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Stoller

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Task Order LM00-721
Control Number: 11-0454

March 22, 2011

U.S. Department of Energy
Office of Legacy Management
ATTN: Arthur W. Kleinrath
Site Manager
955 Mound Road
Miamisburg, OH 45342

Subject: Contract No. DE-AM01-07LM00060, S.M. Stoller Corporation (Stoller) Phase I Groundwater Monitoring Report—Calendar Year 2010

Reference: LM712-06-508, Mound OH Support, Reporting

Dear Mr. Kleinrath:

Enclosed are copies of the *Phase I Groundwater Monitoring Report—Calendar Year 2010* for issue to regulators and other interested parties. This report is due to the regulators by March 31, 2011. The report represents the seventh submittal of an annual report documenting groundwater quality in the Phase I area. All sampling and data analyses were performed in accordance with the *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan*, unless noted otherwise.

The report includes data collected during the four quarterly groundwater sampling events performed during 2010. Data are presented in both time-series plots and map-view plots. Trend analysis was performed on selected wells using the nonparametric Mann-Kendal test to confirm trends in contaminant concentrations over time. The time-series plots are also used to evaluate changes in groundwater quality over time. Additional information includes documentation of any operational changes and maintenance or repair activities that were performed during 2010.

In general, the MNA data for TCE in groundwater indicate that concentrations have decreased in source well 0411; concentrations have been variable in source well 0443 and seep 0617 but have been less than those measured in well 0411. Also, data show that TCE from the 0411/0443 area in Phase I has not impacted the downgradient BVA. The 2010 data do not indicate that the monitoring program should be changed at this time. Semiannual sampling will continue in 2011.

Confirmatory sampling for radium, barium, sodium, and chloride supports the interpretation that the source of elevated radium and barium in well 0445 is the shale bedrock and that dissolved salt is the mechanism that has resulted in elevated levels at this location. Monitoring results for 2010 show levels of barium and combined Ra-226/228 greater than the MCLs in source well 0445, but levels of these constituents remain within the range of background in the downgradient

BVA wells. Levels of barium and combined Ra-226/228 are slightly higher in wells 0400 and 0402, and these wells have shown slight upward trends for those constituents. The 2010 data suggest that these locations should be sampled quarterly to monitor the rate that the levels are increasing in BVA wells and to ensure that levels of combined Ra-226/228 will not exceed the 5 pCi/L MCL in the future.

This document will be posted on the Mound website, http://www.lm.doe.gov/mound/sites.aspx.

If you have any questions or comments, please contact Rebecca Cato at (636) 926-7038.

Sincerely,

Robert C. Ransbottom
Task Manager

RCR:jp

Enclosures

cc: Paul Lucas, EM
Rebecca Cato, Stoller
Charles Friedman, Stoller
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Department of Energy
Office of Legacy Management

March 22, 2011

Mr. Tim Fischer
U. S. Environmental Protection Agency
77 W. Jackson Blvd.
Chicago, IL 60604

Mr. Brian Nickel
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, OH 45402-2911

Subject: Phase I Groundwater Monitoring Report – Calendar Year 2010

Dear Sirs:

Enclosed is the Mound site Phase 1 Groundwater Monitoring Report Calendar Year 2010. Results are consistent with the past and the only modification recommended is to change radium and barium quarterly sampling.

Distribution of this document is listed below and it will also be posted on the Mound Website, www.lm.doe.gov/mound/sites.aspx.

Sincerely,

Arthur W. Kleinrath
DOE LM Mound Site Manager

AWK:jp

Enclosure

Joe Crombie	Reading Room
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LMS/MND/S07535

Mound Site

Phase I Groundwater Monitoring Report Calendar Year 2010

March 2011

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Mound Site

Phase I Groundwater Monitoring Report
Calendar Year 2010

March 2011

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Contents

Abbreviations iii
1.0 Introduction 1
1.1 Purpose 1
1.2 Summary of 2009 Annual Report 1
2.0 Monitoring Program 3
2.1 Monitored Natural Attenuation of TCE 3
2.2 Confirmatory Sampling 3
2.3 Triggers 5
2.4 Groundwater Flow 6
2.5 Deviations from the Sampling Plan 6
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 19
4.3 Recommendations 22
5.0 Inspection of the Monitoring System 23
6.0 Data Validation 25
7.0 Summary 27
7.1 MNA Remedy 27
7.2 Radium and Barium 27
8.0 References 29

Figures

Figure 1. Phase I MNA Remedy Monitoring Locations 4
Figure 2. General Groundwater Flow at the Mound Site 7
Figure 3. TCE Concentrations over Time—1999 through 2010 10
Figure 4. cis-1,2-DCE Concentrations—1999 through 2010 11
Figure 5. 2010 Annual Average Concentrations of TCE and DCE in Phase I Groundwater 12
Figure 6. Barium Concentrations—2000 through 2010 16
Figure 7. Ra-226/228 Levels—2002 through 2009 17
Figure 8. Distribution of Radium and Barium in Phase I Groundwater 18
Figure 9. Sodium Concentrations—2000 through 2010 20
Figure 10. Chloride Concentrations—2000 through 2010 20

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 5
Table 4. Summary of VOC Monitoring Results in Phase I for 2010 9
Table 5. Summary of Trend Analysis Results for TCE in Phase I for 2010 13
Table 6. Summary of 2010 Confirmatory Monitoring Results for Barium and Radium 15
Table 7. Summary of 2010 Confirmatory Monitoring Results for Sodium and Chloride 19
Table 8. Summary of Trend Analysis Results for Barium and Combined Radium in Phase I for 2010 21
Table 9. Summary of Trend Analysis Results for Sodium and Chloride in Phase I for 2010 21

Appendixes

Appendix A Mound Specific Sampling Protocols
Appendix B 2010 Phase I MNA and Confirmatory Sampling Data
Appendix C March 2010 Monitoring Well Inspection Summary

Abbreviations

BVA	Buried Valley Aquifer
DCE	dichloroethylene (dichloroethene)
DOE	U.S. Department of Energy
LOC	level of concern
MCL	maximum contaminant level
µg/L	microgram(s) per liter
mg/L	milligram(s) per liter
MNA	monitored natural attenuation
pCi/L	picocurie(s) per liter
Ra-226	radium-226
Ra-228	radium-228
TCE	trichloroethylene (trichloroethene)
VOC	volatile organic compound

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1.0 Introduction

Phase I is an approximately 52-acre area made up of three distinct sections of the Mound Site property and lies on the southern border of the Mound plant. 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 monitor selected wells to confirm the results of previous investigations in which these conclusions were reached.

