UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 29, 2008

Mr. Mark Smith
60 CES
411 Airmen Drive
Travis AFB, CA 94535-2001

Re: **Travis AFB Final 2nd Five Year Review Report**

Dear Mr. Smith:

EPA has reviewed the Final 2nd Five-Year Review Report dated September 2008. The Report addresses the ongoing and completed response actions at Travis AFB. EPA agrees with the findings, conclusions, and recommendations provided in the Report and concurs the remedial actions for groundwater and soil are protective in the short term. However, in order to be protective in the long term, that will depend on results from the following:

Groundwater Sites - the AF will reassess current remedies and select appropriate final remedies by combining the interim remedial actions from the 2 current IRODs into a final Basewide Groundwater ROD. The planned completion of the ROD in 2010 will ensure the remedy is protective in the long term.

Pending Soil Sites FT005, SD001, SD033 - the planned remedial actions for these sites in the NEWIOU ROD, to start in 2009, are expected to be protective when they are completed.

Soil Vapor Action Sites - based on the ongoing vapor intrusion assessment, preliminary sampling results show there are no major immediate concerns, but protectiveness will be reassessed upon completion of the larger study expected to be done by end of 2009.

As cited in Section 8.1 of the report, the AF is reminded to place a memorandum into the Travis AFB Administrative Record that documents the land use controls for all groundwater sites described in the 2 IRODs.

EPA appreciates the AF's cooperation and efficiency in completing this review. We look forward to working with the AF in its new performance based contract approach to bring all

cleanup sites to a successful closure. Please contact James Chang at (415) 972-3193 if you have any questions regarding this letter.

Sincerely,

Michael Montgomery, Chief
Federal Facilities and Site Cleanup Branch

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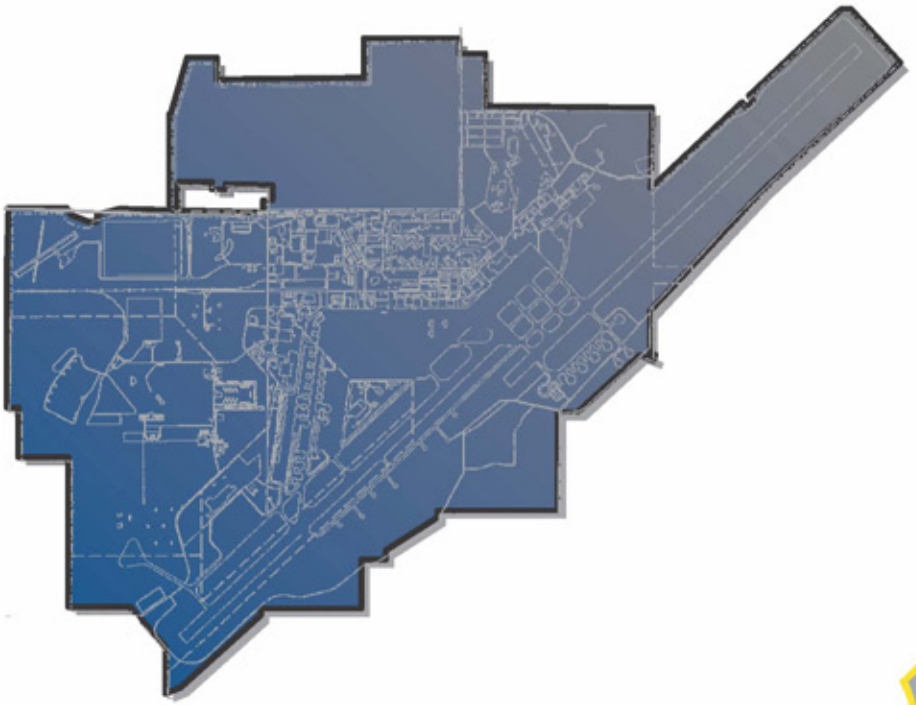
File: 001TAFB_2ndFYR

FINAL

ENVIRONMENTAL RESTORATION PROGRAM

Travis Air Force Base

Second Five-Year Review Report



ES022008001RDD_Cover

SEPTEMBER
2008

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	24 September 2008	Scientific and Technical Reports (Environmental Restoration)

4. TITLE AND SUBTITLE

Remedial Process Evaluation (RPO) Report
Final Second Five-Year Review Report; NEWIOU and WABOU Groundwater Interim Remedial Actions, NEWIOU Soil and Sediment Remedial Actions, WABOU Soil Remedial Actions; Travis Air Force Base, California
CDRL A001b; Paragraph No. 9.7.7

5. FUNDING NUMBERS

F41624-03-D-8595
XDAT 20077030

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348306.05.04.90.03

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10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Statement A: "Approved for Public release: distribution is unlimited."

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The *Second Five-Year Review Report* provides descriptions and evaluations of the groundwater interim remedial actions and soil/sediment remedial actions that have been implemented at Travis Air Force Base, California.

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

NSN 7540-01-280-5500
(rev. 2-89)

Standard Form 298

Prescribed by ANSI Std

239-18

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RDD/080520022 (CLR3813.DOC)

Travis Air Force Base, California

Second Five-Year Review Report

NEWIOU and WABOU Groundwater Interim Remedial Actions
NEWIOU Soil and Sediment Remedial Actions
WABOU Soil Remedial Actions

CDRL A001b; Paragraph 9.7.7

Prepared for

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Contract No. F41624-03-D-8595
XDAT20077030
Task Order 0446

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Executive Summary

The U.S. Air Force, with public and regulatory acceptance, is carrying out groundwater interim remedial actions (IRA) and soil/sediment remedial actions (RA) at multiple contaminated sites at Travis Air Force Base, California. This *Second Five-Year Review Report* provides descriptions and evaluations of these actions, discusses whether they are protective of human health and the environment, and if they are functioning as designed.

Background

This *Second Five-Year Review Report* is required by statute and is prepared in accordance with the U.S. Environmental Protection Agency (EPA) *Comprehensive Five-Year Review Guidance* (EPA, 2001).

Travis Air Force Base (AFB) is the lead agency and responsible party for the groundwater, soil, and sediment remediation efforts being evaluated in this five-year review. EPA, San Francisco Bay Regional Water Quality Control Board (Water Board), and Department of Toxic Substances Control (DTSC) provide regulatory agency oversight.

Ongoing groundwater IRAs are being conducted in accordance with the final Groundwater Interim Record of Decision (IROD) for the North/East/West Industrial Operable Unit (NEWIOU) (Travis AFB, 1998) and the final Groundwater IROD for the West/Annexes/Basewide Operable Unit (WABOU) (Travis AFB, 1999).

The groundwater IRAs were designed and constructed to quickly begin remediation of groundwater contamination, reduce the levels of contamination and potential risk, and collect some of the data necessary for the selection of final cleanup levels and technically and economically feasible long-term actions. The use of IRODs allowed actions to proceed without having final designated cleanup levels, as will be required for the pending Basewide Groundwater Record of Decision (ROD). The interim actions taken under the IRODs use interim remediation goals (IRGs) as performance objectives. These are not legally enforceable standards, but are simply goals during the period of interim groundwater remediation.

Multiple soil RAs in the WABOU were conducted in accordance with final Soil Record of Decision for the WABOU (Travis AFB, 1999). Similarly, within the NEWIOU, soil RAs have mostly been completed in accordance with the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). However, three NEWIOU soil (FT005) and sediment (SD001 and SD033) RAs are not yet complete. The two RODs specify soil and sediment cleanup levels that are protective of human health and the environment.

Groundwater and Soil and/or Sediment Contamination

As a result of past waste management and disposal practices, groundwater and soil and/or sediment at Travis AFB is contaminated at multiple locations. The locations of the groundwater and soil and or sediment sites are shown on Figures ES-1 and ES-2.

The primary groundwater contaminants exceeding the IRGs established by the NEWIOU and WABOU groundwater IRODs include chlorinated volatile organic compounds (VOCs), primarily trichloroethene (TCE) and related compounds. Petroleum-fuel constituents, organochlorine pesticides, and other contaminants are also present at some sites.

Contamination in soil and/or sediment that required remediation to protect human health and the environment primarily included semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and organochlorine pesticides.

Groundwater Interim Remedial Actions

Travis AFB is currently conducting groundwater IRAs at multiple sites to address the groundwater contamination. The groundwater IRAs have been designed and constructed to achieve the following interim objectives:

- **Source Control –** hydraulically contain and remove contaminant mass from the groundwater and vadose zone using groundwater extraction and treatment (GET).
- **Migration Control –** hydraulically contain contamination using a GET system and/or contain contamination using natural physical, chemical, and/or biological processes through monitored natural attenuation (MNA). Sites LF006 and DP039 are the only sites at which MNA was selected as all, or part, of the groundwater IRA in the applicable IROD. At multiple other sites, the viability of MNA as all, or part, of the final groundwater remedy is being *assessed* during the period of interim remediation. The formal selection of MNA as all, or part, of the final groundwater RA at a site will be made in the pending Basewide Groundwater ROD.
- **Offbase Remediation –** hydraulically contain and reduce contaminant concentrations in offbase plumes down to the contaminant-specific IRG using a GET system.

A summary of the groundwater IRA objectives at each contaminated site is provided in Table ES-1.

Both groundwater IRODs prescribe specific groundwater IRAs for individual sites. However, Travis AFB is now employing a more appropriate strategy by consolidating site-specific IRAs with common key components into regional IRAs. The primary objective of this holistic grouping is to maximize contaminant mass removal by avoiding interference between individual groundwater extraction systems. The secondary objective is to reduce costs by avoiding redundancies in the operation and documentation of sites with common components. The primary criteria for grouping site-specific IRAs into consolidated, regional IRAs include the following:

- Commingled groundwater contaminant plumes
- Shared groundwater conveyance and treatment systems
- Hydraulic interactions between site-specific groundwater extraction systems
- Consolidation consistent with the IRA objective(s) provided in the applicable IROD

TABLE ES-1
Summary of Groundwater Interim Remedial Action Performance
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					Performance Assessment Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Question A – Functioning as Intended by IROD?**	**Question B – Remedy Assumptions Still Valid?**	**Question C – New Information Regarding Protectiveness?**	**Performance Assessment Summary**
North IRA	FT004	√				√[b]	Yes	Yes	No	The combination of GET in the source area and MNA in the downgradient areas appear to be effective. Hydraulic capture of the source areas has been achieved. The effectiveness of GET is further demonstrated by declining VOC concentrations observed in the majority of site monitoring wells. Declining trends are observed both in shallow and deep monitoring wells, indicating both the horizontal and vertical extent of the target areas are being addressed. MNA also appears to be a viable remedy. Overall, contaminant concentrations are stable or declining in the FT004 and SD031 MNA wells. The MNA network includes both shallow and deep monitoring wells; MNA appears to be effective throughout the entire thickness of the plume.
	SD031	√				√[b]	Yes	Yes	No	
	LF006				√		Yes	Yes	No	MNA appears to be an effective remedy. Data from monitoring wells indicate that groundwater contamination at LF006 is not migrating.
	LF007B					√	Yes	Yes	No	MNA appears to be a viable remedy. No groundwater contaminants were in LF007B wells sampled during the 2006-2007 GSAP effort.
	LF007C		√	√		--[c]	No	Yes	No	The Migration Control and Offbase Remediation objectives do not appear to be fully achieved. The current configuration of the LF007C GET system does not appear to be fully effective at hydraulically capturing and remediating the TCE plume. TCE continues to be present in offbase monitoring wells at concentrations above the IRG. The extent of this offbase contamination is uncertain. For the remedy at LF007C to be protective in the long-term, follow-up actions need to be taken.
	LF007D					√	Yes	Yes	No	MNA appears to be a viable remedy. Groundwater contamination at LF007D is restricted to a small area near MW261x04 – the only well at which groundwater contaminants were detected at concentrations exceeding IRG. Contaminants do not appear to be migrating offbase to the north or east of LF007D.
South IRA	SS030	√	√	√			No	Yes	No	The source control, migration control, and offbase remediation objectives of the SS030 IRAs have largely been achieved. Contaminant concentrations are declining in all of the extraction wells and all but two of the monitoring wells. The offbase plume is being captured on the south and west sides of the plume. However, increasing TCE concentrations on the east side of the offbase plume indicate contamination may be escaping hydraulic capture. There are insufficient monitoring wells in this area to fully assess the extent of contaminant migration and the local groundwater flow direction. For the remedy at SS030 to be protective in the long-term, follow-up actions need to be taken. No contaminants have been detected in the privately-owned domestic well (DWSET1x30) located downgradient of the SS030 plume.
			√				Yes	Yes	No	The migration control objective has been achieved. The SS029 GET system has achieved hydraulic capture of the plume and is preventing offbase migration of the contaminant plume.
	Southern SS016		√			--[e]	Yes	Yes	No	Commingled OSA/TARA/ST032 plume is hydraulically captured by SS029 Migration Control GET system.
SS029	FT005		√	√			Yes	Yes	No	The Migration Control and Offbase Remediation objectives at FT005 are being achieved. The FT005 GET system appears to have achieved hydraulic capture of the plume and is preventing continued offbase migration.
Central IRA	Northern SS016	√					Yes	Yes		Hydraulic capture of the SS016 TARA source area has been achieved. Within the SS016 OSA source area, concentrations have decreased, but the extent of hydraulic capture is less certain. However, declining VOC concentrations in shallow and deep monitoring wells downgradient of the OSA and TARA source areas indicates that the horizontal and the vertical extent of the SS016 plume is being addressed by these extraction wells. The portion of the commingled SS016 plume (OSA/TARA/ST032) that is not hydraulically captured by the Source Control GET actions is eventually hydraulically captured by the downgradient SS029 Migration Control GET system.
	ST032	√	√[d]			--[e]	Yes	Yes	No	Source control for removal of floating jet fuel has been achieved. Floating jet fuel has been only intermittently observed in MW246x16 from 1999 through 2001. No floating product was detected during 2007. Dissolved-phase fuel contamination is hydraulically captured by the SS029 Migration Control GET system.

TABLE ES-1
Summary of Groundwater Interim Remedial Action Performance
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					Performance Assessment Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Question A – Functioning as Intended by IROD?**	**Question B – Remedy Assumptions Still Valid?**	**Question C – New Information Regarding Protectiveness?**	**Performance Assessment Summary**
West IRA	SS014[f]	√	√			√[b]	Yes	Yes	No	GET systems installed within the WIOU sites are achieving the source control and migration control objectives. Estimates of the extent of hydraulic capture indicate that VOC concentrations above 100 µg/L are being captured by the WIOU GET system. Decreasing trends of VOC concentrations are observed throughout the WIOU plume. The decreasing trend is observed in both shallow and deep monitoring wells, indicating that the horizontal and the vertical extent of the plume is being addressed by the GET system. The combination of GET in the WIOU source areas and MNA in the downgradient area appears to be a viable remedy. Groundwater contamination in the southern WIOU does not appear to be migrating. However, historical and current detections of petroleum hydrocarbons in downgradient wells require continued monitoring. If concentrations increase in these wells, implying that migration is occurring, additional downgradient monitoring wells may be necessary.
	SD033[g]		√			√	Yes	Yes	No	
	SD034[h]	√	√				Yes	Yes	No	
	SS035[i]		√[b]			--[e]	Yes	Yes	No	
	SD036[j]	√	√			--[e]	Yes	Yes	No	
	SD037[k]	√	√			√	Yes	Yes	No	
	SS041[l]		√				Yes	Yes	No	
	SD043[m]		√				Yes	Yes	No	
SS015						√	Yes	Yes	No	MNA appears to be a viable remedy. Data from monitoring wells indicate that groundwater contamination at SS015 is not migrating.
	DP039	√			√		No	Yes	No	The source control objective is mostly being achieved. TCE concentrations in the historical source area are declining and the source area is being hydraulically contained. For the remedy at DP039 to be protective in the long-term, follow-up actions need to be taken. TCE concentrations continue to exceed 1,000 µg/L in areas downgradient of the source area. This area extends about 800 feet beyond the source control GET system and underlies an ongoing demonstration of phytoremediation. The effectiveness of the phytoremediation system at controlling migration of the plume continues to be evaluated. However, the source area GET system does appear to prevent additional contamination from migrating downgradient of the source and thereby decreases VOC concentrations. Migration Control through MNA appears to be generally achieved in the downgradient portion of the DP039 plume. However, TCE concentrations may be increasing in some wells downgradient of the phytoremediation area. The data are not conclusive and the wells will continued to be monitored under the GSAP to determine in the plume is migrating. The southern toe of the plume remains stable. Concentrations of TCE in this area have not been greater than the IRG.
	LF008	√					Yes	Yes	No	The migration control objective at LF008 is being achieved by the GET system. Hydraulic capture of the source area has been achieved. The distribution of contamination in monitoring wells also indicates containment of the plume.

[a] IRA objective specified in the Groundwater NEWIOU and WABOU IRODs (Travis AFB, 1999).
[b] IRA not specified in the Groundwater IROD for the NEWIOU, but implemented by the Air Force to address entirety of commingled plume.
[c] Assessment of MNA not implemented because plume is hydraulically captured by LF007C groundwater extraction system.
[d] TARA.
[e] Assessment of MNA not implemented because plume is hydraulically captured by adjacent groundwater extraction system.
[f] POCO Site SS014 comprises five noncontiguous sites, including Sites 1, 2, 3, 4, and 5. Only Site 1 has a source control objective (floating jet fuel).
[g] EPR Site SD033 comprises five noncontiguous sites: Facility 810, Facility 1917, Storm Sewer System II, the South Gate area, and the West Branch of Union Creek.
[h] ERP Site SD034 is associated with Facility 811.
[i] ERP Site SS035 is associated with Facilities 818 and 819.
[j] ERP Site SD036 is associated with Facilities 872, 873, and 876.
[k] ERP Site SD037 is associated with the Sanitary Sewer System; Facilities 837, 838, 919, 977, 981; the Area G Ramp; and the Ragsdale/V Street area.
[l] ERP Site SS041 is associated with Facility 905.
[m] ERP Site SD043 is associated with Facility 916.

Notes:
GSAP = Groundwater Sampling and Analysis Program
OSA = Oil Spill Area
TARA = Tower Area Removal Action
WIOU = West Industrial Operable Unit
POCO = petroleum-only contaminated
ERP = Environmental Restoration Program

The strategic groupings of individual contaminated groundwater sites into consolidated IRAs are as follows:

- **North IRA –** Sites FT004, SD031, LF006, LF007B, LF007C, and LF007D
- **South IRA –** Sites SS030, SS029, southern portion of SS016, and FT005
- **Central IRA –** northern portion of Site SS016 and Site ST032
- **West IRA –** Sites SS014, SS015, SD033, SD034, SS035, SD036, SD037, SS041, SD043, DP039, and LF008

Additionally, two sites currently managed under the POCO Sites Program are included in this review. Sites SS014 and ST027 are included because petroleum fuel contamination is commingled with chlorinated hydrocarbon contamination.

The groundwater IRA groupings are provided in Table ES-1. The locations of the consolidated, regional groundwater IRA are shown on Figure ES-1.

Soil/Sediment Remedial Actions

Travis AFB has conducted RAs at multiple sites with historical soil and/or sediment contamination. A summary of the NEWIOU and WABOU soil/sediment sites and the associate RA objectives is provided in Tables ES-2 and ES-3. The locations of the sites are shown on Figure ES-2. The soil RAs were designed to achieve the following objectives:

- **Excavation/Onbase Consolidation –** remove contaminated soil through excavation to industrial cleanup levels. Excavated soil is placed in an onbase Corrective Action Management Unit.
- **Land Use and Access Restrictions –** restrict site access and land use activities to prevent worker exposure.

The basic objective of the soil RAs was to remove contaminated soil down to levels protective of onbase workers and/or to restrict residential development and the unauthorized disturbance or relocation of soil. However, if excavation/onbase consolidation reduced residual contaminant concentrations to those that allow for unlimited use and unrestricted exposure, then land use controls (LUCs) would not be required. If excavation only reduced contaminant concentrations to industrial cleanup levels, then LUCs would be implemented to restrict site access and usage. At several sites, LUCs are the only remedy.

Technical Assessment

The primary purpose of this *Second Five-Year Review Report* is to verify that the groundwater IRAs and soil/sediment RAs implemented at Travis AFB are protective of human health and the environment and are functioning as designed.

TABLE ES-2
Summary of NEWIOU Sites Soil and Sediment Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
SD001	Remove sediment contaminants to industrial cleanup levels.	Excavation and LUCs	Final LUC status pending completion of excavation	RA pending.
FT003	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	No LUC required.	RA completed in 2007. Residential cleanup levels achieved.
FT004	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	No LUC required.	RA completed in 2007. Residential cleanup levels achieved.
FT005	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	Final LUC status pending completion of excavation.	Additional excavation of contaminated soil pending.
LF007	Remove soil contaminants to industrial cleanup levels.	Excavation and LUCs	Land use restricted to industrial activities only.	RA completed in 2007. Base CAMU for consolidation of RA soil. LUC inspection on 11 December 2007. No issues found.
SS015	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SS016	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
ST032	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SD033 (soil)	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SD033 (sediment)	Remove contaminated sediment to industrial cleanup levels.	Excavation and LUCs	Final LUC status pending completion of excavation.	RA pending.
SD037	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.

[a]Soil RA objective specified in the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006).

TABLE ES-3
Summary of WABOU Sites Soil Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	LUC Status	Performance Summary Comment
LF008	Remove soil contaminants to residential cleanup levels.	Excavation/Offbase Disposal	No LUC required.	RA complete. Residential cleanup levels achieved by excavation.
RW013	Remove soil contaminants to residential cleanup levels.	Excavation/Offbase Disposal	No LUC required.	RA complete. Residential cleanup levels achieved by excavation. Site closed on 12 May 2004.
DP039	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions (i.e., LUC)	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SS041	Remove soil contaminants to residential cleanup levels.	Excavation/Onbase Consolidation	No LUC required.	RA complete. Residential cleanup levels achieved.
SD042	Remove soil contaminants to residential cleanup levels.	Excavation/Onbase Consolidation	No LUC required.	RA complete. Residential cleanup levels achieved. Site closed on 24 June 2005.
SD043	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions (i.e., LUC)	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
LF044	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions (i.e., LUC)	Land use restricted to industrial activities only.	RA complete. Site used for heavy equipment training starting in November 2006 in accordance with Soil ROD for the WABOU. LUC inspection on 11 December 2007. No issues found
SD045	Remove soil contaminants to residential cleanup levels.	Excavation/Onbase Consolidation	No LUC will be required following approval of soil RA report.	RA completed in 2007. Residential cleanup levels achieved. LUC inspection on 11 December 2007. No issues found
SS046	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found

[a]Soil RA objective specified in the Soil ROD for the WABOU (Travis AFB, 2002).

Groundwater Interim Remedial Actions

Groundwater IRAs are ongoing at multiple NEWIOU and WABOU sites. All groundwater IRAs have been constructed and are successfully operating. The IRAs are largely achieving the objectives specified in the two groundwater IRODs. For sites LF007C, SS030, and DP039; the IRAs are not functioning completely as intended by the two IRODs, but the Air Force is

taking steps to optimize the remedies. A summary of the groundwater IRA performance is provided in Table ES-1.

Opportunities for optimization of the LF007C, SS030, and DP039 groundwater IRA will improve performance and protectiveness:

- **LF007C –** The LF007C plume has migrated offbase. It is not clear that the existing solar-powered extraction wells can control migration or remediate the plume. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force.
- **SS030 –** A portion of the offbase SS030 plume may be migrating toward Site FT005 under the hydraulic influence of the FT005 GET system. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force.
- **DP039 –** The portion of the DP039 plume that is downgradient of the current zone of hydraulic capture may be migrating. Potential follow-up actions will include continuing to monitor concentration trends in downgradient wells and evaluating potential extraction system modifications.

It is anticipated that after the second five-year review of groundwater IRAs, there will be sufficient data to support the development of the Basewide groundwater ROD. This ROD will be prepared by the Air Force in cooperation with EPA, San Francisco Bay Water Board, and DTSC. This ROD will stipulate the final groundwater cleanup concentrations and RAs at Travis AFB.

Soil and/or Sediment Remedial Actions

Through 2007, Travis AFB has successfully completed soil RAs at multiple NEWIOU and WABOU sites. A summary of the soil and/or sediment RAs performance are provided in Tables ES-2 and ES-3.

The soil RA at NEWIOU Site FT005 and the sediment RAs at NEWIOU Sites SD001 and SD003 are pending. Travis AFB will carry out these actions as soon as they can be programmed and scheduled into the next available construction season.

Protectiveness Statements

Protectiveness statements for the groundwater IRAs and soil/sediment RAs implemented at sites within the NEWIOU and WABOU are provided in the following list:

- Groundwater IRAs
  - NEWIOU IRAs - The groundwater interim remedies within the NEWIOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness. Also, for the remedies at Sites LF007C and SS030 to be protective in the long-term, follow-up actions need to be taken.

  - WABOU IRAs - The groundwater interim remedies within the WABOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness. Also, for the remedy at Site DP039 to be protective in the long-term, follow-up actions need to be taken.

- Soil/Sediment RAs
  - NEWIOU Soil RAs – Because the RAs completed at NEWIOU soil sites are protective, the remedies are protective of human health and the environment. The pending soil RA at NEWIOU Site FT005 will be protective of human health and the environment once the remedy is completed.
  - NEWIOU Sediment RAs – Pending sediment RAs at NEWIOU sites SD001 and SD033 will be protective of human health and the environment once the remedies are completed. In the interim, LUCs are in place to restrict residential development and sediment disturbance activities.
  - WABOU Soil RAs – Because the RAs at all WABOU soil sites are protective, the remedies are protective of human health and the environment.

Issues from the First Five-Year Review

The first *Groundwater Five-Year Review* was submitted as a draft document for regulatory agency reviews in April 2003. Most of the issues raised by the regulatory agencies were resolved and the report was finalized, but several issues were deferred. These ongoing issues are summarized in Table ES-4.

Next Five-Year Review

The next five-year review of groundwater IRAs and soil/sediment RAs at Travis AFB is currently scheduled for 2012. The groundwater IRAs will be continued during this time until the final groundwater RAs are selected and carried out.

Travis AFB will also continue to implement and enforce LUCs at soil/sediment sites in accordance with the provisions in the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006) and final Soil ROD for the WABOU (Travis AFB, 2002).

During the interval between the 2008 review and the 2012 review, it is anticipated that sufficient data will be collected to support the development of the Basewide Groundwater ROD. Estimated to be completed in 2010, this ROD will be prepared by the Air Force in cooperation with EPA, San Francisco Bay Water Board, and DTSC, and will stipulate the final groundwater cleanup concentrations and RAs at Travis AFB.

TABLE ES-4
Summary of Key Issues from the First Groundwater Five-Year Review
Second Five-Year Review Report, Travis AFB

First Five-Year Review Issue[a]	Air Force Response[a]	Current Status	Comment
Site LF007C: Evaluate the effects of groundwater flow changes related to the groundwater mound in the LF007C area and the hydraulic capture of the planned GET system.	Agreed that changes in the groundwater flow regime may change, especially after installation of LF007C GET system. Monitoring will be continued under the GSAP.	The LF007C GET system was constructed in 2003, but performance data since that time indicate continued offbase TCE plume migration. Recent optimization of the LF007C extraction wells to support IROD objectives of Migration Control and Off-base Remediation are complete.	Travis AFB will complete the evaluation of groundwater flow characteristics for site LF007C as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site SD031: Install additional well pairs southeast and southwest of the last extraction wells at Site SD031 (EW567x31) to effectively monitor groundwater elevations, hydraulic capture, and TCE plume migration.	Noted and agreed.	The TCE/DCE concentrations at EW567x31 have dropped significantly, and this extraction well is shut down as part of a one-year rebound study, as described in the *Work Plan for RPO Actions at Sites SD031, FT004, and FT005* (CH2M HILL, 2007).	Travis AFB will complete the evaluation of the SD031 monitoring well network as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site DP039: The Source Control and Migration Control objectives are not being achieved. TCE concentrations greater than 1,000 µg/L are found downgradient of the extent of hydraulic capture. Also, TCE exceeding 100 µg/L appears to be migrating downgradient, beyond the area of the treatability studies.	Agreed that the interim remedy is not fully functioning as intended by the WABOU IROD and additional work was needed. Continuing to evaluate the viability of the phytoremediation technology. Placement of additional extraction wells will avoid adverse impacts to the phytoremediation evaluation.	In 2006, the base installed additional monitoring wells within the phytoremediation area and an additional DPE well in the source area[b]. GSAP monitoring is ongoing.	Travis AFB will complete the evaluation of the DP039 monitoring well network, the viability of phytoremediation to stabilize the TCE plume, and other effective groundwater cleanup technologies to meet ROD objectives as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site SS016: The TCE plume appears to be migrating south, under the active taxiways and runways. Additional monitoring wells are needed along the plume axis and transverse axis.	Acknowledged that plume migration is occurring, but the Source Control objective specified in the IROD is being achieved. The downgradient portion of the plume is not accessible for remediation because of the active runway. Monitoring will be continued to confirm that hydraulic capture of the southern extent of the plume is being achieved by the downgradient SS029 GET system. If contaminated ground-	The base recently reactivated EW03x16, a horizontal well near the SS016 source zone. GSAP monitoring is ongoing.	Travis AFB will evaluate the monitoring and extraction well network at the southern end of the SS016 plume as well as cleanup technologies that are appropriate for inaccessible aquifers in support of the upcoming Basewide Groundwater ROD.

TABLE ES-4
Summary of Key Issues from the First Groundwater Five-Year Review
Second Five-Year Review Report, Travis AFB

First Five-Year Review Issue[a]	Air Force Response[a]	Current Status	Comment
	water migrating south from SS016 is not captured by the extraction system at SS029 or FT005, then in the future it may be necessary to expand the existing system or install some other technology to capture and treat contamination before it reaches the Base boundary.		
General: MNA and MNA assessments do not include sufficient geochemical parameters to adequately evaluate attenuation.	Plume stability is the main, but not sole, criterion in assessing the success of MNA. Natural Attenuation Summary Reports will be prepared in the future that will determine whether MNA should be selected as the final remedy at sites undergoing assessment. The Natural Attenuation Summary Reports will be prepared in accordance with the final NAAP[c].	Natural Attenuation Summary Reports for sites, or portions of sites, undergoing MNA assessment are pending. The base will prepare the reports after the stakeholders agree that sufficient data are available to make a decision whether MNA should be selected as a final remedy at each site. The stakeholders will agree on the needed components of the Natural Attenuation Summary Reports.	MNA assessment reports will be completed by the selected environmental contractor. Selection will take place in 2008.

[a]Final *Groundwater Five-Year Review,* Appendix B (CH2M HILL, 2003)

[b]*DP039 Optimization Field Report* (CH2M HILL, 2007)

[c]*Natural Attenuation Assessment Plan* (CH2M HILL, 1998)

Works Cited

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit*. Installation Restoration Program. Travis AFB, California. 24 June.

U.S. Environmental Protection Agency (EPA). 2001. *Comprehensive Five-Year Review Guidance.* Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P. EPA 540R-98-050, PB99-963214. October.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (*from WasteLAN*): Travis Air Force Base		
EPA ID (*from WasteLAN*): CA5570024575		
Region: 9	**State:** CA	**City/County:** Fairfield/Solano

SITE STATUS			
NPL status:	Final X	Deleted	Other (specify) _____
Remediation status (choose all that apply):			Under Construction __ Operating X Complete __
Multiple OUs?*	YES X	NO	Construction completion date: 12 / 31 / 2003
Has site been put into reuse?	YES	NO X	

REVIEW STATUS		
Lead agency:	EPA State Tribe	Other Federal Agency U.S. Air Force
Author name:	CH2M HILL	
Author title: N/A		**Author affiliation:** N/A
Review period:**	January 2008 to July 2008	
Date(s) of site inspection: Site inspection ongoing		
Type of review:	X Post-SARA Non-NPL Remedial Action Site Regional Discretion	Pre-SARA NPL-Removal only NPL State/Tribe-lead
Review number	1 (first) __ 2 (second) X 3 (third) __	Other (specify) _____
Triggering action:		
Actual RA Onsite Construction at NEWIOU Construction Completion Other (specify)		Actual RA Start at OU# X Previous Five-Year Review Report
Triggering action date (*from WasteLAN*): July 2003		
Due date (*five years after triggering date*): July 2008		

*["OU" refers to operable unit.]
**[Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form

Issues:

There are no issues that prevent the North, East, West Industrial Operable Unit (NEWIOU) and West/Annexes/Basewide Operable Unit (WABOU) groundwater interim remedial actions (IRA) being protective. However, optimization opportunities exist for NEWIOU Sites LF007C and SS030 and WABOU Site DP039:

The LF007C trichloroethene (TCE) plume has migrated offbase. The existing solar-powered extraction wells are probably inadequate to control migration or remediate the plume.

A portion of the offbase SS030 TCE plume may be migrating toward Site FT005 under the influence of the FT005 GET system.

The portion of the DP039 TCE plume that is downgradient of the current zone of hydraulic capture may be migrating.

Follow-up Actions:

The Air Force is considering the following follow-up actions for optimization of the LF007C, SS030, and DP039 groundwater IRA:

LF007C -- The LF007C plume is migrating offbase. The existing solar-powered extraction wells are probably inadequate to control migration or remediate the plume. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force. Potential follow-up actions include:

Investigate the extent of TCE contamination above the Interim Remediation Goal (IRG) in the offbase area. Verify the groundwater flow direction(s).

After the offbase plume is characterized, evaluate installing one or more additional extraction wells to hydraulically capture the plume and fully achieve the Migration Control and Offbase Remediation objectives.

Install additional compliance monitoring wells on the east side of the off-base plume to monitor the performance of the enhanced groundwater extraction and treatment (GET) system.

Evaluate optimization measures to improve the achievement of the IRA objectives.

SS030 -- A portion of the offbase SS030 plume may be migrating toward Site FT005 under the hydraulic influence of the FT005 GET system. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force. Potential follow-up actions include:

Characterize the extent of groundwater contamination to the east of the offbase portion of the SS030 plume. Install one or more additional monitoring wells in this area for long-term compliance monitoring.

Evaluate installing one or more extraction wells on the east side of the offbase SS030 plume to prevent contaminant migration in that area.

DP039 -- The portion of the DP039 plume that is downgradient of the current zone of hydraulic capture may be migrating. Potential follow-up actions will include continuing to monitor concentration trends in downgradient wells and evaluating potential extraction system modifications.

Protectiveness Statement(s):

NEWIOU Groundwater Interim Remedial Actions: The groundwater interim remedies within the NEWIOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness. Also, for the remedies at Sites LF007C and SS030 to be protective in the long-term, following-up actions need to be taken.

WABOU Groundwater Interim Remedial Actions: The groundwater interim remedies within the WABOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness. Also, for the remedy at Site DP039 to be protective in the long-term, follow-up actions need to be taken.

NEWIOU Soil Remedial Actions: Because the remedial actions at NEWIOU soil sites are protective, the remedies are protective of human health and the environment. The pending soil RA at NEWIOU Site FT005 will be protective of human health and the environment once the remedy is completed.

NEWIOU Sediment Remedial Actions: Pending sediment remedial actions at NEWIOU sites SD001 and SD033 will be protective of human health and the environment once the remedies are completed. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

WABOU Soil Remedial Actions: Because the remedial actions at all WABOU soil sites are protective, the remedies are protective of human health and the environment.

Other Comments:

It is anticipated that after the second five-year review of groundwater IRA, there will be sufficient data to support the development of the Basewide groundwater Record of Decision (ROD). This ROD will be prepared by the Air Force in cooperation with U.S. EPA, San Francisco Bay Water Board, and California Department of Toxic Substances Control (DTSC). This ROD will stipulate the final groundwater cleanup concentrations and remedial actions at Travis AFB.

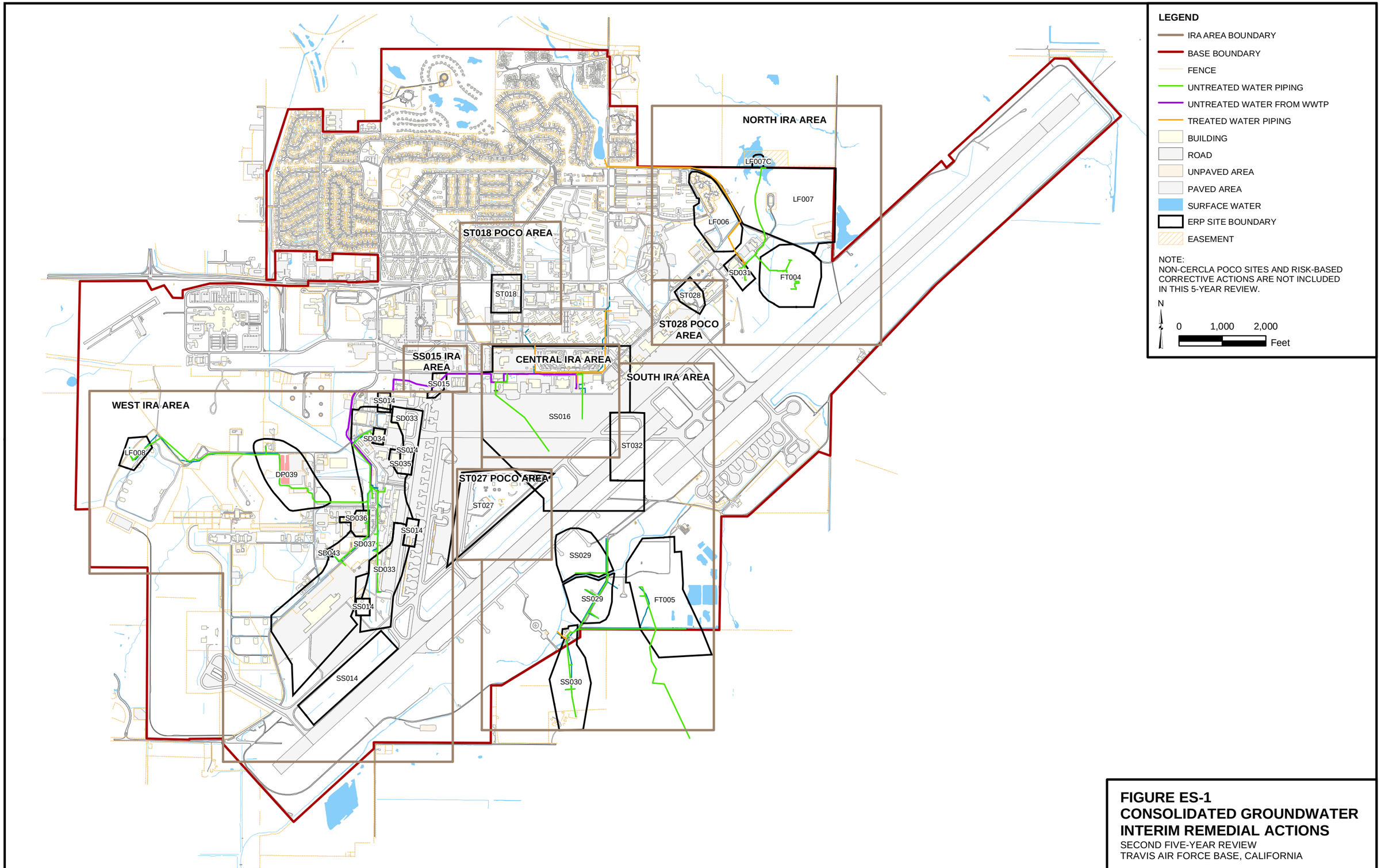

FIGURE ES-1
CONSOLIDATED GROUNDWATER INTERIM REMEDIAL ACTIONS
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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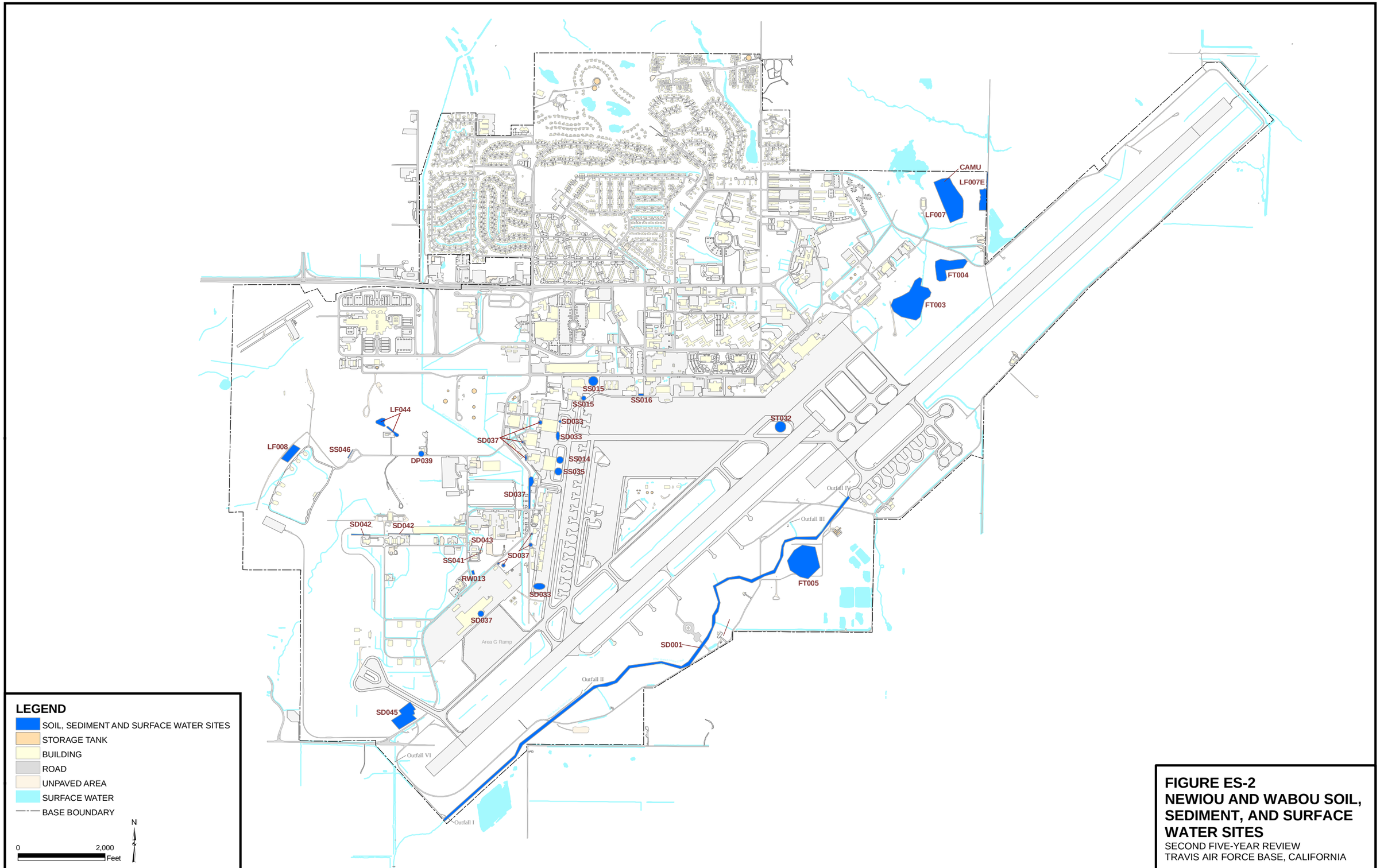

FIGURE ES-2
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SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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Acronyms and Abbreviations

µg/L	micrograms per liter
AFB	Air Force Base
Air Force	U.S. Air Force
ARAR	Applicable or Relevant and Appropriate Requirement
Base	Travis Air Force Base
Base General Plan	Travis AFB General Plan
Cal/EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit
CD	compact disk
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CGWTP	Central Groundwater Treatment Plant
CIP	Community Involvement Plan
CRP	Community Relations Plan
DCA	dichloroethane
DCE	dichloroethene
DPE	dual-phase extraction
DTSC	California Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
ECC	Environmental Chemical Corporation
EIAP	Environmental Impact Analysis Process
EIOU	East Industrial Operable Unit
EPA	U.S. Environmental Protection Agency
ERP	environmental restoration program
ET	evapotranspiration
FFA	*Federal Facilities Agreement*
FS	feasibility study

FTA	Fire Training Area [number]
GET	groundwater extraction and treatment
GSAP	Groundwater Sampling and Analysis Program
ICG	interim cleanup goal
IRA	interim remedial action
IRG	interim remediation goal
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IRP	Installation Restoration Program
LGAC	liquid-phase granulated activated carbon
LTO	long-term operation
LUC	land use control
MAP	Management Action Plan
MCL	maximum contaminant level
MNA	monitored natural attenuation
NAAP	Natural Attenuation Assessment Plan
NCEA	National Center for Environmental Assessment
NEWIOU	North/East/West Industrial Operable Unit
NGWTP	North Groundwater Treatment Plant
NOU	North Operable Unit
NPL	National Priorities List
O&M	operations and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OSA	Oil Spill Area
OU	operable unit
OWS	oil-water separator
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POCO	petroleum-only contaminated
PRG	preliminary remediation goal

RA	remedial action
RAB	Restoration Advisory Board
RI	Remedial Investigation
ROD	Record of Decision
SBBGWTP	South Base Boundary Groundwater Treatment Plant
SVOC	semivolatile organic compound
TARA	Tower Area Removal Action
TCE	trichloroethene
ThOx	thermal oxidation
URS	URS Group, Inc.
UV/Ox	ultraviolet oxidation
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
WABOU	West/Annexes/Basewide Operable Unit
Water Board	Regional Water Quality Control Board
WIOU	West Industrial Operable Unit
WTP	Water Treatment Plant
WTTP	Water Treatment and Transfer Plant

SECTION 1

Introduction

This *Second Five-Year Review Report* provides descriptions and evaluations of the groundwater interim remedial actions (IRAs) and soil and/or sediment remedial actions (RAs) that have been implemented at Travis Air Force Base (AFB or Base), California. The location of Travis AFB is shown on Figure 1-1 (all figures are located at the end of the section or subsection in which they are referenced).

