FIRST FIVE-YEAR REVIEW

Indian Bend Wash Superfund Site
Scottsdale and Tempe, Maricopa County, Arizona

Prepared by:

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Region 9
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FIVE-YEAR REVIEW

First Five-Year Review

for

Indian Bend Wash Superfund Site

Scottsdale and Tempe

Maricopa County, Arizona

SEPTEMBER 2011

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS

1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
µg/L	micrograms per liter
AAW	Arizona American Water Company
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
ARAR	applicable or relevant and appropriate requirement
AZPDES	Arizona Pollution Discharge Elimination System
bgs	below ground surface
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERP	Contingency and Emergency Response Plan
CGTF	Central Groundwater Treatment Facility
COC	contaminant of concern
EPA	U.S. Environmental Protection Agency
FSA	Feasibility Study Addendum
FYR	Five Year Review
GM&EP	Groundwater Monitoring and Evaluation Plan
gpm	gallons per minute
HBGL	Human Health-Based Guidance Level
IBW	Indian Bend Wash
ICs	institutional controls
ITSI	Innovative Technical Solutions, Inc.
LAU	lower alluvial unit
MAU	middle alluvial unit
MCL	maximum contaminant level
MNA	monitored natural attenuation
MRTF	Miller Road Treatment Facility
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIBW	North Indian Bend Wash
NPL	National Priorities List
O&M	operation and maintenance
OU	Operable Unit
PCs	Participating Companies
PCE	tetrachloroethene
PRP	Potentially Responsible Party

LIST OF ACRONYMS CONT.

PVARF	Paradise Valley Arsenic Removal Facility
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objectives
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Levels
SAP	Sampling and Analysis Plan
SIBW	South Indian Bend Wash
SOP	standard operating procedure
SRP	Salt River Project
SVE	soil vapor extraction
TCE	trichloroethene
UAO	Unilateral Administrative Order
UAU	upper alluvial unit
UV/Ox	ultraviolet light/ chemical oxidation
vGAC	vapor phase granular activated carbon
VOC	volatile organic compound

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) Region 9 has conducted this first Five-Year Review (FYR) of the remedial action at the Indian Bend Wash (IBW) Superfund Site (Site), located in the cities of Scottsdale and Tempe, Arizona, in Maricopa County. The IBW Site encompasses approximately thirteen square miles of the Paradise Valley Groundwater Basin, which is an important source of drinking water for the Phoenix metropolitan area.

In 1981, trichloroethene (TCE) and tetrachloroethene (PCE) were discovered in the groundwater at several municipal wells at concentrations exceeding the Arizona Department of Health Services action levels and federal maximum contaminant levels in effect at that time. In 1982, the IBW Site was placed on the EPA's National Priorities List (NPL).

As EPA began its IBW investigation, the highest levels of volatile organic compounds (VOCs) were found in groundwater in Scottsdale, and EPA initially focused resources there. In 1987, EPA divided the IBW Site into two areas: North Indian Bend Wash (NIBW), located north of the Salt River within the City of Scottsdale (approximately 10 square miles); and South Indian Bend Wash (SIBW), located south of the Salt River within the City of Tempe (approximately 3 square miles) (Figure 1). The NIBW and SIBW areas were identified to facilitate management of the Site cleanup because each area had distinct sources of contamination and the NIBW groundwater plumes were not contiguous with the SIBW groundwater plumes. Additionally, the Salt River is considered a hydrologic divide for groundwater flow in the upper alluvial unit.

Groundwater at the IBW Site is present in three distinct layers: the upper alluvial unit, middle alluvial unit, and lower alluvial unit. In NIBW, VOCs are present in all three alluvial units. In SIBW, VOCs are present in low concentrations in the upper and middle alluvial units only.

The potential sources of groundwater contamination in NIBW were identified as Motorola Government Electronics Group, Seimens Corporation, Glaxo Smith-Kline, Beckman Instruments, and other parties. In SIBW, the potential sources of groundwater contamination were identified as DCE Circuits, IMC Magnetics, Arizona Public Service, Circuit Express, Unitog Rental Services, and others.

The decision documents for the selection of the NIBW remedy include the 1988 Scottsdale Groundwater Record of Decision (ROD), 1991 Shallow Soils and Groundwater ROD, and the 2001 Final ROD Amendment. Between 1992 and 1999, four groundwater extraction and treatment systems (Central Groundwater Treatment Facility, Miller Road Treatment Facility, Area 7, and Area 12) and four soil vapor extraction (SVE) systems (Area 6, Area 7, Area 8, and Area 12) were designed, constructed, and placed into routine operation and maintenance. The Area 6, 8 and 12 SVE systems were operated and decommissioned based on performance data;

the Area 6 SVE system was implemented as a voluntary action not required by EPA. The Area 7 SVE system was operated intermittently from July 1994 to December 2009 when it was shut down for long-term rebound testing. This SVE system remains in place. The four groundwater extraction and treatment systems continue to operate as part of the ongoing remedial efforts for NIBW. Presently, EPA is negotiating a final long-term remedy for the Miller Road Treatment Facility which is expected to be selected by the end of calendar year 2011. Since the NIBW groundwater remedies began operations, they have treated a cumulative total of 82 billion gallons of VOCs-contaminated groundwater and over 75,000 pounds of VOCs have been removed from the NIBW aquifers.

The SIBW decision documents for the selection of the remedy include the September 1993 Vadose Zone ROD, 1998 Groundwater ROD, and the 2004 Final ROD Amendment. The remedial actions include soil vapor extraction and monitored natural attenuation (MNA) for groundwater. As of 2010, only four of the 41 groundwater monitor wells sampled semi-annually indicate concentrations of TCE or PCE slightly above the maximum contaminant level (MCL) of 5 µg/L. At the DCE Circuits subsite, soil vapor extraction was implemented intermittently from July 1997 through January 2000 and from July 2005 through June 2007. Indoor air monitoring, which has been conducted at DCE Circuits since 2007, indicates TCE and PCE levels are within EPA's acceptable limits.

The remedies at the IBW Site are currently protective of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. The groundwater extraction and treatment systems which comprise the NIBW remedy are removing VOC mass from the three groundwater zones, reducing VOC concentrations in groundwater, and treating VOC concentrations to below the maximum contaminant levels. The groundwater plume is contained as demonstrated by analysis of groundwater data and predicted by groundwater modeling. At SIBW, identified source areas have been remediated and the monitored natural attenuation remedy has almost met the remedial action objective to restore groundwater to beneficial use. At the DCE Circuits subsite, indoor air monitoring conducted since 2007 is ongoing to ensure concentrations remain within EPA's acceptable levels.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name: Indian Bend Wash (IBW) Superfund Site		
EPA ID: AZD980695969 (NIBW and SIBW)		
Region: 9	**State:** AZ	**City/County:** Scottsdale and Tempe / Maricopa

SITE STATUS	
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)	
Remediation status: ☐ Under Construction ☐ Operating ☒ Construction Complete	
Multiple OUs?* ☒ YES ☐ NIBW, SIBW	**Construction completion date:** 26 September 2006
Has site been put into reuse? ☒ YES ☐ NO	

REVIEW STATUS	
Lead agency: ☒ USEPA ☐ State ☐ Tribe ☐ Other Federal Agency	
Author name: Rachel Loftin	
Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA Region 9
Review period: April 2010 through March 2011	
Date(s) of site inspection: November 16 and 17, 2010	

FIVE-YEAR REVIEW SUMMARY FORM

Type of review: ☒ Statutory (NIBW)

☒ Policy (SIBW) ☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal

☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead

☐ Regional Discretion

Review number: ☒ 1 (first) IBW Sitewide ☐ 2 (second) ☐ 3 (third)

☐ Other (specify) ___________

Triggering action:

☐ Actual RA Onsite Construction at OU#

☐ Actual RA Start at OU#

☒ Construction Completion

☐ Previous Five-Year Review Report

☐ Other (specify)

Triggering action date: Construction Complete: 26 September 2006

Due date: 30 September 2011

FIVE-YEAR REVIEW SUMMARY FORM

Issues: There were no issues identified which affect current or future protectiveness.

Protectiveness Statement: The remedies at the IBW Site are currently protective of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. The groundwater extraction and treatment systems which comprise the NIBW remedy are removing VOC mass from the three groundwater zones, reducing VOC concentrations in groundwater, and treating VOC concentrations to below the maximum contaminant levels. The groundwater plume is contained as demonstrated by analysis of groundwater data and predicted by groundwater modeling. At SIBW, identified source areas have been remediated and the monitored natural attenuation remedy has almost met the remedial action objective to restore groundwater to beneficial use. At the DCE Circuits subsite, indoor air monitoring conducted since 2007 is ongoing to ensure concentrations remain within EPA's acceptable levels.

Other Comments: The following operation and maintenance actions which do not affect current or future protectiveness are in progress:

- There was an instance in 2007 and another in 2008 at the Miller Road Treatment Facility (MRTF) in which partially treated groundwater from well PCX-1 was delivered to the potable supply system. As an interim measure, in 2008 the MRTF was reconfigured to convey treated water from well PCX-1 to a canal instead of the potable supply system. This end use is consistent with the ROD and reflects the way the MRTF was originally operated for several years. Additionally, EPA added a recommendation for a physical secondary fail-safe for wells with a drinking water end use. The remedy is currently protective and the long-term configuration for the MRTF is presently being negotiated with the multiple water rights holders, but has not been finalized. This item will be addressed by finalizing selection of the long-term remedy in 2011 and implementation planned for 2012.

- Key documents for the Miller Road Treatment Facility require updating to include as-built drawings, current process and instrumentation diagrams, and preventive maintenance tasks. The Contingency and Emergency Response Plan needs to be kept on site.

FIVE-YEAR REVIEW SUMMARY FORM

Other Comments – continued:

• The Operations and Maintenance Manuals for the Central Groundwater Treatment Facility and Area 7 require updating to include current figures, a list of alarms, and a troubleshooting section.

• The Area 12 O&M Manual requires updating to include discussion of performance monitoring, routine and preventive maintenance, and alarm testing and calibration protocols. Copies of as-built drawings, piping and instrumentation diagrams, and Sampling and Analysis Plans need to be kept on-site.

SECTION 1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is conducting this Five-Year Review (FYR) for the Indian Bend Wash (IBW) Superfund Site. This document, prepared in accordance with EPA's *Comprehensive Five-Year Review Guidance, EPA 540-R-01-007* (EPA, 2001a), presents the results of the First Sitewide FYR conducted for the Site. This review is conducted consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA §121(c) as amended, states:

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

The NCP part §300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

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

This statutory FYR is required because hazardous substances, pollutants, or contaminants remain above levels which would allow for unrestricted access and unlimited site use. Specifically, contaminants in groundwater are present at levels exceeding the drinking water maximum contaminant levels (MCLs). This review period is from October 2001 through March 2010.

The Indian Bend Wash Superfund Site is comprised of the North IBW (NIBW) area located in Scottsdale, Arizona and the South IBW (SIBW) area located in Tempe, Arizona (Figure 1) as defined in the initial Record of Decision (ROD) dated September 1988. This is the first FYR performed for the Site. The triggering action for this FYR is the Construction Complete documented in the Preliminary Closeout Report dated 26 September, 2006.

SECTION 2.0 SITE CHRONOLOGY

A chronology of significant events/milestones for the IBW Site is presented in Table 2-1. Site background and significant site-related items are further described in the following subsections.

Table 2-1: Chronology of Site Events
Indian Bend Wash Superfund Site, Maricopa County, Arizona

Event	Date
Trichloroethene (TCE) is detected in groundwater samples from several City of Scottsdale and City of Phoenix municipal wells at concentrations exceeding Arizona Department of Health Services action levels in effect at that time.	October 1981
Salt River Project (SRP) Wells 6 and 31 and City of Phoenix Wells 34, 35, and 36 (now Scottsdale Wells 71, 72, and 75) are removed from potable service.	1981
Volatile organic compounds (VOCs) are detected in City of Tempe production wells.	1982
IBW Site is added to the National Priorities List (NPL).	1982
Remedial Investigation (RI) is initiated by EPA, the Arizona Department of Environmental Quality (ADEQ), and a subset of the NIBW potentially responsible parties (PRPs) (referred to as NIBW Participating Companies).	July 1984
SRP Well No. 6 is equipped by the City of Scottsdale with a VOC treatment system and placed back into potable use.	1985
Phase I RI report is released; a sitewide remedial investigation/feasibility study (RI/FS) is ongoing.	August 1986
Feasibility Study completed and Central Groundwater Treatment Facility remedial design initiated.	April 1987
EPA divides IBW into NIBW and SIBW areas.	1987
EPA begins an RI for SIBW.	1988
Feasibility Study is completed for the middle alluvial unit (MAU) and lower alluvial unit (LAU) of NIBW (OU1).	April 1988
ROD is issued for the Scottsdale groundwater, addressing contamination in the middle and lower alluvial units of IBW (OU1).	September 1988
EPA issues a Unilateral Administrative Order (UAO) to Scottsdale parties to install and sample four groundwater monitor wells in the NIBW area.	July 1989
EPA issues a UAO to eight parties (including Motorola) to implement the remedy for the middle and lower alluvial units.	July 1989
UAO is amended; EPA negotiates a CD with the NIBW Participating Companies (PCs).	December 1989
EPA issues the NIBW RI/FS for the upper alluvial unit and the vadose zone (OU2).	April 1991
ROD for NIBW Vadose Zone is signed, to address source sites and the upper alluvial unit, including soil vapor extraction (SVE) at Areas 7 and 12, and additional investigations at potential source areas 3, 5A, 5B, 5C, 6, 9, 11, and 12. (Vadose zone investigations were ongoing at these locations from 1982 through 1996.)	September 1991
CD is signed to implement cleanup actions selected in the 1988 ROD for NIBW Groundwater.	April 1992
Central Groundwater Treatment Facility construction begins.	September 1992
Consent Decree is signed to implement the cleanup actions selected in the NIBW 1991 ROD for the vadose zone (OU2).	11 August 1993
ROD is signed to address VOCs in the SIBW vadose zone.	1993

Table 2-1: Chronology of Site Events
Indian Bend Wash Superfund Site, Maricopa County, Arizona

Event	Date
EPA issues a Certificate of Completion for NIBW Areas 5B and 9.	December 1993
NIBW Central Groundwater Treatment Facility (CGTF) begins operation to extract and treat groundwater from the middle and lower alluvial units.	February 1994
Construction begins on the NIBW Miller Road Treatment Facility (MRTF).	March 1996
EPA issues a “plug-in” document for the SIBW DCE Circuits subsite requiring SVE in the vadose zone at the property.	February 1994
EPA issues a Letter of Determination that performance standards have been achieved at NIBW Area 5C.	April 1994
Arizona American Water raises concerns regarding lower alluvial unit plume impacting well PV-15.	12 May 1994
Construction of an SVE system for NIBW Area 7 is completed and start up begins.	July 1994
NIBW Area 7 SVE is operated intermittently in 1994-96, 1997, 1998-99, 1999-2000, 2008-09.	1994-2009
Routine operation and maintenance (O&M) activities begin at Area 7.	Aug 1994-Oct 1996
PCs complete construction and testing of well 75A to enhance lower alluvial unit groundwater extraction.	Jan-March 1995
EPA issues a Letter of Determination that the performance standards have been achieved at NIBW Area 5A.	March 1995
PCs complete construction and testing of well PCX-1 to enhance lower alluvial unit groundwater extraction.	March –May 1995
Routine O&M begins at the NIBW Area 8 SVE system.	October 1995
PCs voluntarily construct the Miller Road Treatment Facility.	March 1996
NIBW Area 8 SVE system is shut down to conduct a rebound test of the vadose zone.	October 1996
NIBW Area 7 SVE system is shut down to conduct a rebound test of the vadose zone.	October 1996
NIBW Area 12 SVE is constructed and begins operations.	Sept – Dec 1996
NIBW Area 7 SVE system is operated from April 1997 to October 1997, then is shut down for an extended rebound test.	1997
NIBW MRTF begins operations to extract and treat groundwater primarily from the LAU.	April 1997
NIBW Area 8 SVE system is decommissioned upon achieving performance goals.	July 1997
SIBW DCE Circuits subsite SVE system operated intermittently.	July 1997–Jan 2000
Final SIBW Groundwater Feasibility Study is released for the three groundwater plumes including monitored natural attenuation (MNA) for the eastern and central plumes, and pump and treat for the western plume.	August 1997
Construction of Area 12 groundwater extraction and treatment system.	Sept – Dec 1997
EPA issues General Notice letters to PRPs for groundwater contamination at SIBW.	December 1997
SIBW Consent Decree signed by IMC Magnetics, Inc.	January 1998
NIBW Area 12 SVE operations cease pending EPA concurrence that performance objectives have been attained.	March 1998
ROD is signed to address VOCs in the SIBW groundwater.	September 1998
NIBW Area 6 SVE system begins operation as a voluntary remedial action performed by NIBW PCs.	December 1998
NIBW Area 12 groundwater extraction and treatment system begins operation, extracting and treating groundwater from the MAU.	1999

Table 2-1: Chronology of Site Events
Indian Bend Wash Superfund Site, Maricopa County, Arizona

Event	Date
NIBW Area 7 groundwater extraction and treatment system begins operation, extracting and treating groundwater primarily from the middle alluvial unit and to a lesser extent from the upper alluvial unit.	November 1999
NIBW Area 7 SVE begins routine operations.	Sept 1999– May 2000
NIBW Area 6 voluntary SVE activities ceased (June 2000) and SVE system is decommissioned.	August 2000
The NIBW PCs complete a Feasibility Study Addendum (FSA) evaluating seven alternatives for improving existing remedial systems.	November 2000
NIBW Miller Road Treatment Facility (MRTF) experiences control malfunction following area wide power loss.	15 January 2001
MRTF experiences second control malfunction; well PCX-1 is shutdown and detailed investigation commences.	8 February 2001
MRTF investigation completed; additional electronic notification and alarm systems installed.	May 2001
ROD Amendment for NIBW is issued to implement a comprehensive, consolidated site cleanup strategy.	September 2001
MAU extraction Well 7EX-5MA is installed and begins operation at NIBW Area 7.	Oct – Dec 2001
SIBW Consent Decree signed by DCE Circuits.	06 November 2001
EPA issues a second SIBW “plug-in” document to seven additional PRPs requiring SVE in the vadose zone.	January 2002
SVE system removed at SIBW DCE Circuits subsite.	April 2003
Amended CD for NIBW Final ROD Amendment/final remedy signed by the U.S. District Court in Arizona.	6 June 2003
SIBW Consent Decree signed by Arizona Public Service.	21 August 2003
SIBW ROD Amendment is signed changing the remedy for the western plume from pump and treat to monitored natural attenuation.	June 2004
EPA removes a dry well which received hazardous waste at the former DCE Circuits SIBW subsite.	December 2004
NIBW Area 12 Purus system at groundwater extraction and treatment system is decommissioned.	January 2005
Low-flow portable SVE system operated intermittently at SIBW DCE Circuits subsite.	July – Sept 2005
IBW Construction Complete issued in Preliminary Closeout Report.	26 September 2006
Rehabilitation conducted at the Central Groundwater Treatment Facility.	Feb–June 2007
SIBW Consent Decree signed with Unitog Rentals, IMC Magnetics, Circuit Express, Janstar, K&S Interconnect, Sherman Leibovitz, Prestige Cleaners, Service & Sales.	16 March 2007
The low-flow portable SVE system at SIBW DCE Circuits subsite was removed from service.	June 2007
MRTF release of partially treated water to Paradise Valley Arsenic Removal Facility (PVARF) potable water system.	October 2007
Release of untreated water from MRTF to PVARF; groundwater extraction system taken offline.	January 2008
MRTF brought back online; well PCX-1 reconfigured to discharge treated effluent to the Arizona Canal per EPA approved Interim Operating Plan.	25 April 2008
MRTF Rehabilitation begins.	April 2009

Table 2-1: Chronology of Site Events
Indian Bend Wash Superfund Site, Maricopa County, Arizona

Event	Date
CGTF: Air Release Valve Failure near well 71; all air release valves replaced with brass ones.	Aug-Sept 2009
MRTF: Air Release Valve Failure at well PCX-1 well vault; valve replaced and leak detection shutoff added in well vault.	Sept-Oct 2009
CGTF: Untreated water release from drain pipe to soil and pavement; repairs completed.	Nov–Dec 2009
MRTF Rehabilitation completed.	May 2010
Area 7: Valve Failure at well 75EX-MA occurred; valve was replaced.	July 2010
Area 7: UV/Ox system processor short circuited during areawide power loss; processor replaced and backup processor purchased.	June -July 2011
CGTF: Well 71 taken offline for pump and motor replacement; pumping increased at other wells tied into treatment at CGTF to maintain CGTF average pumping rate.	July 2011

SECTION 3.0 BACKGROUND

The IBW Superfund Site encompasses approximately thirteen square miles of the Paradise Valley Groundwater Basin, an important source of drinking water for the Phoenix metropolitan area. As EPA began its investigation, the highest levels of volatile organic compounds (VOC) were found in groundwater in Scottsdale, and EPA initially focused resources there. In 1987, EPA divided the IBW Site into two areas: NIBW, located north of the Salt River within the City of Scottsdale; and SIBW, located south of the Salt River within the City of Tempe (Figure 1). The NIBW and SIBW areas were identified to facilitate management of the Site cleanup because each area had distinct sources of contamination and the NIBW groundwater plumes were not contiguous with the SIBW groundwater plumes. Additionally, the Salt River is considered a hydrologic divide for groundwater flow in the upper alluvial unit.

3.1 PHYSICAL CHARACTERISTICS

This section contains a description of the physical characteristics of the NIBW and SIBW regions and hydrogeology. A general schematic of the hydrogeology of the region is shown on Figure 2.

3.1.1 North Indian Bend Wash

The NIBW area is located within the southern portion of the Paradise Valley Basin in the eastern portion of the Salt River Valley, an irrigated region around the lower course of the Salt River (Figure 1). The river is fed by mountain streams near the Mogollon Rim of the Mogollon Plateau, and it flows southwest to join the Gila River in south-central Arizona. The Paradise Valley Basin is bounded by the McDowell Mountains to the northeast, the Phoenix Mountains to the west, and Camelback Mountain and the Papago Buttes to the southwest. The annual average precipitation is 9.36 inches, which is fairly evenly distributed throughout the year.

The NIBW groundwater plume is located in a highly developed urban setting approximately ten square miles in size in the general vicinity of the Salt River to the south, Chaparral Road to the north, the Pima freeway (Loop 101) to the east, and Scottsdale Road to the west (Figure 3). Nearby environmentally sensitive areas include the Salt River and surrounding wetlands. No environmentally sensitive areas have been identified within the NIBW area. Portions of the NIBW area are located within a one hundred year flood zone. NIBW groundwater is present in four distinct groundwater units; the upper alluvial unit (UAU), middle alluvial unit (MAU), lower alluvial unit (LAU), and the Red Unit. Data indicate TCE and PCE are present in groundwater in the upper, middle and lower alluvial units only.

The thickness of the upper alluvial unit is approximately 120 to 160 feet. The upper alluvial unit consists primarily of sand, course gravel, cobbles, and boulders. Groundwater occurs at depths ranging from approximately 50 feet to approximately 104 feet below ground surface (bgs), with up to 100 feet of saturated thickness. In NIBW, the direction of groundwater movement in the upper alluvial unit is from east to west in the area south of McDowell Road, and from northeast to southwest in the vicinity of Thomas Road. The upper alluvial unit groundwater flows from all directions toward the southwest margin of the NIBW area where bedrock is encountered, fine grained middle alluvial unit sediments are thin or absent, and groundwater moves vertically into the underlying lower alluvial unit (Figure 2).

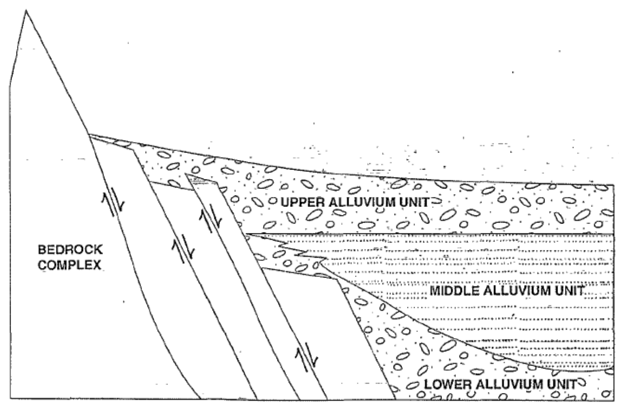


Figure 2 Schematic Hydrogeologic Section

The middle alluvial unit primarily consists of silt, clay, and interbedded fine sands that transmit much of the water that occurs in the unit. The thickness of the middle alluvial unit ranges from approximately 360 to 660 feet. Water elevations in wells perforated in the middle alluvial unit are under confined conditions and occur at depths between approximately 90 feet and 150 feet bgs. The lower alluvial unit consists of weakly to strongly cemented gravel, boulders, sand, sandy clay, silty sand, with some interbedded clayey zones. The lower alluvial unit is coarser grained than the middle alluvial unit and is the principal alluvial unit in the region. The lower alluvial unit is at least 500 feet thick and likely thicker than 700 feet at some parts of the Site. The lower alluvial unit thins out at the basin margin in the vicinity of exposed bedrock at the southwest margin and near the mountainous part of Paradise Valley. Water elevations in wells perforated in the lower alluvial unit are under confined conditions and occur at depths of between approximately 129 and 341 feet bgs.

Water level data indicate a downward-directed vertical hydraulic gradient between the upper and the middle alluvial units, and between the middle and the lower alluvial units across the Site. Groundwater in the upper alluvial unit generally moves from east to west across the Site toward the southwest margin. Upon reaching the southwest margin, groundwater in the upper alluvial unit moves downward into the lower alluvial unit either directly or through a thin layer of middle alluvial unit sediments. This movement results from the regional downward hydraulic gradient caused by large-scale historic and current pumping of the lower alluvial unit – principally at production wells located to the north. This downward vertical movement in the southwest margin is facilitated by the thinning and, in some areas the absence, of middle alluvial unit sediments west of Scottsdale Road.

A facility previously owned by Motorola Government Electronics Group was originally identified as a source of VOCs in groundwater. Subsequently, facilities owned by Seimens Corporation, Glaxo Smith-Kline, and Beckman Instruments were also identified as sources of the VOCs in groundwater in Scottsdale. Other parties, including Salt River Project, were also identified with activities that potentially contributed to the VOCs in groundwater. Large production wellfields located north of the NIBW groundwater plume, draw groundwater primarily from the lower alluvial unit and to a lesser extent from the middle alluvial unit. The upper alluvial unit is not used for potable supply.

3.1.2 South Indian Bend Wash

The SIBW area is located in a highly developed setting approximately three square miles in size primarily within the City of Tempe and small areas of unincorporated Maricopa County (Figure 1). The SIBW groundwater study area is located in the general vicinity of Apache Boulevard to the south, Rural Road to the west, Price Road to the east, and the Salt River to the north. Environmentally sensitive areas located in or adjacent to the SIBW area include the Salt River and the surrounding wetlands as well as Tempe Town Lake. Tempe Town Lake was conceived as a project to transform a portion of the dry Salt River bed into an urban lake to provide recreational opportunities, and promote habitat restoration and economic benefits. The lake is approximately 2 miles long and up to 220 acres in size. During seasonal flooding, it was planned that the dams used to build the lake would be lowered to allow flood waters to pass downstream. Tempe Town Lake is located approximately one mile north of the SIBW groundwater plumes. Portions of the SIBW area are located within a one hundred year flood zone. The groundwater table fluctuates more than 50 feet at the site. These fluctuations in groundwater levels can either leave residual areas of contamination when the water table falls, or cause vadose zone contaminants to become dissolved in the groundwater when the groundwater table rises (USEPA ROD, 1998). The annual average precipitation is 9.36 inches. Figure 4 depicts SIBW and the surrounding area.

The SIBW groundwater is present in three distinct alluvial units: the upper alluvial unit, middle alluvial unit, and lower alluvial unit. The upper alluvial unit is distributed across the entire SIBW area. The upper alluvial unit has an upper layer of clay and sandy silt, and a lower layer primarily composed of sand, gravel, cobble, and boulders. The upper layer is typically not present near the Salt River but is more than 20 feet thick south of the Salt River channel. The upper alluvial unit is encountered from ground surface to approximately 110 to 170 feet bgs. Groundwater flow directions in the upper alluvial unit are south to southwest during non-river flow conditions in the Salt River. These flow directions shift to the south to southeast during river flow conditions in the Salt River when recharge influences groundwater flow directions. Groundwater flow through the upper alluvial unit originates mainly from Salt River recharge (during flow events) and lateral inflow moves vertically downward, eventually entering the middle alluvial unit.

