FIRST FIVE-YEAR REVIEW REPORT FOR TUCSON INTERNATIONAL AIRPORT AREA SUPERFUND SITE PIMA COUNTY, ARIZONA

PREPARED BY

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Date: 9/30/13

Executive Summary

This is the first EPA Five-Year Review (FYR) for the Tucson International Airport Area (TIAA) Superfund Site (site) located in Tucson, Arizona. The purpose of this FYR is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this FYR was the completion of construction of the final component of the remedial action for Operable Unit (OU) 2 on October 29, 2007. Although the Air Force has the lead for remediation activities at Air Force Plant 44 (AFP44), it has agreed to participate in the site-wide review as opposed to completing its own FYR, which would involve duplication of effort.

The site is located in Pima County, in southeastern Arizona. It encompasses sections of southwest Tucson, as well as adjoining lands south of the city. The site includes industrial, commercial, residential, and undeveloped areas. In general, the northern parts of the Superfund site are residential and become more industrial and undeveloped as you move south. The central issue at the TIAA Superfund Site is contamination of groundwater with the plume being approximately four miles long. The plume consists of volatile organic compounds (VOCs), primarily trichloroethylene (TCE). Other contaminants found at lower concentrations include 1,4-dioxane, tetrachloroethene (PCE), dichloroethylene (1,1-DCE), chloroform, carbon tetrachloride, benzene, and chromium.

The TIAA Superfund Site was listed on the National Priorities List in 1983 and is divided into seven separate project areas including the Tucson Airport Remediation Project (TARP), Airport Property, AFP44/Raytheon, Texas Instruments (formerly Burr-Brown Corporation), the 162nd Fighter Wing Arizona Air National Guard (AANG) Property, West Plume B Area, and the former West-Cap of Arizona Property (EPA 1988). This first FYR report focuses on the Tucson Airport Remediation Project (TARP), Airport Property, and AFP44/Raytheon. Texas Instruments, AANG, West Plume B Area, and the former West-Cap of Arizona Property will be reviewed during the second FYR to be completed in the year 2018. The remedies for these areas were modified and the rationale for the change can be reviewed in the ROD Amendment dated April 2012 (EPA 2012a). Consequently, the new remedies have not been implemented at this time and are not within the scope of this document.

The three project areas reviewed here include five OUs; however, this FYR only assesses OUs 1, 2, and 3. OU4 and OU5 are related to 1,4-dioxane, and there are no EPA decision documents currently associated with this contaminant.

In 1988, the U.S. Environmental Protection Agency (EPA) selected in a Record of Decision the following site-wide remedy for the groundwater contamination (OU1) at the site to protect long-term human health and the environment:

- Groundwater extraction from the upper and lower divided aquifer and the regional undivided aquifer
- Treatment of extracted groundwater with packed column aeration
- Treatment of generated off gas using reasonably available control technology (in this case, granular activated carbon)
- Provision of treated groundwater to the municipal water distribution system or recharge of treated groundwater into the aquifer system

In 1997, EPA wrote another ROD that added the following components for the remedial action at the Tucson Airport Property (OU2):

- Soil vapor extraction to remove VOCs from the vadose zone
- Groundwater extraction from the Shallow Groundwater Zone of the upper aquifer to prevent migration of VOCs into the regional aquifer

The AFP44 original remedy (OU3) was written in 1985. The Remedial Action Plan set EPA Maximum Contaminant Levels as the treatment goals. Over time, the Air Force wrote individual remedies for various sites within AFP44. The Air Force modified their 1985 remedy with an Explanation of Significant Difference to address 1,4-dioxane and update the target cleanup levels but this is not included for review as there are no EPA decision documents associated with this contaminant.

The remedial actions for the entire TIAA Superfund Site were implemented in the following stages:

- Startup of the AFP44 groundwater treatment system in 1987;
- Startup of the Tucson Airport Remediation Project (TARP) in 1994; and
- Startup of the Shallow Groundwater Zone and Soil Vapor Extraction system at the Tucson Airport Property in 2007.

The remedy for OU 1 (TARP area wide groundwater) is currently protective of human health and the environment because all exposure pathways to human health and the environment are controlled. However, the remedial action objectives written in the 1988 Record of Decision are unclear and the decision document should be substantially revised as part of any future amendments. Furthermore, the setting of the treatment goal of 1×10^{-6} excess cancer risk should be reviewed for technical feasibility to assure that long term-protectiveness can be achieved.

A protectiveness determination of the remedy at OU2 (Airport Property) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at and near the Three Hangars Building, and by investigating contamination underneath the Three Hangars Building. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made. In addition, to be protective in the long term, the groundwater extraction system northwest of the Airport needs to be reassessed to ensure plume containment.

A protectiveness determination of the remedy at OU 3 (AFP44) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at Building 801. In order assure long term protectiveness, a new Record of Decision with clear remedial action objectives should be written for the site, and the remedy needs to be reassessed in the area of high chromium concentrations since it appears that the remedial action objective of restoration will not be met for this contaminant.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Tucson International Airport Area Superfund Site		
EPA ID: AZD980737530		
Region: 9	**State:** AZ	**City/County:** Tucson, Pima County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:** The Department of Defense led the review of the Air Force Plant 44 portion of the Site.
Author name (Federal or State Project Manager): Martin Zeleznik
Author affiliation: U.S. Environmental Protection Agency
Review period: 10/29/2007 to 12/31/2012
Date of site inspection: February 11 to 13, 2013
Type of review: Statutory
Review number: 1
Triggering action date: 10/29/2007
Due date *(five years after triggering action date)*: 10/29/2012

Five-Year Review Summary Form (continued)

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s):1	**Issue Category: Remedy Performance**			
	Issue: 1988 ROD was written with unclear RAOs and set a 1×10^{-6} excess cancer risk for cleanup which may be technically infeasible.			
	Recommendation: All RAOs and clean up goals should be evaluated as part of any future ROD Amendment associated with sitewide groundwater.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	09/2015
OU(s):2	**Issue Category: Monitoring**			
	Issue: Increasing level of contaminants in groundwater in the Off-Airport Property area northwest of the Airport Property.			
	Recommendation: Containment of contaminants must be achieved in the Off-Airport Property area northwest of the Airport Property.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	12/2015
OU(s): 2	**Issue Category: Changed Site Conditions**			
	Issue: High levels of contaminants were found in newly drilled wells and numerous unknown drains were found inside the Three Hangars.			
	Recommendation: Airport Property should perform a subsurface investigation underneath the Three Hangars and implement appropriate actions.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
Defer	Yes	PRP	EPA/State	12/2015
OU(s): 3	**Issue Category: Remedy Performance**			
No	**Issue:** Concentrations of chromium in the high chromium areas have remained high over the past five years indicating that the remedial action objective of groundwater restoration may not be achievable.			
	Recommendation: Air Force should plan for treatability studies for Chromium on AFP44 and implement appropriate actions.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	09/30/2016

OU(s): 3	Issue Category: Monitoring			
	Issue: There are no clear RAOs for the 1985 ROD for AFP 44 but are in the Remedial Action Plan.			
	Recommendation: Air Force should write a new ROD.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	12/2014

OU(s): 2,3	Issue Category: Monitoring			
	Issue: Soil gas and groundwater data indicates a potential for vapor intrusion at three specific areas.			
	Recommendation: An indoor air investigation should be conducted at the Three Buildings Hangar, the residential area nearby and Building 801.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	12/2014

Protectiveness Statement(s)

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU1	Protective	Not applicable

Protectiveness Statement:
The remedy for OU 1 (TARP groundwater) is currently protective of human health and the environment because all exposure pathways to human health and the environment are controlled. However, the remedial action objectives written in the 1988 Record of Decision are unclear and the decision document should be substantially revised as part of any future amendments. Furthermore, the setting of the treatment goal of 1×10^{-6} excess cancer risk should be reviewed for technical feasibility to assure that long term-protectiveness can be achieved.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU2	Protectiveness Deferred	12/2015

Protectiveness Statement:
A protectiveness determination of the remedy at OU2 (Airport Property) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at and near the Three Hangars Building, and by investigating contamination underneath the Three Hangars Building. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made. In addition, to be protective in the long term, the groundwater extraction system northwest of the Airport needs to be reassessed to ensure plume containment.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU3	Protectiveness Deferred	Not applicable

Protectiveness Statement:
A protectiveness determination of the remedy at OU 3 (AFP44) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at Building 801. In order assure long term protectiveness, a new Record of Decision with clear remedial action objectives should be written for the site, and the remedy needs to be reassessed in the area of high chromium concentrations since it appears that remedial action objective of restoration will not be met .

Contents

Appendixes

Tables

Figures

List of Abbreviations

AAC	Arizona Administrative Code
AANG	Arizona Air National Guard
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
Airport Property	The area of responsibility of the Tucson Airport Authority
AFP44	Air Force Plant 44
AOP	advanced oxidation process
ARAR	applicable or relevant and appropriate requirement
ARS	Arizona Revised Statutes
AZPDES	Arizona Pollutant Discharge Elimination System
bgs	below ground surface
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CRA	Conestoga-Rovers and Associates
DBS&A	Daniel B. Stephens & Associates
˚F	degrees Fahrenheit
1,1-DCE	1,1-dichloroethylene (1,1-dichloroethene)
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FS	feasibility study
FYR	five-year review
GAC	granular activated carbon
gpm	gallons per minute
GSU	gravel subunit
GWTP	ground water treatment plant
HGBL	health-based guidance level
HI	hazard index

HiPOx	hydrogen peroxide and ozone
IC	institutional control
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
KMnO4	potassium permanganate
MCL	maximum contaminant level
MEK	methyl ethyl ketone
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&F	Operational and Functional
O&M	operations and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene (perchloroethene)
PER	Performance Evaluation Report
PHE	Public Health Evaluation
ppbv	parts per billion volume
PRP	potentially responsible party
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RRS	Remedy Required Subsites
SGSL	soil gas screening level
SGZ	shallow groundwater zone
Site	Tucson International Airport Area Superfund Site

SVE	soil vapor extraction
TAA	Tucson Airport Area
TARP	Tucson Airport Remediation Project
TCA	trichloroethane
TCE	trichloroethylene (trichloroethene)
TI	technical impracticability
TIAA	Tucson International Airport Area
UAO	Unilateral Order
UCAB	Unified Community Advisory Board
U.S.C.	United States Code
UV	ultraviolet
VOC	volatile organic compound

First EPA Five-Year Review Report for Tucson International Airport Area Superfund Site

1. Introduction

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of FYRs are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121(c) and the National Contingency Plan (NCP). CERCLA 121 states:

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

EPA interpreted this requirement further in the NCP; 40 *Code of Federal Regulations* (CFR) Section 300.430(f)(4)(ii), which states:

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

Martin Zeleznik of the EPA conducted the FYR and prepared this report regarding the remedies implemented at the Tucson International Airport Area (TIAA) Superfund Site in Tucson, Pima County, Arizona (site). EPA is the lead agency for developing and implementing the remedy for the site—except for Air Force Plant 44 (AFP44), where the U.S. Department of Defense is the lead agency. The Arizona Department of Environmental Quality, as the support agency representing the State of Arizona, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the first EPA FYR for the TIAA Superfund Site. The triggering action for this statutory review is the completion of construction of the final component of the shallow groundwater remedy for Airport Property on October 29, 2007. The FYR is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

The site consists of five operable units (OUs) but only three of them are addressed in this FYR. OU1 is the groundwater remedy as defined by the 1988 Record of Decision (ROD) that focuses on the Tucson Airport Remediation Project [TARP]. OU2 is the remedy as defined by the 1997 ROD, which primarily focuses on remediation at the Airport Property (soils, shallow groundwater, and the Three Hangars Building). OU3 is the remedy selected for AFP44. OU4 is the remediation efforts related to 1,4-dioxane on AFP44 and OU5 is the remediation efforts for 1,4-dioxane north of Los Reales Road and is known as Area A. No final decision documents related to 1,4-dioxane were signed by EPA, and therefore OU4 and OU5 are not included in this FYR. Texas Instruments, the 162nd Fighter Wing Arizona Air National Guard (AANG), West Plume B Area, and the former West-Cap of Arizona Property are part of the TIAA Site but are located in a separate geographical area with different contaminants of concern. The remedies for these project areas were changed from groundwater extraction and treatment to in-situ chemical oxidation in a ROD Amendment dated April 2012 (EPA 2012a). These new remedies have not been implemented and therefore will be reviewed during the second FYR to be completed in the year 2018.

The Air Force has the lead for remediation on AFP44 and there have been previous FYRs completed for portions of this site in the past. However, in the spirit of cooperation and to assist with the goal of reducing duplicative efforts, the Air Force agreed to participate and contribute to this TIAA Superfund Site FYR.

2. Site Chronology

Table 1 lists the dates of important events for the TIAA Superfund Site.

TABLE 1
Chronology of Site Events

Event	Date
Airport Property—Industrial use and disposal of metals, chlorinated solvents and other hazardous wastes began.	**1942**
AFP44—Hughes Missile Systems Company and/or its subsidiaries have operated the AFP44 plant since construction.	**1951–1997**
AFP44—A groundwater sample from a municipal supply well indicated elevated levels of chromium. Residents complained of foul-smelling water.	**1952**
AFP44—A well at AFP44 was closed by the state because of high levels of chromium.	**1976**
AFP44—Under EPA direction, the Air Force and its subcontractor, Hughes Aircraft Company, conducted an investigation and verified trichloroethylene (TCE) contamination at the AFP44 facility and north of the AFP44 facility.	**1981**
TIAA Superfund Site was listed on "Expanded Eligibility List," a Preliminary National Priorities List (NPL).	**July 23, 1982**
TIAA Superfund Site proposed for inclusion on the Final NPL.	**December 30, 1982**
Final NPL listing of TIAA.	**September 8, 1983**
Air Force issues ROD/Remedial Action Plan for Air Plant 44 but this was signed before the Superfund law was amended in 1987	**1986**
Tucson Airport Remediation Project (TARP), Airport Property, and AFP44—The Arizona Department of Health Services (ADHS) completed the remedial investigation (RI) for the area north of Los Reales Road. The Arizona Department of Water Resources (ADWR) conducted a feasibility study (FS). The Air Force issued a ROD for regional groundwater at AFP44.	**1985**
AFP44—The Air Force Remedial Action (RA) Plan for the area south of Los Reales Road was released.	**April 1986**
EPA sent general notice letters to the potentially responsible parties (PRPs) officially notifying them of their potential liability for groundwater remedy north of Los Reales Road.	**August and September 1987**
AFP44—U.S. Air Force began operation of a groundwater pump-and-treat system to address contamination at the AFP44 Facility. Groundwater remediation includes extracting groundwater, treatment for removal of hexavalent chromium (ion exchange) and volatile organic compounds (VOCs; packed column aeration with partial control of emissions using vapor-phase granular activated carbon [GAC]), and re-injecting treated water into the aquifer.	**1987**
The draft "Feasibility Study for Groundwater Remediation in the Tucson Airport Area" report was released for public review and comment.	**March 3, 1988**
TARP ROD signed by EPA to treat the groundwater north of Los Reales Road by pumping and treating the contaminated groundwater followed by discharging the treated water to the municipal water distribution system.	**July 25, 1988**
TARP—EPA and the Settling Parties entered a Consent Decree for the TARP.	**June 1991**

TABLE 1
Chronology of Site Events

Event	Date
EPA issued a Unilateral Order (UAO; Docket No. 92-09, July 9, 1992) to Tucson Airport Authority, City of Tucson, General Dynamics Corporation, and McDonnell Douglas Corporation, for performance of a RI/FS of the TIAA Superfund Site.	**August 25, 1992**
Texas Instruments (formerly Burr-Brown) began operation of a groundwater pump and treat system to address the contamination at its facility.	**1992**
162nd AANG—EPA and the National Guard Bureau signed a Federal Facilities Agreement (FFA).	**1993**
TARP—The TARP treatment plant began operation.	**September 1994**
AFP44—Excavation of contaminated soils (cadmium, chromium, and lead).	**1995**
Airport Property—RI was completed. RI characterized extent of contamination in soil and shallow groundwater zone..	**1996**
Airport Property—Daniel B. Stephens & Associates (DBS&A) completed the RI of the shallow groundwater zone and vadose zone.	**April 1995 – April 1996**
Airport Property—DBS&A completed RI report for EPA submittal.	**October 31, 1996**
AFP44—Raytheon purchased/merged with Hughes Electronics and assumed operation of AFP44, a Government Owned Contractor Operated facility.	**1997**
Airport Property—Excavation of PCB-contaminated soil (El Vado Residential Neighborhood and Three Hangars Area).	**March – May 1997**
Airport Property—EPA approved RI report submitted by DBS&A.	**May 2, 1997**
Airport Property—Conestoga-Rovers and Associates (CRA) prepared an FS and submitted to EPA to identify remedial technologies that may be applicable to the site, and was approved by EPA on July 10, 1997.	**June 10, 1997**
Formation of Unified Community Advisory Board	**September, 1997**
Airport Property—EPA issued a ROD for the selected RA.	**September 30, 1997**
Airport Property—A Consent Decree was signed between EPA and the PRPs for the cleanup.	**February 2000**
TARP and AFP44—1,4-dioxane was discovered in groundwater.	**March – April 2002**
Airport Property—Five extraction wells were installed in gravel subunits to cut off the shallow groundwater zone from the TARP plume.	**2002**
TARP—EPA asked Tucson Water and TARP representatives to begin RI/FS to evaluate available remedial technologies to address 1,4-dioxane contamination.	**2004**
Airport Property—1,4-dioxane was detected at up to 36 micrograms per liter (µg/L).	**2004**
Airport Property—The final Shallow Groundwater Zone remedy and soil vapor extraction (SVE) remedy design report (100% Design) (Final Report) and RA work plan were submitted to EPA.	**July 25, 2004**
Airport Property—EPA approved the final Shallow Groundwater Zone remedy and SVE remedy design report (100% Design; Final Report) and RA work plan.	**September 3, 2004**
Airport Property—Proposal submitted to characterize carbon tetrachloride in the Shallow Groundwater Zone at West End of Runway 3.	**2005**

TABLE 1
Chronology of Site Events

Event	Date
Airport Property—In situ chemical oxidation using potassium permanganate ($KMnO_4$) to treat dichloroethylene (1,1-DCE) concentration at Samsonite Building Area.	**2006**
AFP44—EPA issued an Safe Drinking Water Act Order to the Air Force and Raytheon to design, build, and operate advanced oxidation treatment plant at AFP44 to treat TCE and 1,4-dioxane.	**July 13, 2007**
Airport Property—EPA provided an "Operational and Functional Determination" for the Shallow Groundwater Zone remedy and SVE remedy and routine operation commenced.	**October 29, 2007**
AFP44—Air Force completed Phase I Focused RI to address 1,4-dioxane contamination north of Los Reales Road.	**2008**
AFP44—The Air Force submitted to EPA a Phase II Focused RI of 1,4-dioxane work plan, which includes the TARP area. Tucson Water completed a technical memorandum identifying ultraviolet (UV) light–peroxide advanced oxidation processes were the best available technologies for 1,4-dioxane treatment.	**2009**
AFP44—Advanced oxidation treatment systems operational. The treatment system was designed to remove 1,4-dioxane but also effectively remove VOCs.	**September 2009**
TARP—Tucson Water conducted pilot testing of ozone-peroxide and UV light–peroxide advanced oxidation treatment for 1,4-dioxane and concluded that UV light–peroxide is the preferred technology. AFP44—Air Force conducted Phase II Focused RI.	**2010**
Federal Facilities Agreement for Air Force Plant 44 signed	**September 2011**
Groundwater sampling—All project areas	**Ongoing**

3. Background

As shown in Figure 1, the approximate TIAA Superfund Site boundaries are the Santa Cruz River on the west, Ajo Way on the north, Alvernon Way on the east, and the Hughes Access Road south of the AFP44 on the south. The site is divided into seven separate project areas including the TARP, Airport Property, AFP44,Texas Instruments (formerly Burr-Brown Corporation); AANG Property; West Plume B Area; and the former West-Cap of Arizona Property (EPA 1988).

As shown in Figure 2, the TARP and the Airport Property are located north of Los Reales Road. The soil and groundwater remediation efforts at these properties are addressed by EPA. The AFP44 is located south of Los Reales Road, and the groundwater remediation efforts are addressed by the Air Force (EPA 1988).

The central issue at the TIAA Superfund Site is contamination of groundwater with VOCs, primarily trichloroethylene (TCE). Other contaminants found at lower concentrations include 1,4-dioxane, tetrachloroethene (PCE), 1,1-DCE, chloroform, carbon tetrachloride, benzene, and chromium. The primary source areas identified for this FYR at the TIAA Superfund Site are the historical releases at AFP44 and the Airport Property (EPA 1988, CRA 2012b).

