Five-Year Review Report for the Building 3001 Site Tinker Air Force Base, Oklahoma

Final

Department of the Air Force
Air Force Center for Environmental Excellence, ISM
Brooks City-Base, Texas
and
72nd Air Base Wing, CEV
Tinker Air Force Base, Oklahoma

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This document describes conditions at the Soldier Creek/Building 3001 National Priorities List (NPL) site since the the remedial action defined in the Building 3001 Record of Decision (ROD) was initiated in 1993. The information presented herein conforms with EPA guidance for five-year reviews.The time period covered in this report spans from August 2002 to August 2007 and this is the third five-year review since the remedial action was initiated. The conclusions of this review indicate that the ROD requirements have been fulfilled to the extent practicable.

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Five-Year Review Report
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Tinker Air Force Base, Oklahoma

Submitted to:

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and

72nd Air Base Wing/Civil Engineering Directorate
Environmental Management Division
Tinker Air Force Base, Oklahoma

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September 2007

EXECUTIVE SUMMARY

This is the third Five-Year Review for the Soldier Creek/Building 3001 National Priorities List (NPL) site, Operable Unit 1 (OU-1) at Tinker Air Force Base, Oklahoma. The remedy for the Building 3001 site, OU-1, includes the following:

Building 3001 Groundwater: Conduct an optimization study of the groundwater extraction system. Perform the optimization study in accordance with the 2003 Explanation of Significant Difference (ESD) agreement approved by the U. S. Environmental Protection Agency (USEPA), Region 6. Consistent with the ESD, evaluate the efficacy of current treatment system defined in the 1990 Record of Decision (ROD), which includes: 1) Extraction of contaminated groundwater from the perched zone, top of regional aquifer zone, and regional aquifer zone via extraction wells; 2) Treatment of the contaminated groundwater in a treatment facility constructed specifically for the Building 3001 remedial action; and 3) Reuse of the treated water in industrial operations.

Pit Q-51: Remove approximately 45 gallons of liquid, steam clean the pit, analyze the liquid and wash water, and dispose in a facility that is approved to receive Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste. Backfill the pit with sand and cover it with an 8-inch concrete cap to prevent future use.

North Tank Area (NTA): Install a floating fuel product removal system to recover fuel product floating above the groundwater table. Dispose of recovered fuel at a Resource Conservation and Recovery Act (RCRA) approved facility. Treat the recovered groundwater the Building 3001 treatment plant. Install a vapor extraction system to remove fuel vapors from the subsurface soils, which will then be destroyed in a thermal combustor. Finally, implement removal and disposal of a 750-gallon waste tank, and proper closure of a 235,000 gallon fuel oil tank.

Part of the selected remedial method for NTA was installation of a vapor extraction system to remove fuel vapors from subsurface soils. Vapor extraction was accomplished through extraction of soil vapors along with free product and groundwater, using enhanced vacuum pumping with multi-phase extraction. This method includes both the soil fuel vapor extraction required by the ROD and additional extraction and treatment capabilities that are over and above the requirements of the ROD. Removed liquids are disposed at an approved RCRA facility. Removed vapor exhausts are below *de minimis* treatment requirements, and are therefore vented to the atmosphere.

Five-Year Review Trigger: Because the remedial action selected resulted in hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the U.S. Air Force is required to review the action no less often than every five years after initiation of the selected remedial action. EPA's database contains only one date field for the initiation of remedial action, and the date in that field is September 30, 1992; thus, five year reviews were required beginning in September 1997. The assessments from the five year reviews conducted to date were that the remedies were constructed and operated in accordance with the requirements of the 1990 ROD. Subsequent to the last five year review, Tinker submitted an ESD to EPA in 2003 requesting a temporary shutdown of the extraction wells around Building 3001 in order to obtain 'pre-system operation' ambient and hydrogeological conditions as well as to monitor plume stability. This additional data is intended for use in optimizing the remediation of the groundwater contaminant plume under Building 3001. The ESD was approved by USEPA and implemented in March 2004. The temporary shutdown will continue at least through March 2008.

Protectiveness Statement(s):

Building 3001 Site: The remedy is considered protective in the short-term because the plume is not migrating and there is no evidence of current exposure. However, for the remedy to remain protective in the long-term, a RPO will be conducted within the next two years to obtain further information. A long term protectiveness determination will be made at that time.

NTA Site: The remedy in place is protective of human health and the environment.

Pit Q-51: The remedy in place is protective of human health and the environment.

Samuel E. Coleman, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

9/27/07 Date

SIGNATURE PAGE

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15 Sep 07
Date

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EPA ID# OK1571724391

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION

Site name ***(from WasteLAN)*****:** Tinker AFB (Soldier Creek / Building 3001)

EPA ID ***(from WasteLAN)*****:** OK1571724391

Region: VI | **State:** OK | **City/County:** Tinker AFB/Oklahoma

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:**

Has site been put into reuse? ○YES ☒NO

REVIEW STATUS

Lead agency: ☒EPA ○State ○Tribe ○Other Federal Agency ____________

Author name: Sara Sayler

Author title: Environmental Engineer | **Author affiliation:** Tinker AFB

Review period:** February 2002 to September 2007

Date(s) of site inspection: 04/16/2007 and 06/19/2007

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 Onsite Construction at OU #____ ○Actual RA Start at OU#____
○Construction Completion ☒Previous Five-Year Review Report
○Other (specify)

Triggering action date ***(from WasteLAN)*****:** 09/25/2002

Due date ***(five years after triggering action date)*****:** 09/25/2007

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

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ACRONYMS AND ABBREVIATIONS

72nd ABW / CEVPE	72nd Air Base Wing / Civil Engineering Directorate, Environmental Management Division, Program Engineering Branch
AFB	Air Force Base
aka	Also known as
API	American Petroleum Institute
ARAR	Applicable, Relevant, and Appropriate Requirements
ASTM	American Society of Testing and Materials
B&V	Black and Veatch Waste Science and Technology Corporation
B3001	Building 3001
BWGW	Base-wide Groundwater
CDM	Camp Dresser & McKee, Incorporated
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Contaminant of concern
DNAPL	Dense non-aqueous phase liquid
ESD	Explanation of Significant Difference
FFA	Federal Facilities Agreement
gpm	gallons per minute
G-W	Garber-Wellington
GWTP	Groundwater treatment plant
IC	Institutional control
ICM	Interim corrective measure
IRP	Installation Restoration Program
ITWP	Industrial Wastewater Treatment Plant
LSZ	Lower saturated zone
LTM	Long term monitoring
MCL	Maximum contaminant level
Mg/L	Milligrams per liter
NPL	National Priorities List
NTA	North Tank Area
OC-ALC	Oklahoma City-Air Logistics Center
O&M	Operation and Maintenance
OCC	Oklahoma Corporation Commission
ODEQ	Oklahoma Department of Environmental Quality
OSHA	Occupational Safety and Health Administration
OU	Operable unit
Parsons	Parsons Corporation
Parsons ES	Parsons Engineering Science
PCE	Tetrachloroethylene
PZ	Producing zone
RA	Remedial action
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RPO	Remedial process optimization

SAIC	Science Applications International Corporation
SDWA	Safe Drinking Water Act
SWTA	Southwest Tank Area
TBC	To be considered
TCE	Trichloroethylene
the Base	Tinker Air Force Base
TI	Technical Impracticability
TOR	Top of Regional (Aquifer)
TTNUS	TetraTech Nuclear Utility Services, Inc.
USACE	United States Army Corps of Engineers
USAF	United State Air Force
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
USZ	Upper saturated zone
VEP	Vacuum enhanced pumping
VI	Vapor intrusion
WS	Water Supply (well)

SECTION 1
INTRODUCTION

The U.S. Air Force (USAF) has conducted a Five-Year Review of the remedial action implemented at the Soldier Creek/Building 3001 Federal Facilities NPL site at Tinker Air Force Base (Tinker AFB or "the Base") in Oklahoma. The United States Environmental Protection Agency (USEPA) has the authority to make the final determination concerning the protectiveness of selected remedies at NPL sites pursuant to the FFA, 120 (e) and CERCLA § 121 (c). This Five–Year Review was prepared by Parsons under USAF Contract F41624-03-D-8613, Task Order No. 0229. The primary purpose of five-year reviews is to determine whether the remedies for the Building 3001 site remain protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. These reports evaluate the implementation, operation and maintenance (O&M) of the remedy, and the continued appropriateness of the remedial action objectives (RAOs), including cleanup levels at a site. In addition, Five-Year Review reports identify deficiencies and other issues found during the assessment, if any, and recommendations to address them.

This review is required by statute as defined in Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and Section 300.430 (f) (4) (ii) of the National Oil and Hazardous Substance Contingency Plan. Periodic (no less often than every five years) reviews must be conducted for sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

Executive Order 12580 delegates the authority to conduct five-year reviews to the Departments of Defense and Energy, where either the release is on or is from any facility under the jurisdiction of those departments. In the Federal Facilities Agreement signed on December 9, 1988 between the USAF, USEPA, and the Oklahoma State Department of Health (succeeded by the Oklahoma Department of Environmental Quality (ODEQ) in 1993), the USAF was established as the lead agency for remediation of the Soldier Creek/Building 3001 NPL site. This review is being conducted following USEPA guidance (USEPA, 2001).

This document constitutes the third Five-Year Review for the Building 3001 Operable Unit (OU-1). Tinker AFB completed a previous review for Building 3001 in April 2003 (OC-ALC/EMPE, 2003). The groundwater treatment plant was physically completed in February 1993, and operational shakedown activities followed. Continuous operation of the Groundwater Treatment Plant (GWTP) commenced in June 1994. Five-Year Reviews are required for Building 3001 because hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Pit Q-51 and the North Tank Area (NTA) are included in this volume of the Five-Year Review. The three other OUs which together with OU-1 comprise the entire Soldier Creek/Building NPL site are: Soldier Creek Sediment and

Surface Water (OU-2), the Soldier Creek Off-Base Groundwater (OU-3); and, the Industrial Wastewater Treatment Plant (IWTP)Groundwater (OU-4). The Five-Year Review for OU-2 is a separate volume (Vol. II) to this Five-Year Review. The USAF has completed the remedial action (RA) associated with OU-2, and USEPA Region 6 approved the RA report on January 12, 2006. The USAF has discontinued monitoring associated with the OU-2 Record of Decision (ROD) and has submitted the final Five-Year Review for that OU. The USAF is currently supplementing the August 2000 Feasibility Study associated with OU-3 and OU-4. However, no five-year reviews are included in this document for OU-3 or OU-4 because no remedies have been selected for either of those two operable units.

SECTION 2
SITE CHRONOLOGY

Tinker AFB began industrial processes in 1942 and disposed of industrial wastes on-base until 1979. Following enactment of RCRA in 1976 and CERCLA in 1980, environmental restoration activities were initiated at the Building 3001 Site and other contaminated areas of the Base. In 1981, the Secretary of Defense established the Defense Installation Restoration Program (IRP) to investigate and remediate Department of Defense sites, and to comply with the requirements of RCRA and CERCLA. A chronology of the environmental restoration process at the Building 3001 Site is provided in Table 2.1.

Table 2.1 Chronology of Activities for Building 3001 Site

Investigation/Activity	Description	Event Date (Source)
IRP Phase I records search conducted	Records search conducted to identify past waste disposal activities that may have caused environmental contamination.	1981 (Engineering Science, 1982)
Underground Storage Tanks removed at the NTA	Two tanks (800-gallon waste oil tank and 13,000-gallon gasoline tank) removed at the NTA.	1983-1985 (Battelle, 1993)
IRP Phase II Confirmation/Quantification investigation conducted	TCE detected in groundwater in the vicinity of Building 3001.	1983 (Radian, 1985a and 1985b)
Supply wells in Building 3001 taken out of service	Water supply wells (WS-18 and WS-19) located inside Building 3001 taken out of service.	1984 (Engineering Enterprises, 1984)
Supply wells in Building 3001 plugged	WS-18 and WS-19 located inside Building 3001 plugged.	1986 (Dansby & Associates, 1986)
Remedial investigation (RI) and risk assessment conducted	Pit Q-51 identified as containing hazardous contaminants. Investigation conducted to determine nature and extent of contamination.	1986-1987 (United States Army Corps of Engineers (USACE), 1988a and 1988b)
NPL listing	Soldier Creek/Building 3001 added to the NPL.	July 22, 1987
Building 3001 ROD	Remedies defined for Building 3001 Groundwater, Pit Q-51, and the NTA.	August 16,1990 (USACE, 1990b)
Pit Q-51 RA	Pit Q-51 removed and capped. Decision and Closeout Documents issued.	June 12, 1991 (Oklahoma City/Air Logistics Center (OC-ALC), 1991a and 1991b)

Table 2.1 Chronology of Activities for Building 3001 OU (*continued*)

Investigation/Activity	Description	Event Date (Source)
NTA RA	Waste tank removed, gasoline tanks removed/upgraded, fuel oil tank demolished and closed in place. Free product removal and vapor extraction initiated.	1992-1994 (Parsons Engineering Science, Incorporated (Parsons ES) and Battelle, 1994)
Building 3001 Groundwater RA	Building 3001 Groundwater Treatment Plant and recovery well system startup	1993 (Parsons, 1998b)
First Five-Year Review	Documented efficacy and protectiveness of remedies-in-place for Building 3001 site, Pit Q-51, and the NTA.	1998 (Parsons, 1998b)
Second Five Year Review	Documented efficacy and protectiveness of remedies-in-place, and provided an ESD for optimizing the Building 3001 remedy-in-place.	2003 (OC-ALC/EMPE, 2003)
Implement Recommendations of ESD	Shut down Building 3001 GWTP and well field. Monitor groundwater and contaminant concentration rebound associated with Building 3001 site.	April 2004, (OC-ALC/EM, 2007 and USEPA, 2007b)

SECTION 3
BACKGROUND

3.1 PHYSICAL CHARACTERISTICS

The Soldier Creek/Building 3001 NPL site is located within the northeast quadrant of Tinker AFB, OK. Included in the NPL site are the main branch of Soldier Creek and all tributaries of Soldier Creek originating on Tinker AFB. The Soldier Creek/Building 3001 NPL site is divided into four distinct areas for remediation. Each of these areas is designated as an operable unit (OU). Along with OU-1, which is discussed in this report, OU-2 is the Soldier Creek Sediment and Surface Water, OU-3 is the Soldier Creek Off-Base Groundwater (SCOBGW) and OU-4 is the Industrial Wastewater Treatment Plant (IWTP) groundwater. The IWTP covers an area of approximately 4 acres while the SCOBGW OU covers an area of approximately 230 acres. Both OU-3 and OU-4 do not have a final ROD in place at this time. OU-2 is covered in a separate review. This Five-Year Review only addresses OU-1 and its respective ROD requirements.

OU-1 encompasses the groundwater contamination from sources associated with Building 3001. OU-1 includes the Building 3001 building complex (covering 50 acres), Pit Q-51, the NTA, and the surrounding areas encompassed by the lateral extent of a groundwater contaminant plume emanating from Building 3001. OU-1 covers approximately 220 acres. Though encompassed by OU-1, Pit Q-51 and the NTA are separate RAs within its boundaries.

Building 3001 is the largest active industrial facility at Tinker AFB, and the base employs approximately 24,000 personnel (72nd ABW and Parsons, 2005e). Tinker AFB borders the Oklahoma City metropolitan area that had a population of 506,132 in 2000 (United States Department of Commerce, 2000).

Since Tinker AFB is within the recharge zone of the Garber-Wellington aquifer, a water supply for the base and the surrounding community, OU-1 is in an environmentally sensitive area. In addition, OU-1 borders OUs-2, -3, and -4, which also encompass surface waters and groundwater associated with the Soldier Creek watershed.

3.2 LAND AND RESOURCE USE

3.2.1 Building 3001 Site

Prior to 1941, the site was located on undeveloped pasture and prairie lands. There were some agricultural activities and ranching but no known industrial uses prior to 1941. Beginning in 1941, 960 acres of land, including the area now occupied by OU-1, were donated to the Army Air Corps by the City of Oklahoma City for the construction of the Midwest Air Depot. Renamed Tinker Field in 1942 and subsequently Tinker Air Force Base in 1948, the entire base now covers 5,033 acres (72nd ABW and Parsons, 2005e). OU-1 lies in the most industrialized area of the base. The Building 3001 complex has been involved in reconditioning, modifying, and modernizing aircraft, including jet engine overhaul and missile repair. The industrial processes used or generated solutions containing organic chemicals including trichloroethylene (TCE), tetrachloroethylene (PCE) and metals such as chromium. Fuels for the boiler system included No. 2 fuel oil stored at the NTA. Diesel, gasoline, and waste oil were also stored at the NTA.

Subsequent to the initiation of remedial actions at OU-1, operational activities at Building 3001 have increased with the relocation of the Fighter Propulsion Division to Tinker AFB in 2000. Currently, Building 3001 is under a ten phase renovation program scheduled for completion in 2020 (72nd ABW and Parsons, 2005e).

3.2.2 Surrounding Community

The Soldier Creek/Building 3001 NPL site and OU-1 lie within an area representing transition from residential and industrial/commercial land use on the north and west to agricultural land use to the east and south. Soldier Creek and its tributaries, which flow northwest through the area, are bordered mainly by recreational and residential areas with some areas supporting commercial and industrial land use. Some off-base industries, such as a metal plating facility and a dry cleaning facility, and commercial facilities such as gas stations, auto repair facilities, and a closed sanitary landfill are located within the drainage basin. In addition, three schools, Soldier Creek Elementary, Steed Elementary, and Monroney Junior High are located within the drainage basin. Ten public parks are within the general vicinity of Tinker AFB, including the Joe B. Barnes, Fred F. Meyers, Kiwanis, and Lions Parks. A public golf course is also located north of the base. Five mobile home parks are located north and northeast of Tinker AFB.

The land use plan for the area immediately north of Tinker AFB, between Sooner Road and Douglas Boulevard includes all levels of land use. The areas between Sooner Road and Midwest Boulevard are zoned primarily for housing (single and multifamily units) and low to medium commercial use. The area between Midwest Boulevard and Douglas Boulevard is zoned primarily for heavy commercial and moderate to heavy industrial use.

Soldier Creek, which flows from Tinker AFB into adjacent neighborhoods, is reportedly used for wading and playing by area children and is large enough to support edible fish. No hunting or fishing has been reported to occur in the immediate area outside of Tinker AFB. Hunting and fishing are not permitted on Base. Beneficial uses of Soldier Creek include agriculture, secondary recreation, process and cooling water, and aesthetics. Soldier Creek also supports a warm-water aquatic community.

The off-base properties within the Soldier Creek/Building 3001 NPL site include the former Kimsey Addition to the north, along with commercial/retail establishments and mobile homes to the east. The Kimsey Addition was a residential area consisting of approximately 100 homes adjacent to Tinker AFB. Oklahoma County purchased all of the properties in the Kimsey Addition, and demolished or removed all structures within the addition by the end of 2003. Oklahoma County is developing the former addition as an entry gate and security buffer zone for Tinker AFB, and is operating the area in a manner to protect the airfield and associated clear zone and/or accident potential zone. The commercial/retail facilities between Tinker AFB and East Soldier Creek include convenience stores and self-storage units. The remainder of the site east of Douglas Boulevard and northwest of East Soldier Creek is undeveloped between the Evergreen Mobile Home Park and Interstate 40.

3.2.3 Human and Ecological Use of Resources

The most important source of potable groundwater in the Oklahoma City metropolitan area is the Central Oklahoma aquifer, which is commonly referred to as the "Garber-Wellington (G-W) aquifer." Tinker AFB presently obtains all of its water supply from wells that are screened in the G-W aquifer. Base wells range from 700 to 1,100 feet in total depth, with yields ranging from 205 to 250 gallons per minute (gpm). These wells draw water from deep portions of the Garber-Wellington (in general beginning below 250 feet). At this depth, Tinker obtains groundwater from an uncontaminated portion of the Garber-Wellington. Domestic wells were originally completed in the upper levels of the Garber-Wellington to the northeast of Tinker AFB in the Kimsey Addition. However, in the years prior to their demolition, these homes were connected to Oklahoma City water supply. Due to this connection to city water and Oklahoma County removal of all homes in the Kimsey Addition, Tinker AFB is unaware of any domestic water use in the immediate vicinity of the northeast corner of the Base.

On the east side of Tinker AFB, the G-W aquifer has been classified as a Class IIA aquifer by the State of Oklahoma, indicating that it provides groundwater from a major, unconfined basin that is capable of being used as a drinking water supply with little or no treatment (OAC 785:45-7-3). The western portion of the G-W aquifer basin, which extends from the west side of the base to just west of Oklahoma County, is classified as a Class IIC aquifer, a major confined groundwater basin. The nearby communities of Midwest City and Del City also derive a portion of their water supply from the G-W aquifer.

Until 1993, groundwater was used as a domestic water source by several of the residents living within and adjacent to the boundaries of the Base. All of the down-gradient wells were removed from service in 1994 after municipal water distribution lines were conveyed to and installed at the residences and businesses. No off-base wells are known to be used for drinking water purposes. All of the water supply wells on Tinker AFB are routinely sampled for contaminants.

3.3 HISTORY OF CONTAMINATION

The USAF IRP Phase I identified potential sources of contamination through records searches and reviews of waste management practices (Engineering Science, 1982). The first report of a release to the environment occurred in 1983 during routine wellhead sampling and testing. TCE and PCE were detected in two of the base water supply wells (WS-18 and WS-19) at Building 3001. A Phase II IRP investigation was conducted in 1983 to confirm and quantify contamination resulting from past waste storage practices at Building 3001(Radian, 1985a and 1985b). Sampling was also initiated at East and West Soldier Creek in 1984. Sample results indicated the presence of chromium and solvent contamination in the sediment and surface water. In 1985, fuel and free product contamination were found at the NTA. In September 1987, the Soldier Creek/Building

3001 site was evaluated under the hazard ranking system with a score of 42.24 and was placed on the NPL (scores of 28.5 are generally eligible for the NPL).

RIs were conducted at the Building 3001 OU between 1986 and 1987 to determine the nature and extent of contamination associated with Building 3001, the NTA, and Pit Q-51. The areas with highest concentrations of groundwater contamination were located beneath Building 3001, the NTA, and the Southwest Tank Area (SWTA) (shown on Figure 3.1). TCE and chromium were considered the primary groundwater contaminants, due to significantly high concentrations and widespread occurrence at the site. Other significant contaminants included dichloroethylene, PCE, acetone, toluene, benzene, xylenes, lead, nickel, and barium.

Samples collected from sludge in Pit Q-51 in 1986 indicated TCE, cadmium, chromium, and lead contamination. Leakage from this pit and other similar structures is considered the source of soil and groundwater contamination beneath B3001.

Fuel product in the form of No. 2 fuel oil was discovered beneath a leaking 235,000 gallon underground storage tank (UST) at the NTA. As a result, the soils and groundwater beneath the NTA and the north end of Building 3001 were heavily contaminated with fuel and other organic compounds.

The groundwater used by residents and the work force of Tinker AFB was identified as an exposure pathway. Potential points of exposure included water supply wells and discharge to surface water bodies. Exposure with long-term health effects was deemed a possibility in the 1988 baseline risk assessment (USACE, 1988b). A chronology leading to the NPL listing is provided in Table 3.1.

Table 3.1 Chronology of Activities for Building 3001 OU

Investigation/Activity	Description	Event Date (Source)
IRP Phase I records search conducted	Records search conducted to identify past waste disposal activities that may have caused environmental contamination.	1981 (Engineering Science, 1982)
USTs removed at NTA	Two tanks (800-gallon waste oil tank and 13,000-gallon gasoline tank) removed at NTA.	1983-1985 (Battelle, 1993)
IRP Phase II Confirmation/Quantification investigation conducted	TCE detected in groundwater in the vicinity of Building 3001.	1983 (Radian, 1985a and 1985b)
Supply wells in Building 3001 taken out of service	Water supply wells (WS-18 and WS-19) located inside Building 3001 taken out of service.	1984 (Engineering Enterprises, 1984)
Supply wells in Building 3001 plugged	Water supply wells (WS-18 and WS-19) located inside Building 3001 plugged.	1986 (Dansby & Associates, 1986)
Remedial investigation and risk assessment conducted	Pit Q-51 identified as containing hazardous contaminants. Investigation conducted to determine nature and extent of contamination.	1986-1987 (USACE, 1988a and 1988b)
NPL listing	Soldier Creek/Building 3001 added to the NPL	July 22, 1987

3.4 INITIAL RESPONSE

The USEPA, USAF, and Oklahoma State Department of Health (succeeded by the ODEQ in 1994) signed a Federal Facilities Agreement (FFA) designating the USAF as the only Potentially Responsible Party. Response actions initiated prior to the ROD are discussed below.

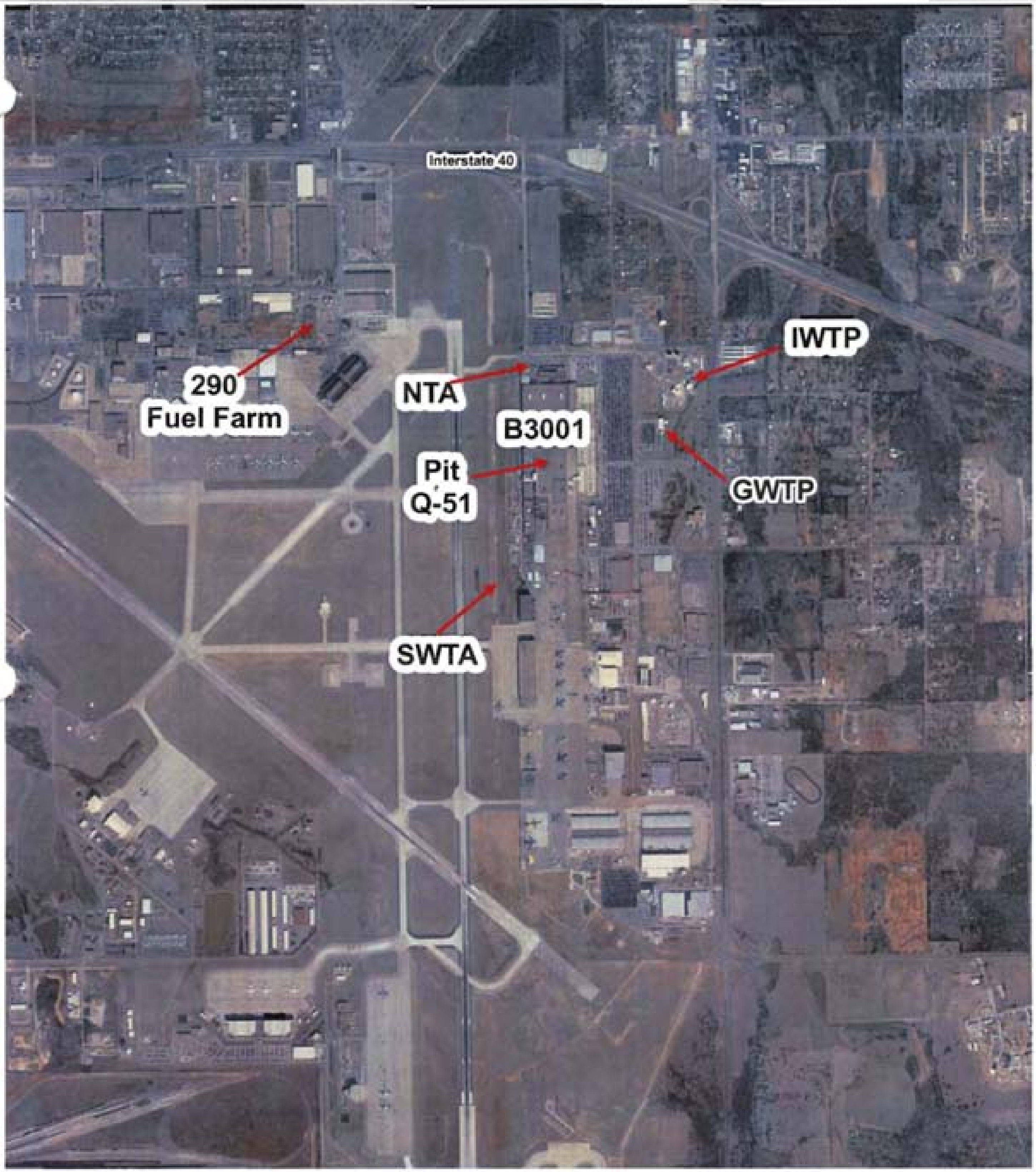
Between 1983 and 1985, two USTs, Tank 3403 (800 gallon waste oil tank) and Tank 3405 (13,000 gallon leaking gasoline tank), were removed from the NTA. Inside of Building 3001, the contents of three pits containing solvent and metals contamination were removed in 1985. The pits were backfilled and capped with concrete. Water supply wells WS-18 and WS-19 were plugged and abandoned in 1986. WS-17 was plugged and abandoned in 1988.

The Building 3001 ROD was signed in August 1990 (USACE, 1990b). Soils and groundwater contamination remain onsite and are in remediation. Groundwater concentrations remain above maximum contaminant levels (MCLs).

3.5 BASIS FOR TAKING ACTION

A Risk Assessment of the Building 3001 site was conducted in August 1988 (USACE, 1988b). A total of 32 chemicals were identified in the remedial investigation (24 organic and eight inorganic). From these, seven indicator chemicals were selected based on toxicity, mobility, frequency of detection, and concentration. The primary contaminants of concern (COCs) are TCE and chromium, because these were the most frequently detected chemicals in each aquifer zone, and these chemicals occurred at significantly high concentrations. The Risk Assessment determined that the only completed exposure pathway at the Building 3001 site was from groundwater used as a drinking water supply on the base. Routes of exposure from contaminated drinking water in the producing zone (PZ) could include ingestion, dermal contact, and inhalation (from showers and industrial processes). The Risk Assessment also recognized the potential for upper aquifer contaminant migration towards Soldier Creek.

Chromium, particularly hexavalent chromium, is a human health threat and a human carcinogen. TCE is a probable human carcinogen. Both compounds are extremely mobile in groundwater. The Building 3001 RA was designed to prevent further increase in risk due to continuing migration towards Soldier Creek and the PZ portion of the aquifer. The RA at Pit Q-51 was designed to mitigate direct exposure to TCE by on base workers. The NTA RA was designed to remove the threat of free product and vapor exposure to on-base workers (USACE, 1990b).



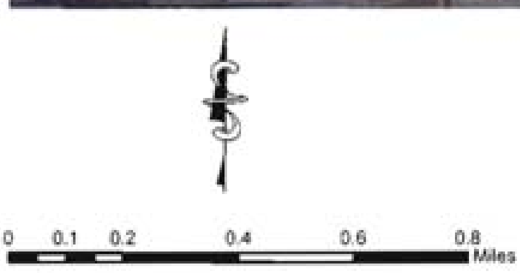


Figure 3.1

Building 3001 OU Location Map

Tinker AFB, Oklahoma

SECTION 4
REMEDIAL ACTIONS

The selected remedy for OU-1 addressed three components: the groundwater associated with Building 3001 activities, Pit Q-51 contaminants, and the NTA impacts. This section discusses the components and operation and maintenance (O&M) aspects of OU-1.

4.1 REMEDY SELECTION

4.1.1 Building 3001 ROD

The Building 3001 ROD, signed in August 1990, prescribed remedies for groundwater and other contaminant sources beneath Building 3001. The RAs selected in the ROD incorporated the following components:

Building 3001 Groundwater

- Installation of monitoring wells to monitor the groundwater contaminant plume.
- Extraction of contaminated groundwater from the perched water zone, top of regional water zone, and regional water zone by exterior and interior extraction wells.
- Treatment of the contaminated groundwater in a treatment facility constructed specifically for the Building 3001 RA.
- Treatment of volatile contaminants by air stripping and carbon adsorption.
- Treatment of metals by chemical reduction and precipitation.
- Reuse of the treated water in Tinker AFB's industrial operations.
- Disposal of the sludge from groundwater treatment operations at an offsite RCRA-permitted facility approved to receive CERCLA waste.

Pit Q-51

- Removal of approximately 45 gallons of liquid.
- Steam cleaning of the pit, analysis of the liquid and wash water, and disposal of wastes in a facility that is approved to receive CERCLA waste.
- Backfilling of the pit with sand and covering with an 8-inch thick concrete cap.

NTA

- Installation of a floating fuel product removal system to recover fuel floating above the groundwater table.
- Disposal of the recovered fuel at a RCRA-approved facility.
- Treatment of the recovered groundwater at the Building 3001 treatment plant.
- Installation of a vapor extraction system to remove fuel vapors from the subsurface soils.

- Thermal combustion of fuel vapors recovered by the removal systems.
- Removal and disposal of a 750-gallon waste tank and proper closure of a 235,000-gallon fuel oil UST.

4.1.2 Explanation of Significant Difference

Tinker AFB submitted an ESD to USEPA and the agency approved the application in May 2003. The purpose of the ESD was to conduct an optimization study of the Building 3001 RA. The most conspicuous component of the ESD optimization study is the shut-down the GWTP and extraction well field. The principal objective of the shut-down is to re-establish a baseline condition for comparability to future actions and to assess rebound of contaminant concentrations and groundwater elevations. The goal of the ESD optimization study is to collect and utilize past, current, and future data associated with this shutdown to support a potential Technical Impracticability (TI) waiver. If a TI waiver is pursued, it will support CERCLA § 121 remedy selection and Applicable, Relevant and Appropriate Requirements (ARAR) waiver requirements, 40 C.F.R. § 300.430 remedy selection and ARAR requirements, and CERCLA § 120 (a) guidelines used in making TI waiver determinations. Long term monitoring (LTM) information is evaluated during the shutdown to determine whether the plume is in equilibrium or migrating, and whether the current remedial action is protective of human health and the environment.

The actions proposed in the ESD were implemented on March 29, 2004. The GWTP and extraction well field were shut down, and the aquifer was allowed to begin recovery. LTM of the sentry wells continues, and based on results of semi-annual groundwater sampling, the groundwater plume is not migrating at an unacceptable rate. Therefore, the GWTP system has remained shutdown while the optimization study continues.

Certain evaluations that were proposed in the 2003 ESD and associated work plans included: center of mass calculations to ascertain plume stabilization, tracer tests, intrinsic bioremediation parameters without the effects of an operating pump-and-treat system, possible source locations, and whether or not the pump-and-treat system had a negative effect on natural attenuation. Not all of these assessments have been completed. Evaluations of vertical migration have not provided conclusive results at this time either. Therefore, the one-year shutdown outlined in the ESD has been extended three times and is still in effect. Data is still being collected for evaluation of the system and optimization of the remedial plans.

4.2 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) are the MCLs and are cited in the Building 3001 Site ROD. TCE and Chromium are the primary COCs and the MCLs for these are 0.005 mg/L and 50 mg/L, respectively. This document was signed by representatives of the USAF and USEPA Region 6 and filed in August 1990. In addition, the ESD and the responses to USEPA comments to the ESD were recorded in 2002. Regulatory approval of the ESD was gained in May 2003.

ARARs reviewed included MCLs established under the Safe Drinking Water Act (SDWA), Clean Air Act requirements related to the emission standards for ambient air quality, and RCRA requirements for the management of hazardous waste.

4.2.1 Building 3001

The RAOs for Building 3001 groundwater are SDWA MCLs. No changes in MCLs or RAOs have been effected since the previous Five-Year Review (OC-ALC/EMPE, 2003).

4.2.2 NTA

At this time, groundwater ARARs at the NTA are the federal MCLs as promulgated under the SDWA. Other ARARs include Oklahoma Water Quality Standards for COCs. At petroleum, oil, and lubricant contaminated sites, Oklahoma Corporation Commission (OCC) established levels for benzene, toluene, ethylbenzene, xylenes, and total petroleum hydrocarbons in groundwater and soil also apply.

Because the NTA is a CERCLA site, MCLs are the primary ARARs for the site. Since the previous five-year review, MCLs for the COCs have not changed.

4.2.3 Pit Q-51

Since the contents of Pit Q-51 were permanently removed from the Building 3001 site and disposed at a facility approved to receive the waste material, all ARARs have been met.

4.3 REMEDY IMPLEMENTATION

A chronology of the remedy development and implementation activities for OU-1 is provided in Table 4.1.

Table 4.1 Summary of Remedy Development and Implementation Activities at OU-1

Investigation /Activity	Description	Date (and Source)
RI.	Determine extent of groundwater contamination from Building 3001.	1988 (USACE, 1988a)
Feasibility study conducted.	Feasibility study for Building 3001 site evaluated alternatives for remediating groundwater plume.	1988 (USACE, 1989b)
FFA signed.	Federal Facilities Agreement signed by Tinker AFB, USEPA, and Oklahoma State Department of Health.	December 1988 (USEPA, 1988)
Quarterly RI conducted.	Supplemental remedial investigation conducted.	1988-1989 (USACE, 1989a)
ROD signed.	ROD for Building 3001 site, including Pit Q-51 and NTA, signed. Identified selected alternatives.	August 1990 (USACE, 1990b)
Groundwater collection pilot test conducted at B3001.	Tested proposed groundwater collection and treatment system on a small-scale.	September 1990 (USACE, 1990b)
Product recovery initiated at NTA.	Product recovered from seven monitoring wells installed at the NTA.	May 1991 (Battelle, 1993)
Additional recovery wells installed at NTA.	Two product recovery wells (RC-1 and RC-2) installed at NTA.	December 1991 (Camp Dresser & McKee, Incorporated (CDM), 1992)
Pit Q-51 remediated.	Pit Q-51 contents were removed and disposed of off-site. Decision document prepared. Site closed.	1991 (OC-ALC, 1991b)
Modeling and system design conducted.	Modeled groundwater flow and designed full-scale groundwater collection and treatment system.	1991 (Black and Veatch Waste Science and Technology Corporation (B&V), 1991)
In-situ respiration and air permeability tests in NTA soils.	Two vapor extraction wells, five tri-level vapor pressure monitoring points, and two blower units were installed for in-situ respiration and air permeability tests.	March 1992 (Battelle, 1993)
One UST removed, one abandoned at NTA.	1,200 gallon sump pump tank removed in April, and 235,000 gallon fuel oil tank abandoned in place in May.	April and May 1992 (Parsons ES and Battelle, 1994)
Additional recovery wells installed at NTA.	Four additional recovery wells (RC-3, RC-4, RC-5, and RC-6) installed to enhance product removal at the NTA.	September 1992 (Roy F. Weston, 1992)

Table 4.1 Summary of Remedy Development and Implementation Activities at OU-1 (*continued*)

Investigation/Activity	Description	Date (and Source)
GWTP construction initiated at Building 3001.	GWTP construction initiated and 33 groundwater extraction wells installed.	1992 (B&V, 1992a and 1992b)
GWTP construction completed and intermittent pumping initiated.	GWTP construction completed and intermittent pumping of Building 3001 groundwater plume initiated.	February 1993 (Tinker AFB)
Fracturing demonstration project conducted at NTA.	Fracturing demonstration project was conducted to determine if fracturing could enhance product recovery at the NTA.	Summer 1993 (Parsons ES & Battelle, 1994)
Focused remedial investigation conducted at NTA.	Supplemental field investigation conducted at the NTA to further delineate the extent of product contamination.	October-December 1993 (Parsons ES & Battelle, 1994)
Extraction system operations fully initiated.	Continuous pumping of groundwater extraction wells at Building 3001 site began.	June 1994 (Tinker AFB)
Expanded fracture injection treatment at the NTA.	Installed additional recovery wells at the NTA and fracture treated the uppermost aquifer.	January 1995 (Parsons ES, 1995)
Building 3001 remediation system evaluated.	Results from one full year of operation were evaluated to evaluate progress and to determine what ways the system could be optimized.	1996 (Parsons ES, 1996)
Building 3001 extraction system evaluated.	Results from 2 years of groundwater extraction at Building 3001 site were evaluated. Volume of contamination removed and remaining in groundwater estimated. Estimates of the time to recover remaining contaminants were made.	September 1997 (Parsons ES, 1998)
First Five-Year Review for the Soldier Creek/Building 3001 NPL Site.	Baseline documentation of the remedy protectiveness for OU-1 and OU-2, and remedial progress at OU-3 and OU-4.	September 1998 (Parsons ES, 1998a)
NTA Recovery System upgrade.	Removed pneumatic free product recovery pumps and installed vacuum enhanced pumping (VEP) system for free product recovery.	January 1999 (Tetra Tech, 1999)
Building 3001 Remedial Process Optimization Study	AFCEE conducts pilot test on horizontal well HW-2 to determine efficacy of soil vapor extraction for this site.	December 2000 (Parsons, 2000)
Technical Impracticability Work plan	Initiate planning and data collection needed for support of Technical Impracticability Waiver Application for the Building 3001 site.	January 2001 (Parsons, 2001a)

Table 4.1 Summary of Remedy Development and Implementation Activities at OU-1 (*continued*)

Investigation/Activity	Description	Date (and Source)
Technical Assessment of the Building 3001 GWTP	Assessed Building 3001 plume capture and containment	February 2001, (Parsons, 2001b)
Second Five-Year Review for the Soldier Creek/Building 3001 Site.	Documented efficacy and protectiveness of remedies at OU-1and OU-2.	April 2003, (OC-ALC/EMPE, 2003)
ESD for GWTP Shutdown	ESD submitted to perform rebound testing of groundwater and contaminant plumes	May 2003 (OC-ALC/EM)
Dual Phase Extraction and Extended Soil Gas Vapor Pilot Test	Conducted 9-month soil gas vapor test at HW-2 to and 4-month dual phase extraction pilot test at monitoring well 1-70B to compare viability and efficacy of both removal technologies.	May 2003 through April 2004 (Parsons, 2004c)
GWTP Shutdown	Groundwater treatment system shut down for rebound testing in support of technical impracticability data collection	April 2004 (Parsons, 2004b)
Remediation at NTA and GWTP shutdown continued at Building 3001 site.	Product recovery at NTA and rebound testing at Building 3001 continued.	2004 – ongoing
Building 3001 Extraction System Shutdown, Operable Unit 1 memorandum to USEPA.	One year extension request for ESD optimization shutdown	February 2007

4.4 SYSTEM O&M

4.4.1 O&M Requirements

Elements of OU-1 that require potential O&M include: 1) the rebound test for the ESD optimization study, 2) the extraction well field and groundwater transport system associated with Building 3001 groundwater; 3) the GWTP for Building 3001 groundwater and 4) the product recovery system at the NTA. The removal of the contents from Pit Q-51 and off-base waste disposal was a permanent remedy and requires no O&M.

4.4.1.1 Rebound Test for ESD Optimization Study

Tinker AFB submitted an ESD to USEPA and the agency approved the application in May 2003. The purpose of the ESD was to conduct an optimization study of the Building 3001 RA. The most conspicuous ESD component of the optimization study is the shut-down the GWTP and extraction well field. The principal objective of the shut-down is to re-establish a baseline condition for comparability to future actions and to assess rebound of contaminant concentrations and groundwater elevations. The goal of the ESD optimization study is to collect and utilize past, current, and future data associated with this shutdown to support a potential Technical Impracticability (TI) waiver. If a TI waiver is pursued, it will support CERCLA § 121 remedy selection and ARAR waiver requirements, 40 C.F.R. § 300.430 remedy selection and ARAR requirements, and CERCLA 120 (a) guidelines used in making TI waiver determinations. Long term monitoring (LTM) information is evaluated during the shutdown to determine whether the plume is in equilibrium or migrating, and whether the current remedial action is protective of human health and the environment.

The actions proposed in the ESD were implemented on March 29, 2004. The GWTP and extraction well field were shut down, and the aquifer was allowed to begin recovery. LTM of the sentry wells continues, and based on results of semi-annual groundwater sampling, the groundwater plume is not migrating at an unacceptable rate. Therefore, the GWTP system has remained shutdown while the optimization study continues.

Certain evaluations that were proposed in the 2003 ESD and associated work plans included: center of mass calculations to ascertain plume stabilization, tracer tests, intrinsic bioremediation parameters without the effects of an operating pump-and-treat system, possible source locations, and whether or not the pump-and-treat system had a negative effect on natural attenuation. Not all of these assessments have been completed. Evaluations of vertical migration have not provided conclusive results at this time either. Therefore, the one-year shutdown outlined in the ESD has been extended three times and is still in effect. Data is still being collected for evaluation of the system and optimization of the remedial plans.

While the ESD is in effect, semi-annual sampling is to be performed to monitor plume migration. If sampling indicates that the plume is migrating at an unacceptable rate, the contingency is to resume operation of the pump-and-treat system. Definition of "unacceptable rate" of contaminant migration is addressed in the response to USEPA comments to the ESD, and further elaborated in the work plan. "Unacceptable rate" of contaminant migration is evaluated based on historic well data. Trend analysis plots were prescribed for key sentry wells, and "maximum allowable increase in concentrations" would be specified for each of these wells. Sentry (a.k.a. sentinel) wells, located on the downgradient edge of the current plume, have historically shown lower levels of TCE contamination. Unacceptable plume migration was defined as concentration rise to 50% greater than the maximum historical high TCE concentration over a period of at least four consecutive sample rounds. If concentrations exceeded that criterion for four consecutive semi-annual sampling rounds, the system would be turned back on. The sentry wells are identified in the work plan (Parsons, 2004b).

Therefore, in order for the remedy to be functioning as intended in the decision documents (*i.e.,* that the shut-down evaluation continue), the remedy is protective as long as the sentry wells do not exceed the unacceptable migration criterion defined in the ESD response to comments.

4.4.1.2 Extraction Well Field and Groundwater Transport System

The Building 3001 extraction well network consists of 33 extraction wells installed in three aquifer zones, as shown in the following Table 4.2. It should be noted that the Top of Regional Aquifer (TOR)-series wells are completed primarily in the upper portion of the lower saturated zone (LSZ), but two of the wells also penetrate the lower portion of the LSZ.