The middle alluvial unit occurs throughout the SIBW area and consists primarily of clay and sandy silt with significant interbedded layers of sand/gravel mixtures. The interbedded stratigraphy encountered within the middle alluvial unit is subdivided into three subunits A, B, and C. The Subunit A is very thin and discontinuous; consequently, no EPA wells are screened in this subunit. The groundwater flow direction in Subunit B is generally west to east, but insufficient data exists to fully characterize the flow direction. The groundwater flow direction in Subunit C varies from due north to east, with northeast appearing to be the predominant flow direction.

The lower alluvial unit is beneath the middle alluvial unit. In SIBW, VOCs are present in the upper and middle alluvial unit only. During the SIBW remedial investigation, the lower alluvial unit was encountered only once. There, it was encountered at 500 feet bgs and was composed of conglomerate dominated by weakly cemented gravel, sand, silt, and rock fragments. Because it has only been encountered at one location, limited data exist to determine the thickness of the lower alluvial unit in the SIBW area. Additionally, limited data exist to estimate groundwater flow directions in the lower alluvial unit.

Approximately 150 facilities were identified as potential sources of VOCs in groundwater. Of these, 70 facilities were evaluated and narrowed down to 30 facilities identified for additional investigation and fieldwork. One source site, DCE Circuits, includes two buildings which were formerly the Borden Milk Company Creamery and Ice Factory which was listed on the National Register of Historic Places for Maricopa County as Inventory No. 16. Low concentrations of VOCs were initially discovered at SIBW in three areas designated as the western, central, and eastern plumes. The western and central plumes are present in the upper alluvial unit where TCE and PCE are the primary constituents of concern, respectively. The eastern plume is present in the middle alluvial unit and TCE is the primary constituent of concern. There are no known VOCs in groundwater in the lower alluvial unit in SIBW. Figure 4 depicts SIBW and the surrounding area. Figure 5 presents the extent of these groundwater plumes in 2004, and Figure 6 presents the extent of these groundwater plumes in March 2010.

In SIBW, surface water is used as the primary drinking water source with groundwater used as a stand-by drinking water supply and for industrial purposes.

3.2 LAND AND RESOURCE USE

NIBW and SIBW land and groundwater uses are described in detail in the following subsections.

3.2.1 North Indian Bend Wash

Land use in the NIBW area is a mix of residential, industrial/commercial, agricultural, public and private recreational, undeveloped space, and waterways and is divided roughly as follows: 53.5 percent residential, 40.0 percent undeveloped/open space/agricultural, 6.5 percent industrial/commercial (Scottsdale Economic Vitality Department, June 2009).

In the NIBW area, a small number of large industrial facilities including semiconductor production, electroplating and finishing, and the aerospace industry have operated from the 1950s for various lengths of time. Operations at many of these facilities have been discontinued, but historically included the use and disposal of organic solvents. Several means of solvent disposal including discharge to dry wells, unlined ponds, or storage tanks led to soil and groundwater contamination. Groundwater is primarily used for municipal and irrigation purposes. Complex water rights and apportionment of groundwater among various municipal, quasi-governmental, and private entities govern groundwater use in the NIBW area. Several municipalities and water purveyors extract groundwater from within, or adjacent to, the NIBW groundwater plume.

3.2.2 South Indian Bend Wash

Land in the SIBW area is developed for residential, commercial, and industrial uses. The area between Apache Boulevard and University Drive is primarily residential. Land use north of University Drive is largely retail and commercial, including light-industrial and auto repair/scrap facilities in the area south of the Salt River. The area east of Rural Road is primarily used by Arizona State University for off-campus housing for students, dormitories, athletic fields, a golf course; and single-family homes. The northernmost area of SIBW has been developed into a regional retail center. The SIBW area also includes the Salt River itself, which is ephemeral and flows during storm events and releases from Roosevelt Dam.

In the SIBW area, a large number of small- to medium-sized industrial facilities including circuit and electronics manufacturing, plastics manufacturing, dry cleaning, metal electroplating and finishing, auto service, dry cleaning, landfills, and quarries have operated since the 1950s. While many of these operations have been discontinued, they included use and disposal of organic solvents which have led to soil and groundwater contamination.

Prior to 1967, groundwater was the primary source of potable water for the City of Tempe. In 1967, the John G. Martinez Water Treatment Plant was constructed, allowing the City of Tempe to rely predominantly on surface water to meet its potable water needs. Groundwater is used for stand-by potable supply and for industrial purposes, primarily those of the Arizona Public Service Ocotillo Power Station. The City of Mesa, located outside but adjacent to the SIBW area, uses groundwater for municipal supply.

3.3 HISTORY OF CONTAMINATION

In 1981, trichloroethene (TCE) was discovered in the groundwater at several municipal wells at concentrations exceeding the Arizona Department of Health Services action levels and federal MCLs in effect at that time. The contaminated wells included Salt River Project wells No. 6 and 31, and City of Phoenix wells No. 34, 35, and 36 (currently City of Scottsdale wells No. 75, 72, and 71, respectively). EPA then sampled 20 additional wells in the surrounding areas, including the City of Tempe production wells. Results from this sampling indicated TCE and tetrachloroethene (PCE) concentrations in some of the City of Tempe production wells above federal MCLs. In 1982, the IBW Site was placed on the EPA's National Priorities List.

3.4 INITIAL RESPONSE

Initial responses at the IBW site are described in the following subsections.

3.4.1 North Indian Bend Wash

In 1981, following the discovery of VOCs in municipal supply wells, the impacted wells were removed from potable use. Well No. 6 was equipped by the City of Scottsdale with a VOC treatment system and returned to potable use in 1985. EPA conducted soil, soil gas, groundwater, and groundwater flow investigations in coordination with the Arizona Department of Environmental Quality, City of Scottsdale, Salt River Project, Motorola (now Motorola Solutions), and Beckman Instruments. The Phase 1 Remedial Investigation was conducted from 1984 to 1986. The NIBW Feasibility Study was completed in early 1988. The investigations found TCE and PCE in groundwater more extensively and at higher concentrations in the area north of the Salt River than in the area south of the Salt River, and began to identify potential sources of the groundwater contamination. EPA issued the Record of Decision for the Scottsdale Groundwater Operable Unit (NIBW) in September 1988.

3.4.2 South Indian Bend Wash

After detection of VOCs in some of the City of Tempe groundwater wells in 1982, the impacted wells were removed from service and no longer used for stand-by potable supply. In 1988, 1990, and early 1993, EPA issued over one hundred general notice letters to obtain information on the business practices and chemical usage at potential source sites. An extensive remedial investigation specifically for the SIBW area began in 1988. EPA reviewed approximately 150 facilities, evaluated 70 potential sources of the groundwater contamination, and identified 30 of these facilities for additional investigation. EPA issued the Record of Decision for SIBW in 1993.

3.5 BASIS FOR TAKING ACTION

The Paradise Valley Basin is an important source of groundwater that has been affected by past chemical releases. Actions were taken to address VOCs, primarily TCE and PCE in groundwater which is used as a drinking water source. In NIBW, the following constituents are chemicals of concern: TCE, PCE, chloroform, 1,1-dichloroethene (1,1-DCE), and 1,1,1-trichloroethane (1,1,1-TCA). In SIBW, the following constituents are chemicals of concern: TCE, 1,1-DCE, and PCE. These chemicals were present in IBW groundwater at concentrations above their respective MCLs. Approximately 70 percent of groundwater is used to provide municipal supply in the IBW area. Remedial actions were taken to protect potable groundwater supply and restore this valuable resource.

SECTION 4.0 REMEDIAL ACTIONS

NIBW and SIBW have undergone extensive investigation to characterize the nature and extent of contamination and to manage the effectiveness of the remedial activities. Interim and final remedies have been selected and implemented at NIBW and SIBW on parallel, but separate tracks. The construction complete date for the Site is 26 September 2006 as documented in the Preliminary Closeout Report (EPA, 2006). The IBW Site is currently in the long term Operation & Maintenance phase.

4.1 REMEDY SELECTION

This section describes the remedy selected for the IBW site.

4.1.1 North Indian Bend Wash

The decision documents for the selection of the NIBW remedy include the 1988 Scottsdale Groundwater ROD, 1991 Shallow Soils and Groundwater ROD, and the 2001 Final ROD Amendment. These documents are discussed below, including a presentation of the remedial action objectives and major components of the selected remedy.

<u>Summary of 1988 ROD</u>

This original NIBW partial remedy was developed to address VOCs in the middle and lower alluvial units in the Scottsdale area. Between March and October of 1990, 23 new monitoring wells were installed, including 12 new middle alluvial unit wells and 11 new lower alluvial unit wells. Groundwater samples and water level measurements were collected from the 23 new wells, as well as from 34 previously existing monitoring wells, and 7 previously existing production wells. The selected remedy was extraction and treatment of VOCs-contaminated groundwater from the middle and lower alluvial units using air stripper technology followed by treatment of air stripper vapors with vapor phase granular activated carbon (Figure 7-A). The original NIBW remedy includes groundwater extraction from four City of Scottsdale VOCs-contaminated production wells: 31, 71, 72, and 75 with treatment at the Central Groundwater Treatment Facility (CGTF) which began operation in 1994. The treated water is delivered to the City of Scottsdale for municipal supply. The 1988 ROD included extensive collection and analysis of groundwater samples, and VOC mass flux analyses to assess groundwater quality over the first year or so of remedy implementation to determine if additional remedial action would be needed.

The remedial action objectives (RAOs) are:

- Protect public health and the environment by protecting unaffected wells from VOCs.
- Provide a mechanism for the long-term management of the VOC-affected groundwater in order to improve the regional aquifer's suitability for potable use and potential recharge/recovery activities by the City of Scottsdale.
- Provide a potable water source for the City within the constraints of projected water demands while utilizing existing facilities to the maximum extent feasible.

The chemical-specific groundwater cleanup standards were assigned based on Arizona proposed or adopted MCLs and Human Health-Based Guidance Levels (HBGLs), EPA MCLs, Arizona Action Levels, or levels determined based on a risk assessment. The applicable drinking water standards and the established cleanup levels as listed in the ROD are shown in Table 4-1.

Table 4-1:
1988 ROD-Specified Cleanup Criteria: Indian Bend Wash

Chemical	Drinking Water Standard (µg/L)		Cleanup Level for Treated Water (µg/L)
	State	Federal	
TCE	5	5	5
PCE	1	-	0.67*
1,1-DCE	7	7	7
1,1,1-TCA	200	200	200
Chloroform**	3	-	0.5

Note: - = none established

µg/L = micrograms per liter

1,1-DCE = 1,1-dichloroethene

1,1,1-TCA = 1,1,1-trichloroethene

*AZ HBGL

**Not a byproduct of municipal water supply chlorination.

Source: U.S. EPA 1988. Record of Decision

Summary of 1991 ROD

In September 1991, EPA issued the Shallow Soils and Groundwater ROD (EPA, 1991) and selected additional remedial actions for the vadose zone and upper alluvial unit at NIBW. The remedial investigation and feasibility study, which focused on the groundwater contamination in the upper alluvial unit and soil contamination at certain industrial facilities, was completed in April 1991.

As part of this remedy, potential source areas were investigated and categorized, and additional investigations were conducted at Areas 3, 5a-5b-5c, 6, 9, 11, and 12. Field investigation data and results of modeling indicated that in all areas except for Area 12, concentrations of VOCs in the vadose zone did not represent a threat to underlying groundwater. As a result, EPA did not require vadose zone remediation in Areas 3, 5a-5b-5c, 6, 9, and 11. Soil vapor extraction (SVE) was determined to be warranted and was subsequently implemented to eliminate the threat to groundwater at Areas 7, 8, and 12. See Figure 3 for these potential source locations.

The remedy also addressed the potential for VOCs in the upper alluvial unit to migrate to the middle and lower alluvial units based upon: 1) vertical movement across the contact between the upper alluvial unit and underlying units, and 2) conduit flow in wells perforated across the upper and middle alluvial units and/or lower alluvial unit. A total of 44 new monitoring wells were installed in three specified areas of the Site during 1992 and 1993, including: 37 upper alluvial unit, 4 middle alluvial unit alluvial unit, 1 middle/lower alluvial unit, and 2 lower alluvial unit monitor wells. This remedy was intended to address the VOCs that migrated from the upper alluvial unit to the underlying middle and lower alluvial units by capturing the groundwater plume at the existing Central Groundwater Treatment Facility extraction and treatment remedy for the middle and lower alluvial units. This ROD also revised certain cleanup standards for water treatment and established cleanup levels for groundwater left in place.

The remedial action objectives are:

- Remove the potential for continued groundwater contamination due to migration of contamination from the vadose zone.
- Reduce VOC mass in the vadose zone to a level that no longer contains MCLs and other groundwater criteria selected in this ROD.

The chemical-specific groundwater cleanup standards were assigned based on Arizona proposed or adopted MCLs or HBGLs, EPA MCLs, Arizona Action Levels, or levels determined based on a risk assessment. The applicable water standards (state and federal) and the established cleanup levels for the primary chemicals of concern are shown in Table 4-2.

Table 4-2
1991 ROD-Specified Cleanup Criteria: North Indian Bend Wash

Chemical	Standard (µg/L)		Cleanup Level for Treated Water & In-Situ GW (µg/L)
	State	Federal	
TCE	3.2	5	5
PCE	0.67	5	5*
1,1-DCE	7	7	7
1,1,1-TCA	200	200	200
Chloroform**	6	100	6**

Note: - = none established

µg/L = micrograms per liter

* MCL

**Not a byproduct of municipal water supply chlorination; AZ HBGL.

Source: U.S. EPA 1991. Record of Decision

Summary of 2001 ROD Amendment – Final ROD

Following the construction and initial operation of the remedy selected in 1988 for groundwater, it became apparent that the groundwater plume had not been contained as intended. Specifically, the lower alluvial unit groundwater plume was moving to the north and threatening the drinking water supply. To prevent VOC impact to the production wells serving the Town of Paradise Valley and a portion of the City of Scottsdale, additional actions were proactively implemented to achieve capture of the groundwater VOCs plume, including construction of the Miller Road Treatment Facility and the Area 7 and Area 12 Groundwater Extraction and Treatment Systems (Figures 7-A and 7-B). The source control remedial actions for the vadose zone were also expanded as part of the final remedy. These actions were completed on a voluntary basis and had not been documented in a previous record of decision.

The purpose of this ROD Amendment was to select a final remedial action for NIBW and consolidate previous actions, including the former voluntary actions, into one final document. The 2001 Final ROD Amendment (EPA, 2001b) addresses aquifer restoration by containment, treatment and monitoring of VOCs in groundwater as well as soil remediation actions.

The following remedial actions which had been previously or voluntarily completed were adopted as part of the final remedy:

- Installation of 24 additional monitoring wells: 2 in the upper alluvial unit, 1 in the upper-middle alluvial units; 16 in the middle alluvial unit, 1 in the middle-lower alluvial unit, and 4 in the lower alluvial unit.
- Installation of two new extraction wells to improve capture in the lower alluvial unit.
- Connection of a replacement extraction well to the Central Groundwater Treatment Facility.
- Construction of the Miller Road Treatment Facility to protect the water supply of the Town of Paradise Valley and portions of the City of Scottsdale.
- Construction of groundwater extraction and treatment systems for the middle alluvial unit at Areas 7 and 12.
- Upgrades to the Central Groundwater Treatment Facility columns to enhance performance and reliability of the air stripping treatment system.

The remedial action objectives are:

- Restore the Upper, Middle and Lower Aquifers to drinking water quality by decreasing the concentrations of the contaminants of concern to below the cleanup standards.
- Protect human health and the environment by eliminating exposure to contaminated groundwater.
- Provide the City of Scottsdale with a water source that meets MCLs for NIBW contaminants of concern (VOCs).
- Achieve containment of the groundwater contamination plume by preventing any further lateral migration of contaminants in groundwater.
- Reuse of the water treated at the Site to the extent possible in accordance with Arizona's Groundwater Management Act.
- Mitigate any soil contamination that continues to impact groundwater.
- Provide long-term management of contaminated groundwater to improve the regional aquifer's suitability for potable use.

The established cleanup levels as listed in the ROD are shown in Table 4-3.

Table 4-3:
2001 ROD-Specified Cleanup Criteria: North Indian Bend Wash

Chemical	MCL / Cleanup Level for Treated Water (µg/L)
TCE	5
PCE	5
1,1-DCE	6
1,1,1-TCA	200
Chloroform*	6*

Note: µg/L = micrograms per liter

*Not a byproduct of municipal water supply chlorination; AZ HBGL.

Source: U.S. EPA 2001. Record of Decision

4.1.2 South Indian Bend Wash

In 1988, EPA separated the South Indian Bend Wash area into two operable units (OU): a Soils OU, and a Groundwater OU. The decision documents for the selection of the remedy include the September 1993 Vadose Zone ROD, 1998 Groundwater ROD, and the 2004 Final ROD Amendment which modified the groundwater remedy based on data from ongoing groundwater monitoring. These documents are discussed below, including a presentation of the Site's remedial action objectives and major components of the selected remedy.

<u>Summary of 1993 ROD</u>

The vadose zone ROD outlines the selection of soil vapor extraction treatment with vapor phase granular activated carbon treatment of extracted soil vapor. The ROD includes two innovative approaches: the use of a "presumptive remedy" which allows EPA to presume that a particular technology–SVE in this case–would be appropriate in cases where it would be effective, and the use of a "plug-in" approach which allows facilities/parcels to be "plugged-in" to the presumptive remedy allowing for streamlined time frames and less documentation to implement the remedy at multiple separate but similar subsites. The "plug-in" criteria was established in this ROD and is based on V-leach modeling, groundwater mixing zone calculations, and a comparison of VOC concentrations to the maximum contaminant levels. Under this remedy, EPA established a groundwater monitoring well network consisting of 30 wells installed by EPA and potentially responsible parties, and production wells which existed prior to EPA's investigation. An additional 32 groundwater monitoring wells were installed by the end of 1993. The final phase of the remedial investigation was completed in 1997.

EPA issued four Unilateral Administrative Orders and one Administrative Order on Consent for focused remedial investigation work at five of the eight subsites identified during the initial phases of the remedial investigation. Arizona Public Service made the determination that soil vapor extraction was appropriate at its site in lieu of conducting focused remedial investigation work. Arizona Public Service implemented soil vapor extraction successfully at this subsite, and EPA approved its closure report in April 2001 documenting that it had completed its soil cleanup.

The first Plug-in Determination (i.e., EPA's finding of whether a facility met the "plug-in" criteria to require SVE treatment) was issued in February 1994 for the DCE Circuits subsite which required SVE treatment. The second Plug-in Determination was issued in January 2002 for the following seven facilities: Circuit Express, Allstate Mine Supply, Desert Sportswear, Cerprobe, Service and Sales, and the City of Tempe Right-of-Way. These facilities did not meet the "plug-in" criteria and EPA determined they did not require SVE treatment. Figure 8 shows the locations of various facilities at the SIBW site.

The remedial action objectives are:

- Adequately protect human health from the ingestion or inhalation of VOCs that migrate from the vadose zone to groundwater.
- Adequately protect human health from the inhalation of VOCs that migrate from the vadose zone to the atmosphere.
- Control the sources of continuing groundwater contamination to minimize loss of the groundwater resources and reduce the degree of groundwater cleanup that may be required.

The ROD established the following cleanup levels, as shown in Table 4-4.

Table 4-4:

1993 ROD Specified Cleanup Criteria: South Indian Bend Wash

	Cleanup Standard			Cleanup Standard (µg/L)
	(MCL)			(MCL)
Acetone	700a		trans1,2-Dichloroethylene	100
Benzene	5		1,2-Dichloropropane	5
Benzyl Chloride	140a		1,3-Dichloropropene	0.19a
Bromodichloromethane	100		Dichlorotetrafluoroethane	100b
Bromoform	100		Ethylbenzene	700
Bromomethane	9.8a		Hexachlorobutadiene	1.4a
Carbon Tetrachloride	5		Methylene Chloride	5c
Chlorobenzene	100		Methylethylketone	350a
Chloroform	100		Styrene	100
Chloromethane	2.8a		1,2,2,2-Tetrachloroethane	0.08d
Dibromochloromethane	100		Tetrachloroethylene (PCE)	5
1,2-Dibromoethane	0.05		Toluene	1,000
1,2-Dichlorobenzene	600		1,2,4-Trichlorobenzene	70
1,3-Dichlorobenzene	600		1,1,1-Trichloroethane	200
1,4-Dichlorobenzene	75		1,1,2-Trichloroethane	5
Dichlorodifluoromethane	1,400a		Trichloroethylene (TCE)	5
1,1-Dichloroethane	1,000d		Trichlorofluoromethane	2,100a
1,2-Dichloroethane	5		1,1,2-Trichloro-2,2,1-Trifluoroethane	210,000a
Cis-1,2-Dichloroethane	70		Vinyl Chloride	2
1,1-Dichloroethylene	7		Xylenes (Total)	10,000

a Level based on Arizona Health-Based Guidance Level (HBGL) for water (June 1992).

b No formal toxicity standards exist for this compound, which is also known as FREON 114. Level is based on a limited no-observed-adverse-effect-level as determined by data from the Hazardous Substance Database, with an uncertainty factor of 10. The study used as the basis was *Campbell DD et al Br J Ind Med 43:107-11 (1986).*

c Level based on proposed MCL.

d Level based on *EPA Region IX Preliminary Remediation Goals, Third Quarter, 1993* for tap water which are based on 10^{-6} excess cancer risk or a non-cancer hazard index of 1 for a person drinking water at the concentration over an average lifetime.

Note: All levels based on MCL unless otherwise footnoted.

Summary of 1998 ROD

The 1998 Groundwater ROD identified the SIBW remedy as groundwater extraction/treatment and plume containment for the western plume; monitored natural attenuation for the eastern and central plumes; establishment of compliance boundaries where the Monitored Natural Attenuation (MNA) remedy was selected; and implementation of institutional controls (ICs). The MNA remedy included a contingency remedy of groundwater extraction and treatment should ongoing groundwater monitoring indicate that the groundwater plume was migrating beyond the specified compliance boundaries (as shown on Figure 4) or that cleanup goals would not be attained within a 30 to 50 year time frame.

Treatment for the western plume included liquid granular activated carbon and air stripping with carbon treatment of vapors and/or ultraviolet light oxidation. Treated groundwater was to be discharged to the City of Tempe's storm drain system leading to Tempe Town Lake or into the Salt River Project Tempe Canal No. 6.

The general remedial action objectives are:

- Maintain protection of human health and the environment by reducing the risk of potential exposure to contaminants.
- Expedite site cleanup and restoration.
- Use permanent solutions to the maximum extent practicable.
- Restore contaminated groundwater to the extent practicable to support existing and future uses.
- Achieve compliance with applicable or relevant and appropriate requirements (ARARs).
- Minimize untreated waste.

The groundwater remedial action objectives are:

- Protect human health by minimizing the potential for human exposure to groundwater exceeding cleanup goals.
- Cost-effectively reduce contamination in groundwater to concentrations that meet cleanup goals to return groundwaters to their beneficial uses to the extent practicable within a time frame that is reasonable, given the particular circumstances of the site.
- Protect groundwater resources by preventing or reducing migration of groundwater contamination above ARARs.

The established cleanup levels as listed in the ROD are shown in Table 4-5.

Table 4-5:

1998 ROD Specified Cleanup Criteria: South Indian Bend Wash

	Aquifer Cleanup Standard	Discharge Limits for Tempe Canal & Re-injection	Discharge Limits for Town Lake (µg/L)	
	(MCL or HBGL)	(MCL or HBGL)	(A&W-Acute)	(A&W-Chronic)
Organics				
Benzene	5b	5b	2,700	180
Bromodichloromethane	100b,c	100b,c	-	
Chloromethane	2.7d	2.7d	270,000	15,000
Chloroform	100b,c	100b,c	14,000	900
1,2-Dibromoethane	0.05b	0.05b	-	-
1,2-Dichloroethane	5b	5b	59,000	41,000
1,1-Dichloroethene	7b,e	7b,e	15,000	950
1,2-Dichloropropane	5b	5b	26,000	9,200
Methylene Chloride	5b	5b	97,000	5,500
1,1,2,2-Tetrachloroethane	0.18d	0.17i	4,700	3,200
Tetrachloroethene (PCE)	5b	5b	6,500	680
Trichloroethene (TCE)	5b	5b	20,000	1,300
Inorganics				
Antimony		6b	88	30
Arsenic		50f	360	190
Barium		2,000b	-	-
Beryllium		4b	65	5.3
Cadmium		5b	-h	-h
Chromium (total)		100b	-	-
Copper		1,300b, g	-h	-g
Cyanide		200b	41I	9.7I
Lead		15b,g	-h	-g
Mercury		2b	2.4	0.01
Nickel		100f	-h	-g
Selenium		50b	20	2.0
Thallium		2b	700	150
Zinc		2,100d	-g	–g

a Aquatic and Wildlife (A&W) (warm water fishery).
b Maximum Contaminant Level (MCL).
c For total trihalomethanes.
d Human Health-Based Guidance Level (HBGL) for drinking water (December 1997 Update).
e Maximum Contaminant Level Goal is identical to the MCL.
f Arizona state MCL.
g Action level, not to be exceeded in more than 10 percent of samples.
h Concentrations vary depending on the hardness of the receiving water body.
i Arizona water quality standard for drinking water sources.

Note: The Arizona Aquifer Water Quality Standards for benzene, 1-2 dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, PCE, total trihalomethanes, TCE, antimony, barium, beryllium, cadmium, chromium, cyanide, selenium, and thallium are identical to the federal MCLs; identical to the state MCL for nickel; and 50 µg/L for lead

Summary of 2004 ROD Amendment

In June 2004, EPA amended the Groundwater OU ROD, based on data accumulated from historic groundwater monitoring indicating that TCE concentrations in the western upper alluvial unit plume were decreasing at a rate such that remedial objectives could be met in a reasonable timeframe. A comparison of historical data with data collected in 2004 indicated that the western plume had migrated downgradient moving south to southwest with the prevailing groundwater flow direction as predicted in the feasibility study, but that TCE concentrations had significantly decreased. During the remedial investigation, TCE was detected at concentrations as high as 540 µg/L in monitoring well SD3W-5U. In 2004, TCE concentrations in this same well were below the MCL. Based on the January 2004 data, the highest TCE concentration in monitoring well SIBW-28U was 6.3 µg/L as compared to 43 µg/L at the time of the 1998 Groundwater ROD. Additionally, the data indicated that the plume was naturally attenuating and was relatively stable. Based on these site conditions, the groundwater remedy for the western upper alluvial unit plume was changed from extraction and treatment to monitored natural attenuation. The ROD Amendment contains a contingency similar in nature to that set forth for the central and eastern plumes in the 1998 ROD. This ROD Amendment did not change the central and eastern plume MNA remedy.

The groundwater remedial action objectives are:

- Protect human health by minimizing the potential for human exposure to groundwater exceeding cleanup standards.
- Cost-effectively reduce contamination in the western plume to concentrations that meet cleanup standards to return groundwater to its beneficial use to the extent practicable within a time frame that is reasonable, given the particular circumstances of the Site.
- Protect groundwater resources by preventing or reducing migration of groundwater contamination above ARARs.

The established cleanup levels as listed in the ROD are shown in Table 4-6.

Table 4-6:

2004 ROD-Specified Cleanup Criteria: South Indian Bend Wash

Chemical	MCL / Cleanup Level for Groundwater (µg/L)
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5

4.2 REMEDY IMPLEMENTATION

Implementation of the NIBW remedy began in 1992. Between 1992 and 1999, four groundwater extraction and treatment systems (Central Groundwater Treatment Facility, Miller Road Treatment Facility, Area 7, and Area 12) and four soil vapor extraction systems (Area 6, Area 7, Area 8, and Area 12) were designed, constructed, and placed into routine operation and maintenance. The Area 6, 8 and 12 soil vapor extraction systems were operated and decommissioned based on performance data; the Area 6 soil vapor extraction system was implemented as a voluntary action not required by EPA. The Area 7 soil vapor extraction system was operated intermittently from July 1994 to December 2009 when it was shut down for long-term rebound testing. This SVE system remains in place. The four groundwater extraction and treatment systems continue to operate as part of the ongoing remedial efforts for NIBW. Since the NIBW groundwater remedies began operations, they have treated a cumulative total of 82 billion gallons of VOCs-contaminated groundwater and over 75,000 pounds of VOCs have been removed from the NIBW aquifers. Three of the groundwater extraction and treatment systems consistently treat TCE and PCE to non-detectable concentrations (detection limit is 0.5 µg/L). Occasional detections of TCE occur at Area 12; these TCE detections are consistently below the MCL. Figure 9 shows the NIBW monitor, extraction, and production wells.

The following subsections provide a description of the various remedy components and a history of their construction and operation.

