential issues identified in previous sections, and many of the conclusions are not definitive or clearly supported by data. For example, issues identified on Pages 4-18 through 4-21 do not appear to be mentioned in the Question A evaluation of the Main Base Plume. Additionally, the assessment of the ICs does not include an evaluation of whether IC requirements are being properly implemented and if so, are still effective. Please refer to the September 2011 ***OSWER Directive 9355.7-18, Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"*** for further guidance.	Text on pages 4-18 through 4-21 includes a portion of the effluent sample result discussion and a summary of treatment system influent sample results. A statement has been added to Section 7.1.1.2 to refer back to Section 4.1.3 where it is stated that the periodic inorganic constituent discharge exceedances have been a regular occurrence throughout the remedial action and the situation has been monitored and coordinated with the regulatory agencies but does not represent a protectiveness issue. The OU-2 rebound study, for which sample results are summarized on pages 4-19 to 4-21, is addressed in the Main Base Plume technical assessment. The technical assessment of institutional controls (ICs) provided for the Main Base Plume (Section 7.1.1.1.4), Castle Vista Plume (Section 7.2.1.1.4), ETC-10 (Section 7.3.1.1.1), FTA-1 (Section 7.5.1.1.1), LF-4 (Section 7.7.1.1.1) and LF-5 (Section 7.8.1.1.1) have been revised to provide an evaluation of whether IC requirements are being properly implemented and are effective. Each section was revised to discuss or provide specific documentation regarding IC compliance such as deed record dates and numbers for

Comment Number	Section	Page	Paragraph	Comment	Response
					deeds with relevant restrictions, dates and record numbers for State Land Use Covenants (SLUCs), whether affected property was transferred with applicable restrictions and SLUCs, whether reporting requirements were met by property owners, and the results of Air Force IC compliance inspections. Since no issues are identified for ICs, a statement has been added to each of the sections indicating that the applicable ICs are properly implemented and effective.
4	7			**Section 7 Technical Assessment, Question B:** Question B does not address emerging contaminants, such as whether groundwater in areas impacted by fire-fighting activities have been tested and analyzed for emerging chemical contamination associated with fluorinated fire-fighting foams. Please add the issue for Sites that the potential presence of these contaminants has been identified, and identify any plans for carrying out these investigations. Because there is a strong likelihood these contaminants were released to the environment during the use of the Site FTA-1, and potentially other areas, and data has not yet been collected to verify there has *not* been an impact to human health and the environment, protectiveness cannot be determined until an investigation, and risk assessment, if necessary, can be conducted. Therefore, the protectiveness determination should be deferred until this investigation can be completed.	Information has been added to Question C regarding the Air Force initiative to evaluate candidate sites for the potential presence of perfluorinated compounds as an emerging contaminant for FTA-1. FTA-1 was impacted by historical fire training activities and is included in the AF assessment of such sites for PFCs. This item has been carried through as an issue and recommendation but there is not currently a protectiveness issue since the sampling has not yet been performed.

Comment Number	Section	Page	Paragraph	Comment	Response
5	8			**Section 8 Issues:** This section is lacking a determination of whether issues affect current or future protectiveness, and does not include discussion of unresolved concerns or items raised by support agencies and the community, or include all of the issues discussed in previous sections. This section needs to be modified to include additional items identified in previous sections and the LTGSP reviews, and present an evaluation of whether each issue affects short-term and long-term protectiveness. Please refer to Exhibit 4-3 in the EPA Guidance for an example table that could be used to develop and summarize this section.	Table 8-1 has been added to provide a section summary in accordance with Exhibit 4-3, including a determination of whether issues affect current or future protectiveness. The Air Force is not aware of any unresolved concerns or items raised by support agencies and the community. Appendix A is reserved for responses to agency comments; any comments considered to be unresolved will be included in Section 8 of the final five year review report. Section 8 issues have been updated to be consistent with the issues affecting protectiveness that are identified in the Section 7 Technical Assessments. Please see the responses to General Comments 2, 3, and 4, regarding how items noted in Sections 4 and 6 are addressed in Section 7.
6	9			**Section 9 Recommendations and Follow-up Actions**: This section does not include responsible party, regulatory oversight, or schedule. Please refer to Exhibit 4-4 in the EPA Guidance for an example table that could be used to summarize this section.	Table 9-1 has been prepared and included following the format of Exhibit 4-4 from the EPA FYR Guidance including identifying the responsible party, regulatory oversight, and schedule.
7	10			**Section 10 Protectiveness Statements:** This section provides an evaluation of protectiveness for each remedial action component of the two Castle OUs, however, protectiveness statements need to be developed at the OU and comprehensive site-wide level. Please include an overarching protectiveness statement for each OU, and an additional comprehensive site-wide protectiveness statement. Please refer to Section 4.5.1 and Exhibits 4-6 and 4-7 of the EPA Guidance, as well as "Evaluating Remedy Protectiveness", Page 2, of the ***September 2012, Letter Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews***.	In Section 10 and the EPA Summary Form, the protectiveness statements for each OU have been changed to reflect the language specified in the ***September 2012, Letter Clarifying the Use of Protectiveness Determinations***. Additionally, operable unit and site-wide comprehensive protectiveness statements have been added to Section 10.

Comment Number	Section	Page	Paragraph	Comment	Response
8	11			**Section 11 Next Review:** The statement "This five-year review is to be completed by March 2014 based on recent EPA guidance" is not consistent with the statement that the last review as finalized in January 2009. Please add that the last (third) five-year review was approved by EPA on March 11, 2009. EPA guidance has always indicated that that deadline is typically five years from the signature date of the previous five-year review report, and therefore this review is due no later than March 11, 2014. EPA now requires that this date will continue to be the due date for all subsequent reviews, regardless of slippage of future EPA approval dates, and therefore, the next review is due no later than March 11, 2019.	The last review was finalized in January 2009 and it is agreed that EPA concurrence was provided on 11 March 2009. The following was added to replace text after the third sentence: "EPA provided concurrence on the third five year review on 11 March 2009. Where EPA has a concurrence role, such as for five-year reviews at NPL sites that are led by other federal agencies, the trigger for subsequent reviews corresponds to EPA's concurrence signature date of the preceding Five-Year Review report. In accordance with EPA guidance *Correction to the Memorandum "Program Priorities for Federal Facility Five Year Reviews"* (EPA, 2012c), all five-year reviews for the former Castle AFB will now be conducted at five-year intervals based on EPA's concurrence date for the third five-year review. Therefore, this five year review is scheduled to be completed by 11 March 2014 and the next five year review will be completed by 11 March 2019."
Specific Comments					
1	1.1 and Figure 2-1			**Section 1.1 Scope of Current Five-Year Review, and Figure 2-1, Primary CERCLA Documents and Integration of Operable Units at the Former Castle Air Force Base:** The description of RODs, OUs, and associated Sites maintained by the AF that are subject to the Fourth Five-Year Review needs clarification. The Review pertains to two OUs: The Groundwater OU and the Source Control OU (SCOU). However, multiple remedial actions and RODs have been established that may or may not be associated with this particular Review, since some Site remedial actions have been completed or the criteria for the remedial actions were superceded and/or amended by subsequent RODs. Further, while much of the Review discusses conditions at the Site	Section 1.1 outlines the five RODs that are currently applicable at the Former Castle Air Force Base and the sites that require review in this Five Year Review. The protectiveness evaluations in this Five Year Review are evaluated against the relevant ROD criteria. Each of the ROD remedies and associated criteria are summarized in Sections 4 and 7. As described in Section 1.1, there are only two OUs at Castle - Groundwater and Source Control. OUs are defined in the ROD documents and the integration of OUs and RODs is described in Section 1.1 and shown in Figure 2-1. The Interim OU-1 ROD and OU-2 ROD were superseded by the CB Part 1 ROD (see Section 2.2 of the CBP1 ROD). This will be stated in the CB Part 1 bullet in Section 1.1. It will also be stated that the

Comment Number	Section	Page	Paragraph	Comment	Response
				and OU level, the evaluation of protectiveness needs to be evaluated with the relevant ROD criteria. For example, some of the Sites in the SCOU RODs are no longer being reviewed as they reached remedial action objectives, but the Figure is not detailed enough to illustrate which sites are subject to the review and summary information is not presented in the text. Additionally, five RODs are mentioned on page 1-3, however there are two additional RODs pertaining to the two initial groundwater treatment systems OU 1 and OU 2, established in 1991 and 1993, which were not identified specifically in this section because they were superseded by the subsequent CB ROD-Part I, as illustrated by Figure 2-1. For purposes of clarifying the status of the Sites, OUs, and associated RODs relevant to the Review in Section 1.1, please clarify the status of all of the RODs in the text, and refer to Figure 2-1 and other supporting figures and tables in the Review. It also may be useful to include a table or notation that identifies the specific relationship between the the (sic) Sites and associated OUs and RODs, or modify the “Five Year Reviews” box on Figure 2-1 to identify which of the SCOU RODs and Groundwater OU RODs are evaluated as part of this review, versus which were evaluated as part of previous reviews, etc.	Groundwater OU is addressed in the two CB RODs and the SCOU is addressed in the three SCOU RODs. The text of Section 1.1, specifically the two paragraphs following the bulleted list of RODs, outlines the sites that are and are not included in this Five Year Review. The first sentence following the bullets indicates all SCOU sites included in the Five Year Review are SCOU ROD 3 sites. Table 1-1 outlines all SCOU sites, site linkages, selected remedies, ROD affiliation, and the rationale for technical assessment or exclusion from technical assessment in this five-year review. Based on the text, figure, and tables that are provided, an additional table or notation identifying the specific relationship between the Sites and associated OUs and RODs is not necessary.

Comment Number	Section	Page	Paragraph	Comment	Response
2	4.1.2.3 and 7.2.1.1.4			**Section 4.1.2.3 CB ROD Part 2 Remedy Implementation, and Section 7.2.1.1.4 CB ROD Part 2 Remedies:** These sections provide a description of the remedy requirements but does not provide sufficient detail regarding status and effectiveness. References are made to the LTGSP but a summary of key results and an evaluation of remedial performance from these reports should be included in the review.	Information regarding the status and effectiveness of CB ROD Part 2 remedy implementation has been added to Sections 7.1.1.1.4 (Main Base Plume) and 7.2.1.1.4 (Castle Vista Plume). Information regarding the status and effectiveness of ICs was added as described in the response to General Comment 3. Otherwise, there is sufficient specific information provided in regard to local well head treatment of the off-based confined zone plume and for water supply wellhead treatment in Sections 7.1.1.1.4 and 7.2.1.1.4.
3	4.1.3			**Section 4.1.3 Main Base and Castle Vista Plume System Operation and Maintenance:** There are several potentially significant issues identified in this section that are not identified and discussed in later portions of the Review. For example, on Page 4-18 the text states "As indicated in the summaries above, the exceedance of certain inorganic discharge limits in treatment plant effluent is a regular occurrence at Castle" and Page 4-19 indicates that the following action "monitoring and reporting in regards to these inorganic discharges continues…" Additionally, on Page 4-21, increases of TCE concentrations in OU-2 wells and on Page 4-22, increases of 1,2-DCE concentrations at Castle Vista Wells during shutdown/rebound operations of these systems were observed, however a thorough evaluation of these issues is not included in subsequent portions of the review. Finally, several occurrences of pipeline leaks and releases of treated and untreated water have occurred over the years but do not appear to be identified or evaluated in subsequent portions of the review. Please add these issues and evaluate their impact on protectiveness.	Inorganic discharges periodically exceed discharge criteria due to differences in the natural inorganic constituent levels present in the HSZs. This has been established as long as the remedy has operated as described in Section 4.1.2.1 and is not a protectiveness issue. As described in the response to General Comment 3, a statement has been added to Section 7.1.1.2 to refer back to Section 4.1.3 where it is stated that these periodic inorganic constituent discharge exceedances have been a regular occurrence throughout the remedial action that has been monitored and coordinated with the regulatory agencies but do not represent a protectiveness issue. (See response to General Comment 3). OU-2 and Castle Vista are currently being monitored and operated in accordance with regulatory-approved rebound work plans. During rebound stages, there is no active capture of the plume but monitoring and restart criteria are established in accordance with the approved plans. There are no protectiveness issues identified with current operations under these approved work plans. The OU-2 and Castle Vista rebound study are addressed in the technical assessments. (See response to General Comment 2).

Comment Number	Section	Page	Paragraph	Comment	Response
					Text has been added to Section 7.1.1.2 to identify and evaluate the leaks in the conveyance lines and at the treatment systems. All releases have been recorded and corrective actions were implemented in accordance with existing O&M plans. Repairs of leaks are addressed when identified and repairs are made under the ongoing O&M and monitoring of the treatment systems. The volumes and concentrations did not exceed recordable quantities, therefore there is no impact on protectiveness.
4				**Section 4.2.2 Remedy Implementation (Vadose Zone Removal/Remedial Actions):** **a.** The ICs that are currently in place and implemented are described in the subsections, but not evaluated to ensure they are still in place and are effective. The AF should verify that the IC procedures are in place and working effectively, and any potential issues should be included in subsequent portions of the Review. **b.** More explanation regarding the LTEM issues should be included to support that the lack of data collection is not a remedy implementation problem, but reflective that ecological issues are not being impacted by the remedy. For example, given the issues identified in Section 7.1.1.4, Early Indicators of Potential Issues, Page 7-10, and Section 8, Issues, Page 8-1, it would appear that the lack of rainfall is hampering the overall ability to evaluate the protectiveness of the remedies, and, in the case of the long-term ecological monitoring (LTEM), is	a. Section 4.2.2 provides a summary of remedy implementation consistent with guidance. Evaluation of ICs as part of the remedies is presented in Section 7, Technical Assessment. Issues, if any, are identified in Sections 7 and 8 not Section 4. Specific documentation has been added to the Section 7 Technical Assessment regarding IC compliance such as deed record dates and numbers for deeds with relevant restrictions, dates and record numbers for SLUCs, whether affected property was transferred with applicable restrictions and SLUCs, discussion indicating whether reporting requirements were met by property owners, and the results of Air Force IC compliance inspections. Since no issues are identified for ICs, a statement has been added to each of the sections indicating that the applicable ICs are properly implemented and effective. (See also General Comment 3). b. Section 7.1.1.4 addresses early indicators of potential issues for the Main Base Plume, for which LTEM is not applicable. The long-term declining regional

Comment Number	Section	Page	Paragraph	Comment	Response
				preventing monitoring, so the protectiveness of the remedies requiring LTEM cannot be quantitatively supported. Alternatively, the lack of rainfall is inhibiting the formation of sensitive habitat, and therefore is not expected to exist. Until rainfall occurs, there is not a concern. **c.** Finally, inspection and monitoring requirements for the landfills are referenced, but significant results not described in all cases. All potentially significant results should be summarized and any issues from the results identified in subsequent portions of the Review, as appropriate. For example, a fire occurred at one of the landfills, potentially impacting the integrity of the cover, but the technical assessment doesn't identify any "natural disasters". Also, where there are issues identified, such as dry well and LTEM concerns described on pages 4-35 and 4-36, they are not identified and evaluated in subsequent portions of the review.	groundwater levels discussed in the section are related primarily to regional overusage of groundwater rather than the low precipitation that has occurred in recent years. c. Summaries and evaluation of inspection and monitoring results for the review period are provided in Section 7 Technical Assessment (Section 7.7.1.1.2 for LF-4, Section 7.8.1.1.2 for LF-5). Discussion of the dry well replacements associated with the landfills has been added to the landfill technical assessments. Information about the fire at LF-4 has been added to Section 4.2.2.5 but was not added to Section 7 because the fire had no impact on the remedy. The small grass fire on the cap area is not considered a natural disaster.