Table 4.2 Groundwater Extraction Wells by Hydrogeologic Zone

Tinker AFB Groundwater Conceptual Model (Tinker AFB, 1994)	U.S. Army Corps of Engineers Designation (USACE, 1988a)	Number of horizontal wells	Number of vertical wells
Upper Saturation Zone (USZ)	P-1 through P-19 (Perched Aquifer)	3	16
LSZ (upper)	TOR-1 through TOR-7 (Top of Regional Aquifer)	1	6
LSZ (lower)	R-1 through R-7 (Regional Aquifer)	1	6

Each well is surrounded by a water-proof well vault containing the well head, piping from the well into the pipe manifold which transports the water to the GWTP, electrical equipment, and instrumentation. The pump in each well pumps with sufficient head to carry the extracted water to the influent holding tank of the GWTP.

This system is operated and maintained by the same staff responsible for operating the GWTP. Some requirements for the extraction and transport system overlap with the GWTP requirements. See Section 4.4.1.3 for the delineation of the requirements associated with staffing, reporting, emergency procedures, etc. Specific O&M requirements for this system are as follows:

1. Perform Daily Inspections and Operations Tasks - see that wells pump according to schedule; observe equipment, instruments, and unit processes for proper operation; maintain daily operating log in current condition; check instruments, controls, and alarms for proper operation; check for visible sign of leaks; collect samples; check sampling results and provide proper feedback to well field operation and control.
2. Perform Periodic Inspections and Routine Maintenance of Equipment - perform periodic inspections of pumps, valves, and piping to identify wear, needs for special maintenance, and insure proper operation; perform lubrication at specified intervals; perform cleaning at specified intervals or as required; repair as necessary.
3. Perform Instrument Inspections and Calibration - periodically, at specified intervals, inspect all instruments including meters, controllers, and electrical equipment for proper working, needs for maintenance; clean; calibrate; repair as necessary.

4. Perform Well Field Maintenance - perform periodic inspections of extraction and monitoring wells; perform maintenance and well redevelopment tasks as needed.

4.4.1.3 GWTP

The GWTP is contained in a pre-engineered metal building. This building also contains chemical storage facilities, a maintenance area, and a control room, which includes office space. The GWTP is located east of Building 3001 and lies within the secured area of the base. An alarm on the door to the building alerts the on-duty operator to the arrival of anyone into or out of the building.

The GWTP consists of the following components:

- An influent holding tank to which the extracted water is pumped.
- An air stripper coupled with a vapor phase activated carbon system for the removal of volatile organics.
- A chemical reduction system for the reduction of hexavalent chromium.
- A chemical precipitation system for the precipitation and removal of trivalent chromium and other metals. This system consists of chemical addition systems, flocculation, and sedimentation in an inclined plate settler.
- Granular media filtration for the removal of additional suspended solids. This filter is a "moving bed" type (Dynasand brand).
- Sludge handling using a sludge holding tank, recessed plate filter press, and thermal sludge dryer. Dried sludge is disposed in a RCRA landfill certified to receive CERCLA wastes.
- An effluent holding tank from which the treated water is pumped for reuse.

O&M requirements for the GWTP are presented in several categories as follows:

1. Develop and Maintain Adequate Operations and Supervisory Staff - hire, train, and supervise O&M staff.
2. Meet Performance Requirements - keep system running; keep down time to a minimum; meet performance specifications including required effluent quality, air quality, and sludge quality; and advise management of any major problems or potential major problems.
3. Meet Reporting Requirements - perform system monitoring; collect required data; perform laboratory audits, if required; develop and maintain system for data management; submit reports as required; make notifications of abnormal operating conditions; maintain daily operations logs, maintenance logs, spare parts inventory, and other logs required; and perform all waste manifesting in a timely manner.
4. Perform Daily Inspections and Operations Tasks- manage water flow through system including associated air flows, sludge flows, and chemical feeds; observe equipment, instruments, and unit processes for proper operation; maintain daily operating log in current condition; check instruments, controls, and alarms for

proper operation; check for visible sign of leaks; collect samples; check sampling results; and provide proper feedback to GWTP operation and control.

5. Perform Periodic Inspections and Routine Maintenance of Small Equipment - perform periodic inspections to identify wear, needs for special maintenance, and ensure proper operation; perform lubrication at specified intervals; perform cleaning at specified intervals or as required; and repair as necessary.
6. Perform Instrument Inspections and Calibration - periodically, at specified intervals, inspect all instruments for proper working and needs for maintenance; clean; calibrate; and repair as necessary.
7. Perform Inspections and Maintenance of Major Equipment - inspect major equipment (major rotating equipment, other equipment with moving parts, and large and/or complicated pieces of equipment) at specified intervals; perform routine maintenance including cleaning, lubrication, performance checks, etc.; perform preventive maintenance tasks; repair, recoat, and replace as necessary; and schedule next inspection.
8. Keep and Update Maintenance Records - using the prescribed system, keep records up to date, regarding maintenance history, equipment replacement, maintenance advisories, etc.
9. Perform Periodic Leak Inspections - in addition to daily observations for leaks, make more thorough inspections on a periodic basis and report findings.
10. Perform Periodic Infrastructure Inspections - periodically inspect building, loading/unloading areas, on-site maintenance area, and utilities supply points for repair and maintenance needs and be aware of and correct any hazards to operators, visitors, delivery personnel, etc.
11. Employ Proper Emergency Procedures - keep staff properly trained in emergency operating procedures, response procedures, and safety practices and update requirements as necessary.
12. Maintain Spare Parts Inventory - update inventory as parts are used and periodically review and update required inventory based on maintenance history.
13. Review and Update O&M Manual and Operating Procedures - perform periodically as required.

4.4.1.4 Product Recovery System at NTA

The original design of the product recovery system specified a dual phase recovery system consisting of a hydrocarbon recovery pump and a groundwater pump. The groundwater pump was installed to create a groundwater cone of depression around the wellbore so that the hydrocarbon pump could collect the floating phase-separated hydrocarbon (free product). This system was installed in 1991, but the groundwater depression pumps are no longer used. It was intended that the water pumped from below the product would be discharged to the Building 3001 groundwater treatment system; however, this design approach was never realized. The pneumatic hydrocarbon pumps are still run intermittently to skim free product from the surface of the water table in two of the recovery wells. An O&M manual was developed for the system, which was expanded to a total of six extraction wells, including submersible electric pumps and the pneumatic pumps. The original pumping schedule and protocols are no longer used except for routine maintenance of the compressor and repairs (Battelle, 1993).

Three additional dual pump pneumatic recovery wells were added in 1995 for a total of nine recovery wells (Parsons ES, 1995). Two recovery wells were installed on the west side of Building 3001 and one monitoring well was converted to a recovery well north of the abandoned 235,000 gallon fuel tank. All pump controls are maintained inside of a locked metal building within the fenced and secured compound.

4.4.2 O&M Activities

O&M activities are conducted by experienced environmental contractors. The contractor personnel are trained in operational and health and safety procedures relevant to the job performance.

4.4.2.1 Rebound Test for ESD Optimization Study

Baseline and semi-annual sampling along with water level measurements are conducted by contractors to Tinker AFB. The sentry wells are sampled semi-annually under the Basewide Groundwater (BWGW) sampling contract. The current BWGW sampling contractor is Science Applications International Corporation (SAIC). Baseline sampling was conducted by Parsons Corporation in 2004, prior to system shutdown. The last round of BWGW samples was collected by SAIC in November 2006. Water levels are collected monthly by SAIC. Based on review of the data, the majority of required information has been collected and exists in sufficient quantity and quality to prepare an adequate evaluation of the rebound effects and impacts at the sentry wells.

4.4.2.2 Extraction Well Field and Groundwater Transport System

Since the last Five-Year Review, three different contractors have been responsible for O&M of the extraction well and groundwater transport system, namely: TetraTech Nuclear Utility Services, Inc. (TTNUS) from April 2003 through December 2003, Dick Corporation (formerly J.A. Jones Environmental Services) from October 2003 through December 2005, and Parsons Corporation from January 2006 through present. These contractors have been responsible for the O&M of this system under contract to the Air Force. Additional details of the operating arrangement appear in Section 4.4.2.2 below. O&M activities related to the extraction and transport system include the necessary tasks to carry out the responsibilities enumerated in Section 4.4.1.3. Based on the inspections associated with this project, all of the required activities are being effectively and regularly performed.

4.4.2.3 GWTP

Since the last Five-Year Review, three different contractors have been responsible for the Groundwater Treatment Plant, namely: TTNUS from April 2003 through December 2003, Dick Corporation (formerly J.A. Jones Environmental Services) from October 2003 through December 2005, and Parsons from January 2006 through present. Each of these contractors have been responsible for operator staffing, operator training, engineering support, system maintenance, monitoring, and reporting results to the on-site Tinker AFB personnel. Some maintenance is performed by the operations staff; other tasks are subcontracted to outside vendors. Each contractor has also been responsible for containerizing dewatered and dried sludge from the sludge handling operation and recovered organics from the air stripping operation for shipment offsite. This waste is transported and disposed under another Tinker AFB contract. Each contractor's responsibilities at the GWTP begin at the influent holding tank (Tank T-1) and continue to the pumping of treated effluent into the reuse system downstream of the effluent holding tank (Tank T-2). Each contractor has also been responsible for operating the extraction well field and transport system and monitoring these components from the GWTP control room (see Section 4.4.1.3 above).

The GWTP is staffed with an operator 24 hours per day, 7 days per week when in operation. Process engineering support has been available from a contractor staff person located at the base. At the time this inspection was performed, the GWTP Superintendent was Mr. Jim Holcomb and the GWTP Chemist was Mr. Eric Houston. Tinker AFB personnel monitor the operation. Mr. Jason Flaming (72^{nd} ABW/CEVPE) has been responsible for the TTNUS, Dick Corporation, and Parsons contracts, and has been conducting daily site visits. The O&M requirements are enumerated in Section 4.4.1.2 above. Based on the inspections associated with this project, all of the required activities are being effectively and regularly performed.

4.4.2.4 NTA Product Recovery System

Since the last Five-Year Review, O&M of the product recovery system was contracted to Dick Corporation (formerly J.A. Jones Environmental Services) until September 2003. Following a brief rebound test from October 2003 until March 2004, O&M of this site has been contracted to Parsons Corporation. A VEP system was installed in 1999 and has been operating continuously (except for the rebound test) to the present. The treatment system consists of nine extraction wells for free product recovery. A high vacuum liquid ring pump is used for vapor phase and liquid phase extraction. The treatment system removes vapor, water, and free product from all of the extraction wells. Parsons maintains and monitors the system on a daily basis; however, cycling of the system (two weeks on, one to six weeks off) was initiated in 2005. Parsons also performs weekly gauging of the tanks and monthly collection of groundwater levels from site monitoring wells. The NTA site manager for Tinker AFB is Mr. Dan Hunt (72^{nd} ABW/CEVPE).

4.4.3 O&M Costs

Average annual costs for the GWTP operation was approximately $500,000 through 2003. Average annual operating costs for the treatment system declined to approximately $300,000 from 2004 through 2006. For the NTA, average annual operating costs have remained stable around $130,000.

The remedy for Pit Q-51 requires no O&M expenditures.

4.4.3 O&M Costs

Average annual costs for the GWTP operation was approximately $500,000 through 2003. Average annual operating costs for the treatment system declined to approximately $300,000 from 2004 through 2006. For the NTA, average annual operating costs have remained stable around $130,000.

The remedy for Pit Q-51 requires no O&M expenditures.

SECTION 5
PROGRESS SINCE LAST FIVE-YEAR REVIEW

5.1 PROTECTIVENESS STATEMENT FROM ROD

"The remedial actions would remove contaminated groundwater from the upper regions of the Garber-Wellington aquifer and treat it to acceptable levels for reuse in the Tinker AFBs industrial operations. By removing and treating the contaminated groundwater, destruction of the mobile contaminants including most of the known and suspected carcinogens will be achieved.

The USEPA reported acceptable carcinogenic risks fall within the range of 1.0 X 10^{-4} to 1.0 X 10^{-6}. The carcinogenic risk for the site if no action were taken is 1.2 X 10^{-5}, which falls within acceptable limits. This number will be further reduced when the proposed remedial action is implemented. Therefore, no unacceptable short-term risks would result from implementation of the remedial alternative. The final RA would prevent the contaminants from migrating further horizontally and vertically within the aquifer thus reducing the risk of exposure to the drinking water zone in the lower aquifer.

Unacceptable short-term risk or cross-media impacts will not be caused by implementation of the selected remedial alternatives. The RA will be permanent and will adequately protect human health and the environments" (USACE, 1990b).

5.2 PROTECTIVENESS STATEMENTS (PREVIOUS REVIEW - 2003)

Building 3001

The previous review states that "The remedy is functioning as designed; however, the remedy is not optimal" (OC-ALC/EMPE, 2003). USEPA, Region 6 concurs with the review findings: "The remedy components are currently functioning as designed, and no deficiencies were identified in the Five-Year Review which impact the protectiveness of the remedies" (USEPA, 2005). Further, the previous review recommends an ESD that would shut down the extraction well field and institute a monitoring program. This program would be used to determine whether the plume is in equilibrium and not migrating. If the plume is in equilibrium, LTM could be substantiated as a satisfactory remedy that would be protective of human health and the environment (OC-ALC/EMPE, 2003).

NTA

"As long as the fuel product remains relatively immobile, the O&M activities currently performed at the site are protective of human health and the environment. Sufficient monitoring and institutional/engineered controls are in place to determine if product is migrating from the NTA" (OC-ALC/EMPE, 2003). Institutional controls are discussed further in section 7.1.1.5.

Pit Q-51

"Pit Q-51 has been effectively remediated with the removal of the pit contents and sealing with an 8-inch thick concrete cap. The site inspection confirmed that the cap is intact" (OC-ALC/EMPE, 2003).

5.3 STATUS OF RECOMMENDATIONS AND FOLLOW-UP ACTIONS FROM SECOND REVIEW

5.3.1 Building 3001 Groundwater

Recommendation: In order to establish pre-pump-and-treat system conditions, a recommendation was made to shut down the GWTP and extraction well field. This action was proposed to re-establish a baseline condition for comparability to future actions and to determine rebound of contaminant concentrations and groundwater elevations. The recommended action stated that past, current, and future data associated with this shutdown would be needed to support a potential TI waiver. LTM information is evaluated during the shutdown to determine whether the plume is in equilibrium or migrating, and whether the current remedial action is protective of human health and the environment.

Current Status: An ESD was submitted to USEPA and approved by the agency in May 2003. A one-year shutdown of the extraction well field and groundwater treatment plant was initiated in April 2004. Three additional one-year shut downs were approved by USEPA, and the GWTP and well field will remain shut down at least through March 2008.

5.3.2 NTA

Recommendation: It was recommended that free product removal continue until such time as the effectiveness and efficiency of the VEP system could be weighed against the benefits of other remedial alternatives.

Current Status: The VEP system was evaluated under a remedial process optimization (RPO) study in 2005 (Parsons, 2005d). Results of the RPO study indicated that various components of the system needed repair and refurbishment. Also the study indicated that the system was still approaching, but had not yet reached asymptotic levels at that time. Refurbishments and repairs have been made, and various operating sequences (*e.g.* cycling) have been employed in attempts to enhance free product recovery. The VEP system continues to operate at the optimum level of efficiency for this particular technology. VEP is fulfilling all of the protectiveness requirements.

5.3.3 Pit Q-51

Recommendation: Annual inspection of the concrete cap was recommended to ensure that the cap integrity is maintained.

Current Status: Periodic inspections are conducted and there is no evidence that the remedy is impaired.

5.4 RESULTS OF IMPLEMENTED ACTIONS AND ACHIEVEMENT OF INTENDED EFFECT(S)

5.4.1 Building 3001 Groundwater

Tinker AFB submitted an ESD to USEPA and the agency approved the application in May 2003. The purpose of the ESD was to conduct an optimization study of the Building 3001 RA. The most conspicuous ESD component of the optimization study is the shutdown the GWTP and extraction well field. The principal objective of the shutdown is to re-establish a baseline condition for comparability to future actions and to assess rebound of contaminant concentrations and groundwater elevations. The goal of the ESD optimization study is to collect and utilize past, current, and future data associated with this shutdown to support a potential TI waiver. If a TI waiver is pursued, it will support CERCLA § 121 remedy selection and ARAR waiver requirements, 40 C.F.R. § 300.430 remedy selection and ARAR requirements, and CERCLA 120 (a) guidelines used in making TI waiver determinations. LTM information is evaluated during the shutdown to determine whether the plume is in equilibrium or migrating, and whether the current remedial action is protective of human health and the environment.

The actions proposed in the ESD were implemented on March 29, 2004. The GWTP and extraction well field were shut down, and the aquifer was allowed to begin recovery. LTM of the sentry wells continues, and based on results of semi-annual groundwater sampling, the groundwater plume is not migrating at an unacceptable rate. Therefore, the GWTP system has remained shutdown while the optimization study continues.

Certain evaluations that were proposed in the 2003 ESD and associated work plans included: center of mass calculations to ascertain plume stabilization, tracer tests, intrinsic bioremediation parameters without the effects of an operating pump-and-treat system, possible source locations, and whether or not the pump-and-treat system had a negative effect on natural attenuation. Not all of these assessments have been completed. Evaluations of vertical migration have not provided conclusive results at this time either. Therefore, the one-year shutdown outlined in the ESD has been extended three times and is still in effect. Data is still being collected for evaluation of the system and optimization of the remedial plans.

5.4.2 NTA

Free product removal continues using VEP. Other remedial alternatives are still under consideration.

5.4.3 Pit Q-51

Periodic inspection of the concrete cap continues and ensures that the cap integrity is maintained. There is no evidence that the remedy is impaired.

5.5 STATUS OF ANY OTHER PRIOR ISSUES

Second Five-Year Review Memorandum - Actions Needed

USEPA Region 6 reviewed the second Five-Year Review for the Building 3001 Site. USEPA concurred with the findings and recommendations of the report, but provided comments for following actions needed on January 25, 2005 (USEPA, 2005). Tinker AFB provided responses to the comments as shown below.

USEPA, Region 6 – Comment

1. The exposure assumptions used in the risk assessment have not changed. USEPA 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 USEPA recommends the USAF evaluate risk using both values, as warranted.

Tinker AFB – Response

The new "provisional values" were not (and still are not) implemented at the time of this Five-Year Review. Because the values were only provisional, performing additional risk assessments is not currently warranted.

USEPA, Region 6 – Comment

2. TCE contamination of the saturated zone ground water on the Tinker AFB property remains above the remedial goal of 5.0 micrograms/liter. This contamination is predominantly from the Building 3001 TCE plume. An institutional control (IC) program is a component of many of the alternatives being evaluated for the property. A ROD Amendment is required to implement and monitor an IC program if remedial goals are not based on unrestricted use and unrestricted exposure. USEPA recommends use of the Institutional Control User Guidance (USEPA, 2000), including the use of the IC Checklist and IC Tracking System, as warranted. Other protective measures may be needed such as a base-wide comprehensive plan that formally restricts the use of ground water.

Tinker AFB – Response

This guidance will be taken into consideration when future situations warrant, in a manner consistent with Air Force policy and guidance on ICs.

USEPA, Region 6 – Comment

3. USEPA recently published the *Draft Guidance For Evaluating The Vapor Intrusion To Indoor Air Pathway From Ground Water and Soils (Subsurface Vapor Intrusion Guidance)* (USEPA, 2002). USEPA recommends that the USAF 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. USEPA recommends that this screening evaluation is necessary for both occupied buildings and structures above the Building 3001 TCE plume and for any remedial systems that off-gas TCE.

Tinker AFB – Response

As a matter of due diligence, Tinker has performed preliminary screening of vapors inside the building. Since no vapors were detected, Tinker is satisfied that there is no vapor intrusion inside Building 3001.

USEPA, Region 6 – Comment

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

Tinker AFB – Response

Since the system is shut down, performance monitoring is not applicable at this time. However, contaminant monitoring is on-going as part of the B3001 extraction system shutdown.

SECTION 6
FIVE-YEAR REVIEW PROCESS

Site visits and interviews were conducted by Ed Heyse, PhD, P.E. and Micah Goodspeed of Parsons on April 17, 2007. Site inspection checklists for NTA and Building 3001 can be found in Appendix B. The current (2006 through 2007) O&M contractor for the sites is Parsons. The prior O&M contractors for the site were TTNUS (2003) and Dick Corporation (2004 through 2005). Management responsibility for the Soldier Creek/Building 3001 Site was transferred from OC-ALC/EM Directorate to the 72[nd] Air Base Wing, Civil Engineering Directorate, Environmental Management Division (72[nd] ABW/CEV) in 2005. Both the environmental management division, program engineering branch (CEVPE) and Parsons maintain a constant presence at the sites.

6.1 COMMUNITY INVOLVEMENT

Community involvement was initiated at the April 17, 2007 restoration advisory board (RAB) (formerly the community advisory board) meetings by announcing that a Five-Year Review process was underway. In addition, questions, comments, or concerns were solicited from the public during the RAB meeting. No comments have been received from the public at this time

6.2 DOCUMENT REVIEW

Documents from the administrative record were reviewed in order to assess the progress and actions taken at the Building 3001 site. The documents are listed in Table 4.1. In addition, monitoring reports required under the ODEQ regulated RCRA program are referenced in this section.

6.3 DATA REVIEW

6.3.1 Building 3001 Groundwater Treatment System Performance

The performance and effectiveness of the groundwater extraction and treatment system was reviewed. Since the last Five-Year Review inspection in April 2003, the GWTP and extraction well field ran continuously until the USEPA-authorized shutdown that was implemented on March 29, 2004. Based on data review through April 2004, the GWTP was found to be in good operating order, well maintained, staffed with competent operating personnel, and supervised by a knowledgeable and informed base staff. According to records reviewed, on-site laboratory results showed two treated groundwater effluent exceedances of chromium in October 2003 and February 2004. No exceedances of chromium were detected in samples analyzed by the off-site laboratory. During this same period, on-site sampling with detector tubes showed effluent vapor exceedances of TCE in March, April, and May 2003, and off-site laboratory results of Summa canisters collected indicated exceedances of dichloroethene and TCE in April and May 2003. While in inactive service (*i.e.,* during the rebound testing), the system is still staffed and maintained by an adequate staff who inspect and maintain the system for operational readiness.

In addition to the GWTP extraction well field, groundwater extracted at the SWTA VEP system was also discharging pre-treated groundwater to the GWTP prior to the 2004 shutdown. The SWTA is an interim corrective measure (ICM) operated under RCRA jurisdiction.

6.3.2 Aquifer Response and Groundwater Contaminant Monitoring

The 2003 ESD initiated a shut-down or rebound test, still in progress, to evaluate the system and optimize remedial plans, including gathering data necessary for a TI waiver (Parsons, 2004b). The one-year shut-down outlined in the ESD has been extended three times and is still in effect (OC-ALC/EM, 2007). Data is still being collected for evaluation of the system and optimization of the remedial plans.

As discussed in Section 4.4.1.1, while the ESD is in effect, semi-annual sampling is performed to monitor plume migration. If sampling indicates that the plume is migrating at an unacceptable rate, the contingency is to resume operation of the pump-and-treat system. Definition of "unacceptable rate" of contaminant migration is addressed in the response to USEPA comments to the ESD, and further elaborated in the work plan. "Unacceptable rate" of contaminant migration is evaluated based on historic well data. Trend analysis plots were prescribed for key wells, and "maximum allowable increase in concentrations" would be specified for each of these wells. Sentry (a.k.a. "Sentinel") wells, located on the downgradient edge of the current plume, have historically shown lower levels of TCE contamination. Table 6.1 identifies the sentry wells and the aquifer zones they are intended to monitor. The sentry wells were identified in the work plan (Parsons, 2004b).

Table 6.1 Sentry Wells

USZ	Upper LSZ	Middle LSZ	Lower LSZ
M-1BR		M-4AR	M-1CR
M-3BR		1-3AR	M-4CR
M-4B		1-6AR	1-12CR
1-14B		1-9AR	1-45CR
1-45B		1-45AR	1-6CR
2-360B			
1-9BR			
1-2B			
2-277B			
1-4B			
2-427B			

Unacceptable plume migration was defined as a concentration rise to 50% greater than the maximum historically high TCE concentration over a period of at least four consecutive sample rounds. If concentrations exceeded that criterion for four consecutive semi-annual sampling rounds, the system would be turned back on.

Therefore, in order for the remedy to be functioning as intended in the decision documents (*i.e.,* that the shut-down evaluation continue), the remedy is protective as long as the sentry wells do not exceed the unacceptable migration criterion defined in the ESD response to comments. To evaluate the remedy for the five-year review, the time-series plots of contaminant concentrations were studied for both TCE and chromium for each of the sentry wells. The location of each of the sentry wells is shown on Figures 6.1 through 6.8. Trend charts of contaminant concentrations in each of the sentry wells are presented as Figures 6.9 through 6.29.

The subsurface underlying Building 3001 site has been divided into 5 discrete hydrostratigraphic units. Figure 6.30 illustrates a cross-sectional view of typical hydrostratigraphic units at the site with associated nomenclatures. These units include: the USZ, the upper shale, the LSZ, the lower shale, and the PZ. Only the USZ (formerly known as the "Perched" aquifer) and the LSZ (formerly divided and referred to individually as the "Top of Regional" and "Regional" aquifers) portions of the aquifer system underlying Tinker AFB were evaluated. The deeper "Producing Zone" is not part of the cleanup requirement described in the ROD for the Building 3001 OU and was not evaluated. As a result of implementing the proposed ESD in 2004, an updated technical approach was developed, and a rebound test workplan was prepared at the time of ESD approval (Parsons, 2004b).

Well measurements obtained in November 2003 were used to evaluate the influence recovery wells exert in controlling plume migration. The hydraulic zones of influence are visible on the November 2003 pre-shutdown potentiometric maps (Figures 6.31 through 6.34). Aquifer recovery, following the April 2004 GWTP shutdown, is indicated on the November 2006 post-shutdown potentiometric maps (Figures 6.35 through 6.38). The return to ambient or near ambient hydrogeologic conditions is providing an understanding of plume behavior when the aquifer is not stressed.

The sentry wells were selected to chart the contaminant concentration trends over the nearly 15-year lifetime of the OU-1 remedial action. As shown on Figure 6.1 through 6.8, the 21 sentry wells were placed at strategic locations for determining whether significant contaminant rebound or other noteworthy behavior is occurring in the USZ and LSZ. No sentry wells were identified for the upper LSZ due to inadequate well distribution in that layer.

Because of its widespread use within and around Building 3001, TCE likely resides beneath the site as free-phase dense non-aqueous phase liquid (DNAPL) in small areas in the upper zones of groundwater saturation. Though it has not been identified at the site, it is likely that TCE is present as a persistent and virtually continuous source throughout OU-1. The USEPA's *Dense Nonaqueous Phase Liquids Workshop Summary* (USEPA, 1992) reports that "groundwater concentrations of 1% or less of effective solubility can be found even in the immediate proximity of the DNAPL." The effective solubility of

TCE is 1,000 milligrams per liter (mg/L), and concentrations greater than 10 mg/L might indicate the presence of DNAPL. Concentrations of TCE in the USZ have been recently measured as high as 40 mg/L (1-70B); therefore, DNAPL may be present. In addition, given that TCE concentrations in the upper LSZ and middle LSZ have been measured in monitoring wells in excess of 3 mg/L, it is possible that the DNAPL has migrated to these layers as well.

6.3.2.1 Evaluation of USZ

The USZ is a shallow, unconfined, water-table aquifer that is known to be perched in the vicinity of Building 3001. The lower boundary of the USZ is the upper shale. The saturated thickness of the USZ ranges from 0 feet, on the east where the upper shale subcrops along Soldier Creek, to 33.9 feet on the west where the depth of the upper shale reaches 50 feet. The mean thickness of the USZ is 15.1 feet.

Figures 6.1 and 6.2 show the distribution of TCE and chromium in the USZ along with the sentry wells selected for monitoring during the rebound test. Figures 6.31 and 6.35 show the pre- and post-shutdown water levels, respectively, for 2003 and 2006. The USZ water levels have recovered dramatically after the extraction well system was shut down.

Concentration trend charts for the USZ sentry wells are shown on Figures 6.9 through 6.19. Concentration data are posted from 1999 (or earlier) through 2006 for the sentry wells. There is no apparent trend or pattern common to the majority of the USZ sentry wells. Three of the USZ sentry wells have exceeded 150% of the historically high concentration for TCE and one for chromium. All of these wells showed a decrease in concentration for subsequent sampling events with the exception of 1-45B, which has not been sampled since the high detection.

6.3.2.2 Evaluation of LSZ (Uppermost portion)

The uppermost portion of the LSZ is unconfined under much of Building 3001. Approximately 1,500 feet west of Building 3001, water levels intersect the aquitard resulting in confined or semi-confined conditions in the uppermost LSZ to the west. The unconfined zone also thins north of Building 3001. An east-west trending groundwater mound located north of Building 3001 is coincident with the discontinuity in the upper shale unit believed to exist at the 1-76 well cluster location and a depression in the USZ water table at the same location. Groundwater flow directions in this layer are generally to the west-southwest.

Figures 6.3 and 6.4 show the distribution of TCE and chromium in the upper LSZ. Figures 6.32 and 6.36 show the pre- and post-shutdown water levels, respectively, for 2003 and 2006. These maps for the upper LSZ show significant shrinkage of the hydraulic zone of influence between November 2003 (prior to system shutdown) and November 2006. Steady-state or near steady-state conditions have likely been achieved over the three year rebound/recovery period.

No trend charts are generated for the upper LSZ, because no sentry wells were designated for this zone. The spatial coverage of the upper LSZ plume is limited for TCE and chromium, and a meaningful sentry well configuration could not be developed.

6.3.2.3 Evaluation of LSZ (Middle Portion)

The middle portion of the LSZ lies below the uppermost portion (discussed above) and acts as a confined aquifer. Groundwater flow in this layer is primarily to the southwest, except northeast and west of Building 3001. There is a local groundwater divide located northeast of Building 3001. The groundwater divide trends northwest-southeast between well 1-87B and the northeast corner of the IWTP. Northeast of the divide, groundwater flow is to the northeast. The southwesterly flow pattern is also interrupted by the capture zone of the extraction wells located just west of Building 3001.

Figures 6.5 and 6.6 show the distribution of TCE and chromium in the middle LSZ along with the sentry wells selected for monitoring during the rebound test. Figures 6.33 and 6.37 show the pre- and post-shutdown water levels, respectively, for 2003 and 2006. The middle LSZ water levels have recovered dramatically after the extraction well system was shut down.

Concentration trend charts for the middle LSZ sentry wells are shown on Figures 6.20, 6.21, 6.22, 6.23, and 6.24. Concentration data is posted from 1994 through 2006 for the sentry wells. There is no apparent trend or pattern common to the five middle LSZ sentry wells, but it is evident that two of the wells have exceeded 150% of the historically high concentration for chromium. Both of these have shown less than 150% of the historic high in subsequent sampling events. None of the five wells have exceeded 150% of their respective historical highs for TCE at any time since treatment system shutdown.

6.3.2.4 Evaluation of LSZ (Lower Portion)

Groundwater in the lower portion of the LSZ is confined or semi-confined by the overlying shale lenses comprising the units above, and the hydraulic heads are characteristically less than 5 feet lower than in the overlying layer. The general flow direction in this unit is to the southwest, except for the pre-shutdown interruption by the capture zone of the extraction wells just west of Building 3001.

Figures 6.7 and 6.8 show the distribution of TCE and chromium in the lower LSZ along with the sentry wells selected for monitoring during the rebound test. Figures 6.34 and 6.38 show the pre- and post-shutdown water levels, respectively, for 2003 and 2006. The lower LSZ water levels have recovered dramatically since the extraction well system was shut down. Steady-state or near steady-state conditions have likely been achieved over the three year rebound/recovery period.

Concentration trend charts for the lower LSZ sentry wells are shown on Figures 6.25, 6.26, 6.27, 6.28, and 6.29. Concentration data is posted from 1994 through 2006 for the sentry wells. There is no apparent trend or pattern common to the five lower LSZ sentry wells. Concentrations exceeded 150% of the historically high concentration for chromium during one sampling event at one well, with lower detections in subsequent sampling events. No TCE concentrations have exceeded 150% of the historic high since shutdown.

6.3.3 NTA

Site data, including free product removal and product thickness in monitoring wells is documented in semi-annual and annual reports (Parsons, 2007b). Since the last five-year review, data is provided in technical reports (Parsons, 2004a; 2005a; 2005b; 2005c; 2007a; 2007b).

6.3.3.1 Free Product Removal

Overall, the total volume free product removed from NTA between July 1991 and June 2006 is estimated at 36,772 gallons. Production data from March 22, 2005 through June 22, 2006 indicates that the VEP system has been removing about 7 gallons of product per day – down about 2 gallons per day from the last Five-Year Review (Parsons, 2007b). Free product monitoring suggests that the distribution and thickness of the free product layer is diminishing.

6.3.3.2 Vapor Extraction

Based on the 2003 Five-Year Review, soil vapor extraction has been conducted by various means since 1990. VEP is the current technology used for soil vapor removal. Mass loading from vapor recovery is well below *de minimis* levels and total vapor recoveries are negligible on a daily and annualized basis (Parsons, 2007b). Based on results of the focused RI (Parsons ES and Battelle, 1994), remediation through natural attenuation was recommended. This alternative was recommended because time is not a critical factor due to long-term monitoring for the Building 3001 groundwater plume. The shallow soils are considered sufficiently impermeable so that soil vapor exposure to potential receptors at the surface will not occur. This needs to be substantiated based on the current CA requirements of USEPA (USEPA, 2007a).

6.3.3.4 Pit Q-51

Other than ARARs, no data were evaluated for Pit Q-51.

6.4 SITE INSPECTIONS

Building 3001 Groundwater

A site visit to the Building 3001 groundwater treatment plant and extraction well field was conducted on April 16, 2007. The site visit was attended by Ed Heyse, PhD, P.E., Micah Goodspeed, John Osweiler, and Eric Houston of Parsons. Since the plant was shut down due to implementation of the ESD, plant operations have diminished to utility maintenance activities. Daily and monthly operation logs for the GWTP, quarterly reports, and chemical use inventories indicated little activity had taken place since 2004 when the plant was shut down. The O&M Plan and associated design and as-built drawings are maintained on-site in the plant office, and some upgrades are underway at the plant while the system is down. Discussions were held at the GWTP with plant operating and supervisory personnel to further assess operating condition of equipment, level of maintenance, housekeeping practices, performance history, and operator knowledge.

NTA

A site visit was completed on the afternoon of April 16, 2007. This visit was attended by Dr. Ed Heyse, Micah Goodspeed, and John Osweiler, all of Parsons. This visit was conducted to establish the current conditions of the site and monitoring systems.

In the previous review, it was noted that a multi-phase or VEP extraction system is now in use at the site, and all of the flow lines from the nine existing extraction wells are below ground and double contained. Currently, all recovered groundwater and contamination is pumped to the treatment unit and manifolded to a liquid ring pump. Although this represents a change from the initial system that was installed as a result of the ROD, the essential remediation mechanics remain the same. While the ROD specifies a vapor extraction remedy, the upgraded system goes one step farther to include not only vapor extraction, but also contaminated groundwater extraction. Treatment of vapor exhausts was discontinued, because emissions do not exceed *de minimis* levels. Treated water obtained in association with the free product removal is discharged to the IWTP. All other equipment on site appears to be secure and compliant with all codes and laws.

Pit Q-51

The location of former Pit Q-51 was visited to observe the condition of the concrete cap on May 3, 2007. Equipment and materials were staged on top of the patch, but the surface was sufficiently visible to determine the condition of the concrete. The concrete patch was intact and all the seals around the joints were in good condition and no separation or deterioration was evident.

6.5 INTERVIEWS

***Building 3001 Groundwater*:** Interviews were conducted with Jason Flaming (72nd ABW/CEVPE), current project manager of the remediation system and plant oversight, on June 19, 2007. In addition, interviews were conducted with Eric Houston of the contract operating company, Parsons, on April 16, 2007.

NTA: Interviews were conducted with Dan Hunt (72nd ABW/CEVPE), the site manager on June 19, 2007, and also Stan Townsend of the contract operating company, Parsons, on June 19, 2007.

***Pit Q-51*:** Because Pit Q-51 is closed according to the ROD, no interviews were conducted as part of this five-year review.

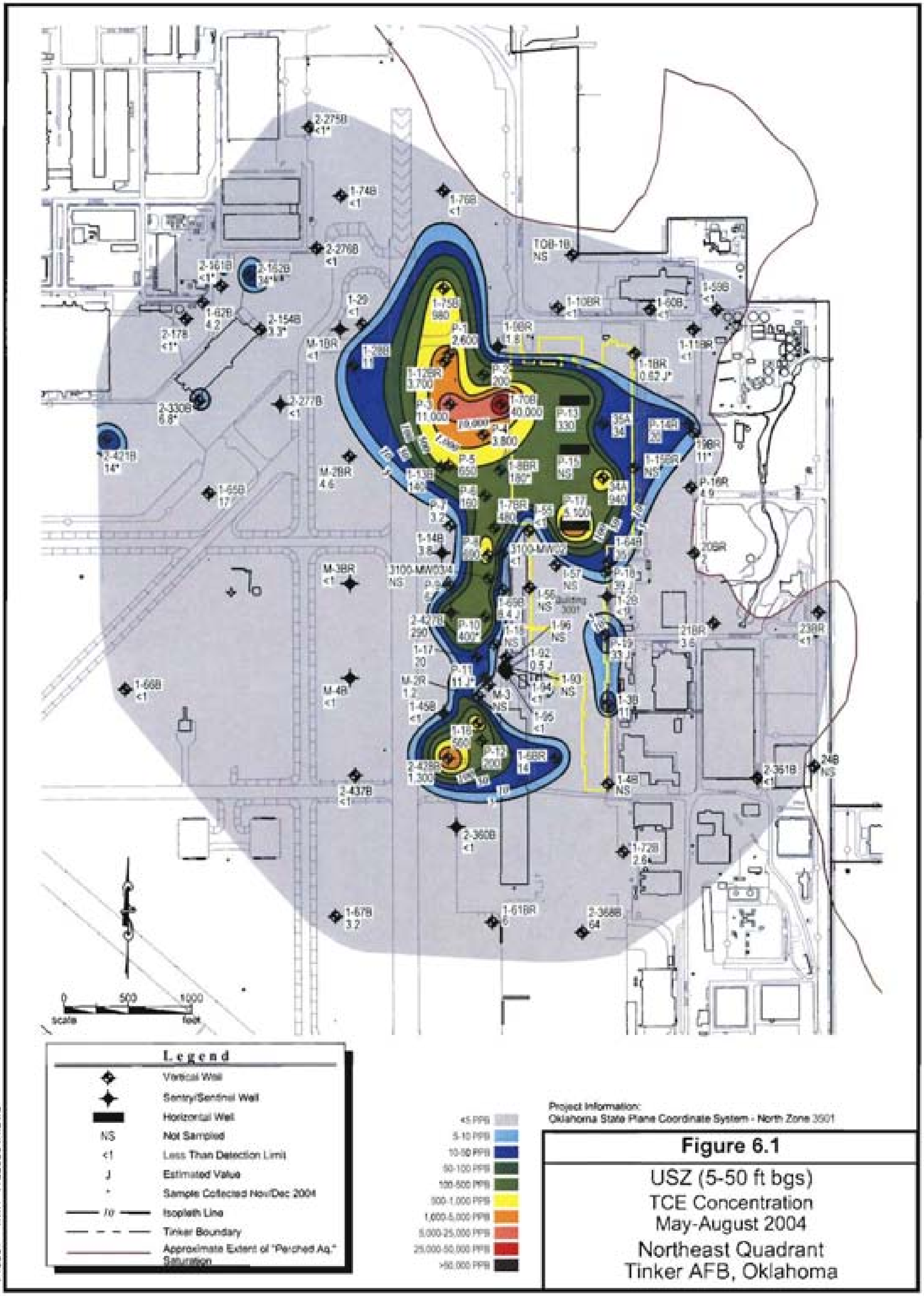


Figure 6.1
USZ (5-50 ft bgs)
TCE Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

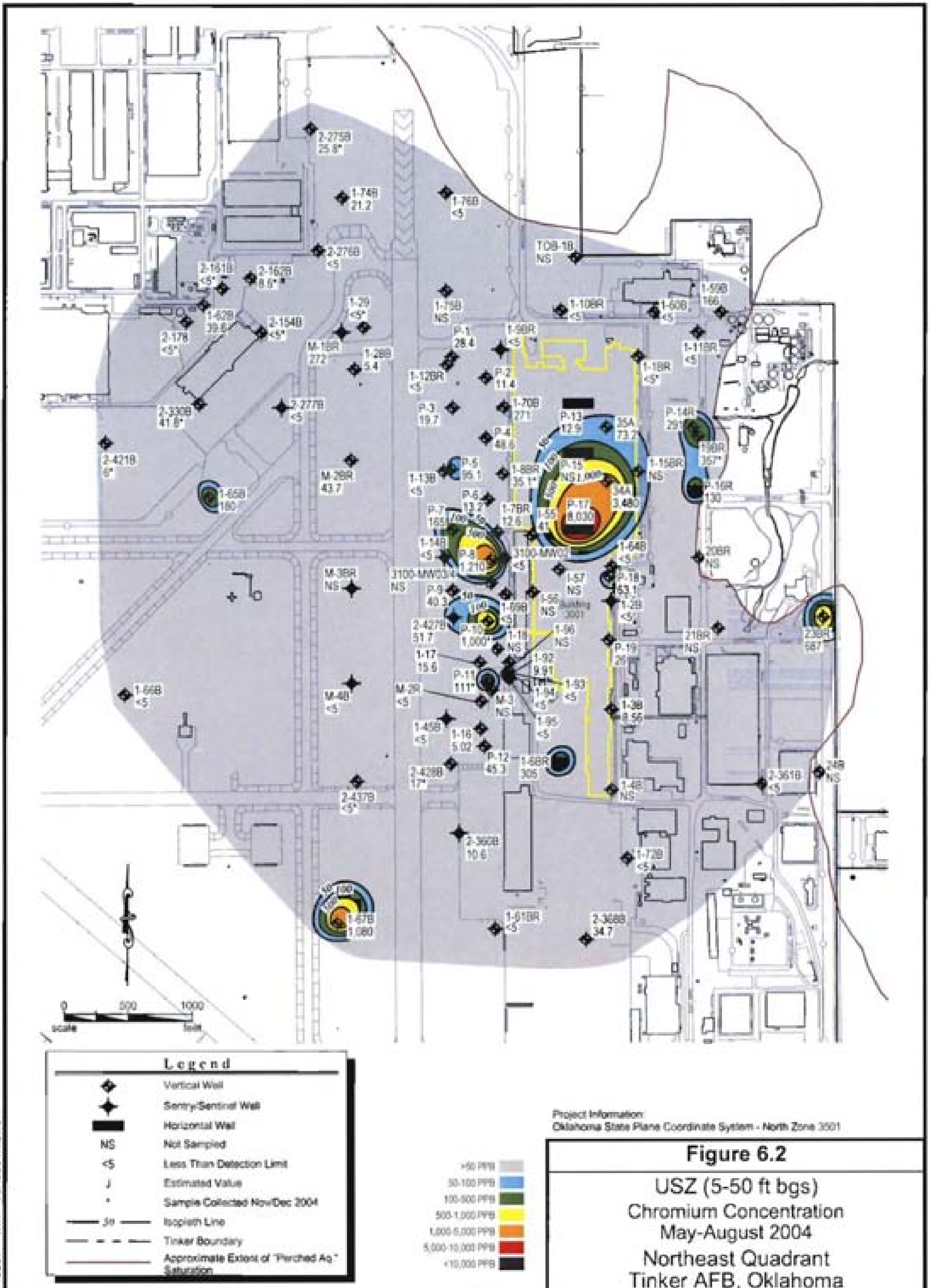


Figure 6.2
USZ (5-50 ft bgs)
Chromium Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

Figure 6.3

Upper LSZ (30-95 ft bgs)
TCE Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

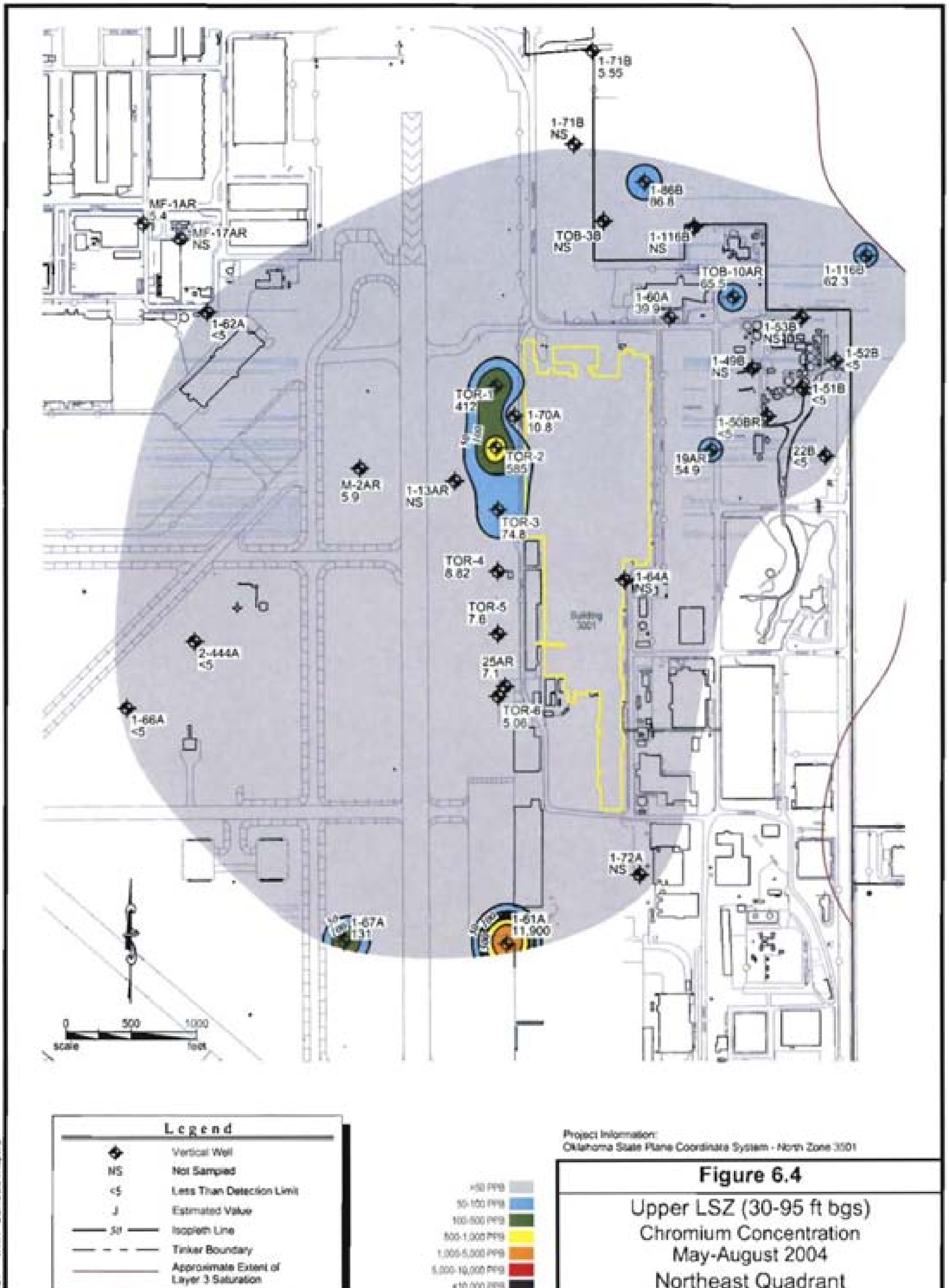


Figure 6.4

Upper LSZ (30-95 ft bgs)
Chromium Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