1.1 Purpose

This report was prepared in support of the selected remedy for Phase I as outlined in the Record of Decision (DOE 2003a) and summarizes the data collected in 2010. This report represents the seventh submittal of an annual report documenting 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* (Phase I Groundwater Monitoring Plan) (DOE 2004), unless noted otherwise.

This report includes data collected during the four quarterly groundwater sampling events performed in 2010. It presents, not only data collected in support of MNA, but also data collected in support of the confirmatory monitoring for radium and barium in selected wells within Phase I. Data are presented in both time-series plots 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 or repair activities associated with the monitoring wells being sampled.

1.2 Summary of 2009 Annual Report

The conclusions and recommendations from the 2009 annual report (DOE 2010a) 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. TCE concentrations in source wells 0441 and 0443 and

seep 0617 continued to exceed the MCL of 5 micrograms per liter (μg/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 2009. No changes were recommended for the MNA remedy monitoring for TCE.

- Combined radium-226 (Ra-226)/radium-228 (Ra-228) and barium levels remained within background levels in the downgradient BVA wells during 2009. Radium and barium levels are slightly higher in well P033 than in the other two BVA wells. Confirmatory sampling showed that combined Ra-226/228 and barium levels in well 0445 continue to vary and at times exceed MCLs; levels were higher in 2009 than in previous years. Changes in sodium and chloride concentrations corresponded with similar changes in barium and combined Ra-226/228 in wells 0445 and P033. No changes were recommended for the confirmatory monitoring program for radium and barium.
- Confirmatory monitoring for nickel and chromium was modified in 2008 to address the elevated chromium and nickel results reported at the end of 2007 in well 0443. Well 0411—a stainless-steel well displaying elevated metals results—and seep 0617 were added to the monitoring program. Chromium and nickel concentrations continue to be elevated in well 0411. Results from well 0443 and seep 0617 indicated levels of chromium and nickel that are less than the level of concern (LOC) of 100 μg/L and are similar to background. The report recommended that confirmatory sampling for chromium and nickel be discontinued at well 0443 because the concentrations of these two metals have been less than the LOC for more than 2 years.

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 in wells 0411 and 0443 and seep 0617 is decreasing and that TCE is not adversely affecting the BVA. This program may be decreased or be terminated altogether when TCE concentrations in wells 0411 and 0443 and seep 0617 meet conditions outlined in the Phase I Groundwater Monitoring Plan (DOE 2004), 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.

Barium and radium are monitored to provide assurance that the understanding of the barium and radium in groundwater is correct. 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 located on the surface—a salt storage shed—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.

The 2007 Groundwater Monitoring Report (DOE 2008) recommended modifications to the monitoring program on the basis of the data collected in 2007. These modifications included reducing sampling frequencies and removing sampling locations for the MNA and confirmatory sampling programs. The 2007 Groundwater Monitoring Report also suggested more minor changes based on comments from regulators. The programs discussed below reflect these adjustments.

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 Groundwater Monitoring Plan (DOE 2004) and in Table 1. Sampling was performed in first and third quarters of 2009.

