

**Office of Legacy Management**

**Mound, Ohio, Site**

**Phase I Groundwater  
Monitoring Report  
Calendar Year 2011**

**September 2012**



U.S. DEPARTMENT OF  
**ENERGY**

Legacy  
Management

This page intentionally left blank

**Office of Legacy Management**

**Mound, Ohio, Site**

**Phase I Groundwater Monitoring Report  
Calendar Year 2011**

**September 2012**

This page intentionally left blank

# Contents

Abbreviations.....	iii
1.0 Introduction.....	1
1.1 Purpose.....	1
1.2 Summary of 2010 Annual Report.....	2
2.0 Monitoring Program.....	3
2.1 Monitored Natural Attenuation of TCE.....	3
2.2 Confirmatory Sampling.....	5
2.3 Triggers.....	5
2.4 Groundwater Flow.....	6
2.5 Deviations from the Sampling Plan.....	6
2.6 Trend Analysis Methodology.....	8
3.0 Phase I MNA Remedy.....	9
3.1 Monitoring Results.....	9
3.2 Trend Analysis.....	11
3.3 Recommendations.....	13
4.0 Phase I Confirmatory Sampling.....	15
4.1 Monitoring Results.....	15
4.2 Trend Analysis.....	20
4.3 Recommendations.....	22
5.0 Inspection of the Monitoring System.....	25
6.0 Data Validation.....	27
7.0 Summary.....	29
7.1 MNA Remedy.....	29
7.2 Radium and Barium.....	29
8.0 References.....	31

# Figures

Figure 1. Phase I MNA Remedy Monitoring Locations.....	4
Figure 2. Regional Groundwater Flow at the Mound Site.....	7
Figure 3. TCE Concentrations over Time—1999 through 2011.....	10
Figure 4. cis-1,2-DCE Concentrations—1999 through 2011.....	11
Figure 5. 2011 Annual Average Concentrations of TCE and DCE in Phase I Groundwater.....	12
Figure 6. Barium Concentrations—2000 through 2011.....	16
Figure 7. Ra-226/228 Levels—2002 through 2011.....	17
Figure 8. 2011 Annual Average Concentrations for Radium and Barium in Phase I.....	18
Figure 9. Sodium Concentrations—2000 through 2011.....	19
Figure 10. Chloride Concentrations—2000 through 2011.....	20
Figure 11. Phase I Geoprobe Sampling Locations.....	24

## Tables

Table 1. Remedy (MNA) Monitoring for Phase I.....	5
Table 2. Confirmatory Monitoring for Phase I.....	5
Table 3. Trigger Levels for Phase I MNA Remedy and Confirmatory Monitoring Programs.....	6
Table 4. Summary of VOC Monitoring Results in Phase I for 2011.....	9
Table 5. Summary of Trend Analysis Results for TCE in Phase I for 2011.....	13
Table 6. Summary of 2011 Confirmatory Monitoring Results for Barium and Radium.....	15
Table 7. Summary of 2011 Confirmatory Monitoring Results for Sodium and Chloride.....	19
Table 8. Summary of Trend Analysis Results for Barium and Combined Radium in Phase I for 2011.....	21
Table 9. Summary of Trend Analysis Results for Sodium and Chloride in Phase I for 2011.....	21

## Appendixes

Appendix A	Mound-Specific Sampling Protocols
Appendix B	2011 Phase I MNA and Confirmatory Sampling Data
Appendix C	March/April 2011 Monitoring Well Photos

## Abbreviations

BVA	Buried Valley Aquifer
DCE	dichloroethylene
DOE	U.S. Department of Energy
LOC	level of concern
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/L	milligrams per liter
MNA	monitored natural attenuation
pCi/L	picocuries per liter
Ra-226/228	radium-226 and radium-228
TCE	trichloroethylene
VOC	volatile organic compound
VSP	Visual Sample Plan

This page intentionally left blank



## 1.0 Introduction

Phase I is an approximately 52-acre area made up of three distinct sections and lies on the southern border of the Mound plant property. This area contains monitoring wells that are screened in both the Buried Valley Aquifer (BVA) and the upgradient bedrock aquifer system. Monitored natural attenuation (MNA) is being used as the remedy for a small, discrete section of the bedrock groundwater system contaminated with trichloroethylene (TCE) to ensure that concentrations of TCE within the bedrock groundwater are decreasing to levels below the Safe Drinking Water Act maximum contaminant level (MCL) and do not impact the downgradient BVA.

Several wells in this area also have levels of barium, radium, chromium, and nickel that exceed MCLs established by the Safe Drinking Water Act. The elevated levels of barium and radium were evaluated and determined to be naturally occurring within the local bedrock matrix serving as the mineral source. The elevated chromium and nickel levels were determined to be the result of corrosion of the stainless-steel well casings. The U.S. Department of Energy (DOE) has committed to monitoring selected wells to confirm the results of previous investigations on which these conclusions were based.

### 1.1 Purpose

This report was prepared in support of the selected remedy for Phase I as outlined in the *Phase I Record of Decision, Miamisburg Closure Project* (DOE 2003a). It summarizes the data collected in 2011, and it documents the progress of the MNA remedy for Phase I. All sampling and data analyses were performed in accordance with the *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan* (DOE 2004), unless noted otherwise.

This report includes data collected during the two semiannual groundwater sampling events performed in 2011. In addition to data collected in support of MNA, additional data are presented in support of the confirmatory monitoring for radium and barium in selected wells located within Phase I that are sampled quarterly. Data will be used to support that elevated levels of barium and radium in groundwater are the result of the interaction between the surrounding bedrock and groundwater with high sodium and chloride that resulted from previous salt storage. Data are presented in both time-series and map-view plots. Trend analysis was performed on selected wells using the non-parametric Mann-Kendall test. This type of long-term trend analysis can be used to confirm trends in contaminant concentrations over time. The time-series plots will also be used to evaluate changes in data over time and to interpret the effectiveness of the MNA remedy.

This report also documents operational changes that occurred during the reporting period and identifies maintenance activities associated with the monitoring wells being sampled.

## 1.2 Summary of 2010 Annual Report

The conclusions and recommendations from the 2010 Phase I Groundwater Monitoring Report (DOE 2011a) were as follows:

- Volatile organic compound (VOC) data collected in support of the MNA remedy demonstrated that the BVA was not impacted by the localized TCE contamination in the bedrock groundwater system near wells 0411 and 0443. TCE concentrations in source wells 0441 and 0443 and seep 0617 continued to exceed the MCL of 5 micrograms per liter ( $\mu\text{g/L}$ ). TCE concentrations in well 0411 have decreased since monitoring began in 1999, as supported by trend analysis, and concentrations have leveled off over the past few years. Statistical analysis did not indicate trends in VOC data from well 0443 and seep 0617 during 2010. No changes were recommended for the MNA remedy monitoring for TCE.
- Combined radium-226 and radium-228 (Ra-226/228) levels and barium concentrations remained within background levels in the downgradient BVA wells during 2010. Radium levels were slightly higher in wells 0400 and 0402 than in the other BVA well P033; however, levels of combined Ra-226/228 were less than the MCL. Confirmatory sampling showed that combined Ra-226/228 and barium in well 0445 continue to vary and exceed MCLs. Combined Ra-226/228 levels exceeded the level of concern (LOC) in this well. Levels of these two constituents were higher in 2009 and 2010 than in previous years. It is possible that a change in sampling methods in late 2008 caused a shift in data. Sodium and chloride results indicated that the highest concentrates are in well 0445, where elevated radium and barium are present. It was recommended that radium samples be collected quarterly to monitor the rate at which the levels appeared to be increasing in the BVA wells.

## 2.0 Monitoring Program

Groundwater in Phase I is monitored for TCE and its degradation products to verify that the concentration of TCE is decreasing by natural attenuation to concentrations less than the MCL. This groundwater monitoring program was established to ensure that the BVA is not negatively affected by TCE-contaminated groundwater within the Phase I bedrock aquifer system. The objective of this monitoring is to protect the BVA by verifying that the concentration of TCE near well 0411, well 0443, and seep 0617 is decreasing and to confirm that TCE is not adversely affecting the BVA. This program may be decreased or terminated when TCE concentrations in well 0411, well 0443, and seep 0617 meet conditions outlined in the monitoring plan, such as reaching the MCL for four consecutive sampling events.

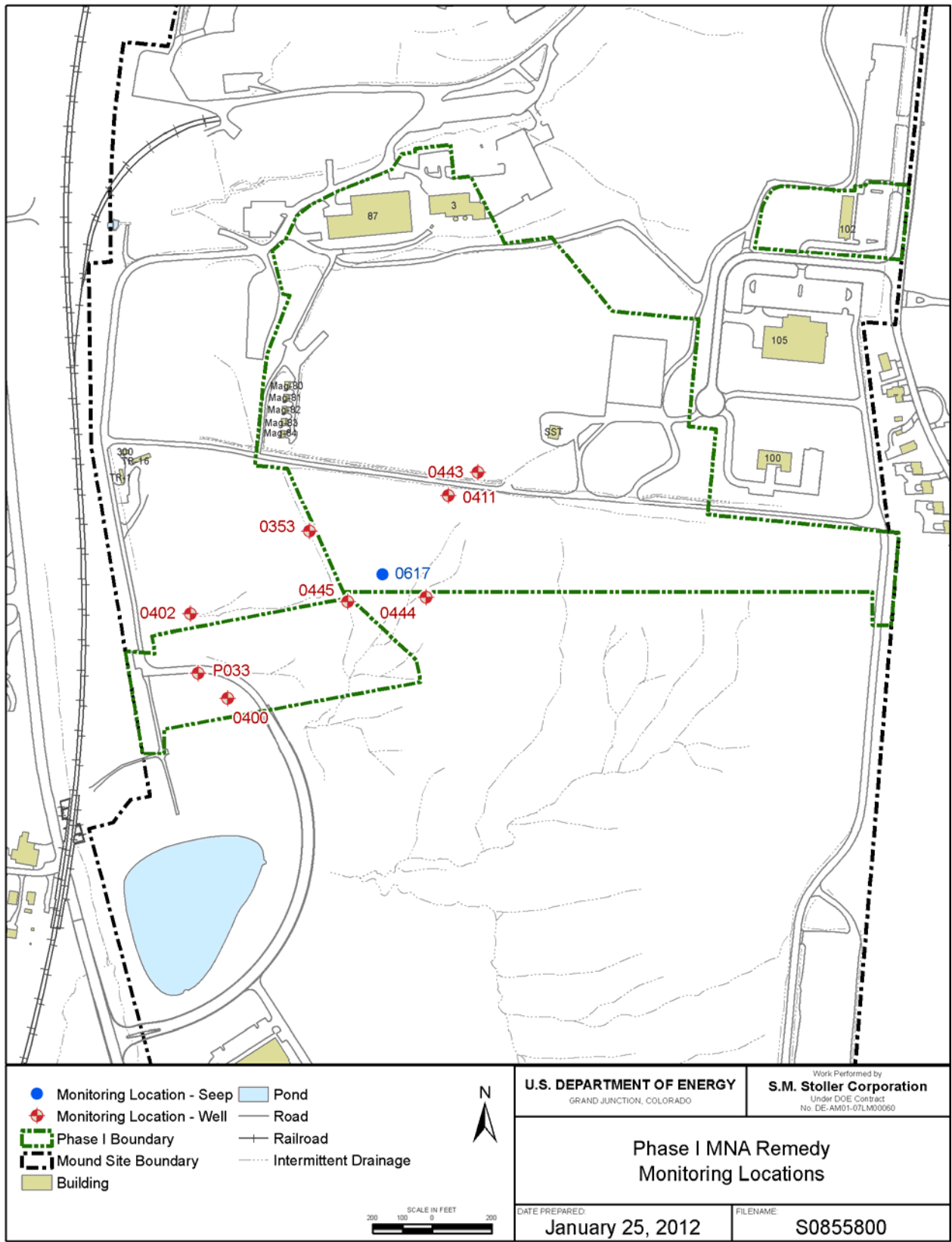
Although not part of the selected remedy, monitoring is performed to evaluate barium and radium impact in the Phase I groundwater. On the basis of investigations, none of these parameters were considered to be contaminants of concern in Phase I.

Monitoring for barium and radium is performed to ensure a correct understanding of the barium and radium in groundwater. If monitoring indicates that the concentrations are not decreasing below the MCL within a reasonable timeframe, the need for an active remediation for these contaminants or additional characterization will be considered. Investigations in this area confirmed that an upgradient salt source on the surface had been infiltrating into the bedrock formation and mobilizing naturally occurring barium and radium in a low-flow area of the bedrock aquifer. Use of the salt storage shed was discontinued in 2003.

In the 2007 *Phase I Groundwater Monitoring Report, Calendar Year 2007* (DOE 2008), modifications to the monitoring program were recommended on the basis of the data collected in 2007. These modifications included reducing sampling frequencies and removing sampling locations from the MNA and confirmatory sampling programs. Minor changes to the program recommended in the 2007 report were made based on comments from the regulators. The programs discussed below reflect those changes.

### 2.1 Monitored Natural Attenuation of TCE

Under the Phase I MNA monitoring program, samples are collected semiannually from selected wells and a seep (Figure 1) and analyzed as outlined in Section 4.3 of the *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan* (DOE 2004) and in Table 1. Sampling was performed in the first and third quarters of 2011.



M:\LTS\1111\0061\07\006\S085558\S0855800.mxd pawels 01/25/2012 8:38:40 AM

Figure 1. Phase I MNA Remedy Monitoring Locations

Table 1. Remedy (MNA) Monitoring for Phase I

Monitoring Location	Area	Parameters
Well 0411	Well 0411 area	Trichloroethylene Dichloroethylene Vinyl chloride
Well 0443		
Well 0353	Downgradient bedrock monitoring	
Well 0444		
Well 0445		
Seep 0617		
Well 0400	Downgradient BVA monitoring	
Well 0402		
Well P033		

All locations are sampled semiannually.

## 2.2 Confirmatory Sampling

The confirmatory sampling program was modified in 2007 and 2009. For 2010, confirmatory samples to evaluate the presence of elevated barium and combined Ra-226/228 were collected quarterly for selected wells as outlined in Table 2. Sodium and chloride are also analyzed in these wells because salt is considered the mechanism that has mobilized naturally occurring radium and barium in the bedrock groundwater. Confirmatory sampling to evaluate the presence of elevated chromium and nickel in select stainless-steel wells was discontinued in 2009.