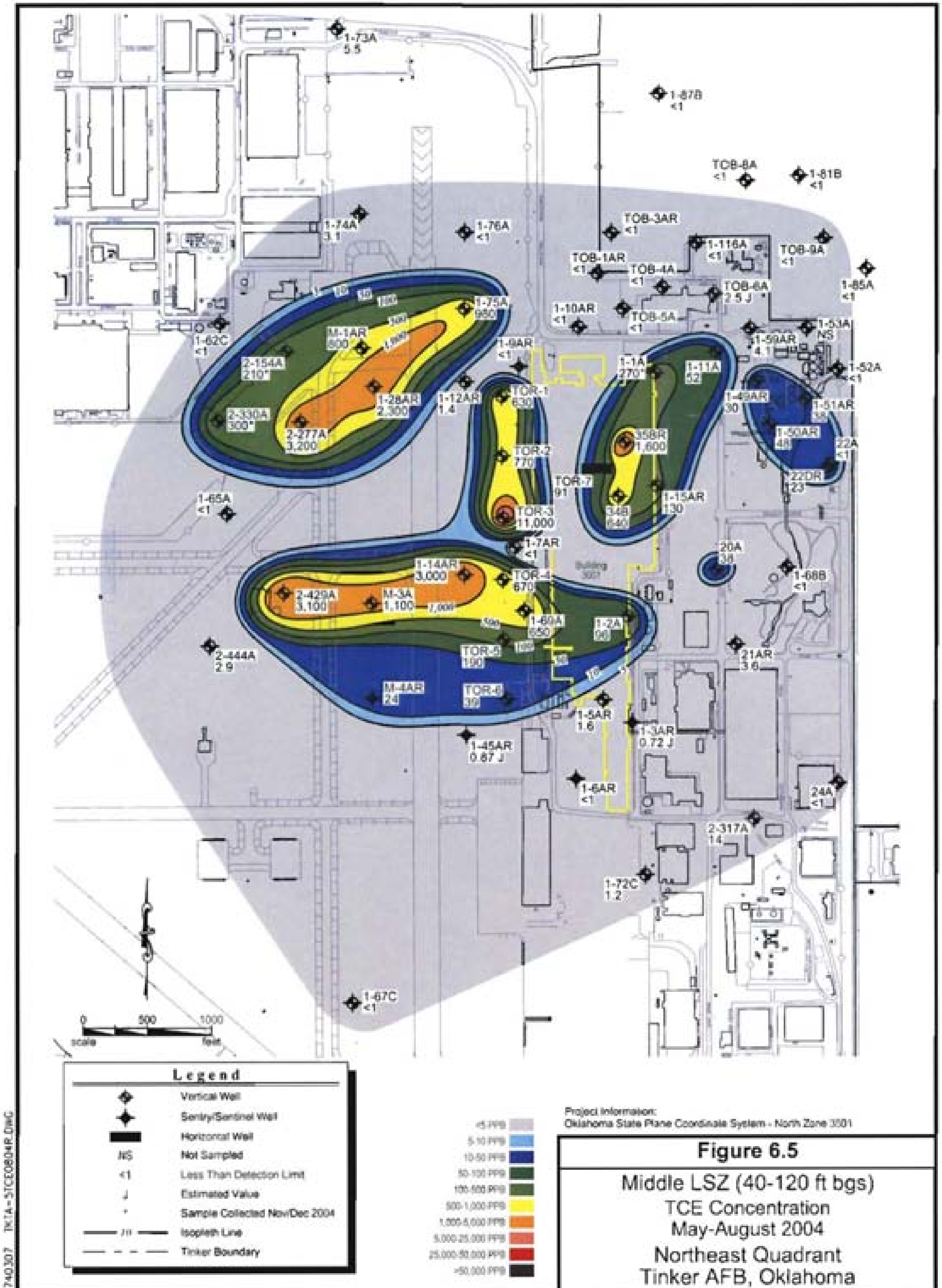
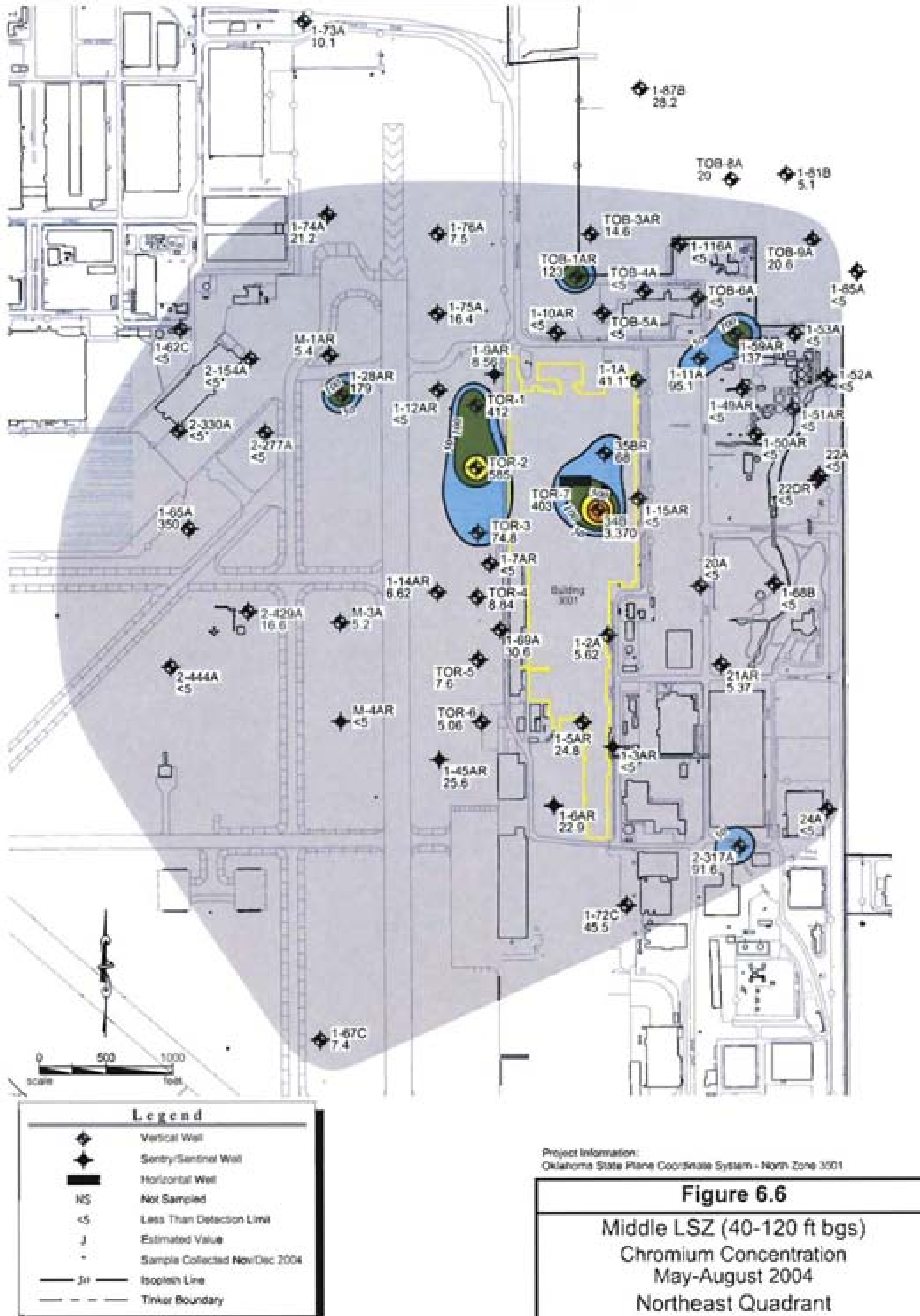


Figure 6.5

Middle LSZ (40-120 ft bgs)
TCE Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma



Project Information:
Oklahoma State Plane Coordinate System - North Zone 3501

Figure 6.6

Middle LSZ (40-120 ft bgs)
Chromium Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

740307 TKTA-5CR0804R.DWG

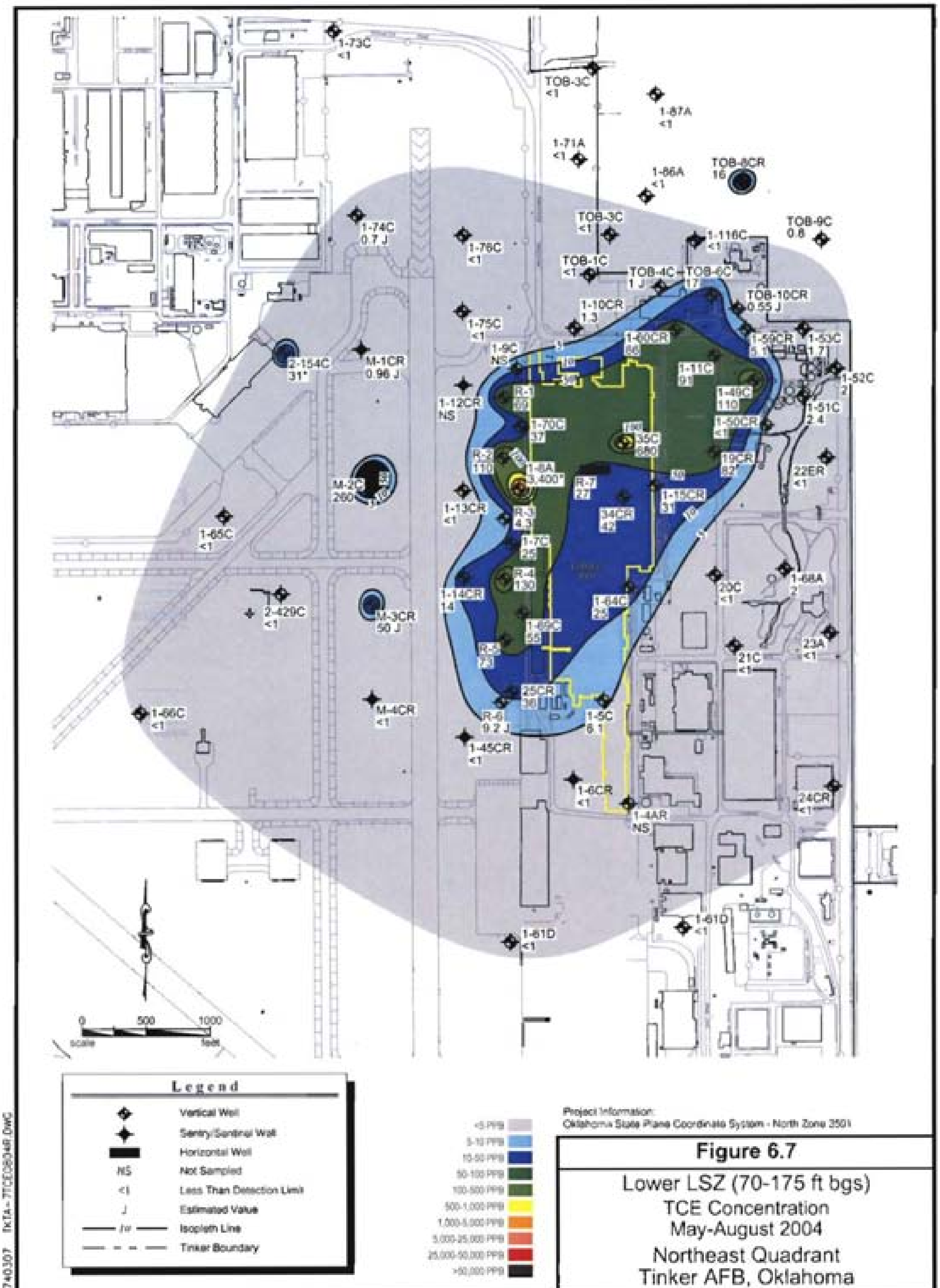


Figure 6.7

Lower LSZ (70-175 ft bgs)
TCE Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

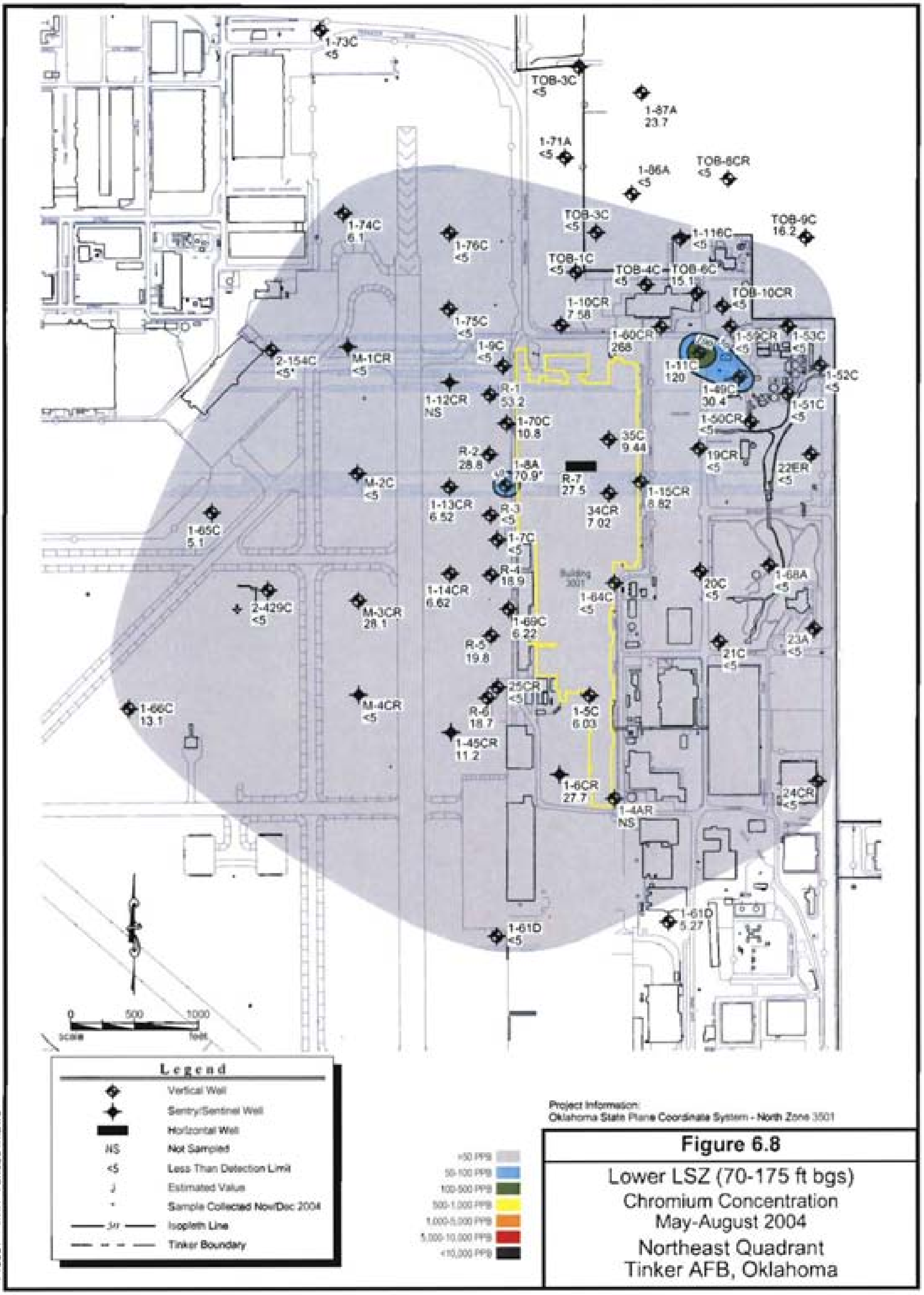


Figure 6.8

Lower LSZ (70-175 ft bgs)
Chromium Concentration
May-August 2004
Northeast Quadrant
Tinker AFB, Oklahoma