Comment Number	Section	Page	Paragraph	Comment	Response
5	7.1	7-1		**Section 7.1 Main Base Plume Remedial Action, Page 7-1:** The text states that contaminants other than TCE are "almost always" at much lower concentrations then TCE and "almost without exception" occur within the TCE plume boundaries, and for these reasons the technical assessment only addresses TCE. These statements are not definitive enough to support that only an assessment of TCE is sufficient to ensure whether the remedies are effective for all constituents of concern. The cases where there is an exception should also be reviewed to ensure other constituents are being addressed when they are above TCE concentrations or outside the TCE plume.	The text in the Draft FYR indicated that PCE exceeded the TCE concentration at MW522. This statement was inadvertently copied from the 2009 FYR. For 2012 and the first two quarters of 2013, there were no VOCs exceeding MCL that were outside of the Main Base Plume. The text in Section 7.1 has been updated accordingly.
6	7.1.1.1			**Section 7.1.1.1 Remedial Action Performance:** The conclusion of this section "Based on a review of factors presented in this section, the remedy is functioning and intended by the decision documents for the Main Base Plume," does not appear to be consistent with the analysis provided, which reveals that capture is not achieved during periods of system shutdown, and concentrations are increasing in wells, in some cases, outside of the capture zones. Additionally, occasional O&M failures resulting in releases of untreated groundwater have occurred, but this does not appear to be addressed by the assessment. Additional language is needed to support that these remedies are performing as expected, and expected to achieve RAOs, and potential exposures are being controlled, despite the operational issues that have occurred due to optimization studies and an aging system and declining regional groundwater levels.	The conclusion is consistent since periods of shutdown have either not affected remedy performance or were done under agency-approved work plans. There are no protectiveness issues identified with current operations under these approved work plans. Text has been added to Section 7.1.1.2 to identify and evaluate the leaks in the conveyance lines and at the treatment systems. All releases have been recorded and corrective actions were implemented in accordance with existing O&M plans. Repair of leaks are addressed when identified and repairs are made under the ongoing O&M and monitoring of the treatment systems. The volumes and concentrations did not exceed recordable quantities; therefore, there is no impact on protectiveness. See response to Specific Comment 3.

Comment Number	Section	Page	Paragraph	Comment	Response
7	7.1.1.1.2	7-4	Last sentence	**Section 7.1.1.1.2, Plume Capture, Page 7-4:** The last sentence of Section 7.1.1.1.2 states that the "Air Force will either demonstrate that migrating contaminants will be captured by extraction wells EW11 and/or EW12;" however, Figure 7-7 shows that EW12 is offline, and based on Figure 7-9, TCE concentration in well MW1008 (12 ug/L) exceeds the MCL and this contamination is not being captured by the extraction wells. Further it does not appear that the vertical extent of the TCE concentrations in the Upper Subshallow Hydrostratigraphic Zone and possibly into the Lower Subshallow Hydrostratigraphic Zone is defined, and concentrations at depth may be increasing. The text also states that the "northeastern plume segment has only one well in exceedance of the MCL [maximum contaminant level] (MW1014);" however, the trichloroethene (TCE) concentration in MW1015 also is an exceedance, based on Figure 7-1 (6.4 micrograms per Liter [ug/L]). Figure 7-2 indicates detections in the Upper Subshallow Hydrostratigraphic Zone at MW1031, and the plume may not be completely delineated in this zone since wells needed to define the vertical extent in the area of the exceedances do not exist. A summary of the evaluation of concentration trends in wells that exceed MCLs along with the extent of contamination horizontally and vertically should be included, along with the capture analysis results to support the evaluation that the Main Base Plume remedial systems are performing as intended, including the OU-2 system, which appears to be lacking data at depth to	EW11 and/or EW12 are both operating in accordance with the decision criteria established in the OU-2 Rebound Study Work Plan. EW12 was down for a period in 2012 for pump replacement. Operation of the wells in the event that contamination migrates from the northeast base plume segment is a separate issue and one or both wells would be operated accordingly in the event they were potentially needed to evaluate capture of migration from the northeast base plume area. Capture is not required in the off-base confined zone where MW1008 is located. MW1031 was installed in 2003 as a USS well for monitoring the former source area after sample results from plume characterization wells established that the USS was not impacted at levels exceeding the MCL. MW1031 has never exceeded the MCL so further definition vertically or laterally hasn't been necessary. No trend graph is needed for MW1031 since it hasn't exceeded the MCL. Trend graphs for all wells can be reviewed using Castle View. MW1014 was the only well above the MCL during the 2012 annual sampling but MW1015 did exceed the MCL in 4Q2012. Sampling in 2013 indicates only MW1015 exceeds the MCL. These wells periodically go above and below the MCL. The text will be corrected to refer to the two wells above the MCL in 2012. As discussed in the 4 December 2013 BCT technical meeting, the continued evaluation of concentration trends, capture analysis and interpretation of site characterization for the OU-2 plume area will be conducted in the Long Term Groundwater Sampling Program reports.

Comment Number	Section	Page	Paragraph	Comment	Response
				confirm delineation and capture of the vertical extent of contamination.	
8	7.1.1.1.4	7-6 and 7-7		**Section 7.1.1.1.4, CB ROD - Part 2 Remedies, Page 7-6:** Pages 7-6 and 7-7 describe the process in place for the remedies, but does not indicate whether these processes have been triggered and the appropriate ICs or wellhead treatments have been put in place, if necessary. Evaluation and supporting data from the LTGSPs should be included and summarized in the assessment. Also, it is not clear whether all the data available to assess off-base plumes and any impacts to other off-base wells is being monitored, and whether the off-site domestic and irrigation well sampling program has been verified to be sufficient.	As described in the responses to General Comment 3 and Specific Comments 2 and 4a, additional detail regarding implementation of ICs has been added to Section 7.1.1.1.4. Statements have been added to indicate that the local wellhead treatment systems implemented and operating in the off-base Confined HSZ have been effective in removing contaminant mass and/or reducing contaminant impact on municipal wells, particularly municipal well AM18. Section 7.1.1.1.4 text has also been modified to clearly indicate that domestic well D5766 is the only public or private source of drinking water well that is being treated and no other supply wells require treatment based on the remedy criteria. Data from the monitoring program is provided in the text to support the evaluation. Section 7.1.1.4 has been updated to indicate that the municipal, domestic and irrigation well monitoring network was evaluated and is determined to be sufficient.

APPENDIX B

FIVE-YEAR REVIEW PUBLIC NOTIFICATION

Declaration of Publication

(2015.5 C.C.P)

STATE OF CALIFORNIA)
) **ss.**
County of Merced)

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of the printer of the Merced Sun-Star, a newspaper of general circulation, printed and published in the City of Merced, County of Merced, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Merced, State of California, under the date of July 14, 1964, Case Number 33224 that the notice, of which the annexed is a printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

JUNE 7, 2013

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Marlyn Gonzalez

Signature

Date: JUNE 7, 2013

This space reserved for County Clerk's Filing Stamp

ATWATER SECURITY STORAGE
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LIEN SALE
JUNE 8, 2013
9:00am - 12:00pm

A $25.00 clearing deposit may be required. No dumping or disposal of any items at this facility. Items in units include, but are not limited to miscellaneous boxes, furniture and personal items. All sales are paid in cash and are non-refundable.

1 . RAYMOND HADZIS	A-38	10 X 20
2. CYNTHIA HLADEK	B-12	5 X 5
3. STEVEN CUTSHALL	B- 45	10 X10
4. RHIANNON HEIM	D- 42	5 X 10
5. AURORA CORTEZ	E- 24	5 X10
6. RUBEN GALVAN	F- 3	10 X10
7. STEVEN HARRISON	F- 7	10 X 10
8. ANTONIO GUZMAN	F-44	5 X 5
9. MARTHA TORRES	F-97	10 X 15
10. LAURA VAIL	G- 22	10 X10
11. MANUEL WILSON	G- 128	5 X10
12. DAVID VILLAREAL	H- 15	10 X 20

SS-146813 5/31, 6/7

Environmental Cleanup Five-Year Review begins at former Castle Air Force Base

U.S. AIR FORCE

The Five-Year Review is a formal evaluation of the ongoing environmental cleanup activities at Castle AFB, Atwater, CA. The report will be issued in 2014 and we are informing you that the process has begun.

If you have any issues or concerns about Castle's cleanup program, or if you have direct knowledge regarding the cleanup remedies, the Air Force would like to talk to you. Please contact Stanley Pehl, Air Force Environmental Coordinator, using the contact information listed below.

The review is basically a report card for the Air Force's cleanup operation, underway at Castle since the 1980s. Past disposal of hazardous materials, such as solvents and other chemicals, resulted in soil and groundwater contamination. Several treatment systems are operating and removing the contamination. While the Air Force is the lead agency conducting this review, the U.S. Environmental Protection Agency and the State of California (Department of Toxic Substances Control and the California Regional Water Quality Control Board) review the Five-Year Review report, which includes a determination on whether the cleanup remedies in place are protective of human health and the environment. The report also provides recommendations if any deficiencies are found.

The last Castle Five-Year Review was completed in 2009 and determined that all remedies were protective and working as intended. This review will evaluate whether the current groundwater remedies, long-term landfill cap maintenance/monitoring, and prescribed institutional controls are protective of human health and the environment.

The Five-Year Review is scheduled to be completed in early 2014 and another public notice will be issued informing the community the review is complete. The Five-Year Review will then be available to the public online at the Air Force Administrative Record at http://afrpaar.lackland.af.mil/ar/.

For more information, contact:
Stanley Pehl, Air Force Civil Engineer Center
210-395-8238
stanley.pehl@us.af.mil
SS-148100 6/7

APPENDIX C

FIVE-YEAR REVIEW SITE INSPECTIONS AND PHOTOGRAPHIC LOGS

Five-Year Review Site Inspection Checklist

SITE INSPECTION DOCUMENTATION FORM

The following is the list of Sites inspected for this five-year review. See the attached site inspection record(s) for a detailed summary of the inspections.

Site Name	Inspection Date
Main Base Plume (OU-2, Phase 3, MW951, D5766)	June 18, 2013
Castle Vista (MW1046)	June 18, 2013
ETC-10	June 18, 2013
ETC-12	June 18, 2013
FTA-1	June 18, 2013
LF-3	June 18, 2013
LF-4	June 18, 2013
LF-5	June 18, 2013

Five-Year Review Site Inspection Checklist – Main Base Plume (OU-2, Phase 3, MW951, D5766)

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: Main Base Plume (OU-2, Phase 3, MW951, D5766)	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**
Remedy Includes: (Check all that apply) G Landfill cover/containment G Access controls **X Institutional controls** **X Groundwater pump and treatment** G Surface water collection and treatment G Other: ____________________	G Monitored natural attenuation G Groundwater containment G Vertical barrier walls
Attachments: Photographic Log	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	
2. **O&M staff** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	

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 ___**See Appendix D for Site Interviews**_________ Contact ______________ ______________ ______ ________ Name Title Date Phone no. Problems; suggestions; G Report attached ______________________________ ______________________________________ Agency ______________ Contact ______________ ______________ ______ ________ Name Title Date Phone no. Problems; suggestions; G Report attached ______________________________ ______________________________________ Agency ______________ 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 interviews** (optional) G Report attached.
See Appendix D for Site Interviews	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	X O&M manual	X Readily available	X Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	X N/A
	X Maintenance logs	X Readily available	X Up to date	G N/A
	Remarks:			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks______________________________			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks______________________________			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks______________________________			
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
7.	**Groundwater Monitoring Records**	X Readily available	X Up to date	G N/A
	Remarks______________________________			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	X Readily available	X Up to date	G N/A
	Remarks______________________________			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks______________________________			

IV. O&M COSTS

1. **O&M Organization**
G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — X Contractor for Federal Facility
G Other____

2. **O&M Cost Records**
G Readily available — G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
______	______	______	G Breakdown attached
______	______	______	G Breakdown attached
______	______	______	G Breakdown attached
______	______	______	G Breakdown attached
______	______	______	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None____

V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map X Gates secured G N/A
Remarks: OU-2 – system fence in good condition, the fence around IW2 is in good condition while the gate post is not vertical the gate can still be locked to prevent entrance, there is no fence around EW-11 and EW-12 as these wells are located within fenced farm land. Phase 3 – system, extraction wells, and injection wells are in good condition. MW951- system fence in good condition. D5766 – Fence is in good condition.

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks: Signs in place on the system fences. There are no signs on the individual extraction and injections wells associated with OU-2 and Phase 3.

C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented G Yes X No G N/A Site conditions imply ICs not being fully enforced G Yes X No G N/A Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________ Frequency _Not Applicable____ Responsible party/agency: United States Air Force ____ Contact ______________________________ ___________________ ________ _____________ Name Title Date Phone no. Reporting is up-to-date G Yes G No X N/A Reports are verified by the lead agency G Yes G No X N/A Specific requirements in deed or decision documents have been met X Yes G No G N/A Violations have been reported G Yes X No G N/A Other problems or suggestions: G Report attached None. ICs to restrict the use of groundwater that exceeds the MCL are in place. ____ ____	
2.	**Adequacy** X ICs are adequate G ICs are inadequate G N/A Remarks____ ____ ____	
D. General		
1.	**Vandalism/trespassing** G Location shown on site map X No vandalism evident Remarks: Evidence of historical graffiti on the fence of several wells, all graffiti has been painted. No evidence of impact on system components. ____ ____	
2.	**Land use changes on site** G N/A Remarks: None____ ____	
3.	**Land use changes off site** G N/A Remarks: None____ ____	
VI. GENERAL SITE CONDITIONS		
A. Roads X Applicable G N/A		
1.	**Roads damaged** G Location shown on site map X Roads adequate G N/A Remarks: Access road does not show any signs of damage. ____	

B. Other Site Conditions	
	Remarks: Sites appear to be in good condition and no unauthorized access. ___

VII. LANDFILL COVERS G Applicable X N/A			
A. Landfill Surface			
1.	**Settlement** (Low spots) Areal extent___ Remarks:___	G Location shown on site map Depth___	G Settlement not evident
2.	**Cracks** Lengths___ Widths___ Depths___ Remarks___	G Location shown on site map	G Cracking not evident
3.	**Erosion** Areal extent___ Remarks___	G Location shown on site map Depth___	G Erosion not evident
4.	**Holes** Areal extent___ Remarks: ___	G Location shown on site map Depth___	G Holes not evident
5.	**Vegetative Cover** G Grass G Cover properly established G No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks: ___		
6.	**Alternative Cover (armored rock, concrete, etc.)** G N/A Remarks___		
7.	**Bulges** Areal extent___ Remarks___	G Location shown on site map Height___	G Bulges not evident

8.	**Wet Areas/Water Damage**	G Wet areas/water damage not evident	
	G Wet areas	G Location shown on site map	Areal extent______________
	G Ponding	G Location shown on site map	Areal extent______________
	G Seeps	G Location shown on site map	Areal extent______________
	G Soft subgrade	G Location shown on site map	Areal extent______________
	Remarks____		
9.	**Slope Instability** G Slides	G Location shown on site map	G No evidence of slope instability
	Areal extent______________		
	Remarks____		
B. Benches	G Applicable	G 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**	G Location shown on site map	G N/A or okay
	Remarks____		
2.	**Bench Breached**	G Location shown on site map	G N/A or okay
	Remarks____		
3.	**Bench Overtopped**	G Location shown on site map	G N/A or okay
	Remarks____		
C. Letdown Channels	G Applicable	G 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**	G Location shown on site map	G No evidence of settlement
	Areal extent______________	Depth____________	
	Remarks____		
2.	**Material Degradation**	G Location shown on site map	G No evidence of degradation
	Material type_______________	Areal extent_____________	
	Remarks:		
3.	**Erosion**	G Location shown on site map	G No evidence of erosion
	Areal extent______________	Depth____________	
	Remarks ____		

4.	**Undercutting** G Location shown on site map G No evidence of undercutting Areal extent______________ Depth____________ Remarks____ ____
5.	**Obstructions** Type_____________________ G No obstructions G Location shown on site map Areal extent______________ Size____________ Remarks____ ____
6.	**Excessive Vegetative Growth** Type: ____________________ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent______________ Remarks: ____
D. Cover Penetrations G Applicable G N/A	
1.	**Gas Vents** G Active G Passive G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
2.	**Gas Monitoring Probes** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
5.	**Settlement Monuments** G Located G Routinely surveyed G N/A Remarks____ ____

E. Gas Collection and Treatment G Applicable G N/A	
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____
F. Cover Drainage Layer G Applicable G N/A	
1.	**Outlet Pipes Inspected** G Functioning G N/A Remarks: ____
2.	**Outlet Rock Inspected** G Functioning G N/A Remarks____ ____
G. Detention/Sedimentation Ponds G Applicable G N/A	
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____
3.	**Outlet Works** G Functioning G N/A Remarks____ ____
4.	**Dam** G Functioning G N/A Remarks____ ____

H. Retaining Walls	G Applicable G N/A	
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____ ____	
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks____ ____	
I. Perimeter Ditches/Off-Site Discharge	G Applicable G N/A	
1.	**Siltation** G Location shown on site map G Siltation not evident Areal extent_______________ Depth_____________ Remarks____ ____	
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks: ____	
3.	**Erosion** G Location shown on site map G Erosion not evident Areal extent_______________ Depth_____________ Remarks____ ____	
4.	**Discharge Structure** G Functioning G N/A Remarks: ____	
VIII. VERTICAL BARRIER WALLS	G Applicable X N/A	
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent_______________ Depth_____________ Remarks____ ____	
2.	**Performance Monitoring** Type of monitoring___________________________ G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential___________________________ Remarks____ ____	

IX. GROUNDWATER/SURFACE WATER REMEDIES X Applicable G N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines X Applicable G N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
X Good condition X All required wells properly operating G Needs Maintenance G N/A
Remarks: The following location-specific items were identified:

OU-2:
EW-11 – Grounding wire between a flange on the aboveground piping is broken.
EW-12 – Grounding wire between a flange on the aboveground piping is broken.