1.1 Purpose of a Five-Year Review

The basic purpose of a five-year review is to determine whether a remedy implemented at a site is, or is expected to be, protective of human health and the environment. The methods, findings, and conclusions of the review are documented in a five-year review report. In addition, a five-year review report identifies any important issues found during the review and provides potential actions to address them.

The specific purpose of this *Second Five-Year Review Report* is to verify that the groundwater IRAs and soil and/or sediment RAs implemented at Travis AFB are protective of human health and the environment and are functioning as designed.

1.2 Authority and Guidance

The U.S. Air Force (Air Force) is preparing this five-year review pursuant to Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 121 and the National Contingency Plan (NCP). CERCLA Section 121 states the following:

> 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 U.S. Environmental Protection Agency (EPA) interpreted this requirement further in the NCP; 40 CFR Section 300.430(f)(4)(ii) states the following:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such

action no less often than every five years after the initiation of the selected remedial action.

This *Second Five-Year Review Report* was prepared in accordance with EPA's *Comprehensive Five-Year Review Guidance* (EPA, 2001). The Travis AFB groundwater IRAs are post-Superfund Amendments and Reauthorization Act actions that, upon completion, will not leave hazardous substances, pollutants, or contaminants onsite above levels that allow for unlimited use and unrestricted exposure. However, these groundwater actions will require 5 or more years to complete.

The soil and sediment RAs conducted at Travis AFB will minimally achieve industrial cleanup levels, or more stringent residential cleanup levels. At sites where the industrial cleanup levels are achieved, land use controls (LUCs) will be enforced to restrict site access and control usage. At sites where the soil RA reduces contaminant concentrations to residential cleanup levels, the land will be available for unlimited use and unrestricted exposure.

1.3 Scope of the Second Five-Year Review

The scope of this *Second Five-Year Review Report* includes the groundwater IRAs and soil and/or sediment RAs at Environmental Restoration Program (ERP) sites at Travis AFB, California.

The Air Force is conducting the groundwater IRAs and soil and/or sediment RAs within the two operable units (OUs) that currently exist at Travis AFB. These OUs include the North, East, West Industrial Operable Unit (NEWIOU) and the West/Annexes/Basewide Operable Unit (WABOU). IRAs to address groundwater contamination at sites within both OUs are currently underway in accordance with the final Groundwater Interim Record of Decision (IROD) for the NEWIOU (Travis AFB, 1998) and the final Groundwater IROD for the WABOU (Travis AFB, 1999). The selection of final groundwater RAs will be made in the pending basewide groundwater Record of Decision (ROD).

Soil RAs at sites within the WABOU have been completed in accordance with the final Soil ROD for the WABOU (Travis AFB, 1999). Within the NEWIOU, soil and/or sediment RAs were mostly completed in accordance with the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006), but RAs at three sites are pending.

This is the second review of NEWIOU and WABOU groundwater IRAs and the first five-year review of WABOU soil RAs and NEWIOU soil and/or sediment RAs. The first five-year review of NEWIOU and WABOU groundwater IRAs was completed in July 2003 (CH2M HILL, 2003). The triggering action for that first five-year review was the implementation of the first groundwater IRAs following the signing of the final Groundwater IROD for the NEWIOU (Travis AFB, 1998). That action was the startup of the South Base Boundary Groundwater Treatment Plant in July 1998.

1.3.1 Groundwater Interim Remedial Actions

The scope of the five-year review includes groundwater IRAs at 15 NEWIOU and 4 WABOU ERP sites. A listing of the sites is provided in Table 1-1. Groundwater IRAs

have been implemented at each of these sites in accordance with the Groundwater IROD for the NEWIOU (Travis AFB, 1998) or Groundwater IROD for the WABOU (Travis AFB, 1999), as applicable.

TABLE 1-1
Summary of NEWIOU and WABOU Groundwater Sites
Second Five-Year Review Report, Travis Air Force Base, California

NEWIOU Groundwater Sites[a]	WABOU Groundwater Sites[b]
FT004	DP039
FT005	LF008
LF006	SD043
LF007	SS041
SS015	
SS016	
SS029	
SS030	
SD031	
ST032	
SD033	
SD034	
SS035	
SD036	
SD037	

[a] Identified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998) as requiring remediation.
[b] Identified in the Groundwater IROD for the WABOU (Travis AFB, 1999) as requiring remediation.

The Air Force developed the groundwater IRODs for NEWIOU and WABOU, rather than a final groundwater ROD, to allow groundwater remediation to begin quickly to reduce contamination and risk. The two groundwater IRODs establish an interim period to evaluate the effectiveness of the IRAs and to monitor the status of each contaminant plume. The Air Force will use this data to establish final groundwater cleanup levels and select technically and economically feasible long-term actions in the final basewide groundwater ROD. The Air Force will publish a Proposed Plan, hold a public comment period, and address the public's comments before the Air Force and the regulatory agencies finalize and approve the final Basewide Groundwater ROD. The projected date for the completion of the Basewide Groundwater ROD is 30 September 2010.

1.3.2 Petroleum-only Contaminated Sites

The Travis AFB Petroleum-only Contaminated (POCO) Sites Program manages petroleum contamination sites. These POCO sites are not governed by either IROD:

- ST018 – North/South Gas Station
- ST027 – Facilities 1918, 1919, and 1754
- ST028 – Facilities 363 and 1201

However, POCO Sites SS014 (Jet-fuel Spill Area) and ST027 (TF33) are addressed by this five-year review because petroleum contamination is commingled with CERCLA

contamination. POCO sites are typically associated with surface and subsurface releases from fuel spills, piping leaks, oil-water separators (OWSs), or underground storage tanks. The POCO Sites Program includes the removal of underground storage tanks and the remediation of POCO soil and groundwater using risk-based cleanup actions. The San Francisco Bay Regional Water Quality Control Board (Water Board) is the lead oversight agency for this program, as CERCLA excludes petroleum as a CERCLA contaminant. For this reason, the POCO sites were not addressed in either IROD. However, the Air Force does address petroleum contamination under CERCLA if it is commingled with CERCLA contaminants, as in the case of Site SS014 at Fuel Storage Area G and Site ST027. Accordingly, POCO Sites SS014 and ST027 will also be included in the pending Basewide Groundwater ROD.

1.3.3 Soil Remedial Actions

The scope of the five-year review includes soil RAs at 9 WABOU sites and soil and/or sediment RAs at 10 NEWIOU ERP sites.

1.3.3.1 WABOU Soil Remedial Actions

The scope of the five-year review includes the following nine WABOU ERP soil sites where soil RAs have been completed in accordance with the Soil ROD for the WABOU (Travis AFB, 2002):

- DP039 – Building 755, Travis AFB Battery and Electric Shop
- LF008 – Landfill 3
- LF044 – Landfill X
- RW013 – Radioactive Burial Site 2/Dry Waste Landfill
- SD042 – Buildings 929/931/940
- SD043 – Building 916
- SD045 – Former Small Arms Range
- SS041 – Building 905, Travis AFB Entomology Shop
- SS046 – Railhead Munitions Staging Area

1.3.3.2 NEWIOU Soil and Sediment Sites

Contaminated soil and/or sediment ERP sites within the NEWIOU that required RA in accordance with the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006) include the following:

- SD001 – Union Creek (sediment only)
- FT003 – Fire Training Area (FTA) 2
- FT004 – FTA-3
- FT005 – FTA-4
- LF007 – Landfill 2
- SS015 – Solvent Spill Area and Facilities 808, 1832, and 552

- SS016 – Oil Spill Area (OSA); Facilities 11, 13/14, 20, 42/1941; and portions of the storm sewer system
- ST032 – MW246/MW-107 Areas
- SD033 – Storm Sewer II, South Gate Area, Facilities 810 and 1917, and West Branch of Union Creek: soil and sediment
- SD037 – Sanitary Sewer System; Facilities 837/838, 919, 977, 981; Ragsdale/V Street Area; and Area G Ramp

1.4 Second Five-Year Review Report Organization

The following list provides a brief summary of the organization and content of this *Second Five-Year Review Report*:

- **Section 1 – Introduction:** Describes the subject, purpose, scope, and plan of development of this *Second Five-Year Review Report*.
- **Section 2 – Chronology:** Provides summary descriptions of key historical events related to the NEWIOU and WABOU Groundwater IRAs and WABOU Soil RAs.
- **Section 3 – Background:** Summarizes the physical characteristics, land and resource use, history of contamination, initial responses, and the basis for taking action.
- **Section 4 – Groundwater Interim Remedial Actions and Soil Remedial Actions:** Describes the basis for the selection and implementation of the groundwater IRAs and soil RAs. Provides summary descriptions of system operations and operation and maintenance (O&M).
- **Section 5 – Progress Since the Last Five-Year Review:** Describes progress towards achieving groundwater interim remediation goals (IRGs) and soil cleanup goals. Provides comparative groundwater contaminant distribution maps (2003 and 2008) for each groundwater IRA.
- **Section 6 – Five-Year Review Process:** Summarizes the administrative components, community notification and involvement, documents reviewed, data reviewed, inspections conducted, and interviews conducted during the development of this report.
- **Section 7 – Technical Assessment:** Provides answers to the three key questions posed in the EPA guidance (EPA, 2001):
  - **Question A –** Is the remedy functioning as intended by the decision documents?
  - **Question B –** Are the assumptions used at the time of remedy selection still valid?
  - **Question C –** Has any other information come to light that could call into question the protectiveness of the remedy?
- **Section 8 – Issues and Follow-up Actions –** Describes issues and potential optimization of groundwater IRAs that may enhance their protectiveness. Also provides the date of the next five-year review.

- **Section 9 – Protectiveness Statements**
- **Appendices**
  - Appendix A: Analytical Data Summaries (compact disk [CD])
  - Appendix B: Chemical Time-series Plots (CD)
  - Appendix C: Groundwater Modeling
  - Appendix D: Groundwater Sites and Contamination
  - Appendix E: Responses to Comments

1.5 Works Cited

CH2M HILL. 2003. Final *Groundwater Five-Year Review*. Environmental Restoration Program. Travis AFB, California. 14 July.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

U.S. Environmental Protection Agency (EPA). 2001. *Comprehensive Five-Year Review Guidance.* Office of Solid Waste and Emergency Response Directive 9355.7-03B-P. EPA 540R-01-007. June.

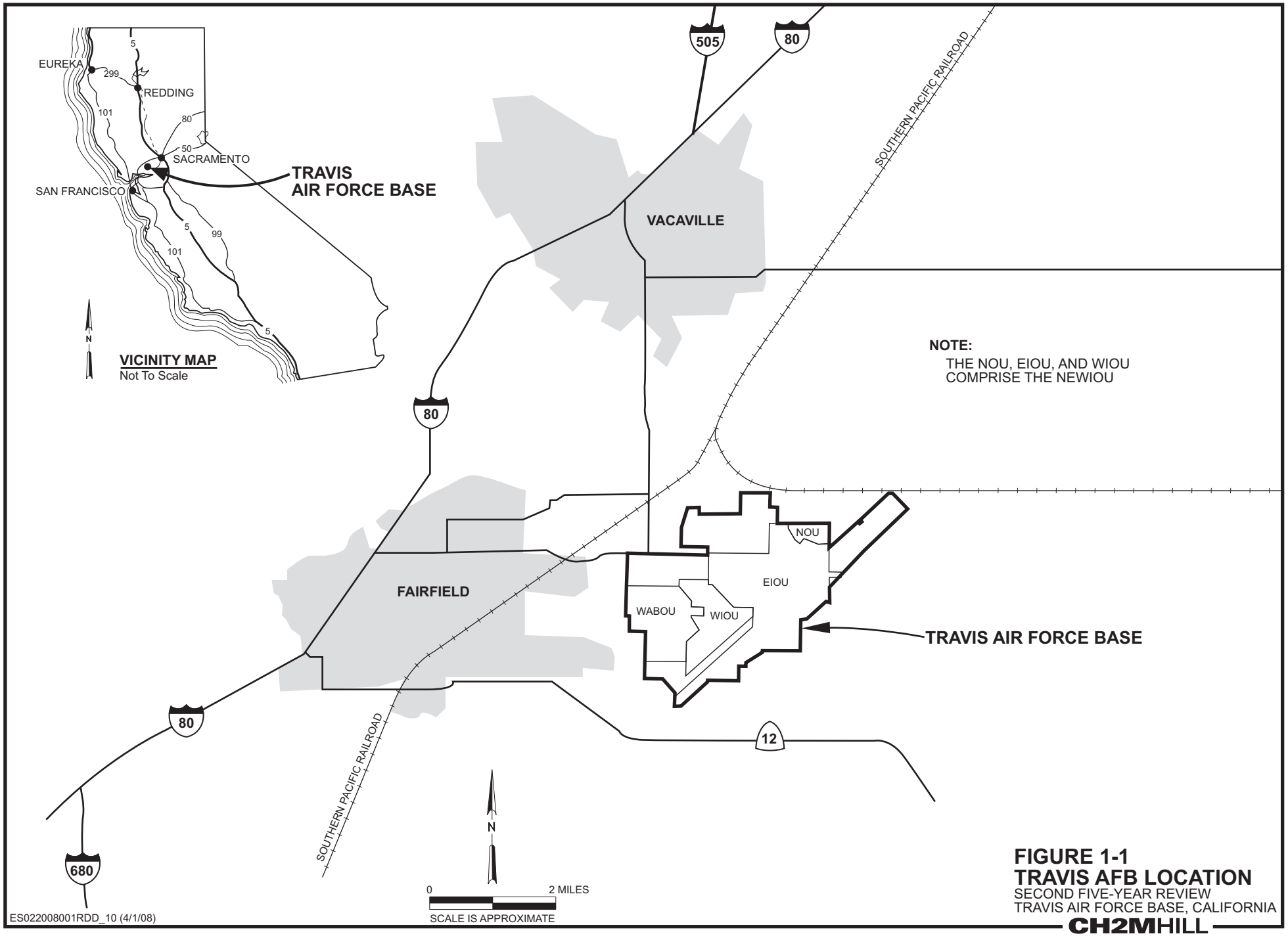


FIGURE 1-1
TRAVIS AFB LOCATION
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

SECTION 2

Chronology

This section provides descriptions of key historical events related to the NEWIOU and WABOU Groundwater IRAs and WABOU Soil RAs at Travis AFB.

2.1 Key Events

As a result of past waste management and disposal practices, groundwater, soil, and sediment at Travis AFB is contaminated at multiple locations. Travis AFB is implementing groundwater IRAs and soil and/or sediment RAs to address this contamination in accordance with CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan, the final Groundwater IROD for the NEWIOU (Travis AFB, 1998b), the final Groundwater IROD for the WABOU (Travis AFB, 1999), the final Soil ROD for the WABOU (Travis AFB, 2002) and the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). The key events related to the Travis AFB environmental management program are summarized in Table 2-1.

TABLE 2-1
Chronology of Key Events
Second Five-Year Review Report, Travis Air Force Base, California

Event	Date(s)
Phase I Preliminary Assessment	1983
Installation Restoration Program (IRP) investigations	1983 – 1994
Pre-National Priorities List (NPL) Response	1983 – 1989
NPL listing	21 November 1989
Federal Facilities Agreement (FFA) signature	27 September 1990
Travis AFB Community Relations Plan (CRP) implemented	1991
Fact sheets describing restoration program activities and milestones published	1993 – present
FFA renegotiated to create four OUs	1993
Consolidation of East Industrial Operable Unit (EIOU), West Industrial Operable Unit (WIOU), and North Operable Unit (NOU) into the NEWIOU	October 1995
Travis AFB Restoration Advisory Board formed	1995
Quarterly restoration program newsletter published and mailed	1995 – present
CERCLA Remedial Investigation/Feasibility Studies	1993 – 1998
Central Groundwater Treatment Plant (CGWTP) online	1995
Final Groundwater IROD for NEWIOU signed	26 January 1998
Travis AFB CRP revised	1998
South Base Boundary Groundwater Treatment Plant online (five-year review trigger)	1998
Final Groundwater IROD for WABOU signed	24 June 1999

TABLE 2-1
Chronology of Key Events
Second Five-Year Review Report, Travis Air Force Base, California

Event	Date(s)
West Treatment and Transfer Plant online	2000
North Groundwater Treatment Plant online	2000
Community Involvement Plan (CIP) (initial)	August 2001
Final Soil ROD for the WABOU signed	December 2002
WABOU Soil Remedial Designs /RAs	2003 – 2007
CIP updated	July 2003
First Five-Year Review	July 2003
CIP updated	April 2006
Final NEWIOU Soil, Sediment, and Surface Water ROD signed	10 May 2006
Final Second Five-Year Review	24 September 2008 (current)
NEWIOU Soil and Sediment RAs completed (SD001, FT005, SD033)	Pending
RD/RA QAPP Update	31 March 2010 (projected)
Basewide Groundwater ROD	Pending (estimated 2010)
Third Five-Year Review	Pending (estimated 2012)

Remediation of both NEWIOU and WABOU contaminated groundwater sites is being conducted under two IRODs, as opposed to a final ROD. These IRAs were implemented to quickly begin remediation of groundwater contamination, reduce the levels of contamination and potential risk, and collect some of the data necessary for the selection of final cleanup levels and technically and economically feasible long-term actions. The use of an IROD allowed groundwater IRAs to proceed without having final designated cleanup levels, as will be required for one or more groundwater RODs.

The groundwater IRAs conducted under the NEWIOU and WABOU Groundwater IRODs uses IRGs and ICGs as performance objectives. These IRGs and ICGs are not legally enforceable standards, but are simply goals used during the period of interim remediation (for the remainder of this report, the term IRG is used synonymously with ICG.)

Soil and sediment RAs for Travis AFB are described in the final NEWIOU Soil, Sediment, and Surface Water ROD and final Soil ROD for the WABOU. Under both RODs, if remedial action reduces residual contaminant concentrations to levels that allow for unlimited use and unrestricted exposure, then land use controls (LUCs) are not required. However, if excavation only reduces contaminant concentrations to industrial cleanup levels, then LUCs will be implemented to restrict residential development and soil disturbance activities.

2.2 NEWIOU and WABOU Groundwater and Soil Sites Chronology

In 1983, the Air Force initiated the IRP to investigate the nature and extent of hazardous waste releases to the environment. On the basis of IRP data evaluated by EPA, Travis AFB

was placed on the NPL on 21 November 1989 (54 Federal Register 48187). Approximately 1 year later, on 27 September 1990, the Air Force, EPA, California Department of Toxic Substances Control (DTSC), and the San Francisco Bay Water Board negotiated and signed the FFA (Travis AFB, 1990) that established the framework and schedule for environmental cleanup at Travis AFB. Travis AFB is the lead agency and is responsible for conducting all follow-up actions related to the groundwater IRAs and soil RAs. EPA Region 9, the Water Board, and DTSC provide regulatory agency oversight of the actions that may be taken by the Air Force.

2.3 NEWIOU Sites

Under the original FFA (Travis AFB, 1990), Travis AFB was treated as a single entity with one associated comprehensive cleanup schedule. Then, in May 1993, the FFA was amended to divide the Base into four OUs to facilitate the overall cleanup program. The OU boundaries are shown on Figure 2-1. The four OUs include the following:

- EIOU
- WIOU
- NOU
- WABOU

Between approximately 1983 and 1994, early IRP investigations, data gathering, and work planning efforts were conducted to preliminarily assess the nature of environmental contamination at Travis AFB. After these efforts were completed, more focused CERCLA remedial investigations (RIs) were performed within each of the Travis AFB OUs between 1994 and 1996. Following the completion of the EIOU, WIOU, and NOU RIs in October 1995; the EIOU, WIOU, and NOU were combined into the NEWIOU. A feasibility study (FS) was then completed for the NEWIOU, and remedial alternatives were developed, screened, and evaluated for each site (Radian, 1996).

2.3.1 NEWIOU Groundwater Sites

The NEWIOU FS was followed by the NEWIOU Groundwater Proposed Plan, which proposed the preferred groundwater IRA alternative for each NEWIOU site. Subsequently, the groundwater IRA for each site was formally selected in the Groundwater IROD for the NEWIOU (Travis AFB, 1998c). Since that time, IRAs have been implemented and are underway at each NEWIOU site identified in the IROD as requiring remediation.

Travis AFB will continue to operate groundwater IRAs at NEWIOU sites until the Basewide Groundwater ROD is completed and the final groundwater remedies are selected and implemented.

POCO sites SS014 and ST027 will also be included in the Basewide Groundwater ROD because of commingled petroleum and CERCLA contamination.

2.3.2 NEWIOU Soil, Sediment, and Surface Water Sites

As with the groundwater sites, the NEWIOU FS included sites with contaminated soil, sediment, and surface water. The NEWIOU Proposed Plan for Soil, Sediment, and Surface

Water (Travis AFB, 1998a) was finalized in 1998. Final remedies for these sites were then selected in the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006).

Soil and sediment sites within the NEWIOU are included in this *Second Five-Year Review Report*, although 5 years have not passed since soil RAs were completed at most sites during 2007. The soil RA at Site FT005 and the sediment RAs at Sites SD001 and SD033 have not yet been completed.

2.4 WABOU Sites

The sequence of events for IRP sites within the WABOU is similar to that for the NEWIOU. After some preliminary IRP investigations and a planning phase, the WABOU RI Report (CH2M HILL, 1997) was completed in May 1997. The subsequent WABOU FS Report was finalized in April 1998 (CH2M HILL, 1998).

2.4.1 WABOU Groundwater Sites

Following the WABOU FS, a Groundwater Proposed Plan for the WABOU was developed and was finalized in April 1998 (Travis AFB, 1998b). The final Groundwater IROD for the WABOU was completed in June 1999 (Travis AFB, 1999). Since that time, groundwater IRAs have been implemented and are currently underway at each WABOU site identified in the IROD as requiring remediation.

Travis AFB will continue to operate groundwater IRAs at WABOU sites until the Basewide Groundwater ROD is completed and the final groundwater remedies are implemented.

2.4.2 WABOU Soil Sites

The final Soil ROD for the WABOU (Travis AFB, 2002) was signed in December 2002. Since that time, soil RAs have been completed at all WABOU sites that were identified in the ROD.

2.5 Basewide Groundwater Record of Decision

The Travis AFB Basewide Groundwater ROD is pending. Currently, all the groundwater remedies being conducted at Travis AFB ERP sites are **IRA**s. The final groundwater RAs will be selected in the pending Basewide Groundwater ROD.

2.6 Works Cited

CH2M HILL. 1998. Final *West/Annexes/Basewide Operable Unit (WABOU) Feasibility Study*. 60th Air Mobility Wing. Travis Air Force Base, California. 23 March.

CH2M HILL. 1997. Final *West/Annexes/Basewide Operable Unit (WABOU) Remedial Investigation (RI) Report*. Installation Restoration Program. Travis AFB, California. 18 May.

Radian. 1996. Final North, *East, West Industrial Feasibility Study*. Travis Air Force Base, California. September.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

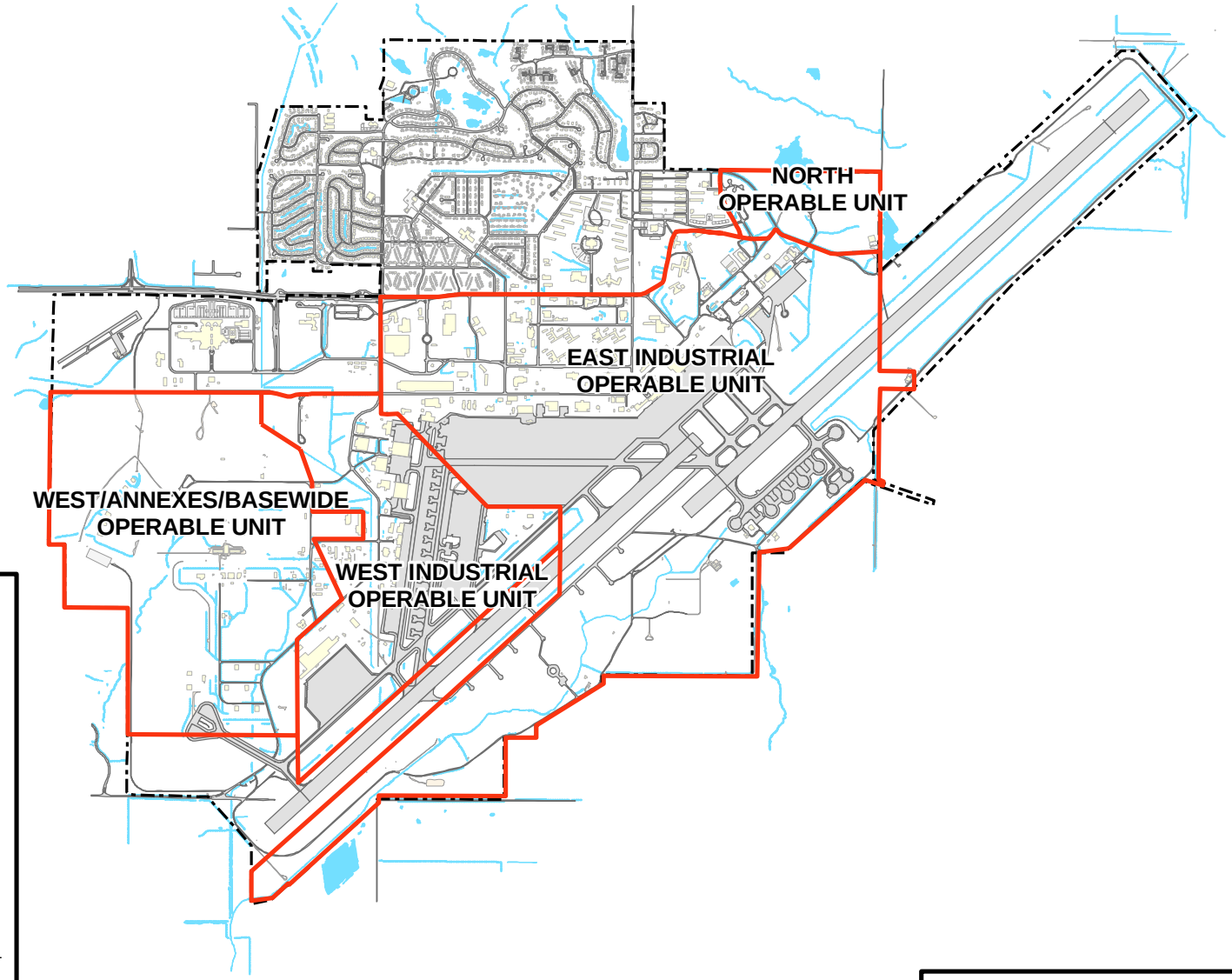
Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998a. Draft Final *Proposed Plan for Soil, Sediment, and Surface Water, North/East/West Industrial Operable Unit*. June.

Travis Air Force Base (Travis AFB). 1998b. *Proposed Plan for Groundwater Cleanup*. April.

Travis Air Force Base (Travis AFB). 1998c. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

Travis Air Force Base (Travis AFB). 1990. *Federal Facilities Agreement*. September.



LEGEND

- BASE BOUNDARY
- ROAD
- UNPAVED AREA
- PAVED AREA
- BUILDINGS
- SURFACE WATER
- INTERMITTENT STREAM
- OPERABLE UNIT (OU) BOUNDARY

NOTE:
THE NEWIOU COMPRISES THE NORTH OPERABLE UNIT (NOU), EAST INDUSTRIAL OPERABLE UNIT (EIOU), AND WEST INDUSTRIAL OPERABLE UNIT (WIOU).

N

0 1,750 3,500 FEET

FIGURE 2-1
OPERABLE UNITS
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG2-1_HISTORICAL_OP_UNITS.MXD 3/6/2008 12:16:09

SECTION 3

Background

This section provides summary descriptions of Travis AFB physical characteristics, land and resources use, and habitats and wildlife. Also provided are brief histories of contamination at the ERP groundwater and soil and/or sediment sites within the NEWIOU and WABOU, the initial response actions at some of these sites, and the basis for taking action to address groundwater and soil and/or sediment contamination.

3.1 Physical Characteristics

Travis AFB is located midway between San Francisco and Sacramento, California, on low-lying ground within 1 mile of Suisun Marsh, an estuary of San Francisco Bay. It is located 3 miles east of downtown Fairfield in Solano County. The Base occupies over 6,000 acres and maintains ownership of, or administrative control over, several properties at offbase locations. Facilities include two major runways, associated taxiways and aircraft parking aprons, numerous hangars, buildings, shops, offices, freight handling and storage areas, and maintenance facilities.

Travis AFB is part of Air Mobility Command and is host to the 60th Air Mobility Wing and other units. The 60th Air Mobility Wing operates C-5 Galaxy and C-17 Globemaster III cargo aircraft and KC-10 Extender refueling aircraft. The primary missions of Travis AFB, since its establishment in 1943, have been strategic reconnaissance and airlift of freight and troops.

3.1.1 Geology and Hydrogeology

Travis AFB is located on the western edge of the Sacramento Valley segment of the Great Valley geomorphic province, which is the a southeast-trending, sediment-filled synclinal basin. Just west of Travis AFB lies the Coast Range geomorphic province, which is composed of folded and uplifted bedrock (Thomasson et al., 1960; Olmstead and Davis, 1961).

The geomorphology of the area is characterized by gently sloping alluvial plains and fans overlying Tertiary sedimentary rock. Coalescing, low-relief fans have been deposited by streams (e.g., Union Creek and Laurel Creek) migrating across the Base over time. The majority of "Older Alluvium" was deposited during the Pleistocene age prior to the last glaciation. Drainages were incised in Older Alluvium during the last glacial period in response to dropping sea levels. Incised channels were filled with "Younger Alluvium" over the past 11,000 years to produce a complex hydrogeologic environment comprising discontinuous beds of sand and silty sand suspended in a matrix of fine-grained silt and clay. Sand lenses are typically elongated parallel to (former) streams, trending south-southeast across the Base. Where present, lenses of sand vary in continuity and thickness. Alluvium ranges in thickness from 0 to approximately 70 feet in the area. The thickness of alluvium generally increases to the southeast. West of Travis AFB, the thickness of alluvium increases to over 200 feet (Thomasson et al., 1960).

3.1.2 Groundwater

Regionally, Travis AFB is located along the eastern edge of the Fairfield-Suisun Hydrologic Basin adjacent to the Sacramento Valley segment of the Central Valley province. The primary water-bearing deposits in the area are Older and Younger Alluvium. Within the alluvium, discontinuous lenses of sand and silty sand are the highest permeability units, elongated parallel to (former) streams and trending south-southeast in most locations. Alluvium varies in thickness from a few feet to approximately 70 feet where present, and is saturated to within 10 to 20 feet of the land surface. The depth of alluvium has been estimated from drilling. In the western part of the Base, wells penetrating the full thickness of alluvium are sparse, and the depth to bedrock is poorly understood.

Groundwater generally flows from north to south across the Base from the foot of the Vaca Mountains to Luco and Hill Sloughs through the alluvium. Flow is primarily lateral. On a local scale, groundwater tends to flow from areas of elevated bedrock (outcrop) toward channels of higher transmissivity alluvium and south to southeast through the latter.

Groundwater is unconfined or semiconfined within the alluvium (depending on location). Infiltration of precipitation, runoff, and irrigation waters; leakage from streams; and lateral flow from the north and northwest recharges alluvial sediments. Groundwater is discharged from alluvium as evapotranspiration (ET), as leakage to streams, through pumping at extraction wells, and as flow to Luco and Hill Sloughs.

3.2 Land and Resource Use

The following subsections describe the usage of land, groundwater, and surface water at Travis AFB.

3.2.1 Land Use

Travis AFB occupies about 6,383 acres of land near the center of Solano County, California, and is located approximately 3 miles east of downtown Fairfield and 8 miles south of downtown Vacaville. Solano County's population in 2006 was approximately 411,680. The 2006 population estimates for Fairfield and Vacaville are 104,897 and 92,691, respectively (U.S. Census Bureau, 2006).

According to the Travis AFB Office of Public Affairs, Travis AFB currently employs about 7,750 active military personnel and 3,323 reservists. Approximately 5,613 people live in 3,466 onbase housing units. There are 3,006 civilians employed at Travis AFB. Approximately 17,000 military and civilian personnel are present daily on the Base.

The land use areas of Travis AFB are grouped into the following eight functional categories:

- **Mission –** Uses are closely associated with the airfield and include facilities, such as maintenance hangars and docks, avionics facilities, and other maintenance facilities. Aircraft operations facilities include control towers, Base operations, flight simulators, and other instructional facilities.
- **Administrative –** Uses include personnel, headquarters, legal, and other support functions.

- **Community –** Uses include both commercial and service activities. Examples of commercial uses include the Base Exchange, dining halls, service station, and clubs; service uses include the schools, chapel, library, and the family support center.
- **Housing –** Uses include both accompanied housing for families and unaccompanied housing for singles, temporary personnel, and visitors.
- **Base Support/Industrial –** Uses are for the storage of supplies and maintenance of Base facilities and utility systems.
- **Medical –** Uses include facilities for medical support, including the David Grant Medical Center.
- **Outdoor Recreation –** Uses include ball fields, golf course, equestrian center, swimming pools, and other recreational activities.
- **Open Space –** Used as buffers between Base facilities and to preserve environmentally sensitive areas.

The lands surrounding Travis AFB on the northeast and east are primarily used for ranching and grazing. Areas to the south are a combination of agricultural and marshland. A few commercial/light industrial areas are present to the north of the Base. The area west of Travis AFB is predominantly residential.

Land use within the WABOU is varied and consists of open grasslands, light industrial support areas, administrative areas, personnel training areas, ammunition storage, and service/storage areas.

Within the NEWIOU, land use mainly includes two major aircraft runways, associated taxiways and aircraft parking aprons, numerous hangars, buildings, shops, offices, freight handling and storage areas, and maintenance facilities.

3.2.2 Groundwater Use

No onbase wells are used for potable water production at Travis AFB.

Intensive extraction of groundwater for human consumption generally occurs only to the west of Travis AFB and Fairfield where the alluvium is thicker and contains a greater abundance of coarse-grained sediment. Groundwater wells in the area of Travis AFB are limited to domestic, stock-watering, and irrigation wells with typical screened depths within 100 feet of ground surface (Weston, 1995). Domestic wells, several of which are downgradient from Travis AFB, are used typically for households and gardens (Weston, 1993). Solano County does not supply water to the residences surrounding Travis AFB. The two nearest domestic wells are within 1,700 feet of the south boundary of Travis AFB.

3.2.3 Surface Water

Surface water is not used as a potable water source at Travis AFB.

Travis AFB is located in the northeastern portion of the Fairfield-Suisun Hydrologic Basin. Within the basin, water generally flows south to southeast toward Suisun Marsh, an

85,000-acre tidal marsh that is the largest contiguous estuarine marsh and the largest wetland in the continental United States. Suisun Marsh drains into Grizzly and Suisun Bays. Water from these bays flows through the Carquinez Straits to San Pablo Bay and San Francisco Bay, and ultimately discharges into the Pacific Ocean near the City of San Francisco.

Union Creek is the primary surface water pathway for runoff at Travis AFB. The head-waters of Union Creek are located approximately 1 mile north of the Base, near the Vaca Mountains, where the creek is an intermittent stream. Union Creek splits into two branches north of the Base, with the main (eastern) branch being impounded into a recreational pond designated as the Duck Pond. At the exit from the Duck Pond, the creek is routed through a storm sewer to the southeastern Base boundary, where it empties into an open creek channel.

The West Branch of Union Creek flows south and enters the northwestern border of Travis AFB east of the David Grant Medical Center in an excavated channel. This channel flows south to the northeast corner of the WABOU. The channel forms the boundary between the WIOU and the WABOU and parallels Ragsdale Street for about 4,000 feet. Flow in the channel is then directed to a culvert under the runway and discharges to the main channel of Union Creek at Outfall II. From Outfall II, Union Creek flows southwest, and discharges into Hill Slough, a wetland located 1.6 miles from the Base boundary. Surface water from Hill Slough flows into Suisun Marsh.

Local drainage patterns have been substantially altered within the Base by the rerouting of Union Creek, the construction of the aircraft runway and apron, the installation of storm sewers and ditches, and general development (e.g., the Base Exchange, industrial shops, maintenance yards, roads, housing, and other facilities). Surface water is collected in a network of underground pipes, culverts, and open drainage ditches. The surface water collection system divides the Base into eight independent drainage areas. The eastern portion of the Base is served by one of the drainage systems that collects runoff from along the runway and the inactive sewage treatment plant area and directs it to Denverton Creek and Denverton Slough. Denverton Creek is an intermittent stream near the Base. The northwestern portion of the WABOU drains to the west toward the McCoy Creek drainage area. McCoy Creek is also an intermittent stream near the Base. With the exception of these drainages, the remaining six drainage areas at the Base empty into Union Creek.

3.2.4 Habitats and Wildlife

Travis AFB has a variety of terrestrial and aquatic/wetland habitats and wildlife that are typical of the region.

3.2.4.1 Terrestrial Habitats

The terrestrial habitats at Travis AFB and adjacent areas consist of herbaceous-dominated habitats (annual grassland, pasture, and early ruderal habitat) and urban habitat (industrial areas, lawns, and ornamental plants), according to the California Department of Fish and Game (CDFG) classification system (Mayer and Laudenslayer, 1988). Aquatic/wetland habitats at Travis AFB include riverine (Union Creek) and riparian habitat, lacustrine (Duck Pond), and herbaceous-dominated wetlands marshes, and vernal pools.

In general, annual grassland habitat is dominated by non-native plant species, such as slender wild oat (*Avena fatua*), fescues (*Festuca)*, soft chess (*Bromus hordeaceus*), field bindweed (*Convolvulus arvensis*), and yellow star-thistle (*Centaurea solstitialis*). Some native plants, such as bunchgrass (*F. viridula)* and johnny-tuck (*Triphysaria eriantha*) may also be found, usually associated with undisturbed areas.

Mowed/disced grassland is generally composed of soft chess, Italian ryegrass (*Lolium multiflorum*), and wild oats (*Chasmanthium latifolium*). Pasture grassland can contain varying frequencies of filaree (*Erodium* sp.), ripgut brome (*Bromus diandrus*), soft chess, Italian ryegrass, and yellow star-thistle. Ruderal grasslands, on the other hand, contain higher numbers of perennial species and, in some areas, woody species such as coyote brush (*Baccharis pilularis*), eucalyptus (*Eucalyptus* sp.), Peruvian pepper-tree (*Schinus molle*), and black locust (*Robinia pseudoacacia*).

The urban habitat onbase contains maintained lawns and trees and shrubs, such as eucalyptus, Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), and coyote brush. Most isolated stands of shrubs or trees are located within or near urban areas, permanent water sources, or near artificial surface mounds (for example, rail lines, blast protection, and building and road foundations).

3.2.4.2 Aquatic and Wetland Habitats

Herbaceous wetland vegetation is found along the permanent (natural or artificial) drainages onbase and can also occur seasonally within vernal pools, swales, and ditches. Native species include salt grass (*Distichlis spicata*); non-native species include meadow fescue (*Festuca elatior*), sickle grass (*Parapholis incurva*), and cattails (*Typha* sp.). Vernally inundated areas support seasonal vegetation such as non-native Mediterranean barley (*Hordeum murinum* ssp. *leporinum*) and brass buttons (*Cotula coronopifolia*) and native plants such as downingia (*Downingia* sp.) and toad rush (*Juncus bufonius*).

Travis AFB has limited topographic relief, and the clayey soils prevent rapid drainage. This swale topography leads to the formation of vernal pools. Vernal pools are shallow depressions or small, shallow pools that fill with water during the winter rainy season, then dry out during the spring and become completely dry during the summer. The annual cycle of vernal pools includes standing water during the winter and spring, and desiccation during the summer and fall. During the time that the vernal pools contain water, biotic communities develop over relatively restricted areas. In the larger areas, grasslands form; in more confined, deeper areas, wetlands form. The vernal wetlands are concentrated along the western, southern, and southeastern boundaries of the Base. All of the surface water bodies on and near the Base empty into the Suisun Marsh. No springs have been recorded within the confines of Travis AFB.

The vernal pools at Travis AFB contain indicator species such as goldfields (*Lasthenia fremontii*), coyote thistle (*Eryngium vaseyi*), dwarf woolly-heads (*Psilocarphus brevissimum*), water pygmy-weed (*Crassula aquatica*), and one or more species of downingia and popcornflower (*Plagiobothrys* sp.).

Although a few willows and coyote brush can be found along Union Creek, the dominant plant species found in the riparian zone of Union Creek are mainly herbaceous and consist of beardless wild rye (*Leymus triticoides*), broad-leaved pepperwort (*Lepidium latifolium*),

Harding grass (*Phalaris aquatica*), and saltgrass. Hydrophytes such as cattails and rushes are also common.

3.2.4.3 Wildlife

Terrestrial vertebrates associated with non-native annual grasslands are commonly found onbase. Typical avian species include ring-necked pheasant (*Phasianus colchicus*), American kestrel (*Falco sparvarius*), American robin (*Turdus migratorius*), and the western meadowlark (*Sturnella neglecta*). Reptiles observed, or potentially occurring, at the Base include the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), and California red-sided garter snake (*Thamnophis sirtalis* ssp. *infernalis*). Common mammals identified include deer mouse (*Peromyscus maniculatus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), black-tailed hare (*Lepus californicus*), and red fox (*Vulpes vulpes*).

Permanent wetlands and seasonally wet areas support aquatic invertebrates, fish, amphibians, reptiles, birds, and mammals. Some aquatic invertebrate species observed in herbaceous wetlands and vernal pools at Travis AFB include vernal pool fairy shrimp (*Branchinecta lynchi*), damselflies (*Odonata sp.*), crayfish (*Orconectes virilis*), and aquatic snails. Amphibian species identified include bullfrog (*Rana catesbeiana*), Pacific tree frog (*Hyla regilla*), and California tiger salamander (*Ambystoma californiense tigrinum*). Aquatic birds observed on or near the Base include mallard (*Anas platyrhynchos*), great egret (*Casmerodiuis albus*), and great blue heron (*Ardea herodias*).

Because wildlife use riverine and riparian habitat somewhat similarly, these habitats are discussed together. Many aquatic invertebrates and amphibians are the same as those discussed above in herbaceous wetlands and vernal pools. These include damselflies, crayfish, aquatic snail, bullfrog, Pacific tree frog, and California tiger salamander. Fish species include mosquitofish (*Gambusia affinis*), fathead minnow (*Pimephales promelas*), threespine stickleback (*Gasterosteus aculeatus*), and bluegill (*Lepomis macrochirus*). Riverine/ riparian habitats are also used extensively by birds and terrestrial mammals for forage, shelter, and as a source of water. These include red-winged blackbird (*Agelaius phoenicus*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*).

Habitats that support special-status species are considered sensitive habitats. Sensitive aquatic/wetland areas include vernal pools, swales, and ditches that can support special-status plants and animals. Urban environments, scattered throughout the Base, can also support special-status species. For example, burrowing owls (*Speotyto cunicularia*) may use man-made culverts, perches, and bare earth areas that contain burrows provided by ground squirrels. Loggerhead shrikes (*Lanius ludovicianus*) may nest on antenna wires and forage in grasslands. Both owls and shrikes are typical species of the grassland habitats onbase. Also, vernal pool fairy shrimp have been found in artificially created depressions that seasonally fill with water.

3.2.4.4 Ecological Risk Assessments

Travis AFB has completed Ecological Risk Assessments (ERA) for all of the soil, sediment, and groundwater sites within the NEWIOU and WABOU.

WABOU ERA. Section 3.2.2 of the final Soil ROD for the WABOU describes the ERA for WABOU soil sites. Section 3.2 of the final Groundwater IROD for the WABOU provides a similar discussion of the ERA for WABOU groundwater sites.

