UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND - REGION I
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April 10, 2017

Mr. John McHugh
U.S. Department of the Army
Environmental, Safety & Health Office
Soldiers Systems Center
General Green Ave
Natick, Massachusetts 01760-5049

Re: *Third Five-Year Review Report (2012-2017) for the Natick Soldier Systems Center*

Dear Mr. McHugh:

This office is in receipt of the Army's Third Five-Year Review Report for the Natick Soldier Systems Center, dated April 2017. EPA reviewed the report for compliance with the *Comprehensive Five-Year Review Guidance* (OSWER Directive No. 9355.7-03B-P dated June 2001). The report discusses all four (4) operable units (OUs) at the Site and makes a short term protectiveness determination for one of those operable units, OU1 (Site-Wide Groundwater Area). The protectiveness statement is required for OU1 only because hazardous substances, pollutants or contaminants remain at OU1.

The OU1 Record of Decision (ROD) for ground water extraction, pump and treat (P&T) with an air stripper and carbon filtration, institutional controls (ICs), monitored natural attenuation (MNA), and long-term ground water monitoring (LTM) was signed on September 19, 2001. An Explanation of Significant Differences (ESD) was signed on May 13, 2013 for OU1. The ESD added all site wide groundwater (AOC's Buildings 22 & 36; Buildings 63, 2, & 45; ARIEM Building; and the MW114-B Area) to the existing operable unit.

EPA concurs with the Army's determination that the remedy is protective in the short term since no one is drinking the water, most of the contamination is contained onsite, and what is migrating offsite is not causing a current risk. However, the Army and EPA agreed that additional work is needed to optimize the extraction system to clean up the part of the plume that is migrating towards the Pegan Cove on the eastern part of the site. Trichloroethene (TCE) remains above the cleanup level in this area following two years of periodic slug volume removal. Therefore, the follow-up action is to optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of TCE contamination in the ARIEM Building Area by August 2017.

Land use controls play a key role in EPA's determination that this OU is protective. Army must continue to ensure that those institutional controls that are in place at the Natick Soldiers Systems Center remain effective until such time that they are no longer necessary and that the remedy in place is protective over the long-term.

This third five-year review was triggered by the second Five-Year Review, completed in April 2012. Consistent with Section 121(c) of CERCLA, the next Five-Year Review must be finalized by April 2022.

Sincerely,

Bryan Olson, Director
Office of Site Remediation and Restoration

cc: Anni Loughlin, EPA-New England
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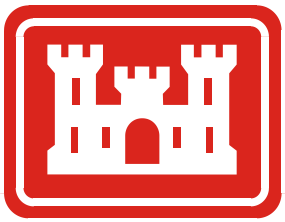
FINAL 2017 THIRD FIVE-YEAR REVIEW REPORT
For
U.S. Army Natick Soldier Systems Center
Natick, Massachusetts

Prepared for:

U.S. Army Natick Soldier Systems Center
Natick, Massachusetts
and
U.S. Army Environmental Command,
Fort Sam Houston, Texas

Prepared by:



U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

April 2017

FINAL 2017 THIRD FIVE-YEAR REVIEW REPORT

For

U.S. Army Natick Soldier Systems Center

Natick, Massachusetts

Prepared for:

U.S. Army Natick Soldier Systems Center
Natick, Massachusetts
and
U.S. Army Environmental Command,
Fort Sam Houston, Texas

Prepared by:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

April 2017

APR 0 4 2017

Ryan L. Raymond
Lieutenant Colonel, U.S. Army
Garrison Commander

Date

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ABBREVIATIONS AND ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
ARIEM	U.S. Army Research Institute for Environmental Medicine
Army	U.S. Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	contaminants of concern
CVOC	chlorinated volatile organic compound
DDT	dichlorodiphenyltrichloroethane
DoD	Department of Defense
ECC	Environmental Chemical Corporation
ERA	ecological risk assessment
ESD	Explanation of Significant Differences
ETA	Engineering Technology Associates, Inc.
FFA	Federal Facility Agreement
FFS	focused feasibility study
FPGS	Former Proposed Gymnasium Site (FPGS)
FR	Federal Register
FS	feasibility study
ft	feet
ft/day	feet per day
FYR	Five-Year Review
gpm	gallons per minute
GWETS	groundwater extraction and treatment system
HHRA	human health risk assessment
HI	hazard index
IC	institutional controls
LGAC	liquid phase granular activated carbon
LTM	long-term monitoring
LTMP	Long-Term Monitoring Plan
µg/L	micrograms per liter
MassDEP	Massachusetts Department of Environmental Protection
MCL	maximum contaminant level
MCP	Massachusetts Contingency Plan
mg/L	milligrams per liter
msl	mean sea level

NAE	North Atlantic Division, New England District
NCP	National Oil and Hazardous Substances Contingency Plan
NERI	New England Research Institute
NFA	No Further Action
NPL	National Priorities List
NSSC	Natick Soldier Systems Center
O&M	operations and maintenance
OU	operable unit
PCB	polychlorinated bipheynls
PCE	tetrachloroethene
PP	Proposed Plan
ppb	parts per billion
ppm	parts per million
ppmv	parts per million by volume
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
SARA	Superfund Amendment and Reauthorization Act
SSI	Supplemental Site Investigation
SVOC	semi-volatile organic compound
TBC	To Be Considered
TCE	trichloroethene/trichloroethylene
TS	treatability study
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
U.S. EPA	U.S. Environmental Protection Agency
USTHAMA	U.S. Army Toxic and Hazardous Materials Agency
UU/UE	unlimited use/unrestricted exposure
VI	vapor intrusion
VGAC	vapor phase granular activated carbon
VOC	volatile organic compound

EXECUTIVE SUMMARY

This is the third five-year review (FYR) report for the U.S. Army Natick Soldier Systems Center (NSSC) and was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) § 121, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 Code of Federal Regulations (CFR) § 300.430(f)(4)(ii).

The purpose of the five-year review is to determine whether the remedy is protective of human health and the environment, and whether the remedy is functioning as intended. A FYR is required by statute when hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE). NSSC was listed on the National Priorities List (NPL) as a result of groundwater contamination found in the T-25 Area and its location relative to the Natick Springvale Municipal Water Supply Well Field.

NSSC is an active research and testing facility owned and operated by the federal government through the Department of the Army. NSSC is located approximately 17 miles west-southwest of Boston in Natick, MA (Figure 1). NSSC has been a permanent Army installation since October 1954. The facility is on a peninsula and is bounded by Lake Cochituate to the south, east and west and by a residential area to the north and northwest. A security fence currently surrounds NSSC. The groundwater beneath the Site is designated as a Zone II wellhead protection area for the Town of Natick's Springvale municipal water supply well field.

Operations at the NSSC include or have included research and development activities in food engineering, food service, clothing, equipment, materials, engineering and aero-mechanical engineering. Some of these operations used solvents including tetrachloroethene (PCE) and trichloroethene (TCE), which resulted in releases to the environment in the past.

NSSC is divided into four operable units (OUs) for environmental cleanup.

OU1 - Groundwater (Facility-wide and T-25 Area)

OU2 - Sediment

OU3 - Soil Removal Actions (Former Proposed Gym Site and Building T62 and T68 Area)

OU4 – Soil Removal Actions (Former Buildings 13 and 14 Area, Boiler Plant Area, and T-25 Area)

A preliminary close out report prepared by the United States Environmental Protection Agency (U.S. EPA) in December 2014 (U.S. EPA, 2014b) concluded that response actions have been completed for the OUs. The response actions at OU2 included the removal of 4,395 cubic yards of PCB-contaminated sediment from three hotspots in Lake Cochituate (Pegan Cove) to unrestricted reuse levels (ICF International, 2010b). OU3 and OU4 included several areas where soil removal actions were performed to unrestricted exposure levels (MATEC, 2007a and ICF International, 2008).

For OU1, the subject of this FYR, the Army continues to operate a groundwater treatment plant to meet remedial action objectives and performance metrics specified in the 2001 Record of Decision (ROD) (U.S. Army, 2001) and 2013 Explanation of Significant Differences (ESD) (U.S. Army, 2013) for the T-25 Area Ground Water (OU1).

OU1 includes all of the contaminated groundwater at NSSC. Site locations (current and historical) are

shown on Figure 2. The areas of remaining PCE and TCE contamination are shown on Figure 3.

The remedy for OU1 as specified in the 2001 ROD included the following components to address the primary chemical of concerns (PCE and TCE). Secondary contaminants of concern were also identified as they resulted in increased site risk.

- Groundwater extraction with air stripping and carbon absorption
- Long-term monitoring
- Institutional controls
- Monitored natural attenuation

The remedial action objectives specified in the 2001 ROD are:

- Prevent contamination in the groundwater, above federal and state drinking water standards, from migrating outside of the T-25 Area toward off-facility receptors;
- Prevent any potential exposure to groundwater beneath the T-25 area and off-facility with contaminant concentrations in excess of federal and state drinking water standards;
- Restore aquifer to drinking water standards within a reasonable time frame; and
- Monitor potential future migration of groundwater contamination to verify that elevated concentrations decrease over time.

OU1 was later expanded as specified in the 2013 ESD to include:

- Increased flow to the T-25 Area Treatment Facility from the Buildings 22 and 36 Area, the Buildings 63, 2 and 45 Area, the MW114B-2 Area, and the Building 42, U.S. Army Research Institute for Environmental Medicine (ARIEM) Area
- Removal of the air stripper from the treatment train and the vapor phase carbon;
- Lowering the ROD cleanup level for manganese to correspond to the U.S. EPA health advisory for manganese
- Adding a clean-up level for 1,4-dioxane in accordance with Massachusetts Department of Environmental (MassDEP) Drinking Water Guidelines

Currently, groundwater remedial activities include: operation of extraction wells; groundwater treatment through the T-25 Area Treatment System located at Building 94; well-head pre-treatment for 1,4-dioxane in the Buildings 63, 2 and 45 area; periodic slug volume removal from wells outside the capture zones in two areas (the MW114B-2 and the ARIEM Building Areas); long-term monitoring for COCs (spring and fall sampling events) and land-use control verification to ensure no potable water supply wells are installed on or off-facility in a prescribed area.

The FYR team as part of this evaluation: (1) reviewed documents prepared during the five-year review period including the annual reports describing the operation of the treatment system; (2) evaluated data from the long-term monitoring program and treatment operations; (3) conducted a site inspection to assess the treatment systems and remedy components; and (4) completed interviews with individuals involved in the cleanup. The results of this review are summarized in the report and overall conclusions are discussed below.

The remedy at OU1 currently protects human health and the environment. PCE and TCE concentrations in groundwater continue to decline, and the extraction wells prevent migration of these contaminants.

Isolated locations of PCE and TCE in groundwater outside the plume capture zone are pumped at the well locations and trucked to the T-25 Treatment System at Building 94. Institutional controls as documented by the annual institutional control certifications prepared by the U.S. Army and Town of Natick during the FYR continue to prohibit the use or installation of private drinking water wells within or near the plume, where the restriction is applied. However, in order for the remedy to be protective in the long-term, the following action needs to be taken:

1. Optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of trichloroethene contamination in the ARIEM Building Area; TCE remains above the cleanup level in this area following two years of periodic slug volume removal.

This FYR also includes recommendations that do not affect overall protectiveness of the remedy but may enhance the evaluation and performance of the groundwater extraction system. These recommendations are included in Section 9.1.

The Five-Year Review Summary Form is included as Table 1.

Table 1

Five -Year Review Summary Form

SITE IDENTIFICATION		
Site Name: U.S. Army Natick Soldier Systems Center		
EPA ID: MA1210020631		
Region: 1	**State:** MA	**City/County:** Natick/Middlesex
SITE STATUS		
NPL Status: NPL		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Army		
Author name (Federal or State Project Manager): U.S. Army Corps of Engineers		
Author affiliation: Department of Defense		
Review period: September 1, 2016 – November 4, 2016		
Date of site inspection: U.S. Army Corps of Engineers Inspection (September 7, 2016) and U.S. EPA Inspection (October 6, 2016)		
Type of review: Policy		
Review number: 3		
Triggering action date April 12, 2012		
Due date *(five years after triggering action date)*: April 12, 2017		

Table 1 (Continued)

Issues and Recommendations Identified in the Five-Year Review:				
Operable Unit 1 – Groundwater	**Issue Category:** Remedy Performance			
	Periodic slug volume removal in ARIEM Building Area has not reduced TCE concentrations to below MCLs.			
	Recommendations: Optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of trichloroethene (TCE) contamination in the ARIEM Building Area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Army	EPA and MassDEP	August 2017

Protectiveness Statement

Groundwater Operable Unit 1	*Protectiveness Determination: Short-term Protective*	*Addendum Due Date (if applicable): N/A*

Protectiveness Statement:

The remedy at OU1 currently protects human health and the environment. PCE and TCE concentrations in groundwater continue to decline and the groundwater extraction wells prevent migration of these contaminants. Isolated locations of PCE and TCE in groundwater outside the plume capture zone are pumped at the well locations and trucked to the T-25 Treatment System at Building 94. Institutional controls as documented by the annual institutional control certifications prepared by the U.S. Army and Town of Natick during the FYR continue to prohibit the use or installation of private drinking water wells within or near the plume, where the restriction is applied. However, in order for the remedy to be protective in the long-term, the following action needs to be taken:

1. Optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of trichloroethene contamination in the ARIEM Building Area; TCE remains above the cleanup level in this area following two years of periodic slug volume removal.

Other Comments:

None.

Sitewide Protectiveness Statement	
Protectiveness Determination: *Protective*	*Addendum Due Date* *If applicable: N/A*

Protectiveness Statement:

The remedy at the Site currently protects human health and the environment because the groundwater exposure is mitigated through institutional controls and the extraction wells contain the plume from moving to the Town of Natick's Water Supply Wells. However, in order for the remedy to be protective in the long-term, the Army needs to optimize the slug volume removal process or evaluate and implement alternative methods to address the localized areas of TCE contamination in the ARIEM Building Area.

1.0 INTRODUCTION

This five-year review (FYR) evaluates the performance of the groundwater remedy (Operable Unit [OU] 1) implemented at the Natick Soldier Systems Center (NSSC) in Natick, Massachusetts. This is the third five-year review for NSSC.

The purpose of this FYR is to determine whether the groundwater remedy is protective of human health and the environment, and whether the remedy is functioning as intended. A FYR is required by statute (at least once every five years) when hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The FYR was conducted by the United States Army Corps of Engineers New England District on behalf of the U.S. Army in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121(c) and the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan, NCP) as described below.

CERCLA § 121c, 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 U.S. Environmental Protection Agency (U.S. EPA) interpreted this requirement further in the NCP; 40 CFR § 300.430(f)(4)(ii) 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."

Management of the contamination at the facility was divided into four operable units. These OUs are listed in Table 2. A preliminary close out report prepared by U.S. EPA in December 2014 (U.S. EPA, 2014b) concluded that response actions have been completed for the operable units. The response actions at OU2 included the removal of 4,395 cubic yards of PCB-contaminated sediment from three hotspots in Lake Cochituate (Pegan Cove) to unrestricted reuse levels (ICF International, 2010b). OU3 and OU4 included several areas where soil removal actions were performed to unrestricted exposure levels (MATEC, 2007 and ICF International, 2008).

At OU1, remaining long-term actions include operation and maintenance of the groundwater treatment system and annual reporting until performance metrics specified in the 2001 ROD are met.

Table 2

Summary of Operable Units, Natick Soldier Systems Center

Operable Unit (OU) Name	Army Designation	Decision Document/Status
OU1 – Groundwater (Facility Wide including T-25 Area, Buildings 22 and 36 Area, Buildings 63, 2 and 45 Area, Monitoring Well 11B-2 Area and ARIEM Building Area)	NRDEC-05 (T-25 Groundwater Area) NRDEC-11 (Post Drinking Water Wells) NRDEC-16 (Buildings 22 and 36)	Record of Decision (U.S. Army, 2001) Explanation of Significant Differences (U.S. Army, 2013) Continued operation of treatment system and long-term monitoring; FYR policy review required until unlimited use/unrestricted exposure (UU/UE) achieved.
OU2 – Sediment Sediment at transitory shelter at T-25 and Buildings 2 and 45 Parking Lot Outfall. Soil and sediment at Building 5, PCB Contamination Site.	NRDEC-07 (Transitory Shelter Area of T-25) NRDEC-10 (Building 5 PCB Contamination Site and Pad) NRDEC-17 (Building 2 and 45 Parking Lot Outfall)	Record of Decision (ICF International, 2009) Response action complete; conditions allow for UU/UE; no FYR required.
OU3 – Soil (Soil Removal Action Former Proposed Gym Site and Building T62 and T68 Area)	NRDEC-06 (Former Proposed Gym Site) NRDEC-03 (Buildings 62 and 68)	Record of Decision (MATEC, 2007a) Response action complete; conditions allow for UU/UE; no FYR required.
OU4 – Soil (Soil Removal Actions Former Buildings 13 and 14 Areas, Boiler Plant Area, and T-25 Area)	NRDEC-12 (Building 13) NRDEC-09 (Building 14) NRDEC-14 (Boiler Plant Area) NRDEC-16 (Storage Area/Chlordane Contamination)	Record of Decision (ICF International, 2008) Response action complete; conditions allow for UU/UE; no FYR required.

2.0 SITE CHRONLOGY

The site chronology presented in Table 3 includes the dates of major events associated with actions related to the investigation and cleanup of groundwater OU1 at NSSC.

Table 3

Chronology of Events for Operable Unit 1 (Groundwater), Natick Soldier Systems Center

Date	Event
1980	Installation Assessment – U.S. Army Toxic and Hazardous Materials Agency (USATHMA, 1980).
1989-1990	New England Research Institute (NERI) performed soil gas surveys in the T-25 Area (NERI, 1989 and 1990).
1991-1992	Expanded Site Investigations by Dames and Moore in the T-25 Area resulting in the installation of monitoring wells (Dames and Moore, 1991).
1993/1994	Phase I RI performed in the T-25 Area (Arthur D. Little, Inc., 1995) to evaluate nature, extent and source of contamination.
1994	NSSC (formerly Natick Army Laboratory Research and Development Center) listed on NPL as a result of groundwater contamination found in the T-25 Area and its location relative to the Natick Springvale Municipal Water Supply Well Field.
1995/1996	Phase II RI performed in the T-25 Area by Arthur D. Little (Arthur D. Little, Inc., 1998). Source of PCE and TCE not determined.
1995-1997	Engineering Technical Associates, Inc. (ETA), developed a groundwater flow and transport model to support evaluation of contaminant transport at NSSC. The model was used to estimate potential T-25 Area groundwater cleanup times (ETA, 1997).
1997	First extraction wells on-line in T-25 Area to contain contaminants.
1999	Final Focused Feasibility Study/ Treatability Study (FFS/TS) for T-25 Area Groundwater (Arthur D. Little, Inc., 1999).
1999	Proposed Plan and Public meeting detailing the Army's preferred remedial alternative (a pump-and-treat system) for the T-25 Area (U.S. Army, 1999).
2001	Final ROD selecting T-25 Groundwater Area remedy (U.S. Army 2001).
2002	MassDEP approved the Town of Natick Zone II delineation for Springvale and Evergreen supply wells. The groundwater beneath the entire NSSC facility was included within the delineated Zone II.
2002-2003	Updated groundwater flow and transport model for the T-25 Area (HydroGeologic, Inc., 2002).
2004	T-25 Groundwater Treatment System Operations and Maintenance Manual (ICF Consulting, 2004b); subsequent updates in 2011 and 2015.
2005	Sampling begins for 1,4-dioxane; 1,4-dioxane detected in the Building 63, 2 and 45 Area.
2006-2010	Ground Water Remedial Optimization Study to evaluate the potential of in-situ biological enhancement to decrease tetrachloroethene (PCE) and trichloroethene (TCE) concentrations in groundwater (ICF Consulting Services, 2010).
2007	First Five-Year Review (ICF International, 2007a)
2007	T-25 System in Building 94 begins receiving and treating groundwater from the Buildings 2 and 36 Area and Buildings 63, 2, and 45 Area under Pilot Study for groundwater containment at Buildings 22 and 36 and Buildings 63, 2 and 45 (MACTEC, 2008a).
2008	An ex-situ wellhead treatment unit was installed to treat the groundwater from the new extraction wells in the Buildings 63, 2, and 45 Area to remove 1,4-dioxane.

Date	Event
2009	Long Term Monitoring Plan for T-25 Area, Buildings 22 and 36 Area and Buildings 63, 2 and 45 Area (Environmental Chemical Corporation (ECC), 2009).
2012	Second Five-Year Review (ECC and AMEC, 2012)
2012	ARIEM Building Investigation Report evaluating vapor intrusion pathway (ICF International, 2012).
2013	Explanation of significant differences prepared by Army to document increasing flow to the Building 94 Area Treatment Facility from four other areas (Buildings 22 and 36 Area, the Buildings 63, 2 and 45 Area, the MW114B-2 Area, and the ARIEM Building Area); removal of the air stripper from the treatment train; lowered the cleanup level for manganese; and expanded clean-up level for 1,4-dioxane (U.S. Army, 2013).
2014	Preliminary Close Out Report prepared by U.S. EPA documenting that all construction activities at NSSC have been completed and no further response actions are anticipated for the site (U.S. EPA, 2014b).
2014	Draft Final Technical Memorandum on Remedial Actions for Small Plumes Outside Capture Zone (ECC, 2014b).
2015	Slug Volume Removal Technical Memorandum documenting removal of CVOCs from the MW114B-2 Area, and the ARIEM Building Area (ECC, 2015c).
1996 -2016	Quarterly groundwater sampling reports and annual reports documenting groundwater sampling and operation and maintenance of the treatment system.

3.0 SITE BACKGROUND

NSSC is an active U.S. Army research and testing facility located approximately 17 miles west-southwest of Boston (Figure 1). NSSC, formerly called the Quartermaster Research and Engineering Command and subsequently the U.S. Army Natick Research and Development Command, has been a permanent U.S. Army installation since October 1954. NSSC's mission includes research and development activities in food engineering, food service, clothing, equipment, materials, engineering and aero-mechanical engineering.

Environmental investigations began at NSSC in the 1980s. NSSC was added to the United States Environmental Protection Agency's National Priorities List (NPL) in May 1994 as a result of groundwater contamination found in the T-25 area and its location relative to the Town of Natick's Springvale Municipal Water Supply Well Field, which is located 2,500 feet to the northwest (Figure 1).

In August 2006, the U.S. Department of the Army and U.S. EPA entered into a Federal Facility Agreement under CERCLA relating to the remedial investigation and cleanup of hazardous substances, pollutants, or contaminants at NSSC. The lead agency for sites at NSSC is the U.S. Department of the Army, and the support agency is the U.S. EPA.

3.1 Physical Characteristics and Land Use

NSSC occupies 78-acres on a small peninsula extending from the eastern shoreline of Lake Cochituate (Figure 1). NSSC is mostly covered with asphalt and buildings. Open, uncovered areas include a baseball field for employee use near the T-25 Groundwater Area and the unpaved perimeter road and embankment. The facility is surrounded by a chain-link fence. The land use surrounding NSSC is residential.

The groundwater beneath the NSSC is designated as a Zone II wellhead protection area for the Town of Natick's Springvale municipal water supply well field (Figure 1).

Groundwater flow at NSSC occurs mainly in the glacially derived overburden soils and fractured portions of the bedrock. The overburden across the installation is comprised mainly of glacial outwash sediments

and includes sand and gravel, fine to coarse sand, silty sand, and clayey silt as shown on the 2004 geologic cross section prepared by ICF International Consulting (Figure 4). Peat has also been found in soil borings advanced in the eastern portion of the site. The lithologic units are variable and appear to be laterally discontinuous. Bedrock is comprised of metamorphic and igneous rock, primarily granodiorite, and follows a regional trend of dipping to the west. Bedrock outcrops are visible along the eastern shore of the South Pond of Lake Cochituate.

NSSC is located within the Lake Cochituate drainage basin, which encompasses approximately 17.7 square miles. The main hydrogeologic features at NSSC and the surrounding area include the South Pond of Lake Cochituate and Fisk Pond. The South Pond of Lake Cochituate, which occupies approximately 0.9 square miles, flows northward to the Middle Pond and then North Pond of Lake Cochituate; the North Pond drains via the Cochituate Brook into the Sudbury River.

Unconsolidated materials at the site form two separate and distinct aquifers. The unconfined water table aquifer, or "A" interval, is monitored by wells screened in a zone between 5 and 35 feet below ground surface. The locally semi-confined, deeper overburden aquifer, or "B" interval, is monitored by wells screened in a zone between approximately 35 and 80 feet below ground surface.

In the shallow or A interval, there is a groundwater divide across the center of the installation. Flow from the groundwater divide radiates outward toward the South Pond of Lake Cochituate (Figure 5). To the east of the divide, groundwater appears to discharge to Pegan Cove, the shallow eastern bay of the South Pond of Lake Cochituate. To the north and west of the divide, water table groundwater flow is generally to the west-northwest.

Deeper overburden groundwater appears to move from east to west beneath NSSC, discharging to the South Pond of Lake Cochituate with local variations beneath the central and southern portion of the installation (Figure 6).

3.2 History of Contamination

Historic uses of PCE and TCE, the primary COCs, have included; indoor and outdoor storage of chemicals; laboratory research; clothing and textile research; drop-testing, and garage operations including spray painting, vehicle maintenance, metals and brush cleaning. However, in most cases the specific source of the PCE and TCE was not identified.

Investigations initially began in a drum storage area in the T-25 Area, where solvents had reportedly leaked but the source was not confirmed. In 1997, the T-25 groundwater treatment system began operation to both contain and treat groundwater in the T-25 Area (Arthur D. Little, Inc., 1995).

In addition to the T-25 Area, previous investigations at NSSC have focused on characterizing the contaminant distribution of PCE and TCE at other locations within NSSC (Figures 2 and 3). The current areas of groundwater contamination and suspected source of contamination are discussed below.

In the Buildings 22 and 36 Area, the primary site related contaminant is PCE in groundwater (Figures 2 and 3). The source of the PCE was inferred to be historic cleaning of kitchen drain grease trap within Building 36. Additional information pertaining to history and contamination in this area can be found in the Final Buildings 22 and 36 Remedial Investigation Report (Harding ESE, 2005) and the Buildings 22 and 36 Feasibility Study Report (Harding ESE, 2008).

In the Buildings 63, 2, and 45 Area, formerly referred to as the Post Drinking Water Well Site, the primary site-related contaminant is TCE in groundwater. The suspected source of the release was historic leakage of heat transfer brine from the Building 2 climate control system into the unlined crawl space beneath Building 2. In the 1980s, TCE use was discontinued, TCE storage tanks were removed, and the crawl space was lined with an impervious membrane. Additional information pertaining to the history and

contamination in this area can be found in the Buildings 63, 2, and 45 Site Investigation Report (Harding ESE, 2008).

The ARIEM Building Area is located approximately 100 feet east of Building 2 on the eastern side of the peninsula (Figures 2 and 3). TCE has been found exceeding the maximum contaminant level in a small triangular area north of the building. The source has not been determined. Further information regarding this contamination can be found in the ARIEM Building Investigation Report (ICF International, 2012).

The MW114B-2 Area is located directly east of Building 1 in the parking lot area adjacent to Pegan Cove (Figure 3). This small area of groundwater contamination is defined by PCE contamination in only one well (MW114B-2). The source of PCE has not been determined. Further information regarding this contamination can be found in the Investigation Report MW-114B-2 Area (ICF International, 2010a).

At the Former Proposed Gymnasium Site, which was historically use as a helicopter landing pad; a petroleum, oil, and lubricant bladder test site; and a parking lot, the primary contaminant initially monitored was petroleum hydrocarbons (U.S. EPA, 2014b). In 2002, the Army conducted a time critical removal action in this area to address soil contaminants in particular benzene that were leaching to groundwater. Approximately 1,233 tons of contaminated soil was excavated from a 40-by 40-by 10-foot deep area to meet unrestricted residential use standards. No further action was recommended at the site for soil per the 2007 ROD (MATEC, 2007a). While benzene was not detected at levels of concern in groundwater collected from a well installed in the soil excavation area, chlorinated compounds were observed (ICF International, 2007a), and consequently groundwater wells in this area continue to be monitored as part of the OU1 Remedy. Additional soil removal actions were completed at the Former Proposed Gymnasium Site in 2012 and 2014 to remove laboratory debris and soil found in the vicinity of the time critical removal action area. Following these soil removals, confirmation samples were collected to confirm that soil levels remaining were below the unrestricted residential use standards (U.S. EPA, 2014b).

The Boiler Plant Site (Building 19) was identified as a potential concern based on the former use of the basement in the building as a pesticide storage and mixing area. In 2001, Army completed a removal action the leach field adjacent to the building to the south. Approximately, 768 cubic yards of soil containing PAHs, PCBs and lead at concentrations exceeding MCP S1/GW-1 standards were removed and confirmation samples were collected to determine that the standards were met. In 2008, a no further action ROD was signed for the Site (ICF International, 2008). While SVOCs were found to be below drinking water criteria from wells sampled as part of the Phase II SI at the site, dieldrin, a pesticide, was detected sporadically above the MCP GW-1 criteria in Well MW-40B-2. While dieldrin was not identified as a COC in the ROD, it is monitored under the long-term monitoring program at this location.

3.3 Initial Response Action

Pre-ROD response actions included the installation and operation of the groundwater extraction at Building 94 at the T-25 Area in November 1997 to contain contaminant migration.

3.4 Basis for Taking Action

The basis for taking action at NSSC was the results of the human health risk assessment (HHRA) prepared during the Phase II RI (Arthur D. Little, Inc., 1998) in the T-25 Area. The HHRA evaluated the probability and magnitude of potential adverse human health risks from contaminants associated with the T-25 Area groundwater (Arthur D. Little, Inc., 1998) for the following scenarios:

Media	Exposure Scenario	Timeframe
Soil	Facility employees using the ball field	Current and future
	Trespassers on the ball filed	Current and future
	Residents near the site potentially exposed to windblown dust from the ball field	Current and future
	Construction workers in the T-25 Area	Future
Groundwater	Workers using site groundwater for industrial uses	Future
	Potential residential users of groundwater from the beneath the T-25 Area	Future

The HHRA determined that groundwater beneath the T-25 Area, resulted in estimated risks that exceeded the PCE and TCE drinking water standards and U.S. EPA's cancer target risk range of 10^{-4} to 10^{-6} and noncancer hazard index of 1 for future residential groundwater use and for dermal contact during future industrial use. PCE and TCE contributed the majority of the site-related risk from exposure to groundwater and were designated as primary COCs. In addition, six metals (chromium, lead, manganese, nickel, thallium, and vanadium), bis(2-ethylhexyl)phthalate, and dichlorodiphenyltrichloroethane (DDT), exceeded their respective drinking water standards and/or caused some increases in site-related risks. As described in the ROD, these chemicals were designated as secondary COCs, since it was unclear whether their presence was site related or attributable to either background conditions or turbidity resulting from the sampling technique (non-low flow procedures were used in the mid- to late-1990's when the RI was completed).

A Tier I ecological risk assessment (ERA) was conducted to assess the ecological impact and risks associated with the surface soil of the Phase II RI (Arthur D. Little, Inc., 1998). The Tier I ERA found no significant ecological risks for the surface soils in the T-25 Area. Ecological risks were not evaluated for the T-25 Area groundwater

The ROD concluded that a response action was necessary to protect public health or welfare from actual or threatened releases of pollutants or contaminants in groundwater.

4.0 REMEDIAL ACTIONS

The ROD for OU1 was signed in September 2001 documenting the cleanup decision for T-25 Groundwater Area. In 2013, an ESD for OU1 was prepared to document changes from the original remedy.

4.1 Remedial Action Objectives (RAOs)

RAOs were developed for the T-25 Groundwater Area to aid in the development and screening of alternatives in the feasibility study.

The RAOs as specified in 2001 ROD are:

- Prevent contamination in the groundwater, above federal and state drinking water standards, from migrating outside of the T-25 Area toward off-facility receptors;
- Prevent any potential exposure to groundwater beneath the T-25 area and off-facility with contaminant concentrations in excess of federal and state drinking water standards;

- Restore aquifer to drinking water standards within a reasonable time frame; and
- Monitor potential future migration of groundwater contamination to verify that elevated concentrations decrease over time.

Table 4 lists the groundwater COCs, cleanup levels and the basis for the cleanup levels as specified in the ROD.

Table 4

T-25 Area Groundwater Cleanup Levels Established in 2001 Record of Decision

Chemical of Concern (COC)	**Cleanup Level (µg/L)**	**Basis for Cleanup Level[1]**
Primary COC		
Tetrachloroethene	5	MCL
Trichloroethene	5	MCL
Secondary COC		
Chromium	100	MCL
Lead	15	U.S. EPA Action Level
Manganese	1,700	U.S. EPA Region 9 Preliminary Remediation Goal for Drinking Water
Nickel	100	MCL
Thallium	2	MCL
Vanadium	50	MCP
DDT	0.3	MCP
Bis(2-ethylhexyl) phthalate	6	MCL

Notes:
[1]MCL – Federal Safe Drinking Water Act, Maximum Contaminant Level
[1]MCP- Massachusetts Contingency Plan, Method GW-1 Standard
ug/l = microgram per liter

4.2 Remedy Selection

The selected remedy for the T-25 Area in the feasibility study was Alternative 3: Groundwater Extraction with Air Stripping/Carbon Adsorption and Long-Term Monitoring, Institutional Controls, and Monitored Natural Attenuation.

The original groundwater extraction and treatment system was constructed to contain T-25 Area groundwater within NSSC, while MNA was selected to address on-and off-site contamination not captured by the extraction and treatment system. Institutional controls were emplaced to prohibit the use of water for drinking water at the facility as well as an ordinance prohibiting installation of potable drinking wells near NSSC. An ESD was prepared in 2013 to include additional extraction of groundwater from the Buildings 22 and 36 Area and the area near Buildings 63, 2 and 45 to reduce migration of contaminated groundwater to Lake Cochituate. Groundwater from these areas is piped through a buried force main and combined with extracted groundwater from the T-25 Area.

The 2013 ESD also included slug volume removal of contaminated groundwater from two localized areas outside of the capture zone of the extraction system to reduce migration to Pegan Cove. The two areas include the ARIEM Building Area (Building 42) and the parking lot area east of Building 1, referred to as the MW114B-2 Area.

The slug volume removal specified in the ESD for the MW114B-2 Area was 2,400 gallons every 3 months. The slug volume removal specified in the ESD for the ARIEM Building Area at Wells MW165B-2 and MW-181B-2 was 960 gallons every three months equally divided between the two wells. The ESD also specified that extraction well MW96B-4 be restarted for two years beginning in 2013 to reduce concentrations to below the PCE MCL. If contaminant volume is not reduced within two years, slug volume removal was to be initiated at that well.

Other changes specified in the ESD included:

- Removal of the air stripper from the treatment train at the T-25 Treatment System
- Establishing MassDEP's revised drinking water guideline for 1,4-dioxane of 0.3 μg/L as a To Be Considered criteria for treatment
- Lowering the manganese cleanup goal specified in the ROD from 1,200 μg/L to 300 μg/L based on the current U.S. EPA health advisory

4.3 Remedy Implementation

The following subsections discuss the implementation of the remedy.

4.3.1 Groundwater Extraction and Treatment System

The Army completed construction of a groundwater extraction and treatment system (GWETS) in 1997 and began operation of the system as a pilot study in November of that year. The ROD was signed in 2001 to document the system, which was installed at Building 94. The system described in the ROD is installed in Building 94 and is referred to as T-25 Area Treatment System. The T-25 Area Treatment System continues to operate.

The GWETS currently includes the following major components (Figure 7):

- Five extraction wells in the T-25 Area (MW-90B-4, MW-94B-4, MW-95B-4, MW-96B-4 and MW 39B HP4); four extraction wells in the Buildings 22 and 36 Area (EW-5, EW-6, EW-7 and EW 8); two extraction wells in the Buildings 63, 2 and 45 Area (EW-3 and EW-4); and one extraction well in the Boiler Plant Area (MW-40BR)
- Equalization tank
- Particulate Filters
- Air stripper (*off-line since 2012*)
- Vapor-phase granulated activated carbon (VGAC) to treat vapor discharge from the stripper (*off-line since 2012*)
- Liquid-phase granulated activated carbon (LGAC) to remove VOCs from the groundwater
- A programmable logic controller controls the function of these treatment components. A detailed description of each of the treatment system's major components is presented in the Operation and Maintenance (O&M) Manual (ECC, 2015a).

Since August 2007, the T-25 Area Treatment System, has also received and treated PCE and TCE contaminated groundwater extracted from the Buildings 22 and 36 Area and the Buildings 63, 2, and 45 Area. In August 2008, a small treatment unit was installed at the Buildings 63, 2, and 45 Area to remove 1,4-dioxane that was found to occur in a portion of the TCE plume in this area. Since neither the carbon filtration nor the air stripping module in the T-25 Area treatment facility efficiently removes 1,4-dioxane, a pre-treatment system was installed to treat the dioxane. The extracted groundwater from the Buildings

63, 2, and 45 Area is pumped to a "remote" equipment shed that houses a chemical oxidation treatment system (see schematic in Figure 8). The remote 1,4-dioxane treatment system is located adjacent to extraction well EW-4. This pre-treatment system acidifies the water, and then uses hydrogen peroxide and iron (Fenton's reagent) in an advanced oxidation treatment process to destroy the 1,4-dioxane before the water is pumped to T-25 Area system.

Treated water from the GWETS is pumped to a storage tank behind Building 10 that supplies the installation's non-potable water distribution system used for lawn sprinklers, cooling tower make up and restroom flushing water. Overflow from the system is discharged to the storm sewer, which discharges to Lake Cochituate. Effluent samples are collected monthly following flow through the carbon treatment units.

During this FYR period, there were changes to the treatment system. Per the 2013 ESD, the air stripper and vapor phase carbon were removed from the treatment train as water could be treated effectively with liquid phase carbon (the air stripper and VGAC remain in the building and can be re-connected if necessary). In addition, slug volume removal began at two areas: the ARIEM Building Area from wells MW165B-2 and MW-181B-2, and east of Building 1 at well MW114B-2. The volumes removed are discussed in Section 6.4.2 and were reported in the Slug Volume Removal Technical Memorandum (ECC, 2015c).

In 2013, a pre-treatment system was installed for Well MW-96B-4, as part of a GWETS upgrade. This pre-treatment system was comprised of an ultraviolet light (UV) disinfection system and filter installed within Building 94. The pre-treatment system was installed due to the discovery of suspended solids and coliform in MW-96B-4, apparently caused by a sanitary sewer line leak discovered and repaired in the spring of 2012. The system was taken off-line in summer 2016 as it was no longer needed.

4.3.2 Operation and Maintenance of Treatment System

The GWETS is operated in accordance with the Groundwater Treatment System O&M Manual (ECC, 2015a). An operator is on-site 2 to 3 days per week to perform routine treatment facility operation and maintenance activities. Due to turbidity in the extracted groundwater and oxidation/precipitation of dissolved iron in the extracted groundwater, the wells and pumps in the Buildings 22 and 36 and Buildings 63, 2, and 45 Areas become clogged and require cleaning on a regular basis. This requires the removal of the clogged pump for cleaning, and replacement of the removed pump with a spare pump while the cleaning is performed. One to two pumps require removal and cleaning every month. Other routine maintenance activities include:

- Filter bag replacement approximately once per week;
- LGAC vessel backwashing approximately once every 3 weeks;
- Processing of backwash solution as needed;
- Weekly cleaning and calibration of the 1,4-dioxane pH sensor, level transducer and flow meter;
- Regular cleaning of process flow meters;
- Chemical drum replacement at the 1,4-dioxane pre-treatment system once per month; and
- Periodic replacement of spent LGAC with new carbon.

The following major O&M events have occurred during the FYR period:

2012. The T-25 Treatment System at Building 94 was modified to eliminate the use of the air stripper and associated equipment. A review of historical influent characteristics and the treatment process indicated that effective treatment of the influent groundwater can be achieved by using only the

liquid phase granular activated carbon. Eliminating the air stripper and associated equipment (effluent pump, two air blowers, the air heater, and vapor phase activated carbon) resulted in considerable reduction of energy consumption and reduction of hazardous waste (spent activated carbon). The system modifications were installed in a manner that allows a return to original design operations if necessary. All original equipment remains in "stand-by" mode, ready to be placed back in service with minimal effort (1-2 days) if necessary.

2013. Extraction well MW-96B-4 was shut down for most of the year. Installation in December of a new pre-treatment system to address coliform bacteria in water pumped from MW-96B-4 was brought back on-line and pre-treatment system tested and started up.

2014. Extraction well MW-96B-4 operated intermittently during the beginning of the year. Due to the discovery of an underground pipeline leak outside the MW-96B-4 vault in February, this well was shut down for 6 months until the pipeline could be repaired. Extraction well MW-90B-4 was redeveloped in summer 2014.

2015. From January through April, MW-96B-4 remained offline due to well repairs and rehabilitation. In 2015, extraction well MW-96B-4 operated continuously from May through the end of the year. Extraction wells EW-3 and EW-4 were taken offline in November and December due to system repairs associated with acid corrosion of the above-ground 1,4-dioxane oxidation system components.

2016. Acid corrosion of various components within the 1,4-dioxane pre-treatment system shed resulted in replacement of much of the system (pumps, control panel components, level switches, etc). Gaseous hydrochloric acid (the acid used to reduce pH to promote the Fenton's oxidation reaction) was determined to be the cause of the corrosion. Therefore, in addition to component replacement, the acid used in the process was switched from hydrochloric to sulfuric. This system was down for most of 2016, during which time there was no groundwater extraction from EW-3 and EW-4. The system was restored on October 14, 2016.

4.3.3 Long-Term Groundwater Monitoring

The ROD required development of a long-term groundwater monitoring plan to evaluate remedy performance and assess future environmental effects, which historically involved quarterly monitoring of wells for the ROD COCs. Long-term monitoring has been performed in over 72 events since 1993. In 2010, groundwater monitoring was amended from quarterly to semi-annually.

Long-term monitoring currently includes sampling select monitoring wells in the fall and spring for VOCs and 1,4-dioxane. A smaller subset of wells are sampled in the spring. Less frequent sampling is performed for secondary COCs as specified in the amended long-term monitoring plan (ECC, 2010). For evaluation in the FYR, select wells were analyzed for dissolved metals, and a sample from the groundwater treatment system was submitted for analysis of the semivolatile organic compounds, bis(2-ethylhexyl)phthalate and DDT in 2015.

As described above, MNA is a component of the remedy specified in the ROD that is intended to address on-and off-site contamination not captured by the extraction and treatment system; i.e., in areas that are outside of the T-25 Area capture zone. Data from long-term monitoring of wells in the areas outside (predominantly north) of the capture zone continue to be assessed for COC trends to demonstrate that concentrations are stable or declining.

4.3.4 Monitored Natural Attenuation

Previously, the long-term monitoring program included the collection of data to assess whether natural attenuation of contamination through biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants is occurring over time. In 2010, it was concluded that there was little potential for natural attenuation of PCE and TCE by biodegradation pathways and analysis of natural attenuation parameters were discontinued (ICF Consulting and AMEC, 2012). Natural attenuation still occurs via dispersion and dilution.

4.3.5 Institutional Controls

The ROD required institutional controls in order to restrict access to groundwater during the T-25 Area groundwater remedial action, both on-facility and off-facility. The Army's Master Plan for NSSC (the Urban Collaborative, LLC, 2012) restricts the on-facility use of groundwater. A town of Natick Board of Health ordinance (February 1999) prohibits both the installation of new drinking water wells and the use of existing private drinking water wells in the area bounded by North Main Street (Route 27), Lake Cochituate, West Central Street (Route 135), and the Massachusetts Turnpike (Route 90). The ordinance also requires a permit for other use such as industrial or irrigation. Appendix A includes the certifications prepared during the FYR period that indicate that the institutional controls are in place and remain effective.

4.3.6 Operation and Maintenance of the Springvale Treatment Plant

A component of the selected remedy includes the Army's support of a portion of the operation and maintenance of the air stripping system at the Town of Natick's Springvale Treatment Plant, to further protect the Town of Natick's drinking water supply. A cooperative agreement (signed in August 2001) between the Army and the Town of Natick was developed through negotiations between the town and the Army, with the involvement of the regulators. The agreement included several provisions including, but not limited to: 1) the Army would provide the Town with a one-time payment of $3.1million to support a portion of the operation and maintenance of the air stripping system at the Town's Springvale Treatment Plant; 2) agreements by the Town to continue operation of the Springvale Treatment Plant, and the Army to continue operation of source area containment of contaminated groundwater at the T-25 Area site, and 3) agreement by the Town of Natick to impose institutional controls in the area for the duration of the cleanup.

5.0 PROGRESS SINCE LAST FIVE-YEAR REVIEW

The previous 2012 FYR (ECC and AMEC, 2012) did not identify any issues associated with the T-25 Area Groundwater Remedy.

The protectiveness statement identified in the second FYR stated:

The T-25 Ground Water remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risk are being controlled.

6.0 FIVE-YEAR REVIEW PROCESS

The following sections describe the components of the FYR evaluation.

6.1 Administrative Components of the Five-Year Review Process

The Army is the lead for the FYR in accordance with 40 CFR §300.430(f)(4)(ii). The FYR was reviewed by Christine Williams of the U.S. EPA, Remedial Project Manager, and David Chaffin of the MassDEP. The FYR was prepared by the U.S. Army Corps of Engineers, New England District team members, including: Cynthia Colquitt (Risk Assessor), Daniel Groher (Environmental Engineer), Michael Kulbersh (Hydrogeologist), and Penelope Reddy (Environmental Engineer).

The review consisted of the following components:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection; and
- Five-Year Review Report Development and Review.

6.2 Community Notification and Involvement

The commencement of the FYR was announced in a public notice appearing in the Metro Daily West Newspaper on October 22, 2016 (Appendix B). The results of the review and the report will be made available at the site information repository located at the Morse Institute Library, 14 East Central Street, Natick, Massachusetts.

6.3 Document Review

This five-year review for the NSSC consisted of a review of relevant documents including previous five-year reviews, long-term monitoring plans, RI reports, FS reports, ESDs, annual reports and monitoring data. This document review section also includes a review of any changes to the Applicable or Relevant and Appropriate Requirements (ARARs) and changes to toxicity values and exposure factors since the ROD was completed. Site-related documents reviewed as part of this effort are listed in Section 7.0.

6.3.1 Review of ARARS

ARARs and TBC criteria for OU1 as identified in the 2001 ROD and the 2013 ESD are included in Appendix C.

There are no changes to the location-specific ARARs that were included in the ESD. The action-specific ARARs related to the air stripper are no longer applicable as the air stripper has been removed from the treatment train. There are no other changes to action-specific ARARs.

A summary of changes to the chemical-specific ARARs is presented below in Table 5. The chemical-specific ARARs for OU1 were compared to current regulations and guidance. Original ARARs were based on the Safe Drinking Water Act MCLs, Massachusetts Contingency Plan (MCP) drinking water regulations and EPA Region 9 Regional Screening Levels. Since the time of the last FYR, 1,4-dioxane was added to the list of chemicals monitored and the health advisory for manganese was adopted. The MCP GW-1 for vanadium was also lowered to 30 ug/L from 50 ug/L. These changes to the chemical-specific ARARs do not affect overall protectiveness as institutional controls prohibit exposure to groundwater.

Table 5

Changes Affecting Chemical-Specific ARARs for Groundwater

Chemical of Concern (COC)	Cleanup Level (µg/L)	Basis for Cleanup Level	Changes in ARARS and TBC	Documented Change
Tetrachloroethene	5	MCL	None identified	None
Trichloroethene	5	MCL	None identified	None
Chromium	100	MCL	None identified	None
Lead	15	U.S. EPA Action Level	U.S. EPA action level for lead in groundwater unchanged	None
Manganese	300	U.S. EPA Region 9	U.S. EPA adopted manganese health advisory in 2004 of 300 µg/L (EPA-822-R-04-003).	2013 ESD
Nickel	100	MCP	None identified	None
Thallium	2	MCL	None identified	None
Vanadium	30	MCP	None identified	None
DDT	0.3	MCP	None identified	None
Bis(2-ethylhexyl) phthalate	6	MCP	None identified	None
1,4-dioxane	0.3	MCP	None identified	2013 ESD

Notes:
COC – Chemical of Concern
ESD – Explanation of Differences
MCL – Federal Safe Drinking Water Act, Maximum Contaminant Level
MCP- Massachusetts Contingency Plan, Method GW-1 Standard
µg/L= micrograms/liter
U.S. EPA Region 9 Preliminary Remediation Goal for Drinking Water

6.3.2 Review of Toxicity Values and Exposure Assumptions

The OU1 HHRA evaluated groundwater exposure by potential future residents using groundwater to drink and bathe in, and workers using groundwater for industrial uses. Since the HHRA was completed, there have been recommended changes in both the toxicity values and exposure assumptions. However, these changes do not affect overall protectiveness because they do not substantially change the results of the risk assessment or call protectiveness of the remedy into question.

Appendix D, Table D-1 includes toxicity values that have been added, revised or rescinded since the HHRA was completed. As discussed above, the cleanup level for 1,4-dioxane, which is based on the Massachusetts Drinking water guideline 0.3 µg/L, was added to the list of chemicals monitored through the 2013 ESD along with an updated health advisory for manganese. These changes would not alter the risk assessment results to require revision of cleanup goals or RAOs.

Appendix D, Table D-2 includes the basic exposure factors used in the OU HHRA as well as the updated recommended exposure factors. In February of 2014, U.S. EPA released *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors*, OSWER Directive 9200.1-120, which provided updated recommendations for several common recommended default exposure factors used to set regional screening levels and calculate human health risks. A few exposure factor assumptions used in the previous HHRAs differ from the new U.S. EPA recommended ones (U.S. EPA, 2014a). Incorporating these revised exposure and toxicity factors into the original OU1 risk assessment

would result in increased non-cancer risk, but would not change the original conclusion that groundwater risks exceed EPA risk limits. The ROD and ESD cleanup goals are based on ARARs (MCLs) and TBCs (manganese health advisory), rather than risk; and institutional controls prevent exposure to groundwater. Therefore, the existing cleanup goals remain protective.

The U.S. Army performed a preliminary assessment for perfluorinated compounds, an emerging contaminant (U.S. EPA, 2014b). The Fire Chief was interviewed. NSSC had several above ground storage tanks where halon had been used in fire suppression systems. However, no release to the environment was documented and there have not been any fires requiring the use of firefighting foam.

6.4 Data Review

As indicated previously, the groundwater pump and treatment system is used to remove contaminants from groundwater to achieve cleanup goals specified in the ROD and to prevent or limit migration of contamination off-site both to the north, where residents are located, and to the east, south and west in the direction of Lake Cochituate.

To determine if these goals are being achieved and to evaluate remedy performance, the following data was reviewed:

(1) Groundwater analytical results from wells sampled under the long-term monitoring program between 2012 and 2016 (Appendix E)

(2) Time-Series plots from the annual reports showing concentration trends for PCE, TCE and 1,4-dioxane for the historical monitoring period of the wells (Appendix F)

(3) Statistical analysis of concentration trends prepared using U.S. EPA software ProUCL Version 5.0 between 2012 and 2016 (Appendix G)

(4) Water-level data and capture zone analysis presented in the groundwater modeling report (ECC, 2009b and ECC, 2015b)

(5) Extraction and Mass removal rates for PCE, TCE and 1,4-dioxane reported for the treatment system in annual reports (Appendix H)

6.4.1 Overview of Groundwater Plume

At NSSC, the primary contaminants in groundwater are PCE and TCE (Figure 3). 1,4-dioxane has also been detected in the Buildings 63, 2 and 45 Area.

6.4.2 Groundwater Analysis and Trends

The following sections discuss groundwater concentrations and trends within specific areas of the groundwater plume. For each of the areas, time series plots for the historical sampling period and this FYR period were examined to determine the data trends. These time series plots and trend analyses are provided in Appendix F and G.

Table 6 below provides a summary of the results of the statistical trend analyses for each of the groundwater remediation areas where concentrations of PCE and TCE remain above the MCLs. The table indicates for each well tested whether there was a statistically significant trend at the 95% confidence level and the direction of the trend. As shown in the table below, many of the wells are showing a decreasing trend. Also, the concentration trends for many wells have reached a "plateau" at very low or non-detect concentrations. Such plateaus are common for pump-and-treat remediation systems, and indicate that rate of mass removal for those locations have become minimal and therefore the rate of aquifer cleanup in those

locations will also decrease.

Table 6

Summary of Data Trend Results for the FYR Period
(January 2012-Spring 2016)

Decreasing Trend	No Trend	Increasing Trend
TETRACHLOROETHENE (PCE)		
MW-18B-HP2 (T-25) MW-90B-4 (T-25) MW112B-2 (22 & 36) MW113A-2 (22 & 36) EW-6 (22 & 36) EW-7 (22 & 36) EW-8 (22 & 36)	MW208B-HP2 (T-25) MW-83B-2 (T-25) MW114B-2 (114-2) MW-96B-4 (T-25) MW105A-1 (22 & 36) MW-111B-2 (22 & 36) MW151A-2 (22 & 36)* MW152A-2 (22 & 36)* EW-5 (22 & 36) MW-37B-HP2 (T-25)	
TRICHLOROETHENE (TCE)		
MW208B-HP2 (T-25) MW-37B-HP2 (T-25) EW-3 (63,2, & 45) EW-4 (63,2, & 45) MW164B-2 (ARIEM) MW165B-2 (ARIEM) MW124B-2 (63, 2, & 45)	MW-90B-4 (T-25) MW123B-2 (63,2, & 45) MW125B-2 (63,2, & 45) MW114B-2 (114-2) MW-18B-HP2 (T-25) MW-83B-2 (T-25)	MW-96B-4 (T-25)
1,4 – DIOXANE		
MW124B-2 (63,2,& 45) EW-3 (63,2, & 45)	MW160A-2	

Notes: *= PCE was not detected in these wells from 2012 to 2015

T-25 Groundwater Area COCs and Trends

In the T-25 Area, the site-related groundwater contaminants are PCE and TCE. Time series plots for the historical sampling period generally indicate decreasing trends for PCE and TCE (Appendix F). Mann-Kendall and Theil-Sen trend tests were performed on six T-25 Area wells. As shown in Table 6, the majority of these wells have statistically significant decreasing trends over the FYR period. A comparison of the PCE and TCE plume footprints between 2011 and 2015 is shown on Figures 9 and 10, respectively. These figures show that the area of impacted groundwater and the concentrations have declined over the five year review period including the area of exceedances of MCLs for PCE and TCE.

Concentrations of PCE have decreased from an historical maximum of 2,000 µg/L in well MW-18B-HP2 to 1.5 µg/L in April 2016 There were only three wells in this area during the FYR period that exceeded the PCE MCL of 5 µg/L. These include: MW-18B-HP2, MW-167B-2, and extraction well MW-96B-4.

Concentrations of TCE have decreased from an historical maximum of 800 µg/L in well MW-35BR to below the MCL at 1.1 µg/L in April 2016 in well MW-37B-HP2. During this FYR period, there were five

wells with a concentration of TCE above the MCL of 5 µg/L (Appendix E). Of these wells only one well MW-208B-HP2 was located off-base. The only well to exhibit an increasing trend for either TCE or PCE is MW-96B-4. This well is an extraction well that was shut down on September 23, 2006, to accommodate the bioremediation pilot test in the area. It remained off from 2007 through 2011. It was brought back online briefly in March 2012 before the discovery of it being impacted by the sanitary sewer line leak (described in Section 4.3). MW-96B-4 was again brought back on line in 2013, and the concentrations of TCE in the well began to increase steadily toward the concentrations previously observed in the well. Since this is an extraction well within the impacted T-25 Area, the increasing trend in well MW-96B-4 is not indicative of a change in the plume configuration, but rather the result of reestablishment of a capture zone and the prior system "equilibrium". As depicted in the time-series plot for MW-96B-4 in Appendix F, the concentrations of TCE captured by this well in the years before it was taken off-line in 2007 ranged between 10 and 20 µg/L. The concentrations have rebounded to similar levels since the well was brought back on line in 2013. This data trend will continue to be assessed as the GWETS is operated in the next five year period.

Buildings 22 and 36 Area COCs and Trends

In this area, the groundwater contamination is principally PCE. Time-series plots for the historical sampling period are shown in Appendix F and generally indicate decreasing trends. As shown in Table 6, the majority of these wells have statistically significant decreasing trends over the historical monitoring and FYR period. Based on the time-series plots and quantitative trend statistics, it appears that the active pump and treatment system continues to effectively reduce contaminant concentrations in this area. A comparison of the PCE and TCE plume footprints from 2011 to 2015 is shown on Figures 9 and 10, respectively. These figures show that the area of impacted groundwater and the concentrations have declined over the FYR period.

The PCE concentration has declined from an historical maximum of 300 µg/L in well MW112B-2 to 54.5 µg/L in extraction well EW-7 in June 2016. Seven wells in this area contained PCE above the MCL including extraction wells EW-6, EW-7 and EW-8 and monitoring wells MW105A-1, MW111B-2, MW112B-2, and MW113A-2 (Appendix E).

During this FYR period, TCE was detected at a maximum concentration of 1.8 µg/L in well EW-7 in June 2016.

Buildings 63, 2 and 45 COCs and Trends

Groundwater contamination in the Buildings 63, 2, and 45 Area includes TCE and 1,4-dioxane. Time-series plots for the historical sampling period are shown in Appendix F and generally indicate decreasing trends. During the FYR period, TCE continued to have a statistically significant downward trend for wells EW-3 and EW-4 (Appendix G) but there was insufficient evidence of trends for the other wells.

The TCE plume footprint in this area has not decreased significantly between 2011 and 2015 (Figures 9 and 10). The stability of the plume may be the result of the location of extraction wells EW-3 and EW-4 not being within the core of the plume.

TCE concentrations have declined from an historical maximum of 205 µg/L in well MW123B-2 to 84.8 µg/L in spring 2016 in the same well. Six wells in this area contained TCE above the MCL during this FYR period including extraction wells EW-3 and EW-4 and monitoring wells MW123B-2, MW124B-2, MW125B-2, and MW160A-2. For this FYR period, the maximum detected PCE and 1,2-dichloroethene concentrations were 0.73 and 1.4 µg/L respectively in MW125B-2.

Historically, the maximum concentration of 1,4-dioxane detected in this area was 150 µg/L from well MW124B-2 in October 2005. During this FYR period the highest 1,4-dioxane concentration, 10 µg/L, was detected in well MW160A-2. Three other wells MW124B-2, MW161A-2, and EW-3 contained 1,4-dioxane above the MCP GW-1 criteria of 0.3 µg/L (Appendix E).

MW114B-2 Area

The primary contaminant in this area is PCE. During the FYR period, PCE was detected at a maximum concentration of 13.8 µg/L in Well MW114B -2 in July 2014. In 2016, concentrations were below the MCL.

Also, within the designated MW114B-2 Area, the ESD (U.S. Army, 2013) specified that extraction well MW-96B-4 be restarted in 2013 to reduce PCE concentrations in Well MW178B-2 and if contamination was not reduced to below MCLs after the two years, slug volume removals from MW-178B-2 would be initiated similar to the slug removal at MW114B-2. Since October 2013, concentrations of PCE and TCE have been below the MCL in Well MW178B-2 (Appendix E) and thus, no slug volume removal was initiated.

Building ARIEM Area

TCE is the principal contaminant in this area. Statistically decreasing trends were identified for MW164B-2 and MW165B-2 based on the FYR data. Although decreasing trends were observed in these wells, the slug removal process does not appear to have been effective at remediating the localized area of TCE contamination adjacent to the ARIEM Building to below MCLs.

TCE was detected at a maximum concentration of 16.6 µg/L in well MW165B-2 in 2009 and during this FYR period the maximum detected concentration was 10.1 µg/L (May 2013). Since slug volume removal began in February 2014, concentrations have remained above the MCL. At MW181B-2, concentrations have been above the MCL in 20 of 21 slug volume removal sampling events (Appendix E). The maximum detected concentration was 27.6 µg/L (March 2014), and the sample collected more recently in May 2016 contained 16.4 µg/L of TCE.

Former Proposed Gymnasium Area

During the FYR period, five wells (MW-4, MW-5R, MW-6, MW 100A-2 and MW 127A-2) were sampled within the Former Proposed Gymnasium Area (Figure 3). Concentrations of PCE and TCE in all wells were below the cleanup goal of 5 µg/L (Appendix E).

Secondary COCs Evaluation

Secondary COCs established in the ROD include: metals (chromium, lead, manganese, nickel, thallium and vanadium), DDT and bis(2-ethylhexyl)phthalate. During the FYR period, secondary COCs were analyzed for in 2015. Groundwater samples from select monitoring wells were analyzed for the dissolved metals and an effluent sample from the T-25 Area Treatment System was analyzed for DDT and bis(2-ethylhexyl)phthalate (see Appendix E). Additionally, two samples were collected from the Boiler Plant Area (MW-40BR and MW-168B-2) and analyzed for DDT.

All of the secondary COCs were below the ROD cleanup levels with the exception of dissolved manganese. Dissolved manganese was detected above the cleanup levels of 300 ug/L in wells MW-128A

and MW-159A-2 at concentrations of 24,300 ug/L and 471 ug/L, respectively (Figure 3). The concentrations measured in Well MW-128A represents an increase from the prior sampling event of this well in 2010. In 2010, manganese was detected in Well MW-128A at 7,380 ug/L. While dissolved manganese concentrations increased in Well MW-128A, concentrations detected in MW-159A-2 were consistent with previous concentrations measured in 2010.

The presence of manganese is likely due to reductive dissolution caused by the presence of organic constituents in groundwater. There was a soil removal in this area associated with a former 1,500 gallon #2 fuel oil tank. The report documenting the removal (ICF International, 2007b) indicated that the tank did not appear to have leaked. However, during this action, petroleum was reportedly observed in a soil sample collected from Well MW-128A at 26 feet bgs.

Vanadium was detected in 1 of 10 samples collected from wells during this FYR period. Vanadium was detected in the sample collected from MW209B-HP2 at a concentration of 6.5 J ug/L, which is below the current MCP, GW-1 standard of 30 ug/L. Historically, the maximum detected vanadium concentration was measured in this well at 10.1 J ug/L in March 2009.

Bis (2-ethylhexyl) phthalate and DDT were non-detect in the effluent sample collected from the treatment system (see Appendix E -LOC G). Additionally, DDT was not detected in the groundwater samples collected from wells MW-40BR and MW-168B-2.

6.4.3 Groundwater Extraction, Capture and Mass Removal

Three areas at NSSC (T-25 Area, Buildings 22 and 36 Area and Buildings 63, 2 and 45 Area), have extraction wells which capture the plume and convey groundwater to the T-25 System at Building 94 for treatment. The following section discusses extraction rates, capture and mass removal in each of these areas.

Potentiometric maps showing groundwater flow in the shallow water table and deep overburden developed from water level data collected in October 2014 (Groundwater Monitoring Event 69) are shown on Figures 5 and 6.

A numerical groundwater flow model (ECC, 2009b and ECC, 2015b), is utilized and updated every five years to determine if the plumes are being captured under operational pumping rates at NSSC (MACTEC, 2008a). For this FYR period, the model was updated to reflect 2014 conditions and re-run to evaluate capture.

Appendix H presents the extraction rate and mass removal rate for each extraction well in each area.

T-25 Groundwater Area

Groundwater is extracted from five extraction wells in this T-25 Area: MW-90B-4, MW-94B-4, MW-95B-4, MW-39B-HP4, and MW-96B-4 (Figures 5 and 6).

The most recent groundwater flow model update in 2014 concluded that the T-25 Area plume as defined by the lateral and vertical extent of MCL concentrations in groundwater is being captured. This update assumed slightly higher pumping rates (5-6%) than the yearly average during the FYR period of 71 gallons per minute (gpm). Figure 11 from the modeling report depicts the simulated groundwater flow using particles to represent the plume above the MCL and flow to extraction wells.

During the FYR period through December 2015, 3.36 pounds of TCE and 1.18 pounds of PCE were removed from the system with the majority of the mass removed from extraction well MW-90B-4, located

within the core of the plume. During the previous FYR period 5.13 pounds of TCE and 6.47 pounds of PCE were removed from the system.

Buildings 22 and 36 Area

Groundwater is extracted from four extraction wells in the Buildings 22 and 36 Area: EW-5 through EW-8 to remove PCE from groundwater (Figures 5 and 6).

The most recent groundwater flow model update in 2014 concluded that the Buildings 22 and 36 Area PCE plume is being captured. This update assumed the average pumping rate of the system for 2012 to 2014 of 6.28 gpm. Figure 12 depicts the simulated groundwater flow using particles to represent the plume above the MCL and flow to extraction wells.

During the FYR period through December 2015, 7.01 pounds of PCE was removed. During the previous FYR period 4.07 pounds were removed.