Phase-3
EW-19 – Electrical panel has corrosion on the 120-volt receptacle and the control panel.
EW-34 – Valve drips on the bottom of the strainer.
EW-36 – Valve drips on the bottom of the strainer.
IW-27 –Valve rusted up and not used.
IW-28 – Not used; there is a hole in the valve body (IW-30 utilized instead of IW-28).

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
X Good condition G Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
X Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks: System is comprised of parts that are readily available from vendors within the California central valley.

B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable X N/A

1. **Collection Structures, Pumps, and Electrical**
G Good condition G Needs Maintenance
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks

C. Treatment System X Applicable G N/A	
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping X Carbon adsorbers G Filters______ G Additive (*e.g.*, chelation agent, flocculent)______ G Others______ X Good condition G Needs Maintenance X Sampling ports properly marked and functional X Sampling/maintenance log displayed and up to date X Equipment properly identified G Quantity of groundwater treated annually______ G Quantity of surface water treated annually______ Remarks: OU-2 – Utilizes two treatment trains in parallel, each treatment train has two 2,000-lb GAC vessels. Phase 3 - Utilizes the existing Phase 3 system. An open tank for discharge of purge water that is run through the Phase 3 system is partially supported by a chunk of PVC pipe beneath the tank. MW951 – Utilizes two 2,000-lb GAC vessels in series. D5766 – Utilizes two GAC vessels in series. For each system sample ports should checked for readability, and re-stenciled as necessary, while they can be read, some are fading. The PVC piping that is part of the treatment system at OU-2, MW951, and D5766, should be monitored for degradation due to UV exposure. ______
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A X Good condition G Needs Maintenance Remarks______
3.	**Tanks, Vaults, Storage Vessels** X N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks______
4.	**Discharge Structure and Appurtenances** G N/A X Good condition G Needs Maintenance Remarks______
5.	**Treatment Building(s)** X N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks______
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning X Routinely sampled X Good condition G All required wells located G Needs Maintenance G N/A Remarks: Monitoring wells are understood to be in good condition. ______

D. Monitoring Data		
1.	Monitoring Data X Is routinely submitted on time	X Is of acceptable quality
2.	Monitoring data suggests: X Groundwater plume is effectively contained	X Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance X 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.

Not Applicable.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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 OU-2 treatment system has a couple of drips from the flex hosing connections. These drips are not significant but should be fixed as some of the drips represent untreated water.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	Main Base Plume	Site Location:	Former Castle Air Force Base

Photograph ID: 1 **Survey Date:** 6/18/2013 **Comments:** D5766 utilizes two granular activated carbon vessels in series.	
Photograph ID: 2 **Survey Date:** 6/18/2013 **Comments:** The D5766 wellhead treatment system.	

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**Main Base Plume**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 3

Survey Date:
6/18/2013

Comments:
The grounding wire between a flange on the aboveground piping is broken at EW-11.

Photograph ID: 4

Survey Date:
6/18/2013

Comments:
There are some valve drips on the bottom of the strainer at EW-34.

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	Main Base Plume	Site Location:	Former Castle Air Force Base

Photograph ID: 5 **Survey Date:** 6/18/2013 **Comments:** Fencing at IW-2 is in good condition.	
Photograph ID: 6 **Survey Date:** 6/18/2013 **Comments:** Piping for the Main Base treatment system.	

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**Main Base Plume**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 7

Survey Date: 6/18/2013

Comments: Water tank for the Main Base treatment system.

Photograph ID: 8

Survey Date: 6/18/2013

Comments: The Main Base treatment System.

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	Main Base Plume	Site Location:	Former Castle Air Force Base

Photograph ID: 9 **Survey Date:** 6/18/2013 **Comments:** MW951 utilizes two, 2,000-pound granular activated carbon vessels in series.	
Photograph ID: 10 **Survey Date:** 6/18/2013 **Comments:** Completion of the extraction well at MW951.	

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**Main Base Plume**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 11 **Survey Date:** 6/18/2013 **Comments:** Piping at the MW951 wellhead treatment system.	
Photograph ID: 12 **Survey Date:** 6/18/2013 **Comments:** OU-2 utilizes two treatment trains in parallel. Each treatment train has two, 2,000-pound granular activated carbon vessels.	

MWH

Photographic Log

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**Main Base Plume**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 13

Survey Date:
6/18/2013

Comments:
The OU-2 treatment system has some minor leaks from the flex hosing connections.

Photograph ID: 14

Survey Date:
6/18/2013

Comments:
The OU-2 treatment system valves and piping; there are some minor leaks from the piping.

Five-Year Review Site Inspection Checklist – Castle Vista (MW1046)

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: Castle Vista (MW1046)	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**

Remedy Includes: (Check all that apply)

G Landfill cover/containment
G Access controls
X Institutional controls
X Groundwater pump and treatment
G Surface water collection and treatment
G Other: ____

G Monitored natural attenuation
G Groundwater containment
G Vertical barrier walls

Attachments: Photographic Log

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Ralph Scull____________ _Field Tech__________ _18 June 13__
   Name Title Date
   Interviewed at site, Phone no. __916-335-9735__________
   Problems, suggestions; None____
   ____

2. **O&M staff** Ralph Scull____________ _Field Tech__________ _18 June 13__
   Name Title Date
   Interviewed at site, Phone no. __916-335-9735__________
   Problems, suggestions; None____
   ____

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 ___**See Appendix D for Site Interviews**_________ Contact ____________ ____________ ________ ________ Name Title Date Phone no. Problems; suggestions; G Report attached ____________ Agency ____________ Contact ____________ ____________ ________ ________ Name Title Date Phone no. Problems; suggestions; G Report attached ____________ Agency ____________ 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 interviews** (optional) G Report attached.
See Appendix D for Site Interviews	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	X O&M manual	X Readily available	X Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	X N/A
	X Maintenance logs	X Readily available	X Up to date	G N/A
	Remarks:			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks____			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks____			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks____			
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A
	Remarks____			
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A
	Remarks____			
7.	**Groundwater Monitoring Records**	X Readily available	X Up to date	G N/A
	Remarks____			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks____			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	X Readily available	X Up to date	G N/A
	Remarks____			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks____			

IV. O&M COSTS

1. **O&M Organization**

G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____

2. **O&M Cost Records**

G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From__________ To__________ ____________________ G Breakdown attached
Date Date Total cost
From__________ To__________ ____________________ G Breakdown attached
Date Date Total cost
From__________ To__________ ____________________ G Breakdown attached
Date Date Total cost
From__________ To__________ ____________________ G Breakdown attached
Date Date Total cost
From__________ To__________ ____________________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: None____

V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map X Gates secured G N/A

Remarks: There is a fence around the area with the 55-gallon treatment canisters that is in good condition. There is not a fence around the current extraction well MW1046. The extraction well is located in a gated senior living community and does not have any signs of vandalism.

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A

Remarks: Signs in place.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented G Yes X No G N/A
Site conditions imply ICs not being fully enforced G Yes X No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________
Frequency _Not Applicable____
Responsible party/agency: United States Air Force ____
Contact ______________________________ ___________________ _________ ____________
Name Title Date Phone no.

Reporting is up-to-date G Yes G No X N/A
Reports are verified by the lead agency G Yes G No X N/A

Specific requirements in deed or decision documents have been met X Yes G No G N/A
Violations have been reported G Yes X No G N/A
Other problems or suggestions: G Report attached
None. ICs to restrict the use of groundwater that exceeds the MCL are in place.

2. **Adequacy** X ICs are adequate G ICs are inadequate G N/A
Remarks____

D. General

1. **Vandalism/trespassing** G Location shown on site map X No vandalism evident
Remarks: None____

2. **Land use changes on site** G N/A
Remarks: None____

3. **Land use changes off site** G N/A
Remarks: None____

VI. GENERAL SITE CONDITIONS

A. Roads X Applicable G N/A

1. **Roads damaged** G Location shown on site map X Roads adequate G N/A
Remarks: Access road does not show any signs of damage.

B. Other Site Conditions	
	Remarks: Site appears to be in good condition and no unauthorized access.

VII. LANDFILL COVERS G Applicable X N/A		
A. Landfill Surface		
1.	**Settlement** (Low spots) G Location shown on site map G Settlement not evident Areal extent_______ Depth_______ Remarks:_______	
2.	**Cracks** G Location shown on site map G Cracking not evident Lengths_______ Widths_______ Depths_______ Remarks_______	
3.	**Erosion** G Location shown on site map G Erosion not evident Areal extent_______ Depth_______ Remarks_______	
4.	**Holes** G Location shown on site map G Holes not evident Areal extent_______ Depth_______ Remarks:	
5.	**Vegetative Cover** G Grass G Cover properly established G No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks: _______	
6.	**Alternative Cover (armored rock, concrete, etc.)** G N/A Remarks_______	
7.	**Bulges** G Location shown on site map G Bulges not evident Areal extent_______ Height_______ Remarks_______	

8.	**Wet Areas/Water Damage** G Wet areas/water damage not evident G Wet areas G Location shown on site map Areal extent______________ G Ponding G Location shown on site map Areal extent______________ G Seeps G Location shown on site map Areal extent______________ G Soft subgrade G Location shown on site map Areal extent______________ Remarks____ ____
9.	**Slope Instability** G Slides G Location shown on site map G No evidence of slope instability Areal extent______________ Remarks____ ____
B. Benches	G Applicable G 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** G Location shown on site map G N/A or okay Remarks____ ____
2.	**Bench Breached** G Location shown on site map G N/A or okay Remarks____ ____
3.	**Bench Overtopped** G Location shown on site map G N/A or okay Remarks____ ____
C. Letdown Channels	G Applicable G 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** G Location shown on site map G No evidence of settlement Areal extent______________ Depth____________ Remarks____ ____
2.	**Material Degradation** G Location shown on site map G No evidence of degradation Material type_______________ Areal extent_____________ Remarks: ____
3.	**Erosion** G Location shown on site map G No evidence of erosion Areal extent______________ Depth____________ Remarks ____ ____

4. **Undercutting** G Location shown on site map G No evidence of undercutting
Areal extent______________ Depth____________
Remarks____
____

5. **Obstructions** Type_____________________ G No obstructions
G Location shown on site map Areal extent______________
Size____________
Remarks____
____

6. **Excessive Vegetative Growth** Type: ____________________
G No evidence of excessive growth
G Vegetation in channels does not obstruct flow
G Location shown on site map Areal extent______________
Remarks:
____

D. Cover Penetrations G Applicable G N/A

1. **Gas Vents** G Active G Passive
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance
G N/A
Remarks____
____

2. **Gas Monitoring Probes**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

3. **Monitoring Wells** (within surface area of landfill)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

4. **Leachate Extraction Wells**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

5. **Settlement Monuments** G Located G Routinely surveyed G N/A
Remarks____
____

E. Gas Collection and Treatment G Applicable G N/A

1. **Gas Treatment Facilities**
   G Flaring G Thermal destruction G Collection for reuse
   G Good condition G Needs Maintenance
   Remarks____
   ____

2. **Gas Collection Wells, Manifolds and Piping**
   G Good condition G Needs Maintenance
   Remarks____
   ____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   G Good condition G Needs Maintenance G N/A
   Remarks____
   ____

F. Cover Drainage Layer G Applicable G N/A

1. **Outlet Pipes Inspected** G Functioning G N/A
   Remarks:
   ____

2. **Outlet Rock Inspected** G Functioning G N/A
   Remarks____
   ____

G. Detention/Sedimentation Ponds G Applicable G N/A

1. **Siltation** Areal extent______________ Depth____________ G N/A
   G Siltation not evident
   Remarks____
   ____

2. **Erosion** Areal extent______________ Depth____________
   G Erosion not evident
   Remarks____
   ____

3. **Outlet Works** G Functioning G N/A
   Remarks____
   ____

4. **Dam** G Functioning G N/A
   Remarks____
   ____

H. Retaining Walls G Applicable G N/A	
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____ ____
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks____ ____
I. Perimeter Ditches/Off-Site Discharge G Applicable G N/A	
1.	**Siltation** G Location shown on site map G Siltation not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks: ____
3.	**Erosion** G Location shown on site map G Erosion not evident Areal extent_______________ Depth_____________ Remarks____ ____
4.	**Discharge Structure** G Functioning G N/A Remarks: ____
VIII. VERTICAL BARRIER WALLS G Applicable X N/A	
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Performance Monitoring** Type of monitoring____________________________ G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential____________________________ Remarks____ ____

IX. GROUNDWATER/SURFACE WATER REMEDIES X Applicable G N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines X Applicable G N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** X Good condition X All required wells properly operating G Needs Maintenance G N/A Remarks: Operating extraction well is MW1046.
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** X Good condition G Needs Maintenance Remarks
3.	**Spare Parts and Equipment** X Readily available G Good condition G Requires upgrade G Needs to be provided Remarks: System is comprised of parts that are readily available from vendors within the California central valley.
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable X N/A	
1.	**Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks

C. **Treatment System** X Applicable G N/A	
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping X Carbon adsorbers G Filters______ G Additive (*e.g.*, chelation agent, flocculent)______ G Others______ X Good condition G Needs Maintenance X Sampling ports properly marked and functional X Sampling/maintenance log displayed and up to date X Equipment properly identified G Quantity of groundwater treated annually______ G Quantity of surface water treated annually______ Remarks: ______
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A X Good condition G Needs Maintenance Remarks______
3.	**Tanks, Vaults, Storage Vessels** X N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks______
4.	**Discharge Structure and Appurtenances** G N/A X Good condition G Needs Maintenance Remarks______
5.	**Treatment Building(s)** X N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks______
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks: This system is comprised of a single extraction well and injection well. There are no monitoring wells associated with this system.
D. Monitoring Data	
1.	Monitoring Data X Is routinely submitted on time X Is of acceptable quality
2.	Monitoring data suggests: X Groundwater plume is effectively contained X Contaminant concentrations are declining

D. Monitored Natural Attenuation
1. **Monitoring Wells** (natural attenuation remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance X 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. Not Applicable.
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.). No issues observed that would impact the effectiveness and function of the remedy.
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. No issues observed with respect to O&M.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	Castle Vista (MW1046)	Site Location:	Former Castle Air Force Base

Photograph ID: 1

Survey Date: 6/18/2013

Comments: The Castle Vista operating extraction well is MW1046.

Photograph ID: 2

Survey Date: 6/18/2013

Comments: The granular activated carbon vessels which serve as the Castle Vista Plume wellhead treatment system.

MWH

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**Castle Vista (MW1046)**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 3

Survey Date:
6/18/2013

Comments:
The treatment system piping.

Five-Year Review Site Inspection Checklist – ETC-10

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: ETC-10	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**

Remedy Includes: (Check all that apply)

G Landfill cover/containment G Monitored natural attenuation
G Access controls G Groundwater containment
X Institutional controls G Vertical barrier walls
G Groundwater pump and treatment
G Surface water collection and treatment
X Other: Ecological monitoring consisting of wetland invertebrate (fairy shrimp) and plant surveys at selected vernal pools, surveys to be conducted every five years, in concert with five-year reviews, or up to 30 years. Surveys initiated in the spring of 2008. ___________

Attachments: Photographic Log

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Ralph Scull____________________ _Field Tech____________ _18 June 13__
Name Title Date
Interviewed at site, Phone no. __916-335-9735____________
Problems, suggestions; None____

2. **O&M staff** Ralph Scull____________________ _Field Tech____________ _18 June 13__
Name Title Date
Interviewed at site, Phone no. __916-335-9735____________
Problems, suggestions; None____

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 ___**See Appendix D for Site Interviews**__________
Contact ________________________ ________________ _______ __________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____

Agency ________________________
Contact ________________________ ________________ _______ __________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____

Agency ________________________
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 interviews** (optional) G Report attached.