Section 3.3 of the final Soil ROD for the WABOU provides a description and history for each WABOU soil site. This section also identifies, for each site, the chemicals of ecological concern (COEC) for surface and subsurface soil, the maximum concentrations detected, and the ecological hazard quotients associated with each contaminant. These findings are summarized in Table II-3-2 of the ROD. Similarly, Section 5.3 of the ROD provides the selected remedial action for each WABOU site, the potential ecological receptors, and the soil cleanup levels determined to be protective of potential ecological receptors.

NEWIOU ERA. Section 3.2.2 of the final NEWIOU Soil, Sediment, and Surface Water ROD describes the ERA for NEWIOU soil and sediment sites. Section 3.3 of the final Groundwater IROD for the NEWIOU describes the ERA for NEWIOU groundwater sites.

Section 3.3 of the final Soil, Sediment, and Surface Water ROD for the NEWIOU provides a description and history for each NEWIOU soil and sediment site. This section also identifies the site-specific COEC for surface soil, subsurface soil, and sediment; the maximum concentrations detected, and the ecological hazard quotients associated with each contaminant. These findings are summarized in Tables II-3-2 and II-3-3 of the final NEWIOU Soil, Sediment, and Surface Water ROD. Similarly, Section 5.3 of the ROD provides the selected remedial action for each NEWIOU site, the potential ecological receptors, and the soil cleanup levels determined to be protective of ecological receptors.

3.3 History of Contamination

As a result of past waste management and disposal practices, groundwater and soil and/or sediment at Travis AFB is contaminated at multiple locations. The locations of the groundwater sites are shown on Figures 3-1. Similarly, the locations of soil and/or sediment sites are shown on Figure 3-2.

More extensive and detailed documentation of the historical groundwater and/or soil and sediment contamination at all the ERP sites is provided in the following applicable RI reports:

- NOU RI Report (Radian, 1995)
- EIOU RI Report (Weston, 1995)
- WIOU RI Report (Radian, 1996)
- WABOU RI Report (CH2M HILL, 1997).

3.3.1 Environmental Restoration Program Groundwater Sites

Summaries of the contaminated groundwater ERP sites identified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998a) and Groundwater IROD for the WABOU (Travis AFB, 1999) as requiring IRAs are provided in the following subsections.

3.3.1.1 NEWIOU Groundwater Sites

Contaminated groundwater ERP sites within the NEWIOU that required IRAs in accordance with the Groundwater IROD for the NEWIOU (Travis AFB, 1998a) include the following:

- **FT004 –FTA-3:** Area used for fire training exercises using burning waste fuels, oils, and solvents on open ground from approximately 1953 through 1962. Historical practices resulted in groundwater contamination with chlorinated volatile organic compounds (VOCs).
- **FT005 – FTA-4:** Area used for fire training exercises using burning waste fuels, oils, and solvents on open ground from approximately 1962 through 1987. Historical practices resulted in groundwater contamination with chlorinated VOCs. The contaminant plume extends onto offbase privately owned property.
- **LF006 – Landfill 1:** A general refuse landfill that used trench and cover methods from approximately 1943 through 1950. Historical practices resulted in groundwater contamination with chlorinated VOC and petroleum-fuel hydrocarbons.
- **LF007B, C, and D – Landfill 2:** A general refuse landfill that used trench and cover methods from approximately 1950 through 1970. Historical practices resulted in groundwater contamination with chlorinated VOC, dioxins, and polychlorinated biphenyls (PCBs). The LF007C contaminant plume extends onto offbase privately-owned property.
- **SS015 – Solvent Spill Area and Facilities 808, 1832, 552:** Facilities used between approximately 1964 through 1980 for solvent stripping of aircraft parts, aircraft maintenance and repair, OWS activities, and hazardous waste accumulation. Historical practices resulted in groundwater contamination with chlorinated VOCs.
- **SS016 –OSA; Facilities 11, 13/14, 20, and 42/1941; and Portions of the Storm Sewer System:** Flightline support areas subject to oil spills, degreasing operations, leaking OWS, equipment maintenance and repair, aircraft and vehicle maintenance, hazardous materials storage, aircraft and vehicle washing, and stormwater runoff. Most of the areas were used from the 1940s through present day. Historical practices resulted in groundwater contamination with chlorinated VOCs.
- **SS029 – Monitoring Well (MW)-329 Area:** Undeveloped land near the south Base boundary. The historical uses resulting in groundwater contamination with chlorinated VOCs are unknown.
- **SS030 – MW-269 Area:** Undeveloped land near the south Base boundary. Historical practices resulted in groundwater contamination with chlorinated VOCs. The contaminant plume extends onto offbase privately owned property.
- **SD031 – Facility 1205:** Area used for maintenance and repair of diesel generators, washrack activities, OWS activities, and aircraft maintenance from approximately 1957 through present day. Historical practices resulted in groundwater contamination with chlorinated VOCs.

- **ST032 – MW-246/MW-107 Areas:** Probable historical jet-fuel spill area. Currently, a thin, intermittently measured layer of floating jet fuel exists in only one monitoring well. Low concentrations of petroleum-fuel hydrocarbons are dissolved in the groundwater.
- **SD033 – Storm Sewer II, South Gate Area, Facilities 810 and 1917, and West Branch of Union Creek:** Support areas used for management of stormwater runoff, fuel transport, aircraft maintenance, and aircraft washing, including the use of washracks and OWS. Historical practices resulted in groundwater contamination with chlorinated VOCs, some semivolatile organic compounds (SVOCs), and petroleum-fuel hydrocarbons.
- **SD034 – Facility 811:** An active aircraft washrack facility with OWS and overflow pond. Leaks from the OWS resulted in a layer of Stoddard solvent floating on the groundwater table. The leaking OWS was replaced in 1994. Historical practices resulted in dissolved groundwater contamination with chlorinated VOCs, SVOCs, and petroleum-fuel hydrocarbons (including Stoddard solvent).
- **SS035 – Facilities 818/819:** Active facilities used for aircraft repair, painting, and washing. A washrack with OWS was constructed in 1970. Historical practices resulted in groundwater contamination with chlorinated VOCs.
- **SD036 – Facilities 872/873/876:** Facilities 872/873/876 consists of multiple-use shops, including a washrack and OWS. Current uses include paint shops, electrical shops, landscape maintenance, paint mixing, and paint accumulation. The buildings were constructed in 1953, and are still in use. Historical practices resulted in groundwater contamination with chlorinated VOCs, some SVOCs, and petroleum-fuel hydrocarbons.
- **SD037 – Sanitary Sewer System; Facilities 837/838, 919, 977, 981; Ragsdale/V Street Area; and Area G Ramp:** Support areas used for management of domestic and industrial wastewater, aircraft maintenance, heavy equipment maintenance, air cargo handling, vehicle washing, fuel transport, and waste accumulation. Operations began in the 1940s and continue through present day. Historical practices resulted in groundwater contamination with chlorinated VOCs, some SVOCs, and petroleum-fuel hydrocarbons.

3.3.1.2 WABOU Groundwater Sites

Contaminated groundwater ERP sites within the WABOU requiring groundwater IRAs in accordance with the final Groundwater IROD for the WABOU (Travis AFB, 1999) include the following:

- **LF008 – Landfill 3:** An inactive historic landfill consisting of a series of small, unlined trenches used to dispose of old pesticide containers. Historical practices resulted in groundwater contamination with organochlorine pesticides.
- **DP039 – Building 755, Travis AFB Battery and Electric Shop:** Prior to 1978, battery acid solutions and solvents were discharged from Building 755 into a sump. These historical practices resulted in contamination of the groundwater with chlorinated VOCs, primarily TCE.
- **SS041 – Building 905, Travis AFB Entomology Shop:** Historical maintenance activities contaminated the groundwater with organochlorine pesticides.

- **SD043 – Building 916:** An emergency electric power facility. Historical practices may have resulted in a release of trichloroethene (TCE) to the groundwater at this site.

3.3.1.3 Petroleum-Only Contaminated Groundwater Sites

The Travis AFB POCO Sites Program manages sites with petroleum contamination. POCO sites are typically associated with surface and subsurface releases from fuel spills, piping leaks, OWSs, or underground storage tanks. The POCO Sites Program includes the removal of underground storage tanks and the remediation of POCO soil and groundwater using risk-based cleanup actions. The San Francisco Bay Water Board is the lead oversight agency for this program, as CERCLA excludes petroleum as a CERCLA contaminant. For this reason, the POCO sites are not addressed in either of the groundwater IRODs. However, the Air Force does address petroleum contamination under CERCLA if it is commingled with CERCLA contaminants. Therefore, the two POCO sites included in this five-year review because of commingled contamination includes the following:

- **SS014 – Jet-fuel Spill Area:** Site SS014 comprises five noncontiguous sites, or subareas, within the WIOU (i.e., Sites 1 through 5). SS014 is a POCO site, but petroleum-fuel hydrocarbons are commingled with TCE contamination. Currently, a thin, intermittently measured layer of floating jet fuel exists only at Site 1, within Fuel Storage Area G.
- **ST027 – Facilities 1918, 1919, and 1754:** Site ST027 is a POCO site used as a test stand area for aircraft engine testing. Currently, only Facility 1918 is used. Historical activities have resulted in groundwater contamination with petroleum-fuel constituents. This contamination is commingled with TCE that probably originates from adjacent ERP Site SS016.

3.3.2 Environmental Restoration Program Soil and Sediment Sites

Historically contaminated soil and sediment ERP sites within the NEWIOU and soil sites within the WABOU are discussed in the following subsections.

3.3.2.1 NEWIOU Soil and Sediment Sites

Contaminated soil and/or sediment ERP sites within the NEWIOU that required RA in accordance with the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006) include the following:

- **SD001 – Union Creek:** Site SD001 contains Union Creek and its associated surface water facilities that follow along the main airstrip. Grass and weeds growing along Union Creek are regularly mowed and tilled to prevent birds and other migratory animals from inhabiting the area. Polynuclear aromatic hydrocarbons (PAHs) were identified in the soil at SD001; pesticides, PAHs, and metals were identified in the creek sediment.
- **FT003 –FTA-2:** Area used for firefighting training exercises using burning waste fuels, oils, and solvents on open ground from approximately 1950 through 1952. Contaminants detected in the soil include PAHs, metals, pesticides, PCBs, and dioxins.
- **FT004 – FTA-3:** Area used for firefighting training exercises using burning waste fuels, oils, and solvents on open ground from approximately 1953 through 1962. The site is now an unused, open field. Soil at the site contains dioxins and metals.

- **FT005 – FTA-4:** Area used for firefighting training exercises using burning waste fuels, oils, and solvents on open ground from approximately 1962 through 1987. From the early 1970s until the fire training area was closed, only waste fuels were burned. Contaminants detected in the soil include PCBs, metals, PAHs, dioxins, and pesticides.
- **LF007 – Landfill 2:** A general refuse landfill that used trench and cover methods from the 1950s through 1974. The former landfill was primarily used for the disposal of general refuse, such as wood, glass, and construction debris. From the early 1950s until 1964, a portion of the eastern part of the site was used for storage of excess and waste materials, including oils, hydraulic fluid, and solvents for resale or disposal. Contaminants detected in the soil include PAHs, PCBs, SVOCs, and metals. Currently, LF007 is also the location of the Base Corrective Action Management Unit (CAMU). The CAMU receives contaminated soil meeting acceptance criteria from the site-specific soil RAs in the NEWIOU and WABOU.
- **SS015 – Solvent Spill Area and Facilities 808, 1832, and 552:** Areas used for solvent stripping of aircraft parts, aircraft maintenance and repair, OWS activities, and hazardous waste accumulation. Aircraft were chemically stripped of paint from approximately 1964 through 1980. In 2004, Facilities 550 and 552 were demolished to construct a POL MILCON project consisting of an office building, a fuel truck maintenance facility, and a large concrete truck parking area. Historical practices resulted in areas of soil contaminated with metals and PAHs.
- **SS016 – OSA; Facilities 11, 13/14, 20, 42/1941; and Portions of the Storm Sewer System:** Flightline support areas subject to oil spills, degreasing operations, leaking OWS, equipment maintenance and repair, aircraft and vehicle maintenance, hazardous materials storage, aircraft and vehicle washing, and stormwater runoff. The OSA was used from the 1940s through the 1980s. Most of the areas were used from the 1940s through present day. Historical practices resulted in areas of PAH and PCB-contaminated soil.
- **ST032 – MW246/MW-107 Areas:** Probable historical fuel spill area located between an active aircraft runway and an abandoned taxiway. Soil contaminants detected at the site include metals, SVOCs, and VOCs. Land use at the site is severely restricted because of the proximity of the runway.
- **SD033 – Storm Sewer II, South Gate Area, Facilities 810 and 1917, and West Branch of Union Creek:** Areas used to handle storm water runoff, fuel transport, aircraft maintenance, and aircraft washdown, including wash racks and OWS. Chemicals used in these areas included fuels, lubricating oils, hydraulic fluids, chlorinated solvents, and soap solutions. Metals, VOCs, and SVOCs were the contaminants detected in sediment at SD033. Surface soil contaminants included metals.
- **SD037 – Sanitary Sewer System; Facilities 837/838, 919, 977, 981; Ragsdale/V Street Area; and Area G Ramp:** Facilities are involved in the handling of domestic and industrial wastewater, aircraft maintenance, heavy equipment maintenance, air cargo, vehicle washing, fuel transport, and waste accumulation. Chemicals used and handled in this area include wastewater, oils, hydraulic fluids, fuels, transformer fluids, and chlorinated solvents. The Air Force began operating these facilities in the 1940s and

continues operations to the present day. Soil contaminants identified at the site include PAHs, fuels, SVOCs, and metals.

3.3.2.2 WABOU Soil Sites

Contaminated soil ERP sites within the WABOU that required RA in accordance with the final Soil Record of Decision for the WABOU (Travis AFB, 2002) include the following:

- **DP039 – Building 755, Travis AFB Battery and Electric Shop:** Prior to 1978, battery acid solutions and solvents were discharged from Building 755 into a sump. These historical practices resulted in contamination of the soil with low concentrations of lead. The sump was removed in 1993. Left undisturbed, lead in the surface soil around the edges of the former sump area does not present an unacceptable risk to local workers or the environment.
- **LF008 – Landfill 3:** An inactive historic landfill consisting of a series of small, unlined trenches used to dispose of old pesticide containers. Historical practices resulted in soil contamination with organochlorine pesticides.
- **LF044 – Landfill X:** Landfill X is not a landfill, but is actually an equipment training area and a stockpiling area for construction debris that contained metals (e.g., cadmium, lead, and silver) and an SVOC (benzo(a)pyrene).
- **RW013 – Radioactive Burial Site 2/Dry Waste Landfill:** Historical practices resulted in soil contamination with low levels of uranium isotopes (U-234, U-235). This dry waste landfill was a fenced backfilled trench that was part of the former Fairfield Air Force Station, an Atomic Energy Commission facility that stored and maintained nuclear weapons.
- **SD042 – Buildings 929/931/940:** Building 929 is a storage shed near a former hazardous waste accumulation area. Building 931 is a maintenance facility for portable electrical generators. Both facilities drain into an adjacent drainage ditch. Sediment within the ditch was contaminated with SVOCs and metals.
- **SD043 – Building 916:** An emergency electric power facility. Historically, at least one electrical transformer on a concrete pad adjacent to the building leaked cooling oil containing a PCB into the surface soil. Left undisturbed, the concentration of PCB does not present an unacceptable risk to either local workers or the environment.
- **SD045 – Former Small Arms Range:** Historical use as small arms training range resulted in lead contamination of the soil.
- **SS041 – Building 905, Travis AFB Entomology Shop:** Historical maintenance activities contaminated the surface soil with organochlorine pesticides.
- **SS046 – Railhead Munitions Staging Area:** Historical railroad operations deposited metals and SVOCs into the surface soil. Left undisturbed, these compounds do not present an unacceptable risk to either local workers or the environment.

3.4 Initial Response

Travis AFB completed soil removal actions at WABOU Site SS041 and NEWIOU Site SS015 and a RCRA corrective action at WABOU Site DP039 before issuance of the final Soil ROD for the WABOU (Travis AFB, 2002) and final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). The Base also completed a groundwater removal action at NEWIOU Site SS016 before issuance of the final Groundwater IROD for the NEWIOU (Travis AFB, 1997).

3.4.1 Site DP039 – Building 755 RCRA Corrective Action

In April 1993, a RCRA corrective action was conducted to close the acid neutralization sump at WABOU Site DP039 (Building 755). This sump was identified in the WABOU RI report (CH2M HILL, 1997) as the most probable source of the TCE contamination migrating from the site. The cobblestones were decontaminated prior to disposal, and the residual liquids and solids at the bottom of the sump were sampled and analyzed for hazardous characteristics. All hazardous waste was contained, transported, and disposed of in accordance with federal, state, and local environmental regulations. The concrete sump and associated piping were demolished and removed from the site. Soil samples were analyzed for hazardous constituents. The excavation was lined with a plastic membrane and backfilled with clean soil.

This RCRA corrective action did not meet residential cleanup standards for soil, so the Air Force selected an appropriate RA for this site in the final Soil ROD for the WABOU (Travis AFB, 2002).

3.4.2 Site SS041 – Cypress Lakes Golf Course Annex Removal Action

In October 2000, a soil removal action began at the Cypress Lakes Golf Course Annex (WABOU Site SS041) to excavate pesticide-contaminated soil from its maintenance yard. This removal action was in response to a request from the Travis AFB Restoration Advisory Board to look for ways to expedite the cleanup of soil sites. Travis AFB and the regulatory agencies agreed to conduct the remedy at this annex as a removal action. They also agreed to forego an Engineering Evaluation/Cost Analysis (EE/CA), because the WABOU RI report (CH2M HILL, 1997), WABOU FS (CH2M HILL, 1998), and WABOU Proposed Plan (Travis AFB, 1998b) (with its public comment period) were equivalent to an EE/CA. The *Action Memorandum for the Removal Action at the Cypress Lakes Golf Course Annex* (Radian, 1999) documents the decision to conduct the removal action at the annex. The *Work Plan for the Removal Action at the Cypress Lakes Golf Course Annex* (Environmental Chemical Corporation [ECC], 2000) describes the tasks needed to successfully conduct the removal action. The excavation and transport of the pesticide-contaminated soil to an approved offbase landfill was completed in January 2001. The *Cypress Lakes Golf Course Annex Removal Action Report* (ECC, 2001) describes the successful excavation, transportation and disposal of pesticide-contaminated soil from the Annex.

This removal action met all residential cleanup standards for soil. Therefore, this Annex site was designated as a No-Further-Action site in the Soil ROD for the WABOU (Travis AFB, 2002).

3.4.3 Site SS015 – Solvent Spill Area and Facilities 550 and 552 Removal Action

In July 2003, a soil removal action was conducted at NEWIOU Site SS015. The details of this removal action are provided in the *Soil Removal Action Summary Report for the NEWIOU Soil Removal Action at Site SS015* (Shaw Environmental, Inc., 2003). The removal action met the industrial cleanup levels of the selected RA and the residual contamination was less than the residential preliminary remediation goals (PRG). However, during a subsequent construction project, a different area of the site was found to have soil contamination less than the industrial PRG, but more than the residential PRG.

Even though this area is under a concrete parking lot, LUCs are being applied to this site in accordance with the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006).

3.4.4 Site SS016 – Tower Area and Oil Spill Area Removal Action

In 1995, Travis AFB also conducted groundwater removal actions within NEWIOU Site SS016 to address relatively high concentrations of VOCs, primarily TCE, and also to protect workers during construction of a hydrant system near the airfield control tower. These removal actions, referred to as the Tower Area Removal Action (TARA) and OSA Removal Actions consisted of groundwater extraction wells and carbon filtration treatment.

The TARA and OSA Removal Actions are still operating and are integrated into the Site SS016 groundwater IRAs specified in the final Groundwater IROD for the NEWIOU (Travis AFB, 1998a).

3.5 Basis for Taking Action

IRAs to address groundwater contamination at ERP sites within the NEWIOU and WABOU are currently underway in accordance with the final Groundwater IROD for the NEWIOU (Travis AFB, 1998a) and the final Groundwater IROD for the WABOU (Travis AFB, 1999).

Soil and sediment RAs at ERP sites within the NEWIOU are being conducted in accordance with the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006).

3.5.1 Groundwater Contamination

Groundwater contamination is currently present at multiple NEWIOU and WABOU ERP sites at concentrations exceeding the IRGs and ICGs established by the Groundwater IROD for the NEWIOU (Travis AFB, 1998a) and the Groundwater IROD for the WABOU (Travis AFB, 1999).

The primary groundwater contaminants at NEWIOU and WABOU ERP sites include chlorinated VOCs, TCE, 1,1-dichloroethene (DCE), cis-1,2-DCE, and 1,2-dichloroethane (DCA). Petroleum-fuel constituents, organochlorine pesticides (alpha chlordane), and other contaminants at concentrations below IRGs and ICGs are also present at some sites.

Extensive and detailed documentation of historical and current groundwater contamination at Travis AFB is provided in Groundwater Sampling and Analysis Program (GSAP) reports. Travis AFB routinely conducts groundwater sampling and analysis activities at all ERP sites. The findings of these activities are regularly published in semiannual and annual

GSAP reports. The most current data are provided in the final 2006-2007 GSAP Report (CH2M HILL, 2008). For ease of reference, excerpts of the 2006-2007 GSAP analytical data are provided on CD as Appendix A and Appendix B of this Five-Year Review Report. These two appendices provide data summaries of current groundwater contamination and chemical time-series plots and figures showing contaminant trends over time.

3.5.2 Soil Contamination

Prior to RA, soil contamination was present at multiple ERP sites within the NEWIOU and WABOU at concentrations that exceeded the Soil Cleanup Levels established by the final Soil ROD for the WABOU (Travis AFB, 2002) and final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006). Soil contaminants included SVOCs, PCBs, and organochlorine pesticides.

Except for Site SD045, soil RAs at ERP sites within the WABOU were completed during 2002 and 2003. The soil RA at SD045 was completed in 2007.

The soil RAs at NEWIOU sites were mostly completed in 2007. However, the sediment RAs at Sites SD001 and SD033 are currently pending. Additional work will also be conducted at Site FT005 to respond to contaminated soil discovered during the 2007 soil RA.

3.6 Works Cited

CH2M HILL. 2008. Final *2006-2007 Groundwater Sampling and Analysis Report.* Environmental Restoration Program. Travis AFB, California. 21 March.

CH2M HILL. 1998. *West/Annexes/Basewide Operable Unit Feasibility Study, 60th Air Mobility Wing, Travis Air Force Base, California*. April.

CH2M HILL. 1997. Final *West/Annexes/Basewide Operable Unit (WABOU) Remedial Investigation (RI) Report.* Installation Restoration Program. Travis AFB, California. 18 May.

Environmental Chemical Corporation (ECC). 2001. *Cypress Lakes Golf Course Annex Removal Action Report*.

Environmental Chemical Corporation (ECC). 2000. *Work Plan for the Removal Action at the Cypress Lakes Golf Course Annex*.

Environmental, Inc. 2003. *Soil Removal Action Summary Report for the NEWIOU Soil Removal Action at Site SS015*.

Mayer, K. and W. Laudenslayer, Jr. 1988. *A Guide to Wildlife Habitats of California.* California Department of Fish and Game. Sacramento, California.

Olmstead F., and G. Davis. 1961. *Geologic Features and Ground-Water Storage Capacity of the Sacramento Valley, California.* U.S. Geological Survey Water-Supply Paper 1497.

Radian. 1999. Action Memorandum for the Removal Action at the Cypress LAEKS Golf Course Annex.

Radian. 1996. Final West Industrial Operable Unit. Installation Restoration Program. Travis AFB. February.

Radian. 1995. Final *Remedial Investigation Report for the North Operable Unit*. Installation Restoration Program. Travis AFB. July.

Thomasson, H.,F. Olmsted, and E. LeRoux. 1960. *Geology, Water Resources and Usable Ground-Water Storage Capacity of Part of Solano County, California.* Geological Survey Water-Supply Paper 1464.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). Final *Soil Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998a. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

Travis Air Force Base (Travis AFB). 1998b. *West/Annexes/Basewide Operable Unit, Travis Air Force Base, Proposed Plan for Soil Cleanup.* Final. July.

U.S. Census Bureau. 2008. *The 2006 Population Estimate for Vacaville City, California.* http://factfinder.census.gov/servlet/SAFFPopulation?_event=Search&_name=vacaville&_state=04000US06&_county=vacaville&_cityTown=vacaville&_zip=&_sse=on&_lang=en&pctxt=fph. Accessed on 25 February 2008.

Weston, Roy F., Inc. (Weston). 1995. Final *East Industrial Operable Unit Remedial Investigation Report*. Travis AFB, California. October.

Weston, Roy F., Inc. (Weston). 1993. *Work Plan Addendum, East Industrial Operable Unit, Travis AFB, California.* Draft Final. September.

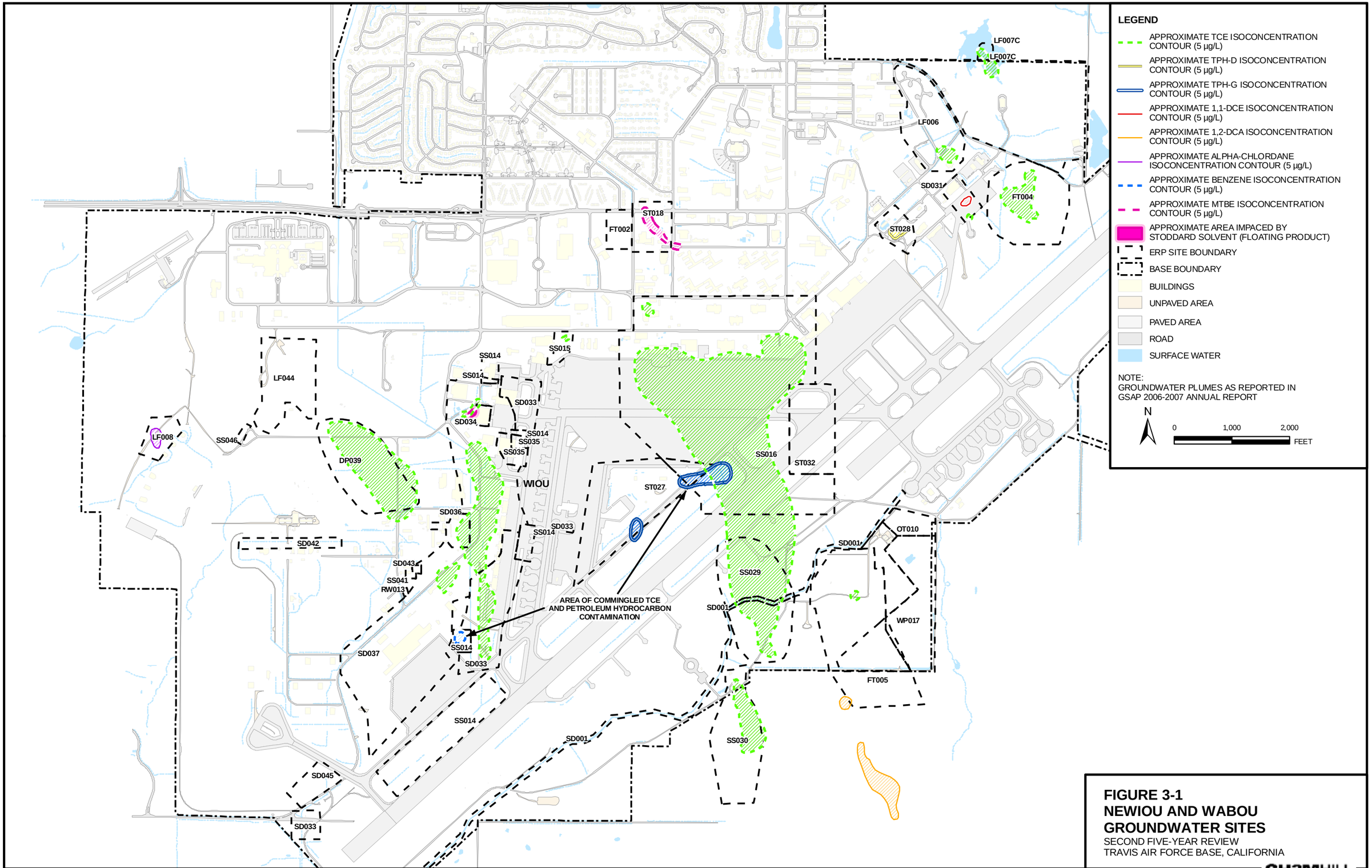


FIGURE 3-1
NEWIOU AND WABOU GROUNDWATER SITES
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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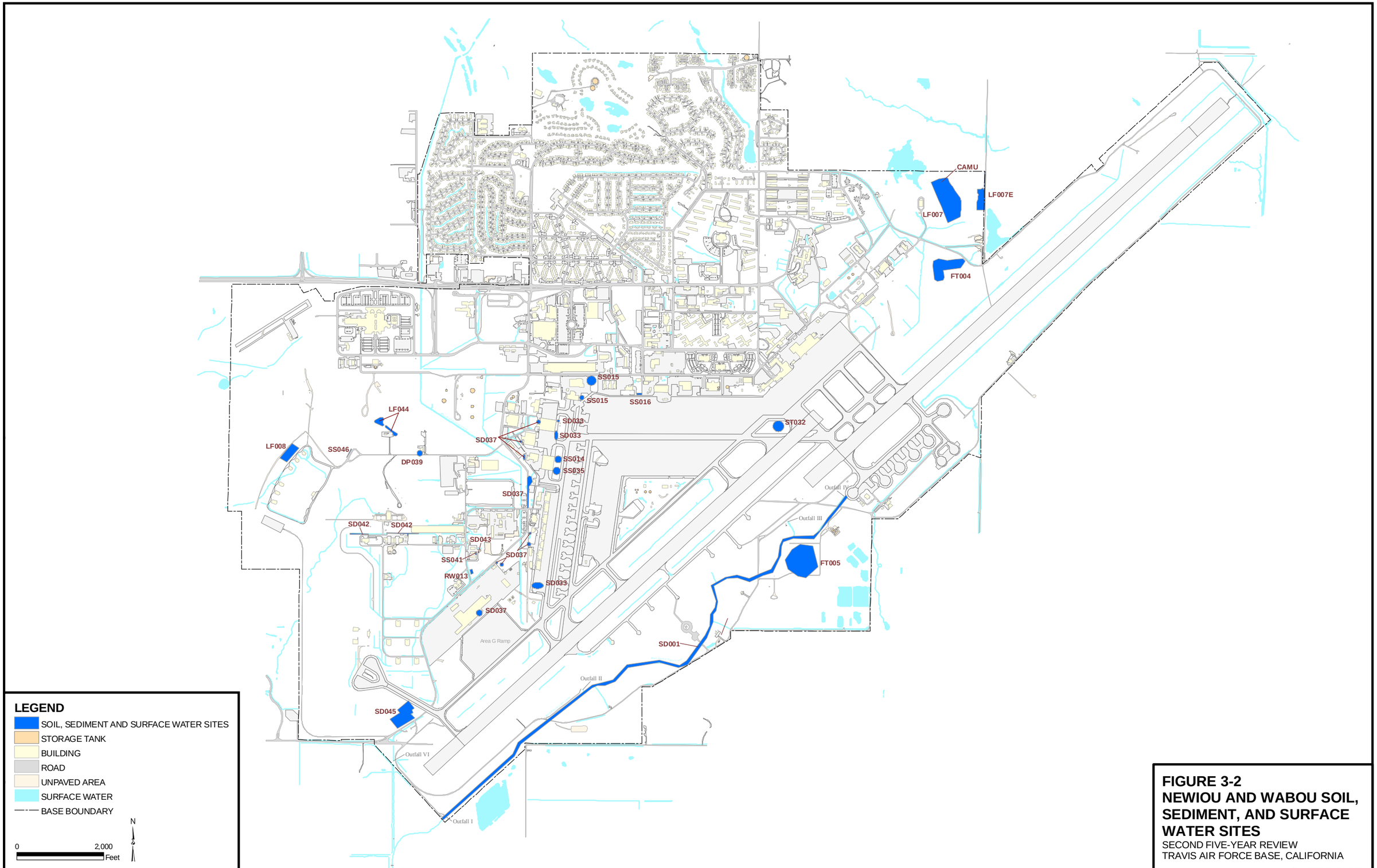

FIGURE 3-2
NEWIOU AND WABOU SOIL, SEDIMENT, AND SURFACE WATER SITES
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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SECTION 4

Groundwater Interim Remedial Actions and Soil and/or Sediment Remedial Actions

This section describes the selection and implementation of groundwater IRAs and soil and sediment RAs at sites within the NEWIOU and WABOU.

4.1 Groundwater Interim Remedy Selection

The IRAs to address groundwater contamination at Travis AFB were selected in the final Groundwater IROD for the NEWIOU (Travis AFB, 1998) and the final Groundwater IROD for the WABOU (Travis AFB, 1999).

Final groundwater RAs will be selected in the pending Basewide Groundwater ROD.

4.1.1 Groundwater Interim Remedial Action Objectives

The groundwater IRAs, as specified in the two IRODs, have been designed and constructed to achieve the following objectives:

- Source Control
- Migration Control
- Offbase Remediation

A summary of the IRA objectives for each ERP site is provided in Table 4-1.

4.1.1.1 Source Control Objectives

The objective of source control is to hydraulically contain and remove contaminant mass from the groundwater and vadose zone using groundwater extraction and treatment (GET) and vapor extraction and treatment in areas where groundwater VOC concentrations are relatively high, typically greater than 1,000 micrograms per liter (µg/L). Source control actions using GET are taken where secondary sources of VOC contamination (i.e., light nonaqueous-phase liquid or dense nonaqueous-phase liquid) are known or are reasonably thought to exist. Dissolved contaminant concentrations of approximately 3,000 µg/L are considered indicators of the possible presence of dense nonaqueous-phase liquids (Travis AFB, 1998). However, as a conservative measure to address uncertainties in the distribution of contamination, source control actions are typically taken where groundwater VOC concentrations exceed 1,000 µg/L.

Source control actions were typically designed and constructed primarily to achieve hydraulic containment and removal of the highest concentrations of groundwater contamination (VOC contaminants at concentrations of 1,000 µg/L and higher), and to prevent these concentrations from migrating to areas with concentrations below 1,000 µg/L. Additional actions, such as the installation of supplemental extraction wells, specifically for the removal

of more contaminant mass, are conducted to the extent that is technically and economically feasible.

4.1.1.2 Migration Control Objectives

The migration control objective is typically achieved using a GET system to hydraulically contain areas of contamination where groundwater concentrations are between 100 and 1,000 µg/L.

Migration control GET systems were designed and constructed primarily to prevent VOC contaminants at concentrations between 100 and 1,000 µg/L from migrating to areas with concentrations below 100 µg/L. However, in areas where it was found to be technically and economically feasible, migration control GET systems were installed to hydraulically contain contamination at lower concentrations. For example, at Site SS029, located near the southern Base boundary, the GET system was designed to hydraulically contain the leading edge of the plume and prevent any offbase migration of groundwater contamination.

Contaminant mass removal is not a primary objective of GET systems installed for the purpose of migration control. Mass removal does occur, but GET extraction wells are typically located within the relatively lower concentration areas of contaminant plumes. Therefore, mass removal is an incidental benefit of the groundwater extraction, but not a specific objective of migration control.

4.1.1.3 Monitored Natural Attenuation Objectives

Monitored natural attenuation relies on natural physical, chemical, and/or biological processes to limit the migration of a contaminant plume, or portion of a plume. Areas of groundwater with relatively low-concentration contamination located hydraulically downgradient of a GET system are typically included in MNA assessments at Travis AFB. Data from these assessments will be used to support the potential use of MNA as the selected remedy for these areas.

The Natural Attenuation Assessment Plan (NAAP) (CH2M HILL, 1998b) is the governing document for sites, or portions of sites, undergoing assessments of MNA. The protocols provided in the NAAP are the basis for determining if the migration control objective has been achieved and the contaminant plume has been stabilized through natural physical, chemical, and/or biological processes.

In accordance with the IRODs (Travis AFB, 1999 and Travis AFB, 1998) and NAAP (CH2M HILL, 1998b), multiple sites at Travis AFB are undergoing MNA or MNA assessment during the period of IRA. These sites include the following:

- LF006 – MNA
- FT004 – MNA assessment combined with GET
- SD031 – MNA assessment combined with GET
- LF007B, LF007D – MNA assessment
- SS014 – MNA assessment (petroleum fuels commingled with VOCs)
- SD033 – MNA assessment combined with GET
- SD037 – MNA assessment combined with GET
- SS015 – MNA assessment

TABLE 4-1
Summary of NEWIOU and WABOU Groundwater Sites and Groundwater Interim Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					IRA Consolidation Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Commingled Plumes**	**Shared Treatment Plant**	**Hydraulic Interactions**	**Comments**
North IRA	FT004	√				√[b]	√	√	√	
	SD031	√				√[b]	√	√	√	
	LF006				√				√	
	LF007B					√			√	
	LF007C		√	√		--[c]		√	√	Since the first five-year review in 2003, construction of the onbase migration control/offbase remediation GET system at LF007C has been completed. In mid-2003, onbase groundwater extraction wells and performance monitoring wells were installed and the extraction system components (e.g., pumps) and the groundwater conveyance system to the NGWTP were constructed. Offbase performance monitoring wells were also installed during this time.
	LF007D					√			√	
South IRA	SS030	√	√	√				√	√	
	SS029		√					√	√	
	ST032	√	√[d]			--[e]	√	√	√	Source control for removal of floating jet fuel discontinued in September 2002. Dissolved plume is hydraulically captured by SS029 migration control.
	Southern SS016		√			--[e]	√	√	√	Commingled OSA/TARA/ST032 plume is hydraulically captured by SS029 migration control.
	FT005-onbase		√					√	√	
	FT005-offbase			√				√	√	Installation of offbase extraction system and performance monitoring wells completed in summer 2003.
Central IRA	Northern SS016	√						√		OSA and TARA source area plumes[d].
West IRA	SS014[f]	√	√			√[b]	√	√	√	POCO site with commingled contamination. Source control at Site 1 for removal of floating jet fuel discontinued in November 2005.
	SD033[g]		√			√	√	√	√	
	SD034[h]	√	√				√	√	√	Source control action for removal of Stoddard solvent floating product is ongoing.
	SS035[i]		√[b]			--[e]	√	√	√	Plume is hydraulically captured by SD037 migration control.
	SD036[j]	√	√			--[e]	√	√	√	
	SD037[k]	√	√			√	√	√	√	
	SS041[l]		√					√	√	
	SD043[m]		√					√	√	
						√				

SS015

TABLE 4-1
Summary of NEWIOU and WABOU Groundwater Sites and Groundwater Interim Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					IRA Consolidation Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Commingled Plumes**	**Shared Treatment Plant**	**Hydraulic Interactions**	**Comments**
	DP039	√	--		√			√		Phytoremediation evaluation is ongoing.
	LF008		√					√		Noncontiguous, single-site plume. Organochlorine pesticide contamination.
	ST027									POCO site – Not specified in IROD, but has commingled CERCLA contamination.

[a] IRA objective specified in the Groundwater NEWIOU and WABOU IRODs [(Travis AFB, 1998) and (Travis AFB, 1999)], respectively.
[b] IRA not specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998), but implemented by the Air Force to address entirety of commingled plume.
[c] Assessment of MNA not implemented because of plume interactions with the LF007C groundwater extraction system.
[d] TARA.
[e] Assessment of MNA not implemented because plume is hydraulically captured by adjacent groundwater extraction system.
[f] POCO Site SS014 comprises five noncontiguous sites, including Sites 1, 2, 3, 4, and 5. Only Site 1 has a source control objective (floating jet fuel).
[g] ERP Site SD033 comprises five noncontiguous sites: Facility 810, Facility 1917, Storm Sewer System II, the South Gate area, and the West Branch of Union Creek.
[h] ERP Site SD034 is associated with Facility 811.
[i] ERP Site SS035 is associated with Facilities 818 and 819.
[j] ERP Site SD036 is associated with Facilities 872, 873, and 876.
[k] ERP Site SD037 is associated with the Sanitary Sewer System; Facilities 837, 838, 919, 977, 981; the Area G Ramp; and the Ragsdale/V Street area.
[l] ERP Site SS041 is associated with Facility 905.
[m] ERP Site SD043 is associated with Facility 916.

Notes:
-- = Migration control not implemented pending evaluation of MNA and phytoremediation effectiveness.
NGWTP = North Groundwater Treatment Plant

DP039 – MNA combined with GET and evaluation of phytoremediation The listed sites initially underwent preliminary assessment of biodegradation factors as part of the preparation of natural attenuation assessment work plans. The plans established that, on an ongoing basis, the MNA assessments would consist primarily of an assessment of plume stability. Therefore, this five-year review focuses on plume stability as the main, but not sole, criterion in assessing the viability of MNA.

In the list above, Sites LF006 and DP039 are the only sites at which MNA was selected as all, or part, of the IRA in the IROD. At LF006, MNA is the selected IRA for the entire site. For DP039, MNA is one component of a three-part IRA rather than a stand-alone remedy. The final selection of MNA as all, or part, of the final RA at a site will be made in the upcoming Basewide Groundwater ROD. For the remainder of the sites, a natural attenuation summary report will be prepared in the future, which will make recommendations regarding whether MNA should be selected as a final remedy at the sites. The natural attenuation summary report will be prepared in accordance with the NAAP (CH2M HILL, 1998b). The projected date for the completion of the summary report is 31 March 2010.

MNA assessments, as part of the IRA, are underway in portions of plumes that are also undergoing GET. These plumes include FT004, SD031, SD033, SD037, and DP039 (MNA formally selected as a partial remedy in WABOU IROD). In these plumes, the higher concentration areas are undergoing GET for the purposes of source control and/or migration control, and the lower concentration areas (i.e., hydraulically downgradient of the GET system) are under assessment to determine if MNA can provide effective migration control. However, until the GET component of the interim remedy is completed and the extraction wells turned off, the MNA component cannot be fully evaluated because migration of the upgradient plume into the MNA assessment plume area may result in increased contaminant concentrations.

4.1.1.4 Offbase Remediation Objectives

The objective of offbase remediation is to prevent further migration of groundwater contaminants using GET to hydraulically contain and remediate the offbase portion of plumes down to the contaminant-specific IRG specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998). All known offbase contaminant plumes originate from sites located within the NEWIOU. These sites include FT005, LF007C, and SS030.

4.1.2 Institutional Controls on Groundwater Use

Travis AFB has land use controls in place at sites with groundwater contamination. These land use controls are described in paragraph 5.6 of the WABOU Groundwater IROD and paragraph 5.1.2 of the NEWIOU Groundwater IROD. The land use controls are also detailed in the base General Plan.

The Travis AFB General Plan (GP) is a long-range planning tool that provides a framework for selecting the locations of future facilities needed to carry out the base mission. The GP describes the specific LUCs for each site, the reasons for the controls, and the areas where the controls are applied. It is also web-based and accessible to all base personnel that are authorized to use the Travis AFB local area network.

Another tool for LUC enforcement is the Air Force Form 332 (AF332) or Base Civil Engineer Work Request. This form must be submitted and approved before the start of any building project at Travis AFB. Approval of this form involves the comparison of the building site with the constraints in the GP. The AF332 serves as the document for communicating any construction constraints to the appropriate offices. Any constraints at the site result in the disapproval of the form unless the requester makes appropriate modifications to the building plans.

Travis AFB also uses the 60 Air Mobility Wing Form 55 or Excavation Permit to enforce the residential development and soil and sediment disturbance restrictions. The requester submits the permit to the Civil Engineer Squadron for any project that involves mechanical soil or sediment excavation, such as digging trenches for underground lines or excavating soil for building foundations. If constraints involving soil disturbance or worker safety exist at the excavation area, the permit describes the appropriate procedures that will prevent unknowing exposure to contamination and measures the workers must implement before the start of excavation.

Both AF332s and excavation permits are subject to an EIAP analysis, conducted pursuant to the National Environmental Policy Act., as promulgated for the Air Force in 32 CFR 989, et. seq. An Air Force Form 813 initiates the EIAP process. The proponent of a proposed action is required to submit the AF332 or excavation permit with the Form 813 so that the appropriate environmental analysis of the proposed action and alternatives to the proposed action is accomplished prior to any construction activities. The EIAP process works to ensure proposed construction sites are reviewed in accordance with the GP. The process also ensures that all environmental factors, as well as established LUCs, are considered in selecting locations for construction projects.

Three plumes of contaminated groundwater migrated off-base; they are associated with sites LF007C, FT005, and SS030 and lie beneath private property. To manage the groundwater IRAs for these sites, Travis AFB purchased long-term easements that grant access rights to the United States, its representatives, agents, and contractors for the purpose of conducting an environment response on the properties. The easements restrict the landowners from interfering or abridging the exercise of the government's rights under the easement. The United States would view any residential development and any well drilling on the properties covered by the easements as interfering with the government's easement and would take appropriate action to prevent interference with its rights under the easement.