Buildings 63, 2 and 45 Area

Groundwater is extracted from two extraction wells in the Buildings 63, 2 and 45 Area: EW-3 and EW-4. The most recent groundwater flow model update in 2014 concluded that the Buildings 63, 2 and 45 Area TCE plume is being captured. This update assumed an average pumping rate of the extraction system for the period from 2012 to 2014 of 2.4 gpm. Figure 13 depicts the simulated groundwater flow using particles to represent the plume above the MCL and flow to extraction wells.

Groundwater in the vicinity of monitoring well MW-125B-2 is outside of the influence of EW-3 and EW-4 and likely discharges to Pegan Cove. Based on groundwater flow there are no other wells between MW-125B-2 and Pegan Cove. This area is being evaluated as part of the optimization work proposed by the Army for the Building 63, 2 and 45 Area.

During the FYR period through December 2015, 1.32 pounds of and 0.05 pounds of 1,4-dioxane was removed from the system. During the prior FYR period 0.71 pounds of PCE and 0.07 pounds of 1,4-dioxane were removed.

While extraction wells EW-3 and EW-4 appear to prevent most TCE from discharging to Lake Cochituate, which was their designed purpose, they are not aggressively removing mass from the center of the plume. As indicated on Figures 5 and 6, groundwater flows principally to the southwest. However, a groundwater divide runs down the center of the peninsula. In the Buildings 63, 2, and 45 area, most of the plume flows to the southwest, however a portion also flows to the southeast towards Pegan Cove. Groundwater is extracted at rates between 2.2 gpm and 2.6 gpm total flow. Due to maintenance needed for the 1,4-dioxane treatment system (described in Section 4.3.2), extraction wells EW-3 and EW-4 were off-line intermittently in 2016.

6.4.4 Groundwater Treatment System

The performance of the groundwater treatment system was evaluated by reviewing the effectiveness of the system at removing the COCs and the reliability of the system.

Mass Removal Rates. The table below summarizes the mass removal rate of the system over the FYR period. Figures 14 and 15 depict the mass removal rates and performance of the GWETS on a monthly and cumulative basis. Figure 16 provides a similar graphical depiction of the 1,4-dioxane mass removal from the groundwater treated in the Buildings 63, 2 and 45 Area, the only area that contains 1,4-dioxane.

Groundwater extraction and treatment system mass removal rates are consistent with the rates observed during the last FYR period (ECC and AMEC, 2012). However, the rates of mass removal appear to be declining as influent concentrations decline from the groundwater extraction wells. Data presented in the following table is extracted from the annual reports for the groundwater extraction systems.

Year	Average Influent Concentration (µg/L)		Average Pumping Rate (gpm) *	Volume Treated (gal)	Treatment System Up-Time (%)	TCE + PCE Mass Removed for Year (pounds)	Cumulative TCE + PCE Mass Removed Since Start-up (pounds)
	TCE	PCE					
2011	NA	NA	~ 85	NA	NA	4.66	99.3
2012	2.9	4.4	80.5	38,000,000	91.7%	3.17	102.5
2013	2.4	3.6	77.9	38,000,000	98.4%	5.75	108.2
2014	2.1	2.6	81.2	41,000,000	98.1%	2.15	110.4
2015	2.0	1.7	71.3	40,000,000	98.7%	1.80	112.2

* Downtime is not factored into the average
NA = indicates not available

TCE and PCE concentrations are monitored monthly in the effluent from the T-25 Area treatment system. Samples are collected after the "polishing" carbon filtration vessel, just before discharge from the building (location "G" on Figure 7). During this FYR period, the concentrations for TCE and PCE were non-detect in the effluent sample every month except for March 2012 and November 2015. Both of these detections were well below the drinking water criteria for TCE of 5 µg/L.

The detection in March 2012 (2.8 µg/L) occurred just after removing the air stripper and vapor phase carbon treatment module from service. The cause of this exceedance was undetermined, but the LGAC was replaced with new carbon, and TCE was not detected afterwards.

The detection in November 2015 was an estimated concentration of 0.27 µg/L. This detection indicates that breakthrough was beginning to occur in the LGAC filters. Therefore, the LGAC in the lead carbon vessel was replaced with new carbon, and subsequent effluent concentrations were non-detect.

1,4-Dioxane is removed in the remote 1,4-dioxane treatment system via oxidation using Fenton's Reagent before combining with extracted groundwater from the Buildings 22 and 36 Area, and entering the T-25 Area Treatment System at Building 94. The remote system treats a combined flow of approximately 2.5 gpm from EW-3 and EW-4. The effluent from the remote 1,4-dioxane treatment system is monitored monthly for 1,4-dioxane content. These data are reported in Appendix E of the Annual GWETS reports. The effluent from the remote treatment system is generally non-detect, indicating complete removal of 1,4-dioxane. During this FYR period, 1,4-dioxane was detected once in 2013; twice in 2014; and four times in 2015. The detected concentrations in the effluent were all less than 1 µg/L, and only exceeded the drinking water guideline of 0.3 µg/L three times. However, since the effluent from the remote system mixes with the total flow through the Building 94 system of approximately 80 gpm, the effluent from the GWETS never exceeded the 0.3 µg/L guideline during this FYR period.

Overall Performance. Since the effluent concentrations from the groundwater treatment system have routinely been non-detect, except for a few isolated instances, the system can be considered to be working as intended. In addition, when COCs have broken-through their respective treatment units, the effluent concentrations have been well below their target cleanup concentrations. The T-25 Area treatment system up-time (the portion of the time the system is operational) for this reporting period is presented in the summary table above. The average up-time for this FYR period was 96.7% of the time. The lowest

operational up-time was 2012 (91.7%), the year that the air stripper and VGAC modules were taken off-line and the system reconfigured to treat the groundwater with LGAC alone.

6.4.5 Vapor Intrusion

EPA conducted a screening of the vapor intrusion (VI) pathway and found only one potential area of concern, the basement at the ARIEM Building, Building 42 (U.S. EPA, 2014b). The groundwater plume is present in the deep portions of the aquifer (30 to 70 feet below ground surface), with the exception of groundwater contamination near Well MW125B-2 near the basement of the ARIEM Building. To evaluate the potential for vapor intrusion in the building, wells were installed adjacent to the basement in the shallow and deep aquifer and sub-slab samples were collected from six locations. Based on the results of the investigation (ICF International, 2012), U.S. EPA and MassDEP agreed with the Army's conclusion that there does not appear to be a complete vapor intrusion exposure pathway in the ARIEM building investigation area.

A portion of the plume extends off-site into the residential area. During the FYR period, seven wells were sampled in the off-facility area for VOCs (MW-201B, MW-202C-2, MW208A-2/MW208B-HP2, MW209B-HP2, MW-211B-4 and MW-212C-2) (Figures 9 and 10). Well MW208A-2 was installed within the shallow aquifer. The other wells are installed within the deeper aquifer. Well MW208A-2 is a couplet to well MW2-08B-HP2 and was screened approximately 27 feet above well MW2-08B-HP2.

PCE, TCE, 1,2-dichlorethene and vinyl chloride were not detected in the shallow off-site well. Since no VOCs were detected in the shallow off-site well and vapor intrusion of TCE from the deeper well is unlikely, the pathway is incomplete. This is consistent with the results of the ARIEM Building Area VI Investigation results. In addition, TCE concentrations in the deeper wells in the off-site area continue to decline. Any future land-use changes are unlikely to affect the VI pathway and the pathway would remain incomplete as the clean water present above the deeper contaminated water would continue to act as a barrier to migration of chlorinated VOCs upward.

6.4.6 Institutional Controls

As discussed in Section 4.2.4, the ROD required institutional controls to restrict access to groundwater during the T-25 Area groundwater remedial action, both on-facility and off-facility.

The Army and Town of Natick annually submit institutional control certifications to indicate that no potable drinking water wells are installed or used on-facility or off-facility in the prescribed area described in Section 4.2.4. A permit is also required by the Town of Natick for other uses such as industrial or irrigation in the prescribed area.

Annual institutional control certifications submitted by the Army and Town of Natick between 2012 and 2016 are included in Appendix A and indicate that no new potable water supply wells were installed on or off-facility nor were any existing private wells utilized for drinking water.

6.4.7 Interviews

As part of the FYR review process, interviews were conducted in accordance with the U.S. EPA Five-Year Review Guidance (U.S. EPA, 2001) and summaries of each interview are provided in Appendix I. Those contacted for interviews included the following:

- James B. Connolly, U.S. Army
- Christine Williams, U.S. EPA, Remedial Project Manager
- David Chaffin, MassDEP

- Marco Kaltofen, Restoration Advisory Board (RAB) Co-Chair
- James M. White, Jr., Town of Natick, Director of Public Health
- Brendan Lareau (Watermark), Treatment Operator

In general, comments related to the site were positive and supportive of the progress with the cleanup. EPA remedial project manager indicated that overall the cleanup was progressing well with one main concern that the 1,4-dioxane unit was off-line during most of 2016 until it was repaired. MassDEP's project manager indicated that it was not necessary to interview him, as he would provide comments on the FYR. The Director of Public Health for the Town of Natick recommended more in person discussions would be helpful when reports are released to facilitate communication. The RAB Co-chair indicated that the community's general concerns remain with cleanup and use of Lake Cochituate and whether groundwater cleanup will continue until restrictions are removed in areas off-site. The Army indicated that the groundwater remedy was operating effectively but additional optimization efforts were being evaluated with a work plan to be prepared in spring of 2017 to accelerate groundwater cleanup.

6.4.8 Site Inspection

The FYR site inspection was conducted on September 7, 2016. The inspections were conducted by the U.S. Army Corps of Engineers (USACE), New England District FYR team identified in Section 6.1, in the presence of U.S. Army Environmental Manager and Watermark, the operators of the groundwater treatment system. The relevant portions of the site inspection checklist (U.S. EPA, 2001) and photographs from the site inspections are presented in Appendix J.

During the site inspection, the FYR team inspected the T-25 Area Treatment System at Building 94 and the oxidation pre-treatment unit for 1,4-dioxane, and the areas of groundwater concern. There were no issues identified with at the T-25 Area Treatment System.

The 1,4-dioxane oxidation pre-treatment unit was off-line at the time of the site visit and according to U.S. Army and treatment operator has been operating periodically since November 2015 but returned to normal operation on October 14, 2016. As discussed previously, acid corrosion of various components of 1,4-dioxane pre-treatment system required replacement of much of the system in 2016.

7.0 TECHNICAL ASSESSMENT

This section of the 2016 FYR details responses to the key questions from the 2001 EPA Guidance on conducting FYRs as follows:

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

Responses are provided as follows:

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

Yes, the remedy is currently functioning as intended in the short-term. The following section details the areas where the remedy is functioning as intended and where additional work is needed for the remedy to function in the long-term.

I. The intent of the remedy is to achieve the four RAOs as described in Section 4.1 and 4.2. Specifically, the remedy is intended to:

1. Prevent contamination in the groundwater, above federal and state drinking water standards, from migrating outside of the T-25 Area toward off-facility receptors. As discussed above, the groundwater extraction system effectively contains the plume in the T-25 Area on-site. The expanded pumping system in the Buildings 22 and 36 Area and the area near Buildings 63, 2 and 45 prevents plume migration to Lake Cochituate and contains the plume. While the 1,-4 dioxane unit in the Building 63, 2 and 45 operated intermittently between November 2015 and October 2016, operation has now been fully restored. Overall, the GWETS is functioning as intended relative to plume containment.

2. Prevent any potential exposure to groundwater beneath the T-25 area and off-facility with contaminant concentrations in excess of federal and state drinking water standards. The effectiveness of the GWETS containing the plume(s), in conjunction with institutional controls that prohibit installation and use of any private potable water supply wells on- or off-facility prevent exposure to the contaminants of concern. The remedy is functioning as intended relative to this RAO.

3. Restore aquifer to drinking water standards within a reasonable time frame. No specific cleanup timeframes were specified in the 2001 ROD for the site. However, the groundwater transport model referenced in the 2001 Feasibility Study indicated that the groundwater in the T-25 Area would reach drinking water standards in 2025 in a groundwater pump-and-treat scenario (U.S. Army, 2001). Subsequent feasibility studies (performed after issuance of the ROD) for the other contaminated areas also assessed groundwater cleanup via pump-and-treat and estimated longer cleanup times. [Achieving cleanup around 2030 in the Buildings 22 and 36 Area (MACTEC, 2008b); and cleanup in 100 years in the Buildings 63, 2, and 45 Area (MACTEC, 2007b).] Thus, though there are no specific requirements in the ROD or ESD for remediation timeframe, the progress of the remedy can be compared to these estimates made in the feasibility studies. It is important to recognize that model estimates are inherently uncertain in that they generally rely on limited data and, in the case of groundwater extraction, often do not reliably estimate the effects of matrix diffusion.

    a. The trend analyses discussed in Section 6.4.2 indicate that groundwater concentrations of COCs throughout the T-25 Area are declining toward the applicable drinking water standards. In addition, the progress of the mass removal of CVOCs from the T-25 Area provides evidence that the aquifer is being restored. Approximately 98 pounds of CVOCs (TCE and PCE) have been removed from the T-25 Area via the groundwater treatment system based on extracted concentrations from the T-25 area wells. The updated estimate of the total mass of CVOCs in the T-25 plume was approximately 111 pounds; approximately 13 pounds less than originally estimated. The removal rate has declined over time from the T-25 Area, however the current removal rate is approximately 2 pounds per year. Therefore, over the next 10 years, it is possible that most of the remaining CVOC mass will be removed from the aquifer. However, the heterogeneous nature of the soil and matrix diffusion effects are likely to impact the cleanup timeframe, and thus, the timeframe is uncertain. In the T-25 Area, the contamination is generally present in the sand and gravel units that are less prone to matrix diffusion effects than finer-grained units.

    b. There has not been a rigorous estimate of CVOC mass in the other two remediation areas, so it is not possible to perform the same comparison of mass removed to mass originally present. However, the concentrations of CVOCs in the remaining monitoring wells in the Buildings 22 and 36 Area and the area near Buildings 63, 2 and 45 are declining toward the

cleanup levels. However, the soil stratigraphy in these areas indicates that there are finer-grained strata that are more likely to have matrix diffusion limitations for the pump-and-treat remediation progress. Thus, the progress toward the remediation goals in these areas are much less certain than for the T-25 Area.

c. The areas near the ARIEM Building and MW114B-2 have been undergoing treatment via periodic slug volume removal. This periodic slug volume removal appears to have successfully remediated the MW114B-2 Area, but not the ARIEM Building Area. Thus, the remedy does not appear to be functioning as intended relative to this RAO and performance metric (i.e., reduction of CVOCs to below MCLs in two years following slug volume removal), therefore a revised remediation approach may be necessary for this area.

4. Monitor potential future migration of groundwater contamination to verify that elevated concentrations decrease over time. The trend analyses discussed in Section 6.4.2 provide strong evidence that the remedy is functioning as intended to decrease the concentrations of the COCs.

II. The ESD specified removal of the air stripper from the treatment train at the T-25 Treatment System in Building 94. Examination of the performance of the groundwater treatment system since March 2012 when the air stripper was taken off-line demonstrates that the liquid phase carbon is sufficient for treating the groundwater. As discussed in Section 6.4.4., the groundwater treatment system performs well and effectively removes the TCE and PCE that are the primary COCs at the facility. While the 1,4-dioxane pretreatment system used to destroy the 1,4-dioxane that is in the groundwater extracted from the Buildings 63, 2 and 45 Area was intermittently operating between November 2015 and October 2016, the system is now fully operational.

III. The ESD established Massachusetts DEP's revised drinking water guideline for 1,4-dioxane of 0.3 µg/L as a TBC for treatment. The 1,4-dioxane oxidation pre-treatment system is achieving the treatment goal. The monitoring data for the GWETS shows that the effluent from the GWETS does not exceed 0.3 µg/L, demonstrating that the remedy is functioning as intended for this requirement.

Based on these considerations discussed above, it is reasonable to consider the remedy to be functioning as intended in the short-term. However, the slug volume removal approach for the ARIEM Building Area does not appear to be achieving the performance metric and will need to be optimized or reevaluated. In addition, a rigorous estimate of contaminant mass in the areas is necessary to determine the progress toward restoring the aquifer to drinking water standards. A rebound test could also be helpful to assess progress toward achieving this goal in these areas.

7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy still valid?

No. There have been changes to exposure assumptions and toxicity values at the time of the remedy; however, these changes do not result in revisions to the cleanup levels or call into question the protectiveness of the groundwater RAOs or remedy.

Section 6.3.2 and Appendix D, Tables D-1 and D-2 present the toxicity values and exposure assumptions that have changed since the HHRA was completed. As shown in Appendix D, updated toxicity values for PCE and TCE now result in higher hazard quotients for non-cancer health effects, and require age-specific adjustments (i.e., increased sensitivity in children) for cancer risk estimates. In addition,1,4-dioxane was also added to the list of monitored chemicals through the 2013 ESD. Because exposure is prevented and detected chemicals levels in shallow groundwater are below vapor intrusion benchmarks as discussed in Section 6.4.4, the changes in toxicity values and exposure factors do not affect the remedy or alter the protectiveness.

In February of 2014, EPA released *Human Health Evaluation Manual, Supplemental Guidance: Update*

of Standard Default Exposure Factors, OSWER Directive 9200.1-120, which provided updated recommendations for several common recommended default exposure factors used to set regional screening levels and calculate human health risks. As shown in Appendix D, a few exposure factor assumptions used in the previous HHRAs differ from the new EPA recommended ones. Incorporating these revised exposure and toxicity factors into the original OUI risk assessment would result in increased non-cancer risk, but would not change the original conclusion that groundwater risks exceed EPA risk limits. The ROD and ESD cleanup goals are based on ARARs (MCLs) and TBCs (manganese health advisory), rather than risk, and institutional controls prevent exposure to groundwater. Therefore the existing clean-up goals remain protective.

OU1 groundwater is not used as a potable water source at this time and is not expected to be used for such purposes in the future. Institutional controls prohibit the installation of private potable water supply wells on and off-facility in a prescribed area near the plume. In addition, evaluation of vapor intrusion has shown that there are no unacceptable exposures to COCs via this mechanism. Therefore, the remedy continues to protect people from being exposed to contaminated groundwater.

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

No. The Army is not aware of any additional information that would question the protectiveness of the remedy.

7.4 Technical Assessment Summary

Based on the data reviewed, the response actions related to the NSSC Groundwater Operable Unit 1 are generally performing as defined and meeting the remedial action objectives. The exposure assumptions, toxicity data, and RAOs used at the time of the remedy are still valid. The slug volume removal method for the localized area of contamination outside the capture zone in the ARIEM Building Area may need to be optimized or other methods evaluated and implemented in order to reduce TCE concentrations in this area to below MCLs.

8.0 ISSUES

Table 7 below lists issues identified during the FYR evaluation.

Table 7

Issues for Operable Unit 1 (Groundwater)

Issue	Affects Protectiveness (Y/N)	
	Current	Future
Periodic slug volume removal in the ARIEM Building Area has not reduced TCE concentrations to below MCLs.	No	Yes

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 8 below lists recommendations and follow up actions to the issues identified during the FYR evaluation.

Table 8

Recommendations and Follow-Up Actions Operable Unit 1 (Groundwater)

Issue	Recommendation and Follow-up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Periodic slug volume removal in the ARIEM Building Area has not reduced TCE concentrations to below MCLs.	Optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of chlorinated VOC contamination in the ARIEM Building Area.	Army	EPA and MassDEP	August 2017	No	Yes

9.1 Other Findings

Recommendations that do not affect overall protectiveness of the remedy but may enhance the evaluation and performance of the remedy are listed below.

1. Update the numerical groundwater flow and transport model with current data to evaluate current PCE and TCE cleanup timeframes for the T-25 Area and evaluate cleanup timeframes for the other areas within the plume.

2. The Army is currently preparing a work plan to optimize groundwater cleanup, which is expected to be completed in the spring of 2017. This work plan will include updating the groundwater flow and transport model to evaluate what effective changes can be made to the treatment system including determining if additional extraction wells placed within the core of the Building 63, 2, and 45 groundwater plume would accelerate groundwater cleanup in this area. The effects of matrix diffusion from the aquifer solids to groundwater will be included in the groundwater modeling and optimization efforts. A similar analysis will be performed for the Buildings 22 and 36 Area. The optimization work plan will also consider if the source areas can be better defined with high resolution characterization.

3. Changes to the groundwater monitoring program from the original ROD may need to be documented. Annual reports should include statistical evaluations to document decreasing trends and remedy performance. Annual reports should also include target capture zone evaluations using synoptic water level data to demonstrate capture.

4. Develop background concentrations for secondary COC to assess if concentrations are representative of background conditions. Secondary COCs found to be related to background conditions (or a laboratory contaminant) should be removed from the long-term monitoring program. While there is a more stringent MCP GW-1 cleanup level for vanadium (30 ug/L), vanadium has not been detected in groundwater at the site above this criterion and was only detected in 1 of 10 monitoring well locations during this FYR period with the single detection

below the MCP criteria. The only secondary COC, above cleanup levels was manganese, which had increased approximately three fold in Well MW-128A between 2010 and 2015. The Army should continue to monitor dissolved manganese in this area and determine the source of the reducing conditions in this area.

5. Consider conducting biological activity reaction test at wells where clogging is occurring to evaluate if the fouling is the result of bacteria.

6. Consider evaluation of U.S. EPA's MNA guidance after the groundwater extraction system is turned off.

10.0 PROTECTIVENESS STATEMENT

The remedy at OU1 currently protects human health and the environment. PCE and TCE concentrations in groundwater continue to decline and extraction wells prevent further migration of these contaminants. Isolated locations of PCE and TCE in groundwater outside the plume capture zone are pumped at the well locations and trucked to the T-25 Treatment System at Building 94. Institutional controls, as documented by the annual institutional control certifications prepared by the U.S. Army and Town of Natick, continue to prohibit the use or installation of private drinking water wells within or near the plume, where the restriction is applied. However, in order for the remedy to be protective in the long-term, the following action needs to be taken:

- Optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of trichloroethene contamination in the ARIEM Building Area; TCE remains above the cleanup level in this area following two years of periodic slug volume removal.

11.0 NEXT REVIEW

The next FYR review will be completed on April 12, 2022.

12.0 REFERENCES

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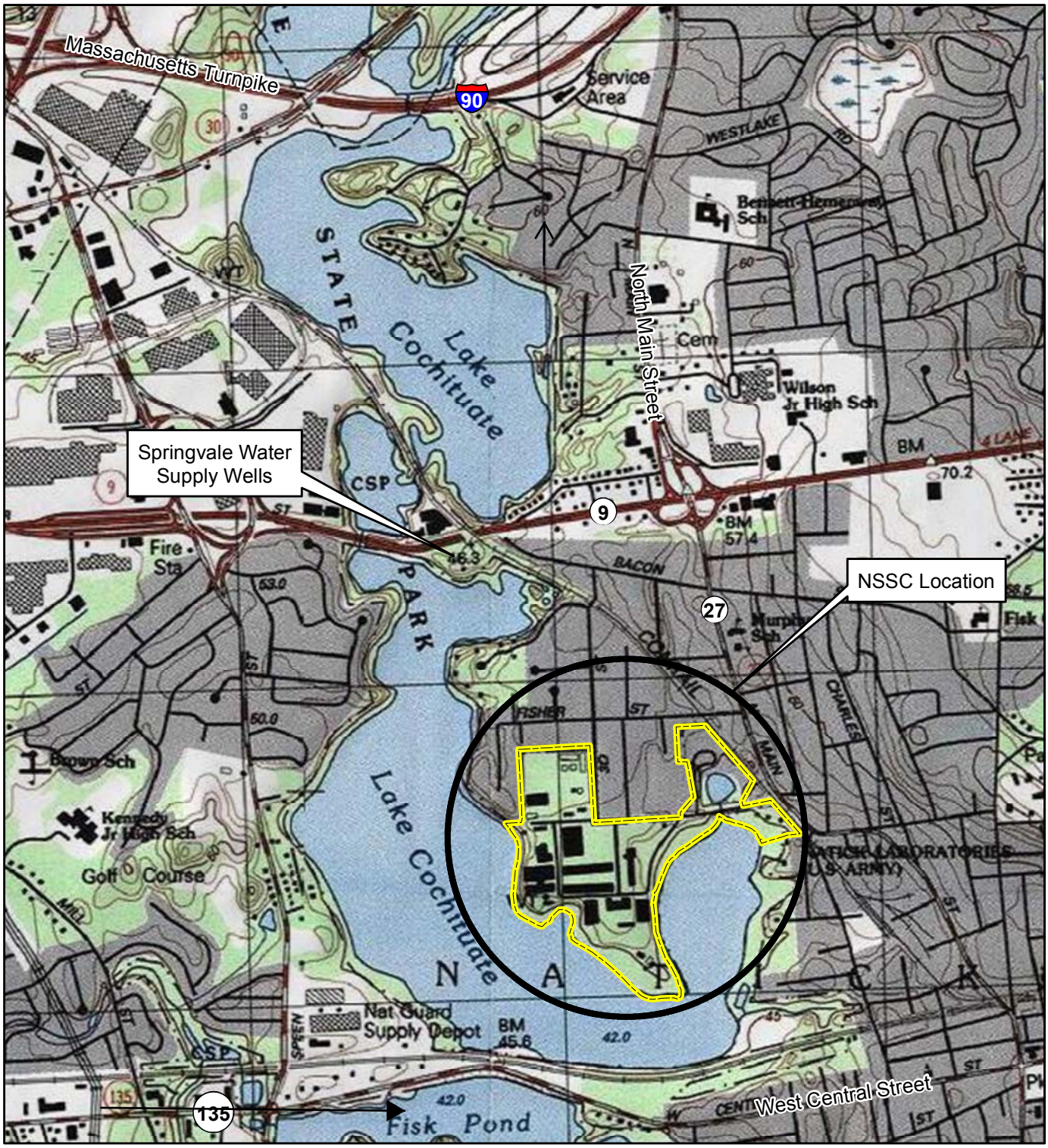
FIGURES



Legend

Installation Boundary

0 750 1,500 Feet

US Army Corps of Engineers
New England District

N

Natick Soldier Systems Center - Site Location Map

FIGURE 1

M:\Projects\NatickGIS\2016\Figures\LocationMap_101716.pdf
M:\Projects\NatickGIS\2016\Figures\LocationMap_101416.mxd
October 17, 2016 DWN: MTW CHKD: PR

Legend

Installation Boundary

Historic Site Boundaries

Location Map

0 250 500 Feet

US Army Corps of Engineers
New England District

Note:
ARIEM Building and Well MW-144B-2 Areas added in 2013 Explanation of Significant Differences (see specific areas figure 3).

Natick Soldier Systems Center - Site Layout

FIGURE 2

M:\Projects\NatickGIS\2016\Figures\SiteMap_101716.pdf
M:\Projects\NatickGIS\2016\Figures\SiteMap_101416.mxd
October 17, 2016 DWN: MTW CHKD: PR

692000 693000 694000

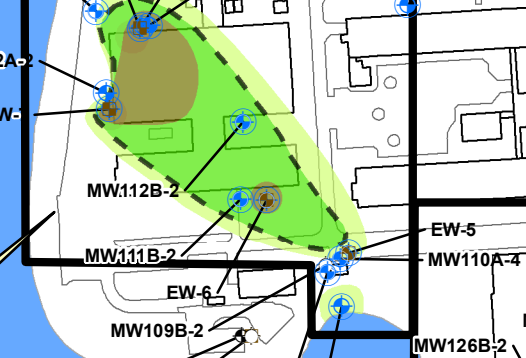
2932000 2931000 2930000

MW-212C-2
MW-202C-2
MW-202B
MW-203B
MW208B-HP2
MW-208A-2
MW-205B
MW-211B-4
T-25 Area Treatment Building (Bldg 94)
MW-95B-4
MW-27B-HP2
MW-9
MW-26B-M7
MW-201B
MW-201A
MW-39B-HP4
MW-15B
MW-37B-HP2
MW-32B-HP2
T-25 Area
MW-38B-HP2
MW-1
MW207B-HP2
MW-35BR
MW-83B-2
MW-25B-2
MW209B-HP2
MW-94B-4
MW-90B-4
MW-18B-HP2
MW-96B-4
MW-88B-HP2
MW-2
MW-2B
MW-12A
MW-3B
MW-3
Little Roundy Pond
MW-51BR
MW-128A
MW-129A
MW178B-2
MW-74B-HP2
MW-5R
MW127A-2
MW102A-2
MW-6
MW-93B-HP2
MW151A-2
EW-8
MW113B-2
MW113A-2
MW-44B-HP2
MW114B-2
MW-11B
MW-11A
MW152A-2
MW169B-2
MW114B-2 Area
EW-1
MW120A-2
MW120B-2
MW-181B-2
MW112B-2
MW165A-2
MW165B-2
EW-5
MW111B-2
MW110A-4
MW122A-2
MW122B-2
EW-6
MW164A-2
MW164B-2
MW109B-2
MW121B-2
MW121A-2
MW126B-2
Buildings 22 and 36 Area
MW-168B-2
MW-40BR
MW156A-2
MW103A*4
MW103B-2
MW125B-2
MW105A-1
MW103A-2
ARIEM Building Area
EW-4
MW-10B
MW123B-2
MW-10A
EW-3
EW-2
MW-13B
South Pond
Lake Cochituate
MW160A-2
MW-14B
MW124B-2
MW-14A
MW163A-2
MW161A-2
MW162A-2
Buildings 63, 2, and 45 Area

692000 693000 694000

Contract No.	W912CG-05-D-007
Description	Distribution of TCE/PCE in Groundwater
Coordinate system	NAD 1983, State Plane, Mass Mainland, in feet
Sources	Figure 2-1 Final Explanation of Signficant Differences for the T-25 Area Ground Water (Operable Unit 1) (U.S. Army 2013).

Date	8OCT2012	Rev.	Date	App. By
DB	C. Guido			
CB				
AB				



Legend

- Existing Extraction Well Location
- Monitoring Well Sampled for PCE and/or TCE
- Monitoring Well Not Sampled for PCE and TCE
- Installation Boundary
- USEPA MCL (ug/L)
- Area Boundary

PCE Concentration Contour

- 0.3-5 ug/L
- 5-25 ug/L
- > 25 ug/L

TCE Concentration Contour

- 0.3-5 ug/L
- 5-25 ug/L
- > 25 ug/L

Figure 3

PCE and TCE Areas of Groundwater Contamination (2013 Explanation of Signficant Differences)

U.S. Army Natick Soldier Systems Center
Natick, Massachusetts

ECC GIS Server
D:\OtherGIS\Natick\MapDocuments\ESD\
ESD_Fig2-1_PCETCE.mxd

0 200 400 Feet

N

NORTH

A

SOUTH

A'

ELEVATION (FEET ABOVE MEAN SEA LEVEL)

170 150 130 110 90 70 50 30 10 -10 -30 -50 -70 -90 -110

SV-3 SV-4 SV-1

SOUTH POND OF LAKE COCHITUATE

MW-202B
MW-202C-2/EB-202C*
MW-211B-4/EB-211B*
MW-208A-2*
MW-208B-HP2
EB-208E-HP
T-28 AREA PROPERTY LINE
MW-95B-4
MW-37B-HP2
MW-35B-M13
MW-83B-2
MW-90B-4 & MW-18B-HP2
MW-88B-HP2
MW-3AB
MW-93B-HP2
MW-44B-HP2
MW-11B
MW-11A

0.54 J
14.2
13.7
8.1
6.9
1.3
1.1
1.8
9.5
1.7
4.1
7.7
6.6
12
15
10
8.2
0.24 J
8.6
0.92 J
2.4

? ? ? ? ? ? ? ? ?

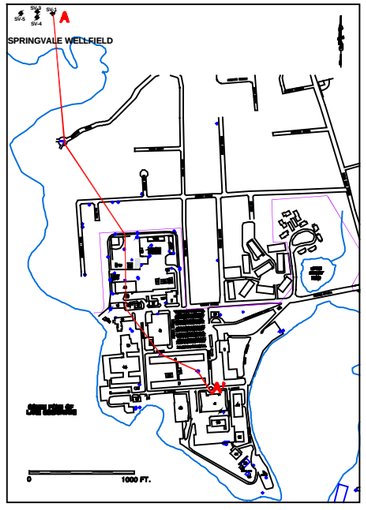
Approximate Groundwater Elevation (Oct. 20, 2003)

MED-COARSE SAND AND GRAVEL [SW/SP]
FINE TO MEDIUM SAND [SP]
SILTY SAND [SM]
CLAYEY SILT WITH VERY FINE SANDS AND CLAYS [ML]
SILT [ML]
TILL
BEDROCK **
PEAT, ORGANIC SOILS [PT]

** Bedrock surface elevations determined by bedrock borings and geophysical survey (Weston).

50
0
FEET
0 900

VERTICAL EXAGGERATION = 18X



LEGEND

2.4 TCE CONCENTRATION (ug/L)*
1.7 PCE CONCENTRATION (ug/L)*
J = ESTIMATED, VALUE BELOW DETECTION LIMIT
• SAMPLE COLLECTION POINT
– INDICATES NOT DETECTED

* TCE and PCE data from MW-202C-2(EB-202C), MW-211B-4(EB-211B), and MW-208A-2 were obtained from the new LTM well field screening/sampling results (Fall 2003). The remaining data were obtained from most recent validated quarterly sampling event Round 33 (April 2003).

ICF CONSULTING

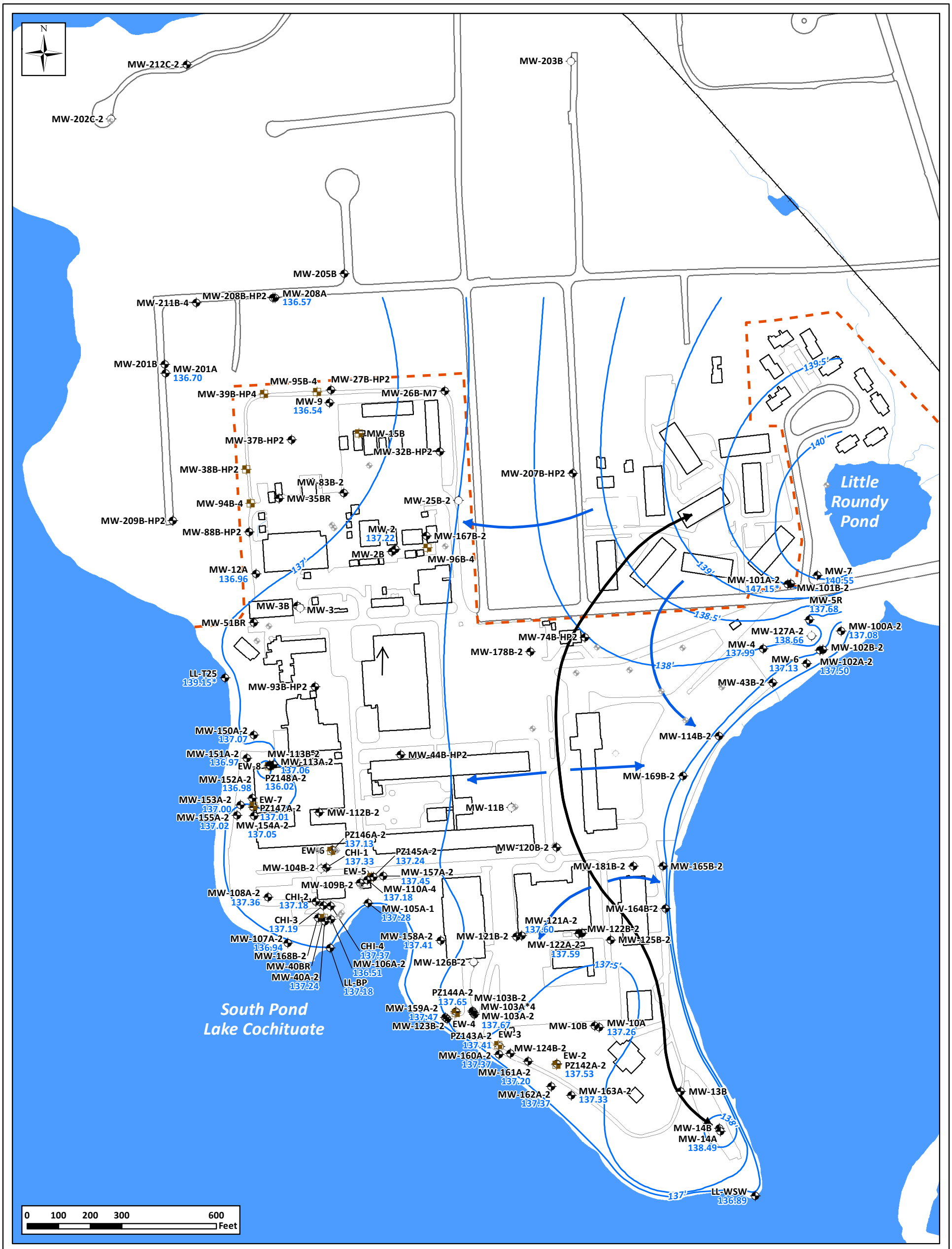
APPROVALS		DATE
DRAWN	MSB	3/2004
CHECKED	KJP	3/2004
QA/CONTROL	THC	3/2004
TECH REVIEW	BPM	3/2004
PROJ MNGR	KJP	3/2004

TITLE

FIGURE 4

GEOLOGIC CROSS–SECTION A–A'

PREPARED FOR: USAEC	SCALE: 1 IN. = 900 FT. HORIZ. 1 IN. = 50 FT. VERT.
DATE: MARCH 2004	DWG. NO.: 032039–024
SOURCE: ICF CONSULTING, INC.	SHEET 1 OF 1



Map Key:

- Existing Extraction Well Location - Gauged
- Monitoring Well Location - Gauged
- Monitoring Well Location - Not Gauged
- Potentiometric Surface
- Groundwater Divide
- Direction of Groundwater Flow
- Installation Boundary
- Railroad Tracks
- Buildings
- Roads and Parking

Note:
Anomalous value (*) was not include in the generation of the potentiometric surface.

PLEXUS scientific
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Suite 350
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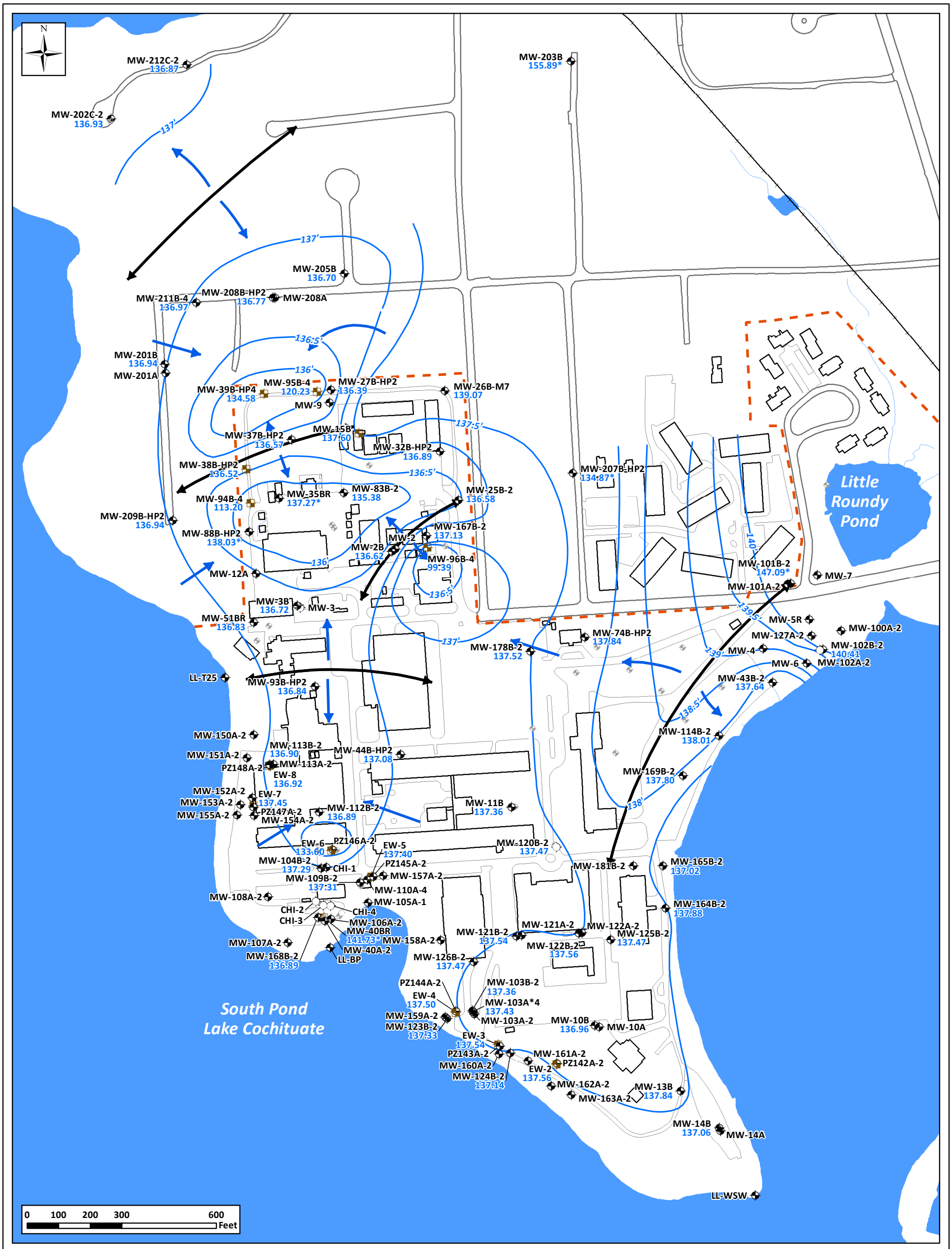
(F) 703.845.8568

Created By: Betsy Bouton
Date: January 2017

FIGURE 5

Interpreted Water Table Piezometric Surface

Groundwater Monitoring Event 73 and Groundwater Treatment System Annual Report



Map Key:

- Existing Extraction Well Location - Gauged
- Monitoring Well Location - Gauged
- Monitoring Well Location - Not Gauged
- Potentiometric Surface
- Groundwater Divide
- Direction of Groundwater Flow
- Installation Boundary
- Railroad Tracks
- Buildings
- Roads and Parking

Note:
Anomalous value (*) was not include in the generation of the potentiometric surface.

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Created By: Betsy Bouton
Date: February 2017

FIGURE 6

Interpreted Deep Overburden Piezometric Surface

Groundwater Monitoring Event 73 and Groundwater Treatment System Annual Report

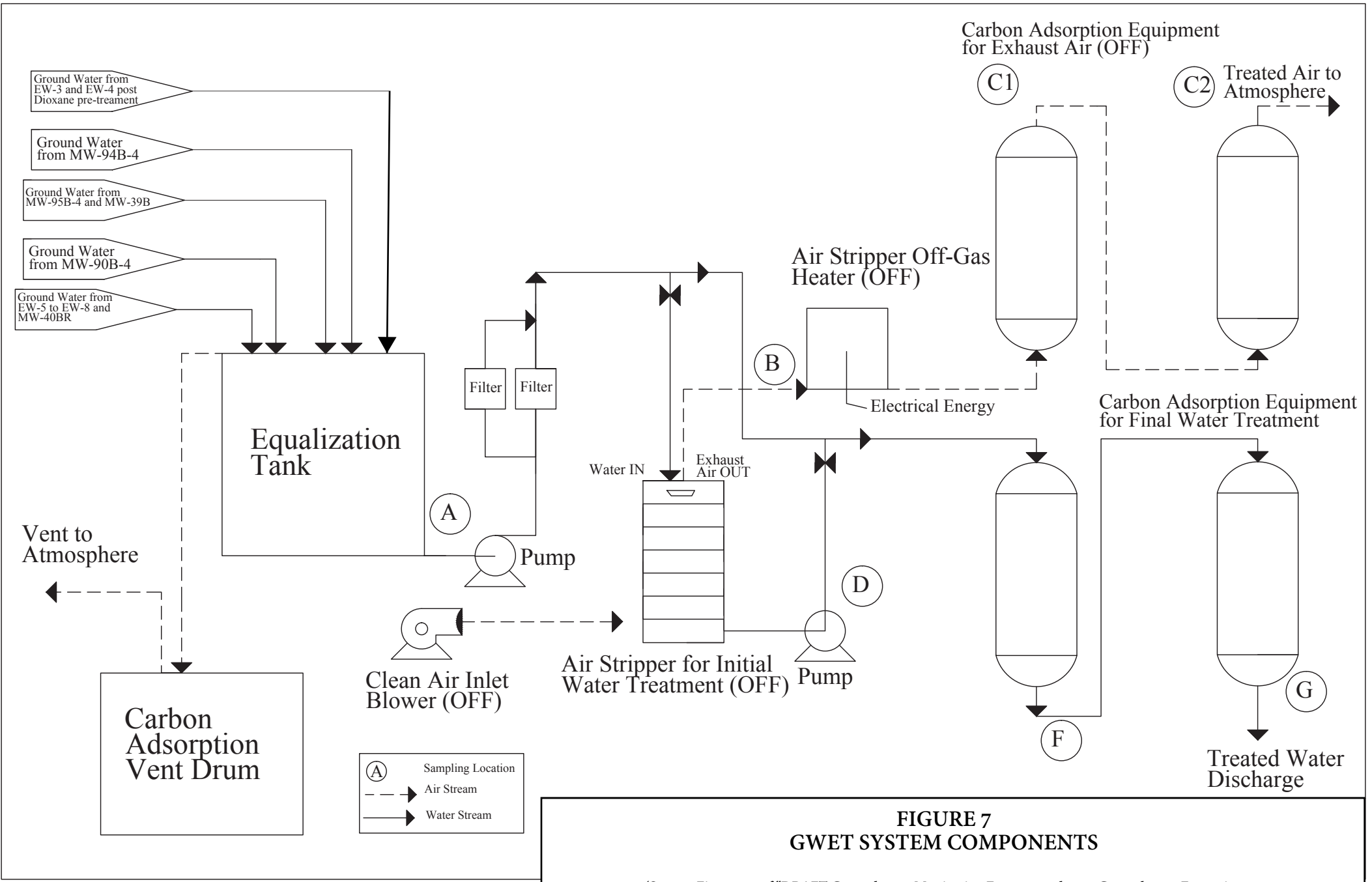
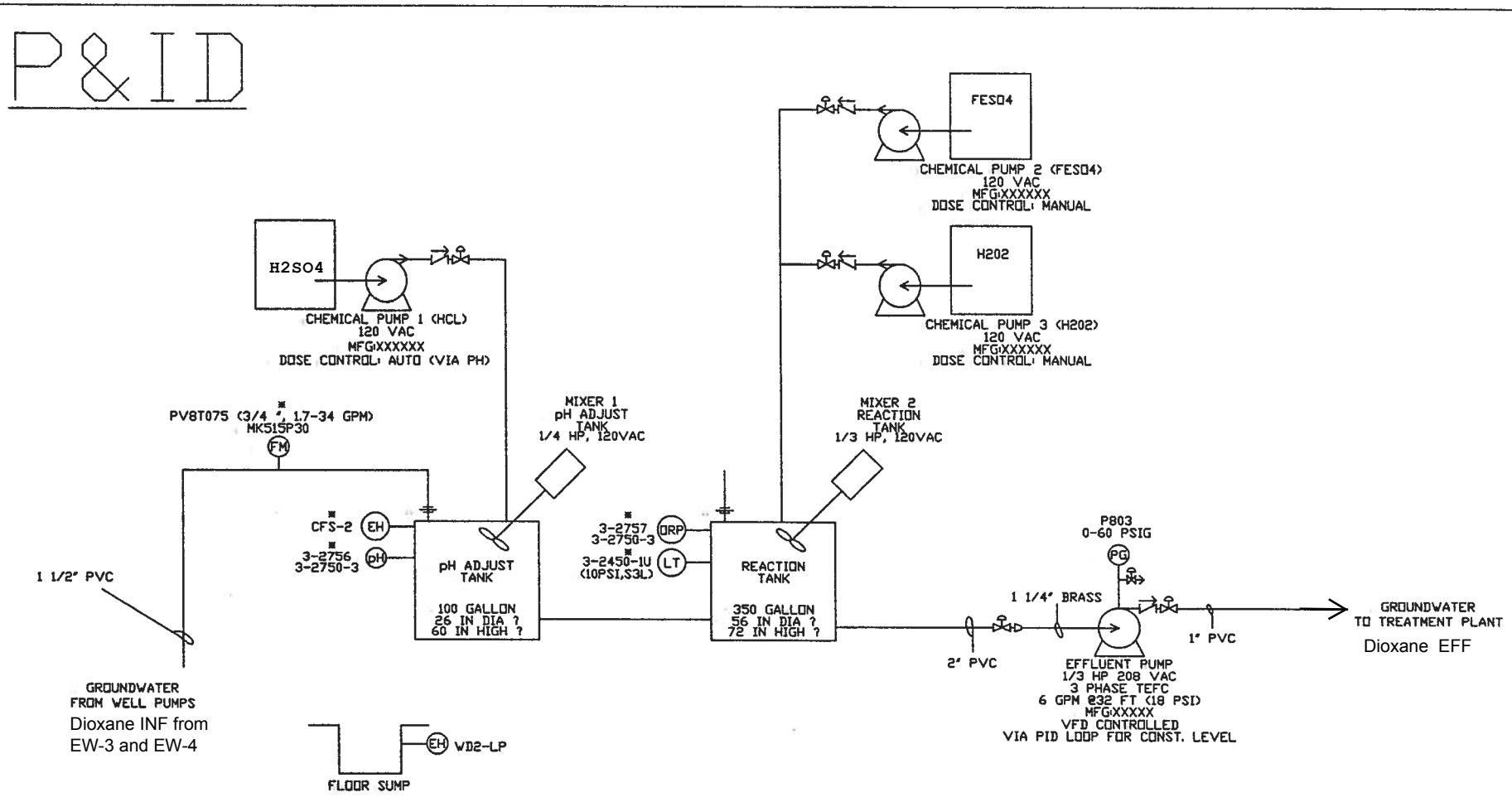


FIGURE 7
GWET SYSTEM COMPONENTS

(Source: Figure 3-1 of "DRAFT Groundwater Monitoring Event 71 and 2015 Groundwater Extraction and Treatment System Annual Report" - Plexus, 2016)



NOTES:
1.) CONTROL PANEL AND SENSORS(*) SUPPLIED BY NES. ALL OTHER COMPONENTS SUPPLIED BY OTHERS.
2.) THIS DRAWING IS INTENDED AS A REFERENCE DOCUMENT FOR NES ONLY.
3.) SYSTEM DESIGN AND FABRICATION BY OTHERS (MACTECH, ECC, CFS).
4) pH AJUSTMENT SWITCHED FROM HCL TO H2SO4 IN 2016

FIGURE 8
1,4-DIOXANE PRE-TREATMENT SYSTEMCOMPONENTS -

(Source: Figure 3-2 of the "DRAFT GROUNDWATER MONITORING EVENT 69 AND 2014 GROUNDWATER TREATMENT SYSTEM ANNUAL REPORT" - ECC, 2015)

LEGEND	
CHECK VALVE	EH EMERGENCY HIGH SWITCH
BALL VALVE	H HIGH LEVEL FOR PUMP TURN ON
SAMPLE PORT	L LOW LEVEL FOR PUMP TURN OFF
RELIEF VALVE	PS PRESSURE SWITCH
SOLENOID VALVE	PG PRESSURE GAUGE
	VS VACUUM SWITCH
	TG TEMPERATURE GAUGE
	VG VACUUM GAUGE
	FM FLOW METER

NATIONAL ENVIRONMENTAL SYSTEMS
508-761-6611
36 MAPLE AVENUE, SEEKONK, MA 02771

PROCESS AND INSTRUMENTATION DIAGRAM

JOB NAME: CF&S / NATICK ARMY LABS

NES PROJECT: 08A209		SHEET M-1	
DATE: 7-3-08	DRAWN: RJD	P&ID	REV:
SCALE: N. T. S.	DESIGN: DTH		

692000 693000 694000

2932000 2931000 2930000

MW-212C-2
MW-202C-2
MW-202B
MW-203B
MW208B-HP2
MW-208A-2
MW-205B
MW-211B-4
MW-95B-4
MW-27B-HP2
MW-9
MW-26B-M7
MW-201B
MW-201A
MW-39B-HP4
MW-15B
MW-37B-HP2
MW-32B-HP2
MW-38B-HP2
MW-1
MW207B-HP2
MW-35BR
MW-83B-2
MW-25B-2
MW209B-HP2
MW-94B-4
MW-90B-4
MW-18B-HP2
MW-96B-4
MW-88B-HP2
MW-2
MW-2B
MW-12A
MW-3B
MW-3
MW178B-2
MW-74B-HP2
MW-5R
MW127A-2
MW-51BR
MW-128A
MW-129A
MW-93B-HP2
MW102A-2
MW-6
MW151A-2
EW-8
MW113B-2
MW113A-2
MW-44B-HP2
MW114B-2
MW-11B
MW-11A
MW152A-2
MW169B-2
EW-7
MW120A-2
MW120B-2
MW112B-2
MW165A-2
MW165B-2
EW-5
MW111B-2
MW110A-4
MW122A-2
MW122B-2
EW-6
MW164A-2
MW164B-2
MW109B-2
MW121B-2
MW121A-2
MW126B-2
MW-168B-2
MW-40BR
MW156A-2
MW103A*4
MW125B-2
MW103B-2
MW105A-1
MW103A-2
EW-4
MW-10B
MW123B-2
MW-10A
EW-3
EW-2
MW-13B
MW160A-2
MW-14B
MW124B-2
MW163A-2
MW-14A
MW161A-2
MW162A-2

Little Roundy Pond

South Pond
Lake Cochituate

Contract No.	W912CG-05-D-007
Description	Distribution of Trichloroethene in Groundwater
Coordinate system	NAD 1983, State Plane, Mass Mainland, in feet
Sources	Boundaries, roads and buildings provided by MACTEC. 2008 aerial digital orthophotos provided by MassGIS.

Date	9-JAN-2012	Rev.	Date	App. By
DB	J. Kim			
CB	F. Roche			
AB	W. Murray			

Legend

- Existing Extraction Well Location
- Monitoring Well Sampled for PCE and/or TCE
- Monitoring Well Not Sampled for PCE and TCE
- Installation Boundary
- USEPA MCL (ug/L)

PCE Concentration Contour

- 0.3-5 ug/L
- 5-25 ug/L
- > 25 ug/L

TCE Concentration Contour

- 0.3-5 ug/L
- 5-25 ug/L
- > 25 ug/L

Figure 9

Distribution of PCE and TCE in Groundwater

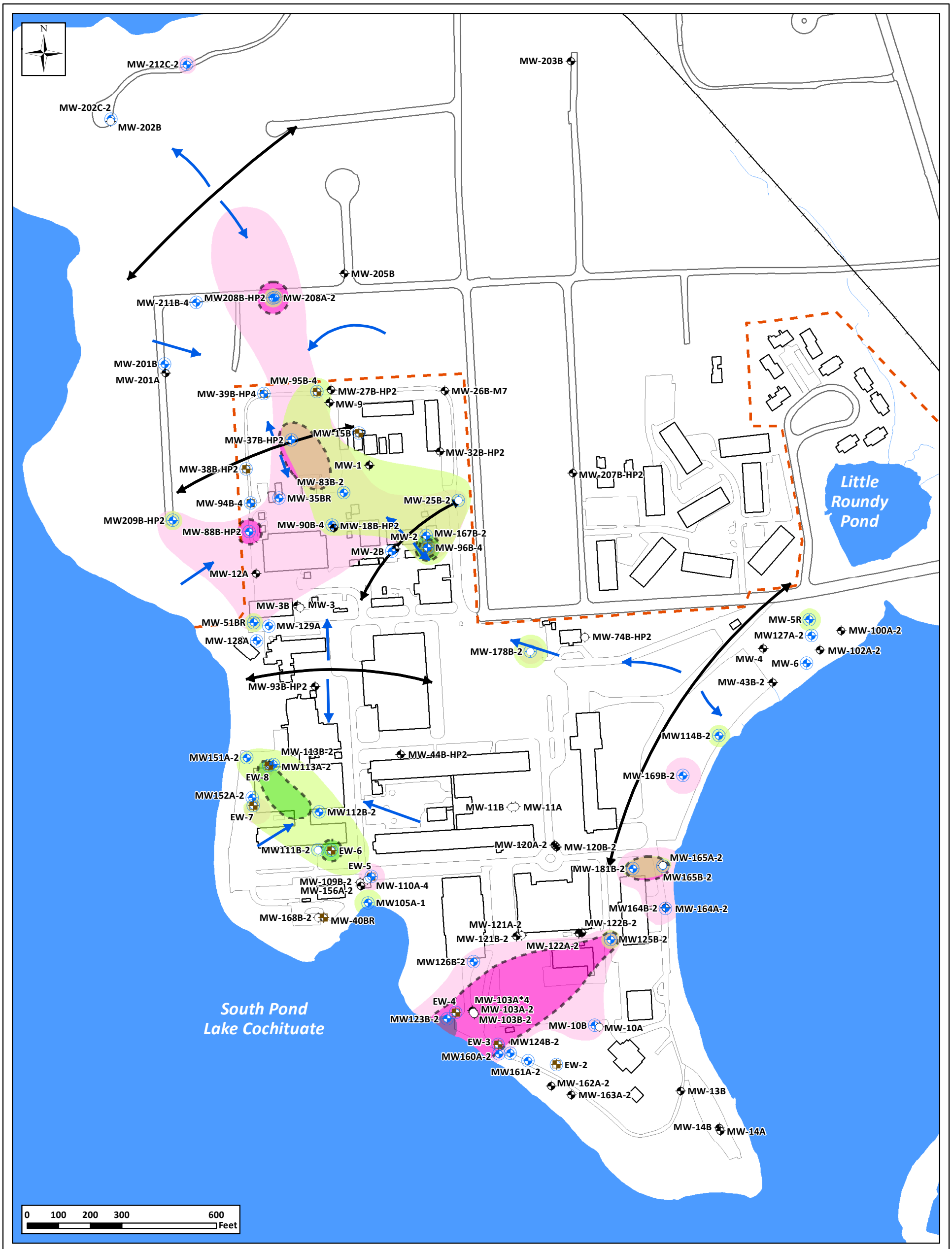
Fall 2011 - Event 63

U.S. Army Natick Soldier Systems Center
Natick, Massachusetts

ECC GIS Server
D:\OtherGIS\Natick\MapDocuments\Quarterly_Report\Event_63\Event63_Fig4-4_PCETCE.mxd

0 100 200 400 Feet

Source of Figure: Draft Final Annual Groundwater Sampling Report for Event 63 (Fall 2011), ECC, April 2012



Map Key:

- Existing Extraction Well Location
- Monitoring Well Sampled for PCE
- Monitoring Well Not Sampled for PCE
- Installation Boundary
- Railroad Tracks
- Buildings
- Roads and Parking
- USEPA MCL (µg/L)

PCE Concentration Contour
- 0.3-5 µg/L
- 5-25 µg/L
- >25 µg/L

TCE Concentration Contour
- 0.3-5 µg/L
- 5-25 µg/L
- >25 µg/L

- Groundwater Divide
- Direction of Groundwater Flow

Note:
Data has not undergone 3rd party validation.

Abbreviation Key:
µg/L = micrograms per liter
J = The positive result reported is a quantitative estimate
MCL = Maximum Contaminant Level
PCE = Tetrachloroethene
TCE = Trichloroethene
USEPA = United States Environmental

PLEXUS scientific
5510 Cherokee Ave.
Suite 350
Alexandria, VA 22312
(P) 703.820.3339
(F) 703.845.8568

Created By: Betsy Bouton
Date: February 2017

FIGURE 10

Distribution of PCE and TCE in Groundwater Fall 2016 - Event 73

Groundwater Monitoring Event 73 and Groundwater Treatment System Annual Report

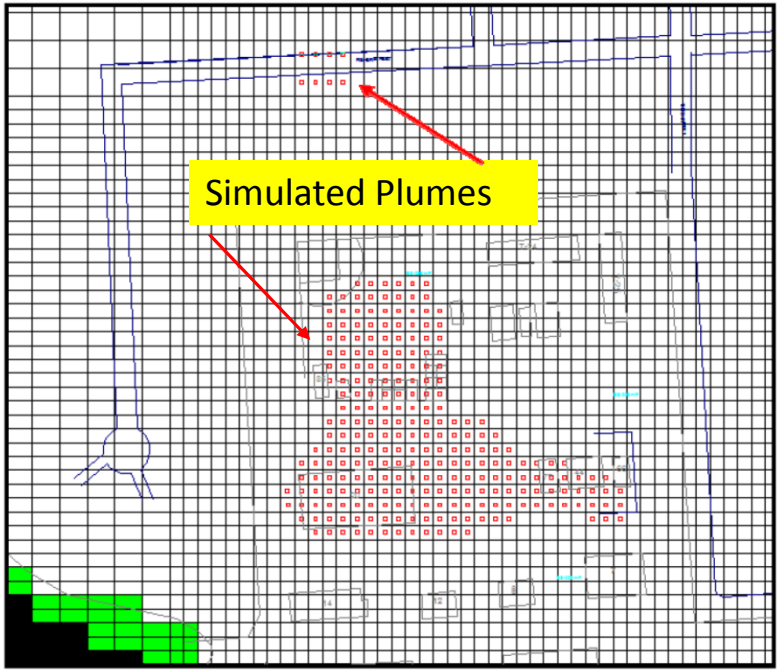


Figure 4: Model representation of Event 69 interpreted extent of TCZ, T-25 Area. Note area corresponding to single exceedance at MW-208 in the upper portion of the figure.

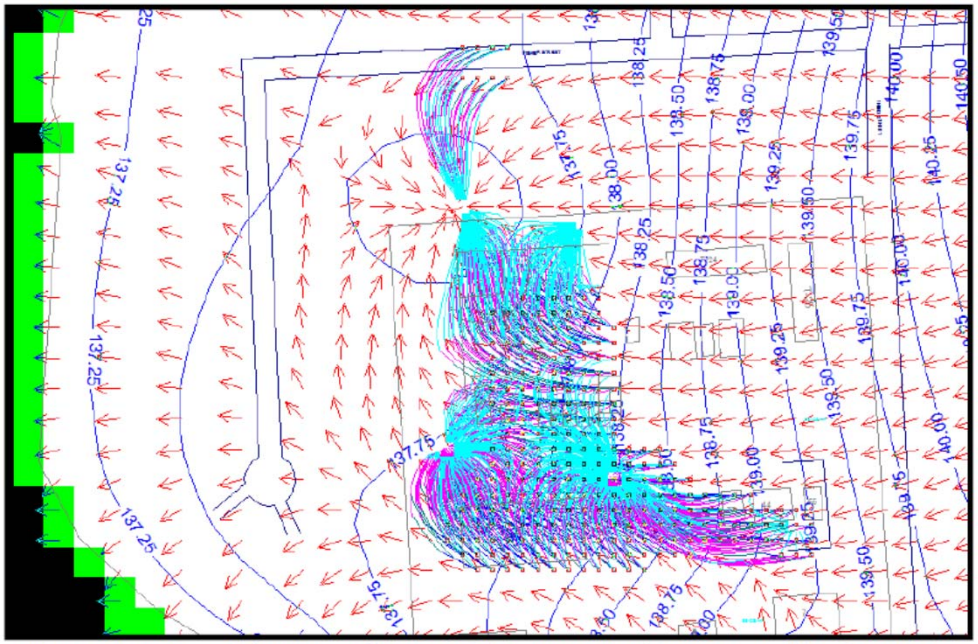


Figure 11: T-25 model capture of TCZ particles, Layer 2, with vectors and head contours. 2014 pumping rates at MW-90B, -94B, -95B, 96B, and 39B. Total pumping of 75.94 gpm.

Source of Figure: Draft Groundwater Monitoring Event 69 and
2014 Groundwater Extraction and Treatment System Annual Report, ECC, April 2015

Figure 11: Capture Zone Analysis for T-25

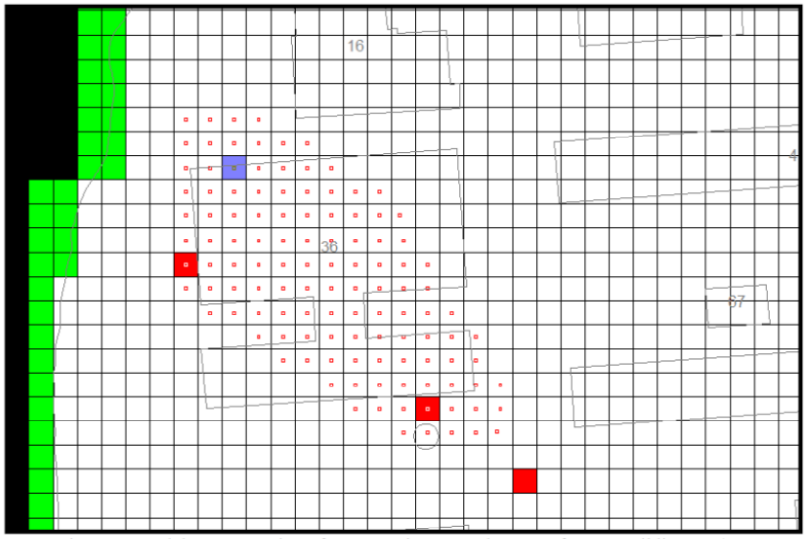


Figure 2: Model representation of Event 69 interpreted extent of TCZ, Buildings 22/36.