4.2.1 Groundwater Extraction and Treatment Systems

<u>North Indian Bend Wash</u>

The Central Groundwater Treatment Facility (CGTF) was constructed between September 1992 and January 1994. The CGTF extracts groundwater from VOC plumes in the middle and lower alluvial units using four extraction wells at a combined flow rate goal of 8,400 gallons per minute (gpm). The remedy is comprised of air stripping followed by vapor granular activated carbon to reduce the VOC concentration in the air stripper off-gas before discharge to the atmosphere. The CGTF includes three air stripper towers designed to operate in parallel with a capacity to treat a combined flow rate of 9,450 gpm with a maximum influent TCE concentration of 1,500 µg/L. In 2010, the highest TCE concentration observed at a well tied into treatment at the CGTF occurred at remedy well 75a with a TCE concentration of 120 µg/L. In 2010, the influent TCE concentrations at CGTF ranged from 70 to 96 µg/L. A site layout of the CGTF is presented on Figure 10. Since operations began, the CGTF has treated over 50 billion gallons of groundwater and returned it to beneficial use, and removed approximately 50 thousand pounds of VOCs from groundwater.

The Miller Road Treatment Facility (MRTF) was constructed between 1996 and 1997 and is designed to treat groundwater extracted from well PCX-1 which is owned by Salt River Project, and wells PV-14 and PV-15 which are owned by Arizona American Water, a private water company. The MRTF consists of three air stripper towers followed by vapor granular activated carbon to reduce the VOC concentration in the air stripper off-gas before discharge to the atmosphere. The MRTF extraction wells are primarily screened in the lower alluvial unit. The MRTF remedy was installed to remove VOCs from the lower alluvial unit and contain the TCE plume at the northern portion of the NIBW area from migrating toward the pumping center associated with Arizona American Water's wellfield. Wells PV-14 and PV-15 consistently show low TCE concentrations at or below the MCL, but are treated via air stripping nonetheless. The treated effluent from PV-14 and PV-15 is typically discharged to an on-site clear well then delivered to Arizona American Water for potable supply. In 2010, the highest TCE concentration observed at a well tied into treatment at the MRTF occurred at well PCX-1 with a TCE concentration of 84 µg/L. In 2010, the influent TCE concentrations at MRTF ranged from 64 to 81 µg/L.

An incident in 2007 and another in 2008, occurred in which partially treated water from MRTF well PCX-1 was introduced into the Arizona American Water's potable supply (detailed in Appendix H). The incident investigations noted that critical system instrumentation was disconnected, wired incorrectly, or out of calibration. Additionally, the control logic and set-points were not properly set. Shortly after the 2008 incident, a third-party conducted a thorough engineering evaluation and the recommendations were implemented from 2008 through 2010. Additionally, in 2008, interim changes in system operations were implemented. These include physically separating well PCX-1 from the portable water system and conveying PCX-1 treated effluent to the Salt River Project Arizona Canal rather than to Arizona American Water's municipal system. EPA also added a recommendation for secondary physical fail-safe measures for wells used for a drinking water end use. As of 2008, interim operation of the MRTF includes PCX-1 treatment through a physically separated air stripper tower operated by the NIBW Participating Companies (a subset of the potentially responsible parties), with the treated effluent discharged to the Salt River Project Arizona Canal, which is a large canal which provides drinking water to downstream users. This interim remedy is consistent with the 2001 Final ROD and the way the MRTF was originally operated.

Since 2008, EPA has been working with the various water rights holders to develop a long-term reconfiguration of this remedy. The negotiations are complicated by complex water rights and water allocations among various entities. As of 2011, several long-term options have been considered and vetted but not successfully negotiated among the various water rights holders. Presently, a long-term option which includes treatment of the PCX-1 water using liquid phase granular activated carbon in series mode, and delivery of the treated water to a potable supply system is being negotiated with planned implementation in 2012. A site layout of the MRTF is presented on Figure 11 and a process flow schematic is shown on Figure 12. Figure 7-A shows the extraction well and pipeline locations. Since operations began, the MRTF has treated over 25 billion gallons of groundwater and returned it to beneficial use, and removed over six thousand pounds of VOCs from groundwater.

The Area 7 remedy was constructed from 1998 to 1999 and extracts groundwater from one upper alluvial unit well and three middle alluvial unit wells. The Area 7 remedy includes a 5,000-gallon equalization tank to balance influent flows; an ultraviolet light/chemical oxidation (UV/Ox) system; a low-profile air stripper to remove any remaining VOCs from the UV/Ox effluent stream; and a vapor-abatement system using vapor granular activated carbon. The Area 7 groundwater extraction and treatment system is designed to treat up to 500 gpm with a maximum TCE concentration of 7,000 µg/L. As of 2010, the highest TCE concentration observed at a well tied into treatment at Area 7 is 1,500 µg/L at well 7EX-4MA. In 2010, the influent TCE concentration to the Area 7 groundwater extraction and treatment system ranged from 430 to 600 µg/L.

Area 7 is a critical remedy component for removing VOCs from the middle alluvial unit and controlling higher VOC concentrations in the middle alluvial unit from migrating to the southwest margin and then into the lower alluvial unit. Treated groundwater is injected into the upper alluvial unit through one of two upgradient injection wells. The treated water may be discharged to the City of Scottsdale's sanitary sewer as an option during non-routine maintenance or following major system modifications. Area 7 includes a soil vapor extraction system which has operated intermittently from 1994 to 2009. It is currently shut-off for rebound testing. The Area 7 site layout is shown on Figure 13; Figure 14 shows the location of the groundwater extraction wells, and Figure 15 shows the Area 7 groundwater extraction and treatment system process flow schematic. Figure 7-B shows the extraction well and pipeline locations. Since operations began, Area 7 has treated over two billion gallons of groundwater and removed over 15 thousand pounds of VOCs from groundwater.

The Area 12 remedy was constructed from 1998 to 1999 and extracts and treats groundwater from well MEX-1MA and the Salt River Project Granite Reef Well, which are screened in the middle alluvial unit. The Area 12 remedy, like the Area 7 remedy, removes VOCs from middle alluvial unit groundwater and controls higher concentrations of VOCs in the middle alluvial unit from migrating to the southwest margin and then into the lower alluvial unit. Area 12 includes an air stripper tower and vapor granular activated carbon designed to treat up to 2,000 gpm up to a maximum TCE concentration of 300 µg/L. In 2010, the highest TCE concentration of 100 µg/L was observed at the Granite Reef well which is tied into treatment at Area 12. In 2010, the influent TCE concentration to the Area 12 groundwater extraction and treatment system ranged from 46 to 62 µg/L. The treated water is conveyed to the Salt River Project Grand Canal and used for irrigation purposes. A soil vapor extraction system was operated at Area 12 between 1996 and 1998 which removed approximately 946 pounds of VOCs from the soil. This system was decommissioned in 1998 when the performance criteria were met. The site layout is shown on Figure 16, the groundwater extraction well network is shown on Figure 17, and a schematic of the groundwater extraction and treatment system is shown on Figure 18. Figure 7-B shows the extraction well and pipeline locations. Since operations began, the Area 12 groundwater extraction and treatment system has treated over five billion gallons of groundwater and removed over five thousand pounds of VOCs from groundwater.

Minor Incidents in 2009 and 2010

During 2009 and 2010, two valve failures and two pipe leaks occurred resulting in minor releases of untreated groundwater to soil and paved areas. One valve failure occurred at well PCX-1 which is tied into treatment at the Miller Road Treatment Facility; the other occurred at well 71 which is tied into treatment at the Central Groundwater Treatment Facility. One pipe leak occurred at the Central Groundwater Treatment Facility; the other occurred at Area 7. These incidents were limited in scope and did not result in public exposure to untreated groundwater.

The valve failures were corrected by replacing the damaged valves. Additionally, an automatic leak detector with alarms and shut-off system was installed in the well vault for PCX-1. The CGTF pipe leak was corrected by rewiring the Remote Terminal Unit, replacing the three manual valves on the drain line, and identifying and replacing the solenoid valves with new alarm communication capabilities. The Area 7 pipe leak was corrected by installation of leak detection switches within Area 7 extraction well vaults; replacement of carbon steel process pipe at Area 7 extraction wellheads; visual inspection of the extraction wellheads prior to and following groundwater collection system startup; and replacement of all wellhead piping three inches in diameter and smaller every two years.

During these incidents, there was no exposure to the public, drinking water was not impacted, and EPA and ADEQ were quickly notified following each incident. Additional measures have been implemented in an abundance of caution to ensure these incidents do not recur. A detailed description of these incidents and the measures taken to correct them are presented in Appendix H, NIBW Groundwater Extraction and Treatment Systems Incidents and Corrective Measures.

4.2.2 Soil Vapor Extraction Systems

Since 1992, one voluntary (Area 6) and three required SVE systems have been constructed and operated in the NIBW area. The required NIBW Area 7 SVE system continues to operate intermittently, based on rebound test data. In the SIBW area, one required (DCE Circuits) and two voluntary SVE systems have been constructed and operated. These are discussed in the following sections.

North Indian Bend Wash

NIBW Area 6 is the location of former Siemens and Dickson Electronic facilities where electronic component manufacturing occurred (Figure 3). The Area 6 SVE system was implemented voluntarily by Siemens and operated from December 1998 to August 2000. The SVE system was decommissioned in August of 2000, followed by issuance of an Area 6 closure letter to EPA in October 2000.

NIBW Area 7 is the location of the former Rolamec facility where machining and pen manufacturing processes occurred (Figure 3). SVE treatment began operation in July 1994 and has been operated intermittently from 1994 to 2009 to address potential source areas in the upper alluvial unit. Area 7 is the single remedy which presently has an operational SVE system (Figure 19). Extracted soil vapor is passed through an aftercooler before being treated by two vapor phase granular activated carbon vessels in a series configuration. The system currently is idle to observe vapor rebound which is being evaluated in 2011. This evaluation may result in recommendations for optimization at Area 7.

NIBW Area 8 was the location of Dickson Electronics, and Marro Plating where silicon wafers were manufactured and metal finishing occurred, respectively (Figure 3). The Area 8 SVE system operated from September 1995 through October 1996 and consisted of two sets of nested SVE wells, each containing three sub-wells which were screened at differing depths. The SVE wells were plumbed to a common header followed by an extraction blower. Treatment of extracted soil vapor included an aftercooler for temperature control and two vapor phase granular activated carbon vessels in series configuration. In July 1997, EPA issued a Notice of Determination that the Area 8 SVE had attained the specified remedial performance standards and the system was decommissioned.

NIBW Area 12 is the present location of a General Dynamics facility and the former location of the Motorola Government Electronics Group, where electronic components were manufactured (Figure 3). An SVE system was operated at Area 12 between 1996 and 1998 which removed approximately 946 pounds of VOCs from the soil. This system was decommissioned in 1998 when the performance criteria were met. Figure 18 shows the Area 12 SVE system process flow schematic. In August 2000, EPA issued a letter determining that Area 12 SVE had attained the specified remedial performance standards.

South Indian Bend Wash

The SIBW monitored natural attenuation remedy has successful reduced VOC concentrations in groundwater in the upper alluvial unit in the western and central plumes, and the middle alluvial unit in the eastern plume. As of 2010, only four of the 41 groundwater monitoring wells sampled semi-annually indicate concentrations of TCE or PCE slightly above the MCL of 5 µg/L. While the VOC concentrations in each of the four monitoring wells vary from one sampling event to the next, the concentrations in these wells consistently range from less than 0.5µg/L to 8 µg/L.

Soil vapor extraction treatment at SIBW began in 1997 following EPA's 1994 plug-in decision requiring SVE treatment for the DCE Circuits subsite. The DCE Circuits SVE treatment was implemented intermittently from July 1997 through January 2000 and from July 2005 through June 2007. The Arizona Public Service Ocotillo Power Station and the Unitog Rental Facility voluntarily implemented soil vapor extraction at their locations (these actions were not incorporated into the final remedy). Both the Ocotillo Power Station and Unitog Rental Facility soil vapor extraction systems achieved the respective remediation goals and received site closure at the completion of the remedial investigation.

The DCE Circuits subsite is a property with VOCs in soil vapors underneath pavement and buildings in an area approximately 80 feet by 120 feet. The buildings on this property were part of the former Borden Milk Company Creamery and Ice Factory which was placed on the National List of Historic Places for Maricopa County in 1984 as Inventory Number 16. The buildings are used as commercial space and include four units: one unit is occupied full time; the other three units are occasionally occupied for various lengths of time. The designation as a National Historic Place limits options for remedial activities. Despite this, EPA actions have included a soil removal, abandonment of a deteriorated underground storage tank, soil vapor extraction, capping of an unsealed soil vapor monitoring well, and installation of ventilation units in the four suites at DCE Circuits. The office suites include air circulation units to ensure indoor air concentrations of TCE and PCE stay within EPA's acceptable limits. Since 2007, indoor air monitoring in the four units has been ongoing at DCE Circuits. The indoor air monitoring results consistently indicate TCE and PCE within EPA's industrial indoor air human health risk range which are acceptable limits.

4.2.3 Groundwater Monitoring

The following sections describe the groundwater monitoring that has been conducted throughout the IBW Site.

North Indian Bend Wash

The NIBW groundwater monitoring includes periodic monitoring of existing production wells; influent and effluent locations at each groundwater treatment system; and numerous monitor wells installed in the upper, middle and lower alluvial units. Monitoring activities have been conducted to meet the requirements of decision documents and additional voluntary monitoring has been conducted by the Participating Companies.

Groundwater level monitoring is conducted by Salt River Project semi-annually in a network of 135 NIBW monitor wells including upper, middle, and lower alluvial unit wells. In addition, water levels are monitored continuously at a select group of lower alluvial unit monitor, production, and extraction wells. Groundwater quality monitoring is conducted for the five NIBW contaminants of concern: TCE, PCE, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), and chloroform. Data generated during monitoring activities is reported in the annual site monitoring reports. The groundwater water quality data reflect significant progress toward restoration of the upper alluvial unit where as of 2010, only five monitoring wells indicate concentrations of TCE above the maximum contaminant level with the highest TCE concentration of 16 µg/L. The data also reflect consistent progress toward restoration of the lower alluvial unit and control of the VOCs plume in the more highly contaminated middle alluvial unit to curtail migration to the southwest margin and the lower alluvial unit. A detailed discussion of groundwater quality and elevation data for the years 2004 to 2009 is presented in Appendix B, Data Review Memo.

Monthly groundwater production data are compiled for wells that pump in excess of 35 gallons per minute and are located within the area bounded by Indian Bend Road in the north, one mile south of McKellips Road in the south, Dobson Road in the east, and Invergordon Road in the west. Monthly and annual production data are presented in the annual site monitoring report. In addition, the vapor abatement systems are sampled quarterly to monitor treatment performance.

Groundwater quality monitoring is conducted for the five NIBW constituents: TCE, PCE, 1,1,1-TCA, 1,1-DCE, and chloroform, at the following frequencies:

- Three times per week at CGTF common sump and MRTF effluent
- Monthly at the three CGTF and the three MRTF extraction wells
- Quarterly at the four Area 7 and two Area 12 wells
- Quarterly at a network of 21 middle and lower aquifer monitor wells throughout the site
- Annually at a network of 90 NIBW monitor wells

Table 4-7 lists the monitoring locations and frequencies for each of the treatment systems.

Table 4-7:

North Indian Bend Wash, Treatment System Performance Monitoring Schedule

Sampling Location	Monitoring Frequency
CGTF	
Raw Water Inlet Header	Weekly
Common Sump (Treated Water)	Three times per week
MRTF	
Treatment Train 2 Effluent	Three times per week
Outfall to Arizona Canal	Monthly
PCX-1	Monthly
PV-14	Monthly
PV-15	Monthly
Area 7	
Raw Water Inlet	Monthly
UV/Ox Effluent	Monthly
Air Stripper Effluent	Monthly
Area 12	
Air Stripper Influent	Monthly
Air Stripper Effluent	Monthly
Discharge to SRP Canal[1]	Monthly

1- Sampling of discharge to SRP canal is required by Arizona Pollution Discharge Elimination System (AZPDES) permit.

South Indian Bend Wash

To evaluate the monitored natural attenuation remedy, SIBW operation and maintenance activities for the western, central, and eastern plumes include collection of groundwater elevation levels and groundwater samples from 41 SIBW wells. These wells are screened in the upper or upper and middle alluvial units, based upon which SIBW plume they are intended to monitor. These wells are sampled on a semiannual (17 wells), annual (10 wells), or biannual (14 wells) basis. In SIBW, the lower alluvial unit was encountered at one location only, and there are no known VOCs in the lower alluvial unit in SIBW. Groundwater elevation data is collected from 31 wells on a semiannual basis and 10 wells on an annual basis. Nineteen wells have been omitted from the monitoring program over time based on historical low concentrations of TCE and/or PCE at these monitor wells.

4.3 OPERATIONS AND MAINTENANCE COSTS

Long term operation and maintenance is currently being conducted at NIBW and SIBW. Operation and Maintenance costs are discussed below.

4.3.1 System Operation and Maintenance Costs

The NIBW operation and maintenance activities consist of routine groundwater monitoring of the remedy extraction wells and monitoring well network, air emissions sampling for the air stripper towers, treatment system influent and effluent monitoring, and soil vapor monitoring at Area 7 when the soil vapor extraction system is in operation (i.e., not in rebound testing mode). Cleaning of the air stripper towers at the various groundwater extraction and treatment systems is also conducted, as needed. The column cleaning removes carbonate scale from the air stripper media which may inhibit volatilization and reduce treatment performance. Wastes produced during column cleaning washing are disposed offsite.

The NIBW estimated operation and maintenance cost from 2005 through 2009 is $15,570,428. This includes $1,785,730 for rehabilitation costs incurred in 2007 for the Central Groundwater Treatment Facility. The total costs exclude project management, work products required by consent decrees, and regulatory oversight. Significant expenditures were incurred in 2007 and 2008–2009 for planned rehabilitation of the air stripper towers to maintain proper operation of the Central Groundwater Treatment Facility and the Miller Road Treatment Facility. The operational costs for the Miller Road Treatment Facility during 2008–2009 also include requirements added following releases in October 2007 and January 2008, including: 24 hour, 7 day a week on-site manned-operation of the system; increased performance monitoring of treated effluent; reconfigurations of conveyance piping to isolate well PCX-1 from the rest of the system; replacement/upgrade of process instrumentation; and reprogramming of control logic. With the exception of the expenditures for the additional requirements, operation and maintenance costs are in line with those projected in the Groundwater ROD and Final ROD Amendment.

The NIBW estimated operation and maintenance costs from 2005 through 2009 are shown in Table 4-8.

Table 4-8:
North Indian Bend Wash, Operation and Maintenance Costs

Treatment System	Year	Actual Cost
CGTF[1]	2005	$ 977,328
	2006	$ 869,181
	2007	$ 2,691,981
	2008	$ 743,867
	2009	$ 800,318
Subtotal		$ 6,082,735
MRTF[2]	2005	$ 678,891
	2006	$ 538,768
	2007	$ 388,762
	2008	$ 2,333,274
	2009	$ 3,089,664
Subtotal		$ 7,029,359
Area 7[3]	2005	$ 292,380
	2006	$ 264,328
	2007	$ 302,172
	2008	$ 325,706
	2009	$ 353,417
Subtotal		$ 1,638,003
Area 12	2005	$ 110,657
	2006	$ 115,578
	2007	$ 107,934
	2008	$ 117,016
	2009	$ 369,146
Subtotal		$ 820,331
TOTAL		**$15,570,428**

1. 2007 cost includes expenditures of $ 1,785,730 for rehabilitation
2. Balance of rehabilitation costs paid in 2010, $ 187,210
3. Costs reflect both SVE and groundwater systems operational costs

The SIBW operation and maintenance activities consist of routine groundwater monitoring for the eastern, central and western plumes; and routine soil vapor and indoor air monitoring at the DCE Circuits subsite. The estimated annual average operation and maintenance cost for SIBW from 2005 to 2010 is $271,000. The average operation and maintenance costs for this period are above the annual operation and maintenance costs of $161,000 projected in the 2004 Final ROD Amendment. The increased cost is due to installation of two additional groundwater monitoring wells since 2005, and the following activities at the DCE Circuits subsite: sealing of a recently discovered uncapped soil vapor monitoring well, installation of ventilation units, and increased frequency of soil vapor and indoor air monitoring.

SECTION 5.0 PROGRESS SINCE THE LAST REVIEW

This is the first FYR performed for the IBW Superfund Site. The triggering action for the IBW FYR is the Construction Complete dated 26 September 2006.

SECTION 6.0 FIVE-YEAR REVIEW PROCESS

The following sections discuss the Five-Year Review data gathering process and findings.

6.1 ADMINISTRATIVE COMPONENTS

This first FYR was led by Ms. Rachel Loftin, EPA Region 9 Remedial Project Manager, for the Site. The Five-Year Review consisted of community notification, document review, data review, ARARs review, ICs review, human health risk assessment, and site inspection. This work was initiated in April 2010, and extended through May 2011. An IBW Five-Year Review kick-off meeting was attended by representatives of EPA, ADEQ, City of Scottsdale, ITSI, Motorola Solutions on behalf of the NIBW Participating Companies, and the Salt River Project in April 2010. Components of the Five-Year Review process discussed in the following subsection are: community notification and involvement, document review, data review, site inspections, and site interviews.

6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

For this Five-Year Review, EPA published a public notice in the Arizona Republic on August 4, 2010, announcing the beginning of the Five-Year Review process. No responses to the public notice were received. EPA and ADEQ also mailed a fact sheet to the IBW mailing list announcing the start of the Five-Year Review. Following the release of the First Five-Year Review, EPA will publish another public notice summarizing the findings of the Five-Year Review, and will make the report available on EPA's website. The report will also be placed in the local information repository near the Site.

6.3 DOCUMENT REVIEW

As part of this Five-Year Review, background documents were reviewed to determine the Site status, remedy implementation, and progress toward meeting the remedial action objectives. Documents selected for review focused primarily on actions taken during the past five years, but range in publication date from 1988 to the present. Appendix A provides a list of the reviewed documents. The most significant documents reviewed were the Records of Decision, groundwater monitoring reports, hydrogeologic studies, and reports on the remedy upgrades that have been implemented to date. Based on these documents, the following sections describe the findings of this Five-Year Review.

6.4 DATA REVIEW

The IBW data from 2001 through 2009 were reviewed for this FYR. The 2009 data represents the most current, full set of data available in early 2010 when this FYR data review was initiated.

The data were reviewed to evaluate whether the remedies at NIBW and SIBW are meeting the Remedial Action Objectives and remain protective of human health and the environment. Data regarding groundwater quality trends, plume containment, soil vapor extraction and performance of the groundwater treatment systems were reviewed. ArcMap GIS project files were used to calculate approximate areas for each of the 2009 NIBW plumes for the upper, middle, and lower alluvial units. All NIBW ArcMap files are registered with a known horizontal datum set: U.S. State Plane, NAD 83, Arizona Central (International Feet). ArcMap stores polygon areas within the properties of the polygon feature based on the specified horizontal datum. As a result, polygons representing plume boundaries within the ArcMap file provided a reliable source to query the approximate extent of each plume, expressed in square feet. Square feet were converted to acres for convenience.

For the 2001 NIBW data, paper copies of figures showing the 2001 plume delineations were used to semi-rectify and digitally trace the approximate plume boundaries to calculate the plume area. The area value associated with the 2001 data was then compared with the 2009 data. In NIBW, VOCs are present in the upper, middle and lower alluvial units with multiple plumes associated with each alluvial unit. In this case, the area of each plume associated with each specific alluvial unit was combined and the total value was used to compare temporal changes in plume size for each alluvial unit. For example, three plumes were associated with upper alluvial unit for 2009. The linear areas of the three plumes in the upper alluvial unit were aggregated for a total linear plume area in that specific alluvial unit (the upper alluvial unit).

A detailed analysis of the data review is presented in the Data Review Technical Memorandum, Appendix B. Relevant groundwater quality and elevation information from the data review is presented in the following subsections.

6.4.1 Groundwater Quality Review

6.4.1.1 North Indian Bend Wash

The groundwater quality data and groundwater elevation trends from October 2001 through October 2009 for TCE, PCE, 1,1,1-TCA, 1,1-DCE, and chloroform were reviewed for the upper, middle and lower alluvial units. Review of NIBW groundwater quality data focused on TCE and PCE since the concentrations of 1,1,1-TCA, chloroform, and 1,1-DCE are below their respective MCLs and encompassed within the TCE plume. While all well data were reviewed for each alluvial unit, several key wells were selected to depict the groundwater quality in each alluvial unit for purposes of this data review. The key wells were selected based on one of the following criteria: (1) the highest TCE or PCE concentrations to monitor concentration trends; (2) TCE or PCE concentrations that have decreased to below the MCLs to delineate plume boundaries and observe changes over time; and (3) wells which serve as sentry wells to guard against off-site plume migration. A table with 2001 and 2009 TCE data for each alluvial unit layer is provided below and compared with 1997 groundwater conditions.

TCE concentrations above the MCL of 5 µg/L in the upper alluvial unit are limited to discrete zones associated with Area 7 and Area 12. In October 2001, there were a total of 23 monitor wells with TCE concentrations exceeding the MCL. The highest TCE concentrations were detected in well PG-31UA and ranged from 12 µg/L in October 2005 to 61 µg/L in October 2008. Based on October 2009 data, 19 upper alluvial unit monitor wells indicate VOC concentrations significantly below the MCL with only five monitor wells (PG-31UA, PG-22UA, E-5UA, PG-5UA, and PG-24UA) in the upper alluvial unit indicating TCE concentrations above the MCL. The maximum TCE concentration in the upper alluvial unit as of 2010 is 16 µg/L.

The TCE plume area in the upper alluvial unit has decreased significantly since October 2001, with plume boundaries appearing to have contracted significantly. Based on October 2001 data, the total TCE plume size was approximately 793 acres. Based on October 2009 data, the total TCE plume size was approximately 221 acres, a decrease of approximately 72 percent. Figure 20-A depicts the October 2009 TCE plume in the upper alluvial unit in comparison with the October 2001 TCE plume.

All PCE concentrations in the upper alluvial unit monitor wells for the years 2005 through 2009 were at or below the laboratory reporting limit of 0.5 µg/L. The TCE concentrations for 1997, October 2001, and October 2009 for key representative upper alluvial unit wells are presented in Table 6-1, below.

Table 6-1:

North Indian Bend Wash – Upper Alluvial Unit TCE Concentrations

UAU Monitor Well	1997 TCE Concentration (µg/L)	October 2001 TCE Concentration (µg/L)	October 2009 TCE Concentration (µg/L)	First Sampling Event TCE Concentration Decreased Below MCL
D-1UA	13	14	< lab reporting limit of 0.5 µg/L	December 2008
E-5UA	39	11	9.8	N/A
PG-5UA	31	15	5.2	N/A
PG-10UA	170	7.9	1.7	October 2003
PG-31UA	190	45	38	N/A

The TCE concentrations in the middle alluvial unit are generally higher than those in the upper and lower alluvial units. Based on 1997 data, TCE concentrations in the middle alluvial unit ranged from 5.9 µg/L at E-10MA to 4,200 µg/L at D-2MA. Based on October 2001 data, there were 21 monitor wells in the middle alluvial unit with TCE concentrations exceeding the MCL. As of October 2009, there were 28 monitor wells in the middle alluvial unit with TCE concentrations exceeding the MCL. Changes in TCE concentrations in the middle alluvial unit groundwater observed from October 2001 to October 2009 are generally small.

Based on October 2009 data for the middle alluvial unit, PCE concentrations above the MCL of 5 µg/L were detected in three monitor wells (PG-38MA/LA, W-2MA, and D-2MA). Based on October 2001 data, PCE concentrations above the MCL of 5 µg/L were detected in two monitor wells (W-2MA, and D-2MA). In the middle alluvial unit, the PCE plume is much smaller than the TCE plume and is completely encompassed by the footprint of the TCE plume. PCE concentrations in monitor wells have generally stabilized or slightly decreased since October 2001.

The Area 7 and Area 12 groundwater extraction and treatment systems were installed to minimize the migration of contaminants to the southwest margin of the NIBW area and nearby production wells. In Area 7, extraction wells, 7EX-3MA, 7EX-4MA, and 7EX-5MA, are controlling significant migration of the high concentration TCE plume to the southwest margin, as evidenced by the slight decrease in the TCE concentration at well PA-12MA2. In Area 12, the remedy is also effectively controlling significant migration to the southwest margin as evidenced by the decrease of the middle alluvial unit plume area with TCE concentrations above 50 ppb since October 2001. At the southwest margin, the TCE concentration at well PG-6MA has increased slightly from 110 ppb in October 2001 to 120 ppb in October 2009. This portion of the TCE plume at the southwest margin is not captured by the middle alluvial unit extraction wells, and it is expected this portion of the TCE plume will likely continue to migrate and be captured by remedy wells in the lower alluvial unit as envisioned by the Record of Decision.

The complex pattern of groundwater movement observed in the middle alluvial unit results from competing influences between various pumping centers and influence at the southwest margin where vertical movement into the lower alluvial unit likely occurs. Groundwater movement in the southern part of the area is generally convergent towards Area 12 extraction wells and the southwest margin. Groundwater movement in the northern part of the area is generally convergent toward the Area 7 extraction wells, the Central Groundwater Treatment Facility extraction wells, and Arizona American Water's production well field.