Table 2. Confirmatory Monitoring for Phase I

Barium, Ra-226/228, Chloride, and Sodium
Well 0400
Well 0402
Well 0445
Well P033

## 2.3 Triggers

The contaminant data are evaluated against previous data collected at each location to determine if MNA is adequately addressing groundwater impact and to monitor the geochemical conditions in the aquifer. Trigger levels and response actions have been established for each contaminant as presented in the *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan* (DOE 2004). The triggers are summarized in Table 3.

Table 3. Trigger Levels for Phase I MNA Remedy and Confirmatory Monitoring Programs

Location	TCE (µg/L)	DCE (µg/L)	Vinyl Chloride (µg/L)	Ra-226/228 (pCi/L)	Barium (mg/L)
0353	5	70	2		
0400	5	70	2	5	1
0402	5	70	2	5	1
0411	30	70	2		
0443	30	70	2		
0444	5	70	2		
0445	5	70	2	75	15
P033	5	70	2	5	1
0617 (seep)	16	70	2		

DCE = dichloroethylene  
 mg/L = milligrams per liter  
 pCi/L = picocuries per liter

The U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency must be notified if trigger levels are exceeded. After notification, the Core Team (U.S. Environmental Protection Agency, Ohio Environmental Protection Agency, and DOE) will determine an appropriate course of action.

## 2.4 Groundwater Flow

Static water level measurements are collected prior to sampling at each well location. Since these measurements are made within a short timeframe, the data were used to depict the general groundwater flow in the area (Figure 2). Two groundwater regimes are present at the site: groundwater in the bedrock and groundwater in the BVA. Groundwater flow in the bedrock typically mimics the topography, with groundwater discharging to the BVA or at seeps from the upper bedrock. Groundwater flow in the BVA flows south, following the downstream course of the Great Miami River.

## 2.5 Deviations from the Sampling Plan

All required locations were sampled in 2011. The only deviation from the sampling plan is that the low-flow sampling method is being used on those wells (bedrock) that typically were bailed dry. Dedicated sampling equipment was installed in the wells in 2008. A different sampling method was used on the bedrock wells, which typically had limited recharge. These locations were sampled at a low flow rate instead of being pumped dry, allowed to recharge, and sampled later. This change in sampling has resulted in a shift in the data for radium and barium.

The updated sampling methods for Phase I are included in Appendix A. These methods were developed by the Mound Groundwater Technical Team and approved by the Mound Core Team.

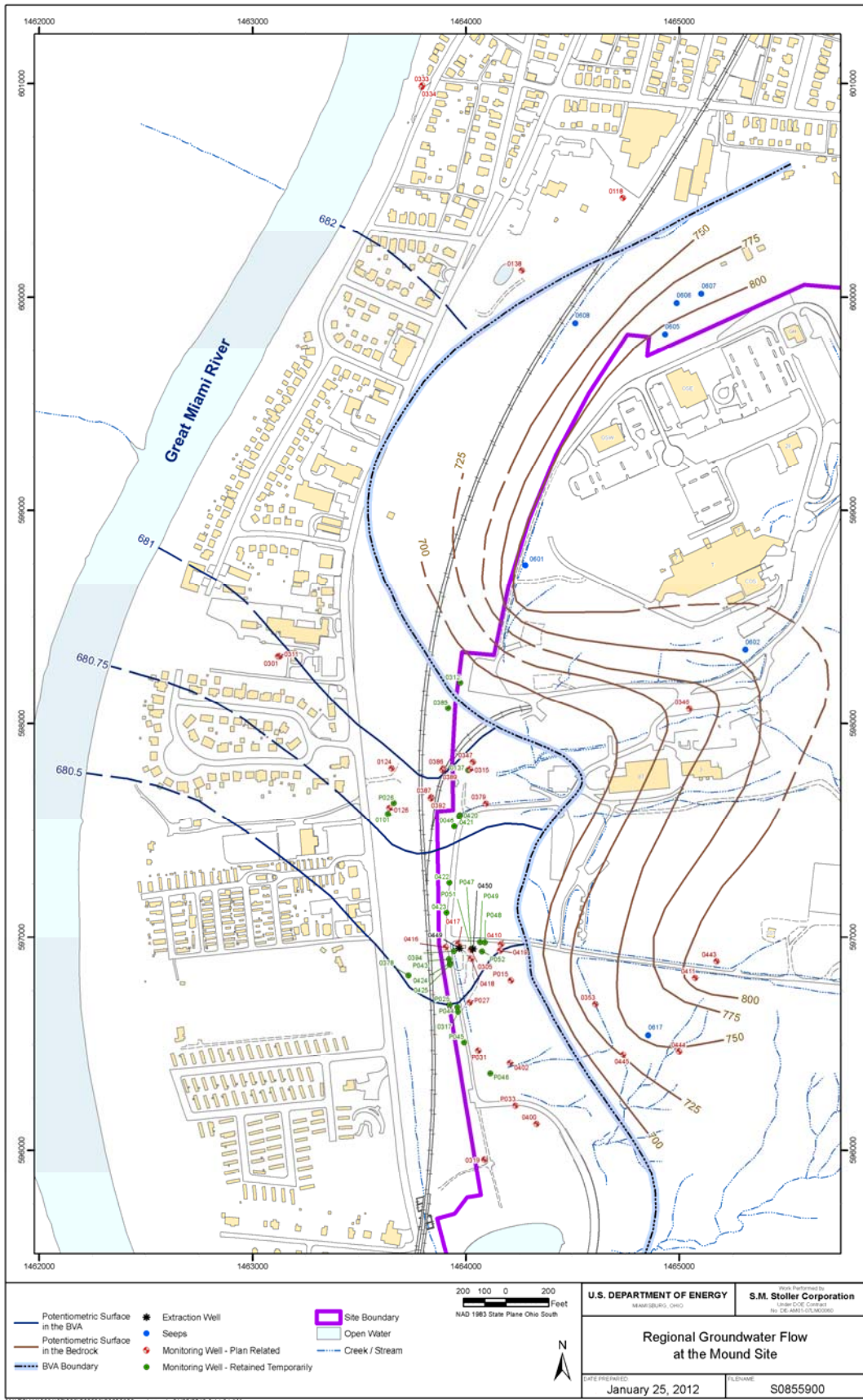


Figure 2. Regional Groundwater Flow at the Mound Site

## 2.6 Trend Analysis Methodology

The computer program Visual Sample Plan (VSP), developed by Battelle Memorial Institute, was used to perform trend analysis; the method used was the nonparametric Mann-Kendall test. The analyses indicate the potential presence of statistically significant downward or upward trends in concentrations at a given location.

The Mann-Kendall test is used for temporal trend identification because it can easily facilitate missing data and does not require the data to conform to a particular distribution (such as a normal or log-normal distribution). The nonparametric method is valid for scenarios where there are a high number of non-detect data points. Data reported as trace concentrations or less than the detection limit can be used by assigning them a common value that is smaller than the smallest measured value in the data set (i.e., one-half the specified detection limit). This approach is valid because only the relative magnitudes of the data, rather than their measured values, are used in the method. A possible consequence of this approach is that the test can produce biased results if a large fraction of data within a given time series are non-detect and if detection limits change between sampling events. The specified detection limit (on the date of analysis) was used in place of concentrations reported as nondetect.

The two-tailed version of the Mann-Kendall test was used to detect either an upward or downward trend for each data set. As part of this approach, a test statistic,  $Z$ , was calculated. A positive value of  $Z$  indicated that the data were skewed in an upward direction, and a negative value of  $Z$  indicated that the data were skewed in a downward direction. The alpha value (or false rejection rate) used to identify a significant trend was 0.05. The beta value (or false acceptance rate) was set at 0.10. A non-parametric estimate of the slope, which is calculated independently of the trend, was determined for each data set using the Sen's non-parametric estimate of the slope in the VSP program. In addition, a 95 percent ( $1-\alpha$ ) two-sided confidence interval about the true slope was obtained.



## 3.0 Phase I MNA Remedy

### 3.1 Monitoring Results

Monitoring results for 2011 (Table 4) continue to show low-level detections of TCE and *cis*-1,2-dichloroethylene (DCE), a TCE breakdown product, in wells 0411 and 0443 and in seep 0617. All VOC concentrations were below the applicable trigger levels (Table 3). Concentrations of TCE in wells 0411 and 0443 and seep 0617 continue to exceed the MCL of 5 µg/L. No detectable concentrations of *trans*-1,2-DCE or vinyl chloride were reported at these three monitoring locations. An estimated detection of TCE less than 1 µg/L was reported in BVA well 0402 during the second sampling event. No detectable concentrations of *cis*-1,2-DCE, *trans*-1,2-DCE, or vinyl chloride were reported in the remainder of the downgradient BVA wells.

Table 4. Summary of VOC Monitoring Results in Phase I for 2011

Well ID	Location	Parameter	First Semiannual Event	Second Semiannual Event
<b>Source Area Wells</b>				
0411	0411 Area	TCE (µg/L)	<b>10.6</b>	<b>9.4</b>
		<i>cis</i> -1,2-DCE (µg/L)	3.3	2.8
		Vinyl Chloride (µg/L)	< 1	< 1
0443	0411 Area	TCE (µg/L)	<b>7.5</b>	<b>5.7</b>
		<i>cis</i> -1,2-DCE (µg/L)	0.49 (J)	0.22 (J)
		Vinyl Chloride (µg/L)	< 1	< 1
0617	Seep/Bedrock	TCE (µg/L)	<b>9.8</b>	<b>6.7</b>
		<i>cis</i> -1,2-DCE (µg/L)	2.2	1.4
		Vinyl Chloride (µg/L)	< 1	< 1
<b>Downgradient Wells</b>				
0353	Bedrock	TCE (µg/L)	ND (< 1)	ND (< 1)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)
0444	Bedrock	TCE (µg/L)	ND (< 1)	ND (< 1)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)
0445	Bedrock	TCE (µg/L)	ND (< 1)	ND (< 1)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)
0400	BVA	TCE (µg/L)	ND (< 1)	ND (< 1)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)
0402	BVA	TCE (µg/L)	ND (< 1)	0.19 (J)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)
P033	BVA	TCE (µg/L)	ND (< 1)	ND (< 1)
		<i>cis</i> -1,2-DCE (µg/L)	ND (< 1)	ND (< 1)
		Vinyl Chloride (µg/L)	ND (< 1)	ND (< 1)

J = estimated value less than the reporting limit

ND = not detected above reporting limit

Values in **bold** exceed the MCL of 5 µg/L for TCE

TCE concentrations in well 0411 (Figure 3) have decreased since monitoring began in 1999; however, concentrations appear to have leveled out between 9 and 12  $\mu\text{g/L}$  over the past few years. The time-concentration plots for well 0443 and seep 0617 indicate that concentrations vary and are typically less than those in well 0411.

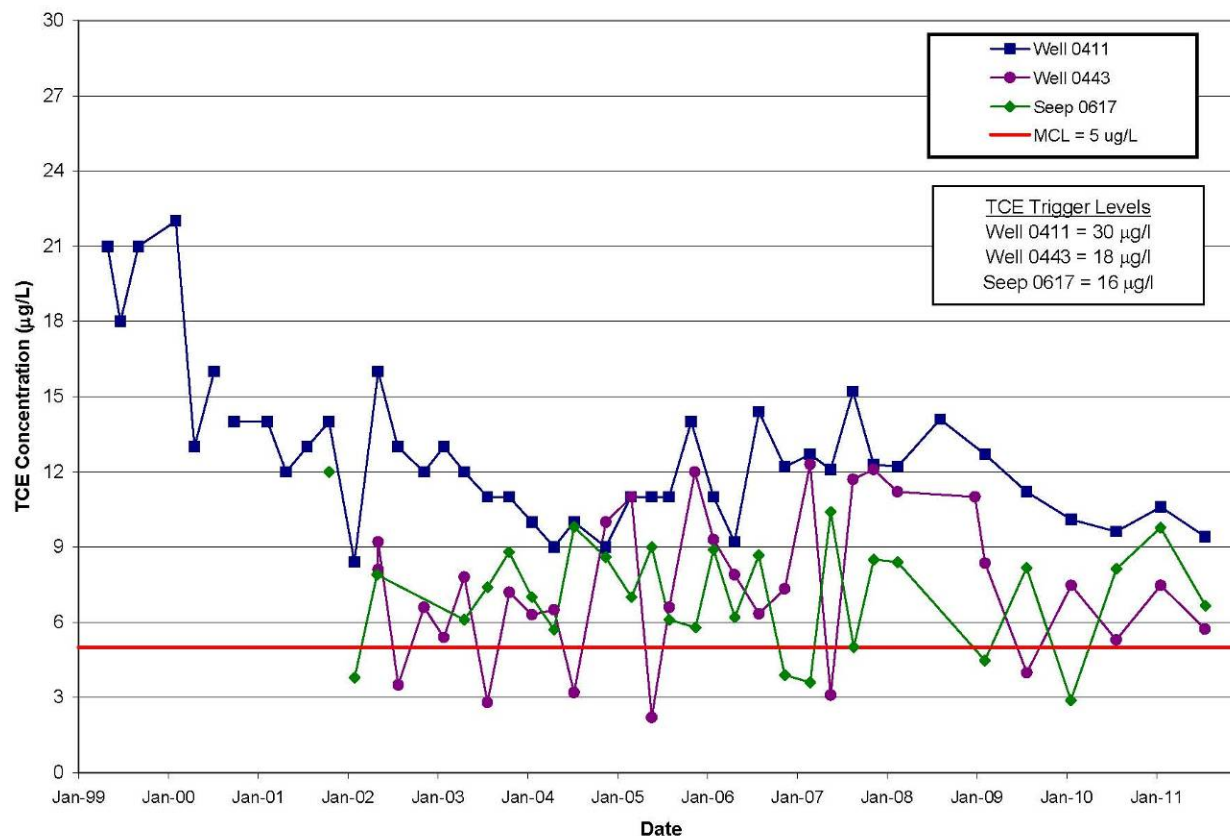


Figure 3. TCE Concentrations over Time—1999 through 2011

The concentration of *cis*-1,2-DCE in groundwater (Figure 4) has been less variable over time than TCE. Detectable concentrations have consistently been reported in well 0411 and seep 0617 since 2008. Estimated detections less than 1 milligram per liter (mg/L) have been reported in well 0443 during the same period. None of the locations exceed the MCL of 70  $\mu\text{g/L}$  for *cis*-1,2-DCE.