Figure 6.9
TCE and Cr Concentrations, Well M-1BR (USZ)
Tinker AFB, Oklahoma

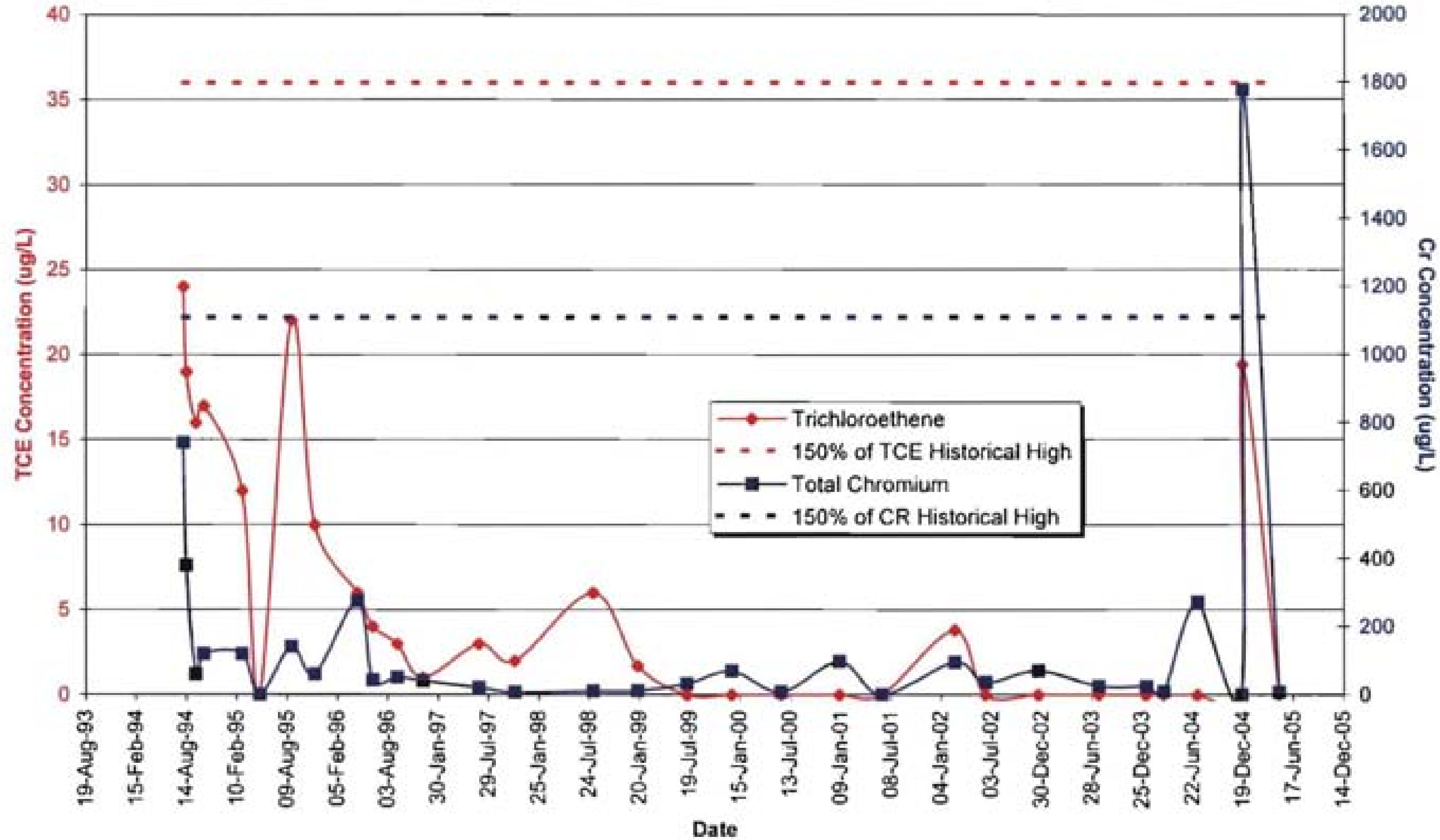


Figure 6.10
TCE and Cr Concentrations, Well M-3BR (USZ)
Tinker AFB, Oklahoma

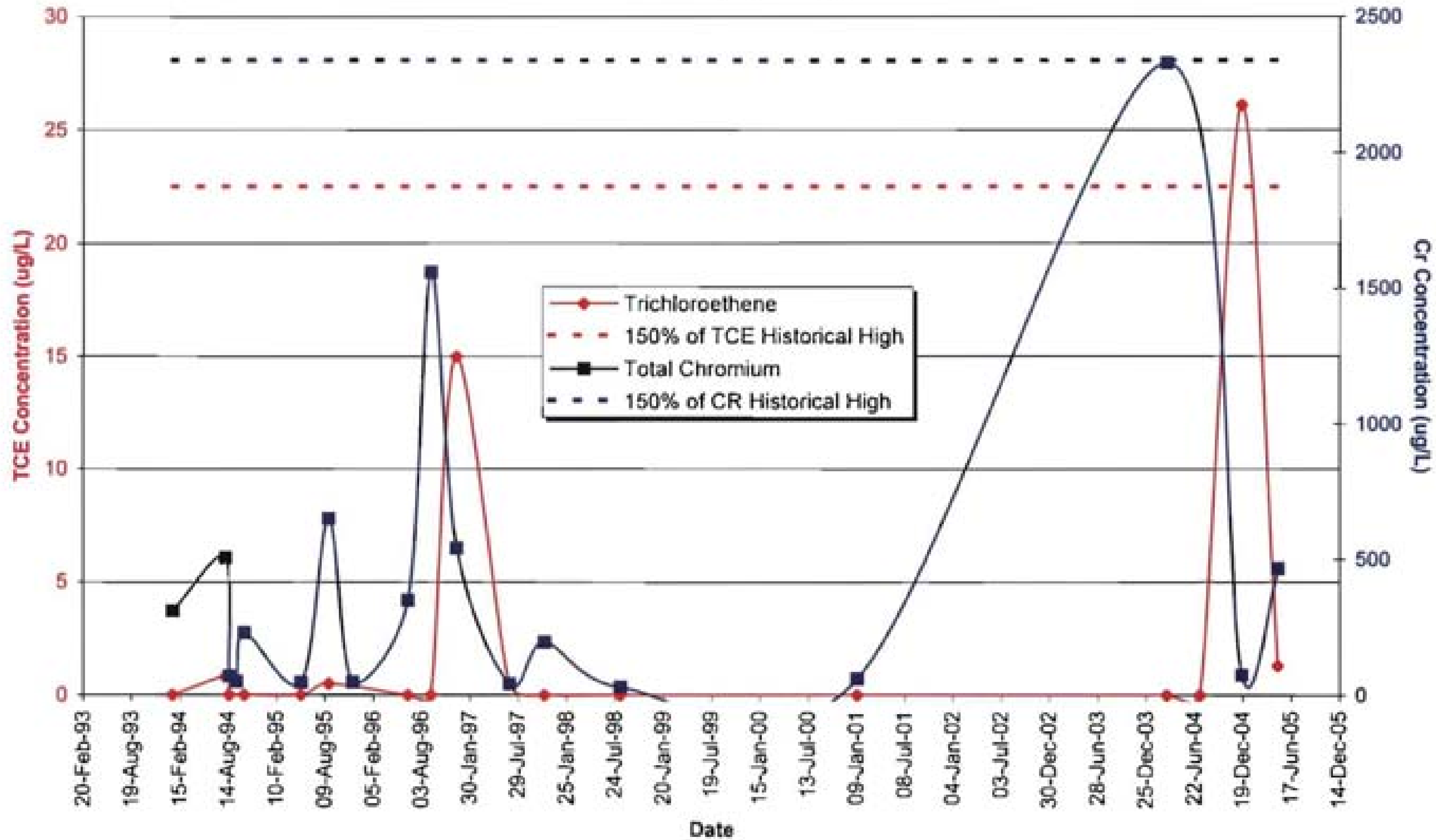


Figure 6.11
TCE and Cr Concentrations, Well M-4B (USZ)
Tinker AFB, Oklahoma

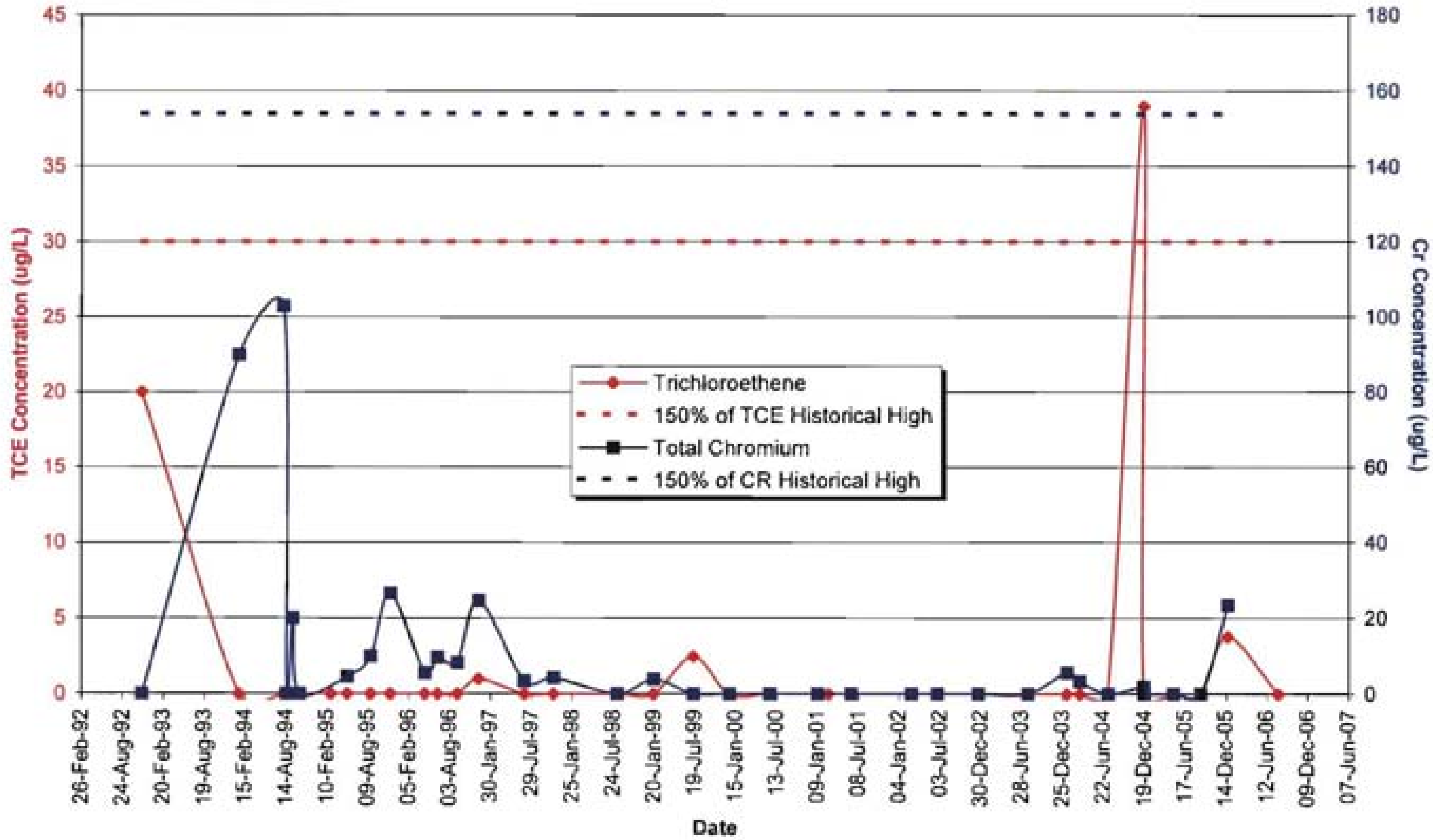


Figure 6.12
TCE and Cr Concentrations, Well 1-2B (USZ)
Tinker AFB, Oklahoma

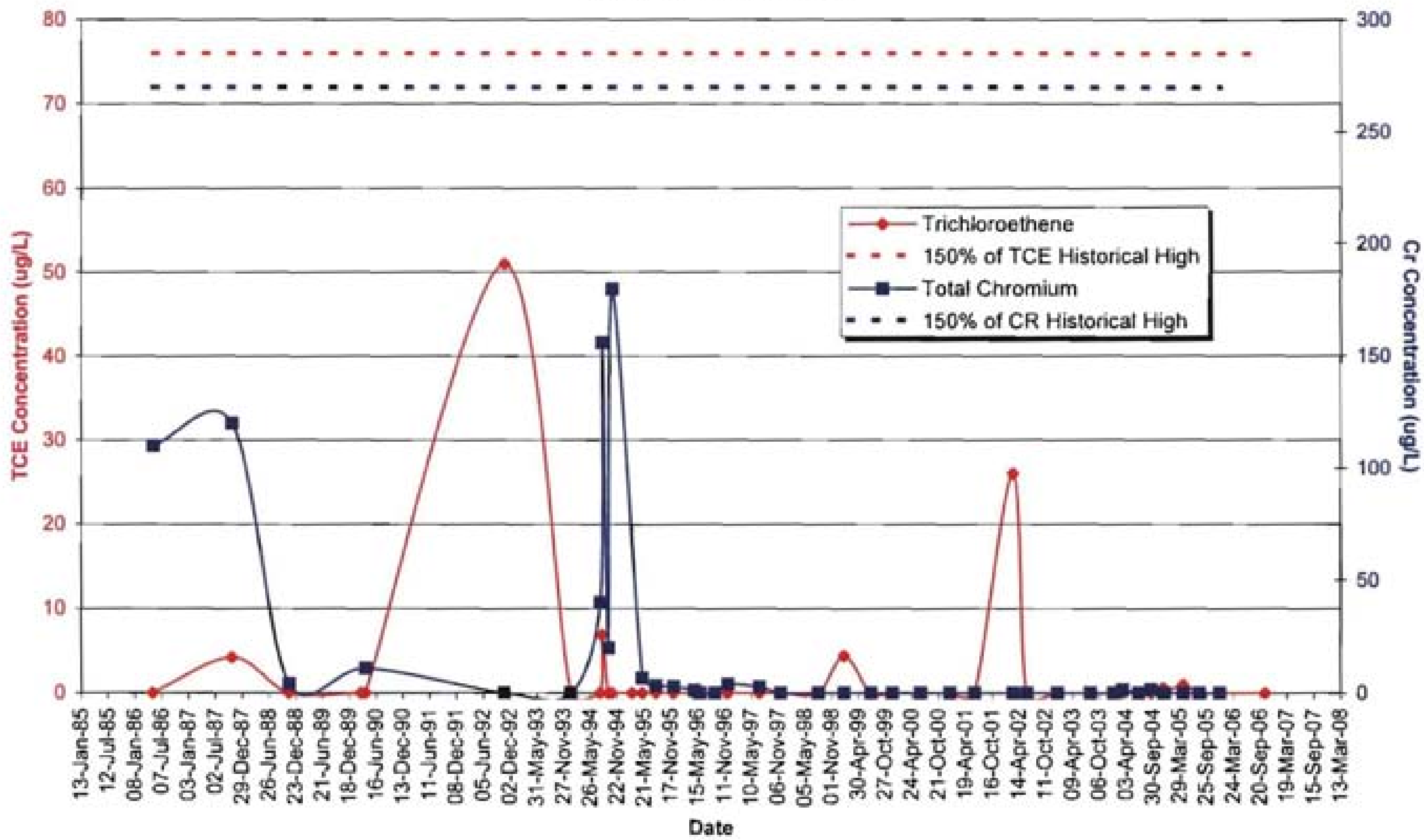


Figure 6.13
TCE and Cr Concentrations, Well 1-4B (USZ)
Tinker AFB, Oklahoma

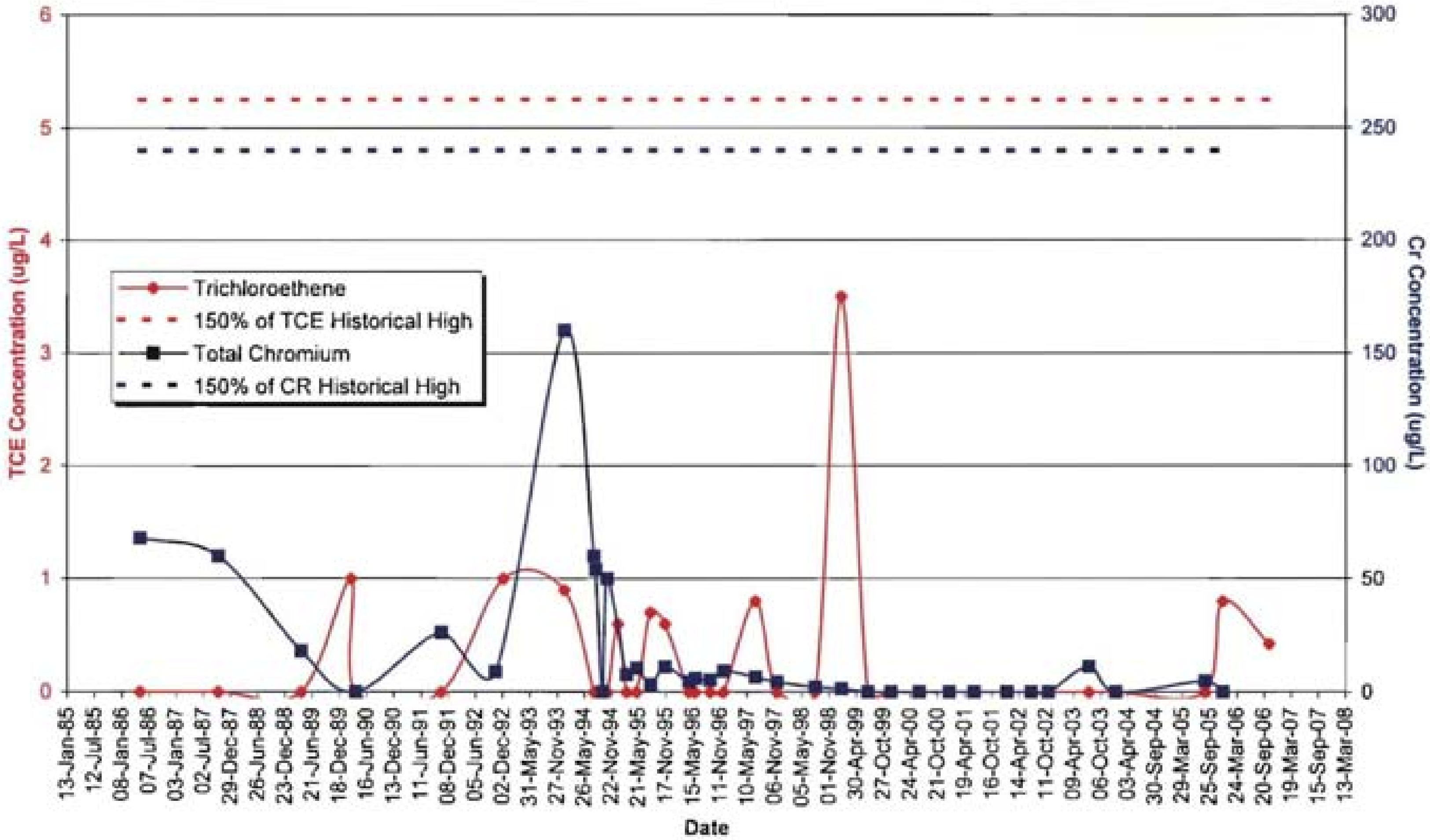


Figure 6.14
TCE and Cr Concentrations, Well 1-9BR (USZ)
Tinker AFB, Oklahoma

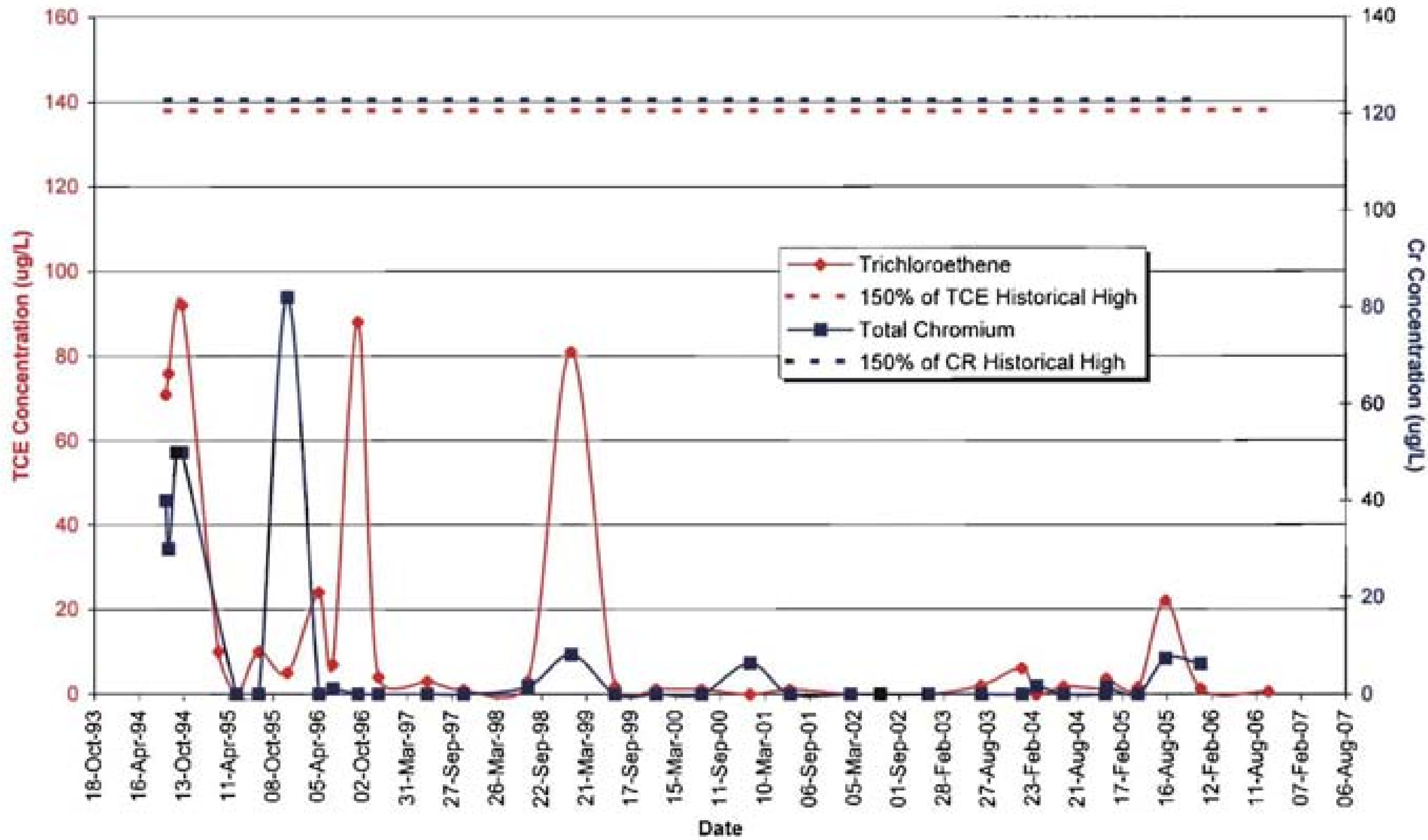


Figure 6.15
TCE and Cr Concentrations, Well 1-14B (USZ)
Tinker AFB, Oklahoma

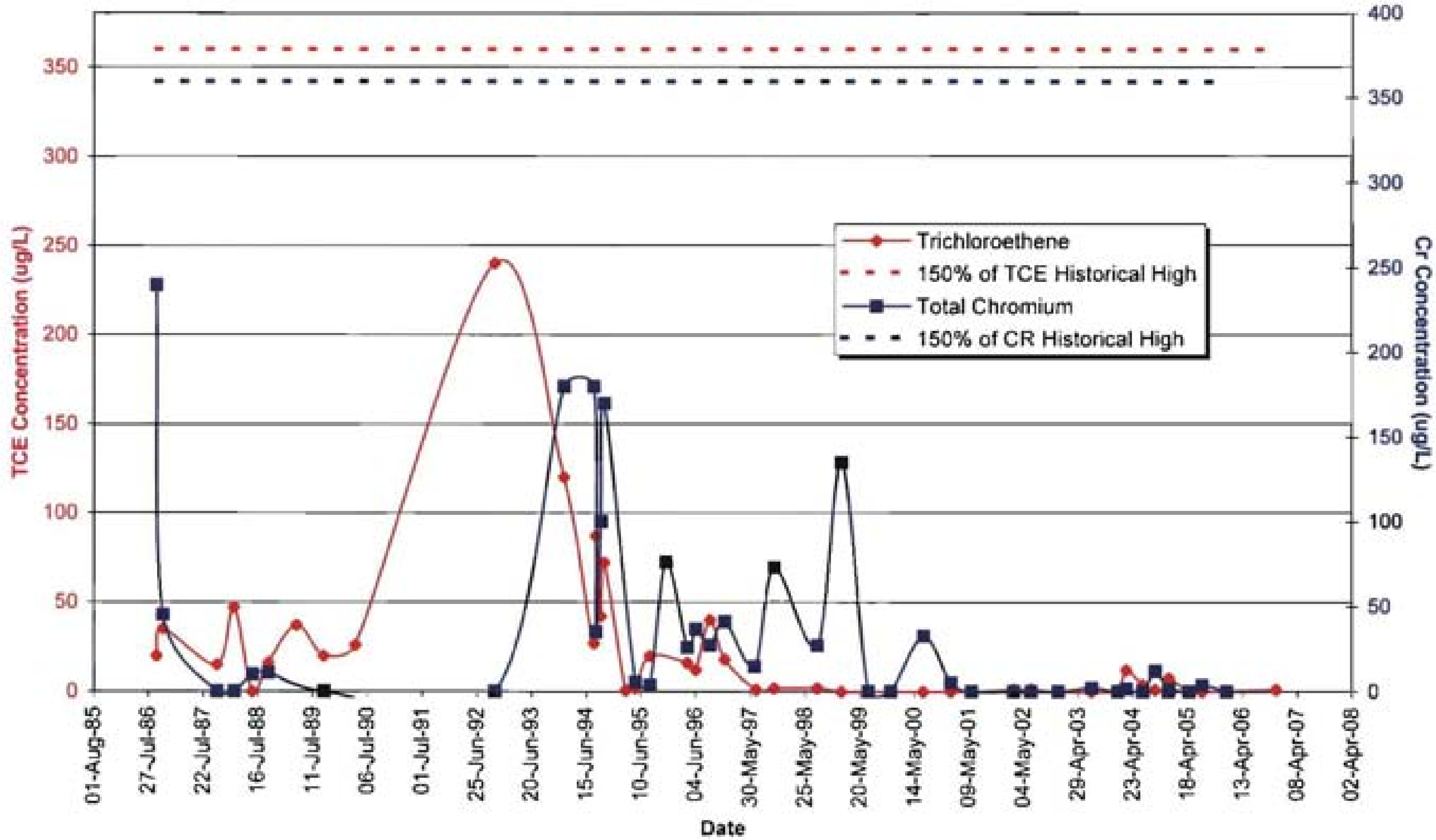


Figure 6.16
TCE and Cr Concentrations, Well 1-45B (USZ)
Tinker AFB, Oklahoma

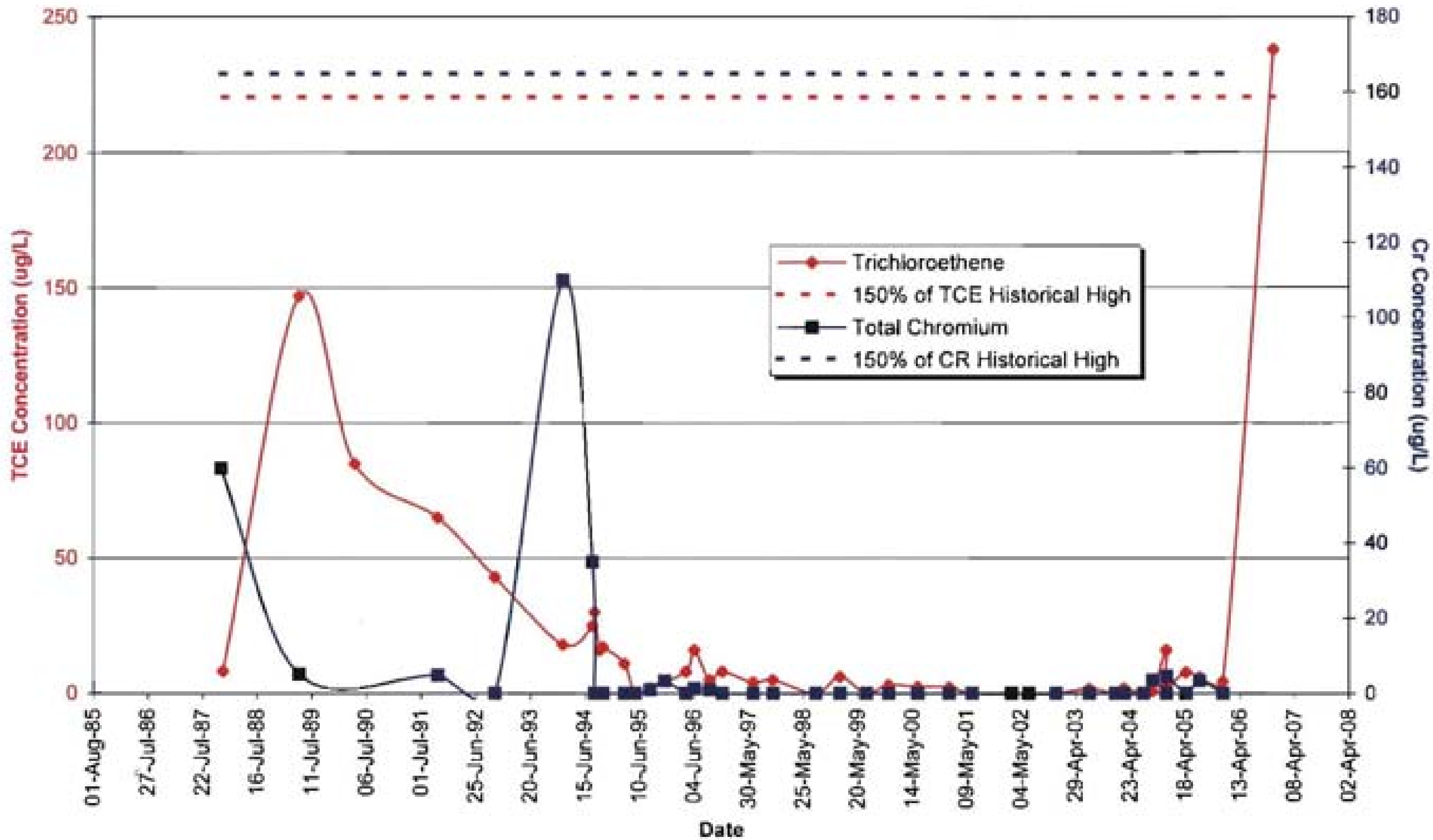


Figure 6.17
TCE and Cr Concentrations, Well 2-277B (USZ)
Tinker AFB, Oklahoma

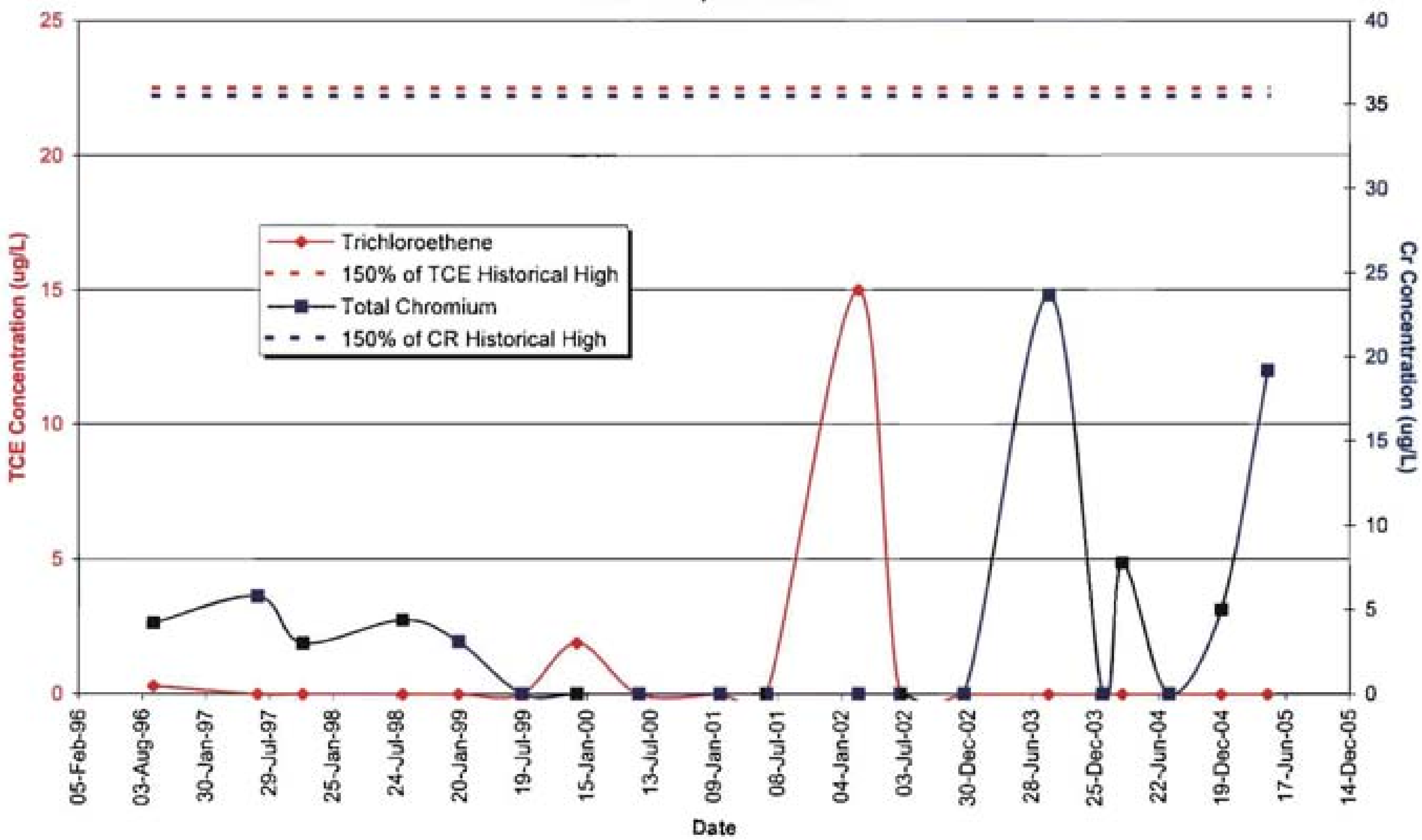


Figure 6.18
TCE and Cr Concentrations, Well 2-360B (USZ)
Tinker AFB, Oklahoma

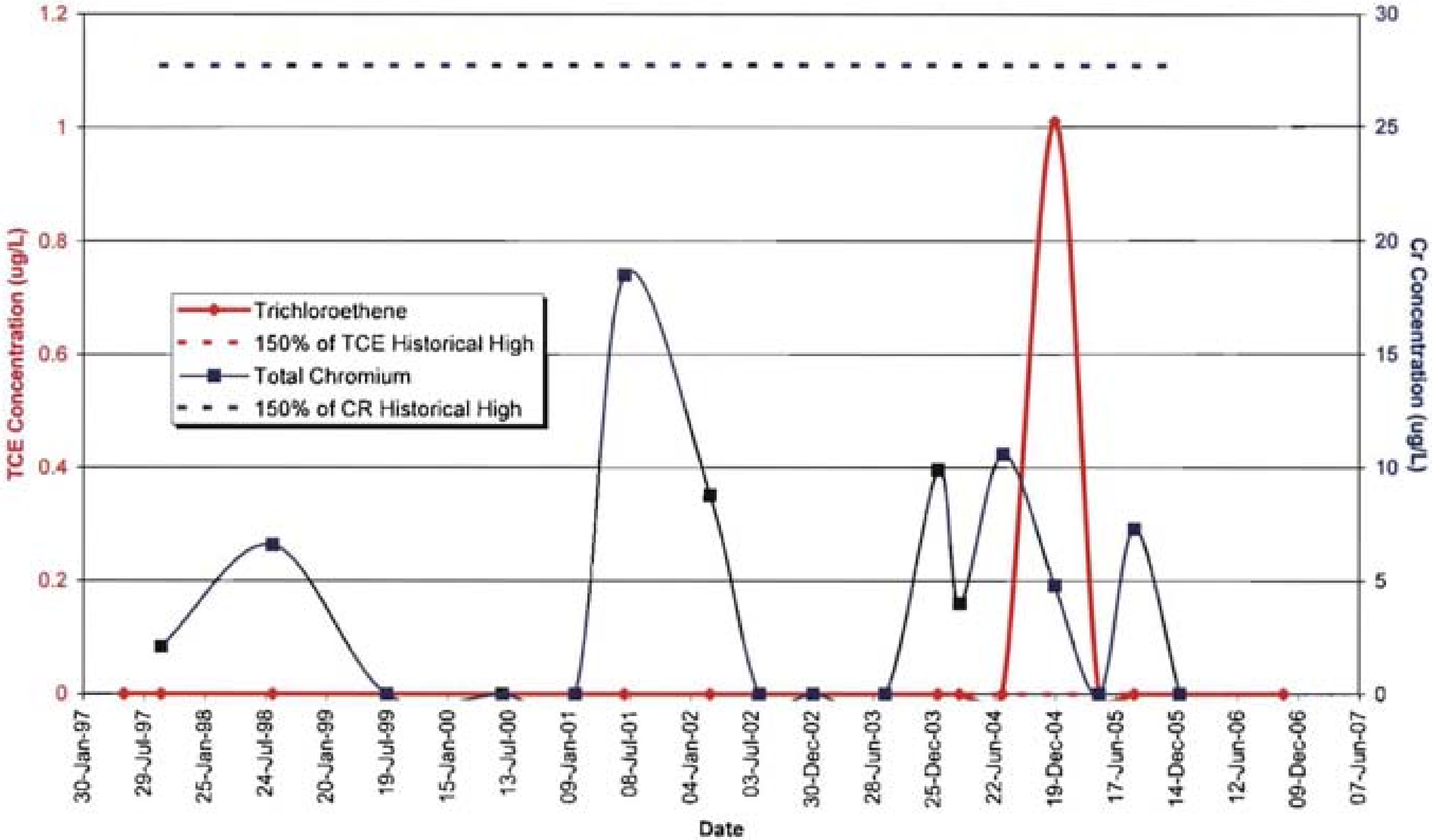


Figure 6.19
TCE and Cr Concentrations, Well 2-427B (USZ)
Tinker AFB, Oklahoma

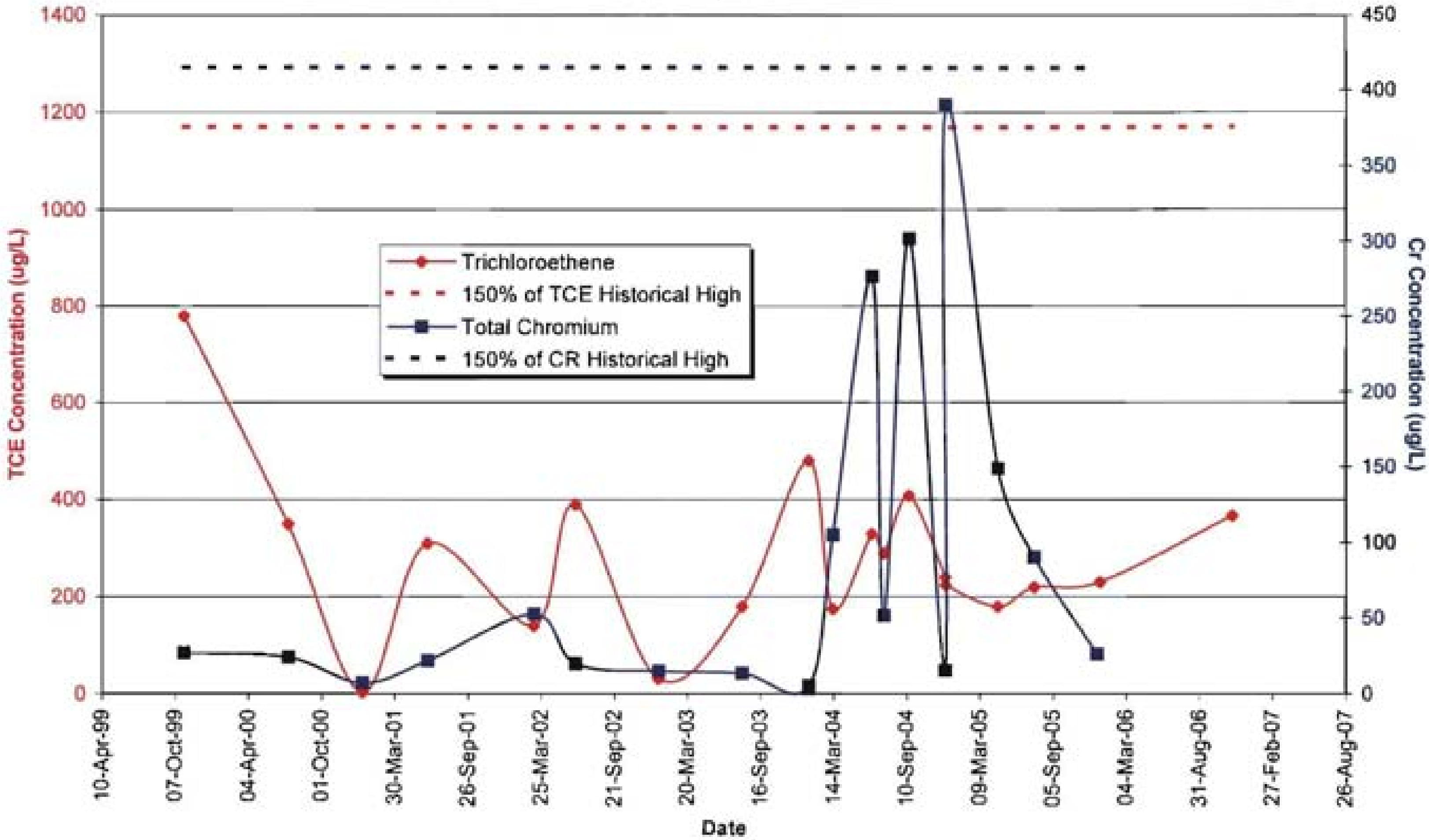


Figure 6.20
TCE and Cr Concentrations, Well M-4AR (Middle LSZ)
Tinker AFB, Oklahoma

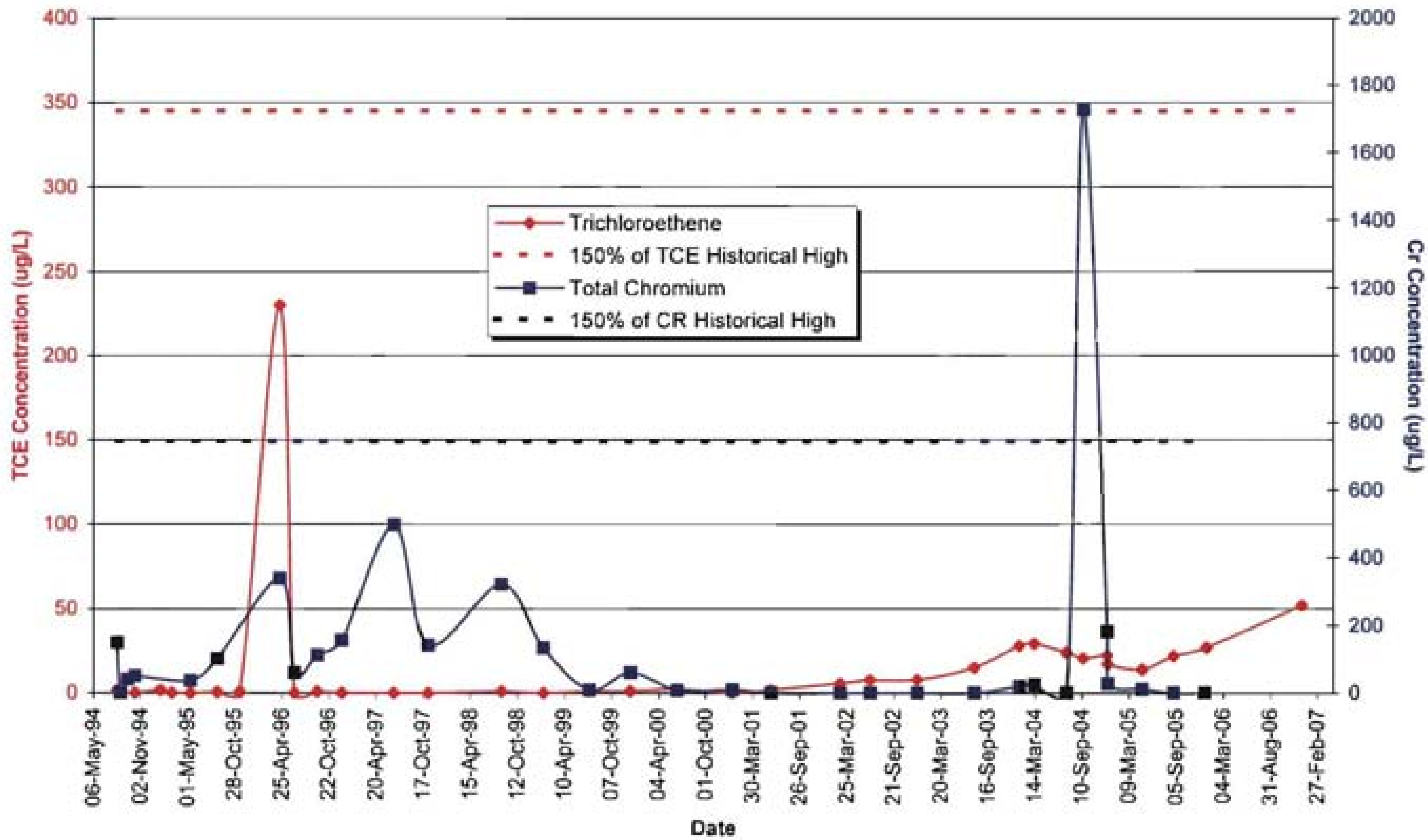


Figure 6.21
TCE and Cr Concentrations, Well 1-3AR (Middle LSZ)
Tinker AFB, Oklahoma

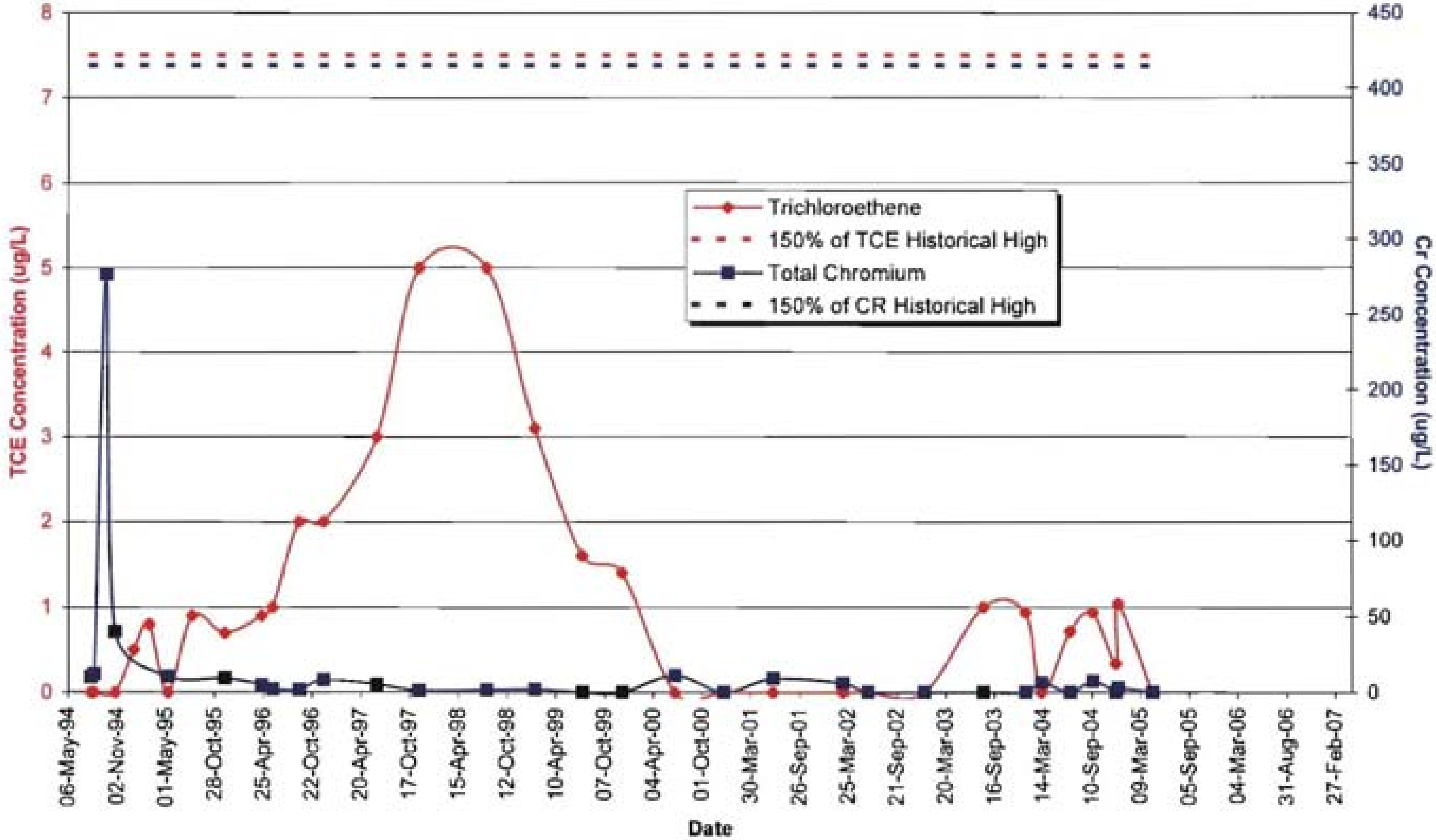


Figure 6.22
TCE and Cr Concentrations, Well 1-6AR (Middle LSZ)
Tinker AFB, Oklahoma

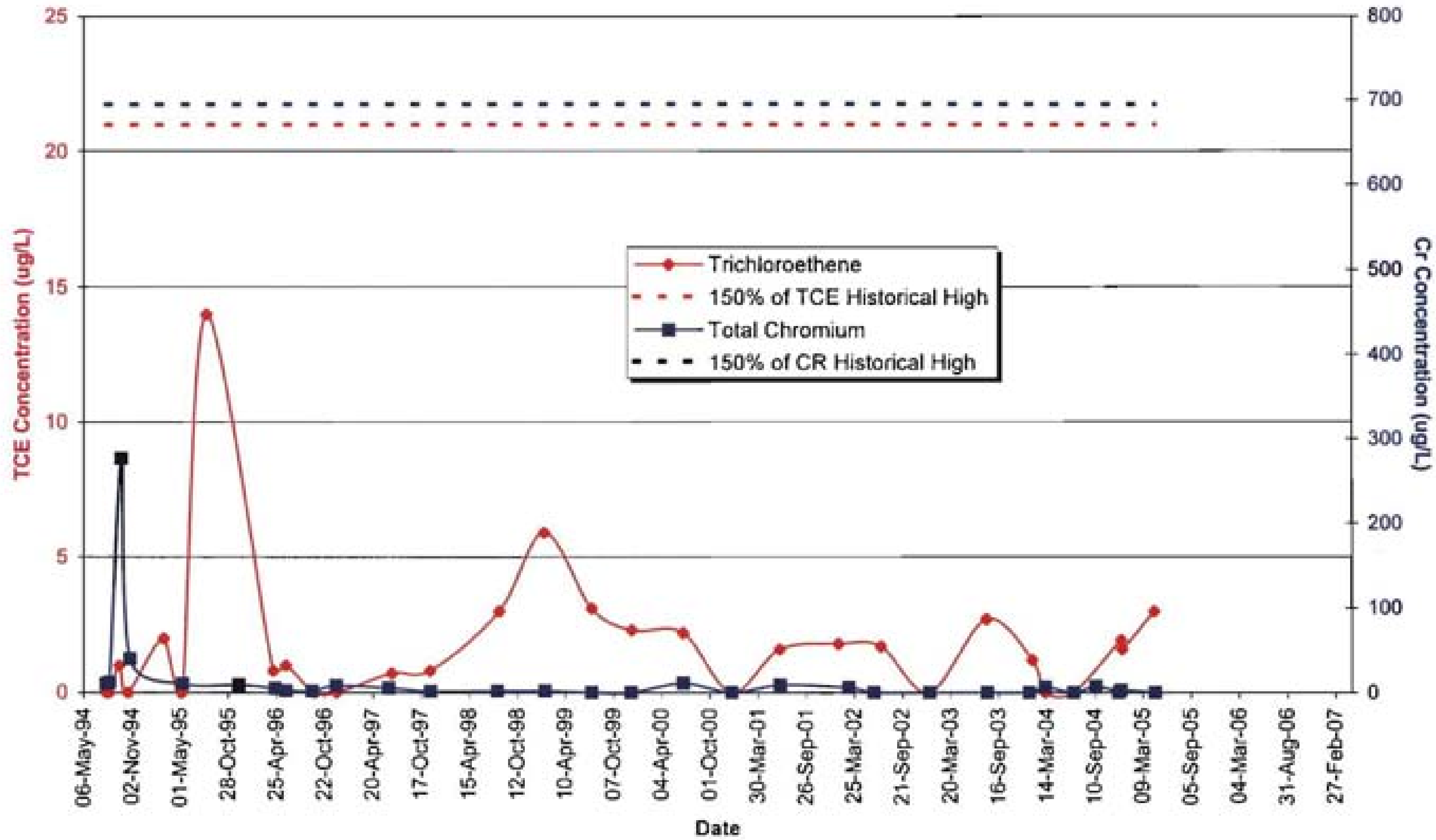


Figure 6.23
TCE and Cr Concentrations, Well 1-9AR (Middle LSZ)
Tinker AFB, Oklahoma

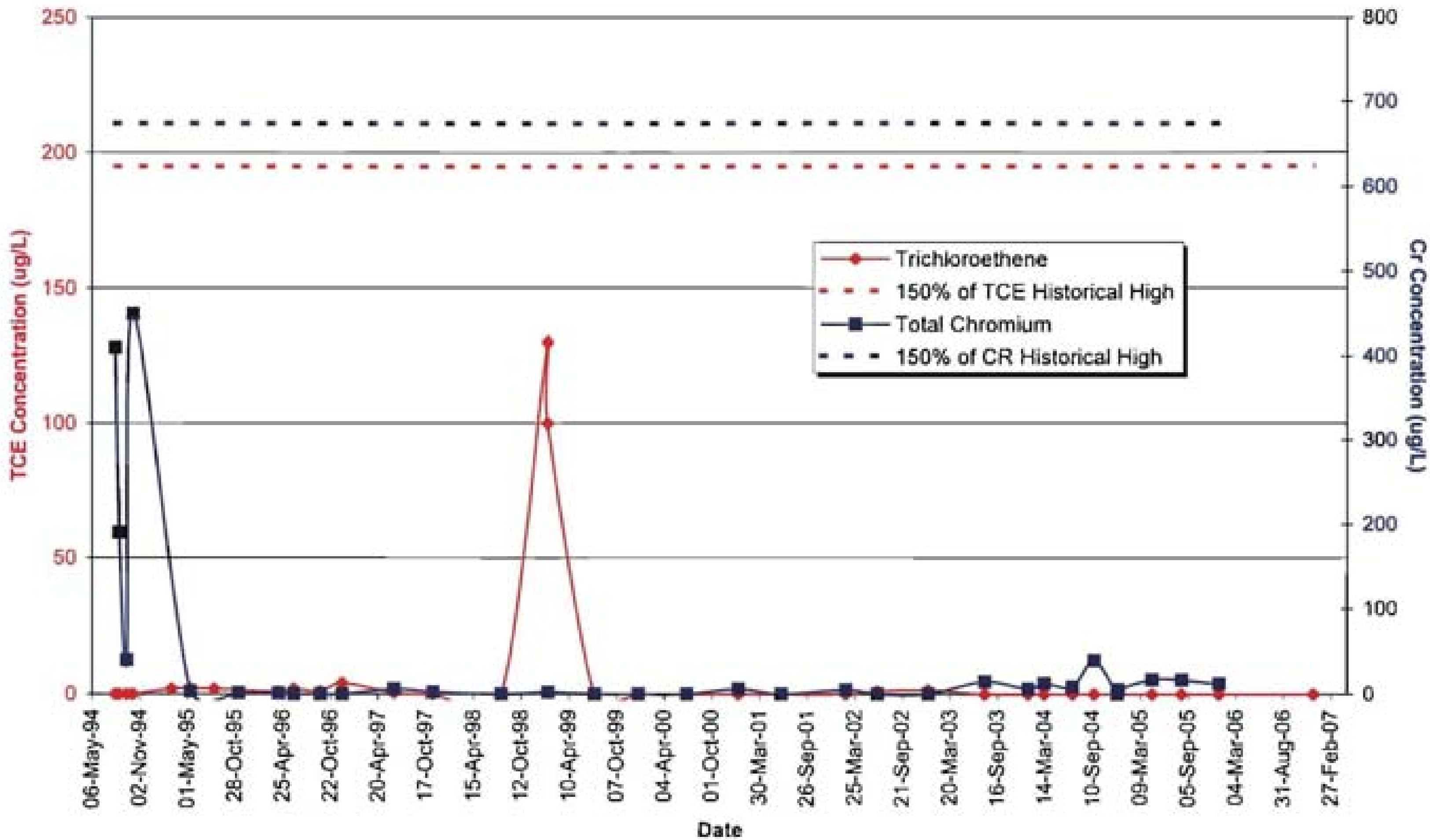


Figure 6.24
TCE and Cr Concentrations, Well 1-45AR (Middle LSZ)
Tinker AFB, Oklahoma

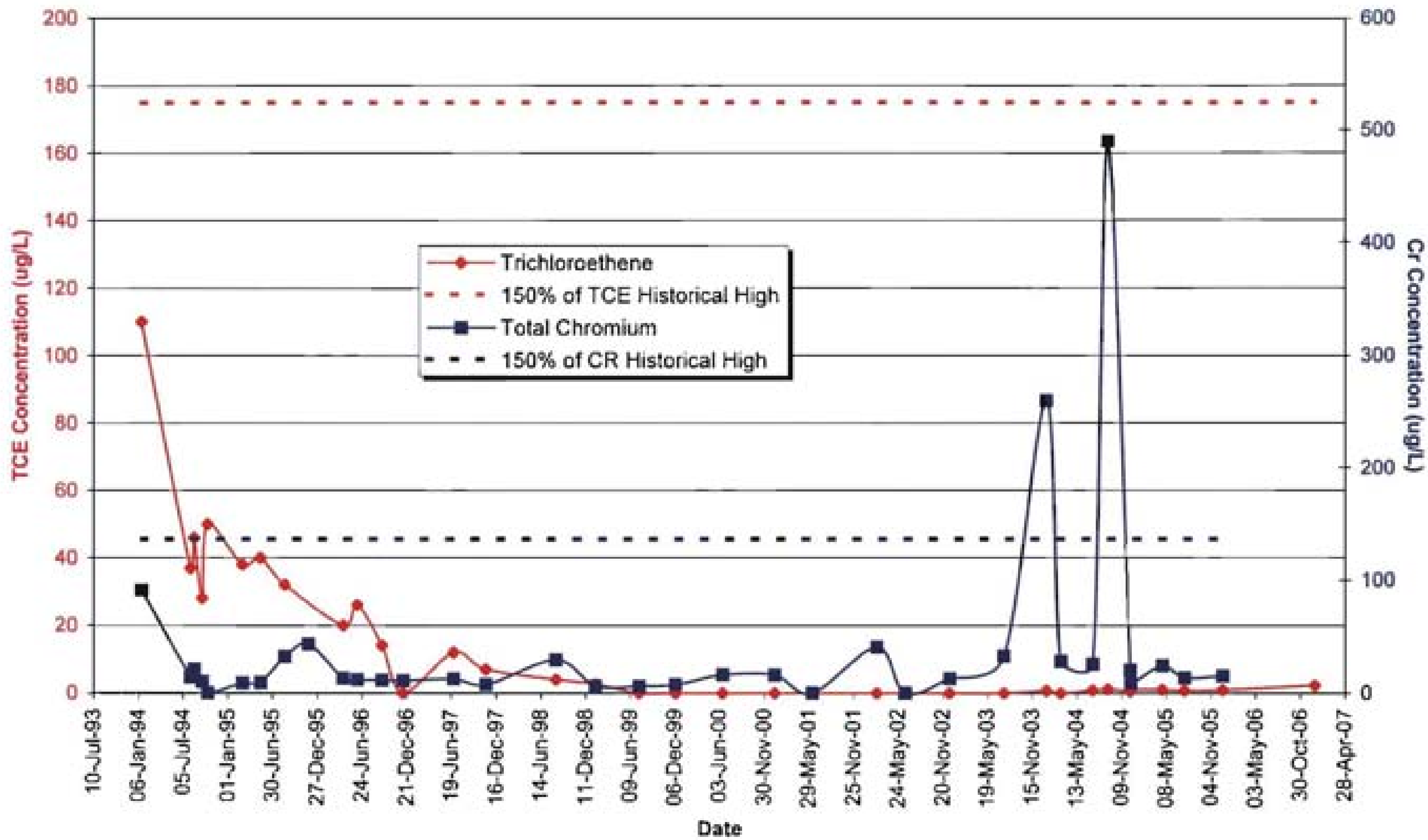


Figure 6.25
TCE and Cr Concentrations, Well M-1CR (Lower LSZ)
Tinker AFB, Oklahoma

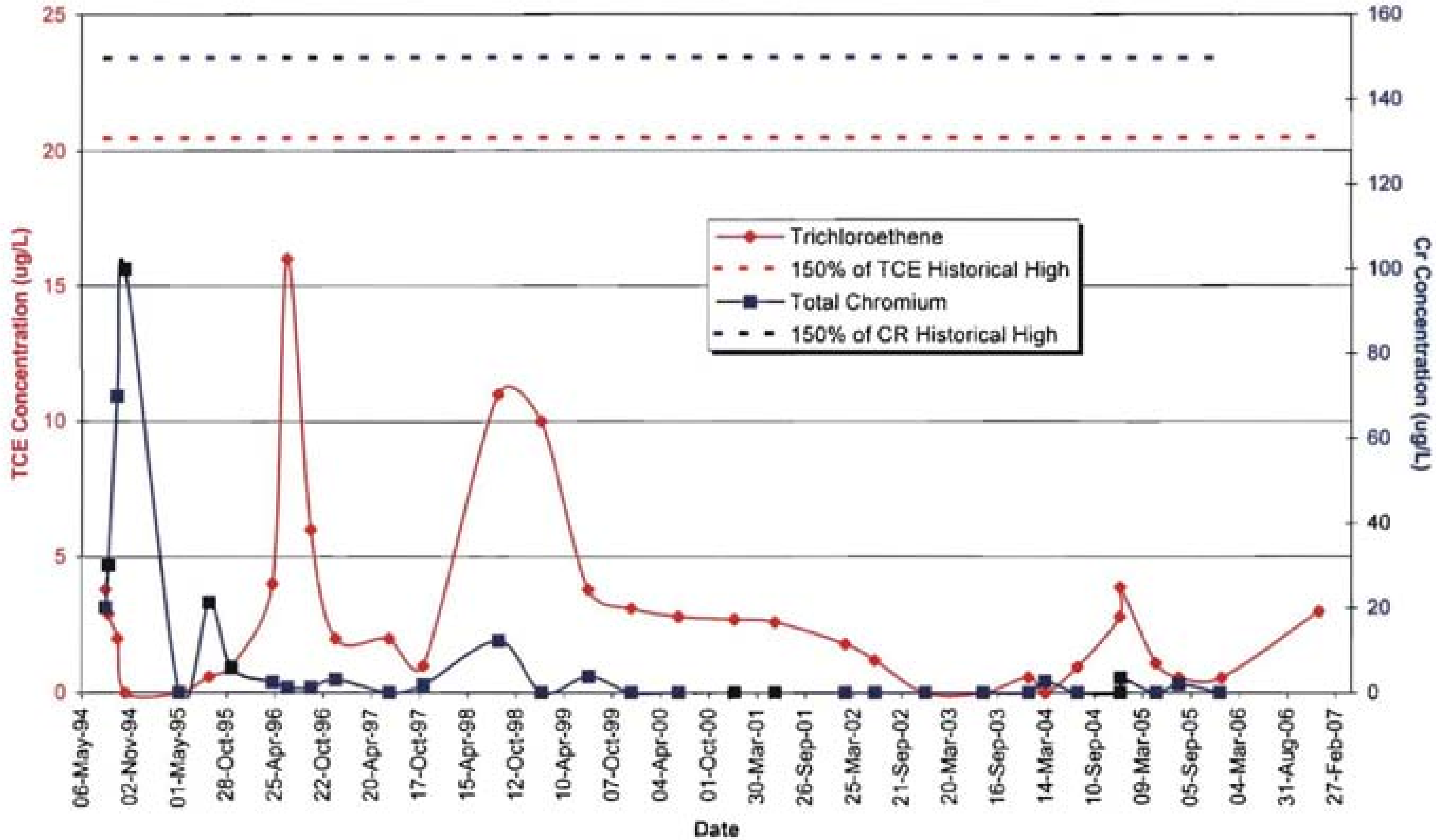


Figure 6.26
TCE and Cr Concentrations, Well M-4CR (Lower LSZ)
Tinker AFB, Oklahoma

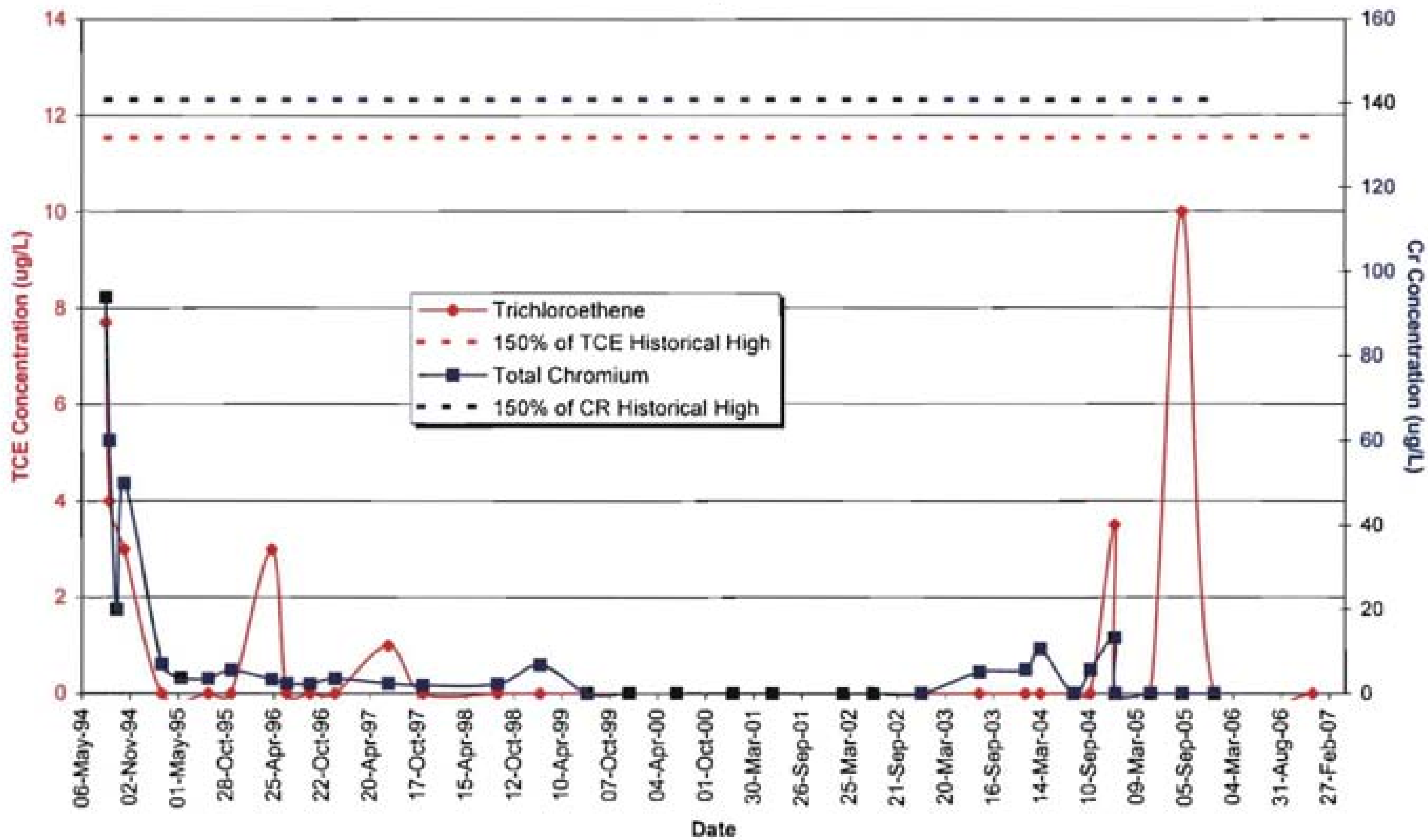


Figure 6.27
TCE and Cr Concentrations, Well 1-6CR (Lower LSZ)
Tinker AFB, Oklahoma

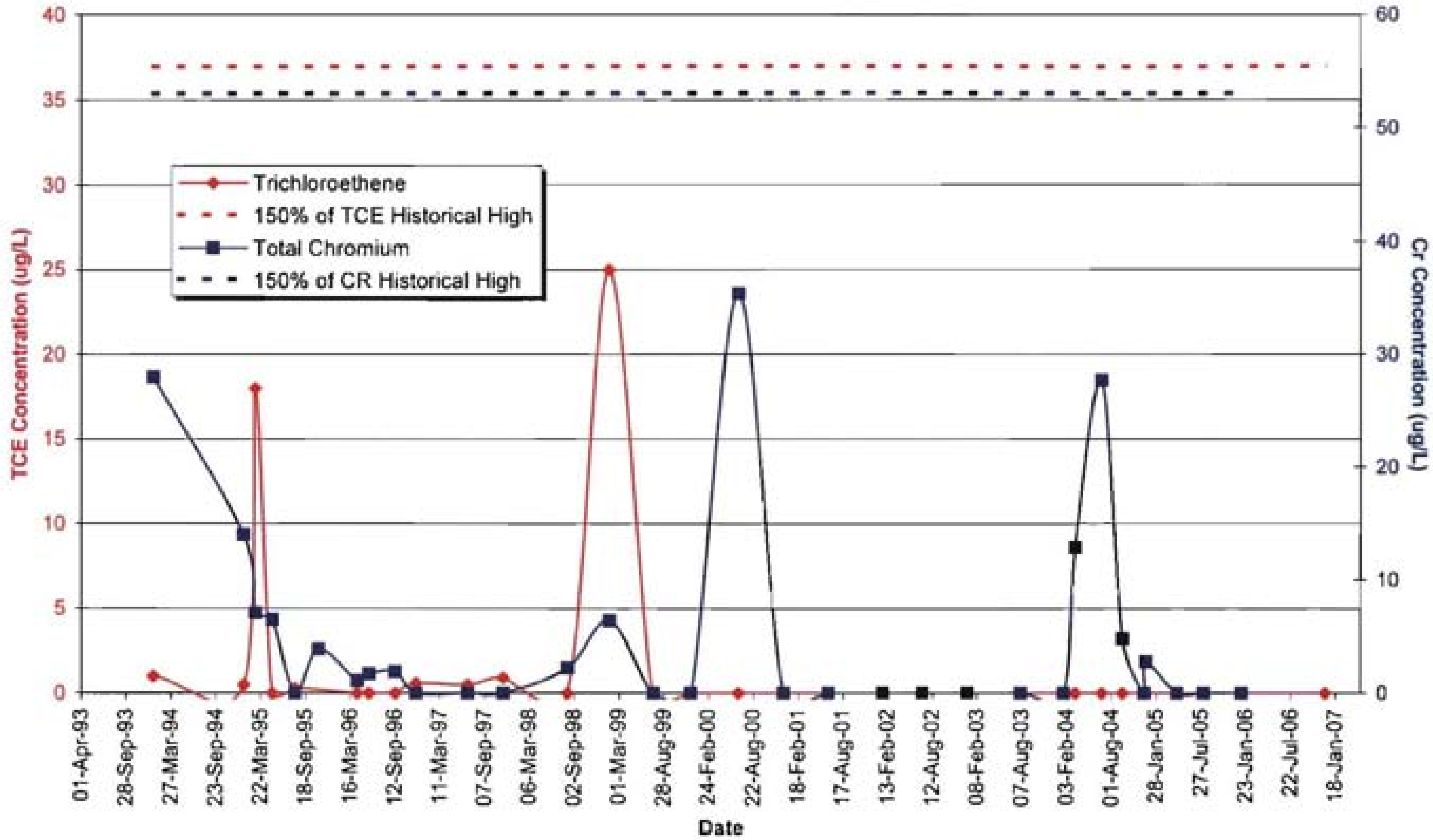


Figure 6.28
TCE and Cr Concentrations, Well 1-12CR (Lower LSZ)
Tinker AFB, Oklahoma

