FINAL
FIVE-YEAR REVIEW REPORT

at
Air Force Plant 4
Fort Worth, Texas

Prepared for:

Air Force Center for Engineering and the Environment and Aeronautical Systems Center

Prepared by:

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Contract No. F41624-03-D-8597
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September 2008

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FINAL

FIVE-YEAR REVIEW REPORT

Second Five-Year Review Report
for
Air Force Plant 4
Fort Worth, Tarrant County, Texas

September 2008

PREPARED BY:

Earth Tech, Inc.

Contract Number F41624-03-D-8597-DO190

PREPARED FOR:

U.S. Air Force
Aeronautical Systems Center
Wright-Patterson Air Force Base, Ohio

Approved by:

Richard D Harstad

RICHARD D. HARSTAD
Chief, Acquisition Environmental,
Safety & Health Division
Engineering Directorate

Date:

31 Oct 2008

Rosalyn A. Jones

ROSALYN A JONES, Notary Public
In and for the State of Ohio
My Commission Expires Jan 13, 2012

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September 16, 2008

Ms. Kristi Doll
HQ AFCEE/EXEC Project Manager
3300 Sidney Brooks Drive, Bldg 532
Brooks City-Base, TX 78235

Reference: **Contract No. F41624-03-D-8597, Task Order No. 0190**

Subject: **Final Five-Year ROD Review Report**

Dear Ms. Doll:

Please find enclosed two electronic copies of the referenced report. This document satisfies the deliverable requirements for Data Item A001c (*Scientific and Technical Reports, Comprehensive Five-year Review Report).*

If you have any questions or comments, please call me at (303) 804-2334.

Sincerely,

Earth Tech, Inc.
An AECOM Company

Dan Schultz

Dan Schultz

Enclosures

cc Mr. George Walters, ASC – 2 copies
Mr. Dave Parse, Earth Tech – 1 copy
Mr. Harvey Browder, AFCEE/ACS (w/o enclosures)
Mr. Everett Kline, ACO (w/o enclosures)
Project File

TABLES

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
AFP4	Air Force Plant 4
Air Force	United States Air Force
ARAR	applicable or relevant and appropriate requirements
ASC	Aeronautical Systems Center
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DSHS	Department of State Health Services
Earth Tech	Earth Tech, Inc.
EPA	United States Environmental Protection Agency
EO	Executive Order
ERH	electrical resistive heating
ESD	Explanation of Significant Difference
ESE	Environmental Science and Engineering, Inc.
FDTA	Fire Department Training Area
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
FSA	fuel saturation area
ft amsl	feet above mean sea level
gpm	gallons per minute
IC	institutional control
ILCR	incremental lifetime cancer risk
IRA	Interim Remedial Action
IRP	Installation Restoration Program
Jacobs	Jacobs Engineering Group Inc.
Lockheed Martin	Lockheed Martin Aeronautics Company
LTM	long-term monitoring
LUC	land use control
MCL	maximum contaminant level
mg/kg	milligram per kilogram
MNA	monitored natural attenuation
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	not detected
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit

ACRONYMS AND ABBREVIATIONS - CONTINUED

PCB	polychlorinated biphenyl
PRB	permeable reactive barrier
POTW	Publicly Owned Treatment Works
RA	remedial action
RAB	Restoration Advisory Board
RI	Remedial Investigation
ROD	Record of Decision
Shaw	Shaw Environmental, Inc.
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TBC	To Be Considered
TCE	trichloroethene
TCEQ	Texas Commission of Environmental Quality
TDH	Texas Department of Health
TMDL	total maximum daily load
TRC	Technical Review Committee
UCL	upper confidence limit
µg/L	micrograms per liter
URS	URS Corporation
USGS	United States Geological Survey
VEP	vacuum-enhanced pumping
VOC	volatile organic compound

EXECUTIVE SUMMARY

This document summarizes the second five-year review for Air Force Plant 4 (AFP4) located in Fort Worth, Tarrant County, Texas. The results of the five-year review indicate that the remedies described in the 1996 Record of Decision (ROD) and revised by two Explanations of Significant Difference (ESDs) are protective of human health and the environment. Overall, the remedial actions (RAs) are functioning as designed, and the deficiencies that were identified do not impact protectiveness. The protectiveness of the RAs is being verified by the long-term monitoring (LTM) program, which monitors sediment, surface water, and groundwater concentrations of contaminants of concern (COCs).

Based on the LTM, system performance data, interviews, and observed changes in plume size and concentrations, the remedies continue to be protective. The RAs continue to remove contaminants, and remedies are optimized and/or adjusted as remediation progresses. There have been no changes in the physical conditions of the site that affect protectiveness.

Some of the exposure assumptions used in the risk assessment have changed since the ROD was signed. Specifically, assumptions have changed for the former Base Realignment and Closure (BRAC) property, which was transferred to non-federal ownership in 2007. When that occurred, the part of the Basewide trichloroethene (TCE) plume that is beneath the former BRAC property became off site. Additional remedial components were implemented in that area to ensure continued protectiveness and were documented in a 2007 ESD.

Toxicity factors have remained the same since the ROD, and there has been no change to the standardized risk assessment methodology that could affect protectiveness. The review of documents, applicable or relevant and appropriate requirements (ARARs), and risk assumptions indicates that most of the remedies applied at AFP4 are functioning as intended in the ROD or will meet the intent of the ROD when completed. Significant differences have been identified, and have been formally addressed in prior ESDs, or will be addressed in a future decision document.

The review identified several items that could be addressed in a future ESD or other decision document:

- The selected remedies (groundwater extraction/treatment) for the Upper Paluxy aquifer and the Paluxy Upper Sand have been discontinued. Although LTM has not identified any increase in COC concentrations in Paluxy groundwater, any change in the selected remedy needs to be formally documented.
- Although the remediation goals for soil beneath Building 181 have been achieved, groundwater volatile organic compound concentrations have rebounded in an approximate 0.1-acre area, and follow-on remediation may be required to achieve the groundwater remediation goals within a reasonable timeframe.
- No new ARARs were identified during this review. However, it may be appropriate to include several recent documents or regulations as "To Be Considered" (TBC) standards. Possible new TBCs include the National Emission Standards for Hazardous Air Pollutants (Site Remediation), the Total Maximum Daily Load (TMDL) for polychlorinated biphenyls (PCBs) in Lake Worth, and the Texas Department of Health fish consumption advisory for Lake Worth.
- The contingency clause of the ROD was implemented when it was recognized that a 0.1-acre area of contaminated groundwater extended off site adjacent to Landfill 3. The bark mulch permeable reactive barrier (PRB) that was installed to address the problem should be recorded in a decision document.

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Air Force Plant 4		
EPA ID *(from WasteLAN)*: TX7572024605		
Region: 6	**State:** TX	**City/County:** Fort Worth/Tarrant

SITE STATUS	
NPL status: ✓Final Deleted Other (specify)	
Remediation status (choose all that apply): Under Construction ✓Operating Complete	
Multiple OUs?* YES ✓NO	**Construction completion date:** September 2006
Has site been put into reuse? YES ✓NO	

REVIEW STATUS
Lead agency: : EPA State Tribe ✓Other Federal Agency: United States Air Force
Author name: United States Air Force and Earth Tech, Inc.
Review period: 6/1/02 to 5/31/07
Date(s) of site inspection: 5/02/07
Type of review: ✓Post-SARA Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion
Review number: : 1 (first) ✓2 (second) 3 (third) Other (specify)

Triggering action:	
Actual RA On-site Construction at OU #___	Actual RA Start at FSA-1
Construction Completion	✓Previous Five-Year Review Report
Other (specify)	
Triggering action date: September 2004 (Support Agency signature date)	
Due date *(five years after triggering action date)*: September 2009	

* ["OU" refers to operable unit.]

FIVE-YEAR REVIEW SUMMARY FORM (cont'd.)

Issues:

The issues identified in this review are primarily related to the length of time needed to complete remediation. Although COC concentrations are decreasing in most areas, the concentration trends suggest that remediation goals will not be met within the timeframes estimated in the ROD. Monitoring of the former BRAC property will also be required for the foreseeable future where the southern lobe of the TCE plume bypasses the Carswell PRB. This does not affect short-term or long-term protectiveness, but may increase costs over the life of the remedial activities. Other issues included the following:

- The selected remedies for the Upper Paluxy and Paluxy Upper Sand (groundwater extraction) have been discontinued. Low hydraulic conductivities make these units less suitable for pump and treat remediation.
- In an interview response and in the 2006 TMDL Implementation Plan, the Texas Commission of Environmental Quality suggested that consideration be given to associating PCB issues and the fish consumption risk with the ROD in some manner to assure the public that PCB issues will continue to be addressed.
- The contingency clause of the ROD was implemented to address a 0.1-acre area of off-site groundwater contamination adjacent to Landfill 3. The action has not yet been documented in a decision document.
- Two Air Force monitoring wells were damaged or destroyed during construction activities on the former BRAC property in April 2007 before institutional controls (ICs)/land use controls (LUCs) could be fully implemented.
- The fenced, restricted area around Landfill 3 is infrequently accessed by unauthorized persons and may need maintenance in some sections.

Recommendations and Follow-up Actions:

To address potentially long remediation times, the Air Force should seek opportunities to optimize the efficiencies of the existing systems and review other technologies that could potentially reduce remediation costs. Monitored natural attenuation should be considered for the Upper Paluxy and Upper Sand, where low hydraulic conductivities make most technologies impractical, and very limited risk to potential receptors may exist. Other possible actions to be considered include:

- Document changes to selected remedies and the implementation of the contingency clause in a decision document.
- Consider possible additional remedial actions upgradient of the former BRAC property to reduce the length of time required to monitor off-site contamination there.
- Evaluate whether to incorporate the Lake Worth TMDL and fish consumption advisory into the ROD as TBCs, or whether another action would also reduce public concern until the advisory is lifted.
- Complete and implement the IC/LUC Implementation Plan for the former BRAC property and improve communication of the IC restrictions in Landfill 3 by installing or updating signs at potential access points. Repair Landfill 3 fencing as needed.

Protectiveness Statement:

The remedy is expected to be protective of human health and the environment upon remediation of the soil, surface water, and groundwater. Human and ecological exposure pathways that could result in unacceptable risks are being managed by institutional controls to prevent exposure to contaminated media. All threats are being addressed by the selected remedies.

Long-Term Protectiveness:

Long-term protectiveness of the RAs will be verified by the long-term monitoring program, which monitors sediment, surface water, and groundwater concentrations of COCs. Long-term protectiveness will be achieved in the TCE plume by a combination of removal, destruction, and degradation of COCs.

1.0 INTRODUCTION

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

The United States Air Force (Air Force) is preparing this Five-Year Review Report pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121 states:

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

The NCP in 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) further states:

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

At National Priorities List (NPL) sites administered by the United States Department of Defense and other federal agencies, Executive Order (EO) 12580 designates the respective agency as the lead agency and delegate's responsibility to conduct the five-year review. The United States Environmental Protection Agency (EPA) is the supporting agency and may concur with and/or supplement the findings of this review.

Under EO 12580, the Air Force has conducted this five-year review of the remedy implemented at the Air Force Plant 4 (AFP4) NPL Site in Fort Worth, Texas. This review was conducted for the entire site from January 2007 through July 2007. The review covers activities conducted between June 1, 2002 and May 31, 2007. This report documents the results of the review.

This is the second five-year review for AFP4. The triggering action for this statutory review is the Support Agency signature date of the first five-year review in September 2004. The five-year review at AFP4 is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

The review is based on site-specific considerations, including the nature of the response actions, the status of response activities, and the proximity to populated areas and sensitive environmental areas. A significant volume of information on the site has been collected over the period. The Air Force has considered all available information in preparing this review including, but not limited to, the Record of Decision (ROD) (Air Force 1996), the Remedial Investigation/Feasibility Study (RI/FS) (Rust Geotech 1995), the two Explanation of Significant Differences (ESDs) for the Basewide trichloroethene (TCE) plume (Aeronautical Systems Center [ASC] 2002b, HydroGeologic 2007), the Long-Term Monitoring (LTM) Plan (Earth Tech, Inc. [Earth Tech] 2002), Remedial Action (RA) Reports, LTM Reports, and other correspondence with the various parties involved with the response actions. While not specifically

referenced, information was excerpted from the ROD and used throughout this document. The principal documents used in preparing this report are referenced in Attachment 2.

The remedies selected in the ROD are described in detail in Section 4.0. The remedies selected in the ROD were modified in 2002 and in 2007, and in both cases, were documented in ESDs.

The first ESD (Jacobs Engineering Group Inc. [Jacobs] 2002) modified the remedy for the Basewide TCE plume source, from surfactant-enhanced dense non-aqueous phase liquid (DNAPL) removal to electrical resistive heating (ERH). Previously, the RI/FS and ROD erroneously assumed that TCE DNAPL had migrated great distances and was likely to occur wherever groundwater concentrations exceeded 10,000 micrograms per liter (µg/L). Subsequent monitoring and the pre-design investigations in 1998 and 1999 indicated that free-phase TCE occurrence was limited to an area beneath Building 181. A successful pilot study was performed in 2000 to evaluate the use of ERH to treat the much smaller source area. The 2002 ESD documented the change from the ROD-proposed remedy to ERH, and the full-scale ERH was also conducted in 2002.

The second ESD was needed to complete the transfer of the golf course Base Realignment and Closure (BRAC) property to the Westworth Redevelopment Authority. A portion of the Basewide TCE plume extends beneath the former BRAC property, so when the property was transferred to non-federal ownership in 2007, the ROD remedy needed to be modified to protect potential off-site receptors.

The 2007 ESD identified remedial components to address the off-site contamination including: a) the existing remedies in place at AFP4; b) the Carswell permeable reactive barrier (PRB), which intercepts and treats the groundwater with the highest concentrations at the federal property boundary; c) monitored natural attenuation for portions of the plume that are off federal property; and d) institutional controls (ICs) and land use controls (LUCs) to ensure that the new users of the property are not exposed to contaminants. It also creates a fourth RA objective to ensure that the remedies remain protective of human health and the environment.

The ROD remedies and other remedial actions are summarized on Figures 1-1 and 1-2.

2.0 SITE CHRONOLOGY

Table 2-1 summarizes significant events and documents from the time contamination was first identified in 1982 through 2007. A number of recurring activities are not shown in Table 2-1. Examples include quarterly groundwater monitoring between 1991 and 1998, semiannual LTM between 1998 and 2007, and operation and maintenance (O&M) activities from 1991 to 2007.

Table 2-1 – Chronology of Significant Events

Event	Date
• Potential contamination noted by private citizen • French Drain No. 1 constructed at AFP4 Landfill 1 • Investigation of groundwater contamination conducted	1982
Technical Review Committee (TRC) established	1983
Phase I records search as part of the Installation Restoration Program (IRP) conducted	1984
• Further investigation of groundwater contamination by Corps of Engineers along southern boundary and East Parking Lot • IRP Phase II, Stage I, Confirmation/Quantification conducted	1985
AFP4 placed on EPA NPL Federal Facility Agreement (FFA) signed	1990
Voluntary interim quarterly groundwater and surface water monitoring	1991 - 1998
Voluntary Interim Remedial Action (IRA) at Fuel Saturation Area (FSA) 1 and FSA-3 groundwater treatment system	1992
• IRA began in Building 181 with operation of a soil vapor extraction (SVE) system • IRA began in the East Parking Lot with the installation and operation of a groundwater extraction and treatment system • Voluntary IRA at the former Carswell Air Force Base Landfills 4 and 5 • Voluntary IRA at AFP4 Landfill 3 began with installation of a vacuum-enhanced pumping (VEP) system	1993
• RI/FS approved by EPA and the Texas Water Commission • The Proposed Plan is issued • The TRC is converted to the Restoration Advisory Board (RAB)	1995
AFP4 ROD selecting the remedy is signed	1996
LTM Plan approved and program implemented	1998 - present
• Site Investigations at AFP4 Landfills 1 and 3 begin • Remedial Design of Building 181 SVE System completed • Startup of expanded FSA-1 treatment system to treat Paluxy groundwater.	1998
Agency for Toxic Substances and Disease Registry Public Health Assessment indicates that polychlorinated biphenyls (PCBs) in fish tissue may constitute an “indeterminate public health hazard”	1998
DNAPL identified in the Walnut Formation in Landfills 1 and 3. DNAPL occurrence in the Walnut Formation investigated and characterized	1998 - 2000

Event	Date
• United States Geological Survey (USGS) fish tissue sampling in Lake Worth • Building 181 SVE System upgraded and begins operation • Remedial design of the East Parking Lot/Window Area Groundwater Pump and Treat system completed	1999
• Construction begins on East Parking Lot/Window Area Groundwater Pump and Treat system • ERH pilot test at Building 181 • Fish consumption advisory issued for Lake Worth • DNAPL extraction initiated at AFP4 Landfill 1 • USGS sediment sampling of Lake Worth	2000
Construction of the East Parking Lot/Window Area Groundwater Pump and Treat system completed and system started	2001
• Interim Groundwater Pump and Treat system at Carswell Landfills 4 and 5 turned off • Carswell PRB built • Explanation of significant differences to document changes to selected remedy for the Basewide TCE Groundwater Plume, from surfactant-enhanced DNAPL removal to ERH (formally approved with the approval of the 2007 ESD) • Full-scale ERH treatment of soils and groundwater beneath Building 181	2002
• Northeast Parking Lot source investigation characterizes northern portion of TCE plume beneath AFP4 • USGS sediment sampling of Lake Worth, Meandering Road Creek, and AFP4 Outfall 4	2003
• Investigation and characterization of DNAPL and PCBs on the west side of AFP4 • USGS sediment sampling of Meandering Road Creek and AFP4 Outfalls for PCBs	2004
• Focused Feasibility Study (FFS) for the Southern Lobe of the TCE Groundwater Plume is completed • Treatment of Upper Paluxy groundwater on west side of AFP4 discontinued after local concentrations remained below remediation goals for four years. • Texas Commission of Environmental Quality (TCEQ) issues one total maximum daily load (TMDL) for PCBs in fish tissue in Lake Worth	2005
• The selected remedy for the southern lobe of the TCE plume is demonstrated to be operating properly and successfully • Interim RA Completion Report for AFP4 remedial actions is approved • EPA issues the Preliminary Closeout Report and Certificate of Completion for remedial actions at AFP4 • USGS conducts additional sediment sampling of Lake Worth, Meandering Road Creek, and AFP4 Outfall 4 • City of Fort Worth fish tissue sampling of Lake Worth (and other urban lakes) • LTM program optimization adds several monitoring locations, eliminates several, and reduces monitoring frequency at many locations	2006

Event	Date
• Lockheed Martin concludes on-site PCB investigations, removes and replaces pavement and other potential low-level PCB source materials, and initiates best management practices to reduce the amount of sediment that can enter storm drains. • Final ESD for the Basewide TCE Groundwater Plume approved. The former Carswell BRAC property is transferred to Westworth Redevelopment Authority. The approval of this ESD also constitutes a formal approval of the 2002 ESD.	2007

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3.0 BACKGROUND

The historical background information presented in the following sections was derived mainly from the RI/FS (Rust Geotech 1995) and the ROD (Rust Geotech 1996). Much of the historical background information presented in those documents had been originally published in the AFP4 Records Search (CH2M Hill 1984).

3.1 Physical Characteristics

AFP4 is located in Tarrant County, Texas, approximately 7 miles northwest of downtown Fort Worth. The facility occupies 760 acres adjacent to the northwest boundary of the city of Fort Worth (Figure 3-1). The plant is bounded on the north by Lake Worth, on the east by Naval Air Station Fort Worth Joint Reserve Base ("NAS Fort Worth," formerly Carswell Air Force Base), and on the south and west by the City of White Settlement. The facility shares active runways and taxiways with NAS Fort Worth.

The topography of the land surrounding AFP4 is generally flat, with the exception of areas adjacent to Meandering Road Creek and Lake Worth. Elevations at the site range from 590 feet above mean sea level (ft amsl) along the shore of Lake Worth to approximately 670 ft amsl at the southwest corner of the facility. Based on the results of a 1982 flood insurance study, neither a 100- nor 500-year flood event will directly affect AFP4.

3.2 Land and Resource Use

AFP4 and the surrounding areas to the south and east are highly urbanized and consequently do not contain much natural vegetation or wildlife. Approximately 70 percent of the AFP4 surface area is covered by buildings, concrete, or asphalt. The remaining 30 percent of the surface area (the west and north portions of the facility) is primarily grass-covered soil. The area west of AFP4 is mainly residential with an abundance of natural vegetation. Lake Worth (to the north) provides recreational boating, fishing, and water skiing. The lake also furnishes municipal water to the city of Fort Worth and is a recharge source to the underlying Paluxy Aquifer, which supplies municipal water to the City of White Settlement.

Residential housing is immediately adjacent to AFP4 to the south and west. Five schools are within a 2-mile radius of AFP4. The area is served by two major interstate highways: I-820 from the north and south and I-30 from the east and west. The communities of White Settlement, Lake Worth Village, Westworth Village, River Oaks, and Sansom Park Village lie within a 3-mile radius of AFP4.

3.3 History of Contamination

Waste oil, solvents, and fuels generated during operations at AFP4 were formerly disposed of in on-site landfills or were used as fuel for fire-training exercises. The ROD reported that some chemical process wastes were discharged directly to the sanitary sewer for treatment by the Fort Worth Publicly Owned Treatment Works (POTW) until the 1970s, when wastes were sent to an on-site chemical waste treatment system prior to discharge to the sanitary sewer. TCE from a former disposal pit and a 1990 release from a leaking degreaser tank are believed to be the primary sources of the Basewide TCE Groundwater Plume.

3.4 Initial Response

Potential contamination at AFP4 was initially observed by a private citizen in September 1982. Since then, a series of focused site investigations and IRAs have been completed. A site investigation was conducted in 1982 to investigate potential groundwater contamination at AFP4. In March 1984, an IRP Phase I Records Search was conducted. Several additional site investigations and RAs were performed, including the RI/FS completed in 1995. IRAs conducted include the AFP4 Landfill 3 vacuum-enhanced extraction system, French Drains 1 and 2 (located at Landfill 1), the Building 181 SVE pilot system, the

East Parking Lot groundwater treatment pilot system, FSA-1 and FSA-3 groundwater treatment systems, and the groundwater treatment system for the former Carswell Landfills 4 and 5.

The site was placed on the NPL in August 1990. The Air Force, EPA, and the State of Texas entered into an FFA in November 1990 to address environmental impacts of operations and waste disposal practices at AFP4.

3.5 Basis for Taking Action

The following sites and media were identified as having contaminant concentrations that potentially pose an excess risk to human health or the environment (ecological receptors) or exceed the lower threshold of an acceptable risk range:

- Soil associated with AFP4 Landfills 3 and 4,
- Sediment along Meandering Road Creek and the inlet of Meandering Road Creek to Lake Worth,
- Soil under Building 181,
- Groundwater in the Terrace Alluvial Flow System, and
- Paluxy Aquifer and Upper Sand groundwater.

The contaminant of concern (COC) concentrations shown in the Basis for Taking Action sections are taken directly from the ROD. Samples were collected in 1994 and 1995.

3.5.1 AFP4 Landfill 3

AFP4 Landfill 3, which is located along the western boundary of AFP4 adjacent to Meandering Road Creek, is a grass-covered area approximately 5 acres in size (Figure 3-2). The landfill is presently enclosed by a chain-link fence. Miscellaneous wastes, including mixed oils and solvents, were discarded at this site from 1942 to 1945. The landfill was inactive from 1945 to 1966. Dirt and rubble were used to fill and grade the landfill during 1966 and 1967.

The highest metal concentrations were detected in samples collected on the western edge of the landfill and east of Meandering Road Creek. The highest concentrations of the other constituents were detected in samples collected in historic drainage ditches that have been filled. According to the ROD, the ranges of concentrations for key COCs detected in soil samples from AFP4 Landfill 3 are:

- TCE (not detected [ND]-19 milligrams per kilogram [mg/kg]),
- Cadmium (ND-96.2 mg/kg),
- Copper (ND-5,590 mg/kg),
- Lead (2-10,400 mg/kg), and
- Zinc (3.8-17,400 mg/kg).

3.5.2 AFP4 Landfill 4

AFP4 Landfill 4, which is located near the southwest boundary of the AFP4 facility, occupies approximately 4 acres of land between Bomber Road (sometimes referred to as Meandering Road) and Meandering Road Creek (Figure 3-2). AFP4 Landfill 4 is grass-covered but is not capped with an engineered cap. This landfill was used for disposal of construction rubble from 1956 to the early 1980s. Other types of wastes may have been disposed there between 1966 and 1973, including small quantities of solvents, oils, fuels, and thinners.

The highest concentrations of metals and semivolatile organic compounds (SVOCs) were detected in samples collected along the western shoulder of the landfill. According to the ROD, the ranges of concentrations for key COCs detected in all soil samples from AFP4 Landfill 4 were:

- TCE (ND-0.03 mg/kg),
- Benzo[*a*]pyrene (ND-13 mg/kg),
- Arsenic (2.4-170 mg/kg),
- Cadmium (ND-160 mg/kg),
- Copper (ND-3,200 mg/kg), and
- Zinc (4.6-12,200 mg/kg).

3.5.3 Meandering Road Creek

According to the ROD, the ranges of concentrations for key COCs detected in samples of Meandering Road Creek sediments were:

- Arsenic (3.1-6.1 mg/kg),
- Cadmium (ND-2.4 mg/kg),
- Copper (13.4-17.8 mg/kg),
- Lead (10-77.4 mg/kg),
- Silver (ND-6.9 mg/kg), and
- Zinc (17.8-87 mg/kg).

3.5.4 Lake Worth

Lake Worth sediment samples were collected off shore north of AFP4, in a cove at the northwest corner of AFP4, and in Woods Inlet, at the mouth of Meandering Road Creek (Figure 3-2). Several volatile organic compounds (VOCs) were detected in the sediment samples at concentrations less than 1.0 mg/kg. SVOCs were detected at concentrations between 1.3 and 7.9 mg/kg. Two PCB compounds, Aroclor 1254 and Aroclor 1260, were detected in two sediment samples at concentrations of 0.1 and 0.11 mg/kg, respectively. The Aroclor 1260 concentration was less than concentrations measured elsewhere in Lake Worth and was considered to be below the anthropogenic background in an urban lake. Only three Meandering Road Creek and Lake Worth samples had concentrations high enough to potentially cause excess risk. The ROD also identified several metal COCs detected in Lake Worth sediments. The ranges of concentrations of those compounds were:

- Arsenic (3.5-6 mg/kg),
- Cadmium (0.4-11.4 mg/kg),
- Copper (8.5-88.4 mg/kg),
- Lead (8-444 mg/kg),
- Silver (ND-13 mg/kg), and
- Zinc (21.9-303 mg/kg).

3.5.5 Building 181

Building 181, the Chemical Process Facility, is part of the Assembly Building/Parts Plant, which is a mile-long building located in the approximate center of AFP4 (Figure 3-2). Spills of TCE reportedly occurred within the Chemical Process Facility. Trenches, sumps, floor drains, and buried pipelines are present throughout this manufacturing facility and are possible pathways for contamination migration under this building.

The key COC at Building 181 is TCE, which was detected at concentrations ranging from ND to 0.22 mg/kg in soil samples collected from borings up to depths of approximately 59 feet near the perimeter of

Building 181. Soils saturated with TCE were also found during the installation of an SVE system under Building 181. TCE in the soil under Building 181 is the main source of TCE contamination in the Basewide TCE Groundwater Plume (formerly referred to as the East Parking Lot Plume).

3.5.6 Terrace Alluvial Flow System/ Basewide TCE Plume

The ROD identified three separate plumes within the Terrace Alluvial flow system, which are distinguished in part by different groundwater flow directions within the Terrace Alluvium. Subsequent monitoring and investigations have further refined the nature of TCE contamination in the Terrace Alluvium. The current configuration is shown on Figure 3-3. The plumes identified in the ROD are:

- Basewide TCE Groundwater Plume,
- West Plume, and
- North Plume.

The largest plume of groundwater contamination is the Basewide TCE Groundwater Plume. This plume begins at the groundwater divide located south and west of the Assembly Building/Parts Plant and Building 181. The plume extends in an easterly and northeasterly direction toward the East Parking Lot and then spreads east and southeast in the direction of NAS Fort Worth (Figure 3-3).

The primary AFP4 sources of the Basewide TCE Groundwater Plume appear to be two former degreaser tanks in Building 181 and possibly the former Chrome Pit 1, also beneath Building 181. A relatively low-level TCE source near the north end of Building 5 was identified during the 2003 Northeast Parking Lot source investigation (Earth Tech 2003). This source appears to be on or near the Terrace Alluvium groundwater divide, so that relatively low concentrations of dissolved TCE are transported to the east to merge with the Basewide TCE Groundwater Plume and to the west to merge with the West Plume (Figure 3-3).

The ROD also identified several former IRP sites southwest of Building 181 as potential contributors to the Basewide TCE Groundwater Plume, including Chrome Pit 2, the former Die Yard Chemical Pits, Fire Department Training Area (FDTA) No. 5 (FDTA-5), and the Wastewater Collection Basins. These potential sources are located east of the groundwater divide. Chrome Pit 3, also proposed in the ROD as a potential source, was shown during detailed groundwater level measurements in 2005 to be west of the groundwater divide and an unlikely source for the Basewide TCE Groundwater Plume. Historical and recent analytical results and past RAs suggest that former Carswell Landfills 4 and 5 and Waste Pile 7 may also contribute as sources of TCE to the southern lobe of the plume, and that a source in the vicinity of the NAS Fort Worth North Apron may contribute TCE to the northern lobe of the plume. The AFP4 RI/FS, ROD, and first five-year review indicated that Carswell Landfill 6 was also a potential contributor to the plume, but the evidence for that was not identified during the document review for this report.

The extent of the Basewide TCE Groundwater Plume is defined primarily by elevated concentrations of TCE, although cis- and trans-1,2-dichloroethene (DCE), and vinyl chloride are also detected in some areas. TCE concentrations in excess of 100,000 µg/L were detected in groundwater samples from beneath Building 181, although most concentrations in that area have been below the 10,000 µg/L remediation goal since 2002. The current plume, as defined by the 5 µg/L contour, covers approximately 890 acres, reduced from an estimated 1,100 acres in 1993. The plume size in 1993 is less precise because groundwater sampling on NAS Fort Worth (then Carswell Air Force Base) was relatively limited during that period.

A second plume of groundwater contamination in the Terrace Alluvial flow system is the West Plume (Figure 3-3). The West Plume was defined in the ROD as a broad area extending from the Assembly Building/Parts Plant westward toward Meandering Road Creek. Subsequent investigations indicate that it

is actually several different areas of groundwater contamination with different sources. It includes a relatively isolated area of TCE-contaminated groundwater around former Chrome Pit 3 that may have once extended to Meandering Road Creek; a plume that flows west into Landfills 1 and 3 from the groundwater divide at the north end of Building 5; a localized area of TCE-contaminated groundwater at FDTA-2; and an area within Landfills 1 and 3 that is sourced primarily by DNAPL and light non-aqueous phase liquid from the former waste oil pits in Landfill 1. Groundwater flow within the West Plume is generally toward the west. Historical TCE concentrations in groundwater samples from the West Plume have ranged from ND to 490,000 µg/L. A recent maximum TCE concentration in groundwater was 87,000 µg/L at Chrome Pit 3. The extremely high TCE concentrations recorded in Landfills 1 and 3 and elsewhere may be partly a result of the sampling methods used, i.e., traditional bailer methods that would induce mixing between DNAPL and groundwater within and adjacent to the monitoring wells. Because favorable conditions for biodegradation of TCE exist in Landfills 1 and 3 and in FDTA-2, the highest solvent concentrations in these areas normally are of cis-1,2-DCE, which has been reported in groundwater at concentrations as high as 0.13 percent in Landfill 3.

The RI/FS and ROD identified a large area on the northern part of AFP4 as the North Plume. Historically, TCE concentrations in this area were unevenly distributed and generally less than 10 µg/L, with the exception of the FSA-3 area, where up to 500 µg/L TCE was reported during the 1980s. Bedrock is relatively shallow at the north end of the plant, generally dipping to the east, but with an uneven surface that influences groundwater flow in the North Plume. Groundwater flow is generally to the east and north but locally would be expected to follow the bedrock surface contours. In addition to TCE, JP-4 jet fuel has been identified on top of the groundwater in monitoring wells in the FSA-3 area. The potential source of this contamination was thought to be leaking fuel lines and storage tanks surrounding the former Jet Engine Test Stand. Although FSA-3 is within approximately 500 feet of Lake Worth, contaminant concentrations in samples from Lake Worth have never exceeded their respective maximum contaminant levels (MCLs).

3.5.7 Paluxy Aquifer and Upper Sand Groundwater

TCE has been detected in Upper Sand groundwater beneath AFP4 in the vicinity of the Window Area. Vertical migration of TCE from the Terrace Alluvial flow system has likely occurred through the Window Area into the Upper Sand groundwater. TCE concentrations in samples of the Upper Sand groundwater ranged from ND to 5,300 µg/L during comprehensive monitoring of the Upper Sand in October 2006.

TCE and related compounds have been detected in the Upper and Middle Paluxy Aquifers in the vicinity of Landfills 1 and 3 and in the East Parking Lot. At Landfills 1 and 3, past evidence indicated that contaminants may have been reaching the Paluxy by vertical migration through faulty well seals, and two Middle Paluxy wells installed before the extent of DNAPL was known have been abandoned to prevent further contamination (P-22M, WITCPM006). However, contaminants in the Upper Paluxy are more widely distributed within and downgradient of Landfills 1 and 3, and it is not certain that vertical migration via faulty wells would result in a plume of that size and shape. Maximum TCE and cis-1,2-DCE concentrations in recent samples from the Upper Paluxy Aquifer on the west side have been approximately 6 µg/L and 400 µg/L, respectively. Maximum contaminant concentrations from the Middle Paluxy Aquifer on the west side have all been below MCLs with the exception of well WITCPM006, which was one of the wells suspected of having a faulty seal, and which was abandoned and replaced in April 2007.

Contaminant concentrations in Middle and Upper Paluxy wells on the east and south sides of the plant are either not detected or are consistently below MCLs, with the exception of East Parking Lot well P-8UN.

TCE concentrations at that Upper Paluxy location periodically increase to levels above the 5 µg/L MCL (Attachment 1, page 6).

3.6 Site Risks

An evaluation of the potential risks to human health and the environment from site contaminants was conducted as part of the Baseline Risk Assessment (BRA), which was part of the RI/FS. The objectives of the BRA were:

- Identify COCs for human health and ecological risk,
- Provide a basis for determining residual chemical levels that are adequately protective of human health and the environment,
- Help determine if response actions are necessary at the site, and
- Provide a basis for comparing the various remedial alternatives and potential effects on human health.

Results of the BRA are presented in Table 3-1 below.

Table 3-1 – Summary of Baseline Risk Assessment Results *

Site	Human Health Risk	Ecological Risk
AFP4 Landfill 3	Contaminants do not pose an excess risk to human health.	Concentrations of copper, lead, and zinc exceed ecological risk thresholds.
AFP4 Landfill 4	Concentrations of benzo[a]pyrene exceed human health-risk thresholds.	Concentrations of arsenic, cadmium, and copper exceed ecological risk thresholds.
Meandering Road Creek/ Lake Worth Inlet	Contaminants do not pose an excess risk to human health.	Concentrations of silver and Aroclor 1254 exceed ecological risk thresholds.
Building 181	Soil contaminants beneath Building 181 do not pose an excess risk to human health, although the presence of TCE in the vadose zone causes groundwater contamination.	Contaminants do not pose an excess risk to the environment.
Terrace Alluvial Flow System	TCE and DCE contamination is the source of contamination in the Paluxy aquifer. Suspected DNAPL beneath the Assembly Building. Upper zone flow system is hydraulically connected to the Paluxy Upper Sand.	Contaminants do not pose an excess risk to the environment.
Paluxy Aquifer/Upper Sand Groundwater	Presence of TCE and 1,2-DCE may cause excess human health risk in the future in the Basewide TCE Groundwater Plume and in the West Plume under AFP4 Landfill 3.	Contaminants do not pose an excess risk to the environment.

* Table 3-1 is reproduced from Table 6-15 in the ROD, and does not present any new risk conclusions.

4.0 REMEDIAL ACTIONS

4.1 Remediation Objectives

The ROD for AFP4 was signed by all parties in July and August 1996. The entire plant site is considered as a single operable unit and has been divided into four different areas where risk or potential excess risk could exceed the lower threshold level of 1.0×10^{-6} incremental lifetime cancer risk (ILCR). The areas requiring remedial action are:

- AFP4 Landfill 3 and 4, Meandering Road Creek, and Lake Worth,
- Paluxy Aquifer and Upper Sand Groundwater,
- Terrace Alluvium Flow System/Basewide TCE Groundwater Plume, and
- Building 181.

The remedial objectives for the AFP4 site were established in the ROD. As required by the NCP, the general goal and objective of the response actions are to effectively mitigate and minimize damage to and provide adequate protection of public health and the environment. The specific goals and objectives of the response actions for the AFP4 site are summarized in Table 4-1.

4.2 Remedy Selection and Implementation

4.2.1 AFP4 Landfills 3 and 4, Meandering Road Creek, and Lake Worth

These sites were grouped together in the ROD because they have similar soil contamination issues. No Action (with monitoring) is the selected remedy. The selected remedy does not take any action to mitigate risk but rather monitors contaminant levels to ensure that the risk remains within acceptable levels for both human health and the environment.

The selected remedy ensures that the remediation goals are met by monitoring the contaminant levels in the surface water and sediments of Meandering Road Creek and Lake Worth, and groundwater samples collected from monitoring wells in and around AFP4 Landfills 1 and 3. Monitoring is currently conducted semiannually, and samples are analyzed for VOCs, Aroclor 1254, and silver. Landfill 3 and 4 soil contaminants arsenic, cadmium copper, lead, and zinc were monitored indirectly by sampling surface water in Meandering Road Creek between 1998 and 2006. That monitoring was discontinued after a review of the data showed that concentrations of the metals in surface water were not detected or were very low and not increasing (Earth Tech 2006). It is assumed that metals concentrations in Landfills 1 and 3 soils have remained relatively unchanged.

If monitoring indicates an increase in the concentrations of COCs, contingency measures will be implemented. According to the ROD, contingency measures may include capping of the landfills or removal or containment of the source material that is causing the increase in surface-water contamination.

Table 4-1 – AFP4 Remedy Summary

Site or Area	ROD/ESD Remedy	Remediation Goals or Objectives	Numeric Goals or Action Levels
AFP4 Landfill 3 - soil	No Action	Prevent ecological exposure to concentrations of copper, lead, and zinc in soil.	none
AFP4 Landfill 4 - soil	No Action	Prevent human ingestion of soil with benzo[*a*]pyrene at concentrations that cause an excess ILCR. Prevent ecological exposure to arsenic, cadmium, and copper in soil at concentrations greater than ecological risk thresholds.	none
Meandering Road Creek - surface water - sediment	No Action (with monitoring)	Prevent ecological exposure to concentrations of silver and Aroclor 1254 in Meandering Road Creek sediments.	Sediment 1.0 mg/kg silver 0.1 mg/kg Aroclor 1254 Surface Water 5,000 µg/L TCE
Lake Worth - surface water - sediment	No Action (with monitoring)	Prevent ecological exposure to concentrations of Aroclor 1254 in Lake Worth sediments.	Sediment 1.0 mg/kg silver 0.1 mg/kg Aroclor 1254 Surface Water 5 µg/L TCE 70 µg/L cis-1,2-DCE 100 µg/L trans-1,2-DCE 2 µg/L vinyl chloride
Building 181 - soil	Soil Vapor Extraction	Prevent TCE concentrations in the soil from causing unacceptable groundwater contamination in the Paluxy Aquifer.	11.5 mg/kg TCE in soil
Paluxy Aquifer and Upper Sand Groundwater - groundwater	• Extraction and Treatment of Paluxy and Upper Sand Groundwater. • Monitoring	Paluxy Aquifer: Prevent future human exposure by ingestion or inhalation and dermal exposure during showering to VOC concentrations above the MCLs. Upper Sand: Prevent contamination in the Upper Sand from causing TCE contaminant levels in the Paluxy Aquifer to exceed 5.0 µg/L.	Paluxy Aquifer 5 µg/L TCE 70 µg/L cis-1,2-DCE 100 µg/L trans-1,2-DCE Upper Sand 400 µg/L TCE

Table 4-1 – AFP4 Remedy Summary (continued)

Site or Area	ROD/ESD Remedy	Remediation Goals or Objectives	Numeric Goals or Action Levels
Terrace Alluvial Flow System/Basewide TCE Groundwater Plume - groundwater	• Enhanced DNAPL removal using ERH [1] • Extraction and Treatment of Terrace Alluvium Groundwater • In situ contaminant destruction at the property boundary (Carswell iron PRB) [2] • Institutional controls and land use controls[2] • Monitored natural attenuation [2] • Monitoring	• Prevent TCE concentrations from exceeding 400 µg/L in the Window Area. • Remove DNAPL from the groundwater in the area under Building 181 and under the southern portion of the Assembly Buildings/Parts Plant. • Prevent Terrace Alluvium groundwater with contamination above MCLs from migrating off AFP4 or NAS Fort Worth. • Prevent groundwater contamination from causing excess risk in surface water. • Ensure that human health and the environment are adequately protected in areas where Terrace Alluvium groundwater contaminants occur off site above the MCLs, and that the existing remedies (including monitored natural attenuation [MNA]) will reduce off-site Terrace Alluvium groundwater concentrations to below the MCLs within a reasonable timeframe.[3]	Bldg 181 source area 10,000 µg/L TCE At property boundary 5 µg/L TCE 70 µg/L cis-1,2-DCE 100 µg/L trans-1,2-DCE 2 µg/L vinyl chloride In window area 400 µg/L TCE Farmers Branch Creek 5,000 µg/L TCE West Fork Trinity River 5 µg/L TCE

[1] The 2002 ESD changed the selected DNAPL-removal technology from surfactant-enhanced pumping to ERH.

[2] New remedy added by the 2007 ESD to maintain protectiveness after the 2007 sale of the Carswell BRAC Parcel G.

[3] New remedial action objective added by the 2007 ESD to maintain protectiveness after the 2007 sale of the Carswell BRAC Parcel G.

4.2.2 BUILDING 181

The selected remedy to prevent soil contamination from leaching to the Terrace Alluvium groundwater is SVE.

The Building 181 SVE pilot system was installed by Environmental Science and Engineering, Inc. (ESE) and started operation in June 1996. The system was expanded and upgraded in 1998 and 1999, and operation of the expanded system began on March 28, 2000. The remedy includes:

- Vapor recovery wells to extract volatilized TCE.
- Removal of contaminants from the extracted air prior to release to the atmosphere by catalytic oxidation. The catalytic oxidation unit was replaced with activated carbon after reduced TCE concentrations made it uneconomical to operate.
- VEP wells to remove perched groundwater from within the vadose zone. The Building 181 SVE treatment system includes a component of dual-phase recovery in three wells. These dual-phase enhanced recovery wells have been run intermittently in the past but are often dry or do not have enough water to pump. Condensate from the Terrace Alluvium is also collected in the system and treated using an air stripper and off-gas treatment with vapor phase carbon.
- Treatment of the groundwater with air stripping and near-zero off-gas emissions. The treated groundwater is then discharged to the POTW.