The fine-grained sediment (described in Section 3.1.1) in the middle alluvial unit results in a mass diffusion process which contributes to plume migration. The middle alluvial unit groundwater unit is predicted to take the longest to restore to MCLs. Based on October 2001 data, the total TCE plume size was approximately 2,122 acres. Based on October 2009 data, the total TCE plume size was approximately 2,280 acres, an increase of approximately 7 percent. This increase in the middle alluvial unit plume size and TCE concentrations reflect remedy changes (based on the 1991 ROD) which were added to control plume migration from the middle alluvial unit to the southwest margin and lower alluvial unit. The overall footprint of the TCE plume in the middle alluvial unit is generally stable. Figure 20-B depicts the TCE plumes for October 2001 and October 2009. The TCE concentrations for 1997, October 2001, and October 2009 from the key representative middle alluvial unit wells are presented in Table 6-2, below.

Table 6-2:
North Indian Bend Wash – Middle Alluvial Unit TCE Concentrations

UAU Monitor Well	1997 TCE Concentration (µg/L)	October 2001 TCE Concentration (µg/L)	October 2009 TCE Concentration (µg/L)	First Sampling Event TCE Concentration Decreased Below MCL
D-2MA	4,200	2,200	1,900	N/A
E-10MA	5.9	13	5.5	Decreased below MCL once in July 2007
M-10MA2	13	33	30	N/A
PA-12MA2	200	590	410	N/A
PG-6MA	89	110	120	N/A
PG-23MA/LA	57	36	21	N/A
PG-38MA/LA	36	6.4	5.5	N/A
PG-48MA/LA	120	110	100	N/A
W-2MA	2,200	3,100	4,000	N/A

In the NIBW area, the TCE concentrations in the lower alluvial unit are significantly lower than those in the middle alluvial unit. In 1997, TCE concentrations in the lower alluvial unit ranged from less than 1.0 µg/L to 160 µg/L. Based on October 2001 data, TCE concentrations were detected above the MCL in 15 lower alluvial unit monitor wells. Based on October 2009 data, TCE concentrations were detected above the MCL at 15 lower alluvial unit monitor wells. The maximum TCE concentration of 200 µg/L was detected in October 2009 at monitor Well PA-6LA. Groundwater contour maps show that the groundwater in the lower alluvial unit flows towards the existing extraction wells, and the TCE plume is contained within the capture zones of the extraction wells at the Central Groundwater Treatment Facility and Miller Road Treatment Facility.

Changes in TCE concentrations in the lower alluvial unit observed between October 2001 and October 2009 generally were small, although TCE concentrations have decreased at some locations within the plume. Based on October 2001 data, the total TCE plume size was approximately 3,102 acres. Based on October 2009 data, the total TCE plume size was approximately 2,874 acres, a decrease of approximately 7 percent. Figure 20-C depicts the TCE plumes for October 2001 and October 2009. The TCE concentrations for October 2001 and October 2009 for key representative lower alluvial unit wells are presented in Table 6-3, below.

In October 2009, PCE concentrations were detected above the MCL of 5 µg/L in four lower alluvial unit monitor wells: PG-2LA, PG-5LA, PA-6LA, and PG-19LA. PCE concentrations in these wells are generally stable or have increased slightly from October 2001 to October 2009.

Table 6-3:

North Indian Bend Wash – Lower Alluvial Unit TCE Concentrations

LAU Monitor Well	1997 TCE Concentration (µg/L)	October 2001 TCE Concentration (µg/L)	October 2009 TCE Concentration (µg/L)	First Sampling Event TCE Concentration Decreased Below MCL
PA-5LA	160	310	190	N/A
PA-6LA	110	180	200	N/A
PA-19LA	96	120	98	N/A
PG-2LA	17	33	91	N/A
PG-40LA	< 0.5	6.5	23	N/A
PG-42LA	< 0.5	0.0	1.0	Always under the MCL
S-2LA	2.1	5.5	3.7	April 2002 and January 2003

6.4.1.2 South Indian Bend Wash

VOCs were initially discovered at SIBW in three areas designated as the western, central, and eastern plumes. The western and central plumes are present in the upper alluvial unit where TCE and PCE are the primary constituents of concern, respectively. The eastern plume is present in the middle alluvial unit and TCE is the primary constituent of concern. The lower alluvial unit was encountered at only one location throughout the SIBW area and there are no known VOCs in the lower alluvial unit. Figure 5 presents the extent of the SIBW groundwater plumes in 2004, and Figure 6 presents the extent of these groundwater plumes in March 2010.

In 1997, a total of 45 upper alluvial unit and 12 middle alluvial unit monitor wells were part of the sampling program in SIBW. Of the 60 monitor wells located in SIBW today, 41 monitor wells are sampled as part of the current monitoring program. Wells that consistently indicate non-detectable concentrations of VOCs over time, are removed from the sampling program.

In the western plume, between January 1994 and February 1996, 139 of 354 samples analyzed from the upper alluvial unit (approximately 39 percent) indicated detectable TCE concentrations, with the highest TCE concentration of 90 µg/L. As of March 2010, TCE is detected in well SIBW-28U only. Concentrations of TCE in this well increased from an initial level of 0.6 µg/L in April 1993, to a peak of 6.3 µg/L in January 2004, subsequently decreasing to 0.79 µg/L in March 2010. Since March 2010, the observed TCE concentrations at well SIBW-28U have remained less than 1.0 µg/L which is significantly below the MCL.

In the central plume, between January 1994 and February 1996, 194 of 355 samples analyzed from the upper alluvial unit (approximately 55 percent) indicated detectable PCE concentrations, with the highest concentration of 59 µg/L. In 2004, PCE was detected in nine monitor wells with the highest PCE concentrations reported at 5.2 µg/L at well SIBW-38U and 5.5 µg/L at well SW-1. As of March 2010, the PCE was detected in 11 monitor wells with the highest concentration of 2.7 µg/L at well SIBW-61U. Based on 2004 data, the total upper alluvial unit central PCE plume size was approximately 1,394 acres. In March 2010, the PCE concentrations in the upper alluvial unit central plume decreased to below the MCL with an observed PCE concentration of 2.7 µg/L. However, PCE concentrations tend to fluctuate from non-detect to slightly above the MCL from one sampling event to the next, at one or two central plume monitor wells. Because of this, there is insufficient data to provide a reasonable estimate of the area of groundwater containing low levels of VOCs.

In the eastern plume, between January 1994 and February 1996, 116 of 258 samples analyzed from the middle alluvial unit (approximately 45 percent) detected TCE concentrations, with the highest TCE concentration of 17.4 µg/L. As of January 2004, TCE was detected at concentrations above the MCL in four of the five monitor wells (one well was installed in 2005) selected as representative of the eastern plume with the highest TCE concentration of 9.6 µg/L. As of March 2010, sampling results indicate TCE detected in five monitor wells at concentrations between 1.2 µg/L and 3.7 µg/L in the eastern plume. In 2004, the TCE middle alluvial unit eastern plume size was approximately 366 acres. As of March 2010, the TCE concentrations in the middle alluvial unit eastern plume decreased to below the MCL with observed concentrations between 1.2 µg/L and 3.7 µg/L. However, TCE concentrations tend to fluctuate from non-detect to slightly above the MCL from one sampling event to the next at one or two eastern plume monitor wells. Because of this, there is insufficient data to provide a reasonable estimate of the area of groundwater containing low levels of VOCs. Figure 5 presents the extent of the groundwater plumes in 2004, and Figure 6 presents the extent of the groundwater plumes in March 2010.

6.4.2 Groundwater Elevation Review

6.4.2.1 North Indian Bend Wash

Groundwater elevation data for the period of October 2001 through March 2010 were reviewed for the upper, middle, and lower alluvial units. Generally, there is an overall increase in elevations most likely due to decreased sitewide groundwater pumping. General trends observed are noted below.

Groundwater elevations in the upper alluvial unit monitor wells were generally unchanged between October 2001 and October 2004. However, groundwater elevations in the monitor wells have increased steadily since October 2004, generally from approximately 9 feet to as much as 33 feet. Figure 21-A presents the groundwater elevation contours for the upper alluvial unit in October 2009.

Middle alluvial unit groundwater elevations remained relatively constant between October 2001 and October 2004, with seasonal variations in most wells. However, as with upper alluvial unit wells, groundwater elevations have increased significantly (from 26 to 60 feet) since October 2004, and seasonal variations in groundwater elevations are now less pronounced. The general rise in groundwater elevations reflects a regional trend, likely associated with decreased sitewide groundwater pumping. Figure 21-B presents the groundwater elevation contours for the middle alluvial unit in October 2009.

In the lower alluvial unit, groundwater elevations have varied seasonally from October 2001 to October 2009 and have risen since October 2004. The magnitude of these rises ranges from 38 to 91 feet, which is greater than the middle alluvial unit and significantly greater than the upper alluvial unit. Similar to the middle alluvial unit, the rise in groundwater elevations is regional, and is mostly likely due to decreased groundwater pumping from the production wells located in the sitewide area, since the majority of the groundwater production wells are screened in the lower alluvial unit. Groundwater pumping has decreased from 41,319 acre feet/year in 2004 to 30,725 acre feet/year in 2009, a decrease of 26 percent. Figure 21-C presents the groundwater elevation contours for the lower alluvial unit in October 2009.

6.4.2.2 South Indian Bend Wash

Based on groundwater elevation data from representative wells screened in the upper and the middle alluvial units across SIBW, elevations declined from 1994 to 2004. However, from 2004 to 2010, water elevations in representative SIBW wells have risen in the upper alluvial unit from 23 to 37 feet, and in the middle alluvial unit from 75 feet to 83 feet. The groundwater potentiometric map for the upper alluvial unit in January 2004 is presented on Figure 22, which indicates the groundwater flow direction is to the southwest. In March 2010, the flow direction is to the south, as shown on Figure 23.

Groundwater elevations for select middle alluvial unit monitor wells at SIBW in 2004 and 2010 are presented on Figures 24 and 25, respectively. The groundwater flow direction in the vicinity of the eastern plume is toward the east in 2004. Based on the March 2010 water elevations, the groundwater flow direction in the vicinity of the eastern plume ranges from a westerly direction to a northwesterly direction. This observed west-to-northwest groundwater flow direction in 2010 is most likely influenced by pumping centers associated with the Arizona Public Service Ocotillo Power Station and the City of Mesa which are in the vicinity of the SIBW area.

6.4.3 Analysis of Groundwater Contamination

Because the IBW cleanup is a groundwater restoration remedy, this Five-Year Review includes groundwater analyses to estimate timeframes to achieve restoration of the upper, middle and lower alluvial units. For NIBW, the groundwater cleanup projections were developed using the batch flush model and a qualitative analysis to provide general estimates only. There are inherent limitations and uncertainty in model and qualitative projections which could affect the cleanup time estimates. Although SIBW groundwater has almost reached the cleanup levels, a statistical analysis was conducted for certain monitoring wells in the upper and middle alluvial unit plumes. A brief discussion of these analyses is provided below. The detailed analyses are provided in Appendix B, Data Review Technical Memorandum.

6.4.3.1 North Indian Bend Wash - Estimated Cleanup Time

TCE concentrations in the upper alluvial unit have declined significantly over the past decade due to successful operation of soil vapor extraction in the vadose zone at source areas, upper alluvial unit groundwater extraction at Area 7, and natural attenuation processes. These declines in TCE concentrations are expected to continue. For the upper alluvial unit, the time projected for TCE concentrations to meet the cleanup standards was estimated to be on the order of 10 years.

A qualitative approach was relied upon to evaluate the middle alluvial unit. These results are consistent with the batch flush model. The evaluation suggests that middle alluvial unit groundwater will take the longest to be restored to below MCLs. Because TCE and PCE concentrations in NIBW are highest in the middle alluvial unit and the middle alluvial unit is composed mainly of fine-grained sediments, the rate-limiting process of mass diffusion (which is not accounted for in the batch flush approach) largely controls cleanup of this unit. The portions of the middle alluvial unit plume with the highest TCE concentrations are captured by Area 7 and Area 12 extraction wells. The portion of the middle alluvial unit plume not captured by the middle alluvial unit extraction wells contains relatively low TCE concentrations, and will slowly migrate to the lower alluvial unit at the southwest margin where the groundwater plume is captured by the lower alluvial unit extraction wells, as envisioned by the ROD. The analyses suggest the middle alluvial unit will take over 70 years to completely achieve cleanup while localized portions of the middle alluvial unit where TCE concentrations are lowest, may be restored in less than 70 years.

For the lower alluvial unit, the batch flush model predicts an overall range in estimated cleanup times from 11 to 70 years for individual lower alluvial unit extraction wells. The shortest cleanup times are projected for wells COS-71 and COS-72 (11 and 14 years, respectively) because they are located in the upgradient portion of the TCE plume. Since these wells also capture TCE mass moving into the lower alluvial unit from overlying units at the southwestern margin, the actual times to reach cleanup goals are anticipated to be longer than those projected by the model. Well PCX-1 is projected to have the longest cleanup time (70 years) because it is located along the plume axis in the downgradient portion of the plume. The projected cleanup time for well COS-75A is 41 years, based on the batch flush model and extrapolation of TCE concentration trends using groundwater modeling.

6.4.3.2 South Indian Bend Wash - Statistical Analysis

Although the SIBW groundwater is almost completely restored, statistical analyses were conducted on SIBW groundwater quality data. A total of 19 monitor wells were selected for these analyses. TCE and PCE concentration data were analyzed using (1) the Kendall tau coefficient test (a non-parametric test used to measure the statistical dependence between two datum points), (2) a trend line fitted to the data plots using the LOWESS method of least squares regression, and (3) a regression analysis. In addition, Mann-Kendall Statistical analyses were performed for a selected subset of wells.

Statistically decreasing trends were found for TCE in three wells in the eastern plume (SIBW-13MC, SIBW-56MC, and SIBW-58MC) and one well (SIBW-28U) in the western plume. Two wells in the central plume (SIBW-38U and SW-1) have statistically decreasing PCE trends. While only six of the 19 wells were statistically decreasing, the rest of the wells have had TCE or PCE concentrations consistently below the MCL for several years; therefore, the rate of decrease in VOC concentrations is not great enough to obtain a Kendall tau value representative of a statistically decreasing trend.

The Mann-Kendall statistical analysis was performed on the select wells mentioned above with Kendal tau values of 0.5 or greater to confirm the statistically decreasing trend. All wells with statistically decreasing trends, using the Kendall tau coefficient test, were positively confirmed by the Mann-Kendall statistical analysis.

6.5 SITE INSPECTIONS

On 16 and 17 November 2010, Mr. Doug Fisher and Ms. Stephanie Archabal, Engineers in Training, of ITSI conducted site inspections of the NIBW treatment facilities (Miller Road Treatment Facility, Central Groundwater Treatment Facility, Area 7, and Area 12). The inspections were attended by Wendy Flood of the Arizona Department of Environmental Quality, Jim Lutton on behalf of the Participating Companies, Craig Miller of the City of Scottsdale, and Rachel Loftin - EPA Remedial Project Manager. The site inspections included a site walk and visual inspection of the monitoring wells. As part of the Five-Year Review inspection, site documents such as health and safety plans, sampling and analysis plans, and Operations & Maintenance manuals were reviewed. A summary of each of the site inspections, site inspection checklists, and photo documentation are provided in Appendices C and D, respectively. During the site visit, no activities were observed that might indicate potentially unsafe exposures to people or the environment. A visual inspection indicated good housekeeping is practiced and the groundwater extraction and treatment systems are clean. At the Miller Road Treatment Facility and Central Groundwater Treatment Facility, there were ample spare parts on site, including a spare blower and blower motor.

The following items were noted:

- Key documents for the Miller Road Treatment Facility require updating to include as-built drawings, current process and instrumentation diagrams, and preventive maintenance tasks. The Contingency and Emergency Response Plan needs to be kept on site.

- The Operation and Maintenance Manuals for the Central Groundwater Treatment Facility and Area 7 require updating to include current figures, a list of alarms, and a troubleshooting section.

- The Area 12 Operation and Maintenance Manual requires updating to include discussion of performance monitoring, routine and preventive maintenance, and alarm testing and calibration protocols. Copies of as-built drawings, piping and instrumentation diagrams, and Sampling and Analysis Plans need to be kept on-site.

6.6 SITE INTERVIEWS

As a part of the Five-Year Review process, interviews were conducted with individuals having knowledge of and/or concerns with the IBW site. E-mail responses to the interview questions were also accepted.

Key personnel associated with the site, including residents, Arizona Department of Environmental Quality, Salt River Project, City of Scottsdale, Motorola Solutions on behalf of the NIBW Participating Companies, Arizona American Water Company, and the Town of Paradise Valley were also interviewed. An overall consensus is that the remedies at NIBW and SIBW are functioning as they were designed. The incidents that have occurred in the last few years, and actions taken to prevent these incidents in the future were also discussed.

All interviewees expressed a desire for expedited implementation of a long-term solution for the Miller Road Treatment Facility. All interviewees also acknowledged that continued collaboration among all the stakeholders is critical to the success of the remedy. The interviews are summarized and presented in Appendix E.

SECTION 7.0 TECHNICAL ASSESSMENT

The following is a technical assessment of the IBW site based on the findings of FYR activities. This assessment answers three basic questions:

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

7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?

7.1.1 North Indian Bend Wash and South Indian Bend Wash

The IBW remedial actions are contributing to restoring groundwater for beneficial use, eliminating exposure to contaminated groundwater to protect human health and the environment, and preventing lateral migration of VOCs in groundwater. This includes actions completed to address VOCs in groundwater in the upper, middle and lower alluvial units, and the vadose zone. The IBW remedy is functioning as intended.

7.1.1.1 Remedial Action Performance

Groundwater extraction and treatment activities at NIBW have met the goal of preventing migration of contaminants and removing contaminant mass from groundwater, as supported by sampling data from monitor and extraction wells gathered since the 2001 ROD Amendment was issued. The Area 7 remedy has successfully reduced the upper alluvial unit contaminant mass in groundwater and the upper alluvial unit plume has decreased significantly. The Area 7 and Area 12 groundwater extraction and treatment systems in the middle alluvial unit have contained the localized areas with the highest TCE concentrations and minimized migration toward the southwestern margin and into the lower alluvial unit. In the lower alluvial unit, the groundwater remedies are capturing the lower alluvial unit plume and preventing it from reaching production wells located north of these groundwater treatment systems.

The VOCs concentration trends for most monitor wells in the central portions of the NIBW middle alluvial unit and lower alluvial unit plumes are decreasing or stable and the plume boundaries have stabilized or contracted slightly. This suggests removal of contaminant mass. Low conductivity of the middle alluvial unit and high TCE concentrations within certain areas of the middle alluvial unit plume suggest that this alluvial unit will take longer than the upper and lower alluvial units to restore. Given the relatively long groundwater flow path to the distal end of the middle alluvial unit plume, it will likely take more than 70 years to be fully remediated.

Soil vapor extraction systems have successfully removed contaminants of concern in soils at Areas 6, 8, and 12. At Area 7, one operating soil vapor extraction system is currently idle pending restart for a rebound test which is being evaluated in 2011.

At SIBW, all wells indicate decreased concentrations of TCE and PCE in the western, central, and eastern plumes as of March 2010. As of March 2010, only three to four SIBW monitoring wells indicate TCE or PCE concentrations slightly above the MCLs. In addition, the plume areas have decreased dramatically since 2004.

7.1.1.2 System Operation & Maintenance

The NIBW groundwater extraction and treatment systems have achieved plume containment. Effluent from these systems is consistently below the laboratory detection limits which are significantly below the MCLs for TCE and the other NIBW contaminants of concern with the exception of release events at the Miller Road Treatment Facility in October 2007, and January 2008. These events identified faults in the operations and maintenance of the Miller Road Treatment Facility that have since been rectified with the application of engineering, administrative, and procedural controls. These corrective measures significantly reduce the likelihood that releases of untreated water to potable water systems will recur. The incidents also led to significant increases in operational costs due to increased performance monitoring, constant staffing of the system, and significant repairs and upgrades of the system. As a result of these incidents, the Operations & Maintenance Manuals, preventative maintenance activities, Contingency Emergency Response Plan, Groundwater Monitoring & Evaluation Plan, and communication plans are in the process of being updated. The remaining NIBW soil vapor extraction and treatment system at Area 7 is currently offline pending a long-term rebound study, and will be reinstated if the findings indicate it is warranted.

For SIBW, groundwater monitoring as part of the monitored natural attenuation remedy for SIBW is conducted according to the EPA approved groundwater monitoring plan (ITSI, 2009). An analysis of groundwater quality data from these monitoring events indicates that the remedy is working as expected. The western, central and eastern groundwater plume areas show natural attenuation of VOCs to below the MCL in all but three to four monitoring wells.

7.1.1.3 Opportunities for Optimization

The groundwater flow model has been updated for this Five-Year Review to assist the cleanup time estimates. The contaminant transport model was constructed in 1999 and needs to be updated with the groundwater concentration data available from 1997 to present. The updated groundwater flow and transport model will be useful to evaluate the existing remedy and assist in identifying opportunities for remedy optimization. A study is currently underway, for certain extraction wells, to ascertain the optimal pumping rate and installation of line shaft and/or higher capacity well pumps, where appropriate, to achieve the maximum VOCs extraction from the alluvial unit and lessen downtime for maintenance and repairs.

Additional opportunities for optimization include establishing a formal program for periodic well rehabilitation, to maximize and maintain extraction yields. Upon completion and evaluation of the Area 7 SVE long-term rebound test and ongoing follow-up activities/analyses, further opportunities for optimization may be identified.

7.1.1.4 Early Indicators of Potential Remedy Issues

There are no potential remedy issues at NIBW. However, as discussed in Section 4.2.1, an incident occurred in 2007 and another in 2008 resulting in partially treated groundwater being introduced to a potable water system. As a result, a rigorous and comprehensive inspection of the Miller Road Treatment Facility and Central Groundwater Treatment Facility treatment systems was conducted immediately following the 2008 incident, to identify equipment and systems in need of replacement and/or repair. The recommendations from this engineering evaluation were implemented in 2008 shortly after the incident. Additionally, in 2008, the Miller Road Treatment Facility was shut down for a short period while well PCX-1 was physically separated from the potable water system and reconfigured to convey the treated effluent to an adjacent canal. This end use is consistent with the ROD and reflects the original MRTF configuration and end use. Negotiations for a long-term solution are in progress. As an additional precaution, preventive maintenance and inspection regimens have been revised to ensure they are thorough and occur at a frequency necessary to ensure the root causes for the former incidents are addressed. The Operations & Maintenance Manuals, Contingency Emergency Response Plans, Communication Plans, and preventative maintenance activities are also being revised for all NIBW remedial systems on a regular frequency to remain updated. The long-term remedy is expected to be selected in 2011 and implementation initiated in 2012.

At SIBW, EPA is conducting monthly indoor air monitoring from March 2011 - August 2011 at DCE Circuits to evaluate whether there is a discernable trend in indoor air levels. Since 2007, indoor air levels of TCE and PCE have been within EPA's acceptable limits.

7.1.1.5 Implementation of Institutional Controls and Other Access Measures

The site ICs are non-engineering methods by which access to contaminated environmental media is restricted. The 1998 SIBW ROD outlines institutional controls which include various Arizona well siting, permitting, and construction restrictions, and notices distributed by the Arizona

Department of Water Resources (ADWR), Arizona Department of Health Services, or EPA concerning risks from exposure to contaminated groundwater. Although specifically identified for SIBW, these ICs are implemented sitewide by transmittal of a written notice of intent for well siting/permitting/construction from ADWR to EPA and Arizona Department of Environmental Quality for review and written approval before implementation.

7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICOLOGY DATA, CLEANUP LEVELS, AND REMEDIAL ACTION OBJECTIVES USED AT THE TIME OF THE REMEDY SELECTION STILL VALID?

7.2.1 North Indian Bend Wash and South Indian Bend Wash

Changes in Standards and To Be Considered (TBCs)

An ARAR review was conducted for this FYR. The review found that there were no changes to the ARARs that affect protectiveness. The draft ARAR review memorandum is presented as Appendix F.

7.2.1.1 Changes in Exposure Pathways

There have been no changes in exposure pathways. Since the vapor intrusion pathway was not evaluated previously, it was evaluated as part of this Five-Year Review for portions of the upper and middle alluvial units at NIBW, and at SIBW areas where depth to groundwater is less than 100 feet. The results indicate that vapor intrusion is not an exposure pathway of concern. However, indoor air monitoring should continue at the DCE Circuits subsite in SIBW to ensure EPA's acceptable levels are maintained. The risk assessment and toxicology analysis, including the vapor intrusion pathway evaluation, is presented as Appendix G.

7.2.1.2 Changes in Toxicity and Other Contaminant Characteristics

The toxicity factor for TCE has changed since the Records of Decision for NIBW and SIBW were implemented. In 2009, EPA harmonized the risk-based screening levels from Regions 3, 6, and 9 into a single table: "Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites." These screening levels are derived from standardized equations combining exposure information assumptions with EPA toxicity data, including new toxicity information.

The EPA selected 5 µg/L as the clean-up level for TCE. Based on the new toxicity numbers in the Regional Screening Level tables, this would result in a 2.5×10^{-6} risk, which remains within EPA's acceptable risk range. Therefore, the clean-up levels chosen for the IBW site are still protective. The risk assessment and toxicology analysis is presented as Appendix G.

7.2.1.3 Changes in Risk Assessment Methods

There have been no changes in risk assessment methods associated with groundwater that affect protectiveness. In January 2009, EPA published Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Part F, Supplemental Guidance for Inhalation Risk Assessment. The previously recommended approach for evaluating the daily intake of chemicals in air took into consideration concentrations in air, inhalation rate, body weight, and exposure conditions. The new approach recommends that the concentration of the chemical in air should be the exposure metric rather than the inhalation intake based on inhalation rate and body weight. Although this guidance changes the calculation method for inhalation risk, it would not significantly change the risk results. In addition, the RAGS Part F calculation method was used in the development of the Regional Screening Levels which were used to evaluate air concentrations at IBW. Accordingly, the conclusions from the IBW air risk evaluations remain valid. The risk assessment and toxicology analysis is presented as Appendix G.

7.2.1.4 Expected Progress Towards Meeting the RAOs

The soil vapor extraction, and groundwater extraction and treatment systems at NIBW have significantly reduced contaminant concentrations in the vadose zone and groundwater, and are reducing the extent of the NIBW groundwater plumes. At SIBW, soil vapor extraction and monitored natural attenuation have almost met the objective to restore the groundwater to its beneficial uses by reducing the contamination levels to below MCLs. The IBW remedy is progressing as expected.

7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?

No new human or ecological receptors were noted for the IBW site during the site inspection. No weather-related events have occurred that have affected remedy protectiveness. There is no other information that calls into question the current protectiveness of the remedy.

SECTION 8.0 ISSUES

There were no issues identified which affect current or future protectiveness.

SECTION 9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The following operations and maintenance actions which do not affect current or future protectiveness are in progress:

- There was an incident in 2007 and another in 2008 at the Miller Road Treatment Facility (MRTF) in which partially treated groundwater from well PCX-1 was delivered to the potable supply system. As an interim measure, in 2008 the MRTF was reconfigured to convey treated water from well PCX-1 to a canal instead of the potable supply system. This end use is consistent with the ROD and reflects the way the MRTF was originally operated for several years. Additionally, EPA added a recommendation for a physical secondary fail-safe for wells with a drinking water end use. The remedy is currently protective and the long-term configuration for the MRTF is presently being negotiated with the multiple water rights holders, but has not been finalized. This item will be addressed by finalizing selection of the long-term remedy in 2011 and implementation planned for 2012.

- Key documents for the Miller Road Treatment Facility require updating to include as-built drawings, current process and instrumentation diagrams, and preventive maintenance tasks. The Contingency and Emergency Response Plan needs to be kept on site.

- The Operations and Maintenance Manuals for the Central Groundwater Treatment Facility and Area 7 require updating to include current figures, a list of alarms, and a troubleshooting section.