See Appendix D for Site Interviews

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	G O&M manual	G Readily available	G Up to date	X N/A
	G As-built drawings	G Readily available	G Up to date	X N/A
	G Maintenance logs	G Readily available	G Up to date	X N/A
	Remarks________________________________			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks________________________________			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks________________________________			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks________________________________			
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A
	Remarks________________________________			
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A
	Remarks________________________________			
7.	**Groundwater Monitoring Records**	G Readily available	G Up to date	X N/A
	Remarks________________________________			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks________________________________			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	G Readily available	G Up to date	X N/A
	Remarks________________________________			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks________________________________			

IV. O&M COSTS

1. **O&M Organization**

G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____
____

2. **O&M Cost Records**

G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: None____
____
____
____
____
____

V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map X Gates secured G N/A

Remarks: Perimeter fence in good condition.
____
____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map X N/A

Remarks: No signs in place.
____
____

C. Institutional Controls (ICs)
1. **Implementation and enforcement** Site conditions imply ICs not properly implemented G Yes X No G N/A Site conditions imply ICs not being fully enforced G Yes X No G N/A Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________ Frequency _Not Applicable____ Responsible party/agency: United States Air Force ____________________________ Contact ______________________ ______________ ________ ____________ Name Title Date Phone no. Reporting is up-to-date G Yes G No X N/A Reports are verified by the lead agency G Yes G No X N/A Specific requirements in deed or decision documents have been met X Yes G No G N/A Violations have been reported G Yes X No G N/A Other problems or suggestions: G Report attached None. ICs to restrict site access and alteration are maintained as part of the Air Force/BoP memorandum of understanding.
2. **Adequacy** X ICs are adequate G ICs are inadequate G N/A Remarks____
D. General
1. **Vandalism/trespassing** G Location shown on site map X No vandalism evident Remarks: None____
2. **Land use changes on site** G N/A Remarks: None____
3. **Land use changes off site** G N/A Remarks: None____
VI. GENERAL SITE CONDITIONS
A. Roads G Applicable X N/A
1. **Roads damaged** G Location shown on site map G Roads adequate G N/A Remarks____

B. Other Site Conditions

Remarks: Site is within United States Bureau of Prisons property and behind a perimeter fence. No signs of human activity observed.

VII. LANDFILL COVERS G Applicable X N/A

A. Landfill Surface

1. **Settlement** (Low spots) G Location shown on site map G Settlement not evident
Areal extent_______________ Depth_____________
Remarks

2. **Cracks** G Location shown on site map G Cracking not evident
Lengths_____________ Widths____________ Depths___________
Remarks

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent_______________ Depth_____________
Remarks

4. **Holes** G Location shown on site map G Holes not evident
Areal extent_______________ Depth_____________
Remarks

5. **Vegetative Cover** G Grass G Cover properly established G No signs of stress
G Trees/Shrubs (indicate size and locations on a diagram)
Remarks

6. **Alternative Cover (armored rock, concrete, etc.)** G N/A
Remarks

7. **Bulges** G Location shown on site map G Bulges not evident
Areal extent_______________ Height_____________
Remarks

8. **Wet Areas/Water Damage** G Wet areas/water damage not evident

G Wet areas G Location shown on site map Areal extent______________
G Ponding G Location shown on site map Areal extent______________
G Seeps G Location shown on site map Areal extent______________
G Soft subgrade G Location shown on site map Areal extent______________
Remarks____
____

9. **Slope Instability** G Slides G Location shown on site map G No evidence of slope instability

Areal extent______________
Remarks____
____

B. Benches G Applicable G 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** G Location shown on site map G N/A or okay

Remarks____
____

2. **Bench Breached** G Location shown on site map G N/A or okay

Remarks____
____

3. **Bench Overtopped** G Location shown on site map G N/A or okay

Remarks____
____

C. Letdown Channels G Applicable G 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** G Location shown on site map G No evidence of settlement

Areal extent______________ Depth____________
Remarks____
____

2. **Material Degradation** G Location shown on site map G No evidence of degradation

Material type_______________ Areal extent_____________
Remarks____
____

3. **Erosion** G Location shown on site map G No evidence of erosion

Areal extent______________ Depth____________
Remarks____
____

4.	**Undercutting** G Location shown on site map G No evidence of undercutting Areal extent______________ Depth____________ Remarks____ ____	
5.	**Obstructions** Type_____________________ G No obstructions G Location shown on site map Areal extent______________ Size____________ Remarks____ ____	
6.	**Excessive Vegetative Growth** Type____________________ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent______________ Remarks____ ____	
D. Cover Penetrations G Applicable G N/A		
1.	**Gas Vents** G Active G Passive G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____	
2.	**Gas Monitoring Probes** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____	
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____	
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____	
5.	**Settlement Monuments** G Located G Routinely surveyed G N/A Remarks____ ____	

E. **Gas Collection and Treatment** G Applicable G N/A	
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____
F. **Cover Drainage Layer** G Applicable G N/A	
1.	**Outlet Pipes Inspected** G Functioning G N/A Remarks____ ____
2.	**Outlet Rock Inspected** G Functioning G N/A Remarks____ ____
G. **Detention/Sedimentation Ponds** G Applicable G N/A	
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____
3.	**Outlet Works** G Functioning G N/A Remarks____ ____
4.	**Dam** G Functioning G N/A Remarks____ ____

H. Retaining Walls G Applicable G N/A

1. **Deformations** G Location shown on site map G Deformation not evident
Horizontal displacement_____________ Vertical displacement________________
Rotational displacement_____________
Remarks____
____

2. **Degradation** G Location shown on site map G Degradation not evident
Remarks____
____

I. Perimeter Ditches/Off-Site Discharge G Applicable G N/A

1. **Siltation** G Location shown on site map G Siltation not evident
Areal extent_______________ Depth_____________
Remarks____
____

2. **Vegetative Growth** G Location shown on site map G N/A
G Vegetation does not impede flow
Areal extent_______________ Type_____________
Remarks____
____

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent_______________ Depth_____________
Remarks____
____

4. **Discharge Structure** G Functioning G N/A
Remarks____
____

VIII. VERTICAL BARRIER WALLS G Applicable X N/A

1. **Settlement** G Location shown on site map G Settlement not evident
Areal extent_______________ Depth_____________
Remarks____
____

2. **Performance Monitoring** Type of monitoring___________________________
G Performance not monitored
Frequency_________________________________ G Evidence of breaching
Head differential____________________________
Remarks____
____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks____ ____ ____
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks____ ____
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____

C. **Treatment System** G Applicable G N/A
1. **Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters____ G Additive (*e.g.*, chelation agent, flocculent)_______________________________ G Others____ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually________________________ G Quantity of surface water treated annually________________________ Remarks____ ____
2. **Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks____ ____
3. **Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks____ ____
4. **Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks____ ____
5. **Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks____ ____
6. **Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks____ ____
D. Monitoring Data
1. Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2. Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

The status of ecological surveys will be documented in the 2013 Five-Year Review.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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 not applicable to this remedy.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

MWH

Photographic Log

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**ETC-10**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 1

Survey Date:
6/18/2013

Comments:
The wetland at ETC-10.

Five-Year Review Site Inspection Checklist – ETC-12

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: ETC-12	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**

Remedy Includes: (Check all that apply)

G Landfill cover/containment
G Access controls
G Institutional controls
G Groundwater pump and treatment
G Surface water collection and treatment
G Monitored natural attenuation
G Groundwater containment
G Vertical barrier walls
X **Other: Ecological monitoring consisting of wetland invertebrate (fairy shrimp) and plant surveys at selected vernal pools, surveys to be conducted every five years, in concert with five-year reviews, or up to 30 years. Surveys initiated in the spring of 2008**. ____________

Attachments: Photographic Log

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Ralph Scull (Name) — Field Tech (Title) — 18 June 13 (Date)
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

2. **O&M staff** Ralph Scull (Name) — Field Tech (Title) — 18 June 13 (Date)
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

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 ___**See Appendix D for Site Interviews**_________ Contact ______________________ ______________ ________ __________ Name Title Date Phone no. Problems; suggestions; G Report attached ____________________________ ____ Agency ______________________ Contact ______________________ ______________ ________ __________ Name Title Date Phone no. Problems; suggestions; G Report attached ____________________________ ____ Agency ______________________ 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 interviews** (optional) G Report attached.
See Appendix D for Site Interviews	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	G O&M manual	G Readily available	G Up to date	X N/A
	G As-built drawings	G Readily available	G Up to date	X N/A
	G Maintenance logs	G Readily available	G Up to date	X N/A
	Remarks______________________________			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks______________________________			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks______________________________			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks______________________________			
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
7.	**Groundwater Monitoring Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks______________________________			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	G Readily available	G Up to date	X N/A
	Remarks______________________________			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks______________________________			

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____

2. **O&M Cost Records**
G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None____

V. ACCESS AND INSTITUTIONAL CONTROLS G Applicable X N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured G N/A
Remarks: ____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks: ____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented G Yes G No G N/A
Site conditions imply ICs not being fully enforced G Yes G No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _ ______________________
Frequency ____
Responsible party/agency United States Air Force ________________________________
Contact ______________________________ ____________________ _________ ____________

Name	Title	Date	Phone no.

Reporting is up-to-date G Yes G No G N/A
Reports are verified by the lead agency G Yes G No G N/A

Specific requirements in deed or decision documents have been met G Yes G No G N/A
Violations have been reported G Yes G No G N/A
Other problems or suggestions: G Report attached
____
____
____
____

2. **Adequacy** G ICs are adequate G ICs are inadequate G N/A

Remarks____
____
____

D. General

1. **Vandalism/trespassing** G Location shown on site map G No vandalism evident

Remarks: ____
____

2. **Land use changes on site** G N/A

Remarks: ____
____

3. **Land use changes off site** G N/A

Remarks: ____
____

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable X N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A

Remarks____
____

B. Other Site Conditions

Remarks: Site is within United States Bureau of Prisons property and behind a perimeter fence. No signs of human activity observed.____

VII. LANDFILL COVERS G Applicable X N/A

A. Landfill Surface

1. **Settlement** (Low spots) G Location shown on site map G Settlement not evident
   Areal extent______________ Depth____________
   Remarks____

2. **Cracks** G Location shown on site map G Cracking not evident
   Lengths____________ Widths___________ Depths__________
   Remarks____

3. **Erosion** G Location shown on site map G Erosion not evident
   Areal extent______________ Depth____________
   Remarks____

4. **Holes** G Location shown on site map G Holes not evident
   Areal extent______________ Depth____________
   Remarks____

5. **Vegetative Cover** G Grass G Cover properly established G No signs of stress
   G Trees/Shrubs (indicate size and locations on a diagram)
   Remarks____

6. **Alternative Cover (armored rock, concrete, etc.)** G N/A
   Remarks____

7. **Bulges** G Location shown on site map G Bulges not evident
   Areal extent______________ Height____________
   Remarks____

8.	**Wet Areas/Water Damage** G Wet areas/water damage not evident G Wet areas G Location shown on site map Areal extent______________ G Ponding G Location shown on site map Areal extent______________ G Seeps G Location shown on site map Areal extent______________ G Soft subgrade G Location shown on site map Areal extent______________ Remarks____
9.	**Slope Instability** G Slides G Location shown on site map G No evidence of slope instability Areal extent______________ Remarks____
B. Benches	G Applicable G 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** G Location shown on site map G N/A or okay Remarks____
2.	**Bench Breached** G Location shown on site map G N/A or okay Remarks____
3.	**Bench Overtopped** G Location shown on site map G N/A or okay Remarks____
C. Letdown Channels	G Applicable G 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** G Location shown on site map G No evidence of settlement Areal extent______________ Depth____________ Remarks____
2.	**Material Degradation** G Location shown on site map G No evidence of degradation Material type_______________ Areal extent_____________ Remarks____
3.	**Erosion** G Location shown on site map G No evidence of erosion Areal extent______________ Depth____________ Remarks____

4. **Undercutting** G Location shown on site map G No evidence of undercutting
Areal extent______________ Depth____________
Remarks____
____

5. **Obstructions** Type_____________________ G No obstructions
G Location shown on site map Areal extent______________
Size____________
Remarks____
____

6. **Excessive Vegetative Growth** Type____________________
G No evidence of excessive growth
G Vegetation in channels does not obstruct flow
G Location shown on site map Areal extent______________
Remarks____
____

D. Cover Penetrations G Applicable G N/A

1. **Gas Vents** G Active G Passive
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance
G N/A
Remarks____
____

2. **Gas Monitoring Probes**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

3. **Monitoring Wells** (within surface area of landfill)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

4. **Leachate Extraction Wells**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

5. **Settlement Monuments** G Located G Routinely surveyed G N/A
Remarks____
____

E. Gas Collection and Treatment G Applicable G N/A	
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____
F. Cover Drainage Layer G Applicable G N/A	
1.	**Outlet Pipes Inspected** G Functioning G N/A Remarks____ ____
2.	**Outlet Rock Inspected** G Functioning G N/A Remarks____ ____
G. Detention/Sedimentation Ponds G Applicable G N/A	
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____
3.	**Outlet Works** G Functioning G N/A Remarks____ ____
4.	**Dam** G Functioning G N/A Remarks____ ____

H. Retaining Walls G Applicable G N/A	
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____ ____
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks____ ____
I. Perimeter Ditches/Off-Site Discharge G Applicable G N/A	
1.	**Siltation** G Location shown on site map G Siltation not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks____ ____
3.	**Erosion** G Location shown on site map G Erosion not evident Areal extent_______________ Depth_____________ Remarks____ ____
4.	**Discharge Structure** G Functioning G N/A Remarks____ ____
VIII. VERTICAL BARRIER WALLS G Applicable X N/A	
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Performance Monitoring** Type of monitoring____________________________ G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential____________________________ Remarks____ ____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks____
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks____
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____

C. **Treatment System** G Applicable G N/A	
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters____ G Additive (*e.g.*, chelation agent, flocculent)_______________________________ G Others____ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually________________________ G Quantity of surface water treated annually________________________ Remarks____ ____
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks____ ____
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks____ ____
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks____ ____
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks____ ____
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks____ ____
D. Monitoring Data	
1.	Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2.	Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

The status of ecological surveys will be documented in the 2013 Five-Year Review.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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 not applicable to this remedy.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

MWH

Photographic Log

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	ETC-12	Site Location:	Former Castle Air Force Base

Photograph ID: 1

Survey Date:
6/18/2013

Comments:
The wetland at ETC-12.

Five-Year Review Site Inspection Checklist – FTA-1

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: FTA-1	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**
Remedy Includes: (Check all that apply) **X Landfill cover/containment** G Monitored natural attenuation G Access controls G Groundwater containment **X Institutional controls** G Vertical barrier walls G Groundwater pump and treatment G Surface water collection and treatment **X Other: Ecological monitoring consisting of wetland invertebrate (fairy shrimp) and plant surveys at selected vernal pools, surveys to be conducted every five years, in concert with five-year reviews, or up to 30 years. Surveys initiated in the spring of 2008.** ____________	
Attachments: Photographic Log	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	
2. **O&M staff** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	

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 ___**See Appendix D for Site Interviews**__________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____________________________________

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____________________________________

Agency ______________________
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 interviews** (optional) G Report attached.

See Appendix D for Site Interviews

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	G O&M manual	G Readily available	G Up to date	X N/A
	G As-built drawings	G Readily available	G Up to date	X N/A
	G Maintenance logs	G Readily available	G Up to date	X N/A
	Remarks____			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks____			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks____			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks____			
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A
	Remarks____			
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A
	Remarks____			
7.	**Groundwater Monitoring Records**	G Readily available	G Up to date	X N/A
	Remarks____			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks____			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	G Readily available	G Up to date	X N/A
	Remarks____			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks____			

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____
____

2. **O&M Cost Records**
G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost
From__________ To__________ __________________ G Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None____
____
____
____
____
____

V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map X Gates secured G N/A
Remarks: Perimeter fence in good condition.
____
____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks: Signs in place.
____
____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented G Yes X No G N/A
Site conditions imply ICs not being fully enforced G Yes X No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________
Frequency _Not Applicable____
Responsible party/agency: United States Air Force ____
Contact ______________________________ ___________________ _________ _____________

Name	Title	Date	Phone no.

Reporting is up-to-date G Yes G No X N/A
Reports are verified by the lead agency G Yes G No X N/A

Specific requirements in deed or decision documents have been met X Yes G No G N/A
Violations have been reported G Yes X No G N/A
Other problems or suggestions: G Report attached
None. ICs to restrict site access and alteration are maintained as part of the Air Force/BoP memorandum of understanding.