2.2 Confirmatory Sampling

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

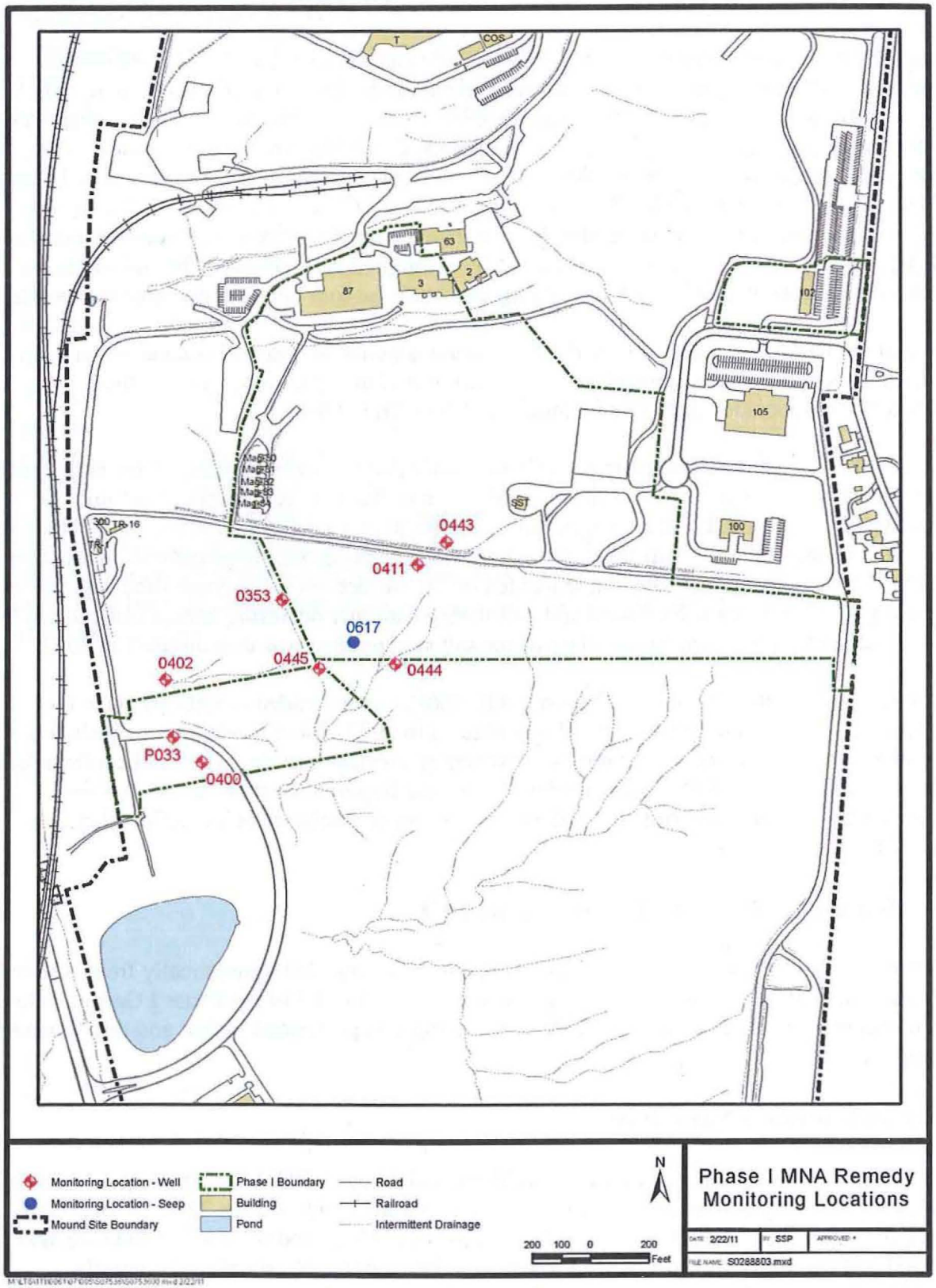

Figure 1. Phase I MNA Remedy Monitoring Locations

Table 1. Remedy (MNA) Monitoring for Phase I

Monitoring Location	Area	Parameters
Well 0411	Well 0411 area	Trichloroethylene (TCE) Dichloroethylene (DCE) Vinyl chloride (VC)
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

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 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)	VC (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		

pCi/L = picocurie(s) per liter
mg/L = milligram(s) 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 are 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 2010. 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 at a later time. This change in sampling may have resulted in a shift in the data.

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.