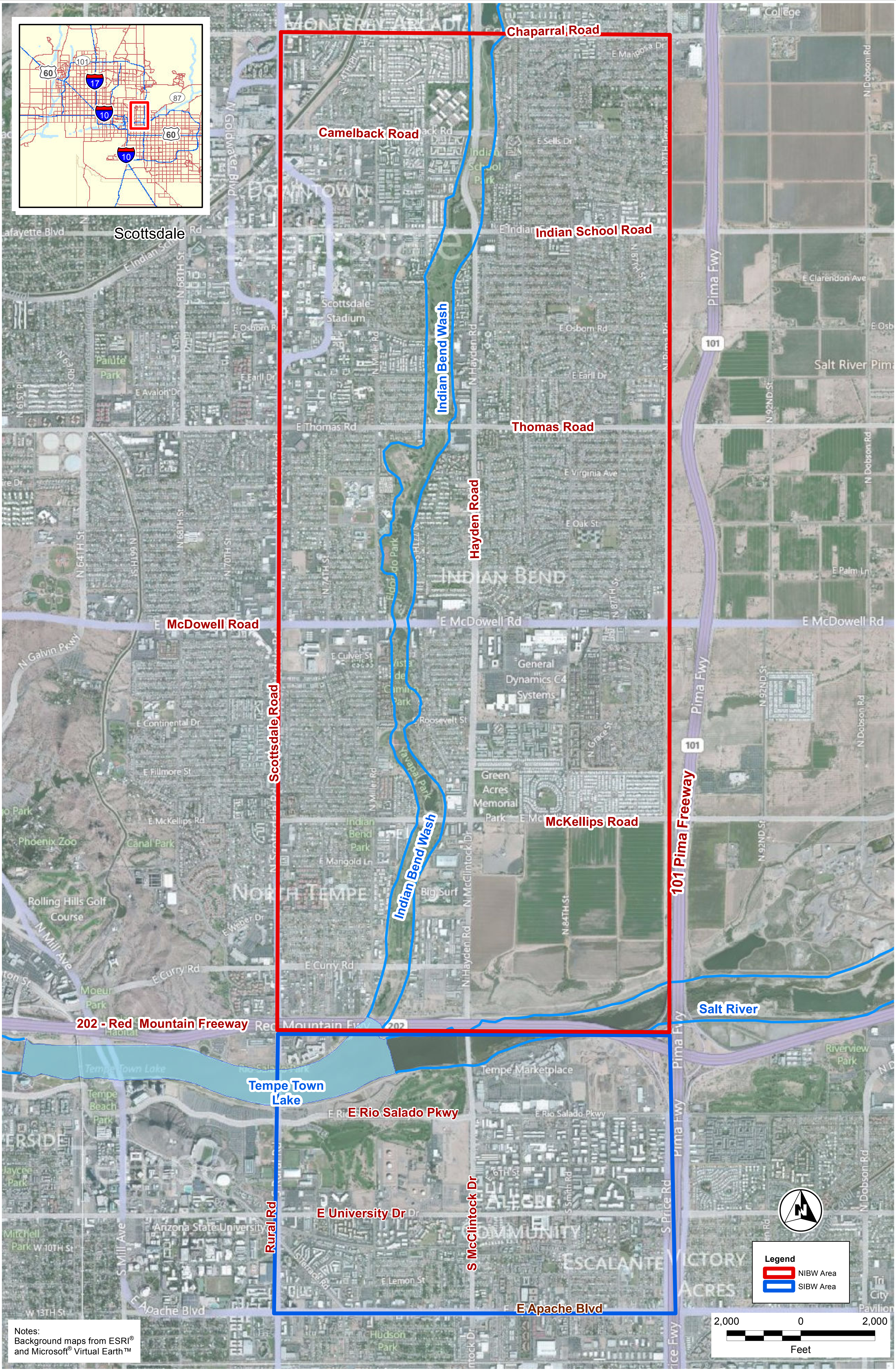
- The Area 12 O&M Manual requires updating to include discussion of performance monitoring, routine and preventive maintenance, and alarm testing and calibration protocols. Copies of as-built drawings, piping and instrumentation diagrams, and Sampling and Analysis Plans need to be kept on-site.

SECTION 10.0 PROTECTIVENESS STATEMENT

The remedies at the IBW Site are currently protective of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. The groundwater extraction and treatment systems which comprise the NIBW remedy are removing volatile organic compound (VOC) mass from the three groundwater zones, reducing VOC concentrations in groundwater, and treating VOC concentrations to below the maximum contaminant levels (MCLs). The groundwater plume is contained as demonstrated by analysis of groundwater data and predicted by groundwater modeling. At SIBW, identified source areas have been remediated and the monitored natural attenuation remedy has almost met the remedial action objective to restore groundwater to beneficial use. At the DCE Circuits subsite, indoor air monitoring conducted since 2007 is ongoing to ensure concentrations remain within EPA’s acceptable levels.

SECTION 11.0 NEXT REVIEW

The Indian Bend Wash site will continue to have Five-Year Reviews in the future until the remaining contamination in the groundwater at the Site achieves the cleanup standards. The next Five-Year Review is due in 2016.



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 1
Indian Bend Wash Superfund Area
Boundary Map

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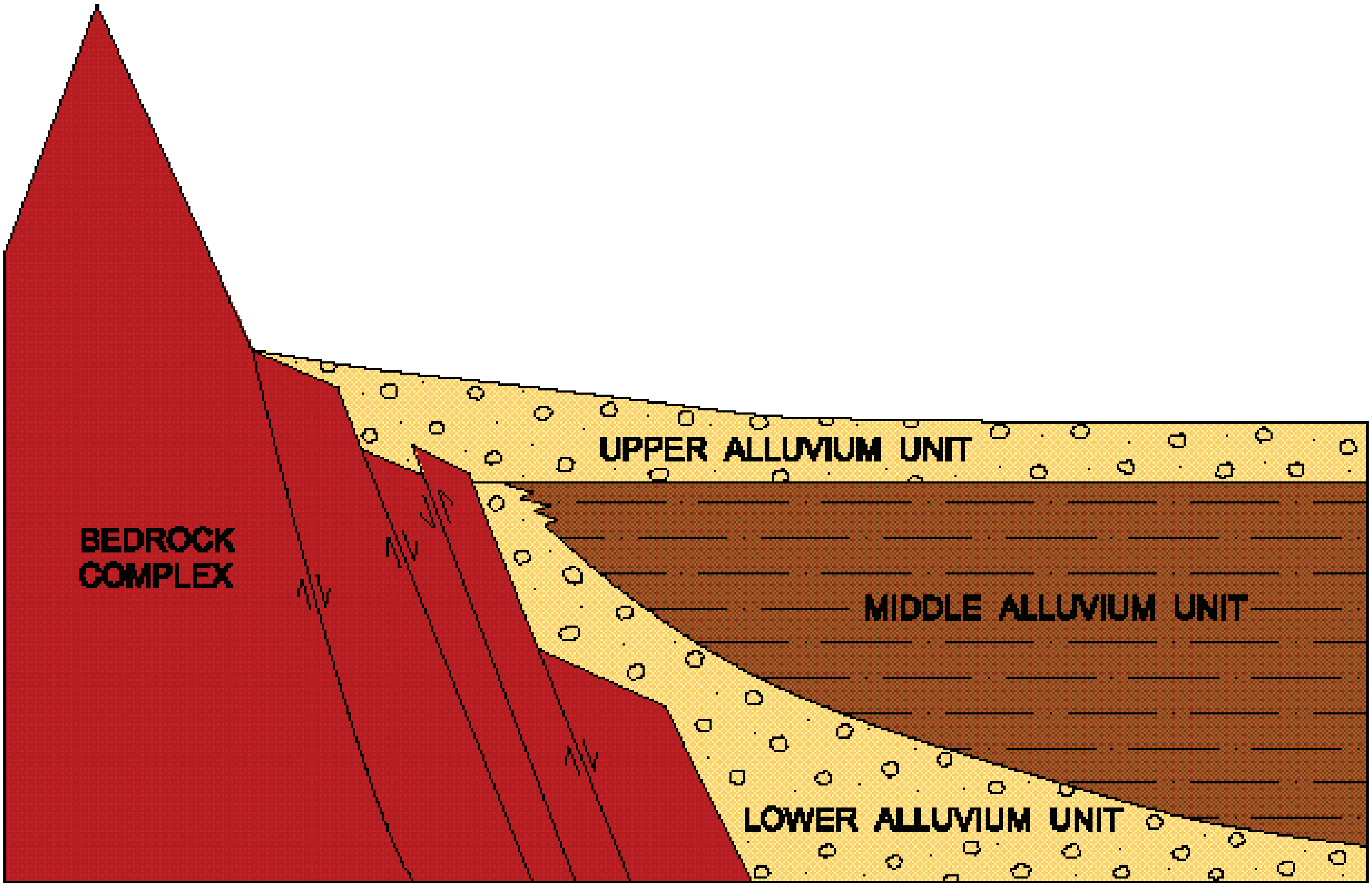

Image courtesy of NIBW Participating Companies

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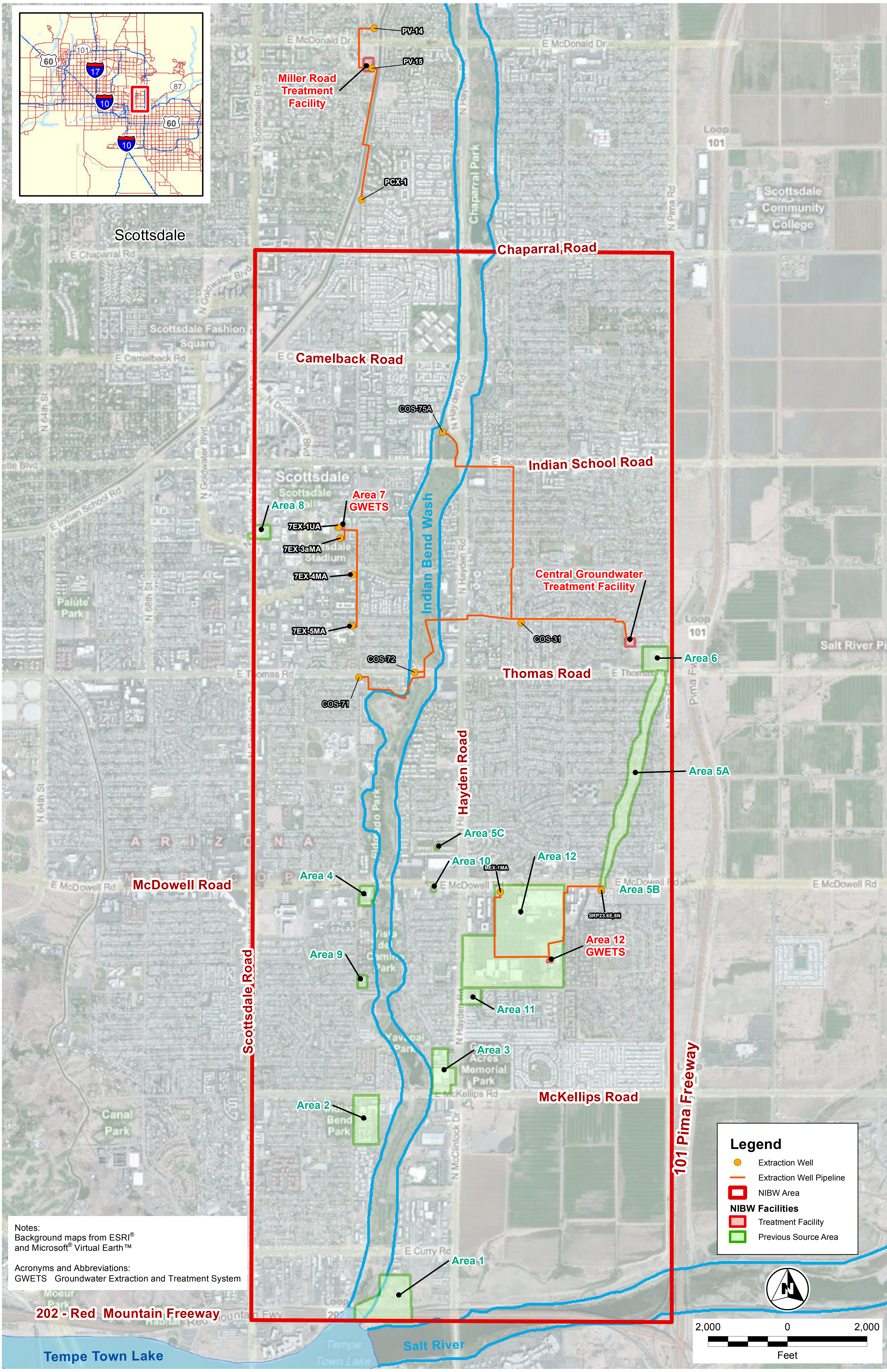
Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 2
Schematic Hydrogeologic Section

O:\0045 TO 44 FRFE-0920, IBW North-South 5-Year Review\5.0 Tech Rpts\Five Year Review Report\Figures\ Figure 2 - Shematic Hydrogeologic



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 3
NIBW Treatment Systems,
Extraction Wells, and Source Areas

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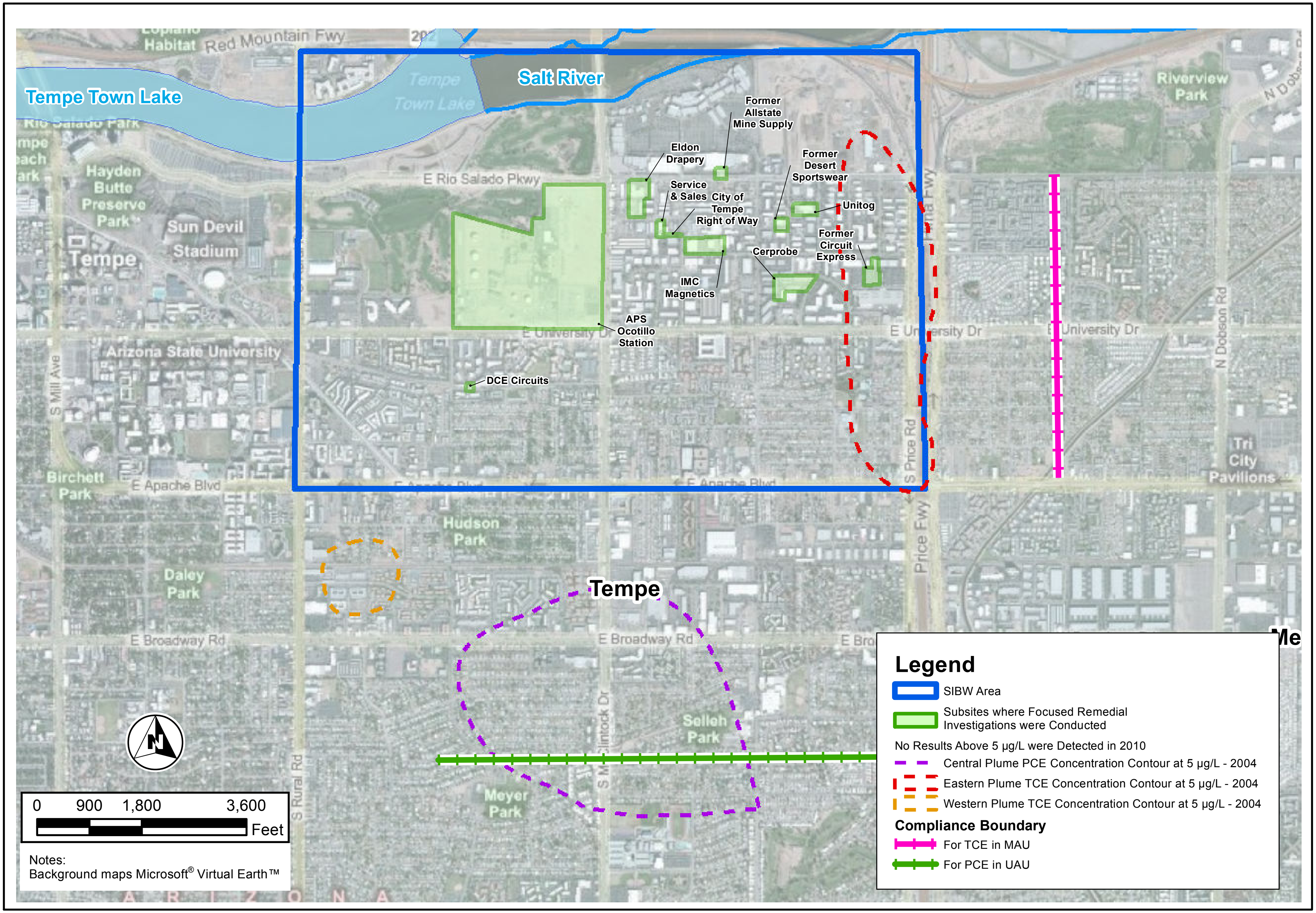

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 4
SIBW Compliance Boundaries and Subsite Locations

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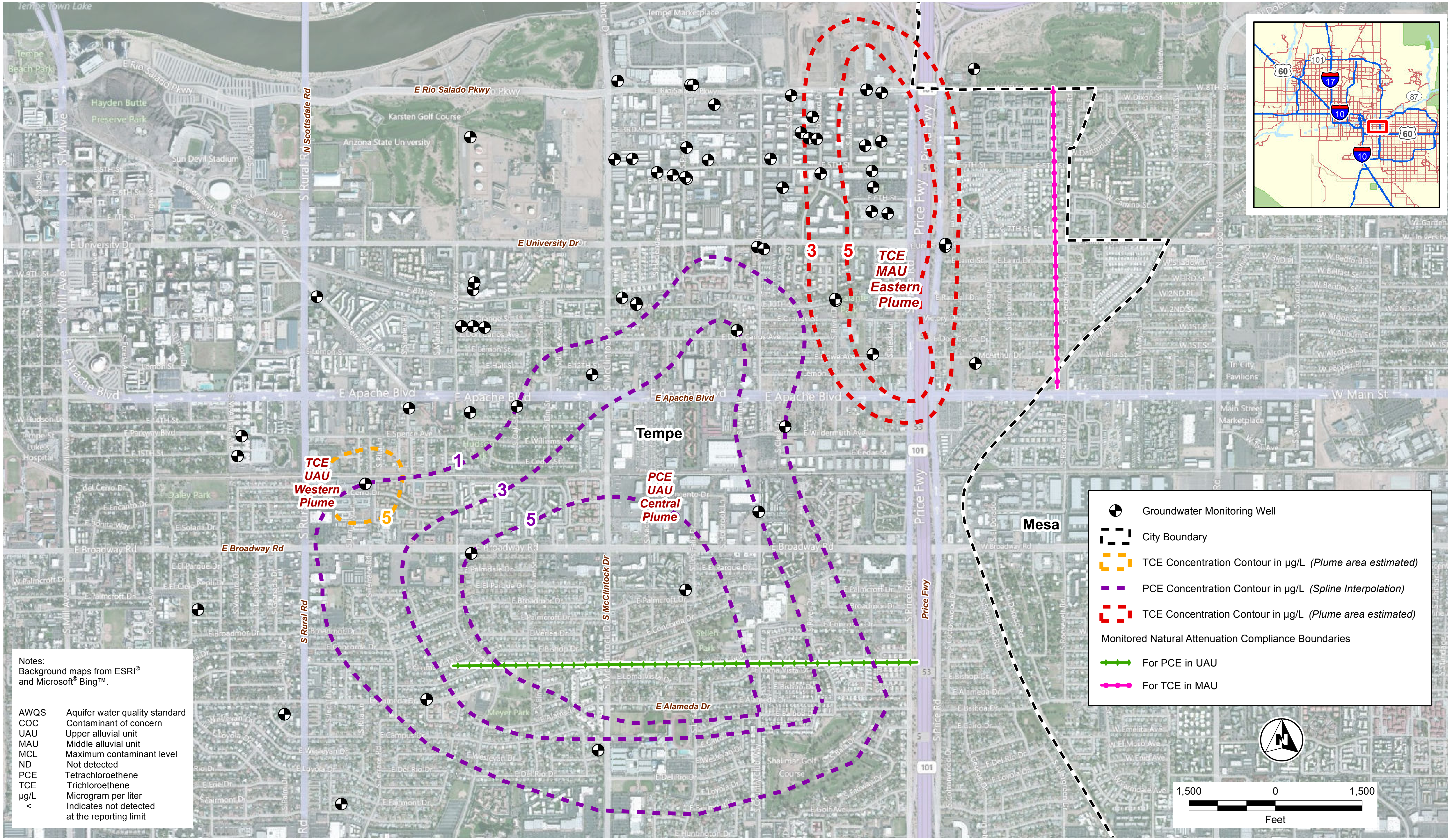

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 5
SIBW Contaminant Concentration Contours
Middle and Upper Alluvial Units
2004

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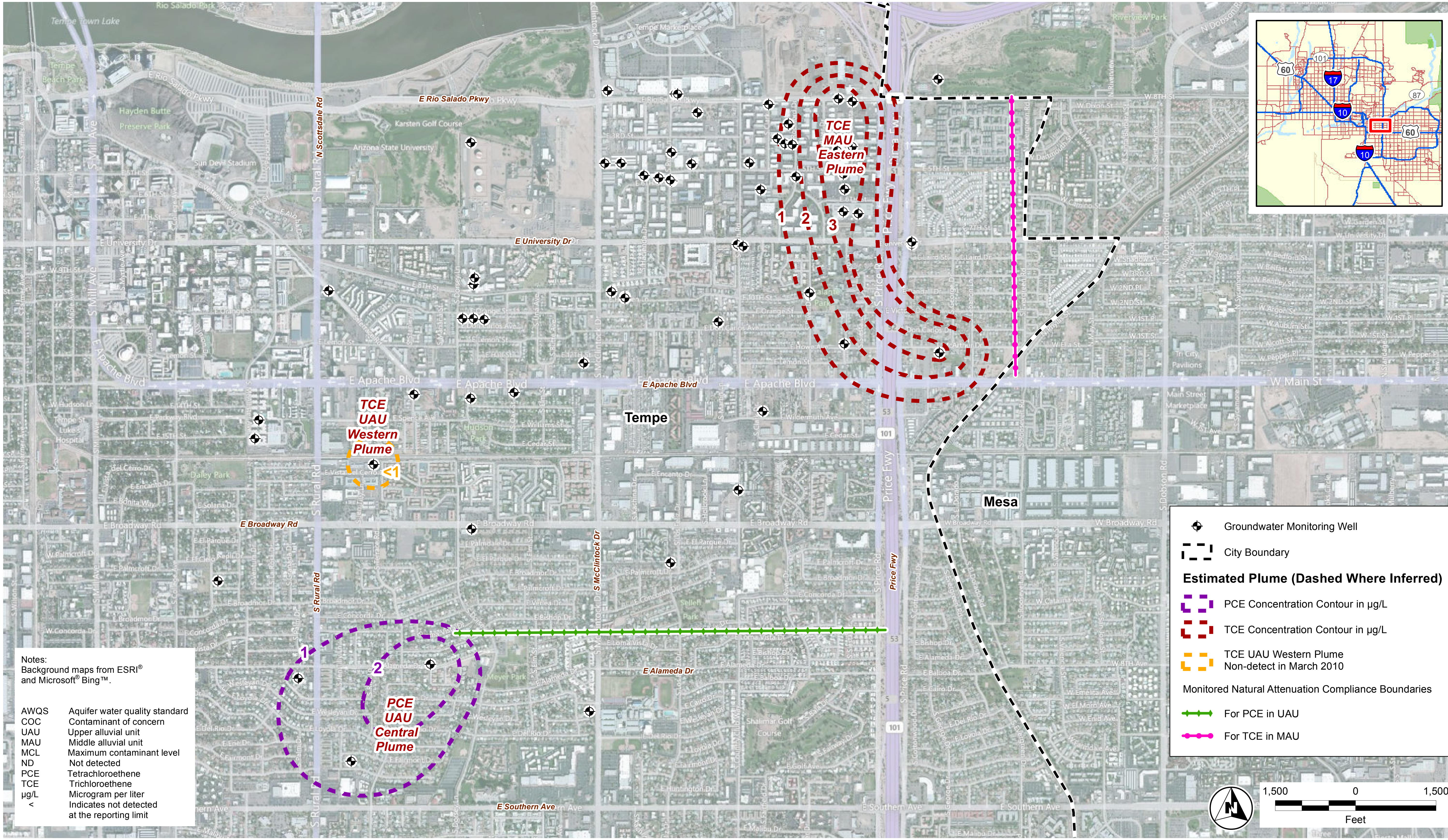

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 6
SIBW Contaminant Concentration Contours
Middle and Upper Alluvial Units
2010

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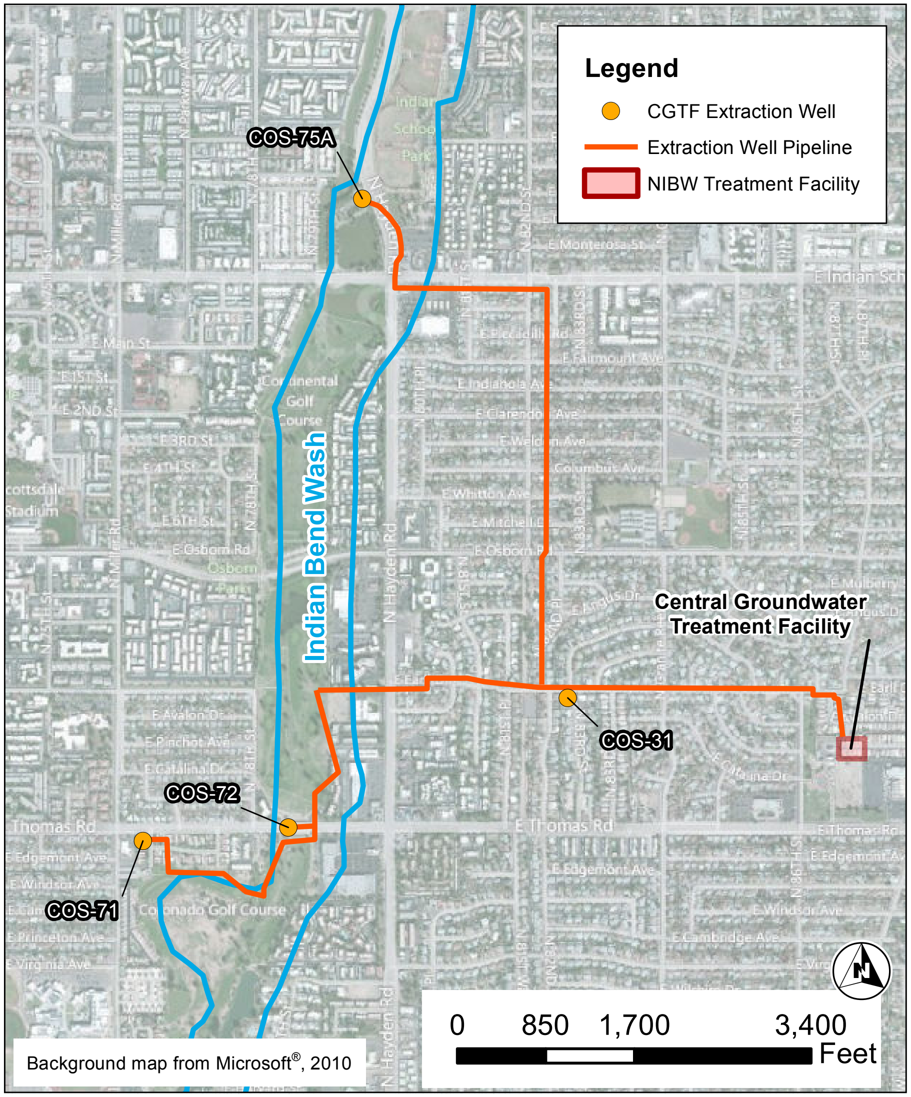
Central Groundwater Treatment Facility (CGTF)



Miller Road Treatment Facility (MRTF)

ITSI Innovative Technical Solutions, Inc. A Gilbane Company	**Five-Year Review Report** Indian Bend Wash Superfund Site Scottsdale and Tempe, Arizona	**FIGURE 7-A** CGTF and MRTF Extraction Well and Pipeline Locations

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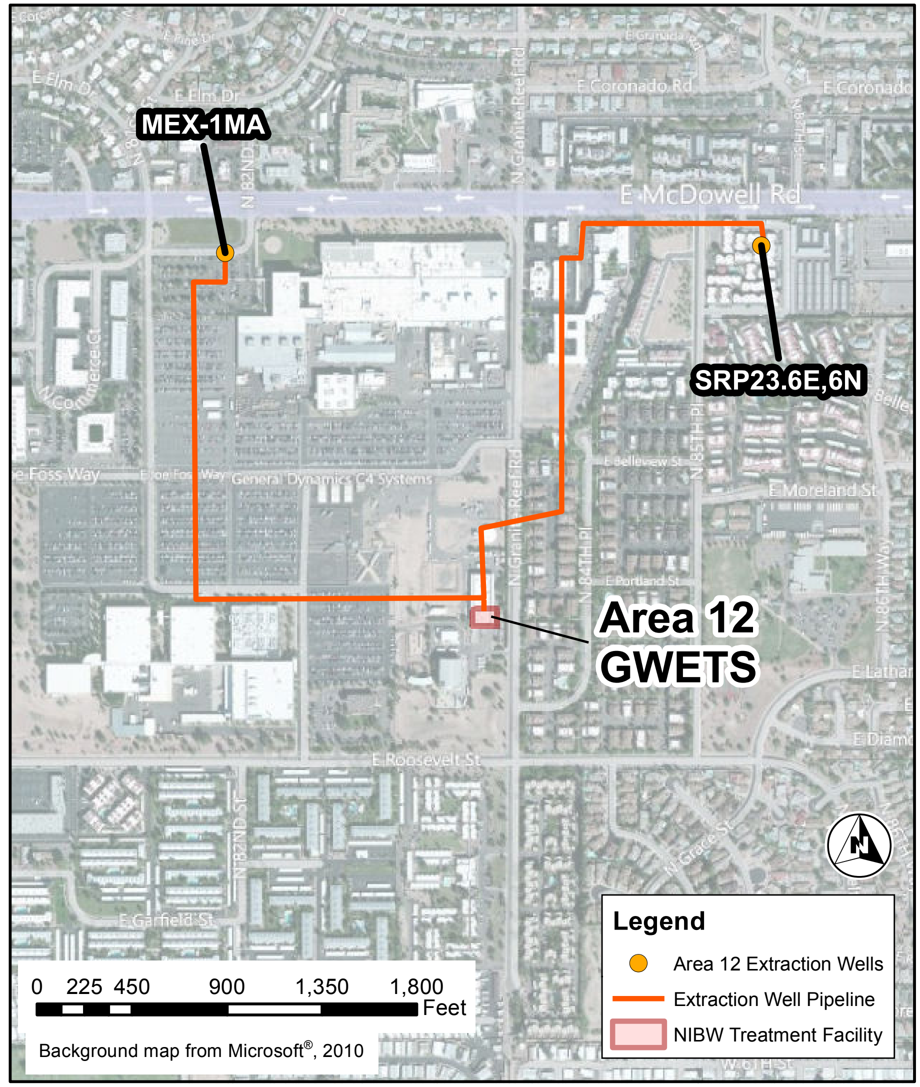
Area 7 Groundwater Extraction and Treatment System (GWETS)