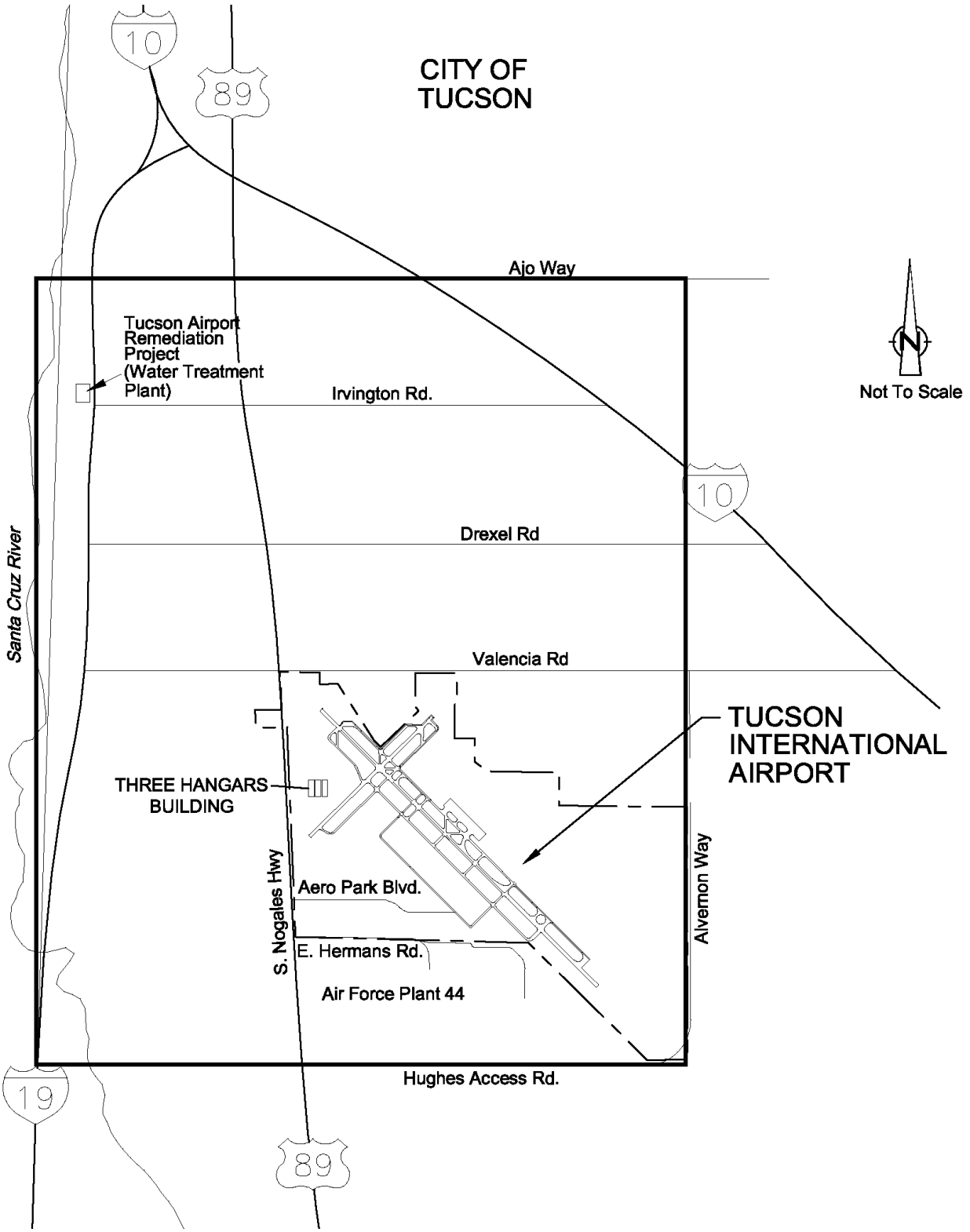
3.1 Physical Characteristics

The TIAA Superfund Site is located in southeastern Arizona and encompasses section of southwest Tucson, as well as adjoining lands south of the city. The TIAA Superfund Site includes industrial, commercial, residential, and undeveloped areas including the Tucson International Airport, AFP44, and part of the San Xavier Indian Reservation (EPA 1988).

The TIAA Superfund Site is located in the Tucson Basin, an alluvial valley bounded by rugged mountain ranges. The Tucson Basin runs approximately 50 miles long and 20 miles wide in an east to west direction. It is a broad, down-faulted, sediment-filled depression surrounded by mountains. The basin is bounded on the east and north by the Santa Rita, Empire, Rincon, Tanque Verde, and Santa Catalina Mountains and on the west by the Sierrita, Black, and Tucson Mountains (EPA 1988). The area was shaped by regional faulting and uplifting, which resulted in the deposition of 2,000 feet of erosional basin fill material in the center of the basin. The basin fill is sub-divided into the following three formations: the Pantano Formation; the Tinaja Beds; and the Fort Lowell Formation. The Pantano Formation is the oldest, whereas the Fort Lowell Formation is the youngest, overlain by a thin veneer of stream alluvium (EPA 1988).

The regional climate of Tucson, Arizona, is semi-arid and characterized by long, hot summers and short, mild winters. Relative humidity is low, particularly during early summer. Rainfall averages 11 inches of per year. Annual evaporation is about four times greater than the average annual precipitation. High temperatures in the summer average about 100 degrees Fahrenheit (˚F). Winter high temperatures average in the upper 60s. The average annual wind speed in the Tucson area is about 8 miles per hour (EPA 1988).

The Santa Cruz River, located on the west side of the Tucson Basin, drains the basin toward the northwest. The Santa Cruz River and its tributaries are dry most of the year, and infiltration is the primary source of water to the aquifers below. Groundwater flow in the Regional Aquifer is generally toward the northwest. A thick interconnected water-bearing unit is present basin wide and is known as the Regional Aquifer. The Regional Aquifer is composed of sand and gravel layers interbedded with thin, discontinuous clay layers of the Fort Lowell Formation (EPA 1988).



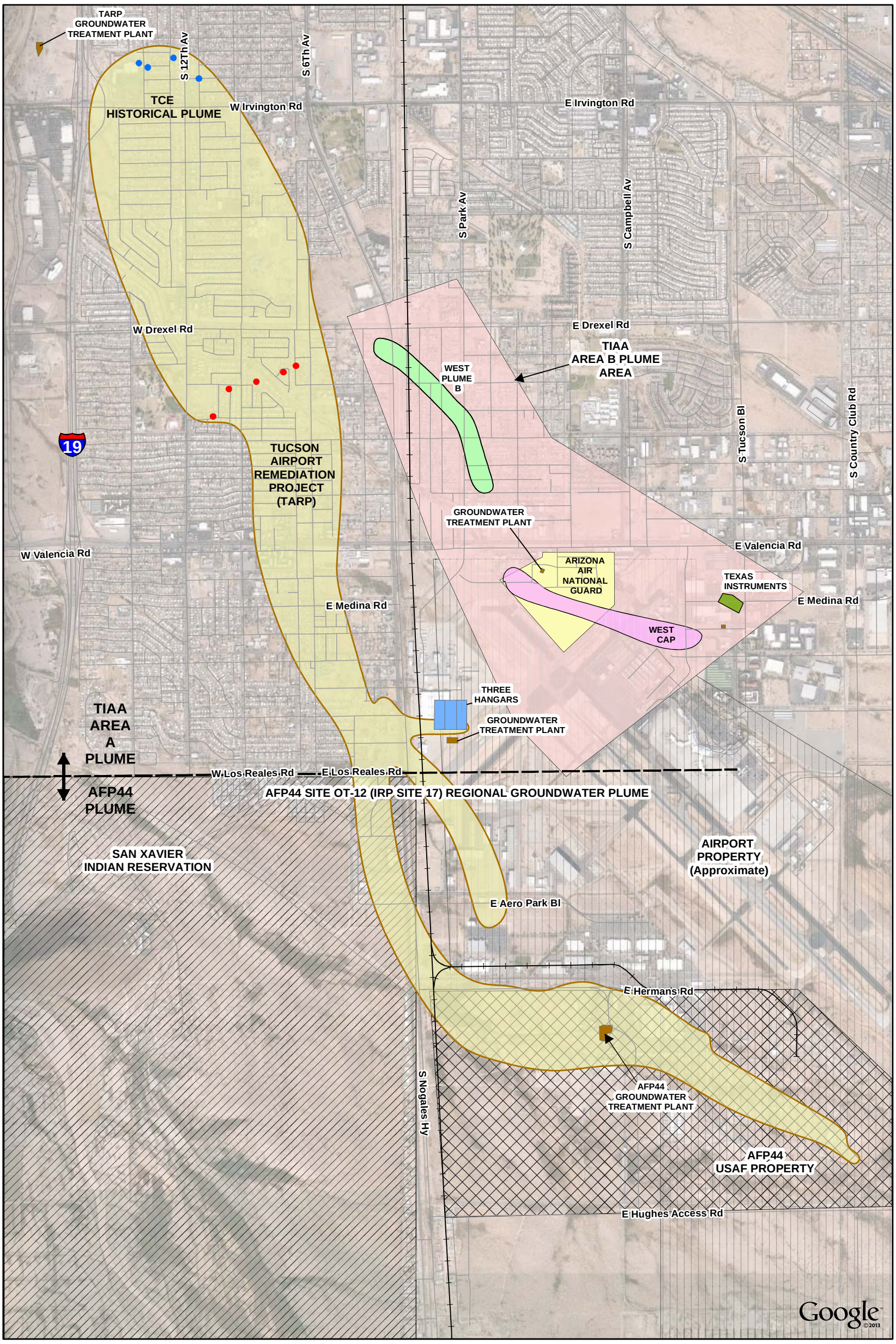
LEGEND

Site Boundary

Notes:
Source: Tenth Performance Evaluation Report, SGZ Remedy & SVE Remedy (March - August, 2012), CRA, November 2012

FIGURE 1
Site Location Map
Tucson International Airport Area Superfund Site
Tucson, Arizona

CH2MHILL



Legend

- Wells TARP North Field
- Wells TARP South Field
- Railroad
- Air Force Plant 44
- Three Hangars
- Groundwater Treatment Plant
- TIAA AREA A / AFP44, Historical TCE Plume (Approximate)
- TIAA Area B Plume
- West Plume B
- Arizona Air National Guard
- Texas Instruments
- West Cap
- Railroad Property
- Airport Property (Approximate)
- San Xavier Indian Reservation

Base Map Source:
AECOM, April 2012. *Preliminary Draft Focused Remedial Investigation/Feasibility Study for 1,4-Dioxane Tucson International Airport Area Superfund Site Area A, Tucson, AZ Volume III Preliminary Draft Conceptual Site Model*

Modified from URS, 2013.

0 1,250 2,500
Feet

N

Figure 2
Site Map
Tucson International Airport Area Superfund Site
Tucson, Arizona

3.2 Hydrology

3.2.1 OU 1- TARP Hydrology

The subsurface of the TARP area (Area A, north of Los Reales Road) consists primarily of alluvial sediments (unconsolidated to consolidated) to depths of at least 400 feet, overlaying bedrock. The Regional Undivided Aquifer (in the northern part of TARP) is composed mainly of coarse-grained materials. Groundwater is encountered at 200 feet below ground surface (bgs), and groundwater flow is to the north-northwest (Malcolm Pirnie/ARCADIS 2012). In general, groundwater elevations in the regional aquifer throughout the area are increasing due to reduced reliance on groundwater (CRA 2012b). The rate of increase in the TARP area ranges up to about 2 feet per year (Malcolm Pirnie/ARCADIS 2012).

In the southern TARP plume area, the alluvial sediments are divided into Upper and Lower Divided aquifers, separated by a confining clay unit. This confining unit is thinner to the north-northwest near a transition zone. The Regional Undivided Aquifer is present at the downgradient edge of the transition zone (Malcolm Pirnie/ARCADIS 2012).

The Upper Divided Aquifer is composed mainly of inter-bedded layers of sandy and clay lenses, and is approximately 70 to 120 feet thick. The groundwater flow in this region is north-northwest, and depth to groundwater is measured at 75 to 100 feet bgs. The underlying confining layer is generally encountered at depths of 160 to 190 feet bgs and ranges from 50 feet to 200 feet thick (Malcolm Pirnie/ARCADIS 2012). In the southern portion of the TARP plume, shallow water-bearing units that exist to the east (that is, beneath the Airport Property) transition into the Upper Divided Aquifer.

The Lower Divided Aquifer is more consolidated than the Upper Divided Aquifer and is comprised of clays, clayey sands, and sand and gravel. Groundwater is encountered at 200 feet bgs. The lithologic logs indicate the Lower Divided Aquifer extends to at least 400 feet bgs (Malcolm Pirnie/ARCADIS 2012).

3.2.2 OU 2 - Airport Property Hydrology

The Airport Property is located in the central portion of the TIAA Superfund Site. Extensive subsurface geological investigations have been completed as part of the RI, the remedial design, and implementation of the RA. The focus of remedial actions at the Airport Property is the Upper Zone of the Upper Divided Aquifer. At the Airport Property, the Upper Zone is further divided into the following four site-specific stratigraphic units:

- Unit 1—10 feet to 15 feet of unconsolidated silt or gravelly sand
- Unit 2—35 feet to 40 feet of consolidated layer of calcified silty fine sand
- Unit 3—20 feet to 40 feet of unconsolidated layer of well to poorly graded silty and gravelly sand
- Unit 4—Unit 4, primarily a clay-rich deposit, an important stratigraphic unit with respect to the SGZ remedy, is further divided into three subunits (DBS&A 1996): an Upper Unit 4 Clay, an interbedded gravel subunit (GSU), and a Lower Unit 4 Clay. Unit 4 is generally found from approximately 80 feet bgs to 158 feet bgs (DBS&A 1996). The Upper Unit 4 Clay is classified as plastic clay that is typically encountered at depths ranging from 80 to 100 feet bgs at an approximate elevation of 2,475 feet above mean sea level. The thickness of the Unit 4 Clay ranges from 10 to 23 feet. The clay contains stringers of interbedded sands and silts throughout its thickness. The Upper Unit 4 Clay is present beneath the entire on–Airport Property portion of the TIAA Superfund Site. The Fort Lowell Formation (unconsolidated silty gravels with sand and clay) is overlain by a thin veneer of stream alluvium (CRA 2012b). The GSU is considered a distinct subunit within the Unit 4 Clay and consists of channelized coarse-grained materials that are unevenly distributed across the Airport Property. The

buried channel deposits (that is, paleochannels) consist primarily of sand and gravel with varying amounts of silt and clay.

Groundwater occurs at a depth of approximately 85 feet bgs within the shallow groundwater at the Airport Property.

3.2.3 OU 3 - AFP 44 Hydrology

The AFP 44 area is underlain by alluvial deposits of the distal portion of coalescing Cienega Creek alluvial fans that originate to the southeast. Distal fan sedimentation is dominated by flood processes and deposits predominantly from braided streams in shifting depositional areas. These deposits grade into fluvial deposits of the Santa Cruz River to the west of Nogales Highway. These deposits are characterized as thin to thick intervals of clay, silt, sand, and gravel. Continuity of these individual layers, especially for potential gravel-filled paleochannels, and their overall interconnectivity are uncertain from a geologic standpoint; however, groundwater behavior indicates a general connection within major units as discussed below. The main aquifer unit is referred to as the regional aquifer that is separated into an Upper Zone and a Lower Zone by an aquitard. The aquitard between the two zones appears to provide nearly complete hydraulic separation based on water levels and aquifer response to pumping. The upper zone of the regional aquifer is also separated into an Upper Unit and a Lower Unit by an aquitard. The majority of the wells at AFP 44 are screened in the Upper Unit, and some are screened across both the Upper Unit and Lower Unit. Groundwater recharge from the surface is minimal given the arid climate. Contaminant concentrations in groundwater differ markedly between the Upper Unit and Lower Unit, suggesting a significant level of hydraulic separation between the units.

The depth to groundwater is approximately 140 feet below ground surface (URS 2012).

3.3 Land and Resource Use

Land use at and near the TIAA Superfund Site has been a mix of various aviation, aerospace, commercial/industrial, and residential. The area in the immediate vicinity of the TIAA Superfund Site tends to be more commercial/industrial than areas slightly farther from the site. The residential properties are predominantly to the west and north, commercial/industrial properties lie predominantly to the east, and open/vacant spaces and washes lie to the south. No major changes to land use are anticipated at this time.

Groundwater is the primary source of water for domestic, industrial, and irrigation water in the area. During the initial investigation of the site, numerous production wells and private wells located within the vicinity of the TIAA Superfund Site contained groundwater that exceeded the TCE maximum contaminant level (MCL) of 5 µg/L. Production wells were either shut down or taken out of service by City of Tucson. Some private wells remain in use, but no use of groundwater containing VOCs above drinking water standards is known to occur at this time.

Prior to 1951, the area where AFP 44 is located was vacant land except for a ranch. Since 1951, when AFP 44 was constructed, the property has been used as an industrial facility. Industrial use of the property will continue for the foreseeable future. The land is zoned industrial and it is very likely that this unique, very large government-owned, contractor-operated facility will be needed to manufacture defense weapons for the foreseeable future.

3.4 History of Contamination

In the past, the companies and facilities in the TIAA Superfund Site used a variety of different chemicals in various industrial processes, including TCE as a metal degreaser and chromium in an electroplating

process. Hazardous substances generated by PRP activities included the following: TCE, 1,1-DCE, 1,1,1-trichloroethane (TCA), and 1,4-dioxane, which was a stabilizing additive to TCA formulations. Additional wastes produced were alcohols, methyl ethyl ketone (MEK), and other solvents; used oil and lubricants; waste paint and sludges; and industrial wastewater treatment residue containing metals such as chromium, cadmium, and cyanide. In 1942, waste-generating activities in the TIAA Superfund Site began sometime after the start of airplane refitting operations in the Airport Property. AFP44 began operation as a government-owned, contractor-operated facility in 1951. Since then, at least 20 facilities potentially capable of releasing hazardous materials have operated in the Airport and AFP44 facility, including aircraft manufacturing, maintenance, and reworking facilities; electronics components manufacturing and assembly facilities; fire drill training areas, and landfills (EPA 1988). The waste disposal by several aircraft and electronics facilities in the area of the TIAA Superfund Site consisted of surface discharge of waste liquids to soils onsite. The drainage areas were ponded with liquid waste runoff, which in turn provided the driving force for contaminants to infiltrate into the underlying groundwater. The flammable wastes, including solvents and fuels, were ignited in unlined pits and doused with large quantities of water during fire-drill training. Over time, water and non-combusted wastes migrated to the underlying saturated zone (EPA 1988).

Contamination at the TIAA Superfund Site was observed as early as 1952, when a sample collected from the municipal supply well on Airport property indicated elevated level of chromium. Grand Central Aircraft Company was the operator of an aircraft refitting facility on Airport property at this time. The next indication of groundwater contamination occurred around 1976, when a well at AFP44 was closed by the State because of high levels of chromium. The Air Force owns the AFP 44 property. Under the direction of EPA, the Air Force, and its contractor, Hughes Aircraft Company, the operator of AFP 44 in 1981, verified high levels of contamination beneath and north of the AFP44 property. The sampling indicated the presence of VOCs such as TCE, 1,1-DCE, TCA, chloroform, benzene, and xylene. The presence of chromium, mostly in hexavalent form, was also confirmed (EPA 1988). In 1985, under cooperative agreement with EPA, ADHS completed an RI for the area north of Los Reales Road and confirmed TCE contamination in groundwater exceeding the MCL of 5 µg/L (EPA 1988). Therefore, on September 8, 1983, the TIAA was listed on the final NPL (EPA 1988). Raytheon currently leases AFP44 from the Air Force.

For the Airport Property, historically, the Three Hangars Area was primarily occupied by large scale military contractors who performed aircraft modification operations, general aircraft and vehicle maintenance, synthetic rubber and plastics manufacturing, charter services, and other industrial activities (EPA 1997a, ADHS 2000).

3.5 Initial Response

No response was taken prior to issuance of the first ROD in 1985. Many of the wells that contained site-related contaminants above cleanup standards were removed from service in the late 1970s and early 1980s.

3.6 Basis for Taking Action

The following subsections summarize detections of contaminants in soil and groundwater and the resulting human health risks.

3.6.1 Soil

During the remedial investigation at the Airport Property soil gas samples were more commonly used to evaluate the nature and extent of VOCs, while soil samples were used to identify impacts from other contaminants. TCE was detected in soil gas at concentrations exceeding the soil gas screening level

(SGSL) of 1.3 µg/L at the Airport Property—specifically, in the area around the Three Hangars Building. TCE was detected at concentrations ranging from 23 µg/L to 46,000 µg/L (EPA 1997a). Chloroform was also detected at elevated concentrations in soil gas near the Three Hangars Area.

A polychlorinated biphenyl (PCB) was detected at concentrations ranging up to 140 milligrams per kilogram (mg/kg) in soil samples collected to the west and southwest of the Three Hangars building. PCBs were also detected in sludge associated with floor drains in the Three Hangars Building and a canale drainage system located south of the Three Hangars Building at concentrations up to 1,100 mg/kg (EPA 1997a). PCB-contaminated soil extending off of the Airport Property into the residential area to the west was cleaned up through a removal action in 1997. PCB-contaminated sludge and soil associated with the Three Hangars Building and canale system was cleaned up between 2000 and 2011 (CRA 2013c); the Construction Inspection Report is under review by EPA.

As a result of these characterization activities, the primary human health risk associated with soil at the Airport Property was the potential for incidental ingestion of soil or inhalation of soil gas vapors.