4.2.3 TERRACE ALLUVIAL FLOW SYSTEM/ BASEWIDE TCE GROUNDWATER PLUME

The selected remedy for the Basewide TCE Groundwater Plume is enhanced DNAPL/groundwater extraction and treatment with destruction of contaminants. The remedy includes:

- When the ROD was signed, the remedy chosen for the removal of DNAPL from under Building 181 was surfactant-enhanced dissolution into groundwater combined with pumping and treating of groundwater, which was an innovative approach at the time. Prior to implementation, ERH was identified as another emerging alternative that seemed to have fewer risks and a higher probability of success in a shorter timeframe. The Air Force documented the change from surfactant-enhanced treatment to ERH in a 2002 ESD (Jacobs 2002). The ERH treatment was applied to soils and groundwater beneath Building 181 in 2002.
- Treating the extracted groundwater by first passing it through an oil/water separator, then through an air stripper. The treated groundwater would then be discharged to the POTW. Air discharged from the air stripper passes through a vapor-phase carbon adsorption unit before discharging to the atmosphere. Note that the East Parking Lot/Window Area Groundwater Pump and Treat system and the Building 181 SVE system do not incorporate the use of oil/water separators. There was no design basis to use separators with these systems since the recovery of DNAPL is not the intent of the East Parking Lot System, and DNAPL will be recovered as a vapor phase in the Building 181 SVE system.
- Use of a barrier to separate the Window Area from high TCE concentrations in the area of Building 181. The barrier installed in the East Parking Lot as part of the East Parking Lot/Window Area Groundwater Pump and Treat system consists of a line of interceptor wells installed across the main paleo-channel in the East Parking Lot, controlling dissolved TCE migration.
- Institutional controls to restrict future use of the Terrace Alluvium groundwater at AFP4 and NAS Fort Worth. AFP4 is currently operated by Lockheed Martin Aeronautics Company (Lockheed Martin), and access to most of the site is restricted by signs, security fencing, motion sensors, 24-hour video surveillance, and armed patrols. Future land use is not expected to

change; however, if land use does change, deed restrictions may be required to limit the use of Terrace Alluvium groundwater and prevent exposure. Deed restrictions would only occur if all or a portion of the property is transferred.

- Installation of additional monitoring wells. A number of additional monitoring wells have been installed.
- Monitoring to track the areal extent and movement of contamination, the contaminant levels within and around the DNAPL remediation area, and the changes in contaminant concentrations within the plume. Monitoring also includes the West Plume, Meandering Road Creek, Lake Worth, Farmers Branch Creek, and the West Fork of the Trinity River. Monitoring of the North Plume was discontinued in 2002.
- The 2007 ESD added several new elements to the selected remedy, including the Carswell PRB, MNA of contaminants where the plume occurs off federal property, and institutional controls/(ICs)land use controls (LUCs) to maintain protectiveness where the plume occurs off site.

The 2007 ESD was needed because of what has been referred to as the "contingency clause" in the ROD. That clause says that if contamination in groundwater appears to be moving off site at concentrations above MCLs, corrective actions may be taken to stop the plume. Corrective actions may include various containment measures such as interceptor wells, interceptor trench, combined wells and trench, a slurry wall, or expansion of an existing system.

The Air Force implemented the contingency clause in 2002 with the construction of the Carswell PRB, anticipating that the sale of the BRAC Parcel G would re-align the federal property boundary in a way that would place part of the Basewide TCE Plume off site.

The Air Force responded similarly with the installation of a bark mulch PRB ("biowall") at the south end of AFP4 Landfill 3, where a small 0.1 acre of the West Plume extended beyond the property boundary. The Carswell PRB was incorporated as part of the remedy for the Basewide TCE Plume in the 2007 ESD. The Landfill 3 PRB has not yet been formally incorporated into the remedy, but may be incorporated in a future decision document.

4.2.4 PALUXY AQUIFER AND UPPER SAND GROUNDWATER

The selected remedy for the Paluxy Aquifer and Upper Sand Groundwater is Enhanced Groundwater Extraction and Treatment With Near-Zero Off-Gas Emissions. The remedy includes:

- Extracting contaminated Paluxy Aquifer groundwater from under AFP4 Landfill 3. Aquifer tests performed after the signing of the ROD indicated that the Paluxy and Upper Paluxy Aquifers were hydraulically connected. This characteristic raised concerns that pumping groundwater from the Middle Paluxy Aquifer could increase VOC concentrations in the Middle Paluxy by drawing groundwater downward from the Upper Paluxy (International Technology Corporation October 1998). For that reason, Middle Paluxy wells WITCPM001 and WITCPM002 were turned of in November 1998 with regulatory concurrence. Paluxy groundwater extraction from the remaining Upper Paluxy well (WITCPU001) was discontinued in June 2005 after influent concentrations from WITCPU001 remained below remediation goals for several years.
- A provision for extracting contaminated Upper and Middle Paluxy groundwater from beneath the Window Area of the East Parking Lot was also included in the ROD. This would occur if Paluxy contamination in the Window Area of the East Parking Lot exceeded the remediation goals (MCLs). Concentrations of COCs at most Middle and Upper Paluxy wells in the East Parking Lot have remained below remediation goals. Concentrations of COCs at well P-8UN have also

been generally below remediation goals since approximately 1995. However, several short-term increases ("spikes") in TCE concentrations occurred in 1998, 2000, and 2006 (Attachment 1, page 6). The anomalous increase in 2006 was not as high as previous increases, but subsequent TCE concentrations have not decreased as quickly as in the past. It is expected that concentrations will return to more typical levels below the remediation goals, but it can also be expected that concentrations may occasionally spike in the future.

- Extracting contaminated Upper Sand groundwater to minimize contamination moving vertically from groundwater in the Terrace Alluvial flow system to the Paluxy Aquifer. It was intended that this would be accomplished using five new extraction wells in the Upper Sand. Hydraulic conductivities measured in monitoring wells during the system design indicated that pumping rates from 1 to 19 gallons per minute (gpm) could be expected. However, two of the Upper Sand extraction wells contained insufficient water to be used as extraction wells, and the remaining three wells produced at rates between 0.1 and 1 gpm. For those reasons, groundwater extraction from the Paluxy Upper Sand was determined to be impractical, and was discontinued shortly after it began.
- Treating extracted groundwater with ultraviolet oxidation or another technology that would result in near zero off-gas emissions with discharge of the treated water to the POTW. The East Parking Lot/Window Area Groundwater Pump and Treat System uses air stripping with off-gas treatment using vapor phase carbon.
- Installing additional monitoring wells in the Paluxy Aquifer and the Upper Sand groundwater to monitor contaminant movement and concentrations. Monitoring will continue as long as contamination exceeds remediation goals in the Paluxy Aquifer and Terrace Alluvial flow system. At the time the ROD was signed, this timeframe was estimated at 3 years for the Paluxy and 15 years for the Paluxy Upper Sand. Although this estimate has not been updated, the observed rate at which groundwater concentrations are decreasing suggests that the timeframe might be much longer. Several Paluxy and Upper Sand monitoring wells have been installed since the signing of the ROD. These wells are associated with remedial activities on the west side of the plant and with the East Parking Lot and the Window Area. Some of these wells have been added to the LTM program as appropriate.

The ROD specified that sampling would be conducted semiannually during remediation and then annually after remediation is complete, and that monitoring could be discontinued when contaminant levels have been shown to remain below remediation goals. As a result of the LTM program optimization in 2006, the frequency for monitoring most Paluxy wells was reduced to annual, and one new Upper Paluxy well (P-9UN) was added to the LTM program. Optimization of the program will continue as needed. For example, it is expected that the monitoring frequency at P-8UN will be returned to semiannual in response to the recent anomalous concentrations observed at that location.

As noted above, the selected groundwater extraction remedies for the Paluxy (west side) and Paluxy Upper Sand were discontinued before the numeric goals were achieved. Monitoring of the Paluxy aquifer at city water supply wells, at the property boundaries, and elsewhere on site has not indicated any increase in concentrations as a result. If groundwater extraction remains impractical, modifications to the existing remedies may be needed for these intervals, and the changes will need to be documented in a future decision document.

4.3 Voluntary and Interim Remedial Actions

4.3.1 AFP4 Landfills 1 and 3

In conjunction with monitoring of AFP4 Landfills 3 and 4 and Meandering Road Creek, two remediation systems were voluntarily installed and operated by the Air Force. These systems are the AFP4 Landfill 3 VEP system and the FSA-1 groundwater treatment system. The VEP system was installed to reduce contamination in the Terrace Alluvium groundwater that may discharge to seeps along Meandering Road Creek. The FSA-1 system is a pump-and-treat system that treats Terrace Alluvium groundwater collected by two French drains. Operation of these systems is not required by the selected remedy for groundwater under AFP4 Landfill 3 (i.e., the West Plume of the Terrace Alluvial flow system), but the systems have been operated to reduce the concentrations of COCs that may have otherwise entered Meandering Road Creek via groundwater seeps. Note that the FSA-1 system also treated (until June 2005) Upper Paluxy groundwater from a single extraction well as part of the ROD remedy for the Paluxy aquifer.

The Air Force also pumps or bails DNAPL from wells W4WNITC, W5WNITC, and F-214 at frequencies ranging from monthly to semiannually. Approximately 6,900 pounds of DNAPL have been removed since this action began in 2001, of which approximately 3,000 pounds were TCE.

Other voluntary systems or remedial activities in Landfills 1 and 3 include the following:

1. A phytoremediation system was installed along Bomber Road to inhibit contaminant movement toward Meandering Road Creek.
2. The Air Force installed a fence around AFP4 Landfill 3 and across Meandering Road Creek as a physical barrier to prevent access to the creek.
3. Monitoring for dissolved landfill metals in Meandering Road Creek (discontinued in 2006, see Section 4.3.2).

It was determined during a remedial process optimization (Earth Tech 2001) that the VEP system was not cost-effective in removing VOCs and was not significantly affecting groundwater discharge at seeps. The system was turned off in 2002 and was subsequently dismantled. Sampling of seeps and surface water was expanded along Meandering Road Creek to monitor any increases in concentrations that might have resulted, but none have been observed to date.

4.3.2 Meandering Road Creek

Interim surface water monitoring for organics and metals was performed prior to the signing of the ROD. After the ROD was signed, voluntary monitoring of surface water for arsenic, cadmium, copper, lead, and zinc was continued in Meandering Road Creek. This voluntary surface water monitoring was discontinued after 8 years, when a review of the data during the 2006 LTM optimization showed that concentrations of the metals were not detected in surface water or were detected at very low concentrations that were not increasing.

4.3.3 Lake Worth

In addition to LTM sampling, the Air Force has funded more detailed Lake Worth sediment sampling that is conducted by the USGS. Those studies were more comprehensive and evaluated Lake Worth bed sediments at different depths and of different ages, streambed sediments, and sediment suspended in stormwater entering the lake. The total PCB concentrations (Aroclor 1254 plus Aroclor 1260) reported by the USGS for Lake Worth sediments were generally much lower than the LTM results (Aroclor 1254 only) from Meandering Road Creek (USGS 2003).

Lake Worth core sampling performed by the USGS also indicated that PCB concentrations have been decreasing after reaching a peak in the 1960s (USGS 2004). Subsequent suspended sediment sampling in Meandering Road Creek and at stormwater outfalls indicated that the storm drain system at AFP4 may be currently discharging PCBs adsorbed to suspended sediment.

In addition, fish tissue sampling has been performed by the USGS, the U.S. Fish and Wildlife Service, and by the City of Fort Worth. The Texas Department of Health (TDH) (now the Department of State Health Services [DSHS]) placed a fish-consumption advisory on the lake in 2000 because of elevated concentrations of PCBs in fish reported by the USGS in 1999. In 2006, the TCEQ issued a TMDL for PCBs in Lake Worth that established target concentrations and a schedule for implementation activities.

Fish tissue sampling since 1999 indicates that PCB concentrations in fish tissue are declining. Sampling by the city of Fort Worth in 2006 detected PCBs (Aroclor 1016 and Aroclor 1260) in only 3 of 39 samples. In all three samples, concentrations were below the 0.04-mg/kg level that the Texas DSHS considers an acceptable risk to human health. Aroclor 1254 was not detected in any of the samples.

Between 2004 and 2006, the Air Force conducted additional investigations to try to identify a source of PCBs on AFP4. A point source of PCBs could not be identified, despite an extensive investigation of potential sources within the Outfall 4 and Outfall SSO drainage areas. In response to the recommendations issued in the final report (Burns & McDonnell 2006), Lockheed Martin implemented several best management practices to reduce the amount of sediment that enters the storm drains, and initiated several remedial actions in areas where low levels of PCBs had been detected.

1. The frequency of street sweeping was increased and sweeping was expanded to include all paved areas in the Outfall 4 and Outfall SSO drainage areas. This practice reduces the amount of sediment that can enter storm drains and addresses the finding in the 2006 investigation that some of the fine debris and sediment accumulated in paved, non-traffic areas contained low levels of PCBs.
2. Sediment was cleaned from a sump in Building 35 and from Manhole 218.
3. Damaged pavement from the area surrounding Building 35 and from in and around the Conservation Sales area was removed and replaced.
4. Finally, the surface in the fenced substation area that is covered with trap rock will be capped with asphalt to keep sediment in this area from reaching the storm drains. This work was in the planning phase as of October 2007.

4.4 SYSTEM OPERATION / OPERATION AND MAINTENANCE

The following sections discuss O&M and costs associated with the remedies required by the ROD and the voluntary actions. There is a single O&M contractor (Shaw Environmental Inc. [Shaw]) that operates all the systems. Because project costs are primarily tracked on a site-wide basis, some of the costs shown below were prorated based on annual site-wide costs. Examples of costs that were prorated are:

- **Project management costs**. These costs include project management, cost control and reporting, contract and government property administration, procurement, preparation of invoices and payment of subcontractors, record maintenance and control, and clerical support.
- **Field office costs**. These costs include rental of two trailers, computer and office equipment, truck rentals and fuel, tools and supplies, health and safety equipment, and electrical and telephone service.

The O&M contractor also provides field support for the Air Force, the tenant contractor (Lockheed Martin), and other contractors. During the review period, these tasks have included disposition of wastes for other Air Force contractors, technical and site support for the tenant contractor's intrusive construction activities during the ongoing plant expansion, and repairing, abandoning, and replacing wells as necessary to maintain the monitoring well network. Annual costs associated with these tasks have been approximately $200,000.

4.4.1 AFP4 LANDFILLS 3 AND 4

The remedy for AFP4 Landfills 3 and 4 was monitoring of surface water and sediments in Meandering Road Creek and Lake Worth. See Section 4.4.2.

4.4.2 MEANDERING ROAD CREEK AND LAKE WORTH

Monitoring of Meandering Road Creek and Lake Worth continues. During the 2006 LTM optimization process, the frequency of surface water monitoring at one Woods Inlet location was reduced to biennial, and sampling at a more distal Woods Inlet location was discontinued. The sediment sampling for silver and Aroclor 1254 was reduced from three grab samples from Meandering Road Creek and Lake Worth to a single sample collected from a sediment trap installed at the mouth of Meandering Road Creek. Sediment sampling continues semiannually. This system was for monitoring only.

4.4.3 BUILDING 181

The Building 181 SVE system has been operated intermittently since the ERH treatment in 2002. During most of 2006, it was operated as a low-volume groundwater pump-and-treat system to extract groundwater from three downgradient dual-phase extraction wells. The normal Building 181 O&M activities include:

- Checking the Building 181 system for and performing repairs, as needed.
- Checking and adjusting treatment components and plant flow rates to maintain optimal performance.
- Responding to alarm conditions and restarting recovery wells and the Building 181 system, as needed.
- Recording SVE, Terrace Alluvium well field, and Building 181 system operational data.
- Collecting monthly city of Fort Worth POTW discharge monitoring water samples (influent and effluent).
- Collecting periodic Building 181 system performance monitoring water samples.
- Measuring quarterly Building 181 area monitoring well groundwater levels.
- Changing bag filters.
- Changing vapor-phase and liquid-phase carbon, as necessary.
- Periodic monitoring of Building 181 system SVE wells with a flame ionization detector to determine total soil-vapor VOC concentrations.
- Maintaining clean and safe working conditions in the Building 181 system area well field, well vaults, and building.

Costs to operate the Building 181 SVE system were estimated by Shaw based on known individual system costs and prorated management and other site costs. The total includes all labor, analytical, reporting, field costs, and some performance evaluation activities.

Project management	$20,000
Field office costs	$18,000
Field labor	$60,000
Travel	$2,000
Laboratory analytical costs	$6,000
Carbon (vapor)	$8,500
Carbon (liquid)	$4,000
Maintenance/repair parts	$4,000
POTW fee	$2,500
Reporting Costs	$15,000
Total Annual O&M Cost, Building 181	**$139,000**

4.4.4 EAST PARKING LOT - WINDOW AREA TREATMENT SYSTEM

The East Parking Lot system was started on November 1, 2001, after being upgraded and expanded to meet the requirements of the ROD. The system withdraws Terrace Alluvium groundwater from 51 extraction wells in the East Parking Lot and in the flightline area of AFP4. Between November 2001 and March 2007, the system treated approximately 125 million gallons of water. The system removed over 2,000 pounds of VOCs during that period, the majority of which was TCE.

In addition to routine maintenance and replacement of mechanical components and replacement of carbon and air stripper packing, non-routine maintenance performed during the review period included:

- Re-grounded the control system and replaced surge protection to protect components during electrical storms,
- Replaced most of the original pressure sensors and variable-frequency drives,
- Replaced pH control/acidification system,
- Replaced other components as needed.

Most repair activities required that the system be turned off or operated at reduced capacity, reducing overall system performance during the period. System performance was also affected by drought conditions that persisted in north Texas during 2005 and 2006. The reduced Terrace Alluvium water levels have required increased operator attention to keep individual wells and the system operational, resulting in increased downtime or operation at reduced capacity.

Costs to operate the East Parking Lot system were estimated by Shaw based on known individual system costs and prorated management and other site costs. The total includes all labor, analytical, reporting, field costs, and some performance evaluation activities.

Project management	$20,000
Field office costs	$18,000
Field labor	$50,000

System Costs:

Engineering support, labor and travel	$28,000
Capital equipment	$15,000
Materials	$17,000
Equipment rental	$2,000
Carbon changeout (estimated, normally less than once per year)	$12,000
Electrical (subcontractor)	$8,000
Laboratory analytical costs	$12,000
Electrical costs (maximum per year)	$30,000
Reporting costs	$22,000
Spare parts	$15,000
POTW	$2,500
Total Annual O&M Cost, East Parking Lot System	**$251,500**

4.4.5 FSA-1 PUMP AND TREAT SYSTEM

The FSA-1 pump and treat system currently treats groundwater removed from Landfill 1 from French Drains 1 and 2, LTM purge water, and groundwater generated during other site activities. The system costs are included here because, for part of the five-year review period, the system also treated Paluxy groundwater as part of the selected remedy for the Paluxy. Paluxy groundwater treatment was discontinued in 2005.

Although not directly related to operation of the FSA-1 system, DNAPL removal costs are included under this system also. Normal FSA-1 O&M is performed by Shaw, and the activities include:

- Checking the FSA-1 system for leaks and making repairs,
- Recording operational data,
- Measuring quarterly West Parking Lot area recovery and monitoring well water levels,
- Changing treatment system bag filters,
- Collecting Meandering Road Creek discharge water samples,
- Checking and adjusting French drain pumps and treatment system components, and
- DNAPL removal from Landfills 1 and 3 and DNAPL disposal.

The following costs are associated with operating the FSA-1 system and DNAPL removal.

Project management	$20,000
Field office costs	$18,000
Field labor	$50,000

System Costs:

Engineering support, labor and travel	$4,000
Capital equipment	$3,000
Carbon changeouts	$14,700
Electrical (subcontractor)	$1,000
Laboratory analytical costs	$6,090
Electrical costs (estimated)	$6,100
DNAPL disposal	$17,000
Reporting costs	$11,300
Total Annual O&M Cost, FSA-1 System	**$151,190**

5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

5.1 Protectiveness Statement from First Five-Year Review

The protectiveness statement from the previous five-year review reads as follows:

The remedy is expected to be protective of human health and the environment upon remediation of the soil, surface water, and groundwater. Exposure pathways that could result in unacceptable risks are being managed by institutional controls to prevent exposure to contaminated groundwater. All threats at the site are being addressed by the various remedial projects, institutional controls, and voluntary actions.

Long-term protectiveness of the RAs will be verified by the Long-Term Monitoring program, which monitors sediment, surface water, and groundwater concentrations of COCs.

This statement was still applicable during the current review period despite the transfer of former government property to private ownership and an improved understanding of the distribution of PCBs in sediments.

5.2 Recommendations from First Five-Year Review

Several recommendations were made in the first five-year review based on comments received from the tenant contractor and the O&M contractor.

Table 5-1 – Response to Recommendations in the First Five-Year Review

Issue	Recommendations	Follow-up Actions	Affects Protectiveness? (Y/N)	
			Current	Future
Trees used in the phyto-remediation project along Bomber Road need to be protected from beavers.	Install protection for trees.	Additional fencing was not installed at this voluntary action.	N	N
One East Parking Lot extraction well may have casing breach or collapse.	If necessary, replace East Parking Lot extraction well TA-83.	Well WJETA083 was replaced.	N	N
Comparison of real East Parking Lot data to USGS model.	After one year of East Parking Lot system operation, compare real data to USGS groundwater model.	Periodic water level measurements indicate that hydraulic capture has been achieved.	N	N

In an interview for the first five-year review, the tenant contractor (Lockheed Martin) indicated that the phytoremediation trees should be protected from damage by beavers. The damage had occurred south of and adjacent to Landfill 3, outside the Landfill 3 fence. Although it would have been desirable to protect the trees for aesthetic reasons and for potential future phytoremediation research, COCs are not detected in groundwater in this area (wells HM-34 and HM-35); therefore, no additional fencing was constructed.

The O&M contractor (Shaw) had a number of comments regarding the operation of the then-new East Parking Lot Groundwater Treatment System. Since the first five-year review, Shaw has replaced a number of system components, improved electrical grounding, and abandoned and replaced well WJETA083. Shaw also commented that East Parking Lot water level data should be collected after one

year of system operation and used to update the original USGS model. Water levels have been measured monthly in the East Parking Lot from 2001 through 2005 and quarterly since 2005. Additional groundwater modeling has not been performed, but Shaw's review of the data has indicated that hydraulic capture has been achieved.

In addition, the EPA made the following four recommendations in its Five-Year Review Memorandum (EPA 2004).

> *(1) The exposure assumptions used in the risk assessment have not changed. EPA conducted a Draft TCE Toxicity Risk Re-Assessment in September 2001. The Draft Re-Assessment provided for a range of potential TCE toxicity and established new "provisional values". These provisional values are more stringent and EPA recommends the Air Force evaluate risk using both values, as warranted.*

The provisional toxicity values have not yet been implemented by the EPA, and a determination of which values to use will be deferred until any future risk assessment for TCE is performed.

> *(2) TCE contamination of the Terrace Alluvium ground water on the BRAC property remains above the remedial goal of 5.0 μg/L. This contamination is predominantly from the base-wide TCE plume. A ROD Amendment is required to implement and monitor an institutional control (IC) program which is a necessary component for transferring the BRAC property to the public. The Air Force shall notify the EPA if a BRAC property transfer occurs before the next Five-Year Review. EPA recommends use of the IC User Guidance (EPA540-F-00-005, September 2000), including the use of the IC Checklist and IC Tracking System (ICTS), as warranted. Even without the transfer of property, other protective measures may be needed such as a base-wide comprehensive plan that formally restricts the use of ground water.*

The BRAC Parcel G property transfer took place in April 2007. To allow the transfer to take place, an ESD was developed and approved that provided for the implementation of institutional controls. The ICs were incorporated into the deed language and will be monitored by the Air Force until contaminant concentrations on the property fall below remediation goals (the MCLs, in this case). A plan to inspect and monitor the ICs will be prepared.

> *(3) EPA recently published the Draft Guidance For Evaluating The Vapor Intrusion To Indoor Air Pathway From Ground Water and Soils (Subsurface Vapor Intrusion Guidance) (EPA530-F-02-052, November 2002). EPA recommends that the Air Force conduct a screening evaluation as to whether or not the vapor intrusion exposure pathway is complete and, if so, whether it poses an unacceptable risk to human health. EPA recommends that this screening evaluation is necessary for both the BRAC property; as well as occupied buildings and structures above the base-wide TCE plume; and for any remedial systems that off-gas TCE.*

The potential for vapor intrusion into residential basements was evaluated in the FFS (HGL 2005). Fourteen soil gas samples were collected near monitoring wells and structures in BRAC Parcel G, and equivalent indoor air values were estimated by applying a reduction factor to the soil gas measurements. The reduction factor incorporated average soil density, porosity, the barrier effect of a foundation, dilution, and other factors.

Based on TCE concentrations in 13 of the 14 soil gas samples, the calculated non-cancer hazards associated with soil gas intrusion into a hypothetical basement were less than 0.0014, and the carcinogenic risks ranged from 2.7×10^{-10} to 8.5×10^{-7}. At one anomalous location, the non-cancer hazard was estimated to be 0.17, and the carcinogenic risk was 6.7×10^{-5}.

Although AFP4 wells were not included in the evaluation, the risks would be expected to be lower than those estimated for BRAC Parcel G because conditions are even less favorable for vapor intrusion beneath AFP4. Groundwater occurs at similar depths, but is often confined, and the soil above the water table is often characterized by less-permeable clay. Where groundwater TCE concentrations are highest (Buildings 181 and 182), the buildings are constructed on slabs, and the construction of the warehouse-type buildings permits a passive, relatively unhindered exchange of outside air. In addition, the air-handling systems in parts of the building used for offices completely exchange the building air volume several times during the day and maintain a positive pressure within those areas.

(4) Performance monitoring and evaluation is necessary to continuously optimize the remedial action at the site.

Influent and effluent concentrations at the systems continue to be monitored, and water levels in the East Parking Lot and West Parking Lot are currently monitored quarterly. The systems have been managed to respond to the reduced concentrations as remediation progresses, and have generally reduced water levels in the Terrace Alluvium.

5.3 Remedial Action Progress

5.3.1 Landfills 3 and 4, Meandering Road Creek, and Lake Worth

Landfills 3 and 4 were grouped together in the ROD because they have similar soil contamination issues and the selected remedy for both was LTM of Meandering Road Creek surface water and sediment. Soil contaminants are cadmium, copper, lead, and zinc at Landfill 3 and arsenic, cadmium, copper, and zinc at Landfill 4. Although LTM is not required for landfill soils, it is not expected that metals concentrations in Landfills 3 and 4 soils have changed significantly over time.

The selected remedy was LTM for VOCs in surface water and silver and Aroclor 1254 in sediments. The ROD identified an action level of 5,000 µg/L for TCE in surface water as the level at which ecological impacts might occur and the respective MCLs as a remediation goal for Lake Worth surface water. TCE was rarely detected in Meandering Road Creek or Lake Worth between 2002 and 2006, and cis-1,2-DCE was only reported at concentrations near the detection limit. All detections were at some fraction of their respective remediation goal or action level. Slightly higher concentrations have been detected in samples collected during non-LTM sampling performed near several upstream seeps, but those concentrations were also below their respective remediation goals.

The LTM program monitored sediment at two Meandering Road Creek locations and one Lake Worth location during most of the review period. The average concentration of Aroclor 1254 in the 28 LTM sediment samples collected between 2002 and 2006 was 0.057 mg/kg, below the 0.1 mg/kg remediation goal. The average concentration of silver in the 28 LTM sediment samples collected between 2002 and 2006 was 1.56 mg/kg, above the 1.0 mg/kg remediation goal.

The silver concentrations are similar to those measured during the previous five-year review period and do not appear to be increasing. A source for silver in sediment was not identified in the RI/FS or in the ROD, although silver was detected above background in several samples from Landfill 3 fill material (Rust Geotech 1995).

<u>*Summary.*</u> Although the average Aroclor 1254 concentration measured in LTM samples and in lake sediment samples collected by the USGS were below the remediation goal, the public may measure future progress by whether the fish consumption advisory can be lifted. Recent PCB concentrations in fish tissue do not warrant a consumption advisory, but the Texas DSHS may require that concentrations remain at the recent levels for some period of time before altering or lifting the advisory. Regarding the

ongoing remediation goal exceedance of silver in sediment, the ROD stated that the ecological risk assessment was conservative and the current concentrations may not constitute a significant additional risk.

5.3.2 Building 181

The remediation goals for the Building 181 area are 11.5 mg/kg TCE in soil and 10,000 µg/L TCE in groundwater. The primary remediation elements are ERH and SVE. Removal and treatment of condensate and groundwater are additional elements of the SVE system. Following expansion and full-scale implementation in 1999, the SVE system initially received high influent vapor concentrations from the expanded well field and removed a substantial mass of TCE during the initial months of operation. A similar effect was noted after the previous expansion. However, soil vapor concentrations decreased, and TCE removal rates declined until the ERH application began in 2002.

The determination to use ERH instead of surfactant-enhanced DNAPL removal occurred after the signing of the ROD, and was documented in an ESD (ASC 2002b). An advantage of ERH was that it could heat and remediate an area without needing to identify specifically where DNAPL resided in the subsurface. It was implemented full-scale in 2002, utilizing the existing SVE system to remove contaminants mobilized in the process (URS Corporation [URS] 2004).

The boiling point of TCE in contact with water (73 degrees Celsius [°]) was reached in nearly all of the unsaturated (vadose) zone deeper than 4 feet during the ERH, but maximum temperatures decreased with depth in the saturated zone. The average temperature in the 0–4 foot interval peaked at approximately 47° C because of heat lost through the concrete slab.

Approximately 1,743 pounds of TCE were removed by the system during the 8-month heating period and the pilot study. The mean TCE concentration in soil was reduced to 0.184 mg/kg, and the 95 percent upper confidence limit (UCL) TCE concentration in soil was reduced to 0.29 mg/kg. The mean TCE concentration in groundwater was reduced to 4,100 µg/L, and the 95 percent UCL TCE concentration has been reduced to 7,400 µg/L. These concentrations are all below the remediation goals of 11.5 mg/kg TCE for soil and 10,000 µg/L TCE for groundwater. A total of approximately 7,700 pounds of TCE have been removed since the initial pilot-scale SVE system began operation in 1993.

Based on the temperatures achieved during the ERH application and the subsequent low soil vapor concentrations, it appears that vadose zone remediation was efficient and complete. The low concentrations of TCE observed in soil vapor since the ERH are most likely a result of volatilization of dissolved TCE from groundwater. Groundwater concentrations appear to be rebounding in a limited area and are currently above the 10,000 µg/L remediation goal in the vicinity of monitoring well MW-10.

Since the ERH application, the SVE system has been operated intermittently, allowing soil vapors to accumulate for 6 to 8 months and then removing those vapors over several weeks or months. It has also been operated intermittently as a low-volume pump-and-treat system, generally pumping less than 0.2 gpm of groundwater from wells UZ-2, UZ-3, and UZ-7 in Building 182. Approximately 0.5 pound of TCE was removed from extracted groundwater during 2006.

Summary. The ERH successfully reduced vadose zone soil concentrations to less than 3 percent of the remediation goal of 11.5 mg/kg TCE. An unknown mass of TCE was also removed from the saturated zone, but TCE concentrations in groundwater are rebounding in a small area, and it is likely that some residual source material remains below the water table. It should be noted that, although residual DNAPL may remain in pore spaces below the water table ("stained soils" have been observed), there has never been any evidence of pooled DNAPL. This is based on numerous soil borings advanced since 1991, and

an investigation of the areas of highest soil vapor concentration using hydrophobic dyes, which also did not identify any DNAPL (URS 2004).

If a source remains below the water table, it is not likely that any significant amounts of TCE could efficiently be removed using SVE. In-situ chemical oxidation, enhanced bioremediation, or other alternatives should be evaluated to destroy, degrade or remove whatever remaining source material that exists.

5.3.3 Terrace Alluvial Flow System/ Basewide TCE Plume

East Parking Lot - Window Area Treatment System. The remediation goal for Terrace Alluvium and Paluxy Upper Sand groundwater in the Window Area is 400 µg/L TCE. The primary remediation elements are a groundwater pump-and-treat system that extracts groundwater from the Terrace Alluvium in the Window Area, and pumping from extraction wells installed to create a hydraulic barrier upgradient of the Window Area. The East Parking Lot pump-and-treat system is designed to isolate the TCE source from the Window Area and the rest of the plume so that downgradient concentrations can be reduced by natural attenuation processes.

Terrace Alluvium TCE concentrations in the East Parking Lot have declined since reaching a peak in 1992. The initial declines can be attributed primarily to source removal efforts in Building 181, indicated by decreasing concentrations upgradient of the East Parking Lot.

Terrace Alluvium TCE concentrations in the East Parking Lot and Window Area have continued to decline during the past five-year review period, but because the plume concentrations entering the East Parking Lot have also declined, it is difficult to isolate the effects of the pump-and-treat system on groundwater concentrations. However, between November 2001 and December 2006, an estimated 1,829 pounds of TCE were removed from groundwater by the system. Of that, approximately 150 pounds were removed during 2006.

TCE removal rates have declined during the review period, due in part to decreasing influent concentrations, from an average of 3,100 µg/L TCE in 2001 to approximately 1,200 µg/L in 2005 and 2006. In addition, the aging of some of the system components has resulted in increasing amounts of system downtime for repairs and maintenance and/or operation at reduced capacity. A third contributing factor during 2005 and 2006 has been reduced groundwater levels in the East Parking Lot and reduced groundwater extraction rates. Drought conditions persisted over north Texas during 2005 and 2006, and repairs to leaking potable water lines at the plant may have further reduced the amount of groundwater flow beneath the East Parking Lot.

The reduced water levels in the Terrace Alluvium also require increased operator attention to keep the well field and system operating properly. As a result, the system has not been operated on weekends since approximately July 2006, or approximately 39 percent of the time. If additional days of downtime for maintenance and repairs are included, the actual time that the system operates in subsequent years may be less than 50 percent. The effect of the drought and the reduced operation schedule was that the average extraction rate in 2006 was approximately 31 gpm, compared to an average rate of 47 gpm during 2004 and 2005. The average rate for the period January through March 2007 was approximately 20 gpm.

Paluxy Upper Sand groundwater was not treated during the review period. However, concentrations have decreased slightly, presumably due to natural attenuation and dilution by less-contaminated groundwater from the Terrace Alluvium.

Former BRAC Property. The remedies for this area include the Carswell zero-valent iron PRB, MNA, and ICs/LUCs. Very limited data have been collected since the remedies for this area were established in the 2007 ESD. However, the Carswell PRB has been functioning since 2002 and removes VOCs with an

efficiency of more than 99 percent in some of the monitoring transects. The area of treated groundwater (below remediation goals) was approximately 9 acres in 2007, leaving an area of approximately 20 acres downgradient from the PRB to be remediated by the PRB and natural attenuation. A 12 to 15-acre area of lower concentrations to the north (phytoremediation area) will be remediated by natural attenuation.

Summary. During the review period, the East Parking Lot treatment system removed TCE mass from the plume and created a hydraulic barrier between the source area and the Window Area and the rest of the plume. Approximately 1,829 pounds of TCE were removed from Terrace Alluvium groundwater between 2001 and 2006. Of that amount, approximately 150 pounds were removed in 2006. At recent production rates, it was estimated that approximately 100 pounds would be removed in 2007. As the rate of TCE removal declines, the per-pound cost to remove TCE is expected to increase, and alternatives should be evaluated to determine whether the VOC contaminants can be removed, destroyed, or degraded using a more cost-effective technology.

5.3.4 FSA-1 System (Paluxy Groundwater)

To fulfill the ROD requirements for Paluxy groundwater, the FSA-1 pump-and-treat system was expanded in 1998 to extract and treat groundwater from two Upper Paluxy and two Middle Paluxy extraction wells in the area downgradient from Landfill 3 and the former waste oil pits. The remediation goals for groundwater in the Paluxy Aquifer are the MCLs.

The system was originally designed to treat groundwater from two reconfigured monitoring wells at FSA-1 and from French Drains 1 and 2 (ESE 1994). Although pumping from FSA-1 was discontinued prior to 1998, the system is still referred to as the "FSA-1 system."

Pumping from the Middle Paluxy was discontinued shortly after it started in 1998 when it became clear that such pumping might increase the rate of vertical migration from the Upper to the Middle Paluxy. Subsequent Paluxy groundwater extraction was limited to well WITCPU001, where extraction rates were constrained by low hydraulic conductivity, limiting the pumping rate to approximately 1 gpm.

Extraction of Upper Paluxy groundwater was discontinued in June 2005 after influent concentrations of TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride had remained below remediation goals for the previous four years. Assuming an annualized rate of 0.75 gpm, the system would have removed an estimated 2.5 million gallons of Upper Paluxy groundwater in 6.5 years and approximately 0.05 pound of VOCs, primarily cis-1,2-DCE and vinyl chloride. As of March 2007, the FSA-1 system continues to treat approximately 5 gpm of groundwater from the two French drains as a voluntary action.

Although concentrations in the Paluxy extraction wells were below the remediation goals, the initial concentrations before groundwater extraction commenced were also low. In contrast, concentrations of cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride at upgradient Upper Paluxy wells remained relatively unchanged during the past 5 years, at concentrations up to 10 times the remediation goals. TCE concentrations were below the remediation goals at all but one Paluxy well.

Summary. During the review period, the influent concentrations from the Paluxy extraction wells were below the remediation goals in an area downgradient of Landfills 1 and 3 and the former waste oil pits. However, higher concentrations of TCE degradation byproducts remain in the Upper Paluxy Aquifer beneath Landfills 1 and 3 and the former waste oil pits.

The remediation goal exceedances are limited to an approximate 7-acre area in the Upper Paluxy on the west side of the plant. The Middle Paluxy is not impacted above the MCLs, and the nearest downgradient property boundary is approximately 2,500 feet to the south. The nearest municipal water supply well is approximately 0.9 mile to the south-southeast. Despite the distance to downgradient receptors, the FS and ROD selected groundwater treatment for the Paluxy because groundwater modeling in the BRA

indicated a potential future threat to drinking water supplies. Given the limited and apparently stable distribution of contaminants in the Upper Paluxy, it appears that the modeling significantly overestimated the mobility of contaminants and the threat to public water supply wells (Section 7.2.2).

Future reductions in Upper Paluxy concentrations using groundwater extraction would be difficult because part of the area is beneath a DNAPL-affected area that is risky to drill through. Low hydraulic conductivities in the Upper Paluxy further limit the effectiveness of groundwater extraction as well as many other technologies. Natural attenuation was not considered as an alternative in the ROD, but might be an acceptable option if the current remedy is modified in the future.

5.3.5 Other Progress

The size of the Basewide TCE Plume was reduced by approximately 75 acres during the review period, or approximately 7 percent. These reductions occurred in three different areas east of the runway. The first was in the vicinity of the Navy ramp at NAS Fort Worth, where the downgradient extent of the central lobe retreated in an apparent response to reduced concentrations coming out of the East Parking Lot (21 acres). The second was the distal extent of the southern lobe of the plume, where it occurred beneath the former Carswell golf course (45 acres). This was believed to be due primarily to hydrologic changes resulting from the construction of a new irrigation pond at the golf course and was first noted in 2000. The third is a 9-acre area immediately downgradient of the Carswell PRB. Groundwater TCE concentrations in this area have been reduced to below the MCLs as a result of installation of the zero-valent iron PRB in 2002.

The shape of the plume in the vicinity of the AFP4 Northeast Parking Lot became better defined after investigations determined that a low-level TCE source is probably located near the north end of Building 5, at the approximate location of a Terrace Alluvium groundwater divide. From there, groundwater with relatively low concentrations of TCE flows to the east and west.

In 2004, a PRB composed of bark mulch, cotton gin waste, and sand (biowall) was constructed at the south end of AFP4 Landfill 3 to intercept low-level groundwater contamination that was moving off site in this area. The wall is approximately 90 feet long, 2 feet wide, and 7 to 10 feet deep. An approximate 0.1-acre off-site area is affected before groundwater is discharged at three seeps (Figure 5-1).

The intent of the biowall was to stimulate biodegradation of contaminants. Moderate increases in total organic carbon concentrations were observed at most downgradient wells, but concentrations returned to previous levels after approximately 2 years. Although downgradient VOC concentrations generally decreased following the biowall installation, upgradient concentrations also decreased.

5.3.6 Administrative Progress

In addition to reports documenting LTM results, O&M, and other site activities, a number of documents were produced to document progress or specific changes at the site.

- ESD to document the change from surfactant-enhanced DNAPL removal to ERH in Building 181 (July 2002)
- FFS for the southern lobe of the TCE Plume on the former Carswell golf course (June 2005)
- Operating Properly and Successfully Demonstration Report to document that the remedies implemented for the former BRAC property were operating properly (June 2006)
- The Final IRA Completion Report for AFP4 (June 2006)
- Preliminary Close Out Report for AFP4 (September 2006)
- ESD to establish that the former BRAC property could be transferred to non-federal ownership without negatively impacting public health or the environment (April 2007)

The April 2007 ESD was created to document the systems that are in place to address off-site groundwater contamination beneath the former Carswell golf course property (BRAC "Parcel G"). When the property was transferred to non-federal ownership in April 2007, the federal property boundary was realigned in such a way that the southern lobe of the plume extends off federal property at concentrations above the remediation goals.

The 2007 ESD identified remedial components that address the off-site contamination including: a) the existing remedies in place at AFP4; b) the Carswell PRB, which intercepts and treats the groundwater with the highest concentrations at the federal property boundary; c) monitored natural attenuation for portions of the plume that would be off federal property; and d) ICs to ensure that the new users of the property are not exposed to contaminants. It also creates a fourth RA objective to ensure that the remedies remain protective of human health and the environment.

In February 2007, the Air Force renewed its discharge agreement with the Fort Worth Water Department for treated groundwater discharged from the treatment systems in the East Parking Lot and Building 181 to the city's sanitary sewer system. The new agreement left the discharge volumes unchanged, but increased the maximum discharge limits allowed for TCE, total petroleum hydrocarbons, and several other VOCs. The previous limits had been the MCLs. This agreement pertains to the system operation and is not related to any ROD requirements.

6.0 FIVE-YEAR REVIEW PROCESS

6.1 Administrative Components

Members of the RAB and the regulatory agencies were notified of the initiation of the five-year review at the public RAB meetings in May and November of 2006. The AFP4 Five-Year Review Team was led by Mr. John Doepker and Mr. George Walters of the ASC, the Air Force's Remedial Project Managers for the AFP4 site. ASC was assisted by technical staff from Earth Tech.

The period of review extended from June 2002 through May 2007.

6.2 Community Involvement

The community was notified of the initiation of the five-year review at a public meeting in May and November of 2006. An update was provided at the May 2007 RAB meeting. No public concerns were identified at the meetings. ASC Public Affairs staff conducted community interviews the week of May 8–11, 2006, and summarized the responses in the October 2006 Draft Community Information Plan (Section 3.3). Participants included regulatory officials, local elected officials, environmental groups, RAB members, and private citizens. The responses are summarized in Section 6.7.

6.3 Document Review

Documents reviewed included, but were not limited to, LTM reports, remedial action and construction completion reports, and O&M reports. The applicable soil and groundwater cleanup levels specified in the ROD were also reviewed. A complete list of documents reviewed is shown in Attachment 2.

6.4 Data Review

6.4.1 Groundwater Monitoring

The LTM program objectives are to monitor for contaminants in groundwater, surface water, and sediments associated with contaminated sites to provide data necessary to recognize if additional RAs are needed to protect public health and the environment. LTM at AFP4 began with semi-annual sampling in April 1998. Previous to this, quarterly monitoring had been performed since 1991.

The current LTM program includes sample collection from 93 monitoring wells, 2 city water supply wells, and 7 surface water and sediment locations. Attachment 1 contains charts illustrating general trends in groundwater quality at LTM locations where TCE or its degradation products have been detected.

With the exception of well WITCPM006, all Middle Paluxy monitoring wells have remained below remediation goals during the review period (Attachment 1). However, TCE concentrations at well WITCPM006, located in the DNAPL area at AFP4 Landfill 1, have been 5 to 6 times the remediation goal of 5 µg/L. Not only are the TCE concentrations anomalous for the Middle Paluxy, the ratio of TCE to its degradation byproducts (cis-1,2-DCE, vinyl chloride) at WITCPM006 is far higher than what is observed in the Terrace Alluvium and the Upper Paluxy in this area. The concentrations were unusual enough to suspect a faulty well seal, and WITCPM006 was abandoned and replaced in April 2007. The preliminary results from the April 2007 LTM indicated that approximately 1 µg/L cis-1,2-DCE was detected in replacement well WSHAWPM007 and that no TCE or other COCs were detected. The preliminary results indicate that the TCE detected at WITCPM006 may not have been indicative of the Middle Paluxy groundwater quality in the area.