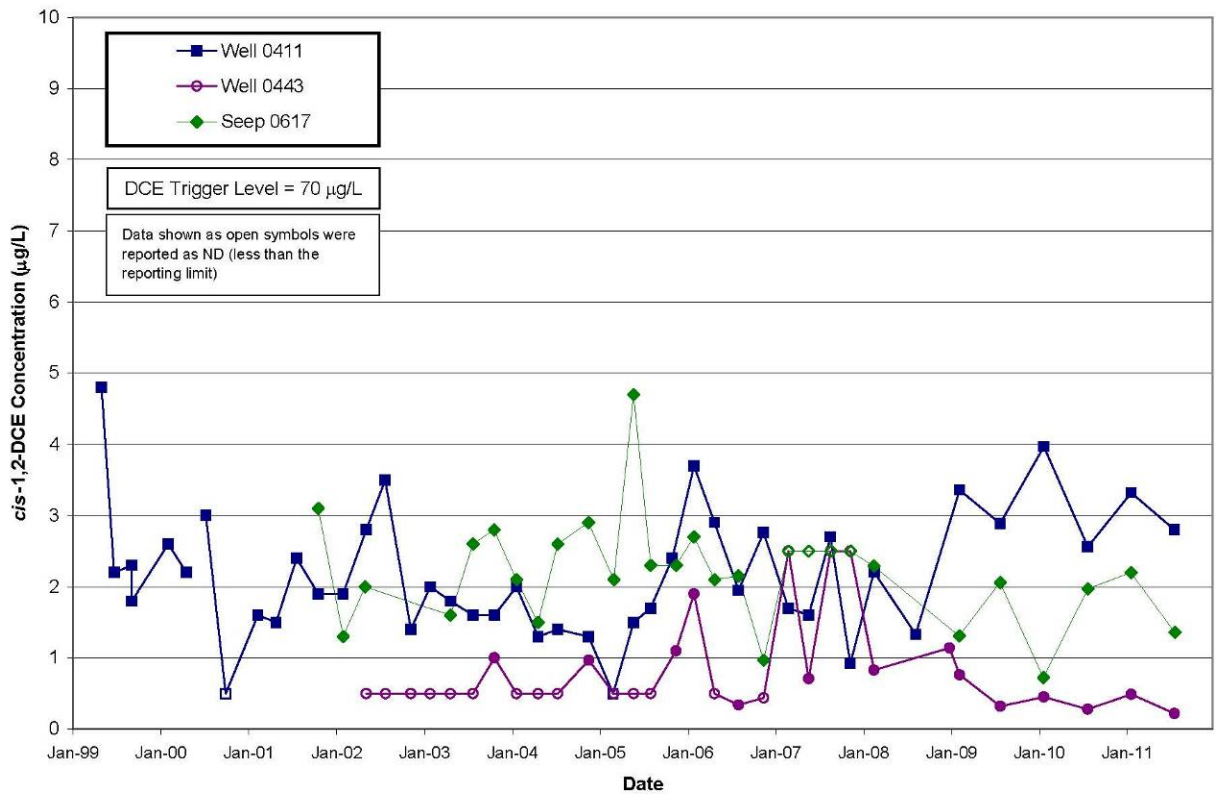


Figure 4. *cis*-1,2-DCE Concentrations—1999 through 2011

The distributions of TCE and DCE in groundwater (Figure 5) indicate that impact is localized in the bedrock groundwater near wells 0411 and 0443 and seep 0617. Wells screened in the bedrock and BVA that are downgradient of the area of VOC impact do not have detectable concentrations of TCE or DCE, with the exception of well 0402.

### 3.2 Trend Analysis

Trend analysis was performed on VOC data using the non-parametric Mann-Kendall test. This test is used for temporal trend identification because it does not require the data to conform to a particular distribution (such as a normal or log-normal distribution). This type of long-term trend analysis can be used to confirm trends in contaminant concentrations over time.

Trend analysis for TCE data collected since 1999 continues to indicate decreasing TCE concentrations in well 0411 and seep 0617, as indicated by negative slopes (Table 5). A statistical downward trend was calculated for TCE in well 0411. Statistically, no trend is present in the data for TCE in well 0443 and seep 0617.

Decreasing *cis*-1,2-DCE concentrations, although small, are present in seep 0617, as indicated by a negative slope. Statistically, no trends, either upward or downward, were determined for the *cis*-1,2-DCE data in the wells and seep.

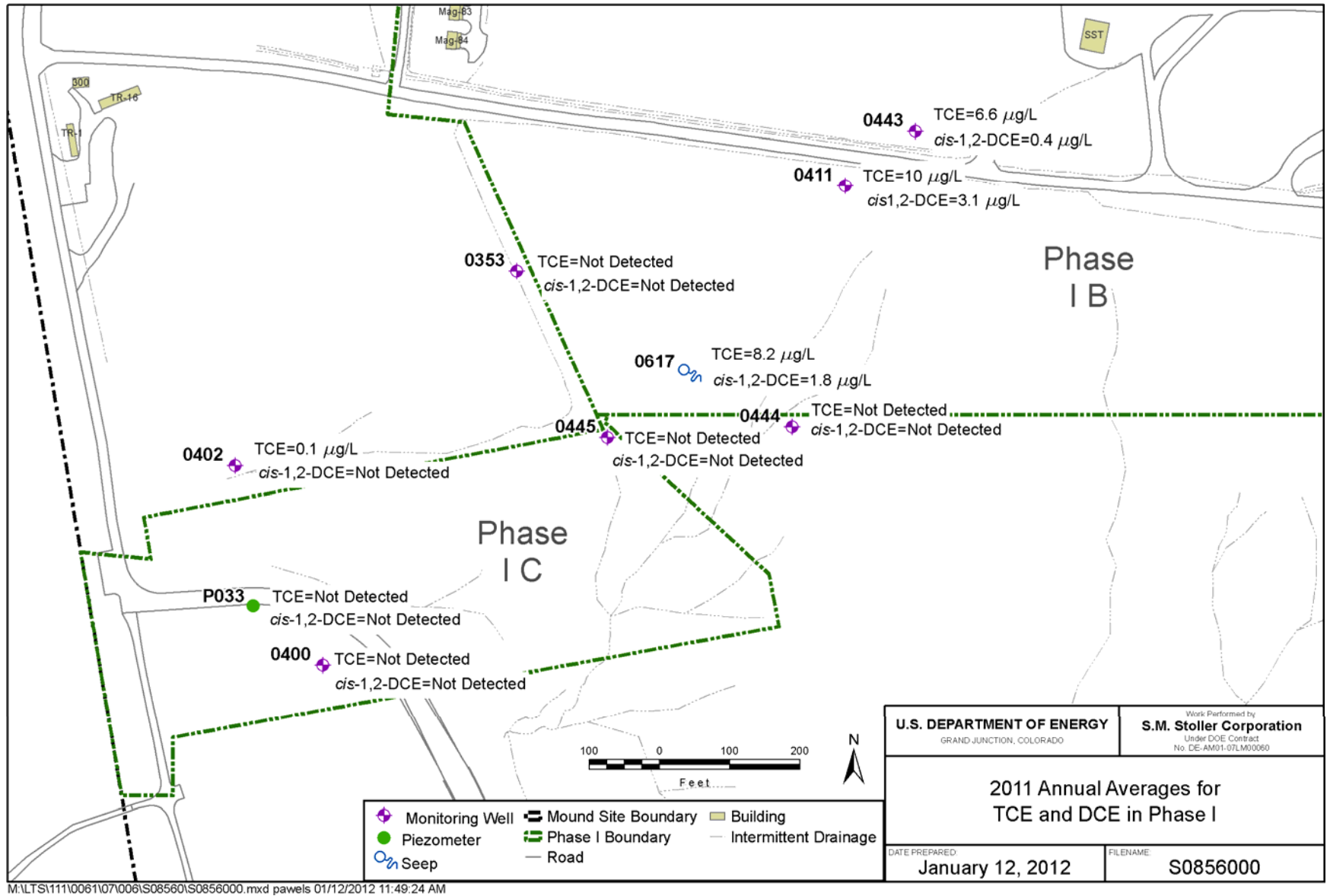


Figure 5. 2011 Annual Average Concentrations of TCE and DCE in Phase I Groundwater

Table 5. Summary of Trend Analysis Results for TCE in Phase I for 2011

Location	Analyte	No. of Samples	Trend	Slope (µg/L/year)	Confidence Interval (µg/L/yr)	
					Lower	Upper
0411	TCE	43	Down	- 0.39	-0.70	-0.16
0443		31	None	0.20	- 0.25	0.70
0617		29	None	- 0.13	- 0.49	0.25
0411	<i>cis</i> -1,2-DCE	43	None	0.04	- 0.05	0.12
0443		31	None	0	- 0.02	0.03
0617		29	None	- 0.07	- 0.15	0.02

µg/L/year = micrograms per liter per year

Evaluation of the slope of the downward trend in TCE concentrations in well 0411 may indicate the timeframe when concentrations may approach the MCL of 5 µg/L. The non-parametric slope calculated for the trend analysis continues to suggest that the MCL may be reached by 2022. The exponential curve fit to the data estimates that the MCL may be reached by 2030. The non-parametric analysis and the exponential curve fit typically represent the decrease of contaminants in groundwater over time and provide good estimates of cleanup timeframes.

### 3.3 Recommendations

No changes to the Phase I MNA sampling program are warranted based on data from 2011. Trend analysis continues to show that TCE concentrations have decreased in source well 0411 since sampling started in 1999. Concentrations of TCE have been variable in source well 0443 and seep 0617 but are generally lower than those measured in well 0411 and are approaching the MCL of 5 µg/L. *cis*-1,2-DCE concentrations vary in the wells and seep. No upward trends have been calculated for *cis*-1,2-DCE, and the concentrations are considerably less than the MCL of 70 mg/L. On the basis of no upward trends in TCE concentrations and TCE concentrations being considerably less than the trigger levels, monitoring frequency is recommended to remain semiannual for 2012. Sampling will continue to be performed during the first and third quarters of the year in an effort to bracket possible seasonal variations.

This page intentionally left blank

## 4.0 Phase I Confirmatory Sampling

Data collected from well 0445 have shown elevated barium concentrations and combined radium levels in excess of the MCLs. The groundwater chemistry in this well is not observed in any other bedrock or BVA well in this area and is likely due to the interaction of salt stored at the site and the underlying bedrock. Data are being collected to monitor for changes in the groundwater quality and to better understand the mechanisms for the increased mobility of barium and radium in this discrete portion of the bedrock aquifer.

### 4.1 Monitoring Results

Monitoring results for 2011 (Table 6) show elevated combined Ra-226/228 levels greater than the MCL of 5 picocuries per liter (pCi/L). The LOC of 75 pCi/L was exceeded in well 0445 only during the third quarter (Table 3). The concentrations of barium in well 0445 exceeded the MCL of 2,000 µg/L in 2011 but were less than the LOC of 15 mg/L. Combined Ra-226/228 and barium levels remain low in the downgradient BVA wells.

Table 6. Summary of 2011 Confirmatory Monitoring Results for Barium and Radium

Well ID	Location	Parameter	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
<b>Source Area Well</b>						
0445	0445 Area	Radium-226 (pCi/L)	<b>20.1</b>	<b>19.9</b>	<b>64.9</b>	<b>36.7</b>
		Radium-228 (pCi/L)	<b>22.2</b>	<b>24.9</b>	<b>39.1</b>	<b>3.63</b>
		Barium (µg/L)	<b>11,600</b>	<b>10,000</b>	<b>11,000</b>	<b>10,200</b>
<b>Downgradient Wells</b>						
0400	BVA	Radium-226 (pCi/L)	0.92	1.48	0.93	0.33
		Radium-228 (pCi/L)	ND (< 0.64)	0.68	ND (< 0.86)	0.60
		Barium (µg/L)	142	97.2	97.9	116
0402	BVA	Radium-226 (pCi/L)	ND (< 0.53)	1.81	ND (< 0.43)	0.60
		Radium-228 (pCi/L)	0.57	ND (< 0.67)	ND (< 0.53)	ND (< 0.58)
		Barium (µg/L)	77.8	47.5	49.9	74.7
P033	BVA	Radium-226 (pCi/L)	0.92	0.91	ND (< 0.60)	0.32
		Radium-228 (pCi/L)	ND (< 0.58)	ND (< 0.64)	ND (< 0.59)	ND (< 0.58)
		Barium (µg/L)	100	84.1	106	92.6

Values in **bold** exceed the MCL of 2,000 µg/L for barium or 5 pCi/L for combined Ra-226/228.  
 ND = not detected above reporting limit

Barium concentrations vary in well 0445 (Figure 6), which is screened within the low-yielding bedrock. The concentrations of barium in this well indicate a general decline starting in 2004; however, starting in 2009, concentrations were higher than in previous years. The general decrease observed from 2004 through 2008 coincides with the removal of the salt from the storage area (SST building on Figure 1) in 2003. A dramatic decrease was indicated in early 2007, but it is likely that the anomalously low data reported in 2007 were not representative of groundwater quality because these concentrations have not been replicated in subsequent sampling events. The higher concentrations reported since the end of 2008 may be the result of changing to low-flow sampling methods and using dedicated sampling equipment. Until the second half of 2008, well 0445 was typically bailed or pumped dry and then sampled the next day. During 2008, dedicated bladder pumps capable of sampling low flows (100 milliliter per

minute) were installed in the Phase I monitoring wells. The samples collected since the second half of 2008 have been sampled using the low-flow method instead of being pumped dry, allowed to recharge, and sampled later.