After completion of the AFP44 RI/FS and proposed plan, VOC-contaminated soils were found underneath the east side of Building 801, west of the sludge drying beds. Because the RI/FS process did not address VOC-contamination in soil associated with the former sludge drying beds, USEPA's presumptive SVE remedy language and narrative standard language were inserted into the individual Installation Restoration Program (IRP) sites. Under the guidance of the USEPA, the Air Force conducted supplemental investigation at Site 5 (Former Sludge Drying Beds and Former Wastewater Treatment Facility) (Earth Tech 1998a) to identify potential VOC sources and to better characterize the vertical and horizontal extent of contamination. Remediation was proposed because the area was considered to be a potential source of groundwater contamination and the soil vapor extraction activities have been completed.

3.6.2 Groundwater

TCE was detected in groundwater at the TIAA Superfund Site at concentrations greater than the MCL of 5 µg/L. The highest concentration of TCE observed in groundwater at the Airport Property was 92,000 µg/L measured in a sample collected from SGZ monitoring well CRA-1 in March 2007 (CRA 2012b). The highest concentrations of TCE are generally found in SGZ wells just south of the Three Hangars Building. Concentrations decrease rapidly away from this area and also decrease with depth: Concentrations in the GSU are lower than in the SGZ and concentrations in the regional aquifer are lower than those in the GSU. Concentrations in the regional aquifer below the Airport Property are generally below 10 µg/L except in wells D-2 and D-8, which have both had concentrations above 30 µg/L in the past 5 years (CRA 2012b). TCE concentrations in the TARP area of the plume are generally below 25 µg/L with the exception of an area near the South Well Field and a larger area in the north-central part of the plume (Malcolm Pirnie/ARCADIS 2012). The highest TCE concentration measured in the TARP monitoring well network between 2008 and 2012 was 97.9 µg/L measured in a sample collected from regional aquifer well R-004A in May 2008 (Malcolm Pirnie/ARCADIS 2012).

In addition to TCE, the following VOCs were detected in groundwater at the site: 1,1-DCE; trans-1,2-DCE; chloroform; benzene; and xylene. However, TCE is the most widespread contaminant in groundwater at the site. As shown on Figure 2 the main plume extends about 6 miles from the eastern portion of the AFP44 site to the North Well Field of TARP.

Chromium was detected above its MCL in groundwater at and adjacent to AFP44, with a maximum concentration of 8,400 µg/L detected in a sample from well E-24. Some chromium was also found in a limited area north of Los Reales Road, although the concentrations of chromium found north of the Los Reales Road did not exceed the Safe Drinking Water Act MCL.

At the time of the RI, the City of Tucson operated production wells for its municipal water supply near the TIAA Superfund Site, some of which had TCE detections above the MCL of 5 µg/L. Similarly, chromium detections above the MCL were found primarily in municipal wells at or adjacent to AFP44. TCE detections above the MCL of 5 µg/L were also found in some of the private wells within the vicinity of TIAA Superfund Site (EPA 1988). As a result, the primary human health risk posed was the potential for direct ingestion of contaminated groundwater.

4. Remedial Actions

4.1 Remedy Selection

This FYR will focus on three of the five Operable Units (OU) for the site. OU 1 (TARP) is considered the site-wide regional groundwater remedy, with the exception of OU 3 where the Air Force is the lead for remediation on the Federal Facility. OU 2 (Airport) is considered the remedy specific to Airport Property, and OU 3 is AFP44. OU 4 (1,4-dioxane remediation activities on AFP44) and OU 5 (1,4-dioxane remediation activities north of Los Reales Road) are both related to the 1,4-dioxane groundwater contaminant plume. There is currently no EPA decision document associated with this emerging contaminant. There are two EPA Records of Decision that were reviewed for the remedial actions for this FYR. The 1988 and 1997 RODs (1988 and 1997) were signed by EPA. There was a ROD issued by the Air Force in 1985 for AFP44 but not signed by EPA because there was uncertainty related to the role of EPA at Federal Facilities until the Superfund law was changed in 1986. Even though the Air Force is the lead agency for AF Plant 44 and thus can conduct the FYR, EPA with agreement by the Air Force decided to include the remedial actions on AFP44 in the TIAA FYR. The findings of this Five-Year Review may offer recommendations for the proposed ROD for AFP44 that is scheduled to be completed in 2016.

4.1.1 OU1 (TARP Groundwater Treatment System)—1988 ROD

In the 1988 ROD, the selected groundwater remedy for Area A (north of Los Reales Road) included groundwater extraction from both the upper divided aquifer and the regional undivided aquifer. Extracted groundwater was to be treated with packed column aeration and the vapor emissions from the packed column facilities treated with GAC. Discharge of treated water was to be provided to the municipal potable water distribution system.

Contaminants of Concern in 1988 ROD with MCLs & State Action Levels (µg/L)

Chemical	MCL or Proposed MCL	State Action Level
Trichloroethylene (TCE)	5	5
1,1-dichloroethylene	7	7
Chloroform	100	3
Chromium (VI)	50 (as total chromium)	
trans-1,2-dichloroethylene	--	70
Benzene	5	5

The goal of the remedy selected was to treat extracted groundwater to an overall excess cancer risk level (presumably for all contaminants combined) of 1×10^{-6}. The ROD further specified treatment of TCE to a concentration of approximately 1.5 µg/L, while noting that the Maximum Contaminant Level for TCE is 5 µg/L and that "treatment will bring the levels of other contaminants well below their respective MCLs, State Action Levels, and 10^{-6} excess cancer risk concentrations." There is ambiguity in the 1988 ROD as to whether it only required the treatment of TCE or all contaminants to the 1×10^{-6} risk per contaminant or cumulatively.

The uncertainty of the 1988 ROD can be best understood through one of the comments and responses in the Responsiveness Summary:

Comment: "It is unclear here, as it is throughout the FS, whether the TCE $1x10^{-6}$ cancer risk level is a treatment objective, an aquifer clean up standard, or both."

EPA Response: "The overall $1x10^{-6}$ excess cancer risk is a treatment objective for all contaminants in groundwater. The treatment objective corresponds to a level of 1.5 ppb, a level that is below the MCL (5 ppb) and $1x10^{-6}$ excess cancer risk concentration (3 ppb) for TCE."

The 1988 ROD states that a combination of the treatment goals of this ROD and the remedial actions taking place at AFP44 will result in an overall restoration of the groundwater basin in this area. There were no remedial action objectives (RAOs) specified in the 1988 ROD.

4.1.2 OU2 (Airport Shallow Groundwater Remedy/TI Zone Remedy) —1997 ROD

The 1997 ROD primarily addresses groundwater, soil and soil gas contamination on the Tucson Airport Property. The selected remedies for OU2, which are being reviewed as part of this FYR, are composed of the following components: 1) SVE for VOC-contaminated soils; 2) extraction, treatment, and reinjection of shallow groundwater outside the Technical Impracticability (TI) Zone to achieve restoration of groundwater to MCLs; and 3) extraction, treatment, and discharge of shallow groundwater within the TI Zone to achieve containment. The Airport Property Landfill Remedy and PCB Soils Remedy, which are also included in the 1997 ROD, will be addressed in the next FYR because these RAs were not completed before the start of this review period for this document.

The RAOs for the selected soil remedy using SVE included achieving lateral and vertical soil vapor containment until contaminant soil gas concentrations have been reduced such that ceasing SVE operations will not cause an impact on groundwater water quality standards to the Shallow Groundwater Zone or to the Regional Aquifer.

The RAOs for the shallow groundwater remedy are two-fold: 1) prevent migration of the VOCs into the Regional Aquifer (or into currently clean portions of the Shallow Groundwater Zone) at levels that result in an exceedance of groundwater cleanup standards (MCLs, see Table 6 of the 1997 ROD); and 2) restore the water in the shallow groundwater outside of the TI Zone to drinking water quality wherever practicable. EPA made the determination that it was not technically practicable to restore the groundwater with concentrations of 47,000 µg/l within the clay zones found in the TI Zone. Therefore, the RAO for the TI Zone is containment.

4.1.3 OU3—(Air Force Plant 44) – 1985 ROD

The ROD developed by the Air Force in 1985 selected groundwater pump and treat as the remedy to address the VOCs and total chromium in groundwater. The Air Force ROD did not select a specific type of treatment system for the groundwater nor did it identify specific RAOs. Subsequent to the ROD, the Air Force developed treatment goals, chemicals of concern, and treatment levels in the RA Plan. The ROD and RA Plan were written before the Superfund law was amended in 1986 and EPA and the State concurrence with the Record of Decision was not part of the process.

The description of the remedy is construction of the reclamation wellfield to extract contaminated groundwater from the Regional Aquifer; withdrawal and treatment of extracted groundwater to remove contaminants; injection of treated water to the groundwater; and monitoring of the groundwater to ensure the effectiveness of the remedial effort and to substantiate termination. The remedial action objective was to restore groundwater. The RA Plan selected the following chemicals of concern and the respective treatment target levels:

Target Treatment Goals in the 1985 Remedial Action Plan for Air Force Plant 44 (µg/L)

Chemical of Concern	Target Treatment Goal
Trichloroethylene (TCE)	5
1,1-Dichloroethylene	0.033
1,1,1- Trichloroethane	16.8
Chromium	50 (as total chromium)

4.2 Remedy Implementation

The following subsections summarize the RAs implemented at the TIAA Superfund Site.

4.2.1 OU1— TARP Groundwater Treatment System

The TARP groundwater treatment facility uses packed column aeration to remove VOCs from the extracted groundwater and vapor-phase GAC treatment of the resulting vapor prior to discharge to the atmosphere. The TARP groundwater treatment facility is comprised of two remediation well fields: the North Well Field and the South Well Field. The combined extracted groundwater from the North Well Field and the South Well Field is conveyed to the TARP groundwater treatment facility, located northwest of the I-19/Irvington Road intersection (Figure 2). The objective of the North Well Field, which consists of four high-capacity extraction wells, is to contain the TCE plume in the Regional Aquifer. The objective of the South Well Field, which includes five low-capacity extraction wells, is to provide mass removal of the TCE from the Regional Aquifer. Together, nine wells pump an average of about 3,531 gallons per minute (gpm) (Malcolm Pirnie/ARCADIS 2012).

The TARP system was started in September 1994 and has pumped over 38.1 billion gallons of groundwater, removing approximately 4,560 pounds of TCE from the aquifer during the 216 months of operation (Malcolm Pirnie/ARCADIS 2012). The treated water from the TARP groundwater treatment facility is delivered to the Tucson Water Department (Tucson Water) distribution system. The current TARP groundwater treatment facility consists of the following components:

- Nine groundwater extraction wells; the North Well Field extraction well capacity ranges from 500 gpm to 1,250 gpm, and the South Well Field extraction well capacity ranges from 60 gpm to 350 gpm
- Conveyance pipeline from the extraction wells to the treatment system (influent)
- Acid tank for scale reduction
- Air stripping tower
- Vapor-phase GAC treatment
- Conveyance pipeline from the treatment system to the Tucson Water distribution system

4.2.2 OU2 – Airport Shallow Groundwater Remedy/TI Zone Remedy

The shallow groundwater contamination at the Airport Property is addressed by the 1997 ROD. The remediation system includes six groundwater extraction wells pumping groundwater to the centralized treatment facility. This treatment facility uses an air stripper to remove VOCs (primarily TCE) from the extracted groundwater. According to the August 2012 monthly operations and maintenance (O&M) report (CRA 2012b), six wells together pump at an average of about 68 gpm. The treated water is re-

injected into the Regional Aquifer upgradient of the extraction system, and the air stripper off-gas is treated by vapor-phase GAC prior to discharge to the atmosphere. The groundwater treatment system was started in October 2007 and has pumped over approximately 85 million gallons of groundwater and removed approximately 1,556 pounds of TCE since the startup (CRA 2012b).

Soil contamination at the Airport Property is addressed by the TI Zone SVE system. The TI Zone SVE system includes four SVE well nests connected through a pipeline to the centralized treatment facility, which treats extracted vapors through vapor-phase GAC prior to discharge to the atmosphere. Each TI Zone SVE well nest consists of two SVE wells, one well screened within Units 2 and 3, and one well screened within Unit 4. According to the August 2012 monthly O&M report (CRA 2012b), the average flow rate of the four TI Zone wells collectively is approximately 297 standard cubic feet per minute. The TI Zone SVE system was started in October 2007 and has removed approximately 5,515 pounds of TCE since the startup (CRA 2012b).

4.2.3 OU3—Air Force Plant 44

In April 1987, the Groundwater Treatment Plant (GWTP) on AFP44 was brought on line. Processes at the GWTP included extraction, treatment (using air stripping), and injection of treated groundwater into the aquifer at a maximum possible rate of approximately 5,000 gpm. The wellfield configuration utilized extraction and injection wells to achieve hydraulic containment of the plume by extracting groundwater from the center of the plume and injecting it along the outside perimeter of the plume. The system was comprised of two separate piping networks: a “high chrome” system and a “low chrome” system. Water from wells in the “high chrome” system was treated by ion exchange to remove chromium before treatment in the air strippers to remove VOCs. The ion exchange treatment system was dismantled in 1994 because chromium levels in the “high chrome” influent were consistently below applicable drinking water criteria (Raytheon 2006). Current influent concentrations of chromium in the “high chrome” system range from 10 to 15 µg/L. Although contaminated groundwater pumped from the “high chrome” system well field displayed low chromium levels, there are areas within the “high chrome” that are monitored and continue to have high levels of chromium. Chromium concentrations in 2010 ranged from 3,840 to 29,800 µg/L in the aquifer.

In 2002, improved analytical methods allowed for more accurate measurement of 1,4-dioxane in groundwater at the TIAA Superfund Site. Sampling of the GWTP influent and effluent indicated that the existing air stripping system was not able to adequately treat 1,4-dioxane in the extracted groundwater. In 2004, the Air Force conducted a technology evaluation for 1,4-dioxane treatment options (Earth Tech 2004). This evaluation determined that an advanced oxidation process (AOP) system, specifically hydrogen peroxide and ozone (HiPOx), could be used to treat both the chlorinated VOCs and 1,4-dioxane for about the same annual cost as the existing packed column aeration system. The original groundwater extraction system and GWTP were taken offline in November 2008 to allow construction of the new AOP system. The AOP system was designed to treat 1,4-dioxane and other contaminants of concern at the site. The system upgrades, necessary repairs, and startup testing were completed, and the system was brought online in September 2009. This system has been functioning in accordance with design specifications since that time. The groundwater remediation system has 28 extraction and 26 recharge wells that are all screened in the upper zone of the regional aquifer. Currently, the operating groundwater remediation system at OT012[1] consists of 11 extraction wells (E01, E02, E04 to E08, E09R, E13, E23, and E24), a HiPOx AOP treatment plant, seven recharge

[1] Regional Groundwater Aquifer and Shallow Groundwater Zone

wells (R02, R08 to R11, R18, and R20), and associated distribution system components. The AOP system treats both 1,4-dioxane and TCE as well as other contaminants of concern.

4.3 Operation and Maintenance

O&M of the treatment systems is necessary to achieve the following objectives set forth in the RODs: containment of VOC-contaminated groundwater and VOC-contaminated soil; mass removal of VOCs; and treatment of extracted groundwater to concentrations less than MCLs to prevent impact to groundwater above water quality standards. Specifically, appropriate and efficient O&M maximizes the operational time of extraction wells and the treatment plant to maximize contaminant removal.

4.3.1 OU1—TARP Groundwater Treatment System O&M

Typically, the areas of the TARP groundwater treatment system that require O&M are groundwater extraction wells, air stripper equipment, conveyance piping, and vapor-phase GAC units. Operation information is submitted to EPA in both semiannual status reports and monthly operational reports. The reports typically include, at a minimum, the following (Malcolm Pirnie/ARCADIS 2012):

- System operating time, downtime, and maintenance activities;
- Quantity of water treated;
- Flow rate of each groundwater extraction wells;
- Influent and effluent TCE concentrations;
- TCE mass removed from the groundwater during the month; and
- Sulfuric acid and sodium hypochlorite delivery volumes.

The *Operation and Maintenance Plan* (O&M plan; City of Tucson Water Department 2001) for the TARP area was submitted in July 2001. The O&M plan lists operating parameters such as flow rates and discharge pressures at extraction wells, flow rates for the air stripper blower, differential pressure for the packed columns and carbon vessels, and monitoring of raw and treated water quality. Regular maintenance activities are as follows:

- Periodic inspections of pumps, valves, filters, tanks and other system components;
- Periodic cleaning of filters;
- Periodic lubrication of pumps, blowers, and motor-operated valves; and
- Control of scale in the packed columns.

No significant issues or problems with O&M of the treatment system have been identified. Annual operation costs were approximately $850,000 in 2001. In 2002, management of 1,4-dioxane in the treated water from the TARP system became necessary because the toxicity of 1,4-dioxane had been re-assessed, resulting in a lower target concentration in the treated water. By 2012, the annual O&M cost of the TARP system was about $1,400,000.

4.3.2 OU2—Airport Property Shallow Groundwater Remedy/TI Zone Remedy O&M

The components of the shallow groundwater remedy groundwater treatment system that typically require O&M are as follows: groundwater extraction wells; conveyance piping; equalization tank and transfer pump; air stripper and effluent tank; vapor-phase GAC; effluent transfer pump; effluent cartridge filters; and re-injection well. The components of the TI Zone treatment system that typically require O&M are as follows: TI Zone SVE wells; SVE conveyance piping from each SVE well to the SVE treatment system; vapor-phase carbon units; flow meters, knock-out pots; transfer pumps; and SVE blowers. Similarly, the components of the Remedy Required Subsites (RRS) SVE system that typically require O&M are: RRS SVE well; SVE blower; SVE air-to-air cooler; knock-out pot and knock-out transfer

pump; vapor-phase carbon unit; and condensate collection tank. Operation reports are submitted to EPA on a monthly basis and as part of the Performance Evaluation Reports (PERs), including, at a minimum, the following:

- Shallow Groundwater Remedy
  - System operating time, downtime, and maintenance activities
  - Quantity of water treated
  - Flow rate of each groundwater extraction wells
  - Influent and effluent TCE concentrations
  - TCE mass removed from the groundwater during the month
- SVE Remedy
  - System operating time, downtime, and maintenance activities
  - Flow rate of each soil vapor extraction wells
  - Influent and effluent TCE concentrations
  - TCE mass removed from the soil during the month

The *Operation and Maintenance Manual: Shallow Groundwater Zone (SGZ) and Soil Vapor Extraction (SVE) Remedy, Tucson International Airport Area Superfund Site—Airport Property* was submitted in October 2007 (CRA 2007). The O&M manual lists operating parameters such as flow rates for extraction and injection wells, flow rates for the air stripper blower, flow rates for the effluent tank transfer pump, and the pH range in influent and effluent water. Similarly, operating parameters are also listed for the TI Zone remedy SVE system and RRS SVE system such as blower flow rate, extraction flow rate at SVE well, well head vacuum pressure, sizing of the soil vapor conveyance piping, and relative humidity. Regular maintenance activities are as follows:

- Perform weekly inspections to monitor equipment performance
- Maintain facility grounds, fences, gates, and wells
- Perform preventative maintenance of system equipment and instrumentation
- Clean filters, replace carbon, and rehabilitate injection, extraction, and monitoring wells

Annual O&M costs were estimated in the 1997 ROD to be between $125,000 and $240,000 for the SVE system (including the RRS SVE system) and between $112,000 and $212,000 for the SGZ system (EPA 1997a). Actual operating costs were not available during the five-year review. Unanticipated costs include use of a sequestering agent to reduce scale at the air stripper, replacement of the rotary lobe blower with a regenerative one, and cleaning of extraction wells to remove biofouling. No significant issues or problems with O&M of the treatment system have been identified.

4.3.3 OU3—Air Force Plant 44 Groundwater Treatment System O&M

As of December 2011, a total of approximately 28 billion gallons have been extracted and recharged and 24,000 lbs of VOCs have been removed from groundwater since the groundwater extraction and treatment system was started in 1987. An estimated 54 lbs of 1,4-dioxane have been removed since startup of the AOP system in 2009. Average pumping and injection rate for the period from July 2011 through June 2012 was about 1,600 gpm, with a resultant VOC mass removal of 123 lbs.

The areas of the AFP 44 groundwater treatment HiPOx system that require O&M are groundwater extraction and injection wells. Operation reports are submitted to EPA as part of the Installation Restoration Program Environmental Remediation Annual Update reports and the information is presented at the Air Force quarterly technical exchange meetings. The reports typically include, at a minimum, the following:

- GWTP Remediation Operations
  - Historical pumpage volumes for extraction and recharge wells
  - Cumulative VOC removal
- Repairs and Maintenance
  - List of repairs and maintenance during reporting period
- Environmental Releases

The *Operation and Maintenance Plan* for AFP 44 HiPOx system lists periodic inspections, maintenance, calibration checks and flow rates. Regular maintenance activities are as follows:

- Periodic inspections of reagent level or inventory
- Periodic inspections of Oxygen/Ozone System
- Periodic inspections of Cooling System
- Periodic inspections of Gas Vent System
- Periodic inspections of Hydrogen Peroxide System
- Periodic inspections of Electrical System
- Periodic inspections of overall Processes

No significant issues or problems with O&M of the HiPOx treatment system have been identified. Annual operation costs were approximately $1,000,000 in 2012.

5. Progress since the Last Five-Year Review

5.1 Previous Five-Year Review Protectiveness Statement and Issues

This report is the first FYR for the TIAA Superfund Site.