2. **Adequacy** X ICs are adequate G ICs are inadequate G N/A
Remarks____

D. General

1. **Vandalism/trespassing** G Location shown on site map X No vandalism evident
Remarks: None____

2. **Land use changes on site** G N/A
Remarks: None____

3. **Land use changes off site** G N/A
Remarks: None____

VI. GENERAL SITE CONDITIONS

A. Roads G Applicable X N/A

1. **Roads damaged** G Location shown on site map G Roads adequate G N/A
Remarks____

B. Other Site Conditions

Remarks: Site is within United States Bureau of Prisons property and behind a perimeter fence. No signs of human activity observed.

VII. LANDFILL COVERS X Applicable G N/A

A. Landfill Surface

1. **Settlement** (Low spots) G Location shown on site map X Settlement not evident
   Areal extent______________ Depth____________
   Remarks

2. **Cracks** G Location shown on site map X Cracking not evident
   Lengths____________ Widths___________ Depths__________
   Remarks

3. **Erosion** G Location shown on site map X Erosion not evident
   Areal extent______________ Depth____________
   Remarks

4. **Holes** G Location shown on site map X Holes not evident
   Areal extent______________ Depth____________
   Remarks: Holes not evident through the HDPE liner that comprises the impermeable cover.

5. **Vegetative Cover** G Grass X Cover properly established G No signs of stress
   G Trees/Shrubs (indicate size and locations on a diagram)
   Remarks: Burrowing animal holes evident over the surface of the vegetative cover. The holes do not appear to have impacted the integrity of the HDPE liner or adversely impacted the stability of the vegetative soil cover.

6. **Alternative Cover (armored rock, concrete, etc.)** X N/A
   Remarks

7. **Bulges** G Location shown on site map X Bulges not evident
   Areal extent______________ Height____________
   Remarks

8. **Wet Areas/Water Damage** X Wet areas/water damage not evident
G Wet areas G Location shown on site map Areal extent_______________
G Ponding G Location shown on site map Areal extent_______________
G Seeps G Location shown on site map Areal extent_______________
G Soft subgrade G Location shown on site map Areal extent_______________
Remarks____
____

9. **Slope Instability** G Slides G Location shown on site map X No evidence of slope instability
Areal extent_______________
Remarks____
____

B. Benches G Applicable X 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** G Location shown on site map G N/A or okay
Remarks____
____

2. **Bench Breached** G Location shown on site map G N/A or okay
Remarks____
____

3. **Bench Overtopped** G Location shown on site map G N/A or okay
Remarks____
____

C. Letdown Channels G Applicable X 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** G Location shown on site map G No evidence of settlement
Areal extent_______________ Depth_____________
Remarks____
____

2. **Material Degradation** G Location shown on site map G No evidence of degradation
Material type________________ Areal extent______________
Remarks____
____

3. **Erosion** G Location shown on site map G No evidence of erosion
Areal extent_______________ Depth_____________
Remarks____
____

4. **Undercutting** G Location shown on site map G No evidence of undercutting
Areal extent______________ Depth____________
Remarks____
____

5. **Obstructions** Type_____________________ G No obstructions
G Location shown on site map Areal extent______________
Size____________
Remarks____
____

6. **Excessive Vegetative Growth** Type____________________
G No evidence of excessive growth
G Vegetation in channels does not obstruct flow
G Location shown on site map Areal extent______________
Remarks____
____

D. Cover Penetrations G Applicable X N/A

1. **Gas Vents** G Active G Passive
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance
G N/A
Remarks____
____

2. **Gas Monitoring Probes**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

3. **Monitoring Wells** (within surface area of landfill)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

4. **Leachate Extraction Wells**
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G Evidence of leakage at penetration G Needs Maintenance G N/A
Remarks____
____

5. **Settlement Monuments** G Located G Routinely surveyed G N/A
Remarks____
____

E. Gas Collection and Treatment G Applicable X N/A		
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____	
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____	
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____	
F. Cover Drainage Layer G Applicable X N/A		
1.	**Outlet Pipes Inspected** G Functioning G N/A Remarks____ ____	
2.	**Outlet Rock Inspected** G Functioning G N/A Remarks____ ____	
G. Detention/Sedimentation Ponds G Applicable X N/A		
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____	
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____	
3.	**Outlet Works** G Functioning G N/A Remarks____ ____	
4.	**Dam** G Functioning G N/A Remarks____ ____	

H. Retaining Walls G Applicable X N/A

1. **Deformations** G Location shown on site map G Deformation not evident
Horizontal displacement_____________ Vertical displacement________________
Rotational displacement_____________
Remarks____
____

2. **Degradation** G Location shown on site map G Degradation not evident
Remarks____
____

I. Perimeter Ditches/Off-Site Discharge G Applicable X N/A

1. **Siltation** G Location shown on site map G Siltation not evident
Areal extent_______________ Depth_____________
Remarks____
____

2. **Vegetative Growth** G Location shown on site map G N/A
G Vegetation does not impede flow
Areal extent_______________ Type_____________
Remarks____
____

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent_______________ Depth_____________
Remarks____
____

4. **Discharge Structure** G Functioning G N/A
Remarks____
____

VIII. VERTICAL BARRIER WALLS G Applicable X N/A

1. **Settlement** G Location shown on site map G Settlement not evident
Areal extent_______________ Depth_____________
Remarks____
____

2. **Performance Monitoring** Type of monitoring___________________________
G Performance not monitored
Frequency_________________________________ G Evidence of breaching
Head differential____________________________
Remarks____
____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A	
1.	**Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks____ ____ ____
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A	
1.	**Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks____ ____
2.	**Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3.	**Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____

C. Treatment System G Applicable G N/A	
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters____ G Additive (*e.g.*, chelation agent, flocculent)________________________ G Others____ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually_______________ G Quantity of surface water treated annually_______________ Remarks____ ____
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks____ ____
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks____ ____
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks____ ____
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks____ ____
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks____ ____
D. Monitoring Data	
1.	Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2.	Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

The status of ecological surveys will be documented in the 2013 Five-Year Review.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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 not applicable to this remedy.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

MWH

Photographic Log

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**FTA-1**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 1

Survey Date:
6/18/2013

Comments:
Burrowing animal holes are evident over the surface of the vegetative cover. The holes do not appear to have impacted the integrity of the HDPE liner or adversely impacted the stability of the vegetative soil cover, however.

Five-Year Review Site Inspection Checklist – LF-3

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: LF-3	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**

Remedy Includes: (Check all that apply)

G Landfill cover/containment
G Monitored natural attenuation
G Access controls
G Groundwater containment
G Institutional controls
G Vertical barrier walls
G Groundwater pump and treatment
G Surface water collection and treatment
X **Other: Ecological monitoring consisting of wetland invertebrate (fairy shrimp) and plant surveys at selected vernal pools, surveys to be conducted every five years, in concert with five-year reviews, or up to 30 years. Surveys initiated in the spring of 2008.** ___________

Attachments: Photographic Log

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Ralph Scull ___ Field Tech ___ 18 June 13
   Name / Title / Date
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

2. **O&M staff** Ralph Scull ___ Field Tech ___ 18 June 13
   Name / Title / Date
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

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 ___**See Appendix D for Site Interviews**__________
Contact ______________________________ ____________________ _________ _____________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____
____

Agency ______________________________
Contact ______________________________ ____________________ _________ _____________
Name Title Date Phone no.
Problems; suggestions; G Report attached ____
____

Agency ______________________________
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 interviews** (optional) G Report attached.

See Appendix D for Site Interviews

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)					
1.	**O&M Documents**				
	G O&M manual	G Readily available	G Up to date	X N/A	
	G As-built drawings	G Readily available	G Up to date	X N/A	
	G Maintenance logs	G Readily available	G Up to date	X N/A	
	Remarks____				
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A	
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A	
	Remarks____				
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A	
	Remarks____				
4.	**Permits and Service Agreements**				
	G Air discharge permit	G Readily available	G Up to date	X N/A	
	G Effluent discharge	G Readily available	G Up to date	X N/A	
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A	
	G Other permits______________________	G Readily available	G Up to date	X N/A	
	Remarks____				
5.	**Gas Generation Records**	G Readily available	G Up to date	X N/A	
	Remarks____				
6.	**Settlement Monument Records**	G Readily available	G Up to date	X N/A	
	Remarks____				
7.	**Groundwater Monitoring Records**	G Readily available	G Up to date	X N/A	
	Remarks____				
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A	
	Remarks____				
9.	**Discharge Compliance Records**				
	G Air	G Readily available	G Up to date	X N/A	
	G Water (effluent)	G Readily available	G Up to date	X N/A	
	Remarks____				
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A	
	Remarks____				

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____
____

2. **O&M Cost Records**
G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached
From__________	To__________	__________________	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None____
____
____
____
____
____

V. ACCESS AND INSTITUTIONAL CONTROLS G Applicable X N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map G Gates secured G N/A
Remarks ____
____

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks ____
____

C. Institutional Controls (ICs)		
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented G Yes G No G N/A Site conditions imply ICs not being fully enforced G Yes G No G N/A Type of monitoring (*e.g.*, self-reporting, drive by) _ ____ Frequency ____ Responsible party/agency United States Air Force ____ Contact ____ ____ ____ ____ Name Title Date Phone no. Reporting is up-to-date G Yes G No G N/A Reports are verified by the lead agency G Yes G No G N/A Specific requirements in deed or decision documents have been met G Yes G No G N/A Violations have been reported G Yes G No G N/A Other problems or suggestions: G Report attached ____ ____ ____ ____	
2.	**Adequacy** G ICs are adequate G ICs are inadequate G N/A Remarks____ ____ ____	
D. General		
1.	**Vandalism/trespassing** G Location shown on site map G No vandalism evident Remarks: ____ ____	
2.	**Land use changes on site** G N/A Remarks: ____ ____	
3.	**Land use changes off site** G N/A Remarks: ____ ____	
VI. GENERAL SITE CONDITIONS		
A. Roads G Applicable X N/A		
1.	**Roads damaged** G Location shown on site map G Roads adequate G N/A Remarks____ ____	

B. Other Site Conditions

Remarks: Site is within United States Bureau of Prisons property and behind a perimeter fence. No signs of human activity observed.____

VII. LANDFILL COVERS G Applicable X N/A

A. Landfill Surface

1. **Settlement** (Low spots) G Location shown on site map G Settlement not evident
Areal extent______________ Depth____________
Remarks____

2. **Cracks** G Location shown on site map G Cracking not evident
Lengths____________ Widths___________ Depths__________
Remarks____

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent______________ Depth____________
Remarks____

4. **Holes** G Location shown on site map G Holes not evident
Areal extent______________ Depth____________
Remarks____

5. **Vegetative Cover** G Grass G Cover properly established G No signs of stress
G Trees/Shrubs (indicate size and locations on a diagram)
Remarks____

6. **Alternative Cover (armored rock, concrete, etc.)** G N/A
Remarks____

7. **Bulges** G Location shown on site map G Bulges not evident
Areal extent______________ Height____________
Remarks____

8. **Wet Areas/Water Damage** G Wet areas/water damage not evident

G Wet areas G Location shown on site map Areal extent_______________

G Ponding G Location shown on site map Areal extent_______________

G Seeps G Location shown on site map Areal extent_______________

G Soft subgrade G Location shown on site map Areal extent_______________

Remarks____

____

9. **Slope Instability** G Slides G Location shown on site map G No evidence of slope instability

Areal extent_______________

Remarks____

____

B. Benches G Applicable G 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** G Location shown on site map G N/A or okay

Remarks____

____

2. **Bench Breached** G Location shown on site map G N/A or okay

Remarks____

____

3. **Bench Overtopped** G Location shown on site map G N/A or okay

Remarks____

____

C. Letdown Channels G Applicable G 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** G Location shown on site map G No evidence of settlement

Areal extent_______________ Depth_____________

Remarks____

____

2. **Material Degradation** G Location shown on site map G No evidence of degradation

Material type________________ Areal extent______________

Remarks____

____

3. **Erosion** G Location shown on site map G No evidence of erosion

Areal extent_______________ Depth_____________

Remarks____

____

4.	**Undercutting** G Location shown on site map G No evidence of undercutting Areal extent______________ Depth____________ Remarks____
5.	**Obstructions** Type_____________________ G No obstructions G Location shown on site map Areal extent______________ Size____________ Remarks____
6.	**Excessive Vegetative Growth** Type____________________ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent______________ Remarks____
D. Cover Penetrations G Applicable G N/A	
1.	**Gas Vents** G Active G Passive G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
2.	**Gas Monitoring Probes** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
5.	**Settlement Monuments** G Located G Routinely surveyed G N/A Remarks____

E. Gas Collection and Treatment G Applicable G N/A
1. **Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____
2. **Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____
3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____
F. Cover Drainage Layer G Applicable G N/A
1. **Outlet Pipes Inspected** G Functioning G N/A Remarks____ ____
2. **Outlet Rock Inspected** G Functioning G N/A Remarks____ ____
G. Detention/Sedimentation Ponds G Applicable G N/A
1. **Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____
2. **Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____
3. **Outlet Works** G Functioning G N/A Remarks____ ____
4. **Dam** G Functioning G N/A Remarks____ ____

H. Retaining Walls	G Applicable	G N/A	
1.	**Deformations**	G Location shown on site map	G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____
2.	**Degradation**	G Location shown on site map	G Degradation not evident Remarks____
I. Perimeter Ditches/Off-Site Discharge	G Applicable	G N/A	
1.	**Siltation**	G Location shown on site map	G Siltation not evident Areal extent_______________ Depth_____________ Remarks____
2.	**Vegetative Growth**	G Location shown on site map	G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks____
3.	**Erosion**	G Location shown on site map	G Erosion not evident Areal extent_______________ Depth_____________ Remarks____
4.	**Discharge Structure**	G Functioning	G N/A Remarks____
VIII. VERTICAL BARRIER WALLS	G Applicable	X N/A	
1.	**Settlement**	G Location shown on site map	G Settlement not evident Areal extent_______________ Depth_____________ Remarks____
2.	**Performance Monitoring**	Type of monitoring___________________________	G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential___________________________ Remarks____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks_______________
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks_______________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks_______________
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks_______________
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks_______________
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks_______________

C. Treatment System G Applicable G N/A

1. **Treatment Train** (Check components that apply)
G Metals removal G Oil/water separation G Bioremediation
G Air stripping G Carbon adsorbers
G Filters____
G Additive (*e.g.*, chelation agent, flocculent)_________________________
G Others____
G Good condition G Needs Maintenance
G Sampling ports properly marked and functional
G Sampling/maintenance log displayed and up to date
G Equipment properly identified
G Quantity of groundwater treated annually________________
G Quantity of surface water treated annually________________
Remarks____
____

2. **Electrical Enclosures and Panels** (properly rated and functional)
G N/A G Good condition G Needs Maintenance
Remarks____
____

3. **Tanks, Vaults, Storage Vessels**
G N/A G Good condition G Proper secondary containment G Needs Maintenance
Remarks____
____

4. **Discharge Structure and Appurtenances**
G N/A G Good condition G Needs Maintenance
Remarks____
____

5. **Treatment Building(s)**
G N/A G Good condition (esp. roof and doorways) G Needs repair
G Chemicals and equipment properly stored
Remarks____
____

6. **Monitoring Wells** (pump and treatment remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G N/A
Remarks____
____

D. Monitoring Data

1. Monitoring Data
G Is routinely submitted on time G Is of acceptable quality

2. Monitoring data suggests:
G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

The status of ecological surveys will be documented in the 2013 Five-Year Review.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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 not applicable to this remedy.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

MWH

Photographic Log

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	LF-3	Site Location:	Former Castle Air Force Base

Photograph ID: 1

Survey Date:
6/18/2013

Comments:
A view of LF-3.

Five-Year Review Site Inspection Checklist – LF-4

(“N/A” refers to “not applicable.”)