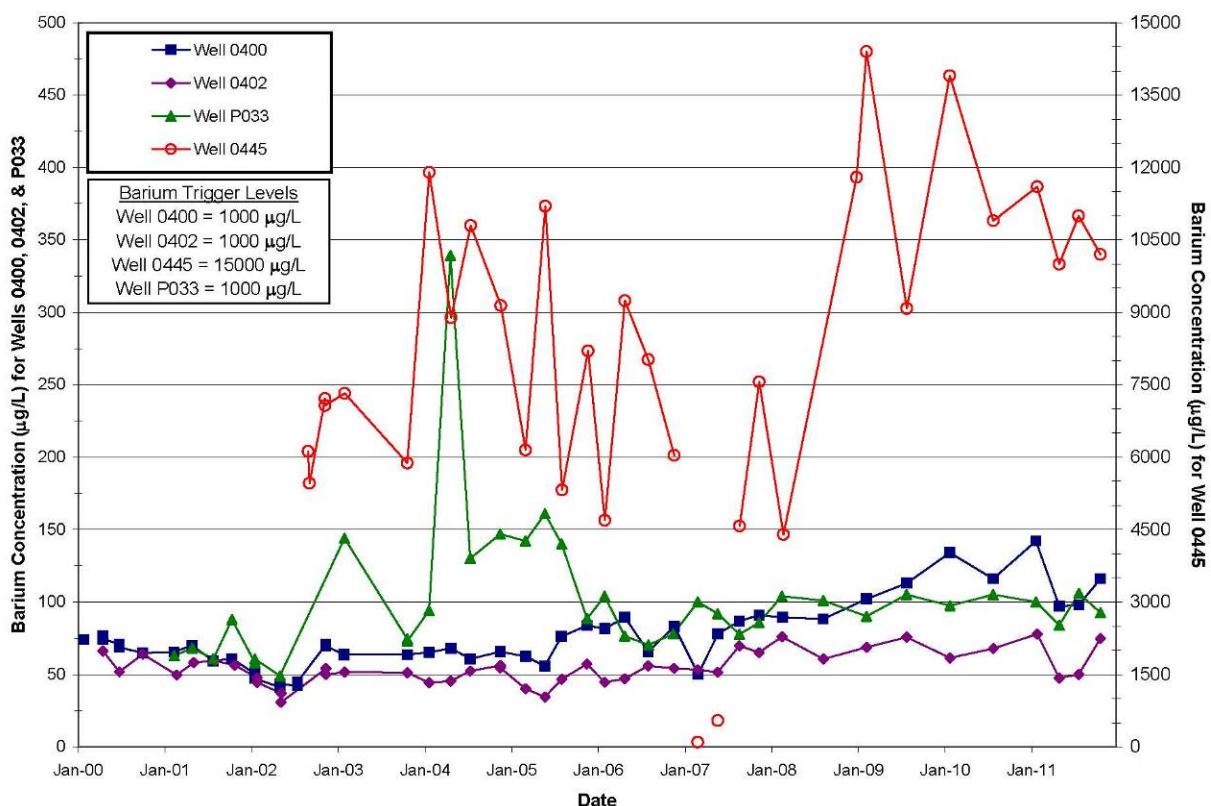


Figure 6. Barium Concentrations—2000 through 2011

Barium concentrations in well P033 (a BVA well) varied and exhibited similar fluctuations in concentrations as those observed in well 0445. However, barium concentrations have been relatively stable in downgradient BVA wells 0400, 0402, and P033 since 2006, although slight increases have been observed in these wells. The levels of barium in those three wells are similar to background (310 µg/L). Background values were obtained from the *Phase I Residual Risk Evaluation, Miamisburg Closure Project (Final)* (DOE 2003b).

Radium levels vary over time in all of the wells (Figure 7), but the largest fluctuations occur in well 0445. The levels of combined Ra-226/228 at this location consistently exceed the MCL of 5 pCi/L and have exceeded the 75 pCi/L LOC numerous times, including once during 2011. Data from 2007 showed a dramatic decrease; however, these anomalously low data likely do not represent groundwater quality and have not been replicated in subsequent sampling events. Levels measured in 2011 are similar to those reported in previous years.



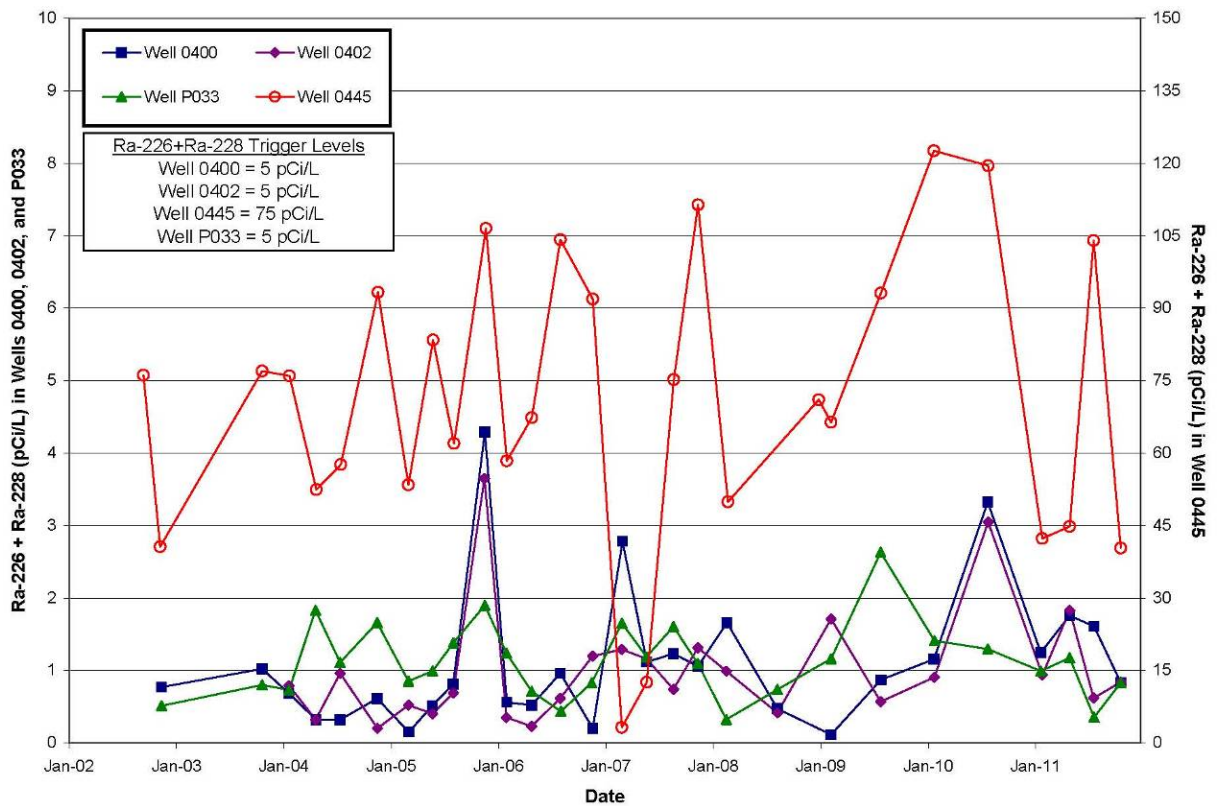


Figure 7. Ra-226/228 Levels—2002 through 2011

Radium levels have been less variable in wells 0400, 0402, and P033, which are BVA wells downgradient of well 0445. Well P033 historically had slightly higher radium levels than the other two BVA wells and exhibited a similar pattern in variability when compared to well 0445. However, data from 2010 indicate that levels in wells 0400 and 0402 increased slightly and were greater than those reported in P033. Levels measured in 2011 were similar in all three wells, were lower than those observed in 2010, and are similar to background (0.996 pCi/L for radium-226). Background values were obtained from the *Phase I Residual Risk Evaluation, Miamisburg Closure Project (Final)* (DOE 2003b). No background values were provided for radium-228.

The distribution of barium and radium in groundwater (Figure 8) indicates that the impact is associated with well 0445. Barium and radium levels are similar to background in the downgradient BVA wells. Figure 8 depicts the annual averages of barium and radium in the monitoring network.

Sodium and chloride are monitored in conjunction with radium and barium because salt is considered the mechanism that has caused elevated radium and barium levels in the bedrock groundwater system. Salt was no longer stored in the SST building after 2003. Sodium and chloride monitoring results (Table 7) indicate that the highest concentrations occur in well 0445, which is where elevated radium and barium levels are detected.

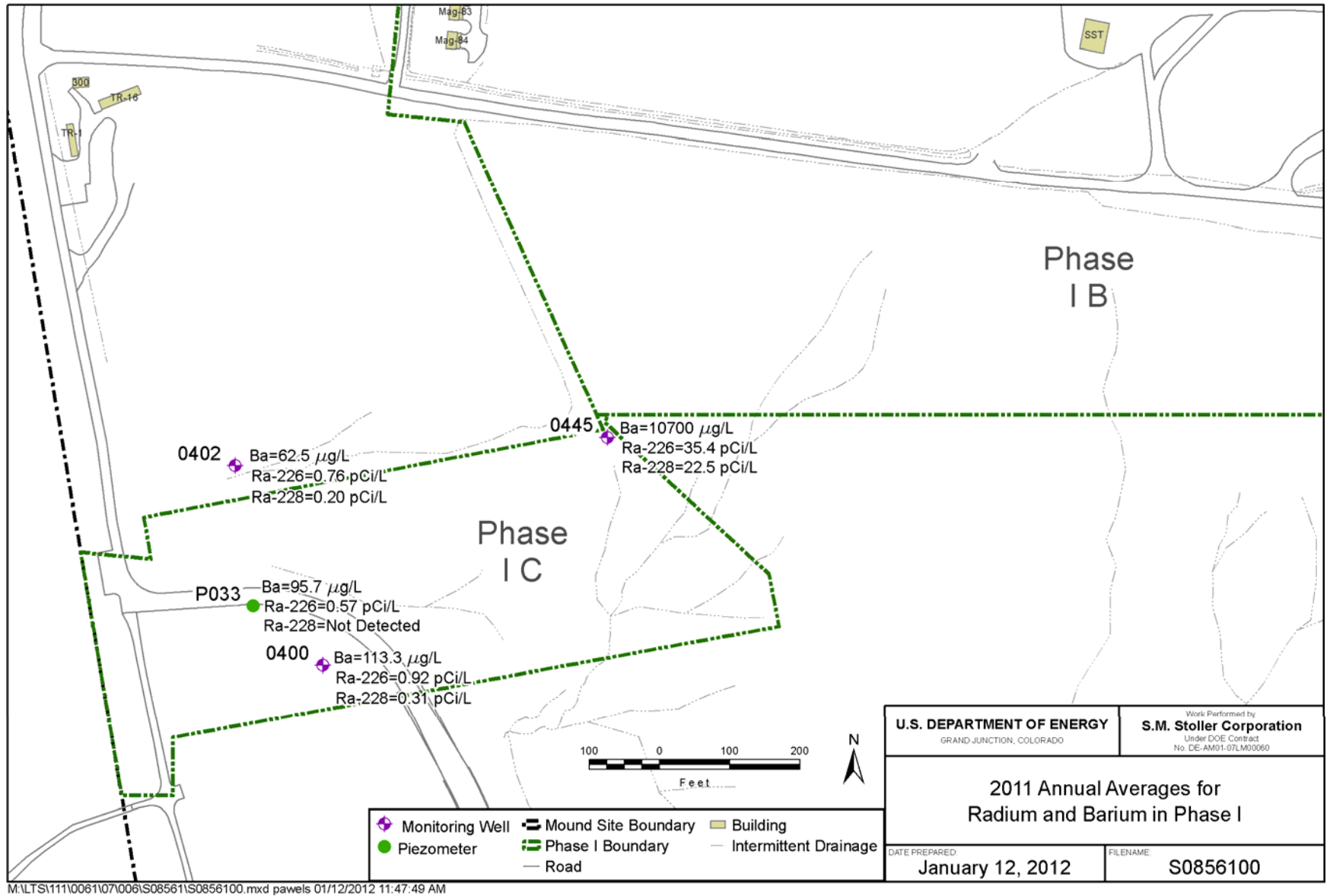


Figure 8. 2011 Annual Average Concentrations for Radium and Barium in Phase I

Table 7. Summary of 2011 Confirmatory Monitoring Results for Sodium and Chloride

Well ID	Location	Parameter	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
<b>Source Area Well</b>						
0445	0445 Area	Chloride (mg/L)	8,510	8,350	8,630	8,310
		Sodium (mg/L)	3,980	3,440	4,200	3,970
<b>Downgradient Wells</b>						
0400	BVA	Chloride (mg/L)	115	18.6	71.9	88.0
		Sodium (mg/L)	67.2	19.5	50.5	56.4
0402	BVA	Chloride (mg/L)	59.0	41.0	42.3	101
		Sodium (mg/L)	46.6	41.7	38.9	64.3
P033	BVA	Chloride (mg/L)	130	129	240	113
		Sodium (mg/L)	83.9	82.9	114	69.2

Extremely high concentrations of sodium and chloride have been reported in well 0445 (Figure 9 and Figure 10), which also has increased radium and barium levels; however, levels vary substantially over time. Downgradient BVA well P033 historically exhibited elevated concentrations of sodium and chloride, which varied in a similar pattern to those observed in well 0445. Substantial decreases in sodium and chloride concentrations were reported in BVA well P033 starting in 2004 and are similar to the changes observed in barium and radium levels at this location. Sodium and chloride concentrations have been stable in BVA wells 0400 and 0402.