5.2 Work Completed at the Site during the Review Period

Work completed during the review period is described in Section 4.2 and Section 4.3.

6. Five-Year Review Process

6.1 Administrative Components

EPA Region 9 initiated the FYR in October 2012 and scheduled its completion for May 2013. Martin Zeleznik, the EPA Remedial Project Manager, led the FYR. The FYR team included Sarah Mueller, Leana Rosetti (community involvement coordinator), and contractor support provided by CH2M HILL. On September 25, 2012, EPA held a scoping call with the review team to discuss the site and items of interest as they related to the protectiveness of the remedy currently in place. A review schedule was established that consisted of the following:

- Community notification
- Document review
- Data collection and review
- Site inspection
- Local interviews
- FYR report development and review

6.2 Community Involvement

On October 18, 2012, a public notice was published in the *Arizona Daily Star*, and on January 10, 2013, it was published in Spanish in *La Estrella,* announcing the commencement of the FYR process for the TIAA Superfund Site, providing Martin Zeleznik as a contact person and inviting community participation. The press notice is available in Appendix B. No one contacted EPA as a result of the advertisement.

The FYR report will be made available to the public once it has been finalized. Copies of the document will be placed in the designated public repository: El Pueblo Public Library, 101 W. Irvington Road, Tucson, Arizona 85714. Upon completion of the FYR, a public notice will be placed in the *Arizona Daily Star* and *La Estrella* to announce the availability of the final FYR report in the site document repository.

6.3 Document Review

This FYR included a review of relevant, site-related documents, including the ROD, RA reports, and recent monitoring data. A complete list of the documents reviewed may be found in Appendix A.

6.4 Applicable or Relevant and Appropriate Requirements Review

Section 121 (d)(2)(A) of CERCLA specifies that Superfund RAs must meet any federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs), which are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site.

Chemical-specific ARARs identified in the selected remedy within the RODs for the ground water at this site and considered for this FYR for continued ground water treatment and monitoring are listed in Table 2. Arizona primary drinking water standards are the same as federal primary drinking standards except for the state standard for chloroform, which is less stringent than federal standards.

TABLE 2
Summary of Ground Water ARAR Changes

Contaminants of Concern	ARARs (µg/L)	Current Regulations (µg/L)	ARARs Changed?
1986 ROD (and subsequent 1993 Remedial Action Plan) Applicable or Relevant and Appropriate Requirements			
Trichloroethene	5	5	No change
1,1-Dichloroethylene	0.033	7	Less Stringent
1,1,1- Trichlorethane	16.8	200	Less Stringent
Chromium	50	100	Less Stringent
1988 Record of Decision Applicable or Relevant and Appropriate Requirements			
1,1-Dichloroethene	7	7	No change
1,2-Dichloroethene (trans-1,2-DCE)	70	100	Less Stringent
Benzene	5	5	No change
Chloroform	3	80 (total trihalomethanes)	Less Stringent
Chromium VI	50	100 (total chromium)	Less stringent
Trichloroethene	5	5	No change
1997 Record of Decision Applicable or Relevant and Appropriate Requirements			
1,1-Dichloroethane	5	NA	No change
1,1-Dichloroethene	7	7	No change
1,1,1-Trichloroethane	200	200	No change
1,2-Dichloroethane	5	5	No change
1,2-Dichloroethene (cis)	70	70	No change
1,2-Dichloroethene (trans)	100	100	No change
1,2-Dichloropropane	5	5	No change
Acetone	700	700	No change
Arsenic	50	10	More Stringent
Benzene	5	5	No change
Bis(2-ethylhexyl)phthalate	6	6	No change
Carbon tetrachloride	5	5	No change
Chlorobenzene	100	100	No change
Chloroform	100	80 (total trihalomethanes)	More Stringent
Chloromethane	2.7	2.7	No change
Chromium (Total)	100	100	No change
Dichlorodifluoromethane (Freon 12)	1,400	1,400	No change

TABLE 2
Summary of Ground Water ARAR Changes

Contaminants of Concern	ARARs (µg/L)	Current Regulations (µg/L)	ARARs Changed?
Ethylbenzene	700	700	No change
Lead	15	15	No change
Methyl ethyl ketone	350	350	No change
Methylene chloride	5	5	No change
Nitrate (as Nitrogen)	10,000	10,000	No change
Tetrachloroethene	5	5	No change
Toluene	1,000	1,000	No change
Trichloroethene	5	5	No change
Trichlorofluoroethane (Freon 113)	210,000	210,000	No change
Trichlorofluoromethane (Freon 11)	2,100	2,100	No change
Trihalomethanes (total)	100	80	No change
Vinyl chloride	2	2	No change
Xylenes	10,000	10,000	No change

Many other changes to the regulations which affected ARARs have occurred since the 1988 and 1997 RODs were developed. The changes are summarized in Table 3.

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Arizona Interim Soil Remediation Standards (Replaced by Arizona Soil Remediation Standards)	Arizona Administrative Code (AAC) R18-8-201 et seq. (Revised numeric limitations in Appendix A of AAC R18-8, Chapter 2.)	1997 ROD	Narrative standard that states that soil concentrations may not cause or threaten contamination of groundwater in exceedance of Arizona Water Quality Standards; also sets soil contamination standards called health-based guidance levels (HBGLs). (New standard provides numeric residential and non-residential soil remediation standards for RAs)	This change in law increases the protectiveness by establishing specific numeric limits for various compounds but does not apply to this site because the soil remediation work is complete.	Results in numerical standards for treating sub-surface soils. Cleanup will meet narrative and numerical standards. Based on the requirements of the original rule, polychlorinated biphenyl (PCB)-contaminated soils and sludges with concentrations above 0.18 mg/kg in residential areas and above 0.76 mg/kg in non-residential area will be excavated for off-site disposal. The revised soil remediation levels separate requirements for PCBs based on the area and type of PCBs (e.g., low risk/high risk) as specified in Appendix A of Title 18, Chapter 7. The original rule stated that any other hazardous substances that may be identified also will be subject to the HBGL ARARs, but the revised rule subjects the soils to the numerical standards in Appendix A. (Subsurface soil must meet the new non-residential standards during cleanup activities)	Former Appendix A renumbered to Appendix B; new Appendix A made by final rulemaking at 13 A.A.R. 971, effective May 5, 2007 (Supp. 07-1).
Federal Aviation Administration Rules	AC 150/5300-13	1997 ROD	Restricts structure heights near airports.	Changes to this advisory do not affect protectiveness.	Applicable to construction of SVE system and permanent structures near airports.	9/28/2012 (Advisory circular updated)

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Aviation Administration Rules	AC 150/5370-2C	1997 ROD	Restricts emissions that may cause a navigational hazard near airports	Changes to this advisory do not affect protectiveness.	Applicable to emission from operation of air strippers, thermal desorption, excavation, construction or any other types of emissions.	9/29/2011 (Advisory circular updated)
Federal Aviation Administration Rules	AC/70/7460-1F	1997 ROD	Establishes marking and lighting requirements for construction equipment or permanent structures near airports.	Changes to this advisory do not affect protectiveness.	Applicable to construction equipment and equipment or permanent structures near airports.	4/15/2000 (Advisory circular updated)
Endangered Species Act 6 United States Code (U.S.C.) §1531	50 CFR 200 and 402	1997 ROD	Establishes procedures for, determining presence of endangered species and protecting their habitats.	There has been no change to this law so no effect on protectiveness.	No endangered species have been at identified the SVE sites and plug-in sites. If any native plants or species are identified as endangered or threatened, construction or other remedial activities will be mitigated to avoid affecting such species or its habitat.	Not Applicable
National Historic Preservation Act, Section 106, 16 U.S.C. §§470 et seq.	36 CFR Parts 65 and 800	1997 ROD	Preserves historic properties by requiring that action be planned to minimize harm to National Historic Landmarks.	There has been no change to this law so no effect on protectiveness.	The Three Hangars have been proposed for designation on the Register of Historic Places. Any SVE activities near the Three Hangars would be managed to minimize harm to the buildings.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Archaeological Discoveries, Historic Preservation	41 ARS §§ 841-847, 865	1997 ROD	Preserves archaeological artifacts and remains.	There has been no change to this law so no effect on protectiveness.	If any archaeological artifacts, human remains, or funerary objects are discovered during construction, excavation or similar activities, such activity must cease temporarily to allow for investigation and preservation of such artifacts, remains, or objects in accordance with the procedures set forth in this ARAR.	Not Applicable
Clean Water Act 402.33 U.S.C. 1342; 40 CFR Part 122 (Implemented in Arizona by Clean Water Act § 402; Arizona Pollutant Discharge Elimination System (AZPDES) ARS 49-255, et seq.)	National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002 (Waste Discharge requirements for Discharges of Storm Water Associated with Construction Activity) (Implemented in Arizona in accordance with 40 CFR 125; AAC 18-9-A-901 to 914)	1997 ROD		More protective as it establishes numeric limits and activity-specific guidelines for stormwater from construction operations greater than 1 acre and establishes a construction general permit for sites meeting these criteria but does not affect this site because construction is complete.	The substantive portions of the previous general permit are action-specific ARARs for the construction of the SVE and groundwater treatment systems. The revised standards promulgated by Arizona are also action-specific ARARs.	Article 9, consisting of Sections R18-9-901 through R18-9-914 and Appendix A, recodified from 18 A.A.C. 13, Article 15 at 7 A.A.R. 2522, effective May 24, 2001.
Federal RCRA Subtitle C; 42 USC §6921 et seq, (RCRA Subtitle C); ARS §49-921 et seq.	40 CFR Part 261 and R18-8-261	1997 ROD	Establishes criteria for Identifying hazardous waste subject to RCRA Subtitle C treatment, storage and disposal requirements.	There has been no change to this law so no effect on protectiveness.	Requires determination as to whether excavated soils and treatment residuals (e.g., spent carbon from the SVE system) or drilling wastes are classified as hazardous waste.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq	49 CFR Section 262.11 and R18-8-262	New Requirement	Regulation of waste from construction and operation of remedial action requires waste generators to determine whether wastes are hazardous wastes and establishes procedures for such determinations.	This law affects the regulation of waste from remedial activities and does not affect protectiveness.	These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of any groundwater treatment units.	No amendment, existing requirement not addressed during initial ROD.
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR Part 264, Subpart X and R18-8-264	1997 ROD	Establishes narrative criteria for regulating miscellaneous treatment units.	There has been no change to this law so there is no effect on protectiveness.	Location, design, construction, operation, maintenance and closure of SVE system, including any on-site disposal, must comply with the substantive portions of the narrative criteria.	Not Applicable
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR Part 264, Subpart AA and BB and R18-8-264	1997 ROD	Regulates emissions from process vents associated with solvent extraction and air strippers.	There has been no change to this law so there is no effect on protectiveness.	Emissions from the SVE treatment system must comply with these subparts.	Not Applicable
Clean Air Act 42 U.S.C. §§ 7401-7671q	40 CFR Part 61	1997 ROD	Controls air emissions of VOCs and gaseous contaminants. (Note: Only applies if the equipment is in service of a liquid that contains at least 10% volatile hazardous air pollutant, such as TCE.)	There has been no change to this law so there is no effect on protectiveness.	Requires reduction of VOC emissions from product accumulator vessels. Also requires leak detection and repair programs.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR Part 264, Subpart I and R18-8-264.170 et seq.	1997 ROD	Establishes requirements for containers holding RCRA hazardous waste for treatment, storage or disposal including condition, management, and inspection of containers, container compatibility with wastes and design and operation of container storage areas	There has been no change to this law so there is no effect on protectiveness.	Containers storing treatment system waste (including RCRA wastewater from the SVE air/water separator and GAC carbon), sludges or soil must comply with substantive provisions.	Not Applicable
RCRA Subtitle C; ARS §49-921 et seq,	40 CFR Part 264, Subpart J and R18-8-264.190 et seq.	1997 ROD	Establishes requirements for tank systems used to store or treat hazardous waste, including design and installation, containment and detection of releases, operating requirements, inspections, responses to leaks or spills and closure and post-closure.	There has been no change to this law so there is no effect on protectiveness.	Tanks used for treatment or storage must comply with substantive provisions.	Not Applicable
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR Part 264 Subpart O and R18-8-264	1997 ROD	Establishes waste analysis requirements, performance standards, operating requirements, monitoring and inspection requirements and, closure requirements.	There has been no change to this law so there is no effect on protectiveness.	An ARAR if the SVE system employs catalytic oxidation or thermal oxidation to treat off-gas.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR Part 268 Subpart E and R18-8-268 et seq.	1997 ROD	Storage of land-banned waste must comply with these requirements. Storage of more than one year requires demonstration that such storage is solely for the purpose of accumulation to allow for proper recovery, treatment, and disposal.	There has been no change to this law so there is no effect on protectiveness.		Not Applicable
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR 262.34	New Requirement	Regulates temporary accumulation of hazardous waste on-site. Specifies procedure for accumulation of hazardous waste on-site for certain amounts of hazardous waste and for certain time periods under generator status.	This law affects the accumulation of waste onsite after it has been generated and, therefore, does not affect protectiveness as there is no waste being generated at the site.	These requirements are applicable to management of waste materials generated as a result of construction of the remedial action and operation of any of the groundwater treatment plants if the waste materials generated are hazardous wastes	No amendment, existing requirement not addressed during initial ROD.
Federal Clean Air Act, 42 U.S.C. §§7401 et seq.	Pima County Bureau of Air Pollution Control Rules and Regulations, Title 17 Pima County Air quality Code, 17.16.430, Subparagraph F		Requires reasonably available control equipment from a stationary source that emits VOCs.	There has been no change to this law so there is no effect on protectiveness.		Not Applicable
Toxic Substances Control Act, 15 U.S.C. 2601 et seq.	40 CFR Parts 702-775	1997 ROD	Disposal of PCB waste in excess of 50 mg/kg must comply with TSCA requirements	There has been no change to this law so there is no effect on protectiveness.	PCB concentrations must be established to determine whether the soils must be sent to an approved TSCA facility. This is both a chemical-specific and an action-specific ARAR.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Resource Conservation and Recovery Act (RCRA) Subtitle C; ARS §49-921 et seq.	40 CFR part 264, Subpart CC and R18-8-164 et seq.	1997 ROD	Establishes air emission standards for tanks and containers.	There has been no change to this law so there is no effect on protectiveness.	Relevant and appropriate if remedy employs on-site treatment.	Not Applicable
RCRA Subtitle D	40 CFR 258.10	1997 ROD	Establishes safety requirements for landfills near airports.	There has been no change to this law so no effect on protectiveness.		Not Applicable
RCRA Subtitle D	40 CFR Part 258 as implemented by ARS Title 49, Chapter 4	1997 ROD	Establishes minimum operating criteria for landfills that receive waste after 1996 and procedures for closures of open dumps.	There has been no change to this law so no effect on protectiveness		Not Applicable
RCRA Subtitle D	40 CFR Part 257	1997 ROD	Establishes criteria for determining whether a solid waste disposal facility poses a threat to human health and the environment.	There has been no change to this law so no effect on protectiveness		Not Applicable
Federal Safe Drinking Water Act, 42 U.S.C. Sec. 300g-1, 40 CFR 141.161	40 CFR Part 141 (Subparts B, C, G), Federal Primary Drinking Water Standards-MCLs	1997 ROD	MCLs were established as health-based drinking water standards to protect public health from contamination that may be found in drinking water from public water systems. The NCP, 40 CFR §300.430(e)(2), provides that remedial actions generally must attain MCLs and non-zero MCLGs where groundwater is a source or potential source of drinking water.	There is no effect on protectiveness as only the arsenic levels, which are not a COC at the site, had a change in MCL since the 1997 ROD.	Forms one of the bases for the development of chemical-specific Shallow Groundwater Zone cleanup levels. The Shallow Groundwater Zone cleanup levels are based on the federal MCLs, as set forth in Table 6.	66FR 6976, Jan. 22, 2001

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Arizona Clean Water Act	Arizona Aquifer Water Quality Standards, R18-11-405, R18-11-406.	1997 ROD	Sets chemical-specific narrative and groundwater standards.	There has been no change to this law and no effect protectiveness.	Narrative standard prohibits discharges to groundwater that would cause a pollutant to be present in an aquifer classified for drinking water. The numeric standards are not more stringent than the federal or the state MCLs and do not set in situ standards but are ARARs with respect to any discharges.	Not Applicable
Arizona Surface Water Quality Standards ARS 49-222	R18-11-101 et seq	New Requirement	Regulates discharges to surface water.	The narrative and numerical water quality standards are more protective than those in place during the initial ROD.	Discharges from treatment systems must comply with narrative and numeric Arizona State Water Quality Standards for Surface Waters if treated water is discharged to surface water.	14 A.A.R. 4708, effective January 31, 2009 (Supp. 08-4).
Clean Water Act § 402; Arizona Pollutant Discharge Elimination System (AZPDES) ARS 49-255, et seq.	40 CFR 125; AAC 18-9-A-901 to 9096	New Requirement	The AZPDES permit program regulates discharges into "waters of the United States" by establishing numeric limits for such discharge.	More protective as it establishes numeric limits and activity-specific guidelines for stormwater from construction operations greater than 1 acre and establishes a construction general permit for sites meeting these criteria. This does not affect this site as there are no construction operations.	The discharge of treated water to "waters of the United States" will meet the substantive effluent limitations of the permit.	Article 9, consisting of Sections R18-9-901 through R18-9-914 and Appendix A, recodified from 18 A.A.C. 13, Article 15 at 7 A.A.R. 2522, effective May 24, 2001.

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Arizona Remedial Action Requirements	ARS 49-280 (replaced by ARS 282.06(A)(2))	1997 ROD	Treatment of groundwater must be conducted in a way to provide for the maximum beneficial use of the waters of the state.	Change in rule number does not affect protectiveness.		Not Applicable
Arizona Groundwater Management Act, ARS Title 45	45-454.01 (Also includes 45-494, 45-495, 45-496, 45-600)	1997 ROD	The regulation exempts new well construction, withdrawal, treatment and injection wells at CERCLA sites from obtaining Arizona Department of Water Resources approval to extract groundwater, subject to compliance with certain substantive provisions.	Additional citations do not affect protectiveness.	The substantive standards set forth in these sections will be complied with in construction and logging of new wells.	Not Applicable
RCRA Subtitle C; ARS §49-921 et seq.	40 CFR 262.34	New Requirement	Regulates temporary accumulation of hazardous waste onsite. Specifies procedure for accumulation of hazardous waste on-site for certain amounts of hazardous waste and for certain time periods under generator status.	This law affects the accumulation of waste onsite after it has been generated and, therefore, does not affect protectiveness. There is no waste generated at the site that would be considered hazardous waste	These requirements are applicable to management of waste materials generated as a result of construction of the remedial action and operation of any of the groundwater treatment plants if the waste materials generated are hazardous wastes	No amendment, existing requirement not addressed during initial ROD.
Safe Drinking Water Act, 42 U.S.C. §300f et seq.	40 CFR 144.24,146	1997 ROD	Establishes criteria for determining exempt aquifers, including current and future use, yield and water quality.	There has been no change to this law so there is no effect on protectiveness.	Applies to design, construction, operation and maintenance of injection wells, if selected to return treated groundwater to the aquifer.	Not Applicable

TABLE 3
Applicable or Relevant and Appropriate Requirements Evaluation

Requirement	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28 Emissions from Air Strippers	1997 ROD	Limits discharges of VOCs from air strippers to 15 lbs/day per site.	There has been no change to this directive so there is no effect on protectiveness.		Not Applicable
	EPA Office of Solid Waste, RCA Groundwater Monitoring; Draft Technical Guidance, Nov., 1992 (EPA/530-R93—001)	1997 ROD	Sets forth requirements for the development and implementation of a groundwater monitoring program	There has been no change to this directive so there is no effect on protectiveness.	Applies to the development of a comprehensive groundwater monitoring program for the site.	Not Applicable

6.5 Review of TIAA Superfund Site Risk Assessments

There have been two risk assessments produced using site-specific data for the TIAA Superfund Site. The first was a Public Health Evaluation (PHE) produced as part of the FS in support of the 1988 ROD. The second was a baseline human health risk assessment (BHHRA) prepared in 1996 in support of the 1997 ROD. In 1986, the Air Force signed a ROD, which was not co-signed by EPA, and implemented a remedy at OU3 (mainly groundwater south of Los Reales Road). There was no risk assessment prepared in support of the Air Force ROD. The 1993 Remedial Action Plan (RAP) produced by the Air Force included a "Risk Assessment" section. In contrast to the site-specific nature of the 1988 PHE and 1996 BHHRA, the 1993 RAP risk section was more of a general discussion of the toxicities of the primary contaminants at AFP44 and how those toxicities relate to the treatment objectives and goals established in the RAP.