I. SITE INFORMATION	
Site name: LF-4	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**

Remedy Includes: (Check all that apply)

- X **Landfill cover/containment**
- G Access controls
- X **Institutional controls**
- G Groundwater pump and treatment
- G Surface water collection and treatment
- G Other: ____
- G Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: Photographic Log

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Ralph Scull __________ Field Tech ______ 18 June 13
   Name / Title / Date
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

2. **O&M staff** Ralph Scull __________ Field Tech ______ 18 June 13
   Name / Title / Date
   Interviewed at site, Phone no. 916-335-9735
   Problems, suggestions; None

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 ___**See Appendix D for Site Interviews**_________ Contact ______________ ______________ ______ ______ Name Title Date Phone no. Problems; suggestions; G Report attached ______________________________ Agency ______________ Contact ______________ ______________ ______ ______ Name Title Date Phone no. Problems; suggestions; G Report attached ______________________________ Agency ______________ 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 interviews** (optional) G Report attached.
See Appendix D for Site Interviews	

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1. **O&M Documents**				
X O&M manual	X Readily available	X Up to date	G N/A	
X As-built drawings	X Readily available	X Up to date	G N/A	
X Maintenance logs	X Readily available	X Up to date	G N/A	
Remarks: Landfill as-builts are maintained as part of the drawings that represent the final composition of the covered landfill. The actual construction as-builts are maintained has part of the construction documentation report which is available on the administrative record.				
2. **Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A	
G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A	
Remarks______				
3. **O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A	
Remarks______				
4. **Permits and Service Agreements**				
G Air discharge permit	G Readily available	G Up to date	X N/A	
G Effluent discharge	G Readily available	G Up to date	X N/A	
G Waste disposal, POTW	G Readily available	G Up to date	X N/A	
G Other permits______	G Readily available	G Up to date	X N/A	
Remarks______				
5. **Gas Generation Records**	X Readily available	X Up to date	G N/A	
Remarks______				
6. **Settlement Monument Records**	X Readily available	X Up to date	G N/A	
Remarks______				
7. **Groundwater Monitoring Records**	X Readily available	X Up to date	G N/A	
Remarks______				
8. **Leachate Extraction Records**	G Readily available	G Up to date	X N/A	
Remarks______				
9. **Discharge Compliance Records**				
G Air	G Readily available	G Up to date	X N/A	
G Water (effluent)	G Readily available	G Up to date	X N/A	
Remarks______				
10. **Daily Access/Security Logs**	G Readily available	G Up to date	X N/A	
Remarks______				

IV. O&M COSTS
1. **O&M Organization** G State in-house G Contractor for State G PRP in-house G Contractor for PRP G Federal Facility in-house X Contractor for Federal Facility G Other___
2. **O&M Cost Records** G Readily available G Up to date X Funding mechanism/agreement in place Original O&M cost estimate___ G Breakdown attached Total annual cost by year for review period if available From___ To___ ___ G Breakdown attached Date Date Total cost From___ To___ ___ G Breakdown attached Date Date Total cost From___ To___ ___ G Breakdown attached Date Date Total cost From___ To___ ___ G Breakdown attached Date Date Total cost From___ To___ ___ G Breakdown attached Date Date Total cost
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: None___
V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A
A. Fencing
1. **Fencing damaged** G Location shown on site map X Gates secured G N/A Remarks: Perimeter fence in good condition. The front entrance gate slightly bent but the gate can be locked, this gate has been like this for over a decade.
B. Other Access Restrictions
1. **Signs and other security measures** G Location shown on site map G N/A Remarks: Signs in place.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented G Yes X No G N/A
Site conditions imply ICs not being fully enforced G Yes X No G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________
Frequency _Not Applicable____
Responsible party/agency: United States Air Force ____
Contact ______________________________ ___________________ _________ _____________

Name	Title	Date	Phone no.

Reporting is up-to-date G Yes G No X N/A
Reports are verified by the lead agency G Yes G No X N/A

Specific requirements in deed or decision documents have been met X Yes G No G N/A
Violations have been reported G Yes X No G N/A
Other problems or suggestions: G Report attached
None. ICs to restrict site access and alteration are maintained as part of the deed transferring the parcel to Merced County and a State Land Use Covenant executed by the Air Force and the State of California.

2. **Adequacy** X ICs are adequate G ICs are inadequate G N/A
Remarks____

D. General

1. **Vandalism/trespassing** G Location shown on site map X No vandalism evident
Remarks: None____

2. **Land use changes on site** G N/A
Remarks: None____

3. **Land use changes off site** G N/A
Remarks: None____

VI. GENERAL SITE CONDITIONS

A. Roads X Applicable G N/A

1. **Roads damaged** G Location shown on site map X Roads adequate G N/A
Remarks: Perimeter access roads around the landfill do not show any signs of damage.

B. Other Site Conditions
Remarks: Site appears to be in good condition and no unauthorized access.

VII. LANDFILL COVERS X Applicable G N/A			
A. Landfill Surface			
1.	**Settlement** (Low spots) Areal extent______________ Remarks:__________	G Location shown on site map Depth____________	X Settlement not evident
2.	**Cracks** Lengths____________ Widths___________ Depths__________ Remarks__________	G Location shown on site map	X Cracking not evident
3.	**Erosion** Areal extent______________ Remarks__________	G Location shown on site map Depth____________	X Erosion not evident
4.	**Holes** Areal extent______________ Remarks: Holes not evident through the HDPE liner that comprises the impermeable cover.	G Location shown on site map Depth____________	X Holes not evident
5.	**Vegetative Cover** G Grass X Cover properly established X No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks: __________		
6.	**Alternative Cover (armored rock, concrete, etc.)** X N/A Remarks__________		
7.	**Bulges** Areal extent______________ Remarks__________	G Location shown on site map Height____________	X Bulges not evident

8.	**Wet Areas/Water Damage** X Wet areas/water damage not evident G Wet areas G Location shown on site map Areal extent______________ G Ponding G Location shown on site map Areal extent______________ G Seeps G Location shown on site map Areal extent______________ G Soft subgrade G Location shown on site map Areal extent______________ Remarks____
9.	**Slope Instability** G Slides G Location shown on site map X No evidence of slope instability Areal extent______________ Remarks____
B. Benches G Applicable X 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** G Location shown on site map G N/A or okay Remarks____
2.	**Bench Breached** G Location shown on site map G N/A or okay Remarks____
3.	**Bench Overtopped** G Location shown on site map G N/A or okay Remarks____
C. Letdown Channels G Applicable X 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** G Location shown on site map G No evidence of settlement Areal extent______________ Depth____________ Remarks____
2.	**Material Degradation** G Location shown on site map G No evidence of degradation Material type_______________ Areal extent_____________ Remarks:
3.	**Erosion** G Location shown on site map G No evidence of erosion Areal extent______________ Depth____________ Remarks ____

4.	**Undercutting** G Location shown on site map G No evidence of undercutting Areal extent_______________ Depth____________ Remarks____ ____
5.	**Obstructions** Type______________________ G No obstructions G Location shown on site map Areal extent_______________ Size_____________ Remarks____ ____
6.	**Excessive Vegetative Growth** Type: _____________________ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent_______________ Remarks: ____
D. Cover Penetrations X Applicable G N/A	
1.	**Gas Vents** G Active X Passive G Properly secured/locked X Functioning X Routinely sampled X Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
2.	**Gas Monitoring Probes** G Properly secured/locked X Functioning X Routinely sampled X Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____ ____
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance X N/A Remarks____ ____
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance X N/A Remarks____ ____
5.	**Settlement Monuments** X Located X Routinely surveyed G N/A Remarks____ ____

E. Gas Collection and Treatment G Applicable X N/A	
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____
F. Cover Drainage Layer X Applicable G N/A	
1.	**Outlet Pipes Inspected** G Functioning X N/A Remarks: ____
2.	**Outlet Rock Inspected** X Functioning G N/A Remarks____ ____
G. Detention/Sedimentation Ponds G Applicable X N/A	
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____
3.	**Outlet Works** G Functioning G N/A Remarks____ ____
4.	**Dam** G Functioning G N/A Remarks____ ____

H. Retaining Walls	G Applicable X N/A
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks____
I. Perimeter Ditches/Off-Site Discharge	X Applicable G N/A
1.	**Siltation** G Location shown on site map X Siltation not evident Areal extent_______________ Depth_____________ Remarks____
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks: The extent of vegetation in the drainage channels should be evaluated to determine if the amount of vegetation is an obstruction to drainage flow off of and away from the landfill cap.
3.	**Erosion** G Location shown on site map X Erosion not evident Areal extent_______________ Depth_____________ Remarks____
4.	**Discharge Structure** X Functioning G N/A Remarks:
VIII. VERTICAL BARRIER WALLS	G Applicable X N/A
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent_______________ Depth_____________ Remarks____
2.	**Performance Monitoring** Type of monitoring___________________________ G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential___________________________ Remarks____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
G Good condition G All required wells properly operating G Needs Maintenance G N/A
Remarks____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A

1. **Collection Structures, Pumps, and Electrical**
G Good condition G Needs Maintenance
Remarks____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
G Good condition G Needs Maintenance
Remarks____

3. **Spare Parts and Equipment**
G Readily available G Good condition G Requires upgrade G Needs to be provided
Remarks____

C. Treatment System G Applicable G N/A
1. **Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters______________________________ G Additive (*e.g.*, chelation agent, flocculent)______________________________ G Others______________________________ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually________________ G Quantity of surface water treated annually________________ Remarks______________________________ ______________________________
2. **Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks______________________________ ______________________________
3. **Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks______________________________ ______________________________
4. **Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks______________________________ ______________________________
5. **Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks______________________________ ______________________________
6. **Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks______________________________ ______________________________
D. Monitoring Data
1. Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2. Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

Not Applicable.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

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.

Drainage ditches do have vegetative growth, which can be cleaned out prior to the rainy season to maintain design flow within the drainage ditches.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**LF-4**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 1

Survey Date:
6/18/2013

Comments:
Drainage ditch at LF-4. Some vegetation is present in the ditch.

Photograph ID: 2

Survey Date:
6/18/2013

Comments:
The LF-4 perimeter fencing is in good condition and signage is in place.

Five-Year Review Site Inspection Checklist – LF-5

("N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: LF-5	**Date of inspection: 18 June 2013**
Location and Region: Castle Airport	**EPA ID: CA3570024551**
Agency, office, or company leading the five-year review: United States Air Force	**Weather/temperature: Clear, Sunny, warm (90s)**
Remedy Includes: (Check all that apply) X **Landfill cover/containment** G Monitored natural attenuation G Access controls G Groundwater containment X **Institutional controls** G Vertical barrier walls G Groundwater pump and treatment G Surface water collection and treatment X **Other: Ecological monitoring consisting of wetland invertebrate (fairy shrimp) and plant surveys at selected vernal pools, surveys to be conducted every five years, in concert with five-year reviews, or up to 30 years. Surveys initiated in the spring of 2008.** ___________	
Attachments: Photographic Log	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	
2. **O&M staff** Ralph Scull (Name) Field Tech (Title) 18 June 13 (Date) Interviewed at site, Phone no. 916-335-9735 Problems, suggestions; None	

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 ___**See Appendix D for Site Interviews**_________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________________

Agency ______________________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________________

Agency ______________________
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 interviews** (optional) G Report attached.

See Appendix D for Site Interviews

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	X O&M manual	X Readily available	X Up to date	G N/A
	X As-built drawings	X Readily available	X Up to date	G N/A
	X Maintenance logs	X Readily available	X Up to date	G N/A
	Remarks: Landfill as-builts are maintained as part of the drawings that represent the final composition of the covered landfill. The actual construction as-builts are maintained has part of the construction documentation report which is available on the administrative record.			
2.	**Site-Specific Health and Safety Plan**	X Readily available	X Up to date	G N/A
	G Contingency plan/emergency response plan	X Readily available	X Up to date	G N/A
	Remarks________________________________			
3.	**O&M and OSHA Training Records**	X Readily available	X Up to date	G N/A
	Remarks________________________________			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	X N/A
	G Effluent discharge	G Readily available	G Up to date	X N/A
	G Waste disposal, POTW	G Readily available	G Up to date	X N/A
	G Other permits______________________	G Readily available	G Up to date	X N/A
	Remarks________________________________			
5.	**Gas Generation Records**	X Readily available	X Up to date	G N/A
	Remarks________________________________			
6.	**Settlement Monument Records**	X Readily available	X Up to date	G N/A
	Remarks________________________________			
7.	**Groundwater Monitoring Records**	X Readily available	X Up to date	G N/A
	Remarks________________________________			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	X N/A
	Remarks________________________________			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	X N/A
	G Water (effluent)	G Readily available	G Up to date	X N/A
	Remarks________________________________			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	X N/A
	Remarks________________________________			

IV. O&M COSTS

1. **O&M Organization**
G State in-house G Contractor for State
G PRP in-house G Contractor for PRP
G Federal Facility in-house X Contractor for Federal Facility
G Other____
____

2. **O&M Cost Records**
G Readily available G Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate____________________ G Breakdown attached

Total annual cost by year for review period if available

From__________ (Date)	To__________ (Date)	____________________ (Total cost)	G Breakdown attached
From__________ (Date)	To__________ (Date)	____________________ (Total cost)	G Breakdown attached
From__________ (Date)	To__________ (Date)	____________________ (Total cost)	G Breakdown attached
From__________ (Date)	To__________ (Date)	____________________ (Total cost)	G Breakdown attached
From__________ (Date)	To__________ (Date)	____________________ (Total cost)	G Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: None____

V. ACCESS AND INSTITUTIONAL CONTROLS X Applicable G N/A

A. Fencing

1. **Fencing damaged** G Location shown on site map X Gates secured G N/A
Remarks: Perimeter fence in good condition.

B. Other Access Restrictions

1. **Signs and other security measures** G Location shown on site map G N/A
Remarks: Signs in place.

C. Institutional Controls (ICs)	
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented G Yes X No G N/A Site conditions imply ICs not being fully enforced G Yes X No G N/A Type of monitoring (*e.g.*, self-reporting, drive by) _Self Reporting ______________________ Frequency _Not Applicable____ Responsible party/agency: United States Air Force ___________________________________ Contact ______________________ ______________ ________ __________ Name Title Date Phone no. Reporting is up-to-date G Yes G No X N/A Reports are verified by the lead agency G Yes G No X N/A Specific requirements in deed or decision documents have been met X Yes G No G N/A Violations have been reported G Yes X No G N/A Other problems or suggestions: G Report attached None. ICs to restrict site access and alteration are maintained as part of the Air Force/BoP memorandum of understanding.
2.	**Adequacy** X ICs are adequate G ICs are inadequate G N/A Remarks____
D. General	
1.	**Vandalism/trespassing** G Location shown on site map X No vandalism evident Remarks: None____
2.	**Land use changes on site** G N/A Remarks: None____
3.	**Land use changes off site** G N/A Remarks: None____
VI. GENERAL SITE CONDITIONS	
A. Roads X Applicable G N/A	
1.	**Roads damaged** G Location shown on site map X Roads adequate G N/A Remarks: Perimeter access roads around the landfill do not show any signs of damage.