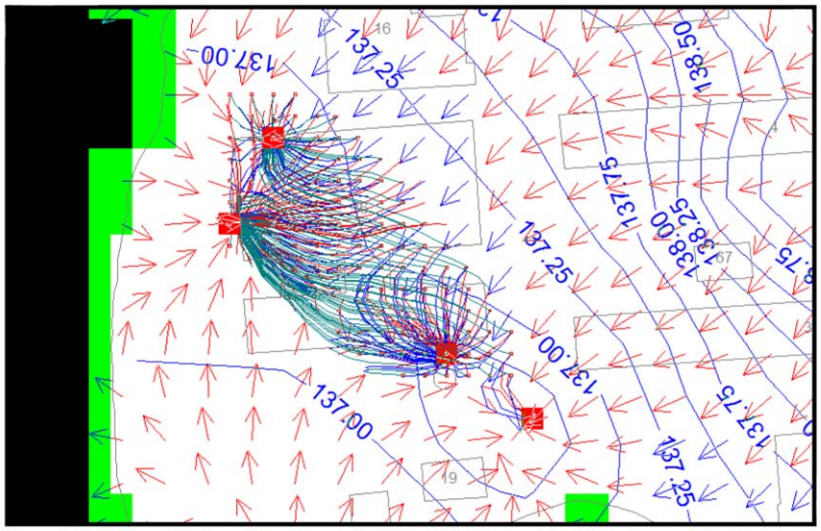
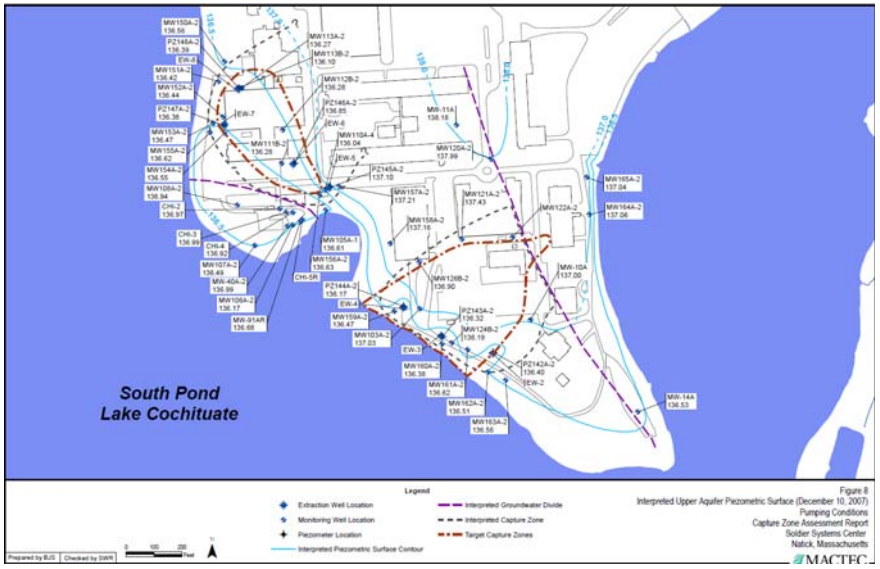


Figure 6: Buildings 22/36 model capture of TCZ particles, Layer 2, with vectors and head contours. 2014 average pumping rates. Total EW-5 through EW-8 pumping rate of 6.28 gpm.

Source of Figure: Draft Groundwater Monitoring Event 69 and
2014 Groundwater Extraction and Treatment System Annual Report, ECC, April 2015



Source of Figure: Draft Groundwater Capture Zone Assessment for Groundwater Plumes at Buildings 22 and 36 and Buildings 63, 2, and 45, ECC, October 2009

Figure 12: Capture Zone Analysis for Buildings 22 and 36

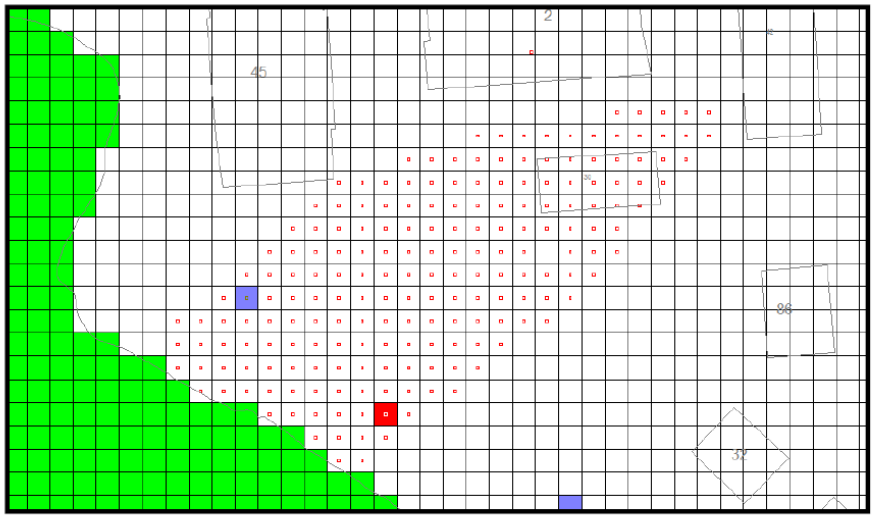


Figure 3: Model representation of Event 69 interpreted extent of TCZ, Buildings 63/2/45

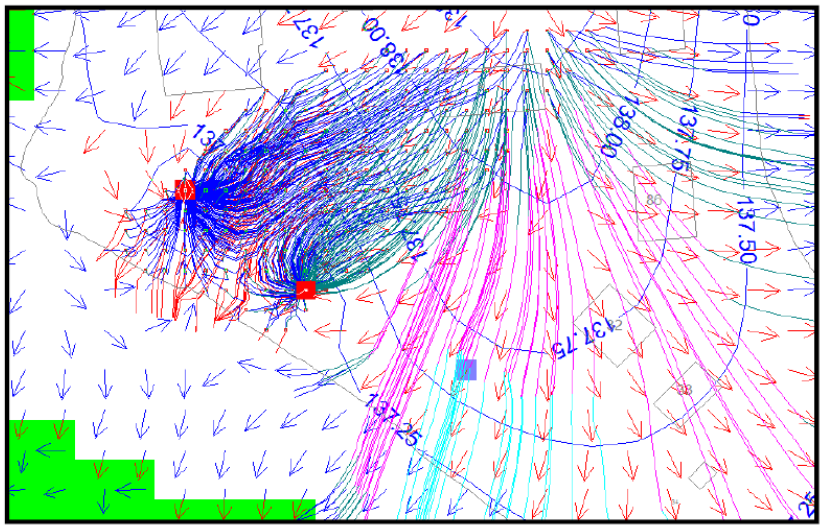
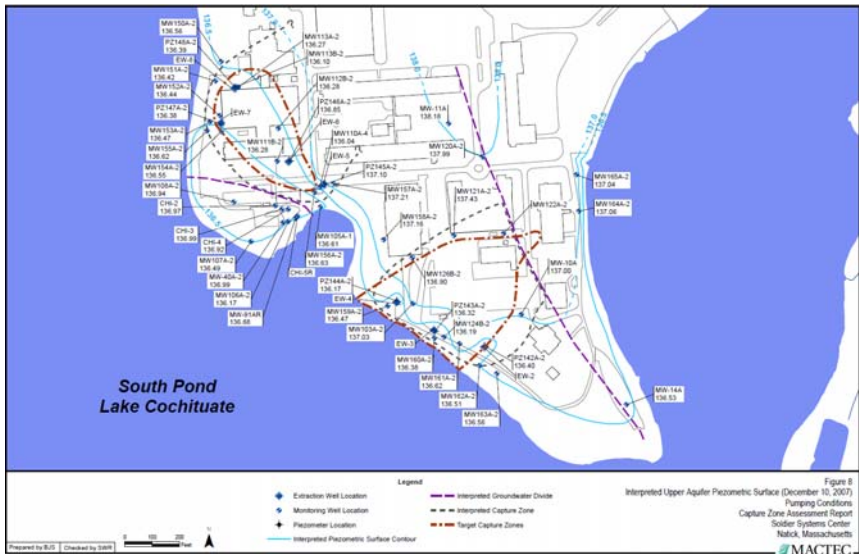


Figure 9: Buildings 63/2/45 model capture of TCZ particles, Layer 2, with vectors and head contours. 2014 average pumping rates. Total EW-2 through EW-4 pumping rate of 2.42 gpm.

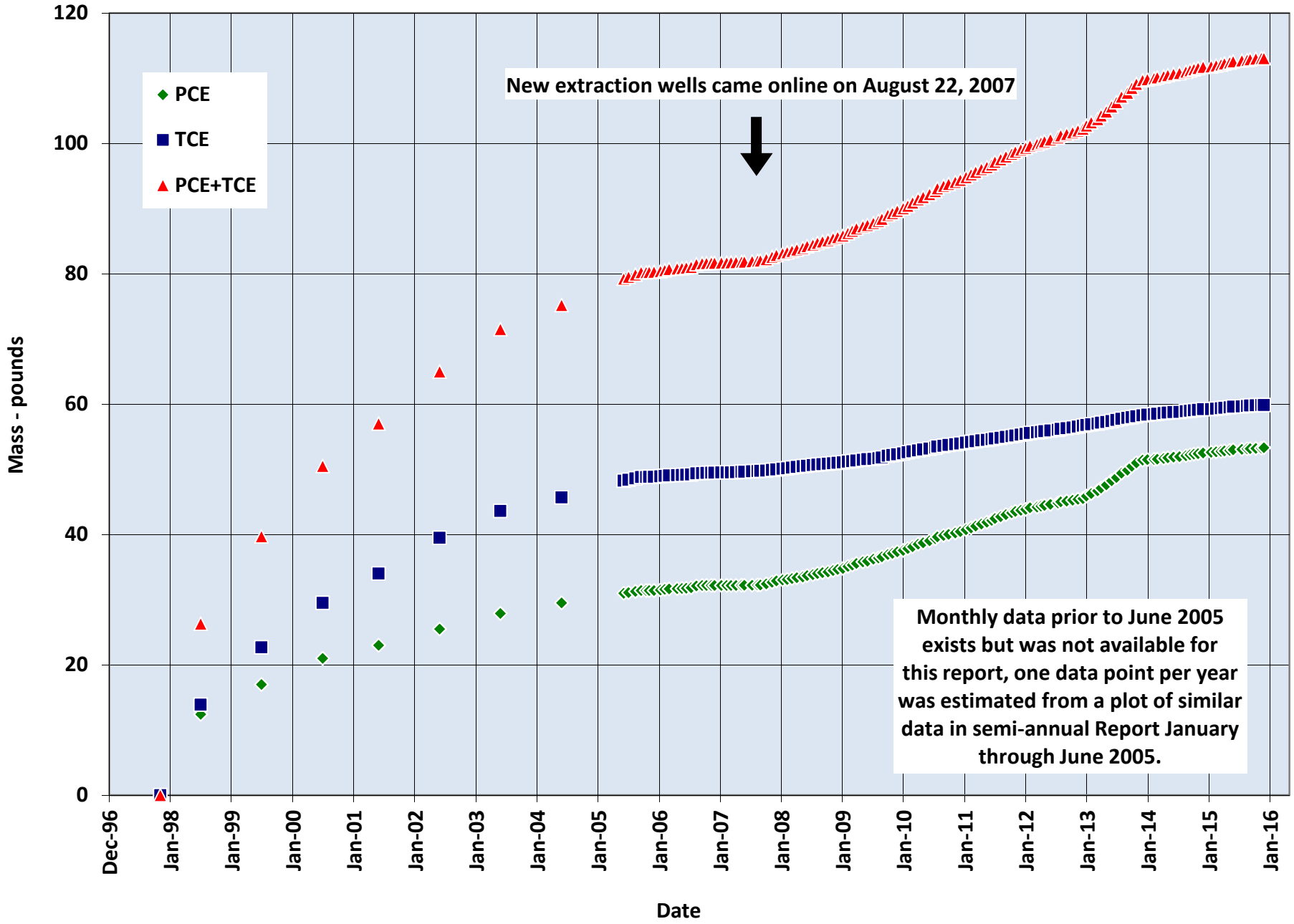
Source of Figure: Draft Groundwater Monitoring Event 69 and
2014 Groundwater Extraction and Treatment System Annual Report, ECC, April 2015



Source of Figure: Draft Groundwater Capture Zone Assessment for Groundwater Plumes at Buildings 22 and 36 and Buildings 63, 2, and 45, ECC, October 2009

Figure 13: Capture Zone Analysis for Buildings 63, 2 and 45

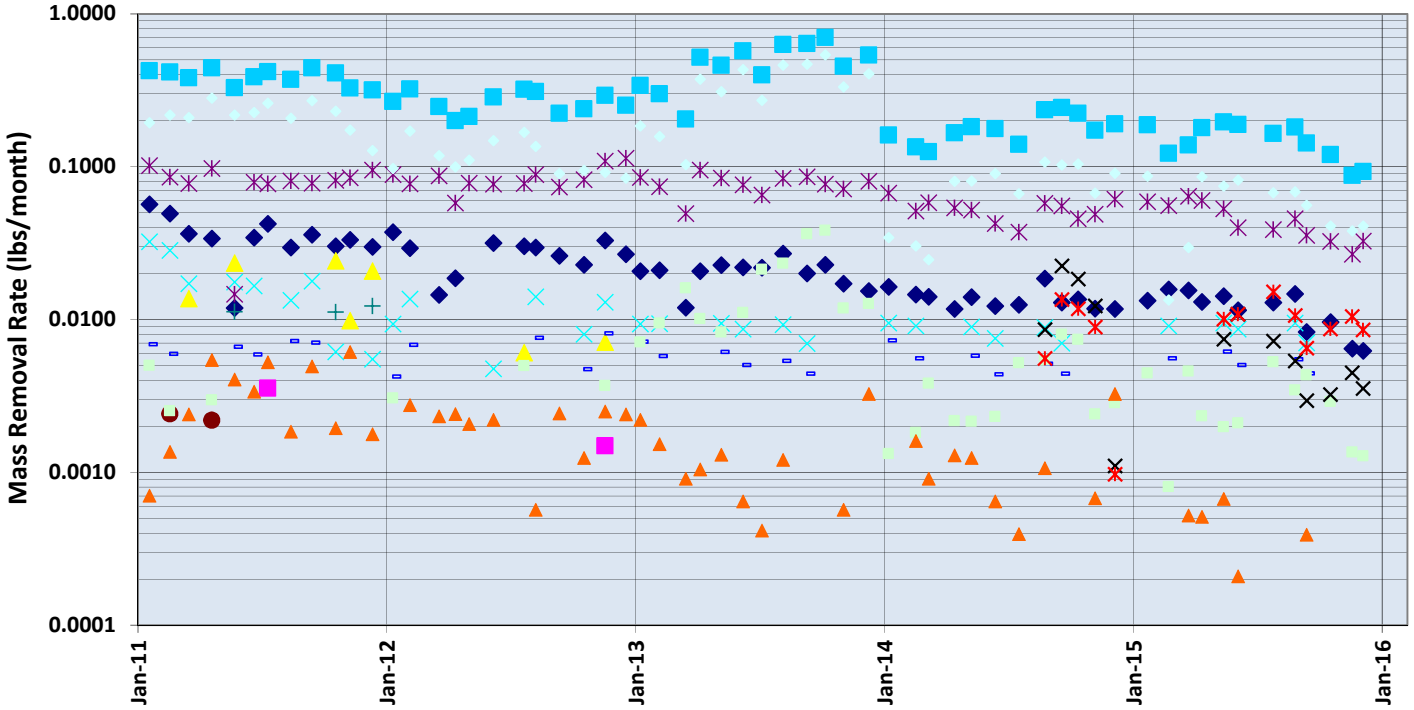
Figure 14: Cumulative Mass of PCE and TCE Removed



Source: Figure 4-11 of "DRAFT Groundwater Monitoring Event 71 and 2015 Groundwater Extraction and Treatment System Annual Report" - Plexus, 2016)

Figure 15: Monthly Mass Removal Rates for PCE, TCE and Dioxane

a. Mass Removal Rates for this Five-Year Review Reporting Period



b. Mass Removal Rates Since System Startup (July 2005)

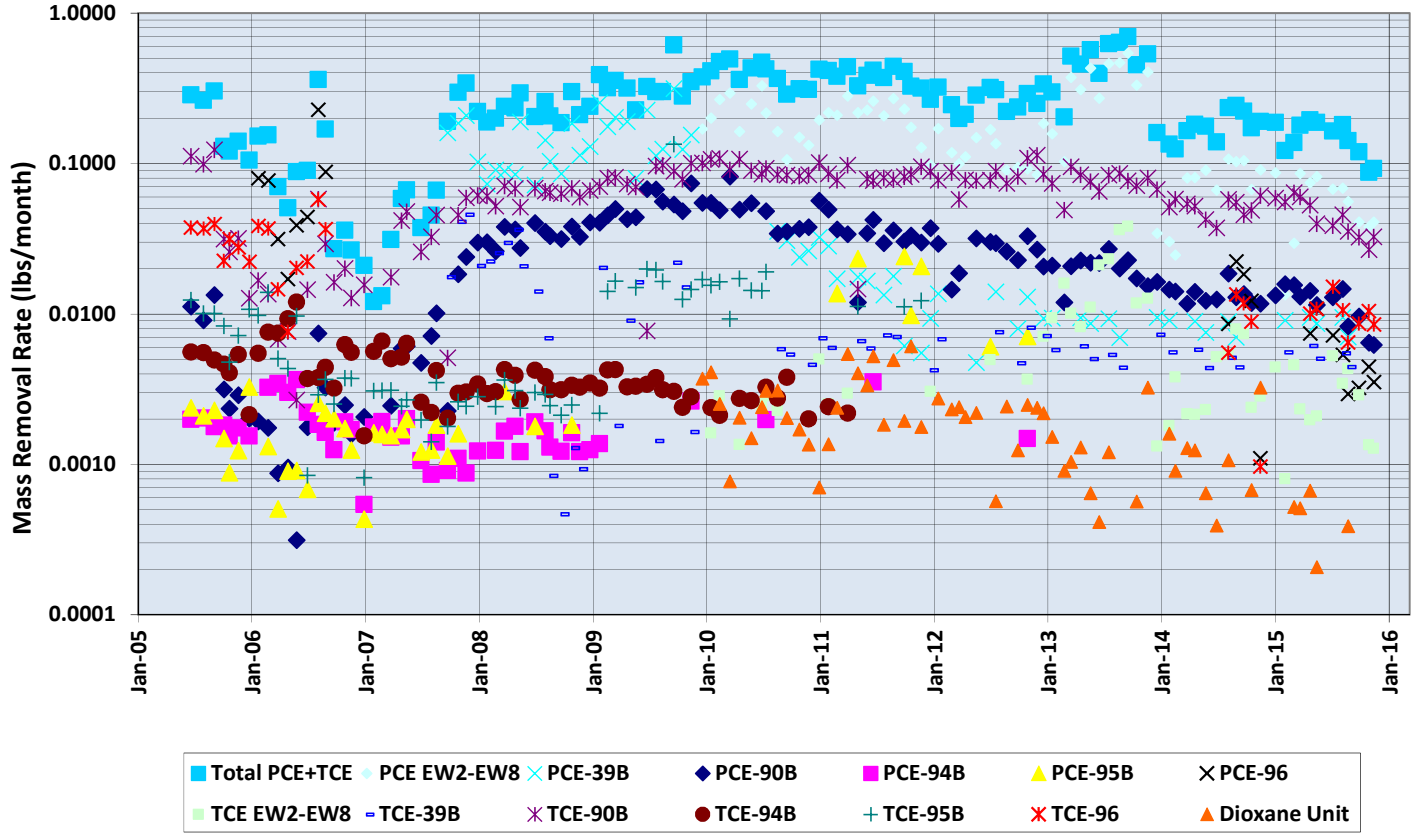
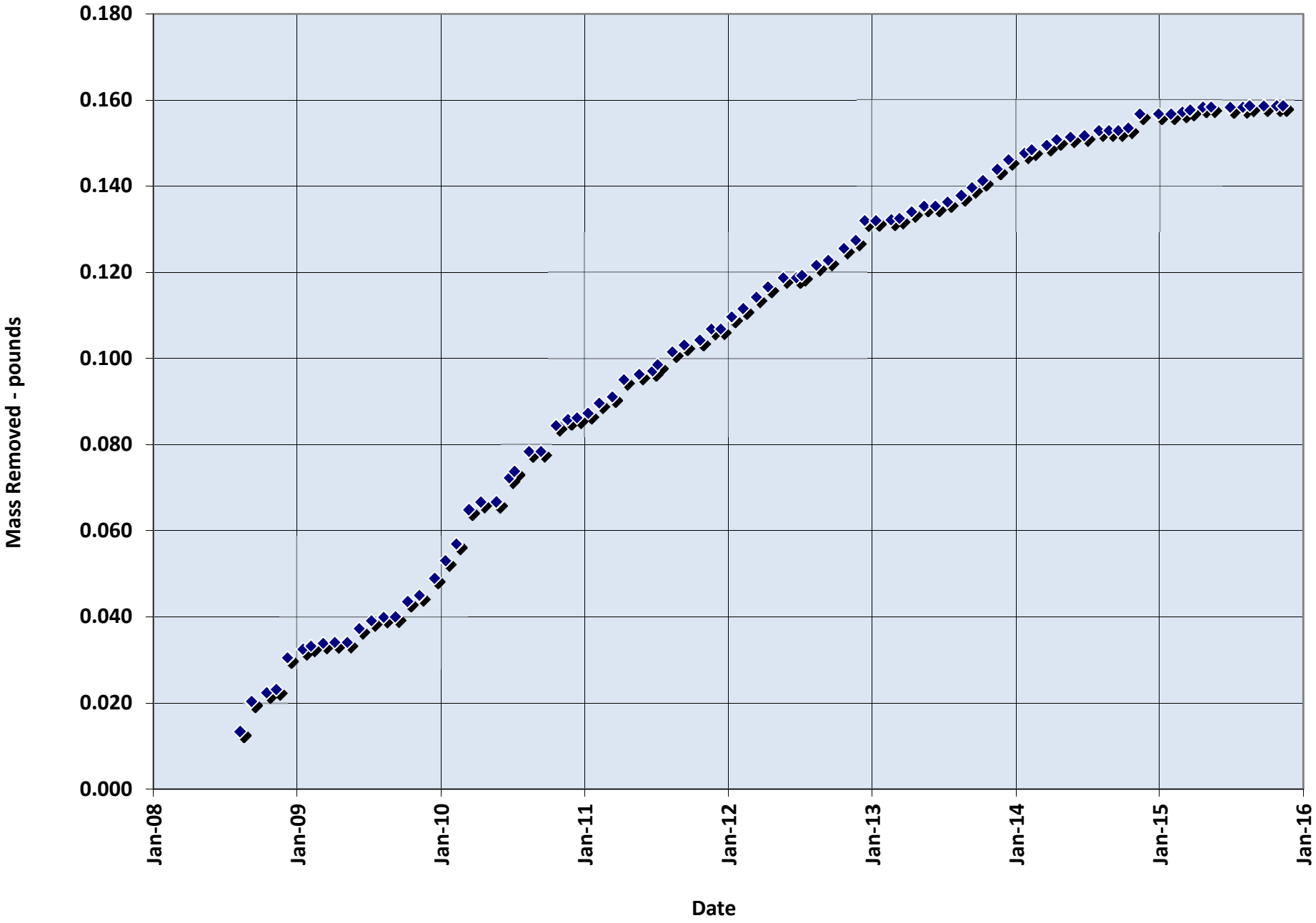


Figure 16 - Cumulative Mass of 1,4-Dioxane Removed



Source: Figure 4-12 of "DRAFT Groundwater Monitoring Event 71 and 2015 Groundwater Extraction and Treatment System Annual Report" - Plexus, 2016)

APPENDICES

APPENDIX A

INSTITUTIONAL CONTROL CERTIFICATIONS

DEPARTMENT OF THE ARMY
US ARMY SOLDIER SYSTEMS CENTER
KANSAS STREET
NATICK, MASSACHUSETTS 01760-5049

REPLY TO
ATTENTION OF

Environmental, Safety and Health Office

10 October, 2013

Christine Williams
U.S. Environmental Protection Agency
5 Post Office Square - Suite 100
Mail Code - OSRR 07-3
Boston MA 02109-3912

SUBJECT: Record of Decision, T-25 Area Ground Water (Operable Unit 1)
Annual Institutional Controls Certification

Dear Christine:

The Environmental health and Safety Office has conducted the required assessment and has determined that the U.S. Army Soldier System Center (SSC) is in compliance with ground water use restrictions outlined in the SSC Real Property Master Plan. No new projects involving use of ground water at the SSC facility were proposed during calendar year 2012.

Attached please find the required letter from the Town of Natick documenting that they are in compliance with the ROD and the Board of Health regulation.

Please call me at (508) 233-5404 if you have any questions.

Sincerely,

John J. McHugh
Chief - Environmental and Health Office

NATICK
UP-BIBLIUM GOD
FOUNDED 1651
INCORPORATED 1781
MASSACHUSETTS

COMMUNITY DEVELOPMENT

BUILDING
PLANNING
ZONING
CONSERVATION

October 2, 2013

Mr. John McHugh
Chief, Environmental and Health Office
U.S. Army Garrison Natick
Kansas Street
Natick, MA 01760-5049

Dear Mr. McHugh:

Enclosed please find the certification required in accordance with the Record of Decision, T-25 Area Ground Water (Operable Unit 1), U.S. Army Soldier Systems Center (SSC), Natick, Massachusetts dated April 1, 2001 (the ROD). The certification is required annually to document the maintenance of institutional controls. Institutional controls were implemented as a component of the T-25 Area ground water remedy to restrict access to human contact with the ground water both on-facility and off-facility throughout the remedial action.

Off-facility, ground water use restrictions are affected through a municipal ordinance that covers the area where contaminated ground water has been found. More specifically, a town of Natick Board of Health regulation prohibits both the installation of new private drinking water wells and the use of existing private drinking water wells in the area to prevent any access or exposure to contaminated ground water. On February 24, 1999 the town of Natick Board of Health published an amendment to its regulations that states:

> *Private wells for drinking water shall not be allowed where a public water supply is available in sufficient quantity and pressure so as to meet U.S. and Massachusetts safe drinking water standards.*

This restriction was imposed within the area bounded by North Main Street (Route 27), Lake Cochituate, West Central Street (Route 135), and the Massachusetts Turnpike (Route 90).

In accordance with the requirements of the ROD, I hereby certify for calendar year 2012 that:

- The Board of Health regulation is in place, and is being properly enforced;
- I have reviewed private well permits issued by the town during the past year and have determined that these permits are in compliance with the Board of Health regulation; and,
- I have reviewed private well permits issued by the town during the past year. No new potable wells have been installed within the area covered by the Board of Health regulation.

Town of Natick records indicate no wells were installed in the past year within the area covered by the Board of Health regulation.

Please call me if you have any questions.

Sincerely,

TOWN OF NATICK

Robert Bois
Environmental Compliance Officer

DEPARTMENT OF THE ARMY
US ARMY SOLDIER SYSTEMS CENTER
KANSAS STREET
NATICK, MASSACHUSETTS 01760-5049

REPLY TO
ATTENTION OF

Environmental, Safety and Health Office

7 October, 2014

Christine Williams
U.S. Environmental Protection Agency
5 Post Office Square - Suite 100
Mail Code - OSRR 07-3
Boston MA 02109-3912

SUBJECT: Record of Decision, T-25 Area Ground Water (Operable Unit 1)
Annual Institutional Controls Certification

Dear Christine:

The Environmental health and Safety Office has conducted the required assessment and has determined that the U.S. Army Soldier System Center (SSC) is in compliance with ground water use restrictions outlined in the SSC Real Property Master Plan. No new projects involving use of ground water at the SSC facility were proposed during calendar year 2013.

Attached please find the required letter from the Town of Natick documenting that they are in compliance with the ROD and the Board of Health regulation.

Please call me at (508) 233-5404 if you have any questions.

Sincerely,

John J. McHugh
Chief - Environmental and Health Office

NATICK
UP-BIBLIUM GOD
FOUNDED 1651
INCORPORATED 1781
MASSACHUSETTS

COMMUNITY DEVELOPMENT

BUILDING
PLANNING
ZONING
CONSERVATION

October 1, 2014

Mr. John McHugh
Chief, Environmental and Health Office
U.S. Army Garrison Natick
Kansas Street
Natick, MA 01760-5049

Dear Mr. McHugh:

Enclosed please find the certification required in accordance with the Record of Decision, T-25 Area Ground Water (Operable Unit 1), U.S. Army Soldier Systems Center (SSC), Natick, Massachusetts dated April 1, 2001 (the ROD). The certification is required annually to document the maintenance of institutional controls. Institutional controls were implemented as a component of the T-25 Area ground water remedy to restrict access to and human contact with the ground water both on-facility and off-facility throughout the remedial action.

Off-facility, ground water use restrictions are affected through a municipal ordinance that covers the area where contaminated ground water has been found. More specifically, a town of Natick Board of Health regulation prohibits both the installation of new private drinking water wells and the use of existing private drinking water wells in the area to prevent any access or exposure to contaminated ground water. On February 24, 1999 the town of Natick Board of Health published an amendment to its regulations that states:

> *Private wells for drinking water shall not be allowed where a public water supply is available in sufficient quantity and pressure so as to meet U.S. and Massachusetts safe drinking water standards.*

This restriction was imposed within the area bounded by North Main Street (Route 27), Lake Cochituate, West Central Street (Route 135), and the Massachusetts Turnpike (Route 90).

In accordance with the requirements of the ROD, I hereby certify for calendar year 2013 that:

- The Board of Health regulation is in place, and is being properly enforced;
- I have reviewed private well permits issued by the town during the past year and have determined that these permits are in compliance with the Board of Health regulation; and,
- I have reviewed private well permits issued by the town during the past year. No new potable wells have been installed within the area covered by the Board of Health regulation.

Town of Natick records indicate no wells were installed in the past year within the area covered by the Board of Health regulation.

Please call me if you have any questions.

Sincerely,

TOWN OF NATICK

Robert Bois
Environmental Compliance Officer

DEPARTMENT OF THE ARMY
US ARMY SOLDIER SYSTEMS CENTER
KANSAS STREET
NATICK, MASSACHUSETTS 01760-5049

REPLY TO
ATTENTION OF

Environmental, Safety and Health Office

7 May 2015

Christine Williams
U.S. Environmental Protection Agency
5 Post Office Square - Suite 100
Mail Code - OSRR 07-3
Boston MA 02109-3912

SUBJECT: Record of Decision, T-25 Area Ground Water (Operable Unit 1)
Annual Institutional Controls Certification

Dear Christine:

The Environmental health and Safety Office has conducted the required assessment and has determined that the U.S. Army Soldier System Center (SSC) is in compliance with ground water use restrictions outlined in the SSC Real Property Master Plan. No new projects involving use of ground water at the SSC facility were proposed during calendar year 2014.

Attached please find the required letter from the Town of Natick documenting that they are in compliance with the ROD and the Board of Health regulation.

Please call me at (508) 233-5404 if you have any questions.

Sincerely,

John J. McHugh
Chief, Environmental and Health Office

NATICK
UP-BIBLIUM GOD
FOUNDED 1651
INCORPORATED 1781
MASSACHUSETTS

COMMUNITY DEVELOPMENT

BUILDING
PLANNING
ZONING
CONSERVATION

April 29, 2015

Mr. John McHugh
Chief, Environmental and Health Office
U.S. Army Garrison Natick
Kansas Street
Natick, MA 01760-5049

Dear Mr. McHugh:

Enclosed please find the certification required in accordance with the Record of Decision, T-25 Area Ground Water (Operable Unit 1), U.S. Army Soldier Systems Center (SSC), Natick, Massachusetts dated April 1, 2001 (the ROD). The certification is required annually to document the maintenance of institutional controls. Institutional controls were implemented as a component of the T-25 Area ground water remedy to restrict access to and human contact with the ground water both on-facility and off-facility throughout the remedial action.

Off-facility, ground water use restrictions are affected through a municipal ordinance that covers the area where contaminated ground water has been found. More specifically, a town of Natick Board of Health regulation prohibits both the installation of new private drinking water wells and the use of existing private drinking water wells in the area to prevent any access or exposure to contaminated ground water. On February 24, 1999 the town of Natick Board of Health published an amendment to its regulations that states:

> *Private wells for drinking water shall not be allowed where a public water supply is available in sufficient quantity and pressure so as to meet U.S. and Massachusetts safe drinking water standards.*

This restriction was imposed within the area bounded by North Main Street (Route 27), Lake Cochituate, West Central Street (Route 135), and the Massachusetts Turnpike (Route 90).

13 East Central Street, Natick, MA 01760

phone: 508-647-6450 / fax: 508-647-6444
website: www.natickma.org

In accordance with the requirements of the ROD, I hereby certify for calendar year 2014 that:

- The Board of Health regulation is in place, and is being properly enforced;

- I have reviewed private well permits issued by the town during the past year and have determined that these permits are in compliance with the Board of Health regulation; and,

- I have reviewed private well permits issued by the town during the past year. No new potable wells have been installed within the area covered by the Board of Health regulation.

Town of Natick records indicate no wells were installed in the past year within the area covered by the Board of Health regulation.

Please call me if you have any questions.

Sincerely,

TOWN OF NATICK

Robert Bois
Environmental Compliance
Officer

DEPARTMENT OF THE ARMY
US ARMY SOLDIER SYSTEMS CENTER
10 GENERAL GREENE AVENUE
NATICK, MASSACHUSETTS 01760-5049

REPLY TO
ATTENTION OF

Environmental, Safety and Health Office

9 November 2016

Christine Williams
U.S. Environmental Protection Agency
5 Post Office Square - Suite 100
Mail Code - OSRR 07-3
Boston MA 02109-3912

SUBJECT: Record of Decision, T-25 Area Ground Water (Operable Unit 1)
Annual Institutional Controls Certification

Dear Christine:

The Environmental health and Safety Office has conducted the required assessment and has determined that the U.S. Army Soldier System Center (SSC) is in compliance with ground water use restrictions outlined in the SSC Real Property Master Plan. No new projects involving use of ground water at the SSC facility were proposed during calendar year 2015.

Attached please find the required letter from the Town of Natick documenting that they are in compliance with the ROD and the Board of Health regulation.

Please call me at (508) 233-5404 if you have any questions.

Sincerely,

John J. McHugh
Chief - Environmental and Health Office

TOWN OF NATICK
MASSACHUSETTS

JEREMY MARSETTE, P.E.
DIRECTOR

November 9, 2016

Mr. John McHugh
Chief, Environmental and Health Office
U.S. Army Garrison Natick
Kansas Street
Natick, MA 01760-5049

Dear Mr. McHugh:

Enclosed please find the certification required in accordance with the Record of Decision, T-25 Area Ground Water (Operable Unit 1), U.S. Army Soldier Systems Center (SSC), Natick, Massachusetts dated April 1, 2001 (the ROD). The certification is required annually to document the maintenance of institutional controls. Institutional controls were implemented as a component of the T-25 Area ground water remedy to restrict access to and human contact with the ground water both on-facility and off-facility throughout the remedial action.

Off-facility, ground water use restrictions are affected through a municipal ordinance that covers the area where contaminated ground water has been found. More specifically, a town of Natick Board of Health regulation prohibits both the installation of new private drinking water wells and the use of existing private drinking water wells in the area to prevent any access or exposure to contaminated ground water. On February 24, 1999 the town of Natick Board of Health published an amendment to its regulations that states:

Private wells for drinking water shall not be allowed where a public water supply is available in sufficient quantity and pressure so as to meet U.S. and Massachusetts safe drinking water standards.

This restriction was imposed within the area bounded by North Main Street (Route 27), Lake Cochituate, West Central Street (Route 135), and the Massachusetts Turnpike (Route 90).

In accordance with the requirements of the ROD, I hereby certify for calendar year 2015 that:

- The Board of Health regulation is in place, and is being properly enforced;
- I have reviewed private well permits issued by the town during the past year and have determined that these permits are in compliance with the Board of Health regulation; and,
- I have reviewed private well permits issued by the town during the past year. No new potable wells have been installed within the area covered by the Board of Health regulation.

Town of Natick records indicate no drinking water wells were installed in the past year within the area covered by the Board of Health regulation.

Please call me if you have any questions.

Sincerely,

TOWN OF NATICK

Jeremy Marsette
Director of Public Works

APPENDIX B

COMMUNITY INVOLVEMENT

NATICK SOLDIER SYSTEMS CENTERS

LEGAL NOTICE
PUBLIC NOTICE
FIVE-YEAR REVIEW OF THE GROUNDWATER REMEDY at the Natick Soldier Systems Center, Natick, Massachusetts

The U.S. Army is currently performing a five-year review of the Operable Unit I (OU-1) groundwater remedy at the Natick Soldier Systems Center (NSSC), Natick, Massachusetts, in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 (c). In 1995, the U.S. Army constructed a groundwater extraction and treatment system at the T-25 Area to control the off-site migration, and reduce the mass, of the groundwater contaminants tetrachlorethene (PCE) and trichloroethene (TCE). An additional treatment unit was added in 2008 to address groundwater contaminant 1,4-dioxane. In 2013, additional areas were incorporated into the groundwater remedy. The purpose of the five- year review is to evaluate the performance of the groundwater cleanup remedy to ensure it remains protective of human health and the environment. If the review identifies issues that affect protectiveness, the five-year review report will recommend improvements. It is not the purpose of the review to reconsider the remedy.

The public may ask questions about, comment on, and contribute to the review process by contacting:

Mr. James Connolly
U.S. Army Soldier Systems Center
10 General Greene Avenue
Natick, MA 01760-5049
(508) 233-5550
James.B.Connolly.civ@mail.mil

The Army plans to issue the five-year review in the spring of 2017. Following release of the report, the Army will also issue a public notice announcing the availability of the report and a statement of its findings.

MORE INFORMATION

Additional information about sites included in the five-year review is contained in the Administrative Record that is maintained at NSSC and the Massachusetts Department of Environmental Protection. For the convenience of the public, a copy of the Administrative Record is also maintained at the Morse Institute Library located at 14 East Central Street, Natick, Massachusetts.

Hours: Monday - Thursday 10 am - 9 pm; Friday - Saturday 10 am - 5 pm Sunday 2pm - 5 pm
Telephone (508) 647-6521 or visit www.morseinstitute .org to confirm times before visiting.

AD#13492993
MWDN 10/22/16

APPENDIX C

OPERABLE UNIT 1 ARARS

ARARS 2001 RECORD OF DECISION

Applicable or Relevant and Appropriate Requirements (ARARs), Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

SELECTED REMEDY
T-25 AREA (Operable Unit 1) GROUNDWATER

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
CHEMICAL- SPECFIC REQUIREMENTS				
GROUNDWATER Federal	Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs); 40 CFR]41.11-141.16, 141.61, 141.62	Relevant and Appropriate	Maximum Contaminant Levels (MCLs) are been promulgated for a number of organic and inorganic contaminants in public drinking water systems.	The remedy will consist of ground water extraction followed by air stripping/carbon adsorption for the on-facility contamination, with MNA for on-facility contamination not contained by the ground water extraction system while it is in operation, and for any on-facility and off-facility contamination remaining after system shut-off. ITwill also include long-term monitoring and institutional controls. The remedy will meet federal MCLs for the primary COCs PCE and TCE, and the secondary COCs chromium, lead, nickel, and thallium throughout the ground water plume at completion.
	SDWA -Non-Zero Maximum Containment Level Goals (MCLGs), 40 CFR 141.50-141.52	Relevant and Appropriate	Maximum Contaminant Level Goals (MCLGs) are non-enforceable health goals for public water systems that are set at levels that would result in no known or expected adverse health effects with an adequate margin of safety.	For those contaminants for which MCLs have not been established, at completion the remedy will meet non-zero MCLGs throughout the ground water plume.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	USEPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs)	To Be Considered	CSFs are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from USEPA's Carcinogen Assessment Group.	CSFs were considered to assess health risks at the site.
	U.S.EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs were considered the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for lifetime.	RfDs were considered to assess health risks from contaminants at the site.
	EPA Region 9 Preliminary Remediation Goals	To Be Considered	EPA Region 9 Preliminary Remediation Goals (PRGs) are risk-based guidelines for evaluating and cleaning up contaminated sites. PRGs can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal if applicable, but are not enforceable regulatory standards. The PRGs are developed using accepted risk assessment algorithms and default exposure factors for residential exposure scenarios, assuming exposure in each medium occurs through multiple routes, in combination with current EPA toxicity values. PRGs are based on a risk level of 1 x 10-6 and/or a hazard quotient of 1.	The remedy will consist of ground water extraction followed by air stripping with carbon adsorption for the on-facility contamination, with MNA for on-facility contamination not contained by the ground water extraction system while it is in operation, and for any on-facility and off-facility contamination remaining after system shut-off. It will also include long-term monitoring and institutional controls. The remedy will meet the EPA Region 9 PRG for the secondary COC manganese (which PRG is a drinking water risk-based guideline) throughout the ground water plume at completion.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
State	Massachusetts Drinking Water Standards, 310 CMR 22.00	Relevant and Appropriate	These standards establish MCLs for a number of organic and inorganic contaminants, in public water systems.	The remedy will consist of ground water extraction followed by air stripping/carbon adsorption for the on-facility contamination, with MNA for on-facility contamination not contained by the ground water extraction system while it is in operation, and for any on-facility and off-facility contamination remaining after system shut-off. It will also include long-term monitoring and institutional controls: The remedy will meet state MCLs for the primary COCs PCE and TCE, and the secondary COCs chromium, lead, nickel, and thallium throughout the ground water plume at completion.
	Massachusetts Contingency Plan (MCP) Method S-1/GW-I Standards, 310 CMR 40.0000	Applicable	These standards consider the potential risk or harm resulting from direct exposure to hazardous materials in the soil and the potential impacts on the ground water at a site.	The remedy will consist of ground water extraction followed by air stripping/carbon adsorption for the on-facility contamination, with MNA for on-facility contamination not contained by the ground water extraction system while it is in operation, and for any on-facility and off-facility contamination remaining after system shut-off. It will also include long-term monitoring and institutional controls. The remedy will meet the MCP Method 1 S-1/GW-I standards for the secondary COCs bis(2-ethylbexyl)phthalate, DDT, and vanadium throughout the ground water plume at completion.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
LOCATION-SPECFIC REQUIREMENTS				
OTHER NATURAL RESOURCES Federal	Fish and Wildlife Coordination Act; 16 USC 661-666, 40 CFR Part 6.302(g)	Applicable	These regulations require protection of fish and wildlife resources related to federal actions that control or modify water bodies.	Remedial activities will be in compliance with these regulations.
ACTION-SPECIFIC REQUIREMENTS				
Federal	CWA -National Pollutant Discharge Elimination System, 40 CFR Part 122-125, 131	Applicable	These regulations contain discharge limitations, monitoring requirements and best management practices for discharges into navigable waters, i.e., surface waters.	The aqueous discharge from the treatment system will be treated using aeration, filtration, air stripping, and carbon adsorption and will be regularly monitored to comply with these regulations. Discharges of treated ground water to surface waters will comply with these regulations.
	Resource Conservation and Recovery Act (RCRA) -Identification and Listing of Hazardous Wastes; Toxicity Characteristic, 40 CFR Part 261.24	Applicable	These requirements identify the maximum concentrations of contaminants for which the waste would be a RCRA-characteristic hazardous waste for toxicity.	Wastes generated from ground water treatment will be analyzed to determine if they are RCRA-characteristic hazardous waste. If analysis results exceed the standards in 261.64, the waste will be disposed of in a RCRA Subtitle C facility.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	RCRA -Standards Applicable to Generators of Hazardous Waste, 40 CFR Part 262	Applicable	These standards establish standards for generators of hazardous waste. Massachusetts has been delegated the authority to administer these standards through its state hazardous waste regulations. The applicable portions of 40 CFR Part 262 are incorporated by reference.	Management of hazardous waste generated from ground water treatment will be managed in accordance with these regulations.
	RCRA-Air Emission Standards for Process Vents, 40 CFR Part 264, Subpart AA	Relevant and Appropriate	These regulations establish requirements for controlling emissions from process vents associated with treatment processes that manage hazardous wastes with organic concentrations of 10 ppm or more.	The air streams from the air stripper and the equalization tank will be treated using carbon adsorption and monitored before and after the carbon tanks to meet these standards. To date these streams have not exceeded 10 ppm.
	RCRA-Air Emission Standards for Equipment Leaks, 40 CFR Part 264, Subpart BB	Relevant and Appropriate	These regulations contain standards for equipment that contains or contacts hazardous waste with organic concentrations of at least 10% by weight.	The air streams from the air stripper and the equalization tank will be treated using carbon adsorption and monitored before and after the carbon tanks to meet these standards. To date these streams have not exceeded 10 ppm.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	USEPA Policy on Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28	To Be Considered	This policy provides guidance on the control of air emissions from air strippers used at Superfund sites.	The air streams from the air stripper and the equalization tank will be treated using carbon adsorption and monitored before and after the carbon tanks to satisfy this policy.
	USEPA Region I .I Memorandum, 12 July 1989 from Louis Gitto to Merril S. Hohman	To Be Considered	This memorandum states that Superfund air strippers in ozone nonattainment areas generally merit controls on all volatile organic compound emissions.	The air streams from the air stripper and the equalization tank will be treated using carbon adsorption and monitored before and after the carbon tanks to satisfy this policy.
State	Massachusetts Surface Water Discharge Permit Program, 314 CMR 3.00	Applicable	These standards regulate the discharge of pollutants to Massachusetts surface waters.	The aqueous discharge from the treatment system will be treated by carbon adsorption after the air stripper and monitored before and after the carbon to meet these standards.
	Massachusetts Air Pollution Control Regulations, 310 CMR 7.00	Applicable	These regulations set emissions Limits necessary to attain ambient air quality standards.	Remedial actions will be conducted to meet the standards for visible emissions (310 CMR 7.06); dust, odor, construction and demolition (310 CMR 7.09); and volatile organic compounds (310 CMR 7.18). If standards are exceeded, emissions will be managed through engineering controls.

ARARs, Criteria, Advisories, and Guidance
Natick US Army Soldiers Systems Center 2001 Record of Decision

ARARs	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Massachusetts Hazardous Waste Management Regulations (HWMR), Requirements for Generators, 310 CMR 30.300	Applicable	These regulations contain requirements for generators, including testing of wastes to determine if they are hazardous wastes and accumulation of hazardous waste prior to off-facility disposal.	Any hazardous waste generated from ground water treatment will be managed in accordance with these regulations.
	Massachusetts HWMR, Use and Management of Containers, 310	Applicable	These regulations set forth requirements. for use and management of containers at hazardous waste facilities.	Any hazardous waste generated from ground water treatment will be managed in accordance with these regulations.
	Massachusetts HWMR, Storage and Treatment in Tanks, 310 CMR 30.699	Applicable	These regulations set forth requirements, for use and management of tanks at hazardous waste facilities.	Any hazardous waste generated from ground water treatment will be managed in accordance with these regulations.
	MADEP Off-Gas Treatment of Point Source Remedial Air Emissions (Policy No. WSC-94-150)	To Be Considered	This policy establishes permitting requirements for air stripper installations.	This policy will be considered when planning and designing the use of air strippers in remedial activities at the site.

NOTES:

ARARs Applicable or Relevant and Appropriate Requirements
CFR Code of Federal Regulations
CMR Code of Massachusetts Regulations
MADEP Massachusetts Department of Environmental Protection

ARARS 2013 EXPLANATION SIGNIFICANT DIFFERENCES

LOCATION-SPECIFIC AND WETLAND PROTECTION ARARS

ESD FOR THE T-25 AREA GROUNDWATER (OPERABLE UNIT 1)
NATICK SOLDIER SYSTEMS CENTER
NATICK, MASSACHUSETTS

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal	Surface Waters, Endangered Species, Migratory Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.]	Applicable	Actions that affect species/habitat require consultation with U.S. Department of the Interior, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Consultation with the responsible agency is also strongly recommended for on-site actions. Under 40 CFR Part 300.38, these requirements apply to all response activities under the National Contingency Plan.	To the extent necessary, actions will be taken to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The U.S. Fish and Wildlife Service, acting as a review agency for the USEPA, will be kept informed of proposed remedial activities.

LOCATION-
SPECIFIC AND WETLAND PROTECTION ARARS

ESD FOR THE T-25 AREA GROUNDWATER (OPERABLE UNIT 1)
NATICK SOLDIER SYSTEMS CENTER
NATICK, MASSACHUSETTS

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal	Floodplains	Floodplain Management Executive Order 11988	TBC	Federal agencies are required to avoid adverse impacts associated with the occupancy and modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative. If no practicable alternative exists, the federal agency is required to design or modify its action to minimize potential harm to or within the floodplain.	Activities are not expected to occur in floodplain areas or adversely affect them. If remedial activities occur within floodplain areas, measures will be taken to minimize alteration/destruction of the floodplain area. Floodplains affected by remedial activities will be restored to maintain natural and beneficial values.
Federal	Wetlands	Protection of Wetlands Executive Order 11990	TBC	Federal agencies are required to avoid adverse impacts associated with the destruction, loss, or degradation of wetlands and to avoid support of new construction in wetlands wherever there is a practicable alternative.	Activities are not expected to occur in wetland areas or adversely affect them. If remedial activities occur within or affect wetland areas or surface waters, measures will be taken to minimize alteration/destruction of the area. Wetlands affected by remedial activities will be restored to maintain natural and beneficial values.

LOCATION-
SPECIFIC AND WETLAND PROTECTION ARARS

ESD FOR THE T-25 AREA GROUNDWATER (OPERABLE UNIT 1)
NATICK SOLDIER SYSTEMS CENTER
NATICK, MASSACHUSETTS

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
State	Floodplains, Wetlands, Surface Waters	Massachusetts Wetland Protection Act Regulations [310 CMR 10.00]	Applicable	These regulations include standards on removing, dredging, filling, or altering inland wetlands and protected areas (including any banks, bordering vegetated wetlands, land under water bodies and waterways, land subject to flooding, or riverfront area). Activities carried out within 100 feet of these areas (i.e., the buffer zone) which may alter an area subject to protection are also subject to regulation. Minor activities within the buffer zone which are temporary in nature and have negligible impacts (e.g., installation of monitoring wells and exploratory borings, sediment sampling, surveying) are not subject to regulation.	Activities involving removal, dredging, filling, or altering of wetlands or protected areas, or adversely affecting them, are not expected. If remedial activities occur within protected areas, measures will be taken to minimize alteration/destruction of the area. Wetlands affected by remedial activities will be restored to maintain natural and beneficial values. All work to be performed within wetlands and the 100-foot buffer zone will be in accordance with the substantive requirements of these regulations. The municipal conservation commission will be apprised of site activities that will affect wetlands or protected areas.

LOCATION-SPECIFIC AND WETLAND PROTECTION ARARS

ESD FOR THE T-25 AREA GROUNDWATER (OPERABLE UNIT 1)
NATICK SOLDIER SYSTEMS CENTER
NATICK, MASSACHUSETTS

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
State	Endangered Species	Massachusetts Endangered Species Act Regulations [321 CMR 10.00]	Applicable	Actions must be conducted in a manner that minimizes the impact to Massachusetts-listed rare, threatened, or endangered species, and species listed by the Massachusetts Natural Heritage Program.	The protection of state listed endangered species, including the boreal turret snail, will be considered during the design and implementation of this alternative.

Prepared by/ Date: SWR 01/22/07
Checked by/ Date: RB 01/22/07
Revised by/ Date: SWR 02/27/13

Notes:

ARAR	=	Applicable or Relevant and Appropriate Requirement
CFR	=	Code of Federal Regulations
CMR	=	Code of Massachusetts Regulations
TBC	=	To Be Considered
USC	=	United States Code
USEPA	=	U.S. Environmental Protection Agency

CHEMICAL-
SPECIFIC ARARs AND TBCs

ESD FOR THE T-25 AREA GROUNDWATER (OPERABLE UNIT 1)
NATICK SOLDIER SYSTEMS CENTER
NATICK, MASSACHUSETTS

Regulatory Authority	Media	Requirement	Status	Requirement/Synopsis	Action To Be Taken To Attain ARAR
Federal	Groundwater	*Drinking Water Health Advisory for Manganese*, EPA-822-R-04-003 (January 2004)	To Be Considered	Health Advisories are estimates of risk resulting from consumption of contaminated drinking water; they consider noncarcinogenic effects only. Health Advisories are to be considered for contaminants in groundwater that may be used for drinking water where the standard is more conservative than either federal or state statutory or regulatory standards. The Health Advisory for manganese is 0.3 ppm.	The health advisory for manganese will be used to evaluate the noncarcinogenic risk resulting from exposure to manganese in groundwater. Exposure to groundwater containing manganese at concentrations greater than the Massachusetts Drinking Water Guideline will be managed through institutional controls that prohibit potable groundwater use. Groundwater use restrictions will be maintained until these standards are achieved.
State	Groundwater	Massachusetts Drinking Water Guidelines	To Be Considered	Massachusetts Office of Research and Standards issues guidance for chemicals in drinking water other than those with Massachusetts MCLs. Concentrations of chemicals having evidence of carcinogenicity are minimized as much as feasible; therefore, guidelines are set at a target excess lifetime cancer risk of one in one million (1x10-6) or at the lowest practical quantitation limit (PQL) if the concentration at 1x10-6 is below the PQL. The Drinking Water Guideline for 1,4-dioxane is 0.3 µg/L.	Exposure to groundwater containing 1,4-dioxane at concentrations greater than the Massachusetts Drinking Water Guideline will be managed through institutional controls that prohibit potable groundwater use. Groundwater extraction will manage the in-situ migration of contaminants, and ex-situ treatment of extracted groundwater will manage ex-situ migration of, and exposure to, 1,4-dioxane. Groundwater use restrictions will be maintained until these guidelines are achieved.

Notes:
ARAR = Applicable or Relevant and Appropriate Requirement
MCL = Maximum Contaminant Level
RfD = Reference dose

Prepared by/ Date: SWR 01/22/07
Checked by/ Date: RB 01/22/07
Revised by/Date: SWR 05/08/13

APPENDIX D

CHANGES IN TOXICITY VALUES AND EXPOSURE FACTORS

Table D-1
Summary of Toxicity Value Changes since Human Health Risk Assessment
Natick Soldiers Systems Center

Chemicals of Potential Concern	Oral Reference Dose (RfD) [mg/kg/day]				Inhalation Reference Dose (RfD) [mg/kg/day]				Oral Cancer Slope Factor (CSF) [mg/kg/day]$^{-1}$				Inhalation Cancer Slope Factor (CSF) [mg/kg/day]$^{-1}$			
	Record of Decision		Updated		Record of Decision		Updated		Record of Decision		Updated		Record of Decision		Updated	
	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source	Value	Source
4, 4' -DDE	ND				ND				3.4E-01	IRIS			ND			
4, 4'-DDT	5.0E-04	IRIS			ND				3.4E-01	IRIS			3.4E-01	IRIS		
Dieldrin	5.0E-05	IRIS			ND				1.6E+01	IRIS			1.61E+01	IRIS		
Endrin Ketone	3.0E-04	Surrogate			ND				ND				ND			
Bis(2-ethylhexyl)phthalate	2.0E-02	IRIS			ND				1.4E-02	IRIS			ND			
Arsenic	3.0E-04	IRIS			ND				1.5E+00	IRIS			1.51E+01	IRIS		
Barium	7.0E-02	IRIS	2.0E-01	IRIS	ND				ND				ND			
Beryllium	5.0E-03	IRIS	2.0E-03	IRIS	ND		5.7E-06	IRIS	4.3E+00	IRIS	ND		8.4E+00	IRIS		
Chromium (values for Cr VI)	5.0E-03	IRIS	3.0E-03	IRIS	ND		2.9E-05	IRIS	ND				4.2E+01	IRIS		
Copper	ND				ND				ND				ND			
Iron	ND				ND				ND				ND			
Lead	ND				ND				ND				ND			
Manganese	2.3E-02	IRIS	2.4E-02	IRIS	1.4E-08	IRIS	1.4E-05	IRIS	ND				ND			
Molybdennum	5.0E-03	IRIS			ND				ND				ND			
Nickle	2.0E-02	IRIS			ND				ND				ND			
Thallium	ND		1.0E-05	PPRTV	ND				ND				ND			
Vanadium	7.0E-03	HEAST	5.0E-04	IRIS	ND				ND				ND			
Tetrachlorethene	1.0E-02	IRIS	6.0E-03	IRIS	ND		1.1E-02	IRIS	5.2E-02	EPA	2.1E-03	IRIS	2.0E-03	EPA	9.1E-04	IRIS
Trichlorethene	6.0E-03	EPA	5.0E-04	IRIS	ND		5.7E-04	IRIS	1.1E-02	EPA	4.6E-02	IRIS	6.0E-02	EPA	1.4E-02	IRIS
Cis-1,2 –Dichloroethene	1.0E-02	HEAST	2.0E-03	IRIS	ND				ND				ND			
1,4-Dioxane	ND		3.0E-02	IRIS	ND		8.6E-03	IRIS	ND		1.1E-01	IRIS	ND		2.0E-02	IRIS

Notes

IRIS Integrated Risk Information System
ATSDR Agency for Toxic Substances and Disease Registry Minimum Risk Level (MRL)
CALEPA California Environmental Protection Agency Slope Factors and Reference Exposure Levels (RELs)
PPRTV Provisional Peer Reviewed Reference Toxicity Value
HEAST Health Effects Assessment Summary Tables 1997
EPA Values were withdrawn from IRS but retained by the Environmental Protection Agency Region I
ND Value or information not determined
Surrogate Endrin was used as a surrogate for endrin Ketone and vanadium peroxide was used as a surrogate for vanadium
(1) Inhalation RfDs [mg/kg/day] were converted from reference concentrations (RfCs) by multiplying the RfC by 20 cubic meters (c^3)/day and then dividing by 70 kilograms
(2) Inhalation CSFs [mg/kg/day]$^{-1}$ were converted from inhalation unit risks (IURs) [ug/m]^3 by multiplying the IUR by 3,500 (70kg X 1000 µg/mg/20m^3/day)

Value in Red denotes toxicity factor is more stringent
Value in Green denotes toxicity factor wasn't included in the ROD
Value in Blue denotes toxicity factor is less stringent
If Updated cell is blank then the current value & source are still valid

Table D-2
Summary of Exposure Factor Changes since Human Health Risk Assessment
Natick Soldiers Systems Center

		Child Age 0 – 6 years			Child Age 7-18 years			Adult			Future Onsite Worker		
Exposure Factors (*units*)	**Scenario**	Original	Updated	Source	Original	Updated	Source	Original	Updated	Source	Original	Updated	Source
Ingestion Rate (*liters per day*)	Average	0.5	0.78	EPA 2014	1.4			2	2.5	EPA 2014			
Skin Surface Area (*square centimeters*)	Average	7,110	6,378	EPA 2014	13,000			20,000	20,900	EPA 2014	2,000	3,470	EPA 2014
Exposure Frequency (*days/year*)	Average	350			350			350			250		
Exposure Duration (*years*)	Average	6			12			30	20	EPA 2014	25		
Averaging Time non cancer (years)	Average										4,563	3,285	EPA 2014
Body Weight (*kilograms*)	Average	15	15	EPA 2014	43			70	80	EPA 2014	70	80	EPA 2014

EPA 2014: USEPA 2014, OSWER Directive 9200.1-120, Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.

RAGS E: Risk Assessment Guidance for Superfund, Pat E, Final. USEPA 2004.