An area of Upper Paluxy groundwater beneath AFP4 Landfills 1 and 3 has not yet met the remediation goals (MCLs), and groundwater from one well in the East Parking Lot (P-8UN) intermittently exceeds the remediation goal for TCE. Paluxy Upper Sand groundwater in the vicinity of the Window Area has also

not yet met the remediation goal of 400 µg/L for TCE. Current remediation goal exceedances for the Paluxy and Paluxy Upper Sand are shown on Figure 6-1.

VOC concentrations continue to decline in nearly all areas of the Terrace Alluvium although remediation goals have not yet been met in several areas shown on Figure 6-2. Areas where TCE concentrations were not decreasing during the review period include:

- Building 181. Some rebound is occurring in a 0.1-acre area after substantial decreases in groundwater TCE concentrations were achieved during the ERH treatment.
- AFP4 Landfills 1 and 3. VOC concentrations are not increasing, but distinct decreasing trends could not be identified at all locations. The presence of DNAPL may limit the possibility of any long-term or large-scale reduction in groundwater concentrations. Groundwater concentrations in the immediate DNAPL areas are high and fluctuate considerably, possibly an effect of ongoing remedial activities. Specifically, periodic DNAPL pumping and bailing may not allow the DNAPL/groundwater interface to reach an equilibrium state.
- Former BRAC property. VOC concentrations are currently decreasing in all areas. However, VOC concentrations at WHGLTA043 had previously increased over a five-year period until they reached a peak in May 2006. The increases in this area were believed to be due to changes in groundwater flow direction caused by the installation of a new irrigation pond in 2000.

6.4.2 Surface Water and Sediment Monitoring

The LTM includes surface water sample collection from Meandering Road Creek, Farmers Branch, West Fork of the Trinity River, and Lake Worth, and sediment sample collection from Meandering Road Creek and the inlet to Lake Worth. The charts in Attachment 1 illustrate the general trends in surface water quality.

Concentrations of TCE have remained below the ROD action level at all surface water sampling locations along Farmers Branch and Meandering Road Creek, and below the MCLs in Lake Worth and the West Fork of the Trinity River.

Since 1998, sediment grab samples have been collected at Lake Worth location LW-03 and at Meandering Road Creek locations C-5 and SW-08 and analyzed for Aroclor 1254 and silver. Beginning in 2006, a single sample from a sediment trap at location C-5 was substituted for the previous three grab samples. The average concentration of Aroclor 1254 in the 28 LTM sediment samples collected between 2002 and 2006 was 0.057 mg/kg. Aroclor 1254 was not detected in 17 of the 28 samples and was above the 0.1 mg/kg remediation goal in five samples. The average concentration of silver in the 28 LTM sediment samples collected between 2002 and 2006 was 1.56 mg/kg, above the 1.0 mg/kg remediation goal. Silver was not detected in 3 of the 28 samples, and was above the remediation goal in 15 samples (Figure 6-3).

6.5 Site Inspection

The site inspection was conducted by the O&M contractor, Shaw, on May 2, 2007. Participants included Rick Wice (Shaw), Robert Sullivan (EPA), Mark Weegar (TCEQ), and George Walters (ASC). All of the active and former treatment systems were observed, and no significant issues affecting the protectiveness of the remedy were noted. However, it was noted that some sections of the fence surrounding Landfill 3 had deteriorated, and that recent flooding had damaged some parts. The site inspection results are included as Attachment 3.

6.6 Interviews

Interviews were held with parties familiar with AFP4 through an emailed questionnaire. These interviewees were chosen to reflect viewpoints from informed individuals representing their organizations. Several responses were received, and they are summarized below and included in Attachment 3. Members of the public were also interviewed as part of a community relations effort in May 2006. Those responses are summarized in Section 6.7.

Overall, there were no significant problems identified in the interviews. The general impression of the project was that it was progressing satisfactorily, but a few areas of concern were expressed. Richard Wice (Shaw), in his response to the O&M questionnaire, reiterated his comments from the first five-year review that there was an unexpected amount of electrical work needed on the East Parking Lot treatment system shortly after the system became operational, but that the remedy is functioning as expected. He also indicated that sampling and O&M activities have been optimized to reduce the overall costs to operate the systems.

John Mummert, commenting on PCB issues for the TCEQ TMDL program, indicated an overall positive impression of the Air Force's efforts to investigate possible AFP4 sources of PCBs to Lake Worth's Woods Inlet. He said that TMDL staff participated in AFP4 technical meetings and an inspection of Meandering Road Creek, and described the level of communication between his office and the Air Force and Air Force contractors, and felt well-informed of the PCB-related activities at the plant.

Mr. Mummert pointed out that the current ROD does not include the human health exposure pathway from the consumption of fish and recommended that consideration should be given to associating PCB issues and the fish consumption risk with the ROD in some manner. He suggested that such inclusion would help to assure the public that PCB issues will continue to be addressed until the consumption risk has been adequately reduced. He pointed out that the consumption advisory has been an issue of public concern and is likely to remain so until the advisory is lifted.

6.7 Community Relations

In May 2006, Air Force representatives interviewed members of the public and local authorities regarding the remediation activities at AFP4 as part of the preparation of an updated Community Relations Plan. The general comments from the interviewees were summarized by Estella Holmes of ASC Public Affairs in February 2007 in the following paragraphs.

In general, there has been little change in community attitudes and concerns since the 2004 Community Relations Plan update. The people interviewed and those they come into contact with are very supportive of both Lockheed Martin and the Air Force. Most see Lockheed Martin as an important part of the local economy and of national security. People are comfortable with the cleanup work the Air Force is conducting and most seem to believe the Air Force is doing a good job. If anything, people trust the Air Force to do the right thing and the cleanup is no longer a part of their lives.

Over one-third of the participants expressed concerns about Lake Worth PCB contamination and the fish-consumption advisory. The next most-often expressed concern was about the overall awareness of the general public. One-third of the participants mentioned this. At the same time, all participants stated they no longer hear any mention of the cleanup or of any concerns or complaints by others. Additionally, all participants were aware of the RAB.

One-quarter of the interview participants felt that communication with the public could be improved. Half of these respondents felt RAB presentations and fact sheets were too technical. Some offered suggestions to expand and improve communication. These suggestions included presenting a brief

summary of the site at each RAB meeting for any newcomers, recapping prior updates before presenting new material and putting a cleanup information website on the Internet.

Other comments and suggestions included the following:

- Establish a Lockheed Martin employee awareness program (one participant).
- Communicate progress on the transfer of property (one participant).
- Explain what is being done to prevent further or new contamination from occurring in the future (one participant).

7.0 TECHNICAL ASSESSMENT

7.1 Question A: Is the remedy functioning as intended by the decision document?

The review of documents, applicable or relevant and appropriate requirements (ARARs), and risk assumptions indicates that the remedies are functioning as intended in the ROD or will meet the intent of the ROD when completed. Significant differences have been identified and have been addressed by implementation of the RAs.

7.1.1 AFP4 Landfills 3 and 4

The selected remedy for these areas was monitoring, and it was not intended to reduce concentrations of metal COCs in landfill soils. The LTM program continues to monitor surface water and sediment from Meandering Road Creek.

The fencing used to restrict access to Landfill 3 and Meandering Road Creek includes two heavy gates designed to allow high surface water flows and debris to pass during flood-stage while restricting access during normal flow conditions. Occasionally, debris can obstruct the gates so that they do not fully close after flood events; this may allow access to the landfill and creek adjacent to the landfill. Although the gates are inspected periodically, it has been infrequently observed that trespassers or vandals have accessed the area, possibly through one of the gates.

7.1.2 Meandering Road Creek and Lake Worth

The selected remedy was LTM for VOCs in surface water and silver and Aroclor 1254 in sediments. TCE was rarely detected in Meandering Road Creek or Lake Worth between 2002 and 2006, and cis-1,2-DCE was only reported at concentrations near the detection limit. All VOC detections were at some fraction of their respective remediation goal or action level.

The average concentration of Aroclor 1254 was below the remediation goal of 0.1 mg/kg during the review period. The average concentration of silver in LTM sediment samples was above the 1.0-mg/kg remediation goal, but was similar to concentrations observed in the previous five-year review period and during the RI.

7.1.3 Building 181 Soil

The upgraded Building 181 SVE system began operation on March 28, 2000. The technology used to remove source material was changed from surfactant-enhanced pumping to ERH, which was implemented in 2002. The combined use of ERH and SVE successfully reduced soil TCE concentrations to less than 3 percent of the remediation goal in just two years, which is three years less than the five years estimated in the ROD.

7.1.4 East Parking Lot and Window Area

The upgraded groundwater treatment plant for the East Parking Lot and Window Area began operation on November 1, 2001. The system has removed approximately 1,800 pounds of TCE since that time and has created a hydraulic barrier to isolate the TCE source from the Window Area and the rest of the plume. TCE concentrations in the Terrace Alluvium have decreased during the review period and continue to decrease. However, the rate at which the system is removing TCE and the rate at which groundwater TCE concentrations are decreasing are both declining. The time estimated in the ROD to complete this remedy was 15 years. At the current rate of decrease in TCE concentrations, it is likely that reaching the 400-µg/L remediation goal in the Window Area will occur beyond the timeframe estimated in the ROD.

The ERH application in Building 181 reduced groundwater TCE concentrations to below the 10,000 µg/L remediation goal in most areas, although some rebound has occurred at two wells. MNA and/or operation

of the Building 181 SVE system alone are unlikely to achieve the groundwater remediation goals within any reasonable timeframe. However, numerous injectable technologies are available that might achieve the groundwater remediation goal relatively quickly in the small remaining area of exceedance.

7.1.5 Paluxy Aquifer and Upper Sand Groundwater

Extraction of Upper Paluxy groundwater was discontinued in June 2005 after concentrations of VOCs had remained below remediation goals at the extraction well for the previous four years. Concentrations of several VOCs remain above remediation goals in the Upper Paluxy beneath AFP4 Landfills 1 and 3. Based on a statistical analysis performed for the 2006 LTM optimization, concentration trends at most of the Upper Paluxy wells in this area were indistinct. Either no trend could be identified or trends were classified as "probably decreasing." The ROD estimated a timeframe of 3 years to remediate the Paluxy. That is, remediation would be complete in 2002. It is not known what the basis for that estimate was.

Extraction of Paluxy Upper Sand groundwater was discontinued shortly after initial testing and operation. It was determined that groundwater extraction would not be feasible due to low hydraulic conductivities encountered in the formation. Concentrations in the Paluxy Upper Sand are decreasing due to natural attenuation and reduced concentrations in the Terrace Alluvium. Although the ROD estimated 15 years to remediate the Paluxy Upper Sand, it is not likely that the 400-µg/L remediation goal will be achieved within that timeframe at the current rate of decrease in TCE concentrations.

In each interval, VOC concentrations remain above their respective remediation goals. The remediation goals and any potential follow-on actions will be reviewed and formalized in a future decision document.

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

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

7.2.1 Changes in Standards to be Considered

The methods used to perform a BRA for AFP4 have not significantly changed during the review period. There were no changes to the ARARs identified in the ROD that change the protectiveness of the remedies However, several new documents or standards have been published since the last review that may be added as "To Be Considered" in a future decision document: 1) the National Emission Standards for Hazardous Air Pollutants standard for remediation systems; 2) the TMDL for Lake Worth; and 3) the fish consumption advisory for Lake Worth.

A list of ARARs applicable to the selected remedies is included in Attachment 4.

7.2.2 Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

EPA conducted a Draft TCE Toxicity Risk Re-Assessment in September 2001. The Draft Re-Assessment provided for a range of potential TCE toxicities and established new "provisional values." These provisional values have not yet been approved. No other toxicity characteristics or contaminant characteristics have changed. Several of the exposure assumptions used in the risk assessment that were reviewed for this report are summarized below.

Exposure Assumptions for Paluxy Groundwater

The groundwater modeling performed in support of the BRA was intended to provide a very conservative assessment of risk to city water supply wells. Subsequent LTM and hydraulic measurements performed by the USGS and during the pre-design investigation indicate that it was excessively conservative and not realistic in light of what is currently known.

The model projected that the highest contaminant concentrations observed in on-site Paluxy and Paluxy Upper Sand wells would reach all city water supply wells within 30 years, and that contaminants from some wells would start to impact the nearest city well (WS-12) within 3 to 7 years (Figures 7-1, 7-2). Not only have contaminants *not* appeared in city wells, they have also not appeared in monitoring wells at the AFP4 property boundary that are approximately half the distance away.

The model appears to make several assumptions that are now known to be overly conservative or incorrect, and they are listed below.

- It assumed that the highest reported concentration at a location was representative of the groundwater in that area. LTM has shown that occasional spikes in concentration have occurred at some wells, but they are not representative of average concentrations in an area.
- The model used the hydraulic conductivity of the Middle Paluxy (39 feet per day) for all Paluxy hydrologic units. The highest COC concentrations are observed in the Upper Paluxy and Paluxy Upper Sand, and the hydraulic conductivities in those units are several orders of magnitude less than those in the Middle Paluxy.
- It assumed a "homogeneous and isotropic" aquifer, even though the groundwater with the highest concentrations (from the Paluxy Upper Sand) would need to pass through two aquitards to reach a Middle Paluxy well screen.
- It assumed a continuous source, and that there would be no retardation or degradation.

Exposure Assumptions for Aroclor 1254

The BRA and ROD characterized Aroclor 1254 in sediment as a potential ecological risk and Aroclor 1260 in sediment as below the anthropogenic background concentrations in Lake Worth. LTM of sediments and other sediment sampling performed during the review period indicate that the average Aroclor 1254 concentration has remained below the remediation goals. However, the BRA did not evaluate the potential for human exposure through consumption of fish.

Analyses of fish tissue by the USGS in 1999 prompted the TDH to issue a fish consumption advisory for Lake Worth in 2000, limiting any potential human exposure. LTM of sediments and sampling of fish tissue and other media continues. The most recent fish tissue sampling by the city of Fort Worth in 2006 detected PCBs (Aroclor 1016 and Aroclor 1260) in only 3 of 39 samples. In all three samples, concentrations were below the health-based assessment comparison value (non-cancer) used by the city for comparison. Aroclor 1254 was not detected in any of the samples.

BRAC Property Transfer

The ROD required that contaminated groundwater remain within federal property and that the Air Force and Navy control groundwater use and manage potential exposures on federal property through institutional controls.

In April 2007 the Air Force BRAC transferred the former Carswell golf course property (BRAC "Parcel G") to non-federal ownership. When that occurred, the federal property boundary was realigned in such a way that a portion of the southern lobe of the TCE Plume extended off federal property at concentrations

above the remediation goals. Land use on the parcel is not expected to change significantly, and the majority of the property is restricted to non-residential uses.

The 2007 ESD identified MNA, ICs, LUCs, and the Carswell PRB as additional remedy components that will ensure protectiveness. In particular, the ICs and LUCs will restrict the use of groundwater on the property and ensure that workers are protected if excavation is performed on the site.

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

LTM data indicate that groundwater and surface water contaminant concentrations are decreasing, and that sediment concentrations are not increasing. The review of O&M and performance monitoring indicates that most the major systems continue to remove contaminants. Soil remediation in Building 181 has been completed in a shorter timeframe than what was projected in the ROD, but some RAs as currently implemented will likely extend beyond their projected timeframes.

7.4 Technical Assessment Summary

Based on the data and historical documents reviewed, the remedies are generally functioning as intended by the ROD and remain protective. The physical conditions of the site have not changed, and the ARARs cited in the ROD for soil, sediments, surface water, and groundwater are being met. Toxicity factors have remained the same since the ROD, and there has been no change to the standardized risk assessment methodology that could affect protectiveness of the remedy. Where remediation goals have not yet been achieved, they will be achieved, although that is expected to take longer than the ROD estimated in several areas. Monitoring and ICs will continue where contamination persists on site and off site.

8.0 ISSUES

Table 8-1 lists the issues identified in this review. None of the issues identified affect protectiveness of the remedies.

Table 8-1 – Issues

Issue	Affects Current Protectiveness?	Affects Future Protectiveness?
The remediation goal for soil beneath Building 181 was met in 2002, 3 years earlier than the 5 years estimated in the ROD. However, groundwater concentrations indicate that source material remains in the saturated zone. SVE is not an efficient technology to remediate groundwater. Using SVE to address contamination in the saturated zone could extend the time and increase the total cost to remediate Building 181.	No	No
Based on current groundwater concentration trends, remediation of the Terrace Alluvium and Paluxy Upper Sand in the Window Area may take longer than the 15 years estimated in the ROD. This could increase the total cost to remediate the Window Area.	No	No
The length of time needed to remediate the Upper Paluxy at Landfills 1 and 3 has exceeded the 3 years estimated in the ROD, and groundwater extraction has been discontinued.	No	No
Two Air Force monitoring wells were damaged or destroyed during construction activities on the former BRAC property in April 2007 before ICs and LUCs could be fully implemented.	No	No
Unauthorized persons have infrequently entered the restricted, fenced area around Landfill 3, and some deterioration was noted during the five-year review inspection (Attachment 3).	No	No
The RAs for the Upper Paluxy and the Paluxy Upper Sand were suspended for technical reasons. Groundwater extraction was not feasible in the case of the Upper Sand, and the remediation goals had been achieved within the capture zone of the Upper Paluxy extraction well.	No	No
The contingency clause of the ROD was implemented to address a 0.1-acre area of off-site groundwater contamination adjacent to Landfill 3. A bark mulch PRB was constructed to intercept the groundwater.	No	No
A small portion of the southern lobe of the Basewide TCE Plume extends onto the former BRAC property where it bypasses the northern end of the Carswell PRB. It is expected that it would take a long time to reach the remediation goals in this area by natural attenuation alone.	No	No
In an interview response and in the 2006 TMDL, the TCEQ suggested that consideration be given to associating PCB issues and the fish consumption risk with the ROD in some manner to assure the public that PCB issues will continue to be addressed. The consumption advisory has been an issue of public concern and is likely to remain so until the advisory is lifted. The TMDL estimated that the fish consumption advisory could remain in place for up to 15 years.	No	No

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9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 9-1 lists recommendations and follow-up actions to address the issues identified in this review. The Air Force is the party responsible for implementing recommendations.

Table 9-1 – Recommendations and Follow-Up Actions

Issue	Recommendations/Follow-up Actions
Remediation of Building 181 groundwater using SVE alone would result in a long remediation time.	Alternative or additional actions should be reviewed to determine if cost savings may be realized by reducing the length of time needed to remediate Building 181 (an in situ reductive technology was implemented in early 2008 to address remaining groundwater issues).
Remediation of the Terrace Alluvium in the Window Area may take longer than the 15 years estimated in the ROD.	Alternative or additional actions should be reviewed to determine if cost savings may be realized by reducing the length of time needed to remediate the Window area.
Remediation of the Paluxy Upper Sand in the Window Area may take longer than the 15 years estimated in the ROD.	Alternative or additional actions should be reviewed to determine if cost savings may be realized by a) reducing the length of time needed to remediate, or b) incorporating MNA into the existing remedy, given the conservative and incorrect assumptions used in the 1995 groundwater model.
Remediation of the Upper Paluxy has taken longer than the 3 years estimated in the ROD.	Alternative or additional actions should be reviewed to determine if cost savings may be realized by a) reducing the length of time needed to remediate, or b) incorporating MNA into the existing remedy, given the conservative and incorrect assumptions used in the 1995 groundwater model.
Monitoring wells were damaged or destroyed on the former BRAC property.	Complete and implement the IC/LUC Implementation Plan. Periodically communicate with the property owner and operators to reaffirm the restrictions that are in place and communicate the locations of Air Force assets on the property.
Unauthorized persons have infrequently entered the restricted, fenced area around Landfill 3, and some deterioration has been noted.	Continue to inspect stream gates periodically, particularly after storm events. Consider installing signs at gates and other potential access areas, and perform fence repairs as needed to control access to this part of the site.
The RAs for the Upper Paluxy and the Paluxy Upper Sand have been discontinued.	If the selected remedies for these intervals cannot be continued, alternative remedies should be considered, and changes should be documented in an appropriate decision document.
The contingency clause of the ROD was implemented to address a 0.1-acre area of off-site groundwater contamination adjacent to Landfill 3.	Document the construction of the Landfill 3 bark mulch PRB in an appropriate decision document.
A small portion of the southern lobe of the Basewide TCE Plume bypasses the Carswell PRB.	Evaluate whether extending the Carswell PRB or some other action might be cost-effective by reducing the length of time required to monitor off-site contamination beneath the former BRAC property.
The TCEQ suggested associating PCB issues and the fish consumption risk with the ROD in some manner to reduce public concern.	Evaluate whether to incorporate the Lake Worth consumption advisory and/or the TMDL into a future decision document in some way, or whether some other action would also reduce public concern until the advisory is lifted.

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10.0 PROTECTIVENESS STATEMENT

The remedy is expected to be protective of human health and the environment upon remediation of the soil, surface water, and groundwater. Exposure pathways that could result in unacceptable risks are being managed by ICs to prevent exposure to contaminated groundwater.

Long-term protectiveness of the RAs will be verified by the LTM program, which monitors concentrations of COCs in sediment, surface water, and groundwater.

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11.0 NEXT REVIEW

It is anticipated that the next five-year ROD review for AFP4 will be required by September 2014, or five years from the signature date of this review.

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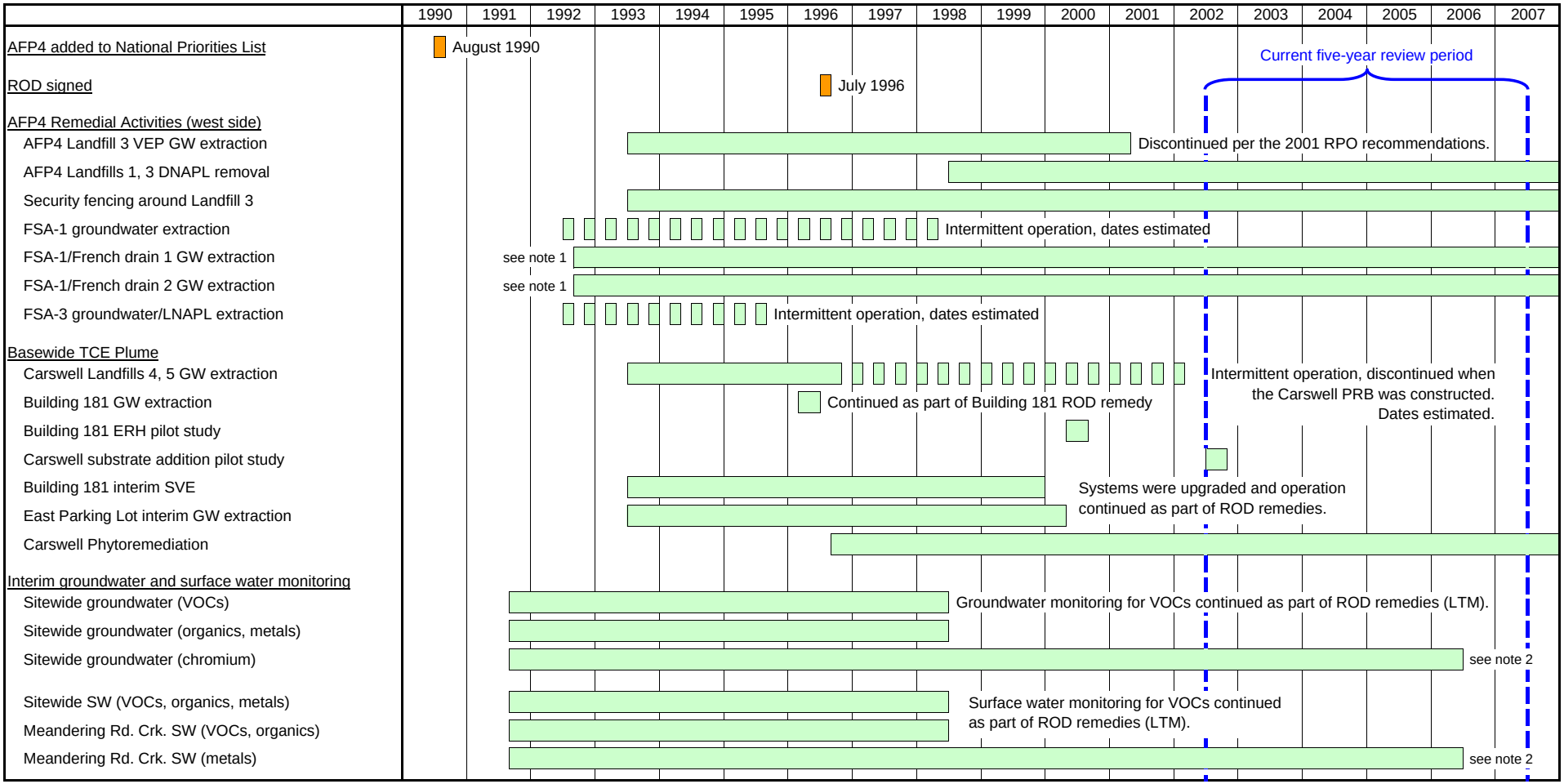
FIGURES

FIGURE 1-1
AFP4 INTERIM AND VOLUNTARY REMEDIAL ACTIONS
Five-Year Review Report - September 2008

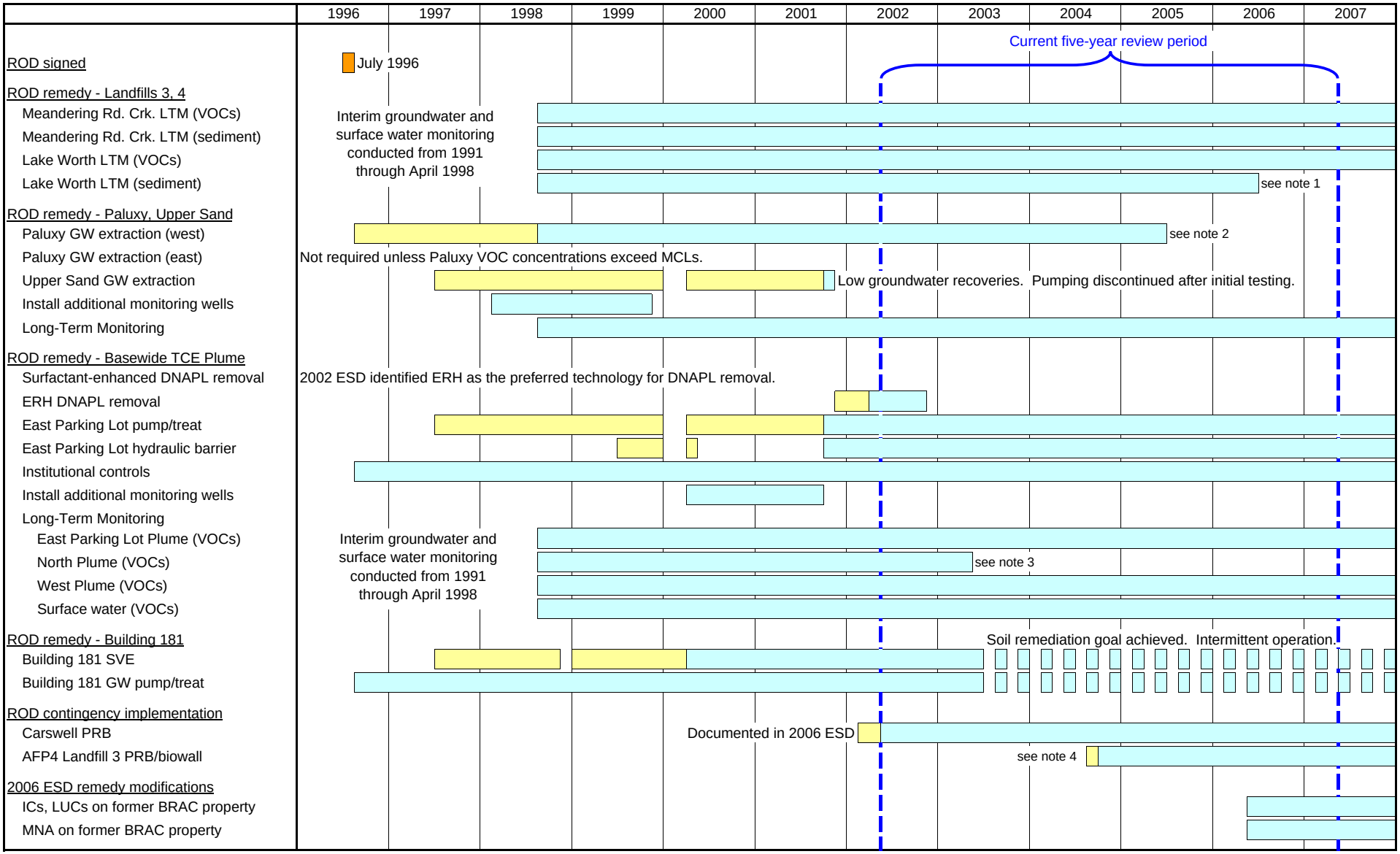


Notes:
1 French drains 1 and 2 were installed in 1982 and 1983, respectively. Prior to being connected to the FSA-1 system in 1992, leachate was removed from the drains and disposed of by various means.
2 Monitoring for metals in Meandering Road Creek and chromium in groundwater was discontinued in response to the 2006 LTM optimization recommendations.

Duration of interim or voluntary remedial activity.

DNAPL dense nonaqueous-phase liquid
ERH electrical resistive heating
GW groundwater
LNAPL light nonaqueous-phase liquid
PRB permeable reactive barrier
ROD record of decision
SVE soil vapor extraction
SW surface water
VEP vacumm-enhanced pumping
VOC volatile organic compound

FIGURE 1-2
AFP4 REMEDY IMPLEMENTATION
Five-Year Review Report - September 2008



Notes:
1 Grab sampling of bed sediments discontinued in 2006. Monitoring of transported sediment in Meandering Rd. Crk continues.
2 Extraction discontinued after extracted groundwater VOC concentrations remained below remediation goals since 2001.
3 Monitoring of North Plume discontinued after VOC concentrations remained below remediation goals since 1998.
4 Constructed in response to a small area of off-site groundwater contamination.

Remedy pre-design, design, and construction

Remedy Implementation

BRAC base realignment and closure
DNAPL dense nonaqueous-phase liquid
ERH electrical resistive heating
ESD explanation of significant differences
GW groundwater
IC institutional control
LUC land use control
MCL maximum contaminant level
MNA monitored natural attenuation
PRB permeable reactive barrier
ROD record of decision
SVE soil vapor extraction
VOC volatile organic compound

AFP4 is located approximately 7 miles west of Fort Worth. The facility shares a runway with NAS Fort Worth JRB, formerly Carswell Air Force Base.

N

0 0.5 1.0 Miles

FIGURE 3-1
AIR FORCE PLANT 4 (AFP4)
SITE LOCATION

Air Force Plant 4
Five-Year Review Report
September 2008

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99406\work\5-Year Review\REPORT\FIGURES\Figure 3-1.ppt

NAS Fort Worth property boundary after BRAC property transfer in April 2007.

N

0 900 1,800 3,600 Feet

1 inch equals 1,800 feet

FIGURE 3-2

AIR FORCE PLANT 4 AND VICINITY

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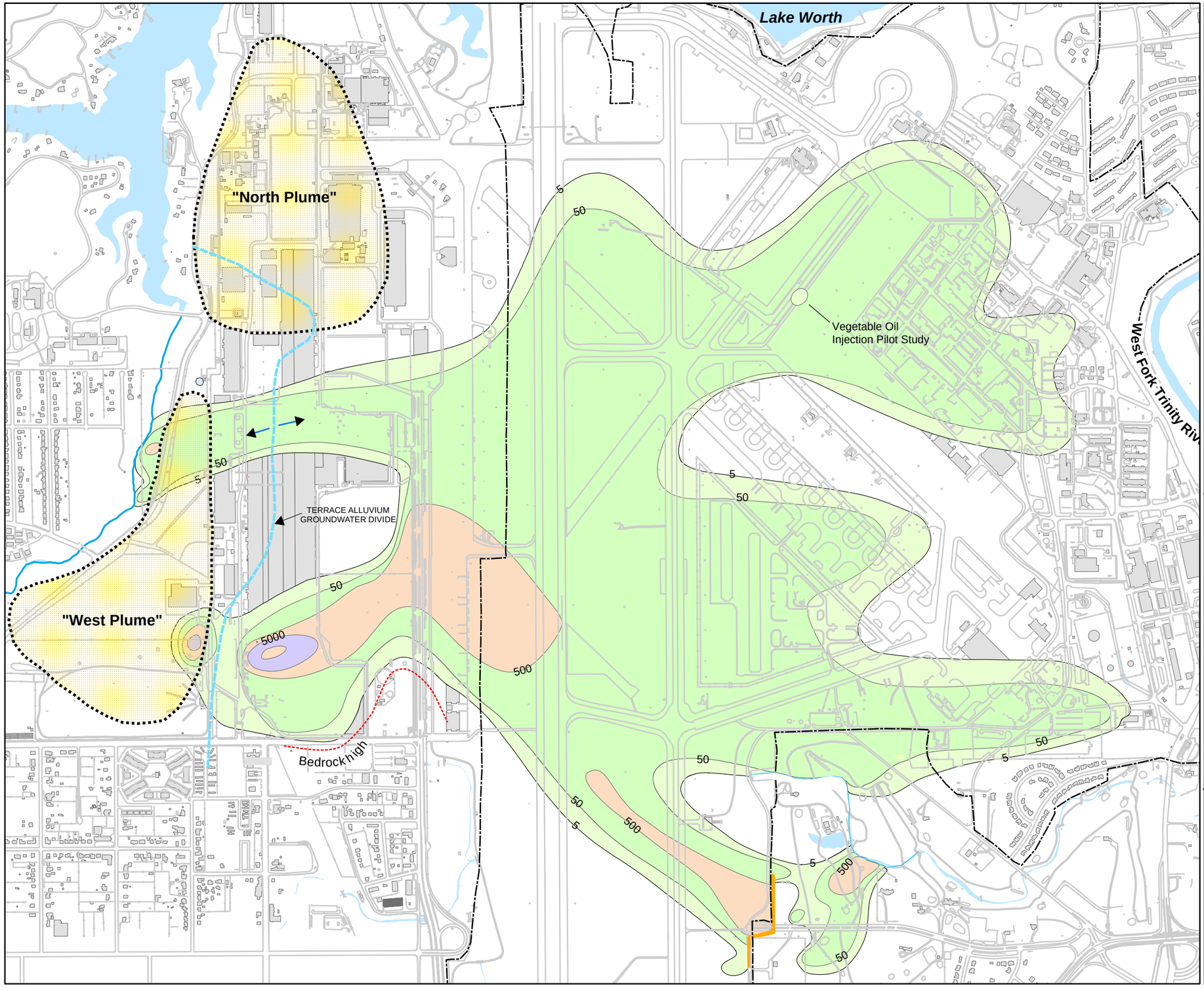
\AFP4 GIS\2007 5Yr Review\5-year Rev Figure 3-2.mxd



Legend

- NAS Fort Worth JRB property boundary
- TCE plume extent (µg/L)
- Carswell Permeable Reactive Barrier
- Location of Groundwater divide upgradient of Building 181 in October 2005
- Terrace Alluvium plumes defined in ROD.
- Groundwater flow directions at groundwater divide beneath AFP4 Buildings 4 and 5
- 5 - 50 µg/L
- 50 - 500 µg/L
- 500 - 5,000 µg/L
- >5,000 µg/L

Notes:

The West and North Plumes are referred to in the RI, the ROD, and the first Five-Year Review. They designate areas of low, widely dispersed, intermittently-detected solvent concentrations in groundwater.

Monitoring of the North Plume was discontinued in 2002. Monitoring of the West Plume continues.

N

0 500 1,000 2,000 Feet

1 inch equals 1,000 feet

FIGURE 3-3

TERRACE ALLUVIUM BASEWIDE TCE PLUME IN MAY 2006

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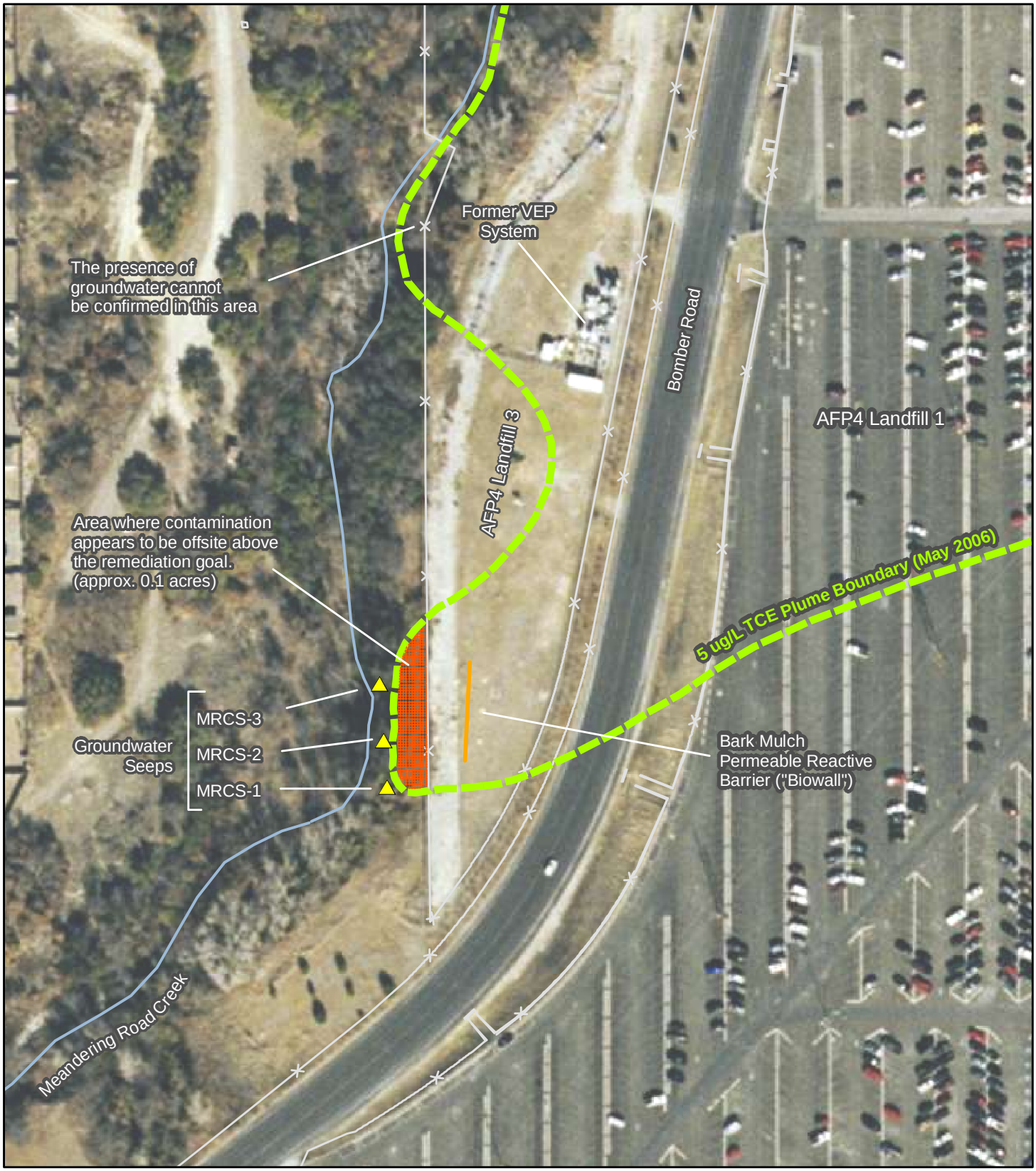
\AFP4 GIS\2007 5Yr.Review\5-year Rev.Figure 3-3.mxd



Offsite plume extent

Groundwater seep location

Plume outline is taken from the May 2006 LTM plume map. The plume outline in the vicinity of the biowall is based on 2007 seep concentrations and analytical results from VEP wells.