B. Other Site Conditions	
	Remarks: Site is within United States Bureau of Prisons property and behind a perimeter fence. No signs of human activity observed.
VII. LANDFILL COVERS X Applicable G N/A	
A. Landfill Surface	
1.	**Settlement** (Low spots) G Location shown on site map G Settlement not evident Areal extent______ Depth______ Remarks: There are various depressions in the landfill surface. The Air Force Representative (Mr. Yuki) indicated that these depressions have been present for a long time, and that during rain events water drainage was maintained off of the landfill and into the rock lined drainage ditches. The observed direction of the depressions indicated that the landfill cap should be directing water off of and away from the landfill cap. The depth and extent of depressions should be evaluated as part of the aerial survey.
2.	**Cracks** G Location shown on site map X Cracking not evident Lengths______ Widths______ Depths______ Remarks______
3.	**Erosion** G Location shown on site map X Erosion not evident Areal extent______ Depth______ Remarks______
4.	**Holes** G Location shown on site map X Holes not evident Areal extent______ Depth______ Remarks: Holes not evident through the HDPE liner that comprises the impermeable cover.
5.	**Vegetative Cover** G Grass X Cover properly established G No signs of stress G Trees/Shrubs (indicate size and locations on a diagram) Remarks: Burrowing animal holes evident over the surface of the vegetative cover. The holes do not appear to have impacted the integrity of the HDPE liner or adversely impacted the stability of the vegetative soil cover.
6.	**Alternative Cover (armored rock, concrete, etc.)** X N/A Remarks______

7.	**Bulges**	G Location shown on site map	X Bulges not evident
	Areal extent_______________	Height_____________	
	Remarks______________________________		
8.	**Wet Areas/Water Damage**	X Wet areas/water damage not evident	
	G Wet areas	G Location shown on site map	Areal extent_______________
	G Ponding	G Location shown on site map	Areal extent_______________
	G Seeps	G Location shown on site map	Areal extent_______________
	G Soft subgrade	G Location shown on site map	Areal extent_______________
	Remarks______________________________		
9.	**Slope Instability** G Slides	G Location shown on site map	X No evidence of slope instability
	Areal extent_______________		
	Remarks______________________________		
B. Benches	G Applicable	X 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**	G Location shown on site map	G N/A or okay
	Remarks______________________________		
2.	**Bench Breached**	G Location shown on site map	G N/A or okay
	Remarks______________________________		
3.	**Bench Overtopped**	G Location shown on site map	G N/A or okay
	Remarks______________________________		
C. Letdown Channels	X Applicable	G 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**	G Location shown on site map	X No evidence of settlement
	Areal extent_______________	Depth_____________	
	Remarks______________________________		
2.	**Material Degradation**	G Location shown on site map	X No evidence of degradation
	Material type________________	Areal extent______________	
	Remarks: Channels are rock lined.		
3.	**Erosion**	G Location shown on site map	X No evidence of erosion
	Areal extent_______________	Depth_____________	
	Remarks ______________________________		

4.	**Undercutting** G Location shown on site map X No evidence of undercutting Areal extent______________ Depth____________ Remarks____
5.	**Obstructions** Type_____________________ X No obstructions G Location shown on site map Areal extent______________ Size____________ Remarks____
6.	**Excessive Vegetative Growth** Type: Vegetative____________________ G No evidence of excessive growth G Vegetation in channels does not obstruct flow G Location shown on site map Areal extent______________ Remarks: The extent of vegetation in the drainage channels should be evaluated to determine if the amount of vegetation is an obstruction to drainage flow off of and away from the landfill cap.
D. Cover Penetrations X Applicable G N/A	
1.	**Gas Vents** G Active X Passive G Properly secured/locked X Functioning X Routinely sampled X Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
2.	**Gas Monitoring Probes** G Properly secured/locked X Functioning X Routinely sampled X Good condition G Evidence of leakage at penetration G Needs Maintenance G N/A Remarks____
3.	**Monitoring Wells** (within surface area of landfill) G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance X N/A Remarks____
4.	**Leachate Extraction Wells** G Properly secured/locked G Functioning G Routinely sampled G Good condition G Evidence of leakage at penetration G Needs Maintenance X N/A Remarks____
5.	**Settlement Monuments** X Located X Routinely surveyed G N/A Remarks____

E. Gas Collection and Treatment G Applicable X N/A		
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks____ ____	
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks____ ____	
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks____ ____	
F. Cover Drainage Layer X Applicable G N/A		
1.	**Outlet Pipes Inspected** G Functioning X N/A Remarks: ____	
2.	**Outlet Rock Inspected** X Functioning G N/A Remarks____ ____	
G. Detention/Sedimentation Ponds G Applicable X N/A		
1.	**Siltation** Areal extent______________ Depth____________ G N/A G Siltation not evident Remarks____ ____	
2.	**Erosion** Areal extent______________ Depth____________ G Erosion not evident Remarks____ ____	
3.	**Outlet Works** G Functioning G N/A Remarks____ ____	
4.	**Dam** G Functioning G N/A Remarks____ ____	

H. Retaining Walls G Applicable X N/A	
1.	**Deformations** G Location shown on site map G Deformation not evident Horizontal displacement_____________ Vertical displacement________________ Rotational displacement_____________ Remarks____ ____
2.	**Degradation** G Location shown on site map G Degradation not evident Remarks____ ____
I. Perimeter Ditches/Off-Site Discharge X Applicable G N/A	
1.	**Siltation** G Location shown on site map X Siltation not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Vegetative Growth** G Location shown on site map G N/A G Vegetation does not impede flow Areal extent_______________ Type_____________ Remarks: The extent of vegetation in the drainage channels should be evaluated to determine if the amount of vegetation is an obstruction to drainage flow off of and away from the landfill cap. ____
3.	**Erosion** G Location shown on site map X Erosion not evident Areal extent_______________ Depth_____________ Remarks____ ____
4.	**Discharge Structure** G Functioning G N/A Remarks: The culverts on the southeastern part of the site that transfers drainage water from the landfill and off site, partially filled with rock. Transfer and drainage of water can still take place, however these culverts should be cleaned out to maintain maximum capacity in the event of significant rain events. ____
VIII. VERTICAL BARRIER WALLS G Applicable X N/A	
1.	**Settlement** G Location shown on site map G Settlement not evident Areal extent_______________ Depth_____________ Remarks____ ____
2.	**Performance Monitoring** Type of monitoring___________________________ G Performance not monitored Frequency_________________________________ G Evidence of breaching Head differential___________________________ Remarks____ ____

IX. GROUNDWATER/SURFACE WATER REMEDIES G Applicable X N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines G Applicable G N/A
1. **Pumps, Wellhead Plumbing, and Electrical** G Good condition G All required wells properly operating G Needs Maintenance G N/A Remarks____ ____ ____
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____
B. Surface Water Collection Structures, Pumps, and Pipelines G Applicable G N/A
1. **Collection Structures, Pumps, and Electrical** G Good condition G Needs Maintenance Remarks____ ____
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** G Good condition G Needs Maintenance Remarks____ ____
3. **Spare Parts and Equipment** G Readily available G Good condition G Requires upgrade G Needs to be provided Remarks____ ____

C. Treatment System G Applicable G N/A	
1.	**Treatment Train** (Check components that apply) G Metals removal G Oil/water separation G Bioremediation G Air stripping G Carbon adsorbers G Filters____ G Additive (*e.g.*, chelation agent, flocculent)________________________ G Others____ G Good condition G Needs Maintenance G Sampling ports properly marked and functional G Sampling/maintenance log displayed and up to date G Equipment properly identified G Quantity of groundwater treated annually________________ G Quantity of surface water treated annually________________ Remarks____
2.	**Electrical Enclosures and Panels** (properly rated and functional) G N/A G Good condition G Needs Maintenance Remarks____
3.	**Tanks, Vaults, Storage Vessels** G N/A G Good condition G Proper secondary containment G Needs Maintenance Remarks____
4.	**Discharge Structure and Appurtenances** G N/A G Good condition G Needs Maintenance Remarks____
5.	**Treatment Building(s)** G N/A G Good condition (esp. roof and doorways) G Needs repair G Chemicals and equipment properly stored Remarks____
6.	**Monitoring Wells** (pump and treatment remedy) G Properly secured/locked G Functioning G Routinely sampled G Good condition G All required wells located G Needs Maintenance G N/A Remarks____
D. Monitoring Data	
1.	Monitoring Data G Is routinely submitted on time G Is of acceptable quality
2.	Monitoring data suggests: G Groundwater plume is effectively contained G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G 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.

The status of ecological surveys will be documented in the 2013 Five-Year Review.

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.).

No issues observed that would impact the effectiveness and function of the remedy.

____
____
____

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 observed holes in the vegetative cover do not appear to penetrate the HDPE liner. The drainage ditches do have vegetative growth, which can be cleaned out prior to the rainy season to maintain design flow within the drainage ditches. The culvert that is partially filled with rock can also be cleaned out prior to the rainy season to maintain design flow.

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C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No issues or observations that would indicate potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. No possible opportunities for optimization observed.

Client:	**Air Force Civil Engineer Center**	**Project:**	**Castle Airport**
Site Name:	**LF-5**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 1

Survey Date: 6/18/2013

Comments: Burrowing animal holes are evident over the surface of the vegetative cover. The holes do not appear to have impacted the integrity of the HDPE liner or adversely impacted the stability of the vegetative soil cover, however.

Photograph ID: 2

Survey Date: 6/18/2013

Comments: One of the culverts on the southeastern part of the Site that transfer drainage water from the landfill and off site. They are partially filled with rock. Transfer and drainage of water can still take place, however.

Client:	Air Force Civil Engineer Center	Project:	Castle Airport
Site Name:	**LF-5**	**Site Location:**	**Former Castle Air Force Base**

Photograph ID: 3	
Survey Date: 6/18/2013	
Comments: Drainage ditch at LF-5. Some vegetation is present in the ditch.	

APPENDIX D

SITE INTERVIEWS

Five-Year Review Interviews

Information gathered from interviews during the site inspection may be key to understanding site status. Interviews should be conducted with various individuals or groups, including the operation and maintenance (O&M) site manager, O&M staff, local regulatory authorities and response agencies, community action groups or associations, site neighbors, and other stakeholders.

When conducting an interview, the interviewer should note the date of the interview, and the name, title, and affiliation of the person interviewed. The interviewer should also indicate whether the interview was conducted at the site, the office, or by phone. Written documentation of the interview should briefly summarize the discussion, address any problems or successes with the implementation of the remedy, and provide suggestions for future reference. Forms to use during interviews are provided at the end of this appendix.

The following tables provide lists of potential individuals to interview and the type of information which may be obtained during the interviews. The potential individuals to be interviewed are categorized by their ability to provide the following types of information:

- Background information;
- State and local considerations;
- Construction considerations; and
- Performance, Operation and maintenance problems.

All of these individuals may be contacted during the five-year review. In most cases interviewing only a few key individuals will provide sufficient information for the review.

Background Information

The individuals listed below may provide information concerning previous and current concerns about the site, influences that affected the remedy decision, and further clarification on decisions made during remedy selection.

Interview	Information Sought
Previous EPA Staff/Management	– staff members may offer insight and clarification on decisions made during remedy selection and implementation
Nearest Neighbors	– neighbors may provide insight into the enforcement of institutional controls, changes in land use, trespassing, and unusual or unexpected activity at the site
Community Representatives*	– members of the community may provide a broader view of site activities and issues than can be obtained during the site inspection

* Several types of individuals may be interviewed: residents/businesses adjacent to or on the site; residents/businesses within the path of migration; local civic leaders, local officials, Community Advisory Group (CAG), Technical Assistance Grant (TAG) group, and local environmental groups; and other audiences listed in the community profile in the Community Involvement Plan.

Some example interview questions are given below.

1. What is your overall impression of the project? (general sentiment)

2. What effects have site operations had on the surrounding community?

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

5. Do you feel well informed about the site's activities and progress?

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

State and Local Considerations

State and local authorities may provide you with information about changes in State laws and regulations and present and prospective land uses and restrictions.

Interview	Information Sought
State Contacts (including those responsible for State water quality, hazardous waste, and environmental health issues)	– changes in State laws and regulations that may impact protectiveness – whether the site has been in compliance with permitting or reporting requirements – information on site activities, status, and issues
Local Authorities (such as police, emergency response or fire departments, and local environmental or planning offices)	– status of institutional controls, site access controls, new ordinances in place, changes in actual or projected land use, complaints being filed, and unusual activities at the site

Some example interview questions are given below.

1. What is your overall impression of the project? (general sentiment)

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

4. Do you feel well informed about the site's activities and progress?

5. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Construction Considerations

It is important for you to determine the status of construction at the site and to ensure that health and safety concerns are addressed.

Interview		Information Sought
Construction Contractor	–	progress of project and changes in design due to field conditions
	–	revisions to the O&M Manual, implementation of the Health and Safety Plan/Contingency Plan
	–	insight into potential O&M problems
Construction Manager	–	overview of all contractor construction activities at the site, health and safety issues, site protectiveness during construction, and the quality of the construction
Local Emergency Response Officials	–	adequacy of contractor's Health and Safety Plan and the contractor's implementation of the Plan
	–	adequacy of contractor's emergency response duties as outlined in the Contingency Plan or Emergency Response Plan of the Health and Safety Plan

Some example interview questions for remedial actions still under construction are given below.

1. What is your overall impression of the project? (general sentiment)

2. What is the current status of construction (*e.g.*, budget and schedule)?

3. Have any problems been encountered which required, or will require, changes to this remedial design or this ROD?

4. Have any problems or difficulties been encountered which have impacted construction progress or implementability?

5. Do you have any comments, suggestions, or recommendations regarding the project (i.e., design, construction documents, constructability, management, regulatory agencies, etc.)?

Performance, Operation and Maintenance Problems

The following individuals may provide information to you regarding the performance of the remedy and status of O&M at the site so that the team can assess the progress of the implementation and effectiveness of the remedy, and any O&M problems.

Interview		Information Sought
O&M Manager/Operating Contractor	–	O&M status of the remedy, compliance with permit and reporting requirements, and complaints filed
	–	effectiveness of the O&M Plan
	–	information about any potential causes for concern about the remedy
		progress and performance of the remedy
O&M Staff	–	effectiveness of the O&M Manual
	–	information about any potential causes for concern about the remedy
		Recommendations for adjusting the mode of operation or optimizing the operations protocol
Remedial Design/Remedial Action Consultant	–	original concepts behind the O&M of the remedy
	–	questions about remedial design parameters, expected performance and cost, and changes that have occurred during implementation

Some example interview questions are given below.

1. What is your overall impression of the project? (general sentiment)

2. Is the remedy functioning as expected? How well is the remedy performing?

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

5. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

6. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

7. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

8. Do you have any comments, suggestions, or recommendations regarding the project?

INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

Name	Title/Position	Organization	Date
James A. Pichner	Admin. Service Mgr.	Castle Airport	June 1, 2013
Leland Hancock	Private Landowner	Castle Gardens Housing	June 4, 2013
Russ Enos	Private Landowner	Adjacent to Airport	June 6, 2013
Marcus Pierce	Remedial Proj. Mgr.	CVRWQCB	June 9, 2013
Chris Chochrane	Remedial Proj. Mgr.	CVRWQCB	June 11, 2013
Mark Hendrickson	Director	Merced Co, Commerce	June 17, 2013
Nadia Burke	Remedial Proj. Mgr.	USEPA, Region IX	July 3, 2013
Theresa McGarry	Remedial Proj. Mgr.	CA DTSC	July 9, 2013
Daniel Chern	Field Manager	CH2M Hill	July 23, 2013
Campbell McLeod	Project Manager	CH2M Hill	July 26, 2013
Randy McCarty	Facilities Manager	US Penitentiary Atwater	(not completed)

INTERVIEW RECORD

Site Name:	**EPA ID No.:**	
Subject:	**Time:**	**Date:**
Type: Telephone Visit Other **Location of Visit:**	Incoming Outgoing	

Contact Made By:

Name:	**Title:**	**Organization:**

Individual Contacted:

Name:	**Title:**	**Organization:**
Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**	

Summary Of Conversation

Page 1 of _____

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Airport Administration - Castle Airport

Interview Completion Date: **June 1, 2013**

Full Name: **James A. Pichner**

Relationship: **Administration Service Manager, County of Merced – Castle Airport**

Complete Address: **2507 Heritage Drive, Atwater, California 95301**
[phone: (209) 385-7686 / (209) 383-4959;
email: jpichner@co.merced.ca.us]

1. What is your overall impression of the project? (general sentiment)

This project has been going very well and has closed numerous CERLA sites over the years.

2. What effects have site operations had on the surrounding community?

I don't know of any bad effects on the surrounding community. The good effect has been the substantial reduction in size of the groundwater plume.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Not aware of any concerns.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details?

Not aware of any.

5. Do you feel well informed about the site's activities and progress?

Yes, I am well informed. I hear from CH2M Hill when things progress.

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No.

7. Do you have any insight and/or clarification on decisions made during remedy selection and implementation that you would like to offer?

No.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Private Landowner

Interview Completion Date: **June 4, 2013**

Full Name: **Leland Hancock**

Relationship: **Private landowner, Castle Gardens Housing Area**

Complete Address: **610 Discovery Bay Boulevard, Discovery Bay, California 94514 [phone: (510) 719-5029]**

1. What is your overall impression of the project? (general sentiment)

Still have one well that they are pumping from on his property. They told him three years ago the site was substantially cleaned up and would be shut down. Every year he asks about it. One well is fenced off and shut off, but some equipment remains there. Can't use his garage because the well is still operating.

2. What effects have Site operations had on you and your household?

Same as above. They come and service the one well that's still pumping on a regular basis.

3. What effects have Site operations had on the surrounding community?

Don't think it has had much effect on the surrounding community.

4. Are you aware of any community concerns regarding the Site or its operation and administration? If so, please give details.

Think company that is handling this is very professional. But he would like to get the well off his property.

5. Are you aware of any events, incidents, or activities at the Site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

Not aware of any.

6. Do you feel well informed about the Site's activities and progress?

Yes. He calls once a year to see if they will close that one well down, but they still

have not done so. They do send a report, but he stated that you need to be an engineer to understand it.

7. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

No.

8. Do you have any insight and/or clarification on decisions made during remedy selection and implementation that you would like to offer?