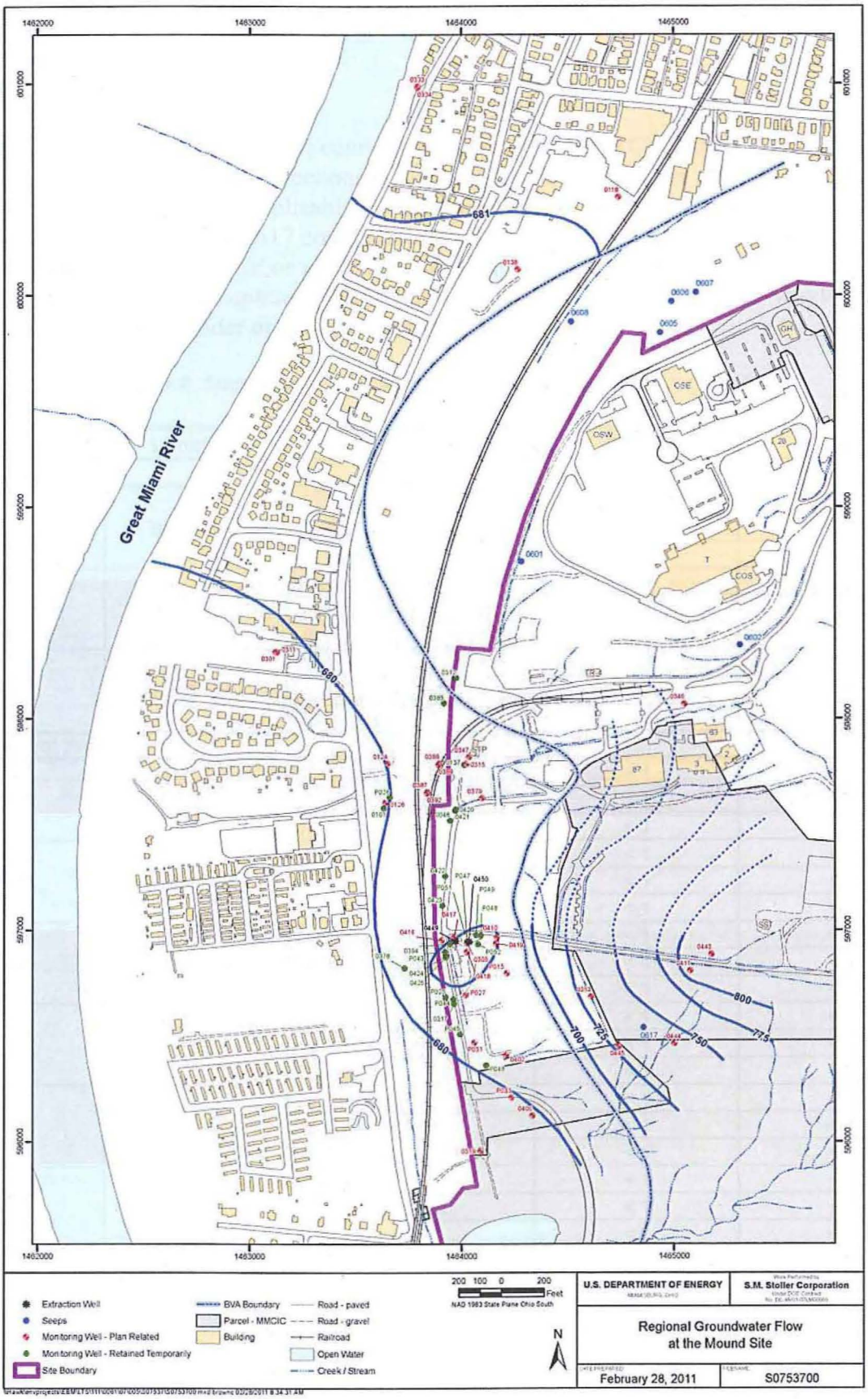

Figure 2. General Groundwater Flow at the Mound Site

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3.0 Phase I MNA Remedy

3.1 Monitoring Results

Monitoring results for 2010 (Table 4) continue to show low-level TCE and *cis*-1,2-dichloroethylene (DCE) detections 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. No detectable concentrations of TCE, *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 2010

Well ID	Location	Parameter	S1	S2
Source Area Wells				
0411	0411 Area	TCE (µg/L)	**10.1**	**9.6**
		cis-1,2-DCE (µg/L)	4.0	2.6
		VC (µg/L)	< 1	< 1
0443	0411 Area	TCE (µg/L)	**7.5**	**5.3**
		cis-1,2-DCE (µg/L)	0.45 (J)	0.28 (J)
		VC (µg/L)	< 1	< 1
0617	Seep/Bedrock	TCE (µg/L)	2.9	**8.1**
		cis-1,2-DCE (µg/L)	0.72 (J)	2.0
		VC (µg/L)	< 1	< 1
Downgradient Wells				
0353	Bedrock	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1
0444	Bedrock	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1
0445	Bedrock	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1
0400	BVA	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1
0402	BVA	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1
P033	BVA	TCE (µg/L)	< 1	< 1
		cis-1,2-DCE (µg/L)	< 1	< 1
		VC (µg/L)	< 1	< 1

J = Estimated value less than the reporting limit
S = semiannual event
VC = vinyl chloride
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 between 9 and 15 µg/L over the past few years. The time-concentration plots for well 0443 and seep 0617 indicate that concentrations vary but are typically less than those in well 0411.

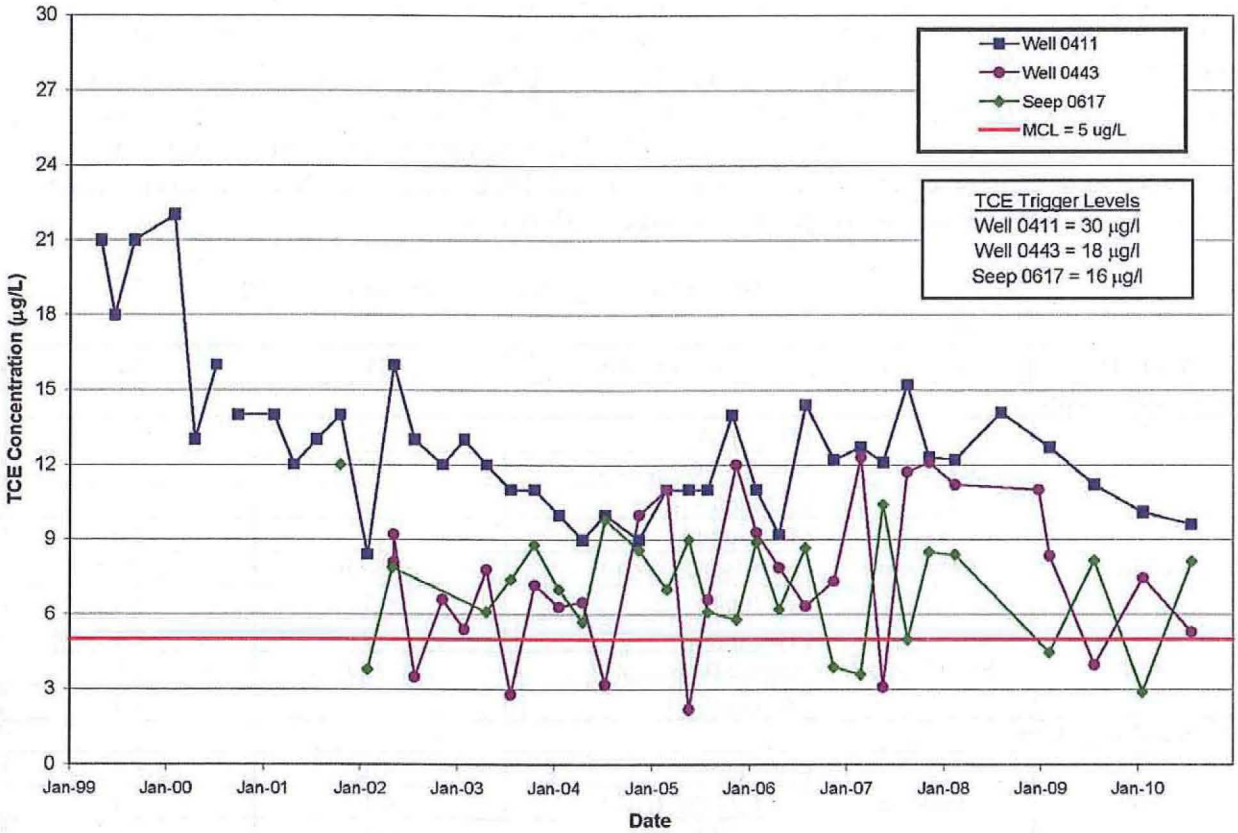

Figure 3. TCE Concentrations over Time—1999 through 2010

Over time, the concentration of *cis*-1,2-DCE in groundwater (Figure 4) has been less variable than the concentration of TCE. Concentrations of *cis*-1,2-DCE in well 0411 and seep 0617 are similar. Concentrations in well 0443 are generally less than those measured in well 0411 and seep 0617. None of the locations exceed the MCL of 70 µg/L for *cis*-1,2-DCE.