Area 12 Groundwater Extraction and Treatment System (GWETS)



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 7-B
Area 7 and Area 12 GWETS
Extraction Well and
Pipeline Locations

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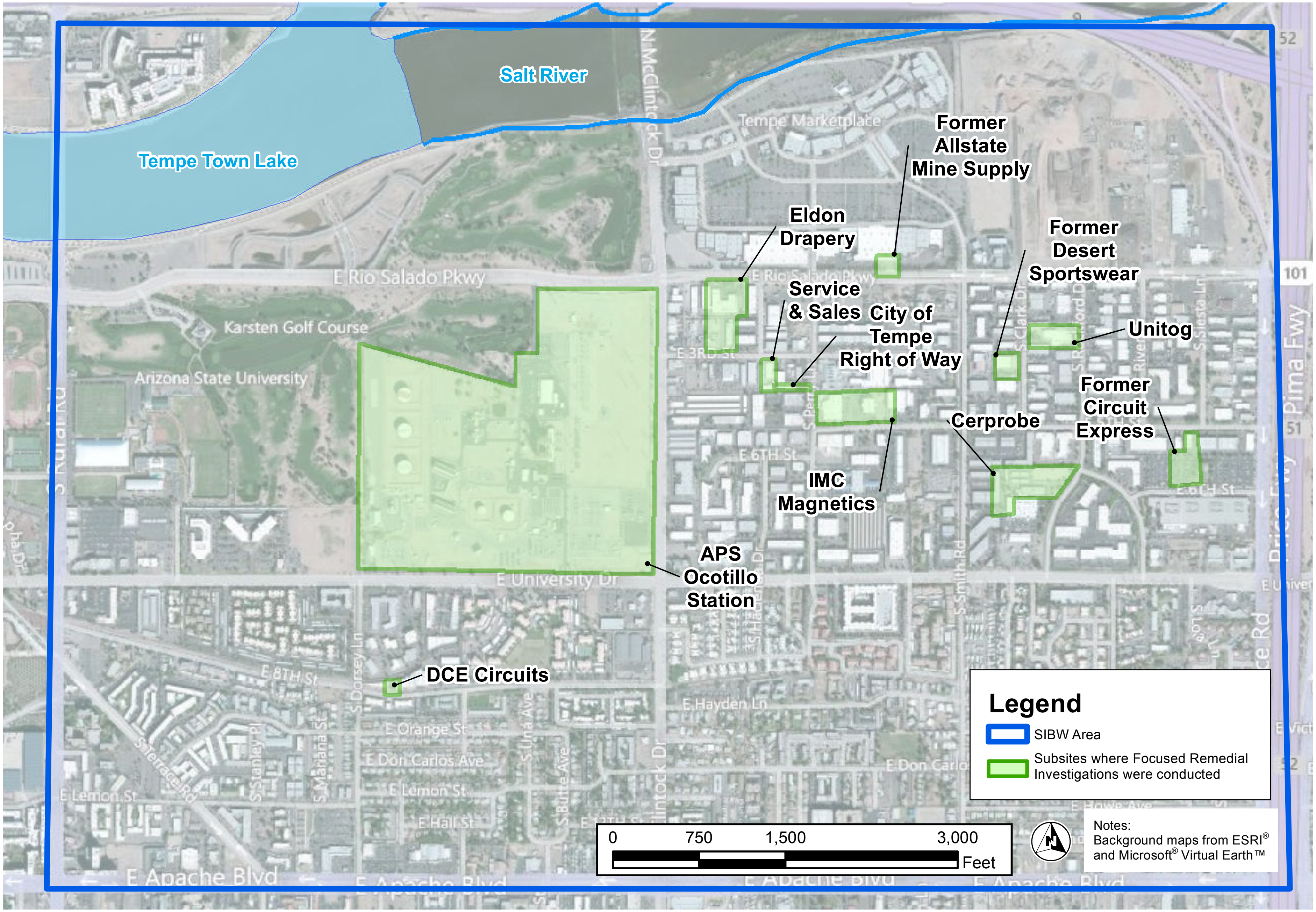

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 8
SIBW Subsite Locations

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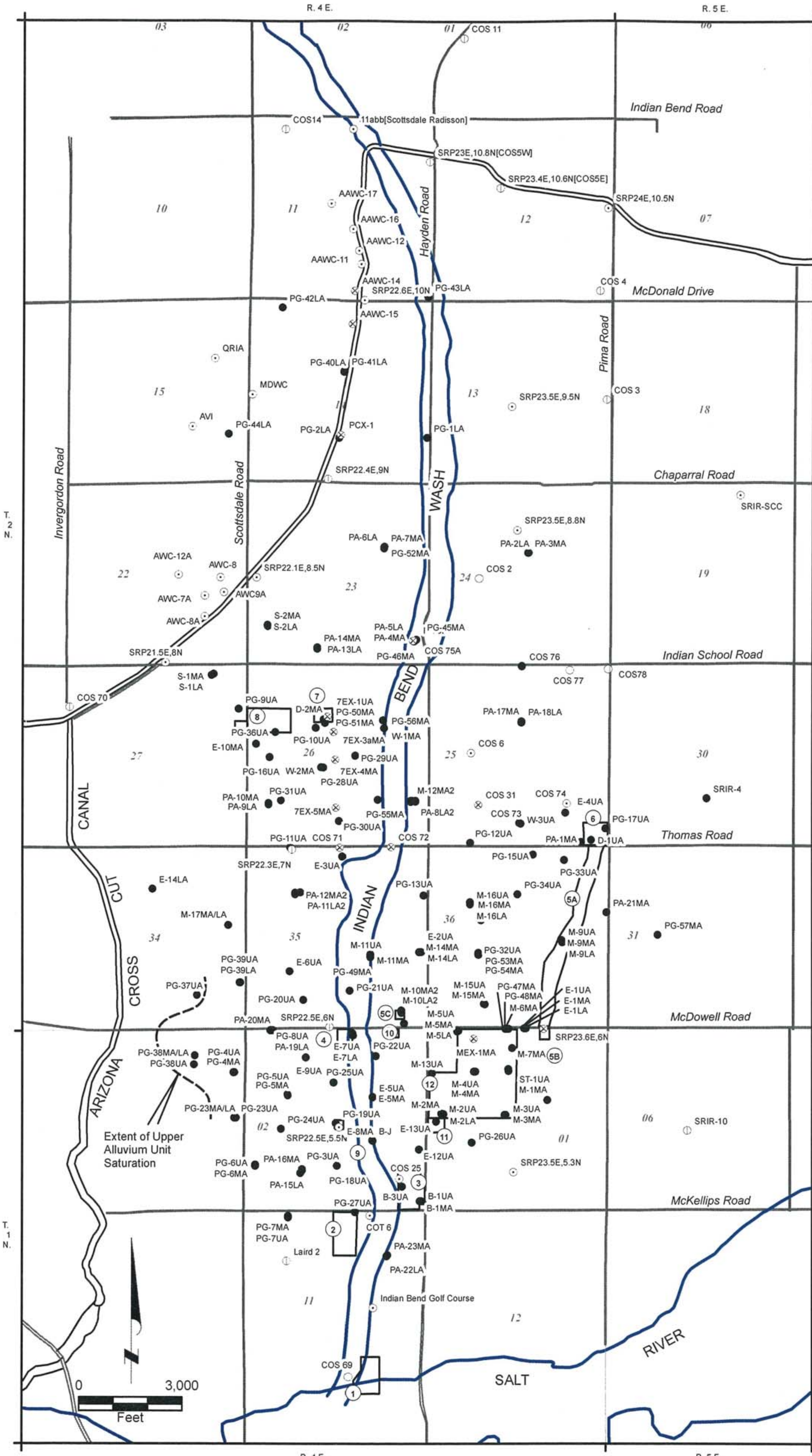
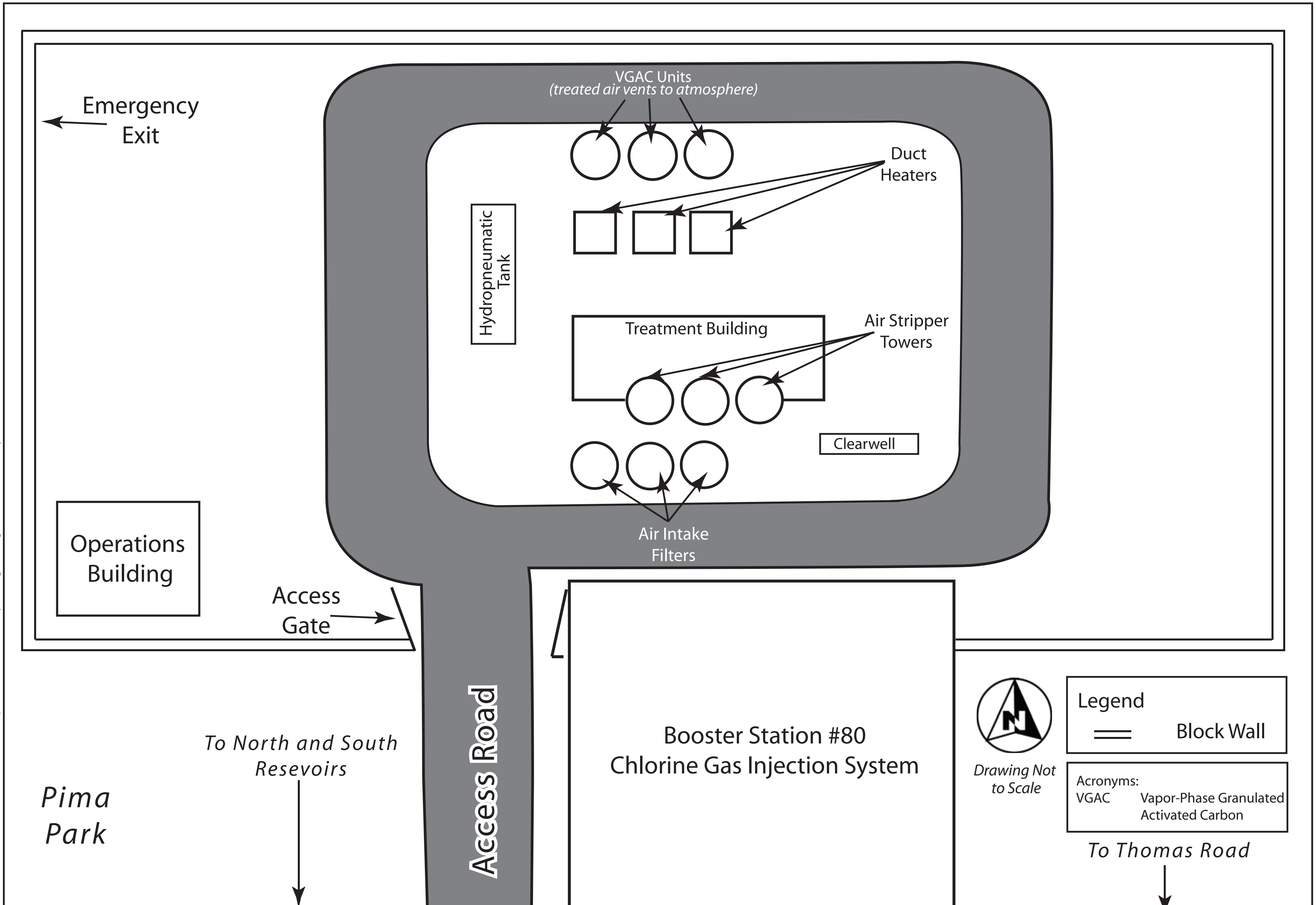


EXPLANATION

PA-15LA ●	Monitor Well Location and Identifier
COS75A ⊗	Extraction Water Well Location and Identifier
COS74 ⊙	Production Water Well Location and Identifier
SRP22.4E, 9N ⦶	Inactive Production Water Well Location and Identifier
COS69 ○	Abandoned Production Water Well Location and Identifier

Image courtesy of NIBW PCs



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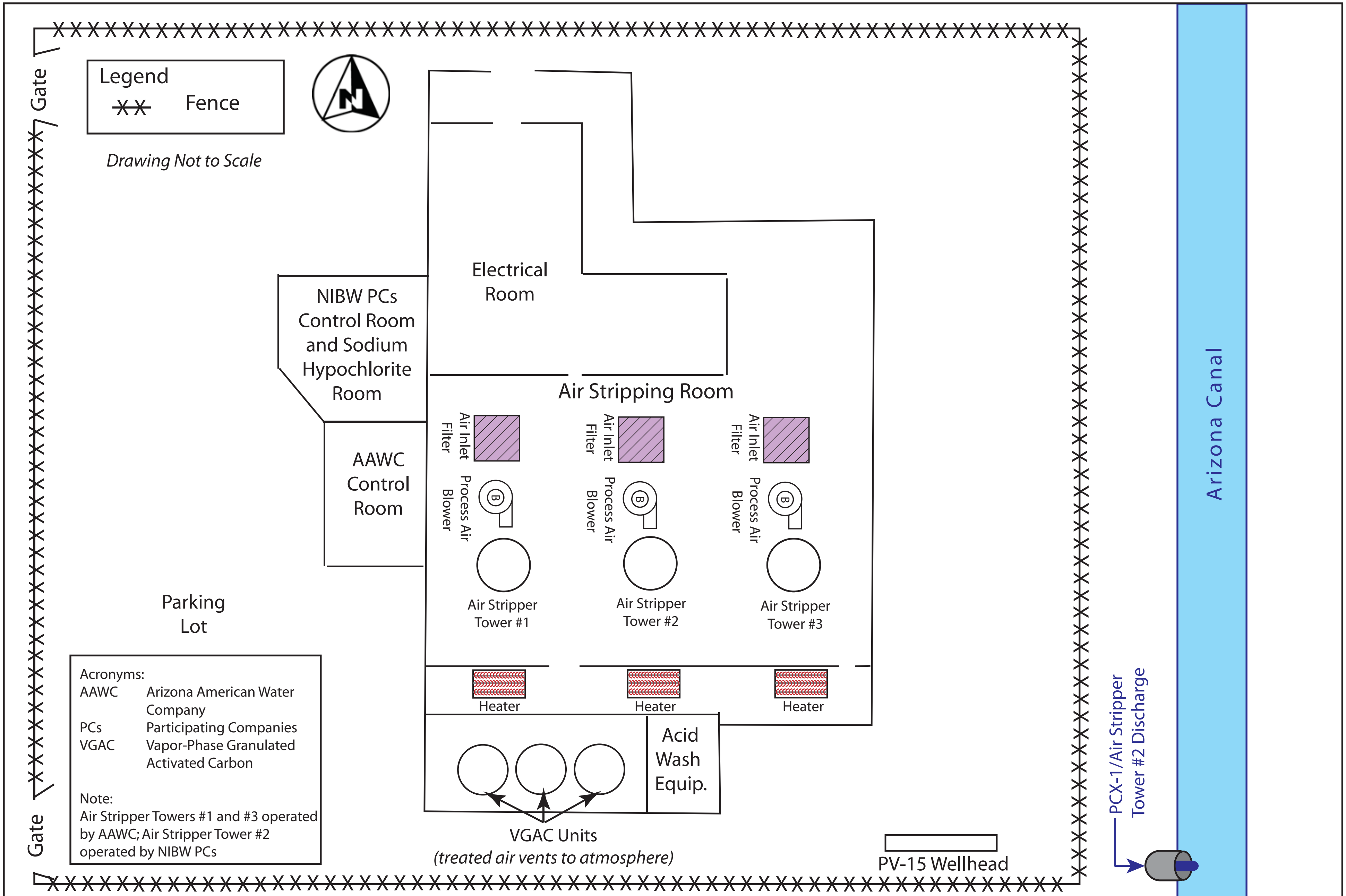
Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 10
Central Groundwater Treatment Facility Site Layout



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 11
Miller Road Treatment Facility
Site Layout

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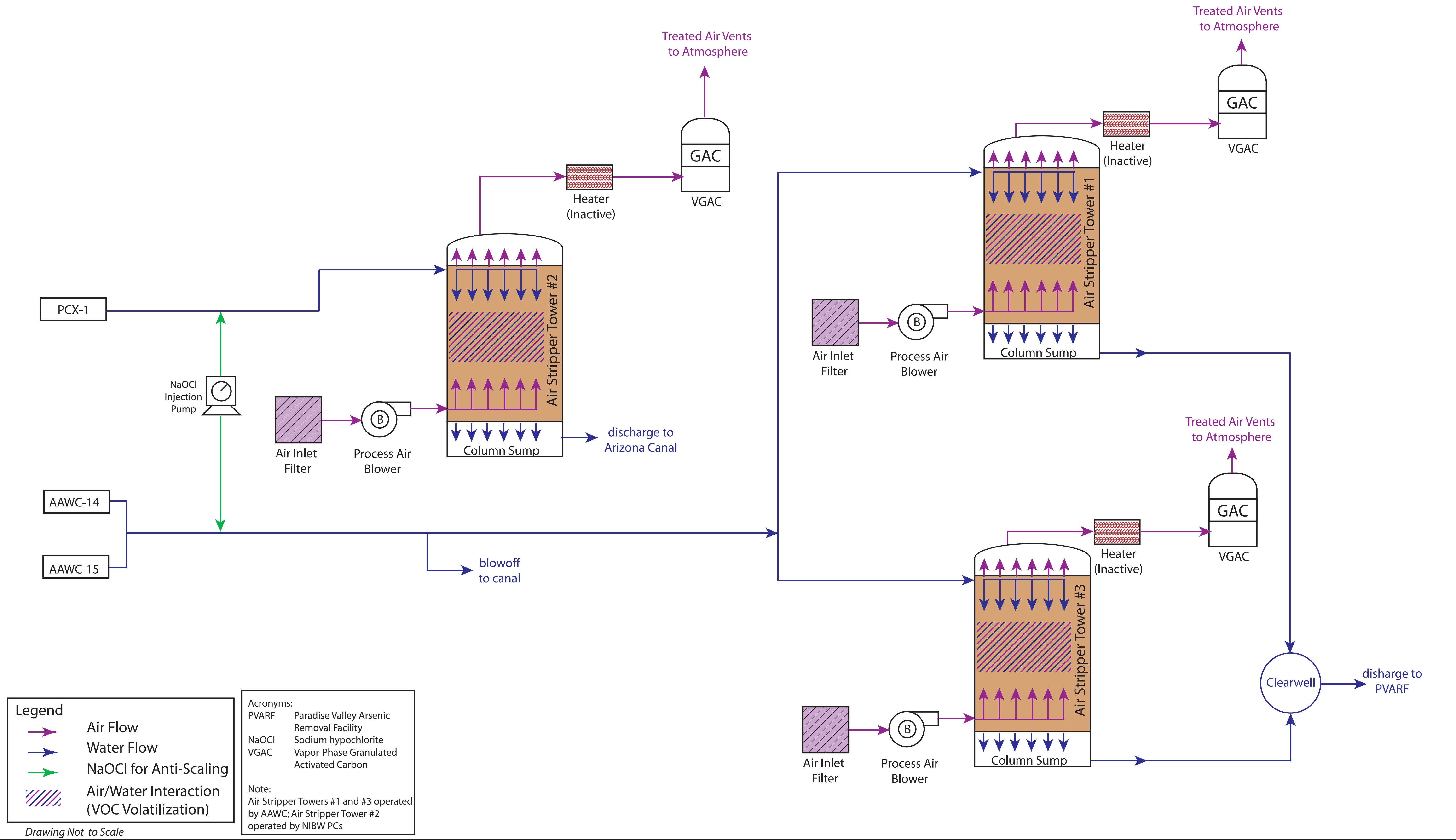

Acronyms:
PVARF Paradise Valley Arsenic Removal Facility
NaOCl Sodium hypochlorite
VGAC Vapor-Phase Granulated Activated Carbon

Note:
Air Stripper Towers #1 and #3 operated by AAWC; Air Stripper Tower #2 operated by NIBW PCs

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 12
Miller Road Treatment Facility
Process Flow Schematic

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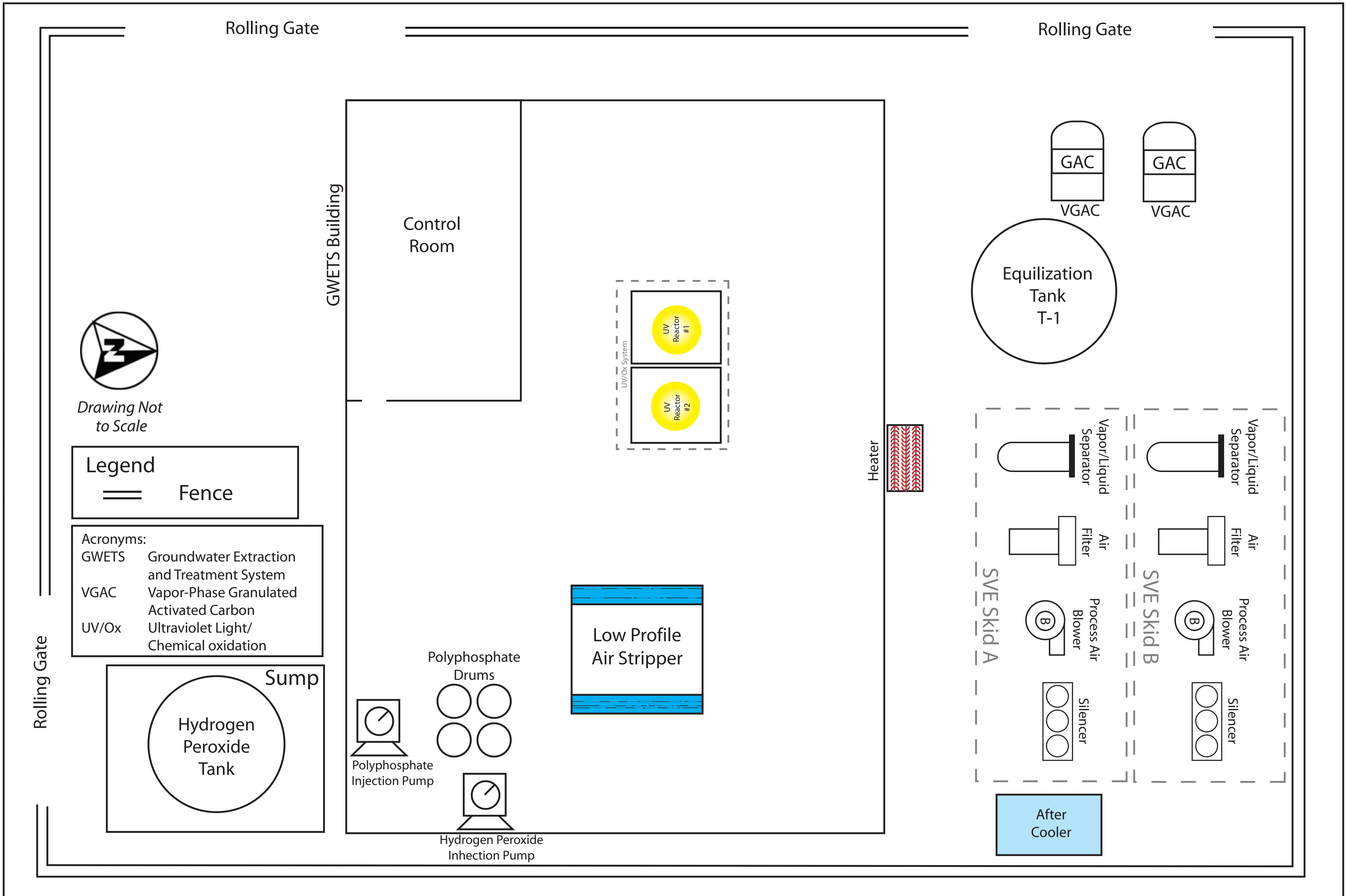

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 13
Area 7 Site Layout

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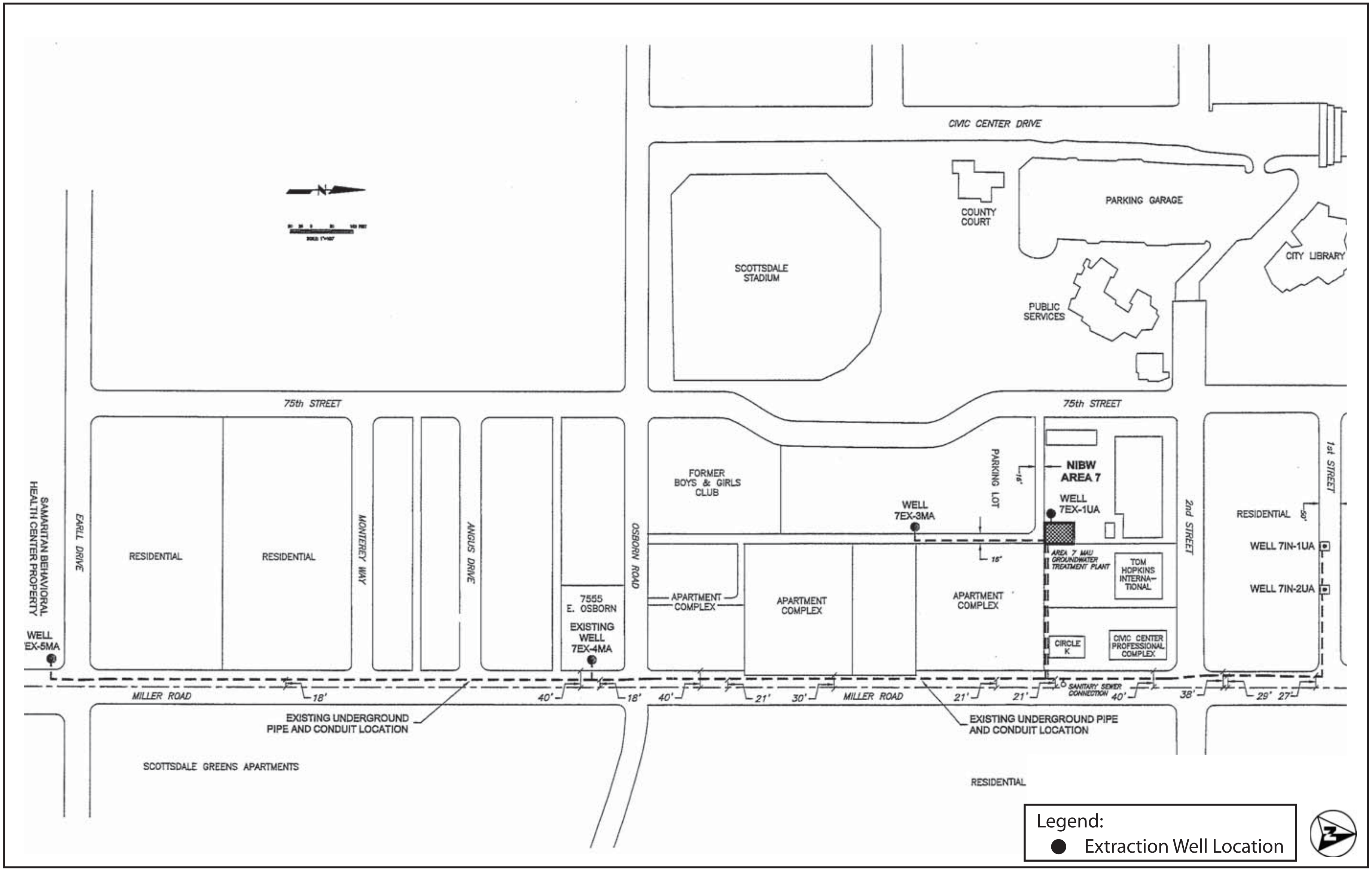