Further, Solano County Ordinance, Chapter 13.10, makes it a misdemeanor to construct a well without a Solano County permit and requires the permit requester to notify the County of all wells within a 100 foot radius of the proposed well site. Given the number of monitoring and extraction wells the government is operating on the easements, this ordinance insures Travis AFB will be notified of a landowner's well drilling plans. Additionally, Travis AFB's wells are frequently monitored, and any landowner actions potentially interfering with the easements would be observed. The landowner would be contacted to rectify the situation. To date, no such activities have been observed and there are no known drinking water wells that draw water from the plumes, as confirmed by the frequent presence of base and contractor personnel in the off-base area as part of conducting the interim remedy.

Throughout their duration, the easements restrict development of new wells and incompatible use of the water below the property.

The existing land use controls both on and off-base will be re-examined and re-addressed as necessary in the final Basewide Groundwater ROD, tentatively scheduled for completion in 2010. The ROD approach to land use controls will be consistent with the land use control approach documented in the NEWIOU Soil, Sediment and Surface Water ROD, including those related to future property transfers, land use controls, and as necessary, more specific land use controls restricting development of new water supply wells and consumption of contaminated groundwater. The Air Force will purchase additional easements in the event the off-base plumes remain contaminated at the expiration of the terms of the easements to restrict new well construction within the contaminated plumes.

4.2 Groundwater Remedy Implementation

Travis AFB has constructed interim groundwater remedies to achieve the groundwater IRA objectives stated in the Groundwater IROD for the NEWIOU (Travis AFB, 1998) and the Groundwater IROD for the WABOU (Travis AFB, 1999).

Routine groundwater monitoring of the interim remedies is conducted under the GSAP.

4.2.1 NEWIOU Groundwater Interim Remedial Actions

For NEWIOU groundwater sites, the IRA specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998) includes the following:

- Alternative 2 – Natural Attenuation/Monitoring (i.e., MNA)
- Alternative 3 – Extraction, Treatment, and Discharge

At most sites, the formal selection of Alternative 2 – MNA, was deferred pending the completion of MNA *assessments* to evaluate the feasibility of implementing MNA for all or part of several contaminant plumes. At the NEWIOU LF006 site, MNA was the selected IRA.

Alternative 3 uses GET to hydraulically capture areas of groundwater contamination and remove contaminant mass.

4.2.2 WABOU Groundwater Interim Remedial Actions

For the WABOU groundwater sites, the IRAs specified in the Groundwater IROD for the WABOU (Travis AFB, 1999) include the following:

- Alternative G3 – Containment/Treatment/Discharge
- Alternative G5 – Source Area and Groundwater Extraction/Treatment/MNA

Similar to the Groundwater IROD for the NEWIOU (Travis AFB, 1998) Alternative 3, the IRA specified in the Groundwater IROD for the WABOU (Travis AFB, 1999) as Alternative G3 is a GET action to prevent the migration of groundwater contamination into hydraulically downgradient areas. Under Alternative G5, a vacuum-enhanced version of GET is used to hydraulically contain and remove relatively high concentrations of VOC from the vadose zone and groundwater at the source of contamination. The GET action is combined with a program of MNA assessment to address the relatively lower levels of

contamination at the leading edge of a plume. At the WABOU DP039 site, MNA was selected as one of the three components of the site IRA.

4.2.3 Site Consolidation

Travis AFB has constructed multiple groundwater IRAs to achieve the source control, migration control, and offbase remediation objectives specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998) and the Groundwater IROD for the WABOU (Travis AFB, 1999). Historically, these IRAs have been described in terms of the actions taken at the individual sites and, in some cases, at collections of sites. Travis AFB is employing a more appropriate strategy by consolidating site-specific IRAs with common key components into regional IRAs. The primary objective of this holistic grouping is to maximize contaminant mass removal by avoiding interference between individual groundwater extraction systems. The secondary objective is to reduce costs by avoiding redundancies in the operation and documentation of sites with common components.

The primary criteria for grouping site-specific IRAs into consolidated, regional IRAs include the following:

- Commingled groundwater contaminant plumes
- Shared groundwater conveyance and treatment systems
- Hydraulic interactions between site-specific groundwater extraction systems
- Consolidation is consistent with the IRA objective(s) provided in the applicable IROD

These criteria led to the strategic groupings of individual contaminated groundwater sites into consolidated IRAs as follows:

- **North IRA –** ERP Sites FT004, SD031, LF006, LF007B, LF007C, and LF007D
- **South IRA –** ERP Sites SS030, SS029, ST032, southern portion of SS016, FT005-onbase, and FT005-offbase
- **Central IRA –** Northern portion of ERP Site SS016
- **West IRA –** ERP Sites SS014, SD033, SD034, SS035, SD036, SD037, SS041, SD043, SS015, DP039, and LF008

The locations of the consolidated, regional IRAs and associated ERP sites are shown on Figure 4-1. This figure also provides the location of POCO sites. POCO Sites SS014 and ST027 are included in this five-year review because petroleum-fuel contamination at these sites is commingled with CERCLA contamination.

A summary of the grouped groundwater sites, the IROD-specified IRA for each site, and a checklist evaluation of the consolidation criteria satisfied are provided in Table 4-1. Summary descriptions of these IRAs are provided in the following subsections.

4.2.3.1 North IRA

The North IRA comprises consolidated groundwater interim actions at NEWIOU ERP Sites FT004, SD031, LF006, LF007B, LF007C, and LF007D. The main components of the North IRA are summarized in Table 4-2. A site map of the North IRA area is provided on Figure 4-2.

TABLE 4-2
Summary of the North Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
FT004 Source Area	Source Control	GET	DPE wells, performance monitoring wells, NGWTP air stripper/VGAC	IRA construction complete. FT004 and SD031 source area plumes are noncontiguous.
SD031 Source Area	Source Control	GET	DPE wells, performance monitoring wells, NGWTP air stripper/VGAC	IRA construction complete.
FT004/SD031[b]	MNA[c]	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete.
LF006	MNA	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete.
LF007B	MNA[c]	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete.
LF007C	Migration Control	GET	Onbase groundwater extraction wells and performance monitoring wells, NGWTP air stripper/VGAC	IRA construction complete. Optimization actions are under evaluation.
LF007C	Offbase Remediation	GET	Offbase performance monitoring wells (groundwater extraction wells located onbase)	IRA construction complete. Optimization actions are under evaluation.
LF007D	MNA[c]	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete.

[a] IRA objective specified in Groundwater IROD for the NEWIOU (Travis AFB, 1998).
[b] Commingled plume.
[c] MNA Assessment.

Notes:
DPE = dual-phase extraction
VGAC = vapor-phase granulated activated carbon

Construction of the FT004, SD031, LF006, LF007B, and LF007D components of the IRAs have been completed and are in long-term operation (LTO).

Since the first five-year review in 2003, construction of the onbase migration control/offbase remediation GET system at LF007C has also been completed. In mid-2003, onbase groundwater extraction wells and performance monitoring wells were installed and the extraction system components (e.g., pumps) and the groundwater conveyance system to the NGWTP was constructed. Offbase performance monitoring wells were also installed during this time.

Routine O&M is conducted in accordance with the NGWTP O&M Manual, Sites FT004, SD031, and LF007 Area C (URS Group, Inc. [URS], 2005).

4.2.3.2 Central IRA

The Central IRA comprises groundwater IRAs at the OSA and TARA contaminant source areas within the northern portion of NEWIOU ERP Site SS016. Table 4-3 summarizes the

main components of the Central IRA. A site map of the Central IRA area is provided on Figure 4-3.

TABLE 4-3
Summary of the Central Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
Northern SS016: OSA Source Area	Source control	GET	2-Phase® extraction well (TPE-W), one horizontal extraction well, two groundwater extraction wells, performance monitoring wells, vapor treatment with ThOx, groundwater treatment at the CGWTP with UV/Ox/LGAC	IRA construction complete. OSA and TARA source areas are noncontiguous plumes.
Northern SS016: TARA Source Area	Source control	GET	Two horizontal extraction wells, performance monitoring wells, groundwater treatment at CGWTP with UV/Ox/LGAC	IRA construction complete.

[a] IRA objective specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998).

Notes:

ThOx = thermal oxidation
UV/Ox = ultraviolet oxidation
LGAC = liquid-phase granulated activated carbon

Construction of the OSA and TARA components of the IRAs are complete and currently in LTO.

Routine O&M is conducted in accordance with the CGWTP O&M Manual, Revision 1 (URS, 2002b).

4.2.3.3 West IRA

The West IRA comprises consolidated groundwater interim actions at POCO Site SS014; WIOU ERP Sites SS015, SD033, SD034, SS035, SD036, SD037; and WABOU ERP Sites SS041, SD043, LF008, and DP039. Table 4-4 summarizes the main components of the West IRA. Additionally, Tables 4-5, 4-6, and 4-7 summarize the components of the noncontiguous SS015, DP039, and LF008 sites of the West IRA. Site maps of the WIOU portion of the West IRA area are provided on Figures 4-4 and 4-5. Site maps for non-contiguous Sites SS015, DP039, and LF008 are provided on Figures 4-6, 4-7, and 4-8, respectively.

Construction of the West IRA is complete and currently in LTO.

Routine O&M is conducted in accordance with the CGWTP O&M Manual (URS, 2002b).

TABLE 4-4
Summary of the West Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
SS014 Source Area	Source control	GET	Free-product removal with passive skimmers	IRA construction complete. Jet-fuel floating-product removal at SS014 Site 1 discontinued in November 2005.
SD034 Source Area	Source control	GET	DPE wells, performance monitoring wells, free-product removal with active skimmers, VGAC vapor treatment at WTTP, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA construction complete. Stoddard solvent floating-product removal is ongoing.
SD036/SD037[b] Source Area	Source control	GET	DPE wells, performance monitoring wells, VGAC vapor treatment at WTTP, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA construction complete. SD036 and SD037 source area plumes are commingled.
SS014/SD033/ SD034/SS035/ SD036/SD037[b]	Migration Control	GET	Conventional extraction wells[c], performance monitoring wells, VGAC vapor treatment at WTTP, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA construction complete. Hydraulically captured portions of commingled plumes. Free product removal of Stoddard solvent at SD034 is ongoing.
SS041	Migration Control	GET	Conventional extraction well, performance monitoring wells, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA construction complete. SS041 and SD043 plumes are non-contiguous with each other and the commingled SS014/SD033/ SD034/SS035/ SD036/SD037 plume.
SD043	Migration Control	GET	Conventional extraction well, performance monitoring wells, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA construction complete.
SS014/SD033/ SD037[b]	MNA[c]	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete. Addresses portion of commingled plume that is not hydraulically captured by source control and migration control extraction systems.

[a] IRA objective specified in Groundwater NEWIOU or WABOU IROD
[b] Commingled plume
[c] MNA assessment

TABLE 4-5
Summary of the SS015 Component of West Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
SS015	Migration Control	MNA assessment	Trigger, point-of-compliance, and guard wells	IRA construction complete

[a] IRA objective specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998).

TABLE 4-6
Summary of the DP039 Component of the West Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
DP039 Source Area	Source control	Source area GET and vapor extraction and treatment	Source area DPE wells, performance monitoring wells, VGAC vapor treatment at WTTP, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	Hydraulically captured source area portion of plume. Installation of additional extraction wells will depend on outcome of ongoing evaluation of phytoremediation.
DP039	MNA	Groundwater monitoring	Trigger, point-of-compliance, and guard wells	IRA construction complete. Addresses leading edge portion of plume that is not hydraulically captured by source control extraction system.
DP039	Migration Control	Pending (GET potential)	Potentially pending additional extraction wells and performance monitoring wells	Potential further construction deferred, pending completion of MNA evaluation and evaluation of phytoremediation effectiveness.

[a] IRA objective specified in the Groundwater IROD for the WABOU (Travis AFB, 1999).

TABLE 4-7
Summary of the LF008 Component of West Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
LF008	Migration Control	GET	Conventional extraction wells, performance monitoring wells, UV/Ox/LGAC groundwater treatment at CGWTP via WTTP	IRA complete. Extracted groundwater flow to CGWTP combined with DP039, West, and Central IRAs.

[a] IRA objective specified in the Groundwater IROD for the WABOU (Travis AFB, 1999).

4.2.3.4 South IRA

The South IRA comprises consolidated groundwater interim actions at NEWIOU ERP Sites FT005, SS029, SS030, and the southern portion of SS016. Table 4-8 summarizes the main components of the South IRA. A site map of the South IRA area is provided on Figure 4-9.

TABLE 4-8
Summary of the South Groundwater Interim Remedial Action
Second Five-Year Review Report, Travis Air Force Base, California

Contaminant Plume	Objective[a]	Implemented IRA	Primary Components	Status and Comments
SS030-onbase Source Area	Source Control	GET	Interceptor trench, performance monitoring wells, air stripper groundwater treatment at SBBGWTP	IRA construction complete. Extracted groundwater flow to SBBGWTP combined with SS030-offbase, SS029, and FT005 flows.
SS030-offbase	Offbase Remediation	GET	Conventional extraction wells, performance monitoring wells, air stripper groundwater treatment at SBBGWTP	IRA construction complete. Optimization actions are under evaluation. Extracted groundwater flow to SBBGWTP combined with SS030-onbase, SS029, and FT005 flows.
ST032	Source Control	Free-product removal	Passive skimmer (free-product removal completed)	IRA construction complete. Jet-fuel removal in one monitoring well discontinued in 2002.
SS029	Migration Control	GET	Conventional extraction wells, performance monitoring wells, air stripper groundwater treatment at SBBGWTP	IRA construction complete. Extracted groundwater flow to SBBGWTP combined with SS030- and FT005 flows.
Southern SS016/ST032[b]	Migration Control	GET	Shared with SS029	IRA construction complete. Commingled plume hydraulically captured by SS029 extraction system.
FT005-onbase	Migration Control	GET	Conventional extraction wells, performance monitoring wells, air stripper groundwater treatment at SBBGWTP	IRA construction complete. Extracted groundwater flow to SBBGWTP combined with SS030 and SS029 flows.
FT005-offbase	Offbase Remediation	GET	Conventional extraction wells, performance monitoring wells, air stripper groundwater treatment at SBBGWTP	IRA construction complete. Optimization actions are under evaluation. Extracted groundwater flow to SBBGWTP combined with SS030, SS029, and FT005-onbase flows.

[a] IRA objective specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998).
[b] Commingled plume.

Construction of the South IRA is complete and currently in LTO.

Routine O&M is conducted in accordance with the South Base Boundary Groundwater Treatment Plant (SBBGWTP) O&M Manual, Revision 3 (CH2M HILL, 2004).

4.2.3.5 POCO Site ST027

POCO Site ST027 is included in this five-year review because petroleum-fuel contamination is commingled with TCE contamination. This TCE contamination probably originates from adjacent ERP Site SS016 and/or an unknown source at the site. A site map of ST027 is provided on Figure 4-10.

Site ST027 is currently managed under the POCO Sites Program. Groundwater monitoring is routinely conducted under the Travis AFB GSAP.

4.3 Groundwater Systems Operation and Maintenance

In combination, routine treatment plant O&M, the Basewide GSAP, and ongoing free-product removal efforts comprise LTO of the existing Travis AFB groundwater IRAs. The LTO requirements for each of the consolidated IRAs are summarized in Table 4-9.

4.3.1 Groundwater Treatment Systems

Detailed descriptions of treatment plant-specific O&M activities are regularly reported to the regulatory agencies in monthly data sheets and in annual O&M reports. The most current O&M treatment plant data are provided in the *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant* (CH2M HILL, 2008).

For each of the three treatment plants, the 2007 annual O&M report provides detailed descriptions of treatment plant processes, modifications, volumes of water and soil vapor treated, reuse of treated water, compliance with discharge requirements, field measurements and observations, influent concentration trends, flowrates and the rate of mass removal, treatment plant uptime/downtime, operating costs, evaluations of effectiveness, issues, and optimization activities. Rolling 12-month operating costs curves for each treatment plant are shown on Figures 4-11, 4-12, and 4-13.

Routine O&M of groundwater treatment facilities is conducted in accordance with the O&M manuals developed for the NGWTP (URS, 2005), CGWTP (URS, 2002b), and SBBGWTP (CH2M HILL, 2004).

4.3.2 Monitored Natural Attenuation Assessments

Ongoing assessment of MNA is being conducted at multiple sites within the consolidated IRAs under the GSAP and in accordance with the Travis AFB NAAP (CH2M HILL, 1998b). This LTO requirement will continue during the period of interim remediation until sufficient data are collected to assess the viability of MNA as a proposed remedy.

TABLE 4-9
Summary of Consolidated Groundwater Interim Remedial Actions LTO Requirements
Second Five-Year Review Report, Travis Air Force Base, California

			LTO Requirement				
				GSAP			
Consolidated IRA	**Component Sites**	**Treatment Plant**	**Extraction, Conveyance, and Treatment System O&M**	**Extraction System Performance Monitoring**	**MNA[a]**	**Free-product Removal (passive skimming)**	**Comments**
North IRA	FT004	NGWTP	√	√	√	NA	
	SD031	NGWTP	√	√	√	NA	
	LF006	NA	NA	√	√	NA	
	LF007B	NA	NA	NA	√	NA	
	LF007C	NGWTP	√	√	NA	NA	
	LF007D	NA	NA	NA	√	NA	
South IRA	SS030	SBBGWTP	√	√	NA	NA	
		SBBGWTP	√	√	NA	NA	
	ST032	SBBGWTP via SS029	NA	NA	NA[b]	NA	Passive skimming of jet fuel floating product discontinued September 2002.
	Southern SS016	SBBGWTP via SS029	NA	NA	NA[b]	NA	
	FT005	SBBGWTP	√	√	NA	NA	
Central IRA	Northern SS016	CGWTP	√	√	NA	NA	
West IRA	SS014	CGWTP via WTTP	NA	NA	√	NA	Site 1 jet-fuel floating product removal discontinued November 2005.
SS029	SD033	CGWTP via WTTP	√	√	√	NA	
	SD034	CGWTP via WTTP	√	√	NA	√	Stoddard solvent floating product removal is ongoing.
	SS035	CGWTP via WTTP	√	√	NA[b]	NA	
	SD036	CGWTP via WTTP	√	√	NA	NA	
	SD037	CGWTP via WTTP	√	√	√	NA	
	SS041	CGWTP via WTTP	√	√	NA	NA	
	SD043	CGWTP via WTTP	√	√	NA	NA	
		NA	NA	NA	√	NA	Treatability study concluded
	DP039	CGWTP via WTTP	√	√	√	NA	Phytoremediation treatability study concluded in 2005, but evaluation of the phytoremediation system is continuing.
	LF008	CGWTP via WTTP	√	√	NA	NA	

[a] MNA assessment, except at Sites LF006 and DP039.

[b] MNA at SS035, Southern SS016, and ST032 discontinued and no longer applicable because plume is hydraulically captured.

Note:

NA = Not applicable

SS015

A listing of the sites undergoing MNA assessment is provided in Table 4-1. Sites LF006 and DP039 are the only sites at which MNA was selected as all, or part, of the IRA in the IROD. At LF006, MNA is the selected IRA for the entire site. For DP039, MNA is one component of a three-part IRA rather than a stand-alone remedy. The final selection of MNA as all, or part, of the final RA will be made in the upcoming Basewide Groundwater ROD. For the remainder of the sites, MNA is being *assessed* as a potential final groundwater remedy. When sufficient data have been collected, a Natural Attenuation Summary Report will be prepared. This document will provide recommendations whether MNA should be selected as all, or part, of the final remedy for a site in the pending Basewide Groundwater ROD. The Natural Attenuation Summary Report will be prepared in accordance with the NAAP.

MNA assessments at ERP Sites LF007C, ST032, SS035 and SS016 have been discontinued for the following reasons:

- **LF007C –** The onbase portion of the plume is under the influence of a GET system completed in 2003.
- **ST032 –** The dissolved petroleum-fuel plume will be hydraulically captured by the SS029 extraction system. In 2000, hydraulic modeling was conducted and determined that if the ST032 contaminant plume migrated downgradient, it would be hydraulically captured by the SS029 GET system. This finding was documented in the Technical Memorandum: Consolidation of Site ST032 into the Southern Interim Remedial Action dated 03 August 2001.
- **SS035 –** The plume will be hydraulically captured by the WIOU GET system SS035 is one of several ERP sites that comprise the much larger WIOU. During the design of the WIOU GET system, the contaminant plumes originating from these individual ERP sites were found, as a practical matter, to be inseparably commingled. Therefore, the contaminant plumes were holistically grouped into a larger plume collectively referred to as the WIOU plume. It was determined that the contaminants originating from the SS035 site would be hydraulically captured by the downgradient WIOU extraction wells. This finding was documented in the final WIOU Interim Groundwater Remedial Design Report dated 25 September 1999.
- **SS016** – In 2000, hydraulic modeling predicted that the portion of the SS016 plume not being captured by the SS016 GET system would be hydraulically captured by the SS029 GET system. This finding was documented in the Technical Memorandum: Consolidation of Site ST032 into the Southern Interim Remedial Action, dated 03 August 2001.

4.3.3 Free-product Removals

LTO for free-product removal actions have historically been conducted at the following sites:

- **SS014 –** Passive skimming: discontinued in November 2005
- **ST032 –** Passive skimming: discontinued in September 2002
- **SD034 –** Active and passive skimming: ongoing

In the second quarter of 2007, none of the SS014 or ST032 monitoring wells contained measurable floating jet fuel. Past free product removal actions have removed most of the

floating jet fuel, but some residual free product may remain. The wells will continue to be monitored for floating product under the Travis AFB GSAP. If future GSAP monitoring detects floating product, Travis AFB will evaluate restarting floating product removal actions at the sites.

4.4 Soil and Sediment Remedy Selection

Soil and sediment RAs at sites within the NEWIOU and WABOU are specified in the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006) and the final Soil ROD for the WABOU (Travis AFB, 2002a).

4.5 Soil and Sediment Remedy Implementation

Summaries of the soil and sediment RAs that were specified in the RODs the NEWIOU and WABOU sites are provided in Table 4-10 and Table 4-11.

TABLE 4-10
Summary of NEWIOU Sites Soil and Sediment Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	IROD-specified Remedial Action[a]
SD001	Excavation and LUCs
FT003	Excavation and Onbase Consolidation[b]
FT004	Excavation and Onbase Consolidation[b]
FT005	Excavation and Onbase Consolidation[b]
LF007	Excavation and LUCs[b]
SS015	LUCs
SS016	LUCs
ST032	LUCs
SD033 (soil)	LUCs
SD033 (sediment)	Excavation and LUCs[b]
SD037	LUCs

[a] Soil RA objective specified in the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006)
[b] Excavated soil placed in onbase CAMU

TABLE 4-11
Summary of WABOU Sites Soil Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	IROD-specified Remedial Action[a]
LF008	Excavation/Offbase Disposal
RW013	Excavation/Offbase Disposal
DP039	Land Use and Access Restrictions (i.e., LUCs)
SS041	Excavation/Onbase Consolidation[b]
SD042	Excavation/Onbase Consolidation[b]
SD043	Land Use and Access Restrictions (i.e., LUCs)
LF044	Land Use and Access Restrictions (i.e., LUCs)
SD045	Excavation/Onbase Consolidation[b]
SS046	Land Use and Access Restrictions (i.e., LUCs)

[a] Soil RA objective specified in the final Soil ROD for the WABOU (Travis AFB, 2002a)
[b] Excavated soil placed in onbase CAMU

4.5.1 Soil and Sediment Remedial Action Objectives

The basic objective of the soil and sediment RAs, as specified in the two RODs, is to reduce contaminant concentrations to industrial cleanup levels so that the sites are safe for Base workers.

Under both RODs, if excavation reduces residual contaminant concentrations to those that allow for unlimited use and unrestricted exposure, then LUCs will not be required. However, if excavation only reduces contaminant concentrations to industrial cleanup levels, LUCs will be implemented to restrict site access and usage. At several sites, LUCs are the only selected remedy.

4.5.2 NEWIOU Soil and Sediment Remedial Actions

For NEWIOU groundwater sites, the RAs specified in the *NEWIOU Soil, Sediment, and Surface Water ROD* include the following:

- **Alternative 17 – Land Use Controls**: Future land use and soil and sediment disturbance activities are restricted.
- **Alternative 18 – Excavation**: Contaminated soils are excavated and placed in the designated CAMU at Travis AFB or taken to an offbase landfill.

4.5.3 WABOU Soil Remedial Actions

For the WABOU soil sites, the RA specified in the final Soil ROD for the WABOU (Travis AFB, 2002a) includes the following:

- Alternative S2 – Land Use and Access Restrictions: similar to NEWIOU ROD Alternative 17 (Travis AFB, 2006)

- Alternative S6 – Excavation/Onbase Consolidation: similar to NEWIOU ROD Alternative 18 (Travis AFB, 2006)

The descriptions of NEWIOU and WABOU ROD soil RA alternatives may vary, but their objectives are identical – to remove contaminated soil down to levels protective of onbase workers and/or to restrict residential development and the unauthorized disturbance or relocation of soil.

Onbase consolidation of contaminated soil excavated from both NEWIOU and WABOU sites is conducted at the CAMU, located within NEWIOU Site LF007. Descriptions of the CAMU approach to the onbase consolidation of excavated soil are provided in Section 4.4 of the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006). In the WABOU ROD, Section 4.2 describes the CAMU, and Section 5.1.4 provides more details concerning the construction of the CAMU and the development of the CAMU soil acceptance levels.

4.5.4 Land Use Controls

The requirements for implementation of LUCs at soil/sediment sites are described in Section 5.4 of the final Soil ROD for the WABOU (Travis AFB, 2002a) and Section 5.4 of the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). The sites with LUCs as all, or part, of the site-specific RA are listed in Table 4-10 and Table 4-11.

4.6 Works Cited

CH2M HILL. 2008. *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant.* Environmental Restoration Program. Travis AFB, California. 27 February.

CH2M HILL. 2004. Final *South Base Boundary Groundwater Treatment Plant Operations and Maintenance Manual, Revision 3.* Travis Air Force Base, California. February.

CH2M HILL 2002. Final *LF007 Soil Remedial Action Design Report and Post-Closure Maintenance Plan.* Installation Restoration Program. Travis Air Force Base, California. 30 August.

CH2M HILL. 2001. Technical Memorandum: *Consolidation of Site ST032 into the Southern Interim Remedial Action.* 03 August.

CH2M HILL. 2000. Final *West Treatment and Transfer Plant Interim Remedial Action Operations and Maintenance Manual (Addendum to the Central Groundwater Treatment Plant O&M Manual)*. Installation Restoration Program. Travis AFB, California. 28 June.

CH2M HILL. 1999. Final *West Industrial Operable Unit (WIOU) Interim Groundwater Remedial Design Report.* Installation Restoration Program. Travis AFB, California. 25 September.

CH2M HILL. 1998b. Final *Natural Attenuation Assessment Plan*. Travis Air Force Base, California. August.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002a. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

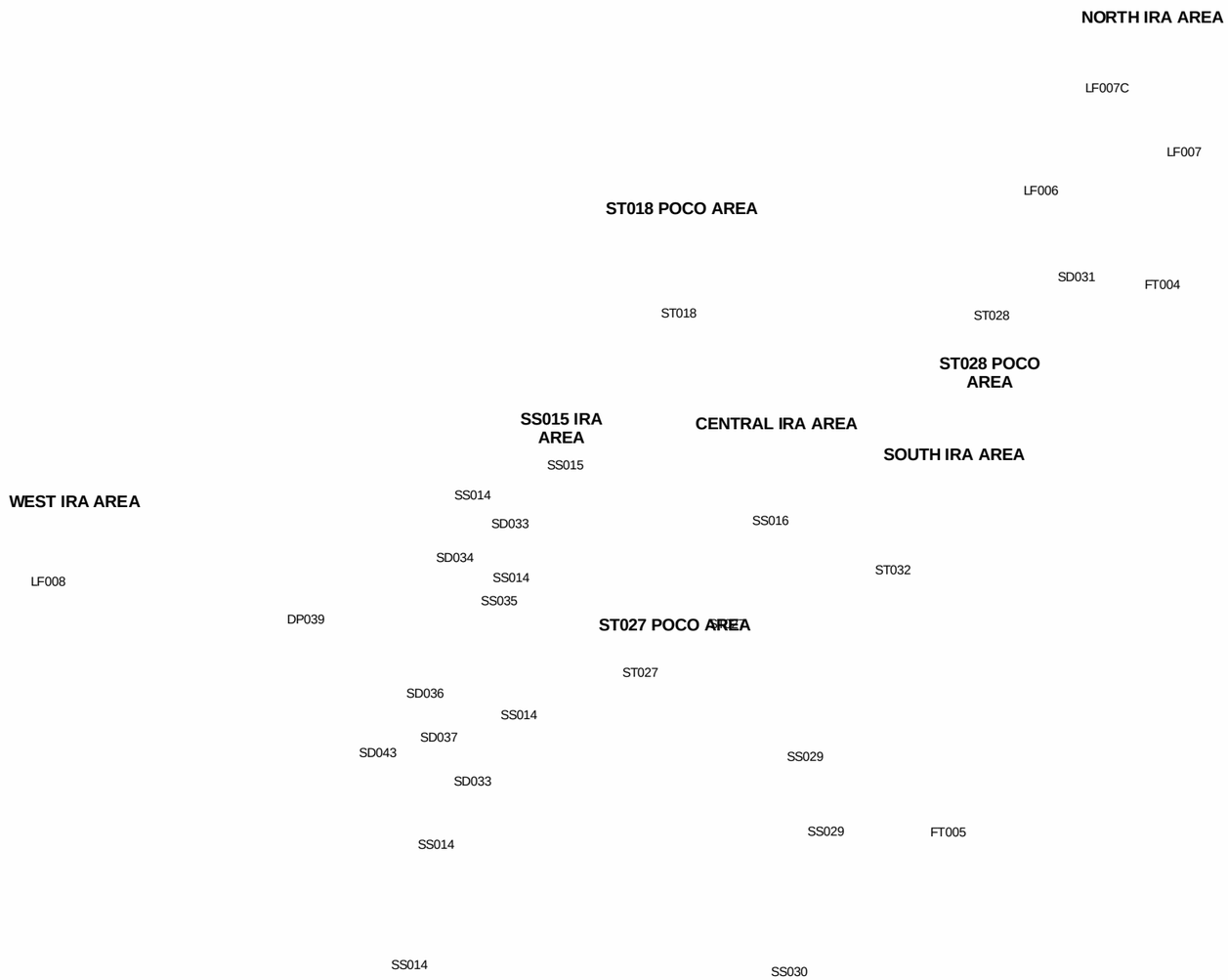
Travis Air Force Base (Travis AFB). 2002b. Final *Travis AFB General Plan.* Travis AFB, California.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

URS Group, Inc. (URS). 2002a. Final *Basewide Soil Remedial Design/Remedial Action (RD/RA) Plan*. Installation Restoration Program. Travis Air Force Base, California. 20 June.

URS Group, Inc. (URS). 2002b. Final *Central Groundwater Treatment Plant Operations and Maintenance Manual. Revision 1.* Travis Air Force Base, California. May.



LEGEND

- IRA AREA BOUNDARY
- BASE BOUNDARY
- FENCE
- UNTREATED WATER PIPING
- UNTREATED WATER FROM WWTP
- TREATED WATER PIPING
- BUILDING
- ROAD
- UNPAVED AREA
- PAVED AREA
- SURFACE WATER
- ERP SITE BOUNDARY
- EASEMENT

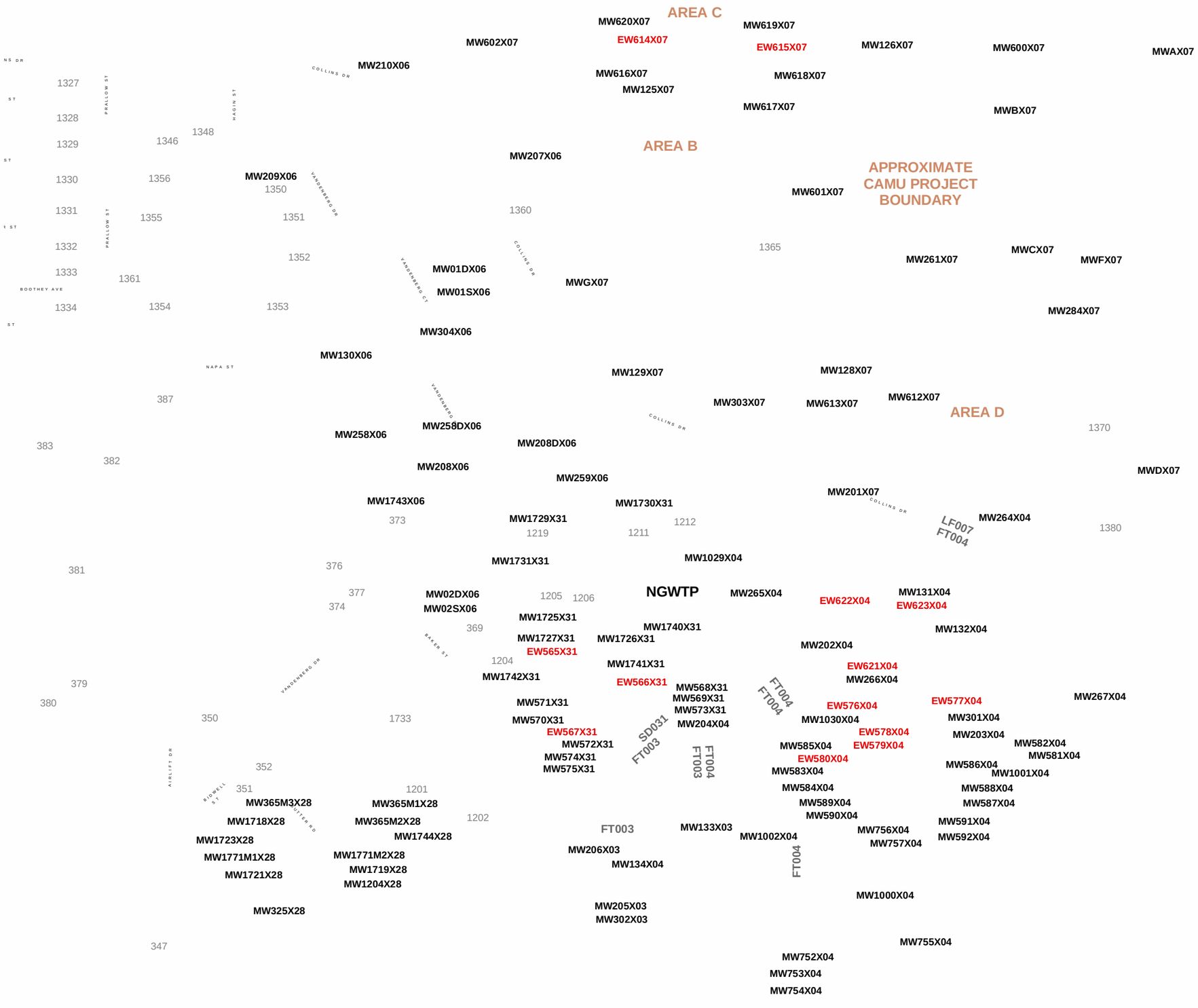
NOTE:
NON-CERCLA POCO SITES AND RISK-BASED CORRECTIVE ACTIONS ARE NOT INCLUDED IN THIS 5-YEAR REVIEW.

0 1,000 2,000
Feet

FIGURE 4-1
CONSOLIDATED GROUNDWATER INTERIM REMEDIAL ACTIONS
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-1_GW_REMEDIATION_AREAS.MXD 7/25/2008 16:39:01



KEY MAP

LEGEND

- GROUNDWATER MONITORING WELL
- EXTRACTION WELL
- ABOVEGROUND STORAGE TANK
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- BASE BOUNDARY
- ERP SITE BOUNDARY
- ROAD
- UNPAVED AREA
- PAVED AREA
- BUILDINGS
- SURFACE WATER
- MAIN WATERLINE
- UNTREATED WATER PIPING
- TREATED WATER PIPING
- APPROXIMATE GROUNDWATER FLOW DIRECTION

0 200 400
FEET

FIGURE 4-2
NORTH IRA - FT004/SD031/LF006/LF007 SITE MAP
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

FIGURE 4-3
CENTRAL IRA - NORTHERN SS016/ST032 SITE MAP
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-3_SS016_SITE_MAP.MXD 3/6/2008 09:51:35

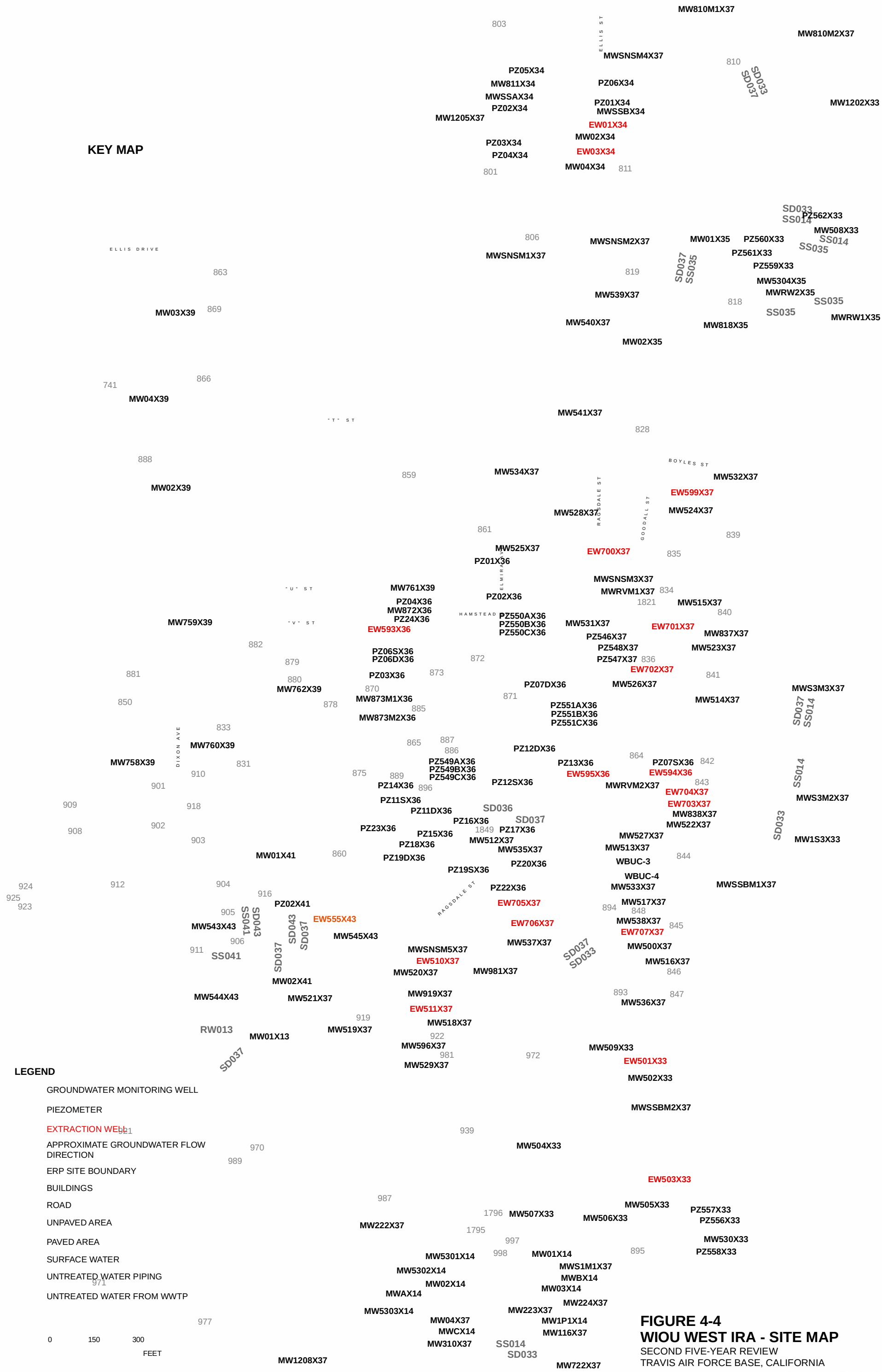


FIGURE 4-4
WIOU WEST IRA - SITE MAP
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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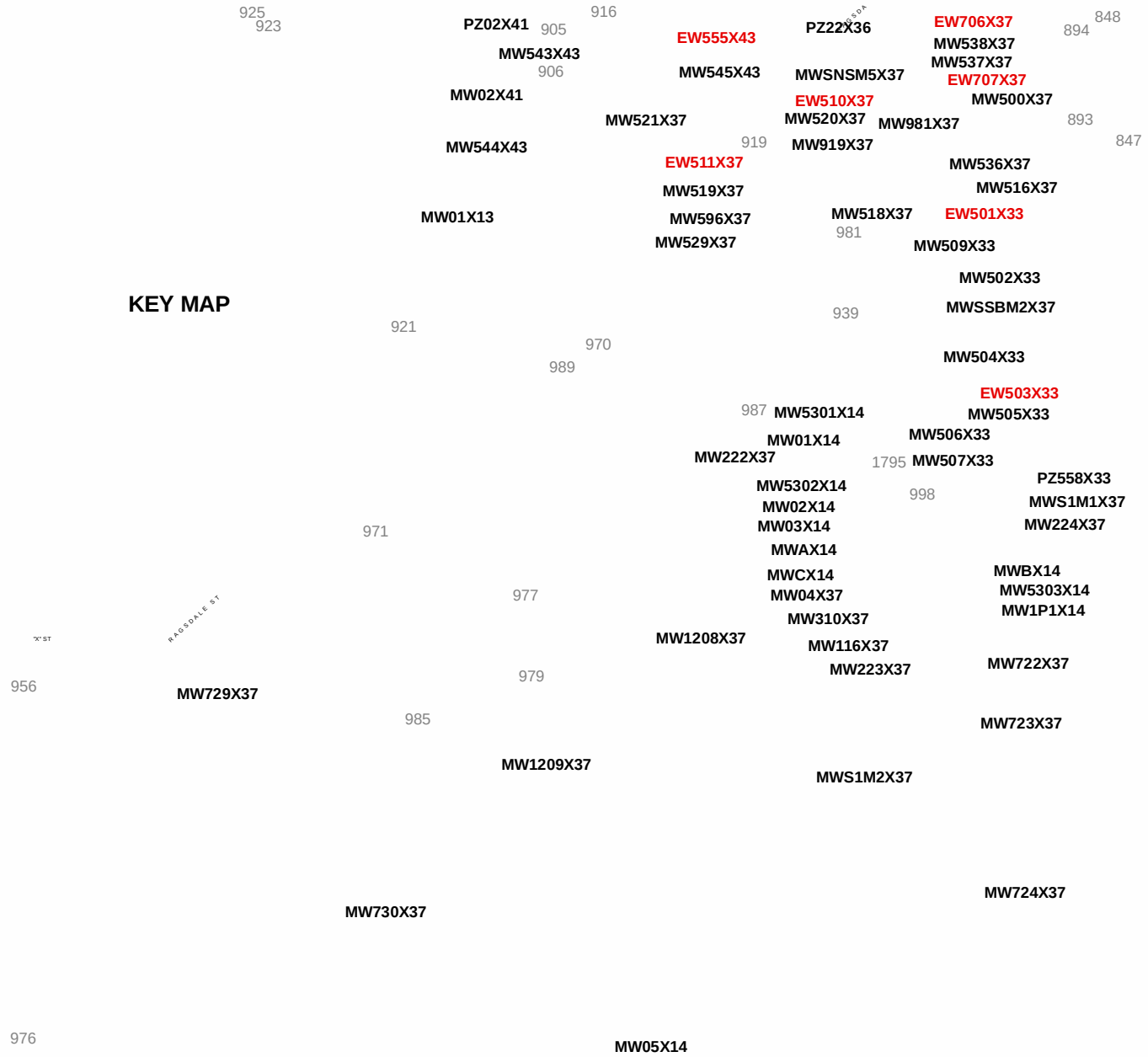

LEGEND

- GROUNDWATER MONITORING WELL
- PIEZOMETER
- EXTRACTION WELL
- ROAD
- UNPAVED AREA
- PAVED AREA
- BUILDINGS
- SURFACE WATER
- UNTREATED WATER PIPING
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- ERP SITE BOUNDARY