6.5.1 1988 Public Health Evaluation (TARP Groundwater Treatment System 1988 ROD)

The PHE in support of the 1988 ROD was performed in accordance with the Superfund Public Health Evaluation Manual (Office of Solid Waste and Emergency Response [OSWER] Directive 9285.4-1, EPA/540/1-86/060). It addressed primarily groundwater contamination north of Los Reales Road, focusing on public supply wells, private drinking water wells and monitoring wells. The PHE identified TCE, chloroform, and benzene as the primary carcinogenic contaminants by ingestion of groundwater. Excess cancer risks, for a 70-year lifetime consumption scenario, ranged from 1.6×10^{-5} to 6.8×10^{-5} for the upper undivided aquifer and from 6.1×10^{-5} to 2.8×10^{-4} in the divided aquifer. The 1988 PHE proposed target cleanup levels for TCE and chloroform at 1.5 µg/L and 0.2 µg/L (respectively), noting that these levels represent the 1×10^{-6} incremental excess cancer risk levels for each and that benzene was expected to be cleaned up along with the TCE treatment. It further noted that hexavalent chromium "has not been demonstrated...carcinogenic via the ingestion route."

A screening assessment of TCE in shallow soil gas samples concluded that "TCE released from soil gas does not represent a health threat."

6.5.2 1996 Baseline Human Health Risk Assessment (Airport Property Shallow Groundwater Remedy/TI Zone Remedy 1997 ROD)

In support of the 1997 ROD, a BHHRA addressing OU2 was prepared by ADHS (1996). The BHHRA evaluated risks associated with contamination in soil, groundwater in the SGZ and soil gas exposures on airport property and at the Burr Brown and former West-Cap properties. Potential health risks were assessed for exposure to VOC contamination in soils and groundwater; Aroclor 1260 (a PCB) in soils and sludges at the Three Hangars Building area of the airport and various contaminants at the TAA's landfill.

The BHHRA identified current exposure pathways for an occupational scenario: exposures to vapors in the breathing zone from soil gas; incidental ingestion of contaminants in surface soil; and inhalation of contaminants as fugitive dust from surface soil. Current exposure pathways for a residential scenario include the following: offsite incidental ingestion of contaminants in surface soil, offsite inhalation of fugitive dust from contamination in surface soil or soil gas, and offsite dermal contact with contamination in surface soil. Future exposure pathways include all current pathways and additionally residential use of groundwater over the area of the shallow groundwater contamination.

The exposure pathways and associated risks identified in the risk assessment are summarized in Table 4.

TABLE 4
Exposure Pathway Analysis

Exposure Scenario & Pathway	Risk Driver(s)	Risk Estimate
Workers' exposure to soil/incidental ingestion, inhalation of fugitive dust or VOCs, dermal contact	Aroclor 1260	Airport Property Former Structure 21: Excess lifetime cancer risk (ELCR) = 6×10^{-4}, hazard index (HI) = 10 Airport Property Former Structure 30: ELCR = 4×10^{-5}, HI <1 Airport Property North Drainage Outfall and Ponding Areas: ELCR = 2×10^{-5}, HI = <1 Airport Property South Drainage Outfall and Ponding Areas: ELCR = 3×10^{-4}, HI = 6
Workers exposure to contaminants in indoor air through vapor intrusion/inhalation of VOCs	None	All estimates less than target levels
Offsite residents exposure to groundwater/ingestion, inhalation of VOCs, and dermal contact	Arsenic, benzene, carbon tetrachloride, chloroform, trichloroethene, tetrachloroethene, 1,2-dichloroethane, 1,2-dichloropropane, and dichloromethane	S-18: ELCR = 6×10^{-5}, HI <1 S-26: ELCR = 2×10^{-4}, HI = 1 S-16B: ELCR = 2×10^{-4}, HI <1 S-21B: ELCR = 7×10^{-6}, HI <1 S-18 and S-26: ELCR = 2×10^{-4}, HI =1 S-16B and S-21B: ELCR = 2×10^{-4}, HI =1 S-18, S-26, S-16B and S-21B: ELCR = 4×10^{-4}, HI =2
Offsite residents' exposure to soil/incidental ingestion, inhalation of fugitive dust or VOCs, dermal contact	Aroclor 1260	Offsite Sediment Contamination Site 1: 2×10^{-5}, HI <1 Site 2: 1×10^{-5}, HI<1 Vacant Lot: 1×10^{-5}, HI<1
Offsite residents' exposure to contaminants in indoor air through vapor intrusion/inhalation of VOCs	None	All estimates less than target levels

6.5.3 Changes to Risk Assessment Assumptions and Factors

The two risk assessments were reviewed to identify any changes in exposure assumptions or toxicity data that would impact protectiveness of the remedies currently in place. Changes in risk assessment factors that can potentially have significant impacts on protectiveness include the following:

- **Emerging contaminants:** 1,4-Dioxane is considered an emerging contaminant and was not evaluated in either the 1988 PHE or the 1996 BHHRA. 1,4-dioxane is one of the major groundwater contaminants at TIAA Superfund Site and the 1,4-dioxane groundwater plume is similar in shape and size to the TCE groundwater plume, and is in the same area. Groundwater concentrations of 1,4-dioxane at the site range from 0.5 µg/L to 83 µg/L. Over a lifetime of exposure, EPA considers drinking water concentrations of 1,4-dioxane in the range of 0.35 to 35 µg/L [corresponding to 1×10^{-6} to $1x10^{-4}$ excess cancer risk for a 70-year exposure] to be protective of the risk of developing cancer. EPA is working with the PRPs (Tucson Airport Authority, AFP44, Tucson Water, and others) to remediate the 1,4-dioxane groundwater contamination. A new treatment plant at AFP44 has been added to treat 1,4-dioxane and Tucson Water is constructing a 1,4-dioxane treatment system at TARP.

  Although 1,4-dioxane treatment systems are either in place (at AFP44) or under construction (at TARP), 1,4-dioxane has not yet been formally included in the remedy for the site. An assessment of 1,4-dioxane in groundwater north of Los Reales Road is the focus of a revised RI/FS and risk assessment currently underway

by the Air Force. Once the RI/FS risk assessment is finalized, 1,4-dioxane cleanup levels should be determined for groundwater and drinking water at the site and formally included in the remedy. EPA's Integrated Risk Information System (IRIS) program is currently reviewing the toxicity of 1,4-dioxane by inhalation exposure. A new toxicity value addressing risks from inhaled 1,4-dioxane will need to be addressed in subsequent FYRs.

- **Vapor Intrusion[2,3]:** EPA's understanding of VOC contaminant migration from soil gas and/or groundwater into buildings has evolved over the past few years, leading to the conclusion that vapor intrusion may have a greater potential for posing risks to human health than was assumed when the two risk assessments were prepared. In September 2002, EPA released an external review draft version of its vapor intrusion guidance titled "Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" (EPA 2002).

  To date there have been two assessments regarding the potential for vapor intrusion at the site. A basic screening of the potential for TCE off-gassing from soils was mentioned in the 1988 PHE, but this screening falls short of a rigorous vapor intrusion assessment process currently being evaluated by EPA Region IX. The vapor intrusion pathway was evaluated in the 1996 BHHRA using soil gas data and the Millington and Quirk's (1961) empirical model to calculate an effective diffusion coefficient and the Karimi model (1987) for estimating flux rate from soil. Since the BHHRA was conducted in 1996, methods/models for evaluating the vapor intrusion pathway have evolved significantly.

Evaluation of the VI pathway using more current methods/models is recommended at specific areas before the next FYR. The Three Hangars Building TI area merits a more thorough vapor intrusion assessment due to the high soil gas readings that are found in and near the TI Zone. Soil gas samples should also be taken in a small residential area across Nogales Highway from the Three Hangars Building where groundwater is less than 100 feet in depth below ground surface and concentrations of TCE are over 50 µg/L. Beneath Building 801 at the AFB 44, several high levels of soil gas have been found indicating a potential for vapor intrusion.

- **Toxicity values:** The Superfund program periodically updates toxicity values used for risk assessment as newer scientific information becomes available. Primary sources include EPA's IRIS and similar peer-reviewed toxicity assessment programs in other federal and state agencies. Since the 1988 PHE and 1996 BHHRA were conducted, there have been a number of changes to the toxicity values for many of the contaminants at the site. Table 5 compares toxicity values used in the 1996 BHHRA with current toxicity values (from the May 2013 Regional Screening Level Table). As noted in Table 5, new or revised toxicity values now exist for almost all of the site-related contaminants addressed in both the 1988 PHE and the 1996 BHHRA. Some new or changed toxicity values, especially those relating to cancer potency, can be expected to have a significant impact on health risks posed by the TIAA Superfund Site contamination; others may have only minimal impact.

  The changes to toxicity values for the following contaminants appear to have the greatest impact on health risks at the site:

  - **TCE:** EPA released the final revised toxicity assessment for TCE to the IRIS database on September 28, 2011 (EPA 2011a). The revised assessment upgraded TCE's carcinogen status to Human Carcinogen from Probable Human Carcinogen. In addition, cancer risks and non-cancer health hazards are determined to be a potential concern at lower levels of exposure than those previously published. However, the MCL of 5 µg/L and the current cleanup level of 1.5 µg/L for drinking water from TARP are both within the revised protective carcinogenic risk range, and EPA considers the MCL of 5 µg/L protective for both cancer and non-cancer effects.
  - **PCE:** EPA released the final revised toxicity assessment for PCE to the IRIS database on February 10, 2012 (EPA 2012b). EPA has concluded that PCE poses less of a human cancer risk compared with previous

[2] Vapor intrusion sites in Arizona should be evaluated in accordance with EPA Region 9's Framework for Investigating and Evaluating Vapor Intrusion.

[3] EPA also supports use of guidance on vapor intrusion published by the Interstate Technology & Regulatory Council.

assessments. The overall impact of this conclusion is that the treatment level may become less stringent. Therefore, this change is not expected to affect the protectiveness of the remedy.

- **Hexavalent chromium (Cr6):** In the intervening years since the 1988 PHE and 1996 BHHRA were produced, there has been uncertainty in the scientific community over whether or not hexavalent chromium has the potential to cause cancer in humans when ingested, especially at environmentally-relevant drinking water concentrations. At present, Superfund risk assessment guidance considers hexavalent chromium a carcinogen, and presents an oral cancer slope factor based on a New Jersey Department of Environmental Protection toxicity assessment. Using the New Jersey toxicity value for oral carcinogenicity, the protective risk range for hexavalent chromium in drinking water, assuming a 70-year lifetime exposure, is 0.013 to 1.3 µg/L (corresponding to a 1×10^{-6} to 1×10^{-4} excess cancer risk range).

  The 1988 ROD did not set a cleanup goal specific for hexavalent chromium in groundwater or drinking water because, as noted above, hexavalent chromium was not considered carcinogenic by ingestion at the time. Given the present Superfund risk assessment approach, if a cleanup level were to be established in accordance with the 1×10^{-6} excess cancer risk goal in the 1988 ROD, it would be 0.013 µg/L. Current water treatment technology is not able to achieve such a low hexavalent chromium concentration. It therefore appears that the remediation goal in the 1988 ROD, of cleanup to a 10^{-6} excess cancer risk value, is not technologically feasible, at least with respect to hexavalent chromium.

  EPA's IRIS program is currently undertaking a re-assessment of hexavalent chromium toxicity and is expected to address the question of toxicity values for the assessment of carcinogenicity by oral exposure. Once the IRIS toxicity re-assessment is finalized, EPA is committed to reviewing the MCL for chromium; the issue of hexavalent chromium cleanup levels for groundwater and drinking water at the site should then be revisited.

In summary, there have been a number of new developments and changes in assumptions and toxicity values that were used for risk assessment since the 1988 PHE and 1996 BHHRA were performed. The most significant appear to be the identification of 1,4-dioxane as a site contaminant in groundwater, the need to more rigorously address the potential for vapor intrusion and the revised toxicity values for hexavalent chromium. Most notably, the revised carcinogenicity status of ingested hexavalent chromium, with its new cancer risk values, calls into question the technical feasibility of achieving the 1×10^{-6} excess cancer risk treatment goal set in the 1988 OU1 ROD and the reinjection treatment goal of 50 ppb for total chromium in the 1986 OU3 ROD.

TABLE 5
Comparison of 1996 and Current Toxicity Values

Chemical	Ingestion Exposure						Inhalation Exposure					
	RfDo (mg/kg-day)			SFo $(mg/kg\text{-}day)^{-1}$			Reference Concentration (mg/m^3)			Unit Risk Factor $(\mu g/m^3)^{-1}$		
	Value used in 1996 Risk Assessment	May 2013 RSL Table	Change in Toxicity	Value used in 1996 Risk Assessment	May 2013 RSL Table	Change in Toxicity	Value used in 1996 Risk Assessment converted to mg/m^3	May 2013 RSL Table	Change in Toxicity	Value used in 1996 Risk Assessment converted to $(\mu g/m^3)^{-1}$	May 2013 RSL Table	Change in Toxicity
Organics												
1,1-Dichloroethane	1.0E-01	2.0E-01	Less toxic	--	5.7E-03	More toxic	4.9E-01	--	Less toxic	--	1.6E-06	More toxic
1,1-Dichloroethylene	--	5.0E-02	More toxic	6.0E-01	--	Less toxic	--	2.0E-01	More toxic	5.1E-05	--	Less toxic
1,2-Dichloroethane	--	6.0E-03	More toxic	9.1E-02	9.1E-02	No change	--	7.0E-03	More toxic	2.6E-05	2.6E-05	No change
1,2-Dichloropropane	1.1E-03	9.0E-02	Less toxic	6.8E-02	3.6E-02	Less toxic	4.0E-03	4.0E-03	No change	--	1.0E-05	More toxic
1,1,2-Trichloroethane	--	4.0E-03	More toxic	5.7E-02	5.7E-02	No change	--	2.0E-04	More toxic	1.6E-05	1.6E-05	No change
1,1,2,2-Tetrachloroethane	--	2.0E-02	More toxic	2.0E-01	2.0E-01	No change	--	--	No change	5.8E-05	5.8E-05	No change
4-Methylphenol	--	1.0E-01	More toxic	--	--	No change	--	6.0E-01	More toxic	--	--	No change
Benzene	--	4.0E-03	More toxic	2.9E-02	5.5E-02	More toxic	--	3.0E-02	More toxic	8.3E-06	7.8E-06	Less toxic
Bis(2-Ethylhexyl)phthalate	--	2.0E-02	More toxic	1.4E-02	1.4E-02	No change	--	--	No change	--	2.4E-06	More toxic
Carbon Tetrachloride	7.0E-04	4.0E-03	Less toxic	1.3E-01	7.0E-02	Less toxic	2.0E-03	1.0E-01	Less toxic	1.5E-05	6.0E-06	Less toxic
Chloroform	1.0E-02	1.0E-02	No change	6.1E-03	3.1E-02	More toxic	3.5E-02	9.8E-02	Less toxic	2.3E-05	2.3E-05	No change
Chloromethane	--	--	No change	1.3E-02	--	Less toxic	--	9.0E-02	More toxic	1.8E-06	--	Less toxic
Dichloromethane	6.0E-02	6.0E-03	More toxic	7.5E-03	2.0E-03	Less toxic	3.0E+00	6.0E-01	More toxic	4.7E-07	1.0E-08	Less toxic
Tetrachloroethylene	1.0E-02	6.0E-03	More toxic	5.1E-02	2.1E-03	Less toxic	3.5E-02	4.0E-02	Less toxic	5.2E-07	2.6E-07	Less toxic
Trichloroethylene	6.0E-03	5.0E-04	More toxic	1.1E-02	4.6E-02	More toxic	2.1E-02	2.0E-03	More toxic	1.7E-06	4.1E-06	More toxic
Vinyl Chloride	--	3.0E-03	More toxic	1.9E+00	7.2E-01	Less toxic	--	1.0E-01	More toxic	8.4E-05	4.4E-06	Less toxic
Polychlorinated Biphenyls	--	--	No change	7.7E+00	--	Less toxic	--	--	No change	--	--	No change
Aroclor 1254	2.0E-05	2.0E-05	Less toxic	--	2.0E+00	More toxic	--	--	No change	--	5.7E-04	More toxic
Aroclor 1260	--	--	No change	--	2.0E+00	More toxic	--	--	No change	--	5.7E-04	More toxic
Inorganics												
Arsenic	3.0E-04	3.0E-04	No change	1.5E+00	1.5E+00	No change	--	1.5E-05	More toxic	4.3E-03	4.3E-03	No change
Beryllium	5.0E-03	2.0E-03	More toxic	4.3E+00	--	Less toxic	--	2.0E-05	More toxic	2.4E-03	2.4E-03	No change
Cadmium	--	1.0E-03	More toxic	--	--	No change	--	1.0E-01	More toxic	1.8E-03	1.8E-03	No change
Chromium (VI)	--	3.0E-03	More toxic	--	5.0E-01	More toxic	--	1.0E-04	More toxic	1.2E-02	8.4E-02	More toxic
Lead	--	--		--	--		--	--		--	--	--

Note:

-- Toxicity value not available
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
$\mu g/m^3$ = micrograms per cubic meter

RfC = reference concentration
URF = unit risk factor
RfDo = oral reference dose
RSL = regional screening level

SFo = oral slop factor

2012 RSL Table = USEPA Regional Screening Levels Table (updated November 2012)

(a)Toxicity values are presented from Table 20, Baseline Risk Assessment 1994 for COPCs that were evaluated for exposure pathways in the risk assessment.

6.6 Data Review

The data review included review of groundwater quality data and other relevant information from the TARP semiannual status reports for the 1988 ROD, the *Tenth Performance Evaluation Report: SGZ Remedy and SVE Remedy* (CRA 2012b) for the shallow groundwater remedy and TI Zone SVE system for the 1997 ROD, and the *2012 AFP 44 IRP Annual Update* (AECOM, 2012), *Final Remediation Completion Report Site 5* (Earth Tech 2006), *HiPOx Operational System* (AECOM, 2012), *Development and Screening of Alternatives for TIAA Superfund Site Area A Feasibility Study* (AECOM 2011), *Draft Interim Remedial Action Completion Report IRP Site 17: Advanced Oxidation System for Regional Groundwater Treatment* (AECOM 2011), and *Site Management Plan for 1,4-dioxane RI/FS* (AECOM 2012) to assess the ongoing remedial activities at AFP44.

The primary purpose of the data review is to determine if the remedy selected is successful in achieving performance standards set forth by the respective RODs or for the AFP44 case, performance standards for a typical Federal Facility CERCLA NPL site.

6.6.1 TARP - OU1

The groundwater quality data and other relevant information from the TARP *Semi-Annual Status Report* (Malcolm Pirnie/ARCADIS 2012) was reviewed to determine if the selected remedy is successful in containing VOC-impacted groundwater and maintaining the TCE concentration in treated water below 1.5 µg/L as specified in the 1988 ROD.

The North Well Field extraction wells of the TARP groundwater system have been successful in maintaining hydraulic capture of the TCE plume boundary of the regional aquifer in the TARP area. Figure 3 indicates that the TCE plume is decreasing in width along the western boundary. In addition, groundwater capture to the northwest is evidenced by the absence of TCE detected at sentinel wells WR-237A, WR-238A, and WR-239A. The highest TCE concentration at the North Well Field is observed at remediation well R-007A at 24 µg/L and the highest TCE concentration at the South Well Field is observed at remediation well R-004A at 47 µg/L.

Concentrations of TCE near well 410T, located on the eastern plume boundary, have been increasing since 1999. TCE concentrations in groundwater samples from monitoring well 410T have increased from approximately 2.9 µg/L (June 1999) to 23.2 µg/L (February 2012). The cause(s) of the increase has not yet been determined. Groundwater in this area appears to be captured by the extraction wells but the increase in TCE concentrations indicates that complete capture may not be occurring upgradient of this area in OU2. Other wells in the area (for example, wells WR-085S and the South Well Field extraction wells) show stable or declining concentrations of TCE.

TCE was not detected in the treated groundwater at concentrations above the laboratory reporting limit of 0.5 µg/L during the past 5 years (Malcolm Pirnie/ARCADIS 2012). This meets the performance standard in the 1988 ROD.

6.6.2 Airport Shallow Groundwater Remedy/TI Zone Remedy - OU2

The following subsections discuss review of groundwater quality data, soil vapor data, and other relevant information from the *Tenth Performance Evaluation Report: SGZ and SVE Remedy* (CRA 2012b) to determine if the selected remedy is successful in achieving performance standards set forth by the 1997 ROD.

6.6.2.1 Shallow Groundwater Zone Remedy and TI Zone Remedy (Groundwater)

The Shallow Groundwater Remedy has been in operation for approximately 5 years. During this period the following trends or observations were identified from concentrations of TCE in site monitoring wells (CRA 2012b):

- TCE is not detected at least half of the time in samples from 29 monitoring wells
- 16 wells show no trend in TCE concentration
- 36 wells show a decreasing concentration of TCE
- 9 wells show an increasing trend in the concentration of TCE

In addition, groundwater elevations have increased in 17 percent of wells (mostly associated with the Regional Aquifer) and have decreased in 72 percent of the wells (CRA 2012b). Concentrations of TCE in the gravel subunit (GSU) measured in August 2012 are shown on Figure 4. The groundwater quality data reviewed generally reveals a decrease in TCE concentrations throughout the site when compared to the baseline sampling results, although there are some exceptions as indicated above. During the technical interviews, concerns were raised on the potential for rising ground water levels to result in additional mobilization and movement of contaminants at the site. EPA will continue to monitor changes in groundwater levels at the site.