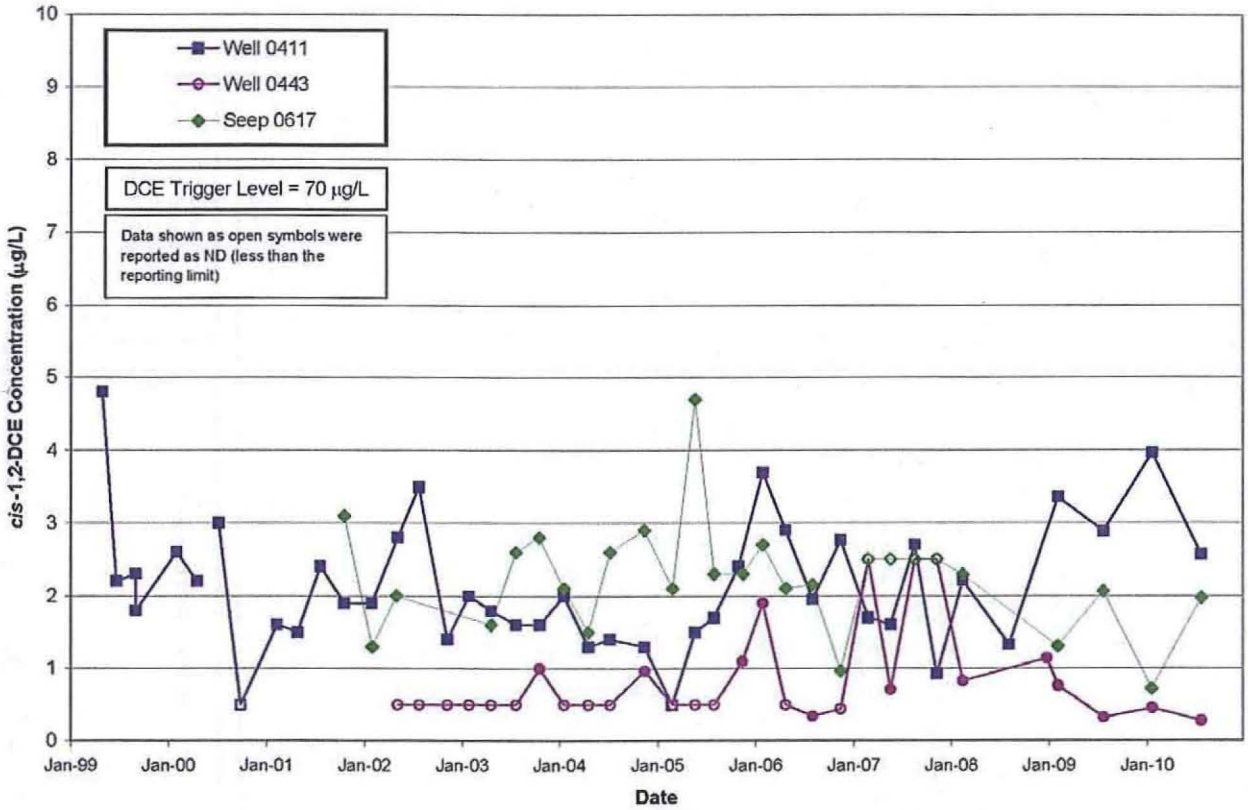

Figure 4. cis-*1,2-DCE Concentrations—1999 through 2010*

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. The annual averages of TCE and DCE in the monitoring network are depicted on Figure 5.

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. No trends were determined 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. No trends, either upward or downward, were calculated from the *cis*-1,2-DCE data in the wells and seep.