Blank cells under the Updated column indicate no update of the exposure factor

Value in Red denotes exposure factor would increase risk estimate

Value in Blue denotes exposure factor would decrease risk estimate

APPENDIX E
GROUNDWATER ANALYTICAL DATA

TABLE E-1

GROUNDWATER ANALYTICAL RESULTS

TETRACHLORETHENE, TRICHLOROETHENE, 1,2-DICHLOROETHENE, AND VINYL CHLORIDE

Table E1 - VOC Data Summary
NSSC Five Year Review - T-25 Area

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier	Result	Qualifier
MW-1	11/27/2012	FS	1	U	2.4		1	U	-	
MW-1	10/31/2013	FS	1	U	1.1		0.5	U	-	
MW-1	6/4/2015	FS	-		2.7		-		-	
MW-1	11/3/2015	FS	5	U	1.3	J	5	U	5	U
MW-128A	10/31/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-128A	11/25/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-128A	12/3/2015	FS	5	U	5	U	5	U	5	U
MW-129A	10/31/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-129A	11/25/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-129A	11/30/2015	FS	5	U	5	U	5	U	5	U
MW-15B	11/27/2012	FS	1	U	1	U	1.3		-	
MW-15B	11/5/2013	FS	1	U	0.5	U	0.74		1	U
MW-15B	5/20/2014	FS	-		-		-		-	
MW-15B	11/3/2014	FS	1	U	0.67		0.55		1	U
MW-15B	6/15/2015	FS	-		-		-		-	
MW-15B	11/4/2015	FS	5	U	0.49	J	5	U	5	U
MW-15B	4/26/2016	FS	-		0.55	J	-		-	
MW-167B-2	11/5/2013	FS	1	U	8.8		1.8		1	U
MW-167B-2	12/3/2014	FS	1	U	5.4		0.51		1	U
MW-167B-2	11/19/2015	FS	5	U	2.4	J	0.57	J	5	U
MW-18B-HP2	5/23/2012	FD	2.6		25.4		47.5		-	
MW-18B-HP2	5/23/2012	FS	2.8		28.5	J	53.2		-	
MW-18B-HP2	11/20/2012	FD	1	U	21.4		2.4		-	
MW-18B-HP2	11/20/2012	FS	1	U	17.8		2.5		-	
MW-18B-HP2	5/30/2013	FD	2.6		18.7		25		-	
MW-18B-HP2	5/30/2013	FS	3.3		18.2		25		-	
MW-18B-HP2	10/31/2013	FD	1.4	J	10.1	J	2.4		1	U
MW-18B-HP2	10/31/2013	FS	1	U	0.5	UJ	2.4		1	U
MW-18B-HP2	5/27/2014	FD	1.4		7.8		14.3		-	
MW-18B-HP2	5/27/2014	FS	1.8		8.5		15.4		-	
MW-18B-HP2	11/18/2014	FD	1		6		20.1		1	U
MW-18B-HP2	11/18/2014	FS	1.1		5.7		19.4		1	U
MW-18B-HP2	6/16/2015	FD	0.43	J	3.8		13.8		-	
MW-18B-HP2	6/16/2015	FS	0.47	J	3.5		14.7		-	
MW-18B-HP2	4/28/2016	FD	2.2		1.5		0.55	J	-	
MW-18B-HP2	4/28/2016	FS	2.2		1.4		0.55	J	-	
MW-201B	11/19/2012	FS	1	U	1	U	1	U	-	
MW-201B	10/30/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-201B	12/4/2014	FS	1	U	0.29	J	0.5	U	1	U
MW-201B	11/17/2015	FS	5	U	5	U	5	U	5	U
MW-202C-2	5/22/2012	FS	-		-		-		-	
MW-202C-2	11/20/2012	FS	1	U	1	U	1	U	-	
MW-202C-2	5/29/2013	FS	-		-		1		-	
MW-202C-2	10/30/2013	FS	1	U	0.5	U	0.5		1	U
MW-202C-2	5/13/2014	FS	-		-		0.84		-	
MW-202C-2	11/6/2014	FS	1	U	0.5	U	0.45	J	1	U
MW-202C-2	6/17/2015	FS	-		-		0.48	J	-	
MW-202C-2	11/18/2015	FS	5	U	5	U	5	U	5	U

Table E1 - VOC Data Summary
NSSC Five Year Review - T-25 Area

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier	Result	Qualifier
MW-202C-2	4/28/2016	FS	-		-		-		-	
MW-208A-2	11/20/2012	FS	1	U	1	U	1	U	-	
MW-208A-2	10/30/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-208A-2	11/17/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-208A-2	11/17/2015	FS	5	U	5	U	5	U	5	U
MW208B-HP2	5/22/2012	FS	-		-		29.9		-	
MW208B-HP2	11/20/2012	FS	1	U	1	U	25.6		-	
MW208B-HP2	5/29/2013	FS	-		1.1		27.6		-	
MW208B-HP2	10/30/2013	FS	1	U	0.5	U	18.3		1	U
MW208B-HP2	5/13/2014	FS	-		0.98		14.3		-	
MW208B-HP2	11/17/2014	FS	1	U	0.85		30.4		1	U
MW208B-HP2	6/17/2015	FS	-		0.58		13.3		-	
MW208B-HP2	11/17/2015	FS	5	U	0.72	J	17		5	U
MW208B-HP2	4/28/2016	FS	-		1.1		8.7		-	
MW209B-HP2	11/19/2012	FS	1	U	1	U	1	U	-	
MW209B-HP2	10/30/2013	FS	1	U	0.5	U	1.8		1	U
MW209B-HP2	12/4/2014	FS	1	U	0.5	U	2.4		1	U
MW209B-HP2	11/18/2015	FS	5	U	5	U	1.8	J	5	U
MW-211B-4	11/21/2012	FS	1	U	1	U	1	U	-	
MW-211B-4	10/30/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-211B-4	11/17/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-211B-4	11/18/2015	FS	5	U	5	U	5	U	5	U
MW-212C-2	11/19/2012	FS	1	U	1	U	1	U	-	
MW-212C-2	10/30/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-212C-2	12/4/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-212C-2	11/17/2015	FS	0.32	J	5	U	0.58	J	5	U
MW-25B-2	5/24/2013	FS	-		1.3		1.5		-	
MW-25B-2	10/31/2013	FS	1	U	0.71		1.2		1	U
MW-25B-2	11/19/2014	FS	1	U	0.82		1.7		1	U
MW-25B-2	11/4/2015	FS	5	U	0.79	J	1.5	J	5	U
MW-2B	12/3/2015	FD	5	U	5	U	5	U	5	U
MW-2B	12/3/2015	FS	5	U	5	U	5	U	5	U
MW-35BR	11/20/2012	FS	1	U	1	U	1	U	-	
MW-35BR	10/31/2013	FS	1	U	0.5	U	0.64		1	U
MW-35BR	11/18/2014	FS	1	U	0.5	U	0.91		1	U
MW-35BR	11/9/2015	FS	5	U	0.37	J	0.85	J	5	U
MW-37B-HP2	5/22/2012	FD	1.2		-		37.7		-	
MW-37B-HP2	5/22/2012	FS	1.2		-		36.1		-	
MW-37B-HP2	11/19/2012	FD	1.7		1	U	48.4		-	
MW-37B-HP2	11/19/2012	FS	1.9		1	U	45.8		-	
MW-37B-HP2	5/29/2013	FS	2.2		1.2		45.9		-	
MW-37B-HP2	10/31/2013	FD	1.2		0.5	U	19.4		1	U
MW-37B-HP2	10/31/2013	FS	1.9		0.67		60.2		1	U
MW-37B-HP2	5/27/2014	FS	-		1		1.8		-	
MW-37B-HP2	11/18/2014	FD	1.5		0.87		35.8		1	U
MW-37B-HP2	11/18/2014	FS	1.6		0.85		34.8		1	U
MW-37B-HP2	6/17/2015	FD	-		0.47	J	3		-	
MW-37B-HP2	6/17/2015	FS	-		0.46	J	3		-	

Table E1 - VOC Data Summary
NSSC Five Year Review - T-25 Area

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier	Result	Qualifier
MW-37B-HP2	11/16/2015	FD	1.5	J	0.7	J	23		5	U
MW-37B-HP2	11/16/2015	FS	1.6	J	0.79	J	24		5	U
MW-37B-HP2	4/27/2016	FD	-		1.7		1			
MW-37B-HP2	4/27/2016	FS	-		1.8		1.1		-	
MW-38B-HP2	11/19/2012	FS	1	U	1	U	1	U	-	
MW-38B-HP2	10/31/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-38B-HP2	11/18/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-38B-HP2	11/4/2015	FS	5	U	5	U	5	U	5	U
MW-39B-HP4	4/13/2012	FS			-		-			
MW-39B-HP4	11/19/2012	FS	-		2.4		1.5		-	
MW-39B-HP4	5/9/2013	FS			-		-			
MW-39B-HP4	11/5/2013	FS			1.9		1.5			
MW-39B-HP4	5/12/2014	FS			1.7		1.1			
MW-39B-HP4	11/10/2014	FS			0.5	U	0.5	U		
MW-39B-HP4	6/8/2015	FS			-		-			
MW-39B-HP4	9/17/2015	FS			-		0.26	J		
MW-39B-HP4	11/23/2015	FS	5	U	1.2	J	0.73	J	5	U
MW-39B-HP4	5/23/2016	FS	-		-		0.46	J		
MW-39B-HP4	6/13/2016	FS			0.53		0.75		-	
MW-51BR	11/21/2012	FS	1	U	1	U	1.7		-	
MW-51BR	10/31/2013	FS	1	U	0.5	U	1.2		1	U
MW-51BR	11/25/2014	FS	1	U	0.5	U	2.1		1	U
MW-51BR	12/1/2015	FS	5	U	5	U	2	J	5	U
MW-83B-2	5/21/2012	FS	-		-		5.8		-	
MW-83B-2	11/28/2012	FS	1	U	1	U	15.1		-	
MW-83B-2	5/28/2013	FS	-		0.87		16.4		-	
MW-83B-2	10/31/2013	FS	1	U	1		13.6		1	U
MW-83B-2	5/14/2014	FS	-		1.1		10.7		-	
MW-83B-2	11/18/2014	FS	1	U	0.5	U	0.5	U	1	U
MW-83B-2	6/16/2015	FS	-		0.47	J	6.8		-	
MW-83B-2	11/30/2015	FS	5	U	0.35	J	5.5		5	U
MW-83B-2	4/28/2016	FS	-		0.96	J	4.5		-	
MW-88B-HP2	11/19/2012	FS	1	U	1	U	2.8		-	
MW-88B-HP2	10/31/2013	FS	1.3		9.7		2.5		1	U
MW-88B-HP2	12/2/2014	FS	1	U	0.45	J	2.1		1	U
MW-88B-HP2	11/4/2015	FS	5	U	0.35	J	1.6	J	5	U
MW-90B-4	4/13/2012	FS			2		6.2			
MW-90B-4	11/19/2012	FS	-		2.7		8.9		-	
MW-90B-4	5/9/2013	FS			4.3		7.3			
MW-90B-4	11/5/2013	FS			1.8		6.9			
MW-90B-4	5/12/2014	FS			1.8		6.7			
MW-90B-4	11/10/2014	FS			1.3		5.4			
MW-90B-4	6/8/2015	FS			1.4		5.1			
MW-90B-4	9/17/2015	FS			1	J	5.7			
MW-90B-4	11/23/2015	FS	5	U	0.8	J	6.1		5	U
MW-90B-4	5/23/2016	FS	-		0.92	J	5.9		-	
MW-90B-4	6/13/2016	FS			1.4		7			
MW-94B-4	4/13/2012	FS			-		-			

Table E1 - VOC Data Summary
NSSC Five Year Review - T-25 Area

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier	Result	Qualifier
MW-94B-4	11/19/2012	FS	-		0.51	J	-		-	
MW-94B-4	5/9/2013	FS			-		-			
MW-94B-4	11/5/2013	FS			0.5	U	0.5	U		
MW-94B-4	5/12/2014	FS			-		-			
MW-94B-4	11/10/2014	FS			0.5	U	0.5	U		
MW-94B-4	6/8/2015	FS			-		0.29	J		
MW-94B-4	9/17/2015	FS			-		0.26	J		
MW-94B-4	11/23/2015	FS	5	U	5	U	0.26	J	5	U
MW-94B-4	5/23/2016	FS	-		-		-		-	
MW-94B-4	6/13/2016	FS			0.6		0.75			
MW-95B-4	4/13/2012	FS			-		-			
MW-95B-4	11/19/2012	FS	-		0.8	J	-		-	
MW-95B-4	5/9/2013	FS			2.8		-			
MW-95B-4	11/5/2013	FS			0.5	U	0.5	U		
MW-95B-4	5/12/2014	FS			-		-			
MW-95B-4	11/10/2014	FS			0.5	U	0.5	U		
MW-95B-4	6/8/2015	FS			-		-			
MW-95B-4	9/17/2015	FS			-		0.23	J		
MW-95B-4	11/23/2015	FS	5	U	5	U	0.22	J	5	U
MW-95B-4	5/23/2016	FS	-		-		-			
MW-95B-4	6/13/2016	FS			0.62		0.75		-	
MW-96B-4	5/24/2012	FS	-		-		-		-	
MW-96B-4	11/27/2012	FS	1	U	1	U	1	U	-	
MW-96B-4	11/1/2013	FS	1	U	0.5	U	0.5	U	1	U
MW-96B-4	11/10/2014	FS			13.2		9.6			
MW-96B-4	6/8/2015	FS			13.2		13.2			
MW-96B-4	9/17/2015	FS			6.8		15			
MW-96B-4	11/23/2015	FS	3.2	J	6.4		15		5	U
MW-96B-4	5/23/2016	FS	3.6		5.2		15.7		-	
MW-96B-4	6/13/2016	FS			0.73		2.4			

Notes

ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
¯= analyzed, but not detected
Blank cells indicate not analyzed

Table E1 - VOC Data Summary
NSSC Five Year Review -Area 22 and 36

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier		Qualifier
EW-5	6/13/2006	FS	0.75	U	4.7		0.75	U	0.75	U
EW-5	5/24/2012	FS	1	U	2.8	J	1	U	1	U
EW-5	11/27/2012	FS	1	U	1	U	1	U	1	U
EW-5	5/24/2013	FS	1	U	0.5	U	0.5	U	1	U
EW-5	11/6/2013	FS	1	U	0.5	U	0.5	U	1	U
EW-5	5/13/2014	FS	1	U	2.5		0.5	U	1	U
EW-5	11/5/2014	FS	1	U	1.1		0.5	U	1	U
EW-5	6/22/2015	FS	1	U	2.2		0.5	U	1	U
EW-5	11/23/2015	FS	5	U	1.8	J	5	U	5	U
EW-6	5/24/2012	FS	1	U	21.5	J	1	U	1	U
EW-6	11/28/2012	FS	1	U	15.5		1	U	1	U
EW-6	5/29/2013	FS	1	U	16.2		0.5	U	1	U
EW-6	11/6/2013	FS	1	U	13.2		0.5	U	1	U
EW-6	5/27/2014	FS	1	U	11.9		0.5	U	1	U
EW-6	11/5/2014	FS	1	U	11.3		1.3		1	U
EW-6	6/22/2015	FS	1	U	9.9		0.5	U	1	U
EW-6	11/30/2015	FS	5	U	1.6	J	5	U	5	U
EW-6	6/13/2016	FS	0.75	U	4.9		0.75	U	0.75	U
EW-7	5/24/2012	FS	1.2		99.6	J	1.2		1	U
EW-7	11/27/2012	FS	1.6		67.6		1.1		1	U
EW-7	5/24/2013	FS	2.4		87.3		1.3		1	U
EW-7	11/6/2013	FS	4		78.4		1.5		1	U
EW-7	5/13/2014	FS	2.7		71.7		1.4		1	U
EW-7	11/5/2014	FS	5.9		69.4		1.6		1	U
EW-7	6/22/2015	FS	3.6		62		1.4		1	U
EW-7	11/23/2015	FS	3	J	37		1.1	J	5	U
EW-7	6/13/2016	FS	3.1		54.5		1.8		0.75	U
EW-8	5/24/2012	FS	1.7		52.1	J	1	U	1	U
EW-8	11/27/2012	FS	1.5		41.1		1	U	1	U
EW-8	5/24/2013	FS	2		47.1		0.69		1	U
EW-8	11/6/2013	FS	1		32.4		0.78		1	U
EW-8	5/13/2014	FS	1.3		32.6		0.68		1	U
EW-8	11/5/2014	FS	1.3		27		0.8		1	U
EW-8	6/22/2015	FS	0.88		26.3		0.62		1	U
EW-8	11/30/2015	FS	1.5	J	21		0.57	J	5	U
EW-8	6/13/2016	FS	1.3		26.3		0.75	U	0.75	U
MW105A-1	11/27/2012	FS	1	U	2.6		1	U		
MW105A-1	11/1/2013	FS	1	U	2.8		0.5	U	1	U
MW105A-1	11/4/2014	FS	1	U	0.49	J	0.5	U	1	U
MW105A-1	11/19/2015	FS	5	U	5.7		5	U	5	U
MW111B-2	5/23/2012	FS	-		31.6		-			
MW111B-2	11/21/2012	FS	1	U	8.2		1	U		
MW111B-2	5/29/2013	FS	-		4.5		-			
MW111B-2	11/4/2013	FS	1	U	3.7		0.5	U	1	U
MW111B-2	5/28/2014	FS	-		6.6		-			
MW111B-2	12/3/2014	FS	1	U	19.1		0.87		1	U
MW111B-2	6/3/2015	FS	-		3.7		-			

Table E1 - VOC Data Summary
NSSC Five Year Review -Area 22 and 36

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier		Qualifier
MW111B-2	11/30/2015	FS	5	U	1.7	J	5	U	5	U
MW111B-2	4/28/2016	FS	-		4.1		-			
MW112B-2	11/29/2012	FS	1	U	7.9		1	U		
MW112B-2	11/1/2013	FS	1	U	6.2		0.5	U	1	U
MW112B-2	11/20/2014	FS	1	U	5.6		0.5	U	1	U
MW112B-2	11/6/2015	FS	5	U	3.5	J	5	U	5	U
MW113A-2	11/20/2012	FD	1	U	15.4		1	U		
MW113A-2	11/20/2012	FS	1	U	13.6		1	U		
MW113A-2	11/4/2013	FS	1	U	10.1		0.5	U	1	U
MW113A-2	5/28/2014	FD	-		14.4		-			
MW113A-2	5/28/2014	FS	-		12.8		-			
MW113A-2	11/6/2014	FS	1	U	8.6		0.5	U	1	U
MW113A-2	6/3/2015	FS	-		6.4		-			
MW113A-2	11/6/2015	FS	5	U	5.1		5	U	5	U
MW113A-2	5/2/2016	FS	-		3.2		-			
MW151A-2	11/20/2012	FS	1	U	1	U	1	U		
MW151A-2	11/1/2013	FS	1	U	0.5	U	0.5	U	1	U
MW151A-2	11/25/2014	FS	1	U	0.5	U	0.5	U	1	U
MW151A-2	11/5/2015	FS	5	U	5	U	5	U	5	U
MW152A-2	11/20/2012	FS	1	U	1	U	1	U		
MW152A-2	11/4/2013	FS	1	U	0.5	U	0.5	U	1	U
MW152A-2	12/4/2014	FS	1	U	0.5	U	0.5	U	1	U
MW152A-2	11/5/2015	FS	5	U	5	U	5	U	5	U

Notes

ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
- = analyzed, but not detected
Blank cells indicate not analyzed

Table E1 - VOC Data Summary
NSSC Five Year Review - Buildings 63, 2 and 45

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier		Qualifier
EW-2	5/24/2012	FS	1	U	1	UJ	1	U	1	U
EW-2	11/1/2013	FS	1	U	0.5	U	0.5	U	1	U
EW-2	11/5/2014	FS	1	U	0.5	U	0.5	U	1	U
EW-2	11/19/2015	FS	5	U	5	U	0.67	J	5	U
EW-3	5/24/2012	FS	1	U	1	UJ	24.1		1	U
EW-3	11/28/2012	FS	1	U	1	U	21.2		1	U
EW-3	5/30/2013	FS	1	U	0.5	U	17.6		1	U
EW-3	11/6/2013	FS	1	U	0.5	U	17.6		1	U
EW-3	5/13/2014	FS	1	U	0.5	U	15.9		1	U
EW-3	12/2/2014	FS	1	U	0.5	U	11.1		1	U
EW-3	6/23/2015	FS	1	U	0.5	U	15.1		1	U
EW-3	11/23/2015	FS	5	U	5	U	7.5		5	U
EW-4	5/24/2012	FS	1	U	1	UJ	27.3		1	U
EW-4	11/27/2012	FS	1	U	1	UJ	22.7		1	U
EW-4	5/28/2013	FS	1	U	0.5	U	28.7		1	U
EW-4	11/5/2013	FS	1	U	0.5	U	23.6		1	U
EW-4	5/13/2014	FS	1	U	0.5	U	21.5		1	U
EW-4	11/5/2014	FS	1	U	0.5	U	20.9		1	U
EW-4	6/18/2015	FS	1	U	0.5	U	18.8		1	U
EW-4	11/23/2015	FS	5	U	5	U	11		5	U
MW-10B	11/26/2012	FS	-		-		1.2		-	
MW-10B	11/5/2013	FS	1	U	0.5	U	0.75		-	
MW-10B	11/6/2014	FS	1	U	-		1		1	U
MW-10B	11/12/2015	FS	5	U	5	U	0.55	J	5	U
MW123B-2	5/23/2012	FS	-		-		102			
MW123B-2	11/28/2012	FS	-		-		68.1			
MW123B-2	5/28/2013	FS	0.76	J	-		102			
MW123B-2	11/1/2013	FS	1		0.5	U	136		1	U
MW123B-2	5/14/2014	FS	1.1		-		112			
MW123B-2	12/2/2014	FS	0.46	J	0.5	U	62		1	U
MW123B-2	6/3/2015	FS	1.4		-		90.3			
MW123B-2	11/13/2015	FS	1.1	J	5	U	74		5	U
MW123B-2	5/2/2016	FS	1		-		84.8			
MW124B-2	11/28/2012	FD	-		-		6.6			
MW124B-2	11/28/2012	FS	-		-		6.5			
MW124B-2	11/1/2013	FD	1	U	0.5	U	3.5		1	U
MW124B-2	11/1/2013	FS	1	U	0.5	U	3.6		1	U
MW124B-2	12/2/2014	FD	1	U	0.5	U	1.9		1	U
MW124B-2	12/2/2014	FS	1	U	0.5	U	1.9		1	U
MW125B-2	5/24/2012	FD	-		-		23.4			
MW125B-2	5/24/2012	FS	-		-		21.2			
MW125B-2	11/21/2012	FD	-		-		19.8			
MW125B-2	11/21/2012	FS	-		-		20.8			
MW125B-2	5/28/2013	FS	-		0.73		22.5			
MW125B-2	10/31/2013	FS	1	U	0.5	U	24.8		1	U
MW125B-2	5/21/2014	FS	-		-		24.8			
MW125B-2	11/19/2014	FS	1	U	0.5	U	28.2		1	U
MW125B-2	6/15/2015	FS	-		-		24			
MW125B-2	11/13/2015	FS	5	U	0.35	J	23		5	U
MW125B-2	4/26/2016	FS	-		0.51	J	27.4			
MW126B-2	11/28/2012	FS	-		-		1.5			
MW126B-2	11/1/2013	FS	1	U	0.5	U	2.1		1	U
MW126B-2	12/3/2014	FS	1	U	0.5	U	1.5		1	U
MW126B-2	12/2/2015	FS	5	U	5	U	0.75	J	5	U
MW160A-2	5/22/2012	FS	-		-		3.5			
MW160A-2	11/28/2012	FS	-		-		3.9			
MW160A-2	5/30/2013	FS	-		-		1.7			

Table E1 - VOC Data Summary
NSSC Five Year Review - Buildings 63, 2 and 45

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code		Qualifier		Qualifier		Qualifier		Qualifier
MW160A-2	11/1/2013	FS	1	U	0.5	U	1.8		1	U
MW160A-2	5/27/2014	FS	-		-		1.9			
MW160A-2	12/2/2014	FS	1	U	0.5	U	0.78		1	U
MW160A-2	6/23/2015	FS	-		-		0.72			
MW160A-2	12/2/2015	FS	5	U	5	U	4.5	J	5	U
MW160A-2	5/2/2016	FS	-		-		8.9			
MW161A-2	11/28/2012	FS	-		-		-			
MW161A-2	11/1/2013	FS	1	U	0.5	U	0.5	U	1	U
MW161A-2	12/2/2014	FS	1	U	0.5	U	0.5	U	1	U
MW161A-2	12/2/2015	FS	5	U	5	U	5	U	5	U

Notes

ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
⁻= analyzed, but not detected
Blank cells indicate not analyzed

Table E1 - VOC Data Summary
NSSC Five Year Review -ARIEM Building

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
MW164B-2	5/24/2012	FS	-		-		7		-	
MW164B-2	11/27/2012	FS	-		-		6.9		-	
MW164B-2	5/29/2013	FS	-		-		7.7		-	
MW164B-2	11/4/2013	FS	1	U	0.5	U	6.9		1	U
MW164B-2	5/21/2014	FS	-		-		6.5		-	
MW164B-2	12/3/2014	FS	1	U	0.5	U	0.85		1	U
MW164B-2	6/17/2015	FS	-		-		3		-	
MW164B-2	12/1/2015	FS	5	U	5	U	2.1	J	5	U
MW164B-2	5/2/2016	FS	-		-		1.5			
MW165B-2	5/24/2012	FS	-		-		9.8		-	
MW165B-2	11/27/2012	FS	-		-		8.9		-	
MW165B-2	5/29/2013	FS	-		-		10.1		-	
MW165B-2	10/31/2013	FS	1	U	0.5	U	8.6		1	U
MW165B-2	2/3/2014	FS					9			
MW165B-2	2/14/2014	FS					8.4			
MW165B-2	3/25/2014	FS					8.1			
MW165B-2	4/1/2014	FS					7			
MW165B-2	4/30/2014	FS					9.3			
MW165B-2	5/21/2014	FS	-		-		10		-	
MW165B-2	7/14/2014	FS					8.2			
MW165B-2	7/18/2014	FS					7.5			
MW165B-2	8/19/2014	FS					7			
MW165B-2	10/20/2014	FS					8.2			
MW165B-2	11/20/2014	FS	1	U	0.5	U	8.6		1	U
MW165B-2	12/10/2014	FS					8.5			
MW165B-2	12/22/2014	FS					7.7			
MW165B-2	1/20/2015	FS					8.4			
MW165B-2	3/10/2015	FS					9.3			
MW165B-2	3/24/2015	FS					7			
MW165B-2	4/27/2015	FS					8.3			
MW165B-2	5/21/2015	FS					8.4			
MW165B-2	6/01/2015	FS	-		0.34	J	6.9		-	
MW165B-2	6/1/2015	FS					6.9			
MW165B-2	7/14/2015	FS					8.6			
MW165B-2	7/20/2015	FS					8.1			
MW165B-2	8/18/2015	FS					8.3			
MW165B-2	12/01/2015	FS	5	U	0.32	J	6.6		5	U
MW165B-2	5/02/2016	FS	-		0.49	J	8.4			
MW181B-2	2/3/2014	FS					25.9			
MW181B-2	2/14/2014	FS					26			
MW181B-2	3/25/2014	FS					27.6			
MW181B-2	4/1/2014	FS					4.1			
MW181B-2	4/30/2014	FS					24.1			
MW181B-2	7/14/2014	FS					20.4			
MW181B-2	7/18/2014	FS					18.8			
MW181B-2	8/19/2014	FS					18.8			

Table E1 - VOC Data Summary
NSSC Five Year Review -ARIEM Building

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	**Date**	**Qc Code**	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
MW181B-2	10/20/2014	FS					22			
MW181B-2	12/10/2014	FS					24			
MW181B-2	12/22/2014	FS					21.1			
MW181B-2	1/20/2015	FS					22.3			
MW181B-2	3/10/2015	FS					22.3			
MW181B-2	3/24/2015	FS					18.8			
MW181B-2	4/27/2015	FS					21.2			
MW181B-2	5/21/2015	FS					20.2			
MW181B-2	6/1/2015	FS					15.8			
MW181B-2	7/14/2015	FS					19.8			
MW181B-2	7/20/2015	FS					21.6			
MW181B-2	8/18/2015	FS					20.7			
MW-181B-2	12/03/2015	FS	5	U	0.4	J	15		5	U
MW-181B-2	12/03/2015	FS	5	U	0.37	J	16		5	U
MW-181B-2	5/23/2016	FS	-		0.35	J	16.4			

Notes
ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
⁻= analyzed, but not detected
Blank cells indicate not analyzed
concentrations in red-font denote samples collected as part of the slug volume removal protocol

Table E1 - VOC Data Summary
NSSC Five Year Review - Area MW114B-2

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
MW114B-2	5/21/2012	FS	-		-		-		-	
MW114B-2	11/20/2012	FS	-		3.6		1	U	-	
MW114B-2	5/28/2013	FS	-		4.5		-		-	
MW114B-2	10/31/2013	FS	1	U	6		0.83		1	U
MW114B-2	2/3/2014	FS			1.4					
MW114B-2	2/14/2014	FS			0.7					
MW114B-2	3/25/2014	FS			3.7					
MW114B-2	4/1/2014	FS			1.5					
MW114B-2	4/30/2014	FS			1.1					
MW114B-2	5/21/2014	FS	-		7.2		1		-	
MW114B-2	7/14/2014	FS			13.8					
MW114B-2	7/18/2014	FS			12.2					
MW114B-2	8/19/2014	FS			4.7					
MW114B-2	10/12/2014	FS			-					
MW114B-2	10/20/2014	FS			7.1					
MW114B-2	11/20/2014	FS	1	U	0.5	U	0.5	U	1	U
MW114B-2	12/10/2014	FS			-					
MW114B-2	12/22/2014	FS			1.4					
MW114B-2	1/20/2015	FS			-					
MW114B-2	1/20/2015	FS			-					
MW114B-2	3/10/2015	FS			2.2					
MW114B-2	3/24/2015	FS			2.7					
MW114B-2	4/27/2015	FS			2					
MW114B-2	5/21/2015	FS			5.3					
MW114B-2	6/1/2015	FS	-		1.5		0.37	J	-	
MW114B-2	6/1/2015	FS			1.5					
MW114B-2	7/14/2015	FS			1.1					
MW114B-2	7/20/2015	FS			0.4					
MW114B-2	8/18/2015	FS			0.8					
MW114B-2	11/9/2015	FS	5	U	5	U	5	U	5	U
MW114B-2	4/26/2016	FS	-		2.6		0.92	J		
MW-169B-2	11/26/2012	FS			1	U	3.3			
MW-169B-2	5/24/2013	FS			-		3.5			
MW-169B-2	10/31/2013	FS			0.5	U	3.2			
MW-169B-2	5/28/2014	FS	-		-		3		-	
MW-169B-2	11/18/2014	FS			0.5	U	2.9			
MW-169B-2	6/16/2015	FS			-		3			
MW-169B-2	11/10/2015	FS	5	U	5	U	2.4		5	U
MW-169B-2	4/25/2016	FS	-		0.45	J	3			
MW-178B-2	11/26/2012	FS			6.7		2.8			
MW-178B-2	5/28/2013	FS			7.3		2.5			
MW-178B-2	10/31/2013	FS			4.5		1.6			
MW-178B-2	5/28/2014	FS	-		4.4		1.2		-	
MW-178B-2	11/20/2014	FS			4		1.3			

Table E1 - VOC Data Summary
NSSC Five Year Review - Area MW114B-2

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
MW-178B-2	6/16/2015	FS			4.1		1.4			
MW-178B-2	11/16/2015	FS	5	U	3.7	J	1.5	J	5	U
MW-178B-2	4/27/2016	FS	-		4.7		1.7			

Notes
ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
- = analyzed, but not detected
Blank cells indicate not analyzed
concentrations in red-font denote samples collected as part of the slug volume removal protocol

Table E1 - VOC Data Summary
NSSC Five Year Review - Former Proposed Gymnasium Area

Location	Date	Group of Analysis	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Parameter	cis-1,2-DCE		Tetrachloroethene		Trichloroethene		Vinyl chloride	
		Fraction	Total		Total		Total		Total	
		Units	ug/L		ug/L		ug/L		ug/L	
Location	Date	Qc Code	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
MW100A-2	5/29/2014	FS	-		-		-		-	
MW102A-2	5/29/2014	FS	-		-		-		-	
MW127A-2	11/1/2013	FS	1	U	0.5	U	0.5	U	1	U
MW127A-2	5/29/2014	FS	-		-		-		-	
MW127A-2	11/19/2014	FS			0.5	U	0.5	U		
MW127A-2	11/10/2015	FS	5	U	5	U	5	U	5	U
MW127A-2	4/25/2016	FS	-		-		-			
MW-4	5/29/2014	FS	-		-		-		-	
MW-5R	11/21/2012	FS	-		2.9		1	U	-	
MW-5R	11/1/2013	FS	1	U	2.3		0.5	U	1	U
MW-5R	5/29/2014	FS	-		1.1		-		-	
MW-5R	11/19/2014	FS	1	U	2.1		0.69		1	U
MW-5R	11/10/2015	FS	5	U	1.5		0.41	J	5	U
MW-6	11/1/2013	FS			0.5	U	0.5	U		
MW-6	5/29/2014	FS	-		-		-		-	
MW-6	11/5/2014	FS			0.5	U	0.5	U		
MW-6	11/16/2015	FS	5	U	5	U	5	U	5	U
MW-6	4/26/2016	FS	-		-		-			

Notes
ug/L = micrograms per liter
cis-1,2-DCE = cis-1,2-Dichloroethene
FS = Field Sample
FD = Field Duplicate
J = Estimated
- = analyzed, but not detected
Blank cells indicate not analyzed

TABLE E-2

GROUNDWATER ANALYTICAL DATA

1,4-DIOXANE

Table E-2 - SVOC Data Summary
NSSC Five Year Review - Area 63,2, and 45 : 1,4 -Dioxane

		Group of Analysis	SVOCs		
			Parameter	1,4-Dioxane	
			Fraction	Total	
			Units	ug/L	
Area	Location	Date	Qc Code		Qualifier
63_2_45	EW-3	5/24/2012	FS	7.4	J
63_2_45	EW-3	11/28/2012	FS	5.7	
63_2_45	EW-3	5/30/2013	FS	4.7	
63_2_45	EW-3	11/6/2013	FS	6.5	
63_2_45	EW-3	5/13/2014	FS	5.2	
63_2_45	EW-3	12/2/2014	FS	3.7	
63_2_45	EW-3	6/23/2015	FS	3.2	
63_2_45	EW-3	11/23/2015	FS	0.86	
63_2_45	MW123B-2	11/28/2012	FS	ND	U
63_2_45	MW123B-2	11/1/2013	FS	ND	U
63_2_45	MW123B-2	12/2/2014	FS	ND	U
63_2_45	MW123B-2	11/13/2015	FS	0.02	J
63_2_45	MW123B-2	5/2/2016	FS	ND	U
63_2_45	MW124B-2	11/28/2012	FD	2	
63_2_45	MW124B-2	11/28/2012	FS	2	
63_2_45	MW124B-2	11/1/2013	FD	1.4	
63_2_45	MW124B-2	11/1/2013	FS	1.3	
63_2_45	MW124B-2	12/2/2014	FS	0.89	
63_2_45	MW124B-2	12/2/2014	FD	1.1	
63_2_45	MW125B-2	11/13/2015	FS	N/A	
63_2_45	MW125B-2	4/26/2016	FS	N/A	
63_2_45	MW126B-2	11/28/2012	FS	ND	U
63_2_45	MW126B-2	11/1/2013	FS	ND	U
63_2_45	MW126B-2	12/3/2014	FS	ND	U
63_2_45	MW126B-2	12/2/2015	FS	ND	U
63_2_45	MW160A-2	5/22/2012	FD	8.4	J
63_2_45	MW160A-2	5/22/2012	FS	5.3	J
63_2_45	MW160A-2	11/28/2012	FS	10	
63_2_45	MW160A-2	5/30/2013	FD	3.8	
63_2_45	MW160A-2	5/30/2013	FS	3.4	
63_2_45	MW160A-2	11/1/2013	FS	4.4	
63_2_45	MW160A-2	5/27/2014	FD	3.3	
63_2_45	MW160A-2	5/27/2014	FS	3.6	
63_2_45	MW160A-2	12/2/2014	FS	2.6	
63_2_45	MW160A-2	6/23/2015	FS	1.4	
63_2_45	MW160A-2	12/2/2015	FS	9.1	
63_2_45	MW160A-2	12/2/2015	FD	9	
63_2_45	MW160A-2	5/2/2016	FS	8.2	
63_2_45	MW160A-2	5/2/2016	FD	6.2	J
63_2_45	MW161A-2	11/28/2012	FS	0.42	
63_2_45	MW161A-2	11/1/2013	FS	0.32	
63_2_45	MW161A-2	12/2/2014	FS	ND	U
63_2_45	MW161A-2	12/2/2015	FS	0.049	

Notes
ug/L = micrograms per liter
FS = Field Sample
FD = Field Duplicate
J = Estimated
ND = analyzed, but not detected
NA = Not Analyzed

TABLE E-3

GROUNDWATER ANALYTICAL DATA

SECONDARY COCS

Table E-3
NSSC Five Year Review - Secondary COCs

				Bldg 94		T-25		T-25		T-25		T-25		T-25		T-25		T-25		T-25	
			Location	LOC G		MW-2B		MW-2B		MW-128A		MW-167B-2		MW-51BR		MW-83B-2		MW-95B-4		MW-96B-4	
			Sample Date	11/23/2015		12/3/2015		12/3/2015		12/3/2015		11/19/2015		12/1/2015		11/30/2015		11/23/2015		11/23/2015	
			Sample ID	TS LOC G-308		MD002B71		MX002B71		MX128A71		MX167B71		MX051B71		MX083B71		TS LOC MW95B-30		TS LOC MW96B-30	
			Qc Code	FS		FD		FS		FS		FS		FS		FS		FS		FS	
Class	**Fraction**	**Parameter**	**Units**	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Metals	D	Chromium	ug/l	5	U	2.8	UJ	3.2	UJ	10.1	J	5	U	10	U	0.646	UJ	5	U	5	U
Metals	D	Lead	ug/l	2.5	U	4.6	UJ	3.4	UJ	7.2	UJ	2.1	J	2.8	UJ	1.4	UJ	2.5	U	2.5	U
Metals	D	Manganese	ug/l	9.9	J	9.8	J	12.4		24300		2.1	U	5.5	U	1.6	U	11.9		734	
Metals	D	Nickel	ug/l	0.968	J	4.2	J	4.6	J	24.9	J	20	U	6.6	J	2.6	U	20	U	2.1	J
Metals	D	Thallium	ug/l	10	U	10	U	10	U	100	U	10	U	10	U	10	U	10	U	10	U
Metals	D	Vanadium	ug/l	25	U	0.692	U	0.886	U	50	U	25	U	50	U	50	U	25	U	25	U
Pest	N	4,4'-DDT	ug/l	0.047	U																
SVOCs	N	Bis(2-Ethylhexyl)phthalate	ug/l	9.4	U																

Notes
ug/L = micrograms per liter
FS = Field Sample
FD = Field Duplicate
J = Estimated
U= analyzed, but not detected
UJ = Estimated Non-Detect

Table E-3
NSSC Five Year Review - Secondary COCs

				63,2, and 45		63,2, and 45		T-25		Boiler Plant		Boiler Plant	
			Location	MW159A-2		MW160A-2		MW209B-HP2		MW-40BR		MW168B-2	
			Sample Date	12/3/2015		12/2/2015		11/18/2015		11/13/2015		11/13/2015	
			Sample ID	MX159A71		MX160A71		MX209B71		MX040B71		MX168B71	
			Qc Code	FS		FS		FS		FS		FS	
Class	**Fraction**	**Parameter**	**Units**	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Metals	D	Chromium	ug/l	1.3	UJ	2.4	UJ	0.902	U				
Metals	D	Lead	ug/l	5	U	2.6	UJ	2.5	U				
Metals	D	Manganese	ug/l	471		148		60.8					
Metals	D	Nickel	ug/l	1.5	U	6.1	J	16	J				
Metals	D	Thallium	ug/l	10	U	10	U	10	U				
Metals	D	Vanadium	ug/l	50	U	50	U	6.5	J				
Pest	N	4,4'-DDT	ug/l							0.047	U	0.047	U
SVOCs	N	Bis(2-Ethylhexyl)phthalate	ug/l										

Notes
ug/L = micrograms per liter
FS = Field Sample
FD = Field Duplicate
J = Estimated
U= analyzed, but not detected
UJ = Estimated Non-Detect

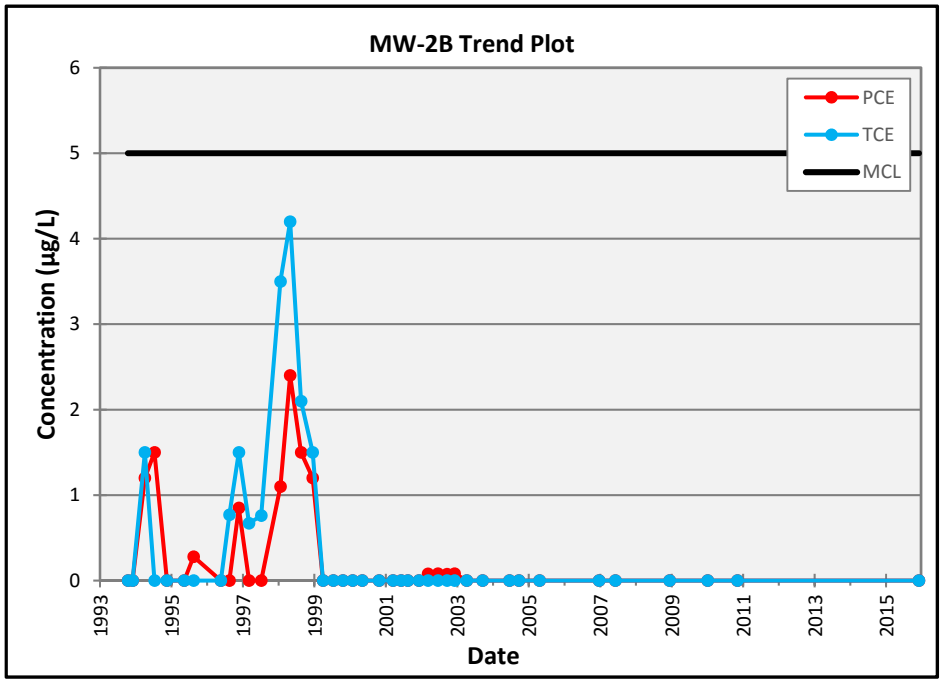
APPENDIX F – TIME SERIES PLOTS FOR CHEMICALS OF CONCERN

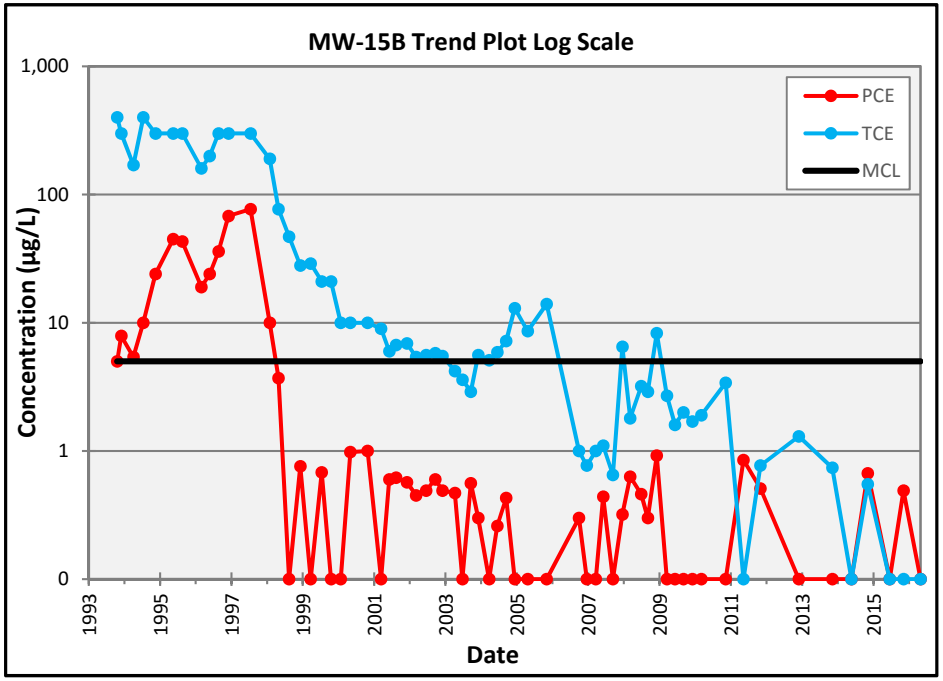
Source: Draft Groundwater Monitoring Event 72 Semi-Annual Memorandum, 12 September 2016 – Plexus Scientific Corporation