For the TI Zone remedy, the extraction wells DP-1 and CRA-5 were installed to not only address TCE groundwater contamination but also to maintain TCE plume capture. At extraction well CRA-5, TCE concentrations have decreased from 23,000 µg/L (baseline) to 1,500 µg/L (August 2012). Similarly, at extraction well DP-1, TCE concentrations have decreased from 2,700 µg/L (baseline) to 1,800 µg/L (August 2012). Most of the TI Zone monitoring wells have shown a decrease in TCE concentrations of one or more orders of magnitude when compared to the baseline concentrations. For example, at monitoring well S-10, the TCE concentrations have decreased from 26,000 µg/L to 820 µg/L (August 2012). At monitoring well S-27, the TCE concentrations have decreased from 6,400 µg/L to 380 µg/L (August 2012). Groundwater elevation contour maps indicate that the extraction system maintains hydraulic capture of the groundwater within the TI Zone.

For the groundwater remedy outside of the TI Zone, extraction wells EW-1, EW-2R, EW-4, and EW-5 were installed to maintain TCE plume capture within the shallow groundwater zone of the Airport Property. The groundwater data suggests that extraction well EW-1 has been effective in TCE mass removal. At well EW-1, TCE concentrations have decreased from 900 µg/L to 190 µg/L (August 2012). Similarly, at extraction well EW-4 TCE concentrations have decreased from 390 µg/L to 40 µg/L (August 2012).

Extraction well EW-4 exhibits localized TCE plume capture as evidenced by the decrease in TCE concentrations from baseline concentrations to August 2012 concentrations noted in monitoring wells S-37 (480 µg/L to 9.6 µg/L), S-38 (440 µg/L to 11 µg/L), and S-21B (370 µg/L to 13µg/L). However, the increasing TCE concentrations noted at monitoring wells S-39 (currently 34 µg/L) and CRA-42 (40 µg/L), located downgradient of the groundwater remedy capture zone suggest that the well may not be containing all of the TCE-impacted groundwater in the northwestern portion of the plume. Although there may not be capture at this location, any contamination that might migrate away would be captured by the TARP (OU1).

The Conceptual Model for the nature and extent of contamination at the Three Hangars had been one source located at the southeastern corner of the buildings, currently identified as the TI zone. In August and September 2012, six soil borings (CRA-51 through CRA-56) (Figure 2.1, CRA 2012b) were installed on the Airport Property underneath and near the Three Hangars, but away from TI zone and depth-discrete groundwater samples were collected. The highest TCE groundwater concentration of 13,000 µg/L was

noted at CRA-51. This finding indicates that the highest concentrations of TCE in the SGZ are no longer found within the TI Zone. In addition, as part of the work of the PCB Soils Remedy, numerous previously unknown drains were discovered inside the Three Hangars Building (CRA, 2013c). The drains are contaminated by PCBs. The elevated TCE concentration at soil boring CRA-51 may be due to historical migration of TCE from the TI Zone, or may be indicative of a previously unknown source area beneath the Three Hangars Building. A subsurface investigation is needed to define the extent of contamination and possibly revise the Conceptual Model.

6.6.2.2 TI Zone SVE Remedy (Soil)

The objective of the SVE Remedy within the TI zone is to laterally and vertically contain VOC soil vapors in subsurface soil until VOC concentrations are reduced such that ceasing operation of the SVE remedy will not cause water quality impacts to the SGZ outside the TI Zone or to the Regional Aquifer above the MCL.

The SVE system within the TI Zone operates using four SVE wells. The operational uptime of the TI Zone SVE System averaged 99 percent for the most recent reporting period (March to August 2012; CRA 2012b). Overall, uptime has been high except during periods of equipment maintenance. The soil vapor data at four SVE extraction wells indicate significant reduction in TCE concentrations compared to baseline TCE concentrations. At SVE well SVE-1U, TCE concentrations have reduced from 280,000 parts per billion volume (ppbv) to 3,000 ppbv (August 2012). Similarly, TCE concentrations have declined from 75,000 ppbv to 330 ppbv at well SVE-2U, from 230,000 ppbv to 340 ppbv at well SVE-3U, and from 67,000 ppbv to 4,600 ppbv at well SVE-4U. The combined influent TCE concentration has decreased from 220,000 ppbv (baseline) to 720 ppbv (August 2012). Measurements of negative pressure at observation wells outside of the TI Zone indicate that migration of soil vapor out from the TI Zone is controlled by the SVE system (CRA 2012b).

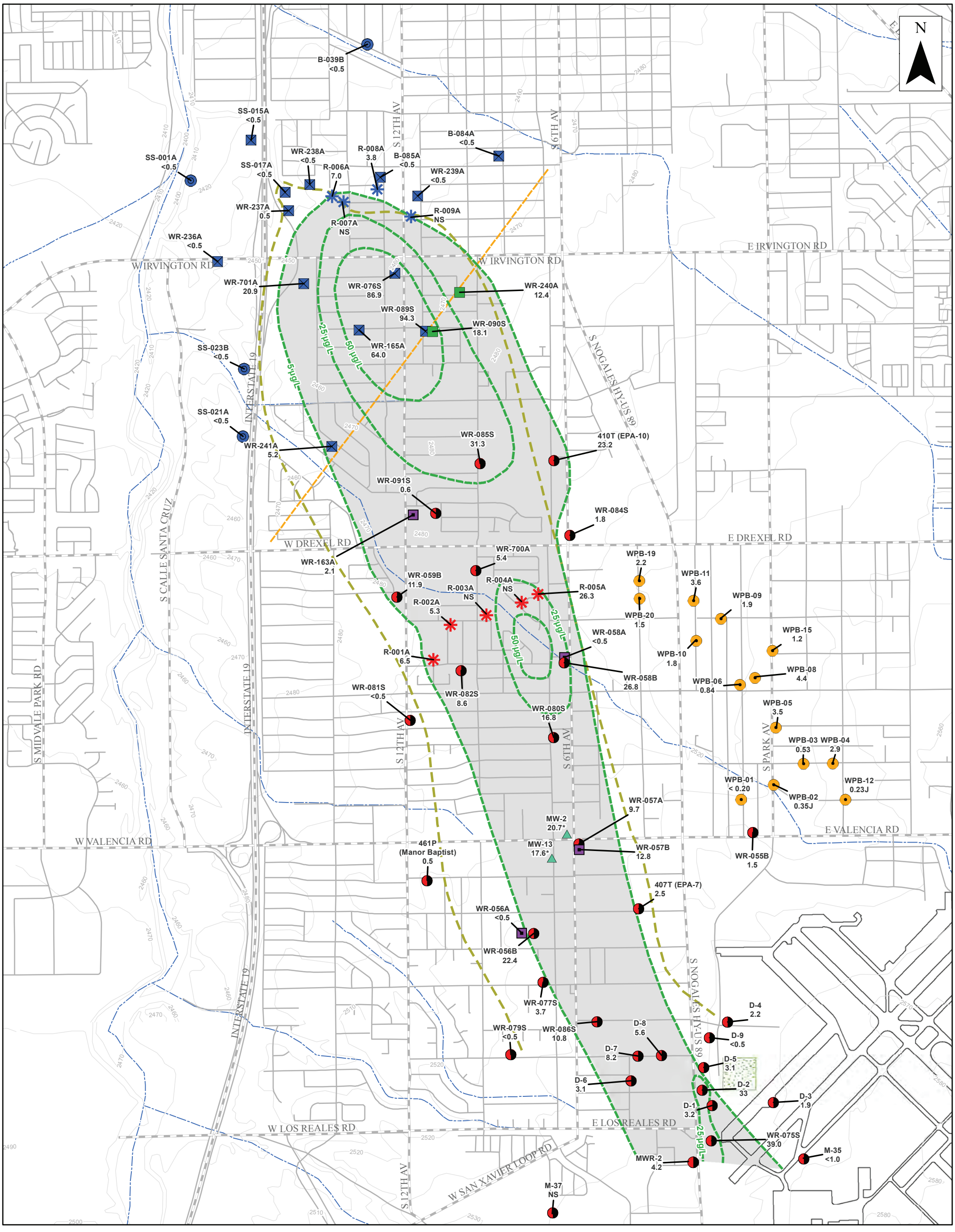
Overall, the TI Zone SVE remedy appears to be successful in VOC mass removal and preventing migration of soil vapors from the TI Zone. However, it is not clear that all of the sources under the Three Hangars Building have been characterized, as is evidenced by the high levels of contamination observed in soil boring CRA-51 and the discovery of numerous drains inside the Three Hangars Building contaminated with PCBs.

6.6.3 AFP 44 OU3

The groundwater quality data and other relevant information from the *Final Remediation Completion Report Site 5* (Earth Tech 2006), *HiPOx Operational System* (AECOM 2012), *Development and Screening of Alternatives for TIAA Superfund Site Area A Feasibility Study* (AECOM 2011), *Draft Interim Remedial Action Completion Report IRP Site 17: Advanced Oxidation System for Regional Groundwater Treatment* (AECOM 2011), and the *Site Management Plan for 1,4-dioxane RI/FS* (AECOM 2012) were reviewed to determine if the selected remedy is successful in containing VOC-impacted groundwater and maintaining the VOC concentrations in treated water below the target treatment levels as specified in the 2008 Explanation of Significant Differences.

AFP 44 extraction wells of the groundwater treatment system have been successful in maintaining hydraulic capture of the VOC and chromium plume boundary of the Regional Aquifer. Data indicate that from the initial operation of the groundwater extraction and treatment plant in 1986, overall, the VOC plume is decreasing in width and in length. As of December 2011, a total of approximately 28 billion gallons have been extracted and recharged and 24,000 lbs of VOCs have been removed from groundwater since the groundwater extraction and treatment system was started in 1987. An estimated 54 lbs of 1,4-dioxane have been removed since startup of the AOP system in 2009. The average pumping and injection rate for the period from July 2011 through June 2012 was about 1,600 gpm, with a

resultant VOC mass removal of 123 lbs. Within 6 years of commencing pump and treat operations, the mapped extent of the Cr plume had decreased from 190 to about 2 acres. However, there are wells within the plume with concentrations of Cr significantly above the MCL.



Legend

- Regional Undivided Aquifer Remediation Well
- Regional Undivided Aquifer Monitor Well
- Regional Undivided Aquifer Production Well
- Transitional Zone Aquifer Monitor Well
- Upper Zone Aquifer Remediation Well
- Upper Zone Aquifer Monitor Well
- Lower Zone Aquifer Monitor Well
- ADEQ LUST Well
- West Plume B Well
- Approximate Contact Between Divided and Undivided Aquifer
- TCE Isoconcentration line February 2012 (Dashed where inferred)
- Approximate Limit of 5 µg/L TCE Concentration February 2012
- Approximate Limit of 5 µg/L TCE Concentration (May 1995)
- Rivers and Washes
- Major Streets
- All Streets
- Three Hangars Area

NS = Not Sampled
TCE Concentrations denoted with an * were obtained from ADEQ LUST file review. MW2 and MW13 data are from first Quarter 2012. The screened interval (SI) of MW13 is 85-115 feet bgs. The SI of MW2 is 80-110 feet bgs.

0 1,000 2,000
Feet

FIGURE 3
TCE Concentrations in the TARP Area, February 2012
Tucson International Airport Area Superfund Site
Tucson, Arizona

Source:
Semi-Annual Status Report, March 2012 through August 2012 (Malcolm Pirnie/ARCADIS 2012)

CH2MHILL

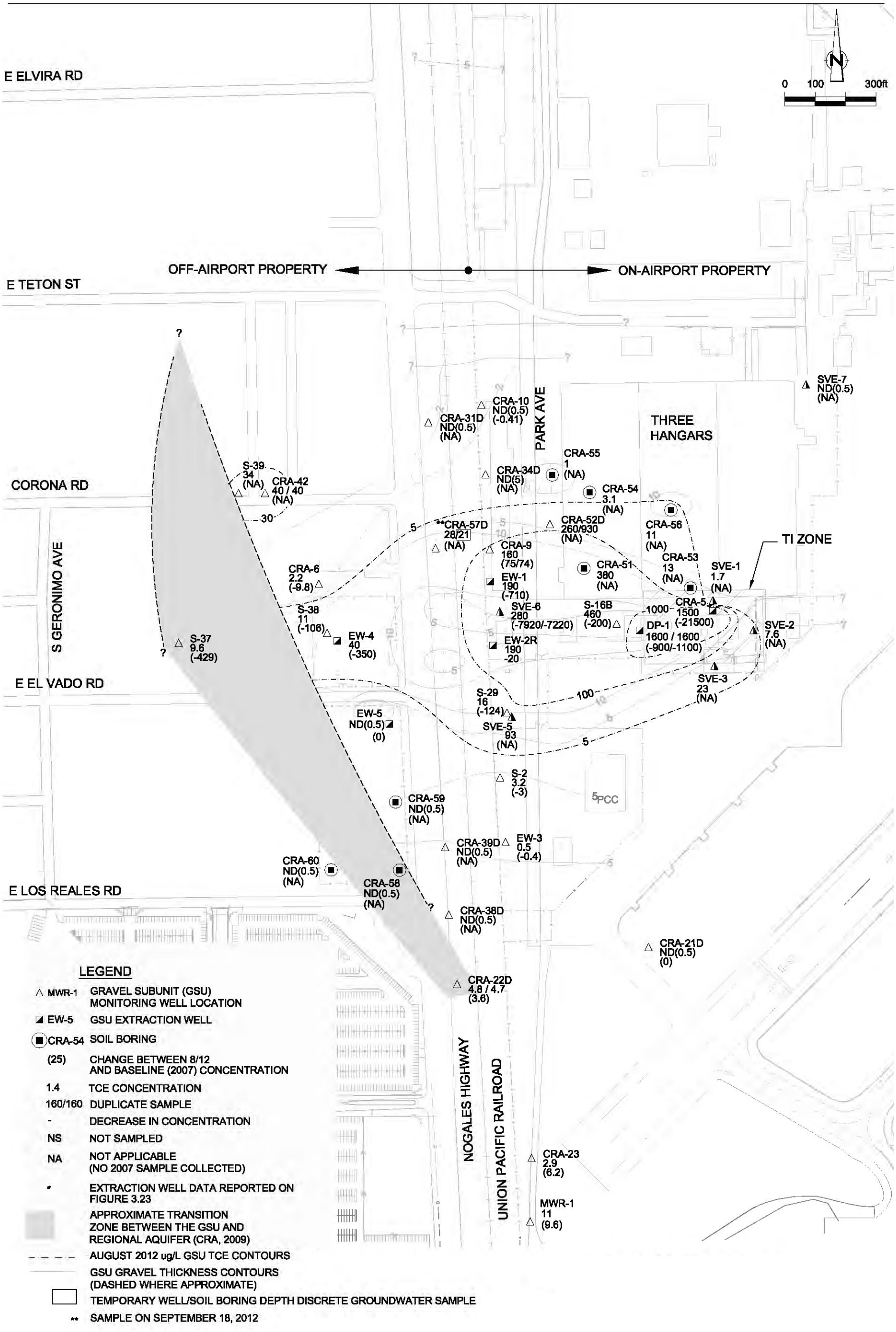


FIGURE 4
TCE Concentrations in the Airport Property GSU, August 2012
Tucson International Airport Area Superfund Site
Tucson, Arizona

Source:
Tenth Performance Evaluation Report, SGZ Remedy & SVE Remedy (March – August 2012). CRA, November 2012.

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6.7 Site Inspection

The EPA remedial project manager and a representative of EPA's contractor performed site inspections of the TARP groundwater treatment facility, Airport Property remediation systems and AFP44 groundwater treatment facility between February 11 and 13, 2013. The inspections were also attended by representatives of the Arizona Department of Environmental Quality (ADEQ) and staff from each site (TARP, Airport Property, and AFP44). The staff associated with each treatment system provided a brief overview of the site layout and a description of the treatment systems. The inspections included the following:

- The TARP groundwater treatment facility, including the north and south well fields;
- The Airport Property remediation systems, including the shallow groundwater remediation system, TI zone SVE system, RRS SVE system, and several representative monitoring and remediation wells;
- The AFP44 groundwater treatment facility including several representative extraction and monitoring wells; and
- Visual observations of the site perimeter and neighboring areas.

The TIAA Superfund Site inspection checklist and photos are provided in Appendices B and C, respectively. Conditions during the inspection were favorable, with mild temperatures and no precipitation.

All inspected areas were secured with adequate fencing and all facilities (TARP, Airport Property, and AFP44) inspected were operating at the time of the site visit. The monitoring well locations inspected were not individually fenced, but were secured with locks if they were located outside of secure areas. Most of the monitoring wells observed during the inspection were in underground, flush-mounted vaults, although others were completed above-grade in a locking vault. Equipment is generally well maintained.

For the TARP groundwater treatment facility, the North Well Field, South Well Field , the chemical tanks, air stripping tower, vapor-phase GAC system, and associated piping were visually inspected. The equipment generally appeared in good condition. The tank was located in a secondary containment pad.

For the Airport Property remediation systems, the inspection included visual inspection of the SGZ remediation system and the SVE remediation system, including the TI Zone SVE system and the RRS SVE system. The groundwater extraction wells associated with the SGZ Remedy were inspected, as were the SVE wells, blower, and aboveground piping associated with TI Zone SVE system. In addition, the air stripping tower, vapor-phase GAC system, and the associated piping were visually inspected. The piping, blower, SVE wells, and vapor-phase GAC associated with the RRS SVE system were also inspected. Overall, the equipment appeared to be operating in good condition.

For the AFP44 groundwater treatment facility, the groundwater extraction wells, vapor-phase GAC system, and associated piping were visually inspected. The equipment generally appeared in good condition.

The TARP groundwater treatment system office, Airport Property remediation system office, and AFP44 groundwater treatment system office appeared to contain all necessary project information. The emergency response plan, O&M manuals, maintenance log books, permits, material safety data sheets, and other project specific information were readily available.

6.8 Interviews

During the FYR process, interviews were conducted with parties impacted by the site or aware of the site, including the community members, current landowners, potentially responsible parties, and regulatory agencies involved in site activities. The purpose of the interviews was to document the perceived status of the site and any perceived problems or successes with the phases of the remedy that have been implemented to date. Most of the community member interviews were conducted in person during February and March 2013, although a few interviews were conducted over the telephone. Technical interviews were conducted by e-mail during February 2013. Complete interviews are included in Appendix C.

Interviews were conducted with 17 community members, including the following: members of the Unified Community Advisory Board (UCAB); the Mayor and City Council; the Pima County Board of Supervisors; and other interested community members. Although many of the community members expressed satisfaction at the progress that has been made at the site, a large number also expressed concerns over emerging contaminants, past actions by Tucson Water, and whether the local, state, and federal government agencies were acting quickly enough to protect the community. Many UCAB members have lived in the area since before the groundwater contamination was discovered and have a lengthy history with the remediation process at the site.

A total of 14 technical interviews were conducted with representatives from the Tucson International Airport, TARP, and AFP44, as well as other individuals that are or currently have been involved in technical issues at the site. Most technical interviewees were current or former project managers for the various entities involved with remediation at the site. No major problems with construction or operation of the treatment systems were identified during the technical interviews. General comments received from the interviewees include the following:

- TIAA—The general consensus among respondents for the TIAA property is that the remediation system is effectively containing VOCs and meeting the performance standards in the 1997 ROD, with the following two potential exceptions:
  - Containment of TCE within the Gravel Subunit in the northwestern portion of the site may not be achieved.
  - Restoration of groundwater within the SGZ has not yet been achieved because it is expected to take a longer amount of time under the current containment remedy.

  Also, increasing groundwater elevations at the site could impact the future protectiveness of the remedy if additional contaminant mass is mobilized. There have been unexpected O&M costs related to the treatment system blower, extraction wells, and air stripper.
- TARP—Respondents associated with the TARP area indicated that the system is operating as intended to protect human health. A primary concern was the need to establish a standard for treatment of 1,4-dioxane within a reasonable time to reduce uncertainty associated with the need to treat this compound at the TARP system. Treatment for 1,4-dioxane is expected to significantly increase the cost of remediation in this area. Also, hexavalent chromium may become an issue for the TARP system in the future, as operation of the system is managed to minimize the concentrations of contaminants in the treated water regardless of whether a MCL has been established.
- AFP44—General consensus among respondents for the AFP44 area is that the groundwater is being contained and contaminant concentrations in groundwater are either stable or declining. However,

the effectiveness of the remedy could be improved by treating residual contamination remaining within source zones of chromium and VOCs. The presence of 1,4-dioxane has resulted in a significant increase in the cost of the remedy due to installation of a system to treat this contaminant, and the presence of hexavalent chromium could further increase the cost in the future.

6.9 Institutional Controls

Institutional controls[4] (ICs) are non-engineering instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action. For example, the methods may include restrictions or limitations on access, media use, or property use

Although ICs were not required in the 1988 ROD, the 1997 ROD discussed alternatives for institutional controls on the use of groundwater and soil at the site. No restrictions on excavation at the site have been established in any of the decision documents; however, Arizona's Well Spacing and Well Impact Rules (Arizona Administrative Code §R12-15-830) prevent drilling of any new production wells that may adversely impact groundwater remediation systems or hydraulic capture of groundwater contamination plumes.

Access to AFP44 is controlled by military security and has very restricted use requirements due to national security issues. There are no exposure issues in OU1 that would require institutional controls.

Additional institutional controls will be evaluated when the Airport Property Landfill Remedy and Airport Property PCB Soils Remedy are completed. Institutional Controls will be required at OU2 (Airport Property) if the site does not meet requirements for unrestricted use and unrestricted exposure.