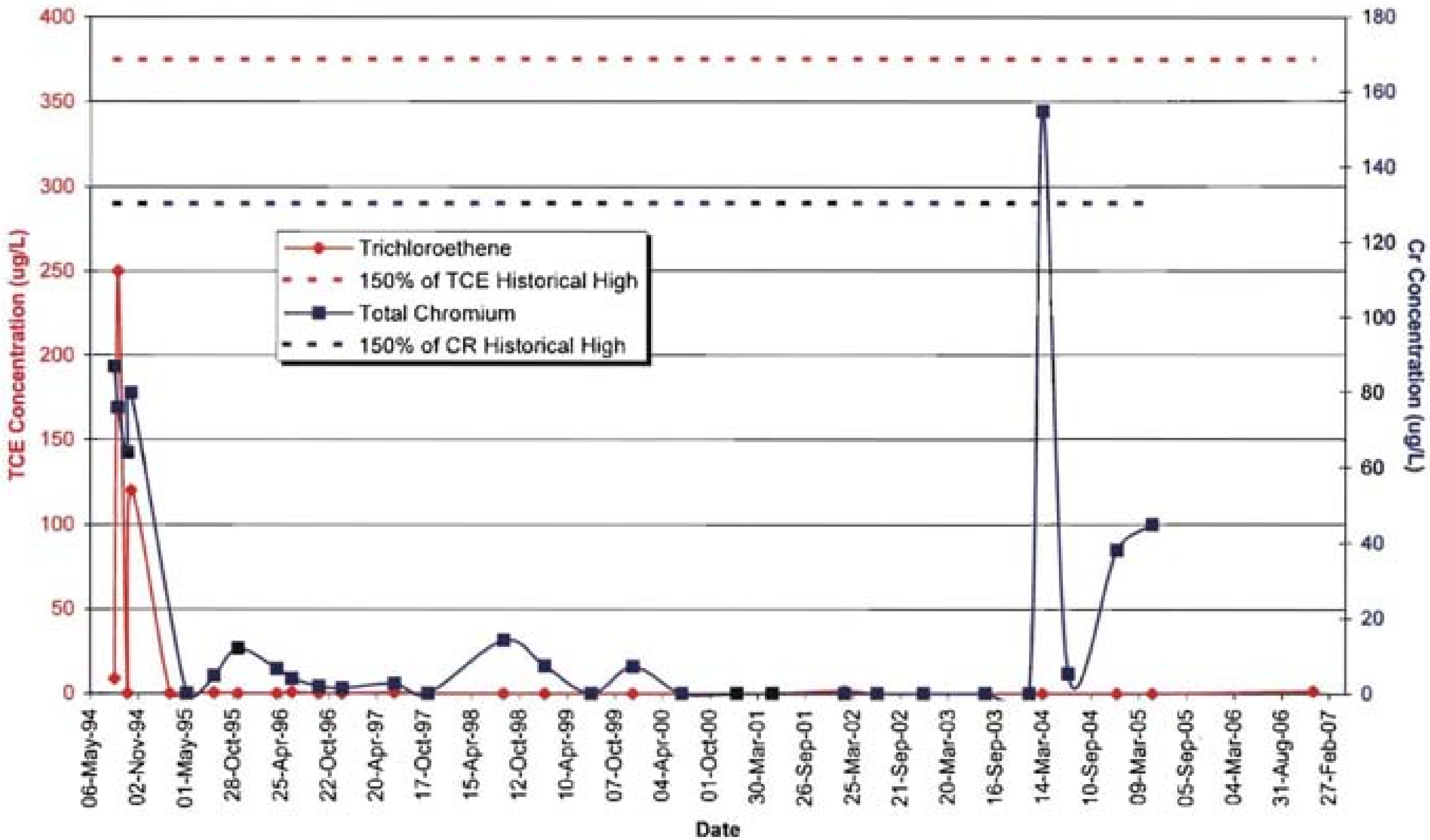
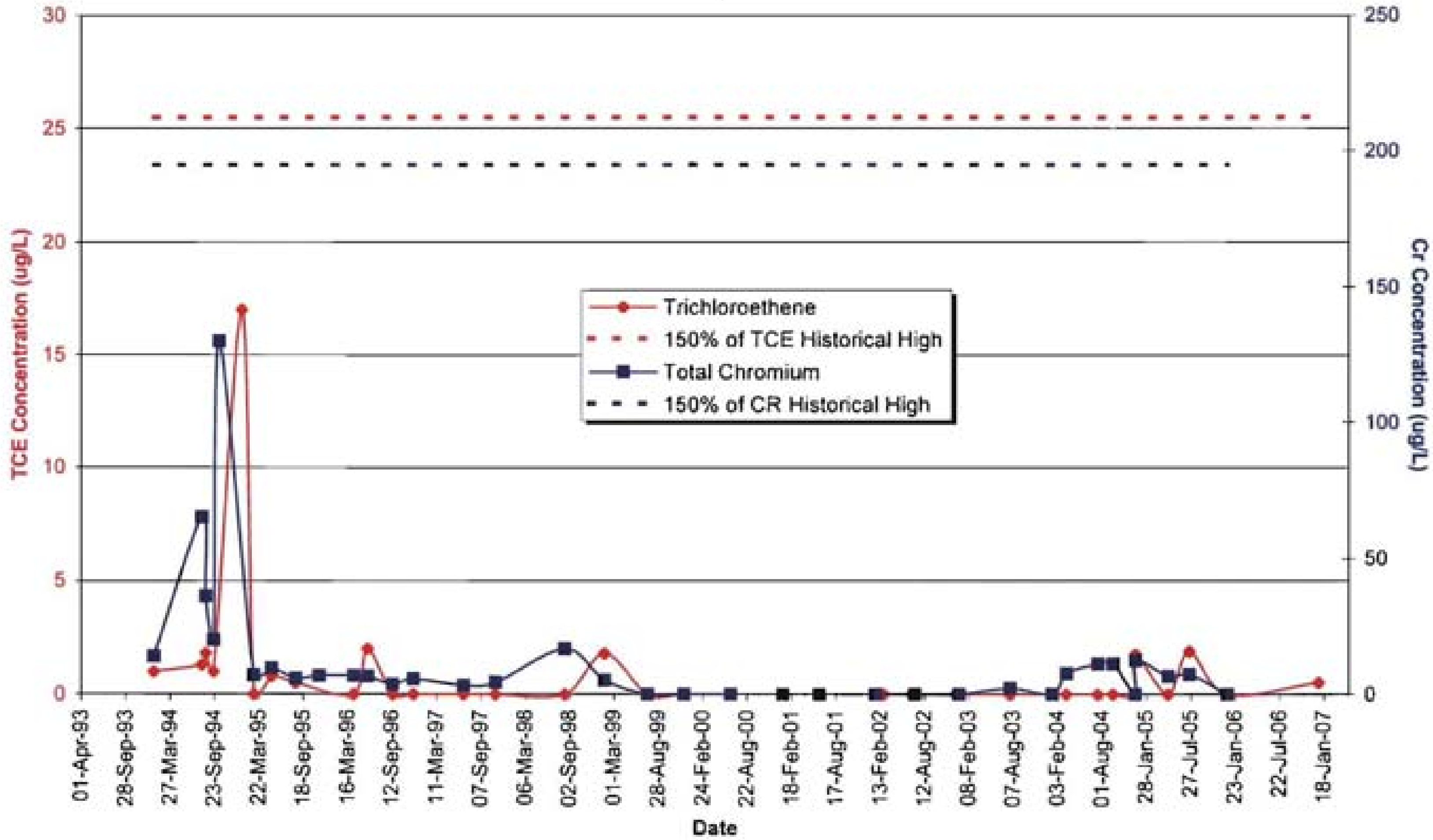


Figure 6.29
TCE and Cr Concentrations, Well 1-45CR (Lower LSZ)
Tinker AFB, Oklahoma



740307 TKTA-GMAP.DWG

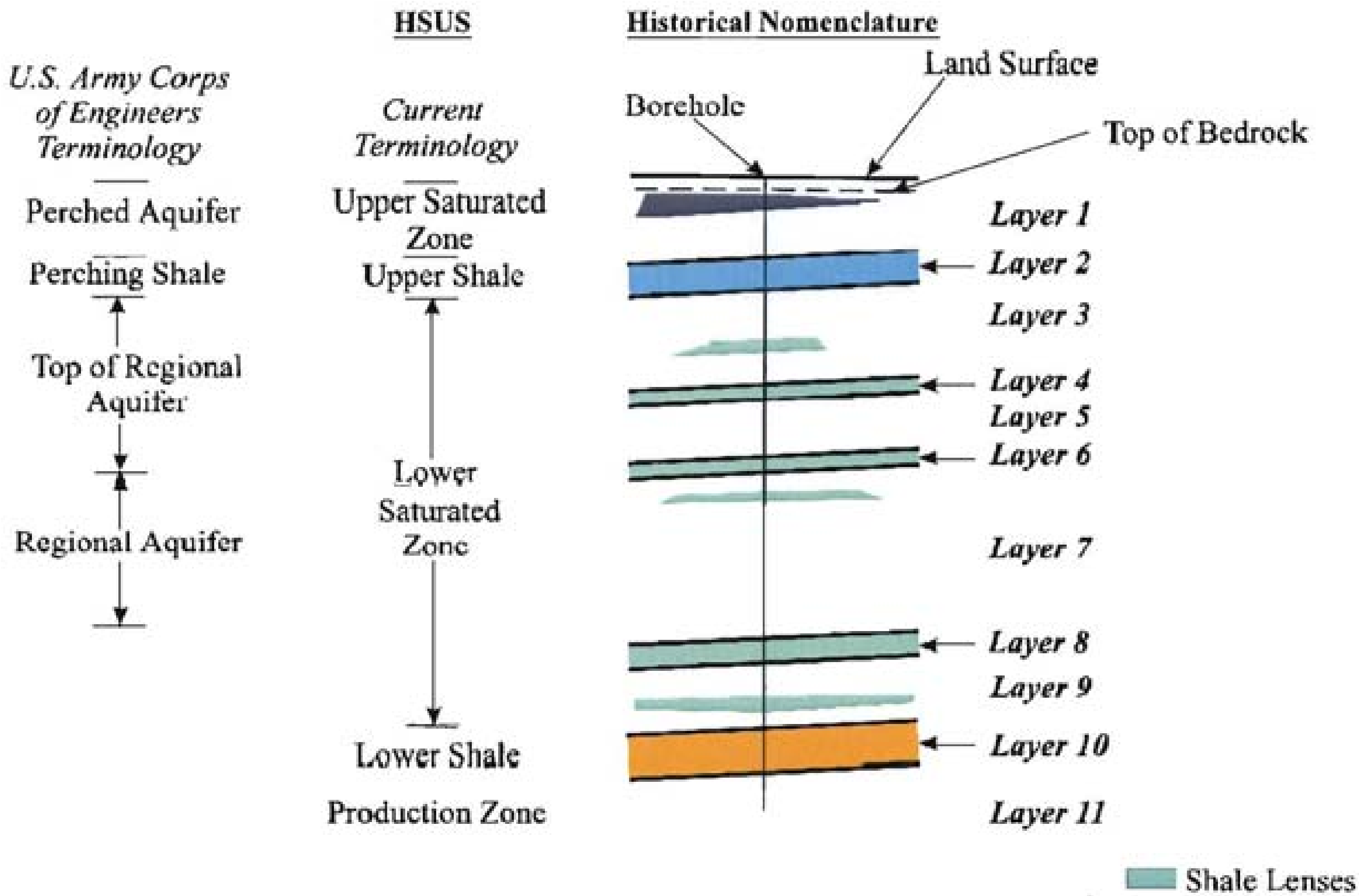


Figure 6.30

Aquifer Zone Terminology and Northeast Quadrant Model Years

Tinker AFB, Oklahoma

745591 TKTA-1WL1103.DWG

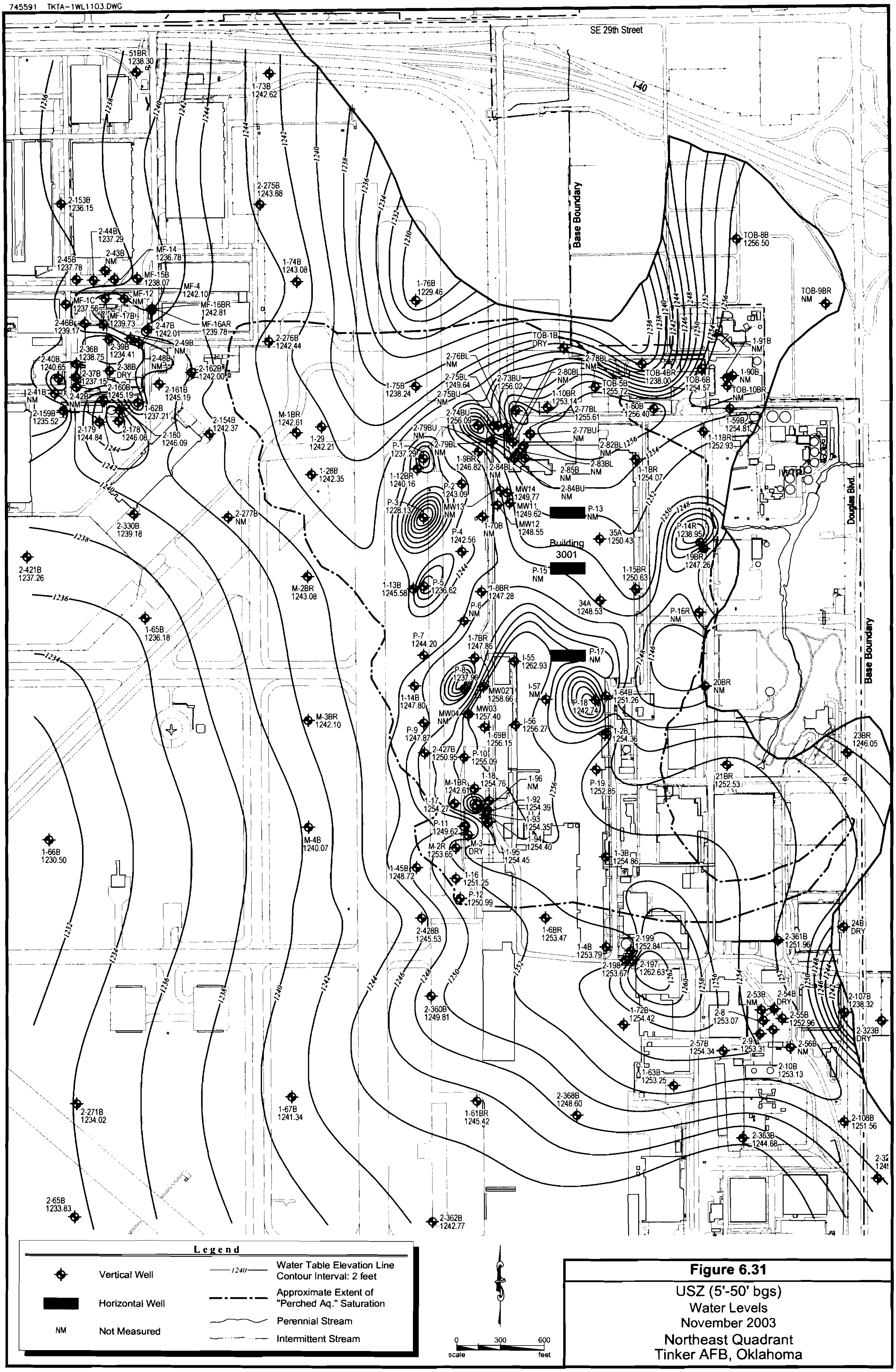


Figure 6.31

USZ (5'-50' bgs)
Water Levels
November 2003
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-3WL1103.DWG

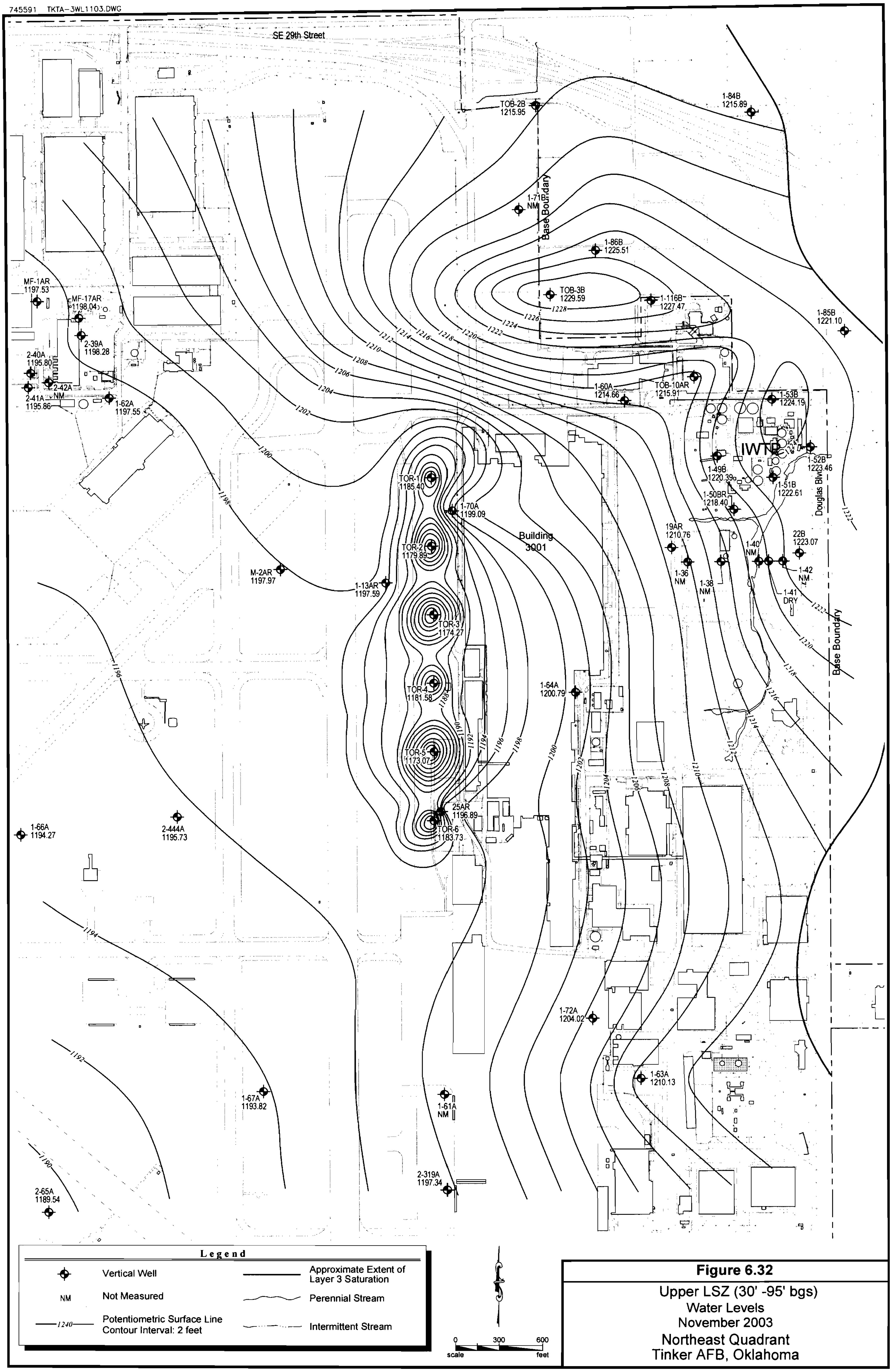
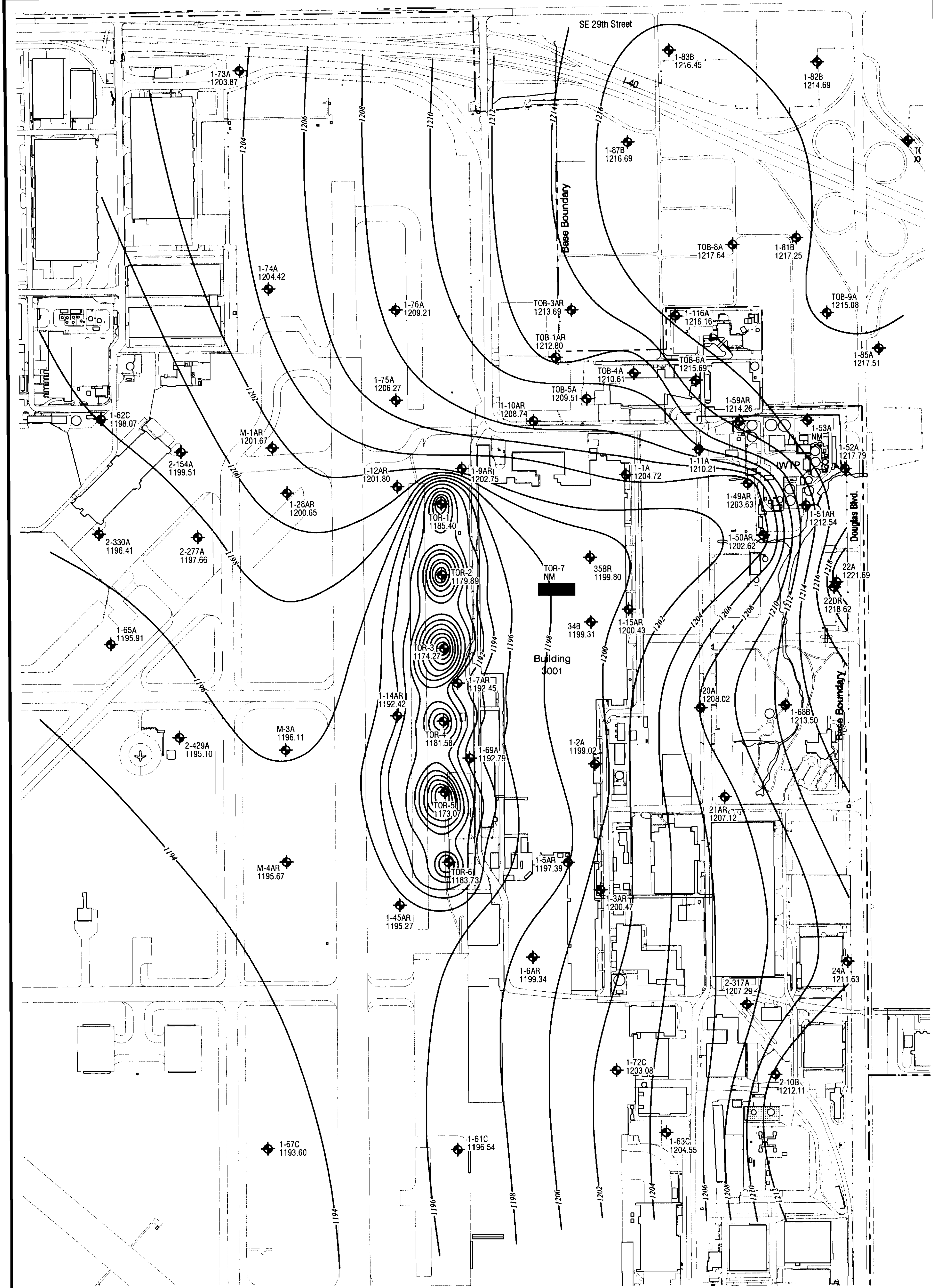


Figure 6.32

Upper LSZ (30' -95' bgs)
Water Levels
November 2003
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-5WL1103.DWG



Legend

⊕	Vertical Well	—1240—	Potentiometric Surface Line Contour Interval: 2 feet
▬	Horizontal Well	~~~	Perennial Stream
NM	Not Measured	—·—·—	Intermittent Stream

scale 0 300 600 feet

Figure 6.33

Middle LSZ (40' -120' bgs)
Water Levels
November 2003
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-7WL1103.DWG

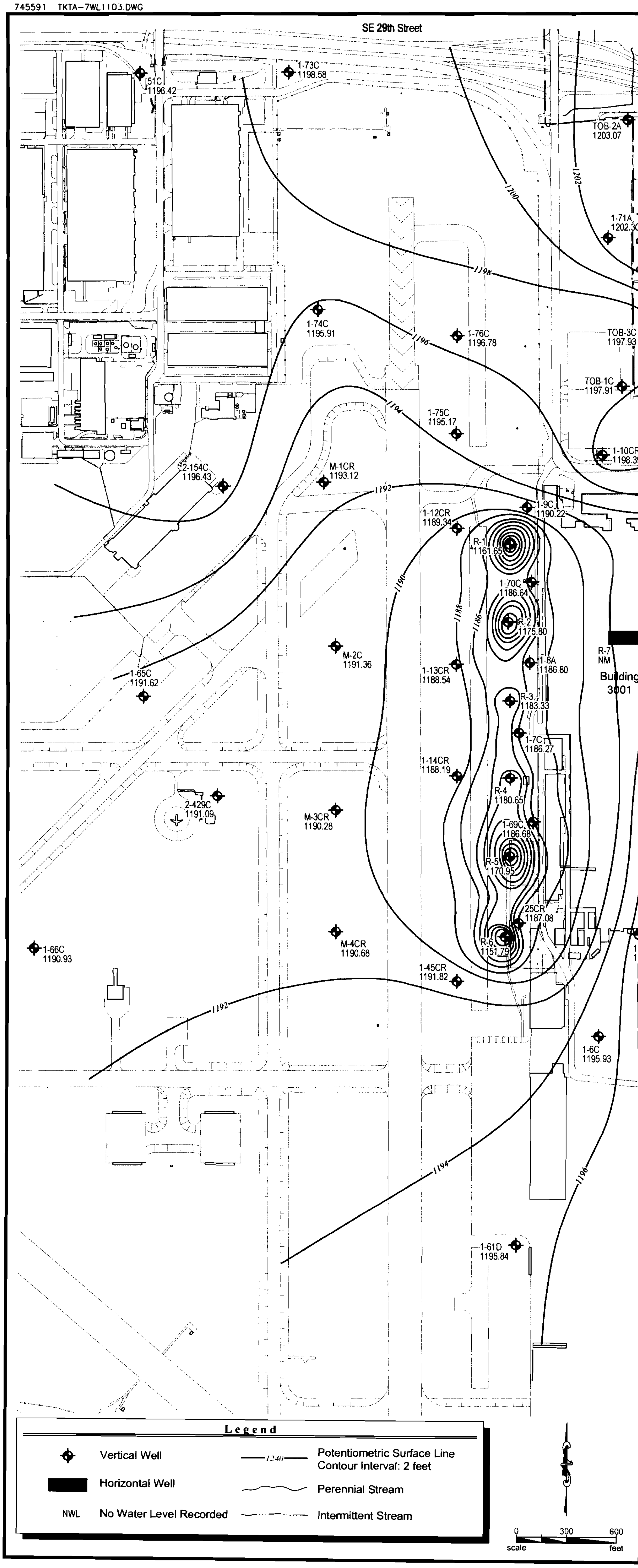


Figure 6.34

Lower LSZ (70-175 ft bgs)
Water Levels
November 2003
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-1WL1106.DWG

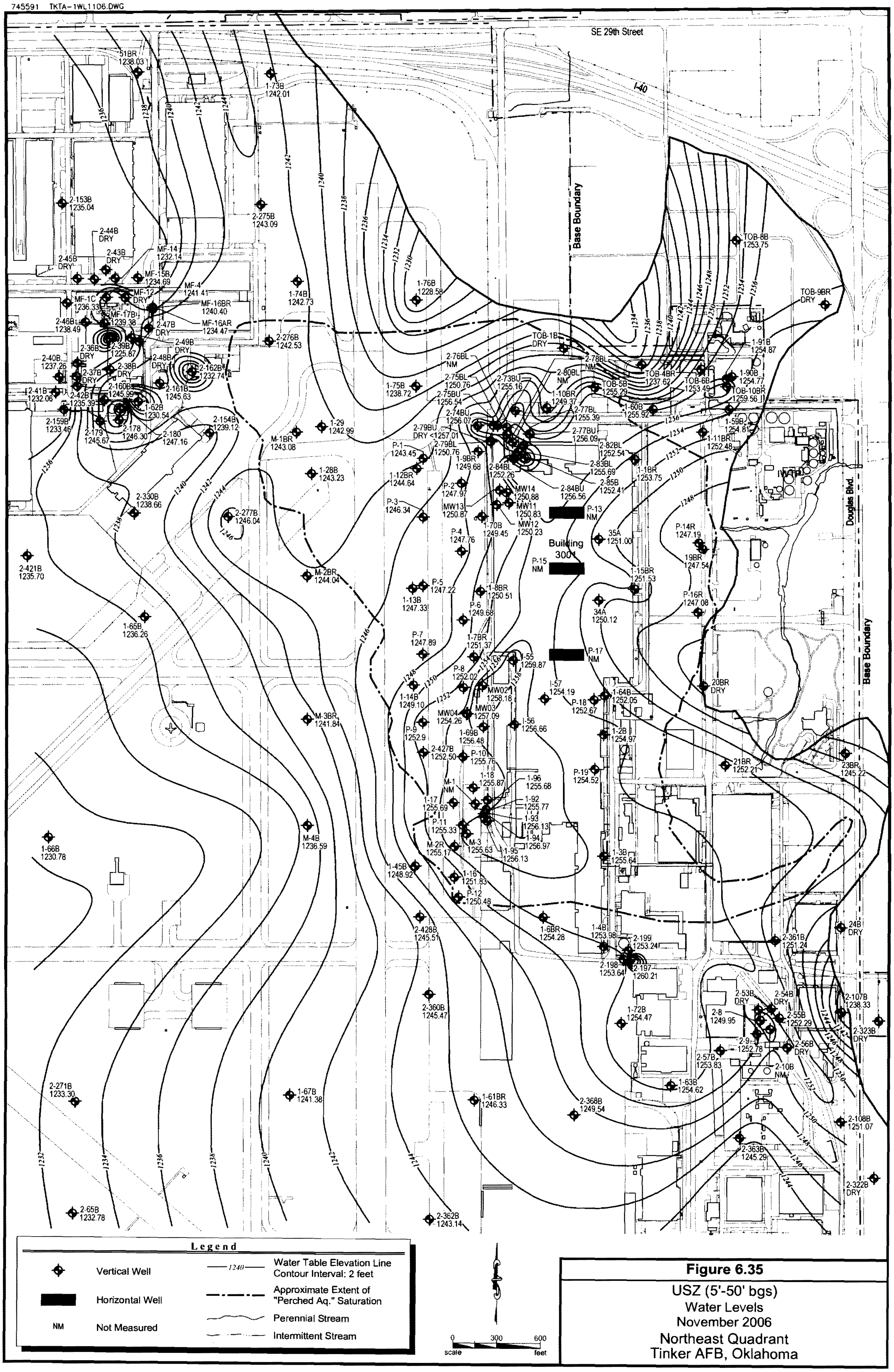
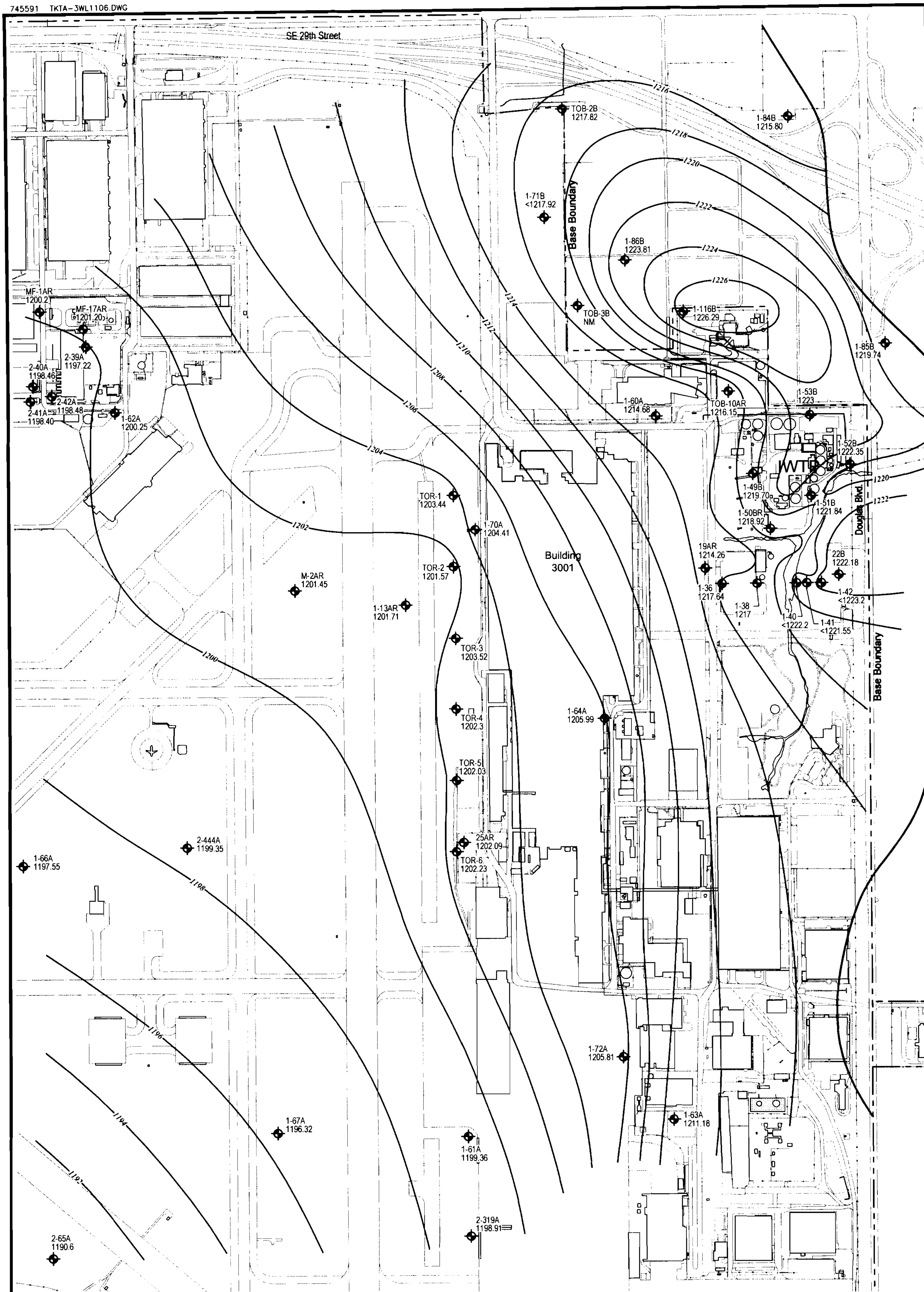


Figure 6.35

USZ (5'-50' bgs)
Water Levels
November 2006
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-3WL1106.DWG



Legend

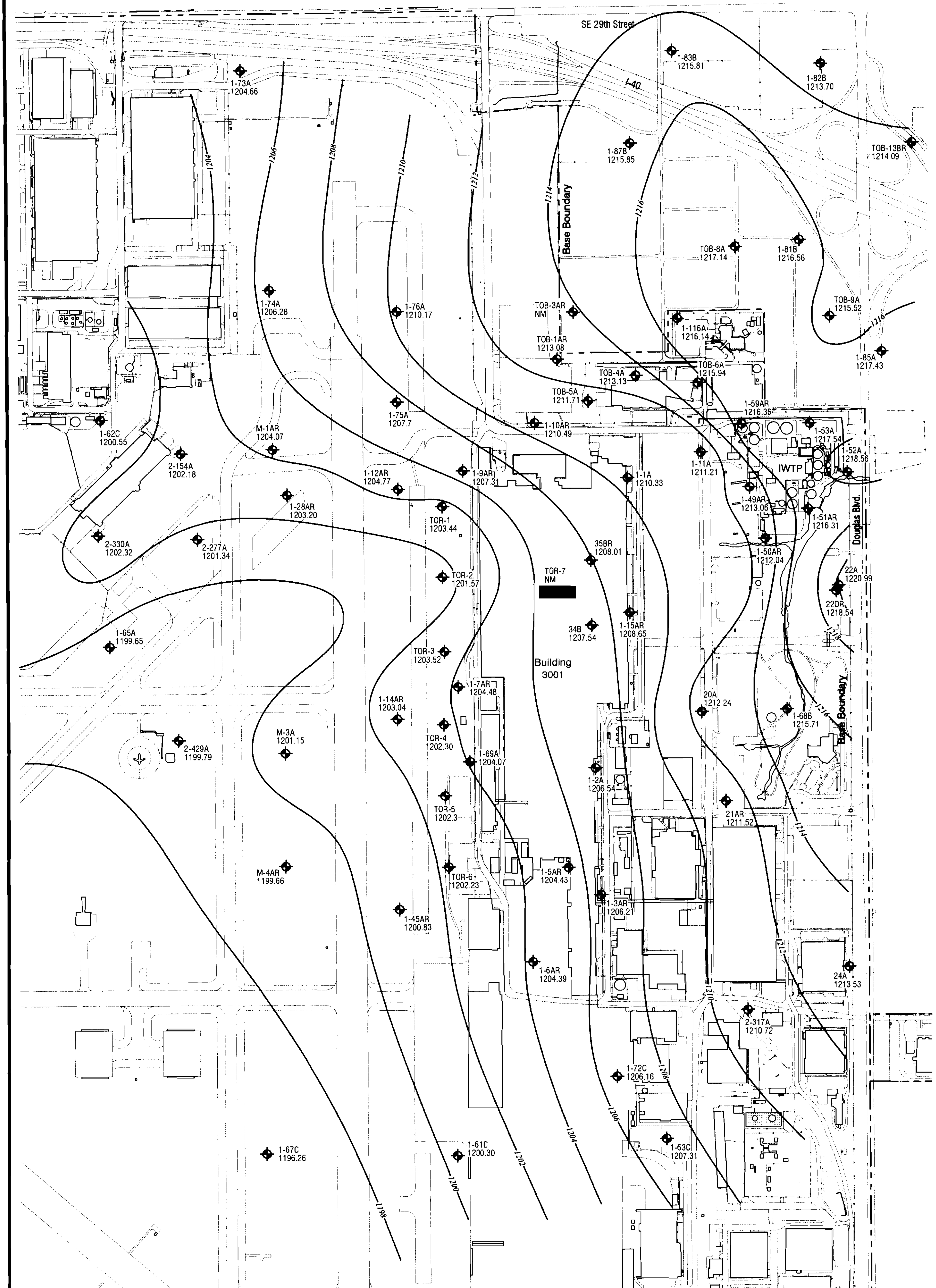
Vertical Well	Approximate Extent of Layer 3 Saturation
NM Not Measured	Perennial Stream
1240 Potentiometric Surface Line Contour Interval: 2 feet	Intermittent Stream

0 300 600 scale feet

Figure 6.36

Upper LSZ (30' - 95' bgs)
Water Levels
November 2006
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-5WL1106.DWG



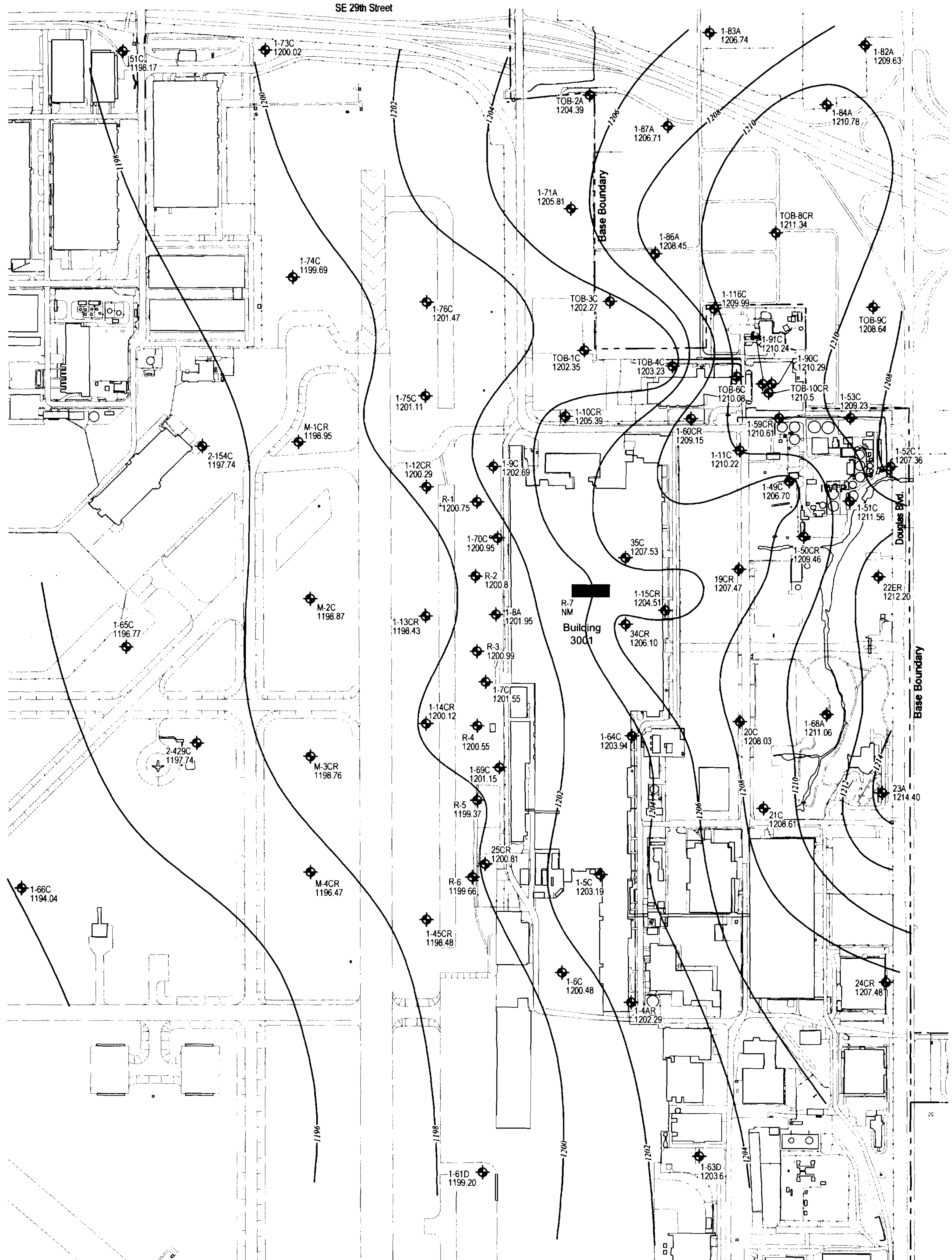
Legend

⊕	Vertical Well	—1240—	Potentiometric Surface Line Contour Interval: 2 feet
▬	Horizontal Well	~~~	Perennial Stream
NM	Not Measured	—·—·—	Intermittent Stream

Figure 6.37

Middle LSZ (40' - 120' bgs)
Water Levels
November 2006
Northeast Quadrant
Tinker AFB, Oklahoma

745591 TKTA-7WL1106.DWG



Legend

⊕	Vertical Well	—1240—	Potentiometric Surface Line Contour Interval: 2 feet
■	Horizontal Well	~~~	Perennial Stream
NWL	No Water Level Recorded	—··—··	Intermittent Stream

0 300 600
scale feet

Figure 6.38

Lower LSZ (70-175 ft bgs)
Water Levels
November 2006
Northeast Quadrant
Tinker AFB, Oklahoma

SECTION 7
TECHNICAL ASSESSMENT

The 1990 ROD provided the original framework for achieving protectiveness of human health and the environment for OU-1. While the 1990 ROD remains the governing document for actions associated with the NTA and Pit Q-51, the 2003 ESD is the most recent decision document in the Administrative Record, and is the current governing document for obtaining protectiveness of human health and the environment at the Building 3001 site. The principle opinion expressed in the ESD is that pump-and-treat technology may not attain site remediation, and a temporary shutdown of the treatment system is needed to optimize the remedial plans for the site. For this Five-Year Review, the current status of the remedy in place resulted from implementing the proposals in the ESD. This technical assessment describes the condition of the remedies in place and factors influencing the protectiveness of each remedy. As such, the technical assessment examines the following three key questions:

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

7.1 BUILDING 3001 SITE

The ESD affected the Building 3001 site more than any other component of OU-1. Monitoring data, changes or updates in standards and assumptions, and any other relevant information were considered in this technical evaluation.

7.1.1 Question A (Building 3001)

Is the remedy functioning as intended by the decision document?

Yes. USEPA provided consent to provisions of the ESD, and monitoring is conducted to ensure compliance.

7.1.1.1 Remedial Action Performance

While in operation through April 2004, the remedial action was operating and functioning as designed. Subsequent to the ESD proposal, rebound testing has been underway to evaluate the system and optimize remedial plans, including gathering data necessary for a TI waiver.

The actions proposed in the ESD were implemented on March 29, 2004. The GWTP and extraction well field were shut down, and the aquifer was allowed to begin recovery. LTM of the sentry wells continues, and based on results of semi-annual groundwater sampling, the groundwater plume is not migrating at an unacceptable rate. Therefore, the GWTP system has remained shutdown while the optimization study continues.

Certain evaluations that were proposed in the 2003 ESD and associated work plans included: center of mass calculations to ascertain plume stabilization, tracer tests, intrinsic bioremediation parameters without the effects of an operating pump-and-treat system, possible source locations, and whether or not the pump-and-treat system had a negative effect on natural attenuation. Not all of these assessments have been completed. Evaluations of vertical migration have not provided conclusive results at this time either. Therefore, the one-year shutdown outlined in the ESD has been extended three times and is still in effect. Data is still being collected for evaluation of the system and optimization of the remedial plans.

While the ESD is in effect, semi-annual sampling is performed to monitor plume migration. If sampling indicates that the plume is migrating at an unacceptable rate, the contingency is to resume operation of the pump-and-treat system. Definition of "unacceptable rate" of contaminant migration is addressed in the response to USEPA comments to the ESD, and further elaborated in the work plan (Parsons, 2004b). Therefore, in order for the remedy to be functioning as intended in the decision documents (*i.e.,* that the shut-down evaluation continue), the remedy is protective as long as the sentry wells do not exceed the unacceptable migration criterion defined in the ESD, ESD response to comments, and work plan (Parsons, 2004b).

The "unacceptable rate" of migration criterion has not been triggered in any of the sentry wells. A few of the wells have short-term spikes in concentration, but none of these has been sustained at 50% greater than the maximum historical high concentration over a period of at least four consecutive sample rounds. One of the most recent spikes (November 2006) in well 1-45B exceeded the TCE trigger concentration for that well in the most recent sampling round only. However, to trigger restarting the pumping system, the increased TCE concentration must be sustained for three more sampling rounds. Therefore, at this time, the remedy is functioning as intended in the decision document.

Though the ROD-based contaminant cleanup levels have not been reached, containment (no horizontal migration) of the plume appears to be effective based on current monitoring data. It was noted that the required semi-annual monitoring frequency was not consistently met in 2006; however, this data gap does not create enough uncertainty to conclude that unacceptable migration may have occurred. Semi-annual monitoring of all sentry wells should be accomplished and evaluated to ensure protectiveness.