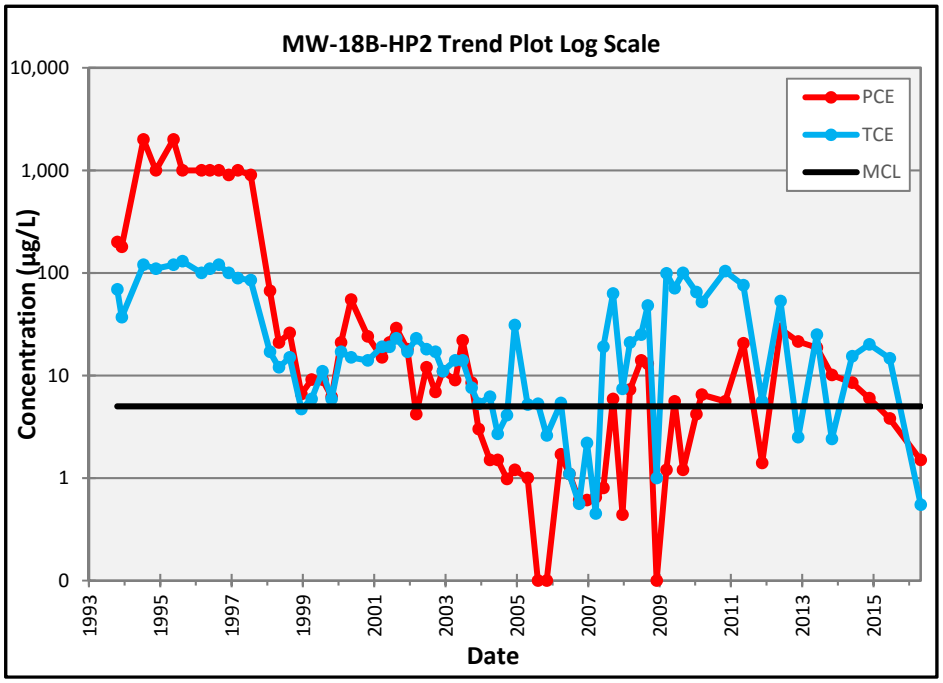
T-25 AREA

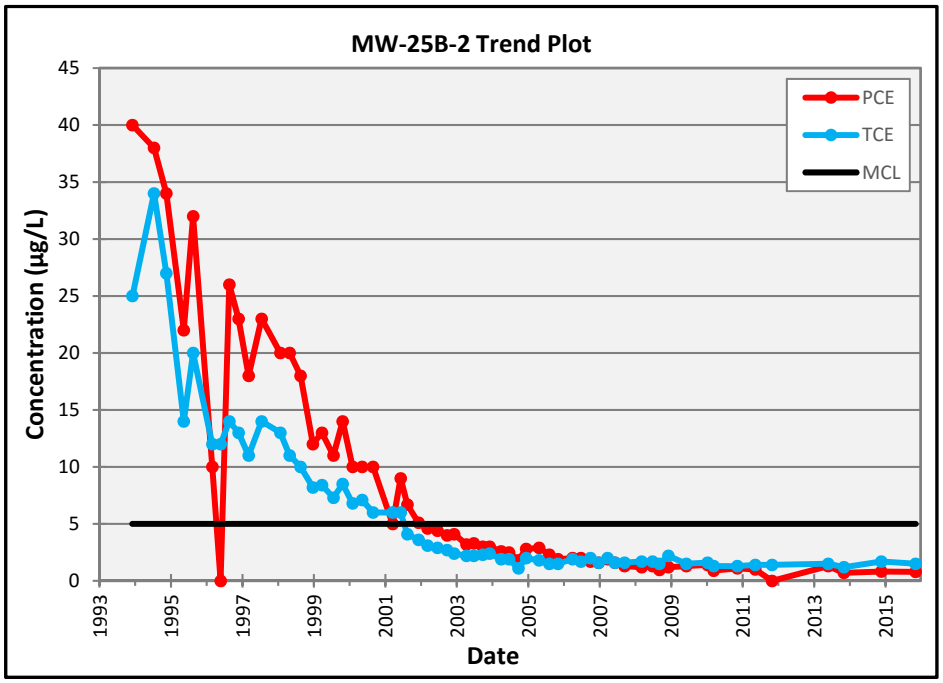
TCE AND PCE TIME SERIES PLOTS

PCE and TCE Concentrations in Selected T-25 Monitoring Wells

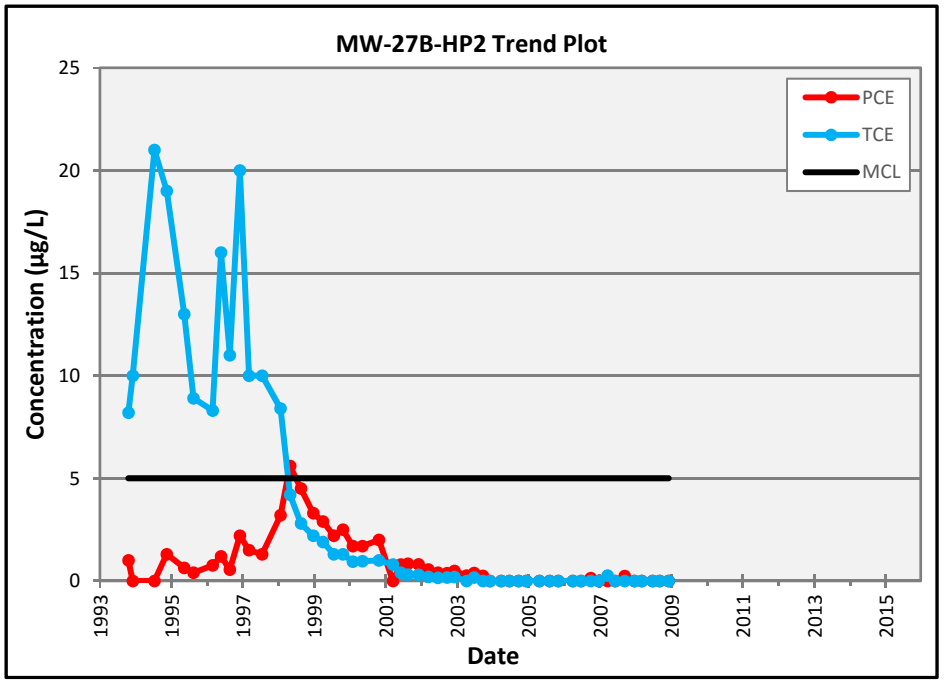


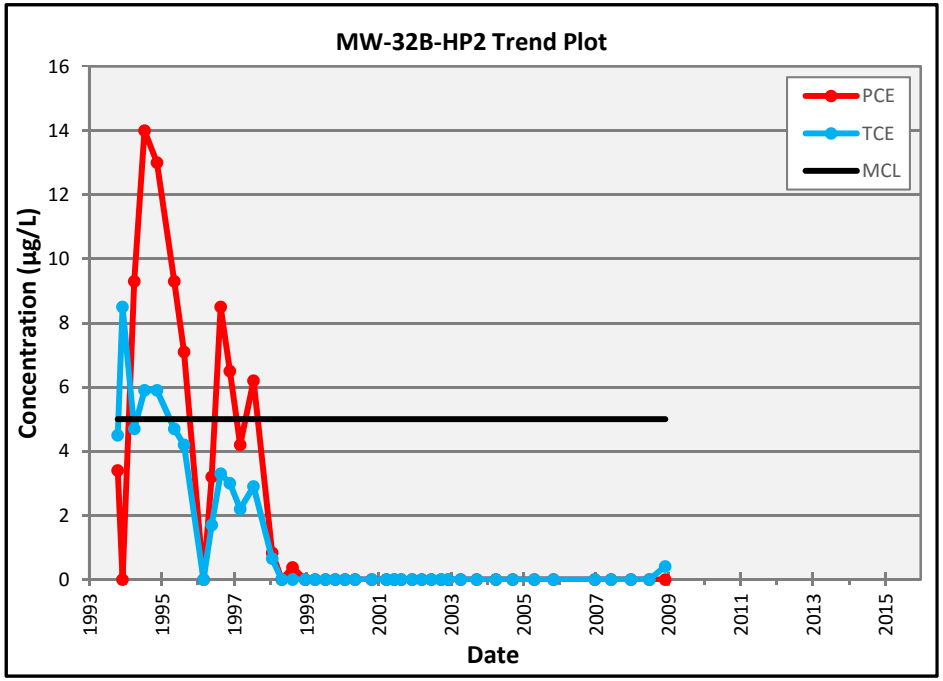


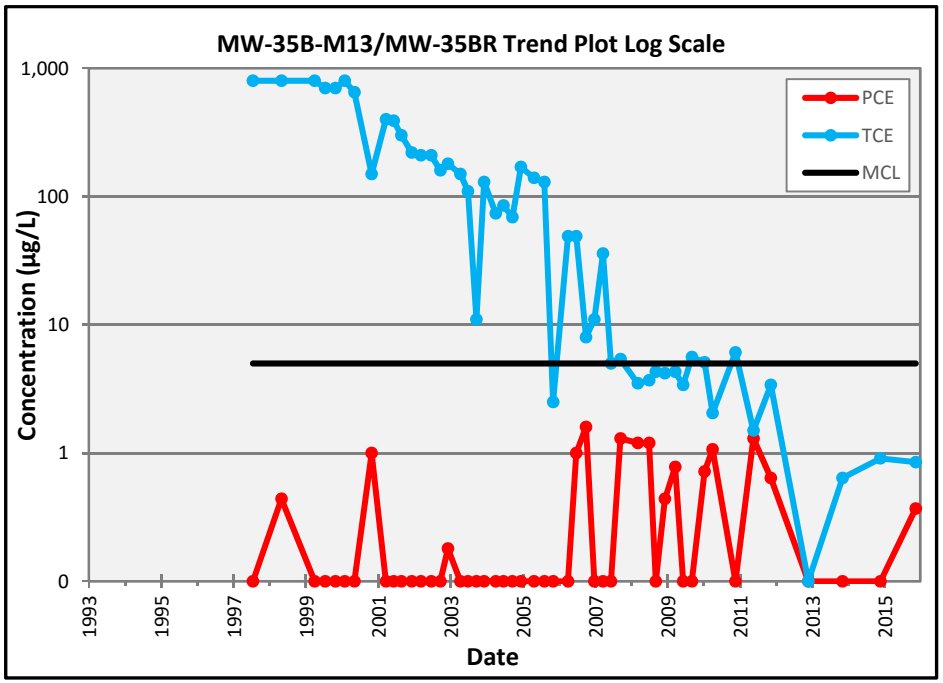


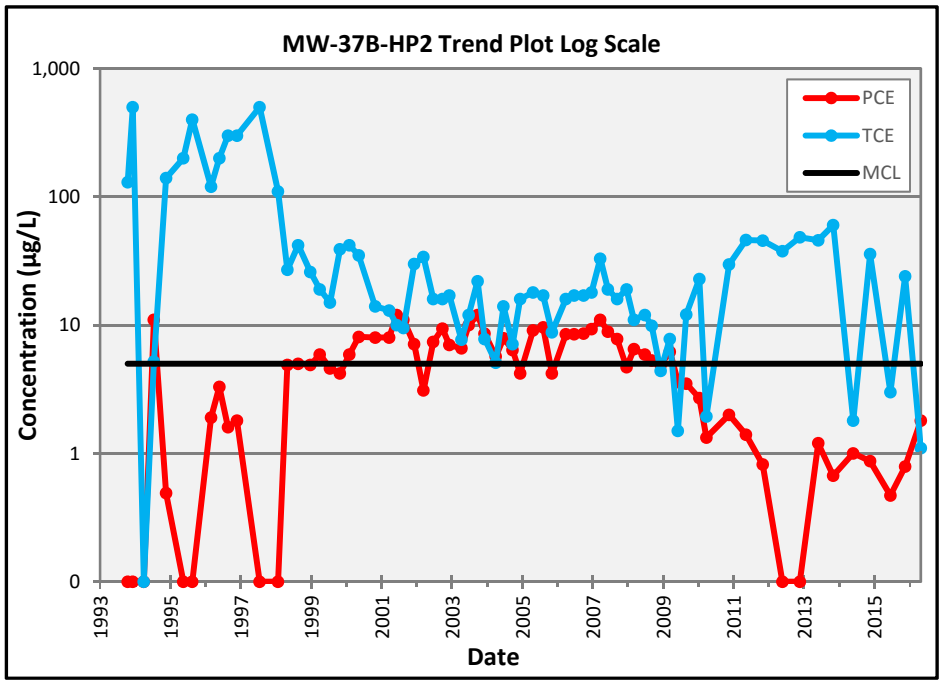


PCE and TCE Concentrations in Selected T-25 Monitoring Wells

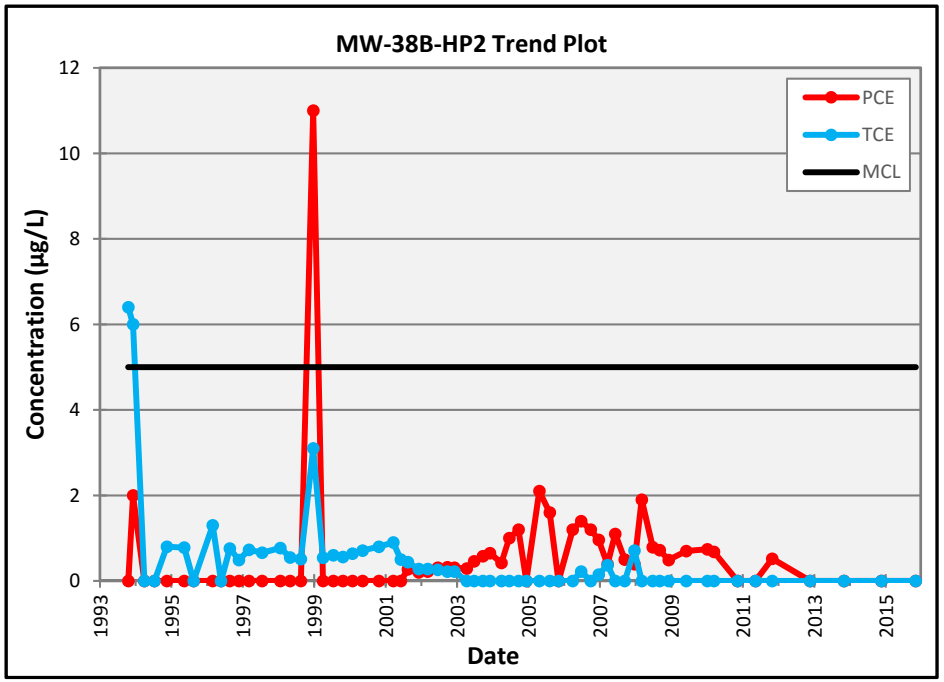


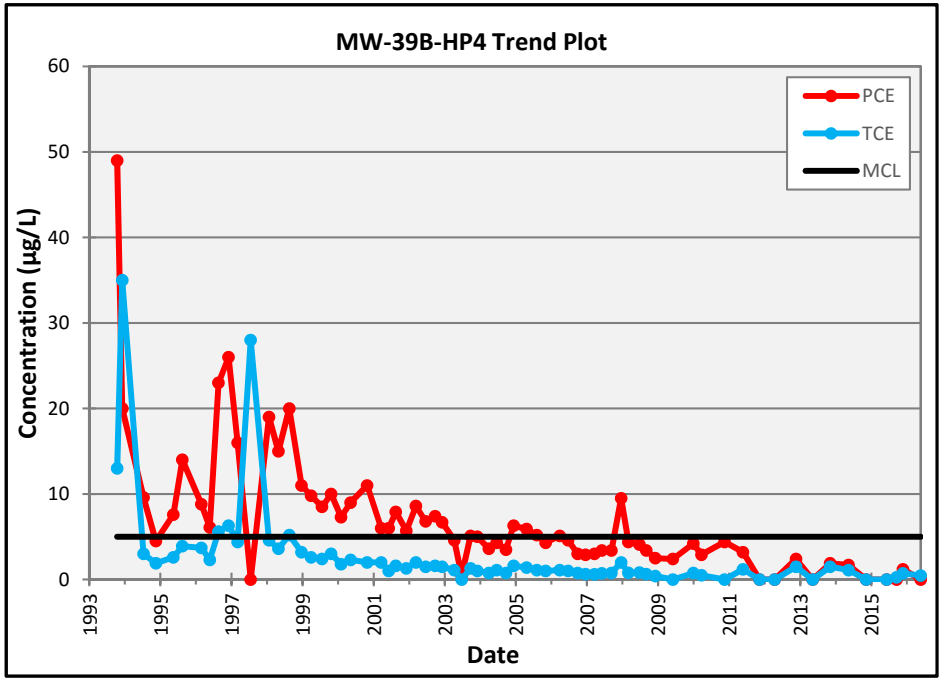


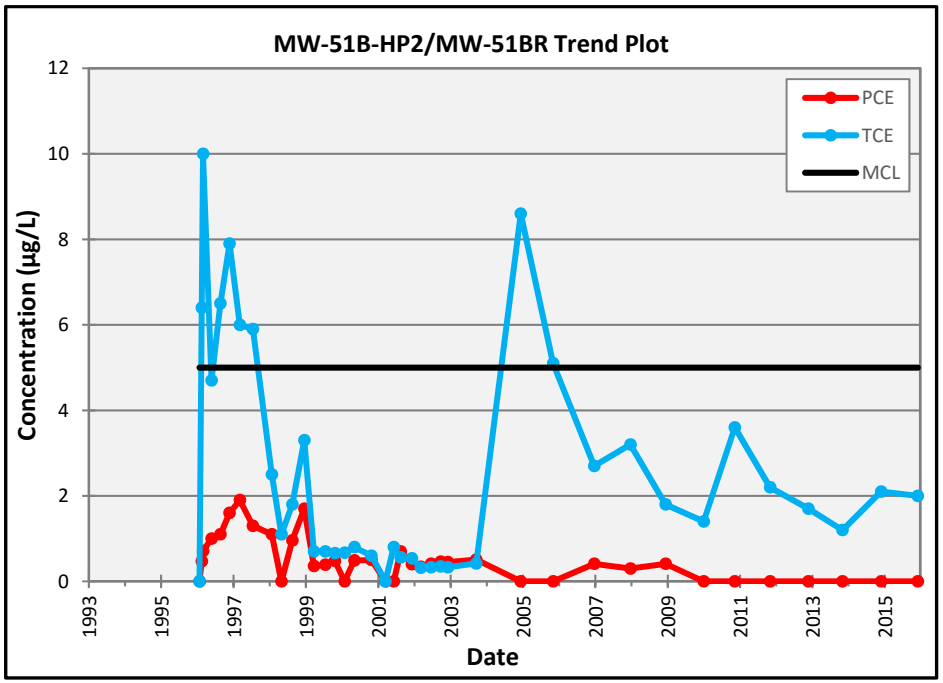


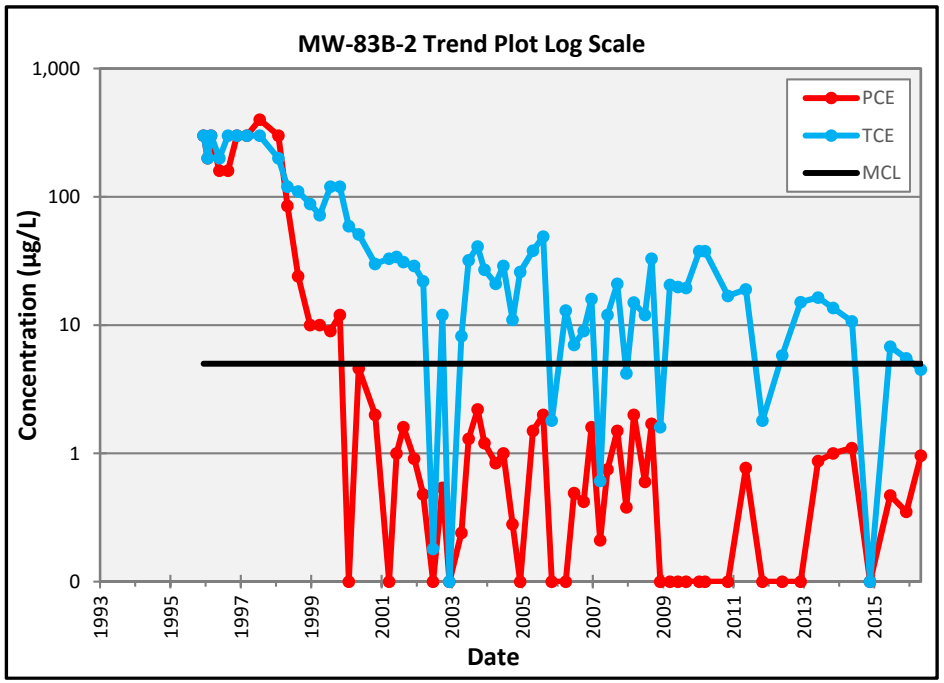


PCE and TCE Concentrations in Selected T-25 Monitoring Wells

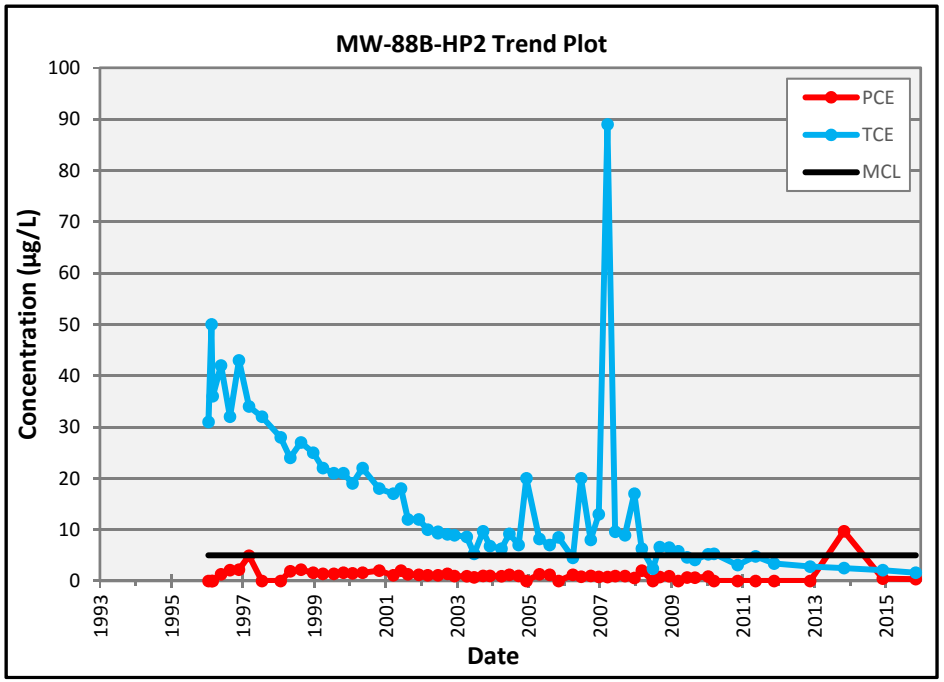


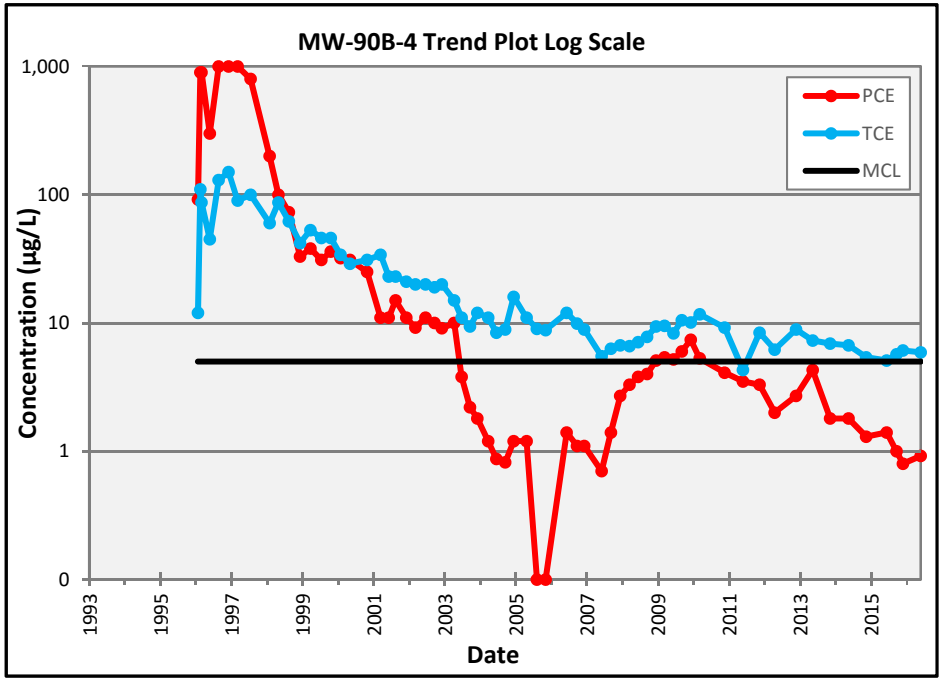


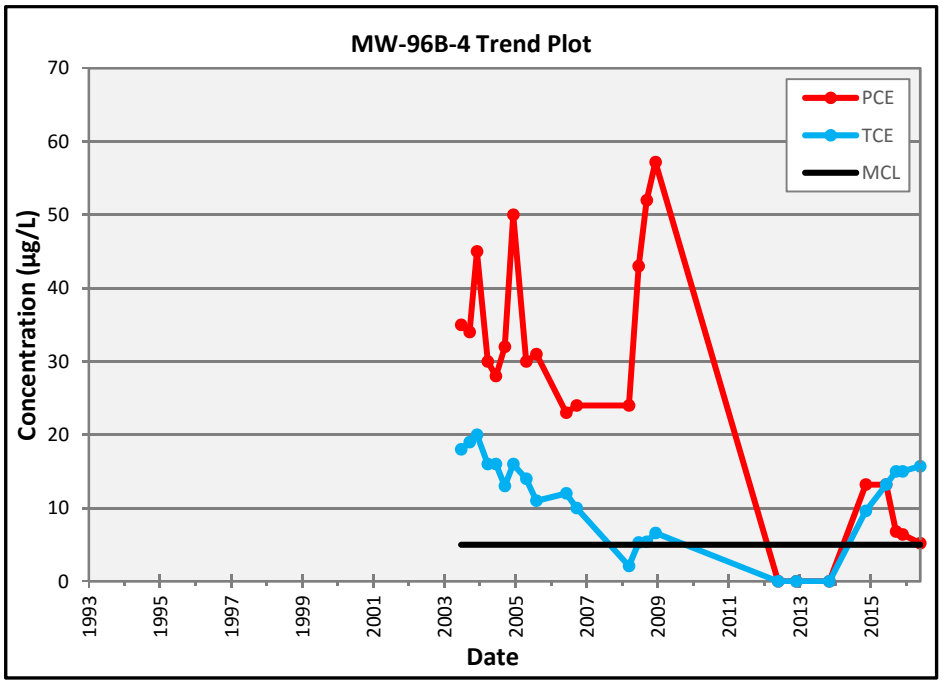


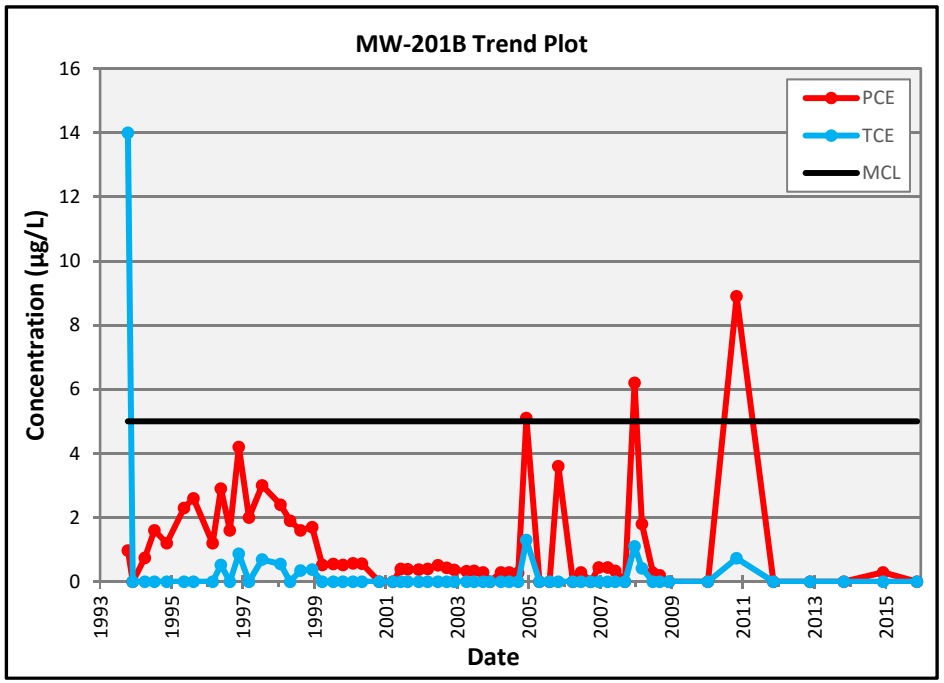


PCE and TCE Concentrations in Selected T-25 Monitoring Wells

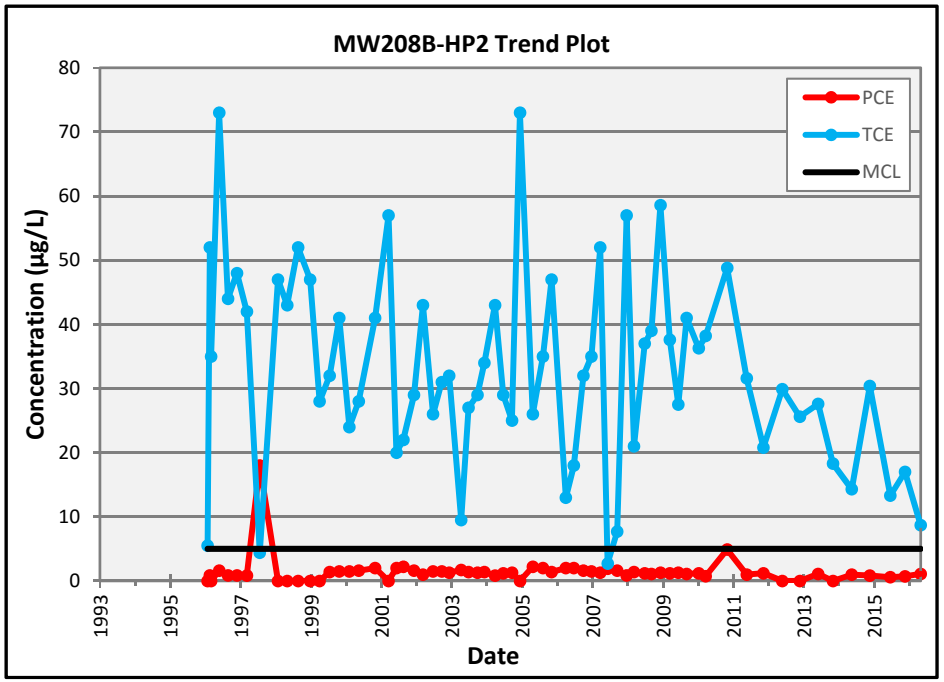


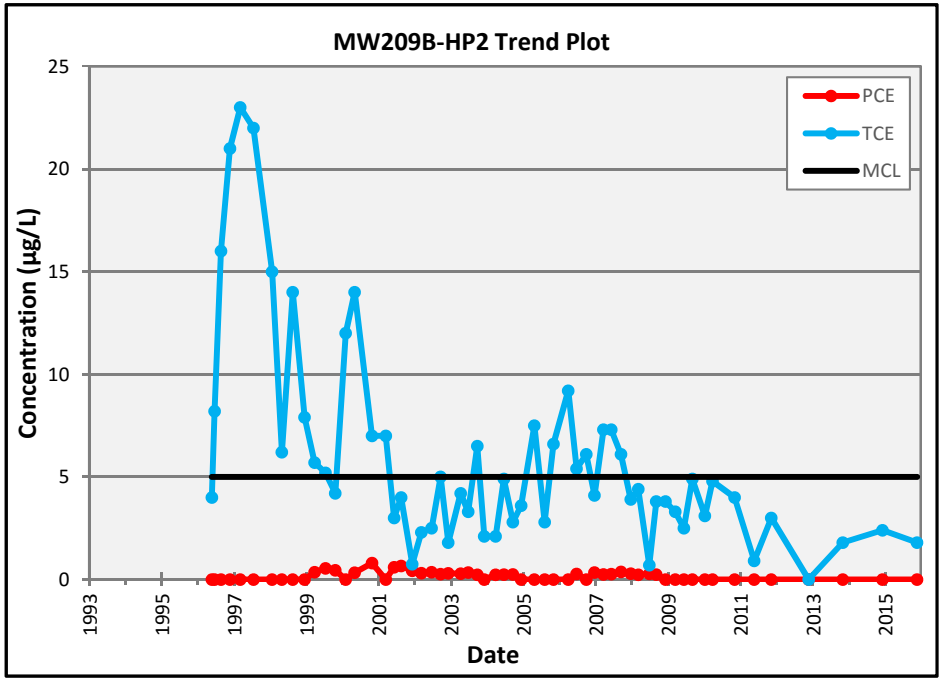


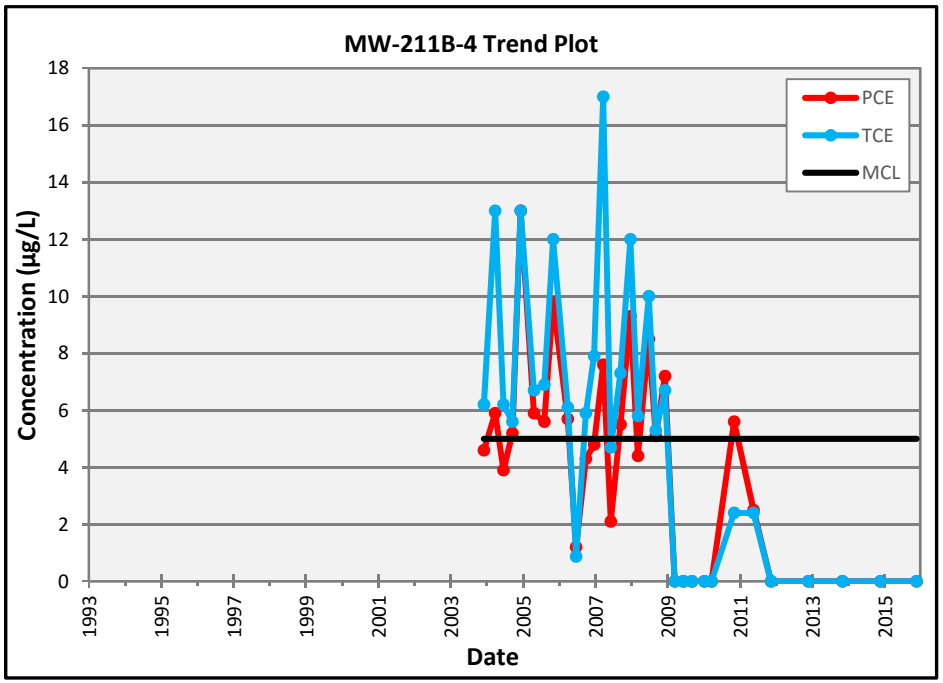




PCE and TCE Concentrations in Selected T-25 Monitoring Wells



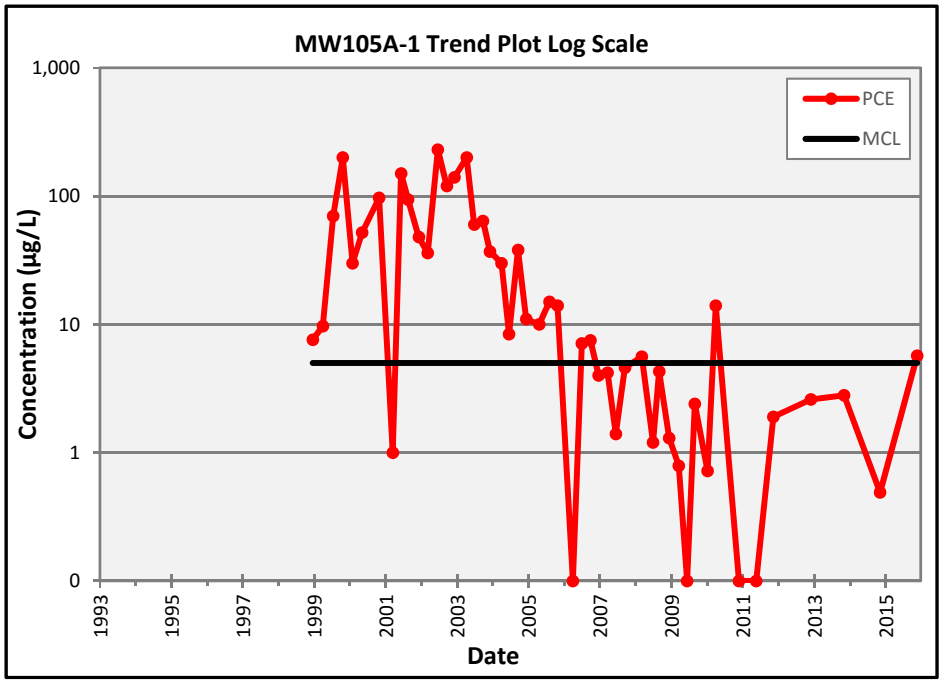


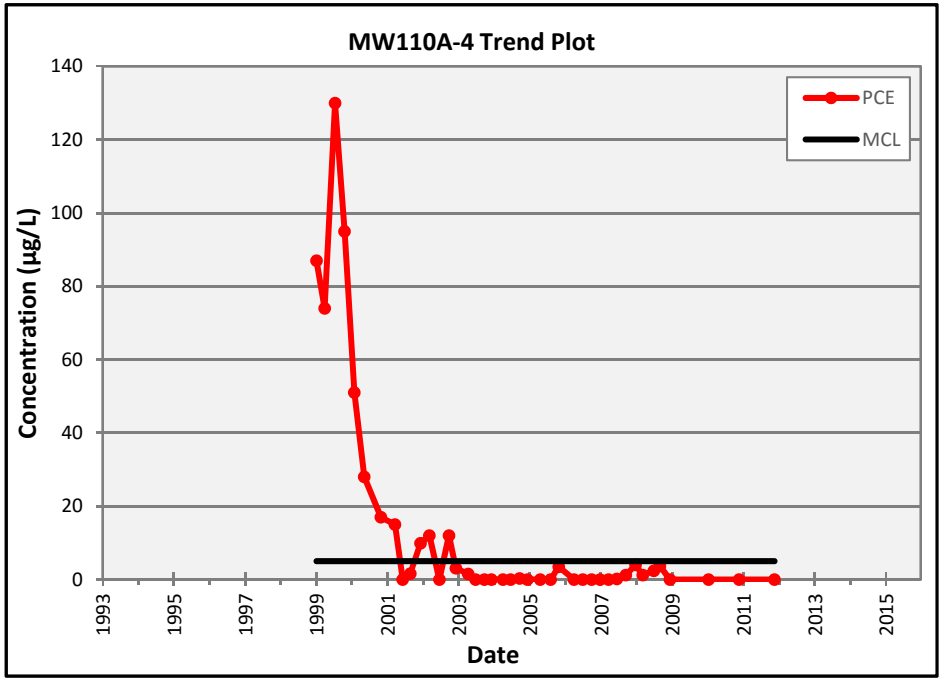


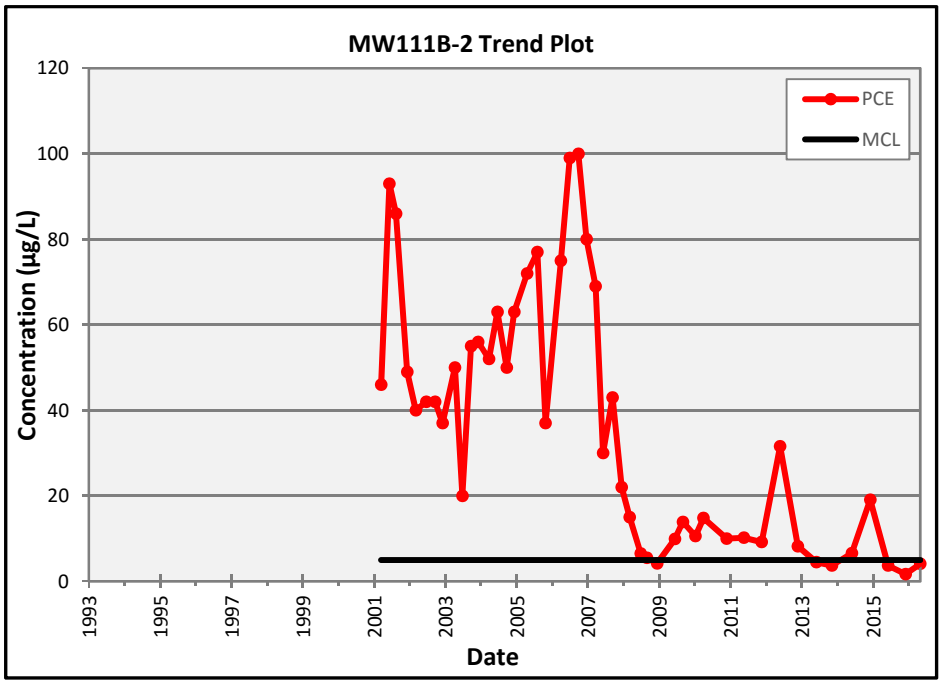
BUILDINGS 22 AND 36 AREA

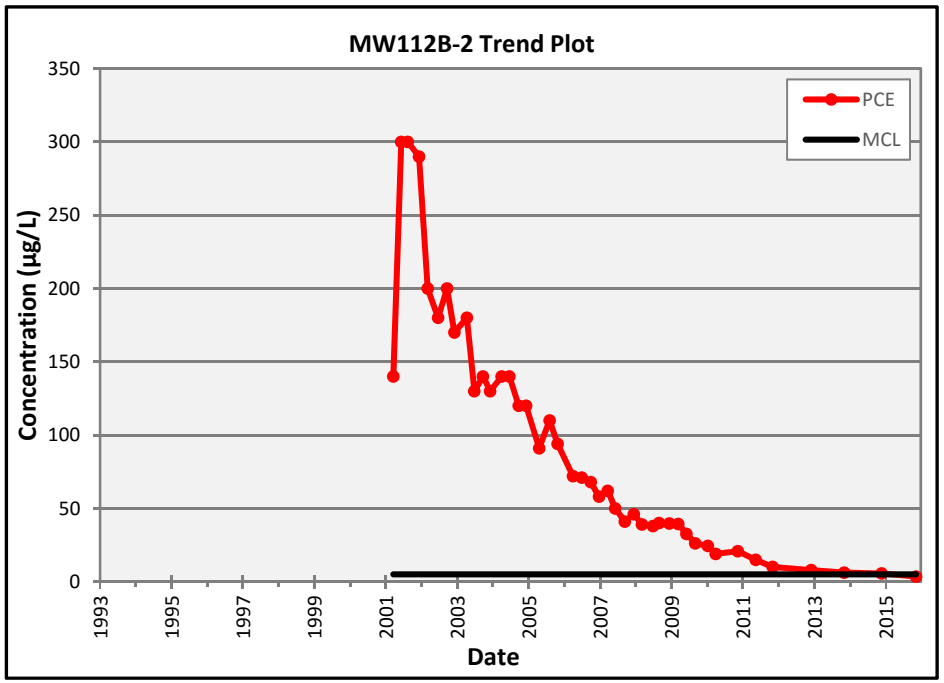
PCE TIME SERIES PLOTS

PCE Concentrations in Selected Buildings 22 and 36 Monitoring Wells

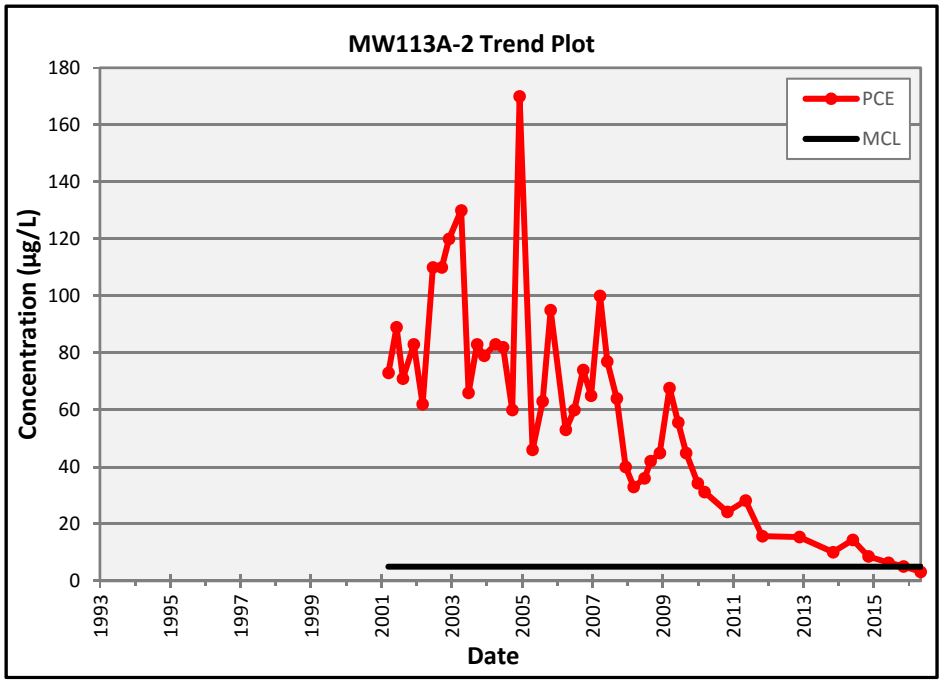


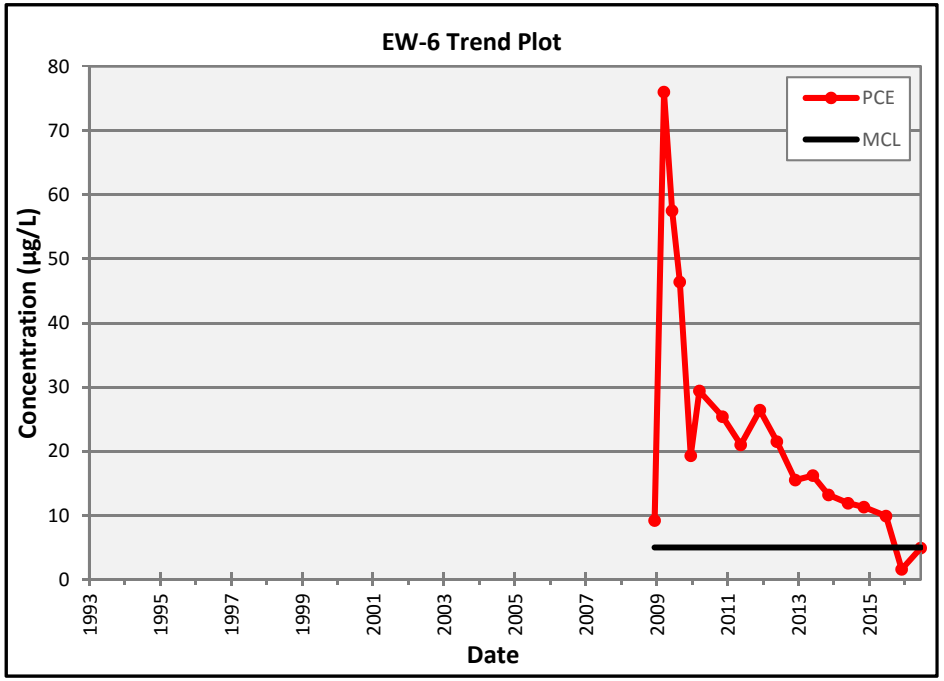


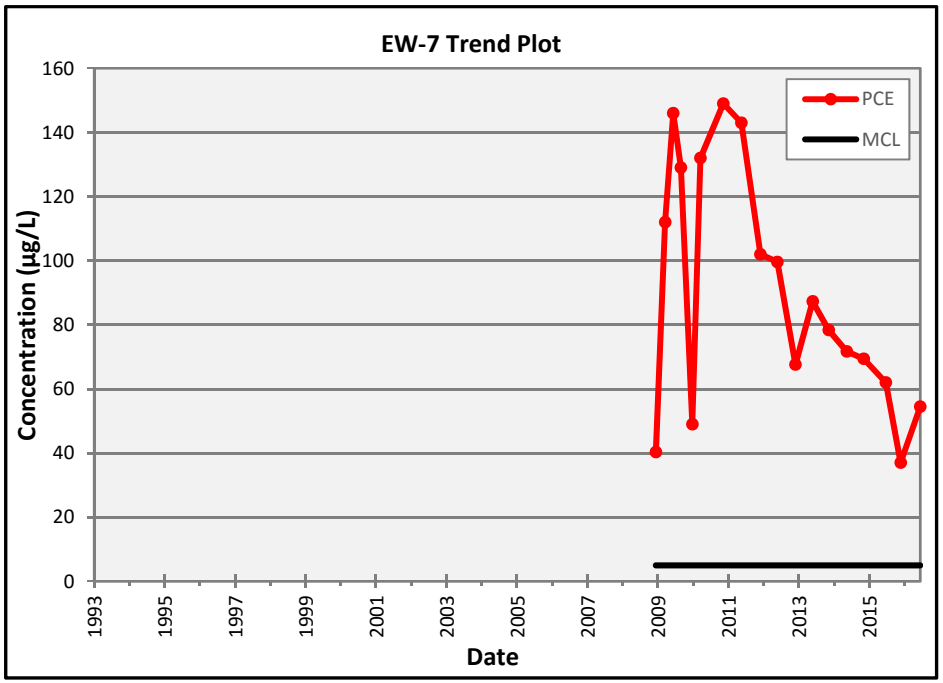


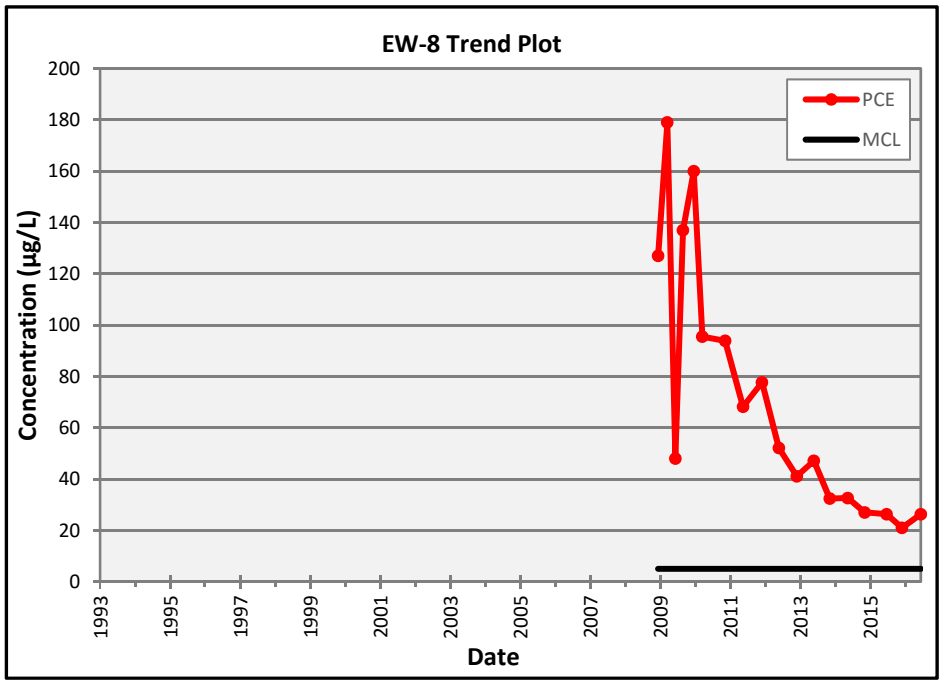


PCE Concentrations in Selected Buildings 22 and 36 Monitoring Wells

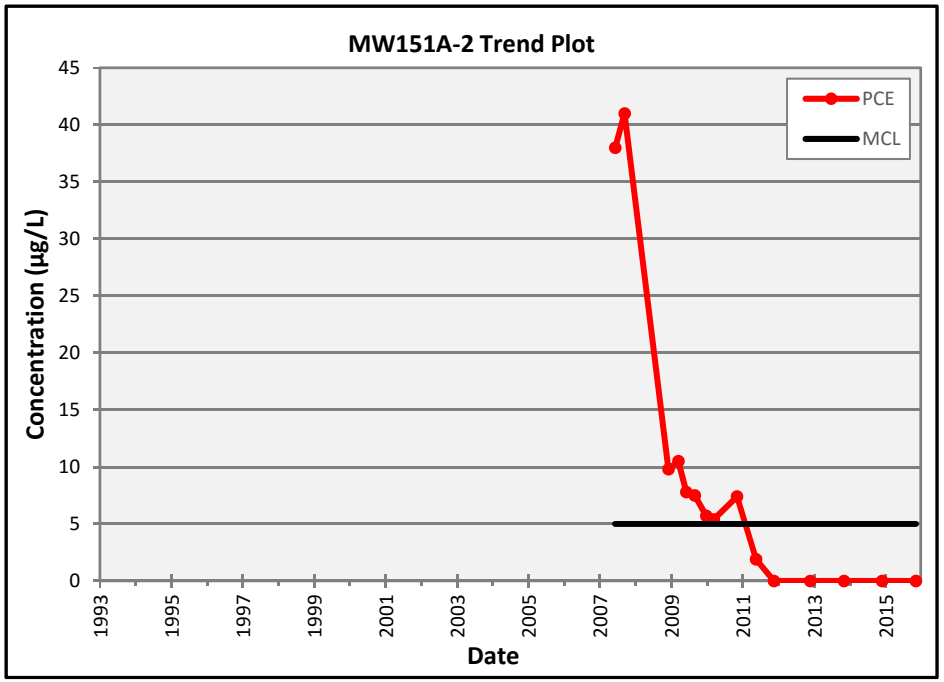


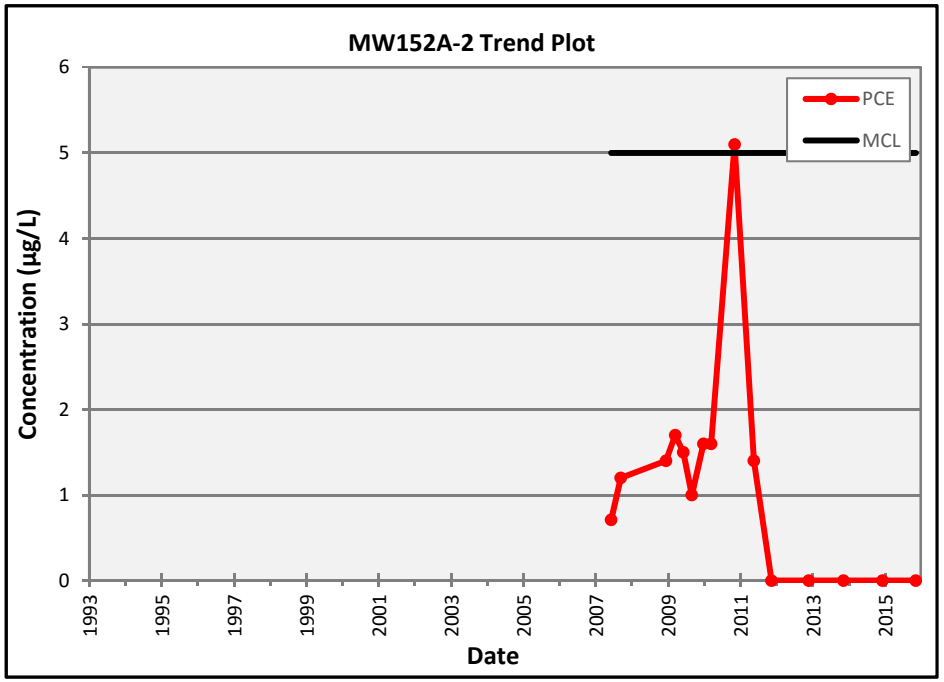


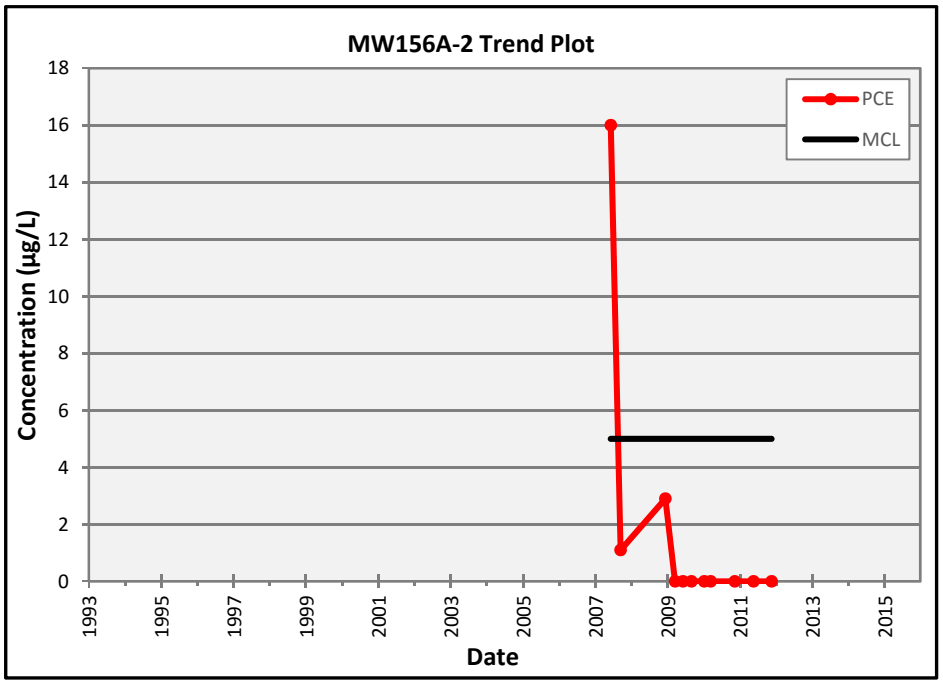


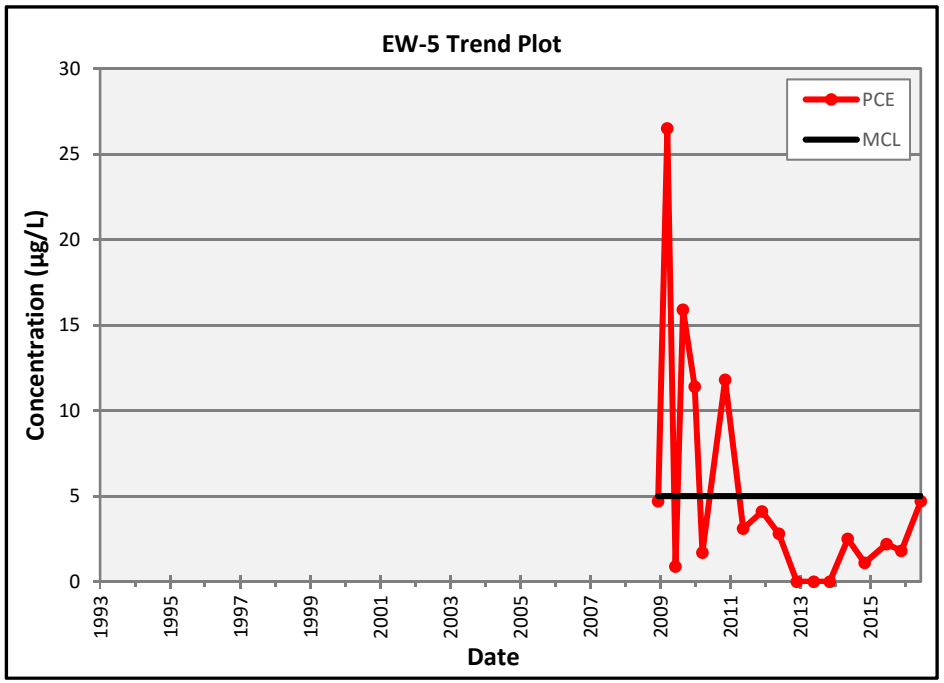


PCE Concentrations in Selected Buildings 22 and 36 Monitoring Wells





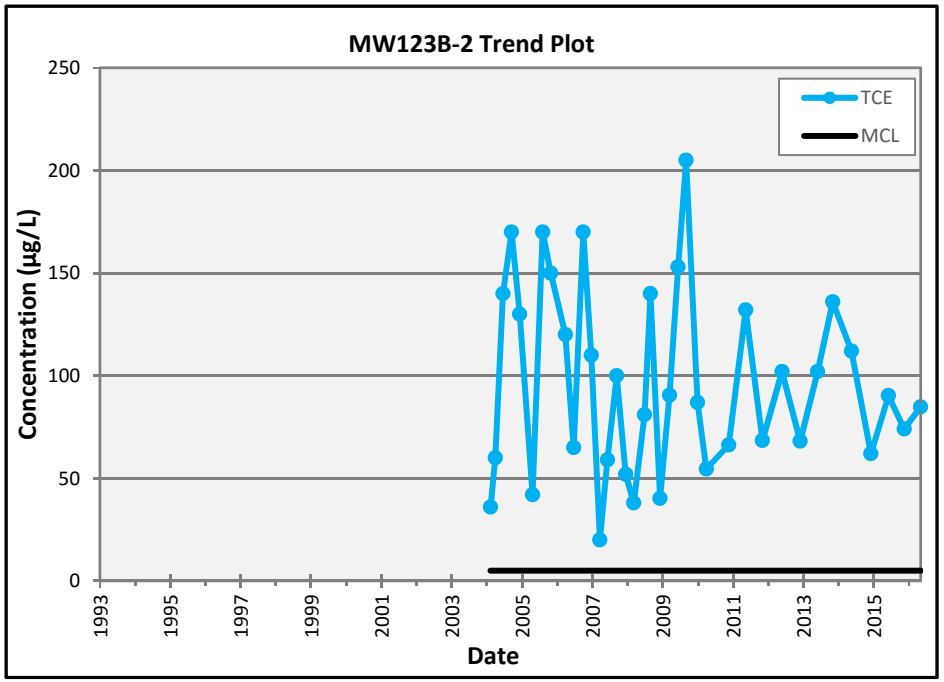


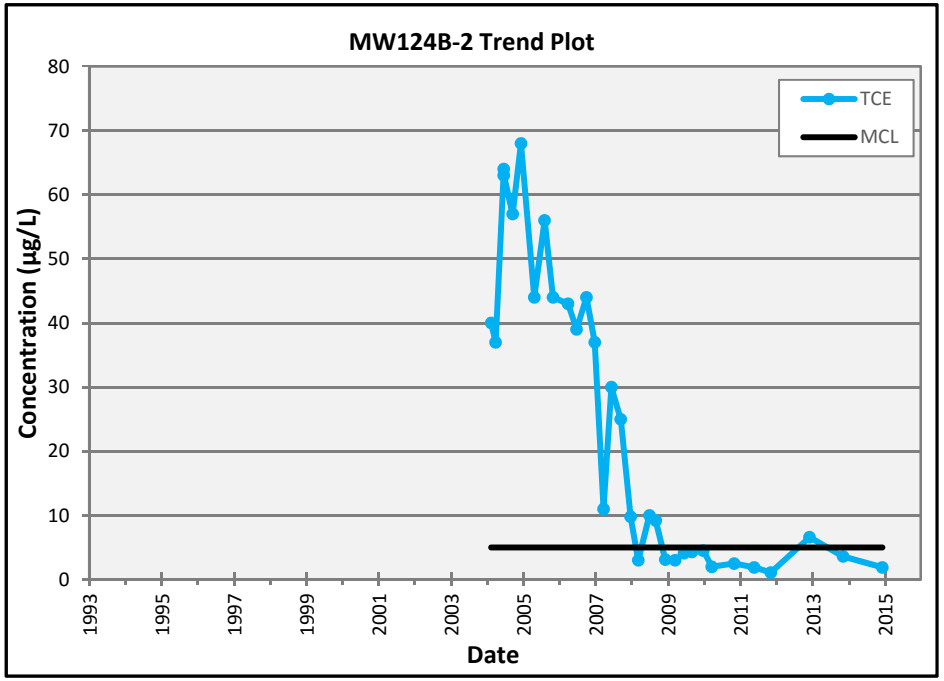


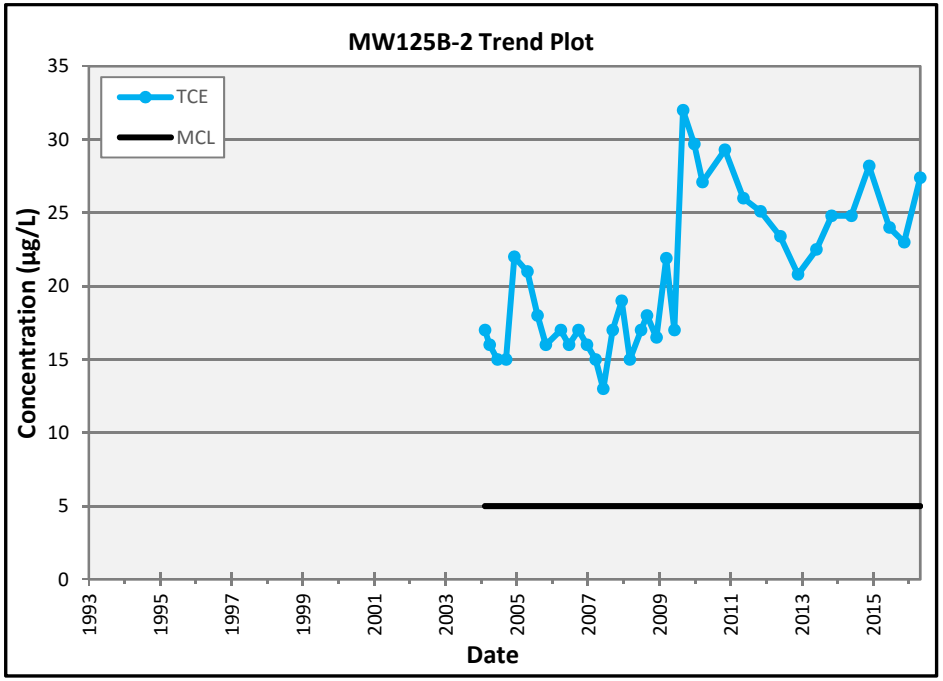
BUILDINGS 63, 2, AND 45 AREA

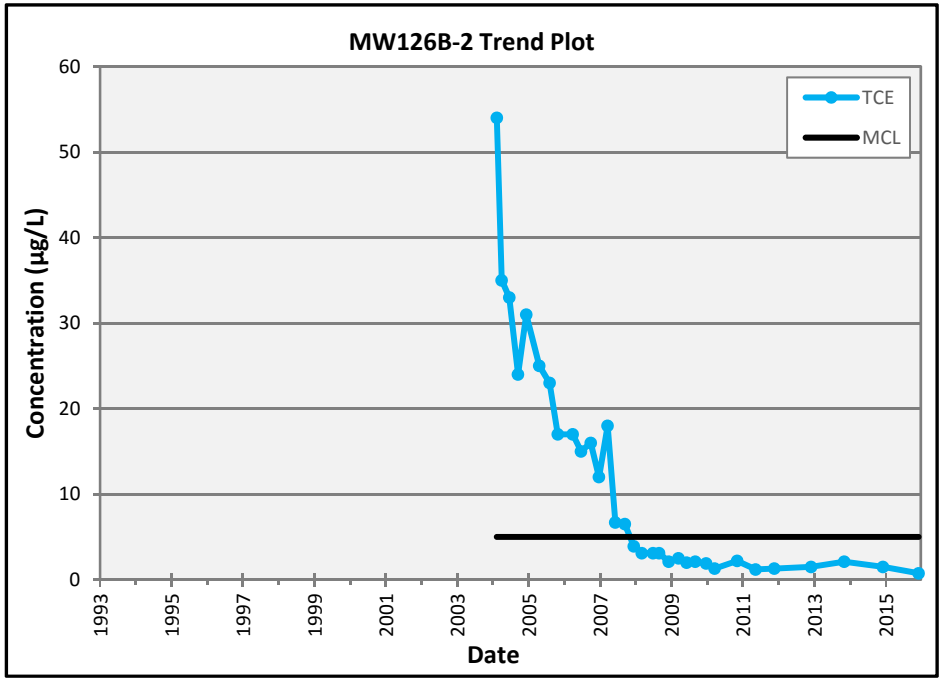
TCE TIME SERIES PLOTS

TCE Concentrations in Selected Buildings 63, 2, and 45 Monitoring Wells

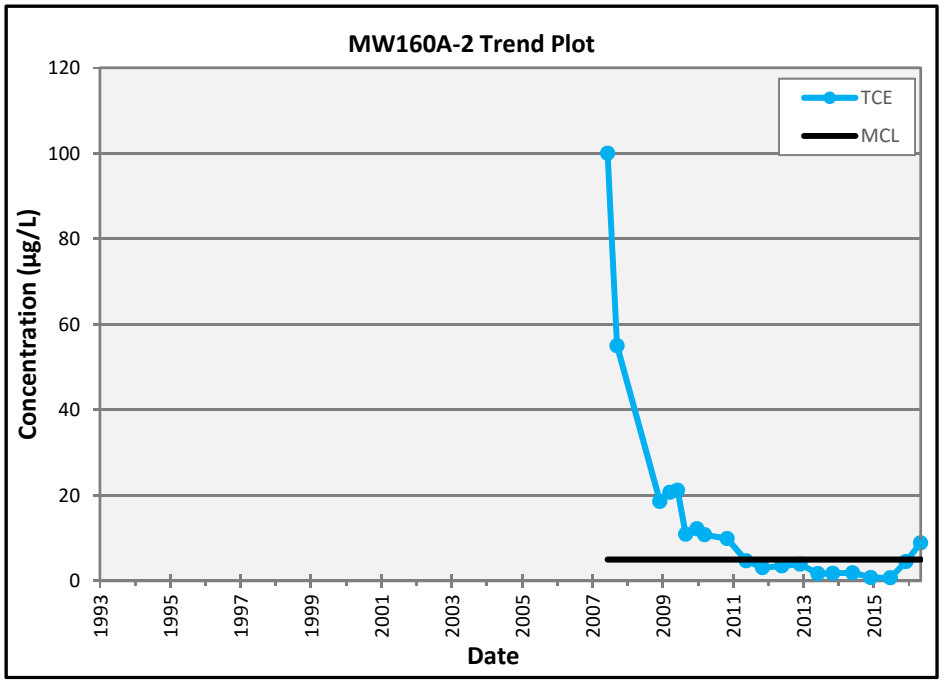


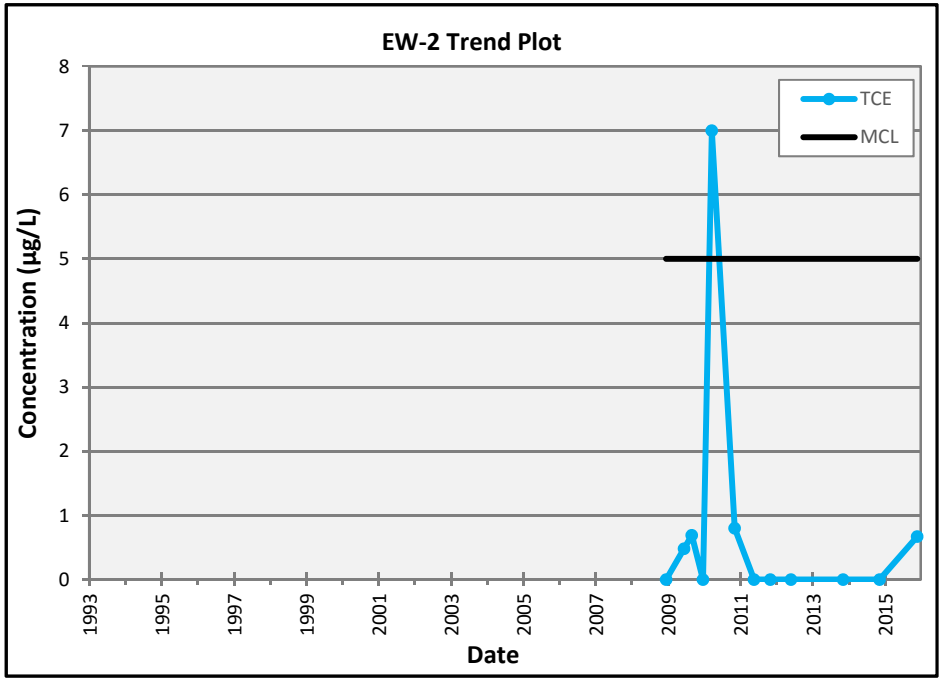


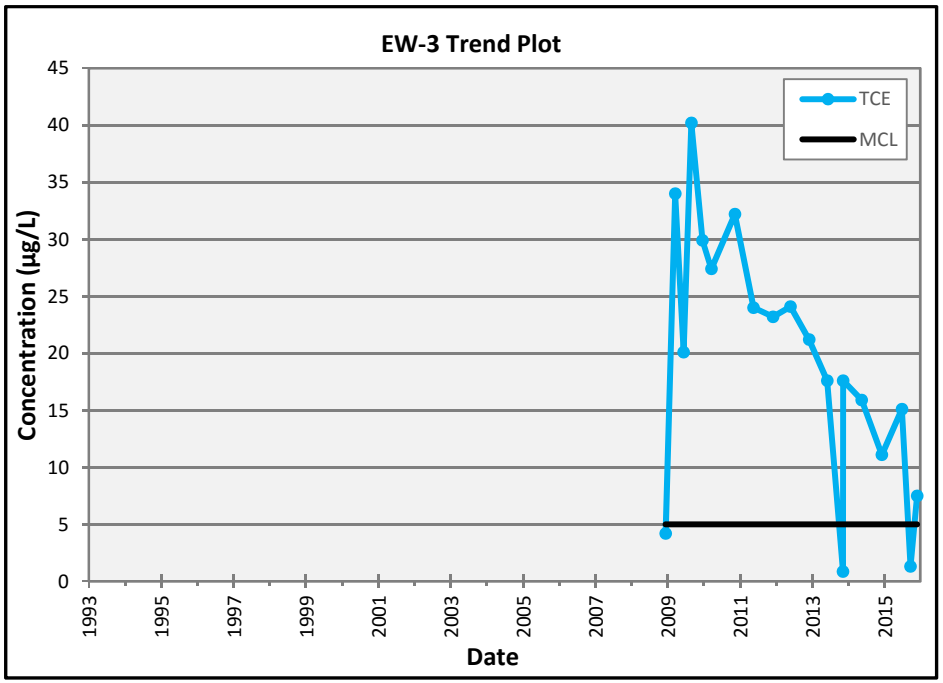


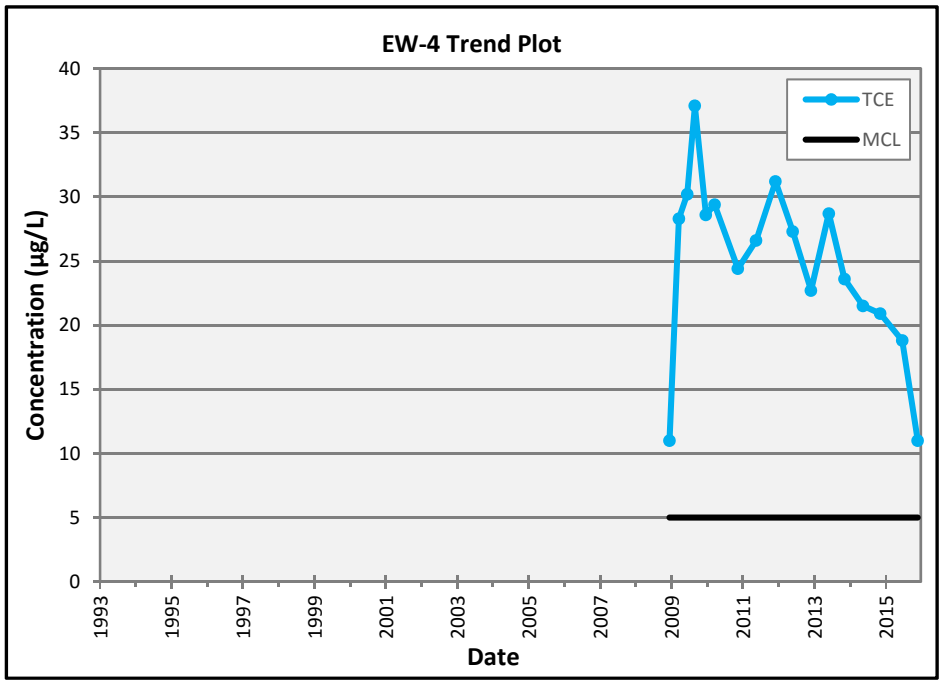


TCE Concentrations in Selected Buildings 63, 2, and 45 Monitoring Wells

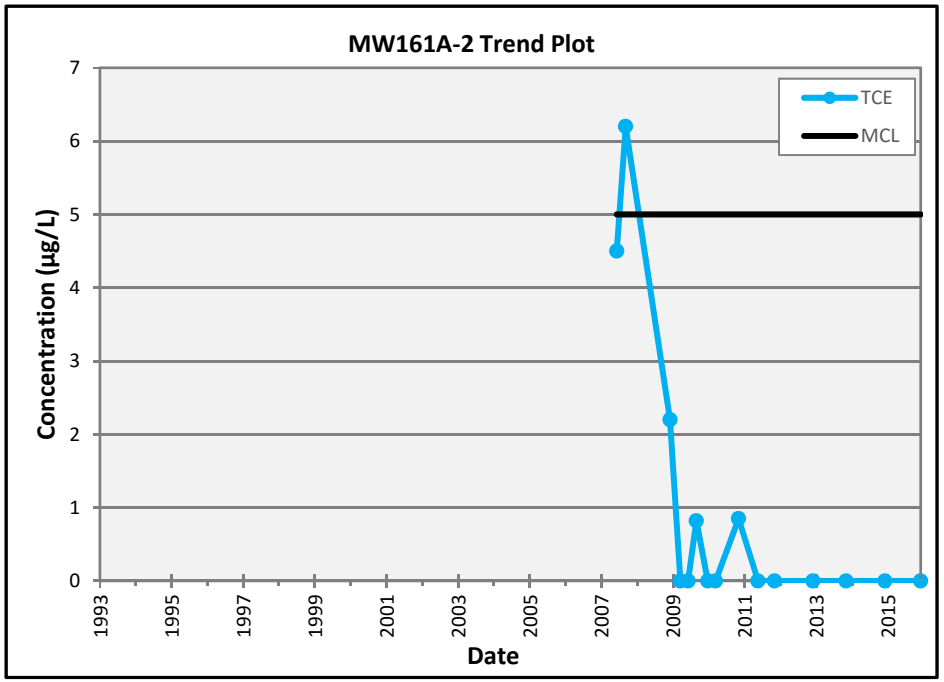


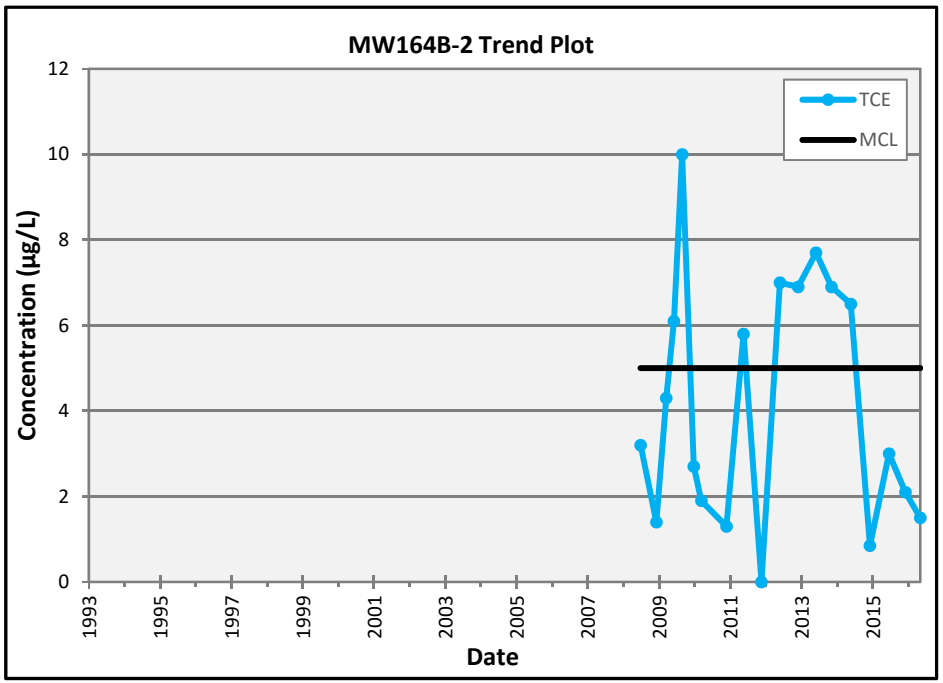


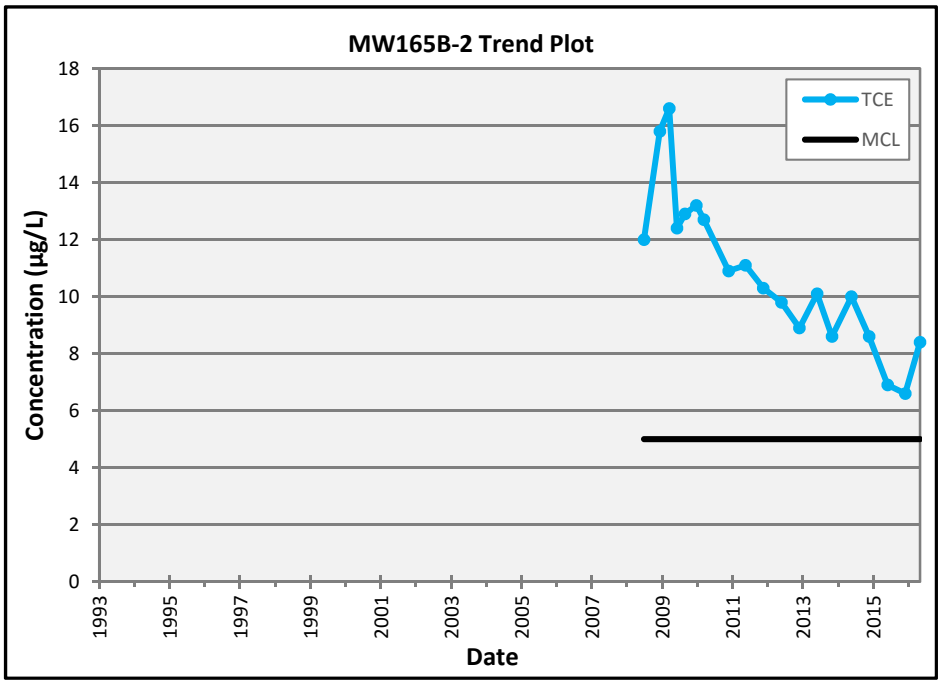




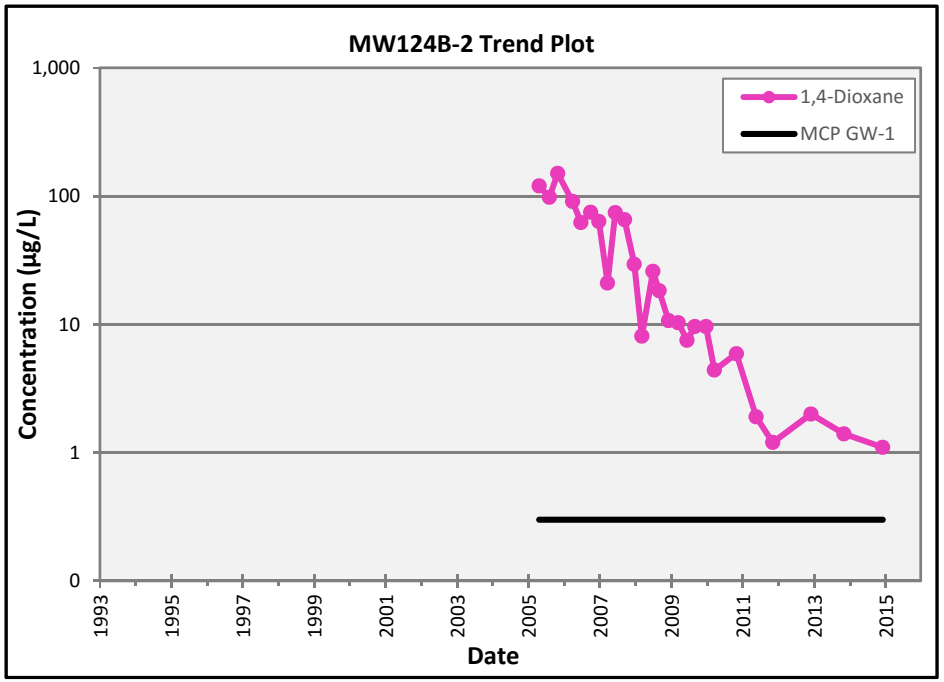
TCE Concentrations in Selected Buildings 63, 2, and 45 Monitoring Wells