0 150 300
FEET

FIGURE 4-5
WEST IRA - WIOU MNA SITE MAP

SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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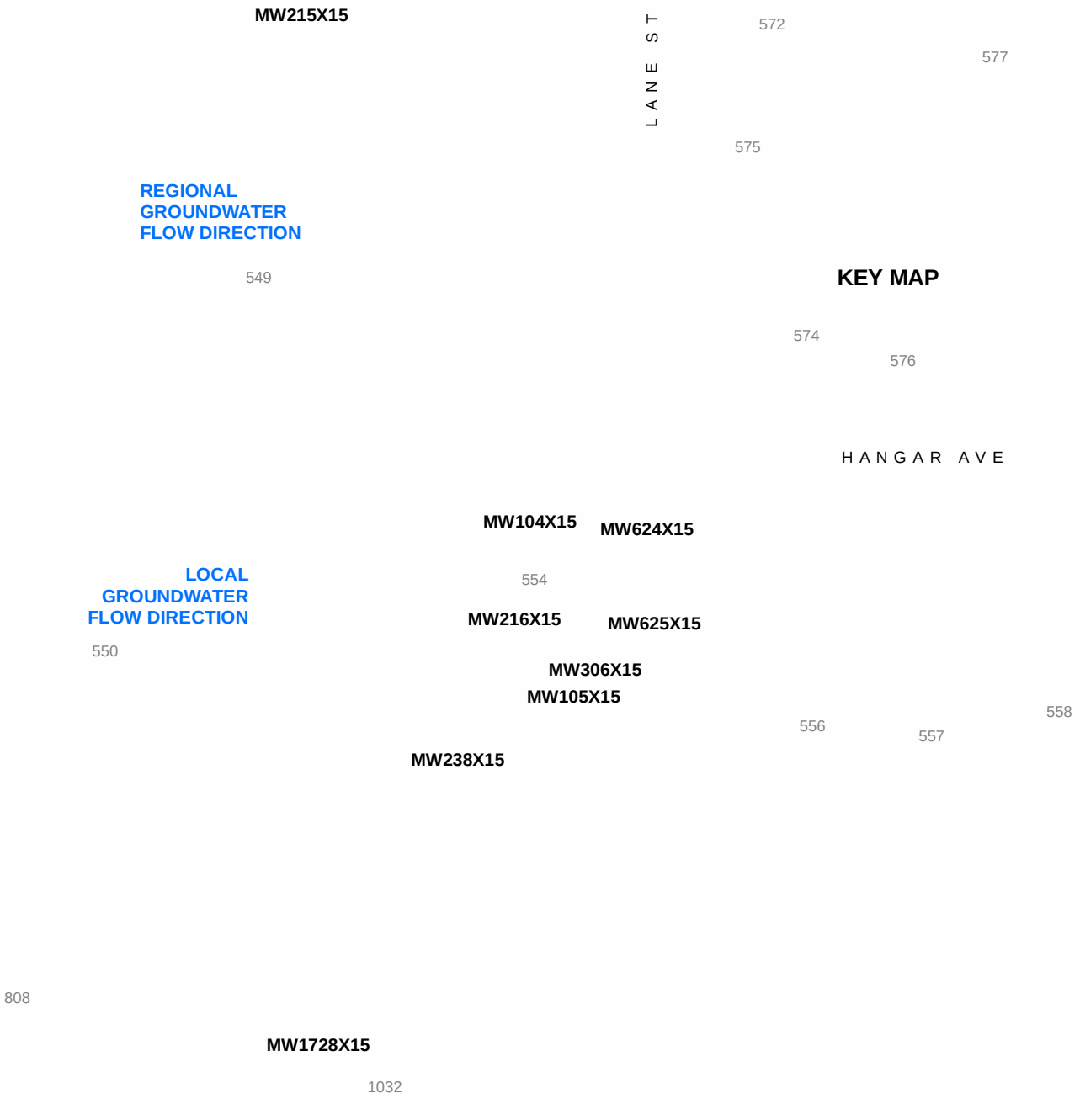


LEGEND

- GROUNDWATER MONITORING WELL
- PAVED AREA
- BUILDINGS
- UNTREATED WATER FROM WWTP
- GROUNDWATER FLOW DIRECTION
- ERP SITE BOUNDARY

0 75 150
FEET

FIGURE 4-6
WEST IRA - SS015 SITE MAP

SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-6_SS015_SITE_MAP.MXD 3/6/2008 12:23:39

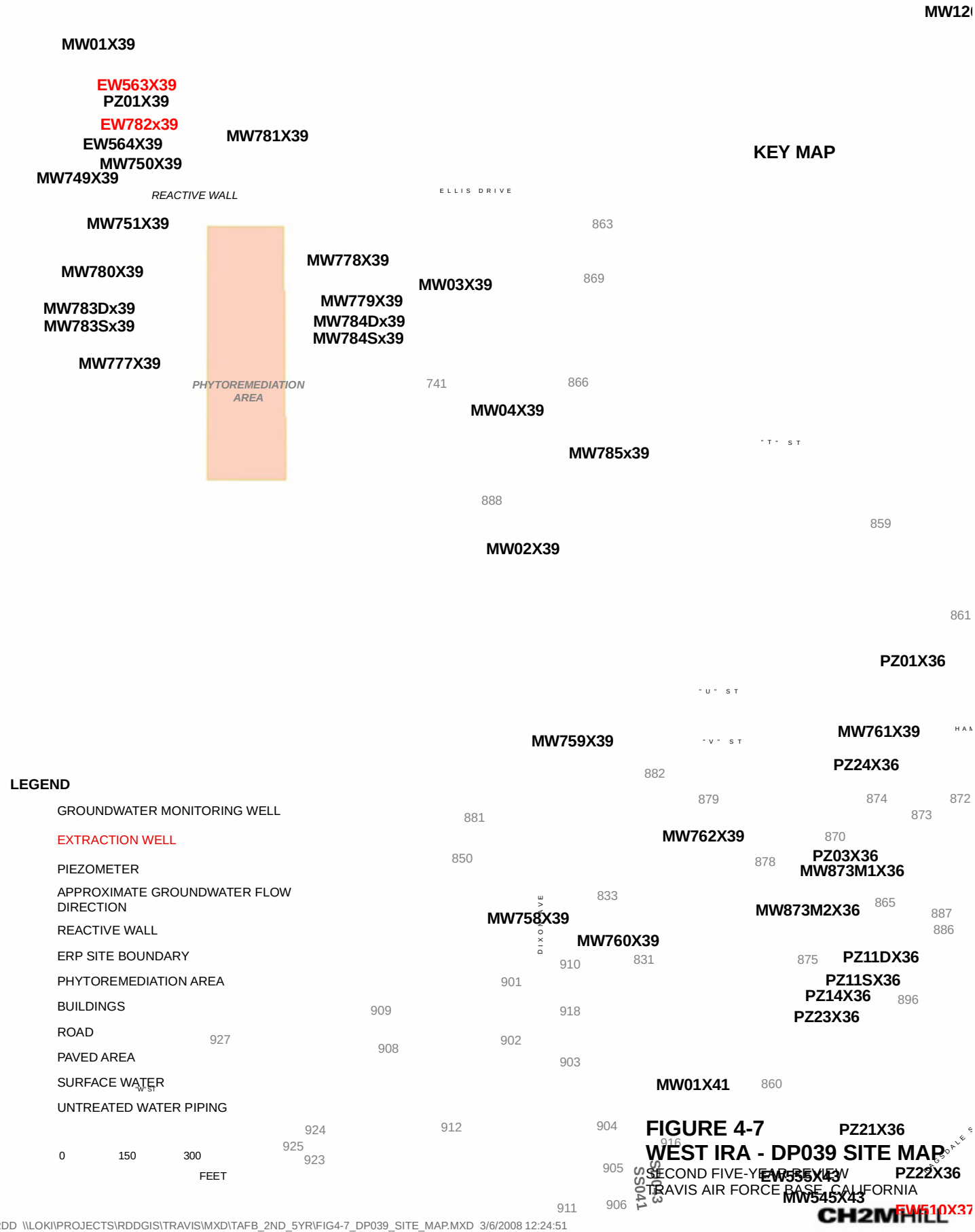


FIGURE 4-7
WEST IRA - DP039 SITE MAP
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-7_DP039_SITE_MAP.MXD 3/6/2008 12:24:51

MW275X08

MW225X08

KEY MAP

MW113X08

MW713X08

EW719X08 MW01X08

MW712X08

MW717X08

996

MW714X08

EW720X08

MW716X08

994

EW721X08

MW114X08

MW252X08

MW115X08

MW311X08

MW715X08

992

MW253X08

LEGEND

GROUNDWATER MONITORING WELL

EXTRACTION WELL

ROAD

UNPAVED AREA

PAVED AREA

BUILDINGS

SURFACE WATER

990

ERP SITE BOUNDARY

UNTREATED WATER PIPING

APPROXIMATE GROUNDWATER FLOW DIRECTION

0 75 150

FEET

988

980

FIGURE 4-8
WEST IRA - LF008 SITE MAP

SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-8_LF008_SITE_MAP.MXD 3/6/2008 12:26:54

KEY MAP

LEGEND

- GROUNDWATER MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- PIEZOMETER
- EXTRACTION WELL
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- ERP SITE BOUNDARY
- BASE BOUNDARY
- BUILDINGS
- ROAD
- UNPAVED AREA
- PAVED AREA
- SURFACE WATER
- UNTREATED WATER PIPING
- TREATED WATER PIPING

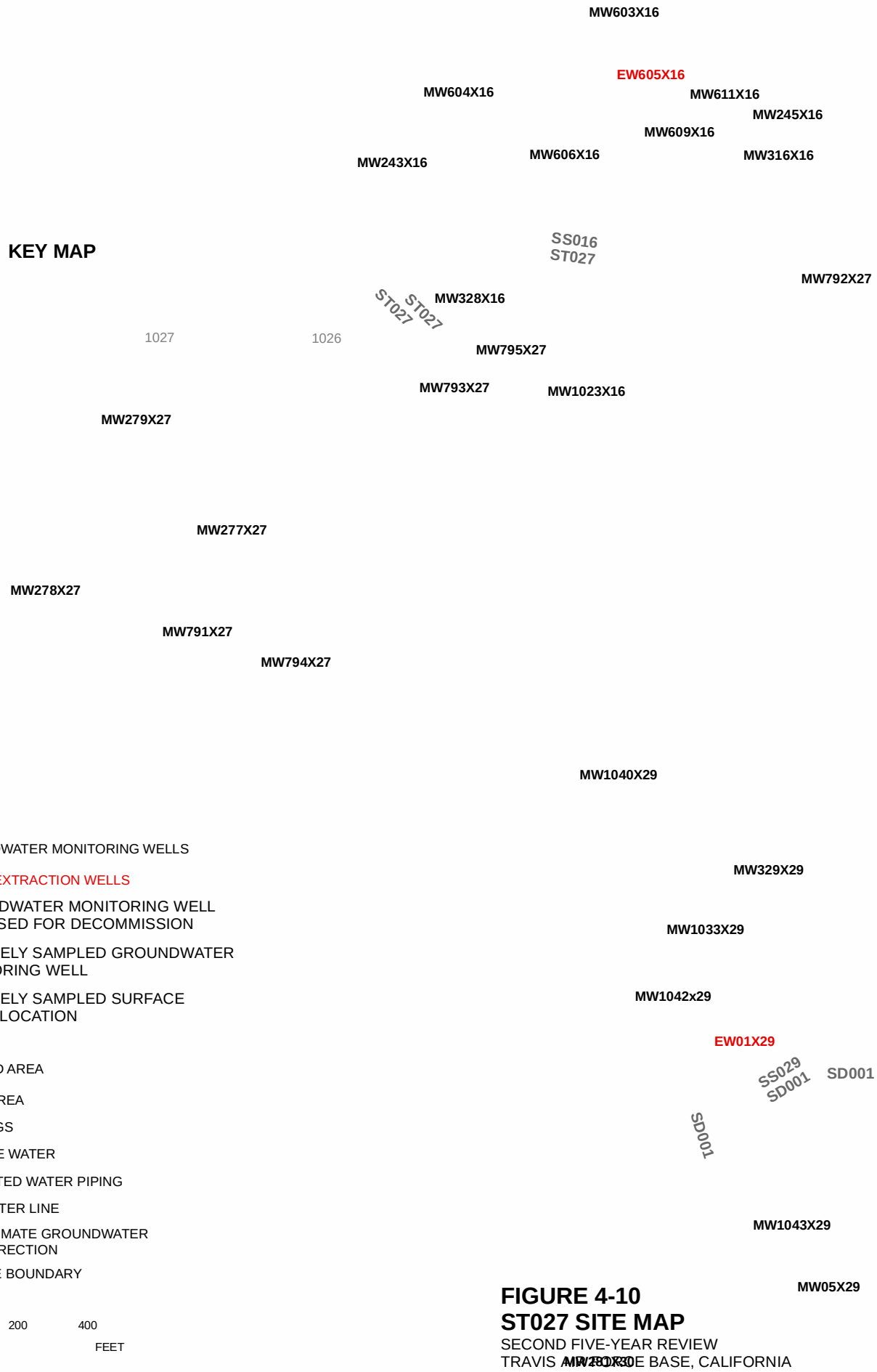
0 200 400
FEET

FIGURE 4-9
SOUTH IRA - FT005/SS029/SS030 SITE MAP

SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-9_FT005.MXD 3/6/2008 12:30:02



LEGEND

- GROUNDWATER MONITORING WELLS
- ACTIVE EXTRACTION WELLS
- GROUNDWATER MONITORING WELL PROPOSED FOR DECOMMISSION
- ROUTINELY SAMPLED GROUNDWATER MONITORING WELL
- ROUTINELY SAMPLED SURFACE WATER LOCATION
- ROAD
- UNPAVED AREA
- PAVED AREA
- BUILDINGS
- SURFACE WATER
- UNTREATED WATER PIPING
- MAIN WATER LINE
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- ERP SITE BOUNDARY

0 200 400
FEET

FIGURE 4-10
ST027 SITE MAP

SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG4-10_ST027.MXD 4/1/2008 11:04:15

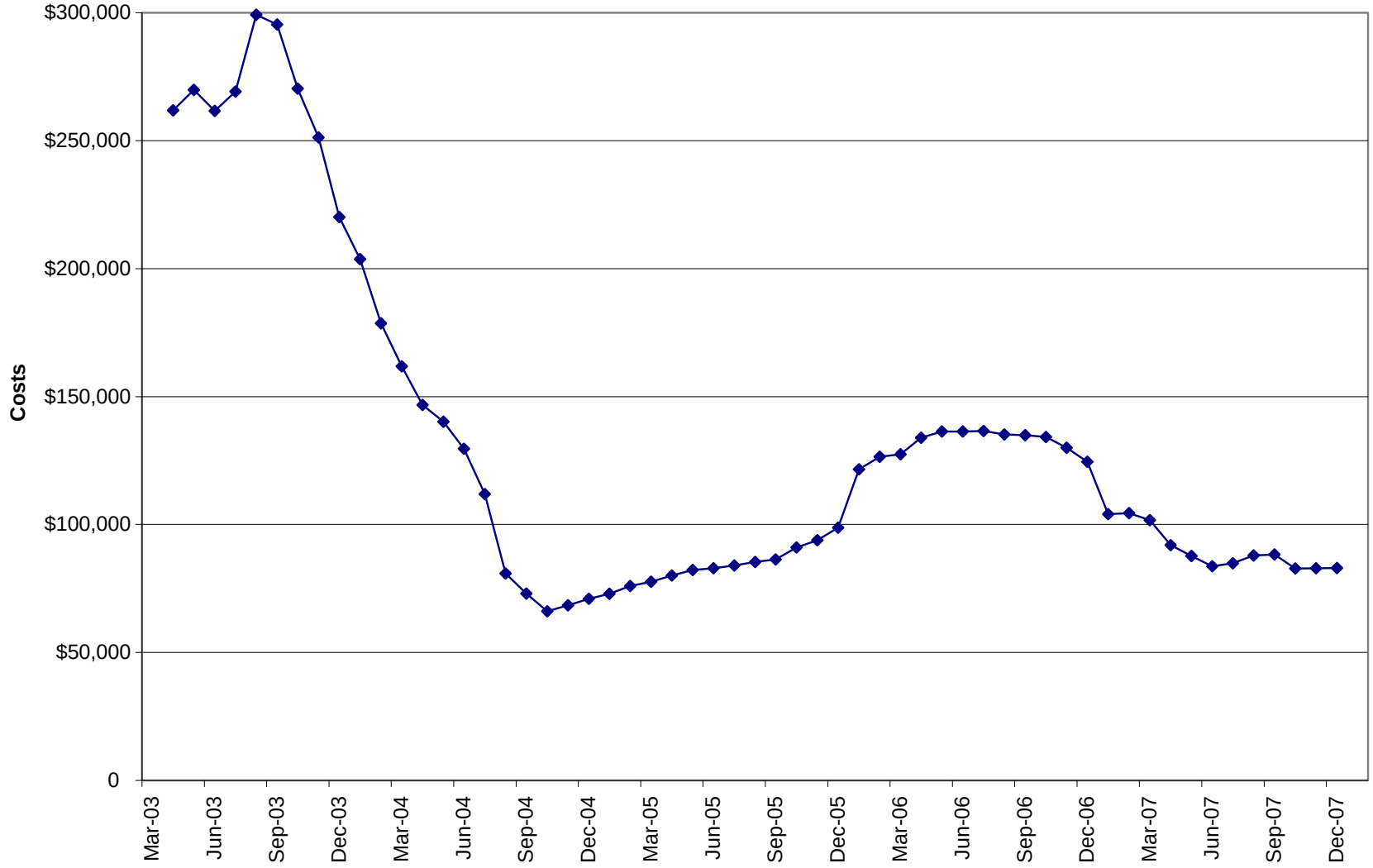


FIGURE 4-11
NGWTP ROLLING 12-MONTH OPERATING COSTS VS. TIME
APRIL 2003 – DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_04 (4/1/08)

CH2MHILL

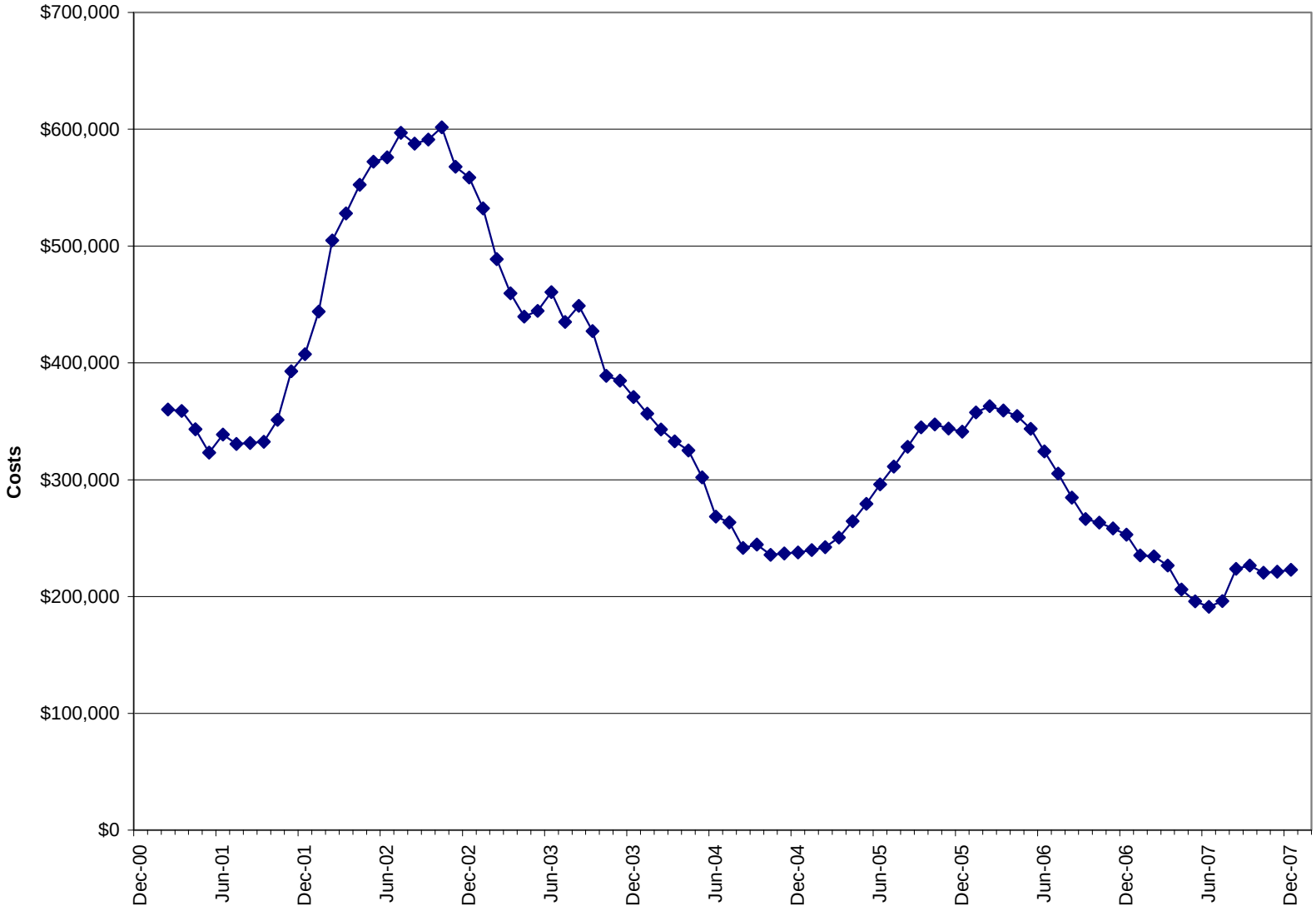


FIGURE 4-12
CGWTP ROLLING 12-MONTH OPERATING COSTS VS. TIME
FEBRUARY 2001 – DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_05 (4/1/08)

CH2MHILL

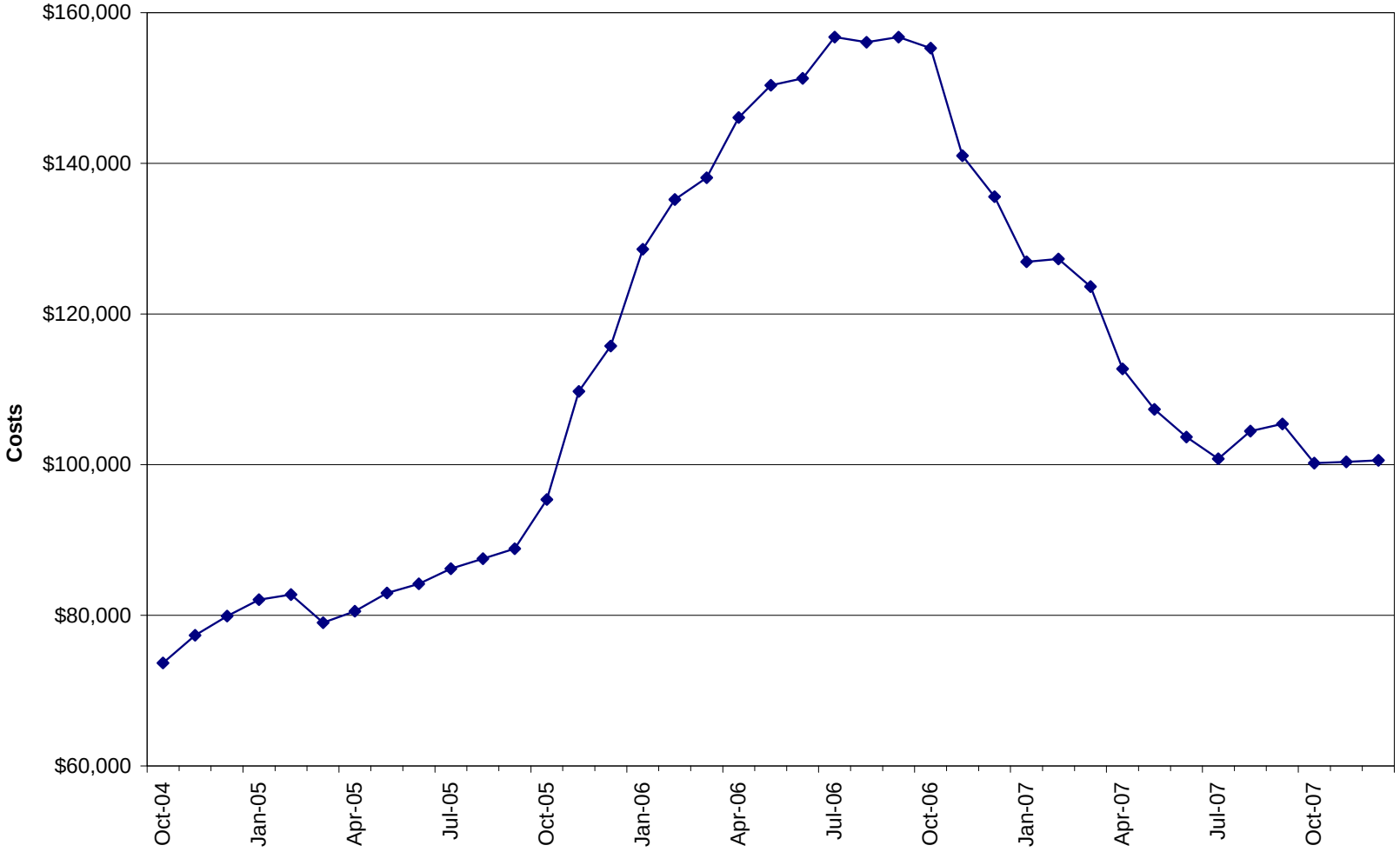


FIGURE 4-13
SBBGWTP ROLLING 12-MONTH OPERATING COSTS VS. TIME
OCTOBER 2004 – DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_06 (4/1/08)

CH2MHILL

SECTION 5

Progress Since the Last Five-Year Review

This section describes the progress made since the first Five-Year Review Report was finalized in July 2003 (CH2M HILL, 2003). The first review addressed groundwater IRAs within the NEWIOU and WABOU. Soil RAs within the WABOU and NEWIOU were not part of the first review because these actions were too recent or had not yet been completed.

5.1 First Five-Year Review Protectiveness Statements

Protectiveness statements from the first five-year review of NEWIOU and WABOU groundwater IRAs (CH2M HILL, 2003) are summarized in Table 5-1. The three questions posed in the initial assessment of interim remedy protectiveness, and the answers to those questions, included the following:

1. Is the remedy functioning as intended by the IROD? – Yes
2. Are the exposure assumptions, toxicity, data, cleanup levels, and RA objectives still valid? – Yes
3. Has any other information come to light that could call into question the protectiveness of the remedy? – No

The first five-year review concluded that each of the fully constructed and operating groundwater IRAs at Travis AFB is meeting the objectives specified in the applicable Groundwater IROD for the NEWIOU (Travis AFB, 1998) or Groundwater IROD for the WABOU (Travis AFB, 1999). The IRAs were found to be operating as intended and deemed to be protective of human health and the environment. The IRAs and associated ERP sites included the following:

- **North IRA –** ERP Sites FT004, SD031, LF006, LF007B, and LF007D
- **South IRA –** ERP Sites FT005-onbase, SS030, SS029, ST032, and southern portion of SS016
- **Central IRA –** Northern portion of ERP Site SS016
- **West IRA –** ERP Sites SS014, SD033, SD034, SS035, SD036, SD037, SS041, SD043, and LF008

At the time of the first review, not all of the groundwater IRAs were complete. The following sections describe the IRAs that were incomplete through 2003 but have since been completed.

TABLE 5-1
Summary of Protectiveness Statements from the First Five-Year Review (2003)
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					First Five-Year Review 2003 Protectiveness Statements
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
North IRA	FT004	√				√[b]	The source control GET remedy at Sites FT004 and SD031 is expected to be, or is protective of, human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled. The MNA remedy at Sites FT004 and SD031 is expected to be, or is protective of, human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
	SD031	√				√[b]	
	LF006				√		The MNA remedy at Site LF006 is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
	LF007B					√	The MNA remedy at Sites LF007B and LF007D is expected to be, or is protective of, human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled. The MNA remedy at Site LF007C is being replaced by a GET action.
	LF007C		√	√		--[c]	The (pending) GET remedy at Site LF007C is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
	LF007D					√	The MNA remedy at Sites LF007B and LF007D is expected to be, or is protective of, human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled. The MNA remedy at Site LF007C is being replaced by a GET action.

TABLE 5-1
Summary of Protectiveness Statements from the First Five-Year Review (2003)
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					First Five-Year Review 2003 Protectiveness Statements
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
South IRA	SS030	√	√	√			The GET remedy at Sites SS029, and SS030, SS029, and FT005 (onbase) is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
			√				
	FT005-onbase		√				
SS029	FT005-offbase			√			The GET remedy at Site FT005 (offbase) is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
Central IRA	SS016/ ST032	√					The GET remedy at Site SS016/ST032 is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
West IRA	SS014	√	√			√[b]	The GET remedy at the WIOU is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
	SD033		√			√	
	SD034	√	√				
			√[b]			--[d]	The MNA remedy at the WIOU is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.
	SD036	√	√			--[d]	
	SD037	√	√			√	
SS035			√				
	SD043		√				
West IRA	SS015					√	The MNA remedy at Site SS015 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.
SS041							

TABLE 5-1
Summary of Protectiveness Statements from the First Five-Year Review (2003)
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**First Five-Year Review 2003 Protectiveness Statements**
West IRA	DP039	√	--		√		The remedy at Site DP039 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.
West IRA	LF008		√				The GET remedy at Site LF008 is expected to be, or is protective of, human health and the environment, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.

[a] IRA objective specified in the Groundwater NEWIOU and WABOU IRODs.

[b] IRA not specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998), but implemented by the Air Force to address entirety of commingled plume.

[c] Assessment of MNA not implemented because plume is hydraulically captured by LF007C groundwater extraction system.

[d] Assessment of MNA not implemented because plume is hydraulically captured by adjacent groundwater extraction system.

Note:

-- = Migration Control not implemented pending evaluation of MNA and phytoremediation treatability study.

5.2 Progress with Groundwater Interim Remedial Actions

Since the first five-year review of groundwater IRAs was conducted in 2003 (CH2M HILL, 2003), construction of all the NEWIOU and WABOU groundwater IRAs has been completed. The groundwater IRAs completed since 2003 include the following:

- **North IRA, Site LF007C –** Construction of the onbase migration control/offbase remediation GET system at LF007C was completed in 2003. Onbase groundwater extraction wells and performance monitoring wells were installed and the extraction system components (e.g., pumps) and the groundwater conveyance system to the NGWTP were constructed. Offbase performance monitoring wells were also installed during this time.
- **South IRA, Site FT005-offbase –** Construction of the offbase remediation GET system at FT005 was also completed in 2003. Offbase groundwater extraction wells and performance monitoring wells were installed and the extraction system components (e.g., pumps) and the groundwater conveyance system to the SBBGWTP were installed.
- **West IRA, Site DP039 –** Additional construction to expand the DP039 DPE system was completed in 2006 (CH2M HILL, 2007). An additional DPE well and monitoring wells were installed and the extraction system components (e.g., pumps) and the groundwater conveyance system to the CGWTP (via the WTTP) were installed.

These additional actions have improved the overall protectiveness of the interim groundwater remedies at Travis AFB. Each action has been successfully integrated into the various groundwater interim remediation systems (i.e., North IRA, South IRA, West IRA).

5.3 Progress with Soil Remedial Actions

Soil RAs at ERP sites within the WABOU and NEWIOU were not included in the first five-year review because these actions were too recent or had not yet been completed.

5.3.1 Progress with WABOU Soil Remedial Actions

Through 2007, the following WABOU soil RAs have been completed in accordance with the Soil ROD for the WABOU (Travis AFB, 2002):

- **LF008 – Excavation/Offbase Disposal**: In 2003, the base removed 1,984 cubic yards of pesticide-contaminated soil from Landfill 3 and placed in the onbase CAMU. Excavated debris were transported to an offbase disposal facility for incineration. Residential cleanup levels were achieved and no LUCs were required.
- **RW013 – Excavation/Offbase Disposal**: During 2002 to 2003, the base removed 38 cubic yards of low-level U-234 and U-235 contaminated soil and waste from Radioactive Burial Site #2 and transported them to an offbase landfill. Residential cleanup levels were achieved and no LUCs were required.
- **DP039 – Land Use and Access Restrictions**: Ongoing management of LUCs since 2002.

- **SS041 – Excavation/Onbase Consolidation**: In 2003, the base removed 49 cubic yards of pesticide-contaminated soil from Building 905 and placed them in an onbase CAMU. Residential cleanup levels were achieved, and no LUCs were required.
- **SD042 – Excavation/Onbase Consolidation**: In 2003, the base removed 11 cubic yards of metals-and PAH-contaminated soil from Buildings 929/931/940 and placed them in an onbase CAMU. Residential cleanup levels were achieved, and no LUCs were required.
- **SD043 – Land Use and Access Restrictions**: Ongoing management of LUCs since 2002.
- **LF044 – Land Use and Access Restrictions**: Ongoing management of LUCs since 2002.
- **SD045 – Excavation/Onbase Consolidation**: In 2007, lead-contaminated soil was removed from the Former Small Arms Range and placed in the onbase CAMU. Residential cleanup levels were achieved, and no LUCs were required.
- **SS046 – Land Use and Access Restrictions**: Ongoing management since 2002.

These completed soil RAs have achieved the RAOs identified in the Soil ROD for the WABOU (Travis AFB, 2002). The soil RAs conducted at Sites LF008, RW013, SS041, SD042, and SD045 achieved residential cleanup levels. Therefore, no soil LUC are required at these sites.

At Sites DP039, SD043, LF044, and SS046; LUCs were installed to restrict site access and prohibit the residential use of the property. Travis AFB is successfully managing the Land Use and Access Restrictions remedy in accordance with Section 5.4 of the final Soil ROD for the WABOU (Travis AFB, 2002).

5.3.2 Progress with NEWIOU Soil and Sediment Remedial Actions

Through 2007, soil and sediment RAs at NEWIOU sites were only partially completed. Travis AFB successfully conducted soil excavations at Sites FT003, FT004, and LF007E in accordance with the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). These actions achieved cleanup levels that allow for unlimited use and unrestricted exposure at each site. Therefore, no LUCs were required at these sites. The soil RA at FT005 has not yet been completed. Additional excavation will be carried out as soon as it can be programmed and scheduled into the next available construction season.

During 2007, LUCs were successfully implemented at Sites SS015, SS016, ST032, and SD037. At these sites, a LUC was the only remedy selected in the ROD. Travis AFB is successfully implementing the LUCs in accordance with Section 5.4 of the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006). Travis AFB has also implemented LUCs at all of the other areas within Site LF007, including the area of the CAMU.

Sediment RAs at Sites SD001 and SD033 are pending. Travis AFB will carry out these actions as soon as they can be programmed and scheduled into the next available construction season. Travis AFB is maintaining LUC at these sites until the RAs are completed and the need for continuing the LUC is reassessed.

More complete descriptions of the RAs conducted through 2007 at the NEWIOU sites and WABOU Site SD045 are provided in the Soil Remedial Action Report (Shaw Environmental, Inc., 2008).

5.4 Status of Follow-up Actions from the First Five-Year Review

A summary of the key follow-up actions from the first five-year review (CH2M HILL, 2003) of NEWIOU and WABOU groundwater IRAs is provided in Table 5-2.

TABLE 5-2
Summary of Key Recommendations and Follow-up Actions from the First Five-Year Review[a]
Second Five-Year Review Report, Travis Air Force Base, California

Issues from Previous Review	Follow-up Actions	Action Taken and Outcome	Date of Action
North groundwater IRA not complete	Complete construction of LF007C GET system	Construction completed. Successfully integrated into North IRA, but additional optimization action may be required.	2003
South groundwater IRA not complete	Complete construction of FT005 GET system	Construction completed. Successfully integrated into South IRA.	2003
West groundwater IRA not complete	Expand DP039 DPE system	Construction completed. Successfully integrated into West IRA, but additional optimization action may be required.	2006
Minimize extraction well volume requiring treatment	Optimize extraction well flowrates	Ongoing	Ongoing
Implement more aggressive remediation of higher concentration groundwater contaminant “hot spots”	Install additional extraction wells at Sites FT004, SS030, SS029, SD033, SD036, SD037, SS016, and DP039	Action partially completed. Additional DPE well installed within DP039 source area in 2006. Additional optimization action may be required.	Pending
Improve groundwater monitoring network	Install additional monitoring wells at Sites SD031, SS030, and SS029	Action partially completed. Additional monitoring wells installed in DP039 phytoremediation area[b]. Installation of additional wells at SD031, SS030, and SS029 is under evaluation.	2006
Optimize remediation of higher concentration groundwater contaminant “hot spots”	Consider in situ technologies to reduce source area contaminant mass	None. Other remediation technologies will be evaluated during development of the Basewide Groundwater ROD.	Pending
Evaluate effectiveness of phytoremediation as a groundwater RA	Complete DP039 phytoremediation treatability study	Phytoremediation treatability study was completed in 2005, but evaluation of the phytoremediation system is ongoing.	Ongoing

[a] Final *Groundwater Five-Year Review* (CH2M HILL, 2003)
[b] *DP039 Optimization Field Report* (CH2M HILL, 2007)

5.5 Progress on Comments on First Five-Year Review

The first *Groundwater Five-Year Review* was submitted as a draft document for regulatory agency reviews in April 2003. The review comments and Travis AFB responses are provided as Appendix B to the (first) final *Groundwater Five-Year Review* (CH2M HILL, 2003). Most of the issues raised by the regulatory agencies were resolved and the report was finalized, but several issues were deferred. These ongoing issues are summarized in Table 5-3.

5.6 Works Cited

CH2M HILL. 2007. *DP039 Optimization Field Report.* Travis AFB, California. Final. May.

CH2M HILL. 2003. Final *Groundwater Five-Year Review*. Environmental Restoration Program. Travis AFB, California. 14 July.

CH2M HILL. 1998. Final *Natural Attenuation Assessment Plan*. Travis Air Force Base, California. August.

Shaw Environmental, Inc. 2008. Draft *Remedial Action Report; North, East and West Industrial Operable Unit and West/Annexes/Basewide Operable Unit; Soil Remedial Action for Sites SD045, FT003, FT004, FT005, Union Creek SD001 and SD033, and LF007 Area E*. 60th Air Mobility Wing. Travis Air Force Base, California. 06 February.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU).* Installation Restoration Program. Travis AFB, California. 26 January.

TABLE 5-3
Summary of Key Issues from the First Groundwater Five-Year Review
Second Five-Year Review Report, Travis AFB

First Five-Year Review Issue[a]	Air Force Response[a]	Current Status	Comment
Site LF007C: Evaluate the effects of groundwater flow changes related to the groundwater mound in the LF007C area and the hydraulic capture of the planned GET system.	Agreed that changes in the groundwater flow regime may change, especially after installation of LF007C GET system. Monitoring will be continued under the GSAP.	The LF007C GET system was constructed in 2003, but performance data since that time indicate continued offbase TCE plume migration. Recent optimization of the LF007C extraction wells to support IROD objectives of Migration Control and Off-base Remediation are complete.	Travis AFB will complete the evaluation of groundwater flow characteristics for site LF007C as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site SD031: Install additional well pairs southeast and southwest of the last extraction wells at Site SD031 (EW567x31) to effectively monitor groundwater elevations, hydraulic capture, and TCE plume migration.	Noted and agreed.	The TCE/DCE concentrations at EW567x31 have dropped significantly, and this extraction well is shut down as part of a one-year rebound study, as described in the *Work Plan for RPO Actions at Sites SD031, FT004, and FT005* (CH2M HILL, 2007).	Travis AFB will complete the evaluation of the SD031 monitoring well network as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site DP039: The Source Control and Migration Control objectives are not being achieved. TCE concentrations greater than 1,000 µg/L are found downgradient of the extent of hydraulic capture. Also, TCE exceeding 100 µg/L appears to be migrating downgradient, beyond the area of the treatability studies.	Agreed that the interim remedy is not fully functioning as intended by the WABOU IROD and additional work was needed. Continuing to evaluate the viability of the phytoremediation technology. Placement of additional extraction wells will avoid adverse impacts to the phytoremediation evaluation.	In 2006, the base installed additional monitoring wells within the phytoremediation area and an additional DPE well in the source area[b]. GSAP monitoring is ongoing.	Travis AFB will complete the evaluation of the DP039 monitoring well network, the viability of phytoremediation to stabilize the TCE plume, and other effective groundwater cleanup technologies to meet ROD objectives as part of the final remedy selection process in support of the upcoming Basewide Groundwater ROD.
Site SS016: The TCE plume appears to be migrating south, under the active taxiways and runways. Additional monitoring wells are needed along the plume axis and transverse axis.	Acknowledged that plume migration is occurring, but the Source Control objective specified in the IROD is being achieved. The downgradient portion of the plume is not accessible for remediation because of the active runway. Monitoring will be continued to confirm that hydraulic capture of the southern extent of the plume is being achieved by the downgradient SS029 GET system. If contaminated ground-	The base recently reactivated EW03x16, a horizontal well near the SS016 source zone. GSAP monitoring is ongoing.	Travis AFB will evaluate the monitoring and extraction well network at the southern end of the SS016 plume as well as cleanup technologies that are appropriate for inaccessible aquifers in support of the upcoming Basewide Groundwater ROD.

TABLE 5-3
Summary of Key Issues from the First Groundwater Five-Year Review
Second Five-Year Review Report, Travis AFB

First Five-Year Review Issue[a]	Air Force Response[a]	Current Status	Comment
	water migrating south from SS016 is not captured by the extraction system at SS029 or FT005, then in the future it may be necessary to expand the existing system or install some other technology to capture and treat contamination before it reaches the Base boundary.		
General: MNA and MNA assessments do not include sufficient geochemical parameters to adequately evaluate attenuation.	Plume stability is the main, but not sole, criterion in assessing the success of MNA. Natural Attenuation Summary Reports will be prepared in the future that will determine whether MNA should be selected as the final remedy at sites undergoing assessment. The Natural Attenuation Summary Reports will be prepared in accordance with the final NAAP[c].	Natural Attenuation Summary Reports for sites, or portions of sites, undergoing MNA assessment are pending. The base will prepare the reports after the stakeholders agree that sufficient data are available to make a decision whether MNA should be selected as a final remedy at each site. The stakeholders will agree on the needed components of the Natural Attenuation Summary Reports.	MNA assessment reports will be completed by the selected environmental contractor. Selection will take place in 2008.

[a]Final *Groundwater Five-Year Review,* Appendix B (CH2M HILL, 2003)

[b]*DP039 Optimization Field Report* (CH2M HILL, 2007)

[c]*Natural Attenuation Assessment Plan* (CH2M HILL, 1998)

SECTION 6

Five-Year Review Process

This section provides descriptions of the administrative components of this *Second Five-Year Review Report*, including the community notification and involvement activities conducted by Travis AFB; the relationship of environmental restoration activities and Travis AFB land use planning; and summaries of the key guidance, decision, and technical documents reviewed.

6.1 Administrative Components

Travis AFB is the lead agency for the groundwater IRAs and soil RAs being evaluated in this five-year review report. The San Francisco Bay Water Board, EPA Region 9, and DTSC participate in this review and provide regulatory agency oversight of the groundwater IRAs and soil RAs implemented at Travis AFB. Other regulatory agencies that may provide guidance on the decisions made by Travis AFB Environmental Flight include the Bay Area Air Quality Management District, the California Department of Fish and Game, the United States Fish and Wildlife Service, and the Solano County Environmental Management Office.

As the lead federal agency, the Air Force is required to perform the five-year reviews for Travis AFB under CERCLA Section 104, 120 under Executive Order 12580. EPA is required to assure that the review adequately addresses the protectiveness of the remedies. The San Francisco Bay Water Board and DTSC represent the interests of the State of California. The DTSC serves as the lead of State of California regulatory agencies.

6.2 Community Notification and Involvement

A copy of this draft *Second Five-Year Review Report* was reviewed by the RAB in April 2008. Public notices were published in both the *Vacaville Reporter* and *Fairfield Daily Republic* and the Travis AFB *Tailwind* in April 2008. Additional public notices will be provided after the *Second Five-Year Review Report* is finalized in summer 2008. A copy of the final report will also be placed in the Vacaville Public Library at 1020 Ulatis Drive, Vacaville, California 95688 (707/449-6290).

6.3 Document Review

6.3.1 Guidance Documents

Travis AFB has prepared this *Second Five-Year Review Report* in accordance with the EPA *Comprehensive Five-Year Review Guidance* (EPA, 2001) and other guidance documents, fact sheets, and memoranda, including:

- *Five-Year Review – Questions & Answers* (EPA, 2004)
- *Five Year Review Process in the Superfund Program* (EPA, 2003)
- *Superfund Today: Focus on Five-Year Reviews and Involving the Community* (EPA, 2002)

6.3.2 Decision Documents

Several regulatory decision documents that are specific to the Travis AFB ERP have also been used in the development of this *Second Five-Year Review Report.* These documents include the following:

- Final Groundwater IROD for the NEWIOU (Travis AFB, 1998c)
- Final Groundwater IROD for the WABOU (Travis AFB, 1999)
- Final Soil ROD for the WABOU (Travis AFB, 2002)
- Final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006b)

As appropriate for each NEWIOU and WABOU ERP site, these IRODs and RODs specify the groundwater IRAs, soil RAs, groundwater IRA objectives, groundwater interim remediation/cleanup goals, soil cleanup levels, and the Applicable or Relevant and Appropriate Requirements (ARAR).