7.1.1.2 Systems O&M

The groundwater extraction and treatment systems have been maintained, and the system can be made operational if necessary. Current operating procedures (*i.e.* monitoring) as defined in the rebound test work plan will maintain the effectiveness of the response action with regard to protecting human health and the environment.

7.1.1.3 Opportunities for Optimization

The GWTP treatment process for chromium should be considered for elimination. Prior to shutdown of the active pump-and-treat system, the most recent influent chromium concentrations were at or below drinking water standards. Therefore, violations of permitted discharge limits are not anticipated if the groundwater pump-and-treat system were to once again operate as it did prior to the current shutdown. However, if pump-and-treat were resumed in a different pumping scenario (such as focusing on the USZ only), chromium treatment could be necessary. Once the rebound test is complete, the need for and goals of pump-and-treat should be re-evaluated, to include possible elimination of chromium treatment. Focused removal of contaminant sources could reduce costs of groundwater extraction and treatment for organics, specifically TCE, as well. This could be achieved by limiting the number of wells that are pumped. Monitoring well sampling should be re-evaluated for efficacy.

7.1.1.4 Early Indicators of Potential Issues

Because the treatment system and well field have been shut down since 2004, there are no equipment breakdowns that indicate any adverse impacts to protectiveness. Risk to potential receptors is currently evaluated by means of groundwater monitoring and sampling.

One of the most recent concentration spikes is in sentry well 1-45B, which exceeded the TCE trigger concentration for that well in the most recent (November 2006) sampling round. However, to trigger restarting the pumping system, the increased TCE concentration must be sustained for three more sampling rounds.

Reviewers note that semi-annual monitoring data were not available for all of the sentry wells. Semi-annual monitoring generally appears to be available through 2005, but few sample results are available for 2006. Although there appear to be some data gaps for 2006, the gaps do not create enough uncertainty to conclude that there could be an unacceptable rate of migration. However, if semi-annual monitoring is not resumed, or "unacceptable rate of migration" is not redefined, this data gap could lead to uncertainty about protectiveness in the future.

7.1.1.5 Implementation of Institutional Controls and Other Measures

Institutional controls are non-engineered means, such as administrative and/or legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of a remedy. This is accomplished by limiting land or resource use and/or by providing information to modify or guide human behavior at the site. Institutional controls may include zoning restrictions, building or excavation permits, well drilling prohibitions, and easements and covenants. Access controls may be implemented to regulate access to the site and any contaminated media. The technologies for access controls consider the potential implementation of active and passive controls. Active controls can consist of physical barriers such as fences, gates, and security forces, while passive controls include administrative controls such as ownership, access permits, and deed restrictions.

Institutional/Engineering Controls Currently in Use at Tinker AFB

Institutional controls are used when contamination is first discovered, when remedies are ongoing and when residual contamination remains on site at a level that does not allow unrestricted use and unlimited exposure after cleanup. TAFB is an active military base; its property boundary is fenced and security allows access only to authorized persons. TAFB has not been identified as a base for closure. Accordingly, continued use as an active Air Force Base and associated land-use restrictions are not anticipated to change during the foreseeable future.

All activities performed at Tinker AFB have to follow the procedures outlined in the Base Plan. A permitting process is in place that requires all locations be reviewed with respect to buried structures and utilities, as well as potential environmental hazards prior to initiating any borings or excavations on TAFB. Prior to issuing permits, all locations are reviewed with respect to the results from environmental site investigations to identify areas where known or potentially contaminated media are present. Any work permitted within these areas includes controls to protect workers from exposure and includes measures to ensure the work does not result in releases or exposures that would adversely impact human health or the environment. Some of these procedures are outlined below.

- TAFB has an established construction review process, which includes a representative from Tinker Environmental Management (EM) to attend all Facility Board Working Panel meetings, EM reviews all digging permits, EM approval of form AF 332s ("Base Civil Engineer Work Request"), and EM approves any "Request for Environmental Impact Analysis" (Form AF 813). These steps ensure that no digging will occur at known contaminated sites unless adequate health and safety precautions are taken by the contractor. In addition, project officials at the Base routinely access the Tinker AFB Geographic Information System prior to approval of projects. This system shows which areas of the Base are contaminated and, therefore shows areas where activities such as excavation, construction, etc. should be prohibited.
- Pumping of shallow groundwater is not allowed on base, commercial or otherwise, except in a site remedial/clean up scenario, or when necessary for construction purposes.
- Partnering with Regulatory Agencies will assume the following format.
  - The Air Force will implement, monitor, maintain and report on the implementation of the Land Use Controls (LUCs).
  - Tinker AFB will supply annual reports containing information such as specific actions taken to implement and enforce LUCs, including annotation of the Base General Plan.
  - Tinker AFB will obtain regulator concurrence for significant changes to use and activity restrictions and LUCs.
  - Tinker AFB will make prompt notification to regulators in the event that a LUC is breached along with corrective measures planned or taken.

Tinker will make prior notification to regulators prior to transfer of property.

7.1.2 Question B (Building 3001)

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

Yes. In accordance with the ESD, optimization of the remedy re-considers all exposure assumptions, toxicity data, cleanup levels, and RAOs.

7.1.2.1 Changes in Standards and TBCs

The cleanup standards, as defined in the ROD, for TCE and chromium remain protective of human health and the environment. In fact, as shown in Table 7.1, chromium cleanup standards were changed in 1991 (USEPA, 1991), and are actually less restrictive than stated in the ROD. Therefore, although the toxicity data for chromium has changed since the ROD, the MCL for chromium as stated in the ROD remains unchanged at 0.05 mg/L.

Table 7.1 Chromium Cleanup Standard

Contaminant	Media	Cleanup Level	Standard		Citation/Year
Chromium	Groundwater	0.05 mg/L	Previous	0.05 mg/L	(USACE, 1990b)
			New	0.10 mg/L	(USEPA, 1991)

7.1.2.2 Changes in Exposure Pathways

Land use on or near the site has not changed and is not expected to change in the foreseeable future. No newly identified COCs or confirmed contaminant sources exist; however, peripheral contaminants are being used to help identify potential source areas.

With regard to the exposure pathways identified in the ROD, no changes require further investigation or action. No toxic by-products of the remedy are in place. Physical site conditions have not changed in such a way that protectiveness of the selected remedy or current rebound testing would be adversely affected.

7.1.2.3 Changes in Risk Assessment Methods

The current ROD requirements are based on a conservative risk assessment and have been formalized for "non-restricted" land use and "non-restricted" exposure. Standardized risk assessment methodologies could bring the site into compliance with a "restricted" use and exposure scenario and provide a less conservative but equally protective remedy. Although the toxicity data for chromium and TCE has changed since the ROD, the MCL for chromium as stated in the ROD remains unchanged at 0.05 mg/L and TCE at 0.005 mg/L.

7.1.2.4 Expected Progress Toward Meeting RAOs

The selected remedy, pump-and-treat, was not progressing as expected; hence, a rebound test was conducted in an attempt to help identify contaminant source areas and optimize the existing system. As of the end of 2006, the data has not provided an explainable pattern of contaminant rebound (OC-ALC/EM, 2007). As stated in Section 11 of the ROD, it was estimated that the pump and treat system would remove 45% of the TCE and 49% of the chromium in the upper most aquifer within two years of start-up. After an initial reduction after start-up, concentration levels entering the GWTP from the well field have remained asymptotic since then. Due to changes over the course of this remedial effort, such as the addition of monitoring wells, dewatering of USZ, changes in sampling protocol and analytical laboratories, progress towards meeting RAOs is difficult to quantify.

7.1.3 Question C (Building 3001)

Has any other information come to light that could call into question the protectiveness of the remedy?

No.

7.2 NORTH TANK AREA (NTA)

The ESD has no direct impact on the remedy at the NTA. However, the remedy in place was evaluated based on the requirements of the ROD. Monitoring data, changes or updates in standards and assumptions, and any other relevant information were considered in this technical evaluation.

7.2.1 Question A (NTA)

Is the remedy functioning as intended by the decision document?

Yes. The treatment system at NTA is functioning as intended by the ROD.

7.2.1.1 Remedial Action Performance

In conformance with the ROD, a floating fuel product removal system is in place and is effectively removing fuel product floating above the groundwater table. Free product is disposed in accordance with the Hazardous Waste Management Plan, and other fluids are treated in accordance with discharge permits The product is disposed at a RCRA approved facility. The treatment system at the site also removes soil vapors, and dissolved phase groundwater contaminants beneath the NTA site.

7.2.1.2 Systems O&M

Operating procedures have maintained optimal effectiveness of this response action. There are no remedy problems or issues associated with this activity.

7.2.1.3 Opportunities for Optimization

Remedy enhancements (pneumatic fracturing, surfactant flushing, VEP, phased-pumping, etc.) have been implemented over the years to meet or exceed design requirements by removing free product, soil gas vapors, and contaminated groundwater. Since free product removal began in 1991, it is estimated that over 36,772 gallons of product have been recovered, which is over three times the 10,000 gallons of product estimated to be on-site in the ROD.

Nonetheless, free product recovery is reaching asymptotic levels, and further optimization is not likely achievable with this technology. The remaining free product at NTA is extremely viscous, resulting in considerable uncertainty in free product measurements and estimates of remaining free product and increased removal difficulty despite numerous remedy enhancements. Although the mobility of the product has almost certainly been substantially reduced, and the current system ensures that containment is effective, it is unlikely that complete free product removal can be accomplished through any technology short of excavation. Free product removal was prescribed for the NTA in order to prevent migration of product towards the B3001 well field. Since the current remedy for the B3001 GWTP and extraction well field is not active and will remain inactive until at least 2008; free product at the NTA site cannot impact the B3001 well field. This site has achieved case closure with the OCC regulatory agency.

7.2.1.4 Early Indicators of Potential Issues

There are no equipment breakdowns that indicate any adverse impacts to protectiveness.

7.2.1.5 Implementation of Institutional Controls and Other Measures

Institutional controls are non-engineered means, such as administrative and/or legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of a remedy. This is accomplished by limiting land or resource use and/or by providing information to modify or guide human behavior at the site. Institutional controls may include zoning restrictions, building or excavation permits, well drilling prohibitions, and easements and covenants. Access controls may be implemented to regulate access to the site and any contaminated media. The technologies for access controls consider the potential implementation of active and passive controls. Active controls can consist of physical barriers such as fences, gates, and security forces, while passive controls include administrative controls such as ownership, access permits, and deed restrictions.

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- The base has an established construction review process, which includes a representative from Tinker Environmental Management (EM) to attend all Facility Board Working Panel meetings, EM reviews all digging permits, EM approval of form AF 332s ("Base Civil Engineer Work Request"), and EM approves any "Request for Environmental Impact Analysis" (Form AF 813). These steps ensure that no digging will occur at known contaminated sites unless adequate health and safety precautions are taken by the contractor. In addition, project officials at the Base routinely access the Tinker AFB Geographic Information System prior to approval of projects. This system shows which areas of the Base are contaminated and, therefore shows areas where activities such as excavation, construction, etc. should be prohibited.
- Pumping of shallow groundwater is not allowed on base, commercial or otherwise, except in a site remedial/clean up scenario, or when necessary for construction purposes.
- Partnering with Regulatory Agencies will assume the following format.
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  - Tinker AFB will supply annual reports containing information such as specific actions taken to implement and enforce LUCs, including annotation of the Base General Plan.
  - Tinker AFB will obtain regulator concurrence for significant changes to use and activity restrictions and LUCs.
  - Tinker AFB will make prompt notification to regulators in the event that a LUC is breached along with corrective measures planned or taken.

Tinker will make prior notification to regulators prior to transfer of property.

7.2.2 Question B (NTA)

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

Based on the remedy selected in the ROD, yes.

7.2.2.1 Changes in Standards and TBCs

The cleanup standards, as defined in the ROD, for free product remain protective of human health and the environment.

7.2.2.2 Changes in Exposure Pathways

Land use on this site or near the site has not changed and is not expected to change in the foreseeable future. No newly identified contaminants of concern or confirmed contaminant sources exist.

With regard to the exposure pathways identified in the ROD, a Risk Assessment conducted in 1996 indicated that the vapor pathway was not a threat to human health due to the depth and confinement of the free product layer (Parsons 1996).

No toxic by-products of the remedy are in place. Physical site conditions have not changed such that protectiveness of the selected remedy would be adversely affected.

7.2.2.3 Changes in Risk Assessment Methods

Standardized risk assessment methodologies (Parsons, 1996) have already brought the NTA site into compliance with a "restricted" use scenario and provided a less conservative but equally protective remedy.

7.2.2.4 Expected Progress Toward Meeting RAOs

The selected remedy, free product removal with vapor recovery, has progressed to the limits of the technology's capability. It is unlikely that the current technology will be able to completely remove all free product under the site.

7.2.3 Question C (NTA)

Has other information has come to light that could call into question the protectiveness of the selected remedy?

No.

7.3 PIT Q-51

The remedy for Pit Q-51 meets all of the requirements for questions A, B, and C. The remedy is functioning properly. The remedy continues to meet all RAOs, and there are no issues that would indicate that the remedy is potentially not protective.

SECTION 8
ISSUES

The ESD and rebound work plan provide a framework to evaluate and decide how to best address the remaining contaminants in Building 3001 groundwater. The rebound test has been on-going since 2004, and the site has been adequately monitored during rebound testing to satisfy protectiveness requirements. Completion of the ESD process, to include adequate monitoring and data evaluation, should be accomplished expeditiously to optimize site remediation and ensure protectiveness in the future. Specifically, the issues identified in Table 8.1 need to be resolved so that future evaluations can provide relevant feedback for resolving the cleanup requirements for this site.

Table 8.1 Issues Affecting Protectiveness

Issue	Relevance	Affects Current Protectiveness	Affects Future Protectiveness
Shut-down/rebound test and TI waiver process	Need to complete process to optimize and complete remediation.	No	Yes
Sentry Well Monitoring	Compliance with TI/Rebound Work Plan	No	Yes
NTA Remedy	Determine mobility and the need to remove remaining product, and how to best achieve site objectives.	No	Yes

While the rebound test is in effect, sentry well monitoring needs to conform to the requirements of the rebound work plan, so that response actions meet the intent of the rebound evaluation. Though preliminary screening was performed, vapor intrusion is another exposure pathway that will likely demand more detailed investigation of Building 3001. Indoor air pathway screening is the most expedient way to address this issue.

VEP is reaching the limit of its optimal efficacy for free product removal at the NTA. The need to remove the remaining product at NTA, and how best to achieve RAOs, need to be evaluated.

SECTION 9
CONCLUSIONS, RECOMMENDATIONS, AND FOLLOW-UP ACTIONS

Specific goals identified in the ROD for OU-1 include preventing future human exposure by ingestion, inhalation, or dermal exposure to TCE concentrations exceeding 0.005 mg/L in the groundwater of the saturated zone(s). No change in this goal has been effected since the last Five-Year Review; however, an ESD was submitted to the USEPA in 2003, and proposed that pump-and-treat technology may not meet remediation goals. The ESD further petitioned the USEPA to allow a temporary shutdown of the B3001 GWTP and well field. The purpose of this shutdown was to allow the groundwater plume to stabilize, while Tinker AFB collected performance monitoring data for use in evaluating the OU-1 RA, as well as to monitor the plume stability. On February 27, 2007, USEPA approved the Air Force request to continue shutdown of the Building 3001 Extraction System for one year until March 2008 (USEPA, 2007b).

Although the goal of 0.005 mg/L TCE in the groundwater of the saturated zones has not been achieved, the currently operating remedy components along with the on-going optimization evaluation/monitoring indicate that remedies are protective with respect to the ROD and ESD. The operating remedy components are functioning as designed, and no deficiencies were identified that impact the protectiveness of the remedies. The optimization components generally comply with the requirements of the ESD that supports the temporary shutdown of the Building 3001 (OU-1) groundwater pump-and-treat system.

The rebound study has not yet been completed. Though other studies are underway using investigative techniques such as environmental forensics and various treatment alternatives, a concerted effort towards site characterization and feasible treatment methods needs to be performed prior to initiating the next phase of treatment optimization.

Performance monitoring needs to be reviewed and perhaps enhanced in order to improve the ability to interpret contaminant plumes. A complete round of groundwater sampling should be collected in 2008 to determine distribution of the COCs across the NPL site. Groundwater levels should be collected contemporaneously with sample collection. In addition the sentry wells used for performance monitoring need to be sampled in accordance to the ESD requirements and possibly re-evaluated for usability in the optimization evaluation. Sentry monitoring of the PZ during optimization needs to be evaluated for future protectiveness (i.e. for impacts of vertical plume migration).

The remedy at NTA has reached a stage of diminishing returns. Since there are ICs in place to prevent unprotected workers from digging in the NTA area, an alternative to VEP should be considered. In addition, free product thickness and distribution need to be more rigorously defined to obtain and verify existing measurements.

SECTION 10
PROTECTIVENESS STATEMENT(S)

Building 3001 Site

The remedy in place is currently protective of human health and the environment, during this period of system optimization. Long-tem protectiveness of the RA will be verified by continued groundwater monitoring and characterization to fully evaluate potential migration and impacts of the contaminant plume under Building 3001.

NTA Site

The remedy in place is protective of human health and the environment.

Pit Q-51

The remedy in place is protective of human health and the environment.

SECTION 11
NEXT REVIEW

The next Five-Year Review will be conducted in 2012, 20 years after implementation of the groundwater remedy at OU-1.

SECTION 12
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APPENDICES

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Tinker AFB (Soldier Cr./Bldg 3001)	**Date of inspection:** 16 April 2007
Location and Region: Oklahoma / Reg 6	**EPA ID:** OK 1571724391
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** Fair

Remedy Includes: (Check all that apply)

- G Landfill cover/containment
- ✓ Access controls
- G Institutional controls
- ✓ Groundwater pump and treatment (not active)
- G Surface water collection and treatment
- ✓ Other Rebound test / monitoring
- G Monitored natural attenuation
- G Groundwater containment
- G Vertical barrier walls

Attachments: G Inspection team roster attached G Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** ______ ______ 16 April 2007
   Name Title Date
   Interviewed ✓ at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached Manages P&T system - system currently not active - shut down

2. **O&M staff** ______ ______ ______
   Name Title Date
   Interviewed G at site G at office G by phone Phone no. ______
   Problems, suggestions; G Report attached ______

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

Agency ______________________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________

Agency ______________________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________

Agency ______________________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________

Agency ______________________
Contact ______________________ ______________ ________ ________
Name Title Date Phone no.
Problems; suggestions; G Report attached ______________________

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

John Drueller, Parsons

Mitch Goodspeed, Parsons

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	✓ O&M manual	✓ Readily available	✓ Up to date	G N/A
	G As-built drawings	G Readily available	G Up to date	G N/A
	G Maintenance logs	G Readily available	G Up to date	G N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	✓ Readily available	✓ Up to date	G N/A
	G Contingency plan/emergency response plan	G Readily available	G Up to date	G N/A
	Remarks			
3.	**O&M and OSHA Training Records**	✓ Readily available	✓ Up to date	G N/A
	Remarks			
4.	**Permits and Service Agreements**			
	G Air discharge permit	G Readily available	G Up to date	G N/A
	G Effluent discharge	G Readily available	G Up to date	G N/A
	G Waste disposal, POTW	G Readily available	G Up to date	G N/A
	G Other permits	G Readily available	G Up to date	G N/A
	Remarks: Treatment system currently shut down			
5.	**Gas Generation Records**	G Readily available	G Up to date	G N/A
	Remarks: Treatment system currently shut down			
6.	**Settlement Monument Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	✓ Readily available	✓ Up to date	G N/A
	Remarks			
8.	**Leachate Extraction Records**	G Readily available	G Up to date	✓ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	G Air	G Readily available	G Up to date	✓ N/A
	G Water (effluent)	G Readily available	G Up to date	✓ N/A
	Remarks: Treatment system shut down			
10.	**Daily Access/Security Logs**	G Readily available	G Up to date	✓ N/A
	Remarks: Site is inside Tinker AFB boundary / fence			

IV. O&M COSTS

1. O&M Organization

G State in-house — G Contractor for State
G PRP in-house — G Contractor for PRP
G Federal Facility in-house — ✓ Contractor for Federal Facility
G Other ____________________

2. O&M Cost Records

G Readily available — G Up to date
G Funding mechanism/agreement in place
Original O&M cost estimate ________ G Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached
			G Breakdown attached

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

Describe costs and reasons: ____________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable G N/A

A. Fencing

1. Fencing damaged — G Location shown on site map — ✓ Gates secured — G N/A
Remarks: Entire site is within Tinker AFB boundary/fence, and patrolled by base security. Treatment plant is secured.

B. Other Access Restrictions

1. Signs and other security measures — G Location shown on site map — G N/A
Remarks ____________________

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	G Yes	✓ No	G N/A
Site conditions imply ICs not being fully enforced	G Yes	✓ No	G N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______

Frequency ______

Responsible party/agency ______

Contact ______ Name ______ Title ______ Date ______ Phone no.

Reporting is up-to-date	G Yes	G No	G N/A
Reports are verified by the lead agency	G Yes	G No	G N/A
Specific requirements in deed or decision documents have been met	G Yes	G No	G N/A
Violations have been reported	G Yes	G No	G N/A

Other problems or suggestions: G Report attached

Site is within Tinker AFB boundary. All drinking water wells in vicinity of contamination have been shut down.

2. **Adequacy** ✓ ICs are adequate G ICs are inadequate G N/A

Remarks ______

D. General

1. **Vandalism/trespassing** G Location shown on site map ✓ No vandalism evident

Remarks Site inside Tinker AFB fence, patrolled by base security

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 G N/A

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

Remarks ______

B. Other Site Conditions

Remarks ____

____

____

____

____

____

VII. LANDFILL COVERS G Applicable G N/A

A. Landfill Surface

1. **Settlement (Low spots)** G Location shown on site map G Settlement not evident
Areal extent__________ Depth__________
Remarks____
____

2. **Cracks** G Location shown on site map G Cracking not evident
Lengths__________ Widths__________ Depths__________
Remarks____
____

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent__________ Depth__________
Remarks____
____

4. **Holes** G Location shown on site map G Holes not evident
Areal extent__________ Depth__________
Remarks____
____

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

6. **Alternative Cover (armored rock, concrete, etc.)** G N/A
Remarks____
____

7. **Bulges** G Location shown on site map G Bulges not evident
Areal extent__________ Height__________
Remarks____
____

8.	**Wet Areas/Water Damage**	G Wet areas/water damage not evident	
	G Wet areas	G Location shown on site map	Areal extent______
	G Ponding	G Location shown on site map	Areal extent______
	G Seeps	G Location shown on site map	Areal extent______
	G Soft subgrade	G Location shown on site map	Areal extent______
	Remarks______		
9.	**Slope Instability** G Slides	G Location shown on site map	G No evidence of slope instability
	Areal extent______		
	Remarks______		
B.	**Benches** G Applicable ✓ N/A		
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	G Location shown on site map	G N/A or okay
	Remarks______		
2.	**Bench Breached**	G Location shown on site map	G N/A or okay
	Remarks______		
3.	**Bench Overtopped**	G Location shown on site map	G N/A or okay
	Remarks______		
C.	**Letdown Channels** G Applicable ✓ N/A		
	(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
1.	**Settlement**	G Location shown on site map	G No evidence of settlement
	Areal extent______	Depth______	
	Remarks______		
2.	**Material Degradation**	G Location shown on site map	G No evidence of degradation
	Material type______	Areal extent______	
	Remarks______		
3.	**Erosion**	G Location shown on site map	G No evidence of erosion
	Areal extent______	Depth______	
	Remarks______		

4. **Undercutting** G Location shown on site map G No evidence of undercutting
Areal extent______________ Depth__________
Remarks____
____

5. **Obstructions** Type_______________________ G No obstructions
G Location shown on site map Areal extent____________
Size____________
Remarks____
____

6. **Excessive Vegetative Growth** Type_______________________
G No evidence of excessive growth
G Vegetation in channels does not obstruct flow
G Location shown on site map Areal extent____________
Remarks____
____

D. Cover Penetrations G Applicable G N/A

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

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

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

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

5. **Settlement Monuments** G Located G Routinely surveyed G N/A
Remarks____
____

E. Gas Collection and Treatment G Applicable ✓N/A	
1.	**Gas Treatment Facilities** G Flaring G Thermal destruction G Collection for reuse G Good condition G Needs Maintenance Remarks______________________________
2.	**Gas Collection Wells, Manifolds and Piping** G Good condition G Needs Maintenance Remarks______________________________
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) G Good condition G Needs Maintenance G N/A Remarks______________________________
F. Cover Drainage Layer G Applicable ✓N/A	
1.	**Outlet Pipes Inspected** G Functioning G N/A Remarks______________________________
2.	**Outlet Rock Inspected** G Functioning G N/A Remarks______________________________
G. Detention/Sedimentation Ponds G Applicable ✓N/A	
1.	**Siltation** Areal extent__________ Depth__________ G N/A G Siltation not evident Remarks______________________________
2.	**Erosion** Areal extent__________ Depth__________ G Erosion not evident Remarks______________________________
3.	**Outlet Works** G Functioning G N/A Remarks______________________________
4.	**Dam** G Functioning G N/A Remarks______________________________

II. Retaining Walls G Applicable G N/A

1. **Deformations** G Location shown on site map G Deformation not evident
Horizontal displacement________ Vertical displacement________
Rotational displacement________
Remarks________

2. **Degradation** G Location shown on site map G Degradation not evident
Remarks________

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

1. **Siltation** G Location shown on site map G Siltation not evident
Areal extent________ Depth________
Remarks________

2. **Vegetative Growth** G Location shown on site map G N/A
G Vegetation does not impede flow
Areal extent________ Type________
Remarks________

3. **Erosion** G Location shown on site map G Erosion not evident
Areal extent________ Depth________
Remarks________

4. **Discharge Structure** G Functioning G N/A
Remarks________

VIII. VERTICAL BARRIER WALLS G Applicable G N/A

1. **Settlement** G Location shown on site map G Settlement not evident
Areal extent________ Depth________
Remarks________

2. **Performance Monitoring** Type of monitoring________
G Performance not monitored
Frequency________ G Evidence of breaching
Head differential________
Remarks________

C. Treatment System ✓ Applicable G N/A

1. **Treatment Train** (Check components that apply)
   ✓ Metals removal G Oil/water separation G Bioremediation
   ✓ Air stripping ✓ Carbon adsorbers
   G Filters_______________
   G Additive (e.g., chelation agent, flocculent)_______________
   G Others_______________
   ✓ Good condition G Needs Maintenance
   G Sampling ports properly marked and functional
   G Sampling/maintenance log displayed and up to date
   ✓ Equipment properly identified
   G Quantity of groundwater treated annually_______________
   G Quantity of surface water treated annually_______________
   Remarks Treatment system is currently shutdown for rebound testing

2. **Electrical Enclosures and Panels** (properly rated and functional)
   G N/A ✓ Good condition G Needs Maintenance
   Remarks_______________

3. **Tanks, Vaults, Storage Vessels**
   G N/A ✓ Good condition ✓ Proper secondary containment G Needs Maintenance
   Remarks_______________

4. **Discharge Structure and Appurtenances**
   G N/A G Good condition G Needs Maintenance
   Remarks_______________

5. **Treatment Building(s)**
   G N/A ✓ Good condition (esp. roof and doorways) G Needs repair
   ✓ Chemicals and equipment properly stored
   Remarks_______________

6. **Monitoring Wells** (pump and treatment remedy)
   ✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition
   ✓ All required wells located G Needs Maintenance G 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 G Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
G Properly secured/locked G Functioning G Routinely sampled G Good condition
G All required wells located G Needs Maintenance G N/A
Remarks

X. OTHER REMEDIES

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

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.).

Original P&T remedy was shut-down through an ESD in order to do a rebound test in April 2004. ESD continues to be in effect. The groundwater extraction and treatment system has been maintained in case it needs to be restarted. Monitoring is conducted iaw the ESD to determine if there is unacceptable migration. To date, monitoring indicates that the plume is NOT migrating at an unacceptable rate. Therefore the remedy is effective.

B. Adequacy of O&M

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

Groundwater extraction and treatment system has been adequately maintained.

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.

Several wells have indicated short term spikes in TCE concentrations, but none have sustained the high concentration that would indicate an unacceptable rate of migration and require re-starting the P&T system. Well I-46B indicated a spike in Nov 2006, continued monitoring will determine if this increase in concentration is sustained.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

The ESD has been extended several times since the initial one-year shut down that started in April 2004. Once monitoring achieves the goals of the ESD, a long-term resolution of the site remedy should be documented.

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Soldier Creek/B3001	**Date of inspection:** 6/19/07
Location and Region:	**EPA ID:** OK1571724391
Agency, office, or company leading the five-year review: Parsons	**Weather/temperature:** Fair

Remedy Includes: (Check all that apply)

- ■ Landfill cover/containment
- X Access controls
- ■ Institutional controls
- X Groundwater pump and treatment (Not Active)
- ■ Surface water collection and treatment
- X Other Rebound Test/monitoring
- ■ 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** Jason Flanning — Name; Env Eng - Tinker — Title; 6/19/07 — Date

   Interviewed ■ at site ■ at office X by phone Phone no. (405)734-4516

   Problems, suggestions; ■ Report attached

   System currently not active - shut down for "rebound test"

2. **O&M staff** ______ Name ______ Title ______ Date

   Interviewed ■ at site ■ at office ■ by phone Phone no. ______

   Problems, suggestions; ■ Report attached ______

3.	**Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply. Agency EPA Reg 6 Contact Michael Herbert ______ ______ ______ 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				
2. Site-Specific Health and Safety Plan	☒ Readily available	☒ Up to date	■ N/A	
■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	■ N/A	
Remarks				
3. O&M and OSHA Training Records	☒ Readily available	☒ Up to date	■ N/A	
Remarks				
4. Permits and Service Agreements				
■ Air discharge permit	■ Readily available	■ Up to date	■ N/A	
■ Effluent discharge	■ Readily available	■ Up to date	■ N/A	
■ Waste disposal, POTW	■ Readily available	■ Up to date	■ N/A	
■ Other permits ______	■ Readily available	■ Up to date	■ N/A	
Remarks: System shut down				
5. Gas Generation Records	■ Readily available	■ Up to date	■ N/A	
Remarks: System Shutdown				
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: Shutdown				
10. Daily Access/Security Logs	■ Readily available	■ Up to date	■ N/A	
Remarks: Site inside Tinker boundary				

IV. O&M COSTS

1. **O&M Organization**
   ■ State in-house ■ Contractor for State
   ■ PRP in-house ■ Contractor for PRP
   ■ Federal Facility in-house ✓ Contractor for Federal Facility
   ■ Other ____________________

2. **O&M Cost Records**
   ■ Readily available ■ Up to date
   ■ Funding mechanism/agreement in place
   Original O&M cost estimate __________ ■ Breakdown attached

   Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
			■ Breakdown attached
			■ Breakdown attached
			■ Breakdown attached
			■ Breakdown attached
			■ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons: ____________________

V. ACCESS AND INSTITUTIONAL CONTROLS ✓ Applicable ■ N/A

A. Fencing

1. **Fencing damaged** ■ Location shown on site map ✓ Gates secured ■ N/A
   Remarks Inside Tinker and building is secure

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 X No ■ N/A

Site conditions imply ICs not being fully enforced ■ Yes X No ■ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) ______

Frequency ______

Responsible party/agency ______

Contact ______ ______ ______ ______

Name Title Date Phone no.

Reporting is up-to-date ■ Yes ■ No ■ N/A

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

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

Violations have been reported ■ Yes ■ No ■ N/A

Other problems or suggestions: ■ Report attached

______

2. **Adequacy** X ICs are adequate ■ ICs are inadequate ■ N/A

Remarks ______

D. General

1. **Vandalism/trespassing** ■ Location shown on site map X No vandalism evident

Remarks ______

2. **Land use changes on site** X N/A

Remarks ______

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

Remarks ______

VI. GENERAL SITE CONDITIONS

A. Roads X Applicable ■ N/A

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

Remarks ______

Site Inspection Checklist

I. SITE INFORMATION	
Site name: B3001 NPL Site / NTA	**Date of inspection:** 4/16/2007
Location and Region: Oklahoma / Reg 6	**EPA ID:** OK1571724391
Agency, office, or company leading the five-year review:	**Weather/temperature:** Fair/Mild

Remedy Includes: (Check all that apply)

- ■ Landfill cover/containment
- ■ Access controls
- ■ Institutional controls
- ■ Groundwater pump and treatment
- ■ Surface water collection and treatment
- ■ Other Vacuum Enhanced Pumping
- ■ 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** Dan Hunt — Env Eng - Tinker — 6/19/07
   Name Title Date
   Interviewed ■ at site ■ (at office) ■ by phone Phone no. (405) 734-4571
   Problems, suggestions; ■ Report attached

2. **O&M staff** Stan Townsend - Parsons — PM - Contractor — 6/18/2007
   Name Title Date
   Interviewed ■ at site ■ at office ■ (by phone) Phone no. (405) 732-9803
   Problems, suggestions; ■ Report attached

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

Agency EPA Reg 6
Contact Michael Herbert Reg 6

Name	Title	Date	Phone no.
Michael Herbert Reg 6			

Problems; suggestions; ■ Report attached

Agency ODEQ
Contact Robert Raplogle

Name	Title	Date	Phone no.
Robert Raplogle	Land Protection Div		(405) 702-5197

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	X■ Readily available	X■ Up to date	■ N/A
■ As-built drawings	■ Readily available	■ Up to date	■ N/A
■ Maintenance logs	X■ Readily available	X■ Up to date	■ N/A
Remarks			
2. Site-Specific Health and Safety Plan	X■ Readily available	X■ Up to date	■ N/A
■ Contingency plan/emergency response plan	■ Readily available	■ Up to date	■ N/A
Remarks			
3. O&M and OSHA Training Records	X■ Readily available	X■ Up to date	■ N/A
Remarks			
4. Permits and Service Agreements			
■ Air discharge permit	■ Readily available	X■ Up to date	■ N/A
■ Effluent discharge	■ Readily available	X■ Up to date	■ N/A
■ Waste disposal, POTW	■ Readily available	X■ Up to date	■ N/A
■ Other permits ____________	■ Readily available	■ Up to date	■ N/A
Remarks			
5. Gas Generation Records	■ Readily available	■ Up to date	X■ N/A
Remarks			
6. Settlement Monument Records	■ Readily available	■ Up to date	X■ N/A
Remarks			
7. Groundwater Monitoring Records	X■ Readily available	X■ Up to date	■ N/A
Remarks			
8. Leachate Extraction Records	■ Readily available	■ Up to date	X■ N/A
Remarks			
9. Discharge Compliance Records			
■ Air	■ Readily available	X■ Up to date	■ N/A
■ Water (effluent)	■ Readily available	X■ Up to date	■ N/A
Remarks			
10. Daily Access/Security Logs	X■ Readily available	X■ Up to date	■ N/A
Remarks			

IV. O&M COSTS	
1.	**O&M Organization** ■ State in-house ■ Contractor for State ■ PRP in-house ■ Contractor for PRP ■ Federal Facility in-house X Contractor for Federal Facility ■ Other ______
2.	**O&M Cost Records** ■ Readily available ■ Up to date X Funding mechanism/agreement in place Original O&M cost estimate ______ ■ Breakdown attached Total annual cost by year for review period if available Approximately $130,000 Annually 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: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ■ N/A	
A. Fencing	
1.	**Fencing damaged** ■ Location shown on site map X Gates secured ■ N/A Remarks ______
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 X No ■ N/A

Site conditions imply ICs not being fully enforced ■ Yes X No ■ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) site visit

Frequency

Responsible party/agency CMTE

Contact Dan Hunt (Name) Env Engineer (Title) (Date) (405)734-4571 (Phone no.)

Reporting is up-to-date X Yes ■ No ■ N/A

Reports are verified by the lead agency X Yes ■ No ■ N/A

Specific requirements in deed or decision documents have been met X Yes ■ No ■ N/A

Violations have been reported X Yes ■ No ■ N/A

Other problems or suggestions: ■ Report attached

2. **Adequacy** X ICs are adequate ■ ICs are inadequate ■ N/A

Remarks

D. General

1. **Vandalism/trespassing** ■ Location shown on site map X No vandalism evident

Remarks

2. **Land use changes on site** X N/A

Remarks

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

Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ■ N/A

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

Remarks

FINAL VERSION

Soldier Creek Sediment and Surface Water (OU2)

Final Five-Year Review

TINKER AIR FORCE BASE, OKLAHOMA
September 2007

Prepared by:

Sara Sayler
72 ABW/CEVPE
7701 Arnold Street
Tinker AFB, OK 73145

(405) 734-4580
DSN: 884-4580

Final Five-Year Review Report for The Soldier Creek Sediment and Surface Water Operable Unit 2

Submitted to:

United States Environmental Protection Agency
Region VI

Prepared by:
Sara Sayler
72nd ABW/CEVPE
7701 Arnold Street, Ste. 204
Tinker AFB, OK 73145-9100
Phone: 405/734-4580
Email: Sara.Wakelamsayler@tinker.af.mil

March 2007

Executive Summary

The ROD, signed in August 1993 provided for a limited action remedy for the Soldier Creek Sediment and Surface Water Operable Unit 2. The remedial actions selected in the ROD incorporate the following: 1) a five-year monitoring program of the Soldier Creek sediment and surface water at on-base and off-base locations to determine if contaminant migration has occurred and, if so, determine if migration has resulted in contaminant concentrations greater than health based cleanup goals, 2) an ecological investigation of Soldier Creek sediment and surface water to further define potential environmental risk, 3) annual monitoring reports to present and evaluate monitoring results for levels exceeding health-based cleanup goals and, finally 4) a five-year ROD review to ensure that the remedy continues to provide adequate protection of human health and the environment or whether additional remedial actions are necessary. The initial five-year review was completed in 1998 and gained regulatory acceptance in October 2002. This document is the third five-year review.

The assessment of the previous review indicated that there were no unacceptable risks to human health and the environment. Numerous remedial activities not required by the ROD have occurred in the area that serve to remove or reduce potential contaminant sources. In addition, results of the human health risk assessments indicate no unacceptable risk to human health and there have been no exceedences of health based screening levels (based on 1 X 10^{-4}). Therefore, sampling has been discontinued and the site is considered closed in accordance with the ROD. A Remedial Action Report (RAR) was submitted and was accepted by the EPA on January 12, 2006.

This Remedial Action Report (RAR) documented that Tinker Air Force Base has completed all construction activities for the remedial action at the Soldier Creek Sediment and Surface Water (OU-2) site in accordance with Close-Out Procedures for National Priorities List Sites (EPA OSWER Directive 9320.2-09A-P, January 2000). A letter dated September 14^{th}, 2004, was received from the Environmental Protection Agency (EPA) which confirmed that the remedial actions conducted at the site were constructed in accordance with the Record of Decision (ROD), August 1993. Tinker Air Force Base (AFB) has completed remedial construction activities necessary to achieve performance standards and site completion.

All site response actions, including remedial actions, were accomplished pursuant to, and in accordance with, the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and consistent with the National Contingency Plan (NCP), 40 CFR Part 300.

SOLDIER CREEK SEDIMENT AND SURFACE WATER (OU-2)
APPROVAL
TINKER AFB

MARK A. CORRELL, Colonel, USAF
Commander

25 Apr 07
Date

ALBERT AGUILAR
Remedial Project Manager
72nd ABW/CEVPE

20 Apr 07
Date

Samuel E. Coleman, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

9/27/07
Date

CONCURRENCES

FIVE-YEAR REVIEW
Tinker Air Force Base
EPA ID# OK1571724391

By: _______________ Date: 9-20-07
Michael Hebert, U.S. EPA
Remedial Project Manager

By: _______________ Date: 9-21-07
George Malone, U.S. EPA
Attorney, Superfund Branch, Office of Regional Counsel

By: _______________ Date: 09/25/07
Mark Peycke, U.S. EPA
Chief, Superfund Branch, Office of Regional Counsel

By: _______________ Date: 09/26/2007
Buddy Parr, U.S. EPA
Team Leader, Louisiana/New Mexico/Oklahoma Remedial Team

By: _______________ Date: 9/26/07
Donald Williams, U.S. EPA
Deputy Associate Director, Remedial Branch

By: _______________ Date: 9/26/07
John Hepola, U.S. EPA
Associate Director, Remedial Branch

By: _______________ Date: 9/27/07
Pamela Phillips, U.S. EPA
Deputy Director, Superfund Division

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name ***(from WasteLAN)*****: Soldier Creek Sediment and Surface Water (OU2)**		
EPA ID ***(from WasteLAN)*****: OK1571724391**		
Region: VI	**State: OK**	**City/County: Tinker AFB/Oklahoma**
SITE STATUS		
NPL status: X Final Deleted Other (specify)		
Remediation status (choose all that apply): Under Construction Operating **x** Complete		
Multiple OUs?* x YES NO	**Construction completion date:** September, 2004	
Has site been put into reuse? YES **x** NO		
REVIEW STATUS		
Lead agency: x EPA State Tribe Other Federal Agency ________		
Author name: Sara Sayler		
Author title: Environmental Engineer	**Author affiliation: Tinker AFB**	
Review period:** August 2002 to August 2007		
Date(s) of site inspection: 06 /16 /2005		
Type of review: **x** Post-SARA Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion		
Review number: 1 (first) 2 (second) **x** 3 (third) Other (specify) __________		
Triggering action: Actual RA Onsite Construction at OU #____ Actual RA Start at OU#____ Construction Completion **x** Previous Five-Year Review Report Other (specify)		
Triggering action date ***(from WasteLAN)*****:** 9 / 30 / 1992		
Due date ***(five years after triggering action date)*****:** 9/30/2007		

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

Five-Year Review Summary Form (cont'd)

Issues:
There are no issues associated with this five-year review.

Recommendations and Follow-up Actions:
A letter dated September 14th, 2004, was received from the Environmental Protection Agency (EPA) which confirmed that the remedial actions conducted at the site were constructed in accordance with the Record of Decision (ROD), August 1993. Tinker Air Force Base (AFB) has completed remedial construction activities necessary to achieve performance standards and site completion.

In addition, a Remedial Action Report (RAR) was submitted and was accepted by the EPA on January 12, 2006. This Remedial Action Report (RAR) documents that Tinker Air Force Base has completed all construction activities for the remedial action at the Soldier Creek Sediment and Surface Water (OU-2) site in accordance with Close-Out Procedures for National Priorities List Sites (EPA OSWER Directive 9320.2-09A-P, January 2000).

All site response actions, including remedial actions, were accomplished pursuant to, and in accordance with, the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and consistent with the National Contingency Plan (NCP), 40 CFR Part 300.

Because the remedies specified in the ROD have been fulfilled and because approval for the Remedial Action Report has been accepted by the EPA, this will be the final Five Year Review report for the Soldier Creek Sediment and Surface Water (Operable Unit 2).

Protectiveness Statement(s):
Based on results of the HHRAs and comparison of data to health-based action levels, there is no unacceptable risk to human health for the SCSSW OU.

In addition, numerous activities have occurred in the area of the SCSSW OU that serve to remove or reduce potential contaminant sources. Certain remedial measures have also recently been implemented by OC-ALC/EM at West Soldier Creek. Flight line criteria at Tinker AFB have prompted upgrades to the landscape along the creek. The channel of the creek has also been concreted. This action serves as a facility improvement as well as a remedial measure (although not identified as a ROD requirement) to minimize the potential for sediments to move off-base and pose a human health or ecological threat to downstream receptors.

Protectiveness of the environment has been attained by these remedial responses. As required in the ROD for this site, annual monitoring efforts were carried out during the previous five years to ensure no danger to human health or the environment exists. Because sampling has been discontinued at the SCSSW OU and the site is considered closed in accordance with the ROD, it is recommended that no further five year reviews be generated.

Other Comments:
No other comments.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
ARAR	Applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
Battelle	Battelle Memorial Institute
BHRA	Baseline human health risk assessment
BTEX	Benzene, toluene, ethylbenzene, and xylenes
B&V	Black & Veatch Waste Science and Technology Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemical of potential concern
Cr	Chromium
CWA	Clean Water Act
DCE	Dichloroethene
DNAPL	Dense non-aqueous phase liquid
EPA	U.S. Environmental Protection Agency
ERA	Ecological risk assessment
FFA	Federal facilities agreement
GWTP	Groundwater treatment plant
HHRA	Human health risk assessment
HHRA I	Human health risk assessment (first annual)
HHRA II	Human health risk assessment (second annual)
HHRA III	Human health risk assessment (third annual)
HI	Hazard index
IRP	Installation Restoration Program
IWTP	Industrial wastewater treatment plant
LSZ	Lower saturated zone
MCL	Maximum Contaminant Level
mg/Kg	Milligrams per kilogram
mg/L	Milligrams per liter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
OAC	Oklahoma Administrative Code
OC-ALC	Oklahoma City -Air Logistics Center
OC-ALC/EMPE	Oklahoma City -Air Logistics Center/Environmental Management Program Engineering
OCC	Oklahoma Corporation Commission
ODEQ	Oklahoma Department of Environmental Quality
O&M	Operation and Maintenance
OSDH	Oklahoma State Department of Health
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
Parsons ES	Parsons Engineering Science, Inc.
PCB	Polychlorinated biphenyl

PCE	Tetrachloroethene (Perchloroethene)
ppb	Parts per billion
POL	Petroleum oil lubricants
ppm	Parts per million
PRP	Potentially responsible party
RA	Risk assessment
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RGO	Remedial goal option
RI	Remedial investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
SCSSW	Soldier Creek sediment and surface water
SCOBGW	Soldier Creek off-base groundwater
SDWA	Safe Drinking Water Act
SF	Slope factor
SVOC	Semivolatile organic compound
TBC	To-be-considered
TCE	Trichloroethene
TPH	Total petroleum hydrocarbon
TTNUS	Tetra Tech NUS, Inc.
µg/L	Micrograms per liter
USACE	United States Army Corps of Engineers
USZ	Upper saturated zone
VOC	Volatile organic compound
WCFS	Woodward-Clyde Federal Services

SECTION 1
INTRODUCTION

The U.S. Air Force has conducted the final five-year review of the remedial action implemented at the Soldier Creek site at Tinker Air Force Base in Oklahoma (Figure 1). The primary purpose of the review is to determine whether the remedy remains protective of human health and the environment. Five-year review reports identify deficiencies, if any, and recommendations to address them. Five-year review reports document the evaluation of the implementation of the remedy and operation and maintenance (O&M), as well as the continued appropriateness of remedial action objectives (RAOs), including cleanup levels at a site. This is the second five-year review for the Soldier Creek site. There have been no additional remedial efforts since the last five-year review, therefore, descriptions of work contained in past five year reviews are not repeated in this five year review to limit repetition. The previous Five-Year Review was submitted in February 2003 and gained regulatory approval through a letter from the USEPA dated January 25, 2005.