N

0 62.5 125 250 Feet

1 inch equals 125 feet

FIGURE 5-1

LOCATION OF 2004 BARK MULCH PERMEABLE REACTIVE BARRIER

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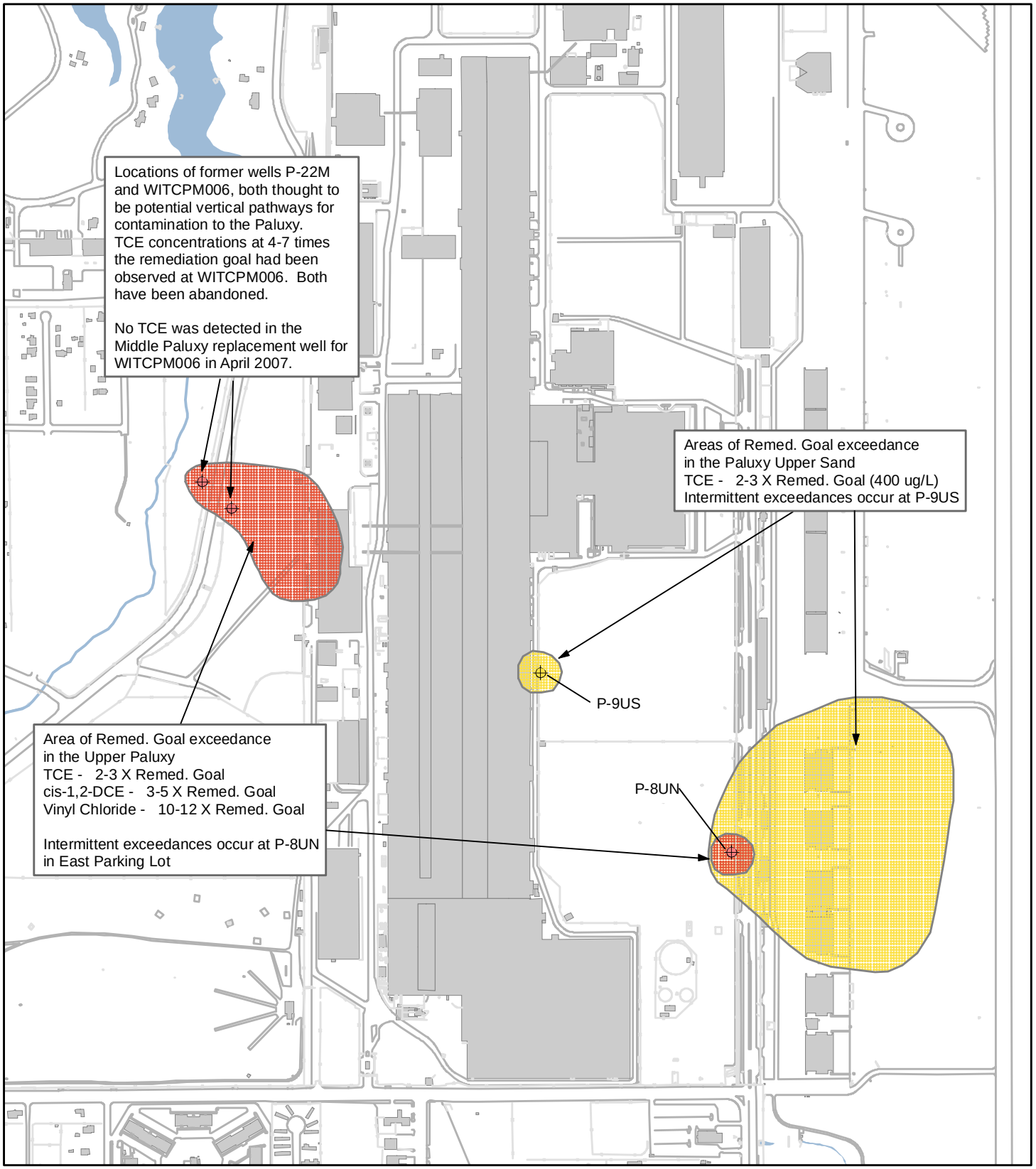
\AFP4 GIS\2007 5Yr.Review\5-year Rev.Figure 5-1.mxd



Remediation goal exceedance(s) in the Upper Paluxy (MCLs)

Remediation goal exceedance in the Paluxy Upper Sand (400 ug/L TCE)

Middle or Upper Paluxy well

Paluxy Upper Sand well

N

0 325 650 1,300 Feet

1 inch equals 650 feet

FIGURE 6-1

REMEDIATION GOAL EXCEEDANCES IN THE UPPER PALUXY AND PALUXY UPPER SAND

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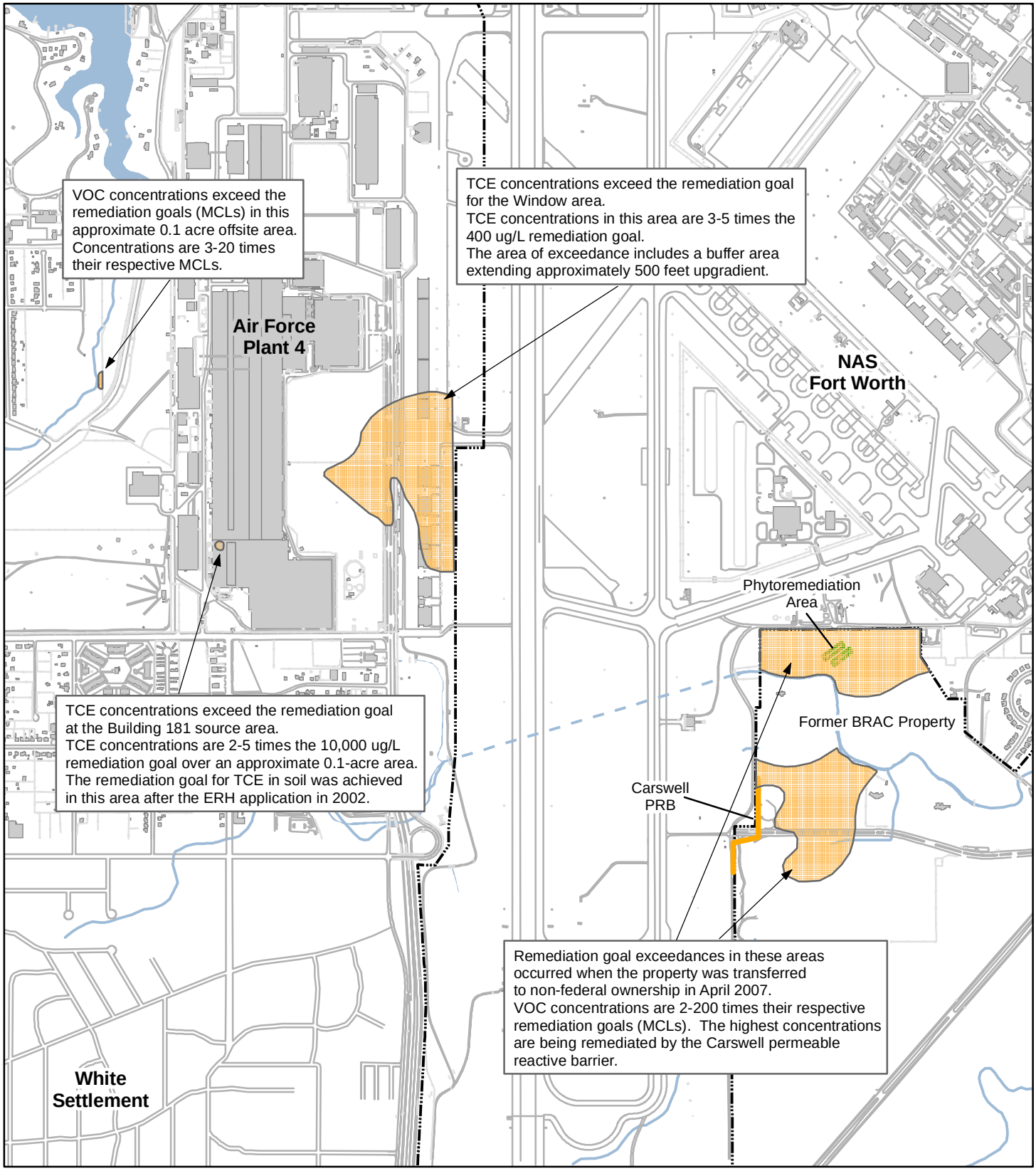
\AFP4 GIS\2007 5Yr Review\5-year Rev Figure 6-1.mxd



Remediation goal exceedance(s) in the Terrace Alluvium

Phytoremediation area

Carswell permeable reactive barrier (PRB)

NAS Fort Worth JRB property boundary after April 2007

N

0 0.125 0.25 0.5 Miles

1 inch equals 0.25 miles

FIGURE 6-2

REMEDIATION GOAL EXCEEDANCES IN THE TERRACE ALLUVIUM

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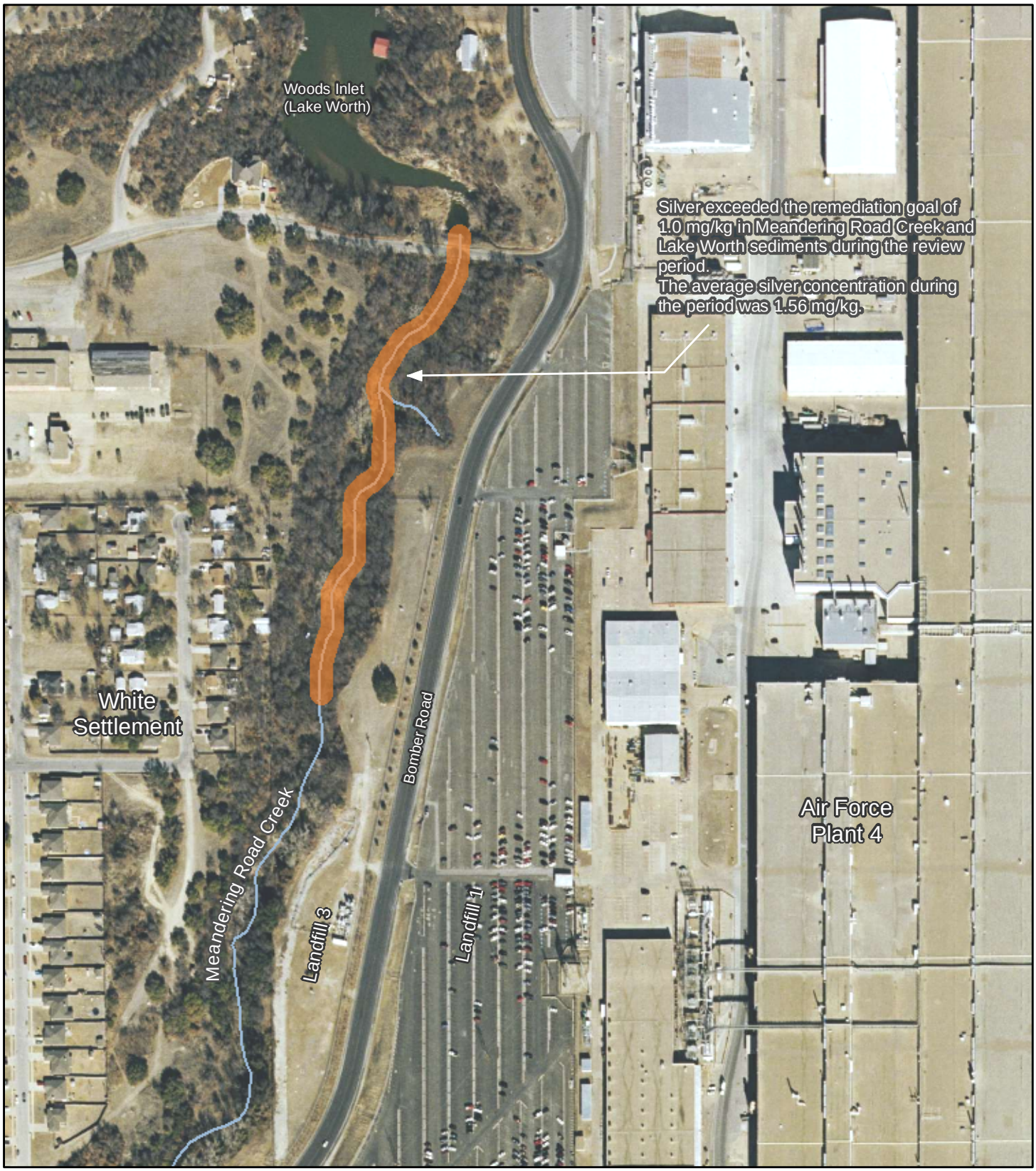
\AFP4 GIS\2007 5Yr.Review\5-year Rev.Figure 6-2.mxd



Remediation goal exceedance for silver in Meandering Road Creek and Lake Worth sediments.

N

NOTE: The average concentration of Aroclor-1254 in sediment during the review period was 0.057 mg/kg, below the 0.1 mg/kg remediation goal.

0 150 300 600 Feet

1 inch equals 300 feet

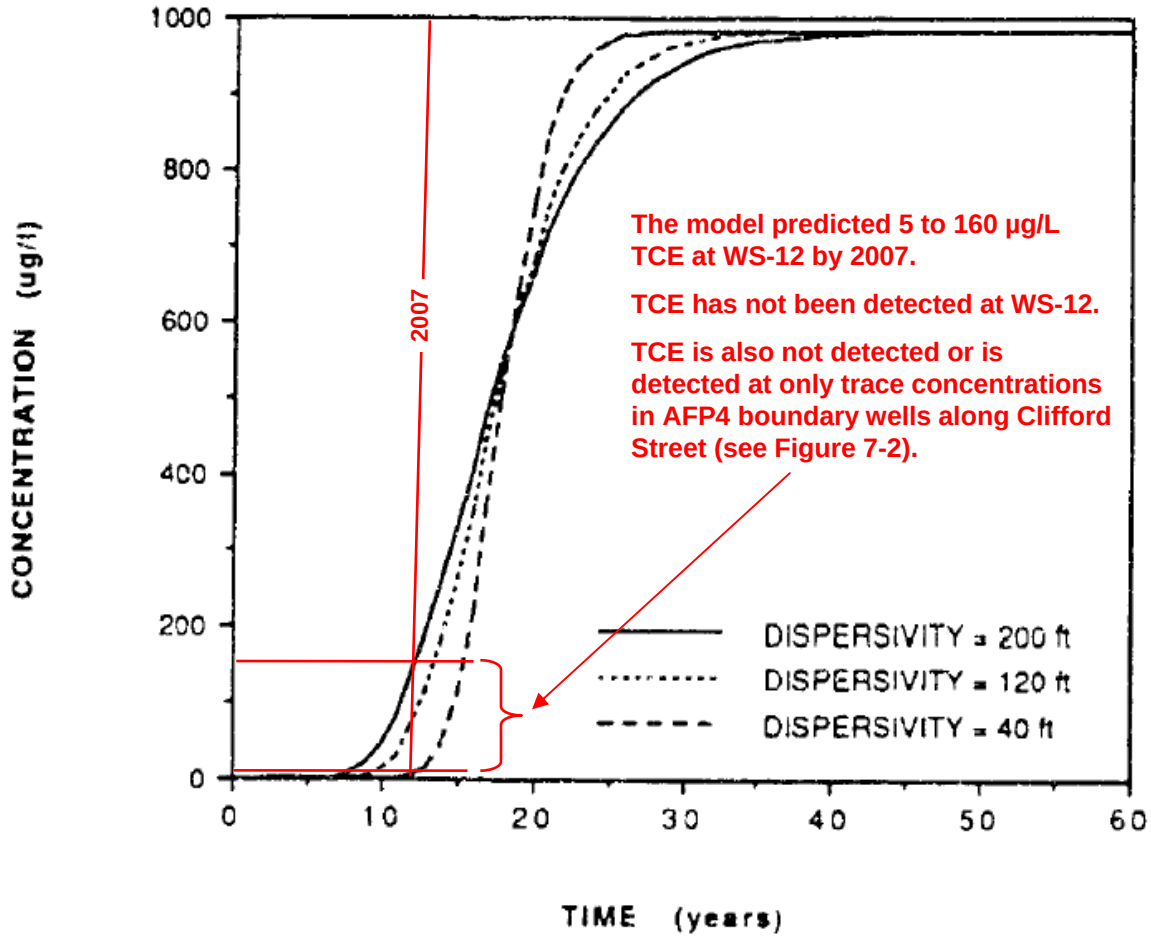
FIGURE 6-3

REMEDIATION GOAL EXCEEDANCES IN MEANDERING ROAD CREEK AND LAKE WORTH SEDIMENTS

Five-Year Review Report
Air Force Plant 4
September 2008

EARTH TECH | AECOM

\AFP4 GIS\2007 5Yr.Review\5-year Rev.Figure 6-2.mxd



After Figure J-20, *Graph of Predicted Concentration Versus Time in WS-12 for TCE Originating from P-9US*

Source: AFP4 RI Report
Appendix J-1: *Hydrogeologic Analytical Modeling for the Baseline Risk Assessment*
Rust Geotech 1995

Time 0 years = 1995

Groundwater modeling performed in 1995 for the baseline risk assessment used assumptions that were very conservative or in some cases, incorrect, based on what has been learned during subsequent investigations and LTM.

No COCs have been detected at city wells since LTM began.

The model assumed the aquifer was "homogenous and istotropic", with high hydraulic conductivity, a continuous source, and no retardation or degradation.

FIGURE 7-1

1995 PREDICTED CONCENTRATIONS AT WATER SUPPLY WELLS

Air Force Plant 4
Five-Year Review Report
September 2008

EARTH TECH | AECOM

99406\work\5-Year Review\REPORT\FIGURES\Figure 7-1.ppt

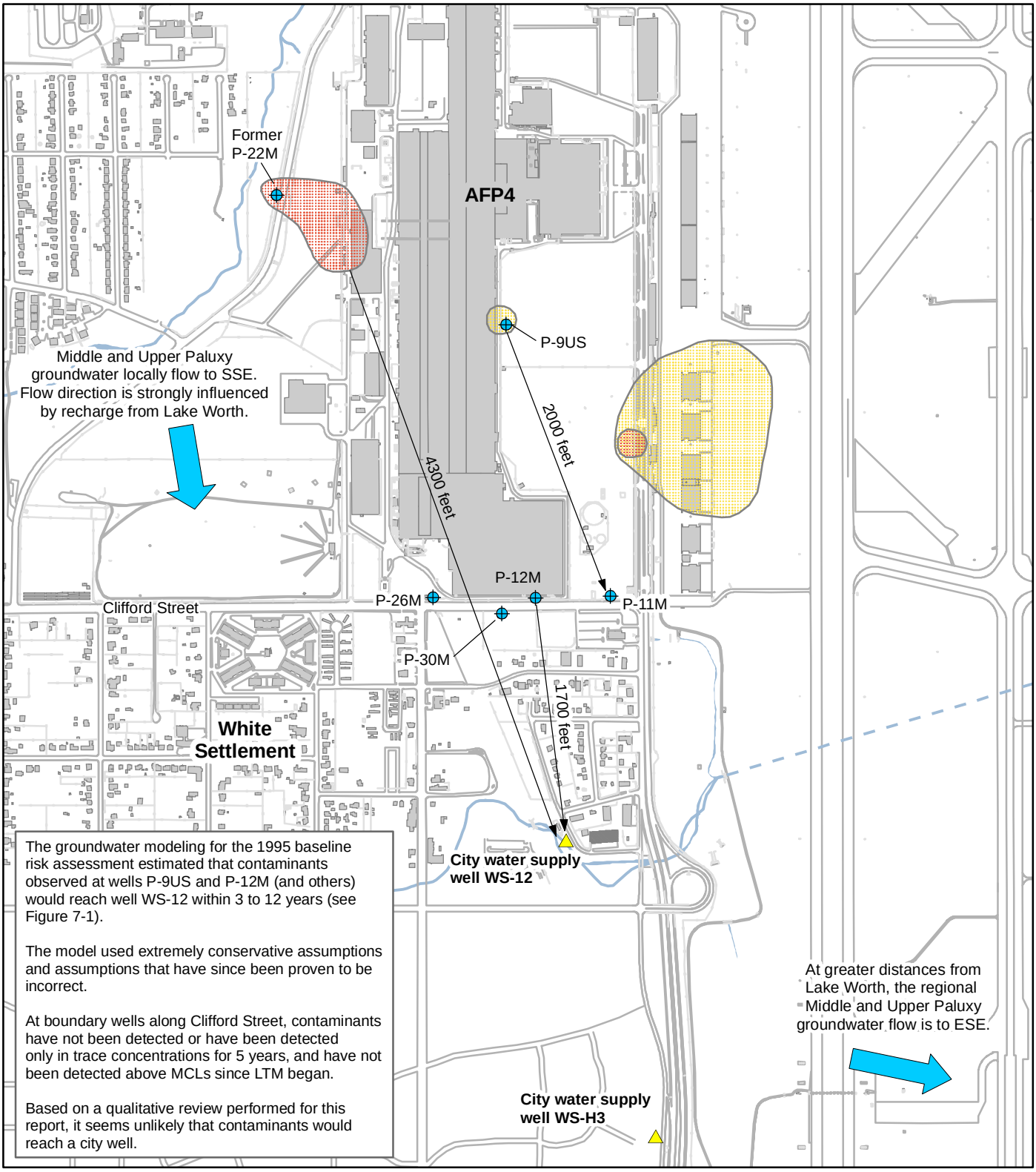


FIGURE 7-2

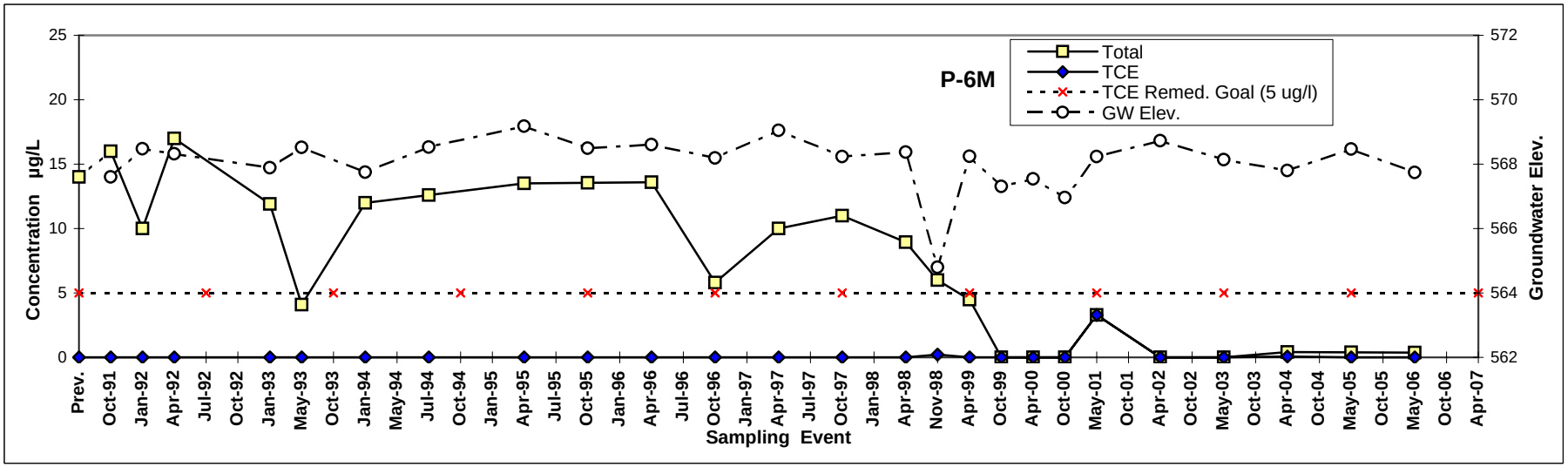
WELLS USED IN THE 1995 GROUNDWATER MODELING FOR THE BASELINE RISK ASSESSMENT

Five-Year Review Report
Air Force Plant 4
September 2008

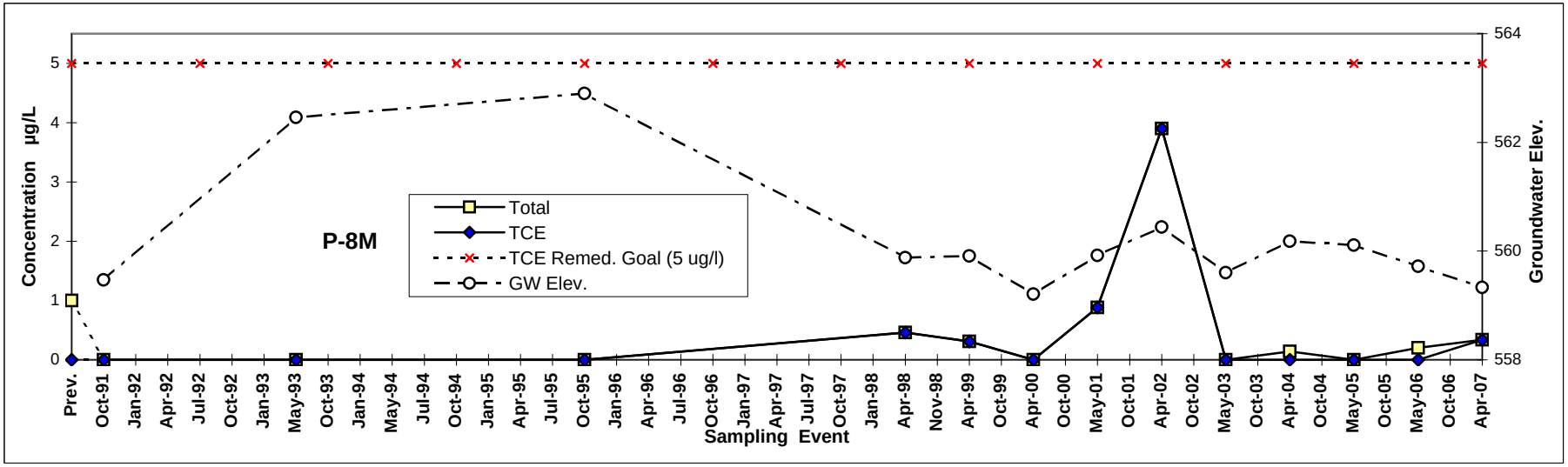
EARTH TECH | AECOM

ATTACHMENT 1

HISTORICAL ANALYTICAL RESULTS FOR TCE AND DEGRADATION PRODUCTS

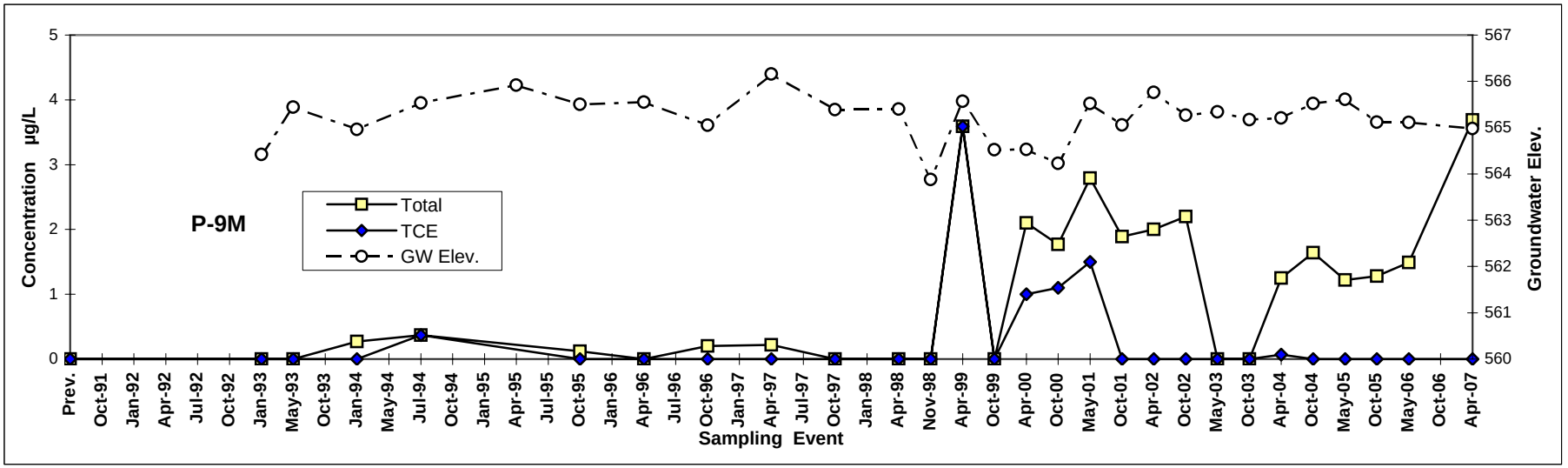


Middle Paluxy well between Building 5 and Building 14

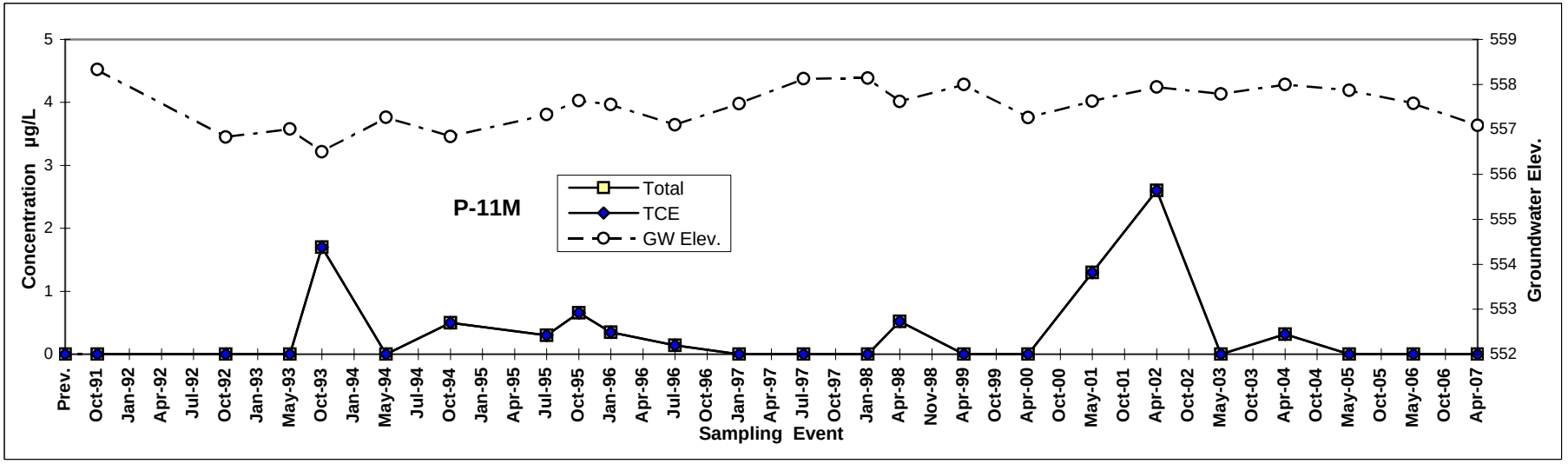


Middle Paluxy well along Lockheed Boulevard

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

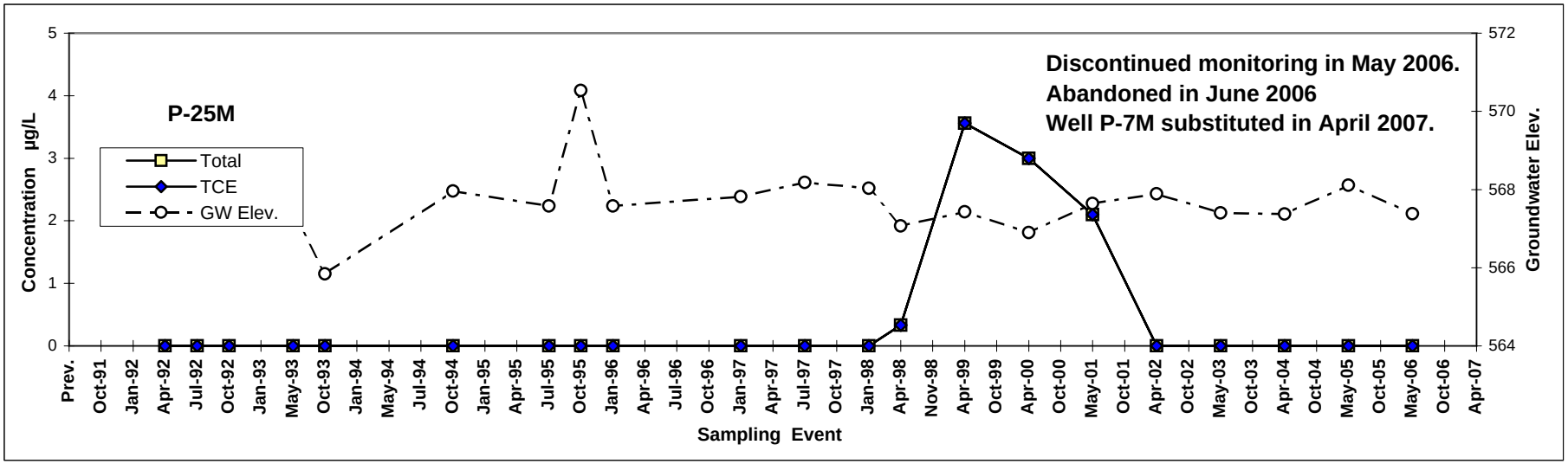


Middle Paluxy well in East Parking Lot adjacent to Building 4

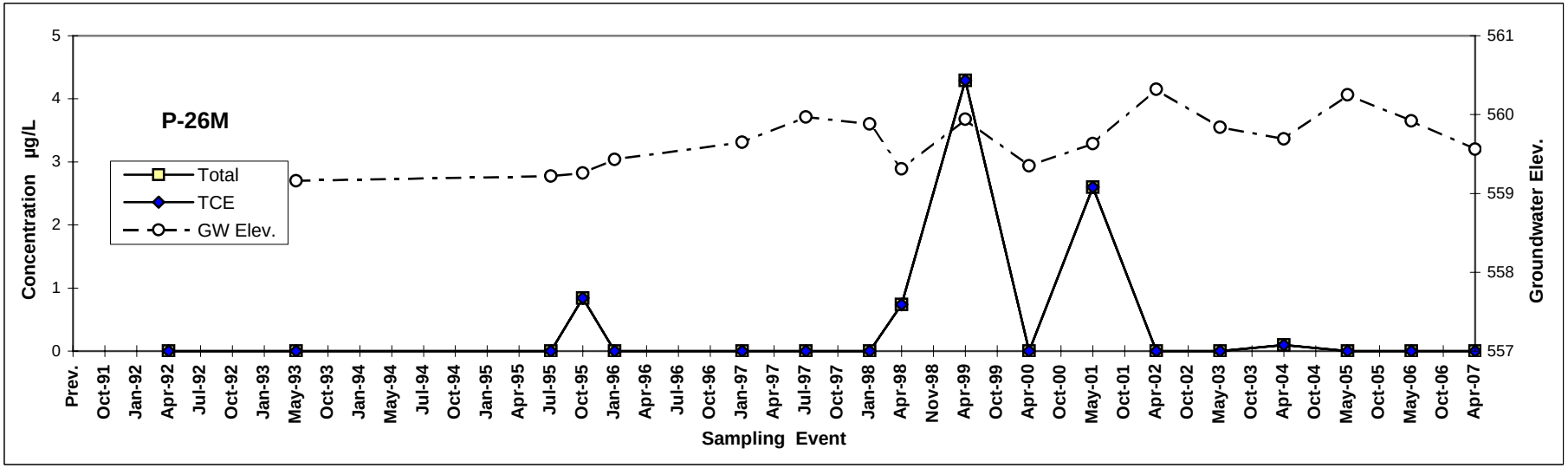


Middle Paluxy well in East Parking Lot near Clifford Avenue

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

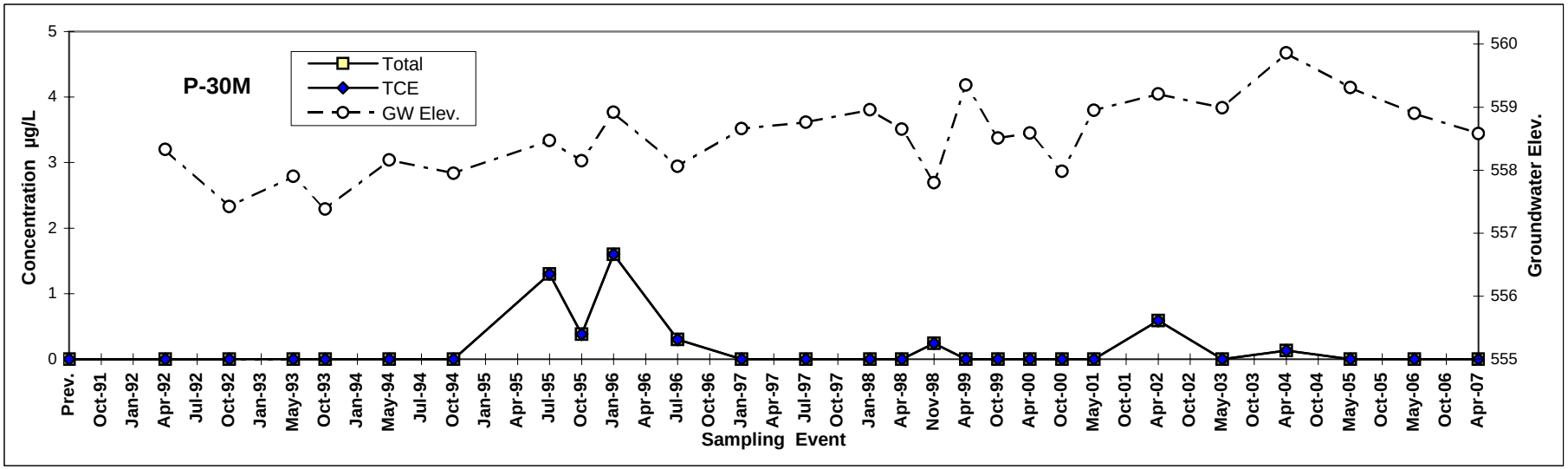


Middle Paluxy well at south end of west parking lot

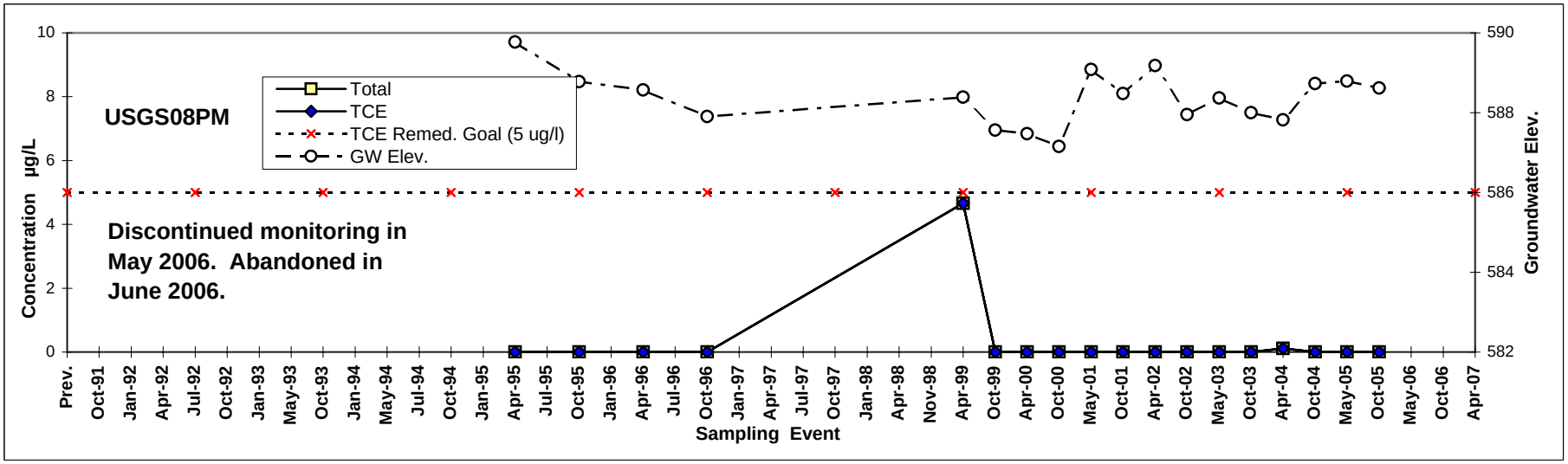


Middle Paluxy well south of Building 181, adjacent to Clifford Avenue

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

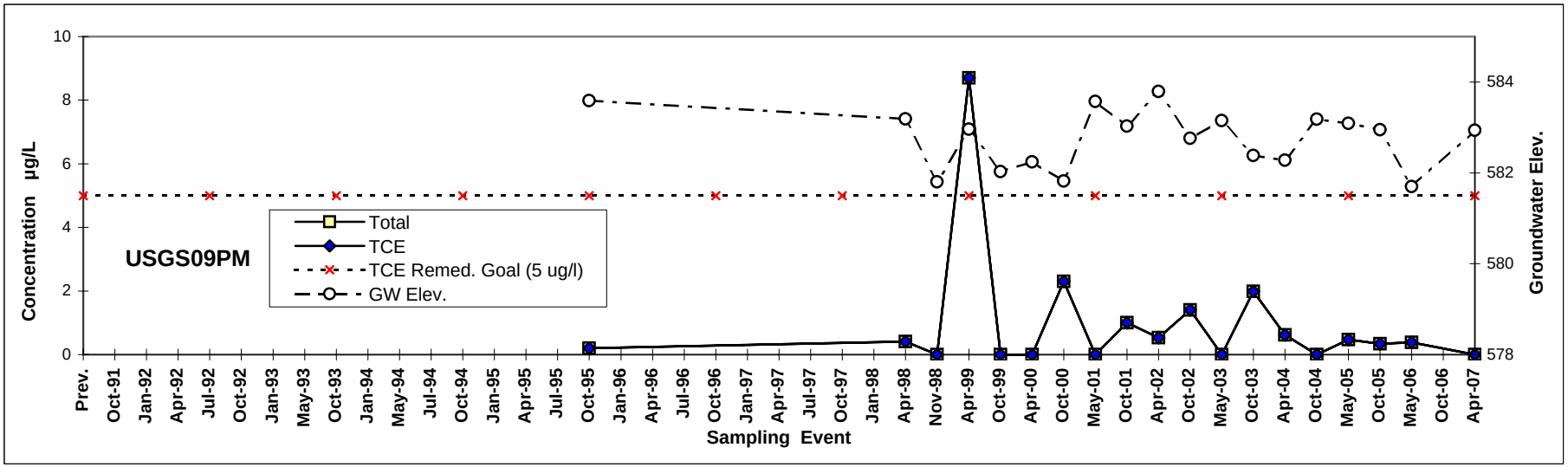


Middle Paluxy well across Clifford Ave. from AFP4

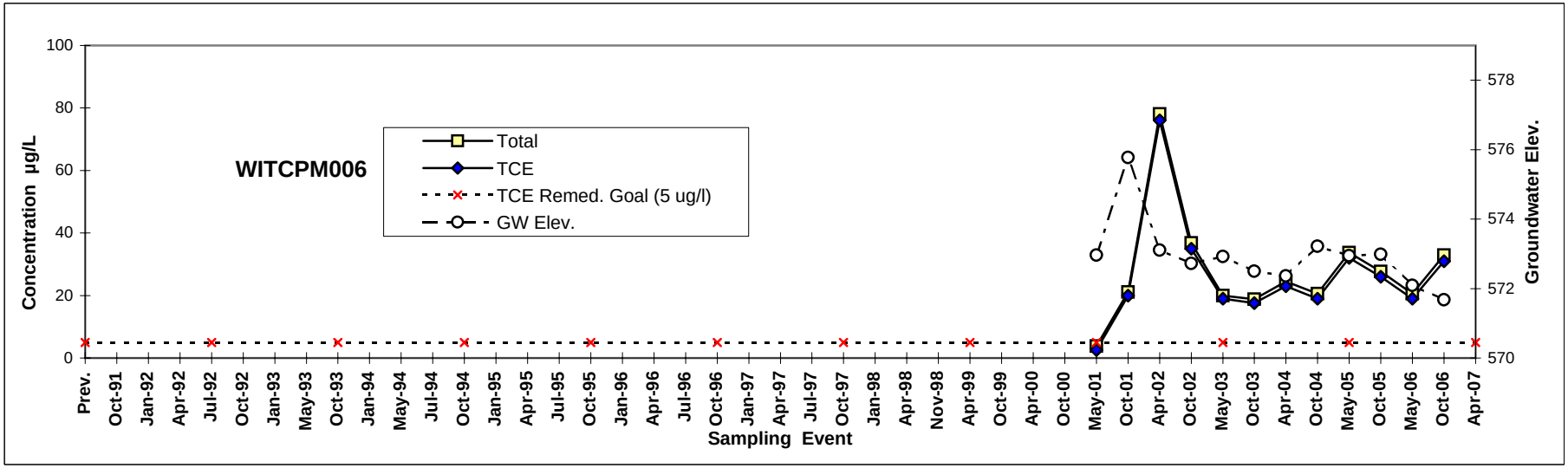


Upgradient Middle Paluxy well located west of AFP4, at intersection of Shoreview Drive and Killdeer Circle

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

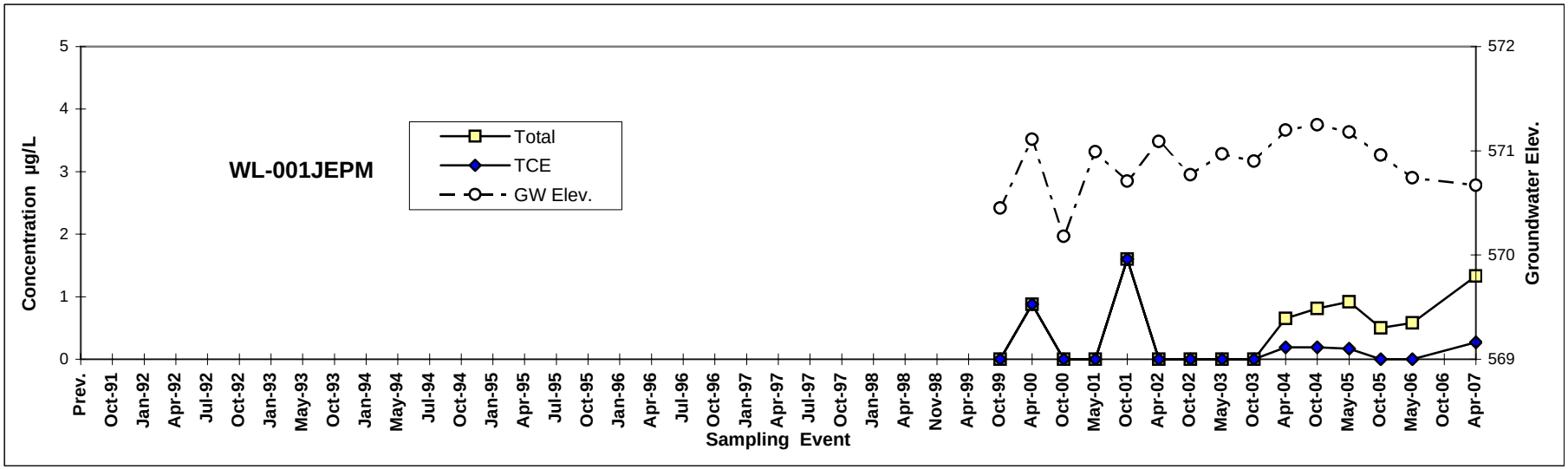


Upgradient Middle Paluxy well at west property boundary, adjacent to National Guard Armory

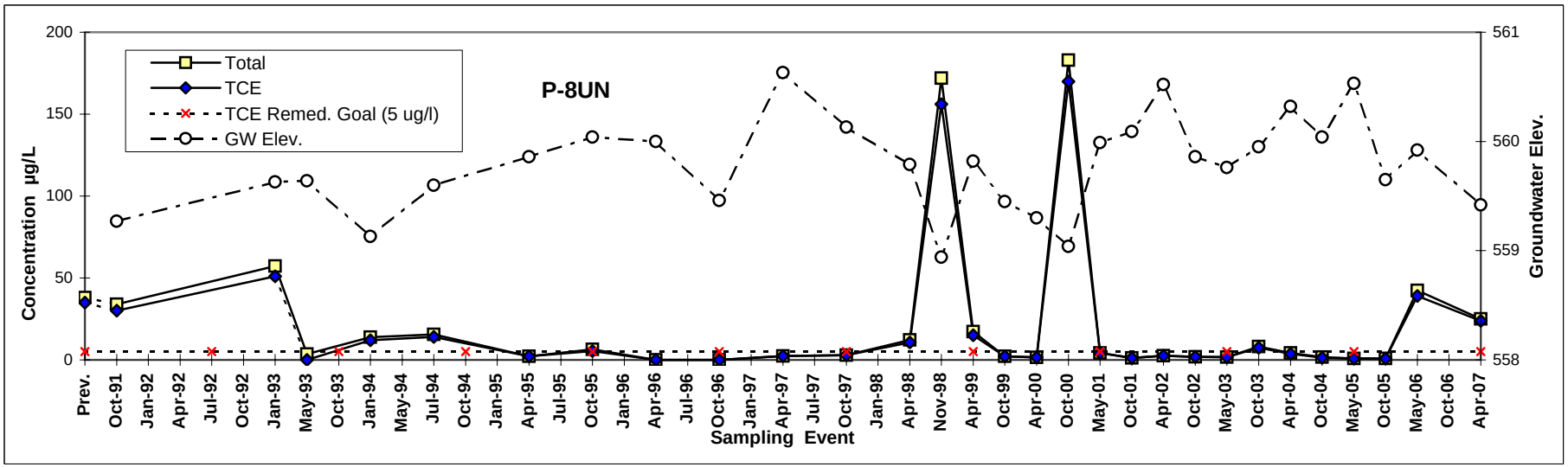


Middle Paluxy well in DNAPL area of West Parking Lot, adjacent to Bomber Road

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

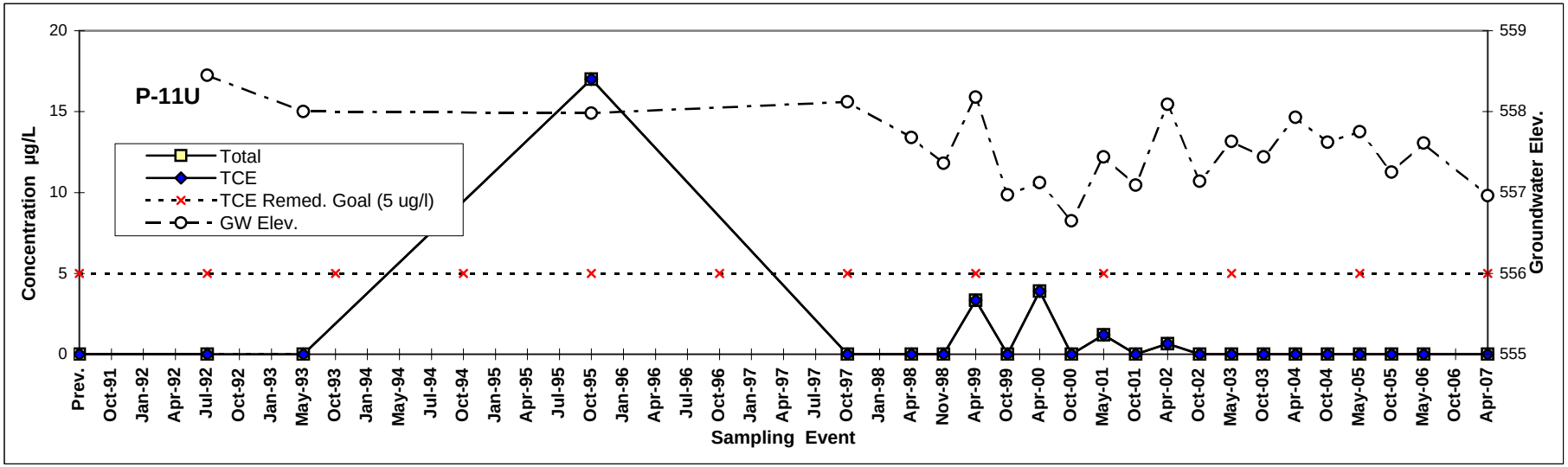


Downgradient Middle Paluxy well on AFP4 flightline east of run station 5

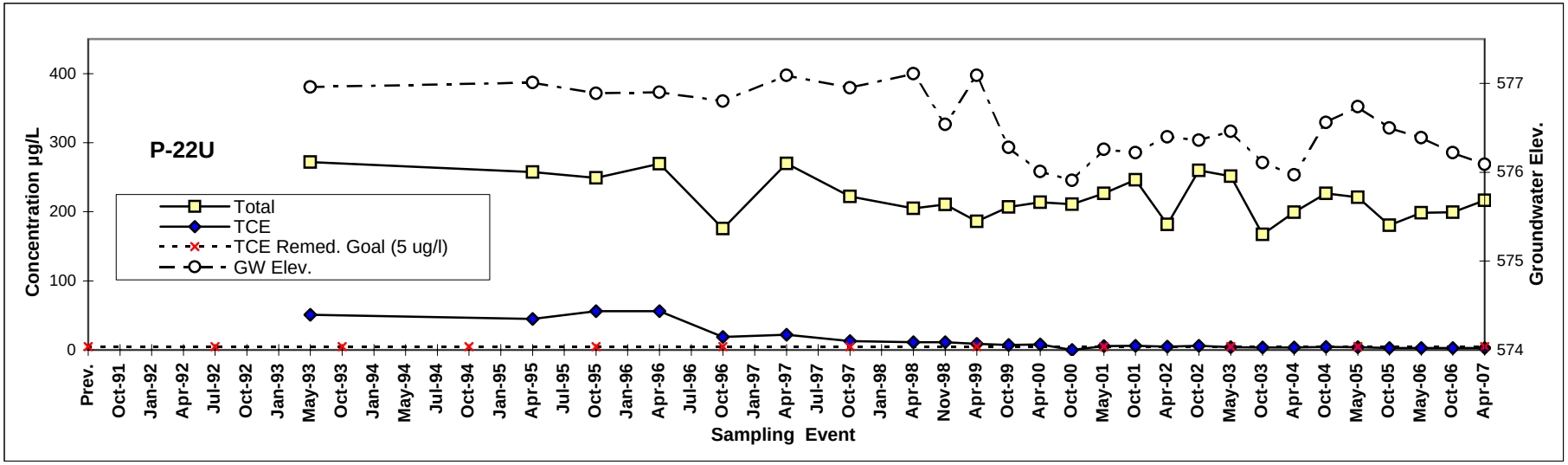


Upper Paluxy well along Lockheed Martin Blvd.