6.4 Technical Data Review

Technical information regarding the implementation and performance of groundwater IRAs and soil and/or sediment RAs were also derived from several sources. The primary documents reviewed during development of this five-year review report included the following:

- Final 2006-2007 Annual GSAP Report (CH2M HILL, 2008b)
- *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant* (CH2M HILL, 2008a)
- Draft *Remedial Action Report; North, East and West Industrial Operable Unit and West/Annexes/Basewide Operable Unit; Soil Remedial Action for Sites SD045, FT003, FT004, FT005, Union Creek SD001 and SD033, and LF007 Area E* (Shaw Environmental, Inc., 2008).
- Technical Memorandum – *Recommendations for Optimization, Groundwater Treatment Systems at Travis Air Force Base* (CH2M HILL, 2007b)
- Final Annual Report on the Status of LUCs on Restoration Sites in 2007 (Travis AFB, 2008).

6.5 Works Cited

CH2M HILL. 2008a. *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant.* Environmental Restoration Program. Travis AFB, California. 27 February.

CH2M HILL. 2008b. Draft *Groundwater Sampling and Analysis Program, 2006-2007 Annual Report.* Environmental Restoration Program. Travis AFB, California. 21 March.

CH2M HILL. 2007. Technical Memorandum – *Recommendations for Optimization, Groundwater Treatment Systems at Travis Air Force Base*. 05 March.

Shaw Environmental, Inc. 2008. Draft *Remedial Action Report; North, East and West Industrial Operable Unit and West/Annexes/Basewide Operable Unit; Soil Remedial Action for Sites SD045, FT003, FT004, FT005, Union Creek SD001 and SD033, and LF007 Area E*. 60th Air Mobility Wing. Travis Air Force Base, California. 06 February.

Travis Air Force Base (Travis AFB). 2008. Final *Annual Report on the Status of Land Use Controls on Restoration Sites in 2007.* Environmental Restoration Program. Travis AFB, California. January.

Travis Air Force Base (Travis AFB). 2006a. Final *Community Involvement Plan Update*. Environmental Restoration Program. Travis AFB, California. 31 August.

Travis Air Force Base (Travis AFB). 2006b. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998a. *West/Annexes/Basewide Operable Unit, Travis Air Force Base, Proposed Plan for Soil Cleanup.* Final. July.

Travis Air Force Base (Travis AFB). 1998b. Draft Final *Proposed Plan for Soil, Sediment, and Surface Water, North/East/West Industrial Operable Unit*. June.

Travis Air Force Base (Travis AFB). 1998c. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

Travis Air Force Base (Travis AFB). 1990. *Federal Facilities Agreement*. September.

U.S. Environmental Protection Agency (EPA). 2004. *Five-Year Review – Questions & Answers*. December.

U.S. Environmental Protection Agency (EPA). 2003. *Five Year Review Process in the Superfund Program*. Office of Emergency and Remedial Response (OSWER) Directive 9355.7-08FS EPA 540-F-02-004. April.

U.S. Environmental Protection Agency (EPA). 2002. *Superfund Today: Focus on Five-Year Reviews and Involving the Community*. Office of Emergency and Remedial Response (OSWER) Directive 9200.2-42FS EPA 540-F-01-011. December.)

U.S. Environmental Protection Agency (EPA). 2001. *Comprehensive Five-Year Review Guidance.* Office of Emergency and Remedial Response (OSWER) Directive 9355.7-03B-P. EPA 540-R-01-007. June.

SECTION 7

Technical Assessment

This section provides discussions regarding the protectiveness of the groundwater IRAs and soil and/or sediment RAs implemented at Travis AFB. The protectiveness of the remedies is determined by answering the following three key questions:

- **Question A –** Is the remedy functioning as intended by the decision documents?
- **Question B –** Are the assumptions used at the time of remedy selection still valid?
- **Question C –** Has any other information come to light that could call into question the protectiveness of the remedy?

The following subsections provide the answers to these questions for the NEWIOU and WABOU groundwater IRAs and soil RAs.

7.1 Groundwater Interim Remedy Assessment

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

Yes, the groundwater interim remedies are largely functioning as intended by the decision documents. The technical data and observations that support this answer are provided in the following subsections.

The IRAs to address groundwater contamination at Travis AFB were selected in two decision documents:

- Final Groundwater IROD for the NEWIOU (Travis AFB, 1998)
- Final Groundwater IROD for the WABOU (Travis AFB, 1999)

The Air Force developed the groundwater IRODs for NEWIOU and WABOU, rather than a final groundwater ROD, to allow groundwater remediation to begin quickly to reduce contamination and risk. The groundwater IROD establishes an interim period to evaluate the effectiveness of the IRA and to monitor the status of each contaminant plume. The Air Force will use this data to establish final groundwater cleanup levels and select technically and economically feasible long-term actions in the final Basewide Groundwater ROD. The Air Force will publish a public notice, hold a public comment period, and address the public's comments before the regulatory agencies finalize and approve the groundwater ROD.

7.1.1.1 Groundwater IRA Objectives

The groundwater IRA objectives specified in the two IRODs include the following:

- Source Control – achieved via GET
- Migration Control – achieved via GET and/or MNA or MNA assessment
- Offbase Remediation – achieved via GET

More complete descriptions of the source control, migration control, and offbase remediation IRA objectives are provided in Section 4.1.1.

7.1.1.2 Groundwater IRA Performance

The groundwater IRAs implemented at Travis AFB are largely operating and functioning as designed. The IRA objectives of source control, migration control, and offbase remediation are being achieved through GET and/or MNA or MNA assessment, although there are some opportunities for optimization at three sites. At LF007C, SS030, and DP039 the IRAs are not functioning completely as intended by the two IRODs, but the Air Force is taking steps to optimize the remedies.

The following data are used to assess the performance of the groundwater IRAs against the IRA objectives stated in the IROD:

- Changes in chemical concentrations in individual wells
- Contaminant-specific plume maps
- Influent concentrations at the groundwater treatment plants
- Hydraulic containment evaluations

Changes in Chemical Concentrations in Individual Wells. Overall, contaminant concentrations in individual wells within the groundwater IRAs are decreasing. Contaminant concentrations measured in individual wells during the 2006-2007 GSAP are provided in Appendix A and Appendix B. Additional information regarding groundwater contamination in extraction and monitoring wells and the contaminant concentration trends for those wells is also provided in Appendix D – Groundwater Sites and Contamination.

Contaminant data for individual monitoring and extraction wells are primarily obtained through the Travis AFB GSAP. Detailed descriptions of the basewide groundwater monitoring program findings and current analytical data are provided in the final 2006-2007 Annual GSAP Report (CH2M HILL, 2008b).

Contaminant-specific Plume Maps. Overall, chemical concentrations within the groundwater IRA contaminant plumes are decreasing. Changes in groundwater contaminant plumes at ERP sites within the North, Central, West, and South IRAs between the time of the first five-year review in 2003 (CH2M HILL, 2003) and this second five-year review in 2008 are depicted on Figures 7-1 through 7-8.

Influent Concentrations at the Groundwater Treatment Plants. Groundwater influent concentrations at the NGWTP, CGWTP, and SBBGWTP are depicted on Figures 7-9, 7-10, and 7-11 (CH2M HILL, 2008a). The concentration trends for the NGWTP and CGWTP are generally decreasing. For the SBBGWTP, the influent trends are more inconsistent.

The three treatment plants receive contaminated groundwater from numerous extraction wells within each ERP site. Fluctuations in the influent concentrations are most common during the first few years of treatment plant operations, as operating adjustments are made, new extraction wells are added or shut down, and other treatment process improvements are incorporated.

- **NGWTP** -- The NGWTP receives contaminated groundwater from extraction wells located within Sites FT004, LF007C, and SD031. The concentrations of total VOCs in the

influent between 2001 through December 2007 are shown on Figure 7-9. The influent concentrations exhibit a generally decreasing trend, indicating that remediation is progressing. During 2007, the influent concentrations decreased to historically low levels and remained relatively constant. Total VOC concentrations during 2007 ranged from approximately 14 µg/L to 65 µg/L (CH2M HILL, 2008a).

- **CGWTP** -- The CGWTP receives contaminated groundwater from extraction wells located at Site LF008, Site DP039, multiple sites within the WIOU, and Site SS016. The concentrations of total VOCs in the influent between 1999 through December 2007 are shown on Figure 7-10. Total influent VOC concentrations at the CGWTP are sporadic, ranging from a high of 1,506 µg/L in February 2000 to a low of 274 µg/L in June 2007. During 2007, influent VOC concentrations ranged between 274 µg/L and 455 µg/L. In part, the fluctuations in the CGWTP influent concentrations are attributable to changes in the operation (or non-operation) of vacuum-enhanced groundwater extraction within the WIOU/DP039 and rebound studies at SS016 associated with the ThOx unit. Overall, influent concentrations at the CGWTP have declined over time.
- **SBBGWTP** -- The SBBGWTP receives contaminated groundwater from extraction wells located within Sites FT005, SS029, and SS030. The concentration of total VOCs in the influent between 2003 through December 2007 are shown on Figure 7-11. Since September 2006, the influent VOC concentrations have increased. This increase may, in part, reflect the repair and maintenance of extraction well pumps. Some of these pumps had gone offline prior to September 2006 and others were pumping at reduced flowrates. Repairing and/or replacing these pumps resulted in an overall increase in the influent flowrate to the SBBGWTP. The increased VOC concentrations may also have resulted, in part, from the migration of groundwater contamination from the upgradient SS016 plume into the SS029 GET system.

Detailed descriptions of the groundwater treatment plant O&M activities are regularly reported to the regulatory agencies in monthly data sheets and in annual O&M reports. The most current O&M treatment plant data are provided in the *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant* (CH2M HILL, 2008a).

Hydraulic Containment Evaluation. Groundwater extraction wells are generally providing effective hydraulic containment of contaminant plumes, or portions of plumes, as applicable to the sites within each IRA. Portions of the offbase SS030 and LF007C plumes may not be captured.

Evaluations of groundwater elevation measurements and numerical computer modeling indicate that hydraulic containment of contaminant plumes is largely being achieved at sites undergoing GET. The estimated extent of hydraulic capture associated with each GET system is shown on Figures 7-1 through 7-8. Following are descriptions of the evaluations:

- **Empirical Data Evaluation –** Hydraulic capture zone estimates under the GSAP are estimated from groundwater elevation data. The most recent site-specific capture zone analyses are presented in Section 4 of the *2006-2007 Annual GSAP Report* (CH2M HILL, 2008b). Capture zones are estimated as the areas where groundwater is interpreted to flow toward an extraction well. First, the groundwater elevation contours (i.e., piezometric maps) are generated with Surfer® Version 8.0 software and refined

using professional judgment. The piezometric maps are used to interpret groundwater flow direction, with flow being perpendicular to the contour lines. The result of this interpretation is an estimated extent of capture for the groundwater extraction system. Contaminant plumes are then drawn using groundwater monitoring well and extraction well sampling data. The contaminant plumes are delineated based on the IRG specified in the applicable IROD. For example, TCE contaminant plumes are delineated using the 5 µg/L concentration specified as the IRG in the NEWOU and WABOU groundwater IRODs. The estimated capture zone is then compared to the GET target area. If an estimated capture zone encompasses the target area, then the target area is interpreted as captured. All capture zone estimates are developed with professional judgment according to hydrogeology, calculated groundwater velocities, aquifer thickness, data density, and pumping rates.

- **Numerical Modeling –** Numerical computer modeling was conducted to supplement the hydraulic capture analyses conducted under the GSAP. More information on the details of the numerical computer modeling conducted for the five-year review is provided in Appendix C. Numerical models were constructed using MicroFEM, Version 3.60 (Hemker and Nijsten, 2003). MicroFEM is a three-dimensional, finite element groundwater modeling code used to solve groundwater flow problems for unconfined, semiconfined, and confined aquifer systems.

7.1.1.3 Groundwater Interim Remedial Action Performance Summaries

The following subsections provide summaries of the performance of the GET and MNA interim groundwater remedies at the sites within each groundwater IRA. Additional and more detailed information on contaminant distribution is also provided in Appendix D.

North IRA Groundwater Extraction and Treatment System – Sites FT004, SD031, and LF007. At Sites FT004 and SD031, the GET systems are reducing contaminant concentrations and achieving hydraulic capture of VOC concentrations greater than 100 µg/L. At Site LF007C, the current configuration of the GET system does not appear fully effective at preventing offbase migration of contamination.

- **Site FT004 –** The FT004 GET system is reducing TCE contaminant concentrations and achieving hydraulic capture of TCE at concentrations greater than 100 µg/L (Figure 7-1). However, TCE concentrations remain above 100 µg/L in the source area. All FT004 wells with TCE concentrations greater than the IRG of 5 µg/L are within the estimated extent of hydraulic capture.

  The effectiveness of the Site FT004 GET system is also demonstrated by the declining TCE concentrations observed in the majority of site monitoring wells. The declining contaminant concentration trends are observed both in shallow and deep monitoring wells, indicating that both the horizontal and vertical extents of the target areas are being addressed.

- **Site SD031 –** At Site SD031, concentrations of TCE and 1,1-DCE have declined below 100 µg/L and hydraulic capture of the plume has been achieved (refer to Figures 7-1 and 7-2). All SD031 wells with TCE and 1,1-DCE concentrations greater than the IRGs are within the estimated extent of hydraulic capture.

- **Site LF007C –** Hydraulic capture of the LF007C plume does not appear to be fully achieved under the current configuration of the GET system (Figure 7-1). Concentrations of TCE in monitoring wells at the Base boundary and in offbase wells are above the 5 µg/L IRG and are not declining.

  Groundwater extraction has apparently not affected the offbase portion of the plume. In the second quarter of 2007, TCE was detected at a concentration of 25 µg/L in the offbase portion of the plume. The extent of the offbase contamination is unclear. TCE concentrations along the Base boundary have risen historically, but have remained fairly stable in recent years (since 2001) and have declined slightly over the last few years. TCE concentrations detected during the 2006-2007 GSAP ranged from 51 to 52 µg/L.

  The full extent of TCE contamination and the groundwater flow directions are uncertain. The current LF007C GET system was brought online in August 2004. However, the extraction wells are located in a vernal pool area and are solar powered; therefore, they only operate during daylight in the summer. These operational constraints limit the overall effectiveness of the current GET system. Travis AFB will evaluate installing additional extraction and/or monitoring wells in the areas of apparent plume migration to define the extent of TCE migration and refine the understanding of groundwater flow direction.

North IRA – Sites FT004 and SD031 Monitored Natural Attenuation Assessment. The combination of GET in the FT004 and SD031 source areas and MNA in the downgradient areas continues to be viable. Overall, TCE concentrations are stable or declining in the FT004 and SD031 MNA wells. The MNA network includes both shallow and deep monitoring wells; MNA appears to be effective throughout the entire thickness of the plume.

TCE is the only contaminant detected at concentrations exceeding the IRG in the FT004 and SD031 MNA areas. The highest TCE concentration detected in the MNA wells was 14 µg/L.

North IRA – Sites LF007B and LF007D Monitored Natural Attenuation Assessment. MNA is an adequate remedy for Area LF007B. No contaminants were detected in LF007B wells sampled during the 2006-2007 GSAP.

At LF007D, MNA also appears to be a viable remedy. Groundwater contamination is limited to a small area in the vicinity of one well. Contamination does not appear to be migrating.

North IRA – Site LF006 Monitored Natural Attenuation. MNA is a viable remedy at Site LF006. The plume does not appear to be migrating and contaminant concentrations are declining (Figure 7-1). During the 2006-2007 GSAP, TCE and TPH-G were the only site contaminants detected at concentrations exceeding IRGs. TCE shows significantly decreasing trends at several LF006 plume wells. No monitoring wells have increasing TCE trends. TPH-G was detected at only one downgradient well, at a concentration of 10 J µg/L, slightly exceeding the IRG of 5 µg/L.

Central IRA Groundwater Extraction and Treatment System – Sites SS016 and ST032. The Site SS016 GET system is reducing source area contaminant concentrations and is largely achieving hydraulic capture of VOC source area concentrations greater than 1,000 µg/L.

The primary objective of the SS016 GET system is source control of TCE concentrations greater than 1,000 µg/L. Within the TARA, TCE concentrations have declined and are currently below 1,000 µg/L. Hydraulic capture of the TARA plume has been achieved.

Within the OSA, TCE concentrations have also declined. However, concentrations remain above 1,000 µg/L in the OSA source area. The OSA plume appears to be partially hydraulically captured. TCE concentrations are declining in monitoring wells downgradient of the source area.

Declining TCE concentrations are observed in both shallow and deep monitoring wells within SS016, indicating that both the horizontal and the vertical extents of the plume are addressed by these extraction wells. However, the effectiveness of hydraulic capture in the OSA is hampered by the extraction system design (extraction wells parallel to, rather than perpendicular to, groundwater flow) and low yields from extraction wells.

Contamination that has escaped the SS016 GET system is migrating southward to the Site SS029 GET system, where it is currently being hydraulically captured.

ST032 (east of SS016) serves as the eastern boundary of the chlorinated hydrocarbon contamination observed at SS016 (Figure 7-3). Chlorinated hydrocarbons are not present at ST032, indicating that the SS016 plume has not migrated east to ST032.

Historically at ST032, high benzene concentrations (exceeding 100 µg/L) have been detected in the Plume A area monitoring wells. However, during 2007, benzene was not detected at concentrations above the IRG. Elevated benzene concentrations (exceeding 100 µg/L) continue to be observed Plume B. No floating product was measured in ST032 wells during 2007.

West IRA Groundwater Extraction and Treatment System – WIOU Sites, Site DP039, and LF008. The WIOU, DP039, and LF008 GET systems are reducing contaminant concentrations and achieving hydraulic capture of contaminant plumes (Figures 7-4, 7-6, and 7-7).

- **WIOU Sites –** The WIOU GET system is hydraulically containing groundwater contamination and reducing contaminant concentrations (Figure 7-4). Overall, trends of decreasing contaminant concentrations, particularly TCE, are observed throughout the WIOU plume. The decreasing concentration trends are observed both in shallow and deep monitoring wells, indicating that the vertical and the horizontal extents of the plume are being addressed by the GET system. However, increasing trends are observed in two wells within the extent of hydraulic capture (MW524x37 and MW533x37). More detail is provided in Appendix D, Section D.3.3.1.

  Site SD034 monitoring wells have historically contained floating product (Stoddard solvent). Hydroskimmers have been periodically deployed at the site to address accumulated product until product recovery reaches low, asymptotic levels. Stoddard solvent was detected in measurable amounts at four Site SD034 monitoring wells during 2007 at thickness ranging from 0.08 to 1.09 feet. Passive skimming devices have been installed to address accumulated product.

- **Site DP039 –** The DP039 source control objective is largely being achieved. TCE concentrations in the historical source area are declining and the source area is being

hydraulically contained. Evaluation of phytoremediation as a potential component of the final groundwater RA is ongoing.

- TCE concentrations in the source area extraction wells and monitoring wells have declined below the source area target concentration of 1,000 µg/L. However, TCE concentrations continue to exceed 1,000 µg/L in areas downgradient of the source area. This area extends about 800 feet beyond the source control GET system and underlies an ongoing phytoremediation evaluation. However, the source area GET system does appear to prevent additional contamination from migrating downgradient of the source, and thereby decreases VOC concentrations.
- Migration control through MNA appears to be generally achieved in the downgradient portion of the DP039 plume. However, TCE concentrations may be increasing in some wells located downgradient of the phytoremediation area. The data are not conclusive and the wells will continued to be monitored to determine if the plume is migrating. The southern toe of the plume remains stable. Concentrations of TCE in this area have not been greater than the IRG.
- Although it is not part of the IROD-specified IRA, the effectiveness of the phytoremediation system at controlling migration of the plume continues to be evaluated. A phytoremediation study was completed in 2005 (Parsons, 2005). This study concluded that, as the eucalyptus trees planted at the site mature, they have the potential to remediate the TCE-contaminated groundwater. The study also found that the root systems of the trees had reached the water table, contaminants were being transported through the tree root systems, and contaminants were being released through transpiration. Travis AFB will continue to collect additional data that may be used to support the possible selection of phytoremediation as part of the final groundwater RA in the future Basewide Groundwater ROD.

- **Site LF008** – Organochlorine pesticide contamination is being adequately addressed by the LF008 GET system. The plume appears stable. Migration of the downgradient portion of the plume is being contained and the higher concentration portions of the plume are being treated. The GET system addresses the full vertical extent of contamination; extraction well screens encompass the full extent of the contaminated aquifer. Monitoring of the downgradient and cross-gradient wells is continuing to confirm the pesticide-contaminated groundwater does not migrate.

West IRA – WIOU Sites Monitored Natural Attenuation Assessment. MNA appears to be successfully controlling the migration of groundwater contamination in the southern portion of the WIOU plume. However, historical and current detections of petroleum hydrocarbons in downgradient wells require continued monitoring. If concentrations increase in these wells, implying that migration is occurring, additional downgradient monitoring wells may be necessary. TPH-G, TPH-D, and TCE were the only contaminants exceeding IRGs in WIOU MNA monitoring wells during 2007.

West IRA – Site SS015 Monitored Natural Attenuation Assessment. MNA appears to be successfully containing the groundwater contamination at SS015. The plume appears stable (refer to Figure 7-5).

South IRA Groundwater Extraction and Treatment System – Sites FT005, SS029, and SS030. The South IRA GET systems at FT005, SS029, and SS030 are reducing contaminant concentrations and largely achieving hydraulic capture of contaminant plumes (Figure 7-8). However, a portion of the offbase SS030 plume may not be fully captured.

- **Site FT005 –** Hydraulic capture of the FT005 1,2-DCA plume is being achieved. Only a relatively small area of the original 1,2-DCA plume remains from 2003. During the 2006-2007 GSAP, 1,2-DCA was not detected in onbase wells and was detected at only four offbase extraction wells and three offbase monitoring wells. The declining 1,2-DCA concentrations observed throughout much of the site illustrate the effectiveness of the FT005 GET system. The FT005 GET system was designed to address the full vertical extent of contamination; extraction well screens encompass the full extent of the contaminated aquifer.

- **Site SS029 –** Hydraulic capture of the SS029 plume is being achieved. Neither TCE nor 1,2-DCA were detected in monitoring wells located near the Base boundary. This indicates that the SS029 plume is not migrating offbase in this area.

  Upgradient SS029 monitoring wells are exhibiting a recent trend of increasing TCE concentrations. These increasing concentrations probably indicate the migration of TCE from the upgradient SS016 plume into the SS029 GET system.

- **Site SS030 –** Offbase SS030 contamination is being hydraulically captured on the south and west sides of the plume. Contaminant concentrations are declining in all of the extraction wells and all but two of the monitoring wells. Hydraulic capture of the eastern portion of the offbase SS030 TCE plume is less certain than for other areas because of a low density of monitoring wells in this area (Figure 7-8). Increasing TCE concentrations in two monitoring wells on the east side of the SS030 plume also indicate that contamination may be escaping the SS030 GET system and migrating to the southeast. The nearby FT005 GET system may be influencing the local direction of groundwater flow. Travis AFB will evaluate installing additional extraction and/or monitoring wells in the area of apparent plume migration to define the extent of TCE migration and refine the understanding of groundwater flow direction. Travis AFB will shut down several FT005 extraction wells for a year-long rebound study concurrently with this evaluation. This action will reduce the hydraulic interactions between the SS030 plume and the FT005 GET system during the study period.

7.1.1.4 Systems Operations and Maintenance

Continued O&M of the groundwater IRA GET systems will maintain the effectiveness of the IRAs. There are no indicators of potential problems or issues beyond those associated with normal O&M and optimization activities.

Detailed descriptions of the groundwater treatment plant O&M activities are regularly reported to the regulatory agencies in monthly data sheets and in annual O&M reports. The most current O&M treatment plant data are provided in the *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant* (CH2M HILL, 2008a).

7.1.1.5 Opportunities for Optimization

Travis AFB routinely evaluates opportunities for optimization of the groundwater IRAs being implemented at the various ERP sites. A summary of current optimization opportunities for the current GET systems is provided in Table 7-1 (CH2M HILL, 2007b).

Additional recommendations for optimization of basewide groundwater monitoring are regularly provided in GSAP reports (CH2M HILL, 2007a).

7.1.1.6 Early Indicators of Potential Issues

There are no early indicators of potential issues that would place the protectiveness of the groundwater IRAs at risk. Normal O&M activities have been successful at keeping GET systems operating.

7.1.1.7 Implementation of Groundwater Institutional Controls and Other Measures

Onbase Locations. Travis AFB has institutional controls in place at all onbase locations with groundwater contamination. More extensive descriptions of these measures are provided in Section 4.1.2.

Offbase Locations. Three plumes of contaminated groundwater have migrated offbase; they are associated with Sites LF007C, FT005, and SS030. These plumes lie beneath private property, and Travis AFB does not have the legal authority to impose any restrictions on the current or future use of these properties.

To gain access to these private properties to manage the groundwater IRAs for these three plumes, Travis AFB has obtained easements that allow Travis AFB representatives and its contractors to access the various IRA components located on private property (e.g., extraction wells and monitoring wells). However, these easements do not restrict the usage of the private property by the landowners.

7.1.2 Question B: Are the Assumptions Used at the Time of Groundwater Remedy Selection Still Valid?

Yes, the assumptions used at the time of groundwater interim remedy selection are still valid. There have not been significant changes in regulatory standards, exposure pathways, contaminant toxicity, or risk assessment protocols that call into question the protectiveness of the groundwater IRAs at Travis AFB.

7.1.2.1 Changes in Standards and TBC

There have been no changes in the standards identified in the WABOU IROD or the NEWIOU IROD that call into question the protectiveness of the groundwater IRAs at Travis AFB.

Action-specific ARAR. There are no major changes to the action-specific ARAR identified in the WABOU or NEWIOU IRODs.

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
North IRA	FT004	√				√[b]	Site FT004 source control objectives have been mostly achieved, except for the northern source area. Discontinue vapor-phase extraction at FT004 and SD031 extraction wells and vapor treatment at the NGWTP. Vapor extraction and treatment adds little value because of low VOC concentrations and because the system is only intermittently operational. Shut down FT004 extraction wells EW578x04, EW579x04, and EW580x04 for a period of one year for a rebound study. These wells are located in the southern portion of the site where VOC concentrations are relatively low. Abandon FT004 extraction well EW623x04 because the water table is typically below the bottom of the screen. Install a new extraction well with a deeper screen between this well and Monitoring Well MW131x04. Continue to operate FT004 extraction wells EW576x04, EW577x04, EW621x04, and EW622x04 and the new replacement well for EW623x04. Site SD031 source control objectives have been mostly achieved. Shut down the SD031 GET system for 1 year and conduct a rebound study. Assess implementing MNA as the remedy for the entirety of the SD031 plume instead of continuing GET.
	SD031	√				√[b]	
	LF006				√		None.
	LF007B					√	None.

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
	LF007C		√	√		--[c]	The migration control and offbase remediation objectives are not being fully achieved. The existing extraction wells may be inadequate to control migration or remediate the plume. Investigate the extent of TCE contamination above the IRG in the offbase area. Verify the groundwater flow direction(s). After the offbase plume is characterized, evaluate installing one or more additional extraction wells to hydraulically capture the plume and achieve the migration control and offbase remediation objectives. Install additional compliance monitoring wells on the east side of the offbase plume to monitor the performance of the enhanced GET system. Evaluate adding batteries to permit operation of extraction wells during night-time hours. Alternatively, connect extraction wells to a permanent power source. Solar power that operates only during daylight hours appears inadequate to achieve the IRA objectives.
	LF007D					√	None.
South IRA	SS030	√	√	√			Source control and migration control at the Base boundary are being achieved. The offbase remediation objective is also being achieved. However, pockets of TCE contamination remain above the IRG. Additionally, TCE contamination may be migrating toward Site FT005 under the influence of the FT005 GET system.

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
SS029							Characterize the extent of groundwater contamination to the east of the offbase portion of the SS030 plume. Install one or more additional monitoring wells in this area for long-term compliance monitoring.
							Evaluate installing one or more extraction wells on the east side of the offbase SS030 plume to prevent contaminant migration in that area.
			√				Migration control is being achieved at the Base boundary. Groundwater quality is improving in the southern part of the plume. Contaminant concentrations in the northern portion of the plume are not improving because of continuing migration of the upgradient Site SS016 plume.
							Continue operating the GET system to address contamination migrating from upgradient Site SS016. Allow extraction wells EW03x29 and EW07x29 to remain turned off because of low TCE concentrations. Routinely re-evaluate.
	FT005		√	√			The migration control has been achieved and the offbase remediation objective is being achieved. Continued operation of all 15 extraction wells is unnecessary.
							Shut down all of the extraction wells for one year, except for the three wells in which 1,2-DCA was detected above the IRG (EW734x05, EW735x05, EW736x05). Conduct a rebound test. This will keep the plume from migrating further and allow time to assess whether 1,2-DCA is still above the IRG in the main body of the plume.

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
							Groundwater pumping at FT005 appears to be causing the offbase contamination at Site SS030 to migrate toward the east. Shutting down most of the extraction wells will also reduce the hydraulic gradient that appears to be causing groundwater contamination from SS030 to migrate eastward.
Central IRA	SS016/ ST032	√					The source control objective is being partially achieved. Elevated VOC concentrations remain within the SS016 source areas, particularly in the OSA. The highest concentrations are found near extraction well EW03x16, which has been offline since 2002 because the water table has declined below the bottom of the well. Abandon extraction well EW03x16 and replace it with two new vertical extraction wells. Although one of the extraction wells within TARA (EW02x16) is also offline, the VOC concentrations in this area are relatively low and do not warrant additional action. Assess the depth to groundwater at EW610x16 to determine whether the water table has drawn down below the pump intake. If so, then EW610x16 should be abandoned and replaced with a deeper vertical extraction well. If not, then the pump should be checked to find out why no groundwater is pumping or flowrates are low. Evaluate additional source control or migration control actions. Groundwater contamination in the southern portion of Site SS016 continues to migrate south, under active aircraft runways and taxiways, into the Site SS029 GET system.

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
West IRA	SS014	√	√			√[b]	The source control and migration control objectives are being successfully achieved. Vapor extraction was discontinued in February 2003 after influent vapor concentrations at the WTTP had reached low and asymptotic levels. The system was brought back online in January 2006 to treat vapor from Site DP039. Recently, the vapor concentrations in the WIOU wells were characterized to assess whether any of these wells should be brought back online. Based on this characterization, vapor extraction from eight of these wells was brought back online. These wells include the following: EW593x36, EW594x36, EW595x36, EW510x37, EW599x37, EW700x37, EW704x37, and EW707x37. No actions should be taken to optimize GET until this startup is completed and evaluated. However, several wells should be considered for shutdown and a rebound study after the vapor startup has been completed. After the vapor system in the WIOU has been restarted and the data evaluated, evaluate shutting down the following extraction wells for a period of one year for a rebound study: EW503x33; EW01x34; EW03x34; EW511x37; EW703x37; and EW705x37. After startup of vapor extraction is completed and startup data evaluated, shut down the following extraction wells for a period of one year for a rebound study: EW503x33, EW01x34, EW03x34, EW511x37, EW703x37, and EW705x37.
	SD033		√			√	
	SD034	√	√				
			√[b]			--[d]	
	SD036	√	√			--[d]	
	SD037	√	√			√	
SS035			√				
	SD043		√				
SS041							

TABLE 7-1
Summary of Optimization Opportunities
Second Five-Year Review Report, Travis Air Force Base, California

IRA	Site	IRA Objective[a]					Optimization Opportunity
		Source Control	Migration Control	Offbase Remediation	MNA	MNA Assessment	
West IRA	SS015					√	None.
West IRA	DP039	√	--[e]		√		The source control objective is being partially achieved near the historical disposal sump. The portion of the plume downgradient of the current source control hydraulic capture may be migrating. Continue to monitor concentration trends in downgradient wells. Complete ongoing phytoremediation system evaluation. If necessary, evaluate installation of additional source control and migration control extraction wells and performance monitoring wells.
West IRA	LF008		√				None.

[a] IRA objective specified in the Groundwater NEWIOU and WABOU IRODs.

[b] IRA not specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998), but implemented by the Air Force to address entirety of commingled plume.

[c] Assessment of MNA not implemented because of interactions with the LF007C groundwater extraction system.

[d] Assessment of MNA not implemented because plume is hydraulically captured by adjacent groundwater extraction system.

[e] Deferred. Migration control not implemented pending completion of phytoremediation system evaluation and evaluation of MNA effectiveness.

The regulatory requirement applicable to property that contains hazardous waste (22 CCR, Chapter 39, Section 67391.1, effective 19 April 2003) requires all land use covenants to be signed by the DTSC and the landowner, and be recorded in the county where the land is located. The signature requirement is considered applicable to soil management units where groundwater wells will be used for monitoring or injection purposes only. Furthermore, federal property cannot be transferred to a nonfederal entity without the appropriate land use covenant, executed by the federal government and recorded in the county where the land is located. In the event that recordation of a land use covenant is not feasible, other mechanisms such as master plans, agreements, or institutional controls can be used to ensure that future land use is compatible with the levels of hazardous materials, wastes, constituents or substances which remain on the property.

The extent to which this state regulation is relevant to federal property will be incorporated into a letter placed in the administrative record files as a minor change to the WABOU and NEWIOU Groundwater IRODs.

Chemical-specific ARAR. There are no changes to chemical-specific ARAR identified in the WABOU or NEWIOU IRODs.

Location-specific ARAR. There are no changes to the location-specific ARAR identified in the WABOU or NEWIOU IRODs.

Vapor Intrusion. An emerging issue at Travis AFB is the migration of VOCs through the vadose zone and into overlying buildings, a process referred to as vapor intrusion. The Air Force is currently developing a plan to identify potential exposure pathways from VOC in the vadose zone and groundwater to buildings and indoor air. This investigation will be performed in a manner consistent with the draft *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (EPA, 2002a) and the interim final *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (DTSC, 2005).

California Assembly Bill 2092 was passed by the California State Legislature on 19 April 2006. This bill mandated that a summary of sites with known or potential vapor intrusion from a hazardous substance release be compiled and posted on the California Environmental Protection Agency (Cal/EPA) website. However, Assembly Bill 2092 was vetoed by the Governor of California on 3 October 2006.

7.1.2.2 Changes in Exposure Pathways

There have been no significant changes in land use, contaminant types, new contaminant sources, or physical site conditions at any of the NEWIOU or WABOU groundwater sites that affect exposure pathways or reduce the effectiveness of the groundwater IRAs.

VOCs in subsurface soil and/or groundwater could potentially migrate through the vadose zone (as soil gas) and into overlying buildings, a process referred to as vapor intrusion. This potential exposure pathway has become an area of increased concern by the EPA and DTSC since the two groundwater IRODs and RODs were signed. Prior to development of the Basewide Groundwater ROD, the Air Force will evaluate this potential pathway using the risk assessment protocol and ARAR agreed upon at that time. The final groundwater cleanup levels specified in the pending Basewide Groundwater ROD will take into account

soil gas contamination and potential human health risks caused by exposure to vapors in indoor air.

7.1.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in contaminant toxicity or other contaminant characteristics that call into question the protectiveness of the groundwater IRAs at Travis AFB.

The toxicity values for several groundwater contaminants, including TCE, chloroform, and vinyl chloride, have changed since the WABOU and NEWIOU IRODs. However, these changes do not affect the protectiveness of the existing groundwater IRAs because of incomplete exposure pathways and the interim nature of the remedies. Final groundwater cleanup levels will be specified in the pending Basewide Groundwater ROD. These final cleanup levels will be developed using current toxicity factors and other contaminant characteristics.

Changes in contaminant toxicity values could have an affect on the results of future human health risk assessments. However, any future risk assessments conducted during development of the Basewide Groundwater ROD will use current toxicity values from EPA and Cal/EPA. Final groundwater cleanup levels will be calculated using the latest toxicity values. Toxicity values (i.e., cancer slope factors and noncancer reference doses will be obtained from the following sources:

- The Integrated Risk Information System (IRIS) database available through the EPA National Center for Environmental Assessment (NCEA) in Cincinnati, Ohio. IRIS, prepared and maintained by EPA, is an electronic database containing health risk and EPA regulatory information on specific chemicals (EPA, 2007).
- The Health Effects Assessment Summary Tables, provided by the EPA.
- Office of Solid Waste and Emergency Response (EPA, 1997), is a compilation of toxicity values published in various health effects documents issued by EPA.
- NCEA, formerly the Environmental Criteria and Assessment Office, as cited in EPA Region 9 PRG Table (EPA, 2004a) at www.epa.gov/docs/region09/waste/sfund/prg/index.html.
- The EPA Region 9 PRG table includes reference doses and slope factors (SF) from NCEA that are not yet available on IRIS or that have been withdrawn from IRIS, pending further evaluation.
- Cal/EPA, Cancer Potency List and Chronic Reference Exposure Levels; Office of Environmental Health Hazard Assessment (OEHHA) (Cal/EPA, 2008; Cal/EPA, 2005a).

Changes in toxicity values may ultimately lead to a lowering of the maximum contaminant levels (MCL) established in the National Primary Drinking Water Standards (40 CFR, Part 141). These MCLs have not changed during the period of interim groundwater remediation. For the pending Basewide Groundwater ROD, groundwater cleanup levels will be developed with consideration of the potential changes to MCLs (e.g., resulting from changed contaminant toxicity values) and ARARs.

The greatest uncertainty with toxicological changes for contaminated groundwater at Travis AFB is associated with TCE. In August 2001, U.S. EPA's Office of Research and Development (ORD) released the draft "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" ("TCE Health Risk Assessment") for external peer review. The draft TCE Health Risk Assessment takes into account recent scientific studies of the health risks posed by TCE. According to the draft TCE Health Risk Assessment, for those who have increased susceptibility and/or higher background exposures, TCE could pose a higher risk through inhalation than previously considered. The draft TCE Health Risk Assessment is available online:

http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249.

The Science Advisory Board, a team of outside experts convened by U.S. EPA, reviewed the draft TCE Health Risk Assessment in 2002. The Science Advisory Board's review of the draft TCE Health Risk Assessment is available at: http://www.epa.gov/sab/pdf/ehc03002.pdf.

In July 2006, the National Academy of Sciences completed additional peer review of scientific issues that were the basis for the draft TCE Health Risk Assessment. In response to this review, EPA will revise the draft TCE Health Risk Assessment. Consequently, review of the toxicity value for TCE may continue for a number of years. This issue will need to be updated in subsequent Five-Year Reviews.

7.1.2.4 Changes in Risk Assessment Methods

There have been no changes in risk assessment methods that question the protectiveness of the groundwater IRAs at Travis AFB.

Some risk assessment methodologies have changed since the two groundwater IRODs. However, these changes do not affect the protectiveness of the existing groundwater IRAs because of incomplete exposure pathways and the interim nature of the remedies. Final groundwater cleanup levels will be specified in the pending Basewide Groundwater ROD. These final cleanup levels will be developed using the latest changes in risk assessment methods.

The major changes that have taken place in risk assessment methodologies include the methods for calculating upper confidence limits, the methods for assessing dermal exposure, the methods for evaluating vapor intrusion into buildings, and default exposure parameters.

The procedures that will be used to conduct any future risk assessments at Travis AFB will be consistent with the following federal and state (i.e. Cal/EPA, and DTSC) guidance documents:

- *Risk Assessment Guidance for Superfund – Volume I: Human Health Evaluation Manual, Part A* (Interim Final) (EPA, 1989).
- *Final Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA, 2004b).
- *Supplemental Guidance for Human Health Multimedia Risk Assessment of Hazardous Waste Sites and Permitted Facilities* (Cal/EPA, 1992).

- *Exposure Factors Handbook Volume I General Factors* (EPA, 1997a).
- *Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Military Facilities* (Cal/EPA, 2005b).
- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA, 2002a).
- *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance) (EPA, 2002a).
- *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (EPA, 2004c).
- *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (Cal/EPA, 2005c).

Future risk assessments will consist of the following six main components:

1. **Selection of Chemicals of Potential Concern –** Summarizes data used in the risk assessment, and identifies the chemicals that are carried through the risk quantification process.
2. **Exposure Assessment –** Identifies the pathways by which potential human exposures could occur; describes how they are evaluated; and evaluates the magnitude, frequency, and duration of these exposures.
3. **Toxicity Assessment –** Summarizes the toxicity of the selected chemicals and the relationship between magnitude of exposure and the occurrence of adverse health effects.
4. **Risk Characterization –** Integrates information from the exposure and toxicity assessments to characterize the risks to human health from potential exposure to chemicals in environmental media.
5. **Uncertainties Analysis –** Summarizes the basic assumptions used in the risk assessment, as well as limitations of data and methodology.

7.1.2.5 Expected Progress toward Meeting Groundwater Interim Remedial Action Objectives

Overall, the groundwater IRAs are progressing as expected. The groundwater IRA objectives specified in the final Groundwater IROD for the NEWIOU (Travis AFB, 1998) and final Groundwater IROD for the WABOU (Travis AFB, 1999) are being achieved. Opportunities for optimization of the IRAs at some sites are possible and being evaluated by the Air Force (see Table 7-1).

7.1.3 Question C: Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Groundwater Remedy?

No, no additional information has become available since the first five-year review, conducted in 2003, that questions the protectiveness of the groundwater IRAs.

No newly identified ecological risks have been found and there have been no impacts from natural disasters (e.g., earthquake, floods, fires).

7.1.4 Groundwater Remedy Technical Assessment Summary

A summary of the groundwater IRA objectives and a performance assessment summary for each groundwater IRA is provided in Table 7-2.

Answers to the three key questions regarding the protectiveness of the groundwater interim remedies are summarized as follows:

- **Question A –** Is the remedy functioning as intended by the decision documents?

  Yes, except for Sites LF007C, SS030, and DP039; the groundwater IRAs are functioning as intended by the final Groundwater IROD for the NEWIOU (Travis AFB, 1998) and the final Groundwater IROD for the WABOU (Travis AFB, 1999).

  No, for Sites LF007C, SS030, and DP039 the IRAs are not functioning completely as intended by the IRODs, but the Air Force is taking steps to optimize the remedies.

- **Question B –** Are the assumptions used at the time of remedy selection still valid?

  Yes, the assumptions used at the time of groundwater IRA selection are still valid. There have not been significant changes in regulatory standards, exposure pathways, contaminant toxicity, or risk assessment protocols that call into question their protectiveness.

- **Question C –** Has any other information come to light that could call into question the protectiveness of the remedy?

  No, no additional information has become available since the first five-year review that questions the protectiveness of the groundwater IRAs.

7.2 Soil Remedy Assessment

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

Yes, the soil remedies implemented at Travis AFB are functioning as intended by the decision documents.

The RAs to address soil and sediment contamination at Travis AFB were selected in two decision documents:

- Final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006)
- Final Soil ROD for the WABOU (Travis AFB, 2002)

7.2.1.1 Soil Remedial Action Objectives

The objectives of the soil and sediment RAs are to remove contaminated soil down to industrial cleanup levels that are protective of onbase workers and/or to restrict residential development and the unauthorized disturbance or relocation of soil.

TABLE 7-2
Summary of Groundwater Interim Remedial Action Performance
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					Performance Assessment Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Question A – Functioning as Intended by IROD?**	**Question B – Remedy Assumptions Still Valid?**	**Question C – New Information Regarding Protectiveness?**	**Performance Assessment Summary**
North IRA	FT004	√				√[b]	Yes	Yes	No	The combination of GET in the source area and MNA in the downgradient areas appear to be effective. Hydraulic capture of the source areas has been achieved. The effectiveness of GET is further demonstrated by declining VOC concentrations observed in the majority of site monitoring wells. Declining trends are observed both in shallow and deep monitoring wells, indicating both the horizontal and vertical extent of the target areas are being addressed. MNA also appears to be a viable remedy. Overall, contaminant concentrations are stable or declining in the FT004 and SD031 MNA wells. The MNA network includes both shallow and deep monitoring wells; MNA appears to be effective throughout the entire thickness of the plume.
	SD031	√				√[b]	Yes	Yes	No	
	LF006				√		Yes		No	MNA appears to be an effective remedy. Data from monitoring wells indicate that groundwater contamination at LF006 is not migrating.
	LF007B					√	Yes		No	MNA appears to be a viable remedy. No groundwater contaminants were in LF007B wells sampled during the 2006-2007 GSAP effort.
	LF007C		√	√		--[c]	No	Yes	No	The migration control and offbase remediation objectives do not appear to be fully achieved. The LF007C GET system does not appear to be fully effective at hydraulically capturing and remediating the TCE plume. TCE continues to be present at offbase locations at concentrations above the IRG. The extent of this offbase contamination is uncertain.
	LF007D					√	Yes		No	MNA appears to be a viable remedy. Groundwater contamination at LF007D is restricted to a small area near MW261x04 – the only well at which groundwater contaminants were detected at concentrations exceeding IRG. Contaminants do not appear to be migrating offbase to the north or east of LF007D.
South IRA	SS030	√	√	√			No	Yes	No	The source control, migration control, and offbase remediation objectives of the SS030 IRA have largely been achieved. Contaminant concentrations are declining in all of the extraction wells and all but two of the monitoring wells. The offbase plume is being captured on the south and west sides of the plume. However, increasing TCE concentrations on the east side of the offbase plume indicate contamination may be escaping hydraulic capture. There are insufficient monitoring wells in this area to fully assess the extent of contaminant migration and the local groundwater flow direction. No contaminants have been detected in the privately-owned domestic well (DWSET1x30) located downgradient of the SS030 plume.
			√				Yes	Yes	No	The migration control objective has been achieved. The SS029 GET system has achieved hydraulic capture of the plume and is preventing offbase migration of the contaminant plume.
	Southern SS016		√[d]			--[e]	Yes	Yes	No	Commingled OSA/TARA/ST032 plume is hydraulically captured by SS029 migration control GET system.
SS029	FT005		√	√			Yes	Yes	No	The migration control and offbase remediation objectives at FT005 are being achieved. The FT005 GET system appears to have achieved hydraulic capture of the plume and is preventing continued offbase migration.
Central IRA	Northern SS016	√					Yes	Yes		Hydraulic capture of the SS016 TARA source area has been achieved. Within the SS016 OSA source area, concentrations have decreased, but the extent of hydraulic capture is less certain. However, declining VOC concentrations in shallow and deep monitoring wells downgradient of the OSA and TARA source areas indicates that the horizontal and the vertical extent of the SS016 plume is being addressed by these extraction wells. The portion of the commingled SS016 plume (OSA/TARA/ST032) that is not hydraulically captured by the source control GET actions is eventually hydraulically captured by the downgradient SS029 migration control GET system.