This review is required by statute. Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and Section 300.430(f)(4)(ii) of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), require that periodic (no less often than every five years) reviews be conducted for sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure following the completion of all remedial actions.

Executive Order 12580 delegates the authority to conduct five-year reviews to the Department of Defense, where either the release is on, or the sole source of the release is from, any facility under the jurisdiction of those departments. In the Federal Facilities Agreement signed on December 9, 1988 between the U.S. Air Force, EPA, and the Oklahoma State Department of Health (succeeded by the Oklahoma Department of Environmental Quality in 1993), the U.S. Air Force was established as the lead agency for remediating the Soldier Creek Site.

SECTION 2
BACKGROUND

SITE DESCRIPTION

The main portion of Soldier Creek is to the east of Tinker AFB; however, two unnamed tributaries (East and West Soldier Creeks) originate on the Base. Soldier Creek flows to the north from its headwaters near Southeast 59th Street to its confluence with Crutcho Creek approximately six miles downstream (Figure 2). According to the Federal Facility Agreement (FFA) for the Base, the Soldier Creek Operable Unit includes Soldier Creek, its tributaries, and any area underlying or adjacent to the waterway that may be contaminated by the migration of hazardous substances, pollutants, or contaminants from Tinker AFB.

The Soldier Creek Sediment and Surface Water (SCSSW) site, or Operable Unit 2 (OU-2), includes Soldier Creek, its tributaries, and any area underlying or adjacent to the waterway that may be contaminated by the migration of hazardous substances or pollutants from Tinker AFB. The tributaries of Soldier Creek are unnamed, but are referred to as East and West Soldier Creeks in this report. As required in the SCSSW ROD, a work plan was created for monitoring this OU and the boundaries of the OU were established in the work plan. As defined in the work plan (WCFS, 1994), these boundaries are as follows: 1) All sediment and surface water of East Soldier Creek that originate on Tinker AFB to the intersection of East Soldier Creek and Interstate 40 north of Tinker AFB, and 2) All sediment and surface water of West Soldier Creek that originate on Tinker AFB to the intersection of West Soldier Creek and Interstate 40 north of Tinker AFB.

The boundaries include the ditches leading from the eight NPDES outfalls to East and West Soldier Creeks, the lower portion of the stream defined as Tributary B in the RI/FS documents (just prior to its confluence with East Soldier Creek), and terrestrial habitats within the 100-year floodplain of the aforementioned stream segments (or within 50 feet from either bank of the stream where it is not located in the 100-year floodplain). These boundaries supercede the boundaries originally established in the Soldier Creek RI (B&V, 1993b).

Environmentally sensitive areas within the Soldier Creek site include the Garber-Wellington aquifer and Soldier Creek as described above. The closest Superfund site is the Mosley Road Landfill site located approximately 6 miles north of Tinker AFB.

LAND AND RESOURCE USE

Prior to 1941, the site was located on undeveloped pasture and prairie lands. There were some agricultural activities and ranching but no known industrial uses prior to 1941. Beginning in 1941, 960 acres of land were donated to the Army Air Corps by the City of Oklahoma City for the construction of the Midwest Air Depot. Renamed Tinker Field in 1942 and subsequently Tinker Air Force Base in 1948, the entire base now covers 5,277 acres.

The on-base portion of the Soldier Creek site is in the northeast quadrant of Tinker AFB, which is the most industrialized area of the base.

The off-base properties within the Soldier Creek site included the Kimsey Addition to the north, along with commercial/retail establishments and mobile homes to the east. The Kimsey Addition was a residential area consisting of approximately 100 homes bounded by Tinker AFB to the south and west, Interstate 40 to the north, and Douglas Boulevard to the east. Since the last Five-Year Review, the properties in the Kimsey Addition and some nearby businesses have been purchased by Oklahoma County. The houses and businesses have been demolished and the parcel is being fenced and gated for use by Tinker AFB (Figure 3). The commercial/retail facilities between Tinker AFB and East Soldier Creek include convenience stores and self-storage units. Other than the Evergreen Mobile Home Park, the remainder of the site east of Douglas Boulevard and northwest of East Soldier Creek is undeveloped between the mobile home park and Interstate 40.

Soldier Creek and its tributaries receive surface runoff from approximately 9,000 acres (14 square miles), at its confluence with Crutcho Creek. Areas of Tinker AFB that contribute runoff or discharge to Soldier Creek and its tributaries include the eastern-most runway areas and the Building 3001 complex. Prior to April 1996, the IWTP discharged treated water to East Soldier Creek. Recharge from East Soldier Creek to the aquifer occurs and remains within the boundaries of Tinker AFB.

Surrounding Community

The Soldier Creek site and Tinker AFB lie within an area representing transition from residential and industrial/commercial land use on the north and west to agricultural land use to the east and south. Soldier Creek and its tributaries, which flow northwest through the area, are bordered by recreational and residential areas with some areas supporting commercial and industrial land use. Some off-base industries, such as a metal plating facility and a dry cleaning facility, and commercial facilities such as gas stations, auto repair facilities, and a closed sanitary landfill are located within the drainage basin. In addition, three schools, Soldier Creek Elementary, Steed Elementary, and Monroney Junior High are located within the drainage basin. There are ten public parks within the general vicinity of Tinker AFB, including the Joe B. Barns, Fred F. Meyers, Kiwanis, and Lions Parks. A public golf course is also located north of the base. Five trailer parks are located north and northeast of Tinker AFB.

The land use plan for the area immediately north of Tinker AFB, between Sooner Road and Douglas Boulevard includes all levels of land use. The areas between Sooner Road and Midwest Boulevard (see Figure 1 for location) were zoned primarily for housing (single and multifamily units) and low to medium commercial use, however, since the last Five-Year Review; the area has become commercial only (Figure 3). Large retail stores such as Lowes, SuperTarget, Kohls, Marshalls, Best Buy and many restaurant and smaller retail stores are currently located in this area. The area between Midwest Boulevard and Douglas Boulevard is zoned primarily for heavy commercial and moderate to heavy industrial use.

Soldier Creek, which flows from Tinker AFB into adjacent neighborhoods, is reportedly used for wading and playing by area children and is large enough to support edible fish. No hunting or fishing has been reported to occur in the immediate area outside of Tinker AFB. Hunting is not permitted on base and fishing is not permitted in Soldier Creek within base boundaries. Beneficial uses of Soldier Creek include agriculture, secondary recreation, process and cooling water, and aesthetics. Soldier Creek also supports a warm-water aquatic community.

Human Use of Resources

The most important source of potable groundwater in the Oklahoma City metropolitan area is the Central Oklahoma aquifer, which is commonly referred to as the "Garber-Wellington aquifer." Tinker AFB presently obtains part of its water supplies from wells that are completed in the Garber-Wellington aquifer. Base wells range from 700 to 1,100 feet in total depth, with yields ranging from 205 to 250 gallons per minute (gpm).

On the east side of Tinker AFB, the Garber-Wellington aquifer has been classified as a Class IIA aquifer by the State of Oklahoma, indicating that it provides groundwater from a major, unconfined basin that is capable of being used as a drinking water supply with little or no treatment (OAC 785:45-7-3). The western portion of the Garber-Wellington aquifer basin, which extends from the west side of the base to just west of Oklahoma County, is classified as a Class IIC aquifer, a major confined groundwater basin. Tinker AFB and the nearby communities of Midwest City and Del City derive a portion of their water supply from the Garber-Wellington aquifer.

Until 1993, groundwater was used as a domestic water source by several of the residents living within and adjacent to the boundaries of the site. Most of these wells were removed from service in 1994 after municipal water distribution lines were conveyed to and installed at the residences and businesses. A records search and site survey indicated that there are no off-base wells adjacent to the northeast portion of the base that are known to be used for drinking water purposes. All of the water supply wells on Tinker AFB are routinely sampled for contaminants.

CONTAMINANTS

The Air Force Installation Restoration Program (IRP) Phase I identified potential sources of contamination through records searches and reviews of waste management practices. The first report of a release to the environment occurred in 1983 during routine wellhead sampling and testing. Trichloroethene (TCE) and tetrachloroethene (PCE) were detected in two of the base water supply wells (WS 18 and WS 19) at Building 3001. A Phase II IRP investigation was conducted in 1984 to confirm and quantify contamination resulting from past waste storage practices at Building 3001. Sampling was also initiated at East and West Soldier Creek in 1984. Sample results indicated the presence of chromium and solvent contamination in the sediment and surface water. In September 1987, the Soldier Creek site was evaluated under the hazard ranking system with a score of 42.24 and was placed on the NPL.

The groundwater used by residents and the work force of Tinker AFB was identified as an exposure pathway. Potential points of exposure included water supply wells and discharge to surface water bodies. Exposure with long-term health effects was deemed a possibility in the 1988 baseline risk assessment. A chronology leading to the NPL listing is provided in Table 1.

Remedial investigations of the SCSSW OU were conducted between 1990 and 1991. Results of the sediment analyses indicated acetone, chloroform, methylene chloride, PCE, toluene, xylene, cadmium, chromium, and lead were the primary sediment contaminants. The primary surface water contaminants were acetone, chloroform, methylene chloride, PCE, toluene, 1,1,1 trichloroethane, cadmium, chromium, and lead.

The surface water and sediment of Soldier Creek were considered as potential exposure pathways for human receptors, but results of the 1993 risk assessment for these media indicated that there was not an unacceptable risk to human health.

Table 1
Activities Leading to NPL Listing for SCSSW OU

Investigation/Activity	Description	Event Date (Source)
Sediment and surface water sampling	Evaluate water quality effects of wastewater discharge from Tinker AFB on Soldier and Crutcho Creeks	October/November 1984 (USEPA, 1984)
Sediment sampling	Site investigation to evaluate magnitude of contamination in East and West Soldier Creeks	October 1985 (HKS, 1985)
Sediment dredging	Dredging of unknown volume of sediment from on-base portions of East and West Soldier Creeks	April/May 1986 (HKS, 1986)
NPDES surface water sampling	Determine surface water concentrations downstream of IWTP effluent discharge location	September 1986 - July 1987 (Tinker AFB)
Sediment and surface water sampling	Sampling was performed to collect sediment and surface water samples at the IWTP and sanitary wastewater treatment plant outfalls.	March - September 1987 (Source:B&V, 1993b)
NPL listing	Main stream of Soldier Creek and all tributaries of Soldier Creek originating on Tinker AFB were included in the NPL site	July 22, 1987

INITIAL RESPONSE

The U.S. Environmental Protection Agency (EPA), U.S. Air Force, and Oklahoma State Department of Health signed a Federal Facilities Agreement (FFA) designating the Air Force as the only Potentially Responsible Party (PRP). Response actions initiated prior to the ROD are discussed below.

In 1986, excavation activities were conducted along East and West Soldier Creek to identify and eliminate potential sources of contamination to Soldier Creek. Approximately 7,500 cubic yards of sediment were removed. In 1990 and 1991, several industrial cross-connections were removed that may have been contaminating the Soldier Creek storm-water system. Between 1990 and 1993, fourteen solvent pits and USTs in the vicinity of Soldier Creek were removed or abandoned.

The SCSSW ROD was signed in September 1993. Contamination remains on-site, but there have been no unacceptable human health risks associated with the levels of contaminants detected. Numerous contaminants, however, were found to present an unacceptable ecological risk. These risks were based on concentrations of site contaminants, which exceeded the lowest available eco-toxicological benchmark for the exposure pathway. The adverse effects were limited to a localized scale in on-base areas.

SECTION 3
REMEDIAL ACTIONS

Remedy Selection and Implementation

The ROD, signed in August 1993 provided for a limited action remedy for the SCSSW OU. The remedial action objectives for the OU were to prevent the ingestion of, or dermal contact with, sediment and surface water with contaminant concentrations greater than health-based cleanup goals and to prevent off-base migration of contaminants with concentrations greater than health-based cleanup goals. Existing or potential groundwater contamination was to be addressed separately under the Soldier Creek Off Base Groundwater (SCOBGW) OU due to the complexity of potential groundwater interactions between all of the OUs at Tinker AFB. The IWTP/SCOBGW investigations included evaluation of the interactions between the creeks and groundwater.

The baseline risk assessment determined that the Soldier Creek sediment and surface water did not pose a risk to human health or the environment in excess of the acceptable risk-based levels established by EPA. However, the environmental assessment conducted as a part of the baseline risk assessment was only qualitative and could not be used to fully assess ecological risk. Long-term monitoring would be used to determine if levels in the creek remain below the health-based cleanup goals over time and quantitatively evaluate the environmental risk, if any, existing at the OU. The remedial actions selected in the ROD incorporated the following components:

- A five-year monitoring program of Soldier Creek sediment and surface water at on-base and off-base locations to determine if contaminant migration has occurred and, if so, determine if migration has resulted in contaminant concentrations greater than health-based cleanup goals.

- An ecological investigation (quantitative and qualitative) of Soldier Creek sediment and surface water to further define potential environmental risk.

- Annual monitoring reports to present and evaluate monitoring results for levels exceeding health-based cleanup goals.

- A five-year ROD review to ensure that the remedy continues to provide adequate protection of human health and the environment or whether additional remedial actions are necessary.

A chronology of the remedy development and implementation activities for the SCSSW OU is provided in the Table 2 below.

Table 2
Summary of Remedy Development and Implementation Activities at SCSSW OU

Investigation/Activity	Description	Date(and Source)
Quarterly groundwater sampling	Sample groundwater in area of East and West Soldier Creeks, Building 3001, and IWTP.	December 1987 - March 1989 USACE, Tulsa District (Source: WCFS, 1998)
Final storm water investigation	Sample surface water to identify contaminant release from Building 3001 storm sewers to East and West Soldier Creeks	October 1989 (NUS, 1989)
Phase I and Phase II RI/FS	Determine extent of sediment and surface water contamination along East, Main, and West Soldier Creeks	Phase I - July 1990 Phase II - June1991 (B&V, 1993b)
HI-IRA and qualitative ERA	Quantitative HHRA and qualitative ERA to establish potential current and future risk to on-base and off-base receptors utilizing sediment, surface water, and groundwater data	February 1993 (B&V, 1993c)
ROD issued/signed	Establish remedial action for the site	Issued - August1993 Signed - September 14, 1993 (B&V, 1993a)
Quantitative ERA II	Quantitative ERA to determine potential effects of chemicals in surface water and sediment on biological environment - included biological survey to determine characteristics of species within on-base and off-base portions of the OU (conducted as ROD requirement)	Vols. I, II, III WCFS, 1997
First -- Seventh year long-term monitoring and annual reports	Quarterly monitoring of sediment and surface water and yearly reporting to present monitoring results and HHRA I (conducted as ROD requirement)	November 1994 through October 2002
Remedial responses	Numerous past and on-going remedial actions in the area to provide protectiveness of the environment such as sediment removal and cementing of creek beds in 1999. (actions not identified as a ROD requirement)	1990 - on-going

Operation and Maintenance Requirements

There are no O&M requirements associated with the continued monitoring remedy. Flight line criteria at Tinker AFB have prompted upgrades to the landscape along West Soldier Creek. The channel of West Soldier Creek has also been concreted. This action serves as a facility improvement for Tinker's mission, as well as a remedial measure (although not identified as a ROD requirement) to minimize the potential for sediments to move off base and pose a human health or ecological threat to downstream receptors.

Remedial Action Objectives

The selected remedial action goals for the SCSSW were based on results of the baseline risk assessment (RA) conducted for the OU (B&V, 1993 c), which included a quantitative baseline human health risk assessment (BHRA), and a qualitative ecological risk assessment (ERA). Results of the BHRA showed that potential risk to human health from Soldier Creek sediment and surface water was within acceptable risk-based exposure levels established by the EPA. The qualitative ERA identified several contaminants that may pose a potential environmental concern, however, additional study was recommended to fully characterize potential risk.

The health-based cleanup goals were identified in the ROD as to-be-considered (TBC) criteria to be used as guidelines for evaluating future concentrations of contaminants detected in Soldier Creek sediment and surface water. TBCs are evaluated in the five-year review with respect to any changes since the time of their development. TBCs can vary due to changes in site characteristics (e.g., receptors, exposures, or pathways) and/or characteristics of the contaminant (e.g., new toxicity information and level of contaminant). The TBCs were initially based on the existing site conditions and contaminant characteristics computed by back-calculating equations used in the BHRA (B&V, 1993b; 1993c).

The ROD response action was based on sediment and surface water data collected during Phase I and Phase II of the RI. For these media, the BHRA evaluated potential risks for incidental ingestion and dermal contact for adult workers and child/adult recreators. Based on the conceptual site model (CSM), which identifies and describes exposure pathways, which may be potentially complete for the site, ten reasonable maximum exposure (RME) scenarios were selected to represent the current and future land use. The exposure pathways and RME assumptions initially evaluated in the BHRA are considered to be applicable to current conditions.

The qualitative ERA focused on the effects of contaminant exposure on general populations of aquatic and terrestrial species typical of the OU area (B&V, 1993 c). It was found that the presence of several metals in surface water and sediment (barium, cadmium, chromium, copper lead, nickel, selenium, silver, and zinc) were of potential environmental concern to aquatic species; however, additional data were needed to fully characterize this risk as well as the potential risk to terrestrial species.

Human Health Risk Assessment

The first annual human health risk assessment (HHRA I) was prepared to provide information on potential "current" and future risks based on data for surface water and sediment samples collected in November 1994, and January, April, and June 1995. The stream segments that were sampled are shown on Figure 4. The data were also used to compare results with those of the RI (B&V, 1 993b) and determine if previous conclusions remained valid. Based on results of the second year of quarterly monitoring, the second annual HHRA (HHRA II) was prepared to address the same issues as the HHRA I. 'Current" data for HHRA II (collected in October 1995, and March, May, and August 1996) were used to identify potential risk and also verify that previous conclusions remained valid. These issues were similarly addressed in the third annual HHRA (HHRA III) using monitoring results from samples collected in January and July 1997.

Although not impacting the overall results, slight differences in methodology are noted between the original BHRA and the long-term HHRAs:

- PCB/pesticide analyses were added as sampling criteria in the long-term monitoring study (these analytes were not included in the RI samples);
- Four stream segments were evaluated for risk in the long-term HHRAs (nine segments were evaluated in the BHRA); and
- Age-corrected skin surface areas for the potential receptors were used in the long-term HHRAs for evaluating exposure to surface water and sediments (these parameters were not corrected in the BHRA).

Despite these slight differences in approach, there were no unacceptable cancer risks or non-carcinogenic hazards calculated during any of the long-term HHRAs. Thus, under the "current" or future stream use conditions for potential on-base or off-base population exposures to sediment and surface water in the SCSSW OU, there continues to be no unacceptable human health risk.

Comparison of Data to Health-Based Cleanup Goals

Based on the remedial action requirements for the SCSSW OU, human health-based cleanup goals were developed to evaluate the long-term monitoring results. These health-based goals were calculated for each chemical using the most health-protective exposure scenario (i.e., the scenario associated with the highest calculated risk or hazard). The residential exposure scenario was used for chemicals found off-base and the construction worker scenario was used for on-base chemicals.

Four sets of human health-based cleanup goals were developed based on acceptable risk levels established by the EPA. This included three levels for carcinogens based on the EPA-acceptable cancer risk range of 10^{-6} (one additional case of cancer per one million), 10^{-5} (one additional case per one hundred thousand), and 10^{-4} (one additional case per ten thousand). One health-based risk level was also calculated for each non-carcinogenic chemical based on the target Hazard Index (HI) of 1.0. For chemicals with both carcinogenic and non-carcinogenic properties, the lower (more health-protective) level was selected. Since surface water is dynamic (constantly changing), the calculated health-based cleanup goals are referred to as "health-based indicators of water quality." Both sediment and surface water values, however, provide the basis for comparing chemical concentrations to health-based levels and for evaluating whether additional remedial action may be necessary at the site.

During the BHRA and subsequent long-term monitoring HHRAs, health-based indicators for water quality were not exceeded for any detected contaminants. No analytes in sediment samples exceeded the 10^{-4} RAO, which is the highest TBC concentration for a chemical detected at the site based on the USEPA-accepted risk range (10^{-6} to 10^{-4}). The third year long-term monitoring annual report (WCFS, 1998) contains the results of the comparison of site data to the acceptable 10^{-4} to 10^{-6} range of health-based cleanup goals.

TBCs are evaluated in the five-year review with respect to any new information on chemical toxicity, which may increase or decrease the TBC. Since the time of the third year monitoring report, toxicity data for two of the detected contaminants (alpha-chlordane and beryllium) have been updated (EPA, 1998). The new cancer and non-cancer toxicity data for alpha-chlordane show that the chemical is less toxic than indicated in the HHRAs. Beryllium was not identified as presenting a potential human health risk using the previous toxicity data, and although new data indicate that the chemical is slightly more toxic as a non-carcinogen, the change in the toxicity value is not significant for the site. [The change in the toxicity value would result in a decrease of the non-carcinogenic action level for sediments from 21,800 to 8,720 milligrams per kilogram (mg/kg). Compared to the range of detected concentrations for beryllium in sediments (1.7 to 0.27 mg/kg), this change is not significant]. Since beryllium was not detected in surface water during the third year monitoring results, there is no effect on the level of risk for this medium. Additionally, the oral slope factor (SF) for beryllium has been withdrawn (the toxicity data show that beryllium is not carcinogenic by ingestion). Thus, the chemical would not be calculated as a carcinogen via ingestion of sediments (i.e., the calculated overall carcinogenic risk would decrease).

Ecological Risk Assessment

The ecological investigation mandated by the ROD for the SCSSW OU was conducted as part of the environmental monitoring program to quantify potential effects of contaminant concentrations on the biological environment of the creek (WCFS, 1997b). The main ERA field activities were performed during October 1994 and June 1995. One noted observation of the ecological survey was that no federally listed threatened or endangered species or their habitats were found to occur within the SCSSW OU.

For sampling data evaluated in the ERA, a constituent was selected as a chemical of potential concern (COPC) if it was detected in one ecological or quarterly-monitoring sample (i.e., detected in at least one sampling event and at one location) at a concentration that exceeded the lowest available ecotoxicological benchmark for the specific medium. Using this screening process, forty-six COPCs (including chemical "groups" in some cases) were identified in either sediment, surface water, or both media. These forty-six chemicals, or groups of chemicals, included:

- Nineteen inorganics: aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, vanadium, and zinc;
- Eleven VOCs/SVOCs: acetone, benzidine, bis(2-ethylhexyl)phthalate, carbon di sulfide, chlorobenzene, 1 ,4-dichlorobenzene, methylene chloride, toluene, 2,3,6-trichloronaphthalene, triphenyl phosphine sulfide, and total xylenes;
- Four phenols and substituted phenols/nonylphenols: 2,4-dimethylphenol, pentachlorophenol, phenols and various substituted phenols (counted as one chemical group), and nonylphenols (counted as one chemical group);
- Total PCBs (counted as one chemical group): Aroclor 1254 and other mixtures;

- Eight organochlorine pesticides: aldrin, alpha- and delta-BHC (counted as one pesticide), alpha-chlordane, dieldrin, endosulfan sulfate, heptachlor, heptachlor epoxide, and methoxychlor;
- Low molecular weight PARs (counted as one chemical group): acenaphthene, anthracene, fluorene, and phenanthrene;
- Medium molecular weight PAHs (counted as one chemical group): fluoranthene and pyrene; and
- High molecular weight PAHs (counted as one chemical group): benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3 -cd)pyrene.

At the concentrations estimated for direct exposures to strictly-aquatic organisms (algae, benthic and water-column invertebrates, and fish) and/or the doses estimated for indirect exposure (via the ingestion pathway) to terrestrial/semi-aquatic birds and mammals, sixteen of the forty-six chemicals were found to pose a potential threat to ecological species. In general, the potential risks to strictly-aquatic organisms were somewhat greater than the potential hazards to terrestrial animals. The potential risks associated with both direct (aqueous) and dietary exposures were largely, but not entirely, confined to on-base portions of East and West Soldier Creeks.

Results of the ERA showed that the most significant COPCs for sediments were cadmium, chromium, copper, nickel, silver, zinc, total PCBs, PAHs, certain organochlorine pesticides, and certain phenolic compounds. Among these, cadmium, chromium, copper, nickel, PCBs, and PAHs were the most ubiquitous. The ERA indicated that potential effects of these contaminants may extend downstream (northward) beyond the ERA study boundary at Interstate 40. However, the potential for downstream hazards was not considered to be of major ecological significance, particularly at higher levels of biological organization (i.e., populations, communities, ecosystems).

The most significant chemicals in surface water were barium, cadmium, chromium, copper, lead, molybdenum, and zinc. All of these chemicals, except molybdenum, were ubiquitous, and were also considered, to some extent, as possible contaminants of concern for areas downstream of Interstate 40. Copper and chromium were of particular concern due to their phytotoxicity and indirect effect on higher trophic levels. These two metals, as well as cadmium and zinc (and possibly barium), were also considered to possibly directly affect invertebrate and fish communities.

Chromium, PCBs, and high molecular weight PAHs appeared to be the most significant chemicals for the ingestion pathways of terrestrial/semi-aquatic receptors. However, the lack of relevant dietary toxicological data prevented detailed quantitative estimation of dietary risk to amphibians and semi-aquatic reptiles (e.g., certain turtles and water snakes), which may be the most sensitive wildlife receptors for the OU.

Toxicity tests (acute and chronic effects under controlled laboratory conditions) were also measured on ecological species exposed to sediment and surface water. With the exception of conditions in off-base portions of West Soldier Creek, which did not appear to be as hazardous to aquatic receptors as indicated by the risk estimates described above (based on the hazard quotient I hazard index approach), the toxicity test results of the initial ERA generally corroborated the risk estimates. Biological surveys, particularly of benthic invertebrate and fish communities, also generally supported conclusions of the risk estimates.

Initial chemical-specific concentrations referred to as preliminary remedial goal options (RGOs) were developed as protective levels for ecological receptors in sediment and surface water of Soldier Creek. These levels are similar to the human health-based cleanup goals and can be used for evaluating chemical concentrations detected in the on-going five-year monitoring efforts and for evaluating whether additional remedial action may be necessary at the site.

It should be noted that the ERA is based on very conservative exposure values and that the risk characterization is inflated by additive conservative assumptions. The degree to which exposures and toxicities are overestimated leads to a great deal of uncertainty in the assessment. Additionally, the adverse effects identified in the assessment were limited to a localized scale in on-base areas. Further data are necessary to more accurately characterize the extent of contamination and the associated potential hazards to ecological receptors in downstream areas. Interpretation of the ecological significance of the ERA results is provided in Section 6.

Additional Remedial Actions

In addition, although it was not required by the ROD, additional corrective measures have been pursued as a means to alleviate the risk to human health and the environment. These measures include removal of contaminated soils in West Soldier Creek and cementing the on-base portion of the channel. In addition, contaminated sediments were removed from East Soldier Creek and the channel was cemented around the dam near the IWTP.

SECTION 4
PROGRESS SINCE LAST FIVE-YEAR REVIEW

Protectiveness statement from ROD

As stated in the ROD, the protectiveness statement is as follows: the selected remedy is protective of human health and the environment because monitoring of the concentrations of the chemicals of concern in Soldier Creek sediment and surface water will be conducted and an ecological investigation will be performed. Continued monitoring will determine if a human health risk develops from these media at the operable unit. Implementation of the selected remedy does not pose any unacceptable short-term risks or cross-media impacts. Because carcinogenic risk levels are within the acceptable risk range (1E-04 to 1E-06) and the HIs for noncarcinogens are less than 1.0, the sediment and surface water contamination at the Soldier Creek Sediment and Surface Water Operable Unit does not present a significant threat to human health. Based on the qualitative environmental assessment conducted as a part of the baseline risk assessment, a significant threat to the environment does not exist. Therefore, the only response action required at this time is that specified in the selected remedy. The continued monitoring of Soldier Creek sediment and surface water at on-base and off-base sampling locations will be adequate to address operable unit contamination because the concentrations of the sediment and surface water COCs do not exceed the remediation goals (risk-based cleanup levels) established for the operable unit. The ecological assessment to be conducted will determine the effects of contaminant concentrations on the biological environment of Soldier Creek. Yearly and at the time of the five-year review, the results of the monitoring program will be evaluated to determine if a remedial action needs to be implemented or additional monitoring needs to be conducted at the operable unit.

Protectiveness Statement from last Five-Year Review

As stated in previous Five-Year Review: The results from the ERA indicated that potential for ecological risk in the area. Subsequent remedial measures have been implemented by OC-ALC/EM to remove or reduce potential contaminant sources and minimize the potential for sediments to move off base and pose a human health or ecological threat to downstream receptors. Continued annual monitoring and evaluation will determine the need for further remedial actions, if necessary.

Status of Recommendations from Last Five-Year Review

Recommendations taken from the previous five-year review are as follows:

Based on results of the HHRAs and comparison of data to health-based action levels, there is no unacceptable risk to human health for the SCSSW OU.

In addition, numerous activities have occurred in the area of the SCSSW OU that serve to remove or reduce potential contaminant sources. Certain remedial measures have also recently been implemented by OC-ALC/EM at West Soldier Creek. Flight line criteria at Tinker AFB have prompted upgrades to the landscape along the creek. The channel of the creek has also been concreted. This action serves as a facility improvement as well as a remedial measure (although not identified as a ROD requirement) to minimize the potential for sediments to move off-base and pose a human health or ecological threat to downstream receptors.

Protectiveness of the environment has been attained by these remedial responses. As required in the ROD for this site, annual monitoring efforts were carried out during the previous five years to ensure no danger to human health or the environment exists. However, since there have been no exceedences of health based screening levels (based on 10^{-4}) in the sampling over the past five years, it is recommended that sampling be discontinued at the SCSSW OU and the site be considered closed in accordance with the ROD.

Additional Progress Since last Five-Year Review

A letter dated September 14th, 2004, was received from the Environmental Protection Agency (EPA) which confirmed that the remedial actions conducted at the site were constructed in accordance with the Record of Decision (ROD) dated August 1993. Tinker Air Force Base (AFB) has completed remedial construction activities necessary to achieve performance standards and site completion.

Subsequently, a Remedial Action Report (RAR) was submitted and was accepted by the EPA on January 12, 2006. This Remedial Action Report (RAR) documents that Tinker Air Force Base has completed all construction activities for the remedial action at the Soldier Creek Sediment and Surface Water (OU-2) site in accordance with Close-Out Procedures for National Priorities List Sites (EPA OSWER Directive 9320.2-09A-P, January 2000).

All site response actions, including remedial actions, were accomplished pursuant to, and in accordance with, the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and consistent with the National Contingency Plan (NCP), 40 CFR Part 300.

SECTION 5
FIVE-YEAR REVIEW PROCESS

The five-year review was conducted by Sara Sayler of 72^{nd} ABW/CEVPE. Typically, the key elements of a five-year review include: document review, interviews, site inspection, evaluation of findings and report preparation. However, because no further action was recommended during the last five-year review and an RAR was completed and accepted, the site inspection, interview and data review elements were not repeated.

Community Involvement

Community involvement was initiated at the April 17, 2007 community advisory board (CAB) meeting by announcing that a Five-Year Review process was underway. Community comments/concerns were also solicited during the CAB meeting.

SECTION 6
TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents? The remedy specified by the ROD included only requirements for sampling at specific locations in and around the OU. The past five years of sampling indicated no consistent areas of concern. Given this information, the remedy can be considered to function as intended.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid? Any changes in these parameters have been accounted for in additional rounds of both ecological and human health risk assessments.

Question C: Has additional information arisen to question the protectiveness of the selected remedy? Not at this time.

SECTION 7
ISSUES FROM PREVIOUS REVIEW

There are no issues from the previous five-year review.

SECTION 8
CONCLUSIONS

Interpretation of Human Health Significance

As required by the ROD, the five-year monitoring program for the SCSSW OU has been implemented. Over the five-year duration of the monitoring program, health-based indicators for water quality (health-based cleanup goals) were not exceeded for any chemical detected in water. Additionally, no analytes in sediment samples exceeded the 1E-04 RAO, which is the highest TBC level (human health-based action level) for a detected chemical based on the EPA-acceptable risk range (1E-06 to 1E-04).

In addition to these results, the quantitative HHRAs did not show an unacceptable health risk. Results of the HHRAs for the first three years of the monitoring program, as well as results of the BHRA, indicate that under "current" or future stream use conditions there is no unacceptable human health risk (cancer or noncancer risk) for potential on-base or off-base receptors due to sediment and surface water exposures for the SCSSW OU.

Interpretation of Ecological Significance

Initial ERA Results

The initial ERA indicated that forty-six chemicals, or chemical groups, were of ecological concern (pesticides, PCBs, PAHs, and other volatile and semi-volatile compounds). Ecological exposures were found to pose some risk of acute and chronic, sub-lethal effects to certain individual receptors or individuals of receptor classes.

The study indicated that the ecological exposures and effects were largely confined to the on-base portions of the SCSSW OU. The concentrations of the PAHs were found to vary between sampling segments and sampling events suggesting that multiple on-base origins for the PAHs may exist. For example, highest PAH concentrations for the second year of monitoring occurred in the stream segment representing Outfall G, but during the third year of monitoring, many of the highest PAR concentrations occurred in the segment representing Outfall F. Data also indicated that discharge from Outfall G is a possible source of the PCB contamination. Although all electrical transformers with PCB-containing oil were replaced at the base in 1989, minor leaks or spills of old transformer oil may have previously entered the storm drain system. There are no known industrial processes that use PCBs in the area.

The ERA states that the adverse affects are clearly limited to a localized scale. This is also why results showed that the most ecologically-relevant actual or potential effects are those on strictly-aquatic communities (i.e., algae, benthic and water-column invertebrates, fish) and small terrestrial/semi-aquatic animals. The ERA states that it is unlikely that larger terrestrial vertebrates (wildlife) are at much risk from site-related chemicals.

The conclusions of this limited initial ERA also indicate that the risk characterization is inflated by additive conservative assumptions and that there is much uncertainty related to the degree to which exposures and toxicities are overestimated. The conclusions indicate that better understanding of the ingestion-pathway exposures is needed (as opposed to estimating dietary constituent concentrations of chemicals) and additional sampling may be required. As an example, the ERA suggests sampling and analyses of plant tissues (particularly fruits), amphibians, and/or small mammals to provide a better understanding of the dietary exposures to higher-level consumers as well as more insights into the actual availability for direct uptake of the chemicals.

Second ERA Results completed since last Five-Year Review
Two basic factors led to the second EA: 1) salient changes in conditions within the SCSSW OU – specifically, the complete removal of the Industrial Waste Treatment Plant and Sewage Treatment Plant effluents, and 2) the substantial uncertainty associated with risk characterization in the first EA. In order to reduce the uncertainty associated with the previous exposure and toxicity assessments, expanded and/or improved procedures intended to fill, or mitigate, many of the key data gaps identified by the initial EA were developed. This was done by: 1) reviewing analytical methodologies to obtain increased analytical sensitivity for some analyses, 2) expanding replication of samples to increase statistical confidence, 3) sampling biological tissues in multiple potential forage or prey items, 4) measuring several physicochemical characteristics to provide further insight into the fate and transport (especially bioavailability) of the COECs, and 5) developing biota-sediment accumulation factors using field-collected biological tissues and data from bioaccumulation tests conducted in the laboratory. Based on the ecological endpoints previously established and focusing on the COECs identified during the initial EA, the second EA re-evaluates exposures to ecological receptors in light of changed conditions, updated toxicological information and the expanded and/or improved site-specific information obtained in 1997.

Interpretation of ecological significance is summarized as follows. The estimated and apparent adverse effects of several of the COECs, based on the results of this second EA, suggest impact at the population and community levels, primarily to strictly-aquatic receptors and small semiaquatic vertebrates). However, these effects are largely confined to on-base portions of the SCSSW OU. In addition, interpretation of significance is blurred by the overt presence of numerous other stresses, particularly the extensive physical modifications of habitats in both creeks.

SECTION 9
DEFICIENCIES

There were no deficiencies identified for the second Five-Year Review of the SCSSW OU. Recommendations identified in the previous Five-Year Reviews were carried out.

SECTION 10
PROTECTIVENESS STATEMENTS

Based on results of the HHRAs and comparison of data to health-based action levels, there is no unacceptable risk to human health for the SCSSW OU.

In addition, numerous activities have occurred in the area of the SCSSW OU that serve to remove or reduce potential contaminant sources. Certain remedial measures have also recently been implemented by OC-ALC/EM at West Soldier Creek. Flight line criteria at Tinker AFB have prompted upgrades to the landscape along the creek. The channel of the creek has also been concreted. This action serves as a facility improvement as well as a remedial measure (although not identified as a ROD requirement) to minimize the potential for sediments to move off-base and pose a human health or ecological threat to downstream receptors.

Protectiveness of the environment has been attained by these remedial responses. As required in the ROD for this site, annual monitoring efforts were carried out during the previous five years to ensure no danger to human health or the environment exists. Because sampling has been discontinued at the SCSSW OU and the site is considered closed in accordance with the ROD, it is recommended that no further five year reviews be generated.

SECTION 11
NEXT REVIEW

A letter dated September 14th, 2004, was received from the Environmental Protection Agency (EPA) which confirmed that the remedial actions conducted at the site were constructed in accordance with the Record of Decision (ROD), August 1993. Tinker Air Force Base (AFB) has completed remedial construction activities necessary to achieve performance standards and site completion.

Subsequently, a Remedial Action Report (RAR) was submitted and was accepted by the EPA on January 12, 2006. This Remedial Action Report (RAR) documents that Tinker Air Force Base has completed all construction activities for the remedial action at the Soldier Creek Sediment and Surface Water (OU-2) site in accordance with Close-Out Procedures for National Priorities List Sites (EPA OSWER Directive 9320.2-09A-P, January 2000).

All site response actions, including remedial actions, were accomplished pursuant to, and in accordance with, the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and consistent with the National Contingency Plan (NCP), 40 CFR Part 300.

Therefore, this will be the final Five Year Review report for the Soldier Creek Sediment and Surface Water (Operable Unit 2).

LIST OF DOCUMENTS REVIEWED

B&V, *Record of Decision, Tinker AFB-Soldier Creek Sediment and Surface Water Operable Unit*, Final Report, August 1993.

B&V, *Remedial Investigation Report, Multi-Phased RemedialInvestigation (RI) of Surface and Subsurface Contamination of Soldier Creek at Tinker AFB, Oklahoma,* Final Report, February 1993.

Ch2MHill, *Seventh Year Long-Term Monitoring Annual Report for Long-Term Monitoring of Soldier Creek Sediment and Surface Water Operable Unit,* Final Report, October 2002.

CH2MHill, *First Event Eighth Year Sampling Report (April 2002 Sampling Event) for Long-Term Monitoring of Soldier Creek Sediment and Surface Water Operable Unit,* Final Report, June 2002.

OC-ALC/EMR, *Memorandum for Chris Villarreal (EPA) on Soldier Creek Sediment and Surface Water Operable Unit,* January 2002.

OC-ALC, *Memorandum for Cathy Scheirman (OC-ALC/EM) on Soldier Creek Sediment and Surface Water Operable Unit*, October 2002.

Parsons ES, *Five-Year Review Report for the Soldier Creek/Building 3001 NPL Site*, Final Report, September 1998

URS Greiner Woodward Clyde, *Ecological Assessment II Report for the 1997 Ecological Assessment of Soldier Creek, Tinker AFB, Oklahoma City, OK*, Final Report, Volumes I, II, and III, May 1999.