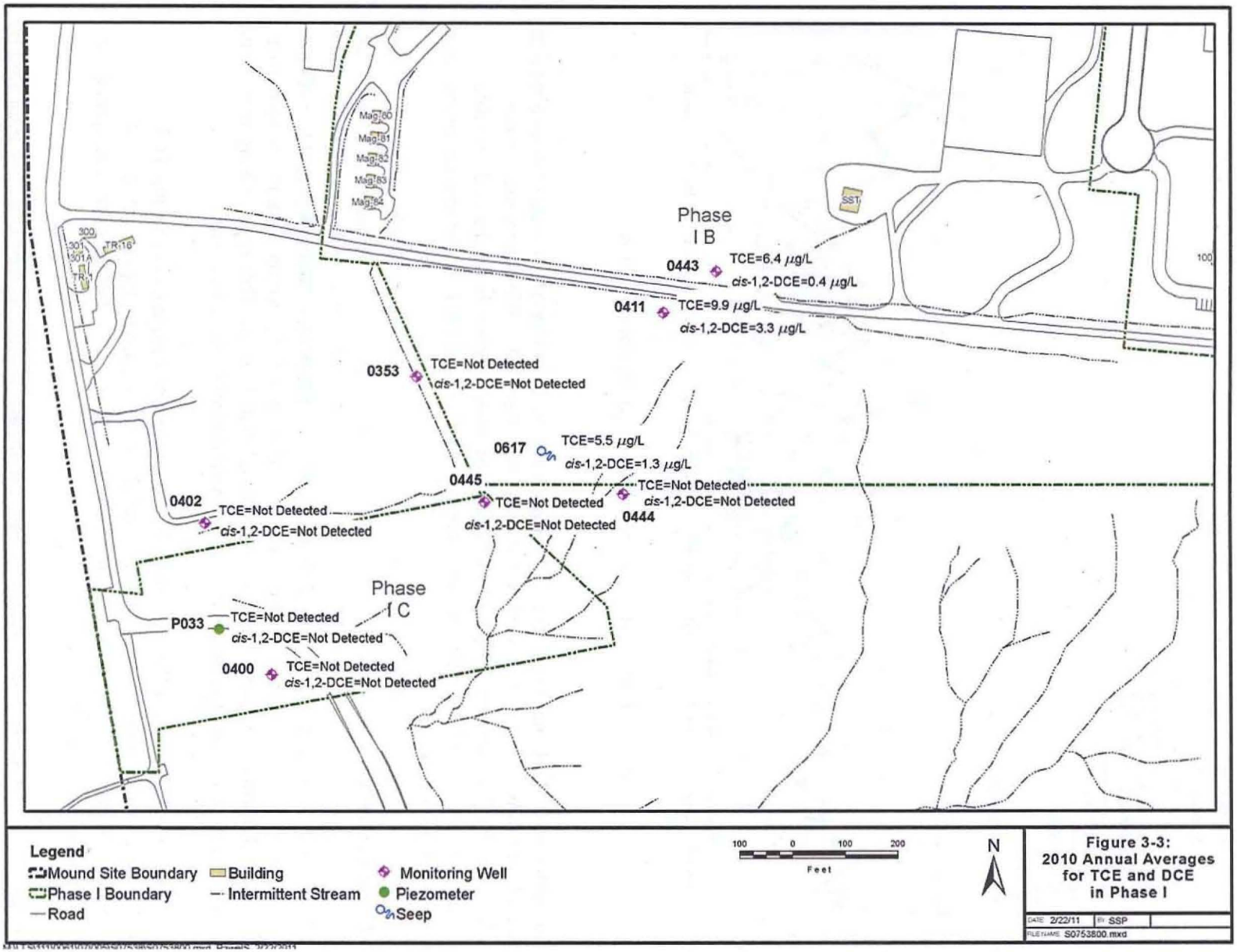

Figure 5. 2010 Annual Average Concentrations of TCE and DCE in Phase I Groundwater

Table 5. Summary of Trend Analysis Results for TCE in Phase I for 2010

Location	Analyte	No. of Samples	Trend	Slope (µg/L/year)	Confidence Interval (µg/L/yr)	
					Lower	Upper
0411	TCE	41	**Down**	- 0.40	-0.75	-0.12
0443		29	None	0.33	- 0.23	0.92
0617		28	None	- 0.17	- 0.53	0.12
0411	*cis*-1,2-DCE	41	None	0	- 0.08	0.11
0443		29	None	0	- 0.01	0.06
0617		27	None	- 0.06	- 0.16	0.06

µg/L/year = microgram(s) per liter per year

Evaluation of the slope of the downward trend in TCE concentrations in well 0411 could indicate when concentrations may approach the MCL of 5 µg/L. The non-parametric slope calculated for the trend analysis suggests 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 2010. Trend analysis continues to show that TCE concentrations have decreased in source well 0411 since sampling started in 1999. Concentrations of TCE have varied in source well 0443 and seep 0617 but are generally less 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 µg/L). On the basis of no upward trends in TCE concentrations and TCE concentrations being considerably less than the trigger levels, monitoring frequency should remain semiannual for 2010. Sampling will continue to be performed during the first and third quarters of the year in an effort to bracket possible seasonal variations.

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4.0 Phase I Confirmatory Sampling

Data collected from well 0445 have shown elevated barium concentrations and total combined radium levels in excess of the MCLs. The groundwater chemistry in this well is not observed in any other bedrock or BVA well located 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 2010 (Table 6) show elevated combined Ra-226/228 levels greater than the MCL of 5 picocuries per liter (pCi/L) and greater than the LOC of 75 pCi/L in well 0445 (Table 3). The concentrations of barium in 0445 exceeded the MCL of 2,000 µg/L in 2010 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 2010 Confirmatory Monitoring Results for Barium and Radium

Well ID	Location	Parameter	S1	S2
Source Area Well				
0445	0445 Area	Combined Ra-226/228 (pCi/L)	123	120
		Barium (µg/L)	13,900	10,900
Downgradient Wells				
0400	BVA	Combined Ra-226/228 (pCi/L)	1.2 (J)	3.3 (J)
		Barium (µg/L)	134	116
0402	BVA	Combined Ra-226/228 (pCi/L)	< 0.9	3.0
		Barium (µg/L)	61.3	67.9
P033	BVA	Combined Ra-226/228 (pCi/L)	1.4 (J)	1.3 (J)
		Barium (µg/L)	97.4	105

Combined Ra-226/228 reported as "<" when both isotopes were reported as less than the method detection limit
J = one of the isotopes was reported as an estimated value less than the reporting limit

Barium concentrations vary in well 0445 (Figure 6), which is screened within the 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. This general decrease observed in 2004 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; however, the anomalously low data reported in 2007 were likely not representative of groundwater quality as 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 sampling methods. 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 milliliters per minute) were installed in the Phase I monitoring wells. Since the second half of 2008, samples have been collected using the low-flow method instead of pumping the wells dry, allowing them to recharge, and sampling at a later time.