Image courtesy of Levine Fricke

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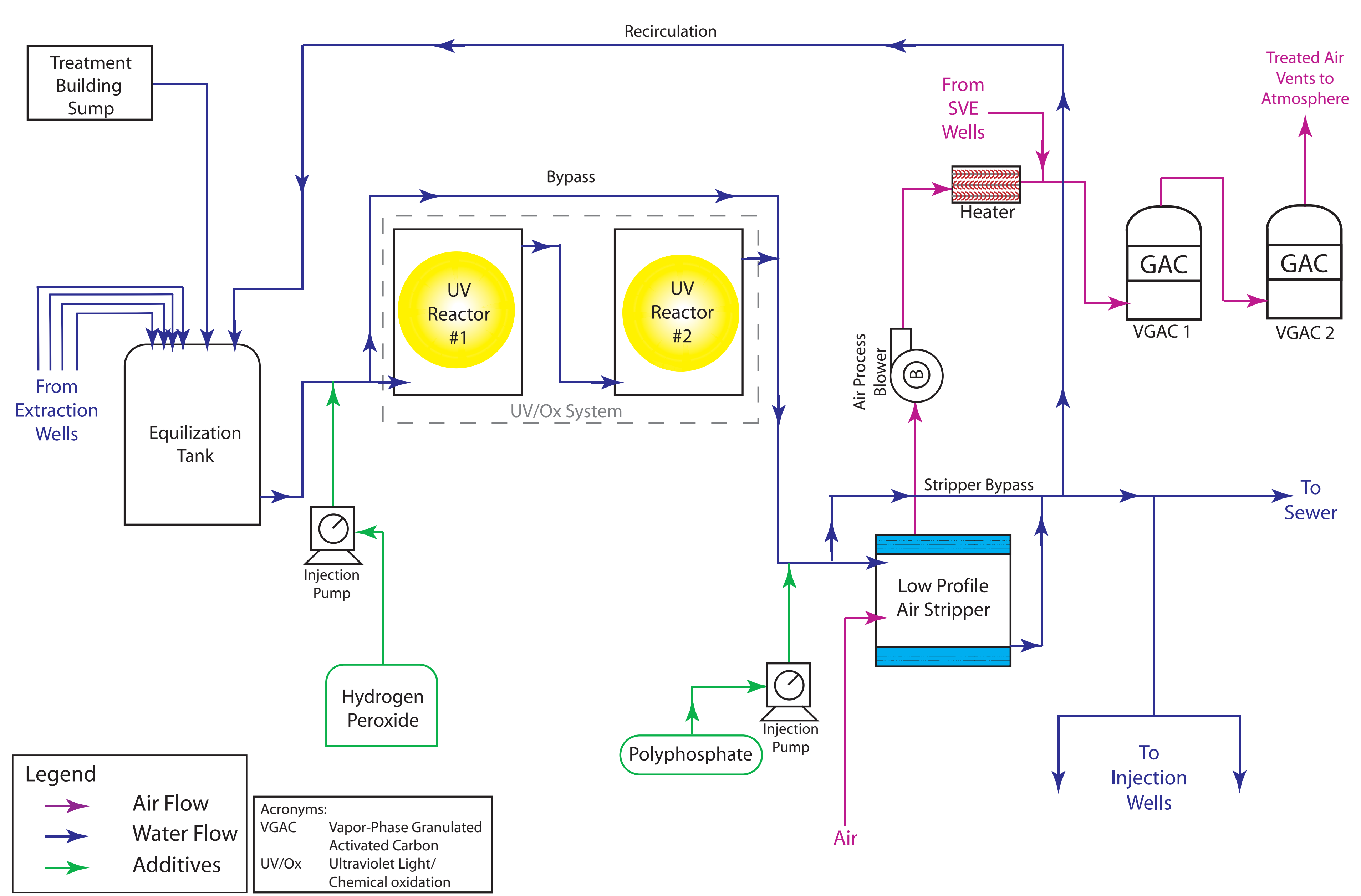
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 14
Area 7 SVE and Extraction Well Locations



Drawing Not to Scale

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 15
Area 7 Groundwater Extraction and Treatment System Process Flow Schematic

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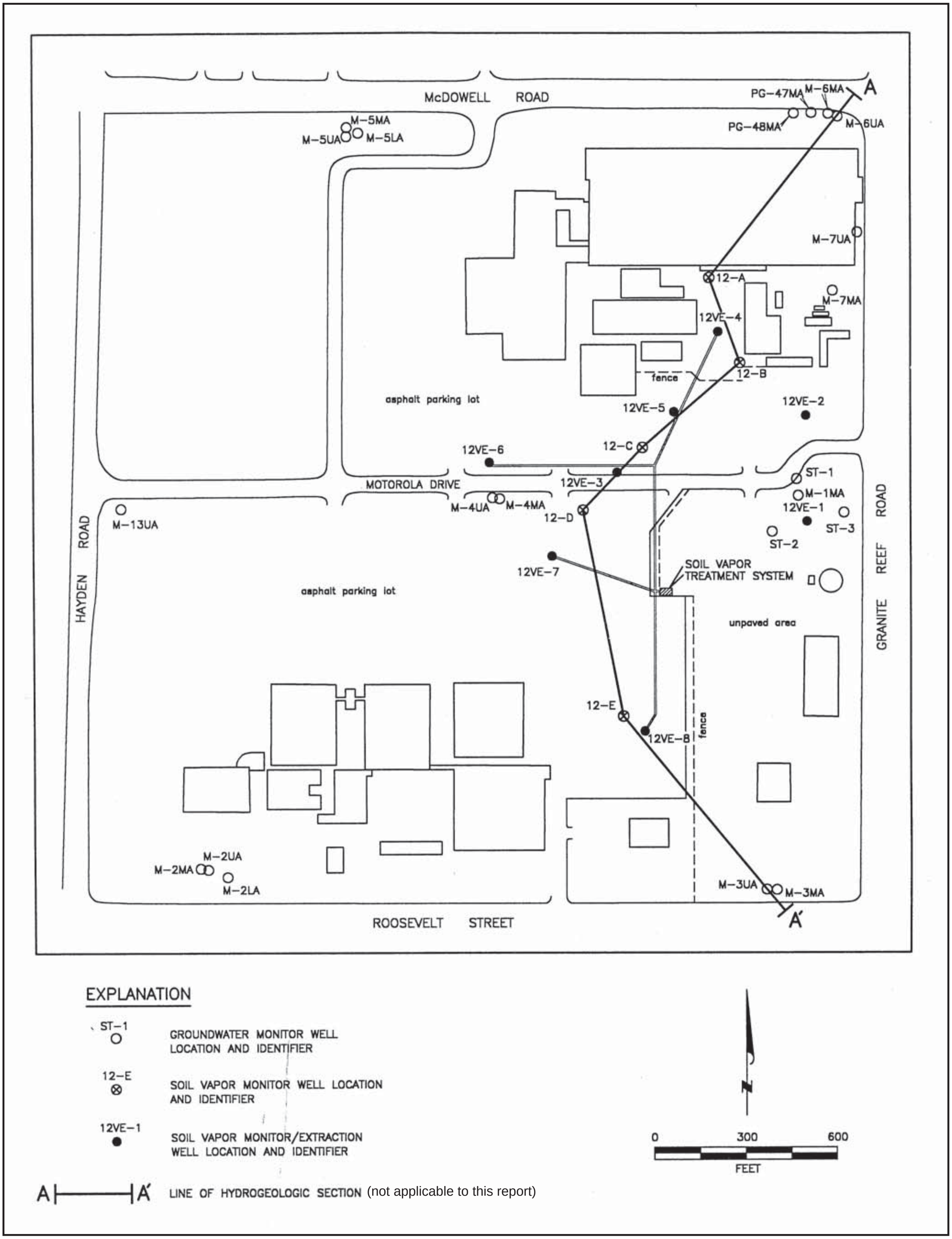

Image courtesy of Levine Fricke,

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 16
Area 12 Site Layout

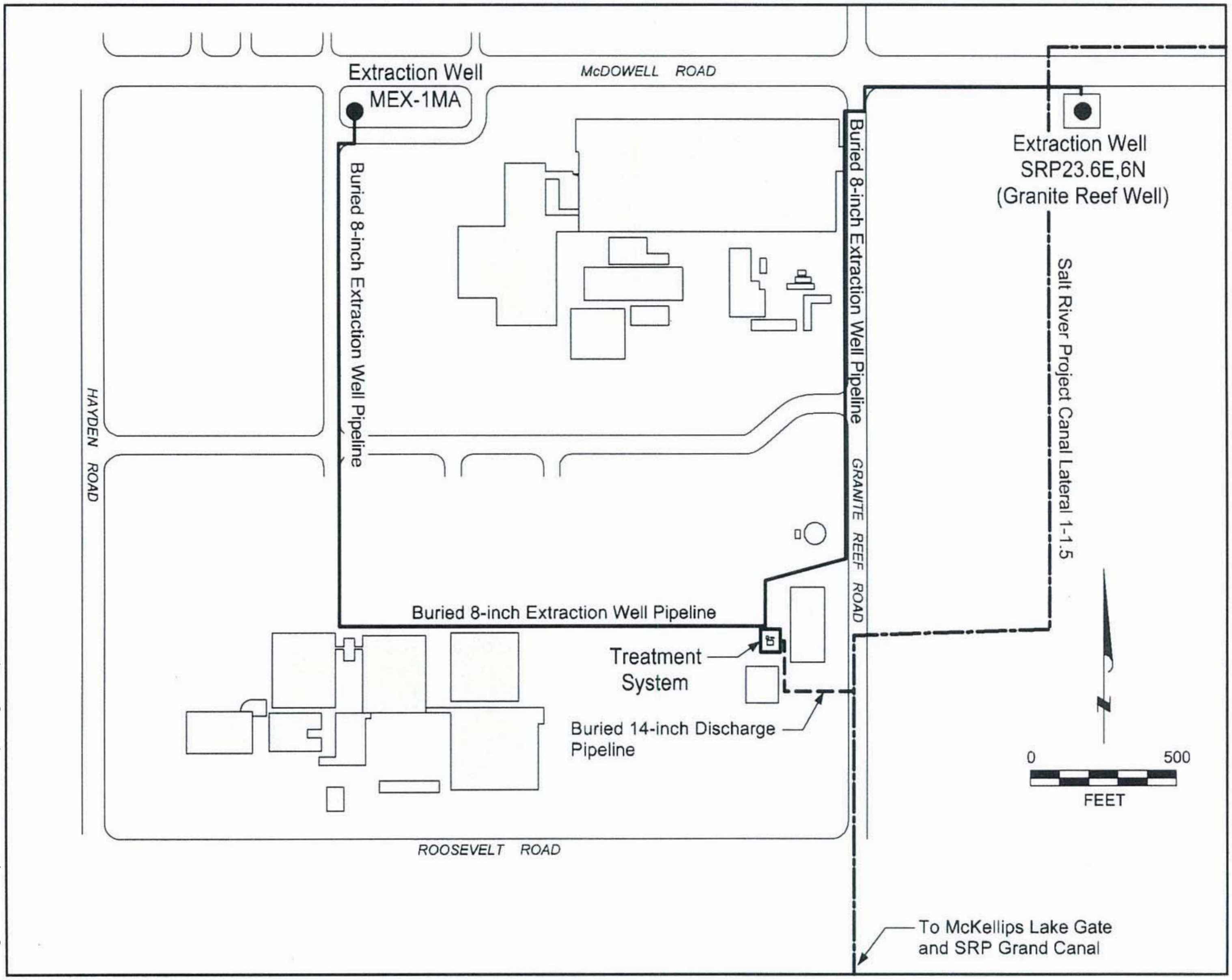

Image Courtesy of NIBW Participating Companies

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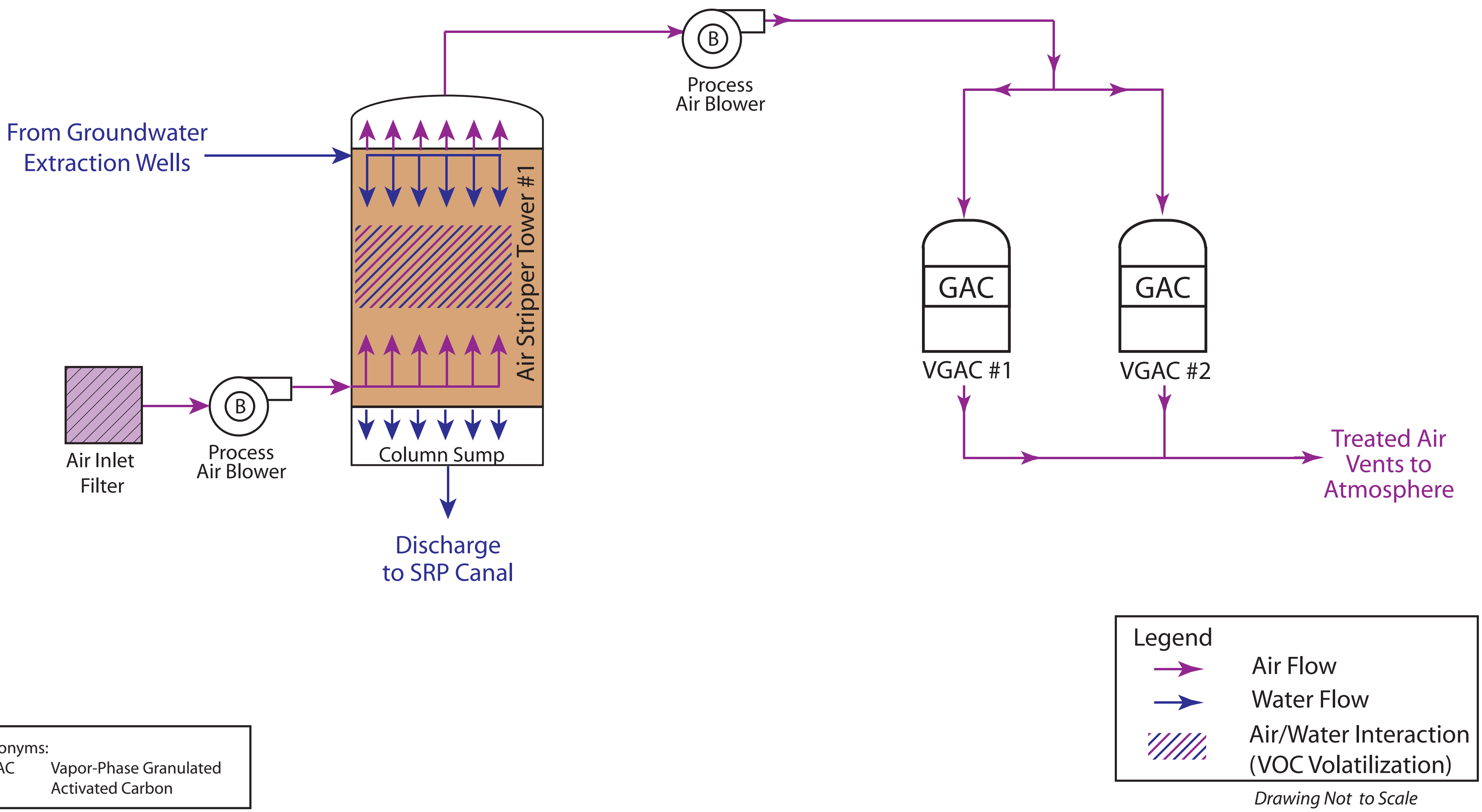
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 17
Area 12 Groundwater Extraction Well Network



Drawing Not to Scale

Acronyms:
VGAC Vapor-Phase Granulated Activated Carbon

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 18
Area 12 Groundwater Extraction and Treatment System

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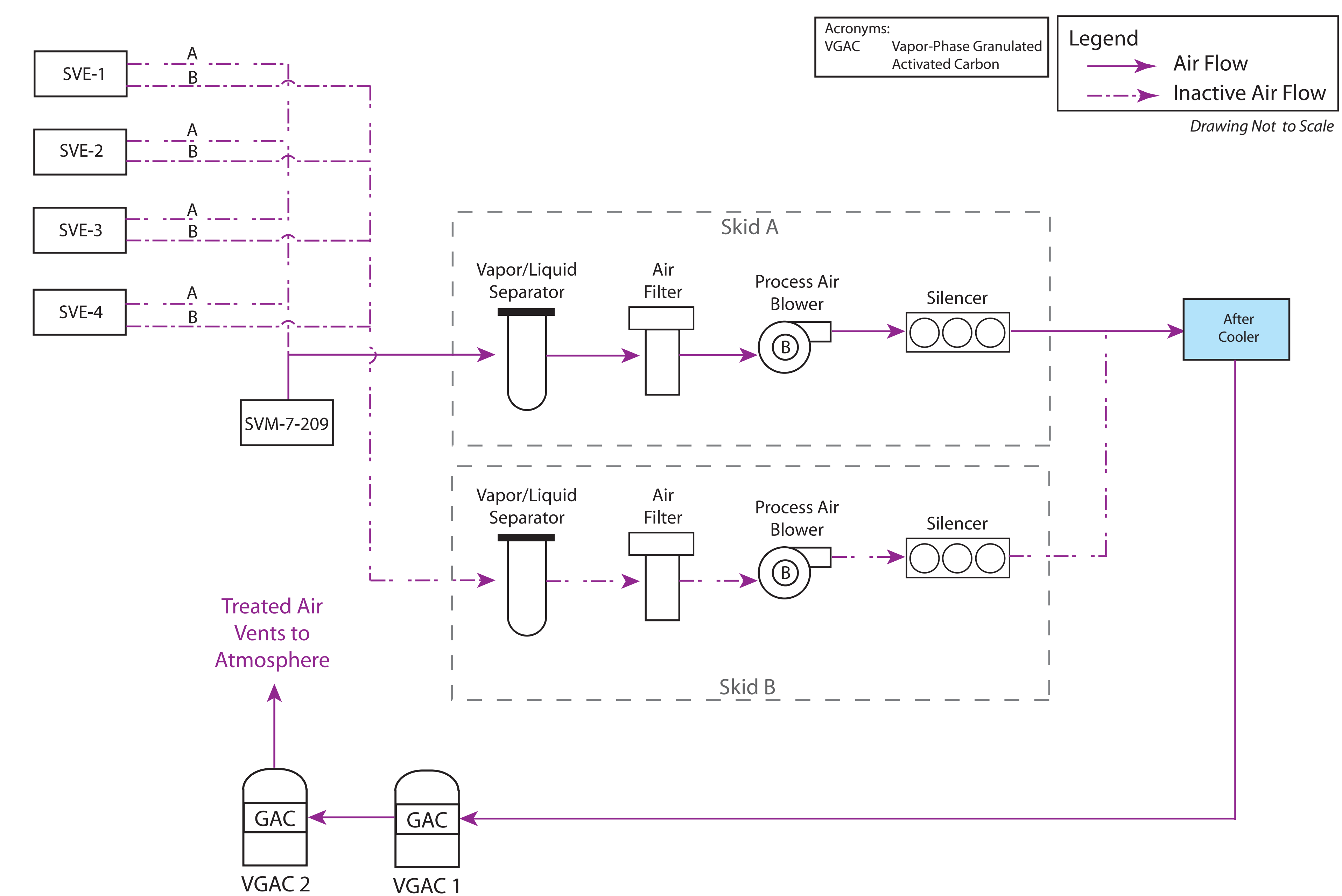

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Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 19
Area 7 SVE System
Process Flow Schematic

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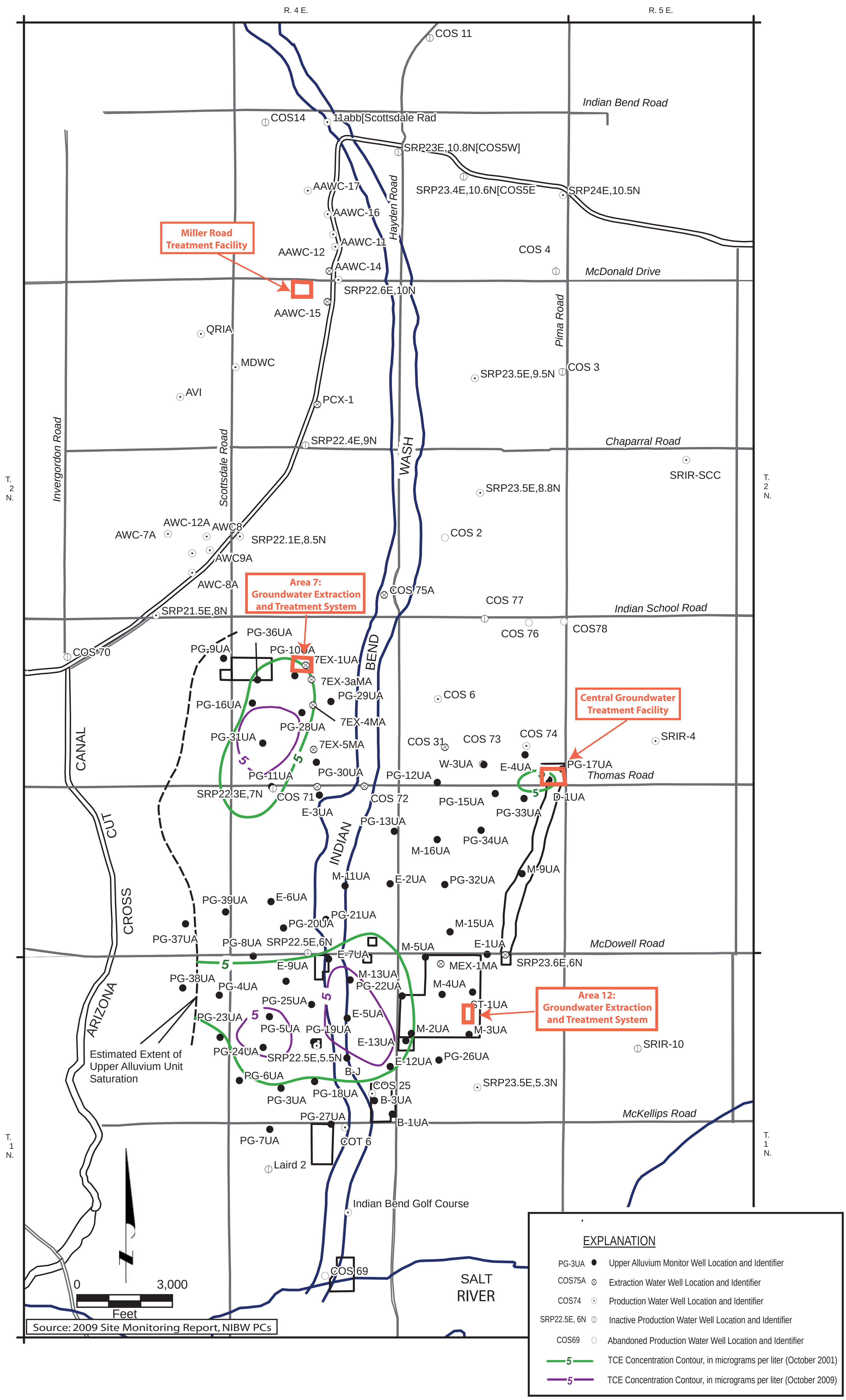

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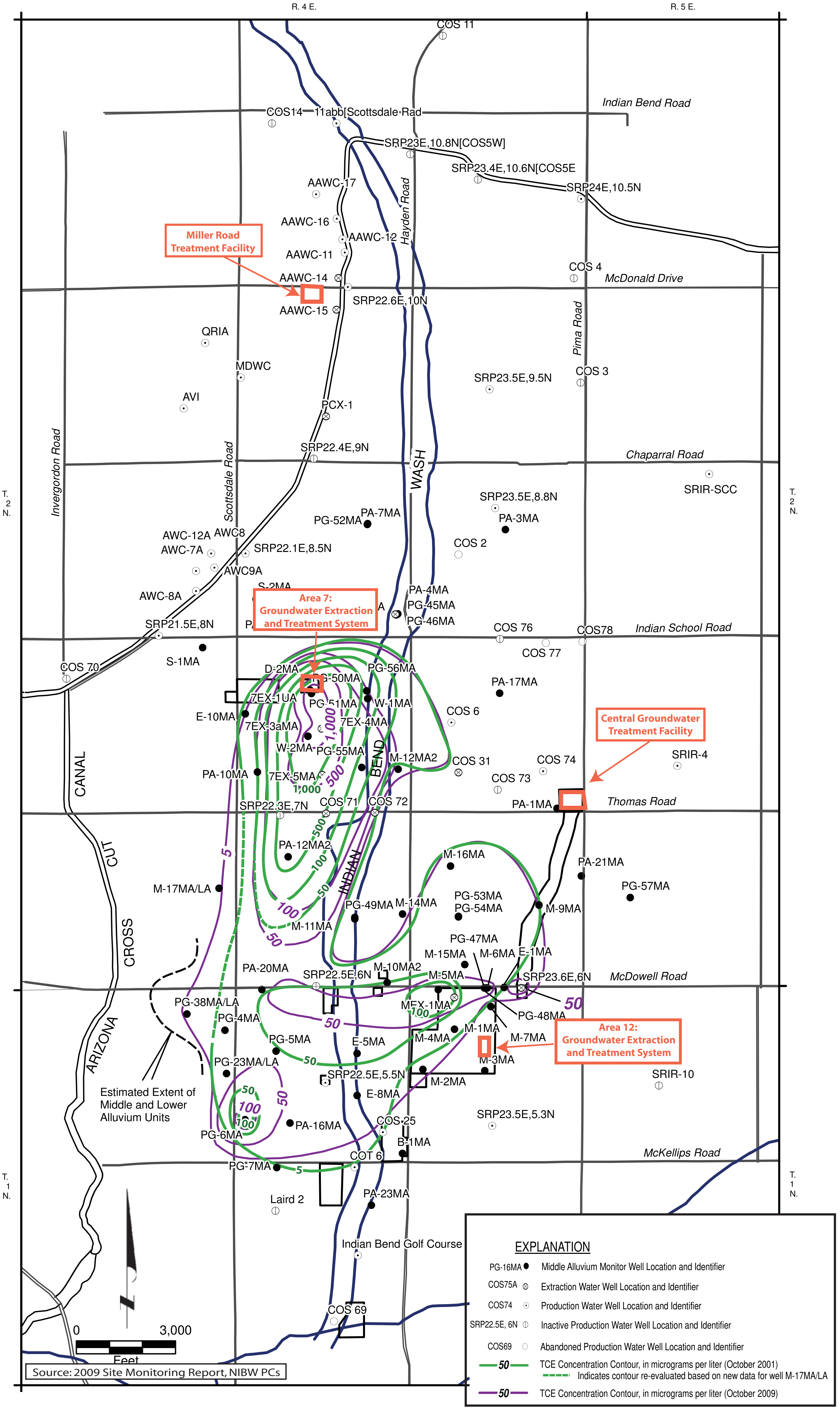
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 20-A
TCE Contours
NIBW Upper Alluvial Unit
October 2001 and October 2009



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 20-B
TCE Contours
NIBW Middle Alluvial Unit
October 2001 and October 2009

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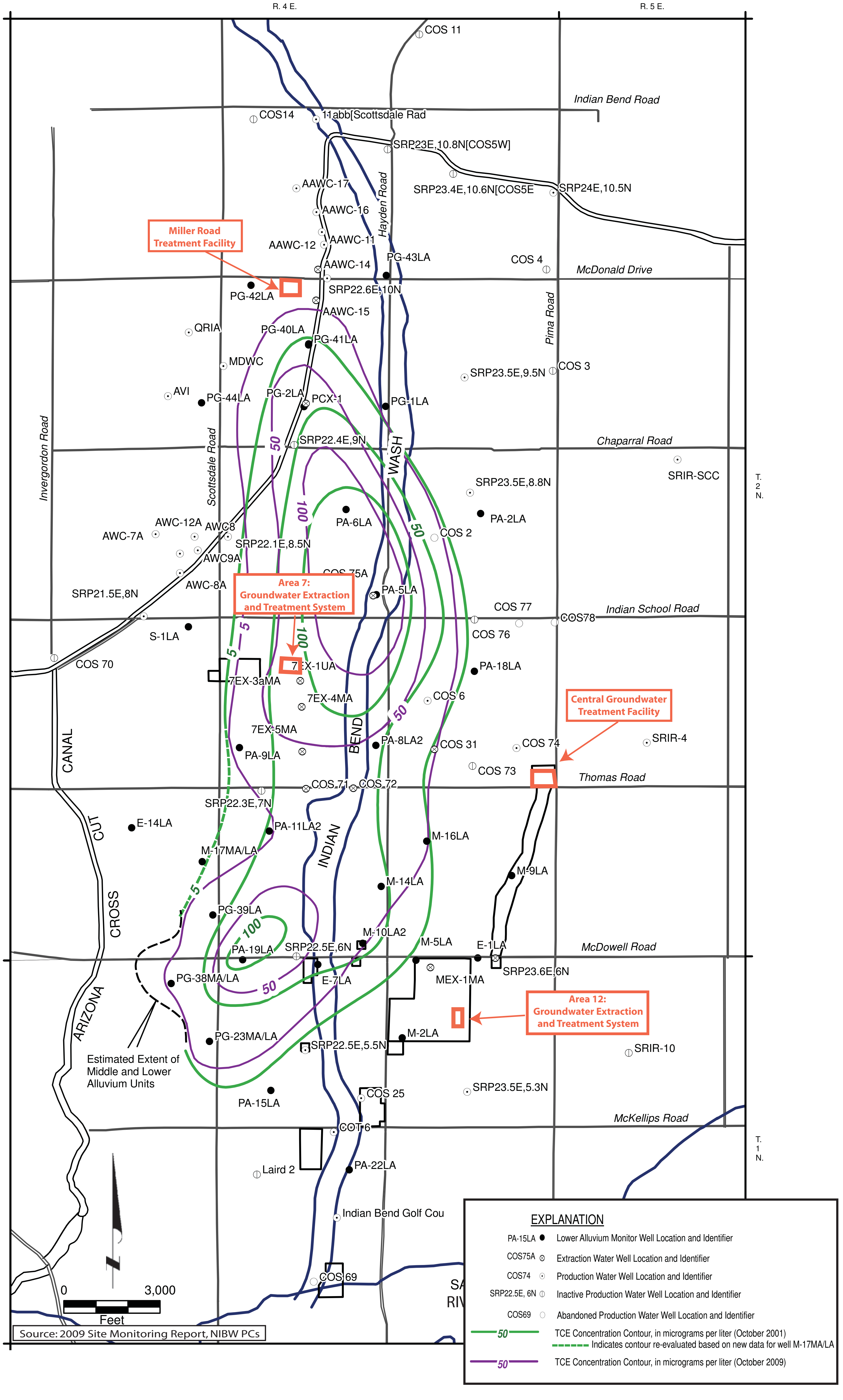