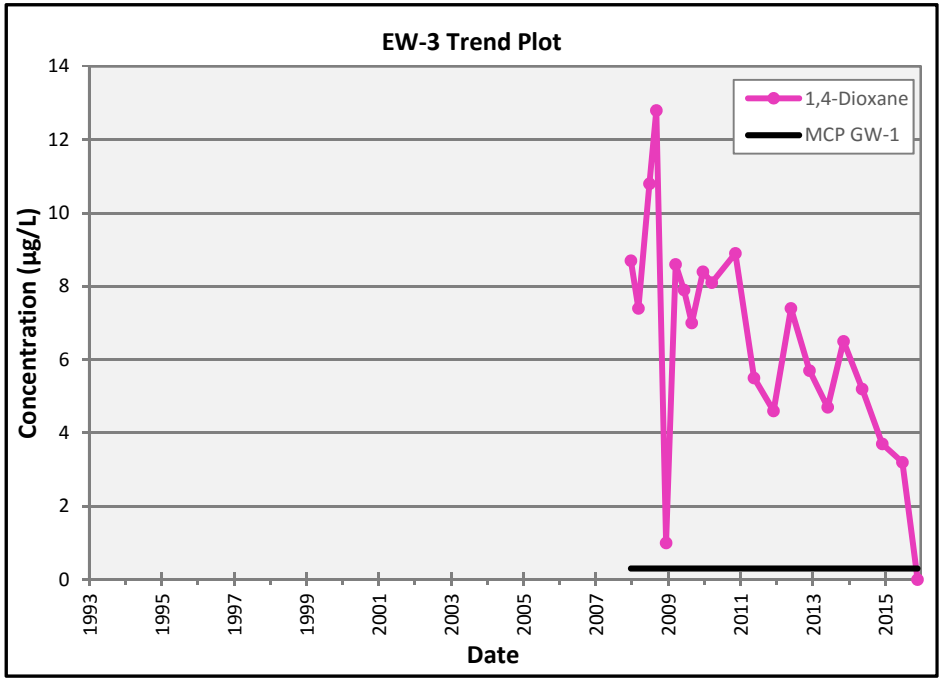


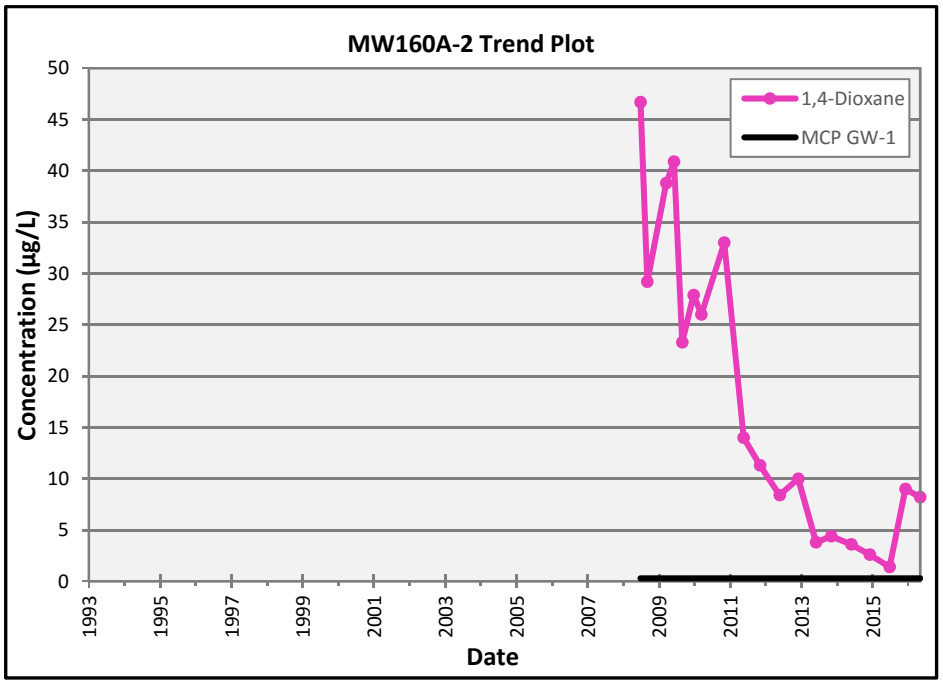




1,4-Dioxane Concentrations in Selected Buildings 63, 2, and 45 Monitoring Wells



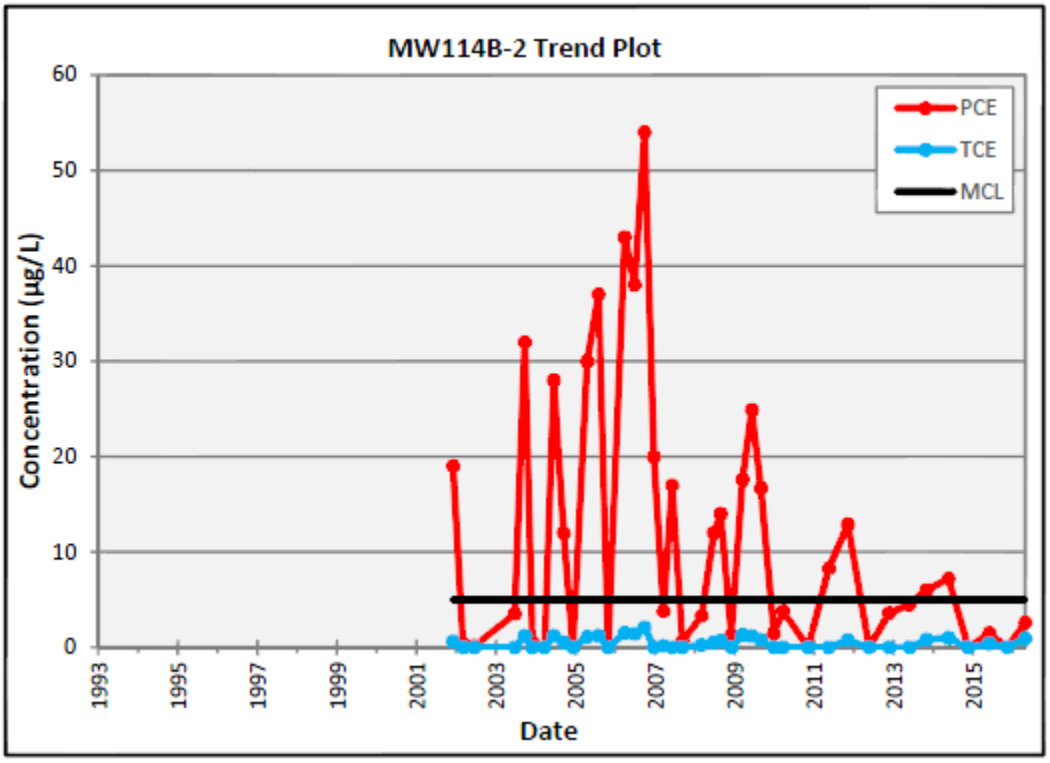




MW114B-2 AREA

PCE AND TCE TIME SERIES PLOTS

MW-114B-2 Area



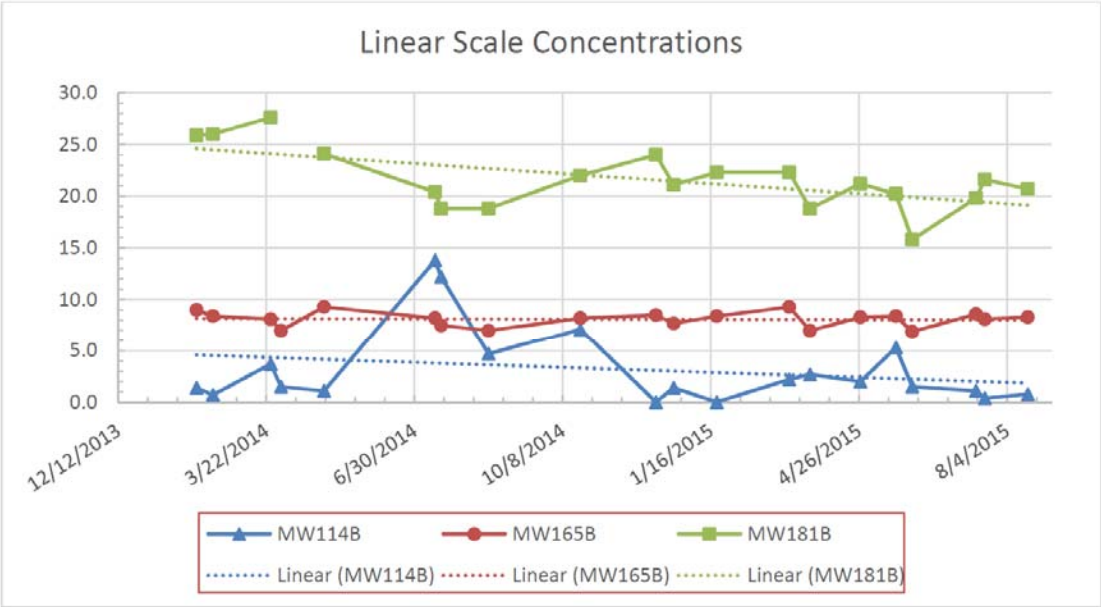


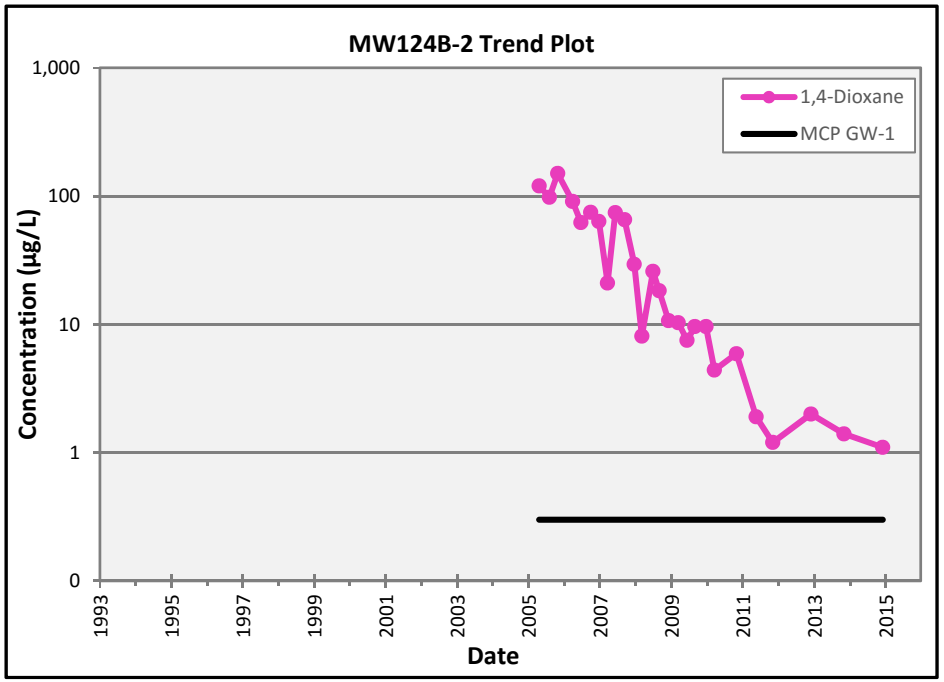
Figure 3 – Slug Removal Trends

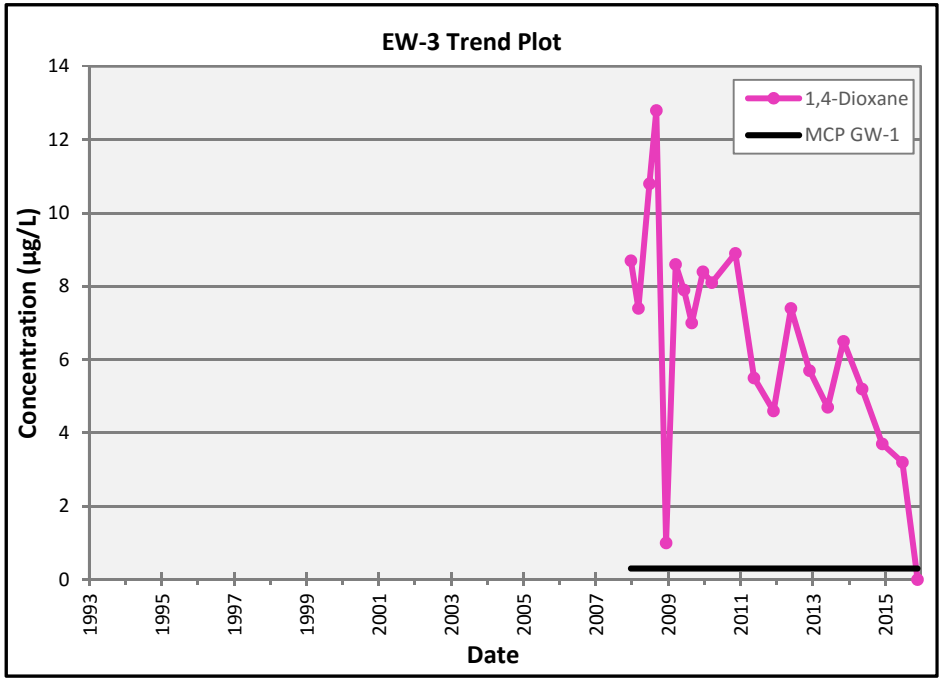
MW-114B-2 Slug Volume Removal Concentrations

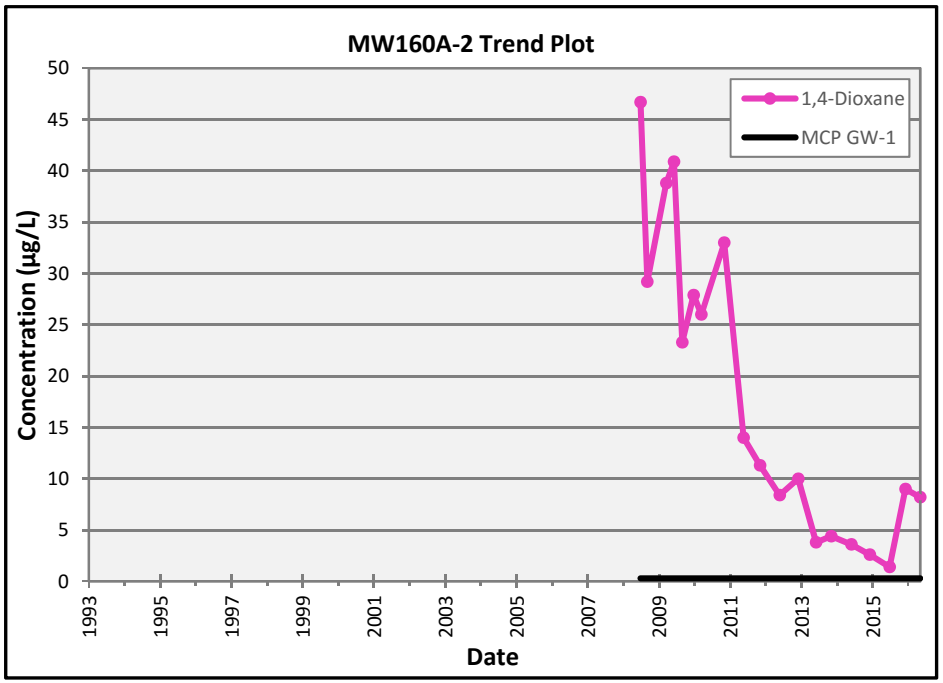
BUILDINGS 63, 2 AND 45 AREA

1,4-DIOXANE TIME SERIES PLOTS

1,4-Dioxane Concentrations in Selected Buildings 63, 2, and 45 Monitoring Wells







APPENDIX G

MANN-KENDALL/
THIEL SEN SLOPE TREND PLOTS FOR
PCE, TCE AND 1,4-DIOXANE

FYR PERIOD

Overview of Statistical Evaluation

Concentration trends in wells that still exceed MCLs or where the data have not consistently remained below MCLs were further assessed using EPA's ProUCL Version 5.0 statistical software (EPA, 2013).

Two statistical tests were used in this five year review: 1) the Mann-Kendall test, which helps determine the presence and direction of a trend (i.e., decreasing, increasing, stable or unknown), and; 2) the Theil-Sen test, which supplements the Mann-Kendall test by generating a nonparametric trend line and provides the slope of the trend line that can be used to extrapolate future values. Both tests are recommended, since together they may outperform analogous parametric tests (such as ordinary least squares). Nonparametric tests do not require fitting to or assuming a presumed distribution of data. The Theil-Sen test is resistant to the effect of outliers, thus extreme values are incorporated as meaningful data as long as there is no reported sampling, laboratory, or other errors.

Table G-1: Summary of Data Trend Results for the FYR Period (January 2012-Spring 2016)		
Decreasing Trend	**No Trend**	**Increasing Trend**
TETRACHLOROETHENE (PCE)		
MW-18B-HP2 (T-25) MW-90B-4 (T-25) MW112B-2 (22&36) MW113A-2 (22&36) EW-6 (22&36) EW-7 (22&36) EW-8 (22&36)	MW208B-HP2 (T-25) MW-83B-2 (T-25) MW114B-2 (114-2) MW-96B-4 (T-25) MW105A-1 (22&36) MW-111B-2 (22&36) MW151A-2 (22&36)* MW152A-2 (22&36)* EW-5 (22&36) MW-37B-HP2 (T-25)	
TRICHLOROETHENE (TCE)		
MW208B-HP2 (T-25) MW-37B-HP2 (T-25) EW-3 (63,2,&45) EW-4 (63,2,&45) MW164B-2 (ARIEM) MW165B-2 (ARIEM) MW124B-2 (63,2,&45)	MW-90B-4 (T-25) MW123B-2 (63,2,&45) MW125B-2 (63,2,&45) MW114B-2 (114-2) MW-18B-HP2 (T-25) MW-83B-2 (T-25)	MW-96B-4 (T-25)
1,4 - DIOXANE		
MW124B-2 (63,2,&45) EW-3 (63,2,&45)	MW160A-2	

* MW151A-2 and MW152A-2 had all PCE nondetects from 2012 to 2015

Table G-2: Summary of P-Value Results for the FYR Period (January 2012-Spring 2016)

PCE		
Well Name	**Area**	**Approximate p-value**
MW-18B-HP2	T-25	<0.01
MW208B-HP2	T-25	0.171
MW-37B-HP2	T-25	0.0634
MW-83B-2	T-25	0.5
MW-90B-4	T-25	<0.01
MW-96B-4	T-25	0.458
MW105A-1	22 & 36	0.367
MW-111B-2	22 & 36	0.0467
MW112B-2	22 & 36	0.0447
MW113A-2	22 & 36	<0.01
MW151A-2	22 & 36	N/A
MW152A-2	22 & 36	N/A
MW156A-2	22 & 36	N/A
EW-5	22 & 36	0.5
EW-6	22 & 36	<0.01
EW-7	22 & 36	<0.01
EW-8	22 & 36	<0.01
MW114B-2	114B-2	0.458

TCE		
Well Name	**Area**	**Approximate p-value**
MW-18B-HP2	T-25	0.0296
MW208B-HP2	T-25	0.0238
MW-37B-HP2	T-25	0.0159
MW-83B-2	T-25	0.0382
MW-90B-4	T-25	0.138
MW-96B-4	T-25	0.0226
MW123B-2	63, 2, & 45	0.265
MW124B-2	63, 2, & 45	0.148
MW125B-2	63, 2, & 45	0.104
EW-3	63, 2, & 45	<0.01
EW-4	63, 2, & 45	<0.01
MW164B-2	ARIEM	<0.01
MW165B-2	ARIEM	0.018
MW114B-2	114B-2	0.171

1,4 - Dioxane		
Well Name	**Area**	**Approximate p-value**
MW124B-2	63, 2, & 45	0.148
MW160A-2	63, 2, & 45	0.174
EW-3	63, 2, & 45	<0.01

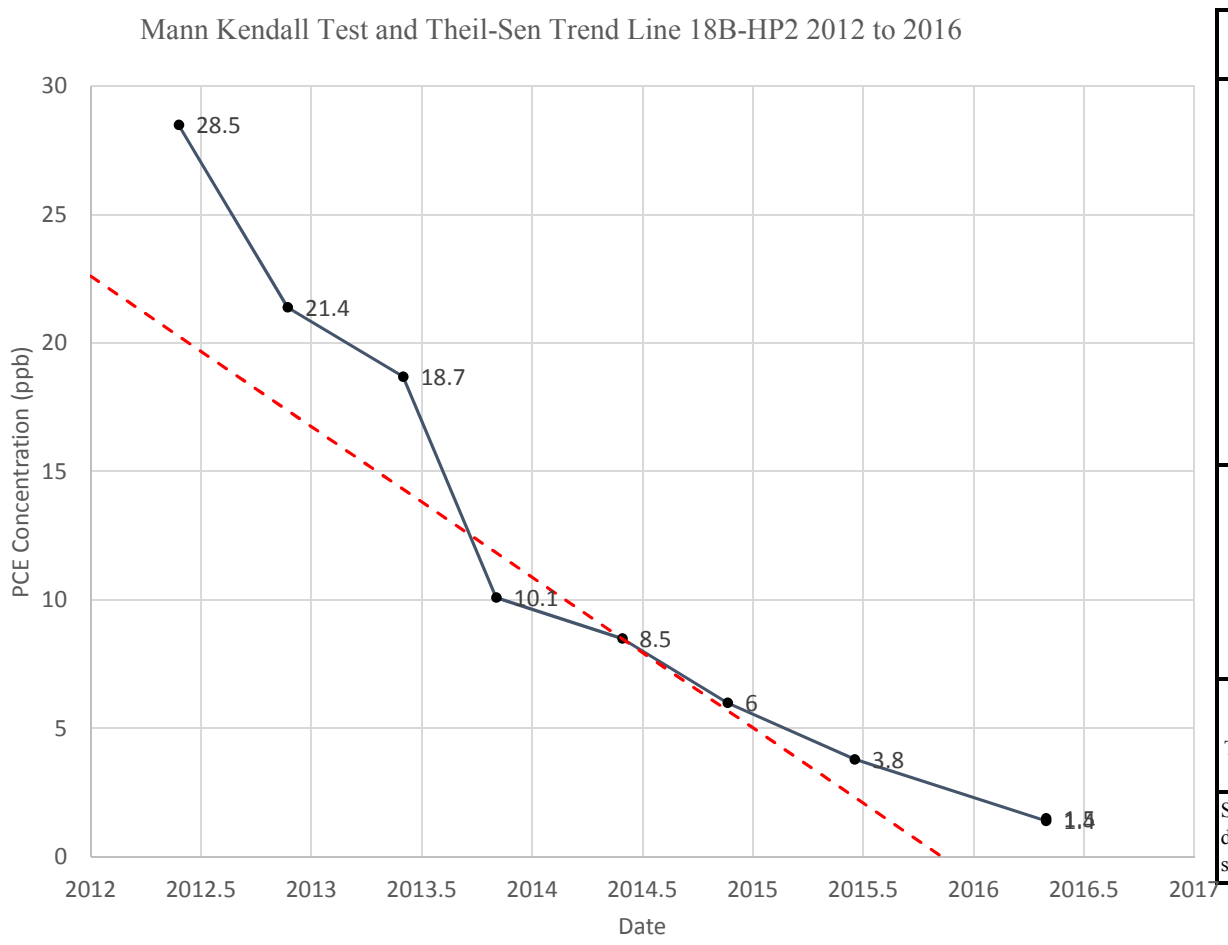
APPENDIX G – MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR PCE 2012-2016 TIME-FRAME

		General Statistics										Mann - Kendall					Theil-Sen Trend Line				
Well Name	Area	Number of Events	Number of Values Reported (n)	Number of Replicates	Number of Nondetects	Minimum - µg/L	Maximum - µg/L	Mean - µg/L	Geometric Mean - µg/L	Median - µg/L	Standard Deviation	Test Value (S)	Tabulated p value	Standard Deviation of S	Standardized Value of S	Approximate p-value	Theil-Sen Slope	Theil-Sen Intercept	Calculate Date to 5ppb	Last Sampling Event Result - µg/L	
18B-HP2	T-25				0											2.9033E-4	-5.8624	11817.762	2015.0	1.4	Statistically significant evidence of a decreasingtrend at the specified level of significance.
208B-HP2	T-25	9	9	1	3	1.4	28.5	11.1	7.118	8.5	9.617	34	0	9.592	3.44	0.171	0.1345	-270.2128	-	1.1	Insufficient evidence to identify a significant trend at the specified level of significance.
37B-HP2	T-25	9	9	0	2	0.25	1.1	0.703	0.618	0.72	0.332	10	0.179	9.487	0.949	0.0634	0.1909	-383.7661	-	1.8	Insufficient evidence to identify a significant trend at the specified level of significance.
83B-2	T-25	10	10	1	3	0.47	1.8	0.95	0.851	0.83	0.483	18	0.034	11.14	1.527		-0.0049	10.3704	-	0.96J	Insufficient evidence to identify a significant trend at the specified level of significance.
90B-4	T-25	9	9	0	0	0.25	1.1	0.667	0.596	0.5	0.315	1	0.54	9.539	0	0.5	-0.3727	752.34	2005.2	1.4	Statistically significant evidence of a decreasingtrend at the specified level of significance.
96B-4	T-25	11	11	0	3	0.8	4.3	1.765	1.568	1.4	1.004	35	0.003	12.77	2.663	0.00387	0.0284	-52.0384	-	0.7	Insufficient evidence to identify a significant trend at the specified level of significance.
105A-1	22 & 36	9	9	0	0	0.25	13.2	5.198	2.3	5.2	5.252	2	0.46	9.487	0.105	0.458	0.6285	-1263.316	-	5.7	Insufficient evidence to identify a significant trend at the specified level of significance.
111B-2	22 & 36	4	4	0	0	0.49	5.7	2.898	2.123	2.7	2.141	2	0.375	2.944	0.34	0.367	-1.8047	3639.9068	-	4.1	Insufficient evidence to identify a significant trend at the specified level of significance.
112B-2	22 & 36	9	9	0	0	1.7	31.6	9.244	6.224	4.5	9.826	17	0.06	9.539	1.677	0.0467	-1.4203	2866.9053	2015.0	3.5J	Statistically significant evidence of a decreasingtrend at the specified level of significance.
113A-2	22 & 36	4	4	0	0	3.5	7.9	5.8	5.566	5.9	1.817	6	0.042	2.944	1.698	0.0447	-3.5022	7065.0205	2015.9	3.2J	Statistically significant evidence of a decreasingtrend at the specified level of significance.
151A-2	22 & 36	7	7	0	4	3.2	15.4	9.029	7.953	8.6	4.602	19	0.001	6.658	2.703	0.00343	-3.5022	7065.0205	2015.9	3.2J	Statistically significant evidence of a decreasingtrend at the specified level of significance.
152A-2	22 & 36	4	4	0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	All nondetects for FYR period.
156A-2	22 & 36	4	4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No measurements taken after 2011.
EW-5	22 & 36				3											0.5	0.1548	-310.3344	-	2.2	Insufficient evidence to identify a significant trend at the specified level of significance.
EW-6	22 & 36	8	8	0	0	0.25	2.8	1.425	0.994	1.45	1.036	1	0.548	8.021	0	9.9089E-4	-3.9666	8001.802	2016.0	1.6	Statistically significant evidence of a decreasingtrend at the specified level of significance.
EW-7	22 & 36	8	8	0	0	1.6	21.5	12.64	10.54	12.55	5.75	26	0	8.083	3.093		-12.3222	24888.836	2019.4	37.0	Statistically significant evidence of a decreasingtrend at the specified level of significance.
EW-8	22 & 36	8	8	0	0	37	99.6	71.63	69.2	70.55	18.47	20	0.007	8.083	2.351	0.00937	-7.9367	16017.9	2017.6	21.0	Statistically significant evidence of a decreasingtrend at the specified level of significance.
114B-2	114B-2	8	8	0	3	21	32.1	34.95	33.31	32.3	10.83	24	0.001	8.083	2.846	0.00222	0.2737	-548.7388	-	2.6	Insufficient evidence to identify a significant trend at the specified level of significance.
		9	9	0		0.25	7.2	3.183	2.117	2.6	2.383	2	0.46	9.592	0.104	0.458					

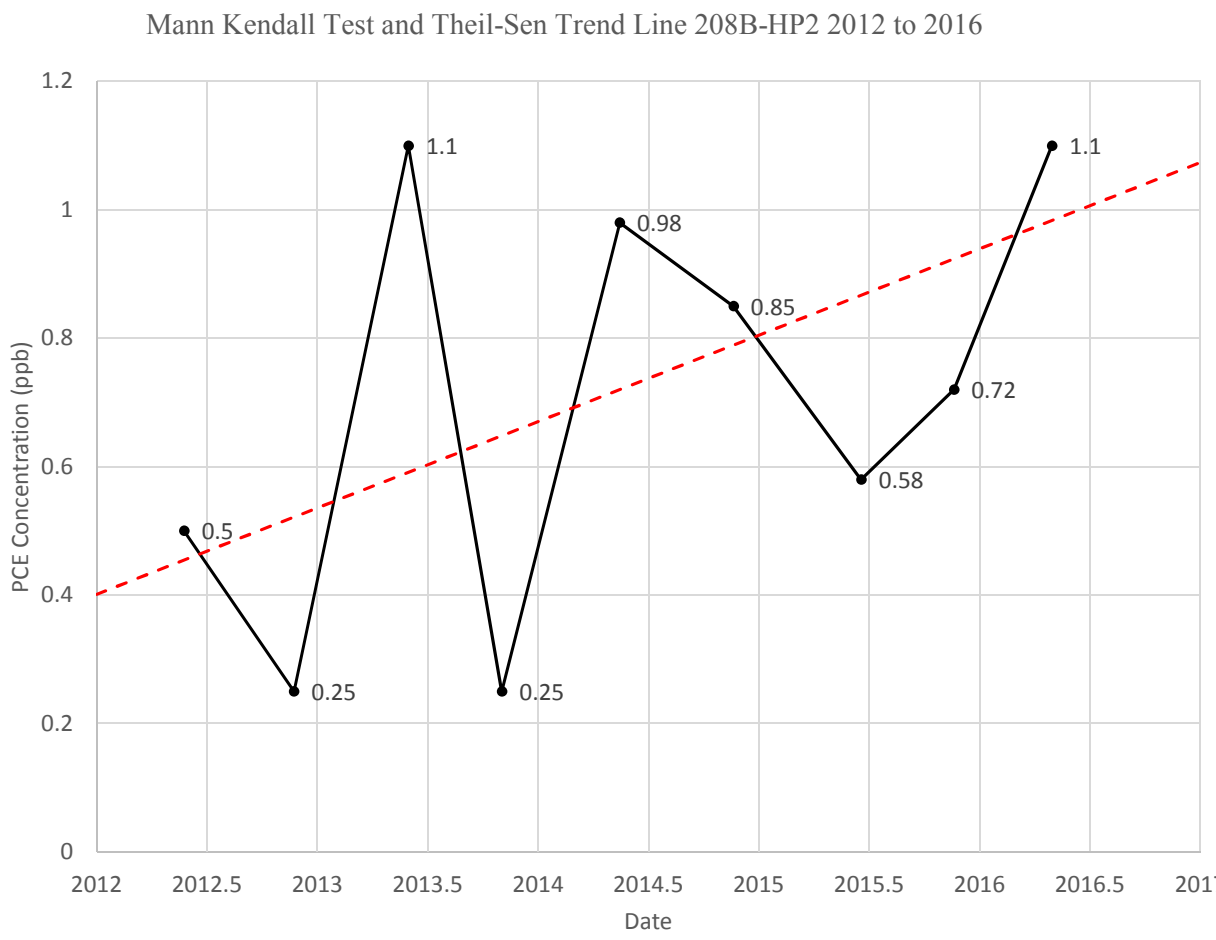
T-25 AREA

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR PCE

2012-2016 TIME-FRAME

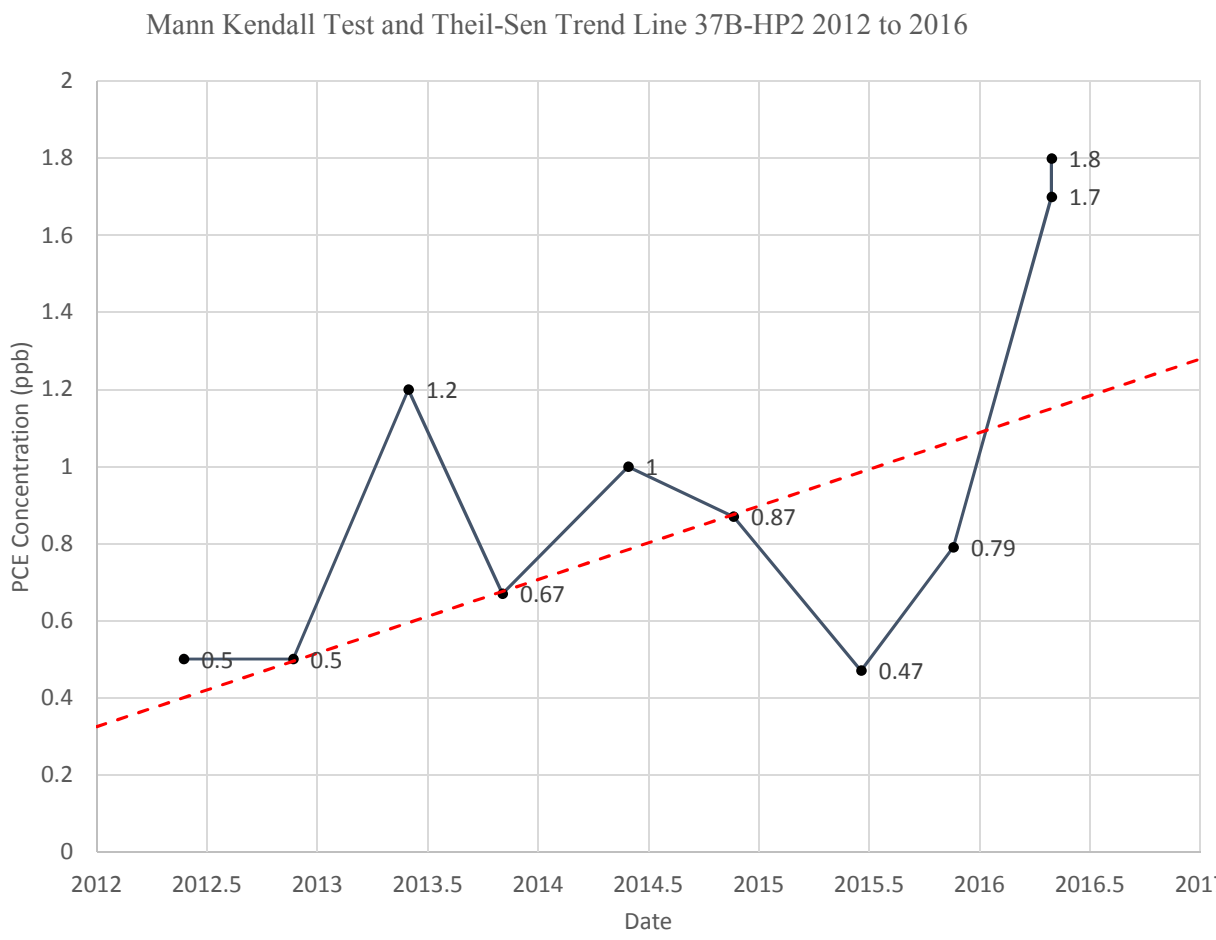


	Well Name	18B-HP2
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	1 0
	Minimum	1.4
	Maximum	28.5
	Mean	11.1
	Geometric Mean	7.118
	Median	8.5
	Standard Deviation	9.617
Mann - Kendall	Test Value (S)	-34
	Tabulated p-value	
	Standard Deviation of S	0 9.592
	Standardized Value of S	-3.44
	Approximate p-value	2.9033E-4
Theil-Sen Trend Line	Theil-Sen Slope	-5.8624
	Theil-Sen Intercept	11817.7615
	Calculate Date to 5ppb	2015.00435
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



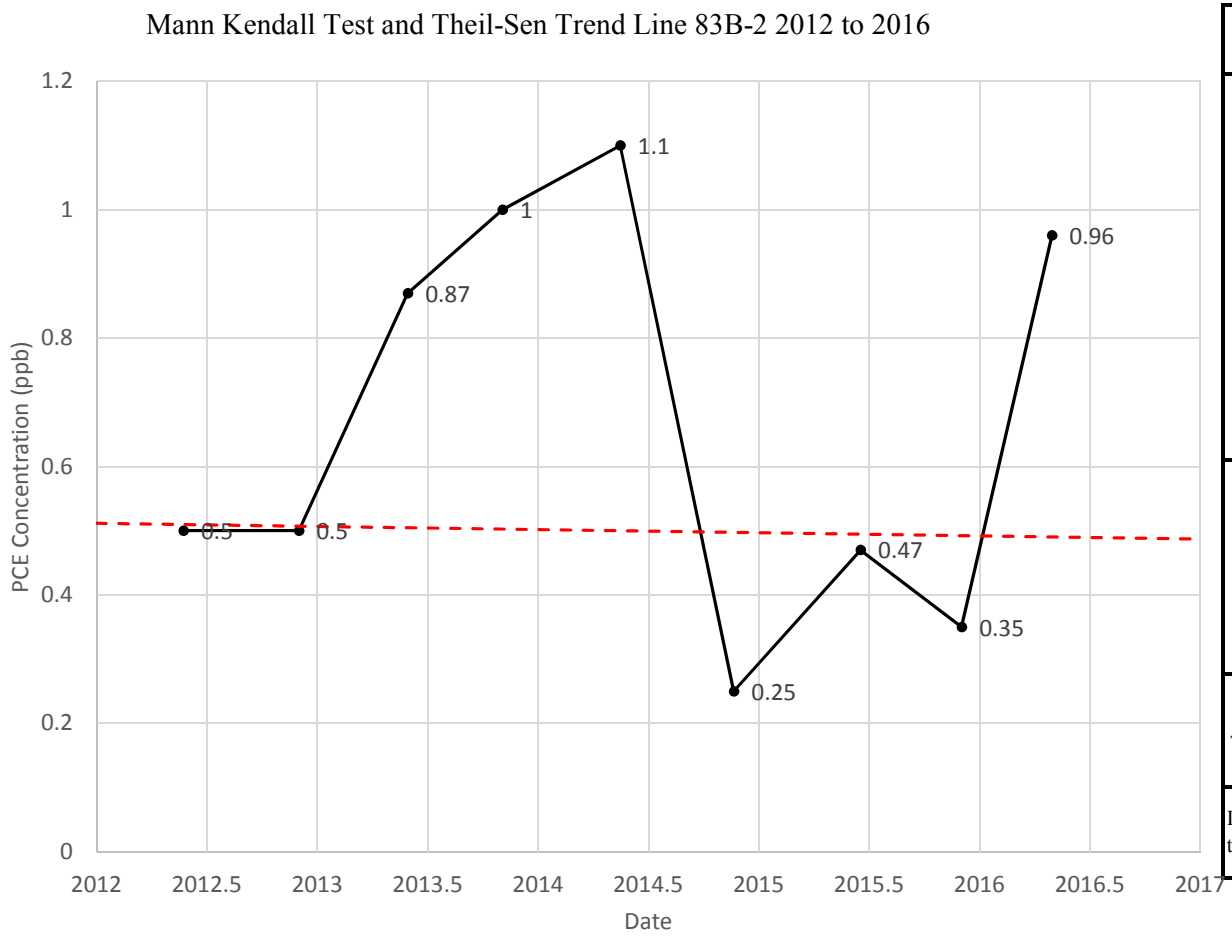
	Well Name	208B-HP2
	Area	T-25
General Statistics	Number of Events	9
	Number of Values Reported (n)	9
	Number of Replicates	0
	Number of Nondetects	3
	Minimum	0.25
	Maximum	1.1
	Mean	0.703
	Geometric Mean	0.618
	Median	0.72
	Standard Deviation	0.332
Mann - Kendall	Test Value (S)	10
	Tabulated p-value	0.179
	Standard Deviation of S	9.487
	Standardized Value of S	0.949
	Approximate p-value	0.171
Theil-Sen Trend Line	Theil-Sen Slope	0.1345
	Theil-Sen Intercept	-270.2128
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.



	Well Name	37B-HP2
	Area	T-25
General Statistics	Number of Events	10
	Number of Values Reported (n)	10
	Number of Replicates	1
	Number of Nondetects	2
	Minimum	0.47
	Maximum	1.8
	Mean	0.95
	Geometric Mean	0.851
	Median	0.83
	Standard Deviation	0.483
Mann - Kendall	Test Value (S)	18
	Tabulated p-value	0.054
	Standard Deviation of S	11.14
	Standardized Value of S	1.527
	Approximate p-value	0.0634
Theil-Sen Trend Line	Theil-Sen Slope	0.1909
	Theil-Sen Intercept	-383.7661
	Calculate Date to 5ppb	-

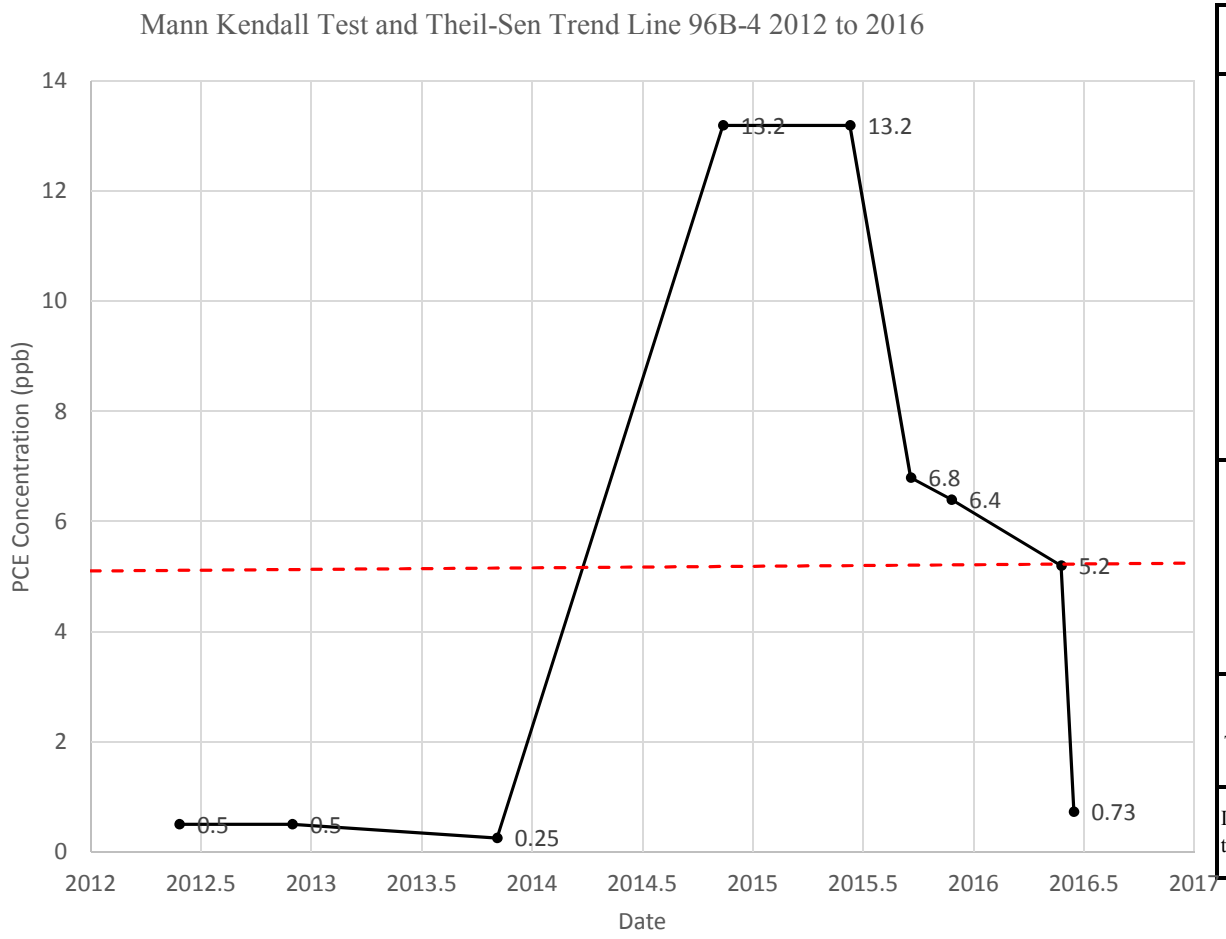
Insufficient evidence to identify a significant trend at the specified level of significance.



	Well Name	83B-2
	Area	T-25
General Statistics	Number of Events	9
	Number of Values Reported (n)	9
	Number of Replicates	0
	Number of Nondetects	3
	Minimum	0.25
	Maximum	1.1
	Mean	0.667
	Geometric Mean	0.596
	Median	0.5
	Standard Deviation	0.315
Mann - Kendall	Test Value (S)	-1
	Tabulated p-value	0.54
	Standard Deviation of S	9.539
	Standardized Value of S	0
	Approximate p-value	0.5
Theil-Sen Trend Line	Theil-Sen Slope	-0.0049
	Theil-Sen Intercept	10.3704
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.

	Well Name	90B-4
	Area	T-25
General Statistics	Number of Events	11
	Number of Values Reported (n)	11
	Number of Replicates	
	Number of Nondetects	0 0
	Minimum	0.8
	Maximum	4.3
	Mean	1.765
	Geometric Mean	1.568
	Median	1.4
	Standard Deviation	1.004
Mann - Kendall	Test Value (S)	-35
	Tabulated p-value	0.003
	Standard Deviation of S	12.77
	Standardized Value of S	-2.663
	Approximate p-value	0.00387
Theil-Sen Trend Line	Theil-Sen Slope	-0.3727
	Theil-Sen Intercept	752.34
	Calculate Date to 5ppb	2005.20526
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



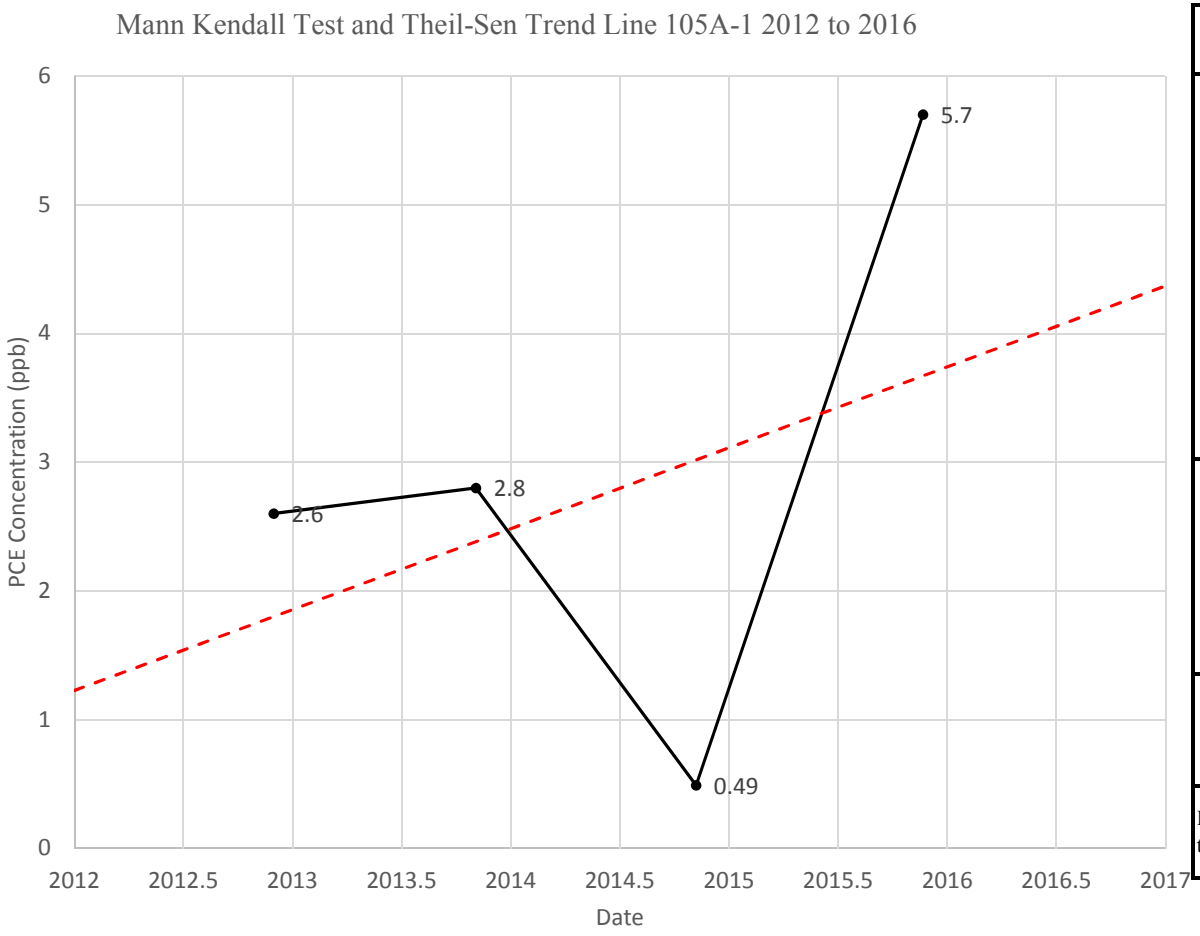
	Well Name	96B-4
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 3
	Minimum	0.25
	Maximum	13.2
	Mean	5.198
	Geometric Mean	2.3
	Median	5.2
	Standard Deviation	5.252
Mann - Kendall	Test Value (S)	
	Tabulated p-value	2 0.46
	Standard Deviation of S	9.487
	Standardized Value of S	0.105
	Approximate p-value	0.458
Theil-Sen Trend Line	Theil-Sen Slope	0.0284
	Theil-Sen Intercept	-52.0384
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.

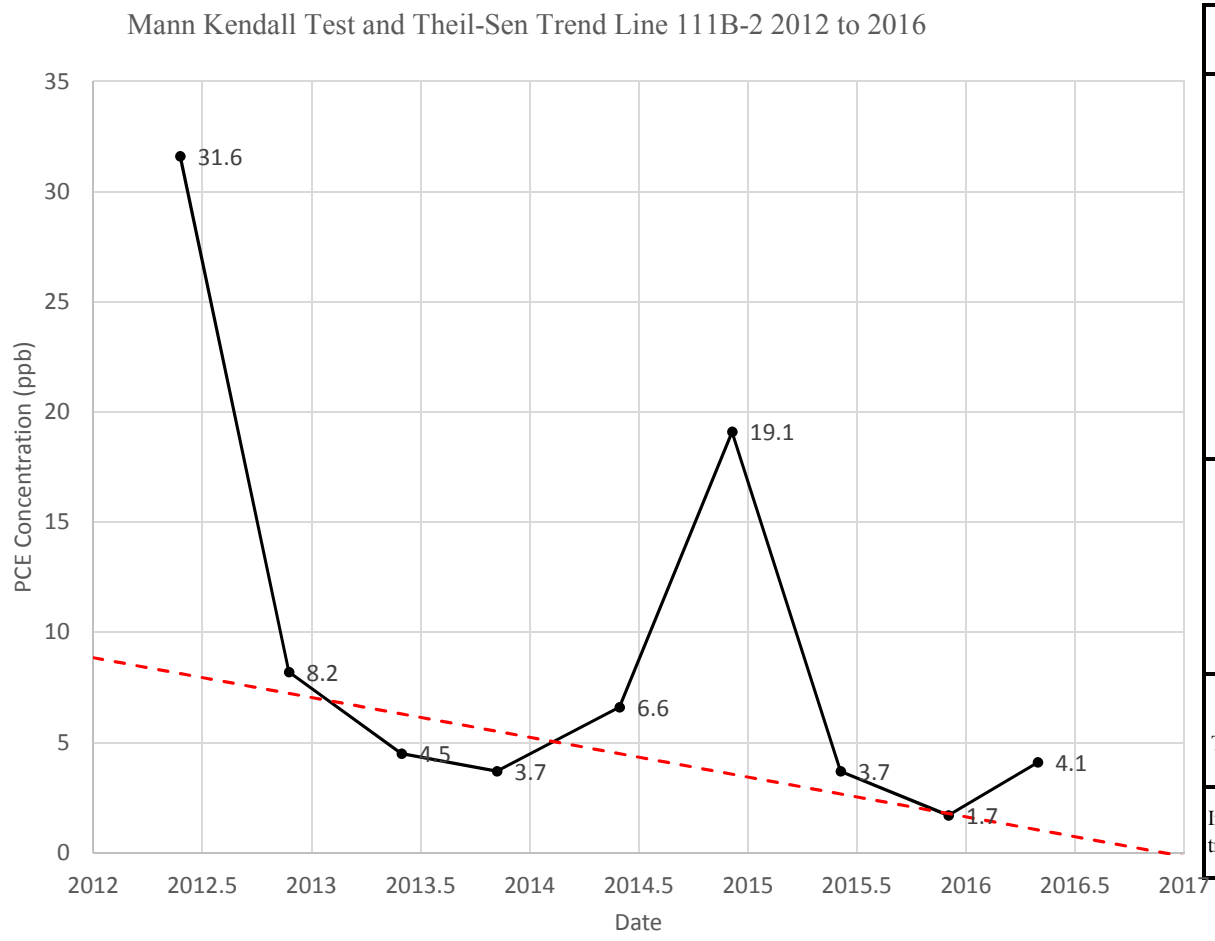
AREA 22 & 36

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR PCE

2012-2016 TIME-FRAME

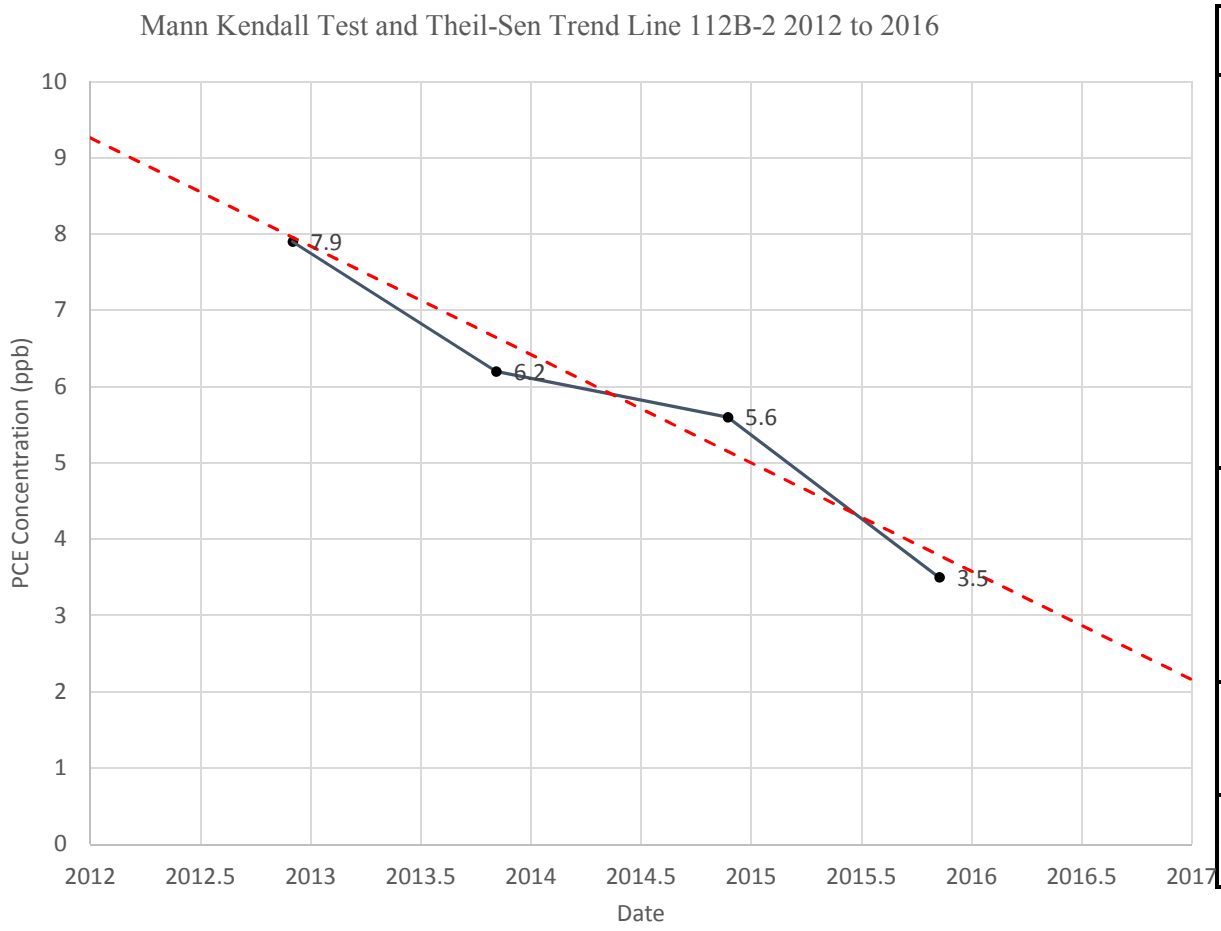


	Well Name	105A-1
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	4
	Number of Replicates	4
	Number of Nondetects	0 0
	Minimum	0.49
	Maximum	5.7
	Mean	2.898
	Geometric Mean	2.123
	Median	2.7
	Standard Deviation	2.141
Mann - Kendall	Test Value (S)	
	Tabulated p-value	2 0.375
	Standard Deviation of S	2.944
	Standardized Value of S	0.34
	Approximate p-value	0.367
Theil-Sen Trend Line	Theil-Sen Slope	0.6285
	Theil-Sen Intercept	-1263.3156
	Calculate Date to 5ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		

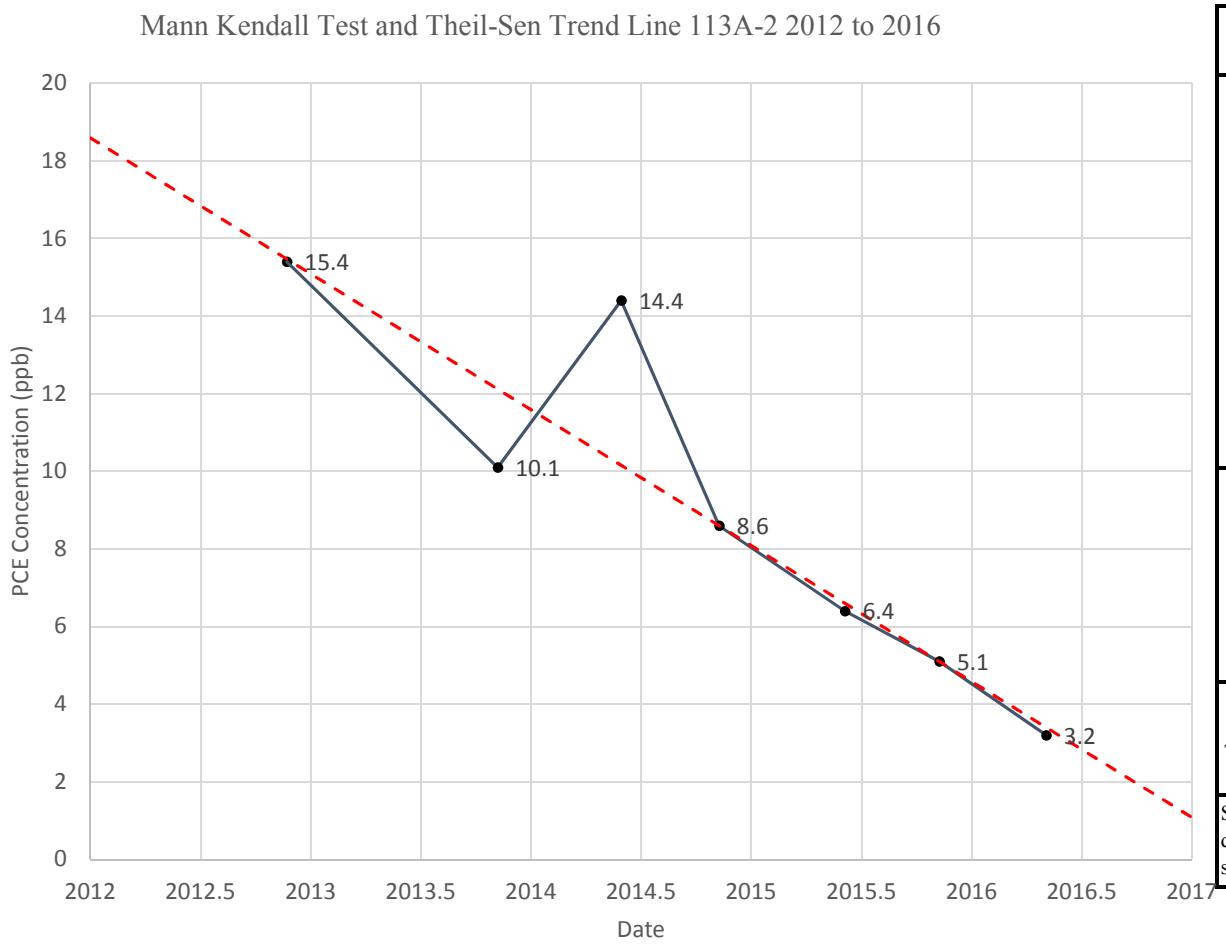


	Well Name	111B-2
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	1.7
	Maximum	31.6
	Mean	9.244
	Geometric Mean	6.224
	Median	4.5
	Standard Deviation	9.826
Mann - Kendall	Test Value (S)	-17
	Tabulated p-value	0.06
	Standard Deviation of S	9.539
	Standardized Value of S	-1.677
	Approximate p-value	0.0467
Theil-Sen Trend Line	Theil-Sen Slope	-1.8047
	Theil-Sen Intercept	3639.9068
	Calculate Date to 5ppb	-

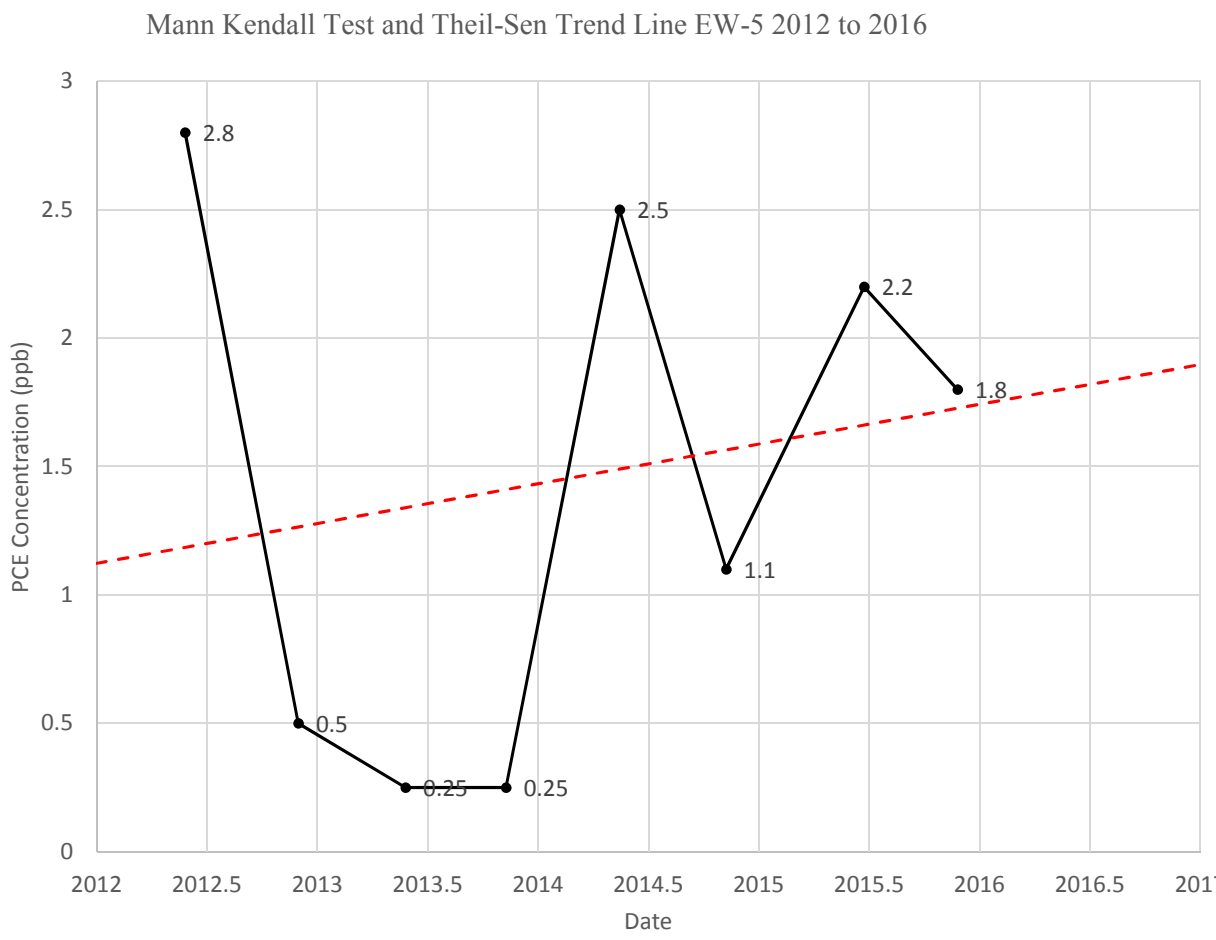
Insufficient evidence to identify a significant trend at the specified level of significance.