[4] Refer to EPA Guidance "Recommended Evaluation of Institutional Controls: Supplement to the Comprehensive Five-Year Review Guidance" OSWER Directive 9355.7-18 http://www.epa.gov/superfund/cleanup/postconstruction/641333.pdf

7. Technical Assessment

7.1 TARP OU1

7.1.1 Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, remedial objectives, and the results of the site inspection indicate that overall the remedy appears to be functioning as intended by the 1988 ROD. The Remedial Actions (RAs) are functioning as designed and have been successful overall in containing TCE contamination in groundwater and treating the specific contaminants in the extracted groundwater to 1×10^{-6} excess cancer risk in the TARP area via the TARP groundwater treatment system.

No significant O&M issues were identified during this review that would affect the effectiveness of the remedy. All O&M procedures are evaluated on an as-needed basis, and the O&M manuals are revised periodically to insure that they reflect current conditions at the site and to address any issues that may have been identified. Based upon the current conditions at the site, no opportunities to optimize O&M were identified during the site inspection.

There were no Institutional Controls for OU1 identified in the 1988 ROD, and none appear to be necessary because there are no exposure issues in OU1 that would require institutional controls at this time.

7.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

As noted in the review of the site's risk assessments, there have been a number of changes in exposure assumptions and toxicity data since the 1988 PHE was performed. In addition, the risk assessment methodology itself has changed; the Superfund Public Health Evaluation Manual, the basis for the 1988 PHE, has been superseded by Risk Assessment Guidance for Superfund (RAGS).

The most significant changes are the identification of 1,4-dioxane, which was not addressed in the 1988 PHE, as a site-related contaminant in groundwater; heightened awareness of vapor intrusion as a potentially significant exposure pathway at sites with VOC contamination; and the revised toxicity assessments and values for TCE and hexavalent chromium.

Most notably, the revised carcinogenicity status of ingested hexavalent chromium, with its new cancer risk values, calls into question the technical feasibility of achieving the 1×10^{-6} ELCR treatment goal set in the 1988 ROD. Implementability is one of the nine criteria by which a remedy is evaluated under CERCLA. The fact that it is not technically feasible to achieve the low concentration of hexavalent chromium in drinking water that correspond to the 1×10^{-6} ELCR treatment goal set forth in the 1988 ROD suggests the need to amend the ROD to set more feasible RAOs and cleanup values.

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

During this FYR, no other information has come to light that could potentially call into question the protectiveness of the remedy.

7.2 Airport OU2

7.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, remedial objectives, and the results of the site inspection indicate that overall the remedy is functioning as intended by the 1997 ROD. The remedies have been mostly successful overall in containing TCE contamination in groundwater at the Airport Property through the shallow groundwater remedy with the exception of one isolated area located northwest off-Airport Property near wells S-39 and CRA-42 where containment has not been achieved. The SVE system at the Airport Property has also been successful in removing VOCs in the soil gas from the subsurface at the TI Zone. But recent sampling results indicate that there may be more than one source. Additional investigations are needed under the Three Hangars Building to make a determination if the remedy is functioning as intended by the decision documents

7.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

7.2.2.1 Exposure Assumptions

As noted in Section 6.5.3, there have been significant improvements in vapor intrusion assessment since the 1996 BHHRA was performed in support of the 1997 ROD. In consideration of the relatively high soil gas concentrations that were observed near the Three Hangers Building area of the airport, a re-evaluation of the potential for vapor intrusion in this area is needed. In addition, a vapor intrusion assessment is also needed for the nearby small residential area just off to the west of airport property.

7.2.2.2 Toxicity Data

Since the 1996 BHHRA was performed, there have been updates to toxicity data for essentially all of the COPCs in that risk assessment. As illustrated in Table 5, the majority of those updates have established or updated oral reference doses or inhalation reference concentrations. Most of these reference doses/concentrations are used for assessing the potential for non-cancer hazards posed by carcinogenic contaminants at the site. With respect to cancer risks, cancer potency values have also changed for many of the contaminants; there have been changes from higher to lower potency values and changes from lower to higher values for both oral slope factors and inhalation unit risk factors. As noted previously, the most significant of these changes in toxicity values apply to TCE and hexavalent chromium.

7.2.2.3 Cleanup Levels and RAOs

The 1997 ROD established drinking water MCLs as cleanup levels and RAOs for groundwater outside of the TI Zone. Since that ROD was signed, there have been few changes to MCLs; the MCLs for chloroform and arsenic have become more stringent and no others have changed (Table 2). The chloroform MCL decreased from 100 to 80 µg/L, while the arsenic MCL was lowered from 50 to 10 µg/L. The Agency has noted its intent to revisit the chromium MCL when the current toxicity re-assessment by the IRIS program is complete; following that review, an adjustment in the hexavalent chromium cleanup number may be warranted. The RAOs, containment of soil vapor and groundwater contamination in the TI Zone, have not changed.

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

During this FYR, no other information has come to light that could potentially call into question the protectiveness of the remedy.

7.3 AFP 44 OU3

7.3.1 Question A: Is the remedy functioning as intended by the decision documents?

Data/documents reviewed and monitoring activities indicate the remedy is functioning as intended by the 1985 ROD, and subsequent RAP. The Air Force implemented recommendations to optimize the remedy throughout the project lifetime. System duration and costs are comparable to the original estimate in the ROD.

The RA continues to operate and function as designed. In 2010, it was updated with the installation of the new AOP system. It is successfully remediating all contaminants of concern (COCs), including 1,4-dioxane. There have been no changes in the physical condition of the site (that is, geology or groundwater levels) that would affect the protectiveness of the remedy.

Monitoring data shows that contaminant levels of TCE and 1,4-dioxane are either slowly decreasing or stable. The groundwater plume is being hydrologically controlled and the plume migration contained. Data values within the plume shows signs of receding. However, concentrations of chromium have remained high. Treatability studies for areas with high levels of chromium are needed.

7.3.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

There is no risk assessment supporting the 1986 Air Force ROD, which addresses remediation of groundwater south of Los Reales Road. The COPCs, exposure pathways and risk assessment issues are generally the same as for OU1 (groundwater north of Los Reales Road), especially the identification of 1,4-dioxane as a site-related contaminant and the revised toxicity assessments and values for TCE and hexavalent chromium. As with OU1, the technical infeasibility of achieving hexavalent chromium concentrations corresponding to the current 1×10^{-6} ELCR level suggests a need to consider revising the ROD.

Beneath Building 801 at the AFB 44, several high levels of soil gas have been found indicating a potential for vapor intrusion.

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

During this FYR, no other information has come to light that could potentially call into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

Overall, the remedies for each of the OUs are mostly functioning as intended by their respective decision documents. The TARP groundwater system is successfully treating all water to drinking water standards, and to the more stringent ROD standards. The TARP has also prevented migration of the sitewide groundwater plume. The AFP44 groundwater system has contained its plume. However, there are data

gaps for assessing vapor intrusion and for identifying potential new sources. There should be a vapor intrusion investigation inside the Three Hangars Building and in the nearby residential community in OU2; and under Building 810 in OU3. There are also recent groundwater samples indicating that there may be additional sources from the Three Hangars Building.

There are some issues that may affect the long-term protectiveness. The decision documents for OU1 (1988 ROD) and OU3 (AFP44) are relatively old and do not have clearly defined objectives. Some of the assumptions in these objectives are no longer valid. The decision documents for OU1 and OU3 need to be significantly rewritten as part of any upcoming ROD amendments. The cleanup goal in OU1 of 1×10^{-6} excess cancer risk for contaminants may be technically infeasible and therefore the remedy would not meet the CERCLA criteria of Implementability. The 1×10^{-6} excess cancer risk standard should be evaluated in any future ROD Amendments for the site.

Containment needs to be achieved in the Off-Airport Property area northwest of the Airport Property to achieve long-term protectiveness. There should be a vapor intrusion investigation in the nearby residential community and inside the Three Hangars Building.

No other information has come to light that could potentially call into question the protectiveness of the remedies.

8. Issues

Table 6 summarizes the current issues for the TIAA Superfund Site.

TABLE 6
Current Issues for the Tucson International Airport Area Superfund Site

	Affects Protectiveness? (Yes or No)	
Issue	**Current**	**Future**
1. OU1 (TARP) – 1988 ROD specifies the treatment goal of 1×10^{-6} excess cancer risk, 10^{-6} but does not specify Remedial Action Objectives	No	Yes
2. OU2 (Airport Property)—In the Off-Airport Property Isolated area northwest of the Airport Property, there are isolated areas of increasing levels of groundwater contamination that suggest the groundwater extraction system is not maintaining complete capture.	No	Yes
3. OU2 (Airport Property)—High concentrations of contaminants detected in newly drilled groundwater wells located in and around the Three Hangars Building suggests there could be additional source areas underneath the Three Hangars Building.	Defer	Yes
4. OU3 (AFP44) — Concentrations of chromium in the high chromium areas have remained high over the past five years indicating that the remedial action objective of groundwater restoration may not be achievable.	No	Yes
5. OU3 (AFP44)—There are no RAOs identified in the 1985 ROD but RAOs were identified in the RAP which were unclear.	No	Yes
6. OU2, OU3 (Airport Property, AFP44) – Soil gas and groundwater data indicates a potential for vapor intrusion at three specific areas.	Defer	Yes

9. Recommendations and Follow-up Actions

Table 7 provides recommendations to address the current issues at the TIAA Superfund Site.

TABLE 7
Recommendations to Address Current Issues at the Tucson International Airport Area Superfund Site

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Yes or No)	
					Current	Future
1. 1988 ROD was written with unclear RAOs and set a 1×10^{-6} excess cancer risk for cleanup which may be technically infeasible for some contaminants.	All RAOs and cleanup goals should be evaluated as part of any future ROD Amendment associated with sitewide groundwater.	Raytheon, U.S. Air Force, City of Tucson, Tucson Airport Authority, Texas Instruments, McDonnell Douglas Corporation, General Dynamics Corporation, Arizona Air National Guard, Burr-Brown Research Corporation (now Texas Instruments), and West-Cap Arizona	EPA	12/2015	No	Yes
2. Levels of contaminants are increasing in the Off-Airport Property area northwest of the Airport Property, which suggests there is not complete capture.	Airport Property should continue groundwater investigations in this area and remedial action(s) should be implemented, if necessary.	Tucson Airport Authority, City of Tucson, General Dynamics Corporation, and McDonnell Douglas Corporation	EPA	12/2014	No	Yes
3. High levels of contaminants were found in newly drilled wells and numerous unknown drains were found inside the Three Hangars.	Airport Property should perform a subsurface investigation underneath the Three Hangars and implement appropriate actions.	Tucson Airport Authority, City of Tucson, General Dynamics Corporation, and McDonnell Douglas Corporation	EPA	12/2015	Defer	Yes
4. Concentrations of chromium in the high chromium areas have remained high over the past five years indicating that the remedial action objective of groundwater restoration may not	Air Force should plan for treatability studies for Chromium on AFP44 and implement appropriate actions.	U.S. Air Force, Raytheon	EPA/Air Force	12/2014	No	Yes

TABLE 7
Recommendations to Address Current Issues at the Tucson International Airport Area Superfund Site

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Yes or No)	
be achievable.						
5. There are no clear RAOs for the 1985 ROD for AFP 44 but are in the Remedial Action Plan.	Air Force should write a new ROD.	U.S. Air Force, Raytheon	EPA/Air Force	12/2015	No	Yes
6. Soil gas and groundwater data indicates a potential for vapor intrusion at three specific areas.	An indoor air investigation should be conducted at the Three Buildings Hangar, the residential area nearby and Building 810.	All PRPs at the site	EPA	12/2014	Defer	Yes

In addition, EPA's IRIS program is currently undertaking a re-assessment of hexavalent chromium toxicity and is expected to address the question of toxicity values for the assessment of carcinogenicity by oral exposure. Once the IRIS toxicity re-assessment is finalized, EPA is committed to reviewing the MCL for chromium; the issue of hexavalent chromium cleanup levels for groundwater and drinking water at the site should then be revisited.

10. Protectiveness Statements

The remedy for OU 1 (TARP groundwater) is currently protective of human health and the environment because all exposure pathways to human health and the environment are controlled. However, the remedial action objectives written in the 1988 Record of Decision are unclear and the decision document should be substantially revised as part of any future amendments. Furthermore, the setting of the treatment goal of 1×10^{-6} excess cancer risk should be reviewed for technical feasibility to assure that long term-protectiveness can be achieved.

A protectiveness determination of the remedy at OU 2 (Airport Property) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at and near the Three Hangars Building, and by investigating contamination underneath the Three Hangars Building. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made. In addition, to be protective in the long term, the groundwater extraction system northwest of the Airport needs to be reassessed to ensure plume containment.

A protectiveness determination of the remedy at OU 3 (AFP44) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at Building 801. In order to assure long term protectiveness, a new Record of Decision with clear remedial action objectives should be written for the site, and the remedy needs to be reassessed in the area of high chromium concentrations since it appears that remedial action objective of restoration will not be met.

11. Next Review

This site requires ongoing FYRs as long as waste is left onsite that does not allow for unrestricted use and unlimited exposure. The next FYR will be due within 5 years of the signature date of this FYR.

Appendix A
List of Documents Reviewed

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List of Documents Reviewed

AECOM. 2011a. *Development and Screening of Alternatives for TIAA Superfund Site Area A Feasibility Study*

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Appendix B
Press Notices

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Press Notices

PUBLIC NOTICE
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEGINS FIVE-YEAR REVIEW OF
TUCSON INTERNATIONAL AIRPORT AREA
SUPERFUND SITE

The United States Environmental Protection Agency (EPA) has begun the five-year review of cleanup actions undertaken at the Tucson International Airport Area Superfund Site, in Tucson, Arizona. The review will evaluate whether the cleanup actions are protective of human health and the environment.

THE REVIEW PROCESS

When EPA's cleanup remedy leaves some waste in place, the Superfund law requires an evaluation of the protectiveness of remedial systems every five years, until the Site has been cleaned up sufficiently to allow unrestricted access. The purpose of the five-year review is to understand how the constructed remedy is operating and to measure the progress towards achieving the Site's cleanup objectives and the protection of human health and the environment.

Specifically, EPA will look at the movement and/or breakdown of the Site's remaining contaminants, located in the groundwater plume at Air Force Plant 44 and in Area A of the Tucson International Airport Area Superfund site. Area A includes the groundwater contamination associated with Tucson Airport Property and the Tucson Area Remediation Project (TARP).

EPA will consult with the Arizona Department of Environmental Quality (ADEQ), other regulatory authorities, EPA's scientific experts, and interview interested members of the public.

Upon completion of the review, a copy of the final report will be placed in the local information repository listed below and a notice will appear in the local paper announcing the completion of the Five-Year Review Report. EPA will monitor the Site and conduct additional five-year reviews until the Site has been sufficiently cleaned up to allow unrestricted use.

COMMUNITY INVOLVEMENT
EPA is always interested in hearing from the public. If you have any issues or concerns about the Tucson International Airport Area Superfund site cleanup, and particularly if you have issues or concerns regarding the operation and maintenance of the as-built remedy, EPA would like to talk with you. Please contact the EPA representatives below.

FOR MORE INFORMATION
Please visit the Tucson International Airport Area website at: www.epa.gov/region09/tucsonairport. Or visit the information repository at the Tucson Public Library El Pueblo Neighborhood Center to review the administrative record.

CONTACT INFORMATION
Martin Zeleznik, EPA Project Manager
(415) 972-3543, zeleznik@epa.gov

David Cooper, Community Involvement Coordinator
(800) 231-3075 or (415) 972-3245; cooper.david@epa.gov

CNS#2394606

Publish October 18, 2012 • Arizona Daily Star

Appendix C
Interview Forms

Appendix D
Site Inspection Checklist

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Site Inspection Checklist

Five-Year Review Site Inspection Checklist
Tucson International Airport Area Superfund Site

I. SITE INFORMATION	
Site name: TIA SGZ/SVE Tucson International Airport Area Superfund Site	**Date of inspection:** 2/10/13
Location and Region: Tucson, AZ, Region IX	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region IX	**Weather/temperature:** Raining, 50°F
Remedy Includes: (Check all that apply) Cover/containment Access controls Institutional controls ✓Groundwater pump and treatment Surface water collection and treatment ✓Other (specify) SVE	
Attachments: Inspection team roster attached Site map attached [in report]	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Name Celia Martinez Title Treatment Plant Operator Date 2/11/13 Interviewed : Phone No 520 730 2571 Problems, suggestions :	
2. **O&M staff** N/A Name Title Date Interviewed: Phone No. Problems, suggestions:	

3. **Local regulatory authorities and responsible 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:

Agency

Contact

Name Title Date Phone No.

Problems; suggestions:

4. **Other interviews** (optional):

III. ONSITE DOCUMENTS AND RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

✓ O&M manual	✓ Readily available	✓ Up to date
✓ As-built drawings	✓ Readily available	✓ Up to date
✓ Maintenance logs	✓ Readily available	✓ Up to date

Remarks

2. **Site-Specific Health and Safety Plan** ✓ Readily available ✓ Up to date

✓ Contingency plan/emergency response plan Readily available Up to date

Remarks _____

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

Remarks first aid. ADEQ, AED, treatment forklift. plant operator certification

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 Siemens, CTI
Other permits _____	Readily available	Up to date	N/A

Remarks

5.	**Gas Generation Records** Remarks	Readily available	Up to date	✓ N/A
6.	**Settlement Monument Records** Remarks	Readily available	Up to date	✓ N/A
7.	**Groundwater Monitoring Records** Remarks	✓ Readily available	✓ Up to date	N/A
8.	**Leachate Extraction Records** Remarks	Readily available	Up to date	✓ N/A
9.	**Discharge Compliance Records** ✓ Air ✓ Water (effluent) Remarks	✓ Readily available ✓ Readily available	✓ Up to date ✓ Up to date	N/A N/A
10.	**Daily Access/Security Logs** Remarks	✓ Readily available	✓ Up to date	

IV. ACCESS AND INSTITUTIONAL CONTROLS			Applicable
A. Fencing			
1.	**Fencing** Remarks	Location shown on site map	✓ Gates secured N/A
B. Other Access Restrictions			
1.	**Signs and other security measures** Remarks	Location shown on site map	✓ N/A
C. Institutional Controls			

1. **Implementation and enforcement**

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

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

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

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** ICs are adequate ICs are inadequate ✓N/A

Remarks

D. General

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

Remarks

2. **Land use changes onsite** ✓N/A

Remarks

_____

3. **Land use changes offsite** ✓N/A

Remarks

_____

V. GENERAL SITE CONDITIONS

A. Roads ✓Applicable

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

Remarks

_____

B. Other Site Conditions

	Remarks
VI. LANDFILL COVERS	Applicable N/A
A. Landfill Surface	
1.	**Settlement** (Low spots) Location shown on site map Settlement not evident Areal extent_____ Depth Remarks
2.	**Cracks** Location shown on site map Cracking not evident Lengths _____ Widths_____Depth Remarks
3.	**Erosion** Location shown on site map Erosion not evident Areal extent_____ Depth Remarks
4.	**Holes** Location shown on site map Holes not evident Areal extent_____ Depth Remarks
5.	**Vegetative Cover** Grass Cover properly established No signs of stress Trees/Shrubs (indicate size and locations on a diagram) Remarks _____
6.	**Alternative Cover** (armored rock, concrete, etc.) N/A Remarks
7.	**Bulges** Location shown on site map Bulges not evident Areal extent_____ Height Remarks

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

3.	**Erosion** Location shown on site map No evidence of erosion Areal extent_____ Depth Remarks_____			
4.	**Undercutting** Location shown on site map No evidence of undercutting Areal extent_____ Depth Remarks			
5.	**Obstruction** Type_____ No obstruction Location shown on site map Areal extent Size Remarks			
6.	**Excessive Vegetative Growth** Type No evidence of excessive growth Vegetation in channels does not obstruct flow Location shown on site map Areal extent Remarks			
D. Cover Penetrations	Applicable	N/A		
1.	**Gas Vents**	Active	Passive	
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
2.	**Gas Monitoring Probes**			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
3.	**Monitoring Wells** (within surface area of landfill)			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
4.	**Leachate Extraction Wells**			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration		Needs O&M	N/A
	Remarks			

5.	**Settlement Monuments** Located Routinely surveyed N/A Remarks
E. Gas Collection and Treatment	Applicable N/A
1.	**Gas Treatment Facilities** Flaring Thermal destruction Collection for reuse Good condition Needs O&M Remarks
2.	**Gas Collection Wells, Manifolds and Piping** Good condition Needs O&M Remarks
3.	**Gas Treatment Facilities** (e.g., gas monitoring of adjacent homes or buildings) Good condition Needs O&M N/A Remarks
F. Cover Drainage Layer	Applicable N/A
1.	**Outlet Pipes Inspected** Functioning N/A Remarks
2.	**Outlet Rock Inspected** Functioning N/A Remarks
G. Detention/Sedimentation Ponds	Applicable N/A
1.	**Siltation** Areal extent_____ Depth_____ N/A Siltation not evident Remarks
2.	**Erosion** Areal extent_____ Depth Erosion not evident Remarks
3.	**Outlet Works** Functioning N/A Remarks
4.	**Dam** Functioning N/A Remarks
H. Retaining Walls	Applicable N/A

1.	**Deformations** Location shown on site map Horizontal displacement_____ Rotational displacement_____ Remarks		Deformation not evident Vertical displacement
2.	Degradation Location shown on site map Remarks		Degradation not evident
I. Perimeter Ditches/Off-Site Discharge		Applicable	N/A
1.	**Siltation** Location shown on site map Areal extent_____ Depth Remarks		Siltation not evident
2.	**Vegetative Growth** Location shown on site map Vegetation does not impede flow Areal extent_____ Type Remarks		N/A
3.	**Erosion** Location shown on site map Areal extent_____ Depth Remarks		Erosion not evident
4.	**Discharge Structure** Functioning Remarks		N/A

VII. VERTICAL BARRIER WALLS		Applicable	✓N/A
1.	**Settlement** Location shown on site map Areal extent_____ Depth Remarks		Settlement not evident
2.	**Performance Monitoring** Type of monitoring Performance not monitored Frequency_____ Head differential Remarks		Evidence of breaching

VIII. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines Ξ: Applicable

1. **Pumps, Wellhead Plumbing, and Electrical**
✓ Good condition ✓ All required wells located Needs O&M N/A
Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
✓ Good condition Needs O&M
Remarks

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

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

1. **Collection Structures, Pumps, and Electrical**
Good condition Needs O&M
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
Good condition Needs O&M NA
Remarks

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

C. Treatment System Applicable

1. **Treatment Train** (Check components that apply)
Metals removal - Oil/water separation - Bioremediation
✓ Air stripping ✓ Carbon adsorbers Air
✓ Filters
✓ Additive (e.g., chelation agent, flocculent)
✓ Good condition Needs O&M
✓ Sampling ports properly marked and functional
✓ Sampling/maintenance log displayed and up to date
✓ Equipment properly identified
✓ Quantity of groundwater treated annually 60 gpm
- Quantity of surface water treated annually
Remarks

2.	**Electrical Enclosures and Panels** (properly rated and functional) N/A ✓Good condition Needs O&M Remarks
3.	**Tanks, Vaults, Storage Vessels** ✓Good N/A Remarks
4.	**Discharge Structure and Appurtenances** ✓Good condition Needs O&M Remarks Injection well is in a secure area.
5.	**Treatment Building(s) – support building** N/A ✓Good condition (especially roof and doorways) Needs repair Chemicals and equipment properly stored Remarks
6.	Monitoring Wells (pump and treatment remedy) ✓Properly secured/locked ✓Functioning ✓Routinely sampled ✓Good condition All required wells located Needs O&M N/A Remarks

D. Monitored Natural Attenuation	✓NA
1.	**Monitoring Wells** (natural attenuation remedy) Properly secured/locked Functioning Routinely sampled Good condition All required wells located Needs O&M Remarks

IX. 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.

X. 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.).

Remedy intended to contain plume, remove VOC mass from vadose zone and groundwater. Remedy appears effective and functioning as designed.