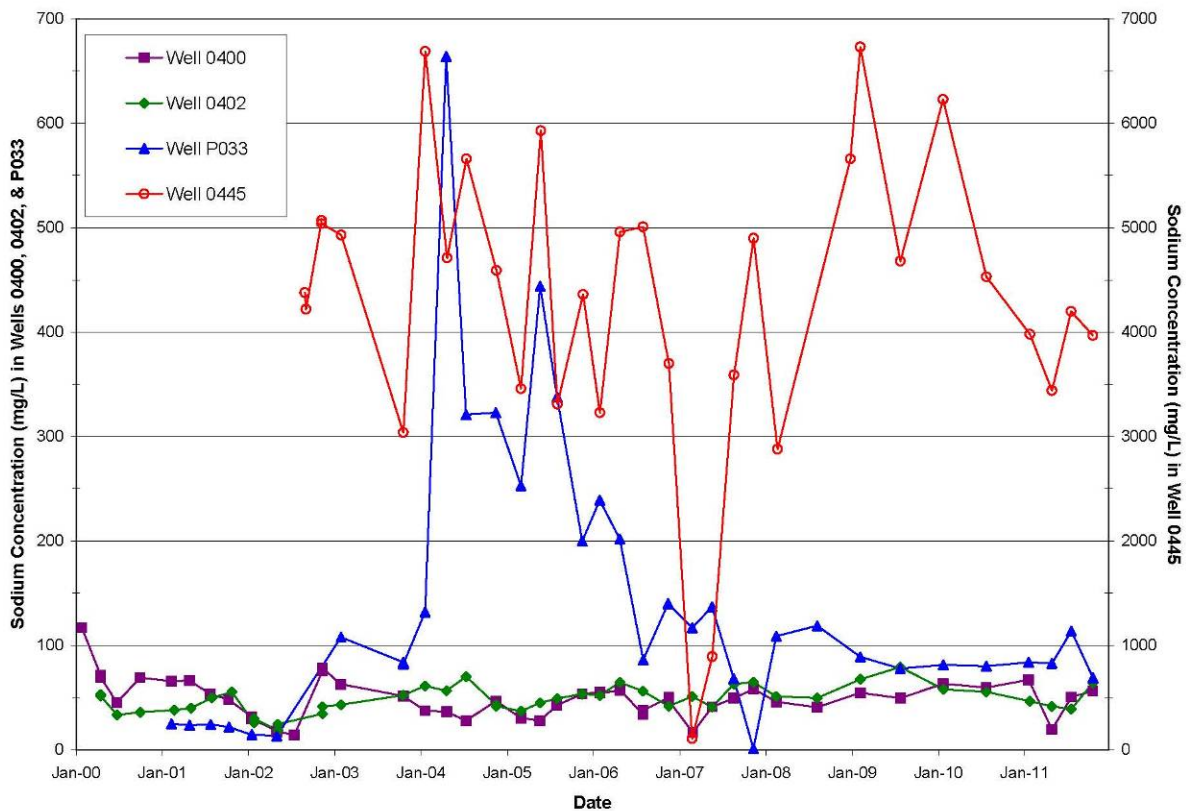


Figure 9. Sodium Concentrations—2000 through 2011

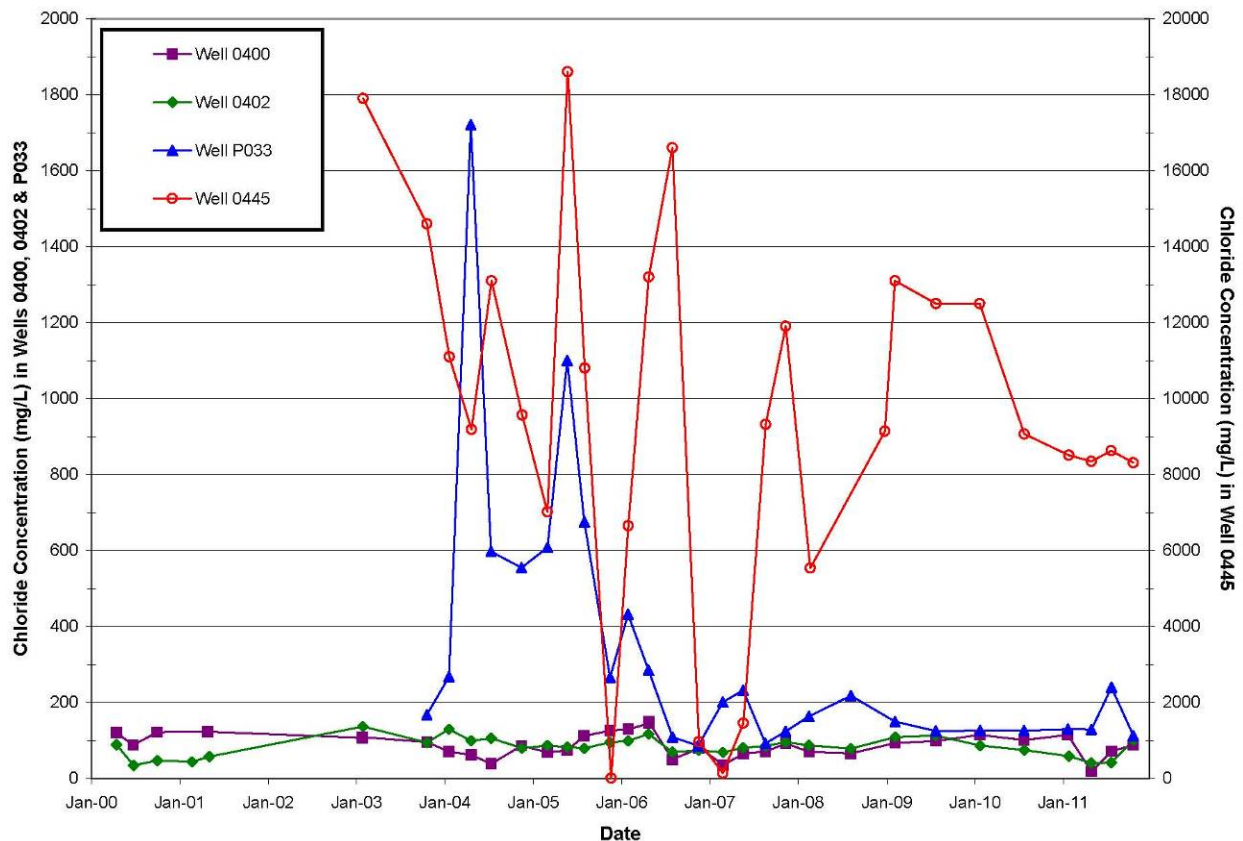


Figure 10. Chloride Concentrations—2000 through 2011

Review of the sodium and chloride data indicates that concentrations in well P033 have generally decreased since salt in the SST building was removed in 2003. The decrease indicates that there is less salt entering into the groundwater system and being detected in the downgradient wells. It is apparent that groundwater affected by salt is stored in the lower permeable bedrock near well 0445, resulting in greater contact time with the shale, which is the source of barium and radium. Naturally occurring barium and radium are leached from the bedrock, put into solution in this discrete portion of the saturated bedrock, and slowly released through the bedrock groundwater system, resulting in the detection of these constituents in the downgradient BVA at very low levels.

## 4.2 Trend Analysis

Trend analysis was performed on barium, radium, sodium, and chloride data using the non-parametric Mann-Kendall test. This test is used for temporal trend identification because it does not require the data to conform to a particular distribution (such as a normal or log-normal distribution). This type of long-term trend analysis can be used to confirm trends in contaminant concentrations over time. Trending was performed using data from 2004 through 2011 because this set of data reflects the possible influence of removing salt from the SST building. However, the two anomalously low data points reported in well 0445 in 2007 were not included in the data set because they likely do not represent actual groundwater quality.

Statistical analysis indicates increased concentrations of barium in wells 0400, 0402, and 0445, as indicated by positive slopes. Statistically upward trends were calculated for barium in wells 0400 and 0402 (Table 8); however, increases are very small. Statistically, no trends, either upward or downward, were determined for the combined Ra-226/228 data in the wells.

Table 8. Summary of Trend Analysis Results for Barium and Combined Radium in Phase I for 2011

Location	Analyte	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Interval (mg/L/yr)	
					Lower	Upper
0400	Barium	26	Up	0.007	0.005	0.010
0402		26	Up	0.004	0.002	0.006
0445		24	None	0.23	-0.36	0.76
P033		26	None	-0.003	-0.010	0.001
Location	Analyte	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Interval (pCi/L/yr)	
					Lower	Upper
0400	Ra-226/228	20	None	0.11	0.05	0.28
0402		20	None	0.11	-0.07	0.29
0445		18	None	3.1	-3.6	8.9
P033		20	None	-0.02	-0.21	0.19

mg/L/yr = milligrams per liter per year

pCi/L/yr = picocuries per liter per year

Trend analysis indicates decreased chloride concentrations in wells 0402, 0445, and P033 and decreased sodium concentrations in wells 0445 and P033, as indicated by negative slopes (Table 9). Statistically downward trends were calculated for both chloride and sodium in well P033. A statistically upward trend in sodium concentrations was calculated for well 0400; however, the increase is small.

Table 9. Summary of Trend Analysis Results for Sodium and Chloride in Phase I for 2011

Location	Analyte	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Interval (mg/L/yr)	
					Lower	Upper
0400	Chloride	26	None	2.2	-3.2	7.2
0402		26	None	-3.7	-7.2	0.29
0445		26	None	-176	-890	564
P033		26	Down	-49.0	-97.5	-21.6
0400	Sodium	26	Up	2.8	0.67	4.6
0402		26	None	0	-2.0	2.4
0445		26	None	-98.6	-330	136
P033		26	Down	-31.2	-52.8	-14.8

mg/L/yr = milligrams per liter per year

### 4.3 Recommendations

The levels of radium and barium measured in the bedrock groundwater at well 0445 are not decreasing to the MCL; however, levels measured in downgradient BVA wells are similar to background. It was initially recommended to discontinue the Phase I confirmatory sampling program for barium and radium, based on the evaluation of the body of data collected since 2004.

It has been concluded that this data set confirms the understanding regarding the presence of elevated naturally occurring barium and radium levels within the low-yield bedrock aquifer downgradient of the SST building. It was considered that the unusual geochemistry caused by salt within the area of well 0445 results in the release of naturally occurring barium and radium from the bedrock matrix. Since 2009, barium, radium, sodium, and chloride levels have generally declined in well 0445. Data collected between 2004 and 2008 also showed a decline; however, a shift in data was observed in 2009 as a direct result of a change in sampling methods. The concentrations of barium have not exceeded the LOC since well 0445 was installed in 2002. The LOC for combined Ra-226/228 is exceeded periodically in this well.

Data from BVA well P033 illustrate that the amount of sodium and chloride discharging from the bedrock aquifer system has decreased significantly since 2004. Significant downward trends in both constituents have been calculated for this well. Salt has been considered the release mechanism for radium and barium from the bedrock matrix.

Sodium and chloride concentrations have decreased in source well 0445 and indicates that the discharge of salt through the bedrock aquifer system may be diminishing. However, even though the salt was removed from the SST building, levels of sodium and chloride have remained elevated in this well due to the low conductivity of the bedrock, which reduces the amount of flushing.

Additional sampling was performed in 2011 due to increasing levels of combined Ra-226/228 in the BVA wells to ensure that the MCL of 5 pCi/L would not be exceeded in the future. The data from 2011 indicate that the levels have returned to typical levels, and the data from 2010 are likely within the natural variation of radium within the BVA. Also, trend analysis did not indicate any trends in the data set from 2004 through 2011.

During review of the March 2012 version of this report, OEPA expressed concern regarding the adequacy of the downgradient monitoring in the BVA. The OEPA requested that discrete groundwater samples be collected at two locations along the interface of the bedrock and the BVA downgradient of well 0445. The OEPA is concerned that the BVA may be impacted by bedrock groundwater originating from the Mound site. Adequate downgradient monitoring has come into question based on recent groundwater flow maps developed for the Mound Site, primarily the OU-1 area, which is immediately upgradient of the Phase I area. With the current understanding of groundwater flow, wells 0400, 0402, and P033 may be too far from the BVA/bedrock interface and may be more cross-gradient than downgradient of outflow groundwater monitored in well 0445. The Mound Core team concurred that discrete groundwater samples should be collected to evaluate the groundwater quality in this area.

In situ groundwater samples will be collected from 2 locations (Figure 11) using direct-push methods. Samples will be submitted for barium, Ra-226, Ra-228, sodium, and chloride analysis. Two sampling events will be conducted during 2012.

Data will be evaluated to determine if the BVA has been impacted by bedrock groundwater with elevated radium and barium levels. If the barium and radium levels measured in the in situ groundwater samples are within the background ranges for the BVA, then the Core Team will agree to discontinue the confirmatory sampling for radium and barium, as outlined above. Background has been defined as those values presented in Section 4 of this annual report.

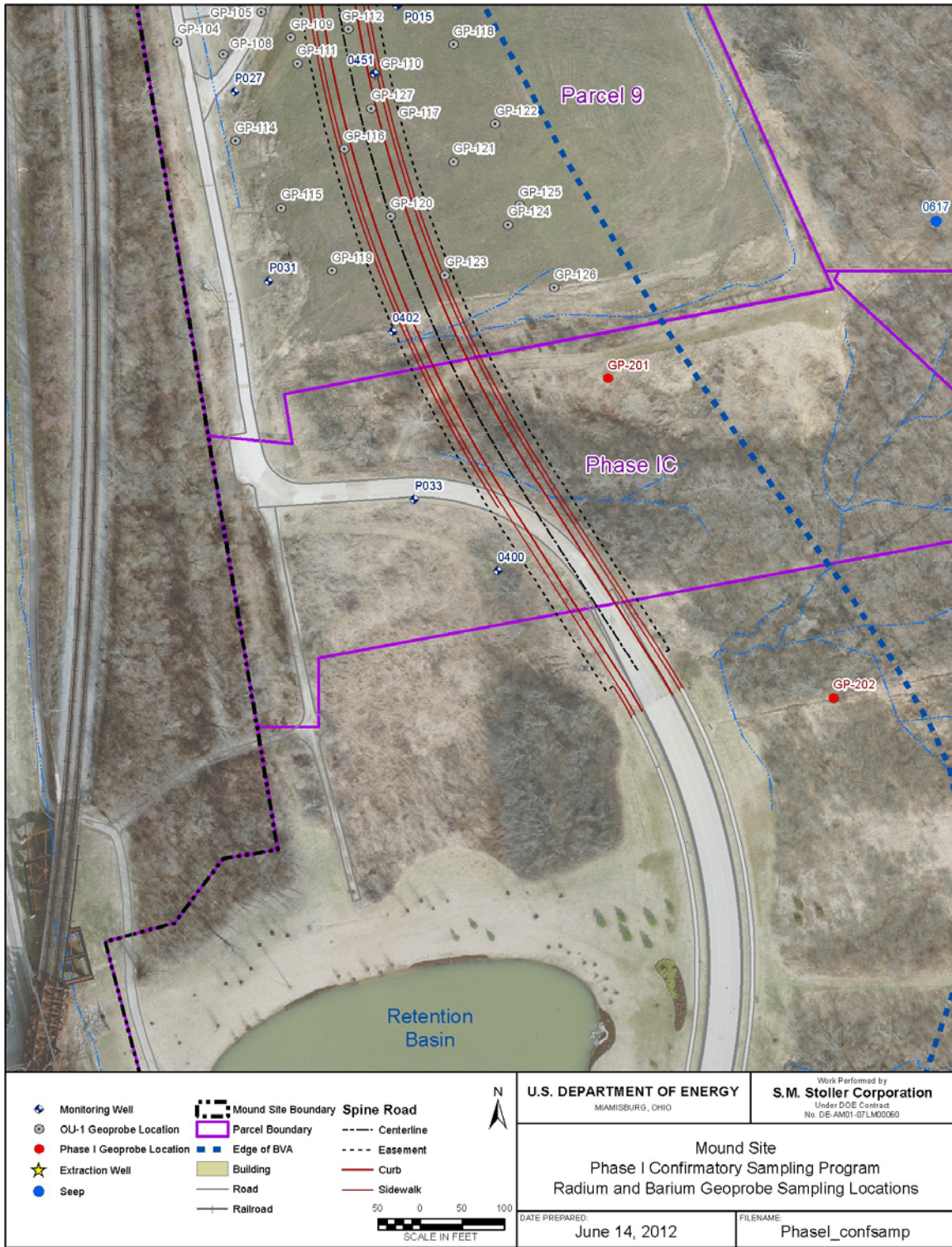


Figure 11. Phase I Geoprobe Sampling Locations



## 5.0 Inspection of the Monitoring System

A routine maintenance program has been established for the long-term groundwater monitoring locations at the Mound site. This program includes periodic inspections that focus on the integrity of each well and the condition of the protective casing and surface pad, the surrounding area, and the route of access. These inspections are usually performed during each sampling event. If these wells were neglected, the surface seals could fail, and contamination could migrate from surface sources to the subsurface.