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

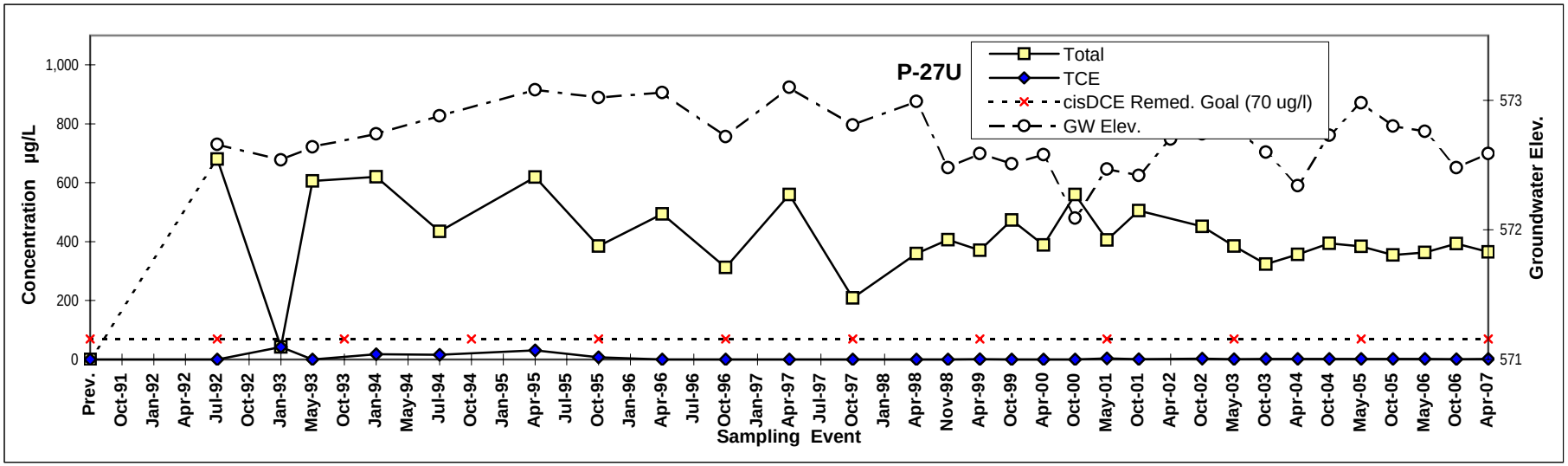


Upper Paluxy well in East Parking Lot near Clifford Avenue

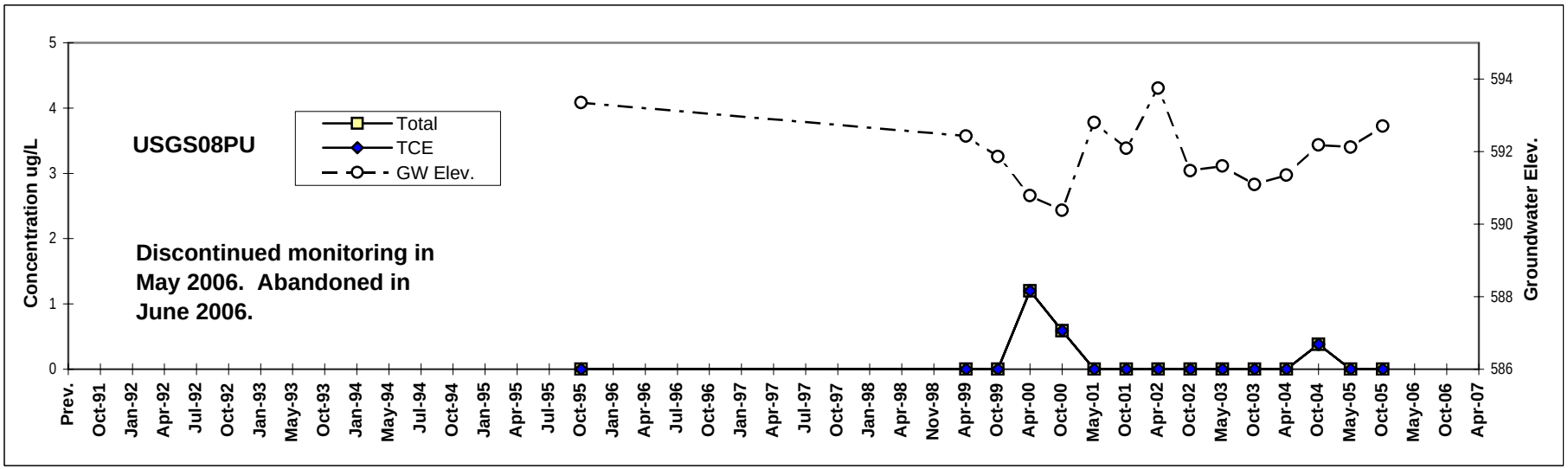


Upper Paluxy well in AFP4 Landfill 3

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

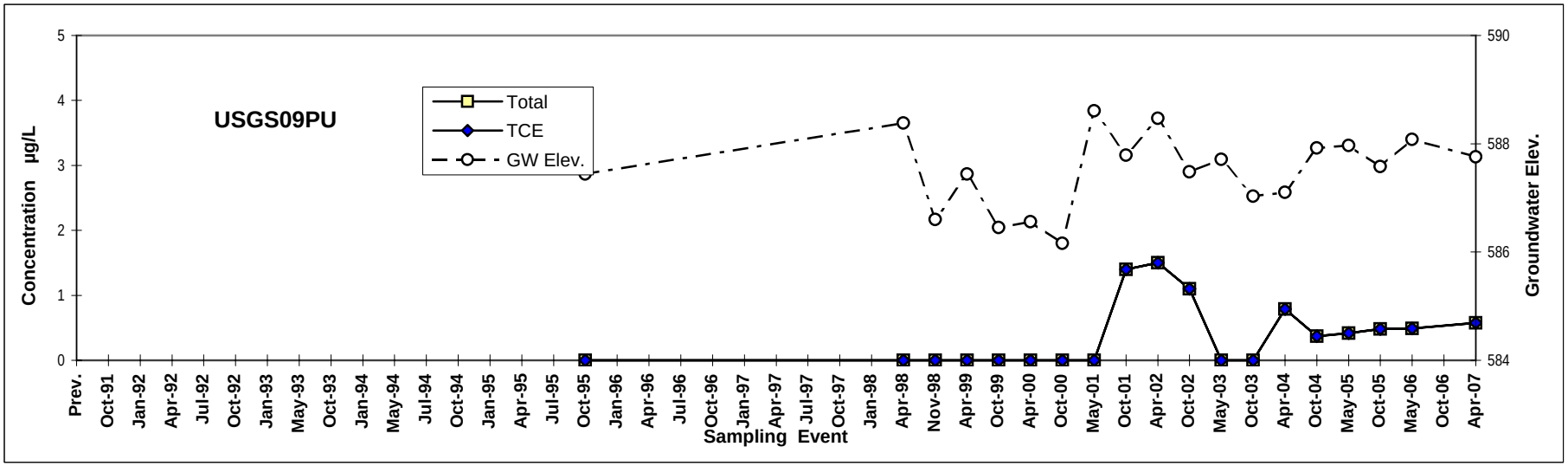


Upper Paluxy well along west side of Bldg. 14

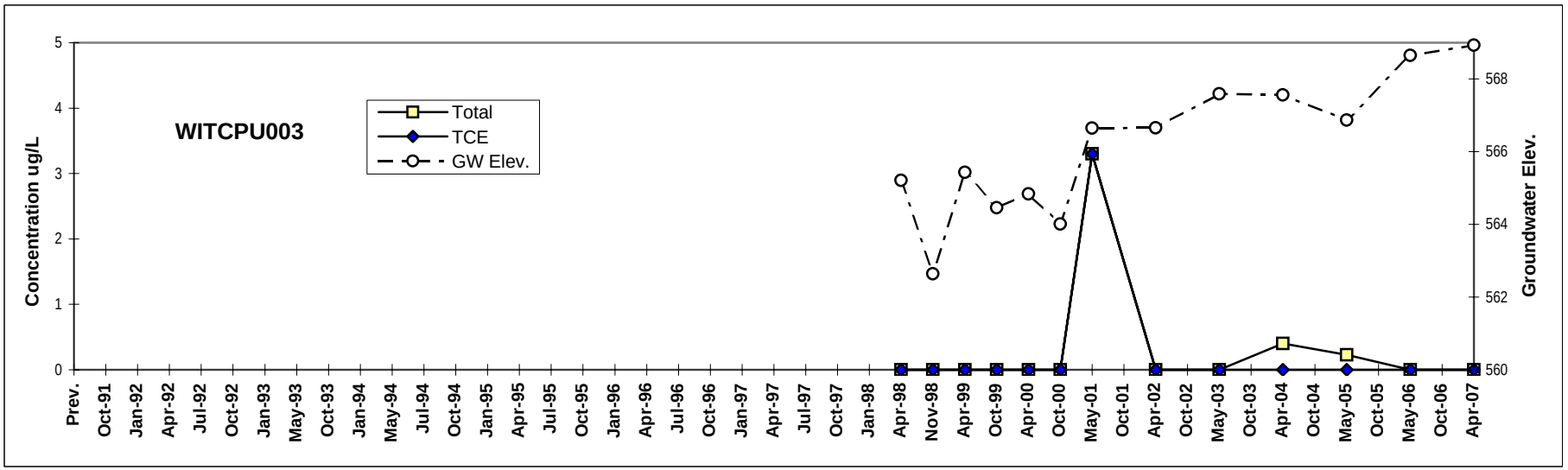


Upgradient Upper Paluxy well located west of AFP4, at intersection of Shoreview Drive and Killdeer Circle

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

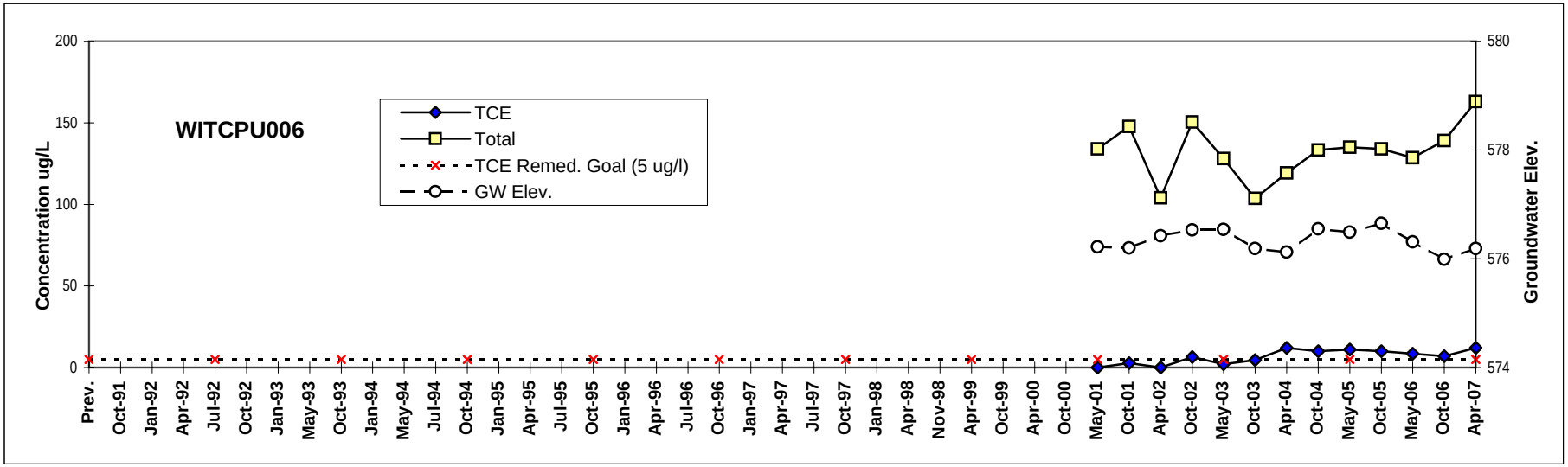


Upgradient Upper Paluxy well at west property boundary, adjacent to National Guard Amory

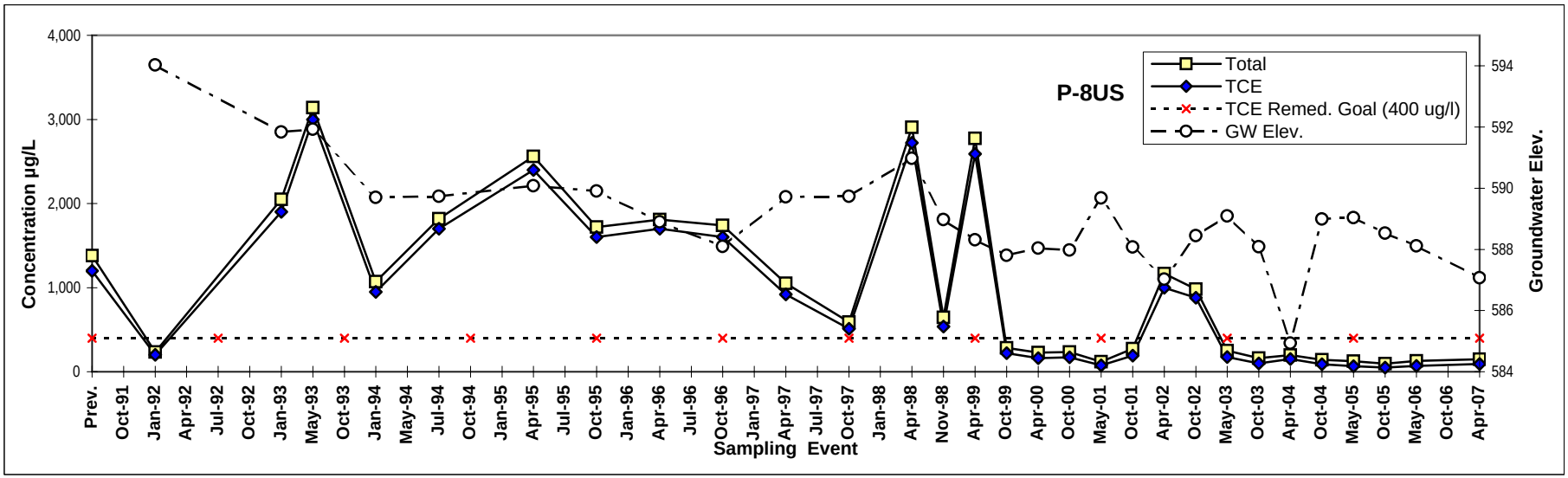


Upper Paluxy well in West Parking Lot

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

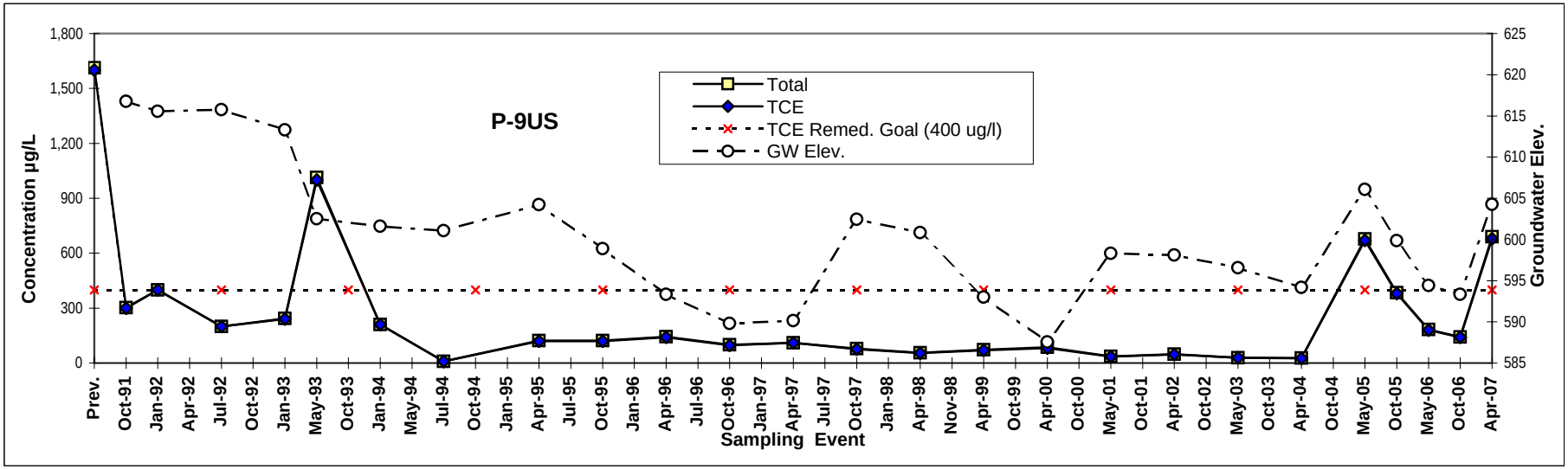


Upper Paluxy well in DNAPL area of West Parking Lot/Landfill 1

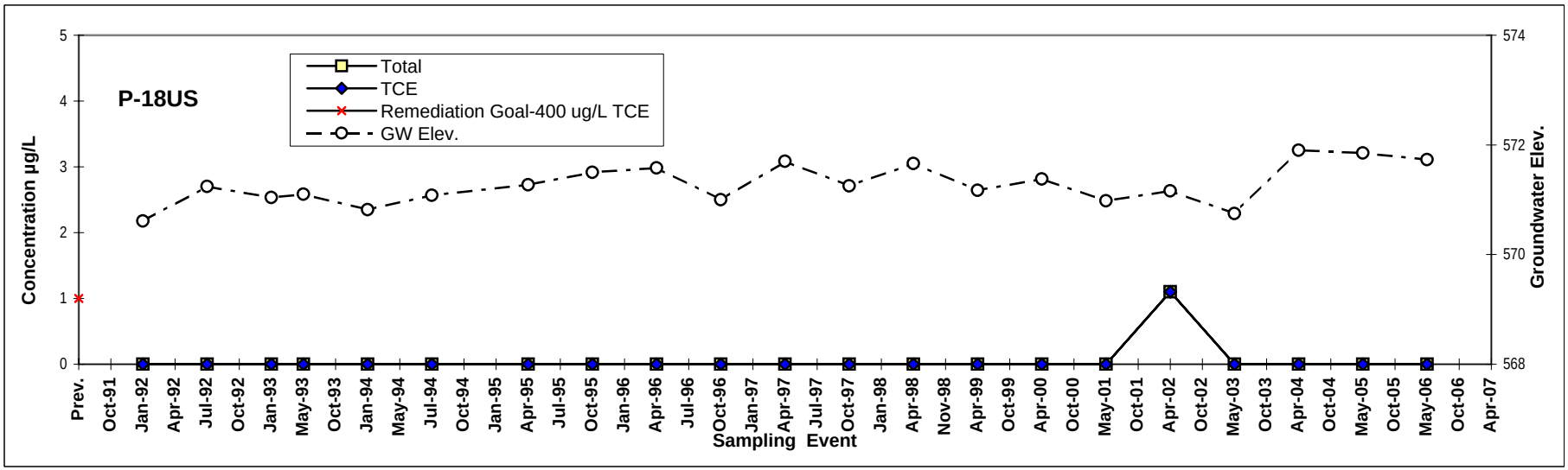


Paluxy Upper Sand well along Lockheed Martin Blvd.

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

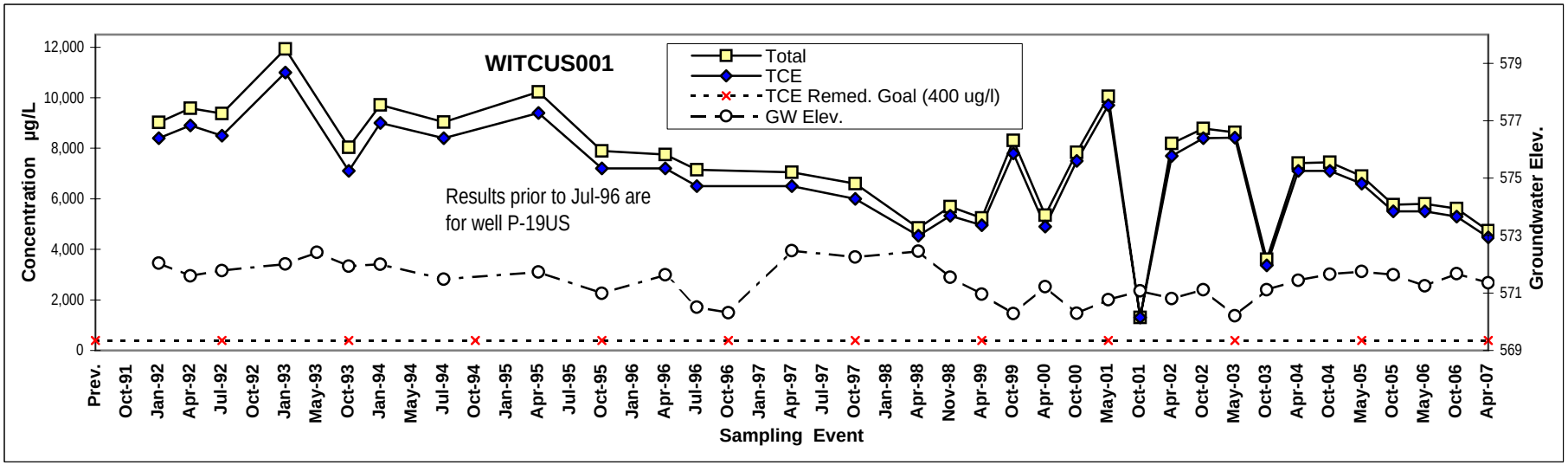


Paluxy Upper Sand well in East Parking Lot

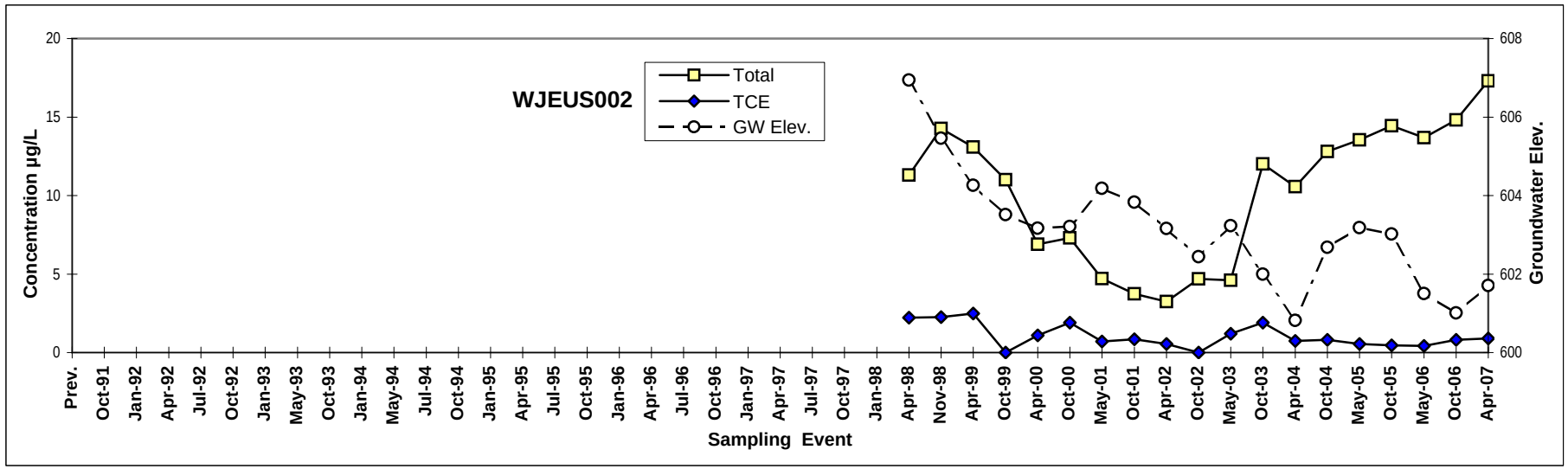


Paluxy Upper Sand well on AFP4 flightline east of run station 22

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

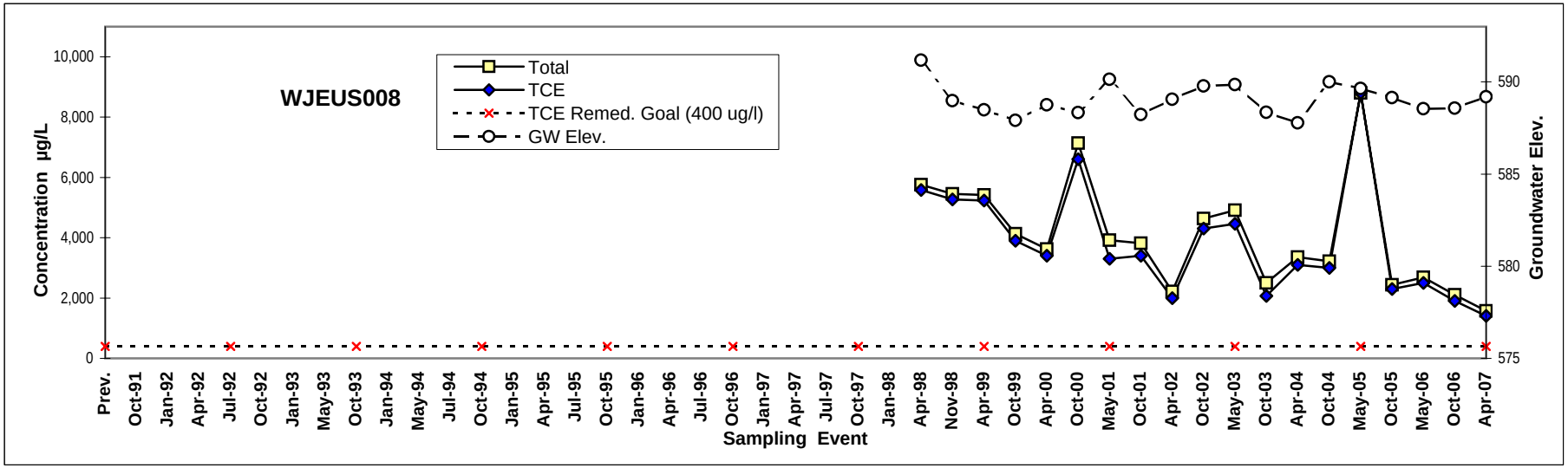


Paluxy Upper Sand well at south end of AFP4 flightline.

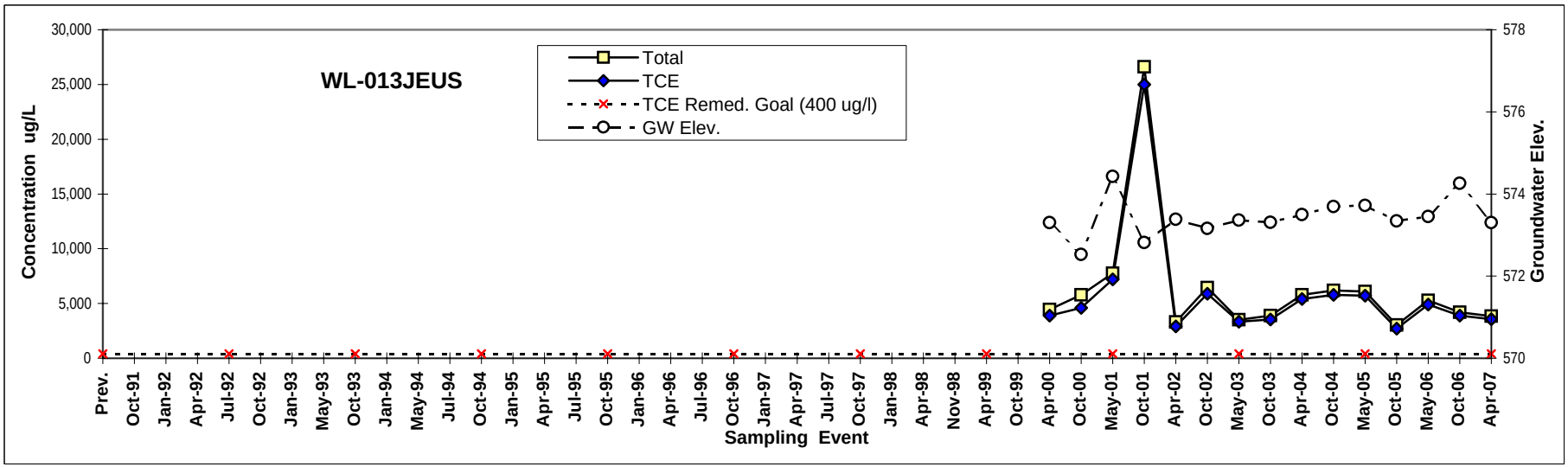


Paluxy Upper Sand well along Lockheed Boulevard.

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

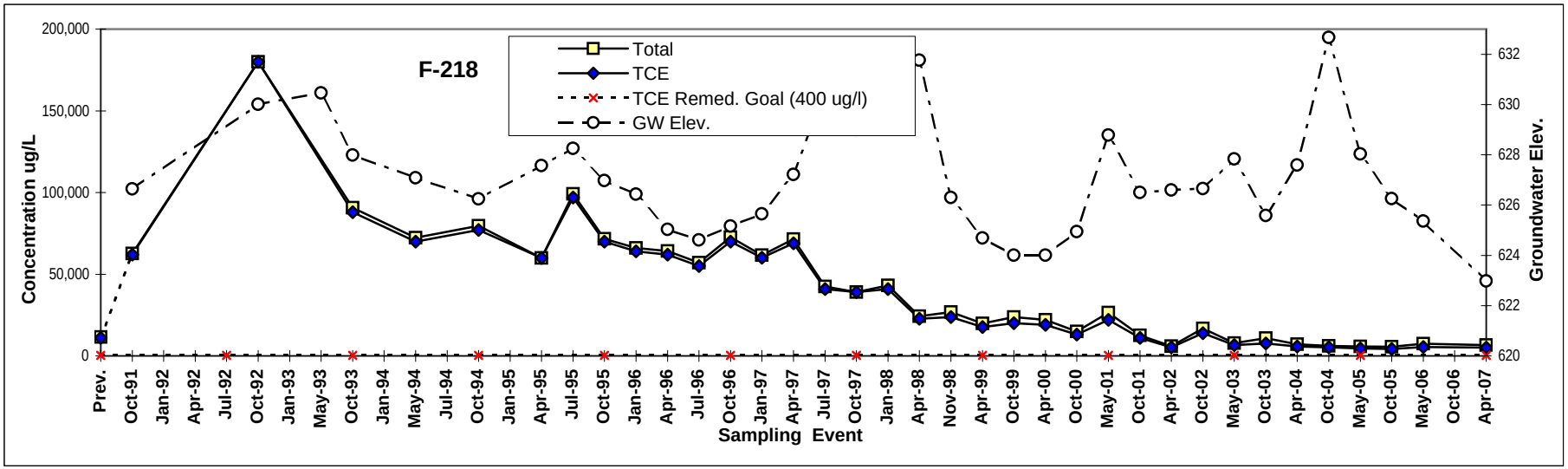


Paluxy Upper Sand well between run stations 10 and 12.

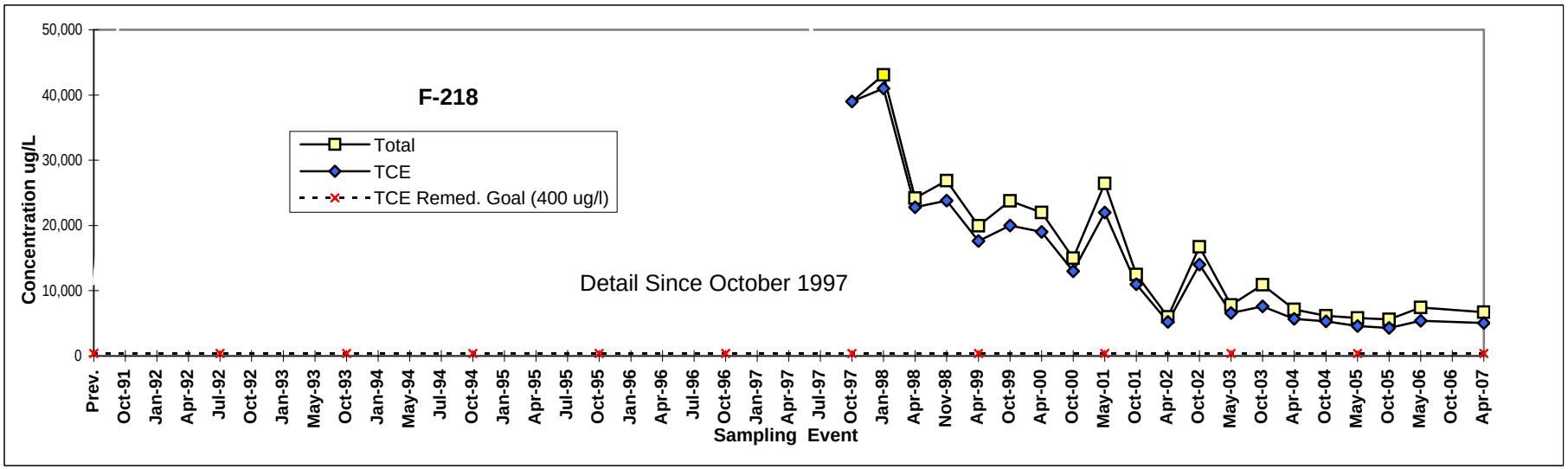


Paluxy Upper Sand well - AFP4 flightline

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

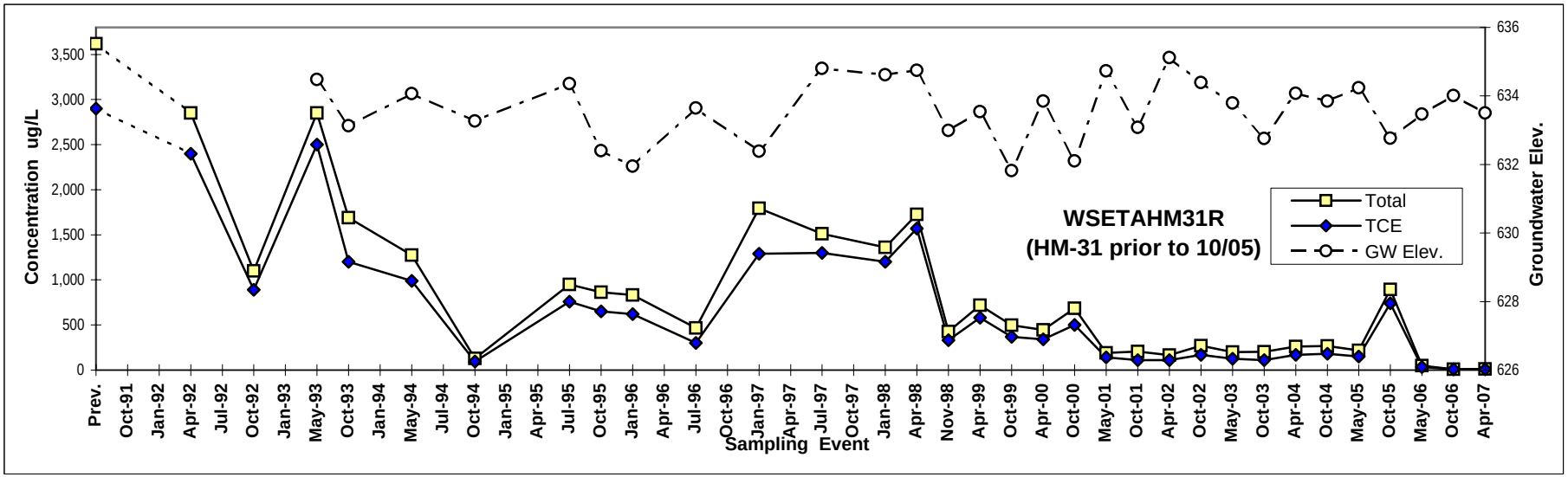


Terrace Alluvium well - East Parking Lot, adjacent to assembly building, near plume axis

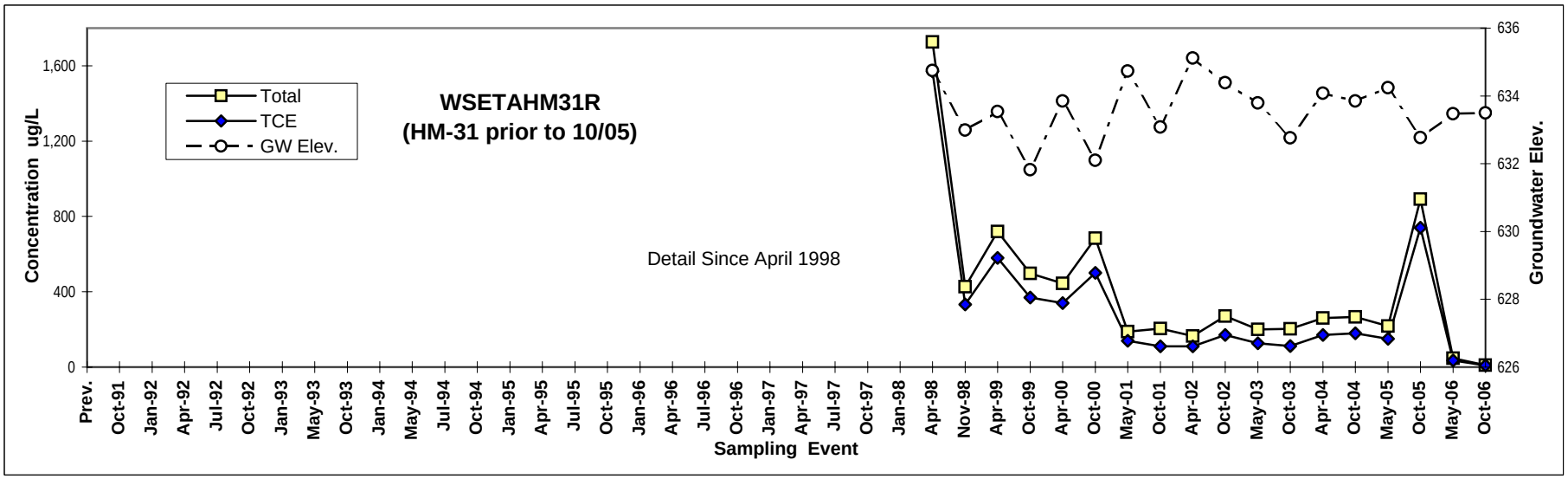


Terrace Alluvium well - East Parking Lot, adjacent to assembly building, near plume axis