FIGURES

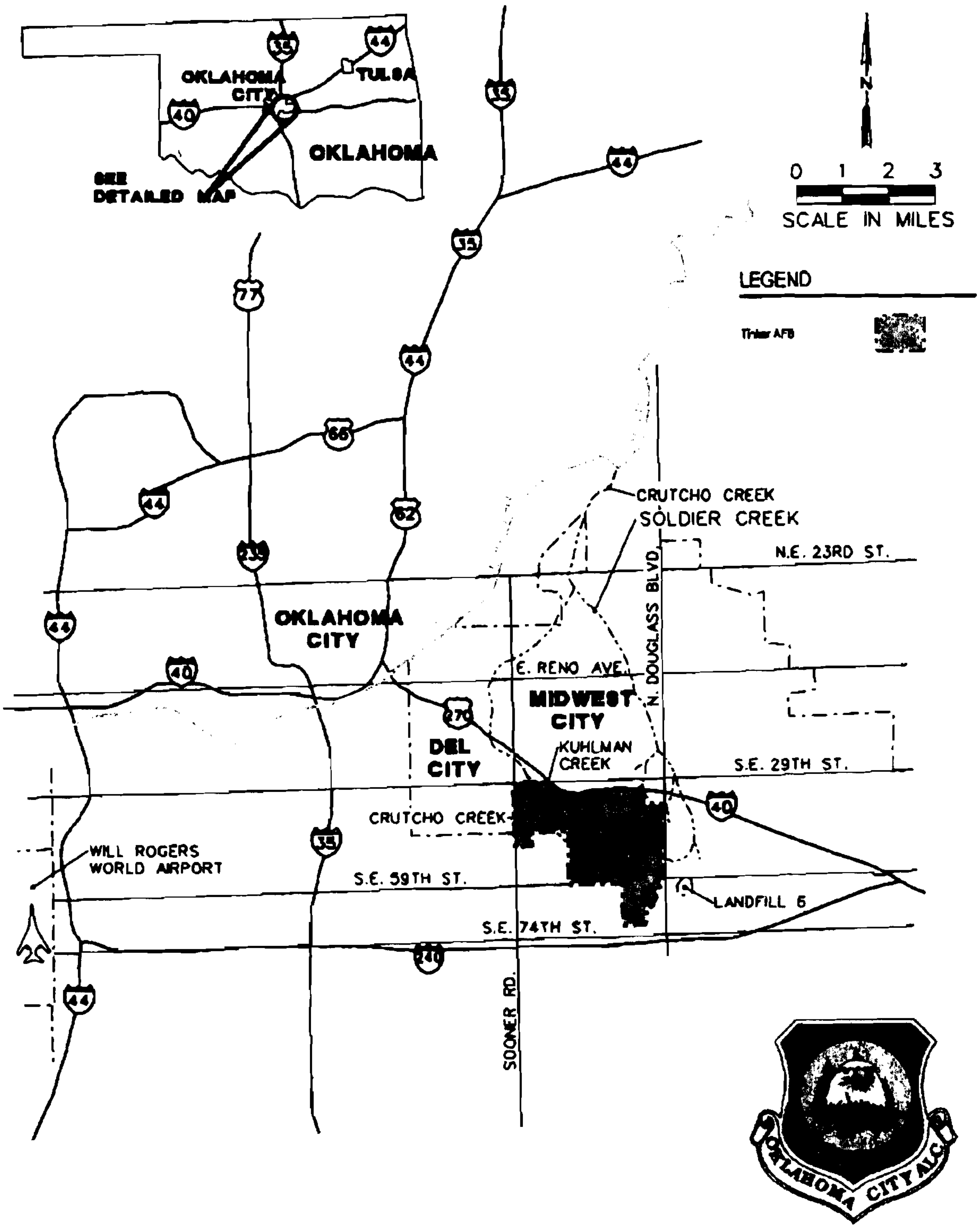

FIGURE 1
Tinker Air Force Base Vicinity Map
Tinker Air Force Base, Oklahoma City, Oklahoma

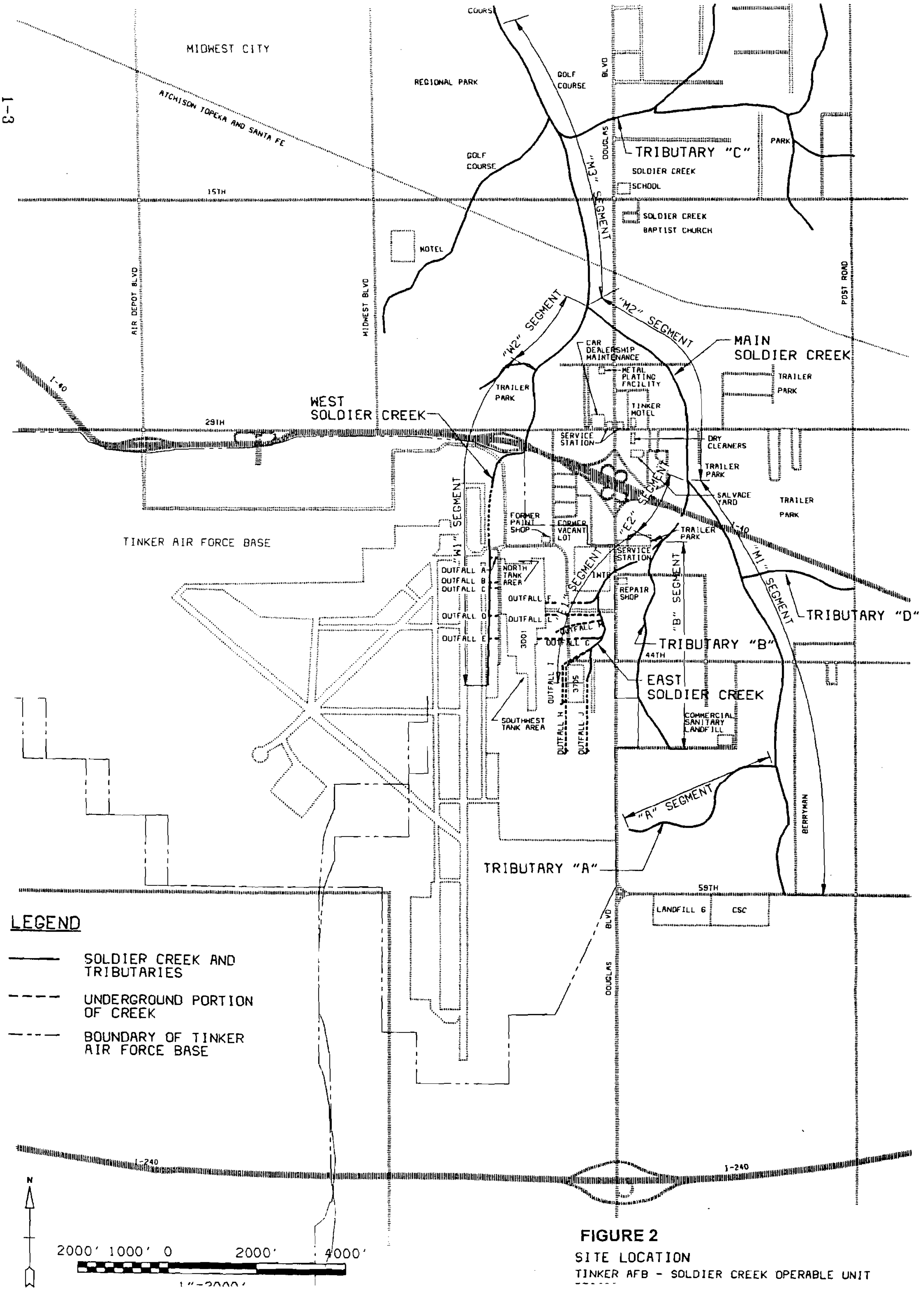

FIGURE 2

SITE LOCATION

TINKER AFB - SOLDIER CREEK OPERABLE UNIT

Figure 3. Location of land use changes since previous Five-Year Review

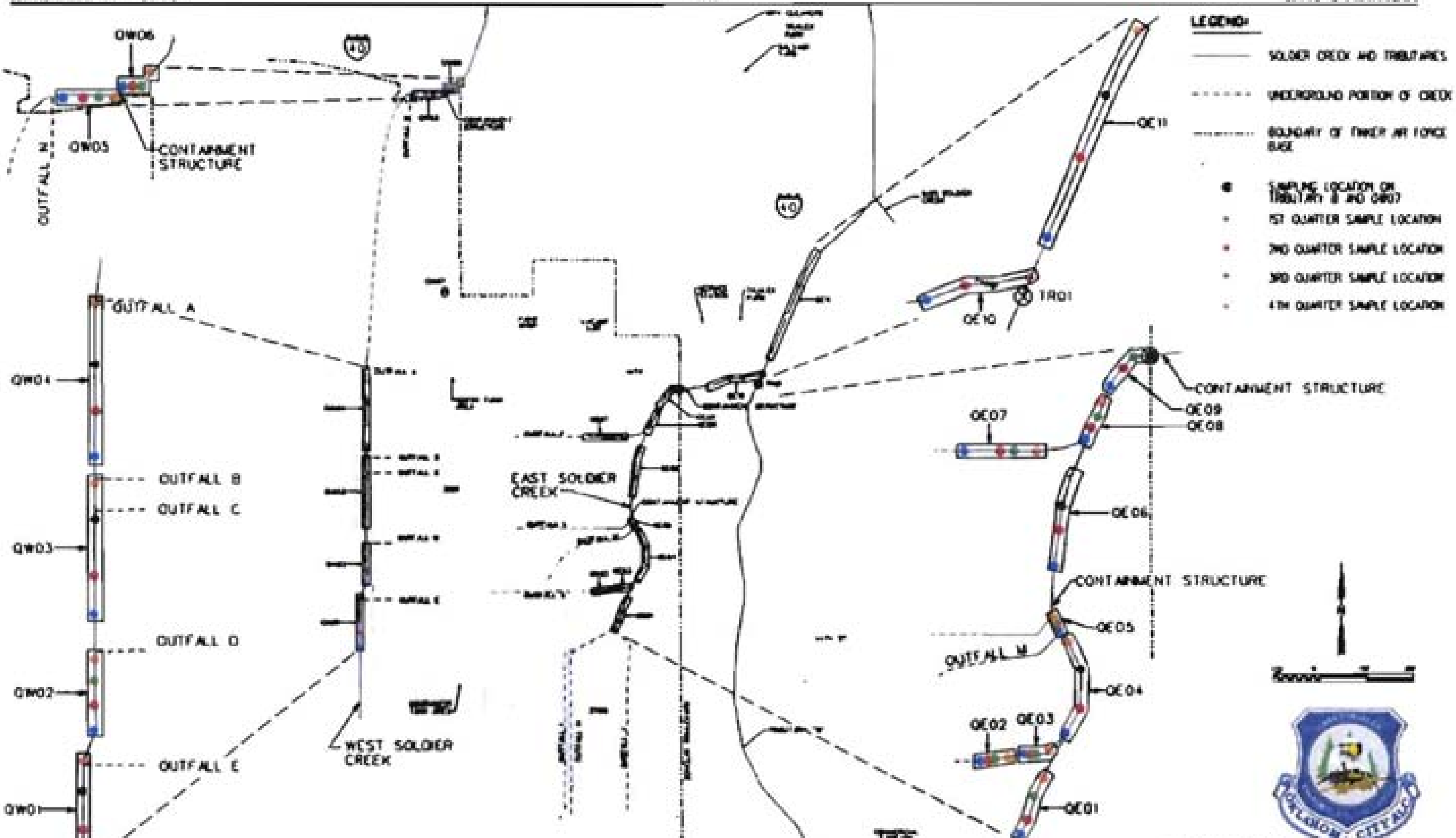

FIGURE 4

Soldier Creek Long-Term Monitoring Sampling Sections and Quarterly Monitoring Sampling Locations
Tinker AFB, Oklahoma City, Oklahoma

APPENDIX A

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	1Qtr1Yr (Nov 1994)	2Qtr1Yr (Jan 1995)	3Qtr1Yr (Apr 1995)	4Qtr1Yr (Jul 1995)	1Qtr2Yr (Oct 95)	2Qtr2Yr (Mar 96)	3Qtr2Yr (May 96)	4Qtr2Yr (Aug 96)	1Evnt3Yr (Jan 97)	2Evnt3Yr (Jul 97)	1Evnt4Yr (Jan 98)
Metals (mg/L)													
Aluminum	7.43	ND	4.3	0.55	0.7	0.15	0.053	0.038	0.18	0.21	0.06	0.73	0.063
Antimony	ND	ND	ND	ND	ND	ND	0.046	0.00091	0.00037	0.00051	0.00055	ND	0.00076
Arsenic	0.0098	ND	0.0026	0.0035	0.0024	0.0031	0.0015	0.0033	0.0033	0.0029	0.0027	0.0038	ND
Barium	1.9	ND	0.61	0.46	0.44	0.68	0.54	0.37	0.49	0.65	0.55	0.62	0.42
Beryllium	0.001	ND	ND	ND	ND	ND	ND	ND	0.00068	0.00014	ND	ND	ND
Boron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.0569	0.0094	0.0036	0.0061	ND	ND	ND	0.001	0.0034	0.0053	0.0012	0.016	0.00075
Calcium	117	ND	92.4	74.4	61.2	99.6	103	67.9	103	91.1	72.4	66.9	69.2
Chromium	0.628	0.0369	0.039	0.52	0.031	0.056	0.014	0.0097	0.015	0.02	0.014	0.045	0.025
Cobalt	0.324	ND	0.031	0.0068	0.008	ND	ND	0.0012	0.0017	0.00054	0.0018	0.001	0.00058
Copper	0.985	ND	0.11	0.08	0.098	0.3	0.27	0.049	0.14	0.36	0.083	0.51	0.061
Iron	4.55	ND	3.4	1.3	1.4	0.28	0.12	1.5	1.7	1.1	0.44	1.9	0.16
Lead	0.325	0.0345	0.0066	0.03	0.0054	0.0048	0.0028	0.0035	0.016	0.0001	0.0016	0.015	0.00034
Magnesium	40.8	ND	44.3	33.3	29.9	45.7	47.2	32.5	49.8	44.7	36.1	33.3	26.4
Manganese	3.06	ND	0.35	0.13	0.44	0.14	0.086	0.12	0.23	0.091	0.067	0.24	0.14
Mercury	ND	ND	ND	0.00018	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	ND	ND	0.57	0.42	0.2	0.3	0.5	0.29	0.56	0.013	0.02	0.0026	0.12
Nickel	3.56	ND	0.33	0.093	0.033	0.016	0.011	0.032	0.049	0.015	0.052	0.013	0.33
Potassium	6.68	ND	5.7	5	4.5	5.7	5.4	9.6	6.2	3.6	2.3	10.1	2.2
Selenium	0.0209	ND	0.0036	0.0041	0.0041	0.0024	0.0027	0.0028	0.021	0.0042	0.0042	0.0018	0.0033
Silver	0.0131	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00013	0.00062	0.0003
Sodium	130	ND	203	106	123	111	179	200	114	68	29.3	29.8	26.4
Thallium	ND	ND	ND	ND	0.0012	ND	ND	ND	ND	ND	ND	ND	ND
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	0.067	ND	0.028	0.018	0.017	0.03	0.026	0.019	0.026	0.023	0.018	0.017	0.017
Zinc	2.4	ND	0.068	0.044	0.034	0.032	0.055	0.076	0.1	0.026	0.036	0.075	0.065
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB's and Chlorinated Pesticides (ug/L)													
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	0.075	ND	ND	ND	ND	ND
Aldrin	ND	ND	ND	0.086	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.58	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	1Qtr1Yr (Nov 1994)	2Qtr1Yr (Jan 1995)	3Qtr1Yr (Apr 1995)	4Qtr1Yr (Jul 1995)	1Qtr2Yr (Oct 95)	2Qtr2Yr (Mar 96)	3Qtr2Yr (May 96)	4Qtr2Yr (Aug 96)	1Evnt3Yr (Jan 97)	2Evnt3Yr (Jul 97)	1Evnt4Yr (Jan 98)
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organics (ug/L)													
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	2	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	ND	ND	2.8	ND	ND	ND	5.4	ND	ND	2.7	6.2	ND	ND
2-Chlorethyl vinyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.4	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	5	60	11	4.6	8.4	12	26	4.4	12	24	7.2	12	5.1
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7	ND	ND
Benzene	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	6	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	4	15	1.9	ND	2.6	1.8	4.0	ND	1.9	2.6	1.6	ND	1.4
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.2	ND	ND
Carbon disulfide	ND	1	ND	1	ND	ND	ND	4	2.5	ND	ND	ND	ND
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	2	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	6	9	ND	1.8	ND	ND	ND	ND	1.0	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	5	ND	ND	ND	ND	ND	ND	ND	ND	1.1	1.8	ND	ND
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	2.4	ND	ND	ND	ND	ND	ND
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	41	ND	ND
Ethyl methacrylate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iodomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	1Qtr1Yr (Nov 1994)	2Qtr1Yr (Jan 1995)	3Qtr1Yr (Apr 1995)	4Qtr1Yr (Jul 1995)	1Qtr2Yr (Oct 95)	2Qtr2Yr (Mar 96)	3Qtr2Yr (May 96)	4Qtr2Yr (Aug 96)	1Evnt3Yr (Jan 97)	2Evnt3Yr (Jul 97)	1Evnt4Yr (Jan 98)
Methylene chloride	14	620	11	150	2.8	5.1	150	2.3	2.3	12	5.9	1.4	3.1
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.4	ND	ND
Tetrachloroethene	3	6	11	7.6	2.1	ND	ND	ND	1.5	ND	ND	ND	1.5
Toluene	1	5	ND	1.4	ND	ND	ND	ND	3.6	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,4-Dichloro-2-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorethene	ND	ND	3.1	14	1.6	ND	ND	9.4	13	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl acetate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/L)													
1,2,4,5-Tetrachloro-benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	1.7	ND	ND	1.0	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.96	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.8	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3/4-Methylphenol	ND	ND	ND	ND	1.3	1.7	1.2	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	1Qtr1Yr (Nov 1994)	2Qtr1Yr (Jan 1995)	3Qtr1Yr (Apr 1995)	4Qtr1Yr (Jul 1995)	1Qtr2Yr (Oct 95)	2Qtr2Yr (Mar 96)	3Qtr2Yr (May 96)	4Qtr2Yr (Aug 96)	1Evnt3Yr (Jan 97)	2Evnt3Yr (Jul 97)	1Evnt4Yr (Jan 98)
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	1.7	2	1.2	ND	1.3	ND	ND	ND	ND	ND
7,12-Dimethylbenz(a)-anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a,a-Dimethylphenethyl-amine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetophenone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Azobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic acid	0.4	ND	ND	ND	2.9	3.9	1.6	1.2	1.2	1.5	ND	ND	ND
Benzyl alcohol	ND	ND	ND	1.7	1.2	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	1	3.6	ND	ND	ND	ND	ND	1.3	13	140	140
Butyl benzyl phthalate	ND	ND	1	ND	ND	ND	3.2	ND	ND	ND	ND	ND	ND
Chrysene	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	1.5
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h,)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,j)acridine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND
Diethyl phthalate	ND	ND	ND	ND	ND	1.2	1.1	ND	ND	ND	ND	ND	ND
Dimethyl phthalate	ND	ND	ND	ND	ND	ND	ND	1	ND	1.3	ND	ND	ND
Diphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	1	ND	ND	1.5	ND	ND	ND	1.6	ND	1.5	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	1Qtr1Yr (Nov 1994)	2Qtr1Yr (Jan 1995)	3Qtr1Yr (Apr 1995)	4Qtr1Yr (Jul 1995)	1Qtr2Yr (Oct 95)	2Qtr2Yr (Mar 96)	3Qtr2Yr (May 96)	4Qtr2Yr (Aug 96)	1Evnt3Yr (Jan 97)	2Evnt3Yr (Jul 97)	1Evnt4Yr (Jan 98)
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	3.5	2.7	ND	2	2	ND	1.4	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	2Evnt4Yr (Jul 98)	1Evnt5Yr (Jan 99)	2Evnt5Yr (Jun 99)	1Evnt6Yr (Apr 00)	2Evnt6Yr (Aug 00)	1Evnt7Yr (Apr 01)	2Evnt7Yr (Sep 01)
Metals (mg/L)									
Aluminum	7.43	ND	0.88	0.66	0.54	0.7	0.26	1.93	1.24
Antimony	ND	ND	0.0019	0.0014	0.0015	0.00113	ND	0.0021	0.0029
Arsenic	0.0098	ND	0.0061	0.0028	0.0029	0.00224	0.0033	ND	0.0058
Barium	1.9	ND	0.52	0.48	0.43	0.517	0.47	0.466	0.658
Beryllium	0.001	ND	0.00012	ND	ND	ND	ND	ND	0.00014
Boron	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.0569	0.0094	0.01	0.0012	0.0071	0.00163	0.000897	0.001	0.0022
Calcium	117	ND	48.5	53.9	76.6	55	57	61.4	46.5
Chromium	0.628	0.0369	0.025	0.0079	0.013	0.00836	0.0067	0.0092	0.0151
Cobalt	0.324	ND	0.00089	0.00063	0.00055	ND	ND	0.0019	0.0023
Copper	0.985	ND	0.14	0.029	0.16	0.0209	0.0241	0.0303	0.0298
Iron	4.55	ND	1.2	0.54	1.2	2.2	0.28	1.96	2.93
Lead	0.325	0.0345	0.0091	0.0014	0.0045	0.00429	0.00174	0.0072	0.0108
Magnesium	40.8	ND	24.1	25.4	25.1	27	26	26.3	22
Manganese	3.06	ND	0.092	0.24	0.22	0.232	0.12	0.328	0.817
Mercury	ND	ND	ND	ND	0.00032	ND	ND	ND	ND
Molybdenum	ND	ND	0.0036	0.0057	0.0046	0.018	ND	ND	ND
Nickel	3.56	ND	0.015	0.0059	0.0052	0.00554	0.0132	0.006	ND
Potassium	6.68	ND	4.7	3.6	10	5.3	5	7.9	6.21
Selenium	0.0209	ND	0.0016	0.0023	0.00066	0.00102	0.00402	ND	ND
Silver	0.0131	ND	0.00036	ND	ND	ND	ND	ND	ND
Sodium	130	ND	36.3	36.4	36.2	25	29	31.6	26.3
Thallium	ND	ND	0.0000075	0.000066	0.00004	ND	ND	0.00098	ND
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	0.067	ND	0.016	0.014	0.012	0.0119	ND	ND	0.0096
Zinc	2.4	ND	0.056	0.051	0.061	ND	0.037	0.0668	0.0647
	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB's and Chlorinated Pesticides (ug/L)									
4,4'-DDD	ND	ND	ND	ND	ND	0.01	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	0.072	ND	ND	ND
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	0.029	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	2Evnt4Yr (Jul 98)	1Evnt5Yr (Jan 99)	2Evnt5Yr (Jun 99)	1Evnt6Yr (Apr 00)	2Evnt6Yr (Aug 00)	1Evnt7Yr (Apr 01)	2Evnt7Yr (Sep 01)
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	0.024	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	0.00084	ND	ND	ND	ND
'	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organics (ug/L)									
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	2	5	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	2	ND	ND	1	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	0.29	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	ND	ND	ND	ND	2	ND	ND	ND	ND
2-Chlorethyl vinyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	5	60	3.1	6.6	10	5	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	2	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	6	0.9	ND	ND	0.19	ND	ND	ND	ND
Bromoform	4	15	ND	3	0.35	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	ND	1	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	2	ND	0.72	0.21	0.25	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	6	9	ND	ND	0.17	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	5	ND	ND	ND	0.27	ND	ND	ND	ND
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methacrylate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iodomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	2Evnt4Yr (Jul 98)	1Evnt5Yr (Jan 99)	2Evnt5Yr (Jun 99)	1Evnt6Yr (Apr 00)	2Evnt6Yr (Aug 00)	1Evnt7Yr (Apr 01)	2Evnt7Yr (Sep 01)
Methylene chloride	14	620	2.2	0.6	0.25	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	3	6	ND	ND	ND	ND	ND	ND	ND
Toluene	1	5	ND	ND	ND	0.81	ND	2.2	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,4-Dichloro-2-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorethene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl acetate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	ND	2	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/L)									
1,2,4,5-Tetrachloro-benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND
3/4-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	2Evnt4Yr (Jul 98)	1Evnt5Yr (Jan 99)	2Evnt5Yr (Jun 99)	1Evnt6Yr (Apr 00)	2Evnt6Yr (Aug 00)	1Evnt7Yr (Apr 01)	2Evnt7Yr (Sep 01)
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
7,12-Dimethylbenz(a)-anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
a,a-Dimethylphenethyl-amine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetophenone	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Azobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	6	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic acid	0.4	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	5.5	ND	11	ND	8	2.2
Butyl benzyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	5	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	ND	ND	2	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h,)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,j)acridine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	1.1
Dimethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	1	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS
WITH RI RESULTS IN SURFACE WATER

Analytes	Phase I RI	Phase II RI	2Evnt4Yr (Jul 98)	1Evnt5Yr (Jan 99)	2Evnt5Yr (Jun 99)	1Evnt6Yr (Apr 00)	2Evnt6Yr (Aug 00)	1Evnt7Yr (Apr 01)	2Evnt7Yr (Sep 01)
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	1	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1qtr1yr (Nov 1994)		2qtr1yr (Jan 1995)		3qtr1yr (Apr 1995)		4qtr1yr (Jul 1995)		1qtr2yr (Oct 95)		2qtr2yr (Mar 96)		3qtr2yr (May 96)		4qtr2yr (Aug 96)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Metals (mg/kg)																		
Aluminum	42300	ND	14100	16400	23400	20000	21000	16400	13400	12900	21000	21200	17000	9490	16700	15400	23400	13500
Antimony	ND	ND	ND	ND	9.8	6.2	7.9	9.5	8.6	ND	15.8	5.6	ND	ND	7.9	ND	17.3	ND
Arsenic	15.7	ND	7.5	7.5	7.2	5.3	8.4	7.2	9	5.7	5.2	8.7	10.5	3.2	6.4	6.1	13.2	7.3
Barium	2910	ND	3850	1010	2380	1350	1860	12000	1690	1050	3350	807	2440	620	1330	1270	1840	2010
Beryllium	ND	ND	1.1	1.3	1.2	1.2	1.5	1.2	0.85	0.82	1.2	1.4	1.2	0.72	1	0.78	1.5	0.97
Boron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	428	15.7	123	328	83.2	132	106	183	415	108	87.3	306	85.1	120	390	158	242	29.8
Calcium	72500	ND	181000	132000	128000	36000	142000	81200	210000	174000	214000	107000	231000	54700	140000	94300	79200	76800
Chromium	2020	186	820	13350	1230	2430	1890	828	2040	3210	912	5140	2920	977	2230	1460	1870	1850
Cobalt	52.1	ND	42.1	35.7	123	91.8	61.7	56.7	21.6	126	108	105	51.8	80.4	109	20.1	90.1	15.1
Copper	600	ND	541	168	650	125	583	246	2210	175	654	1220	551	181	467	217	17000	292
Iron	41200	ND	19000	26600	249000	19800	21100	21800	24900	22200	24900	27900	26700	15500	20200	17800	27500	31800
Lead	586	152	318	184	225	469	268	286	4400	746	498	616	291	187	1050	170	1210	224
Magnesium	20400	ND	22800	15200	16700	12000	13600	10300	306000	17000	24100	13100	12400	9590	17300	15000	6120	9150
Manganese	1490	ND	890	965	836	1750	778	2030	1930	4250	1730	1130	857	653	4140	853	1840	2940
Mercury	2.6	ND	0.55	0.3	.9	.3	.59	.81	0.63	0.58	1.5	1.1	4.7	0.5	0.9	0.67	3.8	0.67
Molybdenum	ND	ND	23.8	26	62.6	34.8	36.9	56.4	25.5	17.9	39.4	136	135	28	32.6	21	62.1	27.7
Nickel	2270	ND	704	1090	3160	1370	2830	1220	747	861	3690	8790	3600	1790	778	431	1420	801
Potassium	2300	ND	2030	2910	4230	4880	3200	2850	1930	1590	2830	2820	2780	1380	2530	2450	3010	2400
Selenium	10.2	ND	3.4	4.2	12	2	4.3	.79	1	0.85	7.2	17.7	6.2	1.3	0.93	0.54	7.2	5.5
Silver	112	ND	64.6	79.4	205	72.2	91.9	6.9	18.7	15.9	112	245	131	80	102	19.1	42.7	2.3
Sodium	ND	ND	1890	819	ND	ND	ND	ND	191	165	400	392	ND	ND	270	296	ND	ND
Thallium	ND	ND	0.38	0.19	ND	ND	.2	ND	0.14	0.18	0.33	0.26	ND	ND	62.6	51.4	61.6	52.5
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	52.9	ND	48.7	58.7	95.7	42.1	67.9	38.4	48.3	47	75.4	112	121	48.7	46.3	31.7	57	56.8
Zinc	640	ND	668	372	1790	506	1280	311	890	542	1920	2570	1670	557	442	209	759	227
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB's and Chlorinated Pesticides (ug/kg)																		
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	260	ND	890	ND	72	63	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ND	ND	57	120	ND	1.4	840	650	ND	ND	3700	2500	ND	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	910	ND	ND	ND	ND	ND	ND	16000	15000	480	250	120	98	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	8300	5200	24000	33000	40000	18000	25000	17000	39000	19000	15000	86000	20000	51000	61000	8200
Aroclor 1260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	480	ND

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1qtr1yr (Nov 1994)		2qtr1yr (Jan 1995)		3qtr1yr (Apr 1995)		4qtr1yr (Jul 1995)		1qtr2yr (Oct 95)		2qtr2yr (Mar 96)		3qtr2yr (May 96)		4qtr2yr (Aug 96)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	140	370	ND	ND	ND	ND	ND	ND	3200	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	25000	18000	890	ND	890	280	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	38	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	180	820	1200	1400	ND	110	52000	49	7000	4600	600	390	310	190	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	210	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organics (ug/kg)																		
1,1,1,2-Tetrachloroethane	ND	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	29	ND	ND	2.6	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	ND	ND	1.7	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	2.1	6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	ND	ND	6.9	12	21	26	2900	51	80	15	62	99	25	7.9	250	19	56	71
2-Chlorethyl vinyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	1700	51	100	62	100	130	950	240	490	82	120	54	200	70	740	62	190	79
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	4.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	1	ND	2.2	ND	1.5	1.7	5.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	36	2	11	15	5.6	2.9	1.5	11	8.7	9.6	4.1	7.6	4.4	ND	3.2	2.7	5.6	6.4
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6	ND	ND	ND	ND	ND	ND
Chlorobenzene	78000	10	41	940	310	3900	18000	64	120	64	180	3.9	240	2500	95	25000	3	13
Chloroethane	86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	9200	2	ND	ND	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	ND	ND	1.8	ND	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.4	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 4
COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1qtr1yr (Nov 1994)		2qtr1yr (Jan 1995)		3qtr1yr (Apr 1995)		4qtr1yr (Jul 1995)		1qtr2yr (Oct 95)		2qtr2yr (Mar 96)		3qtr2yr (May 96)		4qtr2yr (Aug 96)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methacrylate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	4	ND	3.3	2.3	ND	ND	ND	2.5	ND	ND	ND	ND	ND	ND	18	420	ND	1.3
Iodomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	140000	51	24	14	5.4	390	600	15	7.1	7.2	5	6.8	21	4.3	25	24	8.2	3.2
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	83000	11	7.9	16	5.5	ND	17	5.8	3.6	ND	89	87	11	7.3	2.1	12	ND	33
Toluene	980	6	12	3.6	ND	2.9	2.1	150	3	2.7	15	8.5	63	150	760	3.1	15	1.4
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,4-Dichloro-2-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorethene	4100	ND	16	77	4.1	1.7	1.9	1.9	ND	ND	13	16	3.8	2.4	ND	3.7	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl acetate	.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	1000	6	ND	3.4	2.3	ND	ND	1.7	ND	ND	2.2	2.4	2.6	ND	ND	770	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)																		
1,2,4,5-Tetrachloro-benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	140	51	ND	ND
1,2-Dichlorobenzene	3100	ND	340	200	250	570	850	2200	310	ND	44	ND	3000	ND	1600	670	3600	ND
1,3-Dichlorobenzene	280	ND	ND	ND	ND	ND	ND	100	ND	ND	ND	ND	ND	ND	150	1800	520	ND
1,4-Dichlorobenzene	4400	ND	60	ND	ND	210	ND	280	ND	46	ND	ND	2400	ND	250	4100	1200	ND
1-Chloronaphthalene	ND	ND	250	5200	610	2400	ND	3500	1300	960	390	420	1500	2600	260	470	350	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	84	ND	50	ND	ND	ND	ND	350	ND	ND	ND	ND	180	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	1600	ND	ND	700	ND	210	ND	350	1400	1000	310	600	ND	310	ND	2100	280	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	1900	ND	110	150	ND	100	410	1000	1200	100	460	ND	4000	ND	460	10000	610	ND
2-Methylphenol	68	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	1700	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1qtr1yr (Nov 1994)		2qtr1yr (Jan 1995)		3qtr1yr (Apr 1995)		4qtr1yr (Jul 1995)		1qtr2yr (Oct 95)		2qtr2yr (Mar 96)		3qtr2yr (May 96)		4qtr2yr (Aug 96)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1300	ND	ND	1000	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3/4-Methylphenol	ND	ND	88	ND	ND	58	140	ND	160	220	ND	ND	440	60	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17000	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	230	570
7,12-Dimethylbenz(a)-anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a,a-Dimethylphenethyl-amine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	1100	ND	410	3100	260	490	1600	1800	8000	510	4200	2000	17000	500	1900	15000	3100	710
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	44	ND	ND	ND	ND	ND	ND	ND	360	ND
Acetophenone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	1500	ND	830	4800	620	1400	5800	4400	26000	840	11000	11000	36000	2400	3600	29000	5000	2600
Azobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	160	ND	ND	430	ND	ND	ND	350	ND	ND	ND	ND	ND	290	ND
Benzo(a)anthracene	4800	ND	2900	15000	2100	3000	11000	13000	39000	3200	26000	21000	59000	6200	11000	46000	16000	6300
Benzo(a)pyrene	4400	ND	2600	14000	2200	3100	9800	11000	26000	3200	26000	19000	45000	4700	10000	35000	14000	6200
Benzo(b)fluoranthene	9200	ND	6100	28000	4000	6000	19000	20000	9800	6600	49000	33000	83000	8300	20000	43000	27000	9300
Benzo(g,h,i)perylene	4100	ND	1800	1200	1300	1700	7600	6800	17000	1900	20000	11000	19000	2000	5400	16000	10000	3600
Benzo(k)fluoranthene	5300	ND	2400	670	2800	110	15000	81	39000	2600	210	2100	ND	250	410	23000	7400	320
Benzoic acid	ND	ND	170	ND	ND	ND	70	ND	ND	ND	ND	ND	56	69	50	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	79	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	46000	ND	7000	7800	8000	11000	7800	23000	ND	ND	7800	5500	11000	24000	6500	22000	4500	8900
Butyl benzyl phthalate	720	ND	6000	ND	ND	ND	4900	ND	560	ND	230	ND	ND	ND	ND	ND	71	ND
Chrysene	7100	ND	5200	19000	2600	3300	15000	15000	35000	5000	33000	21000	57000	5900	12000	42000	18000	7200
Di-n-butyl phthalate	2200	ND	150	150	130	150	ND	ND	ND	4600	59	ND	ND	ND	54	ND	510	ND
Di-n-octyl phthalate	540	ND	410	400	ND	520	180	11000	700	ND	500	56	1400	8900	ND	210	84	630
Dibenz(a,h,)anthracene	110	ND	750	420	150	ND	1600	1300	ND	ND	1300	2100	6000	570	1100	4100	770	840
Dibenz(a,j)acridine	ND	ND	ND	ND	ND	ND	ND	ND	1400	89	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	480	ND	250	1500	160	340	1000	1000	5500	310	2500	1600	11000	360	1200	8000	1600	ND
Diethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	120	ND	ND	ND	ND	160	ND	ND
Dimethyl phthalate	ND	ND	ND	ND	57	ND	ND	ND	660	530	300	ND	86	280	ND	ND	ND	ND
Diphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	11000	ND	6400	3800	6300	8100	25000	23000	53000	8000	100000	85000	120000	14000	35000	120000	30000	14000
Fluorene	880	ND	410	2600	300	560	2400	2200	12000	530	5900	3600	23000	820	1700	16000	2700	620

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1qtr1yr (Nov 1994)		2qtr1yr (Jan 1995)		3qtr1yr (Apr 1995)		4qtr1yr (Jul 1995)		1qtr2yr (Oct 95)		2qtr2yr (Mar 96)		3qtr2yr (May 96)		4qtr2yr (Aug 96)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	3800	ND	1700	4600	1100	1600	6100	5600	19000	1700	14000	8200	20000	1900	4700	15000	8900	3400
Isophorone	ND	ND	ND	ND	ND	ND	98	ND	ND	57	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	150	50	ND	ND	ND	ND	ND	ND	ND	47	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	690	ND	1000	860	1100	3700	980	1600	5900	800	2500	1100	15000	690	2200	4100	2700	520
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	490	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	6700	ND	3800	3700	3300	6200	22000	14000	58000	5200	73000	58000	110000	7100	18000	110000	28000	9100
Phenol	ND	ND	ND	ND	63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	10000	ND	7800	55000	4500	6400	26000	33000	51000	7100	80000	58000	110000	14000	27000	88000	28000	11000

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1Evnt3Yr (Jan 97)		2Evnt3Yr (Jul 97)		1Evnt4Yr (Jan 98)		2Evnt4Yr (Jul 98)		1Evnt5Yr (Jan 99)		2Evnt5Yr (Jun 99)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Metals (mg/kg)														
Aluminum	42300	ND	22700	13800	12000	8940	16300	10500	11900	8690	12300	12400	16200	14700
Antimony	ND	ND	ND	ND	7.6	6.2	2.9	7.4	7.2	4.1	21.7	ND	3.7	21.2
Arsenic	15.7	ND	15.7	7.2	5.3	4.8	9.7	3.6	12.2	4.4	38.2	10.5	12	6.2
Barium	2910	ND	3200	1790	2370	655	4550	599	890	914	1680	1860	1880	884
Beryllium	ND	ND	1.7	0.81	0.97	0.93	1	0.93	0.97	0.73	1	0.9	0.89	0.8
Boron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	428	15.7	80	112	837	255	127	193	291	115	58.4	74.1	297	961
Calcium	72500	ND	141000	121000	79300	67800	102000	70200	96700	59200	226000	147000	99100	40900
Chromium	2020	186	2800	1110	1700	1210	994	1830	732	734	600	372	896	2060
Cobalt	52.1	ND	61.7	166	36.6	16.4	331.1	78.3	23.9	10.1	12	47.7	50.4	45.6
Copper	600	ND	581	2010	548	401	1390	498	514	94.5	324	267	401	514
Iron	41200	ND	24400	18500	15300	20300	27000	14100	18500	14700	107000	91000	23000	17500
Lead	586	152	528	422	415	160	1280	306	158	188	3230	176	433	1060
Magnesium	20400	ND	27100	22000	23900	7320	14900	10500	17900	10500	22600	23400	27100	4920
Manganese	1490	ND	1780	1890	1830	725	5370	887	1390	898	918	1620	5750	2430
Mercury	2.6	ND	3.7	0.55	8.3	0.41	1.2	0.69	1.1	2.9	0.085	0.038	0.39	0.8
Molybdenum	ND	ND	41.8	262	14.5	7.7	62.8	97.3	14.6	14.6	12.6	74.1	6.6	11.7
Nickel	2270	ND	1430	6470	180	480	3590	3010	300	184	173	827	665	308
Potassium	2300	ND	2730	2050	1430	1400	2580	1550	1720	1280	881	2020	3050	2610
Selenium	10.2	ND	7.5	10.3	2.1	1.9	3.2	2.6	3.1	1.6	5.5	1.4	1.6	1.6
Silver	112	ND	99.2	725	15.2	14.8	45.3	236	16.3	12	8.7	5.6	18.6	26
Sodium	ND	ND	ND	ND	242	517	244	170	181	194	463	228	169	202
Thallium	ND	ND	127	126	37.8	36.5	61.8	40.9	8.6	1.3	ND	ND	0.66	1
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	52.9	ND	82.9	117	45.8	36	92.2	51.7	47.6	31.8	54.9	29.5	44.2	44.3
Zinc	640	ND	1180	2310	671	268	647	924	489	264	618	262	388	691
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB's and Chlorinated Pesticides (ug/kg)														
4,4'-DDD	ND	ND	ND	ND	42	37	ND	ND	5.7	ND	ND	ND	110	94
4,4'-DDE	ND	ND	ND	ND	8.5	ND	ND	ND	100	ND	ND	ND	68	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	ND	1100	430
Aldrin	ND	ND	6.7	ND	97	ND	ND	ND	110	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	140	170
alpha-Chlordane	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	210	ND
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	10000	82000	3600	240	13000	9000	4700	380	19000	16000	1600	38
Aroclor 1260	ND	ND	ND	ND	680	ND	ND	ND	ND	ND	ND	96	ND	660

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1Evnt3Yr (Jan 97)		2Evnt3Yr (Jul 97)		1Evnt4Yr (Jan 98)		2Evnt4Yr (Jul 98)		1Evnt5Yr (Jan 99)		2Evnt5Yr (Jun 99)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.2	30
delta-BHC	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	310	220
Dieldrin	ND	ND	ND	ND	2.1	ND	ND	ND	ND	ND	ND	ND	38	25
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	ND
Endosulfan II	ND	ND	ND	ND	93	79	ND	ND	590	ND	ND	ND	7.1	22
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.1	ND
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30000	ND	190	7.8
gamma-BHC (Lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	20	23	ND	ND	ND	25	ND	ND	ND	73	6.7
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95
Heptachlor epoxide	ND	ND	ND	ND	2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organics (ug/kg)														
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone (MEK)	ND	ND	47	37	48	18	62	16	59	12	910	420	1100	770
2-Chlorethyl vinyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	1700	51	26	190	230	97	210	63	130	570	730	640	1000	2200
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	1	ND	ND	21	ND	ND	ND	ND	ND	ND	2.3	ND	2.8
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	36	2	5.7	8.7	9.2	ND	10	9.3	ND	ND	15	2.3	2.8	6.7
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	78000	10	140	910	2100	18000	32	15	2000	20000	310	10000	300	38000
Chloroethane	86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	9200	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	ND	ND	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1Evnt3Yr (Jan 97)		2Evnt3Yr (Jul 97)		1Evnt4Yr (Jan 98)		2Evnt4Yr (Jul 98)		1Evnt5Yr (Jan 99)		2Evnt5Yr (Jun 99)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	4.3	ND	ND	ND	ND	ND	ND	ND
Ethanol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methacrylate	ND	ND	ND	ND	ND	ND	ND	7.4	ND	ND	ND	ND	ND	ND
Ethylbenzene	4	ND	8.1	53	ND	ND	12	60	ND	ND	ND	ND	ND	ND
Iodomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	140000	51	5	17	21	5.5	7.7	6.3	6.9	ND	1.7	ND	7.1	5.3
Styrene	ND	ND	500	330	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	83000	11	ND	ND	ND	ND	2.2	ND	ND	ND	ND	13	ND	ND
Toluene	980	6	34	21	ND	13	2.5	1.3	ND	ND	ND	2.1	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,4-Dichloro-2-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorethene	4100	ND	ND	ND	1.9	ND	ND	ND	ND	ND	ND	29	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	3.5	ND	ND	ND	ND	ND	ND	ND
Vinyl acetate	.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	2.8	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	1000	6	ND	6.1	ND	3.1	9.4	2.4	ND	ND	ND	ND	ND	610
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)														
1,2,4,5-Tetrachloro-benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	357	ND	ND	ND
1,2-Dichlorobenzene	3100	ND	ND	1200	220	130	920	190	1400	11000	ND	ND	ND	ND
1,3-Dichlorobenzene	280	ND	ND	ND	ND	380	ND	ND	150	1100	ND	61	ND	ND
1,4-Dichlorobenzene	4400	ND	51	ND	130	1100	ND	100	890	6300	365	240	ND	ND
1-Chloronaphthalene	ND	ND	46	230	160	60	38000	250	890	3700	2600	1300	700	1000
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	64	ND	62	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	343	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	1600	ND	220	53	500	290	82	ND	78	710	ND	ND	ND	500
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	521	ND	ND	ND
2-Methylnaphthalene	1900	ND	280	410	470	4500	71	ND	95	1600	120	3300	220	4400
2-Methylphenol	68	ND	ND	ND	ND	ND	83	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	1700	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1Evnt3Yr (Jan 97)		2Evnt3Yr (Jul 97)		1Evnt4Yr (Jan 98)		2Evnt4Yr (Jul 98)		1Evnt5Yr (Jan 99)		2Evnt5Yr (Jun 99)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
3-Methylcholanthrene	ND	ND	ND	ND	250	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3/4-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	506	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	727	ND	ND	ND
7,12-Dimethylbenz(a)-anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a,a-Dimethylphenethyl-amine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	1100	ND	2000	860	2200	280	2400	2200	420	1300	590	830	1700	120
Acenaphthylene	ND	ND	ND	ND	43	ND	60	ND	90	520	67	ND	ND	ND
Acetophenone	ND	ND	ND	ND	110	ND	530	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	1500	ND	3200	1900	4400	440	12000	7700	1100	5000	2600	1800	3000	110
Azobenzene	ND	ND	ND	ND	ND	ND	530	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	110	94	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	4800	ND	9900	4700	7100	1700	46000	34000	8000	10000	21000	6200	8600	1700
Benzo(a)pyrene	4400	ND	11000	5000	9300	1900	63000	39000	9300	7200	25000	7200	8400	2000
Benzo(b)fluoranthene	9200	ND	13000	5900	11000	2300	55000	40000	13000	7300	35000	8700	13000	2100
Benzo(g,h,i)perylene	4100	ND	5300	2100	4300	960	60000	34000	8900	4000	19000	4900	8300	1400
Benzo(k)fluoranthene	5300	ND	8600	5500	12000	2000	59000	33000	8300	5900	22000	6800	8900	1600
Benzoic acid	ND	ND	ND	ND	280	ND	1800	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	46000	ND	7500	19000	13000	14000	16000	4200	5200	5500	5600	8300	3500	13000
Butyl benzyl phthalate	720	ND	470	ND	510	ND	68	ND	ND	ND	ND	ND	ND	ND
Chrysene	7100	ND	12000	6300	12000	2300	66000	47000	12000	12000	33000	8900	12000	2700
Di-n-butyl phthalate	2200	ND	200	ND	68	50	470	ND	53	ND	ND	ND	140	ND
Di-n-octyl phthalate	540	ND	660	500	ND	ND	510	ND	130	ND	ND	ND	ND	ND
Dibenz(a,h,)anthracene	110	ND	1900	900	1500	360	15000	11000	2700	620	7000	1900	ND	ND
Dibenz(a,j)acridine	ND	ND	330	ND	ND	ND	200	940	ND	ND	140	ND	ND	ND
Dibenzofuran	480	ND	1200	790	1500	180	800	1400	220	750	450	400	110	ND
Diethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	530	430
Dimethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	11000	ND	32000	18000	24000	6500	160000	100000	27000	26000	5900	20000	23000	6500
Fluorene	880	ND	2200	1200	2500	280	4200	3500	420	1600	1200	760	1700	190

TABLE 4

COMPARISON OF LONG-TERM MONITORING MAXIMUM ANALYTE CONCENTRATIONS WITH RI RESULTS IN SEDIMENT

Analytes	Phase I	Phase II	1Evnt3Yr (Jan 97)		2Evnt3Yr (Jul 97)		1Evnt4Yr (Jan 98)		2Evnt4Yr (Jul 98)		1Evnt5Yr (Jan 99)		2Evnt5Yr (Jun 99)	
	RI	RI	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in	0-6 in	6-12 in
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	3800	ND	4700	2200	4500	1000	49000	31000	7900	3900	18000	4500	7600	1400
Isophorone	ND	ND	ND	ND	ND	470	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	293	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	690	ND	1400	1700	2100	4000	9400	9400	3900	3400	17000	2900	3700	4100
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	274	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	6700	ND	21000	11000	16000	3500	70000	51000	7100	16000	18000	7700	18000	2600
Phenol	ND	ND	ND	ND	ND	ND	86	ND	ND	46	506	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	10000	ND	25000	11000	16000	2900	120000	80000	20000	19000	45000	14000	20000	3800

TABLE 5

Sediment Samples with Analytical Concentrations Greater than BHRA 10^{-6} Screening Criteria First Event Eighth Year Sampling, April 2002

Field ID	Analyte	Final Result	Units	Carcinogenic 10-6	Final Validation Flag
SC-QE11-SD-1902DL	Benzo(a)anthracene	3100	ug/Kg	1600	
SC-QE11-SD-1902DL	Benzo(a)pyrene	3700	ug/Kg	1600	
SC-QE11-SD-1902DL	Benzo(b)fluoranthene	5800	ug/Kg	1600	J
SC-QE11-SD-1902	Benzo(k)fluoranthene	1800	ug/Kg	1600	J
SC-QE11-SD-1902	Chrysene	2500	ug/Kg	1600	
SC-QE11-SD-1903	Benzo(a)anthracene	2000	ug/Kg	1600	
SC-QE11-SD-1903	Benzo(a)pyrene	2100	ug/Kg	1600	J
SC-QE11-SD-1903	Benzo(b)fluoranthene	2600	ug/Kg	1600	J
SC-QE11-SD-1903	Benzo(k)fluoranthene	1700	ug/Kg	1600	J
SC-QE11-SD-1903	Chrysene	1800	ug/Kg	1600	

DL=Diluted

TABLE 6

Sediment Samples with Analytical Concentrations Greater than HHRA 10^{-6} Screening Criteria First Event Eighth Year Sampling, April 2002

Field ID	Analyte	Final Result	Units	Carcinogenic 10^{-6}	Final Validation Flag
SC-QE11-SD-1902DL	Benzo(a)pyrene	3700	ug/Kg	1057.55	
SC-QW06-SD-1902	Benzo(a)pyrene	1100	ug/Kg	1057.55	J
SC-QE11-SD-1903	Benzo(a)pyrene	2100	ug/Kg	1057.55	J

DL=Diluted

APPENDIX B
PHOTOS

1. Stream gauging and sampling point at Outfall G to East Soldier Creek.
2. Stream sampling segment QEO6 on East Soldier Creek.
3. Excavation at West Soldier Creek, prior to concrete pouring.
4. Preparation for concrete channel along West Soldier Creek.
5. Excavation of West Soldier Creek channel for concrete resurfacing. Note monitoring wells for Building 3001 recovery system in background.
6. Excavation activities prior to concrete pouring for flightline drainage. Building 3001 to the east, flightline and runway to the west. Monitoring wells and extraction well field to east.

1. Stream gauging and sampling point at Outfall G to East Soldier Creek.

2. Stream sampling segment QEO6 on East Soldier Creek.

3. Excavation at West Soldier Creek, prior to concrete pouring.

4. Preparation for concrete channel along West Soldier Creek.

5. Excavation of West Soldier Creek channel for concrete resurfacing. Note monitoring wells for Building 3001 recovery system in background.

6. Excavation activities prior to concrete pouring for flightline drainage. Building 3001 to the east, flightline and runway to the west. Monitoring wells and extraction well field to east. Looking north.