The primary deficiency identified in the 2010 Groundwater Monitoring Report (DOE 2011a) was ponded water around wells 0353 and 0402. These wells are along the sides of the clean soil stockpile for the Operable Unit 1 excavation subcontractor. This area was regraded, and drainage around the wells was improved at the end of 2010.

General maintenance was performed on the wells in March and April 2011. The wells were repainted, and vegetation and soil buildup were removed. Photographs of the wells after maintenance are in Appendix C.

This page intentionally left blank

## 6.0 Data Validation

Each quarter's data were validated in accordance with procedures specified in the *Environmental Procedures Catalog*, LMS/POL/S04325, "Standard Practice for Validation of Laboratory Data." This procedure also fulfills the requirements of applicable procedures in the *Mound Methods Compendium* (MD 80045). Data validation was documented in reports prepared for each quarter (DOE 2011b, 2011c, 2011d, 2012). All 2011 data, including data validation qualifiers, are summarized in Appendix B.

Laboratory performance is assessed by reviewing and evaluating the following quality indicators:

- Sample shipping and receiving practices
- Chain of custody
- Laboratory blanks
- Preparation blanks
- Laboratory replicates
- Serial dilutions
- Detection limits
- Peak integrations
- Matrix spikes and matrix spike duplicates
- Holding times
- Instrument calibrations
- Interference check samples
- Radiochemical uncertainty
- Laboratory control samples
- Sample dilutions
- Surrogate recoveries
- Confirmation analyses
- Electronic data

This page intentionally left blank

## 7.0 Summary

This report documents the groundwater sampling results for the Phase I MNA remedy sampling in 2011. It also includes results associated with confirmatory monitoring for radium and barium in Phase I.

### 7.1 MNA Remedy

The objective of the MNA monitoring is to protect the BVA by verifying that the concentrations of TCE near well 0411, well 0443, and seep 0617 are decreasing to levels below the MCL. Also, monitoring provides evidence that TCE originating from the area monitored by wells 0411 and 0443 is not adversely impacting the BVA.

The distribution of TCE and *cis*-1,2-DCE in groundwater continues to indicate that VOC impact is localized in the bedrock groundwater near wells 0411 and 0443 and downgradient seep 0617. Concentrations at these three monitoring locations exceed the MCL of 5 µg/L. TCE levels in well 0411, which has the highest concentrations, have decreased since monitoring began in 1999, and concentrations have leveled off over the past few years. Low levels of *cis*-1,2-DCE continue to be present at all three locations. Statistical analysis indicates decreasing concentrations of TCE in well 0411 and seep 0617 and a downward trend in TCE concentrations in well 0411. Trend analysis continues to estimate that the MCL of 5 mg/L for TCE in well 0411 may be reached between 2022 and 2030. No statistical trends were present in the data from well 0443 and seep 0617. TCE data show that the downgradient BVA is not affected by the localized TCE impact in the bedrock groundwater.

Monitoring associated with the MNA remedy will continue. The evaluation of the 2011 data does not suggest the monitoring program should be changed at this time. Semiannual sampling will continue in 2012.

### 7.2 Radium and Barium

Groundwater monitoring for barium and radium is performed to ensure a correct understanding of the occurrence of elevated barium and radium in the bedrock groundwater. Sodium and chloride are monitored in conjunction with radium and barium because the salt is considered the mechanism that has increased concentrations of radium and barium in the bedrock groundwater system. If monitoring indicates that the concentrations of barium and combined Ra-226/228 are not decreasing below the MCL within a reasonable timeframe, changes to the monitoring program may be considered.

Monitoring results for 2011 continue to show elevated combined Ra-226/228 and barium levels greater than the MCLs for both constituents in bedrock well 0445. The levels of barium and radium in the bedrock groundwater continue to vary. Barium concentrations have been less than the LOC since monitoring started in 2004. The levels of combined Ra-226/228 periodically exceed the LOC, and during 2011, levels were greater than the LOC only during the third quarter. The concentrations of barium in well 0445 had been decreasing since 2004; however, starting in late 2008, barium concentrations, as well as combined Ra-226/228, were higher than in previous years. The higher levels reported since the end of 2008 may be the result of changing to low-flow sampling methods in the bedrock well and using dedicated sampling equipment. Levels of both of the constituents have declined since 2008, when the sampling method was

changed. Statistical analysis does not indicate a trend, either upward or downward, in barium or combined Ra-226/228 data collected since 2004.

Combined Ra-226/228 levels and barium concentrations remain within background levels in the downgradient BVA wells. Trend analysis indicates an upward trend in barium in the two wells, although the increases are very small. No trends, either upward or downward, were indicated in the combined Ra-226/228 data in wells 0400 and 0402. Additional sampling was performed in 2011 due to increasing levels of combined Ra-226/228 in the BVA wells to ensure that the MCL of 5 pCi/L would not be exceeded in the future. The data from 2011 indicate that the levels have returned to typical levels, and the data from 2010 are likely within the natural variation of radium within the BVA.

Sodium and chloride monitoring results continue to indicate that the highest concentrations occur in well 0445, where elevated radium and barium are also detected. Trend analysis indicates decreasing concentrations in sodium and chloride in well 0445. Sodium and chloride data indicate that groundwater impacted by the salt within the bedrock aquifer is still discharging into the BVA; however, data from well P033 indicate that this impact has decreased. Evaluation of the sodium and chloride data with respect to the concentrations of barium and radium show that the presence of elevated salt in the groundwater increases barium and radium.

Although the levels of radium and barium in the bedrock groundwater are not decreasing to the MCL, it is recommended to discontinue the Phase I confirmatory sampling program for barium and radium, based on the evaluation of the body of data collected since 2004. This data set confirms the understanding regarding the presence of elevated barium and radium levels within the low-yield bedrock aquifer downgradient of the SST building. It was considered that the unusual geochemistry in well 0445 resulted in the release of naturally occurring barium and radium from the bedrock matrix.

## 8.0 References

DOE (U.S. Department of Energy), 2003a. *Phase I Record of Decision, Miamisburg Closure Project* (Final), prepared by the Miamisburg Closure Project, for the U.S. Department of Energy, Ohio Field Office, July.

DOE (U.S. Department of Energy), 2003b. *Phase I Residual Risk Evaluation, Miamisburg Closure Project* (Final), prepared by the Miamisburg Closure Project, for the U.S. Department of Energy, Ohio Field Office, March.

DOE (U.S. Department of Energy), 2004. *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan* (Final), prepared by CH2M Hill – Miamisburg Closure Project, for the U.S. Department of Energy, Ohio Field Office, September.

DOE (U.S. Department of Energy), 2008. *Phase I Groundwater Monitoring Report Calendar Year 2007*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2011a. *Phase I Groundwater Monitoring Report Calendar Year 2010*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2011b. *Data Validation Package – January, February, March 2011, Mound, Ohio*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, June.

DOE (U.S. Department of Energy), 2011c. *Data Validation Package – April, May, June 2011, Mound, Ohio*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, September.

DOE (U.S. Department of Energy), 2011d. *Data Validation Package – July, August, September 2011, Mound, Ohio*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, December.

DOE (U.S. Department of Energy), 2012. *Data Validation Package – October, November, December 2011, Mound, Ohio*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, February.

*Environmental Procedures Catalog*, LMS/POL/S04325, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

*Mound Methods Compendium*, Issue 2, MD-80045, prepared by BWXT of Ohio, Inc.

This page intentionally left blank



## **Appendix A**

### **Mound-Specific Sampling Protocols**

This page intentionally left blank

## Procedure A1 – Sampling Method for BVA Wells

The following procedure will be utilized for collection of groundwater samples from wells at the Mound Site screened in the BVA using a low-flow method.

Field parameter measurements to be recorded:

- Water quality indicators (pH, dissolved oxygen, and specific conductance)
- Temperature
- Oxidation-reduction potential (ORP)
- Turbidity
- Water level

Groundwater samples will be collected using the following procedural steps for low-flow sampling:

1. Measure the depth to water prior to purging or portable sampling pump.

If a portable pump is used for sampling of wells, the water level should be measured again for monitoring of drawdown during purging. Purging can commence immediately. Pumps should be lowered to approximately 2 ft above the bottom of the screened interval. Efforts should be made to slowly lower pumps into wells to prevent agitation of the water column.

2. Turn pump on at lowest setting and slowly increase the flow rate until water begins to emerge from the discharge tube. Adjust the flow rate to approximately 500 mL/min.
3. After 1 pump/tubing volume has been purged, water quality indicators, DO, ORP, and turbidity will be measured at regular intervals based on volume purged (1 pump/tubing volume) or time (at least 3 minutes apart).
4. Monitor the water level in the well. If drawdown is occurring, the purge rate should be decreased until drawdown stops or a purge rate of 100 mL/min is obtained. If a purge rate of 100 mL/min cannot be maintained, contact the project lead to determine appropriate action for the well.
5. Sample collection can begin as soon as the drawdown and the water quality indicators have stabilized. Stability will be considered achieved when the criteria in Table A–1 are achieved and the turbidity of the water has reached 50 NTUs. A lower NTU level is required when chromium and nickel are analytes.

Table A–1. Stabilization Criteria for Field Parameters

Parameter	Criteria
Water Level	< 0.05 ft
pH	± 0.2 units
Dissolved Oxygen	±10 %
Specific Conductance	±10 %
Turbidity	≤ 50 NTU
Turbidity – Cr & Ni analyses	≤ 10 NTU

## Procedure A2 – Sampling Method for Wells 0411 and 0443

The following procedure will be utilized for collection of groundwater samples from low-yield bedrock wells 0411 and 0443 in Phase I at the Mound Site.

Field parameter measurements to be recorded:

- Water quality indicators (pH, dissolved oxygen, and specific conductance)
- Temperature
- Oxidation-reduction potential (ORP)
- Turbidity
- Water level

Groundwater samples will be collected using the following procedural steps:

1. Measure the depth to water prior to purging or portable sampling pump.

If a portable pump is used for sampling of wells, the water level should be measured again for monitoring of drawdown during purging. Purging can commence immediately. Pumps should be lowered to approximately 2 ft above the bottom of the screened interval. Efforts should be made to slowly lower pumps into wells to prevent agitation of the water column.

2. Turn pump on at a flow rate of 100 mL/min to 200 mL/min until water begins to emerge from the discharge tube.
3. After 1 pump/tubing volume has been purged, water quality indicators, temperature, ORP, and turbidity will be measured at regular intervals based on volume purged (1 pump/tubing volume) or time (at least 3 minutes apart).
4. Monitor the water level in the well. If drawdown in the wells is greater than 3 ft, stop purging water and contact the project lead to determine appropriate action for the well. Sampling method will likely be changed to that in Procedure A3.
5. Sample collection can begin as soon as the drawdown and the water quality indicators have stabilized. Stability will be considered achieved when the criteria in Table A–2 are achieved and the turbidity of the water has reached 50 NTUs. A lower NTU level is required when chromium and nickel are analytes. If the turbidity criteria cannot be attained and the other parameters meet criteria, contact the project lead to determine appropriate action for the well.

Table A–2. Stabilization Criteria for Field Parameters

Parameter	Criteria
Water Level	< 3 ft
pH	± 0.2 units
Dissolved Oxygen	±10 %
Specific Conductance	±10 %
Turbidity	≤ 50 NTU
Turbidity – Cr & Ni analyses	≤ 10 NTU

### **Procedure A3 – Sampling Method for Wells 0353, 0444, and 0445**

The following procedure will be utilized for collection of groundwater samples from low-yield bedrock wells 0353, 0444, and 0445 in Phase I at the Mound Site.

Field parameter measurements to be recorded:

- Water quality indicators (pH, dissolved oxygen, and specific conductance)
- Temperature
- Oxidation-reduction potential (ORP)
- Turbidity
- Water level

Groundwater samples will be collected using the following procedural steps:

1. Measure the depth to water prior to purging or portable sampling pump.

If a portable pump is used for sampling of wells, the water level should be measured again for monitoring of drawdown during purging. Purging can commence immediately. Pumps should be lowered to approximately 2 ft from the bottom of the screened interval. Efforts should be made to slowly lower pumps into wells to prevent agitation of the water column.

2. Turn pump on at a flow rate of 100 mL/min.
3. Sample collection can begin after 1 pump/tubing volume has been purged.
4. Water quality indicators, DO, ORP, and turbidity will be measured after the removal of 1 pump/tubing volume and at the end of sampling, and recorded.
5. Measure and record the depth of water after collecting samples.