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

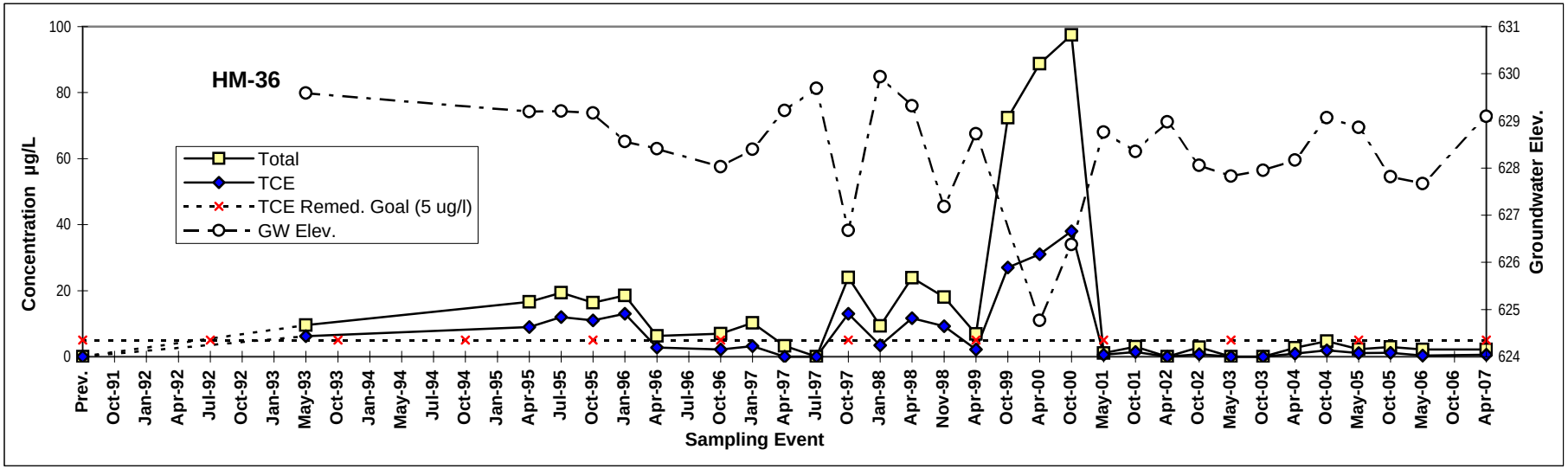


Terrace Alluvium well - adjacent to Clifford Ave. (former HM-31)

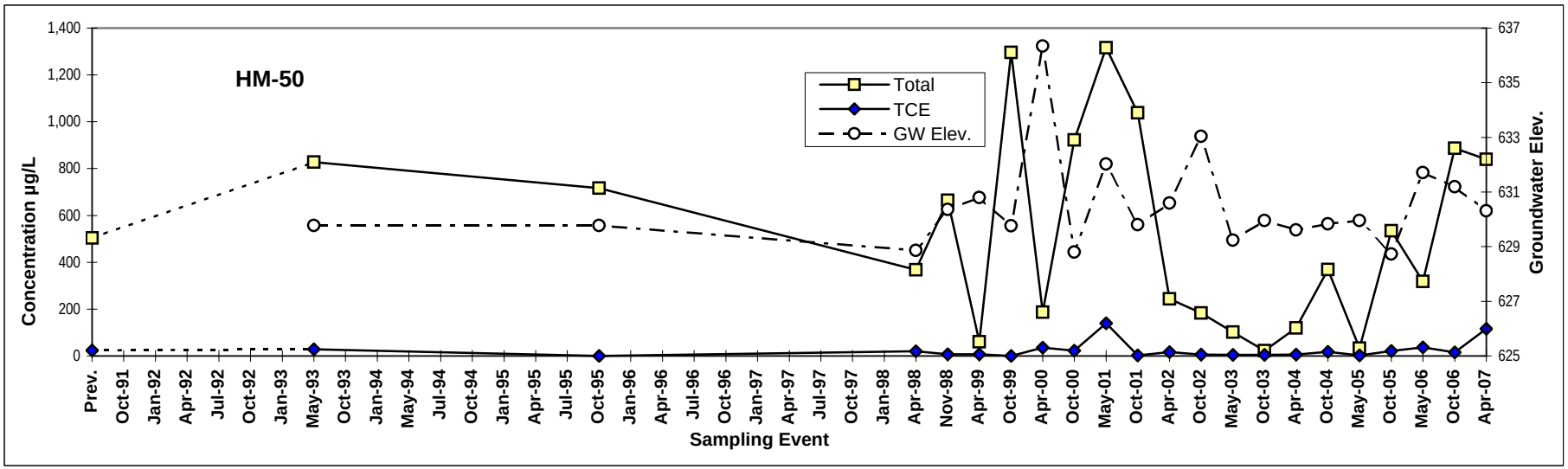


Terrace Alluvium well - adjacent to Clifford Ave. (former HM-31)

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

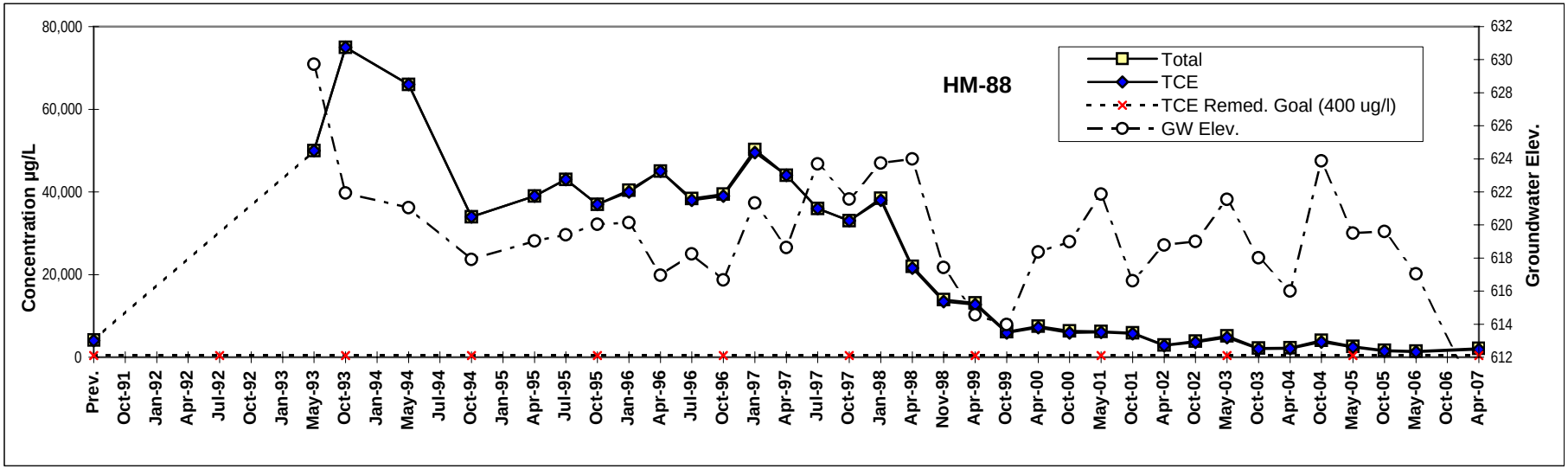


Terrace Alluvium well - AFP4 Landfill 3

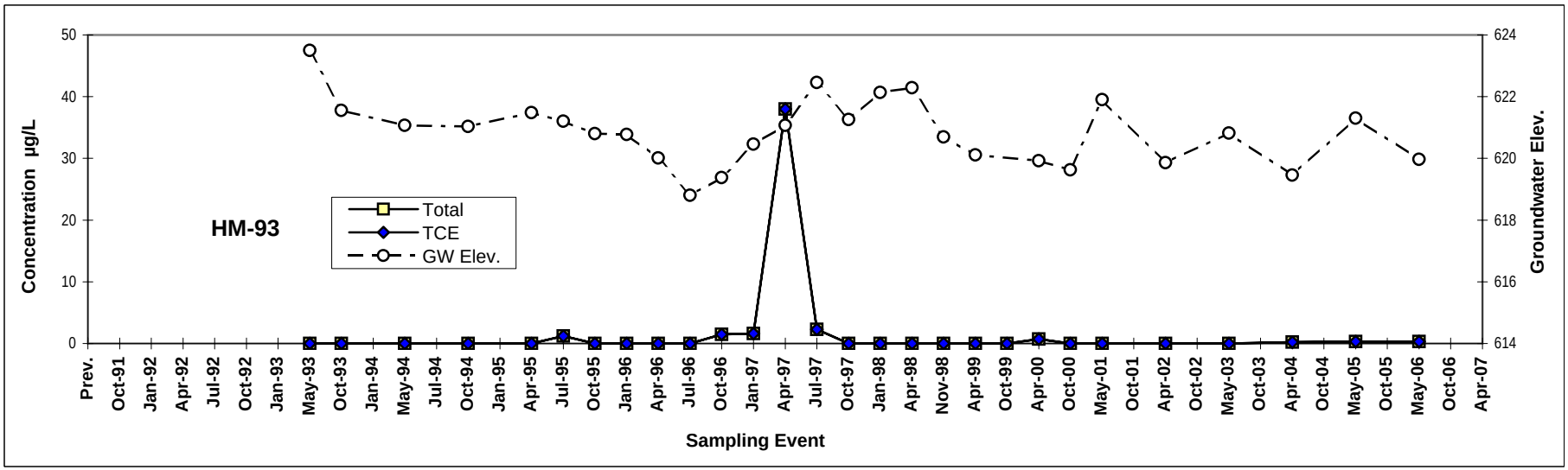


Terrace Alluvium well - west parking lot.

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

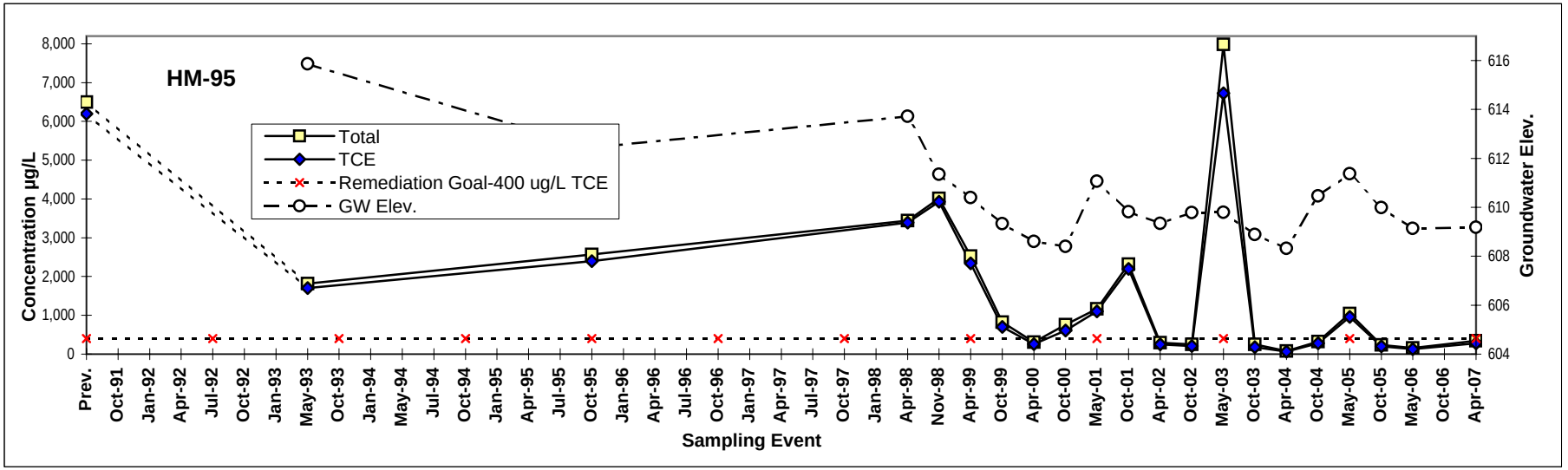


Terrace Alluvium well - East Parking Lot, near plume axis

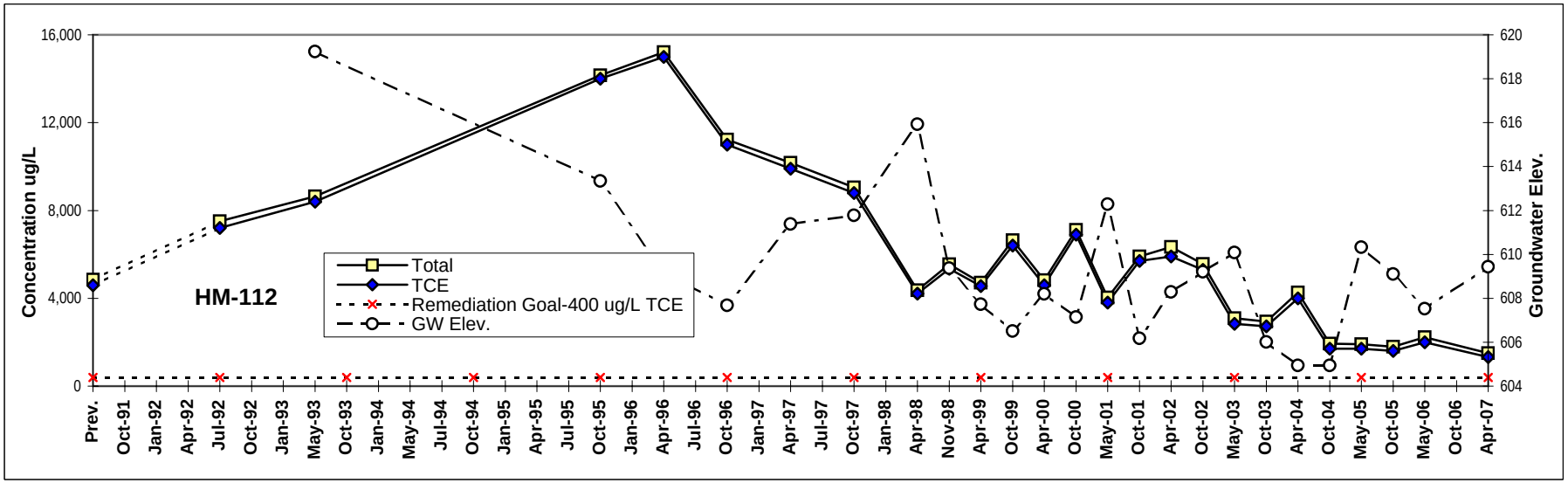


Terrace Alluvium well - East Parking Lot

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

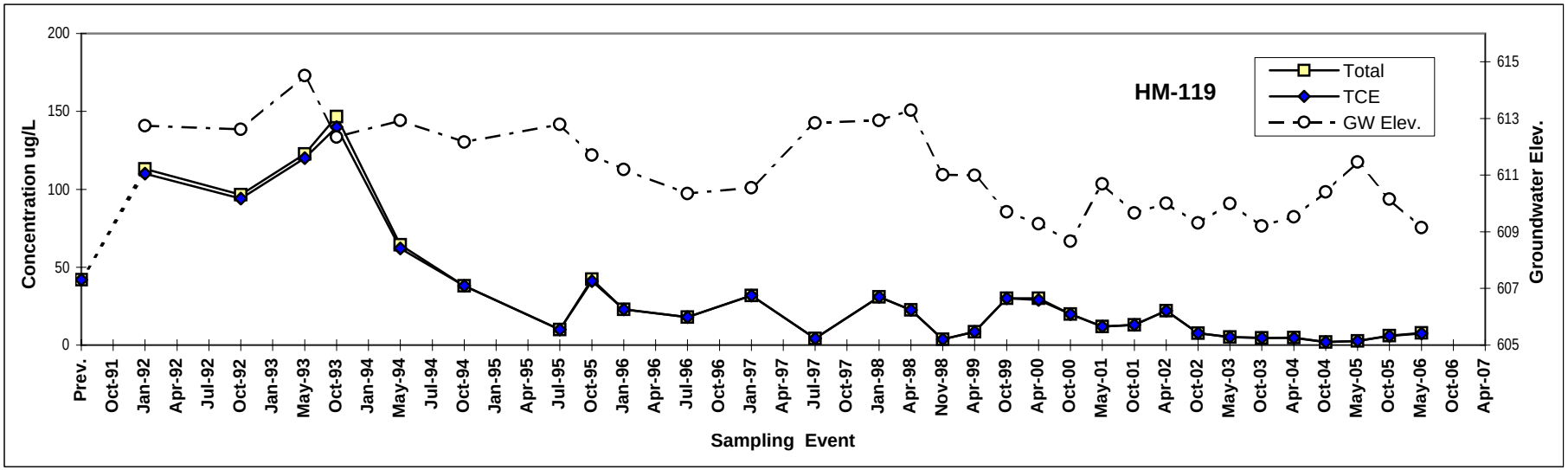


Terrace Alluvium well - AFP4 flightline

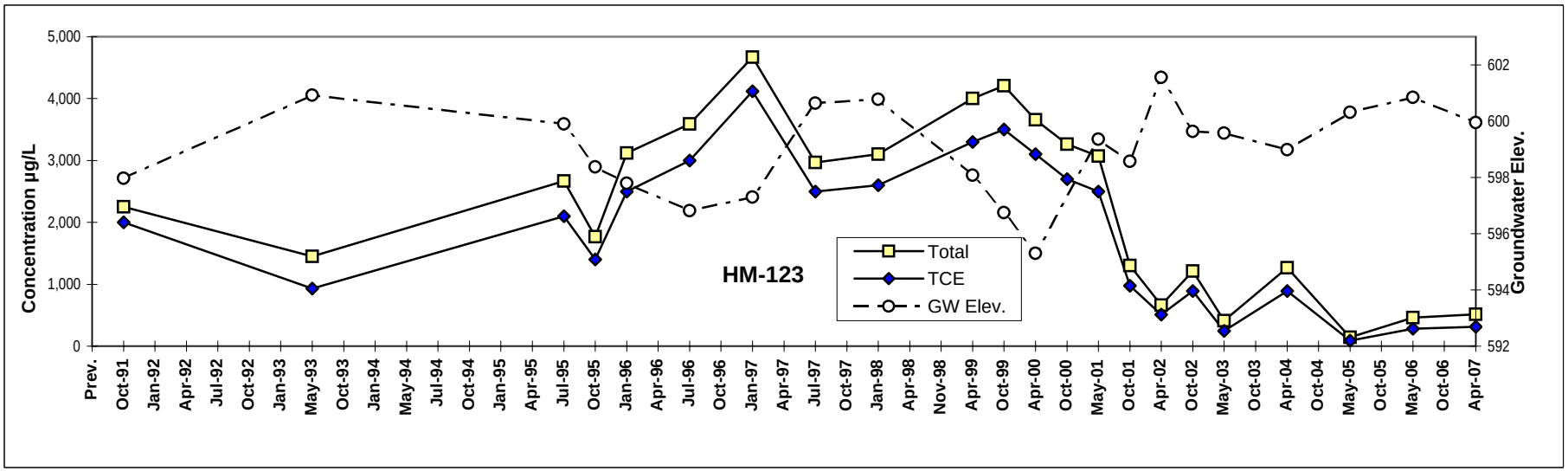


Terrace Alluvium well - AFP4 flightline

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

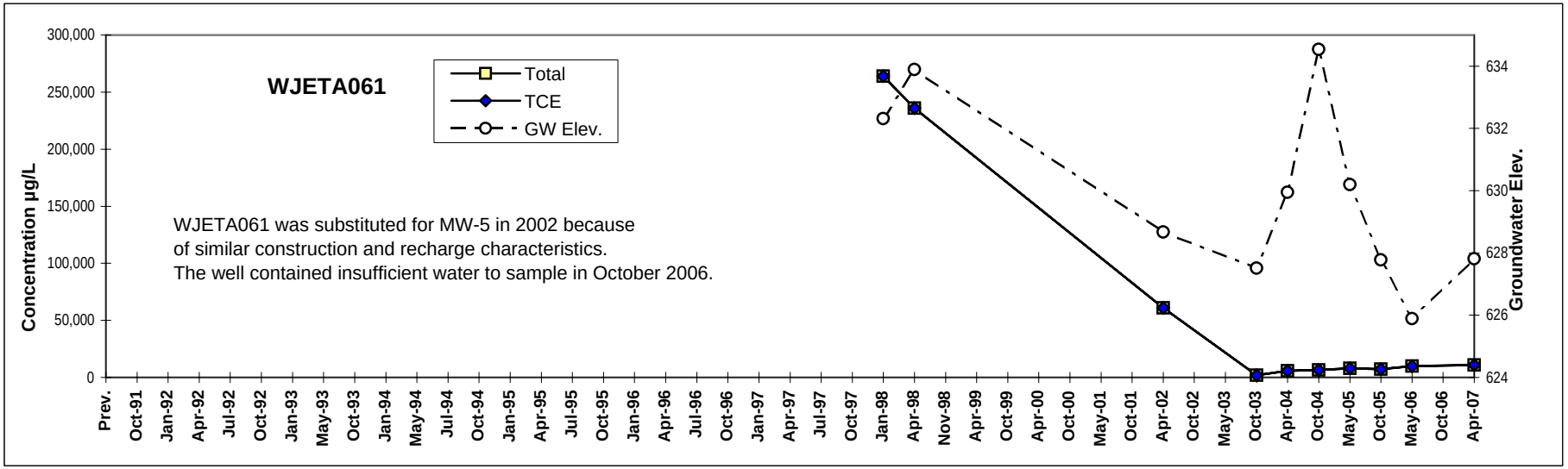


Terrace Alluvium well - north NAS Fort Worth flightline

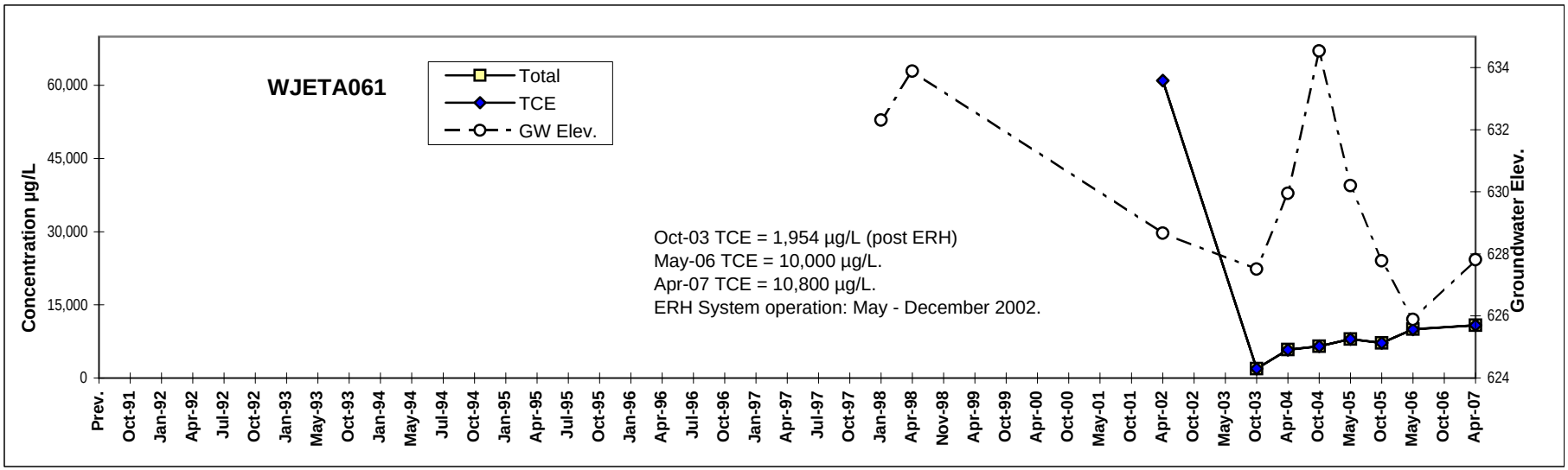


Terrace Alluvium well - NAS Fort Worth flightline

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

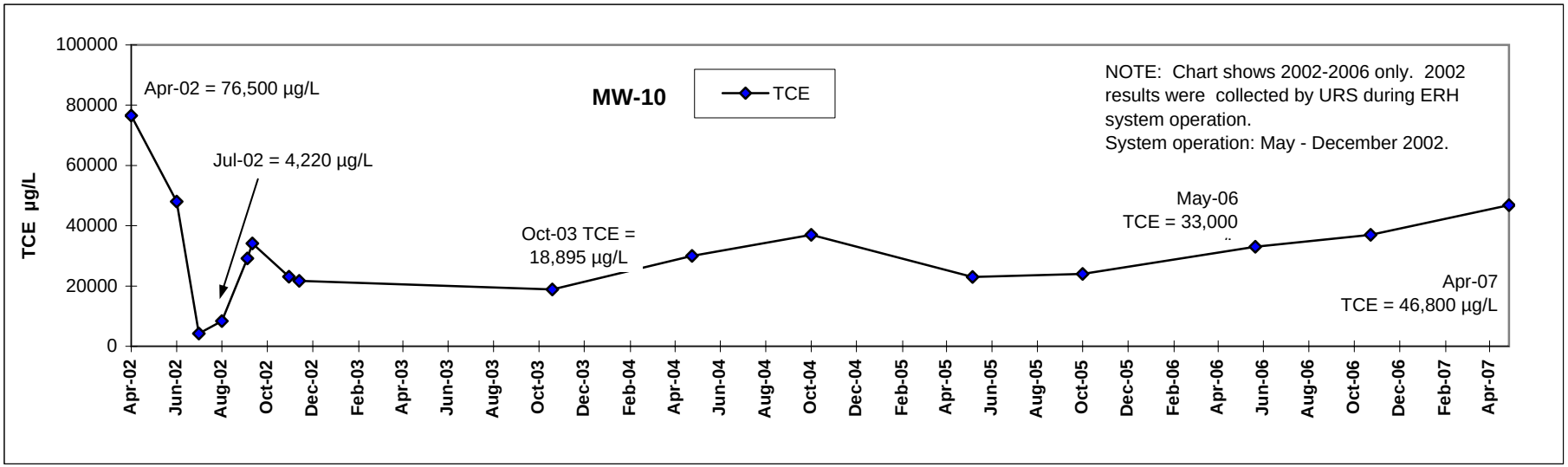


Terrace Alluvium well inside Building 181

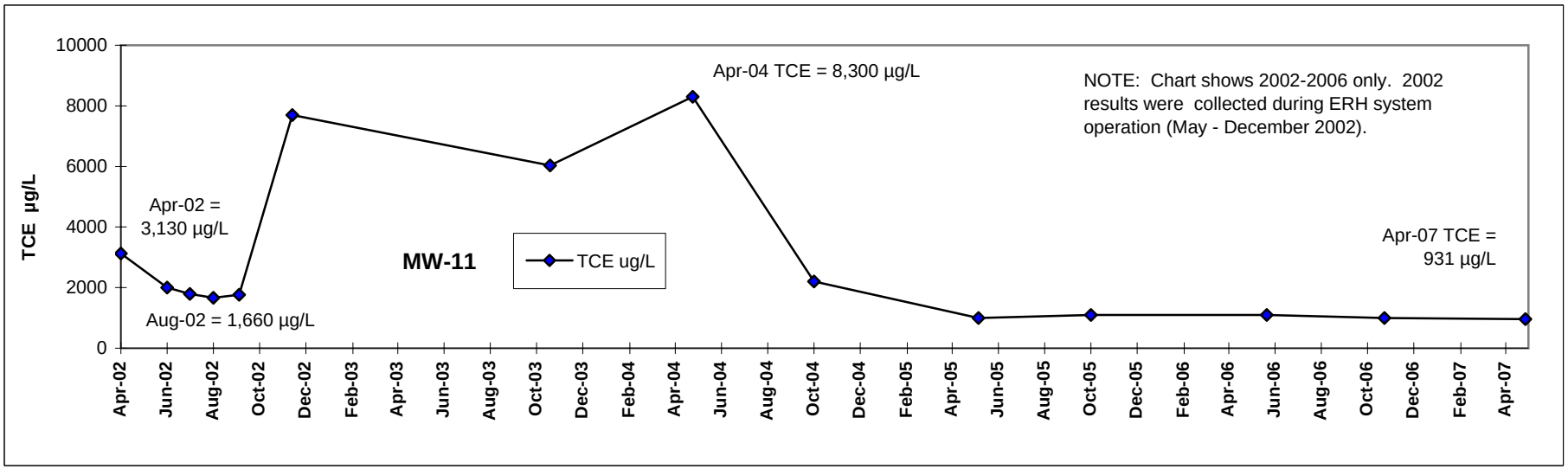


Terrace Alluvium well inside Building 181

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

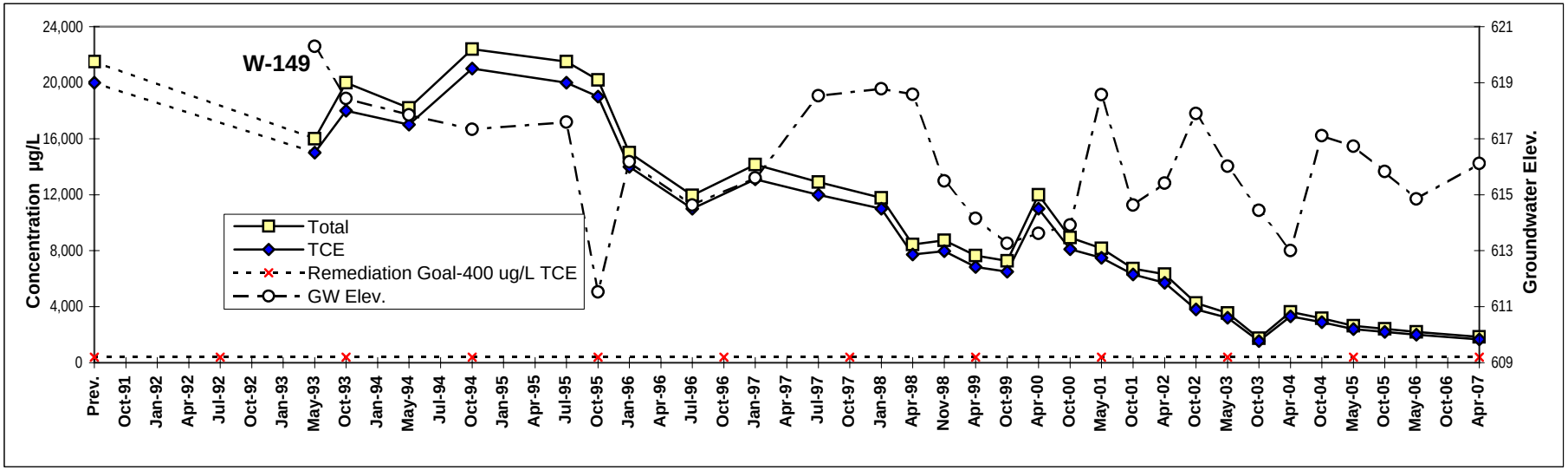


Terrace Alluvium well inside Building 181

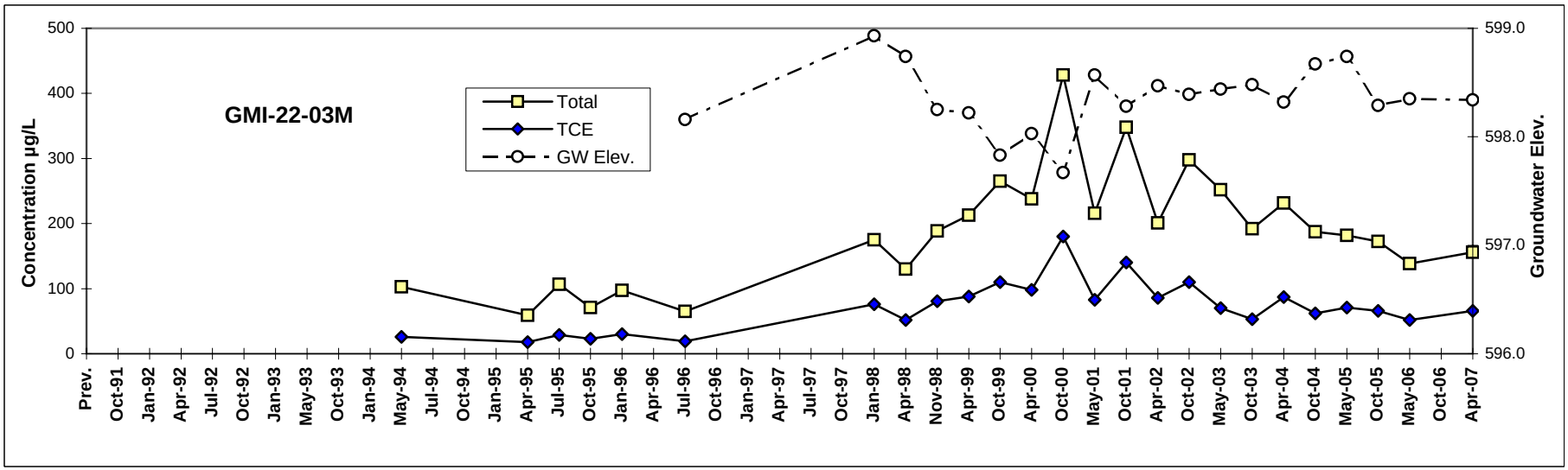


Terrace Alluvium well inside Building 181

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

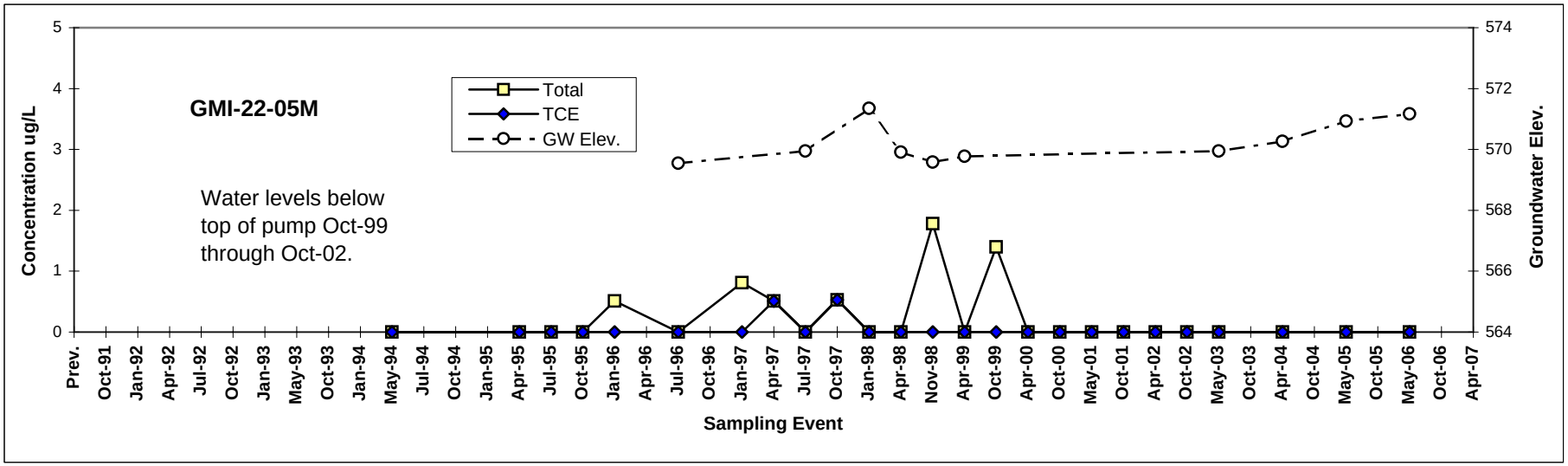


Terrace Alluvium well - East Parking Lot adjacent to Lockheed Boulevard, near plume axis

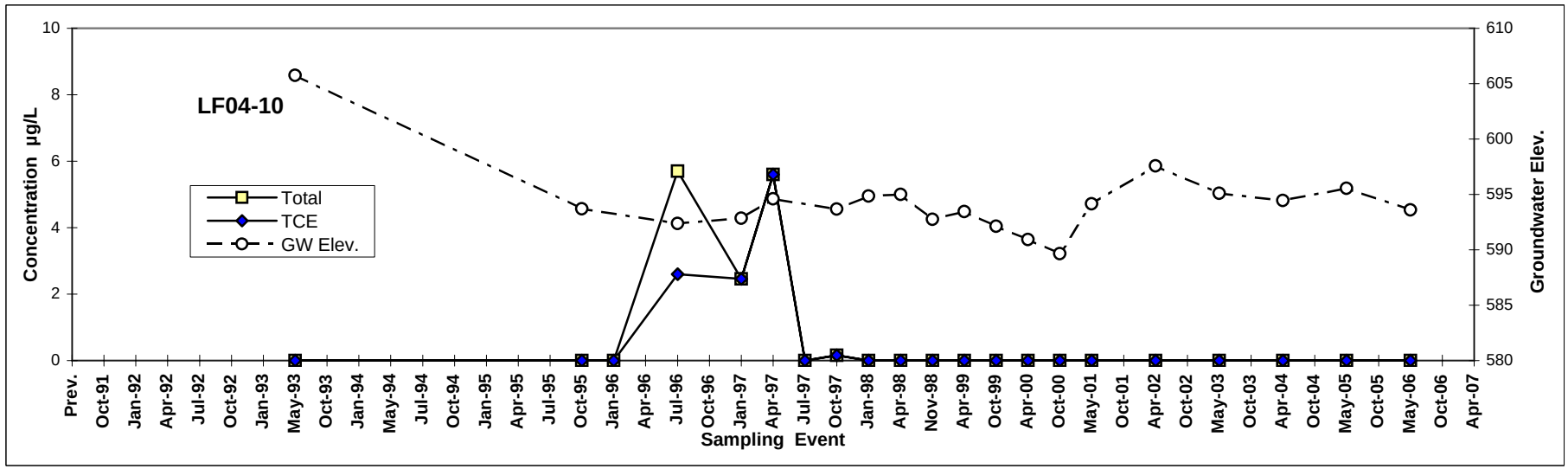


Terrace Alluvium well - NAS Fort Worth Base

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

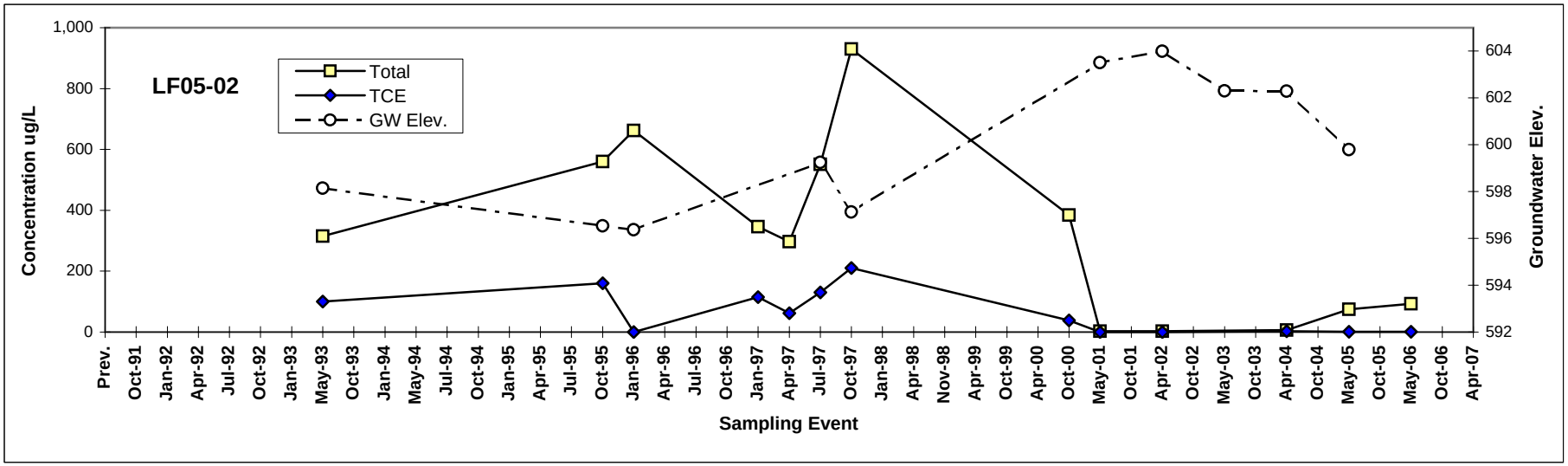


Terrace Alluvium well - NAS Fort Worth Base

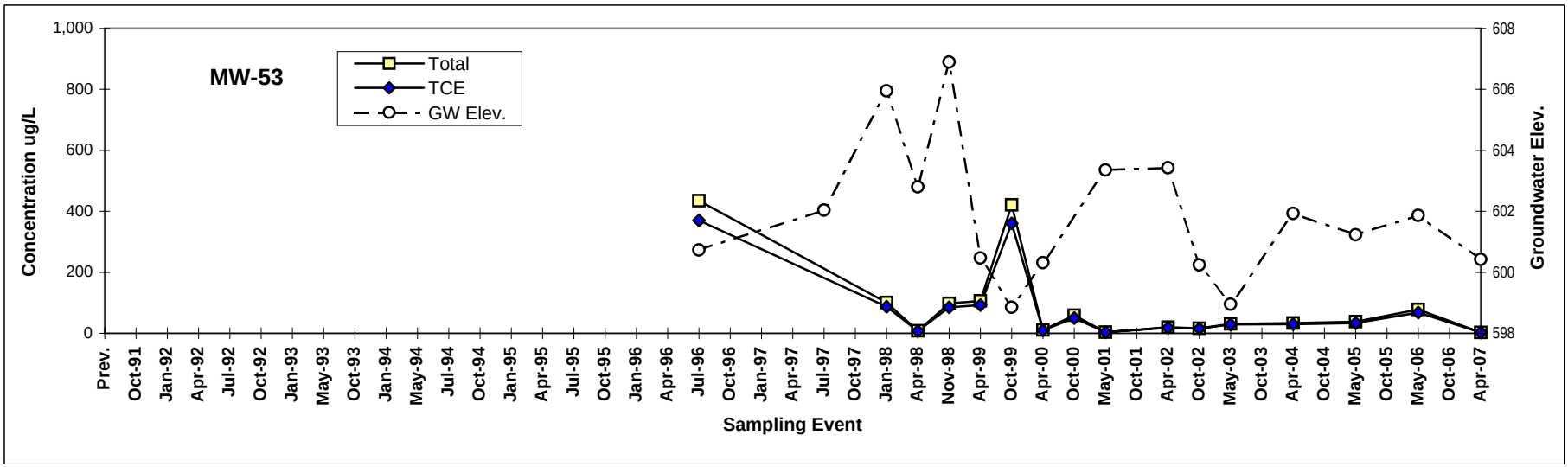


Terrace Alluvium well - former Carswell golf course, downgradient from Landfill 4