No.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Private Landowner

Interview Completion Date: **June 6, 2013**

Full Name: **Russ Enos**

Relationship: **Private landowner, land adjacent to Castle Airport**

Complete Address: **6434 Shaffer Road, Winton, California 95388 [phone: (209) 756-5735]**

1. What is your overall impression of the project? (general sentiment)

The guys are good guys. The location of the pumps and test wells is a problem and has been. Meters are in the way; they have to get access to them and it is a pain. Wish they had put them on the borders or edges of our properties. Have to dodge them with tractors and equipment.

2. What effects have Site operations had on you and your household?

Can't do much about them anyway, but wish the meters are out of the way. The location is bothering them. Affects everything on their property. Those who have to have access are driving in and out.

3. What effects have Site operations had on the surrounding community?

It's great. It was an old Air Force Base and solvents went into the water table, and they are almost finished with the cleanup. The groundwater is almost clean. Would be nice to get the meters and equipment out of there. They put their contaminated soil on the Base property but abuts the landowner's property (Landfill 4), and it's a pile about 4 feet tall and covered with weeds.

4. Are you aware of any community concerns regarding the Site or its operation and administration? If so, please give details.

Keep the weeds down and mow at Landfill 4. Squirrels and weeds are an issue.

5. Are you aware of any events, incidents, or activities at the Site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

No. The landowner fenced off their whole ranch just for that purpose, for

themselves, so there's no access onto their personal land.

6. Do you feel well informed about the Site's activities and progress?

Yes. Because the guys who are working there are all good guys and are working with them. Just the location issue is a problem. It was set up 6, 8 years ago. Trying to farm that piece and are losing land to this.

7. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

Everything else is positive. All good people, they respect us. They drive slow to keep the dust down.

8. Do you have any insight and/or clarification on decisions made during remedy selection and implementation that you would like to offer?

No.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Remedial Project Manager - CVRWQCB

Interview Completion Date: **June 9, 2013**

Full Name: **Marcus Pierce**

Relationship: **Central Valley Region Water Quality Control Board (CVRWQCB)**

Complete Address: **11020 Sun Center Drive #200, Rancho Cordova, California 95670**
[phone: (916) 464-4733 / (916) 464-4645;
email: mpierce@waterboards.ca.gov]

1. What is your overall impression of the project? (general sentiment)

The Air Force has successfully completed most of the remedial actions specified in Castle's Records of Decision (RODs). Groundwater remedial actions have not been completed yet, but the Air Force has been successful in reducing the extent and total mass of their groundwater plumes.

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

Yes. The project regulators meet with Air Force representatives at least twice per year to discuss the status of ongoing remedial activities. The Air Force provides semi-annual and annual monitoring reports that provide updates on project activities. Central Valley Water Board staff typically visit the former base at least once per year to inspect groundwater treatment facilities and landfills, and/or observe field work. These site visits are coordinated with representatives of the Air Force.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

No, except for minor releases of untreated groundwater. The releases are typically caused by mechanical or electrical failures in the groundwater extraction/treatment systems or by accidents. The Air Force has addressed these minor releases promptly and reported them in a timely manner to the project regulatory team along with the corrective actions that were implemented.

4. Do you feel well informed about the site's activities and progress?

Yes.

5. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

Management and operation of the Air Force's remedial actions at the former base has been efficient.

6. Do you have any insight and/or details regarding changes in State laws and regulations that may impact protectiveness at the Site that you can share?

No.

7. Do you have any other information on site activities, status, and/or issues that you would like to offer?

Due to a declining water table, there may be volatile organic compounds (VOCs) left behind in the vadose zone that could pose a future threat to water quality or to human health. I do not expect this to be a base-wide problem. However, the Air Force should consider investigating residual VOC concentrations in a few of the former hotspots in the shallow hydrostratigraphic zone.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Remedial Project Manager - CVRWQCB

Interview Completion Date: **June 11, 2013**

Full Name: **Chris Cochrane**

Relationship: **Engineering Geologist – Central Valley Region Water Quality Control Board (CVRWQCB)**

Complete Address: **11020 Sun Center Drive #200, Rancho Cordova, California 95670**
[phone: (916) 464-4820 / (916) 464-4645;
email: cmcochrane@waterboards.ca.gov]

1. What is your overall impression of the project? (general sentiment)

Stanley Pehl, Air Force Environmental Coordinator, provides site information in a timely manner and schedules all meeting and site visits as needed.

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

We have had routine communications and submittal from the Air Force and our comments on the submittals are responded to promptly. Routine site visits to locate on site facilities and on site review and observation of groundwater sampling was conducted. The on-site visit to locate facilities and observe groundwater sampling was successful.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

No.

4. Do you feel well informed about the site's activities and progress?

Yes.

5. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

No.

6. Do you have any insight and/or details regarding changes in State laws and regulations that may impact protectiveness at the Site that you can share?

No.

7. Do you have any other information on site activities, status, and/or issues that you would like to offer?

No.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Director - Merced Co. Dept. of Commerce, Aviation & Economic Development

Interview Completion Date: **June 17, 2013**

Full Name: **Mark Hendrickson**

Relationship: **Director – Merced County Department of Commerce, Aviation & Economic Development**

Complete Address: **2222 M Street, Merced, California 95340 [phone: (209) 385-7686 / (209) 383-4959; email: mhendrickson@co.merced.ca.us]**

1. What is your overall impression of the project? (general sentiment)

The project has been going well and has successfully closed numerous CERCLA sites over the past several years.

2. What effects have site operations had on the surrounding community?

We are generally unaware of any positive or negative impacts on the surrounding community. Considering that there has been a substantial reduction in the size of the groundwater plume, we would anticipate a positive reaction upon such news being conveyed to the public.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

We are not aware of any concerns as noted in the question.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

Vandalism in the form of graffiti has occurred on fencing around some of the monitoring wells in recent months. These incidents have been reported to the Merced County Sheriff's Department.

5. Do you feel well informed about the Site's activities and progress?

My staff does feel well informed. CH2MHill does a nice job of keeping us posted of regular progress.

6. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

We appreciate the ongoing relationship we have with those responsible for the remediation and thank them for their daily efforts to successfully reclaim the site.

7. Do you have any insight and/or clarification on decisions made during remedy selection and implementation that you would like to offer?

No.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Remedial Project Manager - USEPA Region IX

Interview Completion Date: **July 3, 2013**

Full Name: **Nadia Burke**

Relationship: **Remedial Project Manager, Environmental Engineer – United States Environmental Protection Agency (USEPA), Region IX**

Complete Address: **75 Hawthorne Street, SFD-8-1, San Francisco, California 94105 [phone: (415) 972-3187 / (415) 947-3526; email: burke.nadiahollan@epamail.epa.gov]**

1. What is your overall impression of the project? (general sentiment)

The AF is generally managing the project very well, and the project appears to have adequate resources to stay on schedule. The remedial actions that have been implemented at the Site to address groundwater have generally been successful in containing and reducing groundwater contamination concentrations. However, their efficiencies and performance, as well as the adequacy of the monitoring well networks have been impacted by regional declines in groundwater levels. Therefore, many technical issues have surfaced with regards to whether the systems are operating and monitored optimally or appropriately. There also seems to be an increasing number of repairs needed to address spills and leaks due to the aging remedial treatment systems.

2. What effects have site operations had on the surrounding community?

EPA is uncertain of the impact of the affects regarding the operations on the local community, since we haven't been directly informed by the AF regarding any particular concerns. As this does not appear to be reported regularly, this may need to be reviewed to ensure any community impacts are documented and reported in the FYR. Also, EPA is aware of certain incidents, such as a fire on the landfill, that may have had some impact on the adjacent landowner. Other direct impacts, such as well head treatment systems located on private property are well documented, and would likely to be on-going until cleanup is achieved, however it is unknown if there are any particular concerns the residents have on the on-going activities.

EPA is aware of concerns regarding potential community exposure to production well contaminants not associated with the AF operations, and the AF continues to monitor for constituents that may be sourced by non-AF activities. Recently, the Merced County of Governments approached EPA with regards to concerns with

redevelopment of the transferred AF property and potential impact the remedial systems may have that might impede or affect their plans or options, as well as the concern regarding the cost of completing the environmental cleanup needed for redevelopment they are now responsible for as the property owners.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Yes, see #2 above.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details.

Yes, see #2 above.

5. Do you feel well informed about the site's activities and progress?

Yes. Stanley Pehl, Air Force Environmental Coordinator, and the AF contractors provide site information to regulators in a timely manner, and schedules all meeting and site visits as needed. Document reviews and technical meetings are coordinated by Mr. Pehl, primarily with the support of their contractor, CH2MHill, and the project appears to have sufficient resources required to satisfy the requirements of the regulatory agencies.

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Yes. The EPA suggests that the AF review their strategy for achieving closure with the existing systems, monitoring network, and contracting mechanisms, or if changes are likely to be needed, including decision document modifications to address optimization needs, and an increased demand for O&M repairs should they be necessary to keep up with an older system and changing site conditions. EPA also recommends that that AF also review their contracting mechanisms closely to ensure there is an incentive to agree to requirements of the regulatory agencies, as it is sometimes difficult to reach consensus if the agency requirements fall outside of the contract scope of work or budget.

7. Do you have any insight and/or clarification on decisions made during remedy selection and implementation that you would like to offer?

Yes. Site conditions have changed over time, and the remedial decisions made in the past may no longer be appropriate for current conditions, and may need to be re-visited.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Remedial Project Manager - DTSC

Interview Completion Date: **July 9, 2013**

Full Name: **Theresa McGarry**

Relationship: **California Department of Toxic Substances Control (DTSC)**

Complete Address: **8800 Cal Center Drive, Sacramento, California 95826**
[phone: (916) 255-3664; email: tmcgarry@dtsc.ca.gov]

1. What is your overall impression of the project? (general sentiment)

The project is adequately managed. Remedial actions have been generally successful. Regional declines in groundwater levels have created some concerns for potential for residual contaminants in vadose zone for some areas. The Team continues to address this issue.

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

Yes. DTSC and has visited the site, and meets or participates in conference calls with the Air Force representatives and their contractors on a regular basis. Monitoring reports are provided on semiannual and annual basis.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

No.

4. Do you feel well informed about the site's activities and progress?

Yes.

5. Do you have any comments, suggestions, or recommendations regarding the Site's management or operation?

Adequate management. Mr. Stanley Pehl, Air Force Environmental Coordinator, is always receptive to discussing and addressing all regulatory concerns.

6. Do you have any insight and/or details regarding changes in State laws and regulations that may impact protectiveness at the Site that you can share?

No.

7. Do you have any other information on site activities, status, and/or issues that you would like to offer?

Issues sometime arise due to Air Force use of Performance based contracts. Contractors may resist regulatory requests when the work was not anticipated and included in scopes of work. For example, requests regarding Operation and Maintenance (O&M) procedures such as dry well replacement doesn't carry the same importance as achieving closure or other performance objective.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Field Manager – CH2M HILL

Interview Completion Date: **July 23, 2013**

Full Name: **Daniel Chern**

Relationship: **Staff Engineer / Field Manager – CH2M HILL**

Complete Address: **2485 Natomas Park Drive, Suite 600, Sacramento, California 95833-2937 [phone: (916) 286-0339 / (916) 920-8463; email: daniel.chern@ch2m.com]**

1. What is your overall impression of the project? (general sentiment)

Project is going well. The groundwater treatment plants (GWTPs) were down-sized and simplified. The GWTPs are maintaining plume capture even after turning off several extraction wells. The groundwater sampling program has been simplified by introducing PDBs.

2. Is the remedy functioning as expected? How well is the remedy performing?

Yes, the GWTPs are functioning as expected. The groundwater plumes are properly contained. Several extraction well pumps have been and are in the process of being replaced. The landfill cap is functioning properly, and landfill gasses are not migrating.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Yes, the groundwater monitoring data shows contaminant concentrations remaining steady or decreasing. In addition, the plume size has decreased since the last 5-year review.

4. Is there a continuous on-site operation and maintenance (O&M) presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of Site inspections and activities.

Yes, we have one staff member on site daily. His tasks include collecting system readings twice a week, collecting groundwater and treatment system samples, and performing other O&M tasks. As needed, staff from Turlock, CA and Sacramento, CA would visit the site to help troubleshoot the GWTPs, oversee subcontractors, or assist with sampling.

5. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

The Phase 3 GWTP treatment was down-graded from an air stripper and three 20,000-lb GAC vessels down to two 10,000-lb GAC vessels. The OU-2 GWTP treatment was down-graded from two 20,000-lb GAC vessels down to four 2,000-lb GAC vessels. At the Castle Vista treatment system, a new extraction well (MW1046) was installed and started up. Groundwater extraction was ceased from EW39. The effectiveness of the treatment systems remain the same, while the system efficiency has increased and energy consumption decreased.

6. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please give details.

Yes, several leaks have occurred along the groundwater conveyance lines, and several extraction well pumps were replaced. This is due to aging equipment and materials. The SCADA system requires additional attention, as the software has become obsolete, and the hardware has become old and worn out.

7. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

In the groundwater sampling program, many wells were converted to PDBs to increase sample quality and decrease sampling time. The annual event was also changed from Q1 to Q2, so sampling would take place when the water levels are highest and field conditions are most conducive to sampling. In addition, the semi-annual sampling event was changed from Q3 to Q4, when the water levels are lowest.

8. Have there been any issues related to compliance with permitting and reporting requirements, and/or any complaints filed that you are aware of, in the last five years?

There are no known compliance issues in the last five years. Minor leaks have occurred; however, the leaks did not exceed the recordable quantities.

9. Have there been any issues related to compliance with permitting and reporting requirements, and/or any complaints filed that you are aware of, in the last five years?

None.

Castle Airport (Former Castle Air Force Base) Five-Year Review Interview

Project Manager – CH2M HILL

Interview Completion Date: **July 26, 2013**

Full Name: **Campbell McLeod**

Relationship: **Project Manager – CH2M HILL**

Complete Address: **2485 Natomas Park Drive, Suite 600, Sacramento, California 95833-2937 [phone: (916) 286-0256 / (916) 920-8463; email: campbell.mcleod@ch2m.com]**

1. What is your overall impression of the project? (general sentiment)

The O&M activities have successfully operated the pump and treat systems as designed and monitored the Landfills. Value has been provided by capturing and remediating the MCL contaminate plume and reinjecting the treated groundwater for reuse. The work has been performed in a cost-effective and efficient manner.

2. Is the remedy functioning as expected? How well is the remedy performing?

The remedy is functioning as designed. Pump and treat has been effective at meeting the ROD requirements.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

The data indicates that overall the plume size and concentration has decreased over the last 5 years. The selected remedy for LF and GW is successfully meeting the ROD requirements.

4. Is there a continuous on-site operation and maintenance (O&M) presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of Site inspections and activities.

There is one staff on-site. His responsibilities include collecting system data, groundwater sampling inspection of the Landfills and treatment systems and general O&M activities. Additional support to on-site staff is supplied from Sacramento office and nearby Turlock.

5. Have there been any significant changes in the O&M requirements, maintenance schedules,

or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

The monitor well sampling has been changed from low-flow to PDBs. This data is comparable and change has reduced sampling time. As the MCL plume size and configuration has changed the number of extraction wells operating has been reduced to reflect the changed condition. The number of GAC vessels online at the Phase 3 system has been reduced from 2 pair of 20K GAC vessels and air stripper to one pair of 10K GAC vessels. Likewise the OU 2 system vessels have been reduced to two pair of 2K GAC vessels. A pair of GAC drums are used to treat GW at Castle Vista from new MW1046. These changes have continued to be protective but more cost effective.

6. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please give details.

The conveyance lines taking treated GW to the injection wells has leaked several times. The SCADA system is old and several upsets has occurred. As the treatment systems are downsized they transition to a manual operation. Many of the EW pumps have reached their end of life cycle and are being replaced. The CAT-OX SVE system inherited from the previous contract was unreliable and had to be replaced.

7. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

The change to PDBs has reduced time spent sampling. The reorganization of sampling events to Q2 and Q4 for the annual and semiannual sampling to better align with high and low water levels and better sampling weather. The reports have been refocused and made more concise. Rebound studies have been implemented to better understand amount of remaining mass and select best extraction well configuration.

8. Have there been any issues related to compliance with permitting and reporting requirements, and/or any complaints filed that you are aware of, in the last five years?

There have been several small leaks at the treatment systems that have been reported to the AF and agencies. But these have been small volumes at low concentrations and not exceeded recordable quantities.

9. Have there been any issues related to compliance with permitting and reporting requirements, and/or any complaints filed that you are aware of, in the last five years?

None.