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

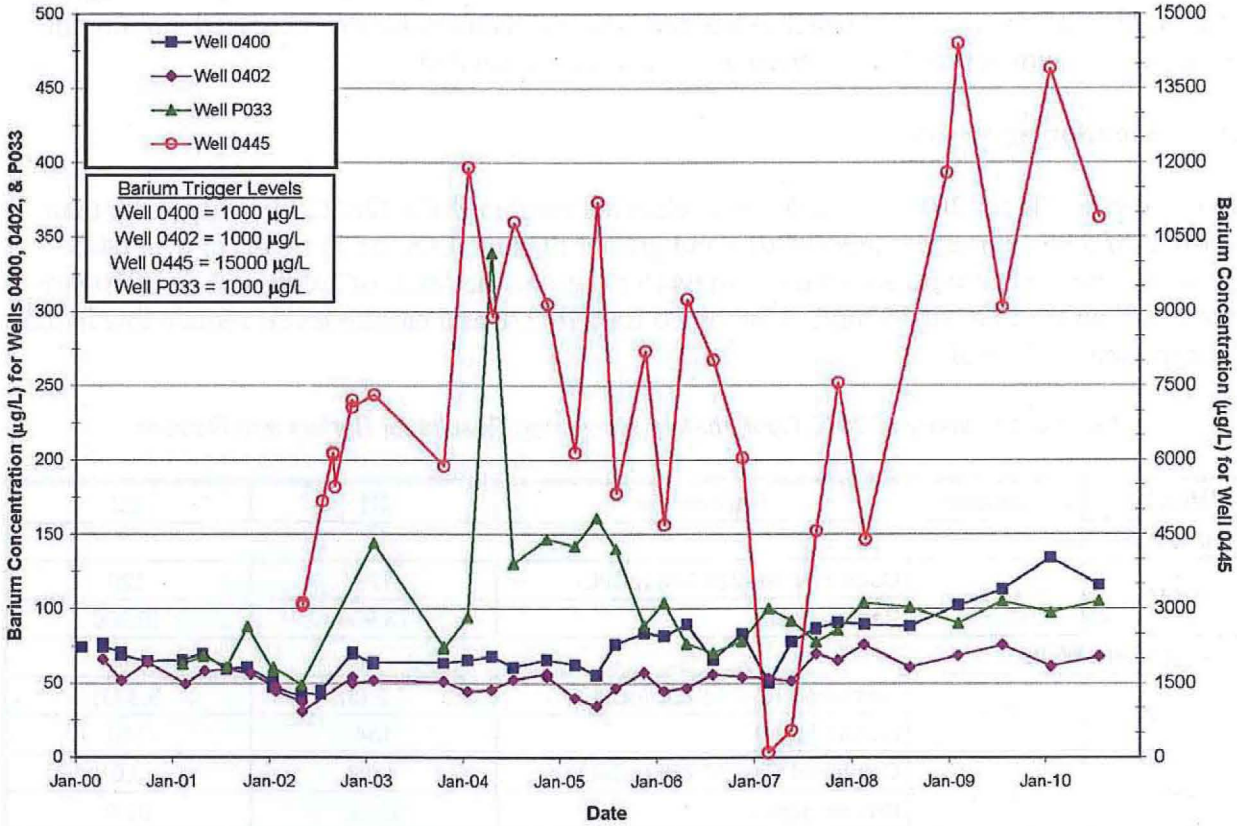

Figure 6. Barium Concentrations—2000 through 2010

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. 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 2010 are generally higher than those reported in previous years.

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

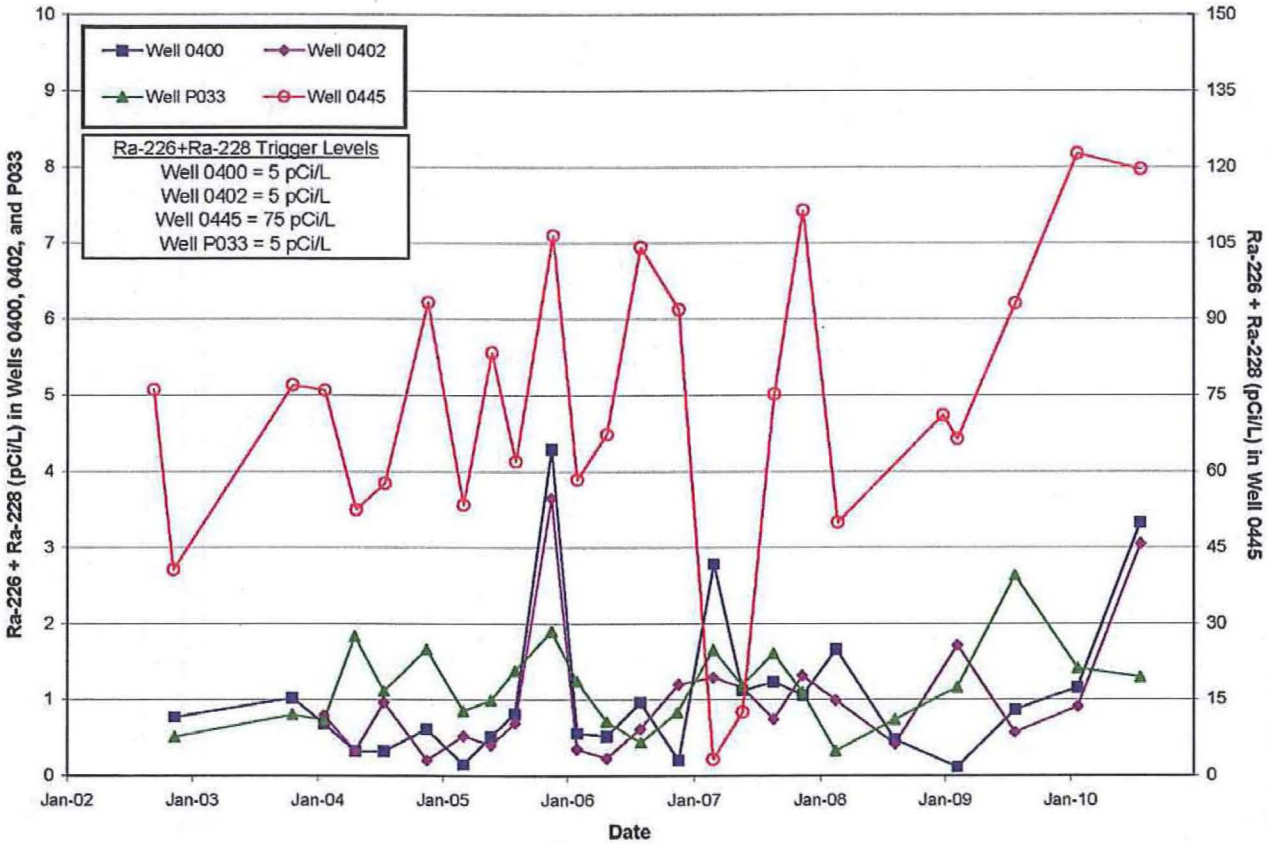

Figure 7. Ra-226/228 Levels—2002 through 2009

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 are in well 0445, which is where elevated radium and barium levels are detected.