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

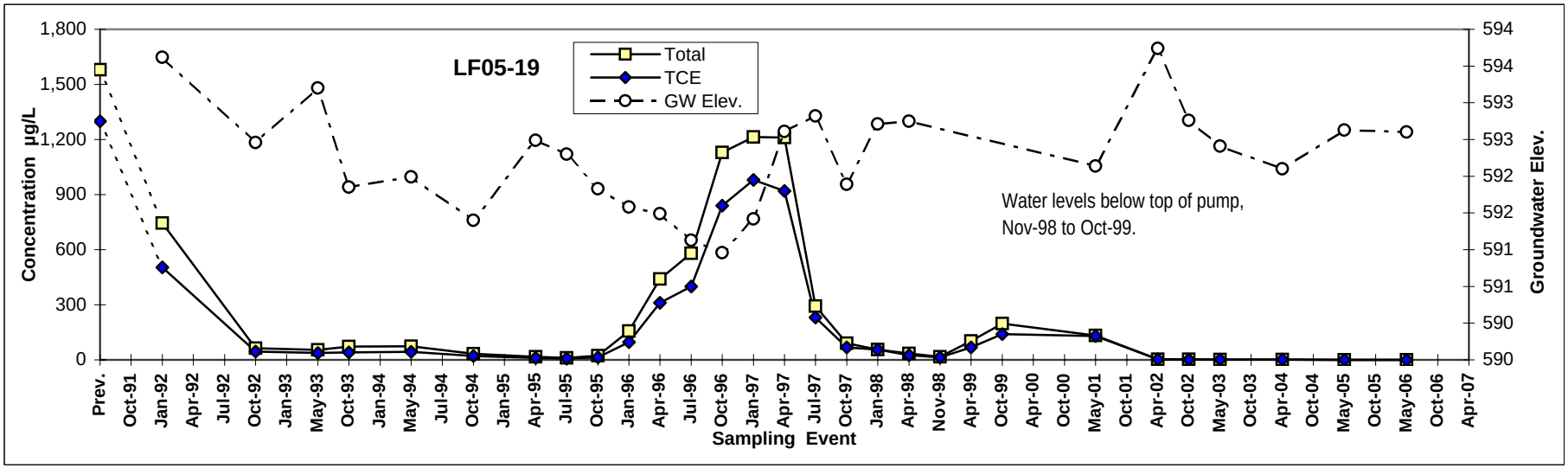


Terrace Alluvium well - Carswell Landfill 5

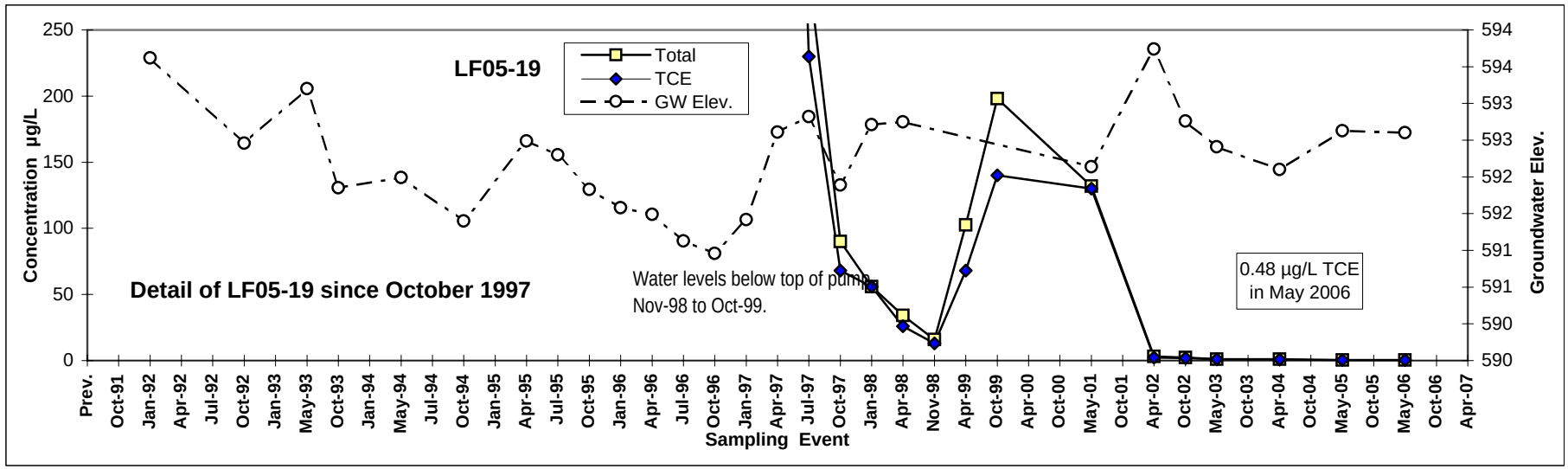


Terrace Alluvium well - NASFW, former Carswell ALCM area

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

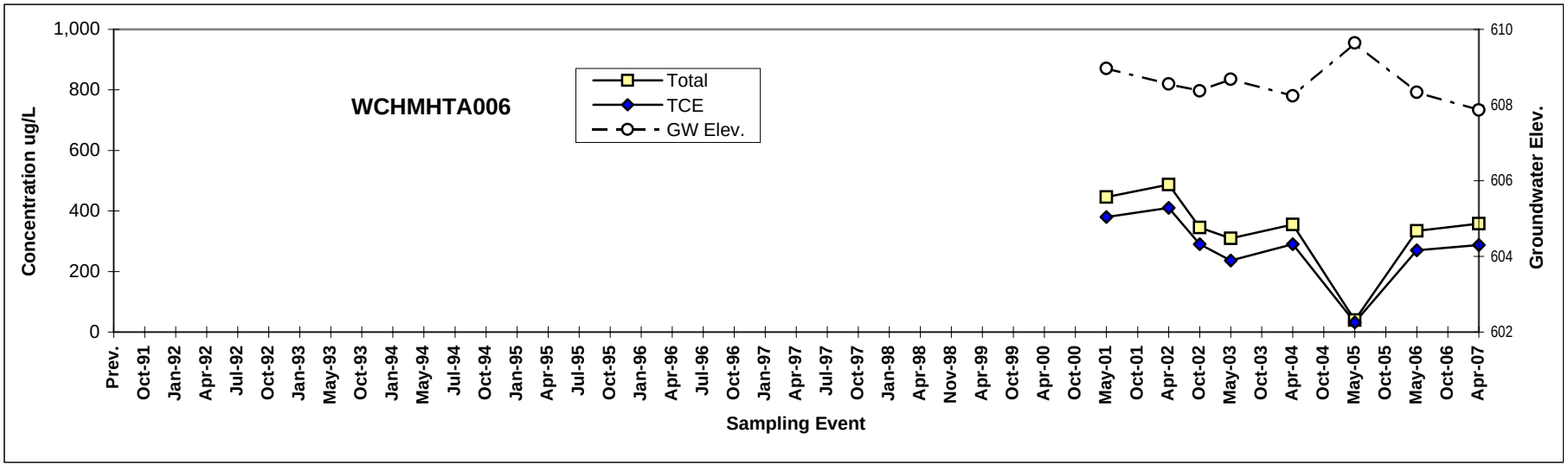


Terrace Alluvium well - near golf course club house and cart maintenance building

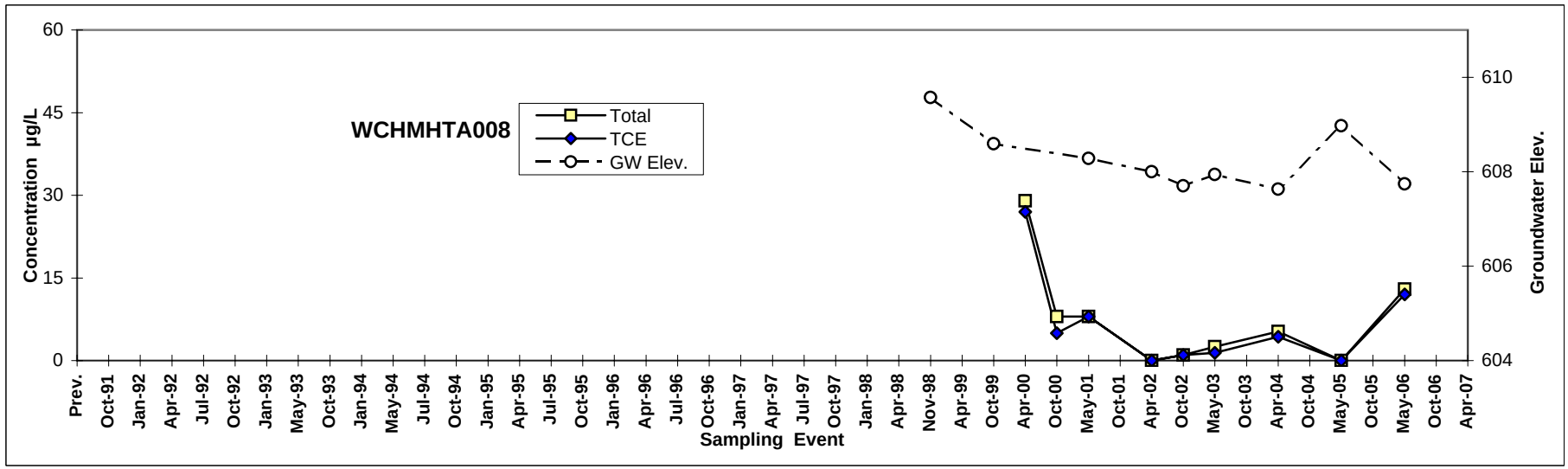


Terrace Alluvium well - near golf course club house and cart maintenance building

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

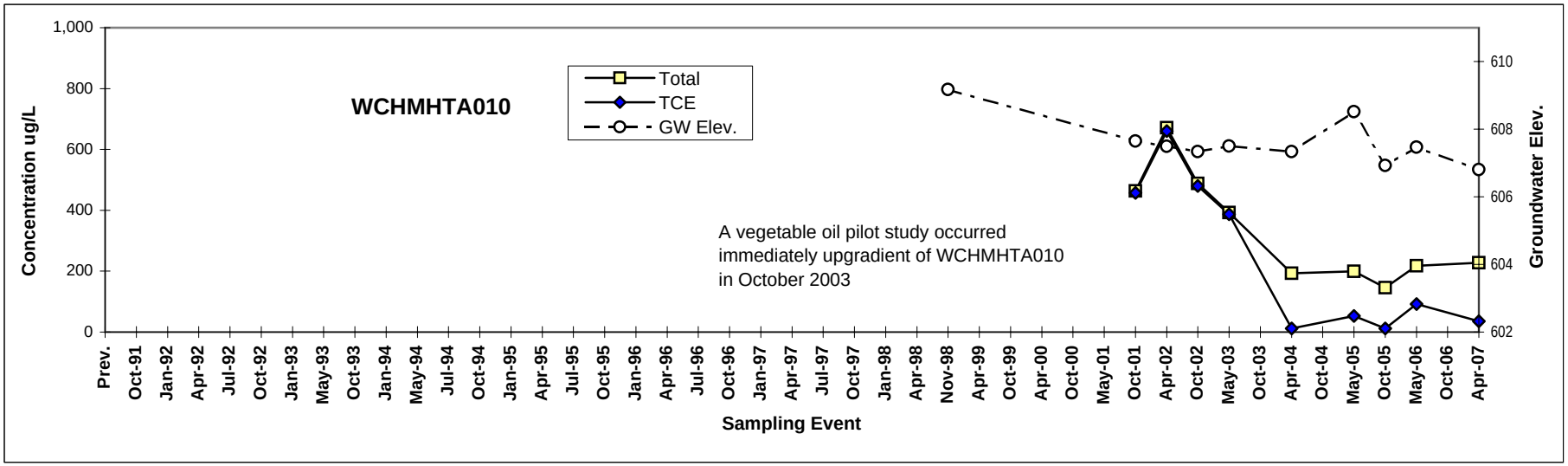


NAS Fort Worth Terrace Alluvium well at taxiway B and F

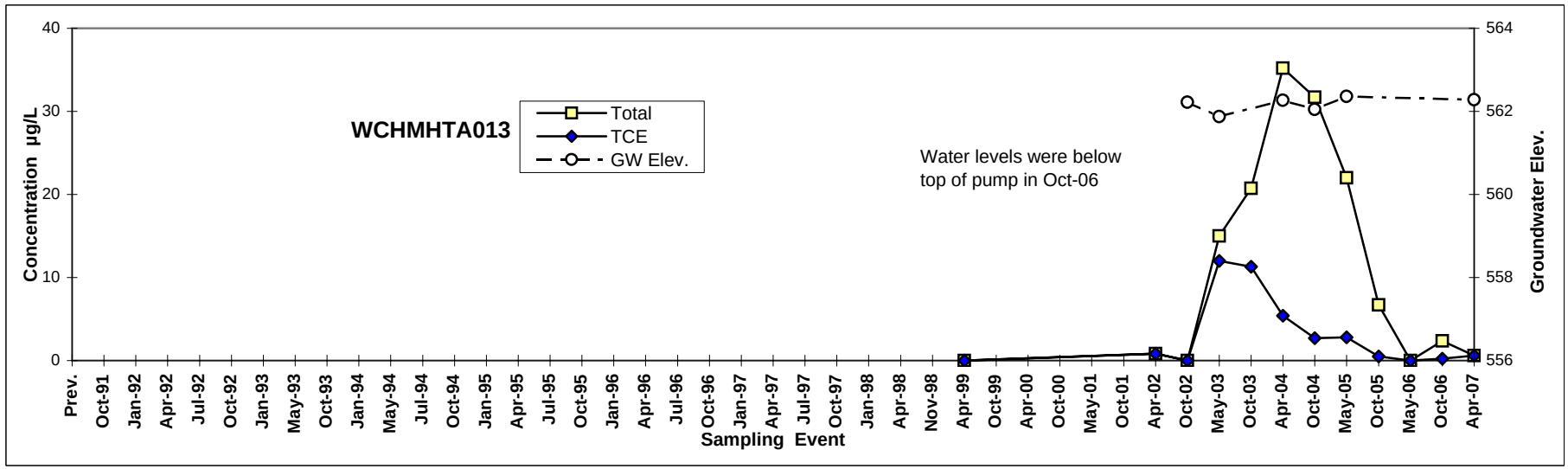


NAS Fort Worth Terrace Alluvium well - Alert Apron

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

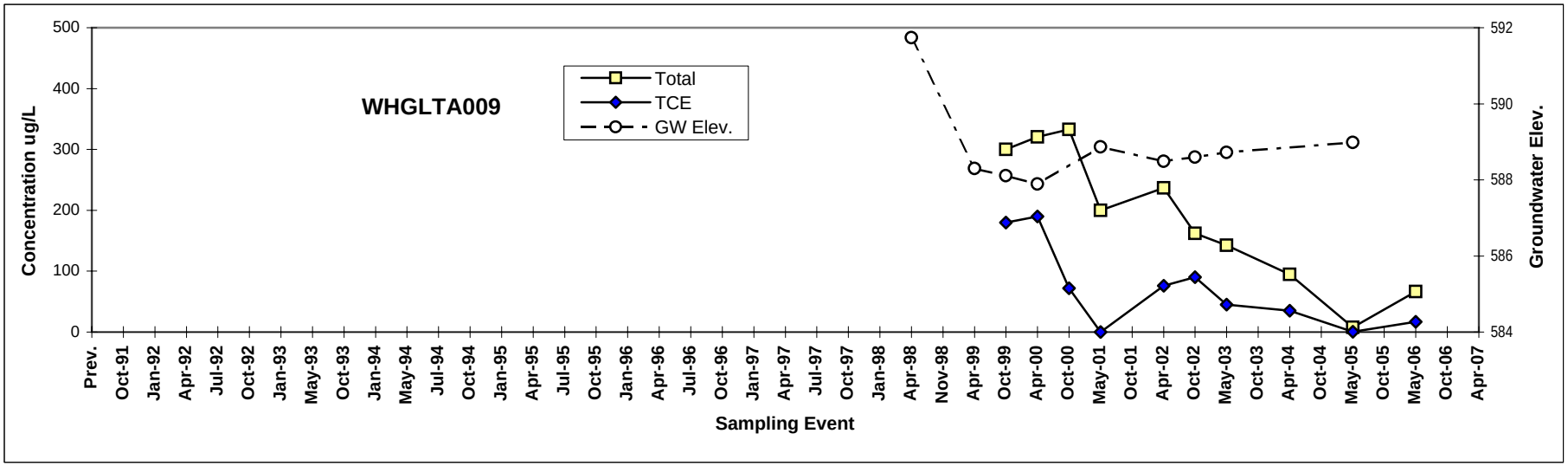


NAS Fort Worth Terrace Alluvium well - Alert Apron

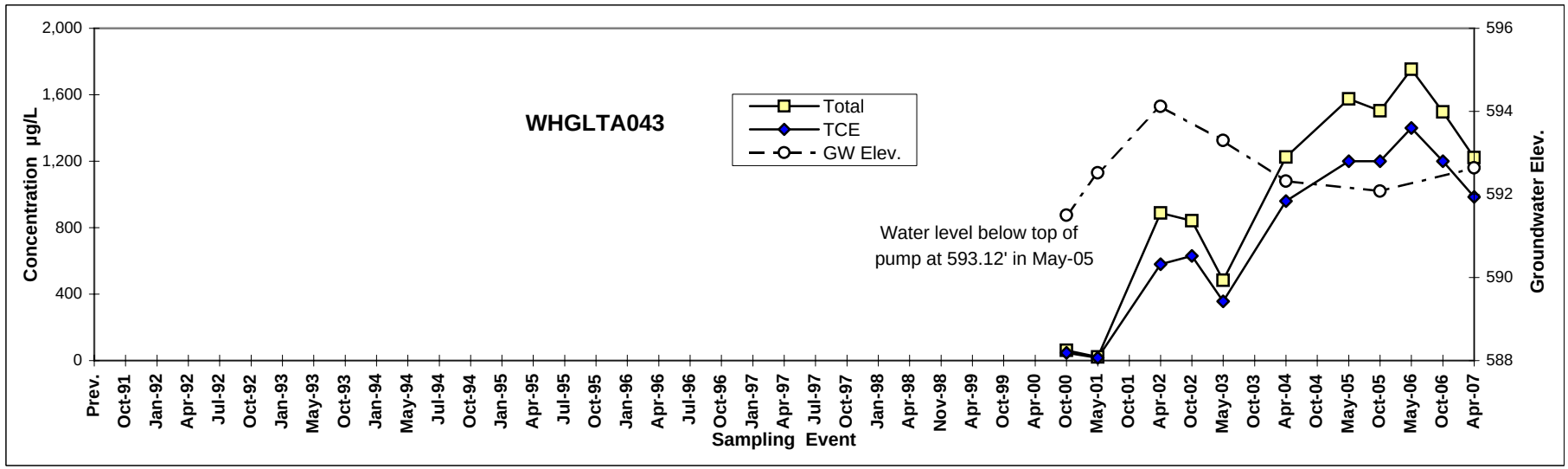


NAS Fort Worth Terrace Alluvium well

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

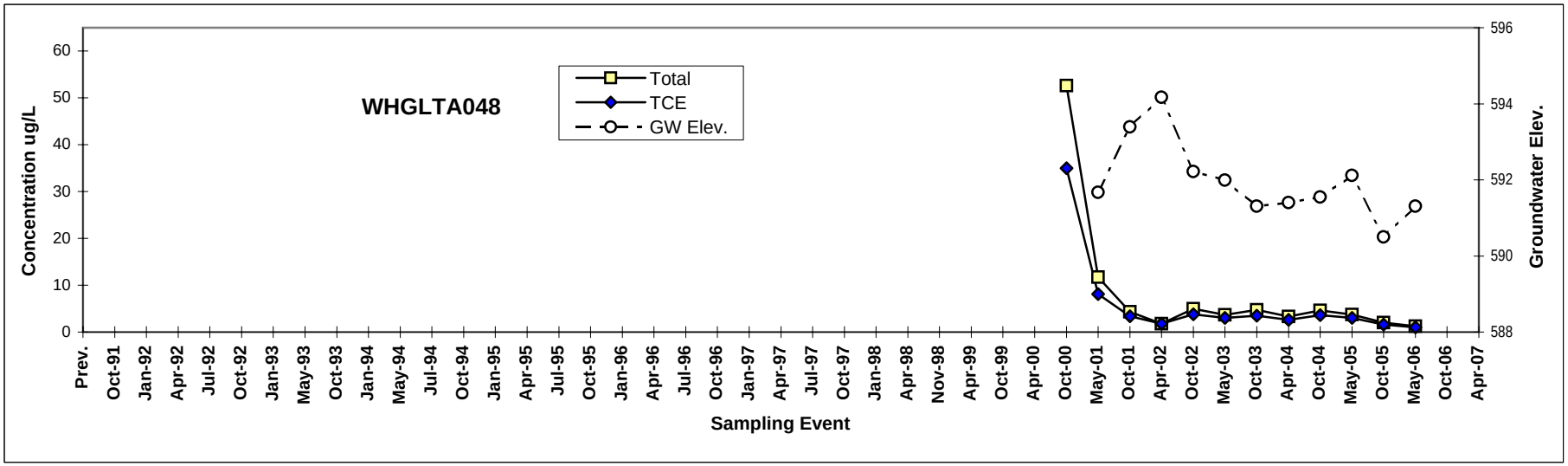


NASFW Terrace Alluvium well east of the Marine Ramp

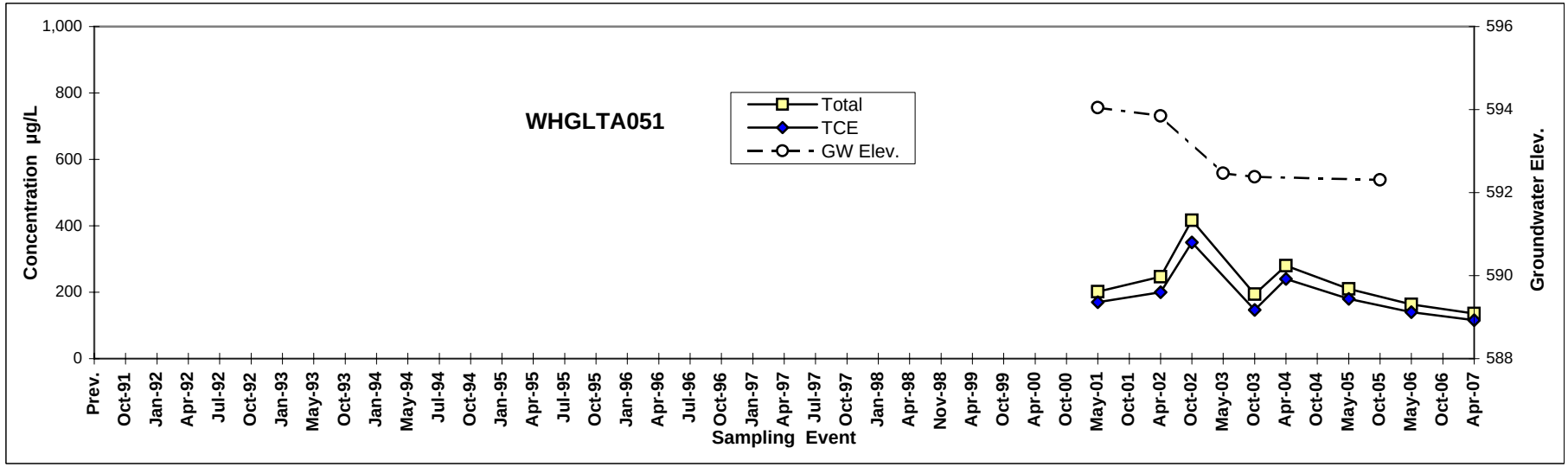


NAS Fort Worth Terrace Alluvium well - downgradient from PRB and adjacent to Farmers Branch

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

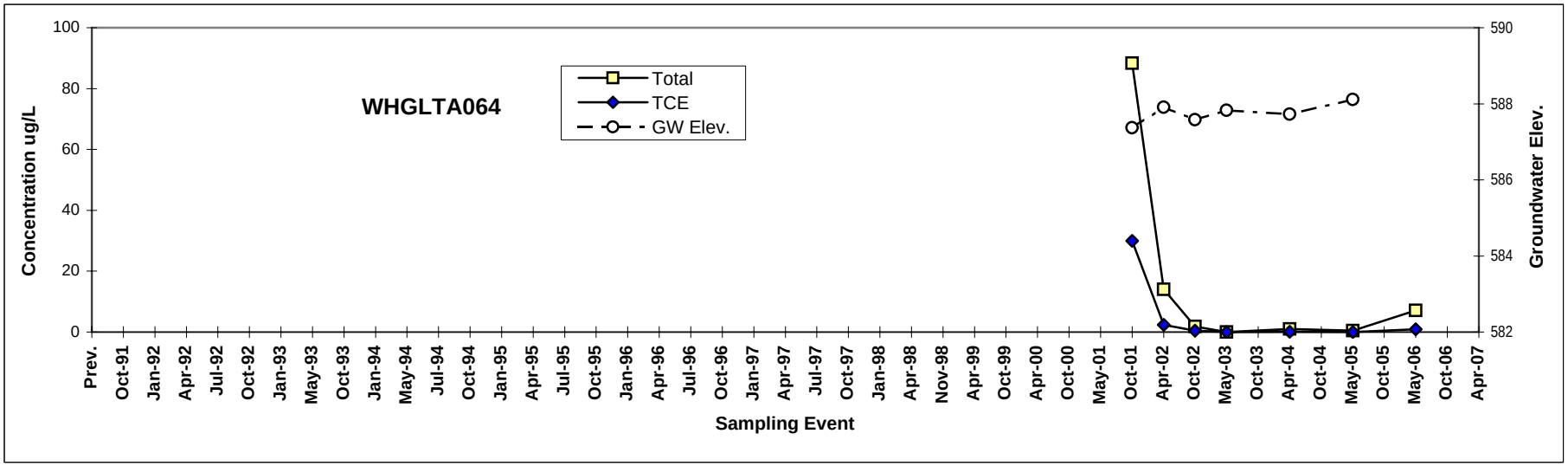


Golf Course Terrace Alluvium well along White Settlement Road near Highway 183

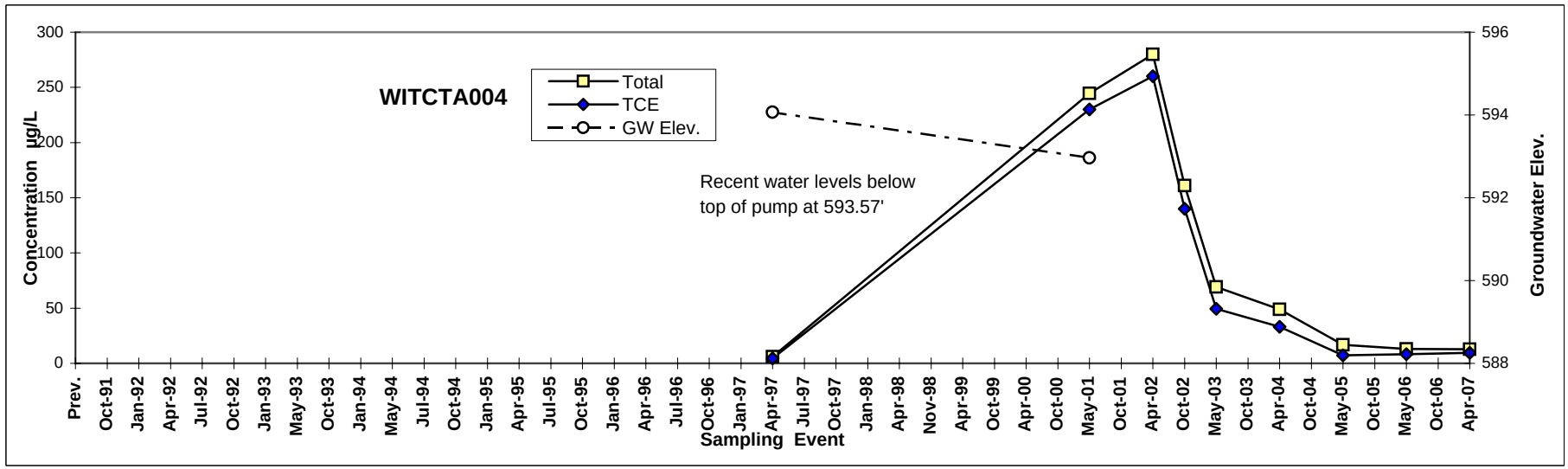


Golf Course Terrace Alluvium well west of phytoremediation area

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

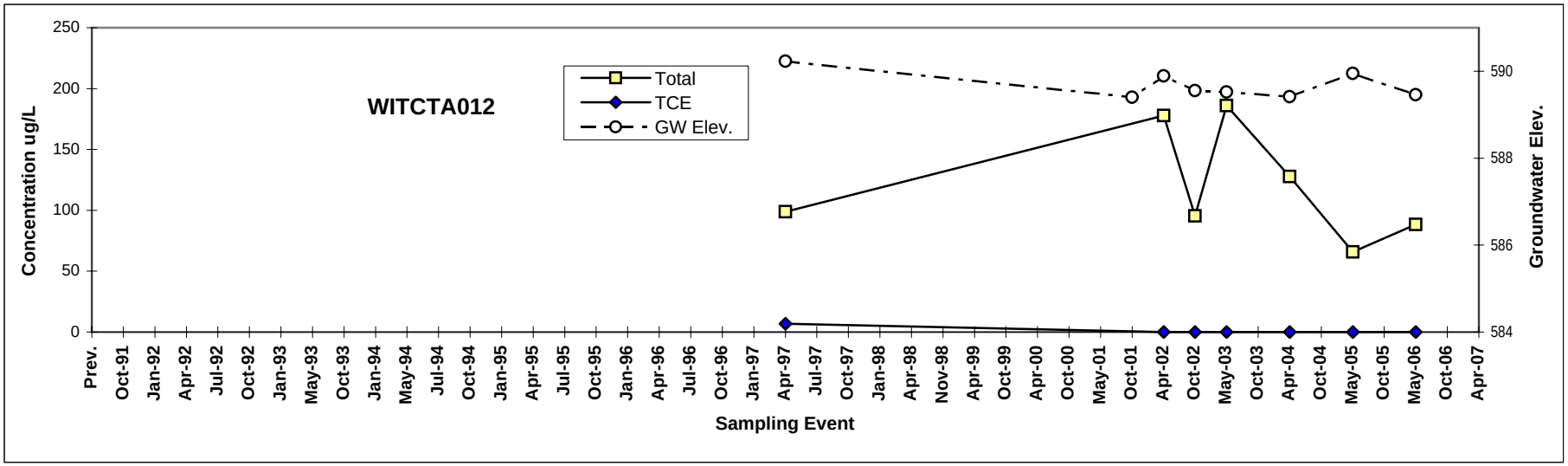


NAS Fort Worth Terrace Alluvium well east of Navy ramp

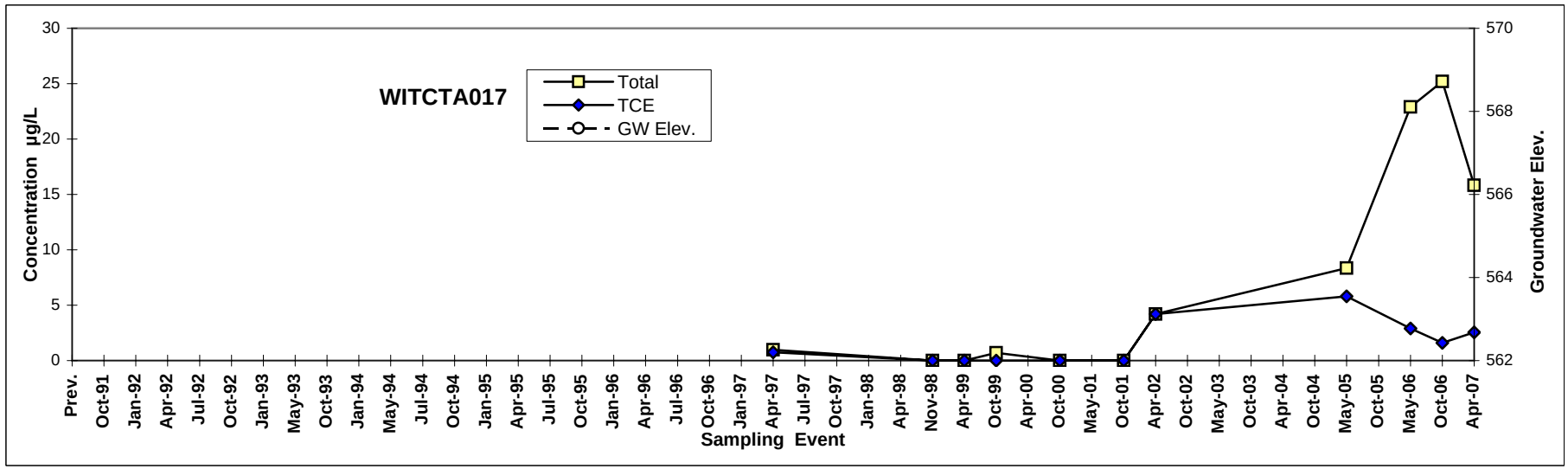


NAS Fort Worth Terrace Alluvium well near Air National Guard ramp and next to Building 1655

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

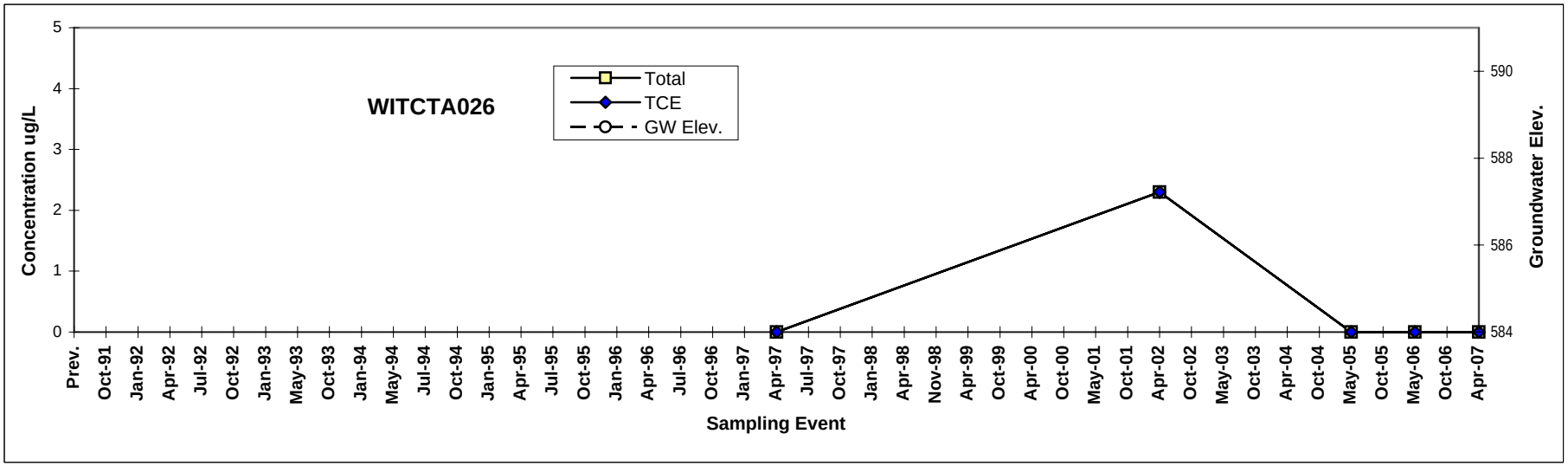


NAS Fort Worth Terrace Alluvium well, behind Building 1730

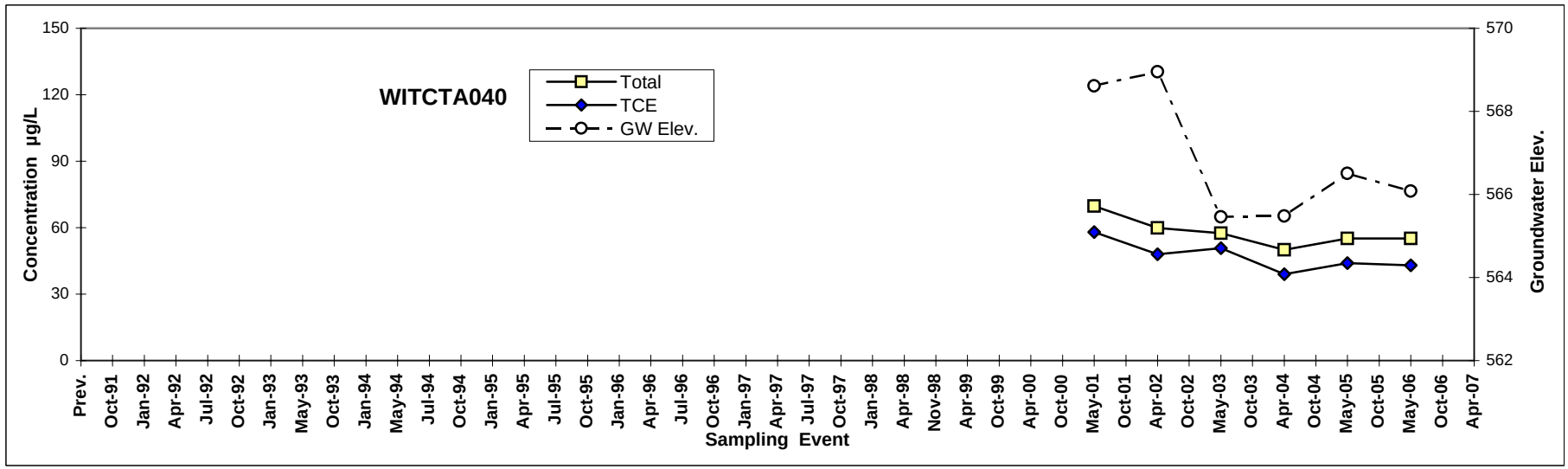


NAS Fort Worth Terrace Alluvium well next to MWR building (hobby shop)

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

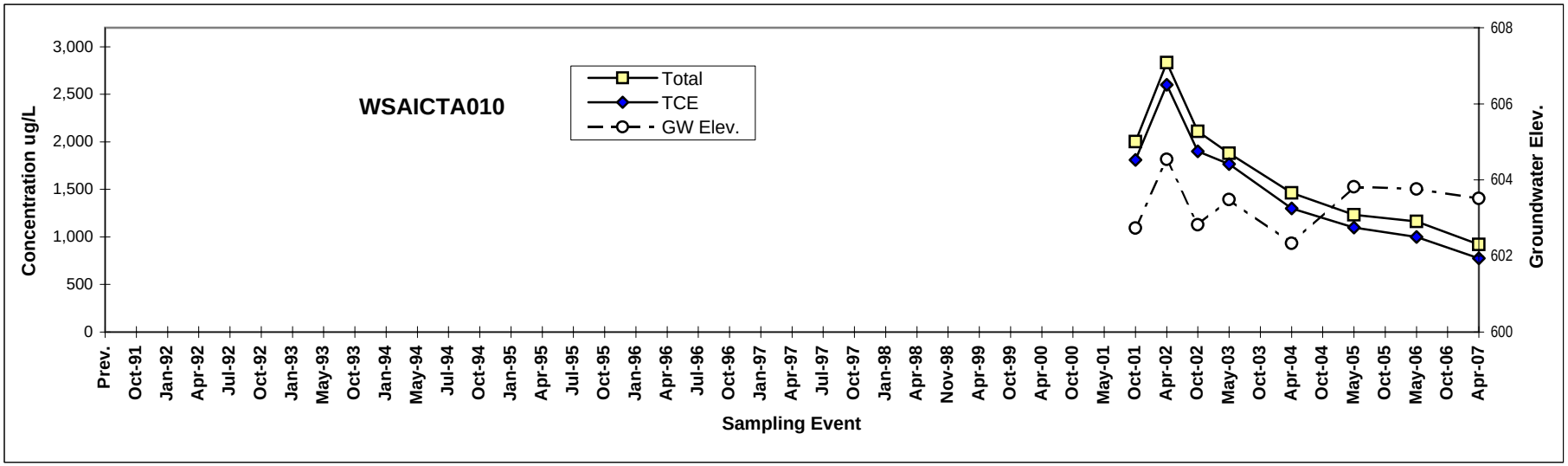


NAS Fort Worth Terrace Alluvium well, behind Building 1730

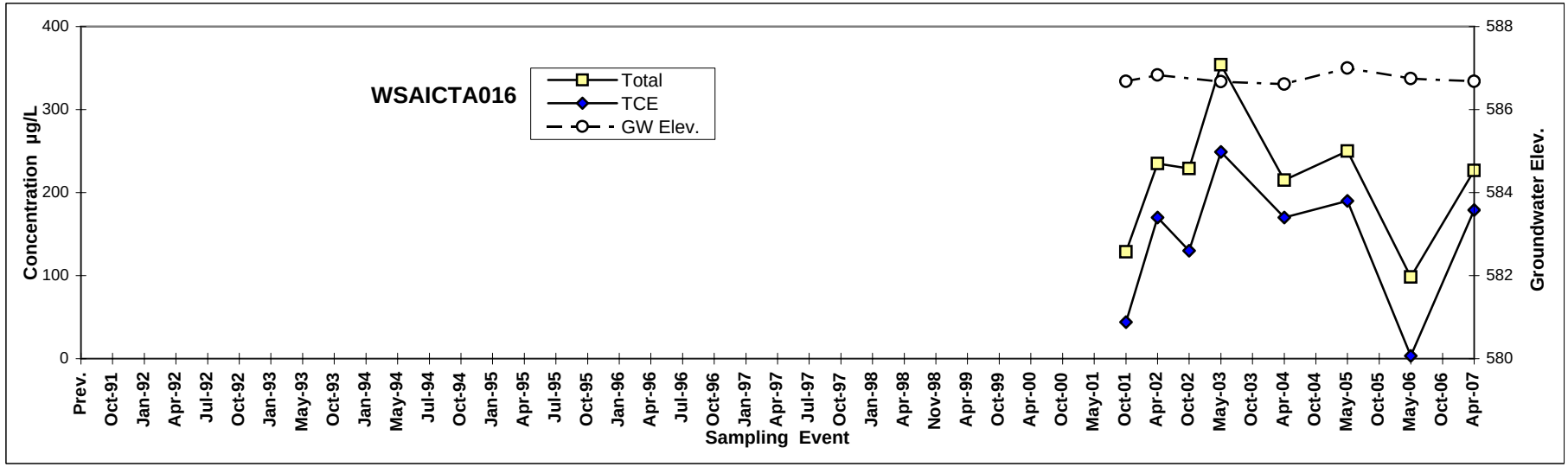


NAS Fort Worth Terrace Alluvium well next to MWR building (hobby shop)

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

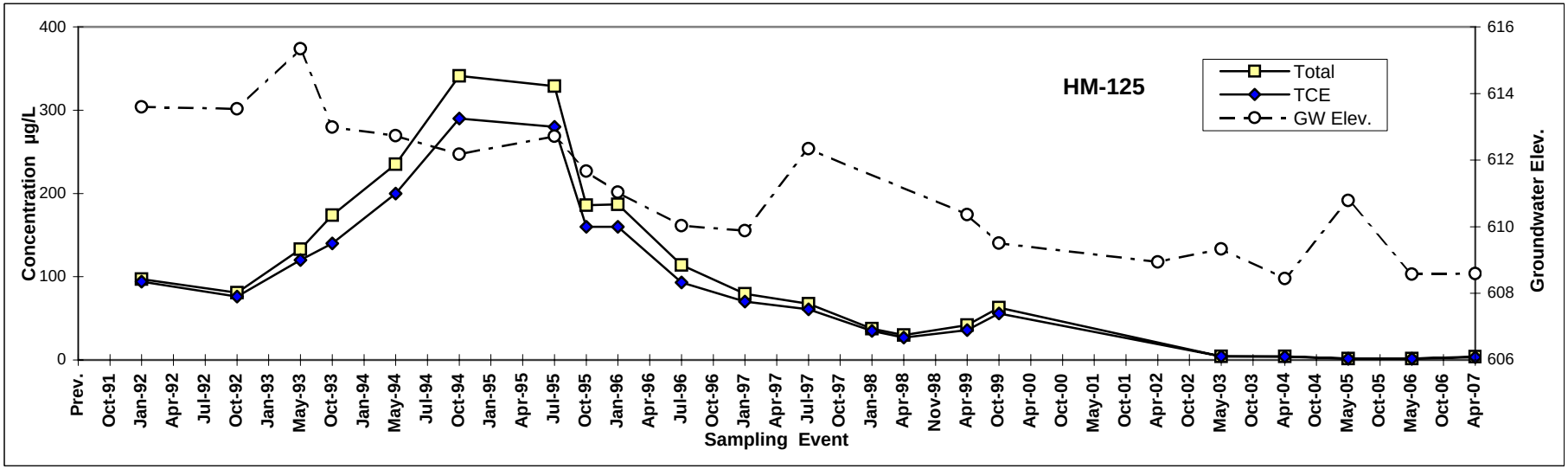


NAS Fort Worth Terrace Alluvium well on south flightline area between runway and taxiway F