## Procedure A4 – Sampling Method for Seeps

The following procedure will be utilized for collection of surface water samples from seeps at the Mound Site.

Field parameter measurements to be recorded:

- pH
  - specific conductance
  - Oxidation-reduction potential (ORP)
1. Note condition of seep water (qualitative description of flow, color, turbidity, etc.) prior to sampling.
  2. Create a surface basin for ponding of seep water if one is not present.
  3. Allow water to flush through the basin until water becomes clear (similar condition prior to creating basin).
  4. Samples may be collected by using a transfer container or by submerging the sample bottle into the basin. This is not acceptable for pre-preserved sample bottles; a transfer container will be used for collecting samples.

## **Appendix B**

### **2011 Phase I MNA and Confirmatory Sampling Data**

This page intentionally left blank



Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0400	Barium	1/26/2011	0.142	0.001	mg/L		F
0400	Barium	5/4/2011	0.0972	0.001	mg/L		F
0400	Barium	7/26/2011	0.0979	0.001	mg/L		F
0400	Barium	10/25/2011	0.116	0.001	mg/L		FJ
0402	Barium	1/31/2011	0.0778	0.001	mg/L		F
0402	Barium	5/4/2011	0.0475	0.001	mg/L		F
0402	Barium	7/25/2011	0.0499	0.001	mg/L		F
0402	Barium	10/25/2011	0.0747	0.001	mg/L		FJ
0445	Barium	1/31/2011	11.6	0.001	mg/L		FQ
0445	Barium	5/4/2011	10	0.001	mg/L		FQ
0445	Barium	7/25/2011	11	0.001	mg/L		FQ
0445	Barium	10/25/2011	10.2	0.001	mg/L		FQ
P033	Barium	1/26/2011	0.1	0.001	mg/L		F
P033	Barium	5/4/2011	0.0841	0.001	mg/L		F
P033	Barium	7/26/2011	0.106	0.001	mg/L		F
P033	Barium	10/25/2011	0.0926	0.001	mg/L		F
0400	Chloride	1/26/2011	115	0.66	mg/L		FJ
0400	Chloride	5/4/2011	18.6	0.132	mg/L		F
0400	Chloride	7/26/2011	71.9	0.66	mg/L		F
0400	Chloride	10/25/2011	88	0.66	mg/L		FJ
0402	Chloride	1/31/2011	59	0.66	mg/L		F
0402	Chloride	5/4/2011	41	0.66	mg/L		F
0402	Chloride	7/25/2011	42.3	0.66	mg/L		F
0402	Chloride	10/25/2011	101	0.66	mg/L		FJ
0445	Chloride	1/31/2011	8510	66	mg/L		FQ
0445	Chloride	5/4/2011	8350	66	mg/L		FQ
0445	Chloride	7/25/2011	8630	66	mg/L		FQ
0445	Chloride	10/25/2011	8310	66	mg/L		FQ
P033	Chloride	1/26/2011	130	0.66	mg/L		F
P033	Chloride	5/4/2011	129	0.66	mg/L		F
P033	Chloride	7/26/2011	240	1.32	mg/L		F
P033	Chloride	10/25/2011	113	0.66	mg/L		F
0353	cis-1,2-Dichloroethene	1/31/2011	0.1	0.1	µg/L	U	FQ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0353	cis-1,2-Dichloroethene	7/25/2011	0.1	0.1	µg/L	U	FQ
0400	cis-1,2-Dichloroethene	1/26/2011	0.1	0.1	µg/L	U	F
0400	cis-1,2-Dichloroethene	7/26/2011	0.1	0.1	µg/L	U	F
0402	cis-1,2-Dichloroethene	1/31/2011	0.1	0.1	µg/L	U	F
0402	cis-1,2-Dichloroethene	7/25/2011	0.1	0.1	µg/L	U	F
0402	cis-1,2-Dichloroethene	12/8/2011	0.1	0.1	µg/L	U	
0411	cis-1,2-Dichloroethene	1/26/2011	3.32	0.1	µg/L		FJ
0411	cis-1,2-Dichloroethene	7/25/2011	2.8	0.1	µg/L		FQ
0443	cis-1,2-Dichloroethene	1/26/2011	0.49	0.1	µg/L	J	FJ
0443	cis-1,2-Dichloroethene	7/25/2011	0.22	0.1	µg/L	J	FQ
0444	cis-1,2-Dichloroethene	1/31/2011	0.1	0.1	µg/L	U	FQ
0444	cis-1,2-Dichloroethene	7/25/2011	0.1	0.1	µg/L	U	FQ
0445	cis-1,2-Dichloroethene	1/31/2011	0.1	0.1	µg/L	U	FQ
0445	cis-1,2-Dichloroethene	7/25/2011	0.1	0.1	µg/L	U	FQ
0617	cis-1,2-Dichloroethene	1/25/2011	2.2	0.1	µg/L		J
0617	cis-1,2-Dichloroethene	7/27/2011	1.36	0.1	µg/L		
P033	cis-1,2-Dichloroethene	1/26/2011	0.1	0.1	µg/L	U	F
P033	cis-1,2-Dichloroethene	7/26/2011	0.1	0.1	µg/L	U	F
0353	Dissolved Oxygen	1/31/2011	2.25		mg/L		FQ
0353	Dissolved Oxygen	7/25/2011	0.7		mg/L		FQ
0400	Dissolved Oxygen	1/26/2011	2.15		mg/L		F
0400	Dissolved Oxygen	5/4/2011	9.19		mg/L		F
0400	Dissolved Oxygen	7/26/2011	6.47		mg/L		F
0400	Dissolved Oxygen	10/25/2011	4.17		mg/L		FJ
0402	Dissolved Oxygen	1/31/2011	5.05		mg/L		F
0402	Dissolved Oxygen	5/4/2011	6.17		mg/L		F
0402	Dissolved Oxygen	7/25/2011	4.67		mg/L		F
0402	Dissolved Oxygen	10/25/2011	3.12		mg/L		FJ
0402	Dissolved Oxygen	12/8/2011	4.19		mg/L		
0411	Dissolved Oxygen	1/26/2011	1.48		mg/L		F
0411	Dissolved Oxygen	7/25/2011	1.32		mg/L		FQ
0443	Dissolved Oxygen	1/26/2011	4.31		mg/L		F
0443	Dissolved Oxygen	7/25/2011	7.97		mg/L		FQ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0444	Dissolved Oxygen	1/31/2011	4.35		mg/L		FQ
0444	Dissolved Oxygen	7/25/2011	4.09		mg/L		FQ
0445	Dissolved Oxygen	1/31/2011	1.1		mg/L		FQ
0445	Dissolved Oxygen	5/4/2011	0.89		mg/L		FQ
0445	Dissolved Oxygen	7/25/2011	2.88		mg/L		FQ
0445	Dissolved Oxygen	10/25/2011	4.03		mg/L		FQ
0617	Dissolved Oxygen	1/25/2011	9.49		mg/L		
0617	Dissolved Oxygen	7/27/2011	7.15		mg/L		
P033	Dissolved Oxygen	1/26/2011	1.41		mg/L		F
P033	Dissolved Oxygen	5/4/2011	5.47		mg/L		F
P033	Dissolved Oxygen	7/26/2011	5.14		mg/L		F
P033	Dissolved Oxygen	10/25/2011	3.32		mg/L		F
0353	Oxidation Reduction Potential	1/31/2011	134.6		mV		FQ
0353	Oxidation Reduction Potential	7/25/2011	41.9		mV		FQ
0400	Oxidation Reduction Potential	1/26/2011	44.7		mV		F
0400	Oxidation Reduction Potential	5/4/2011	150.3		mV		F
0400	Oxidation Reduction Potential	7/26/2011	69.9		mV		F
0400	Oxidation Reduction Potential	10/25/2011	111		mV		FJ
0402	Oxidation Reduction Potential	1/31/2011	109.7		mV		F
0402	Oxidation Reduction Potential	5/4/2011	12.7		mV		F
0402	Oxidation Reduction Potential	7/25/2011	-30.7		mV		F
0402	Oxidation Reduction Potential	10/25/2011	215.2		mV		FJ
0402	Oxidation Reduction Potential	12/8/2011	188.4		mV		
0411	Oxidation Reduction Potential	1/26/2011	107.9		mV		F
0411	Oxidation Reduction Potential	7/25/2011	57.9		mV		FQ
0443	Oxidation Reduction Potential	1/26/2011	90		mV		F
0443	Oxidation Reduction Potential	7/25/2011	60.4		mV		FQ
0444	Oxidation Reduction Potential	1/31/2011	115.2		mV		FQ
0444	Oxidation Reduction Potential	7/25/2011	63		mV		FQ
0445	Oxidation Reduction Potential	1/31/2011	-75.9		mV		FQ
0445	Oxidation Reduction Potential	5/4/2011	-77.1		mV		FQ
0445	Oxidation Reduction Potential	7/25/2011	-90.2		mV		FQ
0445	Oxidation Reduction Potential	10/25/2011	75.6		mV		FQ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0617	Oxidation Reduction Potential	1/25/2011	114.8		mV		
0617	Oxidation Reduction Potential	7/27/2011	138.9		mV		
P033	Oxidation Reduction Potential	1/26/2011	77.9		mV		F
P033	Oxidation Reduction Potential	5/4/2011	159.1		mV		F
P033	Oxidation Reduction Potential	7/26/2011	120		mV		F
P033	Oxidation Reduction Potential	10/25/2011	161.3		mV		F
0353	pH	1/31/2011	6.85		s.u.		FQ
0353	pH	7/25/2011	6.77		s.u.		FQ
0400	pH	1/26/2011	6.96		s.u.		F
0400	pH	5/4/2011	7.03		s.u.		F
0400	pH	7/26/2011	6.92		s.u.		F
0400	pH	10/25/2011	6.7		s.u.		FJ
0402	pH	1/31/2011	7.02		s.u.		F
0402	pH	5/4/2011	7.25		s.u.		F
0402	pH	7/25/2011	6.91		s.u.		F
0402	pH	10/25/2011	6.62		s.u.		FJ
0402	pH	12/8/2011	6.94		s.u.		
0411	pH	1/26/2011	6.89		s.u.		F
0411	pH	7/25/2011	6.73		s.u.		FQ
0443	pH	1/26/2011	6.89		s.u.		F
0443	pH	7/25/2011	6.84		s.u.		FQ
0444	pH	1/31/2011	7.02		s.u.		FQ
0444	pH	7/25/2011	6.8		s.u.		FQ
0445	pH	1/31/2011	6.8		s.u.		FQ
0445	pH	5/4/2011	7		s.u.		FQ
0445	pH	7/25/2011	6.86		s.u.		FQ
0445	pH	10/25/2011	6.34		s.u.		FQ
0617	pH	1/25/2011	6.98		s.u.		
0617	pH	7/27/2011	6.99		s.u.		
P033	pH	1/26/2011	6.93		s.u.		F
P033	pH	5/4/2011	6.81		s.u.		F
P033	pH	7/26/2011	6.82		s.u.		F
P033	pH	10/25/2011	6.64		s.u.		F

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0400	Radium-226	1/26/2011	0.923	0.369	pCi/L		FJ
0400	Radium-226	5/4/2011	1.48	0.425	pCi/L		F
0400	Radium-226	7/26/2011	0.928	0.571	pCi/L		FJ
0400	Radium-226	10/25/2011	0.33	0.271	pCi/L		UFJ
0402	Radium-226	1/31/2011	0.366	0.527	pCi/L	U	F
0402	Radium-226	5/4/2011	1.81	0.29	pCi/L		F
0402	Radium-226	7/25/2011	0.447	0.428	pCi/L		UF
0402	Radium-226	10/25/2011	0.596	0.253	pCi/L		JF
0445	Radium-226	1/31/2011	20.1	0.377	pCi/L		FQ
0445	Radium-226	5/4/2011	19.9	0.297	pCi/L		FQ
0445	Radium-226	7/25/2011	64.9	0.301	pCi/L		FQ
0445	Radium-226	10/25/2011	36.7	0.287	pCi/L		FQ
P033	Radium-226	1/26/2011	0.924	0.7	pCi/L		UF
P033	Radium-226	5/4/2011	0.91	0.301	pCi/L		F
P033	Radium-226	7/26/2011	0.247	0.569	pCi/L	U	F
P033	Radium-226	10/25/2011	0.316	0.161	pCi/L		JF
0400	Radium-228	1/26/2011	0.322	0.58	pCi/L	U	F
0400	Radium-228	5/4/2011	0.276	0.642	pCi/L	U	F
0400	Radium-228	7/26/2011	0.68	0.653	pCi/L		UF
0400	Radium-228	10/25/2011	0.499	0.863	pCi/L	U	FJ
0402	Radium-228	1/31/2011	0.569	0.549	pCi/L		UF
0402	Radium-228	5/4/2011	0.0182	0.668	pCi/L	U	F
0402	Radium-228	7/25/2011	0.171	0.531	pCi/L	U	F
0402	Radium-228	10/25/2011	0.244	0.575	pCi/L	U	FJ
0445	Radium-228	1/31/2011	22.2	0.929	pCi/L		FQ
0445	Radium-228	5/4/2011	24.9	0.777	pCi/L		FQ
0445	Radium-228	7/25/2011	39.1	0.501	pCi/L		FQ
0445	Radium-228	10/25/2011	3.63	1.49	pCi/L		JFQ
P033	Radium-228	1/26/2011	0.0667	0.582	pCi/L	U	F
P033	Radium-228	5/4/2011	0.262	0.64	pCi/L	U	F
P033	Radium-228	7/26/2011	0.106	0.59	pCi/L	U	F
P033	Radium-228	10/25/2011	0.515	0.578	pCi/L	U	F
0400	Sodium	1/26/2011	67.2	0.1	mg/L		F