TABLE 7-2
Summary of Groundwater Interim Remedial Action Performance
Second Five-Year Review Report, Travis Air Force Base, California

		IRA Objective[a]					Performance Assessment Criteria			
IRA	**Site**	**Source Control**	**Migration Control**	**Offbase Remediation**	**MNA**	**MNA Assessment**	**Question A – Functioning as Intended by IROD?**	**Question B – Remedy Assumptions Still Valid?**	**Question C – New Information Regarding Protectiveness?**	**Performance Assessment Summary**
	ST032	√	√[d]			--[e]	Yes	Yes	No	Source control for removal of floating jet fuel has been achieved. Floating jet fuel has been only intermittently observed in MW246x16 from 1999 through 2001. No floating product was detected during in 2007. Dissolved-phase fuel contamination is hydraulically captured by SS029 migration control GET system.
West IRA	SS014[f]	√	√			√[b]	Yes	Yes	No	GET systems installed within the WIOU sites are achieving the source control and migration control objectives. Estimates of the extent of hydraulic capture indicate that VOC concentrations above 100 µg/L are being captured by the WIOU GET system. Decreasing trends of VOC concentrations are observed throughout the WIOU plume. The decreasing trend is observed in both shallow and deep monitoring wells, indicating that the horizontal and the vertical extent of the plume is being addressed by the GET system. The combination of GET in the WIOU source areas and MNA assessment in the downgradient area appears to be a viable remedy. Groundwater contamination in the southern WIOU does not appear to be migrating. However, historical and current detections of petroleum hydrocarbons in downgradient wells require continued monitoring. If concentrations increase in these wells, implying that migration is occurring, additional downgradient monitoring wells may be necessary.
	SD033[g]		√			√	Yes	Yes	No	
	SD034[h]	√	√				Yes	Yes	No	
	SS035[i]		√[b]			--[e]	Yes	Yes	No	
	SD036[j]	√	√			--[e]	Yes	Yes	No	
	SD037[k]	√	√			√	Yes	Yes	No	
	SS041[l]		√				Yes	Yes	No	
	SD043[m]		√				Yes	Yes	No	
SS015						√	Yes		No	MNA appears to be a viable remedy. Data from monitoring wells indicate that groundwater contamination at SS015 is not migrating.
	DP039	√	--[f]		√		No	Yes	No	The DP039 source control objective is being partially achieved. TCE concentrations in the historical source area are declining and the source area in the vicinity of the former sump is being hydraulically contained. TCE concentrations continue to exceed 1,000 µg/L in areas downgradient of the source area. This area extends about 800 feet beyond the source control GET system and underlies an ongoing demonstration of phytoremediation. The effectiveness of the phytoremediation system at controlling migration of the plume continues to be evaluated. However, the source area GET system does appear to prevent additional contamination from migrating downgradient of the source and thereby decreases VOC concentrations. Migration control through MNA appears to be generally achieved in the downgradient portion of the DP039 plume. However, TCE concentrations may be increasing in some wells downgradient of the phytoremediation area. The data are not conclusive and the wells will continue to be monitored under the GSAP to determine in the plume is migrating. The southern toe of the plume remains stable. Concentrations of TCE in this area have not been greater than the IRG.
	LF008		√				Yes	Yes	No	The migration control objective at LF008 is being achieved by the GET system. Hydraulic capture of the source area has been achieved. The distribution of contamination in monitoring wells also indicates containment of the plume.

[a] IRA objective specified in the Groundwater NEWIOU and WABOU IRODs.
[b] IRA not specified in the Groundwater IROD for the NEWIOU (Travis AFB, 1998), but implemented by the Air Force to address entirety of commingled plume.
[c] Assessment of MNA not implemented because of interactions with the LF007C GET system.
[d] SS016/ST032 plume hydraulically captured by SS029 groundwater extraction system.
[e] Assessment of MNA not implemented because plume is hydraulically captured by adjacent GET system.
[f] Migration control not implemented pending evaluation of MNA and phytoremediation.

Under both RODs, if excavation reduces contaminant concentrations to those that allow for unlimited use and unrestricted exposure (i.e., to residential cleanup levels), then LUCs will not be required. However, if excavation only reduces contaminant concentrations to industrial cleanup levels, LUCs will be implemented to restrict site access and usage. At several sites, LUCs are the only remedy specified in the applicable ROD.

7.2.1.2 Soil Remedial Action Performance

The soil RA completed through 2007 has achieved the RA objectives stated in the two RODs. An additional soil RA is pending at Site FT005. A sediment RA is pending at Sites SD001 and SD033.

NEWIOU Sites Soil and Sediment Remedial Action Performance. Soil RAs at ERP sites within the NEWIOU were conducted in accordance with the final Soil, Sediment, and Surface Water ROD for the NEWIOU (Travis AFB, 2006). A summary of the NEWIOU sites soil and sediment RA performance is provided in Table 7-3 and the following list of key performance information (Shaw Environmental, Inc., 2008):

- The soil RAs conducted at Sites FT003, FT004, LF007E, and SD045 achieved residential cleanup levels. Therefore, no LUCs are required at these sites.
- LUCs are being successfully implemented at NEWIOU Sites SS015, SS016, ST032, and SD037 to restrict residential development and unauthorized disturbance and relocation of soil. These LUCs were the only soil RAs implemented at these sites. The results of site inspections conducted by Travis AFB indicate that the LUCs are functioning as designed and are effective at restricting land use to industrial purposes only. There was no evidence of unauthorized land uses or unauthorized soil disturbances in controlled areas (Travis AFB, 2008).
- The sediment RAs at Sites SD001 and SD033 are pending. Site SD033 has separate remedies for soil (LUCs) and sediment (excavation and LUCs). The LUC remedy is being implemented, but the excavation of contaminated sediment is pending. Travis AFB will carry out these actions as soon as they can be programmed and scheduled into the next available construction season.
- Additional excavation of contaminated soil at Site FT005 is also pending. Travis AFB will carry out this additional action as soon as it can be programmed and scheduled into the next available construction season.

TABLE 7-3
Summary of NEWIOU Sites Soil and Sediment Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
SD001	Remove sediment contaminants to industrial cleanup levels.	Excavation and LUCs	Final LUC status pending completion of excavation.	RA pending.

TABLE 7-3
Summary of NEWIOU Sites Soil and Sediment Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
FT003	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	No LUC required.	RA complete in 2007. Residential cleanup levels achieved.
FT004	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	No LUC required.	RA completed in 2007. Residential cleanup levels achieved.
FT005	Remove soil contaminants to industrial cleanup levels.	Excavation and Onbase Consolidation	Final LUC status pending completion of excavation.	Additional excavation of petroleum-contaminated soil pending.
LF007	Remove soil contaminants to industrial cleanup levels.	Excavation and LUCs	Land use restricted to industrial activities only.	RA completed in 2007. Base CAMU for consolidation of RA soil. LUC inspection on 11 December 2007. No issues found
SS015	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SS016	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
ST032	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SD033 (soil)	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SD033 (sediment)	Remove contaminated sediment to industrial cleanup levels.	Excavation and LUCs	Final LUC status pending completion of excavation.	RA pending.

TABLE 7-3
Summary of NEWIOU Sites Soil and Sediment Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
SD037	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	LUCs	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.

[a] Soil RA objective specified in the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006).

WABOU Sites Soil Remedial Action Performance. Except for Site SD045, soil RAs at ERP sites within the WABOU were completed during 2002 and 2003 in accordance with the final Soil ROD for the WABOU (Travis AFB, 2002). The soil RA at Site SD045 was completed in 2007 (Shaw Environmental, Inc., 2008). A summary of the WABOU sites soil RA performance is provided in Table 7-4 and the following list of key performance information:

- The soil RAs conducted at Sites LF008, RW013, SS041, SS042, and SD045 achieved residential cleanup levels. Therefore, no LUCs are required at these sites.
- LUCs are being successfully implemented at Sites DP039, SD043, LF044, and SS046 to restrict residential development and unauthorized disturbance and relocation of soil. These LUCs were the only soil RAs implemented at these sites.

TABLE 7-4
Summary of WABOU Sites Soil Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
LF008	Remove soil contam-inants to industrial cleanup levels.	Excavation/Offbase Disposal	No LUC required.	RA complete. Residential cleanup levels achieved by excavation.
RW013	Remove soil contam-inants to industrial cleanup levels.	Excavation/Offbase Disposal	No LUC required.	RA complete. Residential cleanup levels achieved by excavation.
DP039	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions[b]	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
SS041	Remove soil contam-inants to industrial cleanup levels.	Excavation/Onbase Consolidation	No LUC required.	RA complete. Residential cleanup levels achieved.

TABLE 7-4
Summary of WABOU Sites Soil Remedial Actions
Second Five-Year Review Report, Travis Air Force Base, California

ERP Site	Objective[a]	Implemented RA	Land Use Controls Status	Performance Summary Comment
SD042	Remove soil contaminants to industrial cleanup levels.	Excavation/Onbase Consolidation	No LUC required.	RA complete. Residential cleanup levels achieved.
SD043	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions[c]	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found.
LF044	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions[d]	Land use restricted to industrial activities only.	RA complete. Site used for heavy equipment training starting in November 2006 in accordance with Soil ROD for the WABOU. LUC inspection on 11 December 2007. No issues found
SD045	Remove soil contaminants to industrial cleanup levels.	Excavation/Onbase Consolidation	No LUC will be required following approval of soil RA report.	RA completed in 2007. Residential cleanup levels achieved. LUC inspection on 11 December 2007. No issues found
SS046	Restrict site access to prohibit residential use. Prevent surface-disturbing activities that could create a risk of human exposure.	Land Use and Access Restrictions[e]	Land use restricted to industrial activities only.	LUC inspection on 11 December 2007. No issues found

[a]Soil RA objective specified in the *Soil ROD for the WABOU* (Travis AFB, 2002a).

[b]Site DP039 LUC described in Base General Plan, Appendix E, Attachment 1 (Travis AFB, 2002b).

[c]Site SD043 LUC described in Base General Plan, Appendix E, Attachment 2 (Travis AFB, 2002b).

[d]Site LF044 LUC described in Base General Plan, Appendix E, Attachment 3 (Travis AFB, 2002b).

[e]Site SS046 LUC described in Base General Plan, Appendix E, Attachment 4 (Travis AFB, 2002b).

7.2.1.3 Systems Operations/O&M

The only ongoing system operations issue related to the soil RAs completed at the NEWIOU and WABOU sites is continued implementation of LUC at the sites where they are in place.

7.2.1.4 Opportunities for Optimization

There are no known opportunities for optimization of the soil RAs implemented at Travis AFB.

7.2.1.5 Early Indicators of Potential Issues

There are no early indicators of potential issues related to the soil RAs at Travis AFB.

7.2.1.6 Implementation of Institutional Controls and Other Measures

In accordance with the two soil RODs, Travis AFB implements land use and access restrictions at soil RA sites not remediated to residential cleanup standards. The purpose of these LUCs is to restrict residential development and unauthorized disturbance and relocation of soil. Travis AFB conducts formal annual inspections of the LUC measures to monitor their performance. The most recent inspection was conducted in December 2007. No issues were identified at any of the sites (Travis AFB, 2008).

More complete descriptions of LUCs are provided in the final Soil Record of Decision for the WABOU (Travis AFB, 2002), the final NEWIOU Soil, Sediment, and Surface Water ROD (Travis AFB, 2006), and Section 4.5.4 of this report. Also, since the signing of the two RODs, the Travis AFB General Plan has been revised to document the presence of soil contaminants and to enforce the land use restriction, particularly regarding unauthorized disturbance and use of soil at the sites.

7.2.2 Question B: Are the Assumptions Used at the Time of Soil Remedy Selection Still Valid?

Yes, the assumptions used at the time of soil and/or sediment remedy selection are still valid. There have not been significant changes in regulatory standards, exposure pathways, contaminant toxicity, or risk assessment protocols that call into question the protectiveness of the remedies.

7.2.2.1 Changes in Standards and TBC

There have been no changes in the standards identified in the WABOU ROD (Travis AFB, 2002) or the NEWIOU ROD (Travis AFB, 2006) that call into question the protectiveness of the soil and/or sediment at Travis AFB.

Action-specific ARAR. There are no changes to the action-specific ARAR identified in the ROD.

The regulatory requirement applicable to property that contains hazardous waste (22 CCR, Chapter 39, Section 67391.1, effective 19 April 2003) requires all land use covenants to be signed by the DTSC and the landowner, and be recorded in the county where the land is located. The signature requirement is considered applicable to soil management units where groundwater wells will be used for monitoring or injection purposes only. Furthermore, federal property cannot be transferred to a nonfederal entity without the appropriate land use covenant, executed by the federal government and recorded in the county where the land is located. In the event that recordation of a land use covenant is not feasible, other mechanisms such as master plans, agreements, or institutional controls can be used to ensure that future land use is compatible with the levels of hazardous materials, wastes, constituents or substances which remain on the property.

The extent to which this state regulation is relevant to federal property will be incorporated into a letter placed in the administrative record files as a minor change to the WABOU and NEWIOU Groundwater IRODs.

Chemical-specific ARAR. The only changed chemical-specific federal requirement applicable to soil remediation is the Toxic Substances Control Act (TSCA) (40 CFR Part 761). However, there are no Travis AFB soil sites that contain PCB concentrations greater than 2 milligrams per kilograms (mg/kg). This regulation was updated on 16 January 2007, to provide a de minimus quantity of PCBs for export. This change does not put into question the protectiveness of the remedy.

Chemical-specific requirements were developed for Travis AFB using the 1 October 1999 PRG developed by EPA and the human health screening process. The soil cleanup goals took into consideration the accumulative affects of multiple chemicals of concern and industrial future use for the site. The EPA updated the PRG table in 2004 (EPA, 2004a).

Location-specific ARARs. There are no changes to the location-specific ARAR identified in the RODs.

7.2.2.2 Changes in Exposure Pathways

There have been no significant changes in land use, contaminant types, new contaminant sources, or physical site conditions at any of the NEWIOU or WABOU soil and/or sediment sites that affect exposure pathways or reduce the effectiveness of the remedies.

7.2.2.3 Changes in Toxicity and Other Contaminant Characteristics

There have been no significant changes in contaminant toxicity or other contaminant characteristics that question the protectiveness of the soil RAs at Travis AFB.

7.2.2.4 Changes in Risk Assessment Methods

There have been no significant changes in risk assessment methods that question the protectiveness of the soil and/or sediment RAs at Travis AFB.

7.2.2.5 Expected Progress Toward Meeting Soil and/or Sediment Remedial Action Objectives

The soil and/or sediment RAs are progressing as expected and RA objectives specified in the final ROD are being achieved. Soil RAs are complete at all sites, except for planned excavation of petroleum-contaminated soil at Site FT005. Sediment RAs at Sites SD001 and SD033 are pending.

7.2.3 Question C: Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Soil Remedy?

No, no additional information has been obtained since completion of the soil remedies in 2007 that questions the protectiveness of those remedies.

No newly identified ecological risks have been found, and there have been no impacts from natural disasters (e.g., earthquake, floods, fires).

7.2.4 Soil Remedy Technical Assessment Summary

A summary of the soil and/or sediment RA objectives and a performance evaluation for NEWIOU soil and/or sediment sites is provided in Table 7-3. A similar summary is provided in Table 7-4 for the WABOU soil sites.

Answers to the three key questions regarding the protectiveness of the soil and/or sediment remedies are summarized as follows:

- **Question A –** Is the remedy functioning as intended by the decision documents?

  Yes, the soil IRAs are functioning as intended by the final *NEWIOU Soil, Sediment, and Surface Water ROD* (Travis AFB, 2006) and final *Soil ROD for the WABOU)* (Travis AFB, 2002)

- **Question B –** Are the assumptions used at the time of soil and/or sediment remedy selection still valid?

  Yes, the assumptions used at the time of soil and/or sediment remedy selection are still valid. There were no significant changes in regulatory standards, exposure pathways, contaminant toxicity, or risk assessment protocols that questions the protectiveness of the remedies.

- **Question C –** Has any other information come to light that could question the protectiveness of the remedy?

  No, no additional information has been obtained since completion of the soil remedies in 2007 that questions the protectiveness of those remedies.

7.3 Works Cited

California Environmental Protection Agency (Cal/EPA). 2008. California Potency Factors: California Cancer Potency Values Table. Office of Environmental Health Hazard Assessment. http://www.oehha.ca.gov/risk/chemicalDB/index.asp. 25 January.

California Environmental Protection Agency (Cal/EPA). 2005a. Office of Environmental Health Hazard Assessment (OEHHA). Chronic Reference Exposure levels. http://www.oehha.ca.gov/air/chronic_rels/allchrels.html. February.

California Environmental Protection Agency (Cal/EPA). 2005b. *Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Military Facilities*. Department of Toxic Substances Control. 27 October.

California Environmental Protection Agency (Cal/EPA). 2005. Interim Final *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*.

California Environmental Protection Agency (Cal/EPA). 1992. *Supplemental Guidance for Human Health Multimedia Risk Assessment of Hazardous Waste Sites and Permitted Facilities.* July.

California Department of Toxic Substances Control (DTSC). 2005c. Interim Final *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air.* February.

CH2M HILL. 2008a. *2007 Annual Report – Central Groundwater Treatment Plant, North Groundwater Treatment Plant, and South Base Boundary Groundwater Treatment Plant.* Environmental Restoration Program. Travis AFB, California. 27 February.

CH2M HILL. 2008b. *Final Groundwater Sampling and Analysis Program, 2006-2007 Annual Report.* Environmental Restoration Program. Travis AFB, California. 21 March.

CH2M HILL. 2007. Technical Memorandum – *Recommendations for Optimization, Groundwater Treatment Systems at Travis Air Force Base*. 05 March.

CH2M HILL. 2003. Final *Groundwater Five-Year Review*. Environmental Restoration Program. Travis AFB, California. 14 July.

Hemker, C.J. and Nijesten, G.J. 2003. *Groundwater Flow Modeling Using MicroFEM. Version 3 User's Manual.*

Parsons. 2005. Final *Interim Technical Report for the Demonstration of Phytostabilization of Contaminated Groundwater Using Tree Plantings at Travis Air Force Base, California; Addendum Report No. 3.* Air Force Center for Environmental Excellence, Environmental Science Division; Brooks City-Base, Texas. 30 September.

Shaw Environmental, Inc. 2008. Draft *Remedial Action Report; North, East and West Industrial Operable Unit and West/Annexes/Basewide Operable Unit; Soil Remedial Action for Sites SD045, FT003, FT004, FT005, Union Creek SD001 and SD033, and LF007 Area E*. 60th Air Mobility Wing. Travis AFB, California. 06 February.

Travis Air Force Base (Travis AFB). 2008. Final *Annual Report on the Status of Land Use Controls on Restoration Sites in 2007*. Environmental Restoration Program. Travis AFB, California. January.

Travis Air Force Base (Travis AFB). 2006. Final *North, East, and West Industrial Operable Unit (NEWIOU) Soil, Sediment, and Surface Water Record of Decision*. Environmental Restoration Program. Travis AFB, California. 10 May.

Travis Air Force Base (Travis AFB). 2002. Final *Soil Record of Decision for the West/Annexes/ Basewide Operable Unit (WABOU).* Installation Restoration Program. Travis AFB, California. December.

Travis Air Force Base (Travis AFB). 1999. Final *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit (WABOU)*. Installation Restoration Program. Travis AFB, California. 24 June.

Travis Air Force Base (Travis AFB). 1998. Final *Groundwater Interim Record of Decision for the North, East, and West Industrial Operable Unit (NEWIOU)*. Installation Restoration Program. Travis AFB, California. 26 January.

Travis Air Force Base (Travis AFB). 1990. *Federal Facilities Agreement*. September.

U.S. Environmental Protection Agency (EPA). 2007. Integrated Risk Information System (IRIS). http://www.epa.gov.iris/.

U.S. Environmental Protection Agency (EPA). 2004a. *Region 9 Preliminary Remediation Goals (PRG) Tables*. http://www.epa.gov/Region9/waste/sfund/prg/.

U.S. Environmental Protection Agency (EPA). 2004b. Final *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment*). EPA/540/R/99/005. Office of Solid Waste and Emergency Response, Washington, DC. PB99-963312. July.

U.S. Environmental Protection Agency (EPA). 2004c. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings.* Office of Emergency and Remedial Response. 22 February.

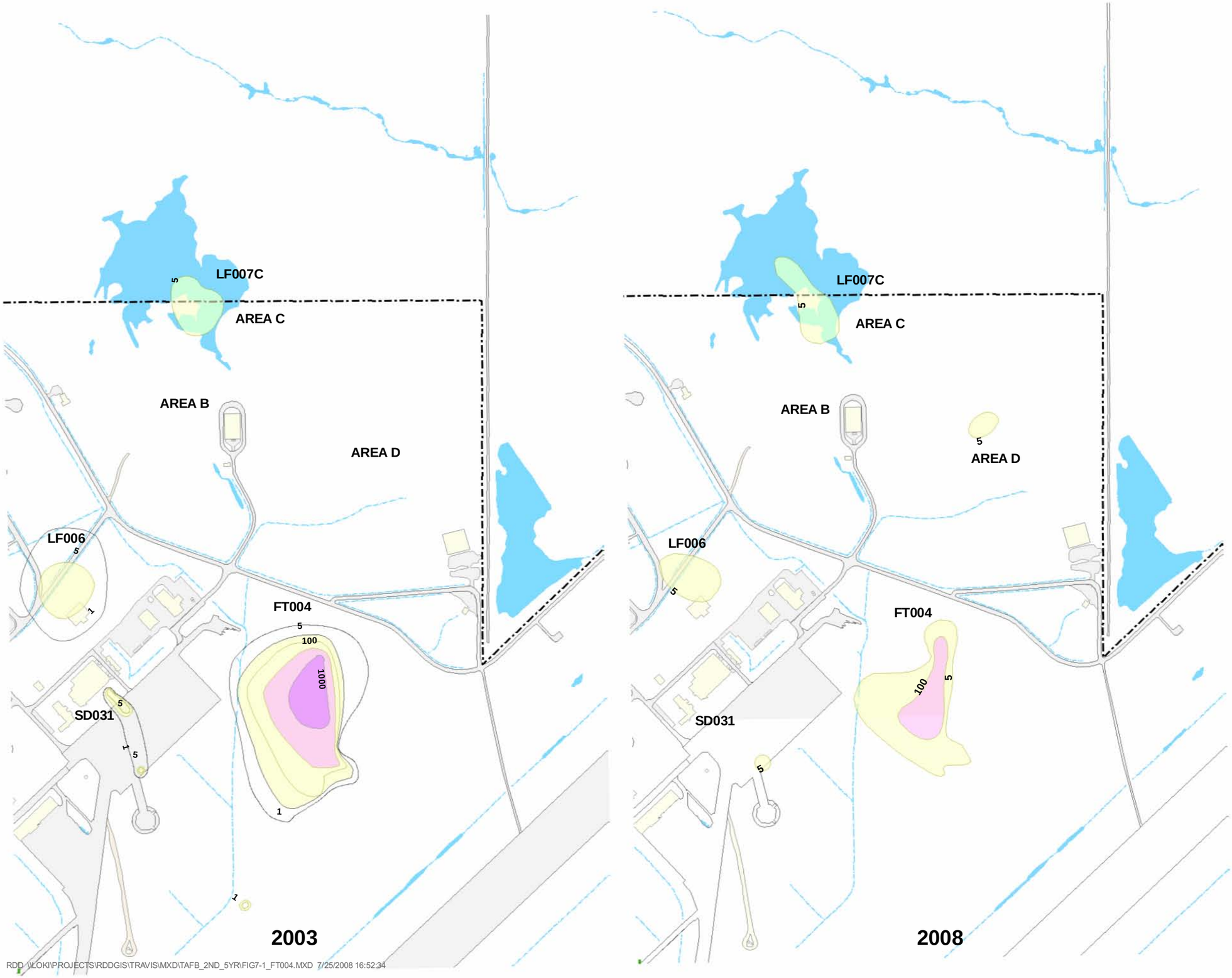
U.S. Environmental Protection Agency (EPA). 2002a. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance). 29 November.

U.S. Environmental Protection Agency (EPA). 2002b. *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites.* Office of Emergency and Remedial Response. OSWER 9285.6-10. December.

U.S. Environmental Protection Agency (EPA). 2001. *Comprehensive Five-Year Review Guidance.* Office of Solid Waste and Emergency Response Directive 9355.7-03B-P. EPA 540R-01-007. June.

U.S. Environmental Protection Agency (EPA). 1997. *Health Effects Assessment Summary Tables*: Annual Update, FY 1997. National Center For Environmental Assessment, Office of Research and Development and Office of Emergency and Remedial Response, Washington, DC.

U.S. Environmental Protection Agency (EPA). 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A*. EPA/540/1-89/002. December.



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KEY MAP

LEGEND

GROUNDWATER MONITORING WELL

EXTRACTION WELL

TCE CONCENTRATIONS (µg/L)

5 ≤ TCE <100

100 ≤ TCE <1,000

TCE ≥ 1,000

APPROXIMATE EXTENT OF HYDRAULIC CAPTURE (DASHED WHERE LESS CERTAIN)

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

BASE BOUNDARY

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

SURFACE WATER

NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
SOURCE CONTROL, MIGRATION CONTROL, OFFBASE REMEDIATION, MNA

0 275 550
FEET

FIGURE 7-1
NORTH IRA - SITES FT004, SD031, LF006 AND LF007C TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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KEY MAP

LEGEND

GROUNDWATER MONITORING WELL

EXTRACTION WELL

DCE CONCENTRATIONS (µg/L)

1,1-DCE ≥6

100 ≤ DCE <1,000

APPROXIMATE EXTENT OF HYDRAULIC CAPTURE (DASHED WHERE LESS CERTAIN)

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

SURFACE WATER

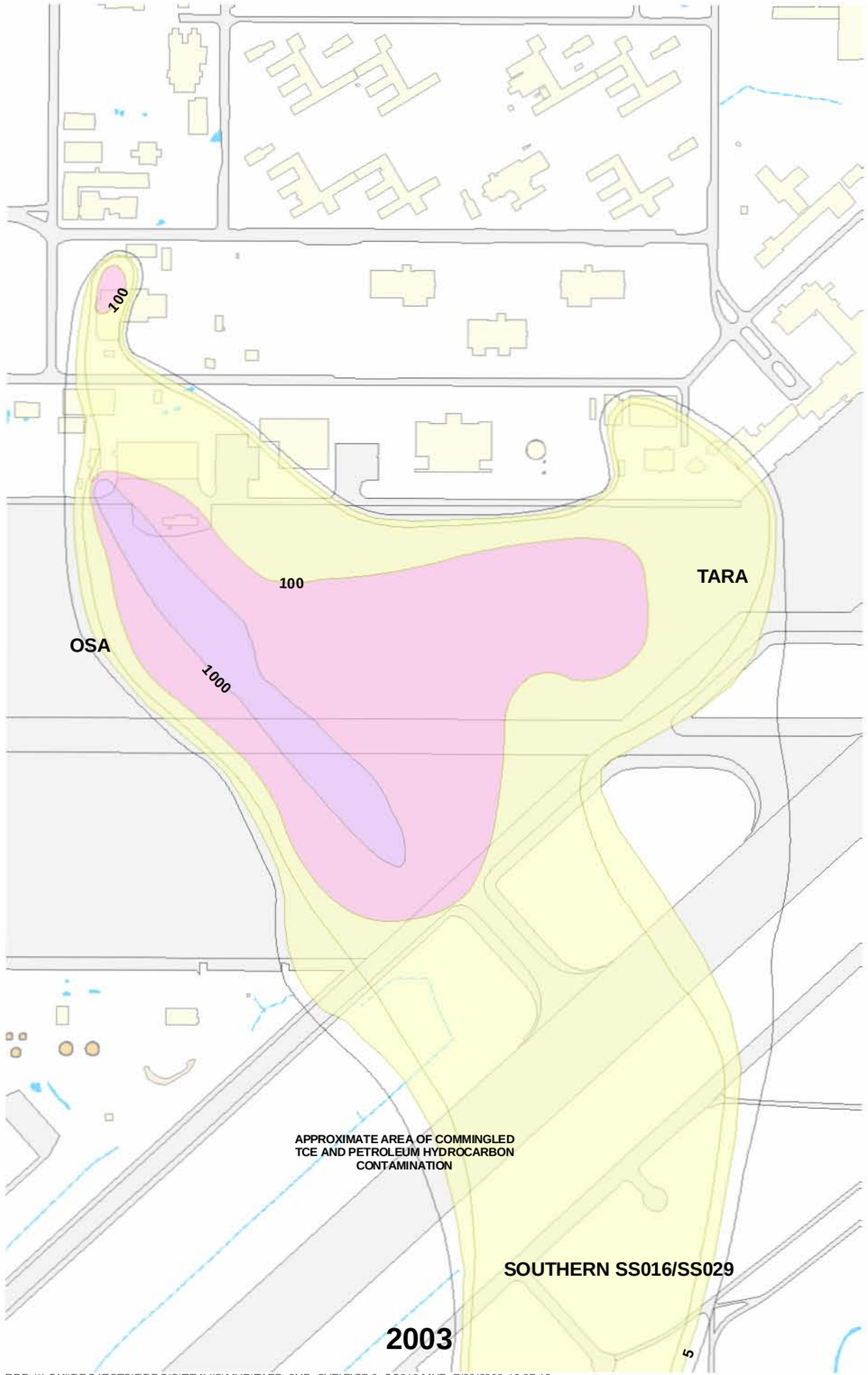
NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

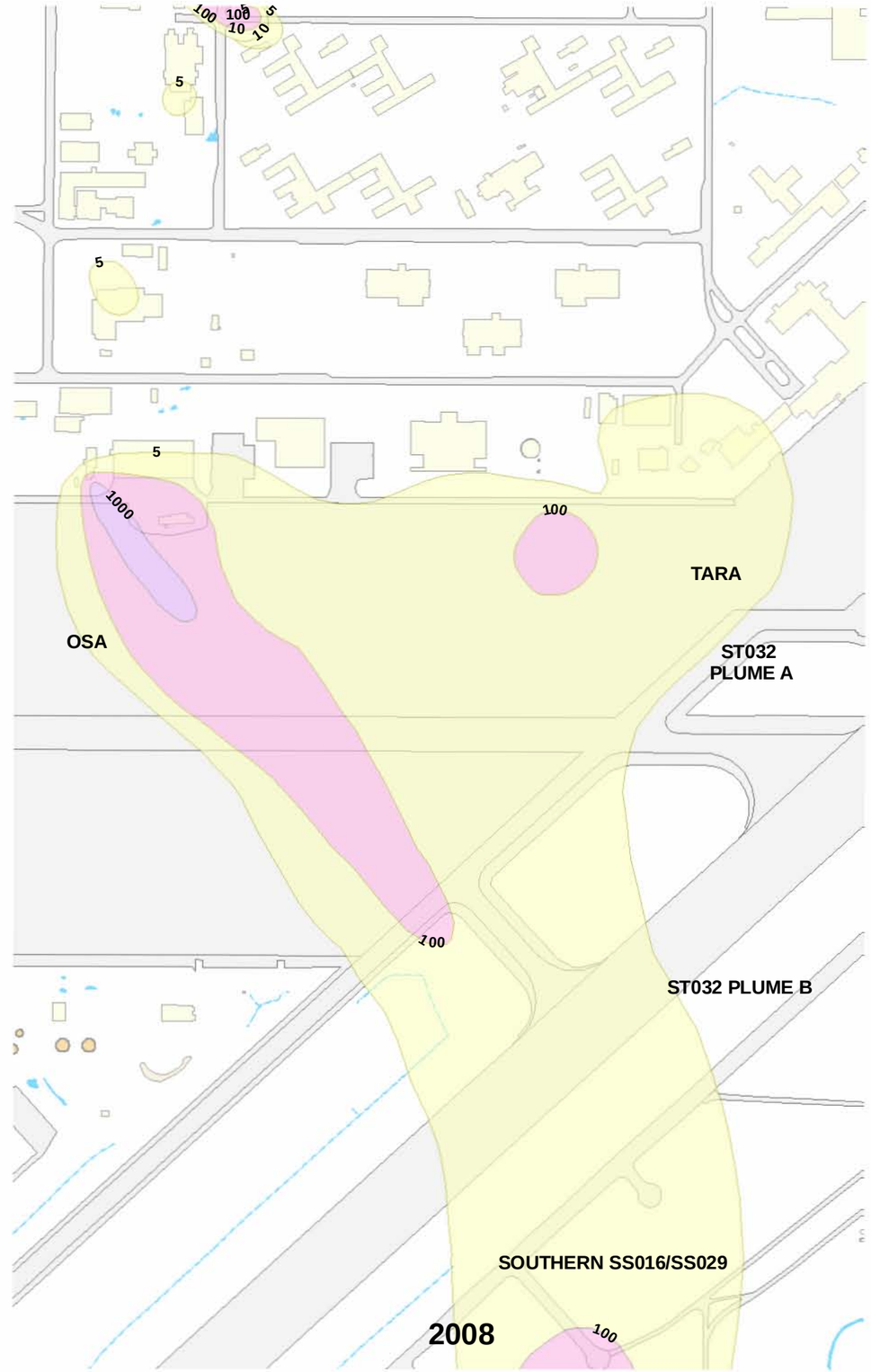
GROUNDWATER IRA:
SOURCE CONTROL, MIGRATION CONTROL, MNA

0 125 250
FEET

CH2MHILL

FIGURE 7-2
NORTH IRA - SITE SD031
1,1-DCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA





KEY MAP

LEGEND

- PIEZOMETER
- GROUNDWATER MONITORING WELL
- VERTICAL EXTRACTION WELL
- HORIZONTAL EXTRACTION WELL

TCE CONCENTRATIONS (µg/L)

- 5 ≤ TCE <100
- 100 ≤ TCE <1,000
- TCE ≥ 1,000
- APPROXIMATE EXTENT OF HYDRAULIC CAPTURE
- 5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)
- ABOVEGROUND STORAGE TANKS
- BUILDINGS
- UNPAVED AREA
- PAVED AREA
- ROAD
- SURFACE WATER

NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.
3. THE OSA AND TARA HORIZONTAL EXTRACTION WELLS ARE SCREENED APPROXIMATELY 30 FEET BELOW GROUND SURFACE NEAR THE BEDROCK INTERFACE.

GROUNDWATER IRA:
SOURCE CONTROL, MIGRATION CONTROL

0 275 550
FEET

FIGURE 7-3
CENTRAL IRA - SITES SS016 AND ST032
TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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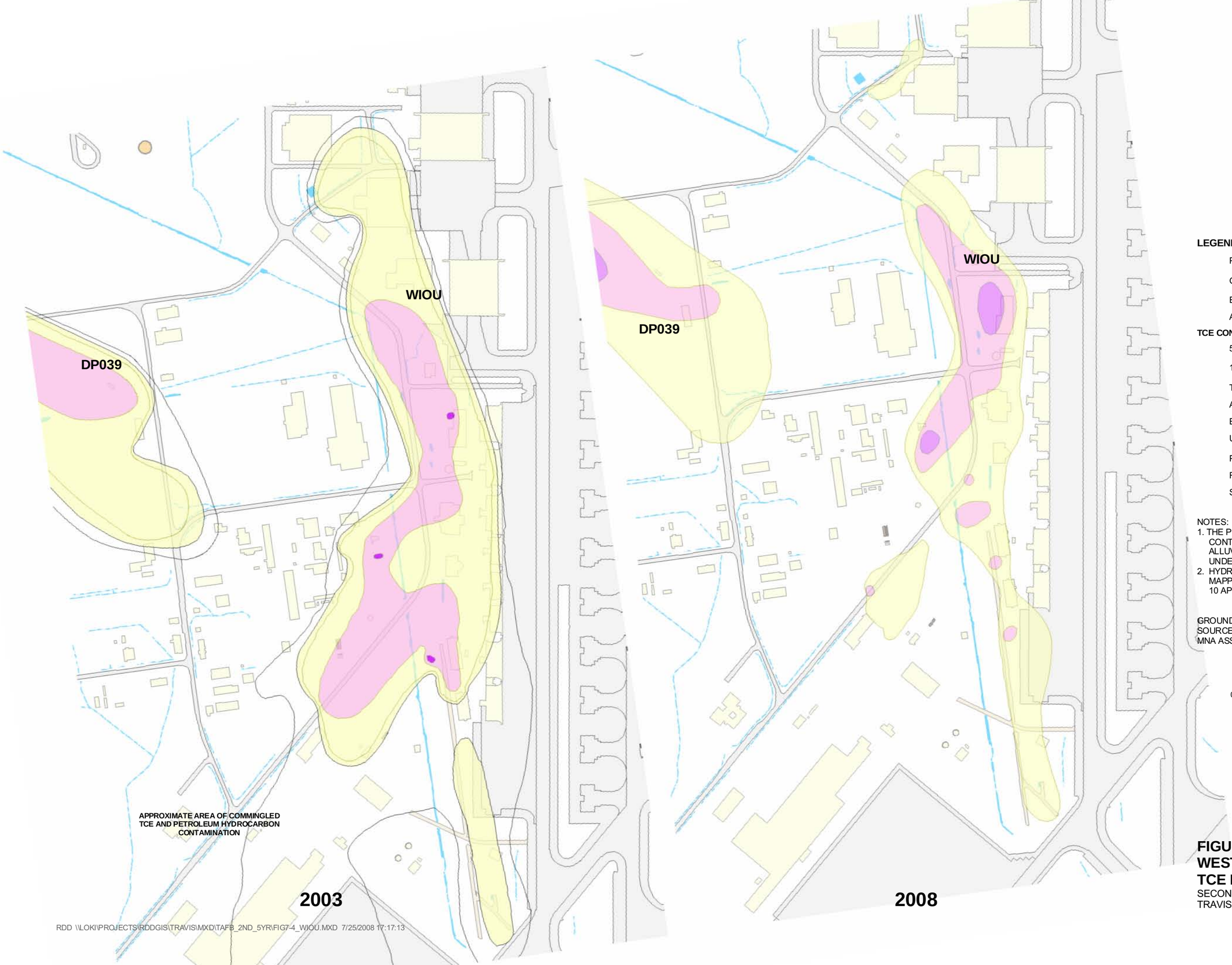

KEY MAP

LEGEND

- PIEZOMETER
- GROUNDWATER MONITORING WELL
- EXTRACTION WELL
- APPROXIMATE EXTENT OF HYDRAULIC CAPTURE

TCE CONCENTRATIONS (µg/L)

- 5 ≤ TCE <100
- 100 ≤ TCE <1,000
- TCE ≥ 1,000
- ABOVEGROUND STORAGE TANKS
- BUILDINGS
- UNPAVED AREA
- PAVED AREA
- ROAD
- SURFACE WATER

NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
SOURCE CONTROL, MIGRATION CONTROL,
MNA ASSESSMENT

0 250 500
FEET

CH2MHILL

FIGURE 7-4
WEST IRA - WIOU SITES
TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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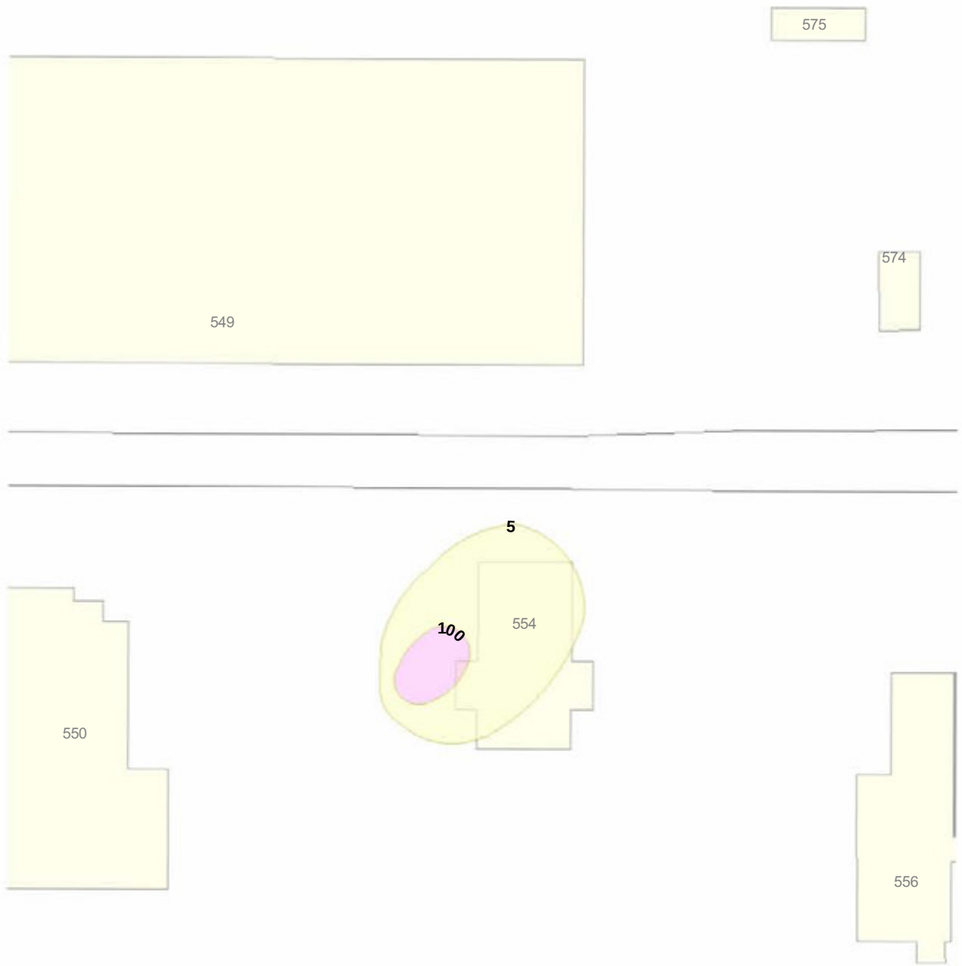