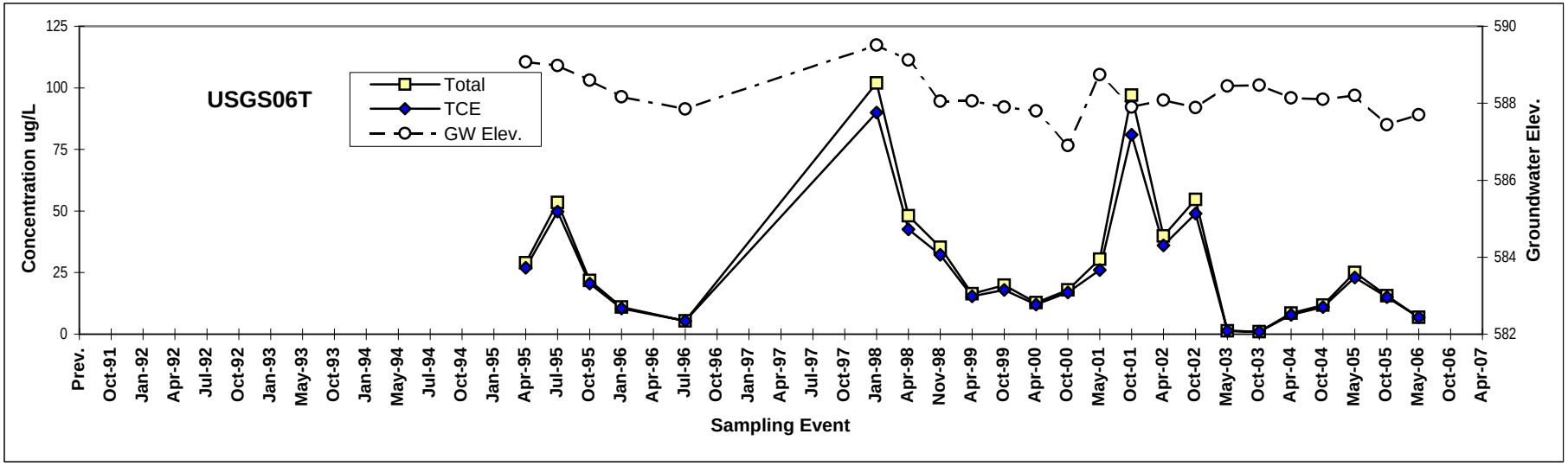


NAS Fort Worth Terrace Alluvium well near base dormitories

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

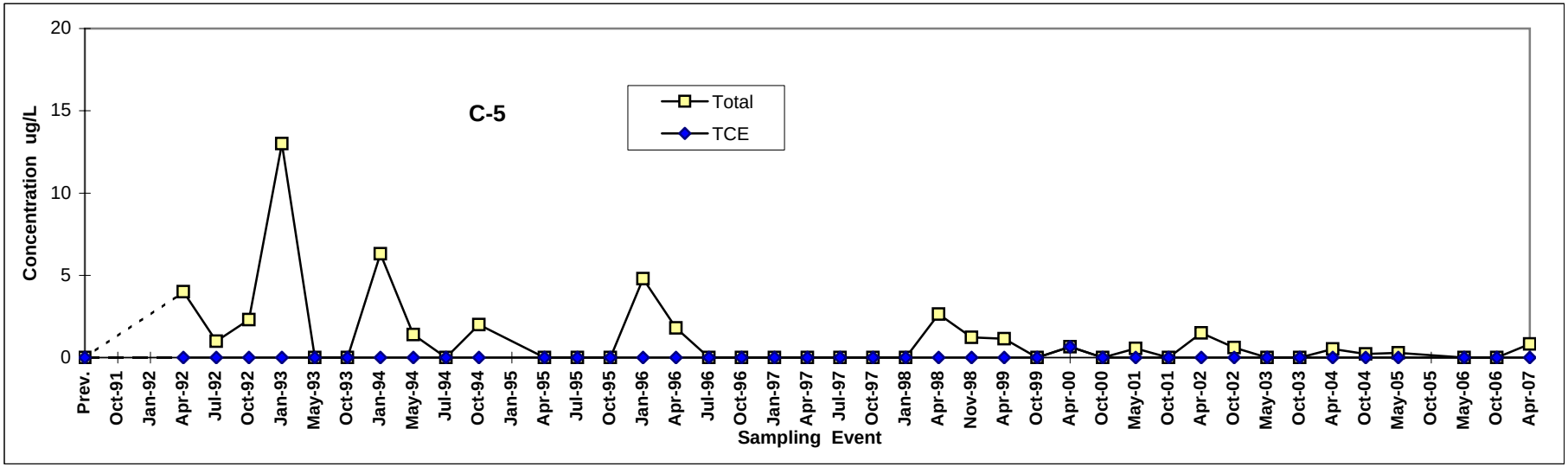


Terrace Alluvium well - NAS Fort Worth flightline along taxiway F near former Carswell ALCM area



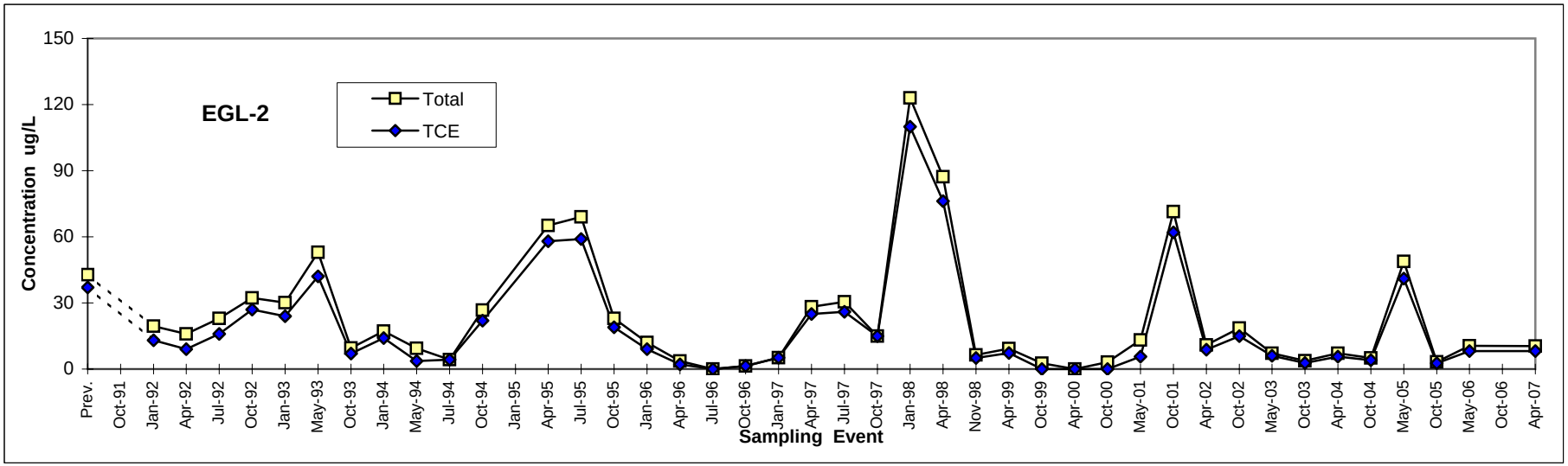
Terrace Alluvium well - NAS Fort Worth, along taxiway C-east, near Marine Ramp

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

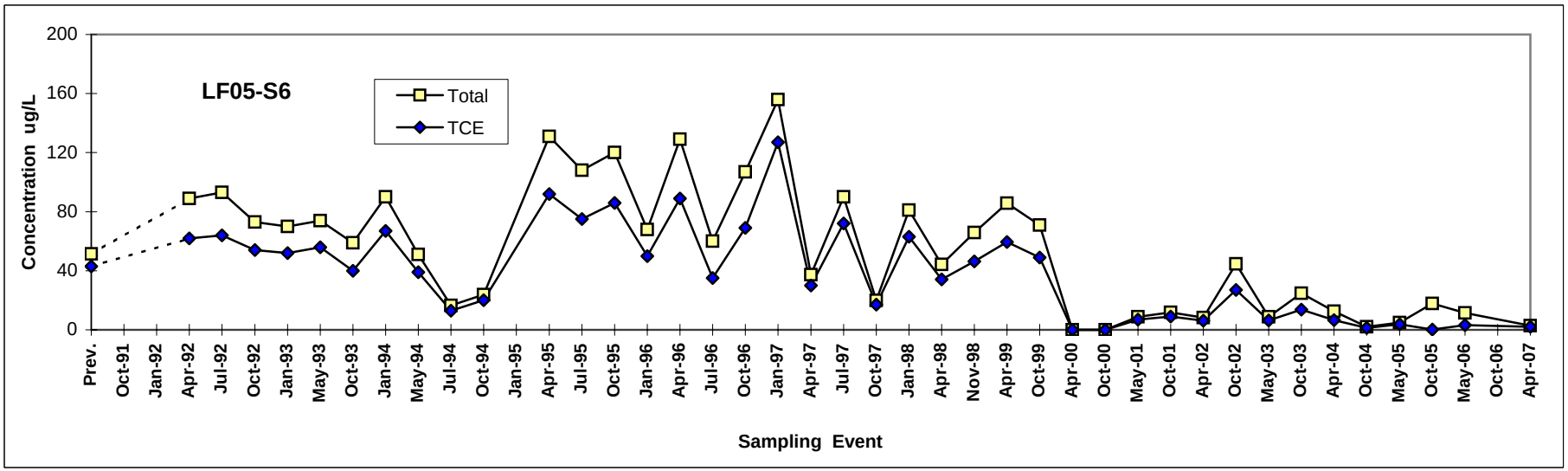


Surface location - Meandering Road Creek

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

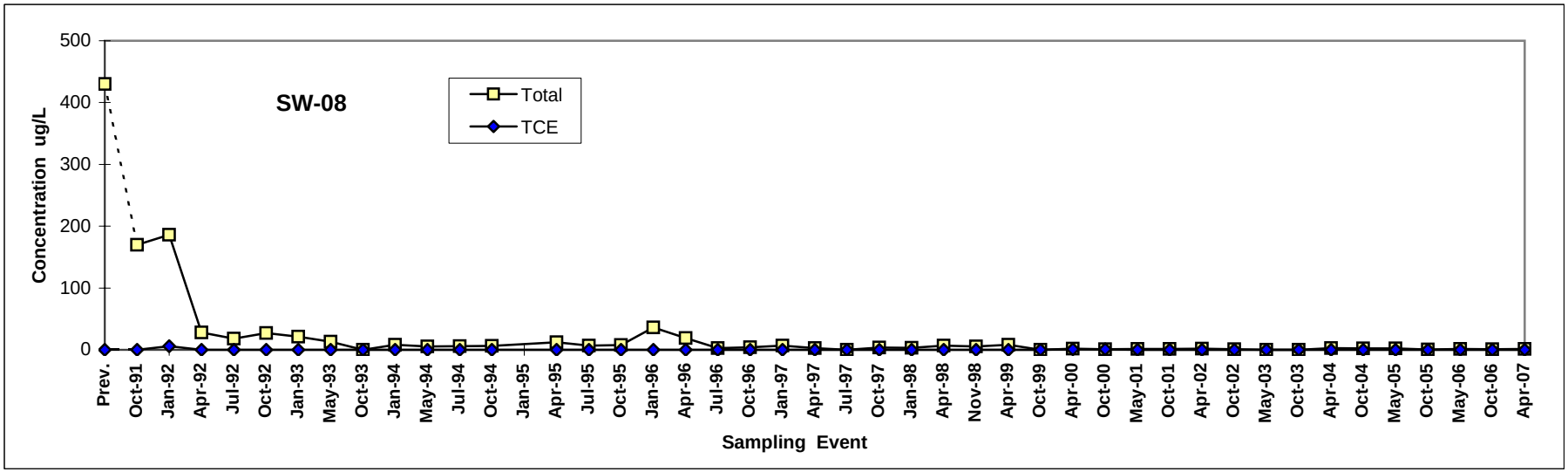


Surface location - Farmers Branch aqueduct outlet

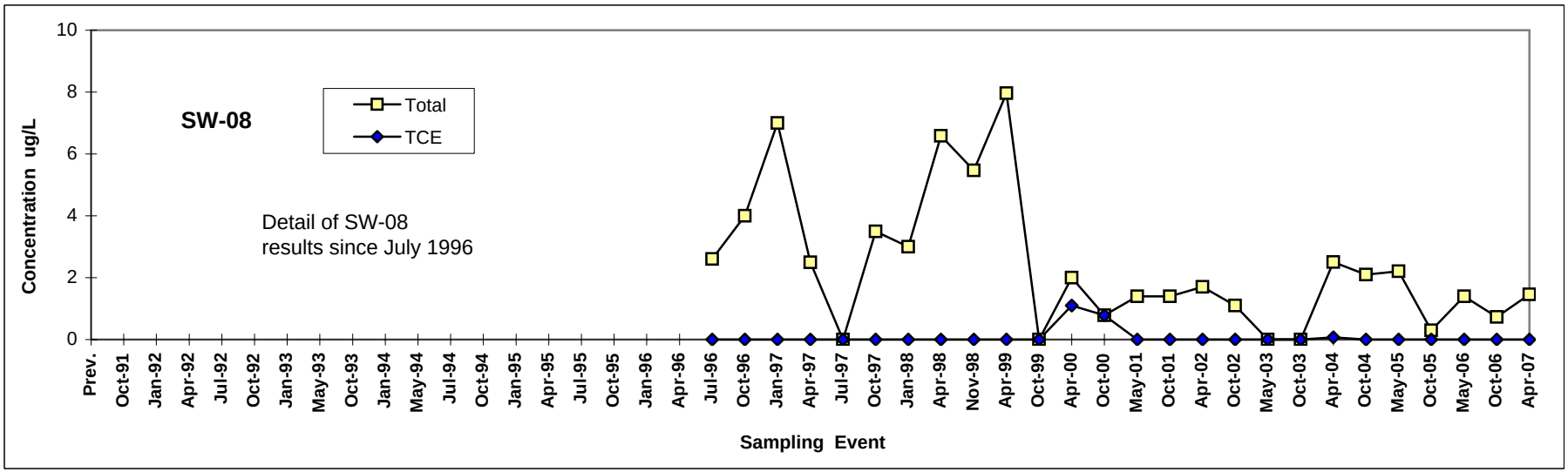


Surface location - Farmers Branch, NAS Fort Worth, downstream from confluence with unnamed tributary

"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

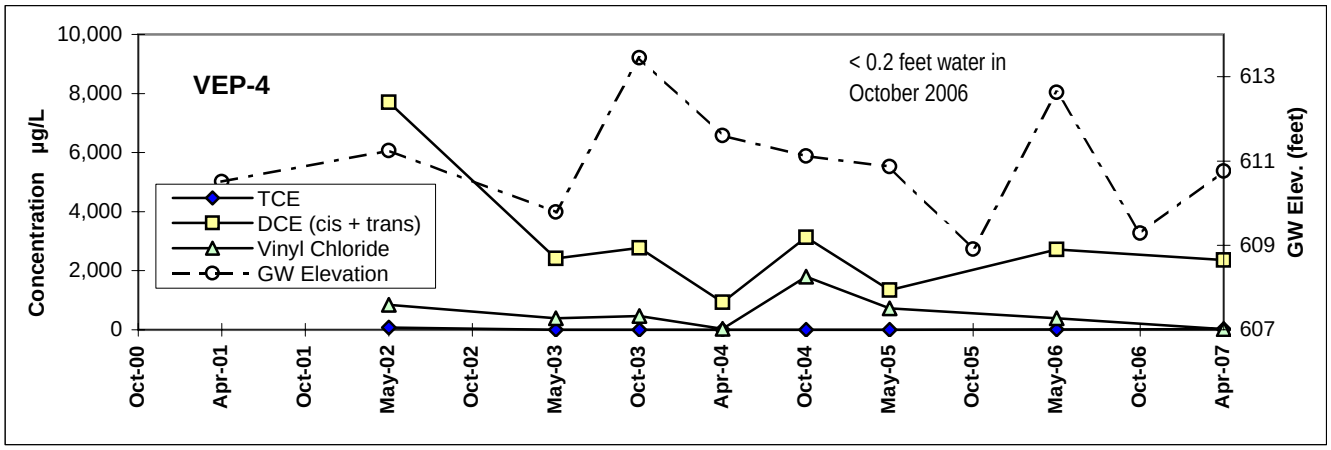


Surface location - Meandering Road Creek

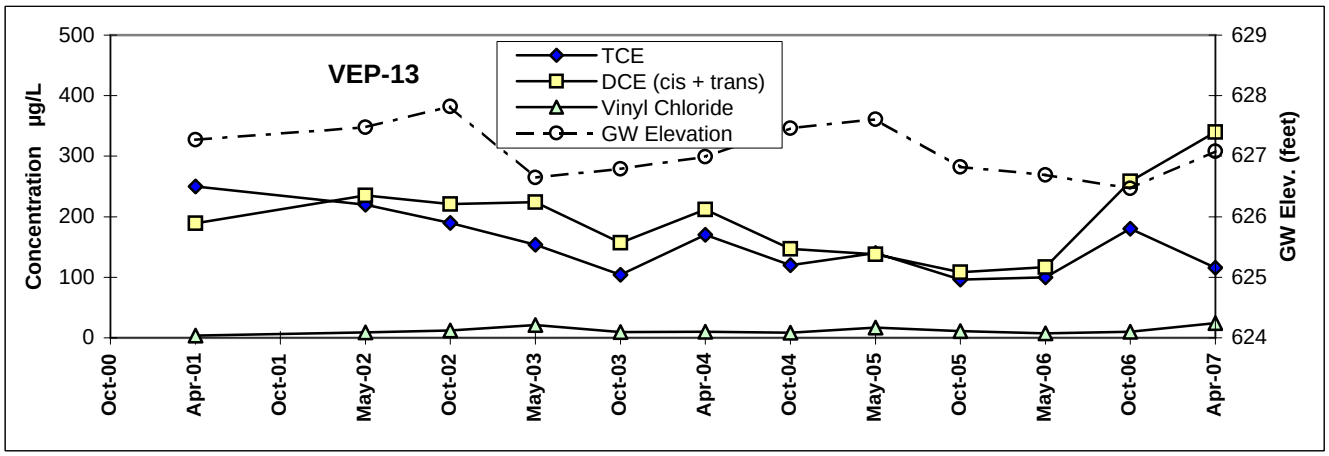


Surface location - Meandering Road Creek

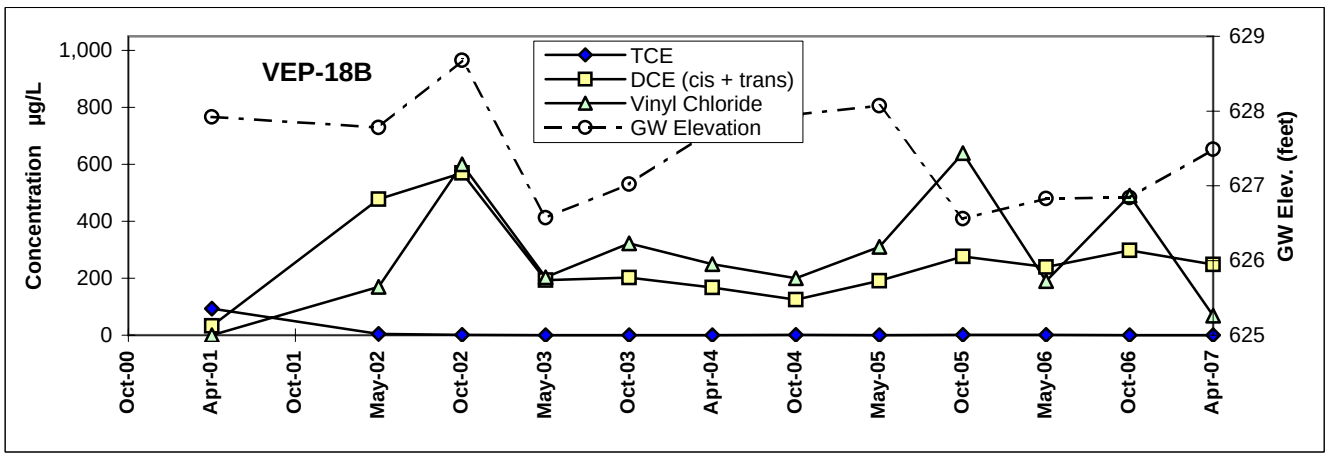
"Total" concentration = TCE plus cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride



North VEP well field, approximately 30 feet northwest of DNAPL well F-214

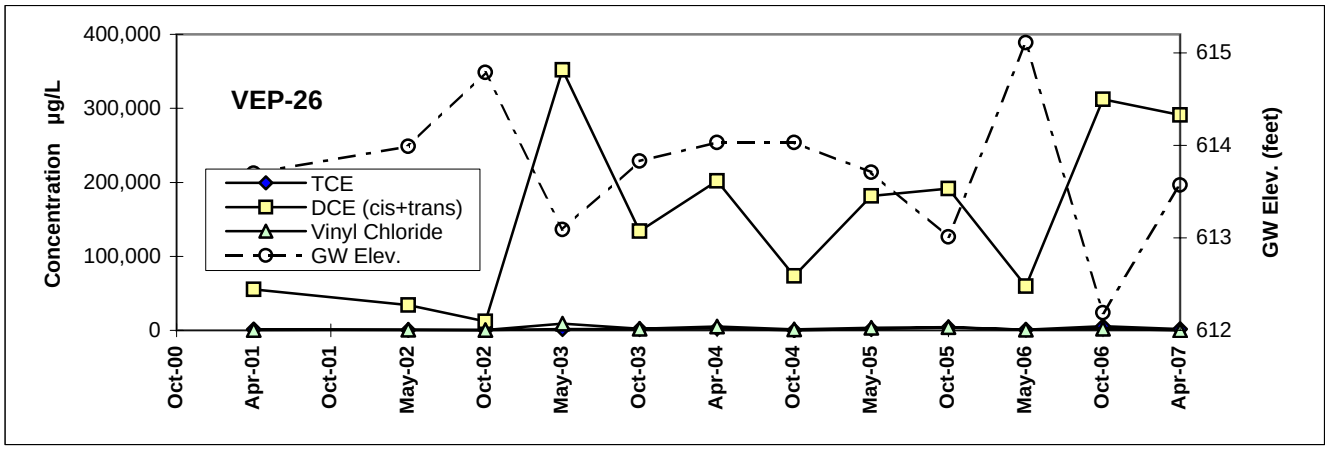


South VEP well field

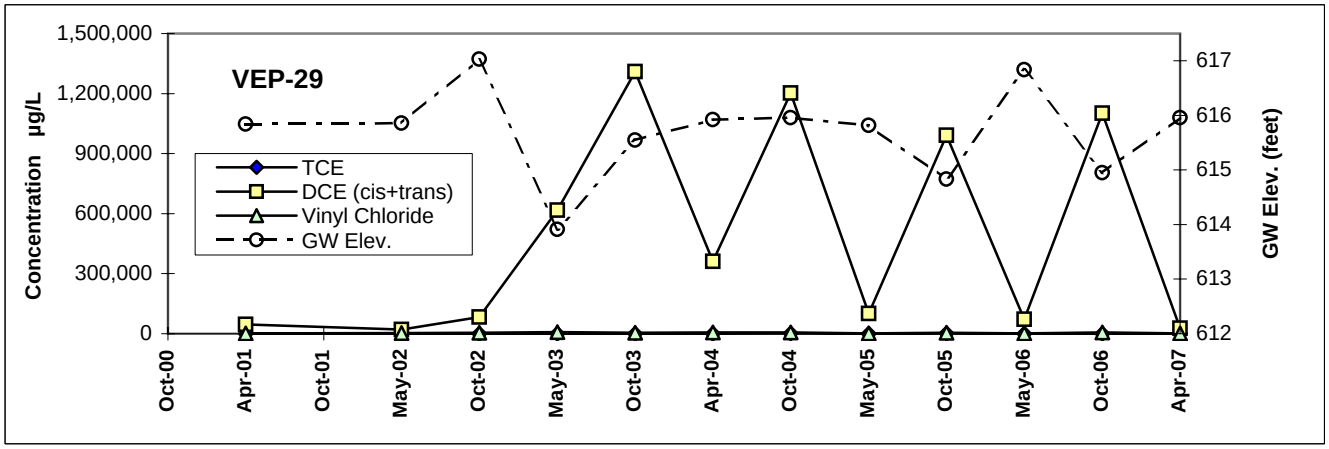


South VEP well field

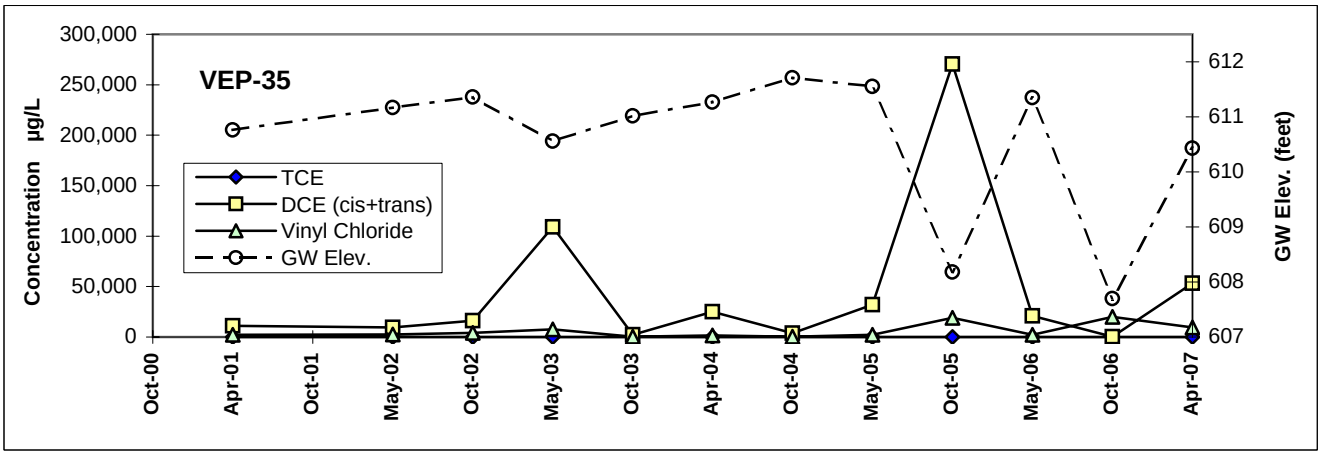
April 2001 VEP results were reported as AFCEE screening level data. Samples were collected with field blanks and duplicates, and were analyzed at a qualified analytical laboratory using all appropriate quality control/assurance procedures. However, results were not subjected to a data validation review.



North VEP well field, approximately 90 feet south-southwest of DNAPL well F-214



North VEP well field, approximately 25 feet southwest of DNAPL well F-214



North VEP well field, approximately 90 feet north of DNAPL well F-214

April 2001 VEP results were reported as AFCEE screening level data. Samples were collected with field blanks and duplicates, and were analyzed at a qualified analytical laboratory using all appropriate quality control/assurance procedures. However, results were not subjected to a data validation review.

ATTACHMENT 2

LIST OF DOCUMENTS REVIEWED

Attachment 2
List of Documents Reviewed

Aeronautical Systems Center (ASC). 2002 (February). *Community Relations Plan, Air Force Plant 4, Draft.*

Aeronautical Systems Center (ASC). 2002 (March). *Personal communication from Don Yates.*

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Remedial Investigation Report, Appendix A, ARARs Table.

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ATTACHMENT 3

SITE INSPECTION REPORT AND INTERVIEW RESPONSES

AFP4
Five-Year Review Site Inspection
(Attachment 3)

Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: ACPY (LMAERO)	**Date of inspection:** 5/2/2007
Location and Region: FORT WORTH, TX	**EPA ID:**
Agency, office, or company leading the five-year review: SHAW, TCEQ, EPA	**Weather/temperature:** CLEAR / WARM

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☐ Institutional controls
- ☑ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other Report Focused on EPL, B181 SVE; EPL PoT AMS EPA-1 PoT
- ☐ Monitored natural attenuation
- ☑ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** RANDALL L. McDANIEL (Name) SITE SUP (Title) 5/2/07 (Date)
   Interviewed ☒ at site ☒ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached NO PROBLEMS

2. **O&M staff** — (Name) _____ (Title) _____ (Date) _____
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

RB Wise 6/28/07 SHAW

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☒ O&M manual — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ As-built drawings — ☒ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Maintenance logs — ☒ Readily available — ☐ Up to date — ☐ N/A

   Remarks: AFB4 SITE office has up to date documents and SITE FILE

2. **Site-Specific Health and Safety Plan** — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Contingency plan/emergency response plan — ☒ Readily available — ☐ Up to date — ☐ N/A

   Remarks: CP/ER is part of EHSP

3. **O&M and OSHA Training Records** — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks:

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Other permits ____ — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks: NO PERMITS needed CERCLA SITE, POTW Agreements UP TO DATE, Air Discharge ~~EXEMPT~~ Exemption up to date

5. **Gas Generation Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks:

6. **Settlement Monument Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks:

7. **Groundwater Monitoring Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks:

8. **Leachate Extraction Records** — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks:

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Water (effluent) — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks: POTW Agreement for EPA and IBI. Surface Water Agreement EPA-1 to MEANDER Flood Check

10. **Daily Access/Security Logs** — ☒ Readily available — ☒ Up to date — ☐ N/A

    Remarks: ON Field Activity DAILY LOG

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other SHAW EW & INF INL

2. **O&M Cost Records** See Attached Separate Cover

☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

From _____ To _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: EPL SYSTEM POOR DESIGN AND POOR CONSTRUCTION problems. Electrical problems continue. Site are quickly solved. ADEQUATE SPARE PARTS ON SITE

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing LF3 FENCE ACROSS MEANDERING Road CREEK

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks MINOR DAMAGE TO TOP OF FENCE, SOME CONCRETE DAMAGE, FENCE STILL SECURES AREA, RECENT FLOOD DAMAGE

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☑ N/A

Remarks _____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

(LF3)

Type of monitoring (*e.g.*, self-reporting, drive by) Drive By Work in Area

Frequency 3X Week

Responsible party/agency Shaw

Contact Name: Ramona McDaniel | Title: Site Supv | Date: 6/27/07 | Phone no.: 917 722-8176

Reporting is up-to-date Normal DAily Site Logs ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☐ Yes ☒ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

~~LF3 Fence~~

NO Specific IC Requirements - Shaw keeps an eye on LF3

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☒ N/A

Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks

2. **Land use changes on site** ☒ N/A

Remarks

3. **Land use changes off site** ☒ N/A

Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A

Remarks

B. Other Site Conditions

Remarks _____

_____

_____

_____

_____

_____

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent _____ Depth _____
   Remarks _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths _____ Widths _____ Depths _____
   Remarks _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent _____ Depth _____
   Remarks _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent _____ Depth _____
   Remarks _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks _____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks _____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent _____ Height _____
   Remarks _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
   - ☐ Wet areas ☐ Location shown on site map Areal extent_____
   - ☐ Ponding ☐ Location shown on site map Areal extent_____
   - ☐ Seeps ☐ Location shown on site map Areal extent_____
   - ☐ Soft subgrade ☐ Location shown on site map Areal extent_____

   Remarks_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability

   Areal extent_____
   Remarks_____

B. Benches ☐ Applicable ☐ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
   Remarks_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
   Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
   Remarks_____

C. Letdown Channels ☐ Applicable ☐ N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
   Areal extent_____ Depth_____
   Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
   Material type_____ Areal extent_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
   Areal extent_____ Depth_____
   Remarks_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations ☐ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____

E. Gas Collection and Treatment ☐ Applicable ☐ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____

F. Cover Drainage Layer ☐ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks_____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☐ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ☐ Siltation not evident
   Remarks_____

2. **Erosion** Areal extent_____ Depth_____
   ☐ Erosion not evident
   Remarks_____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks_____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks_____

H. Retaining Walls ☐ Applicable ☐ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks_____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☑ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☑ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☑ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   ☑ Good condition ☐ All required wells properly operating ☑ Needs Maintenance ☐ N/A
   Remarks POOR DESIGN AND INSTALLATION of NORMAL WEAR & TEAR require periodic well and well unit O&M. Many VFD wear out and surge (Thunderstorm) reset.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☒ Good condition ☐ Needs Maintenance
   Remarks

3. **Spare Parts and Equipment**
   ☑ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks ADEQUATE Supply VFDs, I/O modules and pressure sensors FN wells / kept onsite, motor and pumps FN systems onsite.

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
   ☐ Good condition ☐ Needs Maintenance
   Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☐ Good condition ☐ Needs Maintenance
   Remarks

3. **Spare Parts and Equipment**
   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks

C. Treatment System ☑ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   - ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   - ☑ Air stripping (EPL/BIBI) ☑ Carbon adsorbers (FSAI, EPL/BIBI) LPGAC
   - ☑ Filters BAG FILTERS
   - ☐ Additive (*e.g.*, chelation agent, flocculent)
   - ☐ Others UPGAC ~~ES~~ EPL / BIBI
   - ☑ Good condition ☐ Needs Maintenance → EPL
   - ☑ Sampling ports properly marked and functional
   - ☑ Sampling/maintenance log displayed and up to date
   - ☑ Equipment properly identified
   - ☐ Quantity of groundwater treated annually 2005 - 2006
   - ☐ Quantity of surface water treated annually

   2004 – 22,769,504 gallons
   2005 – 27,032,986
   2006 – 16,190,654 – drought yr
   2007 THW MW –

   Remarks 2006 A DROUGHT YEAR

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☑ Good condition ☐ Needs Maintenance
   Remarks

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☑ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☑ Good condition ☐ Needs Maintenance
   Remarks

5. **Treatment Building(s)**
   ☐ N/A ☑ Good condition (esp. roof and doorways) ☐ Needs repair
   ☑ Chemicals and equipment properly stored
   Remarks

6. **Monitoring Wells** (pump and treatment remedy) LTM AND AS needed
   ☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled ☐ Good condition
   ☑ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks

D. Monitoring Data

1. Monitoring Data
   ☑ Is routinely submitted on time ☑ Is of acceptable quality

2. Monitoring data suggests:
   ☑ Groundwater plume is effectively contained ☑ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs Maintenance ☑ N/A

Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

MAIN EPL PLUME Shrinking. Conc down in plume Only minor residual VOCs in GW at B181, NOT AN ACTIVE SOURCE AT NO MASS FLUX.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O&M ADEQUATE AND AT AN Appropriate level.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.
	Since 2002 The EPL electrical And control issues have seen more costly than normally expected w/ + P&T unit. In 2002 major rewiring of electrical surge And grounding was required due to improper installation by DB Firm.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
	~~Old OCt~~ Shaw removed The EPL Field System And installed A in-line mixer, old stuff was over blown junk that did not work. Sampling programs optimized, carbon managed for best value; B/181 SVE Field optimized, residual hot spot being addressed with localized P&T and down the road an in situ Technology if funded. Residual cont CRP3 being monitored, new wells installed. LF3 Seawall in place may had TOC recharge.

LF3 Seep and MRC SW optimized from monthly to ~~Semimonth~~ Si-monthly to quarterly. At several systems metals and Gen Chem parameters dropped or frequency adjusted.

AFP4
Five-Year Review Interviews
(Attachment 3)

AIR FORCE PLANT 4

2007 FIVE-YEAR RECORD OF DECISION REVIEW

QUESTIONNAIRE

For the following questions, please note that *"the project"* refers to the remedies specified in the Record of Decision, specifically the Building 181 soil vapor extraction system (with electrical resistive heating), the East Parking Lot/Window Area groundwater treatment system, the Fuel Saturation Area 1 system, and the Long-Term Monitoring program.

However, please feel free to also comment on the Air Force's voluntary remedial actions, including the Carswell permeable reactive barrier, the phytoremediation plantings, the bark mulch reactive barrier in AFP4 Landfill 3, and the Air Force's efforts to identify and remediate any potential sources of PCBs. You may also include any other concerns or issues you wish to discuss. Your responses should focus primarily on the status of the project over the last 5 years, since approximately June 2002. Please return your comments no later than April 6, 2007.

The following comments pertain to the PCB investigation and remediation activities associated with the fish tissue PCB contamination and fish consumption advisory in Lake Worth and the resulting Total Maximum Daily Load (TMDL) and Implementation Plan. Comments were provided by the TMDL Section of the TCEQ Chief Engineer's Office and the TMDL Program of the TCEQ Region 4 Water Section.

1. What is your overall impression of the project? (general sentiment)

The overall impression of PCB-related activities is positive. Numerous studies have been conducted and others are in progress to locate any remaining sources of PCBs at AFP4. Air Force-funded investigations made the link between AFP4 sources and PCBs in Woods Inlet, and additional investigations have continued since that time.

2. Have there been routine communications or activities (meetings, site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please give purpose and results.

TMDL staff have attended regular AFP4 technical meetings when the on-going PCB-related activities have been discussed. Telephone and e-mail contacts have been made as needed, including obtaining comments on the draft Implementation Plan for the TMDL. A site visit was made to AFP4 (in conjunction with one of the technical meetings) during the TMDL process. TMDL staff accompanied Lockheed and Shaw Environmental staff in May 2006 on a routine survey of Meandering Road Creek to examine seeps and general creek condition.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.

No major incidents have occurred related to TMDL activities. Responses were made to a couple general inquiries from the public on fish consumption and PCB issues. One person was referred to

the City of Fort Worth with questions concerning possible dredging activities in Lake Worth (unrelated to the TMDL).

4. Do you feel well informed about the site's activities and progress?

Yes – updates have been provided via the technical meetings and through telephone/e-mail as needed.

5. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Overall site activities related to PCB issues have been positive. Sampling activities have continued in an effort to locate any significant PCB sources at the site. Other efforts (housekeeping, etc.) are being evaluated to prevent any PCB release. Recent results from fish sampling by the City of Fort Worth indicate a substantial decline in fish tissue PCB levels.

Ultimate removal of the fish consumption advisory will require fish tissue data collected with the assistance of the Seafood and Aquatic Life Group of the Texas Department of State Health Services (TDSHS). Coordination with TDSHS on the timing and details of fish tissue sampling is necessary to ensure collection of data appropriate for reassessment of the fish consumption risk in Lake Worth.

The current ROD does not directly address PCBs as a chemical of concern, and does not include the human health exposure pathway from the consumption of fish. As indicated in the Implementation Plan for the TMDL, consideration should be given to associating fish tissue sampling activities and other issues related to PCBs and the consumption risk with the ROD in some manner. Although source tracking and remediation activities have been conducted, and additional activities are planned or underway, such inclusion will help to assure the public that PCB issues will continue to be addressed until the consumption risk has been adequately reduced. The consumption advisory has been an issue of public concern and is likely to remain so until the advisory is lifted. Inclusion will also allow the Air Force to specifically point to actions taken to address the consumption risk issue and to successes in reducing the risk.

Air Force Plant 4 Five-year ROD Review
Interview Response received 4 July 2007
Rick Wice
Shaw Environmental, Inc. (O&M)

AIR FORCE PLANT 4

2007 FIVE-YEAR RECORD OF DECISION REVIEW

O&M QUESTIONNAIRE

For the questions listed below, *"the project"* refers to the Building 181 SVE system, the East Parking Lot/Window Area groundwater treatment system, and the Fuel Saturation Area 1 system. If you would prefer to fill out separate questionnaires for each system, please do so.

However, please feel free to also comment on the Air Force's voluntary remedial actions, including the Carswell permeable reactive barrier, the phytoremediation plantings, the bark mulch reactive barrier in AFP4 Landfill 3, and the Air Force's efforts to identify and remediate any potential sources of PCBs. You may also include any other issues you wish to discuss.

Your responses should focus primarily on the status of the project over the last 5 years, since approximately June 2002. You may enter your responses directly in this MS Word document and email it back to dan.schultz@earthtech.com, or write your comments and fax back to 303-694-4410. Please return your comments no later than April 6, 2007. Thank you.

1. What is your overall impression of the project?

Good, MAIN plume shrinking And Source areas Isolated or near Remediation Goal

2. Is the remedy functioning as expected? How well is the remedy performing?

EPL - Doing well, some Electrical issues ongoing

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities. Yes, Daily O&M EPL, All Systems Checked, OM Acts As onsite ABC/AFCEE ITRP Support Person.

5. Have there been any significant changes in the O&M requirements or maintenance schedules in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts. NO, Simply Adjusted (Optimized) B181 Vapor side only RW Aft times.

6. Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details. Yes EPL electrical poor Design And Construction Caused more time And materials Problems Managed. In 2002 Major "2001" Electrical rework needed <1 yr After RC date!

7. Have there been opportunities to optimize O&M? Please describe changes and resultant or desired cost savings or improved efficiency. 10-20K/yr Saved.
Yes. Simply pgrams optimized. Carbon usage optimized 40-60K/yr.
Site Staff 2001-2006 reduced From 2 to 1+PT, as need. 80-90K reduction.

8. Do you have any comments, suggestions, or recommendations regarding the project?

They Jog well.

ATTACHMENT 4

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ATTACHMENT 4
Applicable or Relevant and Appropriate Requirements
Air Force Plant 4, Ft. Worth, Texas
Five-Year ROD Review, September 2008

Media	Requirement	Citation	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Groundwater	TAC, Title 31, Chapter 290	Texas Drinking Water Standards	Applicable	State regulation establishing Texas drinking water standards. These standards are written to comply with the requirements of the Safe Drinking Water Act and Federal Primary Drinking Water Regulations. The purpose of these standards is to ensure the safety of public water supplies.	Requirements for contaminant levels in the water supply of White Settlement (Paluxy Aquifer). Dissolved TCE contamination migrating to the Paluxy Upper Sand and then to the Paluxy Aquifer must be controlled to comply with this ARAR.
Surface Water	40 CFR Part 403	National Pollutant Discharge Elimination System (NPDES) - General Pretreatment Regulations for Existing and New Sources of Pollution	Applicable	The NPDES was designed to regulate and reduce pollution discharges to navigable waters of the United States. Part 403 addresses pretreatment standards to control pollutants that pass through or interfere with treatment processes in POTW.	Remediation technologies that involve discharge to POTW must comply with these federal regulations during operation. The selected remedies will attain discharge requirements as set forth in the site-specific Ft. Worth POTW Discharge Agreement.
	TAC, Title 30, Chapter 307	Texas Surface Water Quality Standards	Applicable	State regulation establishing quality standards for surface water. The goal of this chapter is to maintain the quality of surface water in the state consistent with public health and enjoyment, protection of the environment, and operation of existing industries and economic development.	Remediation technologies that involve discharge to surface water must comply with these state regulations during operation.
	TAC, Title 31, Chapter 290	Texas Drinking Water Standards	Relevant and Appropriate	State regulation establishing Texas drinking water standards. These standards are written to comply with the requirements of the Safe Drinking Water Act and Federal Primary Drinking Water Regulations. The purpose of these standards is to ensure the safety of public water supplies.	The selected remedies will attain state MCLs in the water supply of Lake Worth and the West Fork of the Trinity River after completion of remedial activities. Exceedence of MCLs will be the target for determining if corrective action is needed.
	40 CFR Part 141, 143	Safe Drinking Water Act - National Primary and Secondary Drinking Water Standards	Relevant and Appropriate	Federal regulations establishing national primary and secondary drinking water standards. The SDWA establishes MCLs and secondary MCLs for organics, inorganics, radioactivity, and turbidity.	The selected remedies will attain federal standards in the water supply of Lake Worth and the West Fork of the Trinity River after completion of remedial activities. Exceedence of standards will be the target for determining if corrective action is needed.
Air	TAC, Title 30, Chapter 307, Subchapter 106X	Permit By Rule - Waste Processes and Remediation	Applicable	State air authorizations for activities that produce more than a de minimis level of emissions but less than other New Source Review (NSR) permitting options. Provides requirements from various treatment systems to be used on remediation projects.	Remediation technologies that emit air contaminants regulated under this statute will attain the appropriate operating, monitoring, and recordkeeping standards during operation.
	TAC, Title 30, Chapter 115	Control of Air Pollution from Volatile Organic Compounds (VOCs)	Applicable	State regulation establishing standards for VOC emission controls.	Remediation technologies that emit VOCs to the air must comply with these state regulations during operation.