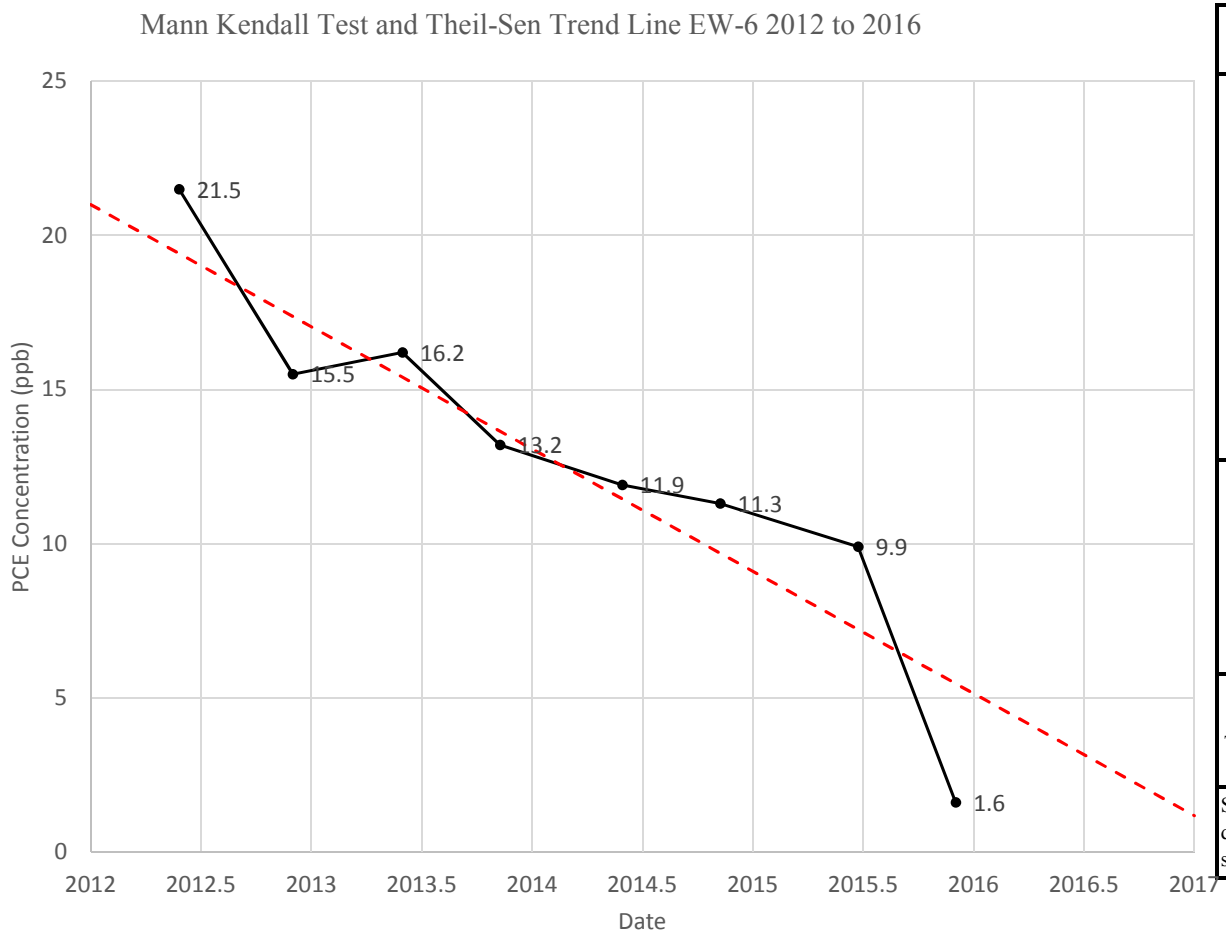
	Well Name	112B-2
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	4
	Number of Replicates	4
	Number of Nondetects	0 0
	Minimum	3.5
	Maximum	7.9
	Mean	5.8
	Geometric Mean	5.566
	Median	5.9
	Standard Deviation	1.817
Mann - Kendall	Test Value (S)	-6
	Tabulated p-value	0.042
	Standard Deviation of S	2.944
	Standardized Value of S	-1.698
	Approximate p-value	0.0447
Theil-Sen Trend Line	Theil-Sen Slope	-1.4203
	Theil-Sen Intercept	2866.9053
	Calculate Date to 5ppb	2015.00056
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



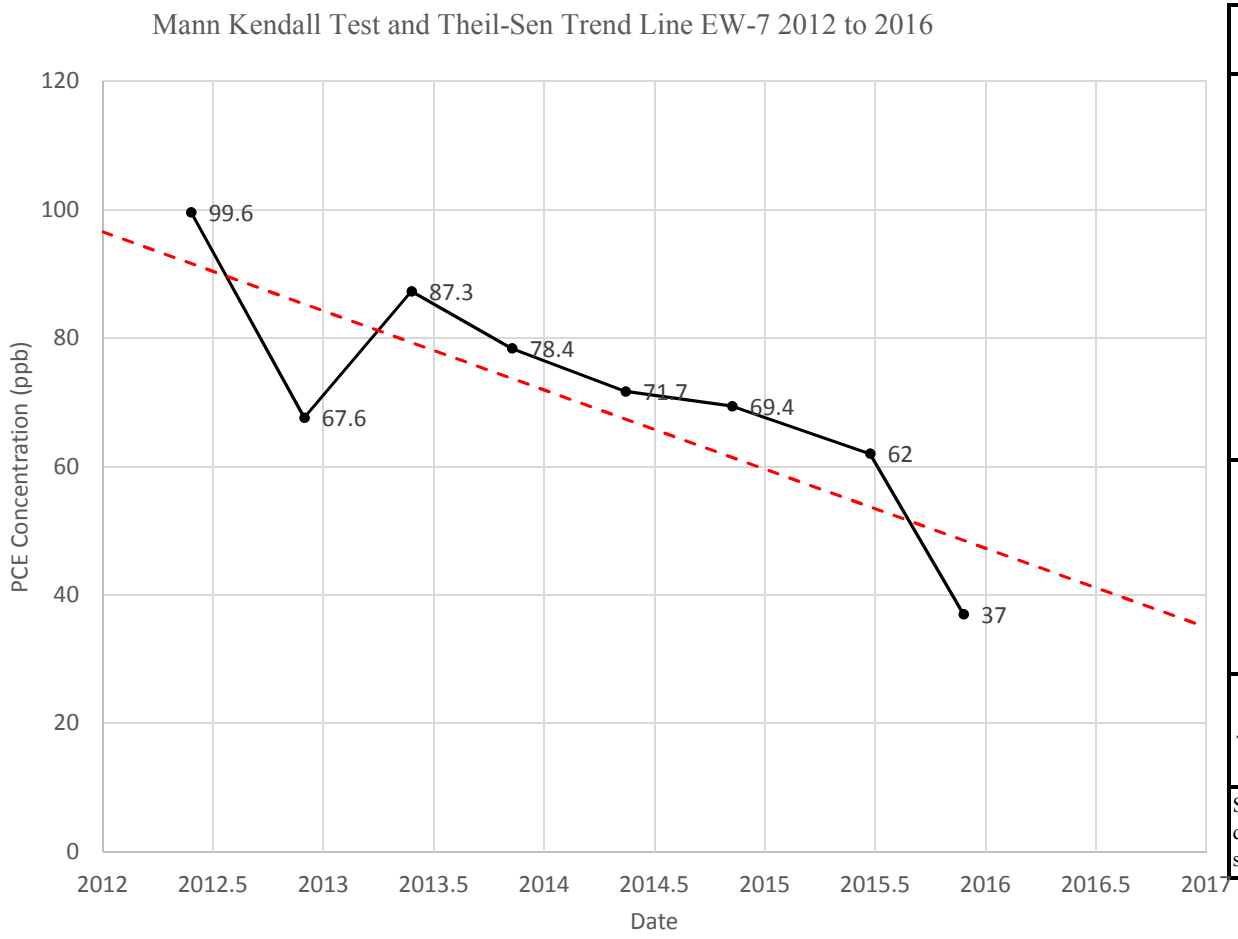
	Well Name	113A-2
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	7
	Number of Replicates	7
	Number of Nondetects	0 0
	Minimum	3.2
	Maximum	15.4
	Mean	9.029
	Geometric Mean	7.953
	Median	8.6
	Standard Deviation	4.602
Mann - Kendall	Test Value (S)	-19
	Tabulated p-value	0.001
	Standard Deviation of S	6.658
	Standardized Value of S	-2.703
	Approximate p-value	0.00343
Theil-Sen Trend Line	Theil-Sen Slope	-3.5022
	Theil-Sen Intercept	7065.0205
	Calculate Date to 5ppb	2015.88159
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



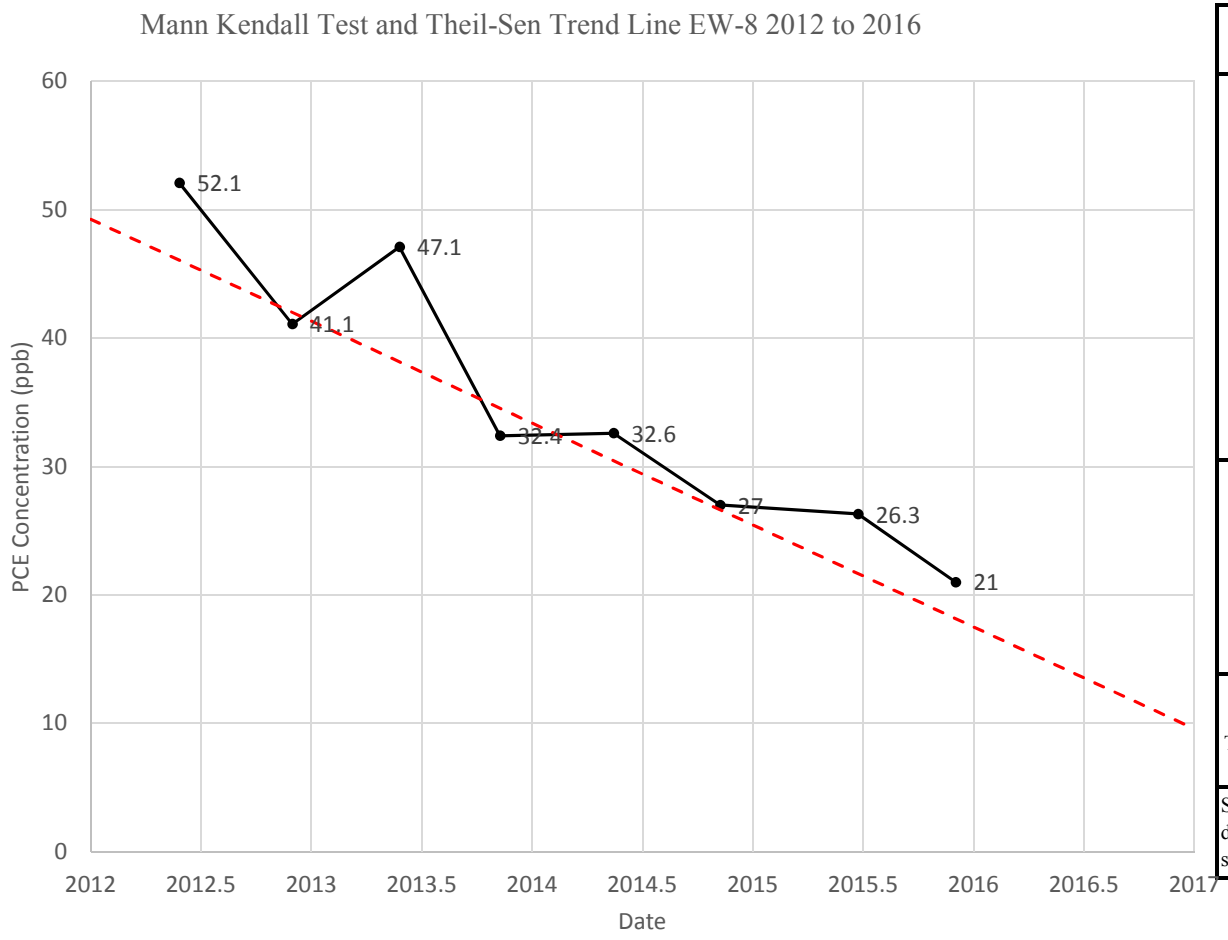
	Well Name	EW-5
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	8
	Number of Replicates	8
	Number of Nondetects	0 3
	Minimum	0.25
	Maximum	2.8
	Mean	1.425
	Geometric Mean	0.994
	Median	1.45
	Standard Deviation	1.036
Mann - Kendall	Test Value (S)	
	Tabulated p-value	10.548
	Standard Deviation of S	8.021
	Standardized Value of S	
	Approximate p-value	0 0.5
Theil-Sen Trend Line	Theil-Sen Slope	0.1548
	Theil-Sen Intercept	-310.3344
	Calculate Date to 5ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		



	Well Name	EW-6
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	8
	Number of Replicates	8
	Number of Nondetects	0 0
	Minimum	1.6
	Maximum	21.5
	Mean	12.64
	Geometric Mean	10.54
	Median	12.55
	Standard Deviation	5.75
Mann - Kendall	Test Value (S)	-26
	Tabulated p-value	
	Standard Deviation of S	0 8.083
	Standardized Value of S	-3.093
	Approximate p-value	9.9089E-4
Theil-Sen Trend Line	Theil-Sen Slope	-3.9666
	Theil-Sen Intercept	8001.802
	Calculate Date to 5ppb	2016.03439
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



	Well Name	EW-7
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	8
	Number of Replicates	8
	Number of Nondetects	0 0
	Minimum	37
	Maximum	99.6
	Mean	71.63
	Geometric Mean	69.2
	Median	70.55
	Standard Deviation	18.47
Mann - Kendall	Test Value (S)	-20
	Tabulated p-value	0.007
	Standard Deviation of S	8.083
	Standardized Value of S	-2.351
	Approximate p-value	0.00937
Theil-Sen Trend Line	Theil-Sen Slope	-12.3222
	Theil-Sen Intercept	24888.8362
	Calculate Date to 5ppb	2019.43129
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

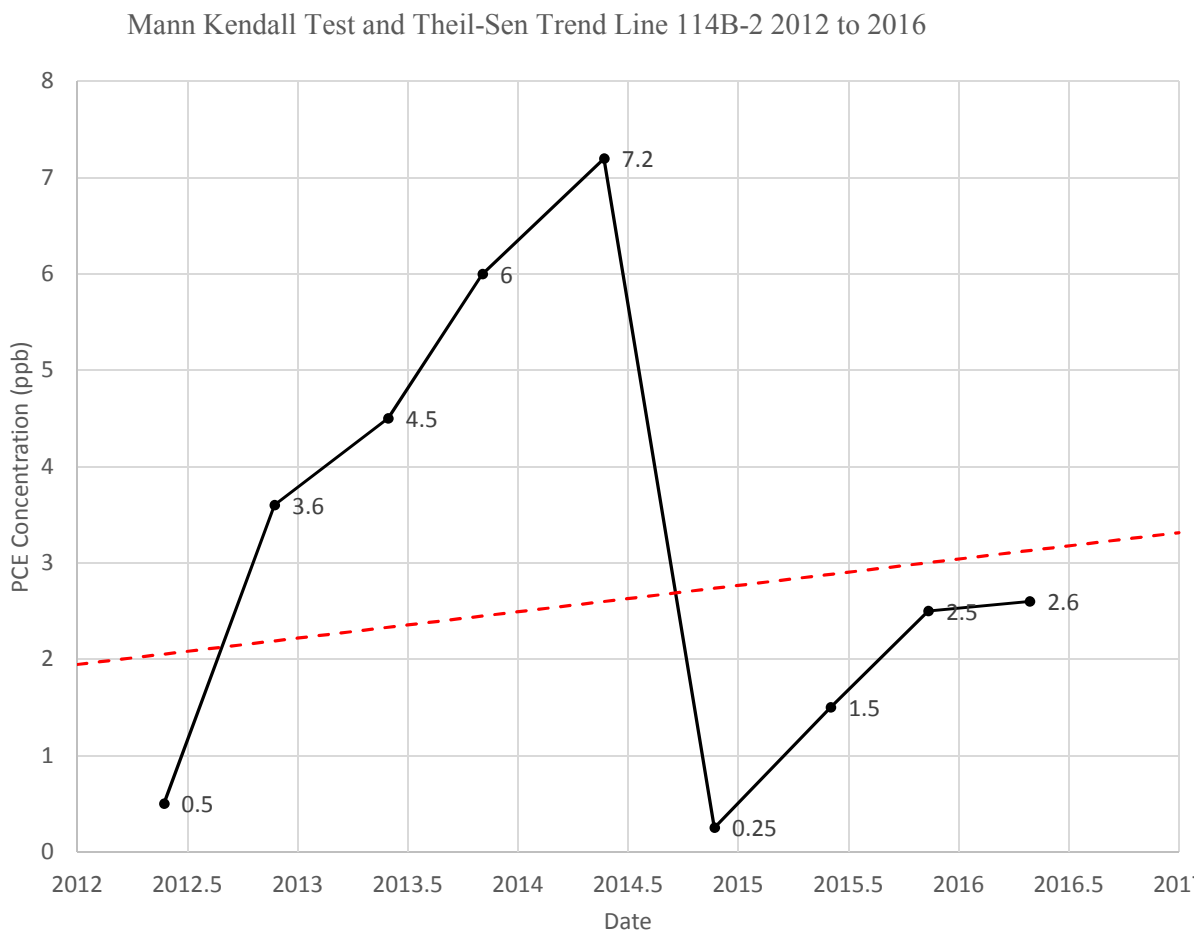


	Well Name	EW-8
	Area	22 & 36
General Statistics	Number of Events	
	Number of Values Reported (n)	8
	Number of Replicates	8
	Number of Nondetects	0 0
	Minimum	21
	Maximum	52.1
	Mean	34.95
	Geometric Mean	33.51
	Median	32.5
	Standard Deviation	10.85
Mann - Kendall	Test Value (S)	-24
	Tabulated p-value	0.001
	Standard Deviation of S	8.083
	Standardized Value of S	-2.846
	Approximate p-value	0.00222
Theil-Sen Trend Line	Theil-Sen Slope	-7.9367
	Theil-Sen Intercept	16017.9001
	Calculate Date to 5ppb	2017.57659
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

AREA 114B-2

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR PCE

2012-2016 TIME-FRAME



	Well Name	114B-2
	Area	114B-2
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 3
	Minimum	0.25
	Maximum	7.2
	Mean	3.183
	Geometric Mean	2.117
	Median	2.6
	Standard Deviation	2.383
Mann - Kendall	Test Value (S)	
	Tabulated p-value	2 0.46
	Standard Deviation of S	9.592
	Standardized Value of S	0.104
	Approximate p-value	0.458
Theil-Sen Trend Line	Theil-Sen Slope	0.2737
	Theil-Sen Intercept	-548.7388
	Calculate Date to 5ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		

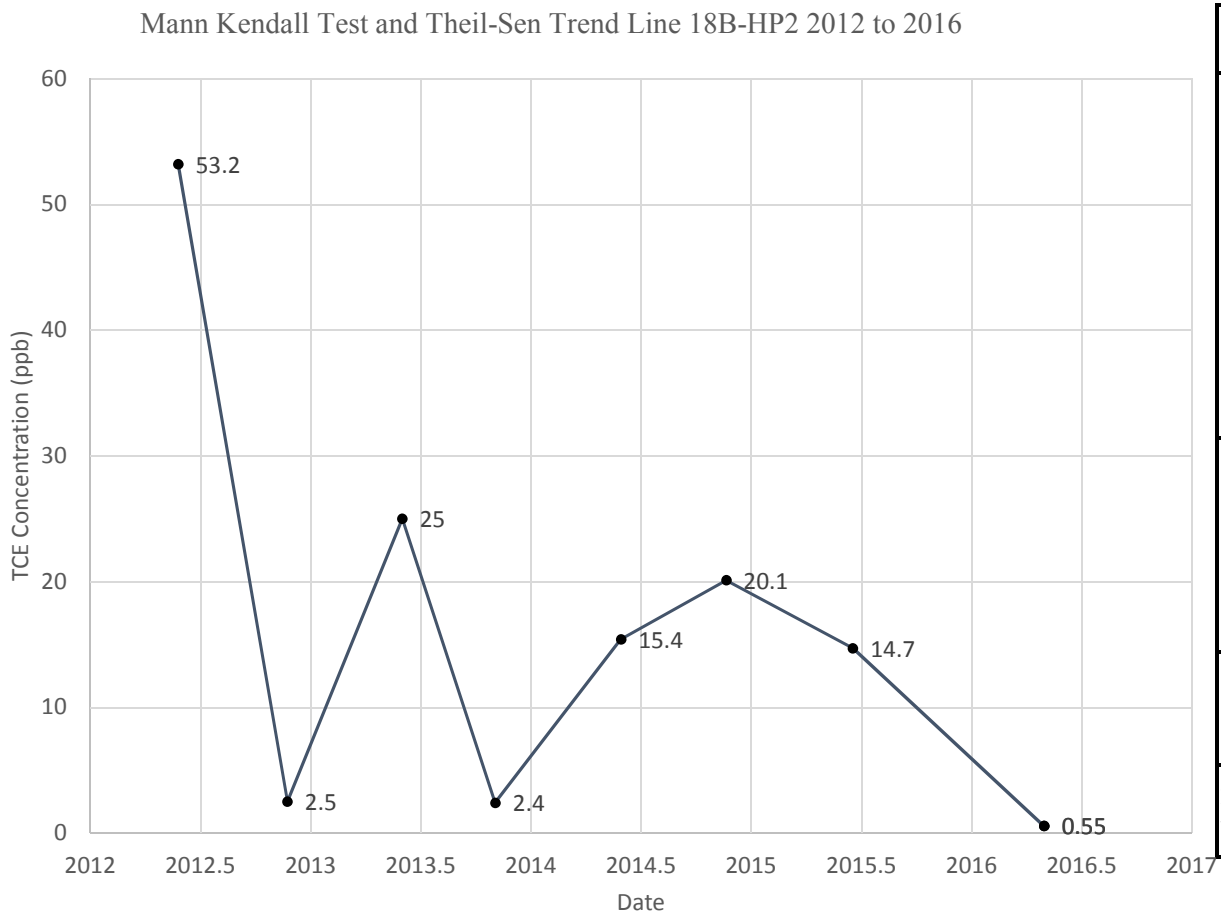
APPENDIX G – MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR TCE 2012-2016 TIME-FRAME

		General Statistics										Mann - Kendall					Theil-Sen Trend Line				
Well Name	Area	Number of Events	Number of Values Reported (n)	Number of Replicates	Number of Nondetects	Minimum - µg/L	Maximum - µg/L	Mean - µg/L	Geometric Mean - µg/L	Median - µg/L	Standard Deviation	Test Value (S)	Tabulated p value	Standard Deviation of S	Standardized Value of S	Approximate p-value	Theil-Sen Slope	Theil-Sen Intercept	Calculate Date to 5ppb	Last Sampling Event Result -µg/L	
18B-HP2	T-25				0							-19	0.038	9.539	-1.887	0.0296	N/A	N/A	-	0.55J	Insufficient evidence to identify a significant trend at the specified level of significance.
208B-HP2	T-25	9	9	1	0	0.55	53.2	14.93	6.058	14.7	17.02	20	0.022	9.592	1.981	0.0238	-4.8538	9793.6471	2017.1	8.7J	Statistically significant evidence of a decreasingtrend at the specified level of significance.
37B-HP2	T-25	9	9	0	0	8.7	50.4	20.57	19.05	18.3	7.979	-25	0.014	11.18	-2.147	0.0159	-9.3345	18835.617	2017.3	1.1	Statistically significant evidence of a decreasingtrend at the specified level of significance.
83B-2	T-25	10	10	1	1	1	60.2	25.89	10.99	29.9	22.76	18	0.038	9.592	1.772	0.0382	-3.1378	6327.4971	-	4.5	Insufficient evidence to identify a significant trend at the specified level of significance.
90B-4	T-25	9	9	0	0	0.25	16.4	8.739	5.91	6.8	5.472	-15	0.141	12.85	-1.09	0.138	-0.3906	793.206	-	7.0	Insufficient evidence to identify a significant trend at the specified level of significance.
96B-4	T-25	11	11	0	3	5.1	8.9	6.473	6.399	6.2	1.061	20	0.022	9.487	2.003	0.0226	3.9478	-7946.953	2014.3	2.4	Statistically significant evidence of an increasingtrend at the specified level of significance.
123B-2	63, 2, & 45	9	9	0	0	0.25	13.7	8.017	3.438	9.6	6.989	-7	0.306	9.539	-0.629	0.265	-5.0854	10334.187	-	84.8	Insufficient evidence to identify a significant trend at the specified level of significance.
124B-2	63, 2, & 45	9	9	0	0	62	136	92.36	89.78	90.3	23.41	3	N/A	9.539	1.044	0.2148	-2.3373	4710.5497	2013.2	1.9	Statistically significant evidence of a decreasingtrend at the specified level of significance.
125B-2	63, 2, & 45	3	3	0	0	1.9	6.6	4.033	3.561	3.6	2.38	13	0.13	9.539	1.258	0.104	0.9961	-1982.535	-	27.4	Insufficient evidence to identify a significant trend at the specified level of significance.
EW-3	63, 2, & 45	9	9	0	0	20.8	28.2	24.32	24.22	24	2.329	-28	0.005	11.14	-2.425	0.00766	-4.4717	9022.0026	2016.5	7.5	Statistically significant evidence of a decreasingtrend at the specified level of significance.
EW-4	63, 2, & 45	10	10	0	0	0.86	24.1	13.23	9.013	15.3	7.911	-22	0.002	8.083	-2.598	0.00469	-3.196	6459.1972	2019.5	11.0	Statistically significant evidence of a decreasingtrend at the specified level of significance.
164B-2	ARIEM	8	8	0	0	11	28.7	21.81	21.08	22.1	5.457	-25	0.006	9.539	-2.516	0.00594	-1.5856	3200.5192	2015.3	1.5	Statistically significant evidence of a decreasingtrend at the specified level of significance.
165B-2	ARIEM	9	9	0	0	0.85	7.7	4.717	3.713	6.5	2.782	-21	0.022	9.539	-2.897	0.018	-0.6807	1379.7962	2019.7	8.4	Statistically significant evidence of a decreasingtrend at the specified level of significance.
114B-2	114B-2	9	9	0	5	6.6	10.1	8.656	8.57	8.6	1.257	10	0.179	9.487	0.949	0.171	0.1751	-352.2198	-	0.92J	Insufficient evidence to identify a significant trend at the specified level of significance.
		9	9	0		0.25	2.5	0.791	0.606	0.5	0.7										

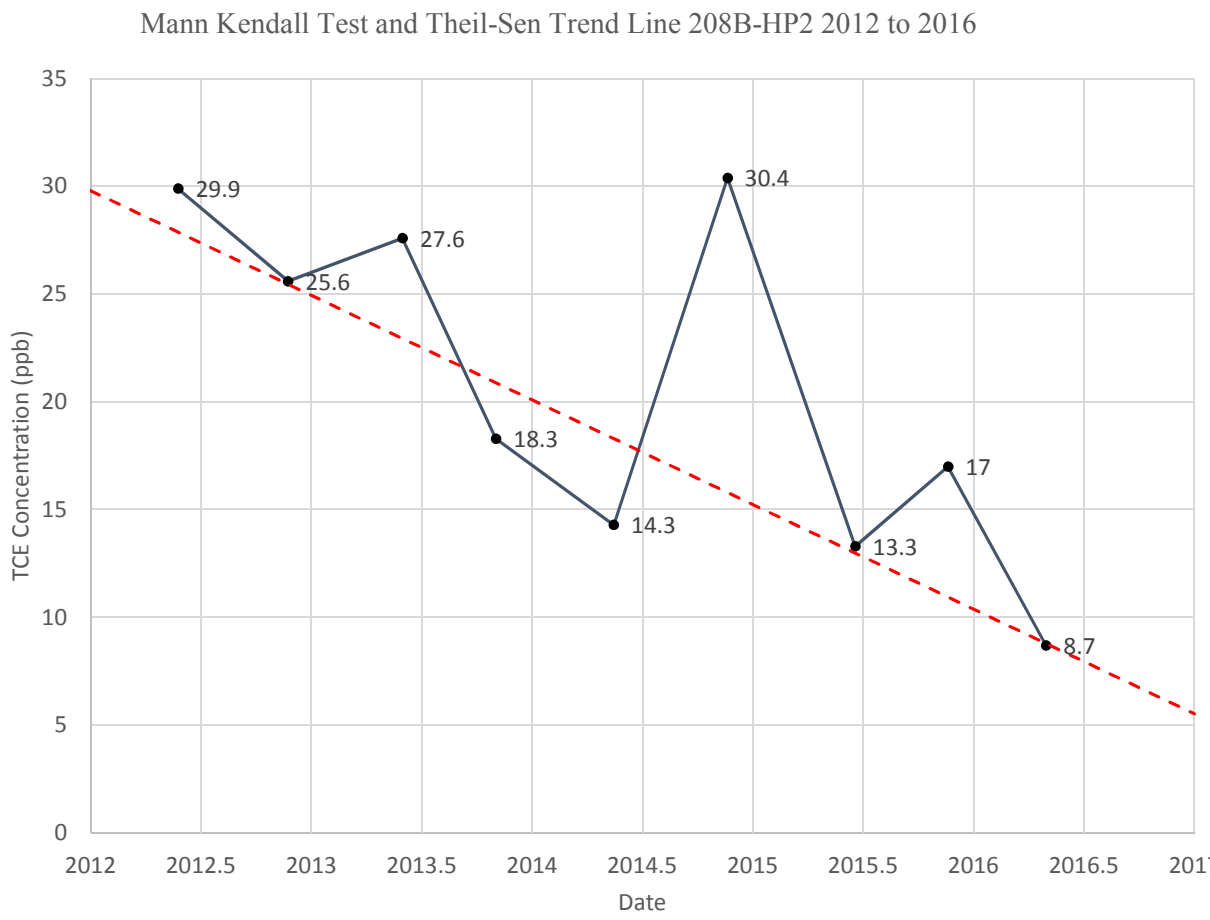
T-25 AREA

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR TCE

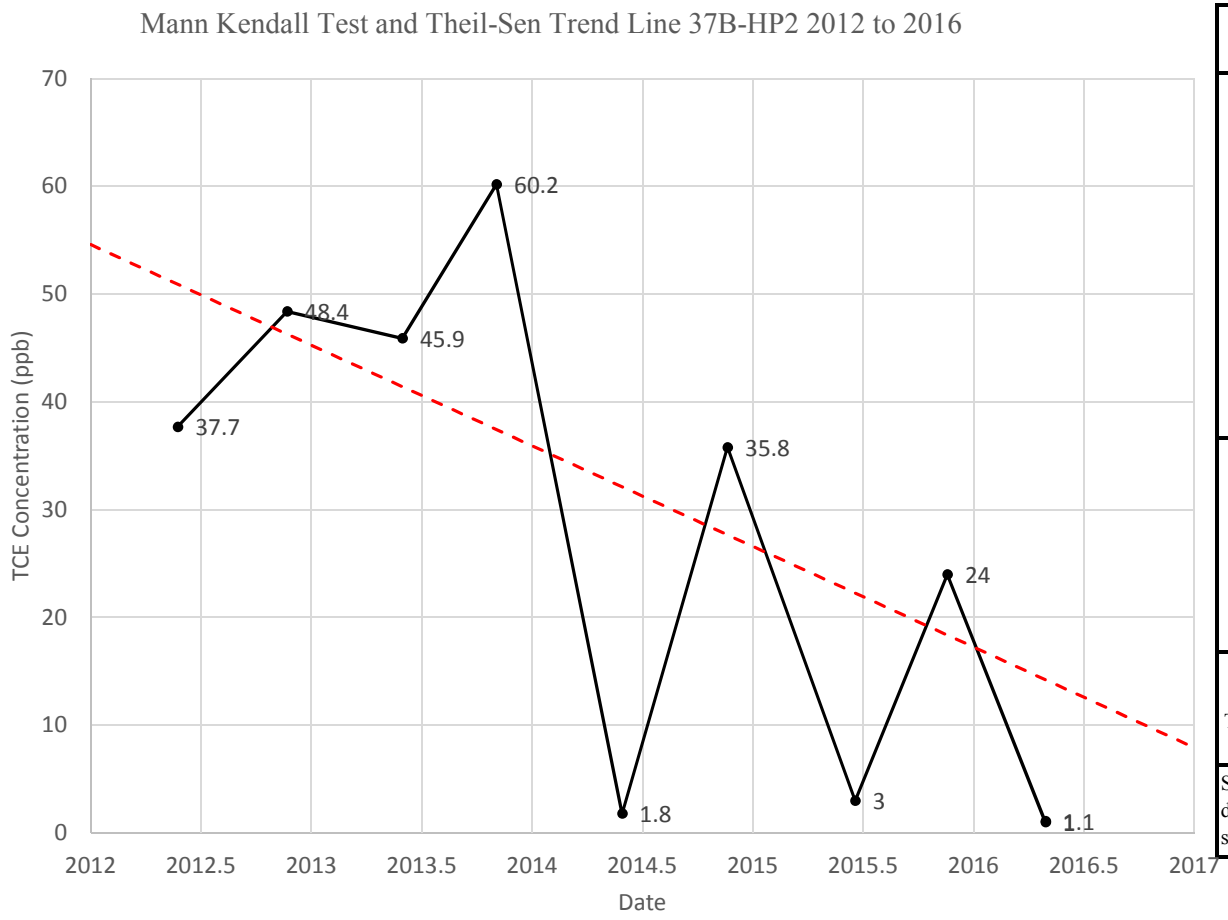
2012-2016 TIME-FRAME



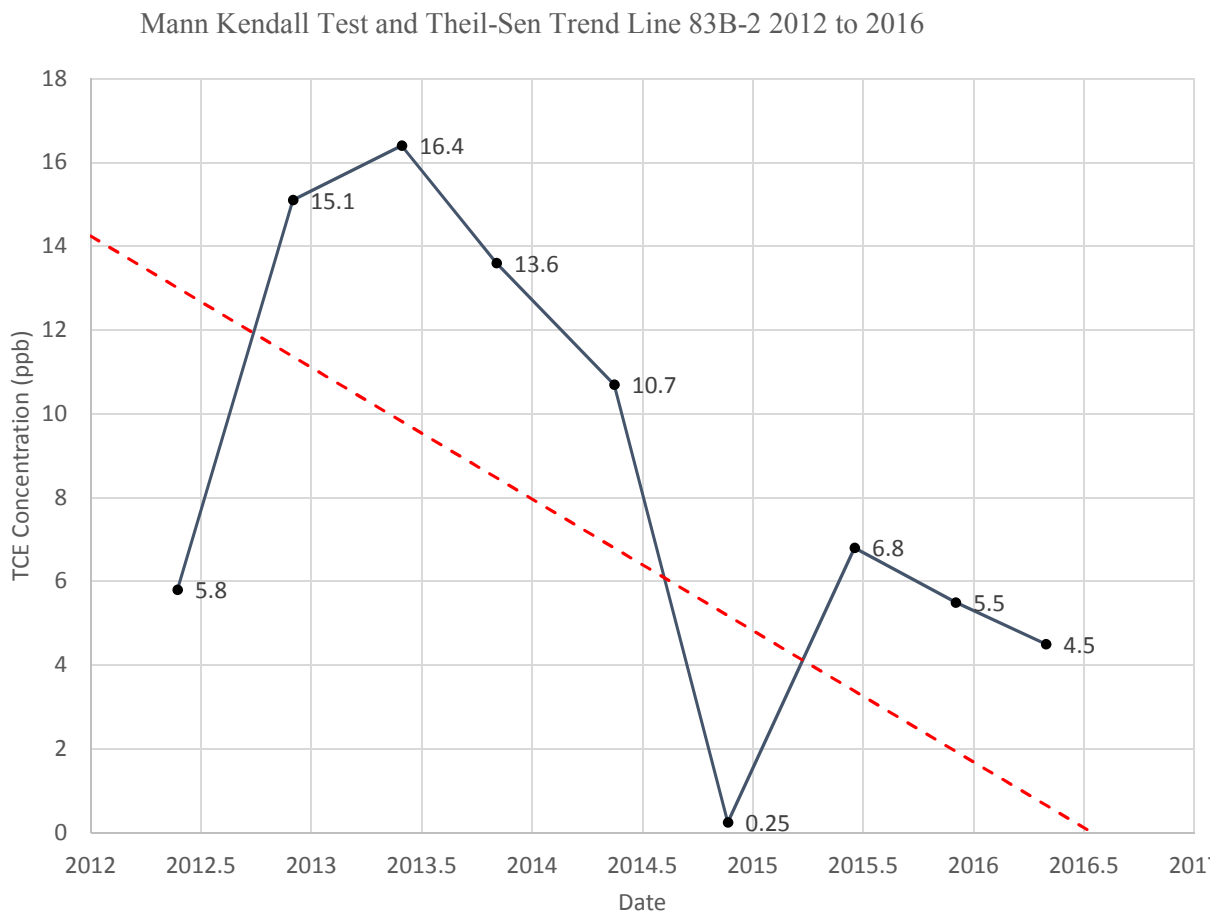
	Well Name	18B-HP2
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	1 0
	Minimum	55
	Maximum	0. 2
	Mean	53. 4.93
	Geometric Mean	1 058
	Median	6. 4.7
	Standard Deviation	1 02
Mann - Kendall	Test Value (S)	17. 19
	Tabulated p-value	- 038
	Standard Deviation of S	0. .539
	Standardized Value of S	9 - 1.887
	Approximate p-value	0296
Theil-Sen Trend Line	Theil-Sen Slope	0. A
	Theil-Sen Intercept	N/ /A
	Calculate Date to 5ppb	N -
Insufficient evidence to identify a significant trend at the specified level of significance.		



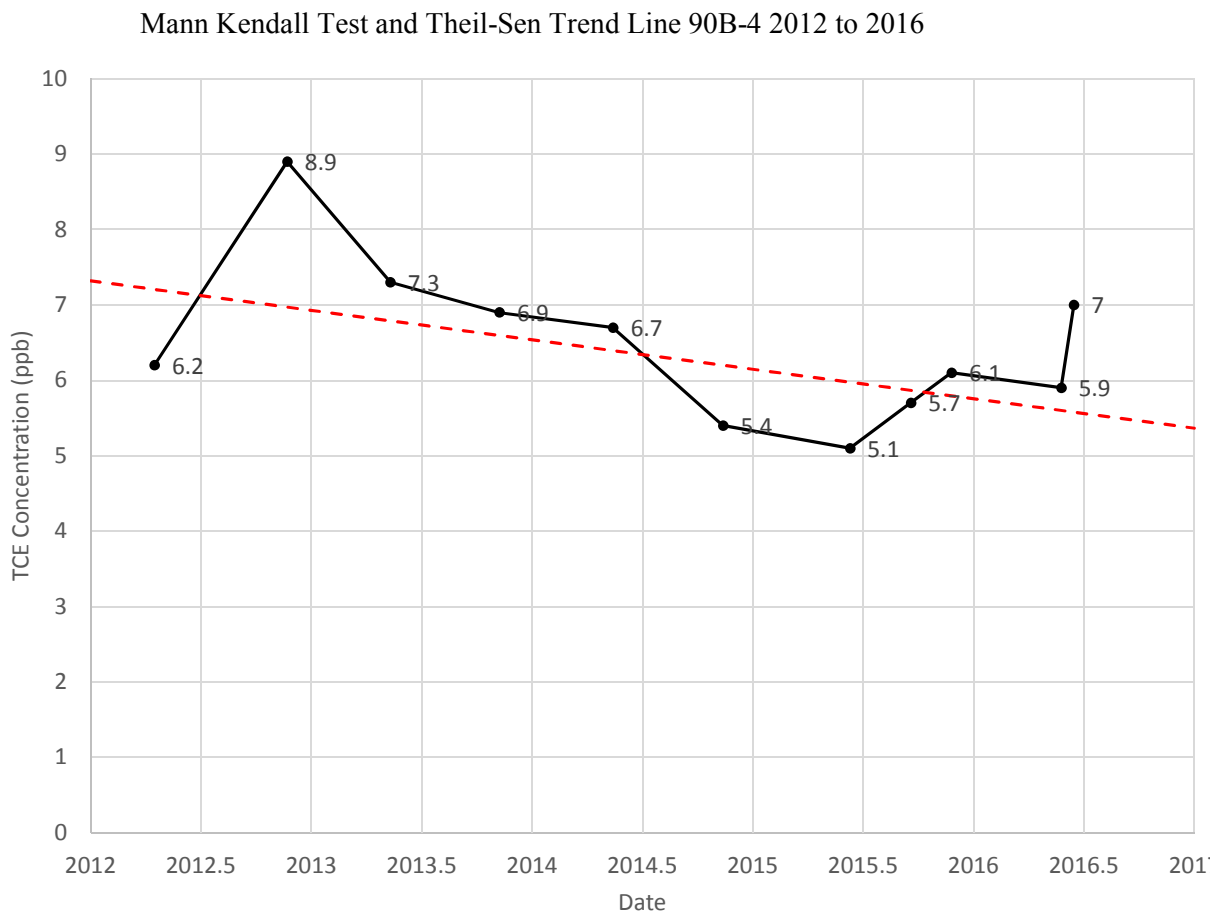
	Well Name	208B-HP2
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	8.7
	Maximum	30.4
	Mean	20.57
	Geometric Mean	19.05
	Median	18.3
	Standard Deviation	7.979
Mann - Kendall	Test Value (S)	-20
	Tabulated p-value	0.022
	Standard Deviation of S	9.592
	Standardized Value of S	-1.981
	Approximate p-value	0.0238
Theil-Sen Trend Line	Theil-Sen Slope	-4.8538
	Theil-Sen Intercept	9795.6471
	Calculate Date to 5ppb	2017.10971
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



	Well Name	37B-HP2
	Area	T-25
General Statistics	Number of Events	10
	Number of Values Reported (n)	10
	Number of Replicates	
	Number of Nondetects	0
	Minimum	
	Maximum	60.2
	Mean	25.89
	Geometric Mean	10.99
	Median	29.9
	Standard Deviation	22.76
Mann - Kendall	Test Value (S)	-25
	Tabulated p-value	0.014
	Standard Deviation of S	11.18
	Standardized Value of S	-2.147
	Approximate p-value	0.0159
Theil-Sen Trend Line	Theil-Sen Slope	-9.3345
	Theil-Sen Intercept	18835.6168
	Calculate Date to 5ppb	2017.31392
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

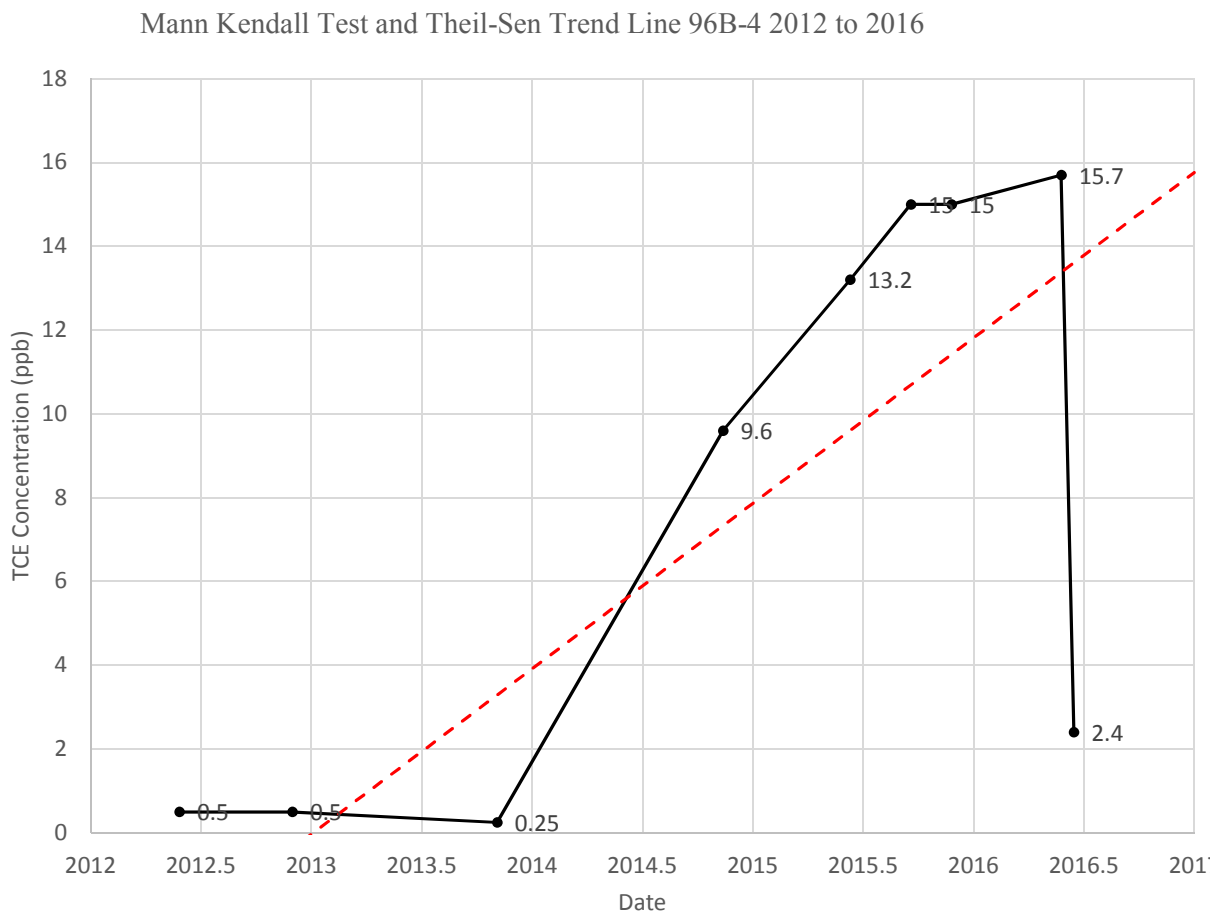


	Well Name	83B-2
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 1
	Minimum	0.25
	Maximum	16.4
	Mean	8.739
	Geometric Mean	5.91
	Median	6.8
	Standard Deviation	5.472
Mann - Kendall	Test Value (S)	-18
	Tabulated p-value	0.038
	Standard Deviation of S	9.592
	Standardized Value of S	-1.772
	Approximate p-value	0.0382
Theil-Sen Trend Line	Theil-Sen Slope	-3.1378
	Theil-Sen Intercept	6327.4971
	Calculate Date to 5ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		



	Well Name	90B-4
	Area	T-25
General Statistics	Number of Events	11
	Number of Values Reported (n)	11
	Number of Replicates	0
	Number of Nondetects	0
	Minimum	5.1
	Maximum	8.9
	Mean	6.473
	Geometric Mean	6.399
	Median	6.2
	Standard Deviation	1.061
Mann - Kendall	Test Value (S)	-15
	Tabulated p-value	0.141
	Standard Deviation of S	12.85
	Standardized Value of S	-1.09
	Approximate p-value	0.138
Theil-Sen Trend Line	Theil-Sen Slope	-0.3906
	Theil-Sen Intercept	793.206
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.

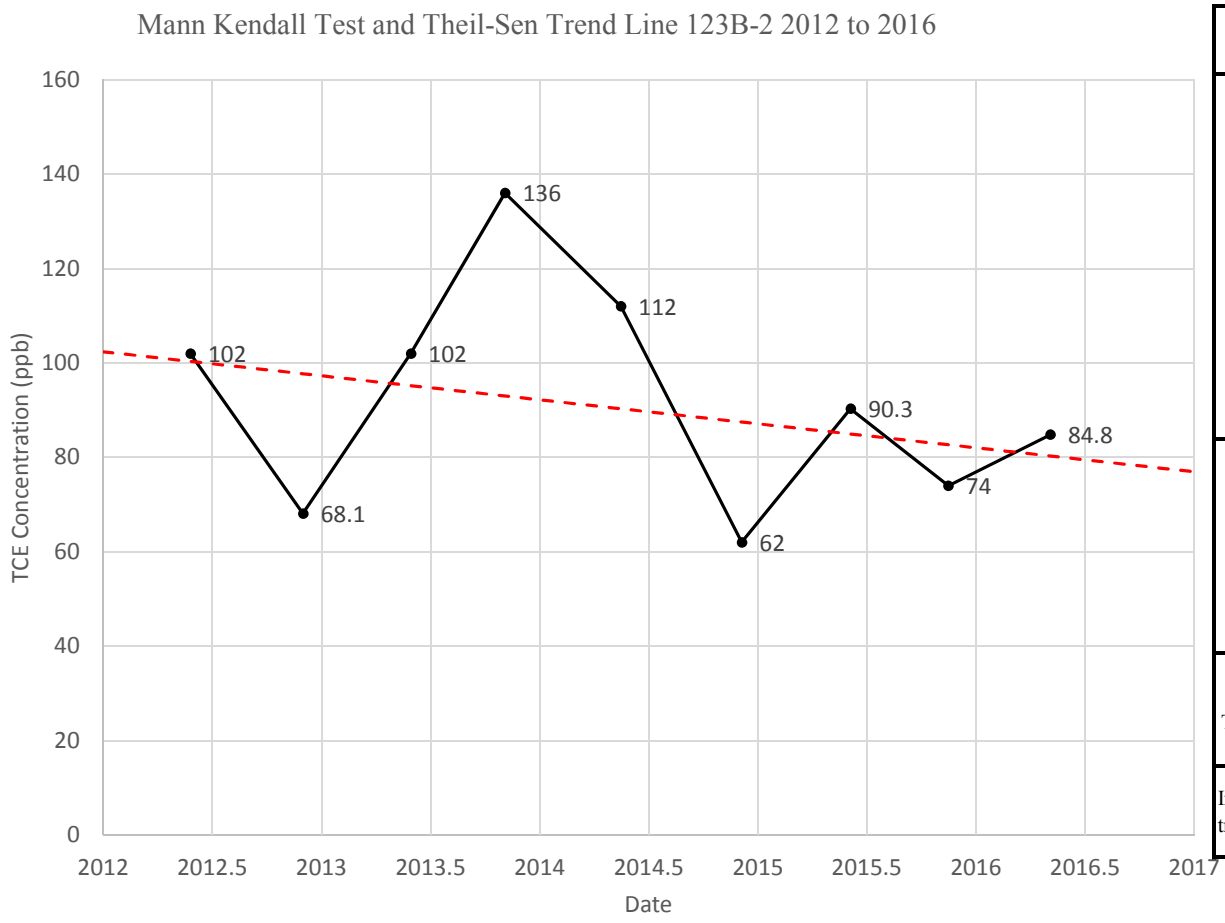


	Well Name	96B-4
	Area	T-25
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 3
	Minimum	0.25
	Maximum	15.7
	Mean	8.017
	Geometric Mean	3.438
	Median	9.6
	Standard Deviation	6.989
Mann - Kendall	Test Value (S)	20
	Tabulated p-value	0.022
	Standard Deviation of S	9.487
	Standardized Value of S	2.003
	Approximate p-value	0.0226
Theil-Sen Trend Line	Theil-Sen Slope	3.9478
	Theil-Sen Intercept	-7946.9529
	Calculate Date to 5ppb	2014.27451
Statistically significant evidence of an increasingtrend at the specified level of significance.		

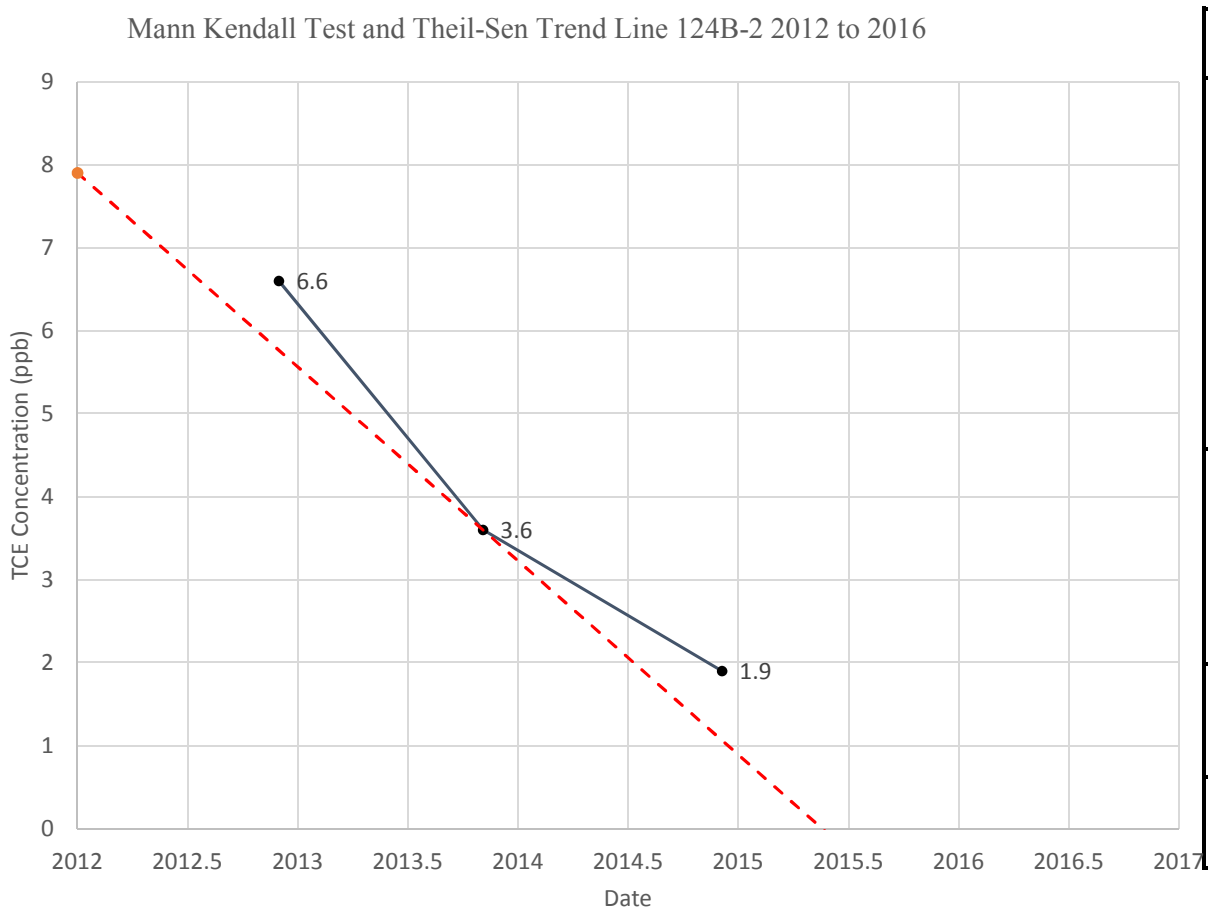
BUILDINGS 63, 2, AND 45 AREA

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR TCE

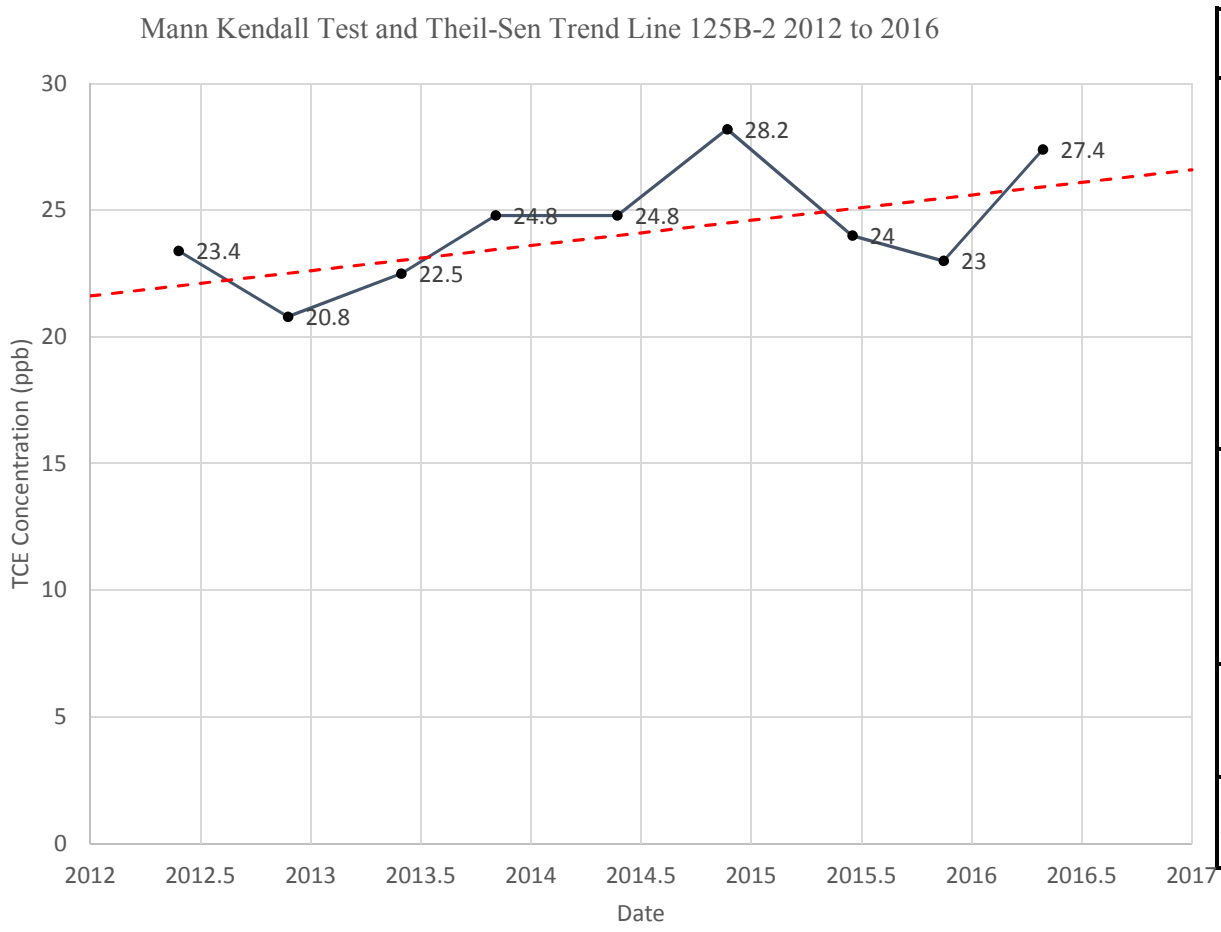
2012-2016 TIME-FRAME



	Well Name	123B-2
	Area	63, 2, & 45
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	62
	Maximum	136
	Mean	92.36
	Geometric Mean	89.78
	Median	90.3
	Standard Deviation	23.41
Mann - Kendall	Test Value (S)	-7
	Tabulated p-value	0.306
	Standard Deviation of S	9.539
	Standardized Value of S	-0.629
	Approximate p-value	0.265
Theil-Sen Trend Line	Theil-Sen Slope	-5.0854
	Theil-Sen Intercept	10334.1873
	Calculate Date to 5ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		

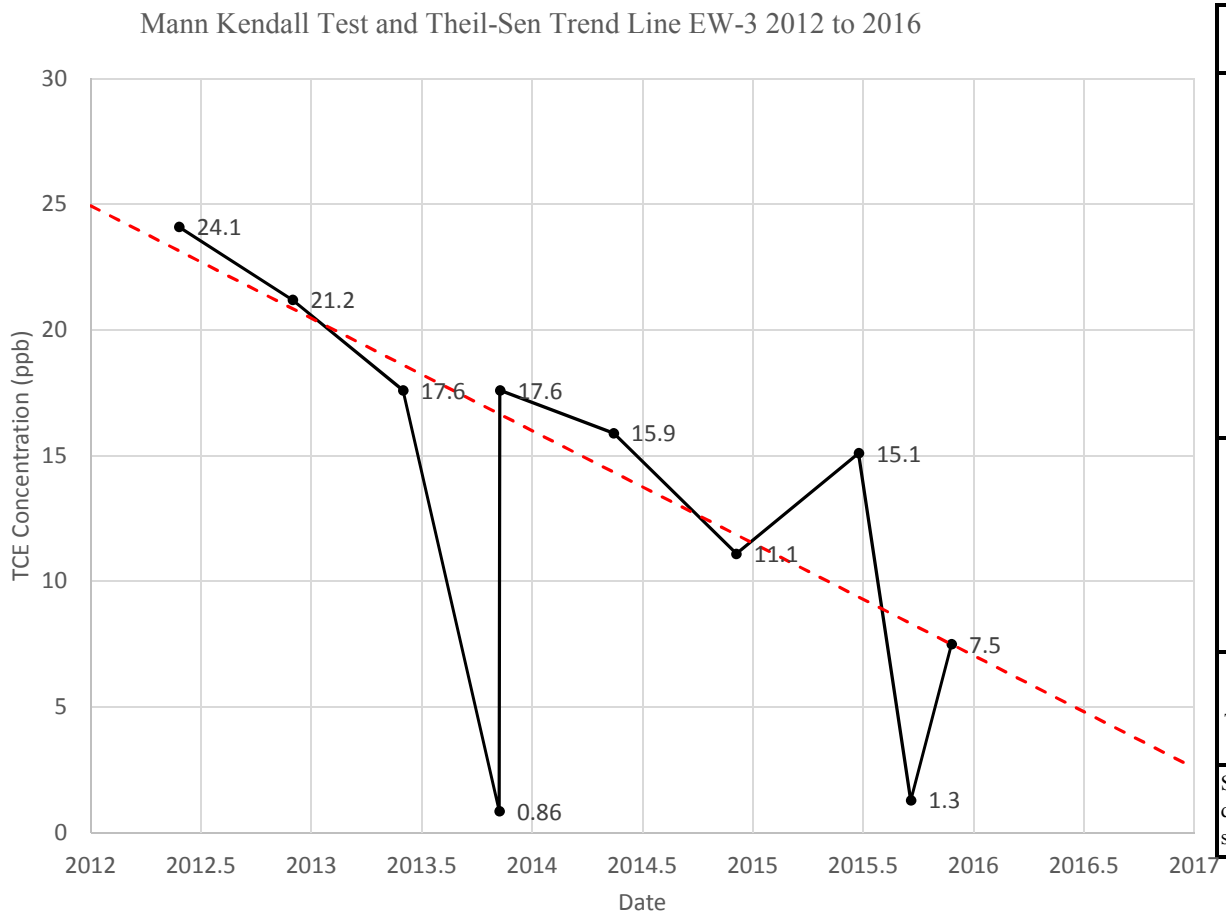


	Well Name	124B-2
	Area	63, 2, & 45
General Statistics	Number of Events	3
	Number of Values Reported (n)	3
	Number of Replicates	0
	Number of Nondetects	0
	Minimum	1.9
	Maximum	6.6
	Mean	4.033
	Geometric Mean	3.561
	Median	3.6
	Standard Deviation	2.38
Mann - Kendall	Test Value (S)	-3
	Tabulated p-value	N/A
	Standard Deviation of S	1.915
	Standardized Value of S	-1.044
	Approximate p-value	0.148
Theil-Sen Trend Line	Theil-Sen Slope	-2.3373
	Theil-Sen Intercept	4710.5497
	Calculate Date to 5ppb	2013.24165
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

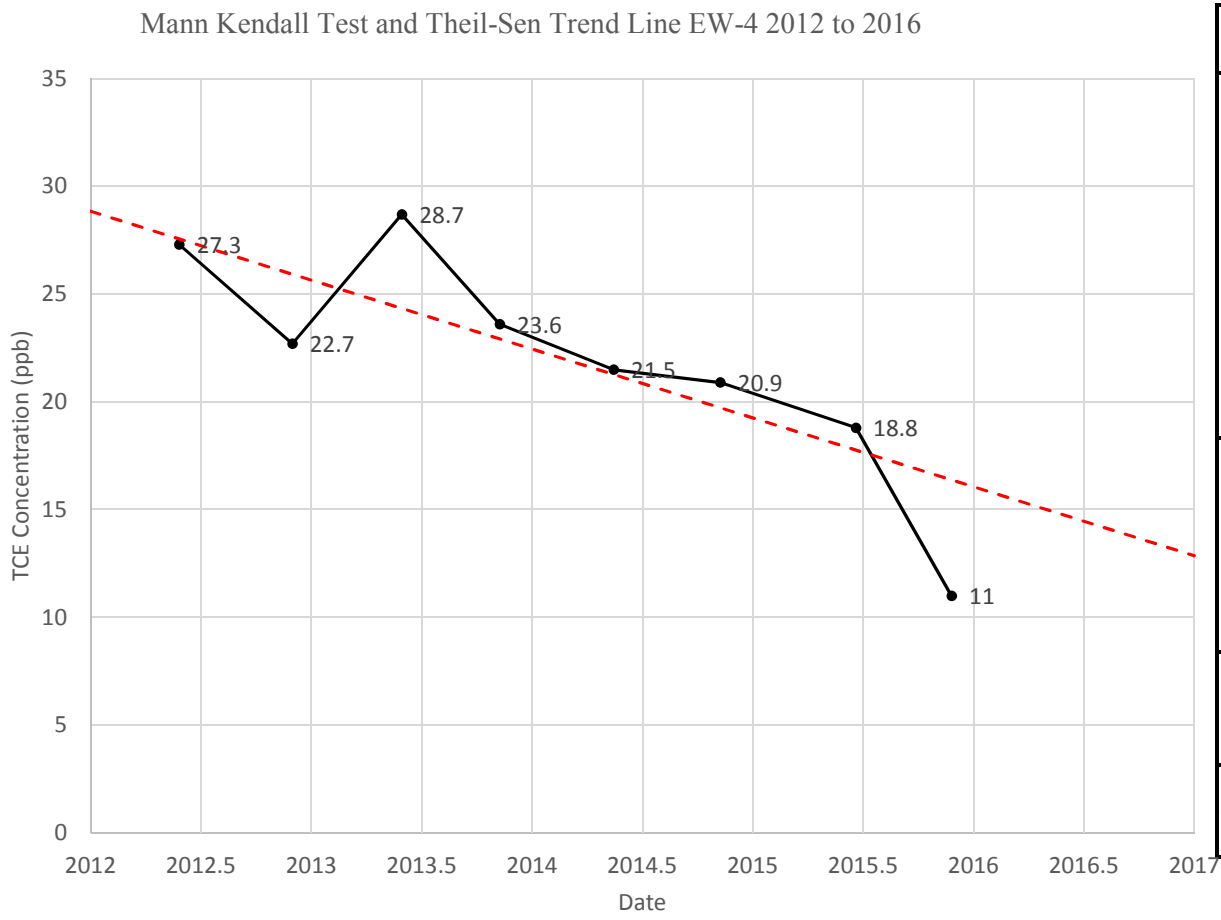


	Well Name	125B-2
	Area	63, 2, & 45
General Statistics	Number of Events	9
	Number of Values Reported (n)	9
	Number of Replicates	0
	Number of Nondetects	0
	Minimum	20.8
	Maximum	28.2
	Mean	24.32
	Geometric Mean	24.22
	Median	24
	Standard Deviation	2.329
Mann - Kendall	Test Value (S)	13
	Tabulated p-value	0.13
	Standard Deviation of S	9.539
	Standardized Value of S	1.258
	Approximate p-value	0.104
Theil-Sen Trend Line	Theil-Sen Slope	0.9961
	Theil-Sen Intercept	-1982.5352
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.