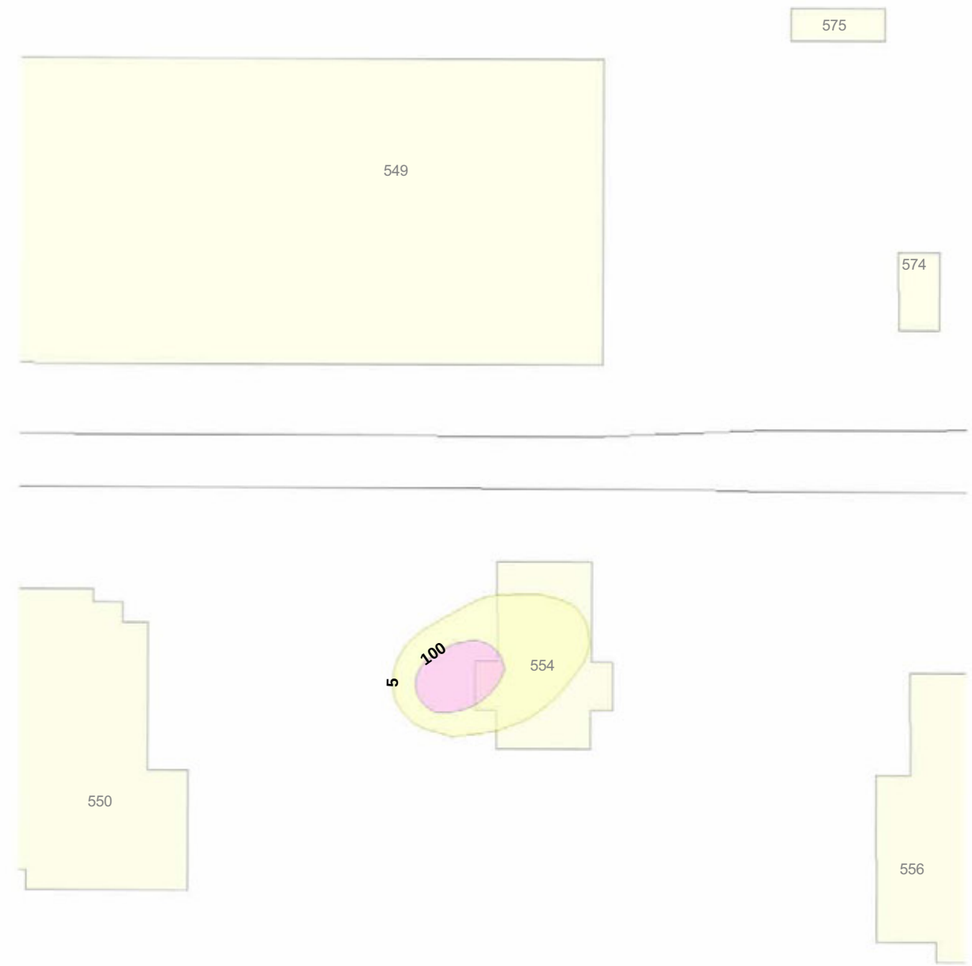

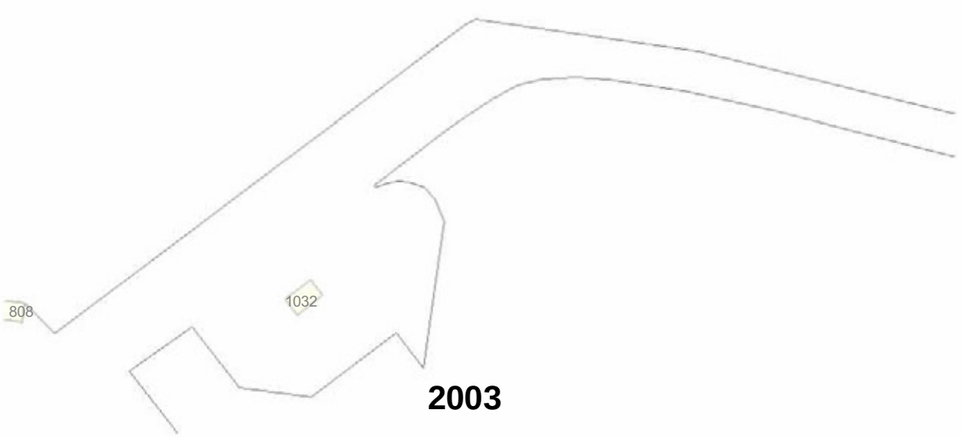

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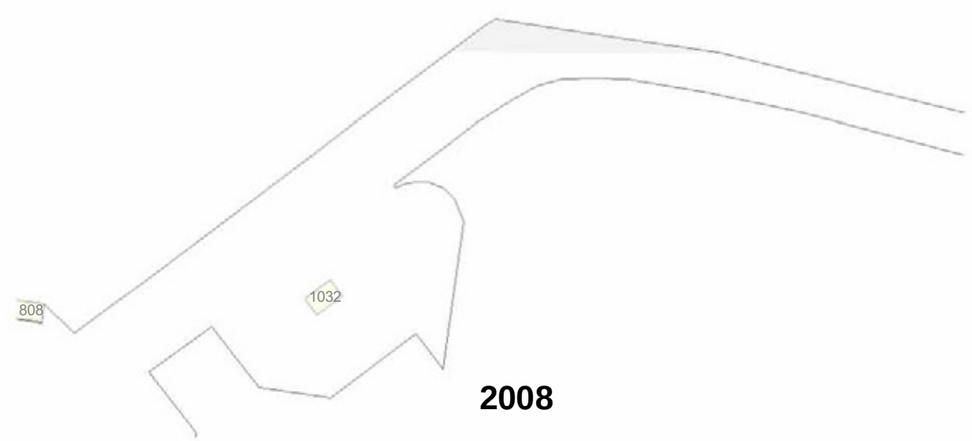

2008

KEY MAP

LEGEND

GROUNDWATER MONITORING WELL

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

TCE CONCENTRATIONS (µg/L)

5 ≤ TCE <100

100 ≤ TCE <1,000

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
MNA ASSESSMENT

0 50 100
FEET

FIGURE 7-5
WEST IRA - SITE SS015
TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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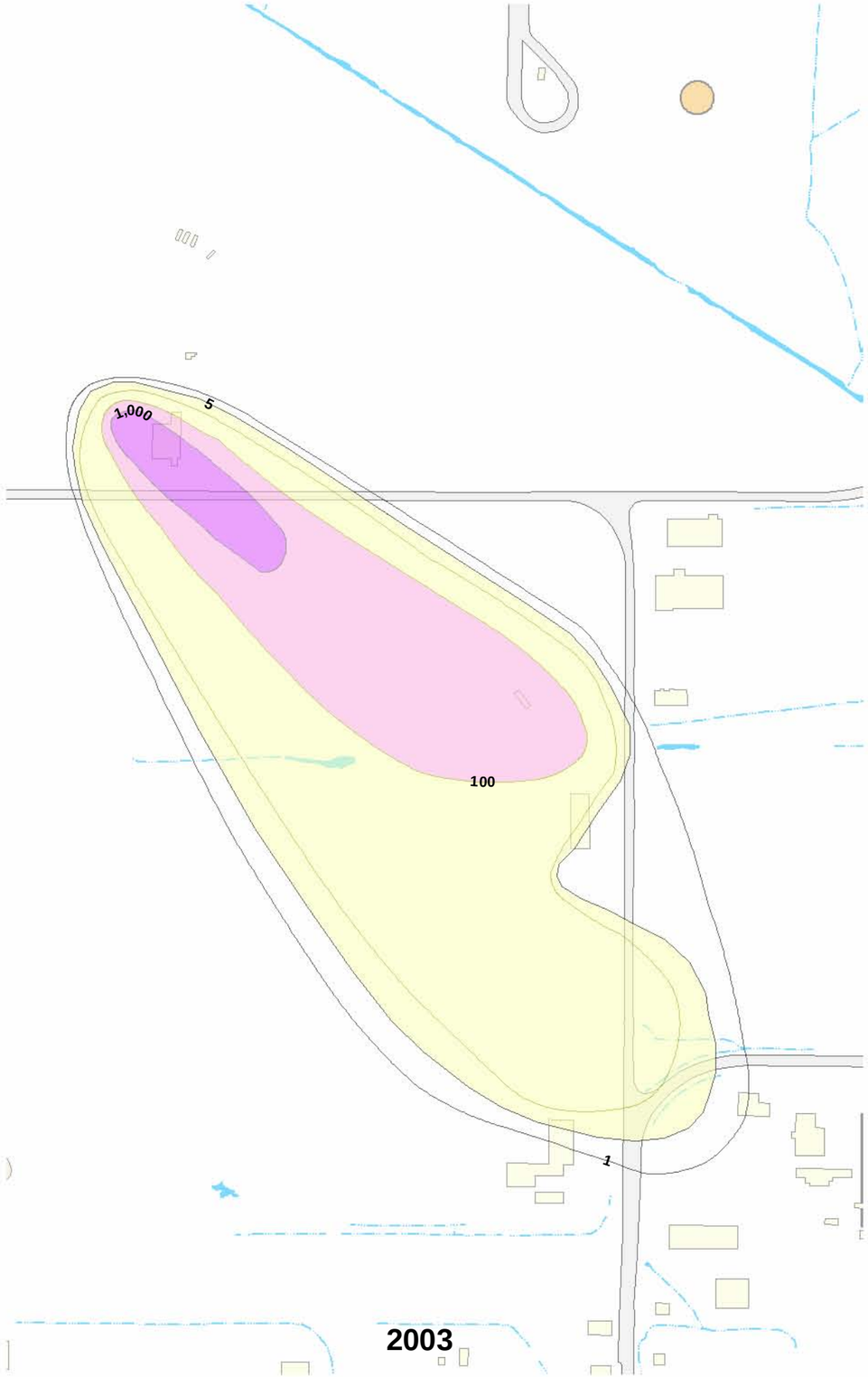

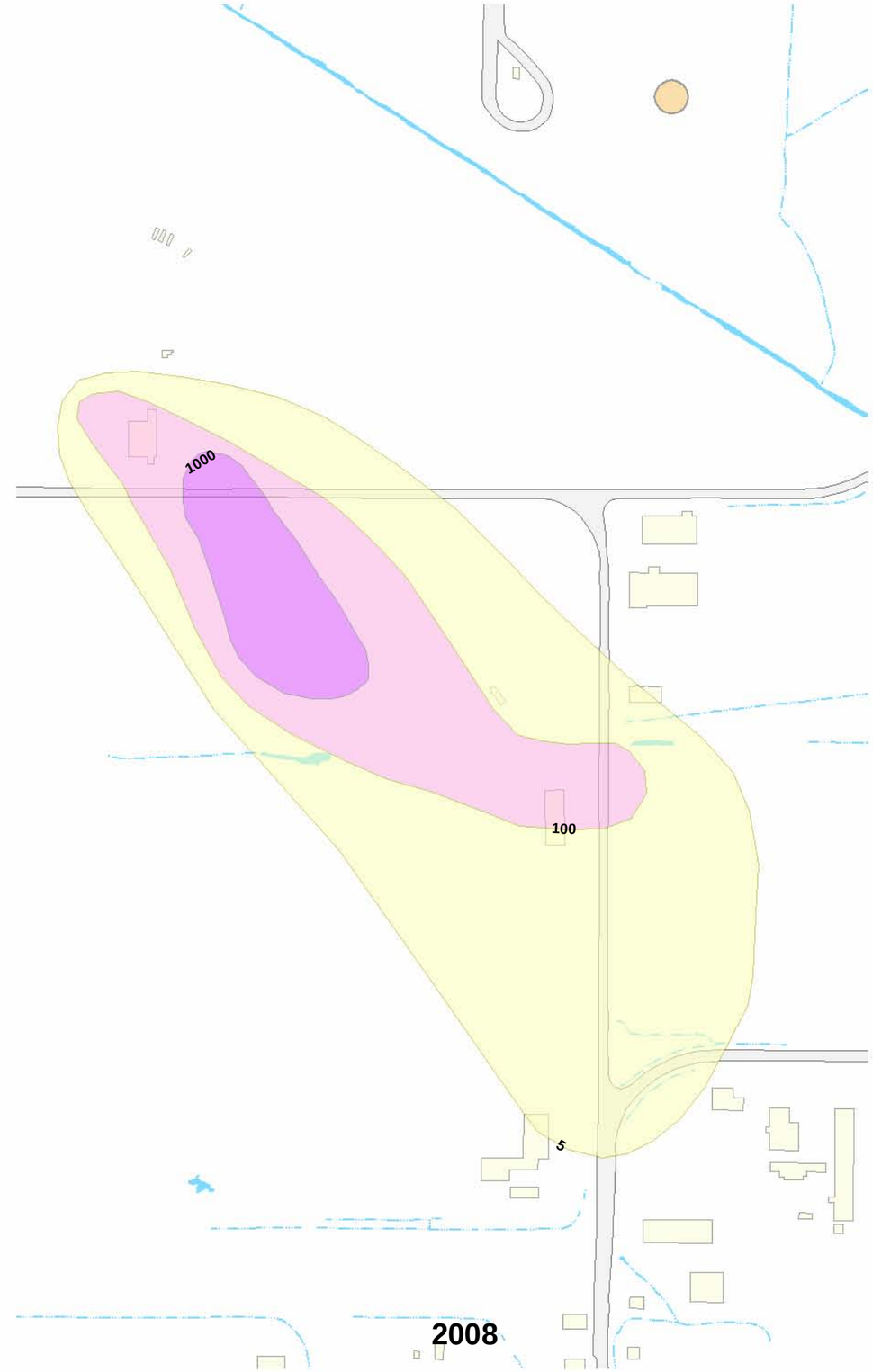

KEY MAP

LEGEND

PIEZOMETER

GROUNDWATER MONITORING WELL

EXTRACTION WELL

APPROXIMATE EXTENT OF HYDRAULIC CAPTURE (DASHED WHERE LESS CERTAIN)

PHYTOREMEDIATION AREA

TCE CONCENTRATIONS (µg/L)

5 ≤ TCE <100

100 ≤ TCE <1,000

TCE ≥ 1,000

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

ABOVEGROUND STORAGE TANKS

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

SURFACE WATER

NOTES:
1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
SOURCE CONTROL, MNA

0 150 300
FEET

FIGURE 7-6
WEST IRA - SITE DP039
TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

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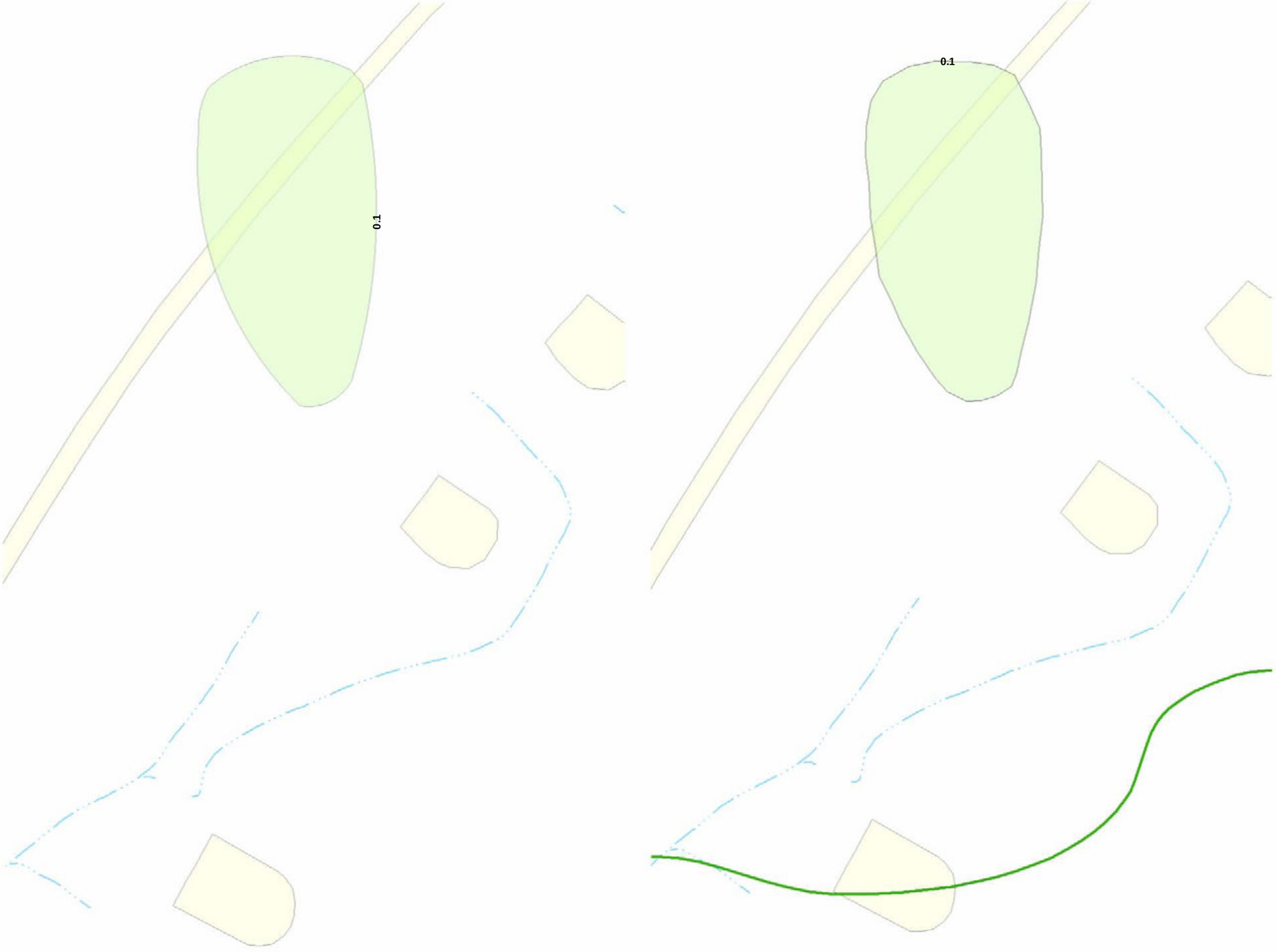

KEY MAP

LEGEND

PIEZOMETER

GROUNDWATER MONITORING WELL

EXTRACTION WELL

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

APPROXIMATE EXTENT OF HYDRAULIC CAPTURE (DASHED WHERE LESS CERTAIN)

ALPHA CHLORDANE ≥ 0.1 µg/L

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

SURFACE WATER

NOTES:

1. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
2. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
MIGRATION CONTROL

0 50 100
FEET

FIGURE 7-7
WEST IRA - SITE LF008
ALPHA CHLORDANE DISTRIBUTION
2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

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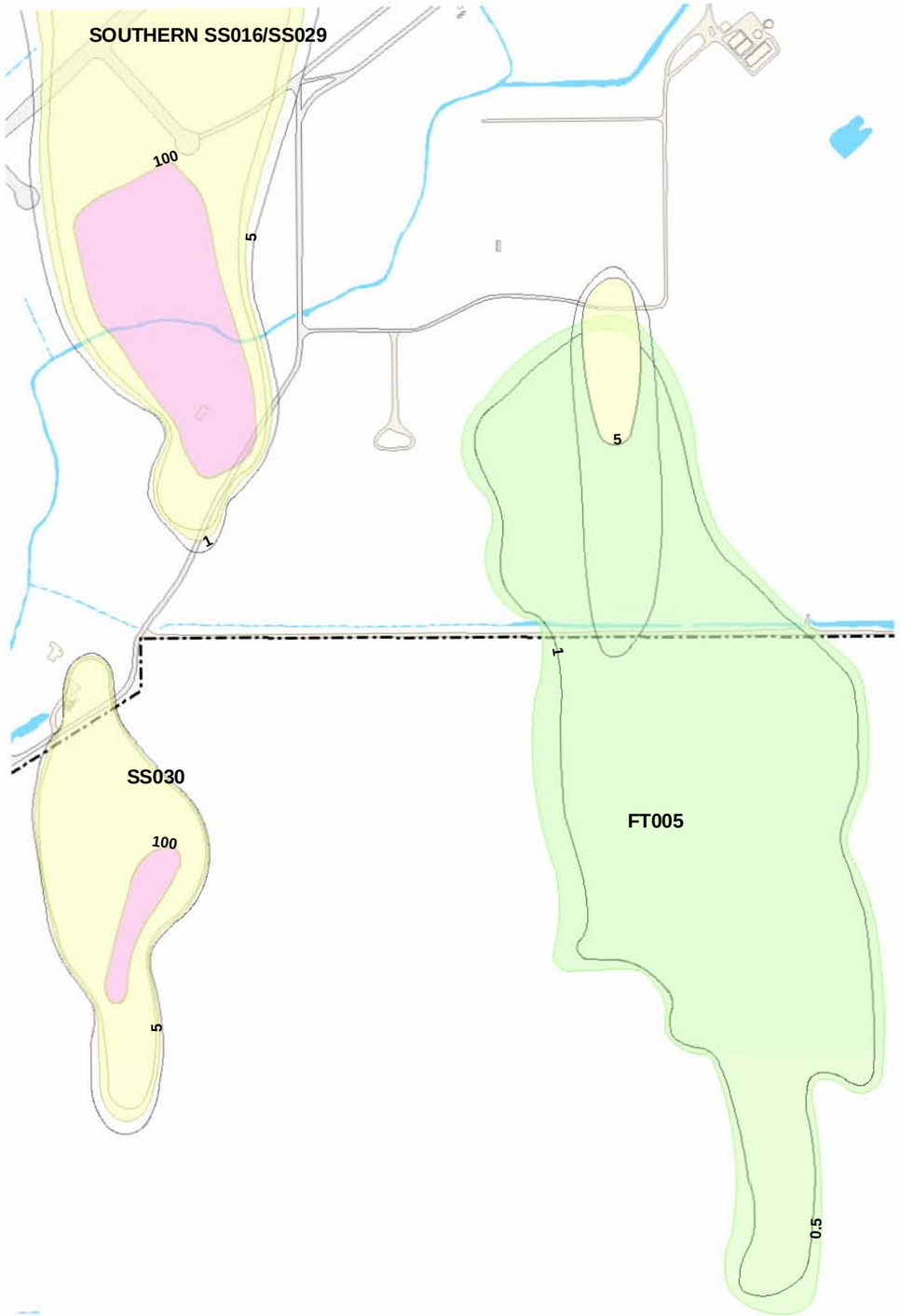
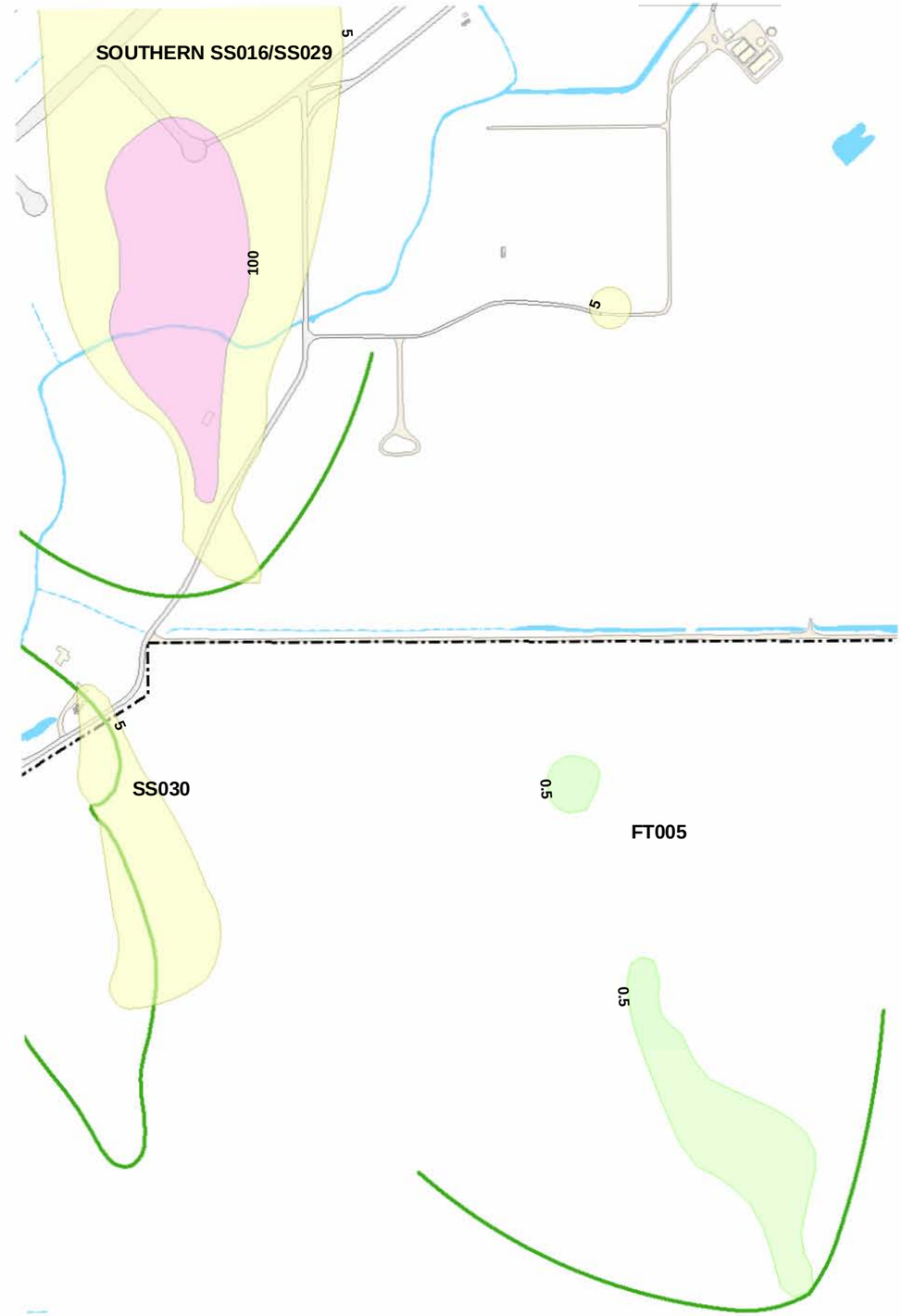


2003



2008

KEY MAP

LEGEND

PIEZOMETER

GROUNDWATER MONITORING WELL

EXTRACTION WELL

1,2-DCA ≥ 0.5 µg/L

TCE CONCENTRATIONS (µg/L)

5 ≤ TCE <100

100 ≤ TCE <1,000

TCE ≥ 1,000

APPROXIMATE EXTENT OF HYDRAULIC CAPTURE (DASHED WHERE LESS CERTAIN)

5 APPROXIMATE ISOCONCENTRATION CONTOURS (µg/L)

BASE BOUNDARY

BUILDINGS

UNPAVED AREA

PAVED AREA

ROAD

SURFACE WATER

NOTES:
1. 2003 PLUME BASED ON A COMBINATION OF IN-SITU AND MONITORING WELL DATA COLLECTED BETWEEN 1998 AND 2002.
2. THE PLUMES SHOWN REPRESENT GROUNDWATER CONTAMINANT CONDITIONS WITHIN THE SATURATED ALLUVIUM THICKNESS OF THE SINGLE AQUIFER UNDERLYING TRAVIS AFB.
3. HYDRAULIC CAPTURE CALCULATION AND PLUME MAPPING DATES: 14 JULY 2003 AND 10 APRIL 20008.

GROUNDWATER IRA:
SOURCE CONTROL, MIGRATION CONTROL, OFFBASE REMEDIATION

0 275 550
FEET

FIGURE 7-8
SOUTH IRA -
SITES FT005, SS029, SS030
TCE DISTRIBUTION 2003 TO 2008
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

CH2MHILL

RDD \\LOKI\PROJECTS\RDDGIS\TRAVIS\MXD\TAFB_2ND_5YR\FIG7-8_FT005.MXD 7/25/2008 17:33:24

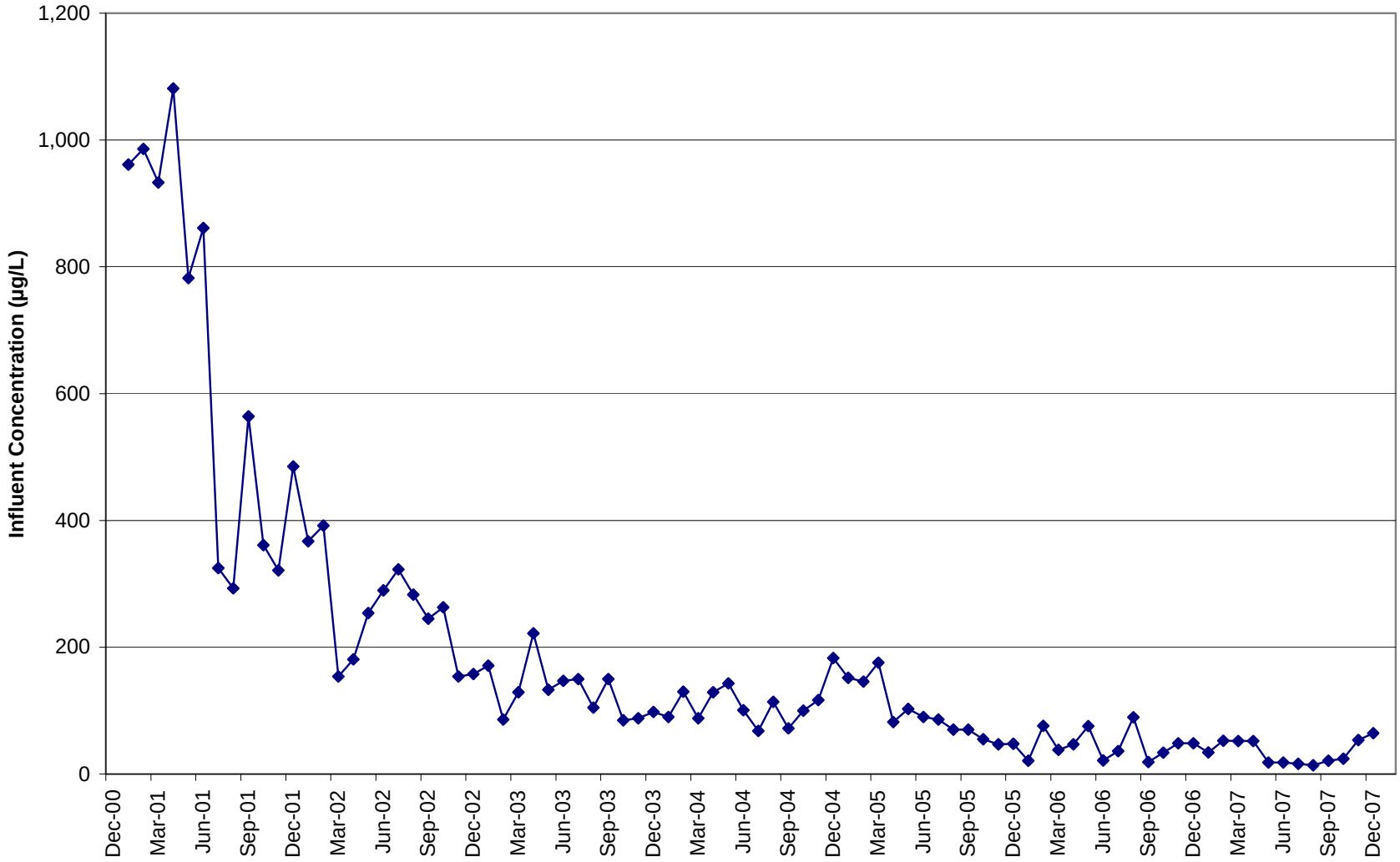


FIGURE 7-9
NGWTP GROUNDWATER INFLUENT TOTAL VOC CONCENTRATION VS. TIME JANUARY 2001 – DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_02 (3/6/08)

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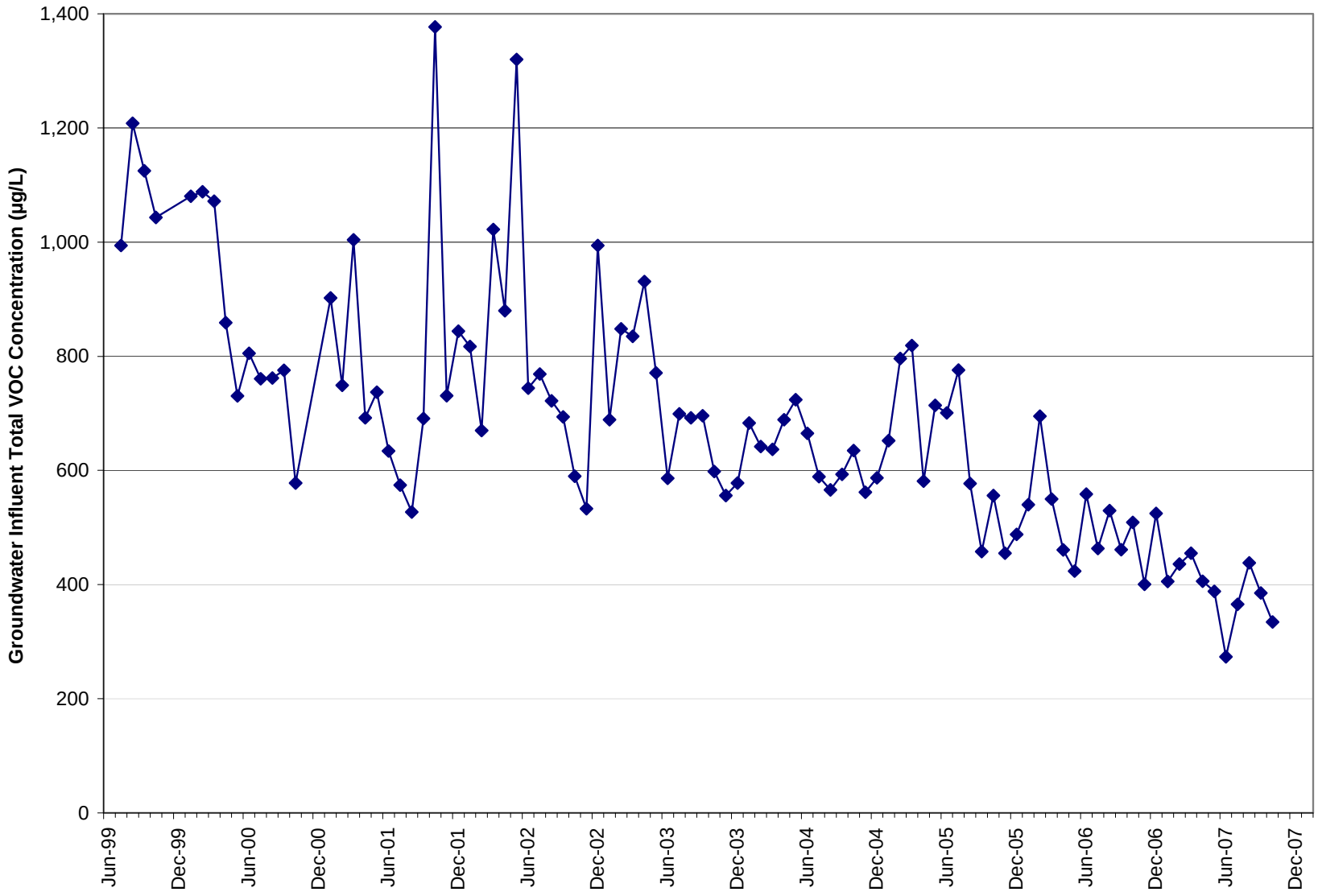

FIGURE 7-10
CGWTP GROUNDWATER INFLUENT TOTAL VOC CONCENTRATION VS. TIME JULY 1999 - DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_01 (3/6/08)

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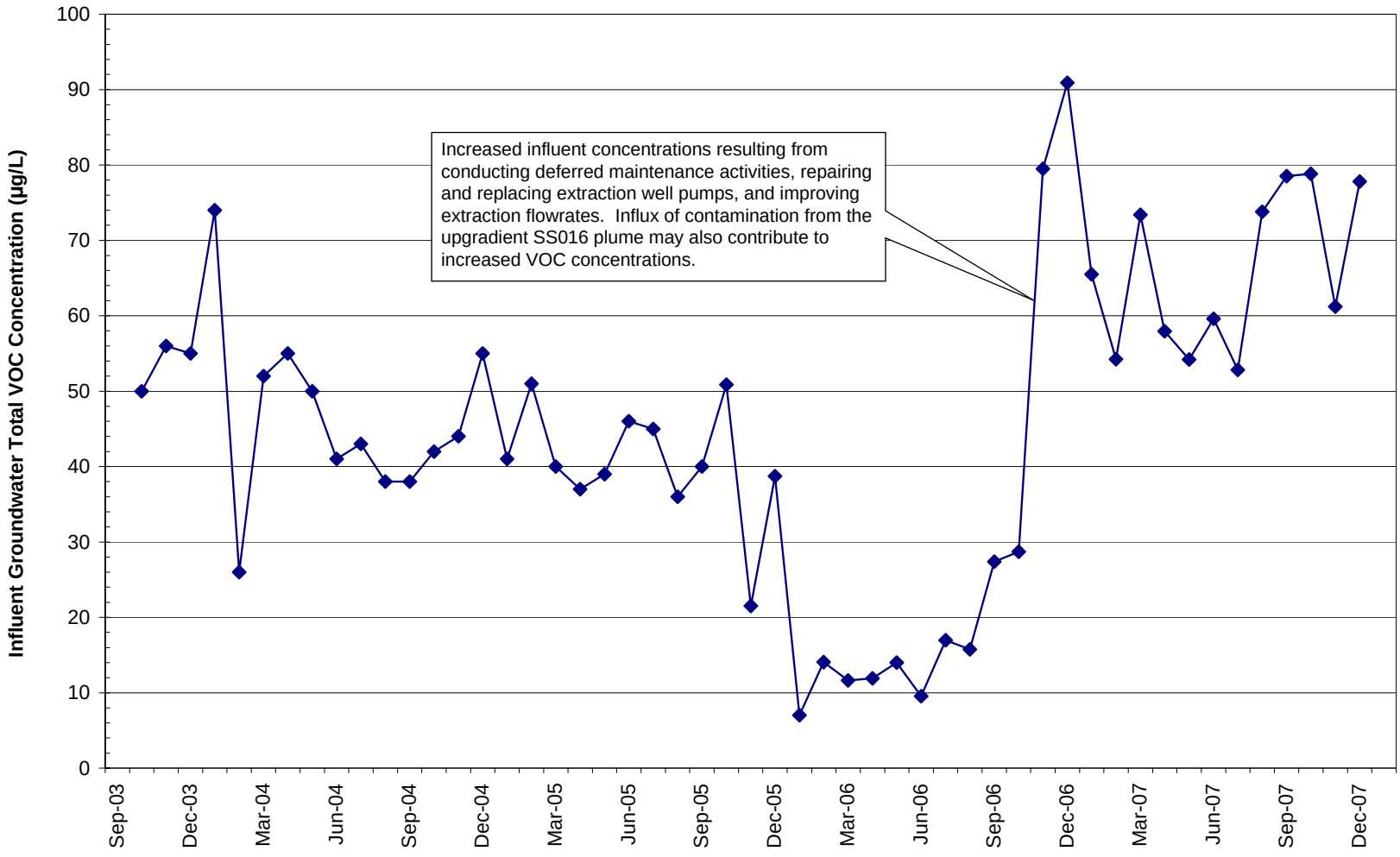

FIGURE 7-11
SBBGWTP GROUNDWATER INFLUENT TOTAL VOC CONCENTRATION VS. TIME OCTOBER 2003 – DECEMBER 2007
SECOND FIVE-YEAR REVIEW
TRAVIS AIR FORCE BASE, CALIFORNIA

ES022008001RDD_03 (3/6/08)

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SECTION 8

Issues and Follow-up Actions

This section describes current issues and potential follow-up actions and/or improvements to current site operations, activities, or conditions that may affect the current and/or future protectiveness of the groundwater IRAs and soil and/or sediment RAs currently implemented or planned at Travis AFB.

Travis AFB is the lead agency for implementing all recommendations and follow-up actions related to the groundwater IRAs and soil RAs. EPA Region 9, San Francisco Bay Water Board, and DTSC will provide regulatory agency oversight of any actions that may be taken.

8.1 Groundwater Interim Remedial Action Issues and Follow-up Actions

All groundwater IRAs at NEWIOU and WABOU sites have been constructed and are successfully operating. However, the following recommendations for optimizing the LF007C, SS030, and DP039 groundwater IRAs will improve performance and protectiveness:

- **LF007C –** The LF007C plume is migrating offbase. The existing solar-powered extraction wells are probably inadequate to control migration or remediate the plume. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force. Potential follow-up actions include:
  - Investigate the extent of TCE contamination above the IRG in the offbase area. Verify the groundwater flow direction(s).
  - After the offbase plume is characterized, evaluate installing one or more additional extraction wells to hydraulically capture the plume and fully achieve the migration control and offbase remediation objectives.
  - Install additional compliance monitoring wells on the east side of the offbase plume to monitor the performance of the enhanced GET system.
  - Evaluate adding batteries to permit operation of extraction wells during night-time hours. Alternatively, connect extraction wells to a permanent power source. Solar power that operates only during daylight hours appears inadequate to achieve the IRA objectives.

- **SS030 –** A portion of the offbase SS030 plume may be migrating toward Site FT005 under the hydraulic influence of the FT005 GET system. Additional characterization of offbase contaminant distribution, groundwater flow direction, and potential extraction system modifications are being evaluated by the Air Force. Potential follow-up actions are as follows:
  - Characterize the extent of groundwater contamination to the east of the offbase portion of the SS030 plume. Install one or more additional monitoring wells in this area for long-term compliance monitoring.
  - Evaluate installing one or more extraction wells on the east side of the offbase SS030 plume to prevent contaminant migration in that area.
- **DP039 –** The portion of the DP039 plume that is downgradient of the current zone of hydraulic capture may be migrating. Potential follow-up actions will include continuing to monitor concentration trends in downgradient wells and evaluating potential extraction system modifications.

In addition, the Air Force will place a memorandum into the Travis AFB Administrative Record that documents the land use controls for all groundwater sites that are described in the groundwater interim records of decision for the NEWIOU and the WABOU.

It is anticipated that after the second five-year review of groundwater IRAs, there will be sufficient data to support the development of the Basewide Groundwater ROD. This ROD will be prepared by the Air Force in cooperation with EPA, San Francisco Bay Water Board, and DTSC. This ROD will stipulate the final groundwater cleanup concentrations and RAs at Travis AFB.

8.2 Soil and/or Sediment Remedial Action Issues and Follow-up Actions

There are no issues that prevent the NEWIOU and WABOU soil RAs from being protective. The two primary outcomes of the soil RAs completed at the sites include the following:

- Excavation achieved cleanup levels that permitted unrestricted use of the site.
- LUCs are being successfully enforced by Travis AFB to permit only industrial use of the site.

All soil and sediment RAs at NEWIOU and WABOU sites have been completed, except sediment RAs at Sites SD001 and SD033 and the soil RA at Site FT005. The Air Force will complete these actions as soon as they can be programmed and scheduled into the next available construction season.

8.3 Next Five-Year Review

The next five-year review will be completed in approximately July 2012. This third review will include all the NEWIOU and WABOU groundwater IRAs and all the soil and sediment RAs that have been completed by that time. Travis AFB expects to include the pending soil RA at FT005 and sediment RAs at SD001 and SD033 in the third five-year review report.

SECTION 9

Protectiveness Statements

This section provides protectiveness statements for groundwater IRAs and soil and/or sediment RAs in the NEWIOU and WABOU.

9.1 Groundwater Interim Remedial Actions

Travis AFB is conducting groundwater IRAs at multiple sites within the NEWIOU and WABOU.

The Air Force developed groundwater IRODs for NEWIOU and WABOU instead of a final groundwater ROD, to allow groundwater remediation to begin quickly to reduce contamination and risk. The groundwater IROD establishes an interim period to evaluate the effectiveness of the IRAs and to monitor the status of each contaminant plume. The Air Force will use this data to establish final groundwater cleanup levels and select technically and economically feasible long-term actions in the final Basewide Groundwater ROD. The Air Force will publish a Proposed Plan, hold a public comment period, and address the public's comments before the Air Force regulatory agencies finalize and approve the groundwater ROD.

9.1.1 NEWIOU Groundwater Interim Remedial Actions Protectiveness Statement

The groundwater interim remedies within the NEWIOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness. Also, for the remedies at Sites LF007C and SS030 to be protective in the long-term, follow-up actions need to be taken.

9.1.2 WABOU Groundwater Interim Remedial Actions Protectiveness Statement

The groundwater interim remedies within the WABOU currently protect human health and the environment because exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, final remedial action objectives and a final remedy must be chosen and completed in order to ensure long-term protectiveness.

Also, for the remedy at Site DP039 to be protective in the long-term, follow-up actions need to be taken.

9.2 Soil and Sediment Remedial Actions

Travis AFB has conducted soil RAs at multiple sites within NEWIOU and WABOU.

9.2.1 NEWIOU Soil and Sediment Remedial Action Protectiveness Statement

Soil RAs within NEWIOU are complete, except for the soil RA at Site FT005. Sediment RAs at Sites SD001 and SD033 are also pending. Travis AFB will carry out these actions as soon as they can be programmed and scheduled into the next available construction season.

9.2.1.1 Completed Soil Remedial Actions

Because RAs at all NEWIOU soil sites are protective, the remedies are protective of human health and the environment.

9.2.1.2 Pending Soil/Sediment Remedial Actions

The soil RA at NEWIOU Site FT005 and the sediment RAs at NEWIOU Sites SD001 and SD003 will be protective of human health and the environment once the remedies are completed. In the interim, LUCs are in place to restrict residential development and soil/sediment disturbance activities.

The soil remedy at Site FT005 and the sediment remedies at Sites SD001 and SD033 will be carried out as soon as they can be programmed and scheduled into the next available construction season.

9.2.2 WABOU Soil Remedial Actions

Because the RAs at all WABOU soil sites are protective, the remedies are protective of human health and the environment.

9.3 Soil Vapor Actions

Currently, Travis AFB is conducting a vapor intrusion assessment at all sites where the potential for vapor intrusion exists. The assessment is ongoing and is expected to be completed by the end of 2009.

Preliminary data show there is no complete pathways for vapor intrusion and protectiveness will be reassessed upon completion of the larger vapor investigation.