B. Adequacy of O&M

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

O&M is properly implemented and supports the current and long-term effectiveness of the remedy.

C. Early Indicators of Potential Remedy Failure

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.

Replaced blower with a different type that requires less maintenance; added sequestering agent to reduce scale. No anticipated effect on protectiveness.

D. Opportunities for Optimization

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

None identified at this time.

Five-Year Review Site Inspection Checklist
Tucson International Airport Area Superfund Site

I. SITE INFORMATION	
Site name: TARP Tucson International Airport Area Superfund Site	**Date of inspection:** 2/12/13
Location and Region: Tucson, AZ, Region IX	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region IX	**Weather/temperature:** Clear, 50s
Remedy Includes: (Check all that apply) Cover/containment Access controls Institutional controls ✓ Groundwater pump and treatment Surface water collection and treatment Other (specify)	
Attachments: Inspection team roster attached Site map attached [in report]	
II. INTERVIEWS (Check all that apply)	
1. **O&M site manager** Name Hugh O'Reilly Title Treatment Plant Operator Date 2/12/13 Interviewed : Phone No Problems, suggestions :	
2. **O&M staff** Name Title Date Interviewed: Phone No. Problems, suggestions:	

Martin Zelezik
Rick Edwards
Marc Herman
Alva Bentley

3. **Local regulatory authorities and responsible 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:

Agency

Contact

Name Title Date Phone No.

Problems; suggestions:

4. **Other interviews** (optional):

III. ONSITE DOCUMENTS AND RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

✓ O&M manual	✓ Readily available	✓ Up to date
✓ As-built drawings	✓ Readily available	✓ Up to date
✓ Maintenance logs	✓ Readily available	✓ Up to date

Remarks

2. **Site-Specific Health and Safety Plan** ✓ Readily available ✓ Up to date

✓ Contingency plan/emergency response plan ✓ Readily available ✓ Up to date

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 RCRA P	Readily available	✓ Up to date	N/A

Remarks stored offsite

5.	**Gas Generation Records** Remarks	Readily available	Up to date	✓N/A
6.	**Settlement Monument Records** Remarks	Readily available	Up to date	✓N/A
7.	**Groundwater Monitoring Records** Remarks	✓Readily available	✓Up to date	N/A
8.	**Leachate Extraction Records** Remarks	Readily available	Up to date	✓N/A
9.	**Discharge Compliance Records** Air Water (effluent) Remarks	Readily available Readily available	Up to date Up to date	✓N/A ✓N/A
10.	**Daily Access/Security Logs** Remarks	✓Readily available	✓Up to date	

IV. ACCESS AND INSTITUTIONAL CONTROLS ✓Applicable			
A. Fencing			
1.	**Fencing** Remarks	Location shown on site map	✓Gates secured N/A
B. Other Access Restrictions			
1.	**Signs and other security measures** Remarks perimeter fence, security patrols	Location shown on site map	N/A
C. Institutional Controls			

1. **Implementation and enforcement**

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

Type of monitoring (e.g., self-reporting, drive by)
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** ICs are adequate ICs are inadequate ✓N/A
Remarks

D. General

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

2. **Land use changes onsite** ✓N/A
Remarks

3. **Land use changes offsite** N/A
Remarks
Some commercial development nearby

V. GENERAL SITE CONDITIONS

A. Roads Applicable

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

B. Other Site Conditions

Remarks

VI. LANDFILL COVERS Applicable ✓ N/A

A. Landfill Surface

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

2. **Cracks** Location shown on site map Cracking not evident
   Lengths _____ Widths_____ Depth
   Remarks

3. **Erosion** Location shown on site map Erosion not evident
   Areal extent_____ Depth
   Remarks

4. **Holes** Location shown on site map Holes not evident
   Areal extent_____ Depth
   Remarks

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

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

7. **Bulges** Location shown on site map Bulges not evident
   Areal extent_____ Height
   Remarks

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

3.	**Erosion**	Location shown on site map	No evidence of erosion	
	Areal extent_____	Depth		
	Remarks_____			
4.	**Undercutting**	Location shown on site map	No evidence of undercutting	
	Areal extent_____	Depth		
	Remarks			
5.	**Obstruction**	Type_____	No obstruction	
	Location shown on site map	Areal extent		
	Size			
	Remarks			
6.	**Excessive Vegetative Growth**	Type		
	No evidence of excessive growth			
	Vegetation in channels does not obstruct flow			
	Location shown on site map	Areal extent		
	Remarks			
D. Cover Penetrations		Applicable	N/A	
1.	**Gas Vents**	Active	Passive	
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
2.	**Gas Monitoring Probes**			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
3.	**Monitoring Wells** (within surface area of landfill)			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration			
	Remarks			
4.	**Leachate Extraction Wells**			
	Properly secured/located	Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration		Needs O&M	N/A
	Remarks			

5.	**Settlement Monuments** Located Routinely surveyed N/A Remarks
E. Gas Collection and Treatment	Applicable N/A
1.	**Gas Treatment Facilities** Flaring Thermal destruction Collection for reuse Good condition Needs O&M Remarks
2.	**Gas Collection Wells, Manifolds and Piping** Good condition Needs O&M Remarks
3.	**Gas Treatment Facilities** (e.g., gas monitoring of adjacent homes or buildings) Good condition Needs O&M N/A Remarks
F. Cover Drainage Layer	Applicable N/A
1.	**Outlet Pipes Inspected** Functioning N/A Remarks
2.	**Outlet Rock Inspected** Functioning N/A Remarks
G. Detention/Sedimentation Ponds	Applicable N/A
1.	**Siltation** Areal extent_____ Depth_____ N/A Siltation not evident Remarks
2.	**Erosion** Areal extent_____ Depth Erosion not evident Remarks
3.	**Outlet Works** Functioning N/A Remarks
4.	**Dam** Functioning N/A Remarks
H. Retaining Walls	Applicable N/A

1.	**Deformations** Location shown on site map Horizontal displacement_____ Rotational displacement_____ Remarks		Deformation not evident Vertical displacement
2.	Degradation Location shown on site map Remarks		Degradation not evident
I. Perimeter Ditches/Off-Site Discharge		Applicable	N/A
1.	**Siltation** Location shown on site map Areal extent_____ Depth Remarks		Siltation not evident
2.	**Vegetative Growth** Location shown on site map Vegetation does not impede flow Areal extent_____ Type Remarks		N/A
3.	**Erosion** Location shown on site map Areal extent_____ Depth Remarks		Erosion not evident
4.	**Discharge Structure** Functioning Remarks		N/A

VII. VERTICAL BARRIER WALLS		Applicable	✓ N/A
1.	**Settlement** Location shown on site map Areal extent_____ Depth Remarks		Settlement not evident
2.	**Performance Monitoring** Type of monitoring Performance not monitored Frequency_____ Head differential Remarks		Evidence of breaching

VIII. GROUNDWATER/SURFACE WATER REMEDIES ✓ Applicable N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☑ Applicable

1. **Pumps, Wellhead Plumbing, and Electrical**
✓ Good condition All required wells located Needs O&M N/A
Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
✓ Good condition Needs O&M
Remarks

3. **Spare Parts and Equipment**
✓ Readily available Good condition Requires upgrade Needs to be provided
Remarks
3 Store rooms throughout City

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

1. **Collection Structures, Pumps, and Electrical**
Good condition Needs O&M
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
Good condition Needs O&M NA
Remarks

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

C. Treatment System ✓ Applicable

1. **Treatment Train** (Check components that apply)
Metals removal Oil/water separation Bioremediation
✓ Air stripping ✓ Carbon adsorbers
Filters
✓ Additive (e.g., chelation agent, flocculent) sulfuric acid. Sodium hypochlorite
✓ Good condition Needs O&M
✓ Sampling ports properly marked and functional
✓ Sampling/maintenance log displayed and up to date COCs, daily log, monthly operational report
✓ Equipment properly identified Available in reports
Quantity of groundwater treated annually
— Quantity of surface water treated annually
Remarks

2.	**Electrical Enclosures and Panels** (properly rated and functional) N/A ✓ Good condition Needs O&M Remarks
3.	**Tanks, Vaults, Storage Vessels** N/A ✓Good condition Remarks
4.	**Discharge Structure and Appurtenances** ✓ Good condition Needs O&M Remarks
5.	**Treatment Building(s) – support building** N/A ✓ Good condition (especially roof and doorways) Needs repair Chemicals and equipment properly stored Remarks
6.	Monitoring Wells (pump and treatment remedy) ✓Properly secured/locked ✓Functioning ✓Routinely sampled ✓Good condition All required wells located Needs O&M N/A Remarks

D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ✓Properly secured/locked ✓Functioning ✓Routinely sampled ✓Good condition All required wells located Needs O&M Remarks MW-700A

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IX. 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.

X. 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.).

Remedy was designed to contain the plume and provide treated groundwater as a potable water resource. The remedy appears to be effective and functioning as designed.

B. Adequacy of O&M

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

O&M procedures are designed, implemented and recorded appropriately. Equipment was in good condition and downtime due to maintenance is minimal.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of .unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

None noted.

D. Opportunities for Optimization

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

None noted.

Five-Year Review Site Inspection Checklist
Tucson International Airport Area Superfund Site

I. SITE INFORMATION	
Site name: Air Force Plant 44 Tucson International Airport Area Superfund Site	**Date of inspection:** 2/13/13
Location and Region: Tucson, AZ, Region IX	**EPA ID:**
Agency, office, or company leading the five-year review: EPA Region IX	**Weather/temperature:** clear, 40s

Remedy Includes: (Check all that apply)

- Cover/containment
- Access controls
- Institutional controls
- ✓ Groundwater pump and treatment
- Surface water collection and treatment
- Other (specify)

Attachments: Inspection team roster attached Site map attached [in report]

II. INTERVIEWS (Check all that apply)

1. **O&M site manager**

Name Ryan Jacobs Title System operator Date 2/13/13

Interviewed : Phone No 520 460 6754

Problems, suggestions :

2. **O&M staff**

Name	Title	Date

Interviewed: Phone No.

Problems, suggestions:

3. **Local regulatory authorities and responsible 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:

Agency

Contact

Name Title Date Phone No.

Problems; suggestions:

4. **Other interviews** (optional):

III. ONSITE DOCUMENTS AND RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

✓ O&M manual	✓ Readily available	✓ Up to date
✓ As-built drawings	✓ Readily available	✓ Up to date
✓ Maintenance logs	✓ Readily available	✓ Up to date

Remarks

2. **Site-Specific Health and Safety Plan** ✓ Readily available ✓ Up to date

✓ Contingency plan/emergency response plan ✓ Readily available ✓ Up to date

Remarks ERP part of H+SP

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 SWPPP NOI	✓ Readily available	✓ Up to date	N/A

Remarks Army Kitter 820 has permits

5.	**Gas Generation Records** Remarks	Readily available	Up to date	✓ N/A
6.	**Settlement Monument Records** Remarks	Readily available	Up to date	✓ N/A
7.	**Groundwater Monitoring Records** Remarks	✓ Readily available	✓ Up to date	N/A
8.	**Leachate Extraction Records** Remarks	Readily available	Up to date	✓ N/A
9.	**Discharge Compliance Records** ✓ Air ✓ Water (effluent) Remarks	✓ Readily available ✓ Readily available	✓ Up to date ✓ Up to date	N/A N/A
10.	**Daily Access/Security Logs** Remarks	✓ Readily available	✓ Up to date	

IV. ACCESS AND INSTITUTIONAL CONTROLS			Applicable ✓ N/A
A. Fencing			
1.	**Fencing** Remarks	Location shown on site map	Gates secured N/A
B. Other Access Restrictions			
1.	**Signs and other security measures** Remarks	Location shown on site map	N/A
C. Institutional Controls			

1. **Implementation and enforcement**

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

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

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

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** ICs are adequate ICs are inadequate N/A

Remarks

D. General

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

Remarks

2. **Land use changes onsite** N/A

Remarks

_____

3. **Land use changes offsite** N/A

Remarks

_____

V. GENERAL SITE CONDITIONS

A. Roads ✓Applicable

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

Remarks

_____

B. Other Site Conditions

	Remarks
	VI. LANDFILL COVERS Applicable ✓ N/A
A. Landfill Surface	
1.	**Settlement** (Low spots) Location shown on site map Settlement not evident Areal extent_____ Depth Remarks
2.	**Cracks** Location shown on site map Cracking not evident Lengths _____ Widths_____Depth Remarks
3.	**Erosion** Location shown on site map Erosion not evident Areal extent_____ Depth Remarks
4.	**Holes** Location shown on site map Holes not evident Areal extent_____ Depth Remarks
5.	**Vegetative Cover** Grass Cover properly established No signs of stress Trees/Shrubs (indicate size and locations on a diagram) Remarks _____
6.	**Alternative Cover** (armored rock, concrete, etc.) N/A Remarks
7.	**Bulges** Location shown on site map Bulges not evident Areal extent_____ Height Remarks

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

3.	**Erosion** Location shown on site map No evidence of erosion Areal extent_____ Depth Remarks_____
4.	**Undercutting** Location shown on site map No evidence of undercutting Areal extent_____ Depth Remarks
5.	**Obstruction** Type_____ No obstruction Location shown on site map Areal extent Size Remarks
6.	**Excessive Vegetative Growth** Type No evidence of excessive growth Vegetation in channels does not obstruct flow Location shown on site map Areal extent Remarks

D. Cover Penetrations	Applicable	N/A	
1.	**Gas Vents** Active	Passive	
	Properly secured/located Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration		
	Remarks		
2.	**Gas Monitoring Probes**		
	Properly secured/located Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration		
	Remarks		
3.	**Monitoring Wells** (within surface area of landfill)		
	Properly secured/located Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration		
	Remarks		
4.	**Leachate Extraction Wells**		
	Properly secured/located Functioning	Routinely sampled	Good condition
	Evidence of leakage at penetration	Needs O&M	N/A
	Remarks		

5.	**Settlement Monuments** Located Remarks	Routinely surveyed	N/A
E. Gas Collection and Treatment		Applicable	N/A
1.	**Gas Treatment Facilities** Flaring Thermal destruction Collection for reuse Good condition Needs O&M Remarks		
2.	**Gas Collection Wells, Manifolds and Piping** Good condition Needs O&M Remarks		
3.	**Gas Treatment Facilities** (e.g., gas monitoring of adjacent homes or buildings) Good condition Needs O&M N/A Remarks		
F. Cover Drainage Layer		Applicable	N/A
1.	**Outlet Pipes Inspected** Remarks	Functioning	N/A
2.	**Outlet Rock Inspected** Remarks	Functioning	N/A
G. Detention/Sedimentation Ponds		Applicable	N/A
1.	**Siltation** Areal extent_____ Depth_____ Siltation not evident Remarks		N/A
2.	**Erosion** Areal extent_____ Depth Erosion not evident Remarks		
3.	**Outlet Works** Remarks	Functioning	N/A
4.	**Dam** Remarks	Functioning	N/A
H. Retaining Walls	Applicable	N/A	

1.	**Deformations**	Location shown on site map	Deformation not evident
	Horizontal displacement_____		Vertical displacement
	Rotational displacement_____		
	Remarks		
2.	Degradation	Location shown on site map	Degradation not evident
	Remarks		
I. Perimeter Ditches/Off-Site Discharge		Applicable	N/A
1.	**Siltation**	Location shown on site map	Siltation not evident
	Areal extent_____	Depth	
	Remarks		
2.	**Vegetative Growth**	Location shown on site map	N/A
		Vegetation does not impede flow	
	Areal extent_____	Type	
	Remarks		
3.	**Erosion**	Location shown on site map	Erosion not evident
	Areal extent_____	Depth	
	Remarks		
4.	**Discharge Structure**	Functioning	N/A
	Remarks		

VII. VERTICAL BARRIER WALLS		Applicable	✓ N/A
1.	**Settlement**	Location shown on site map	Settlement not evident
	Areal extent_____	Depth	
	Remarks		
2.	**Performance Monitoring**	Type of monitoring	
	Performance not monitored		
	Frequency_____	Evidence of breaching	
	Head differential		
	Remarks		

VIII. GROUNDWATER/SURFACE WATER REMEDIES	✓Applicable	N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines Ξ: Applicable

1. **Pumps, Wellhead Plumbing, and Electrical**
   ✓Good condition All required wells located Needs O&M N/A
   Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ✓Good condition Needs O&M
   Remarks

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

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

1. **Collection Structures, Pumps, and Electrical**
   Good condition Needs O&M
   Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   Good condition Needs O&M NA
   Remarks

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

C. Treatment System ✓Applicable

1. **Treatment Train** (Check components that apply)
   Metals removal Oil/water separation Bioremediation
   Air stripping Carbon adsorbers
   Filters
   ✓Additive (e.g., chelation agent, flocculent) → Advanced oxidation with ozone
   ✓Good condition Needs O&M
   Sampling ports properly marked and functional
   Sampling/maintenance log displayed and up to date
   Equipment properly identified
   Quantity of groundwater treated annually
   Quantity of surface water treated annually
   Remarks

Air stripping towers shut down when AOP system started up because AOP treats for TCE

Formation of bromate was an issue at startup. Added O_3 monitor to adjust ~~freq~~ as needed to minimize bromate formation.

2.	**Electrical Enclosures and Panels** (properly rated and functional) N/A ✓Good condition Needs O&M Remarks
3.	**Tanks, Vaults, Storage Vessels** N/A ✓Good condition Remarks
4.	**Discharge Structure and Appurtenances** ✓Good condition Needs O&M Remarks
5.	**Treatment Building(s) – support building** N/A ✓Good condition (especially roof and doorways) Needs repair Chemicals and equipment properly stored Remarks
6.	Monitoring Wells (pump and treatment remedy) ✓Properly secured/locked ✓Functioning ✓Routinely sampled Good condition All required wells located Needs O&M N/A Remarks

D. Monitored Natural Attenuation N/A	
1.	**Monitoring Wells** (natural attenuation remedy) Properly secured/locked Functioning Routinely sampled Good condition All required wells located Needs O&M Remarks

IX. 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.

X. 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.).

Remedy is intended to contain the plume and remove VOC mass. Remedy appears to be effective and functioning as designed. Previous implementation of ISCO could be enhanced.

B. Adequacy of O&M

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

O&M procedures are implemented and recorded appropriately. Equipment was in good condition.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of .unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

None noted.

D. Opportunities for Optimization

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

May be able to enhance pumping strategy and source area treatment through ISCO.