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0400	Sodium	5/4/2011	19.5	0.1	mg/L		F
0400	Sodium	7/26/2011	50.5	0.1	mg/L		F
0400	Sodium	10/25/2011	56.4	0.1	mg/L		FJ
0402	Sodium	1/31/2011	46.6	0.1	mg/L		F
0402	Sodium	5/4/2011	41.7	0.1	mg/L		F
0402	Sodium	7/25/2011	38.9	0.1	mg/L		F
0402	Sodium	10/25/2011	64.3	0.1	mg/L		FJ
0445	Sodium	1/31/2011	3980	1	mg/L		FQ
0445	Sodium	5/4/2011	3440	1	mg/L		FQ
0445	Sodium	7/25/2011	4200	1	mg/L		FQ
0445	Sodium	10/25/2011	3970	1	mg/L		FQ
P033	Sodium	1/26/2011	83.9	0.1	mg/L		F
P033	Sodium	5/4/2011	82.9	0.1	mg/L		F
P033	Sodium	7/26/2011	114	0.1	mg/L		F
P033	Sodium	10/25/2011	69.2	0.1	mg/L		F
0353	Specific Conductance	1/31/2011	1342		umhos/cm		FQ
0353	Specific Conductance	7/25/2011	1377		umhos/cm		FQ
0400	Specific Conductance	1/26/2011	1229		umhos/cm		F
0400	Specific Conductance	5/4/2011	618		umhos/cm		F
0400	Specific Conductance	7/26/2011	1058		umhos/cm		F
0400	Specific Conductance	10/25/2011	1138		umhos/cm		FJ
0402	Specific Conductance	1/31/2011	1205		umhos/cm		F
0402	Specific Conductance	5/4/2011	905		umhos/cm		F
0402	Specific Conductance	7/25/2011	953		umhos/cm		F
0402	Specific Conductance	10/25/2011	1251		umhos/cm		FJ
0402	Specific Conductance	12/8/2011	926		umhos/cm		
0411	Specific Conductance	1/26/2011	1567		umhos/cm		F
0411	Specific Conductance	7/25/2011	1487		umhos/cm		FQ
0443	Specific Conductance	1/26/2011	1614		umhos/cm		F
0443	Specific Conductance	7/25/2011	1503		umhos/cm		FQ
0444	Specific Conductance	1/31/2011	1230		umhos/cm		FQ
0444	Specific Conductance	7/25/2011	1217		umhos/cm		FQ
0445	Specific Conductance	1/31/2011	27040		umhos/cm		FQ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0445	Specific Conductance	5/4/2011	15910		umhos/cm		FQ
0445	Specific Conductance	7/25/2011	24200		umhos/cm		FQ
0445	Specific Conductance	10/25/2011	12970		umhos/cm		FQ
0617	Specific Conductance	1/25/2011	1802		umhos/cm		
0617	Specific Conductance	7/27/2011	1824		umhos/cm		
P033	Specific Conductance	1/26/2011	1270		umhos/cm		F
P033	Specific Conductance	5/4/2011	1261		umhos/cm		F
P033	Specific Conductance	7/26/2011	1655		umhos/cm		F
P033	Specific Conductance	10/25/2011	1265		umhos/cm		F
0353	Temperature	1/31/2011	6.58		C		FQ
0353	Temperature	7/25/2011	17.82		C		FQ
0400	Temperature	1/26/2011	10.53		C		F
0400	Temperature	5/4/2011	10.53		C		F
0400	Temperature	7/26/2011	13.6		C		F
0400	Temperature	10/25/2011	13.22		C		FJ
0402	Temperature	1/31/2011	10.68		C		F
0402	Temperature	5/4/2011	8.12		C		F
0402	Temperature	7/25/2011	13.14		C		F
0402	Temperature	10/25/2011	12.52		C		FJ
0402	Temperature	12/8/2011	12.05		C		
0411	Temperature	1/26/2011	9.65		C		F
0411	Temperature	7/25/2011	16.97		C		FQ
0443	Temperature	1/26/2011	9.58		C		F
0443	Temperature	7/25/2011	16.95		C		FQ
0444	Temperature	1/31/2011	8.68		C		FQ
0444	Temperature	7/25/2011	17.32		C		FQ
0445	Temperature	1/31/2011	9.39		C		FQ
0445	Temperature	5/4/2011	11.37		C		FQ
0445	Temperature	7/25/2011	16.61		C		FQ
0445	Temperature	10/25/2011	14.02		C		FQ
0617	Temperature	1/25/2011	7.62		C		
0617	Temperature	7/27/2011	19.52		C		
P033	Temperature	1/26/2011	12.47		C		F

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
P033	Temperature	5/4/2011	11.76		C		F
P033	Temperature	7/26/2011	14.43		C		F
P033	Temperature	10/25/2011	14.15		C		F
0353	Tetrachloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0353	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0400	Tetrachloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0400	Tetrachloroethene	7/26/2011	0.2	0.2	µg/L	U	F
0402	Tetrachloroethene	1/31/2011	0.2	0.2	µg/L	U	F
0402	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	F
0402	Tetrachloroethene	12/8/2011	0.2	0.2	µg/L	U	
0411	Tetrachloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0411	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0443	Tetrachloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0443	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0444	Tetrachloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0444	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0445	Tetrachloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0445	Tetrachloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0617	Tetrachloroethene	1/25/2011	0.2	0.2	µg/L	U	
0617	Tetrachloroethene	7/27/2011	0.2	0.2	µg/L	U	
P033	Tetrachloroethene	1/26/2011	0.2	0.2	µg/L	U	F
P033	Tetrachloroethene	7/26/2011	0.2	0.2	µg/L	U	F
0353	trans-1,2-Dichloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0353	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0400	trans-1,2-Dichloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0400	trans-1,2-Dichloroethene	7/26/2011	0.2	0.2	µg/L	U	F
0402	trans-1,2-Dichloroethene	1/31/2011	0.2	0.2	µg/L	U	F
0402	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	F
0402	trans-1,2-Dichloroethene	12/8/2011	0.2	0.2	µg/L	U	
0411	trans-1,2-Dichloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0411	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0443	trans-1,2-Dichloroethene	1/26/2011	0.2	0.2	µg/L	U	F
0443	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ



Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0444	trans-1,2-Dichloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0444	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0445	trans-1,2-Dichloroethene	1/31/2011	0.2	0.2	µg/L	U	FQ
0445	trans-1,2-Dichloroethene	7/25/2011	0.2	0.2	µg/L	U	FQ
0617	trans-1,2-Dichloroethene	1/25/2011	0.2	0.2	µg/L	U	
0617	trans-1,2-Dichloroethene	7/27/2011	0.2	0.2	µg/L	U	
P033	trans-1,2-Dichloroethene	1/26/2011	0.2	0.2	µg/L	U	F
P033	trans-1,2-Dichloroethene	7/26/2011	0.2	0.2	µg/L	U	F
0353	Trichloroethene	1/31/2011	0.11	0.11	µg/L	U	FQ
0353	Trichloroethene	7/25/2011	0.11	0.11	µg/L	U	FQ
0400	Trichloroethene	1/26/2011	0.11	0.11	µg/L	U	F
0400	Trichloroethene	7/26/2011	0.11	0.11	µg/L	U	F
0402	Trichloroethene	1/31/2011	0.11	0.11	µg/L	U	F
0402	Trichloroethene	7/25/2011	0.19	0.11	µg/L	J	F
0402	Trichloroethene	12/8/2011	0.14	0.11	µg/L	J	
0411	Trichloroethene	1/26/2011	10.6	0.11	µg/L		F
0411	Trichloroethene	7/25/2011	9.42	0.11	µg/L		FQ
0443	Trichloroethene	1/26/2011	7.47	0.11	µg/L		F
0443	Trichloroethene	7/25/2011	5.73	0.11	µg/L		FQ
0444	Trichloroethene	1/31/2011	0.11	0.11	µg/L	U	FQ
0444	Trichloroethene	7/25/2011	0.11	0.11	µg/L	U	FQ
0445	Trichloroethene	1/31/2011	0.11	0.11	µg/L	U	FQ
0445	Trichloroethene	7/25/2011	0.11	0.11	µg/L	U	FQ
0617	Trichloroethene	1/25/2011	9.78	0.11	µg/L		
0617	Trichloroethene	7/27/2011	6.66	0.11	µg/L		
P033	Trichloroethene	1/26/2011	0.11	0.11	µg/L	U	F
P033	Trichloroethene	7/26/2011	0.11	0.11	µg/L	U	F
0353	Turbidity	1/31/2011	85.2		NTU		FQ
0353	Turbidity	7/25/2011	25.7		NTU		FQ
0400	Turbidity	1/26/2011	589		NTU		F
0400	Turbidity	5/4/2011	307		NTU		F
0400	Turbidity	7/26/2011	104		NTU		F
0400	Turbidity	10/25/2011	66.8		NTU		FJ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0402	Turbidity	1/31/2011	45		NTU		F
0402	Turbidity	5/4/2011	2.93		NTU		F
0402	Turbidity	7/25/2011	9.97		NTU		F
0402	Turbidity	10/25/2011	6.07		NTU		FJ
0402	Turbidity	12/8/2011	45.4		NTU		
0411	Turbidity	1/26/2011	169		NTU		F
0411	Turbidity	7/25/2011	36.5		NTU		FQ
0443	Turbidity	1/26/2011	2.3		NTU		F
0443	Turbidity	7/25/2011	41.6		NTU		FQ
0444	Turbidity	1/31/2011	179		NTU		FQ
0444	Turbidity	7/25/2011	300		NTU		FQ
0445	Turbidity	1/31/2011	7.64		NTU		FQ
0445	Turbidity	5/4/2011	15.4		NTU		FQ
0445	Turbidity	7/25/2011	22.9		NTU		FQ
0445	Turbidity	10/25/2011	3.98		NTU		FQ
0617	Turbidity	7/27/2011	77.9		NTU		
P033	Turbidity	1/26/2011	6.31		NTU		F
P033	Turbidity	5/4/2011	1.22		NTU		F
P033	Turbidity	7/26/2011	9.8		NTU		F
P033	Turbidity	10/25/2011	3.02		NTU		F
0353	Vinyl chloride	1/31/2011	0.2	0.2	µg/L	U	FQ
0353	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	FQ
0400	Vinyl chloride	1/26/2011	0.2	0.2	µg/L	U	F
0400	Vinyl chloride	7/26/2011	0.2	0.2	µg/L	U	F
0402	Vinyl chloride	1/31/2011	0.2	0.2	µg/L	U	F
0402	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	F
0402	Vinyl chloride	12/8/2011	0.2	0.2	µg/L	U	
0411	Vinyl chloride	1/26/2011	0.2	0.2	µg/L	U	F
0411	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	FQ
0443	Vinyl chloride	1/26/2011	0.2	0.2	µg/L	U	F
0443	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	FQ
0444	Vinyl chloride	1/31/2011	0.2	0.2	µg/L	U	FQ
0444	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	FQ

Location ID	Analyte	Sample Date	Result	Detection Limit	Units	Laboratory Qualifier	Validation Qualifier
0445	Vinyl chloride	1/31/2011	0.2	0.2	µg/L	U	FQ
0445	Vinyl chloride	7/25/2011	0.2	0.2	µg/L	U	FQ
0617	Vinyl chloride	1/25/2011	0.2	0.2	µg/L	U	
0617	Vinyl chloride	7/27/2011	0.2	0.2	µg/L	U	
P033	Vinyl chloride	1/26/2011	0.2	0.2	µg/L	U	F
P033	Vinyl chloride	7/26/2011	0.2	0.2	ug/L	U	F

This page intentionally left blank

## **Appendix C**

### **March/April 2011 Monitoring Well Photos**

This page intentionally left blank



*Well 0353*



*Well 0400*



*Well 0402*

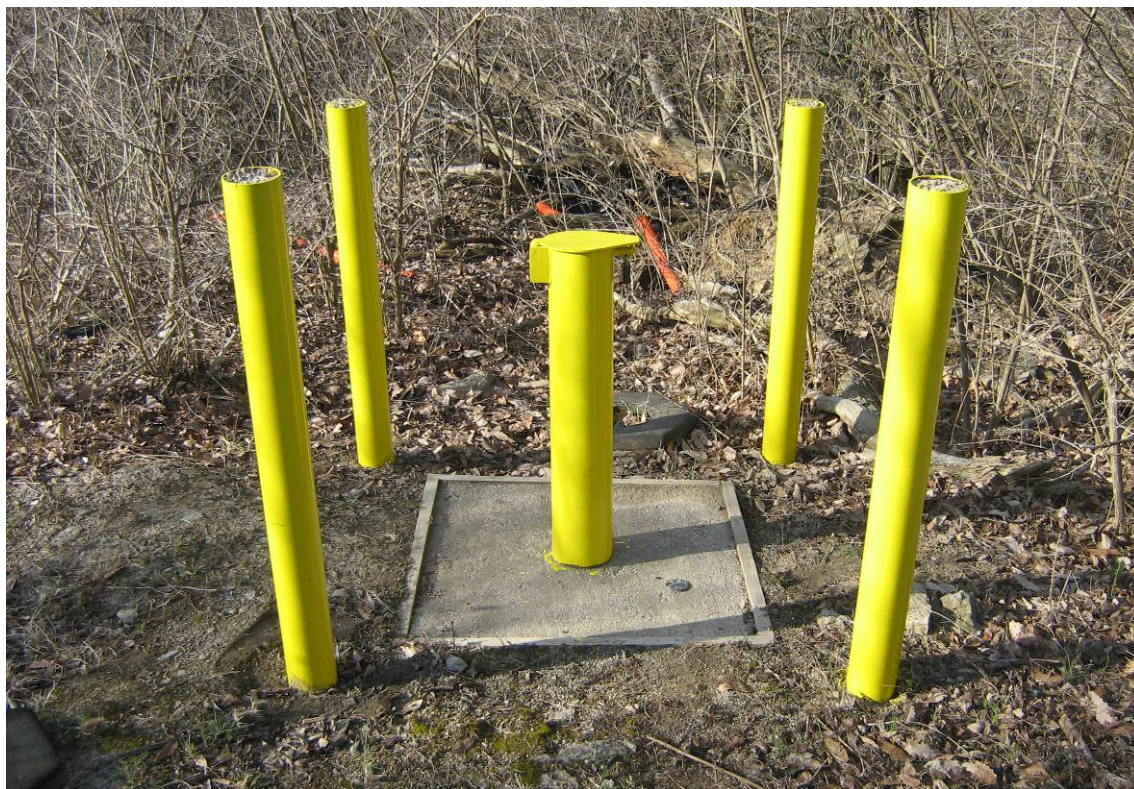


*Well 0411*





*Well 0443*



*Well 0444*



*Well 0445*



*Well P033*