	Well Name	EW-3
	Area	63, 2, & 45
General Statistics	Number of Events	10
	Number of Values Reported (n)	10
	Number of Replicates	0
	Number of Nondetects	0
	Minimum	0.86
	Maximum	24.1
	Mean	13.23
	Geometric Mean	9.013
	Median	15.5
	Standard Deviation	7.911
Mann - Kendall	Test Value (S)	-28
	Tabulated p-value	0.005
	Standard Deviation of S	11.14
	Standardized Value of S	-2.425
	Approximate p-value	0.00766
Theil-Sen Trend Line	Theil-Sen Slope	-4.4717
	Theil-Sen Intercept	9022.0026
	Calculate Date to 5ppb	2016.45965
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

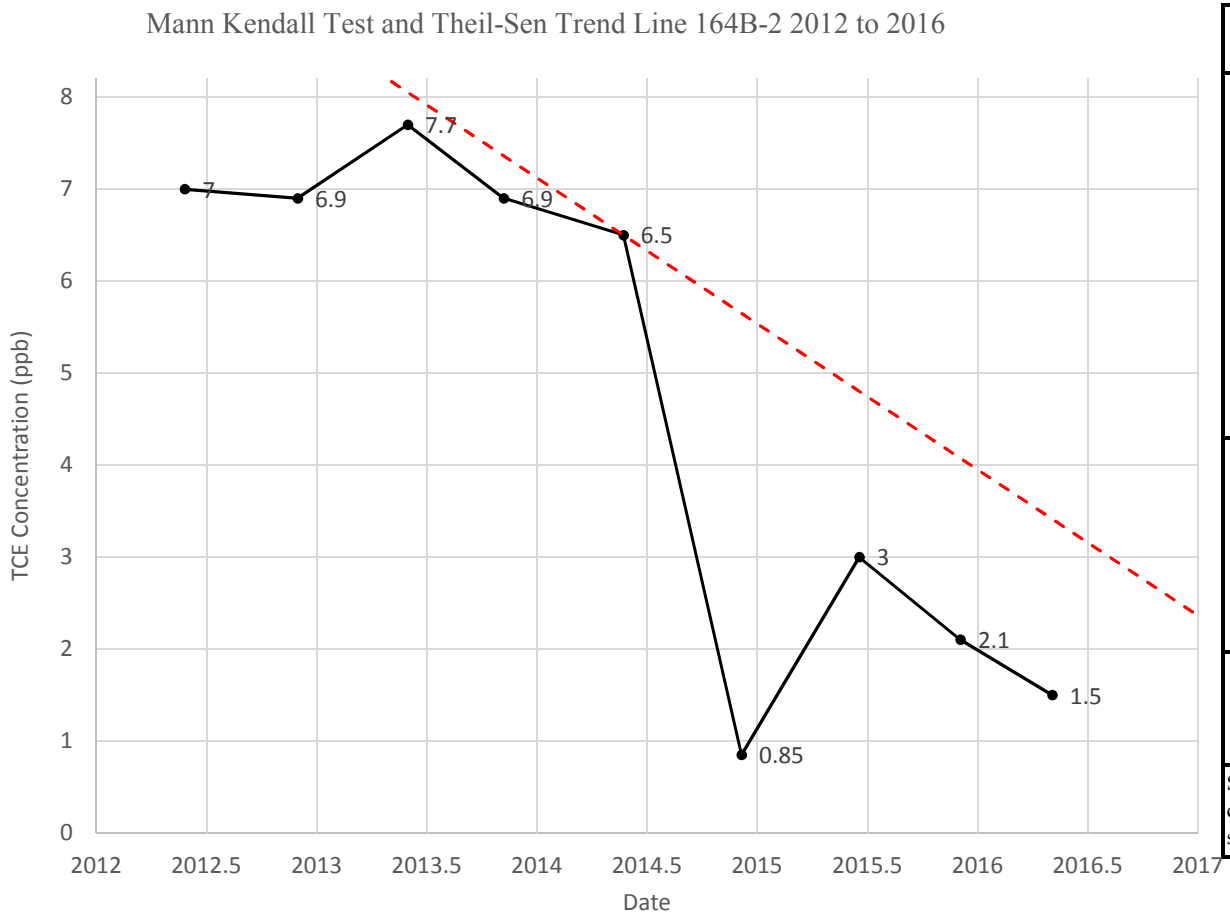


	Well Name	EW-4
	Area	63, 2, & 45
General Statistics	Number of Events	
	Number of Values Reported (n)	8
	Number of Replicates	8
	Number of Nondetects	0 0
	Minimum	11
	Maximum	28.7
	Mean	21.81
	Geometric Mean	21.08
	Median	22.1
	Standard Deviation	5.457
Mann - Kendall	Test Value (S)	-22
	Tabulated p-value	0.002
	Standard Deviation of S	8.083
	Standardized Value of S	-2.598
	Approximate p-value	0.00469
Theil-Sen Trend Line	Theil-Sen Slope	-3.196
	Theil-Sen Intercept	6459.1972
	Calculate Date to 5ppb	2019.46095
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

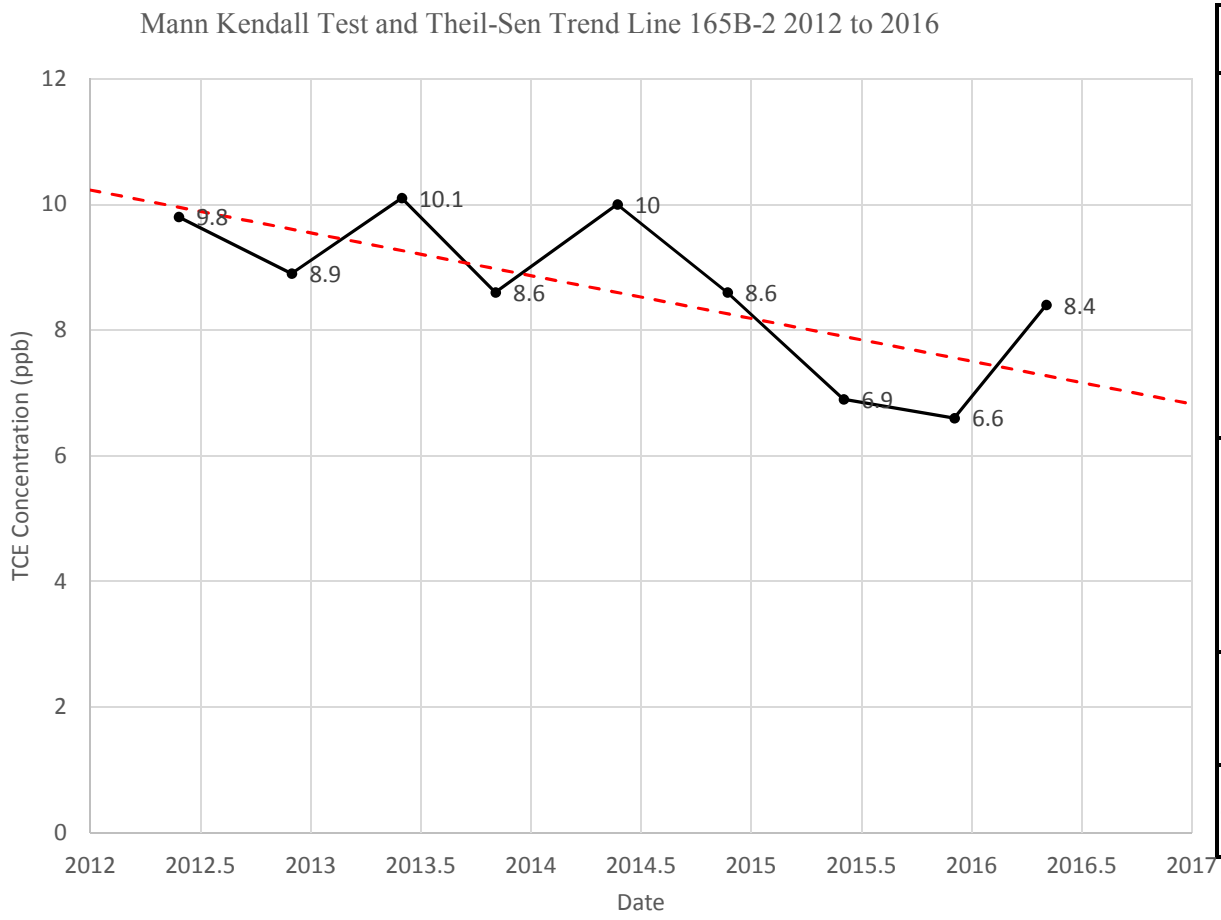
BUILDINGS ARIEM AREA

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR TCE

2012-2016 TIME-FRAME



	Well Name	164B-2
	Area	ARIEM
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	0.85
	Maximum	7.7
	Mean	4.717
	Geometric Mean	3.713
	Median	6.5
	Standard Deviation	2.782
Mann - Kendall	Test Value (S)	-25
	Tabulated p-value	0.006
	Standard Deviation of S	9.539
	Standardized Value of S	-2.516
	Approximate p-value	0.00594
Theil-Sen Trend Line	Theil-Sen Slope	-1.5856
	Theil-Sen Intercept	3200.5192
	Calculate Date to 5ppb	2015.33754
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

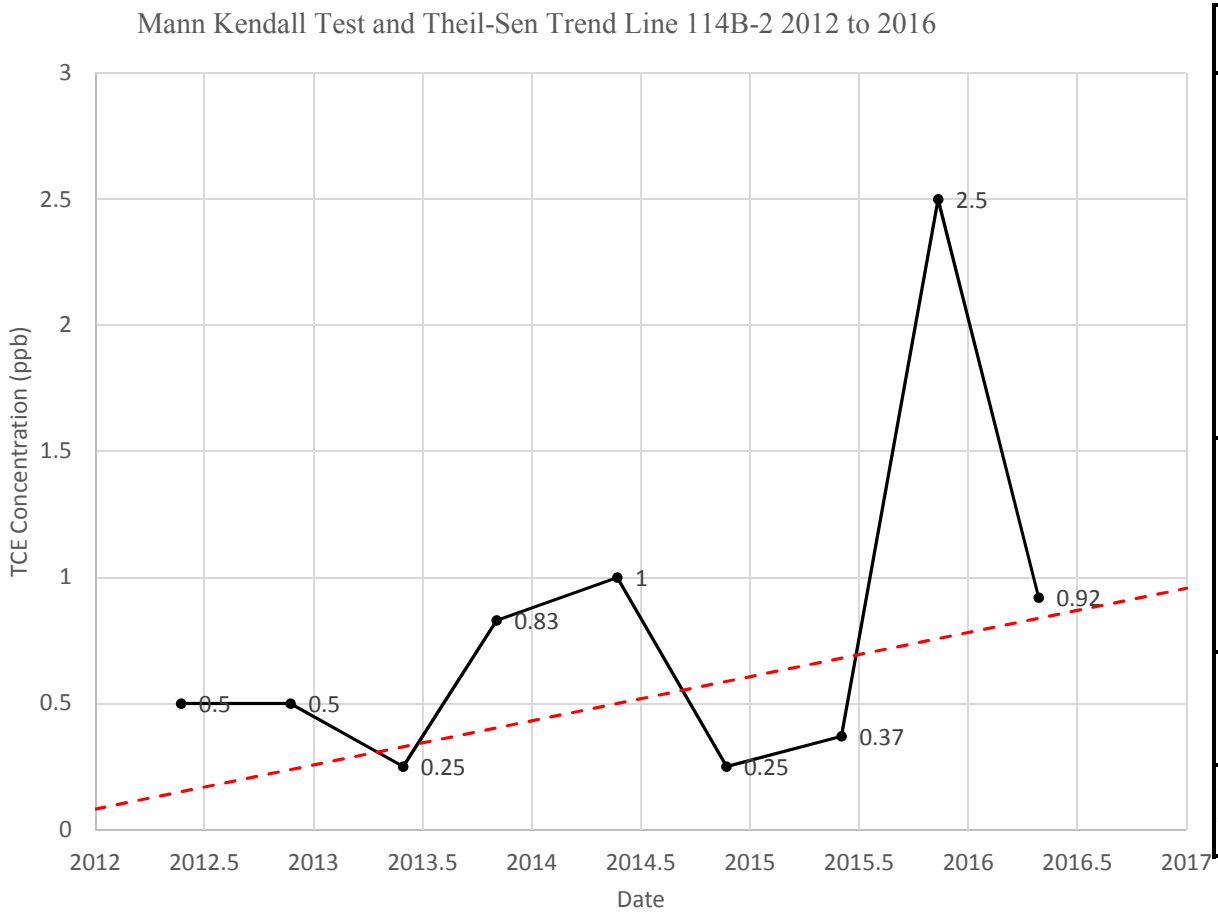


	Well Name	165B-2
	Area	ARIEM
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	6.6
	Maximum	10.1
	Mean	8.656
	Geometric Mean	8.57
	Median	8.6
	Standard Deviation	1.257
Mann - Kendall	Test Value (S)	-21
	Tabulated p-value	0.022
	Standard Deviation of S	9.539
	Standardized Value of S	-2.097
	Approximate p-value	0.018
Theil-Sen Trend Line	Theil-Sen Slope	-0.6807
	Theil-Sen Intercept	1379.7962
	Calculate Date to 5ppb	2019.68004
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

AREA 114B-2

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR TCE

2012-2016 TIME-FRAME



	Well Name	114B-2
	Area	114B-2
General Statistics	Number of Events	9
	Number of Values Reported (n)	9
	Number of Replicates	0
	Number of Nondetects	5
	Minimum	0.25
	Maximum	2.5
	Mean	0.791
	Geometric Mean	0.606
	Median	0.5
	Standard Deviation	0.7
Mann - Kendall	Test Value (S)	10
	Tabulated p-value	0.179
	Standard Deviation of S	9.487
	Standardized Value of S	0.949
	Approximate p-value	0.171
Theil-Sen Trend Line	Theil-Sen Slope	0.1751
	Theil-Sen Intercept	-352.2198
	Calculate Date to 5ppb	-

Insufficient evidence to identify a significant trend at the specified level of significance.

APPENDIX G – MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR 1,4-DIOXANE

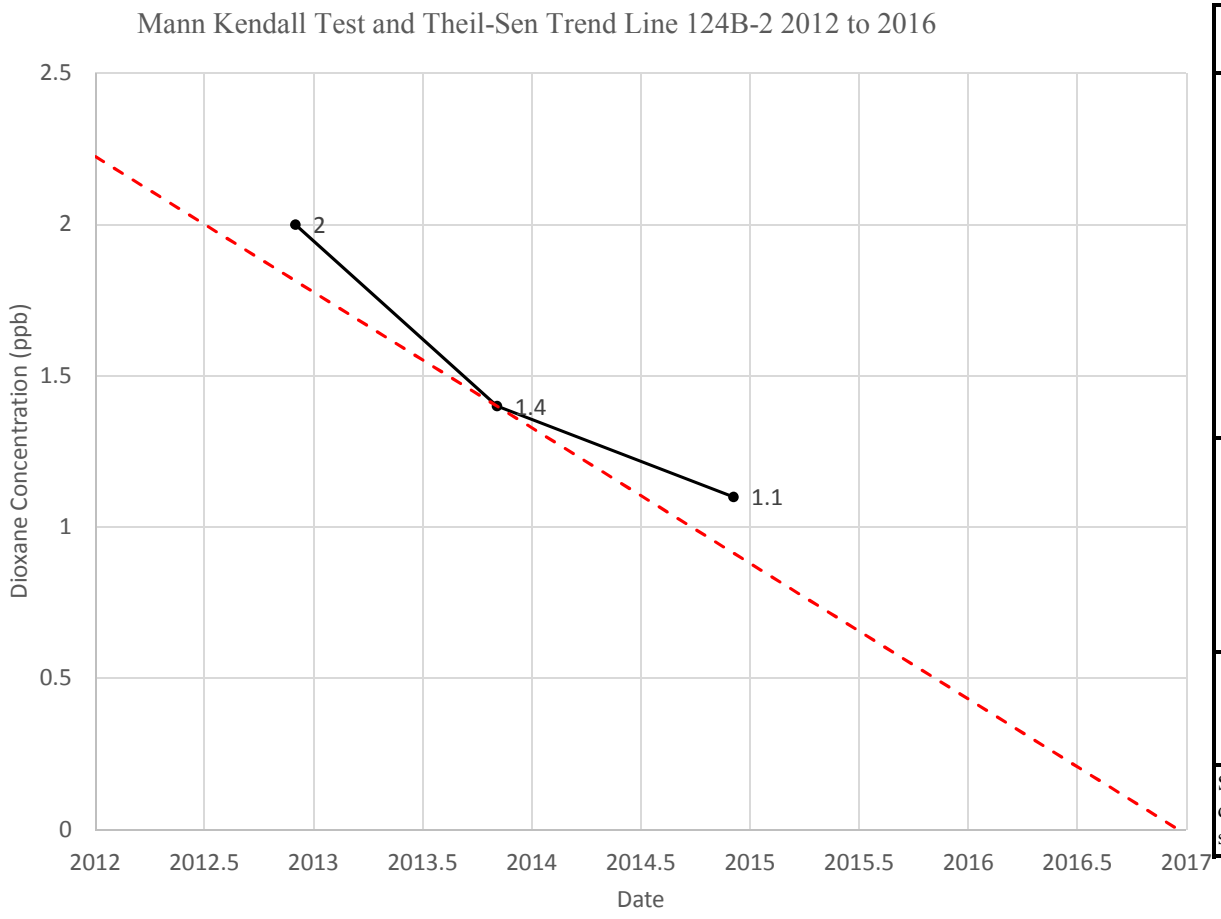
2012-2016 TIME-FRAME

		General Statistics										Mann - Kendall					Theil-Sen Trend Line				
Well Name	Area	Number of Events	Number of Values Reported (n)	Number of Replicates	Number of Nondetects	Minimum - µg/L	Maximum - µg/L	Mean - µg/L	Geometric Mean - µg/L	Median - µg/L	Standard Deviation	Test Value (S)	Tabulated p-value	Standard Deviation of S	Standardized Value of S	Approximate p value	Theil-Sen Slope	Theil-Sen Intercept	Calculate Date to 5ppb	Last Sampling Event Result - µg/L	
124B-2	63, 2, & 45				0							3	N/A		1.044		-0.4482	904.0029	2016.3	1.1	Statistically significant evidence of a decreasingtrend at the specified level of significance.
160A-2	63, 2, & 45	3	3	0	0	1.1	2	1.5	1.455	1.4	0.458	10	0.179	1.915	0.938	0.1674	-0.9787	1975.9009	-	8.2	Insufficient evidence to identify a significant trend at the specified level of significance.
EW-3	63, 2, & 45	9	9	0	0	1.4	10	5.711	4.802	4.4	3.177	22	0.002	9.592	2.598	0.00469	-1.5834	3194.0943	2017.0	0.86	Statistically significant evidence of a decreasingtrend at the specified level of significance.
		8	8	0		0.86	7.4	4.658	4.02	4.95	2.062			8.083							

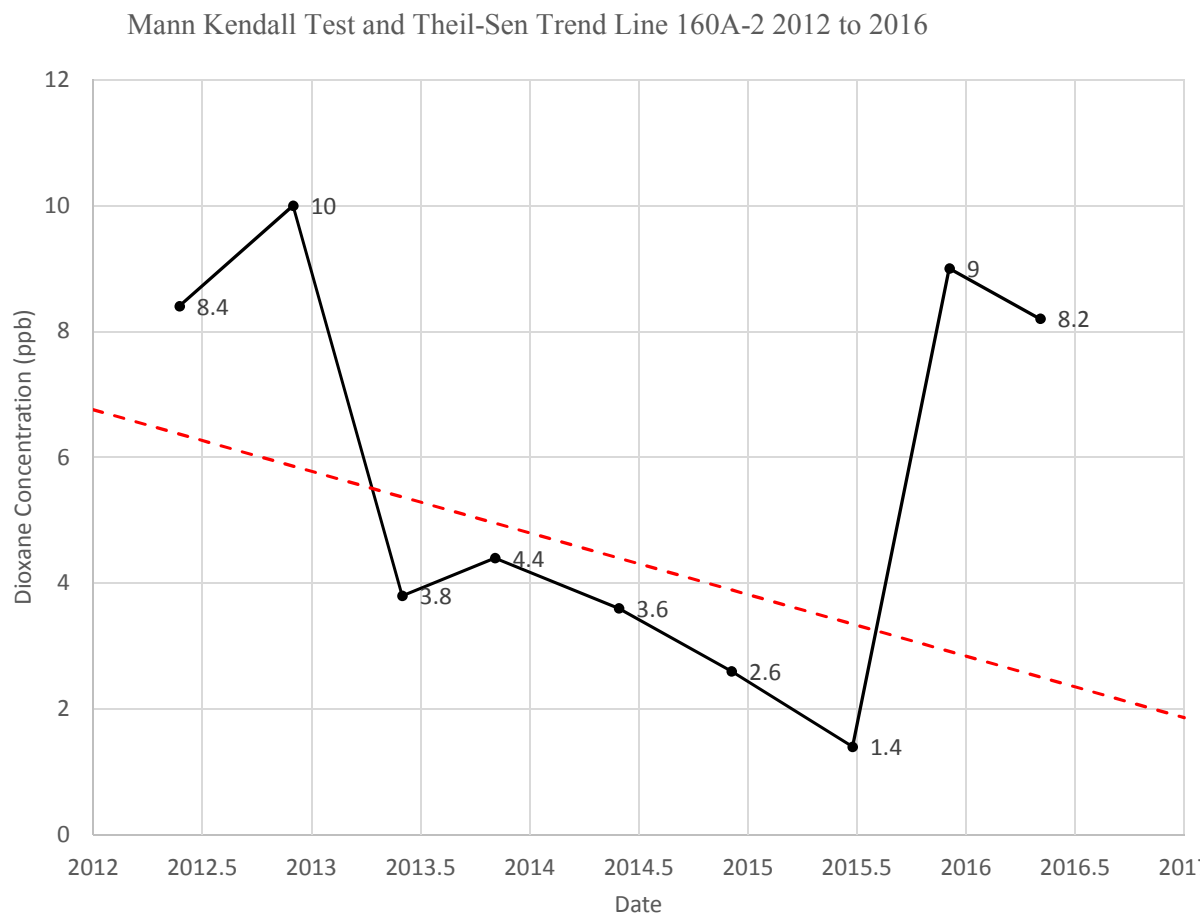
BUILDINGS 63, 2, AND 45 AREA

MANN-KENDALL/THIEL SEN SLOPE TREND PLOTS FOR 1,4-DIOXANE

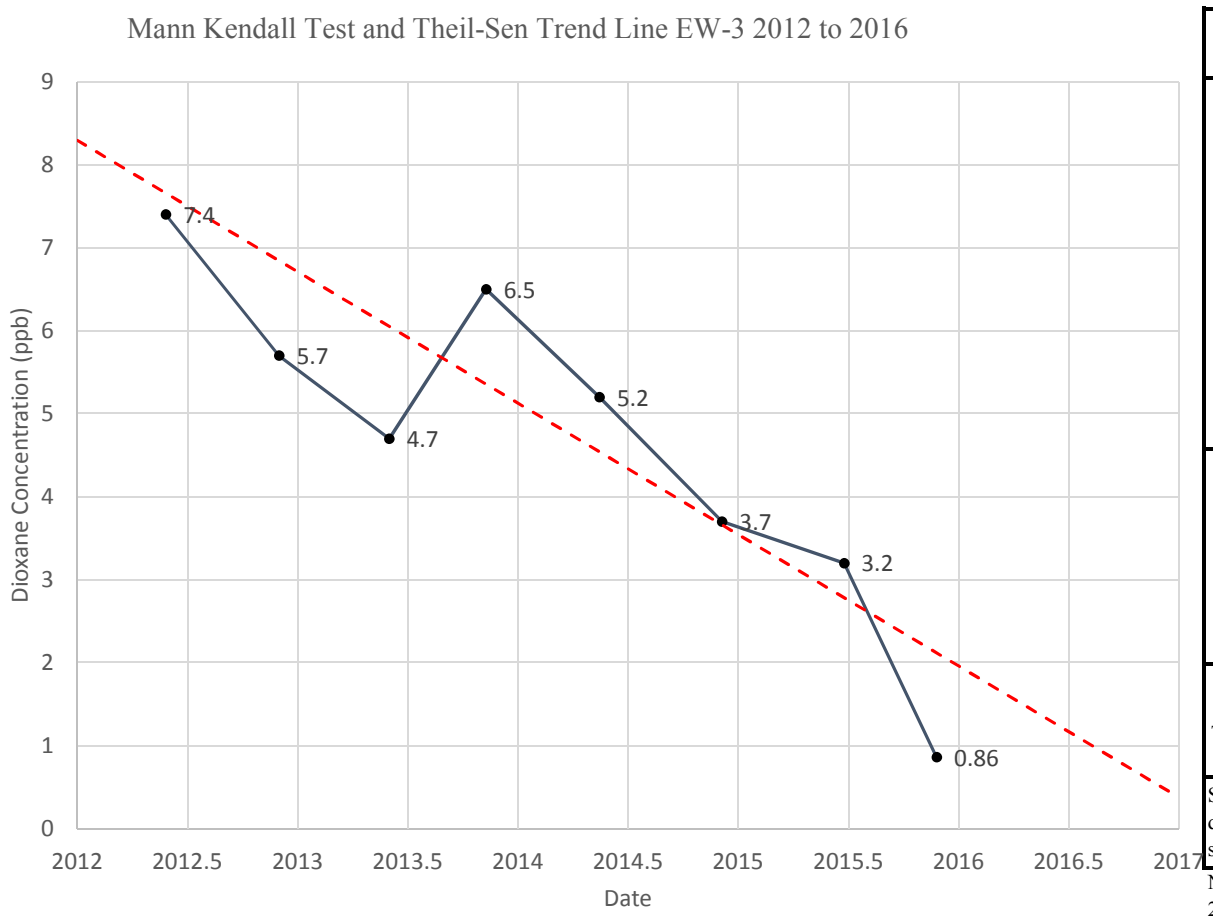
2012-2016 TIME-FRAME



	Well Name	124B-2
	Area	63, 2, & 45
General Statistics	Number of Events	
	Number of Values Reported (n)	3
	Number of Replicates	3
	Number of Nondetects	0 0
	Minimum	1.1
	Maximum	
	Mean	2 1.5
	Geometric Mean	1.455
	Median	1.4
	Standard Deviation	0.458
Mann - Kendall	Test Value (S)	-3
	Tabulated p-value	N/A
	Standard Deviation of S	1.915
	Standardized Value of S	-1.044
	Approximate p-value	0.148
Theil-Sen Trend Line	Theil-Sen Slope	-0.4482
	Theil-Sen Intercept	904.0029
	Calculate Date to 0.3 ppb	2016.29384
Statistically significant evidence of a decreasingtrend at the specified level of significance.		



	Well Name	160A-2
	Area	63, 2, & 45
General Statistics	Number of Events	
	Number of Values Reported (n)	9
	Number of Replicates	9
	Number of Nondetects	0 0
	Minimum	1.4
	Maximum	10
	Mean	5.711
	Geometric Mean	4.802
	Median	4.4
	Standard Deviation	3.177
Mann - Kendall	Test Value (S)	-10
	Tabulated p-value	0.179
	Standard Deviation of S	9.592
	Standardized Value of S	-0.938
	Approximate p-value	0.174
Theil-Sen Trend Line	Theil-Sen Slope	-0.9787
	Theil-Sen Intercept	1975.9009
	Calculate Date to 0.3 ppb	-
Insufficient evidence to identify a significant trend at the specified level of significance.		



	Well Name	EW-3
	Area	63, 2, & 45
General Statistics	Number of Events	8
	Number of Values Reported (n)	8
	Number of Replicates	0
	Number of Nondetects	0
	Minimum	0.86
	Maximum	7.4
	Mean	4.658
	Geometric Mean	4.02
	Median	4.95
	Standard Deviation	2.062
Mann - Kendall	Test Value (S)	-22
	Tabulated p-value	0.002
	Standard Deviation of S	8.083
	Standardized Value of S	-2.598
	Approximate p-value	0.00469
Theil-Sen Trend Line	Theil-Sen Slope	-1.5834
	Theil-Sen Intercept	3194.0943
	Calculate Date to 0.3 ppb	2017.04831
Statistically significant evidence of a decreasingtrend at the specified level of significance.		

Note: The 0.86 from 11/23/2015 was noted in 2015 Annual Report

APPENDIX H

EXTRACTION WELL FLOW RATES AND MASS REMOVAL RATES

Appendix H
Annual Extraction Well Flow Rates and Mass Removal Statistics

NSSC Third FYR

		Flow Rate Information						Mass Removal Current and Prior FYR						
		Average Yearly Flow Rates				Through August		TCE Mass Removed This FYR (Lb) 1/2012 through 12/2015*	PCE Mass Removed This FYR (Lb) 1/2012 through 12/2015*	1,4-Dioxane Mass Removed This FYR (Lb) 1/2012 through 12/2015*		TCE Mass Removed Last FYR - 1/2007 through 12/2011 - (LBS)	PCE Mass Removed Last FYR - 1/2007 through 12/2011 (LBS)	1,4-Dioxane Mass Removed Last FYR (Lb) 1/2007 through 12/2012
Areas	**Wells**	**2012**	**2013**	**2014**	**2015**	**2016**								
T-25	MW-90B-4	31.1	27	24	20.01	9.00		3.11	0.85	N/A		4.07	2.07	N/A
T-25	MW-94B-4	7.1	8.42	8.94	8.41	7.58		0.00	0.00	N/A		0.16	0.04	N/A
T-25	MW-95B-4	23.2	17.8	24	23.28	37.15		0.00	0.01	N/A		0.48	0.11	N/A
T-25	MW-39B-HP4	14.4	16.7	15	15			0.12	0.21	N/A		0.43	4.24	N/A
T-25	MW-96B-4	Off	Off	Off*	1.18	0.95		0.12	0.11	N/A		0.00	0.00	N/A
63,2 and 45	EW-2**	Off	Off	Off	Off	Off								
63,2 and 45	EW-3	1.5	1.12	1.09		0.00				0.05				0.07
63,2 and 45	EW-4	1.1	1.12	1.33		0.00								
22 & 36	EW-5	1.4	0.72	1.26		0.60		1.32	7.01	N/A		0.71	5.06	N/A
22 & 36	EW-6	1.4	1	1.15	6.93	0.86				N/A				N/A
22 & 36	EW-7	2.1	1.81	1.93		0.74				N/A				N/A
22 & 36	EW-8	2.2	2.02	1.95		1.37				N/A				N/A
Boiler Area	MW-40BR	0.8	0.59	0.5		0.20				N/A				N/A
	Flow from T-25 Wells to Treatment System	75.8	69.92	71.94	66.7	53.73	Total Mass (LBS) - T-25 Area	3.36	1.18	N/A		5.13	6.47	N/A
	Flow from EW-3 through EW-8 & MW-40BR to Treatment System	10.5	8.38	9.21	6.93	3.77	Total Mass (LBS) - Areas 22&36 & 63,2 & 45	1.32	7.01	N/A		0.71	5.06	N/A
	Total Flow to Treatment System	86.3	78.3	81.15	74.81	58.45	Total By Systems	4.67	8.19	N/A		5.85	11.52	N/A
	% T-25 Extraction Wells	87.83%	89.30%	88.65%	90.74%	93.55%	% Mass T-25 Area	71.81%	14.44%	N/A		87.79%	56.12%	N/A

Notes:

* - Extraction well MW96B-4 worked periodically in 2014
** - Extraction well ceased operation in December 2011

APPENDIX I

SITE INTERVIEWS

INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached record(s) for a detailed summary of the interviews.

Name	Title/Position	Organization	Date
Brendan Lareau	Treatment Operator	Watermark	09/07/16
Christine Williams	Remedial Project Manager	U.S. EPA	10/06/16
Marco Kaltofen	Co-Chair RAB	RAB	10/11/16
James M. White	Direct of Public Health	Town of Natick	10/12/16
James B. Connolly	Environmental Scientist	NSSC	10/25/16

Interview with Treatment Operator
Brendan Lareau, Watermark
In-person on September 7, 2016

1. What is your overall impression of the project including operation of the groundwater treatment system and long-term monitoring as part of the groundwater remedy at Natick Soldier Systems Center (NSSC)?

   Running well.

2. What is the process for operation and treatment of the groundwater treatment system? Describe operation, O&M procedures, sampling, and permit requirements.

   Groundwater flow from extraction wells to the treatment plant (Building T-25) into equalization tanks and then through bag filters to be treated by liquid phase carbon. Treated water is discharged to the lake or to a holding tank for reuse at the facility including for use at the cooling tower and at sprinklers and hydrants. 1,4-dioxane treatment unit is located separately near extractions wells EW-3 and EW-4 and includes a unit containing sulfuric acid and peroxide for removal of 1,4-dioxane. Groundwater monitoring and discharge sampling is conducted in accordance with long-term monitoring and maintenance and O&M plans.

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

   Remedy is performing well and as designed.

4. Have there been any significant changes to operation and maintenance requirements, sampling and schedule for the groundwater treatment system since the last FYR? If so what are the changes and how are the changes documented?

   None that I am aware of.

5. Have there been any issues with groundwater treatment system and how have those been addressed?

   Minor O&M includes cleaning extraction well screens when pumping rates decline and screen and wells appear clogged. Wells are redeveloped as needed.

   The 1,4-dioxane system has been off-line to replace the holding stand for sulfuric acid tank, which had corroded, rewiring of extraction well 4 and installation of electrical panel and programmable logic system.

6. What measures or opportunities for optimization, if any, have been take to maintain or improve groundwater treatment since the last FYR? Have these measure had any affect?

A work plan for optimizing groundwater cleanup is currently being developed.

7. What are the annual O&M cost for operation of the groundwater treatment system?

   Unable to provide. Performance base contract.

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

   None.

Interview with Remedial Project Manager
Christine Williams, Untied States Environmental Protection Agency
In-person on October 6, 2016

1. What is your overall impression of the project including operation of the groundwater treatment system and long-term monitoring as part of the groundwater remedy at Natick Soldier Systems Center (NSSC)?

   Great.

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

   Yes, I completed the 5YR inspection. During the inspection, I discussed the issue with the Army regarding the 1,4-dioxane system in Buildings 63, 2 and 45 Area being off-line.

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

   None.

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

   Yes.

5. Are you aware of any changes in laws or regulations that would affect remedy implementation or protectiveness?

   None that I am currently aware of.

6. Are you aware of any issues that may call into question short-term or long-term protectiveness?

   1,4-dioxane treatment unit not operating.

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

   No.

Interview with Restoration Advisory Board Co-Chair
Marco Kaltofen
Via Telephone on October 11, 2016

1. What is your overall impression of the project at U.S. Army Solider Systems Center, Natick, Massachusetts (NSSC)?

   Successful. We have dealt with three major issues: 1) air pollution from the incinerator which was removed; 2) surface water issues from that facility which were discharging to the regional sewer; and 3) groundwater contamination from the facility impacting the water supply.

2. What effects has cleanup at NSSC had on the surrounding community?

   Natick relies on its own groundwater supplies. Prior to the treatment system, there was a serious problem that people were unable to drink from their tap. With the treatment system, people can drink the water, and the cleanup should result in water supply source that is safe in the future.

3. Are you aware of any community concerns regarding the site and cleanup conducted at NSSC?

   The community is concerned about the use of the Lake Cochituate. Past discharges made fish inedible and certain parts of Lake Cochituate are off-limit for recreational use. Sediment removal is a partial solution as materials still sequestered.

4. Are you familiar with the various processes that NSSC is utilizing to contain the contamination on site?

   Yes.

5. Do you feel comfortable in the process that NSSC is utilizing to keep the contaminants from migrating off site?

   Yes. Groundwater is being treated at the groundwater treatment plant and mercury has been removed from products at the facility and no longer discharging to the sewer.

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

   Yes.

7. Are there any other items you want to discuss?

   Yes. I have a few concerns. I am concerned that the water treatment plant may not operate for the lifetime of groundwater cleanup leaving contamination in place. ICs

will remain in place but there should be point where ICs are no longer needed. Also, I am concerned that people including immigrant populations may be eating the fish from Lake Cochituate for protein.

Interview with Town of Natick, Director of Public Health
James M. White, Jr.
Via Telephone on October 12, 2016

1. What is your overall impression of the project including operation of the groundwater treatment system and long-term monitoring as part of the groundwater remedy at Natick Soldier Systems Center (NSSC)?

   Good.

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

   We receive updated reports but would be helpful to have in person communication such as a telephone call or conversation to receive an overview of the report's findings and discuss what the results mean as the reports can be lengthy.

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

   None.

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

   Same response as comment 2.

5. Are you aware of any changes in laws or regulations that would affect remedy implementation or protectiveness?

   None.

6. Are you aware of any issues that may call into question short-term or long-term protectiveness?

   None.

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

   No additional comments from those provided above.

Interview with U.S. Army Natick Soldier Systems Center, Environmental Scientist
James B. Connolly
Via Written Correspondence on October 25, 2016

Interview Questions

1. What is your overall impression of the project including operation of the groundwater treatment system and long-term monitoring as part of the groundwater remedy for Operable Unit 1 at Natick Soldier Systems Center (NSSC)?

   The groundwater treatment system is effectively containing contamination and cleaning groundwater as described in the ROD. Long-term monitoring indicates that the cleanup is progressing approximately as expected by the groundwater model. We are pursuing optimization to hopefully identify and implement additional or alternative strategies with a goal of expediting cleanup.

2. Are you aware of any past or planned construction or changes in land-use at NSSC that have the potential to affect the groundwater remedy or its effectiveness?

   No. The current Master Plan was developed in compliance with the ROD.

3. Are you aware of any plans to use the groundwater beneath the NSSC or neighborhood area downgradient?

   No.

4. Are there any plans to modify the operation of the groundwater remedy?

   There are no current plans. The performance-based contract for operation and maintenance of the treatment system includes a task to develop optimization strategies for future treatment system operations. Should the Army choose to implement an optimization program that may require the treatment system operations to change, the Army will consult with EPA and Mass DEP to obtain concurrence prior to any modification.

5. Are you aware of any community concerns regarding the groundwater remedy?

   Not at this time.

6. Are you aware of any issues that may call into question the short-term or long-term protectiveness?

   No.

7. Have there been any complaints, violations or incident related to the site requiring a

response your office. If so, please give details of the events and results of the responses?

None.

8. Are there any additional comments you would like to add regarding the groundwater remedy?

   No.

APPENDIX J
SITE INSPECTION

Site name: Natick Solider Systems System	**Date of inspection:** 09/07/16
Location and Region: Natick, MA, Region 1	**EPA ID:** MA1210020631
Agency, office, or company leading the five-year review: USACE	**Weather/temperature:** Clear, 78 degrees

Remedy Includes: (Check all that apply)

☐ Landfill cover/containment
☐ Access controls
x Institutional controls
x Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Other_____
_____
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls

Attachments: Inspection team roster attached and site map **(documented in FYR text)**

II. INTERVIEWS (Check all that apply)

1. **O&M Treatment Operator** Brendan Lareau (Watermark)
Name Title Date
Interviewed x at site ☐ at office ☐ by phone Phone no.
Problems, suggestions; ☐ Report attached

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

Please refer to Treatment Operator Interview in Site Interview Appendix in FYR.

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

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

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

3. **O&M and OSHA Training Records** — ☐ Readily available — ☐ Up to date — ☐ N/A
Remarks Requested that training records be placed in T-25 Treatment System Area. Training records were added subsequent to inspection. _____
_____

4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	x N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	x N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	x N/A
	☐ Other permits_____	☐ Readily available	☐ Up to date	x N/A
	Remarks_____			
5.	**Gas generation Records**	☐ Readily available	☐ Up to date	x N/A
	Remarks_____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	x N/A
	Remarks_____			
7.	**Groundwater Monitoring Records**	x Readily available	☐ Up to date	☐ N/A
	Remarks. reported in annual reports			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	x N/A
	Remarks_____			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	x N/A
	☐ Water (effluent)	x Readily available	☐ Up to date	☐ N/A
	Remarks_____reported in annual reports _____			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	x N/A
	Remarks_____			

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house x Contractor for Federal Facility
☐ Other

_____

2. **O&M Cost Records (Not available during site inspection)**

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

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

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

Describe costs and reasons: __None indicated. _____
_____
_____
_____
_____
_____

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

A. Fencing☐

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

Remarks_____
_____

B. Other Access Restrictions

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

Remarks_____
_____

C. Institutional Controls (ICs)

1. **Implementation and enforcement (Please refer to notes Comments Section Below)**

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

Type of monitoring (*e.□.*, self-reporting, drive by) ____see note below_____
Frequency _____
Responsible party/agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☐ N/A
Other problems or suggestions: ☐ Report attached

Comments: IC includes prohibitions for installing water supply wells off-site (see Appendix A for Certifications). Certification available for 2012 through 2015. No drinking water supply wells have been installed at facility.

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

D. General

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

2. **Land use changes on site** x N/A
Remarks_____

3. **Land use changes off site** x N/A
Remarks_____

IX. GROUNDWATER/SURFACEWATER REMEDIES x Applicable ☐ N/A

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

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks _____T-25 System operating well; general O&M includes cleaning screens on extraction wells; extraction wells are redeveloped as needed when pump rates decline; carbon change out 1 to 2times per year. 1,4-dioxane pre-treatment unit has been off-line for periods of time since July 2016 for replacement of extraction well components (EW-3), to update electrical panel and programmable logic system and to replace sulfuric acid stand, which had corroded.
_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
X Good condition Needs Maintenance
Remarks_____
_____

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

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

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

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

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

C. Treatment System ☐ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping x Carbon adsorbers
x Filters
☐ Additive_____
☐ Others_____
☐ Good condition ☐ Needs Maintenance
x Sampling ports properly marked and functional
x Sampling/maintenance log displayed and up to date
x Equipment properly identified
☐ Quantity of groundwater treated annually_see FYR text_____
☐ Quantity of surface water treated annually__see FYR text_____
Remarks_____
_____

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

3. **Tanks, Vaults, Storage Vessels**
☐ N/A x Good condition☐ Proper secondary containment ☐ Needs Maintenance
Remarks_____
_____

4. **Discharge Structure and Appurtenances**
☐ N/A x Good condition☐ Needs Maintenance
Remarks_____
_____

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

6. **Monitoring Wells** (pump and treatment remedy)
☐ Properly secured/locked ☐ Functioning☐ ☐ Routinely sampled x Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

D. Monitoring Data

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

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

X. OTHER REMEDIES

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

XI. OVERALL OBSERVATIONS

Implementation of the Remedy, Adequacy of O&M, and Early Indication of Remedy Failure

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
T-25 system functioning as intended with routine O&M conducted. The pre-treatment unit for 1,4-dioxane system has been off-line for periods of time. Army has been trouble shooting system as indicated above.

SITE INSPECTION PHOTOS

Photo 1. Building 94 (Location of T-25 Treatment System).


Photo 2. T-25 Treatment System. Pipes from extraction wells entering into equalization tank.

Photo 3. T-25 Treatment System equalization tank, bag filters and influent sampling port.

Photo 4. T-25 Treatment System 2,000 lbs. liquid phase carbon vessels.

Photo 5. Building 22 facing south.


Photo 6. Buildings 45 and 2 facing in a northerly direction.

Photo 7. 1,4-Dioxane pre-treatment unit in Building 63, 2 and 45 Area facing in a southwesterly direction.

Photo 8. 1,4-Dioxane pre-treatment unit mixing and reactant tanks.

Photo 9. Extraction well 4.

Photo 10. Building 42 (ARIEM Building Area).

Photo 11. Well MW-181B-2 to the north of Building 42.

APPENDIX K

RESPONSES TO REGULATORY AGENCY COMMENTS

Responses to Regulatory Agency Comments on the Draft Third Five-Year Review (FYR) Report for U.S. Army Soldier Systems Center, Natick, Massachusetts, dated December 9, 2012

United States Environmental Protection Agency's Comments on the Draft FYR dated January 26, 2017

1. **Page iv, the NSSC has not yet been deleted off the NPL, please change the summary form to reflect this.**

   Response: Summary form has been corrected.

2. **Page iv, please include the date of the EPA FYR inspection on October 6, 2016.**

   Response: The date of the EPA FYR inspection was added.

3. **Page iv, the triggering action was the date EPA signed the last FYR. Please change to April 12, 2012. Also, please change the due date to April 12, 2017 here and on page 26.**

   Response: Due date was revised as requested.

4. **Page v, since this site is construction complete, please also include a similar, but a more, site- wide protectiveness statement. The site-wide protectiveness statement should read something like: "The remedy at the site currently protects human health and the environment because the groundwater exposure is mitigated through institutional controls and the treatment system contains the plume from moving to the Town's water supply wells. However, in order for the remedy to be protective in the long-term the Army needs to optimize the slug volume removal process or evaluate and implement alternative methods to address the localized area of trichloroethene contamination. "**

   Response: A site-wide protectiveness statement has been included on page vi.

5. **Page 7, for clarity please add "2001" in the title of Table 4.**

   Response: "2001" was added to the table for clarity.

6. **Page 11, under subsection 4.3.3, Long-Term Groundwater Monitoring it would be worth including a phrase or sentence that demonstrates that the sampling of wells occurs in locations that assess groundwater on-site and off-site as the ROD requires "long-term groundwater monitoring including MNA parameters both on-facility and off-facility. ROD p. 69. If as a result of the 2010 conclusion that MNA analysis was no longer necessary, this is no longer the case, then this must be explained and/or noted in this section.**

   Response: A paragraph was added to Section 4.3.3 indicating that LTM monitoring continues in areas outside of the T-25 Area capture zone to monitor COC trends.

7. **Page 2, Section 6.0. Please correct the spelling of "revivew" in the title of this section.**

   Response: Spelling was corrected.

8. **Page 13, Section 6.3.2: In the next to last paragraph it is stated that "...incorporating these revised exposure assumptions into the original OU1 risk assessment would not change risk estimates substantially enough to require altering the cleanup goals at the Site." As shown in the attached Table 1, the changes in toxicity factors and exposure factors identified in Appendix Tables D-1 and D-2, respectively (corrected per following comment on Appendix D-1), would result in higher non-cancer risks for TCE, PCE, and cis-1, 2-DCE for the child and adult resident and the onsite worker; and for manganese for the onsite worker. Updating the risk estimate would not change the previous conclusion that groundwater risks were greater than EPA risk limits. Regardless, the ROD and ESD cleanup goals would continue to be based on ARARs (MCLs for TCE and PCE, and health advisory for manganese), and the institutional controls would prevent exposure to cis-1, 2-DCE. Therefore, the remedy is considered protective. Please delete the following sentence "However, incorporating these revised exposure and toxicity factors into the original OU1 risk assessment would not change risk estimates substantially enough to require altering the cleanup goals at the Site.", and add the following: "Incorporating these revised exposure and toxicity factors into the original OU1 risk assessment would result in increased non-cancer risk, but would not change the original conclusion that groundwater risks exceed EPA risk limits. The ROD and ESD cleanup goals are based on ARARs (MCLs) and TBCs (manganese health advisory), rather than risk; and institutional controls prevent exposure to groundwater. Therefore, the existing cleanup goals remain protective. "**

   Response: The sentence was modified as requested.

9. **Page 13, Table 5, the cleanup level for manganese is 300µ/l. Please change 1700 to 300 µg/l per the ESD.**

   Response: The cleanup level was corrected as requested.

10. **Page 13, Table 5. The cleanup level for nickel is stated as 100 µg/L based on MCL, however the basis for cleanup level should be corrected to MCP. There is no MCL for nickel. In the "Basis for Cleanup Level" column, it states that the Nickel level is MCL, when in fact, the cleanup level is derived from the MCP. See 310 CMR 40.0974(2): TABLE 1++, available at http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/mcp-method-l-groundwater- standards.html. The table should be modified to reflect this information.**

    Response: The table was modified as requested.

11. **Page 13, Table 5, the cleanup level for vanadium is stated as 50 µg/L based on the MCP, however the MCP lists 30 µg/L. See 310 CMR 40.0974(2): TABLE l++, available at http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/mcp-method-l-groundwater- standards.html. Given the change in level, the Army should also address this value and explain whether the more stringent level should govern at this site. If so, the Army should discuss whether future decision documents are anticipated to incorporate this value as a clean-up value and how remedial actions will be affected such that additional action or monitoring efforts will be required. An evaluation of the FYR metals analysis should include this change.**

Response: During this review period groundwater samples were collected from 10 monitoring and/or extraction wells. Of the 10 samples, only the sample collected from MW209B-HP2 contained vanadium at a concentration of 6.5 J µg/L. The maximum detected vanadium concentration historically was detected in this well (maximum concentration of 10.1 J µg/L in March 2009). Thus, of the wells sampled at NSSC for vanadium, none of the concentration have measured concentrations above the MCP criterion.

The following text has been added to Section 9.1, #4: "While there is a more stringent MCP GW-1 cleanup level for vanadium (30 ug/L), vanadium has not been detected in groundwater at the site above this criterion and was only detected in 1 of 10 monitoring well locations during this FYR period with the single detection below the MCP criteria. The only secondary COC, above cleanup levels was manganese, which increased approximately three fold in Well MW-128A between 2010 and 2015. The Army should continue to monitor dissolved manganese in this area and determine the source of the reducing conditions in this area."

12. **Page 13, table 5, The "Basis for Cleanup Level" column for 1,4-dioxane should state "MCP," not 0.3. The Cleanup Level of 0.3 for 1,4-dioxane is based on the MCP.**

Response: The "basis for cleanup level" column has been revised as requested.

13. **Page 15, Table 6, indicates that there is a statistically significant increase of TCE at extraction well MW-96B-4. However, the Army does not further mention or address this increase. Please discuss the relevance of this data and whether it affects the environmental protectiveness finding. If it does have an effect on the protectiveness finding or on the effectiveness of the current remedy, please discuss how this issue will be addressed and the impacts mitigated or resolved.**

Response: Extraction well MW-96B-4 was off-line from 2007 through approximately 2013. During this period, since groundwater was not drawn toward the well, TCE concentrations measured in the well declined from ~ 20 µg/L to ND. Once the well was restarted in 2013, the concentrations in the well rebounded to levels similar to when the system was online. This is consistent with an extraction well that captures mass within a plume. The increasing trend in well MW-96B-4 (Table 6) is the result of the reestablishment of a prior "equilibrium." The text has been modified to explain the increasing trend observed.

14. **Page 17, please add a discussion of trends for the secondary CoCs. EPA noted the steady increase of manganese levels at MW128A. Please investigate the cause of this increase.**

Response: During this FYR, the Army sampled secondary COCs in 2015. All of the secondary COCs were below the ROD cleanup levels in the monitoring wells except for dissolved manganese. Dissolved manganese was detected above the cleanup level of 300 ug/L in wells MW-128A and MW-159A-2 at concentrations of 24,300 ug/L and 471 ug/L, respectively.

The dissolved manganese concentration measured in Well MW-128A represents an approximately three-fold increase from the prior sampling event of this well in 2010. In 2010, manganese was detected in Well MW-128A at 7,380 ug/L. While dissolved manganese concentrations increased in Well MW-128A, dissolved manganese concentrations detected in Well MW-159A-2 were consistent with concentrations measured in the well in 2010.

The presence of dissolved manganese is likely due to reductive dissolution caused by the presence of organic constituents in groundwater. There was a soil removal in this area associated with a former tank (ICF International, 2007b). The report states that "Elevated concentrations (but below MCP S-1/GW-1 standards) of lighter-weight petroleum hydrocarbons, an oily sheen, and a petroleum odor were observed in a soil sample (26 to 28 feet bgs) from MW-128A. MW-128A is located off the northwest corner of Building 15 near a former 1,500 gallon, single-walled, No. 2 fuel oil UST (Tank 15), which was reportedly installed in 1979 and removed in 1991. Although there was no observed evidence of leakage during the removal of the tank, the detection of the lighter-weight petroleum hydrocarbons at MW-128A may suggest that the former UST may have leaked and impacted soils and ground water." The Army indicated that it was not known whether the former UST was equipped with spill protection bucket on the fill, and if spills during filling was a potential source of petroleum given the fact the tank itself did not appear to be leaking.

Additional text was added to Section 6.4.2 to discuss dissolved manganese trends in groundwater and in Section 9.1 to recommend that the Army should continue to monitor dissolved manganese in this area and determine the source of the reducing conditions.

15. **Page 19, third paragraph, please discuss the lack of plume control on the east side near Pegan Cove.**

Response: Groundwater detected in monitoring well MW-125B-2 is on the other side of the groundwater divide (Figure 6), and outside of the influence of EW-3 and EW-4. Concentrations of TCE are detected above the MCL in this well and TCE is expected to discharge to Pegan Cove likely above MCLs prior to being diluted. Based on groundwater flow there are no other wells between MW-125B-2 and Pegan Cove. This area is being evaluated as part of the optimization work proposed by the Army for the Building 63, 2 and 45 Area.

The following text was added to Section 6.4.3 “Groundwater in the vicinity of monitoring well MW-125B-2 is outside of the influence of EW-3 and EW-4 and likely discharges to Pegan Cove. Based on groundwater flow there are no other wells between MW-125B-2 and Pegan Cove. This area is being evaluated as part of the optimization work proposed by the Army for the Building 63, 2 and 45 Area.”

16. **Page 20, Section 6.4.5. It is stated that the VI pathway was investigated and it was found that currently this pathway is incomplete. Is there a possibility VI could be a concern in the future? Would this be a concern if there are any land use changes? Please expand the discussion in this section to address these issues.**

Response: Clean water is present above the deeper contaminated water acting as a barrier to migration of chlorinated volatile organic compounds upward. Any future land-use changes are unlikely to affect the VI pathway and the pathway would remain incomplete as the clean water present above the deeper contaminated water would continue to prevent a barrier to migration of chlorinated volatile organic compounds upward. Text has been expanded as requested.

The following text was added to Section 6.4.5 “Any future land-use changes are unlikely to affect the VI pathway and the pathway would remain incomplete as the clean water present above the deeper contaminated water would continue to act as a barrier to migration of chlorinated volatile organic compounds upward.”

17. **Page 22, Section 7.1 Question A: The opening statement of this section, which says that the remedy is mostly working as intended, is a little bit confusing. It is unclear from**

this statement why the remedy is not completely functioning as intended. Please reword to be more specific such as, "The remedy is currently functioning as intended at 4 out of 5 Areas of Concern, the following section details the areas where the remedy is functioning as intended and where additional work is needed to make the remedy function as intended."

Response: Text was revised as follows: "Yes, the remedy is currently functioning as intended in the short-term in four of the five areas. The following section details the areas where the remedy is functioning as intended and where additional work is needed for the remedy to function as in the long-term.

18. **Page 23, The Army indicates that the third RAO, to "Restore aquifer to drinking water standards within a reasonable time frame, "is only partially performing as intended because the slug volume removal approach is not successfully remediating the ARIEM Building Area, and a more detailed analysis of total mass present is necessary to determine whether remediation is functioning as intended for the third RAO. The Army has directly addressed the issues with the ARIEM Building Area, however, it is unclear as to whether the slug removal optimization study will also include a new and more accurate analysis of total mass present in areas other than the T-25 area. If so, please make that clear. If not, this issue must be addressed in some way.**

Response: In Section 9.1- Other Findings, the second recommendation now states that: "The Army is currently preparing a work plan to optimize groundwater cleanup, which is expected to be completed in the spring of 2017. This work plan will include updating the groundwater flow and transport model to evaluate what effective changes can be made to the treatment system including determining if additional extraction wells placed within the core of the Building 63, 2, and 45 groundwater plume would accelerate groundwater cleanup in this area. The effects of matrix diffusion from the aquifer solids to groundwater will be included in the groundwater modeling and optimization efforts. A similar analysis will be performed for the Buildings 22 and 36 Area. The optimization work plan will also consider if the source areas can be better defined with high resolution characterization."

19. **Page 24, According to the FYR, the remedy (including the six listed RAOs) is only "partially functioning as intended." FYR, p. 24. The Army then goes on to state that "a rigorous estimate of contaminant mass in the area is necessary to determine progress toward restoring the aquifer to drinking water standards. A rebound test could also be helpful to assess progress toward achieving this goal." FYR, p. 24. As mentioned in the comment above, it is unclear whether these suggested or recommended actions would be included in the optimization study or other recommended actions specified on pages 25 and 26 of the FYR. If these actions are included, then the Army should make that clear.**

Response: The Army is currently preparing to collect data to develop the optimization plan. Once data are collected, Army will consider FYR recommendations and the data to develop an optimization plan.

20. **Page 24, Section 7.2: The 2nd paragraph refers to "Section 6.3.3...". This section does not occur in Section 6. Please revise. In the 3rd paragraph, please delete "However, incorporating these revised exposure and toxicity factors into the original OU1 risk assessment would not change risk estimates substantially enough to require altering the cleanup goals at the Site.", and add the following: "Incorporating these revised exposure and toxicity factors into the original OUI risk**

assessment would result in increased non-cancer risk, but would not change the original conclusion that groundwater risks exceed EPA risk limits. The ROD and ESD cleanup goals are based on ARARs (MCLs) and TBCs (manganese health advisory), rather than risk, and institutional controls prevent exposure to groundwater. Therefore, the existing cleanup goals remain protective. "

Response: The section will be correctly referenced as Section 6.3.2. The text has been revised as requested.

21. Page 24, section 7.2, please add a paragraph to indicate that while the OUI ROD does not have the EPA MNA guidance as a TBC in the ARAR tables the Army will follow that guidance when the treatment system is turned off. On page 22, #3, the text identified that there are no timeframes identified in the OU1 ROD or ESD for when groundwater cleanup is required. However, EPA has issued guidance on implementing monitored natural attenuation remedies that was not identified as To Be Considered in either the ROD or ESD. The Army needs to identify that the MNA component of the groundwater remedy is consistent with this guidance in order to be able to say it is protective (or this may be discussed in Section 7.2).

Response: Text was added to Section 9.1 indicating that Army will consider U.S. EPA's MNA guidance in evaluating MNA after the groundwater extraction and treatment systems are turned off.

22. Page 24, Question C, please discuss the cleanup levels used during the PCB soil removal at the Building 5 Transformer release. If levels were protective of the current use, industrial commercial, an IC should be included a CERCLA decision document and in Master Plan that notes the area cannot be used for barracks or base housing until an investigation and possible cleanup to residential levels. This particular issue was not evaluated during the OU3 or OU4 Rl/FS.

Response: PCBs in the Building 5 pad area and surrounding soil were addressed under the TSCA program. Cleanup Goals for PCBs and completion of the cleanup was described in Section 3.9 and Section 5.17.3.1 of the Master Environmental Plan (MEP), respectively (Argonne 1993). As described in the MEP, cleanup was completed to allow unrestricted use and no further action is required. PCBs that discharged through the outfall and resulted in contaminated sediment were addressed under CERCLA as described in the Final Sediment Remedial Action Completion Report, Operable Unit 2 (ICF International, 2010a). Pegan Cove sediments were cleaned up to allow unrestricted use, and no further action is required.

23. Page 26, Add additional recommendation to evaluate the upward trend of manganese at MW 128A.

Response: The Army has added evaluation of manganese as an additional recommendation under Section 9.1, item #4.

24. Figure 3 seems redundant. Figure 2 and figure 10 could be referenced in section 3.2 instead of Figures 2 and 3.

Response: Figure 3 was included to compare the area of the plume specified in the ESD versus the earlier site designations on Figure 2.

25. **Figures should be updated with the most recent groundwater flow and contaminant maps from the fall 2016 sampling rounds, it is confusing to see 2014 groundwater flow maps when the 2015 maps are available now and the 2016 maps should be available by next month**.

    Response: The report has been updated with the 2016 groundwater flow and contaminant concentration maps. Please note the contaminant concentration maps were generated with unvalidated data. Because the 2016 fall event data was not available during the period in which the FYR was prepared, it was agreed during the October 2016 scoping meeting with the regulatory agencies that the FYR team would complete a comparison of the fall 2016 data to the 2015 data to identify any significant changes. The FYR team did not identify any significant changes when comparing the fall 2016 data (unvalidated data) to the 2015 data.

26. **Table 5: 1,4-dioxane basis for cleanup is a numerical value, it should be updated to reflect where the .3 came from (MassDEP drinking water guidelines/GW-1 standard).**

    Response: Table 5 will be updated to correctly state the basis for the 1,4-dioxane cleanup goal**.**

27. **Appendix B - Army should have a RAB meeting this spring to update the public on this document and plans for additional investigation at the building 63, 2 & 45 Area of Concern**.

    Response: Army plans to have a RAB meeting in the spring to update the public on the additional investigation at the Building 62, 2 and 45 Area and the FYR.

28. **Appendix C - the Region 9 PRGs should be updated with the EPA RSLs**

    Response: This table was not modified as it was pulled directly from the 2001 ROD.

29. **Appendix Table D-1: Per Section 5.3 of the EPA Regional Screening Level (RSL) User Guide, the updated oral Reference Dose (RID) for manganese should be the "non-diet" value of 2.4E-02 mg/kg- day, rather than the "diet" value of 1.4E-01 mg/kg-day. Since this correct value is slightly higher than the ROD value of 2.3E-02 mg/kg-day, the revised value should continue to be colored blue. Per Section 5.4 of the EPA RSL user guide, the updated oral RID for vanadium should be 5.0E-04 mg/kg-day rather than 9.0E-03 mg/kg-day to adjust to the molecular weight of vanadium in vanadium pentoxide. The RID for TCE should be 5.0E-04 mg/kg-day, rather than 5.4E-04 mg/kg-day. Please revise the table.**

    Response: Appendix D, Table D-1 has been updated as requested.

Massachusetts Department of Environmental Protection's Comments on Draft FYR received on January 12, 2017.

1. Section 3.2 (History of Contamination): Comparison of Figures 2 and 3 suggests that remedial actions have been completed at several historic groundwater contamination sites (Boiler Plant Area, Water Supply Well Site, and Former Proposed Gymnasium Site); however, the report does not confirm or otherwise explain the status of these sites. To document the situation, please

include a brief description of these sites, including the contaminants of concern, site history, and the current status.

Response: Remedial actions, soil removal actions, have been completed at the Boiler Plant Area and the Former Proposed Gymnasium Site. These actions were documented in no further actions RODs listed in Table 2 of the FYR. Because response actions have been completed for these sites and construction is complete, the FYR does not provide a lengthy history for these sites but rather focuses on groundwater contamination remaining. The Army can provide you with the documents referenced in Table 2 for the soil operable units. U.S. EPA's Preliminary Close Out Report (U.S. EPA, 2014b) also includes a discussion of the actions taken for the soil operable units. No other remedial actions were completed at the Post Drinking Water Well Site, which was later renamed as the Building 63, 2 and 45 Area as the title of the site was confusing to the public.

2. Section 6.4, Second Paragraph: Please include a citation to identify the "groundwater modeling report".

Response: A citation was added in Section 6.4 following the sentence in the fourth bullet to provide references to the groundwater modeling reports.

3. Section 6.4.2, T-25 Groundwater Area COCs and Trends: An increasing trend was identified in samples collected from well MW-96B-4 (Table 6). The report should include a brief discussion of the significance of this trend.

Response: Please see response to EPA Comment 13.

4. Section 6.4.2, Buildings 63, 2 and 45 COCs and Trends: As noted here, the TCE plume footprint did not decrease significantly during the five-year review period, possibly a result of the nearby extraction wells being located outside the core of the plume. Consistent with this observation, the trend analyses indicate that TCE concentrations in samples collected from wells MW-123B-2 (84.8 ug/L) and MW-125B-2 (27.4 ug/L) have stabilized well above the MCL. These conditions indicate that the cleanup time for the Buildings 63, 2, and 45 Area may extend indefinitely into the future unless the configuration of extraction wells is adjusted or additional source area remediation is conducted. Consequently, the report should include an evaluation of cleanup time, and if appropriate, the report should include recommendations to ensure that cleanup of the Buildings 63, 2 and 45 Area will be completed in a reasonable timeframe.

Response: The FYR recommends in Section 9.1 that a numerical groundwater flow and transport model be updated with current data to evaluate current PCE and TCE cleanup timeframes for the T-25 Area and evaluate cleanup timeframes for the other areas within the plume. It is our understanding that this will be completed as part of the optimization work. The FYR team is not scoped to run the numerical model.

The Army is currently preparing a work plan to optimize groundwater cleanup, which is expected to be completed in the spring of 2017, which will use the groundwater flow and transport model to evaluate what effective changes can be made to the treatment system including determining if additional extraction wells placed within the core of the Building 63, 2, and 45 would accelerate groundwater cleanup in this area.

5. Section 6.4.2, Secondary COCs Evaluation: The elevated concentration of manganese (24,300 ug/L) reported in the sample collected from well MW-128A suggests the presence of reducing conditions induced by a nearby release of organic contamination. The report should include an

explanation based on an assessment of relevant site data or a recommendation to conduct an assessment.

Response: Please see response to EPA comment 14.

6. Section 6.4.2, Secondary COCs Evaluation: The report should note that DDT was reported above the MCL (25 ug/L vs. 0.3 ug/L) in the sample collected from well MW-95B-4 (Appendix E). The report should include a brief discussion of the significance of this result, and if appropriate, recommendations for assessment.

   Response: Appendix E, Table E-3 inaccurately reported a DDT detection of 25 µg/L in well MW-95B-4 in the T-25 Area. The appendix table was revised accordingly.

7. Section 6.4.4: The report should include (e.g., tables in an appendix) or cite separate documents that present the TCE, PCE, and 1,4-dioxane results from the monthly treatment system effluent samples.

   Response: Text was added to Section 6.4.4 indicating that the COC effluent concentration data was obtained from Appendix E of the GWETS Annual Reports.

8. Section 7.1: Based on the information presented here and the protectiveness statement provided in Section 10.0, which indicates that the remedy is protective in the short-term, it appears the report should state that the answer to Question A is "No". Also refer to Exhibit 4-5 of USEPA's FYR guidance (USEPA, 2001).

   Response: Text has been revised as suggested in EPA comment 17.

9. Figure 4: Red arrows should be deleted or explained in the legend.

   Response: The red arrows were deleted.

Massachusetts Department of Environmental Protection's Comments on Draft FYR received on March 1, 2017.

1. To explain the status of the Boiler Plant Area, Water Supply Well Site, and Former Proposed Gymnasium Sites, which are identified in Figure 2, please add a brief discussion of the status of these sites to Section 3.2 (History of Contamination) of the report (refer to MassDEP Comment 1 and the Army's response to that comment).

   Response: A brief discussion has been added to Section 3.2.