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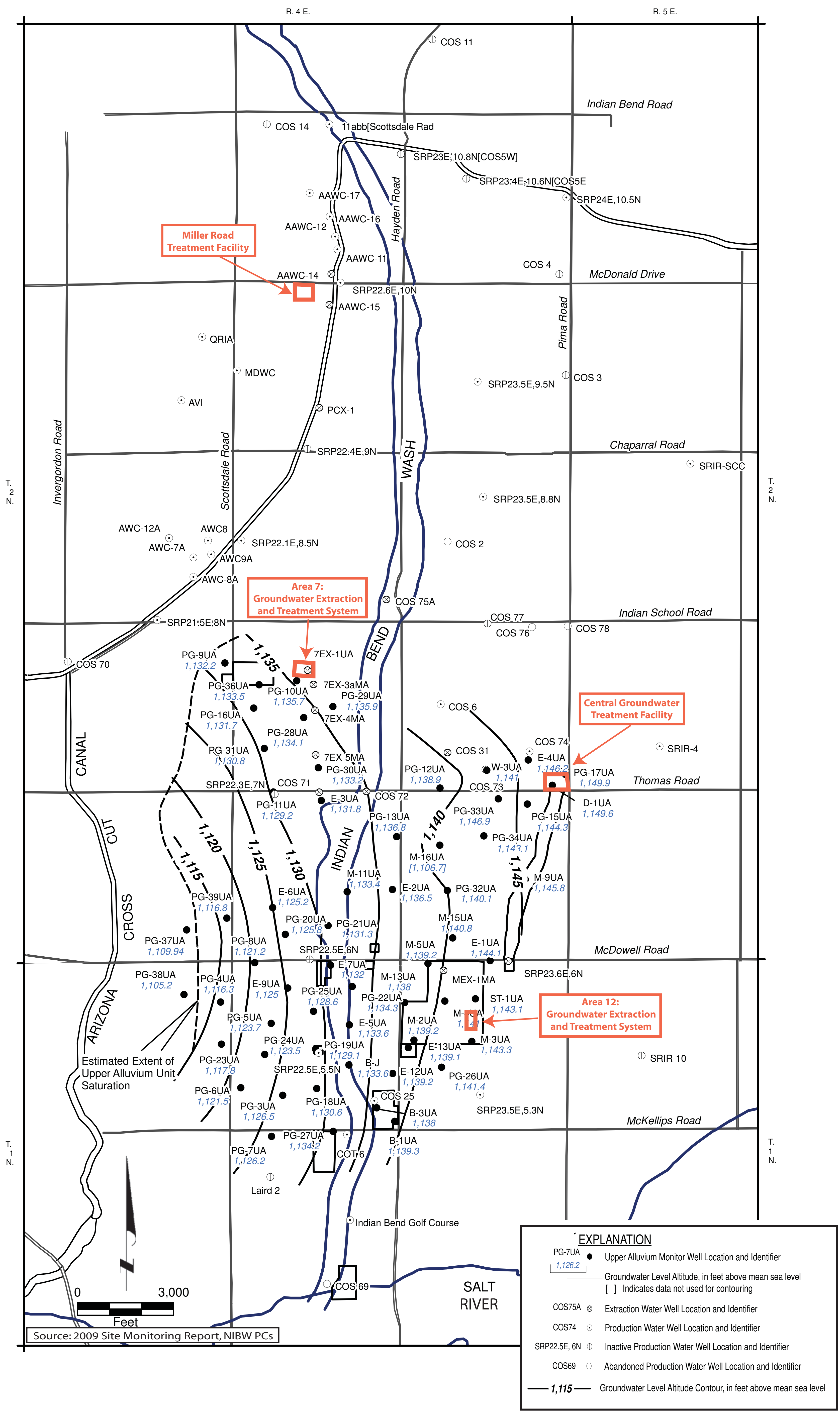
Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 20-C
TCE Contours
NIBW Lower Alluvial Unit
October 2001 and October 2009



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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 21-A
Groundwater Elevation Contours
NIBW Upper Alluvial Unit
October 2009

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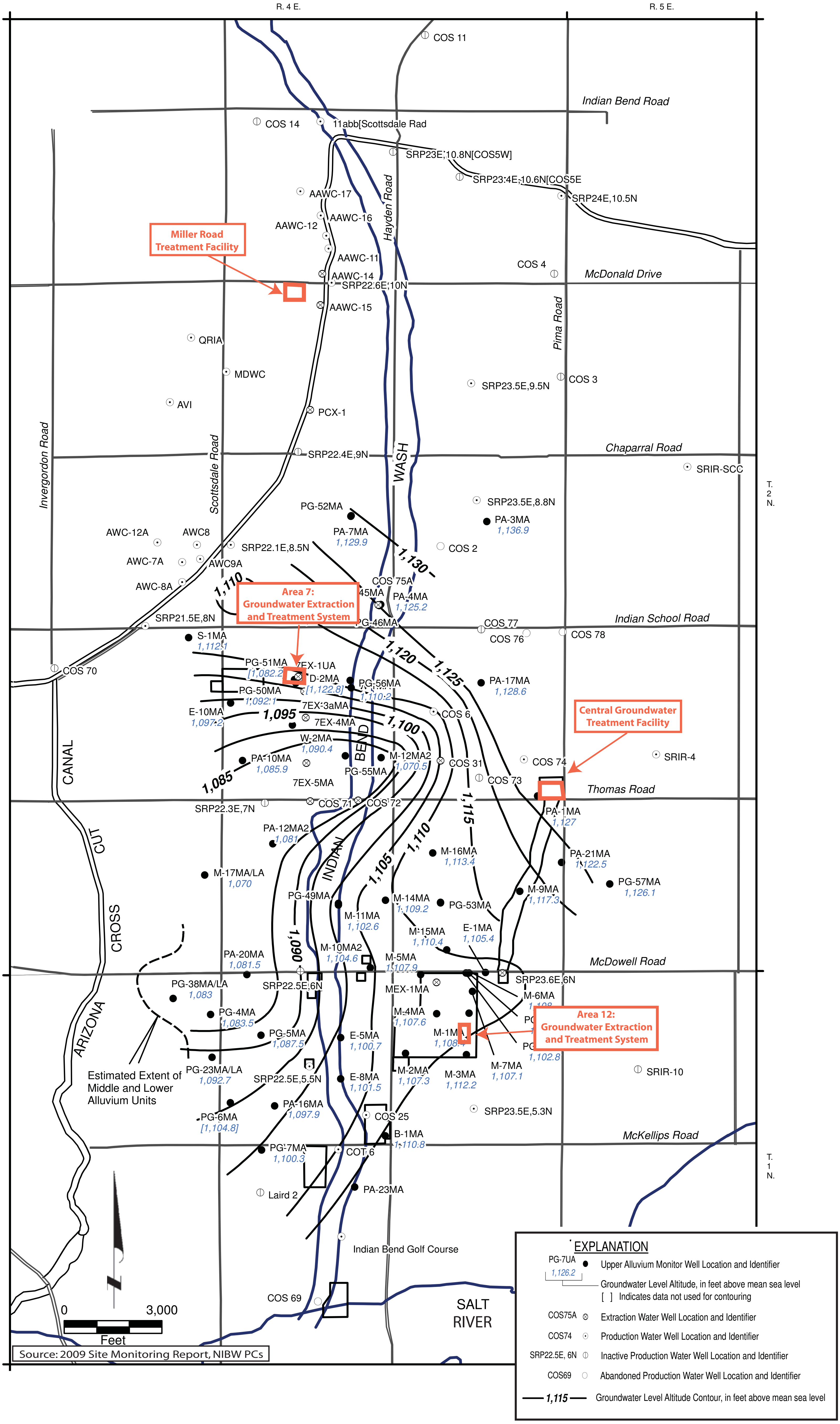

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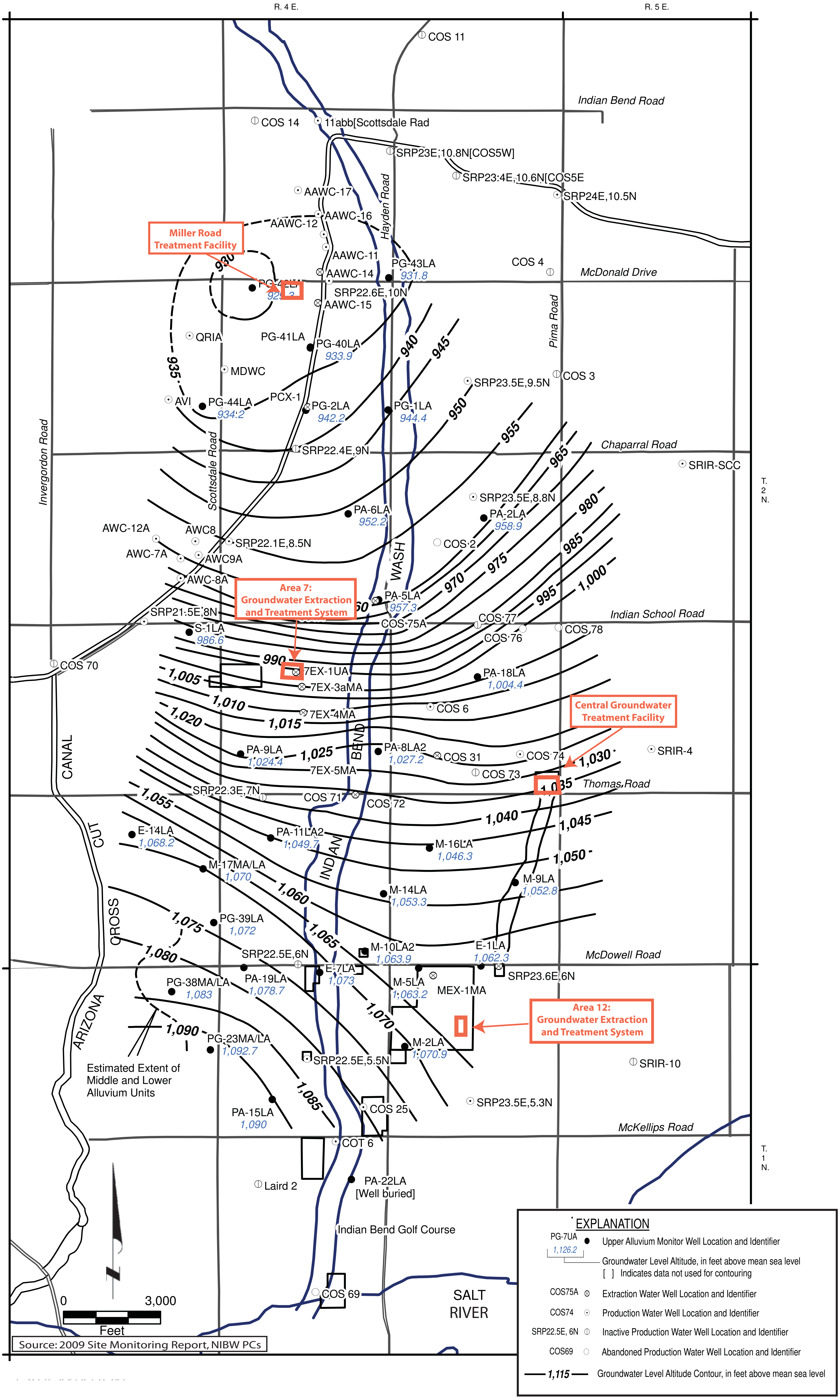
Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 21-B
Groundwater Elevation Contours
NIBW Middle Alluvial Unit
October 2009



Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

Figure 21-C
Groundwater Elevation Contours
NIBW Lower Alluvial Unit
October 2009

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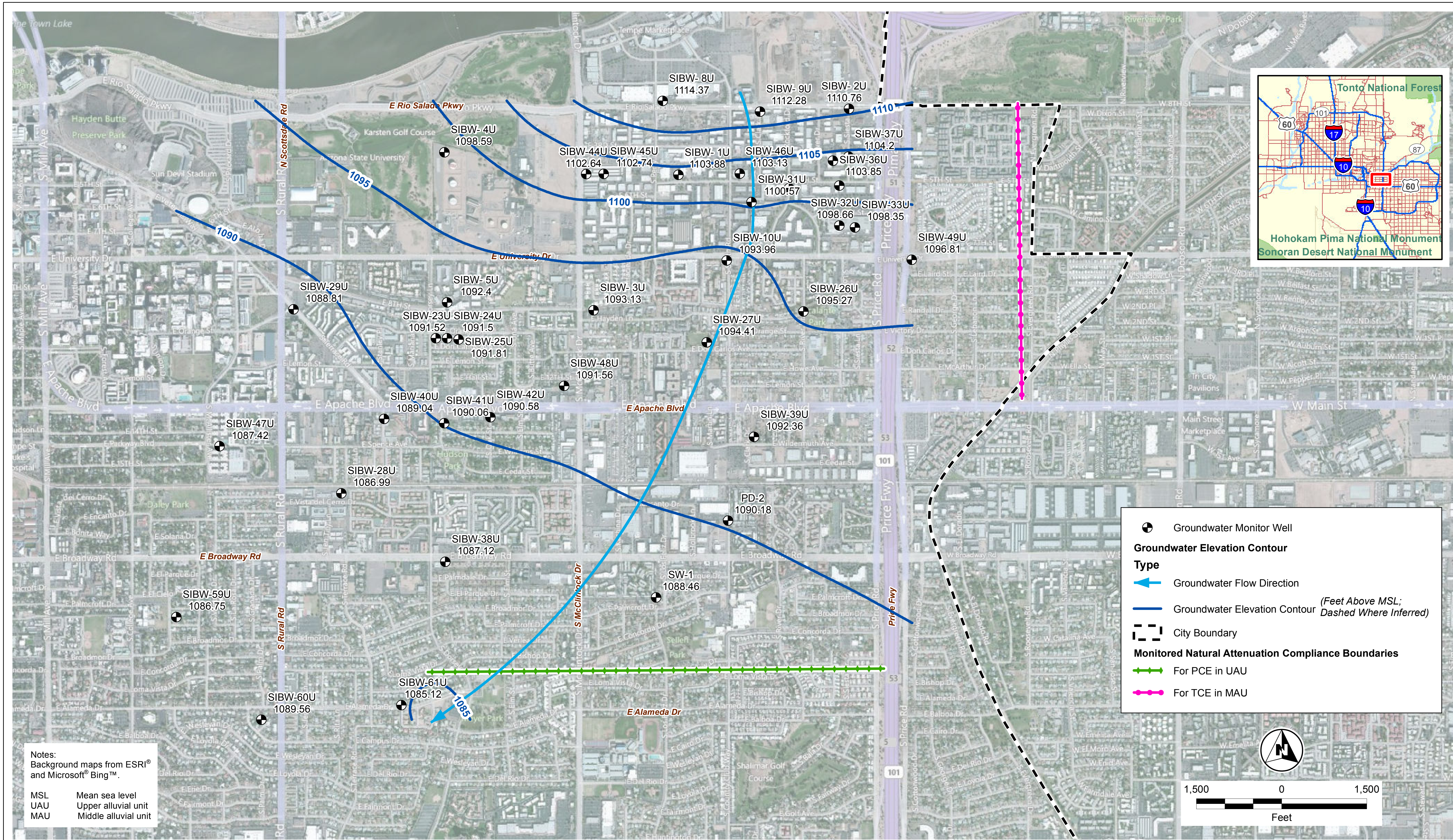

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 22
Groundwater Elevation Contours
SIBW Upper Alluvial Unit
2004

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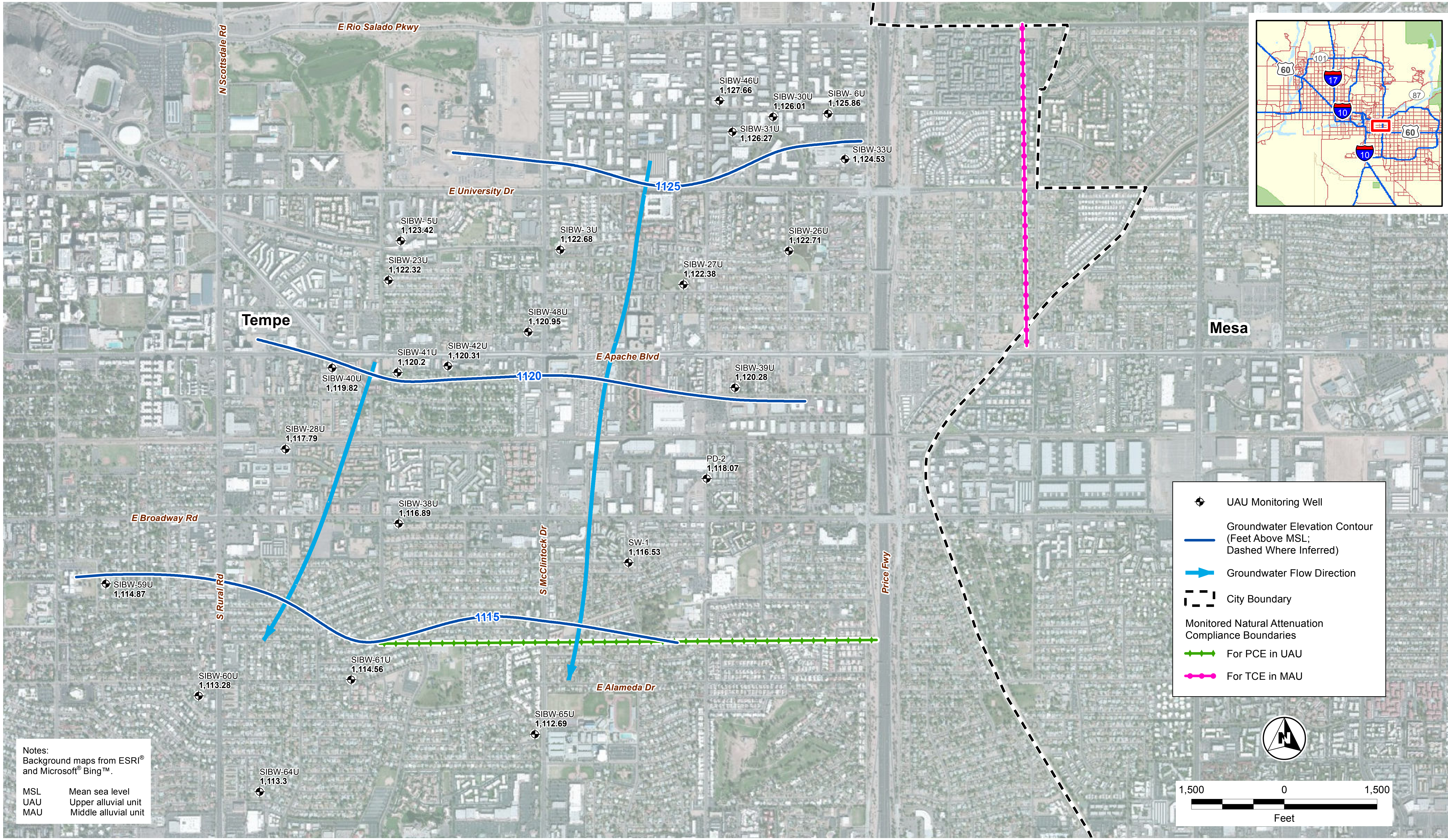

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 23
Groundwater Elevation Contours
SIBW Upper Alluvial Unit
2010

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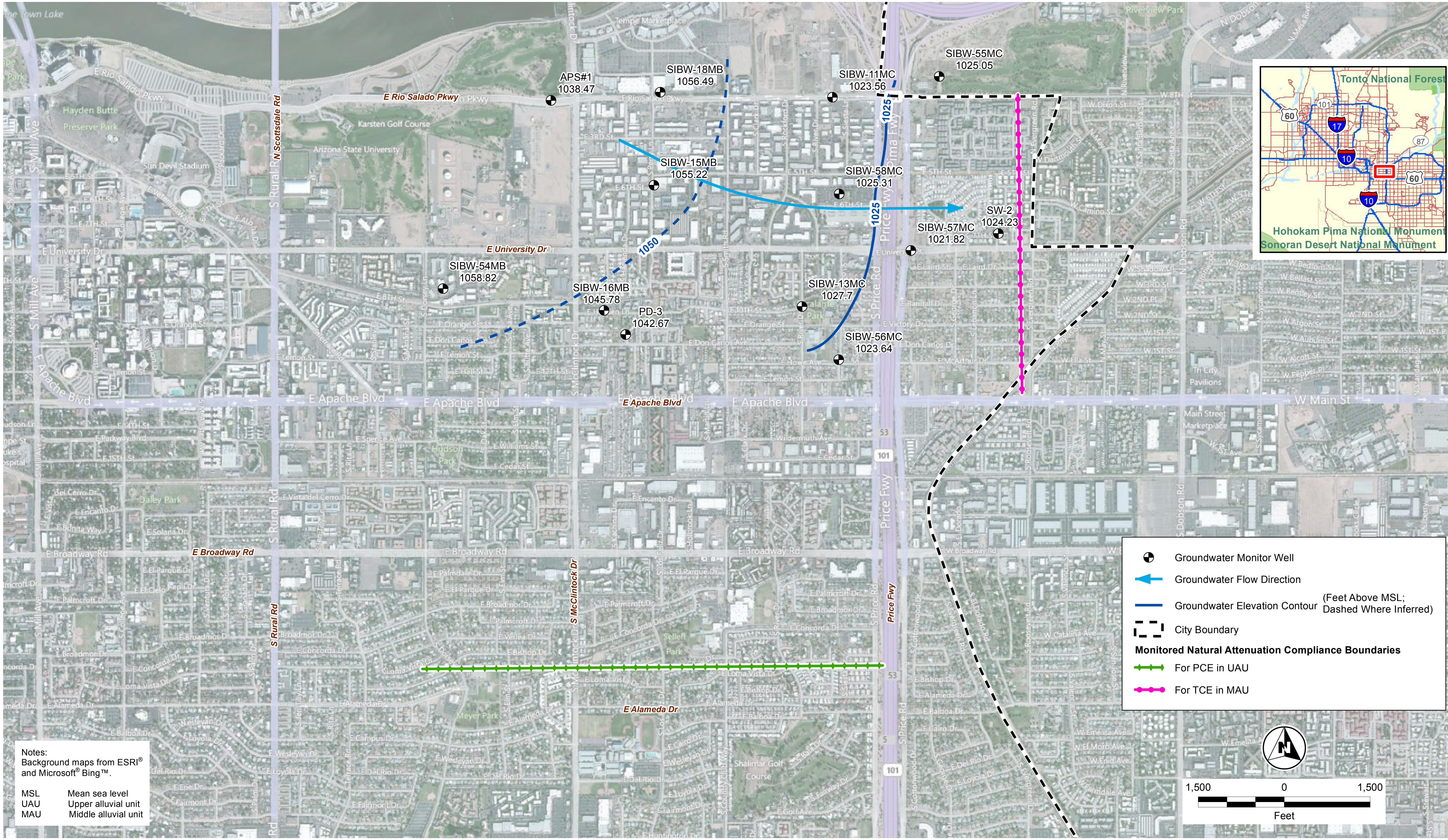

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 24
Groundwater Elevation Contours
SIBW Middle Alluvial Unit
2004

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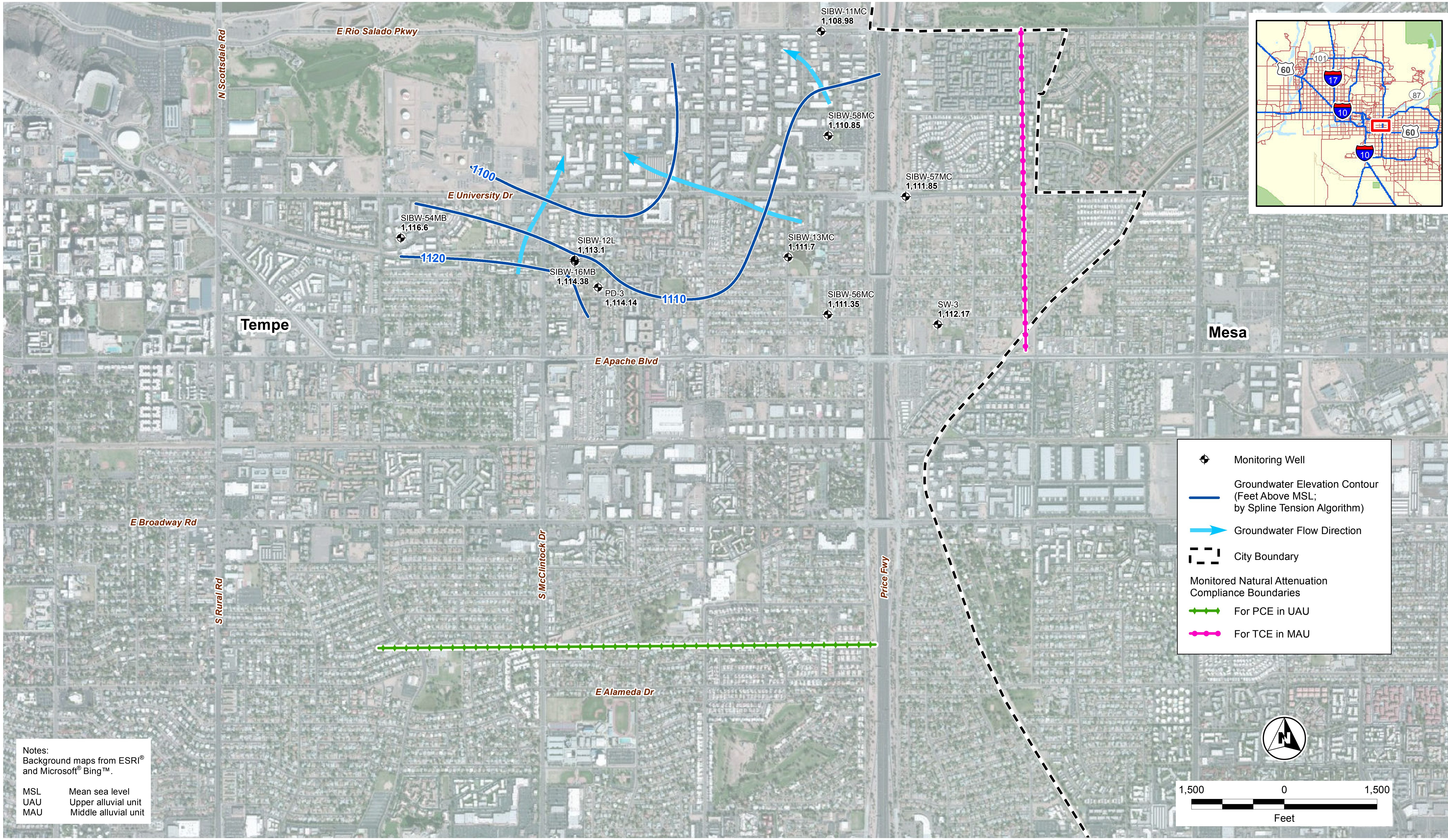

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Five-Year Review Report
Indian Bend Wash Superfund Site
Scottsdale and Tempe, Arizona

FIGURE 25
Groundwater Elevation Contours
SIBW Middle Alluvial Unit
2010

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