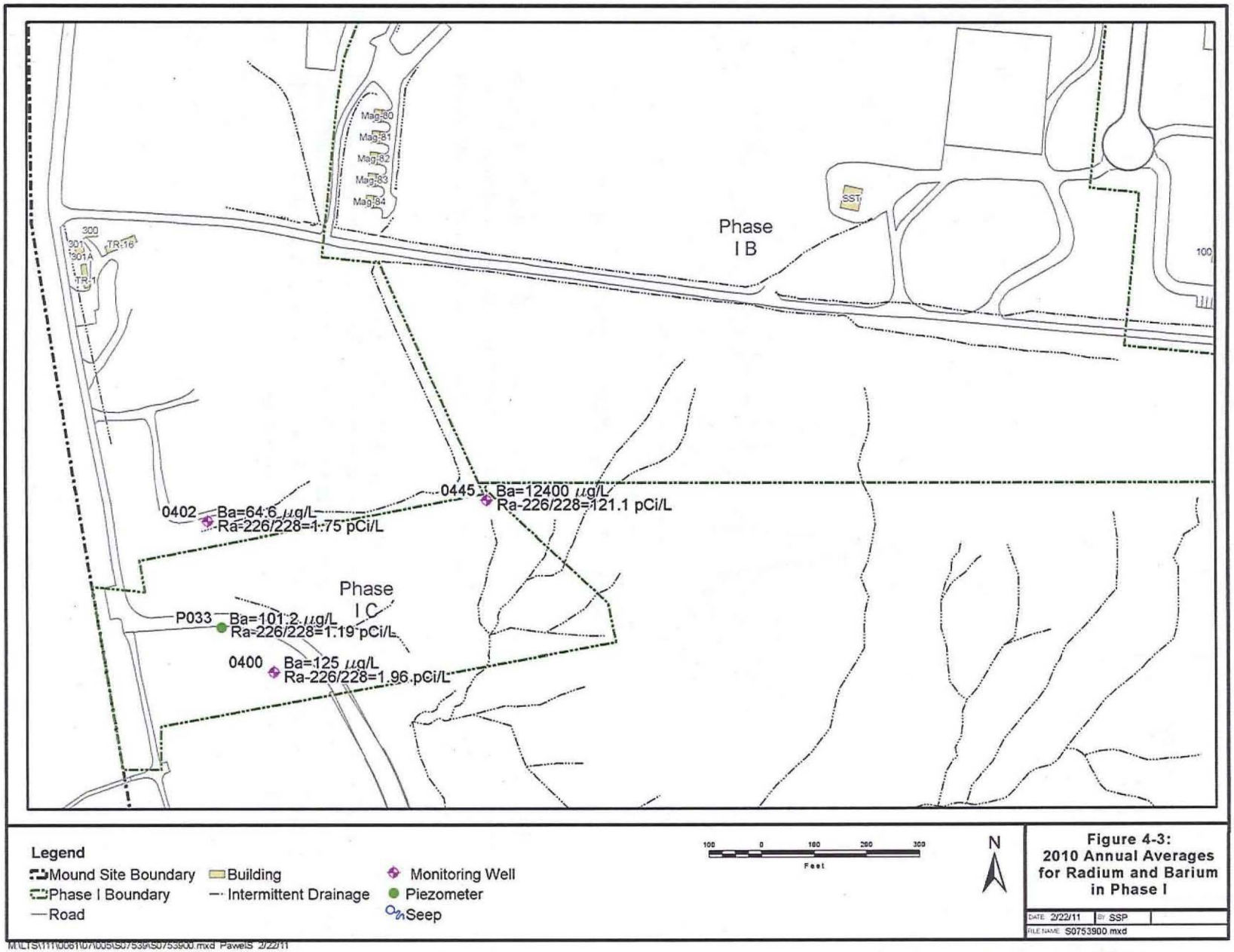

Figure 8. Distribution of Radium and Barium in Phase I Groundwater

Table 7. Summary of 2010 Confirmatory Monitoring Results for Sodium and Chloride

Well ID	Location	Parameter	S1	S2
Source Area Well				
0445	0445 Area	Chloride (mg/L)	12,500	9,070
		Sodium (mg/L)	6230	4530
Downgradient Wells				
0400	BVA	Chloride (mg/L)	115	101
		Sodium (mg/L)	63.4	59.7
0402	BVA	Chloride (mg/L)	87.0	75.3
		Sodium (mg/L)	58.1	55.6
P033	BVA	Chloride (mg/L)	126	126
		Sodium (mg/L)	81.5	80.1

Extremely high concentrations of sodium and chloride have been reported in well 0445 (Figure 9 and Figure 10), which also has had increased radium and barium levels; however, levels vary substantially over time. Downgradient BVA well P033 shows elevated concentrations of sodium and chloride, which vary similarly to concentrations 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 but are slightly higher than in previous years.

A review of the sodium and chloride data indicates that well P033 showed a delayed and lower concentration response to the elevated levels observed in well 0445; however, this response is not as obvious as in previous years. This observation was illustrated more prominently in the sodium data than in the chloride data. The decrease in response indicates that less salt is entering 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 into the downgradient BVA.

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 2010, as this set of data reflects possible influence from the removal of 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.

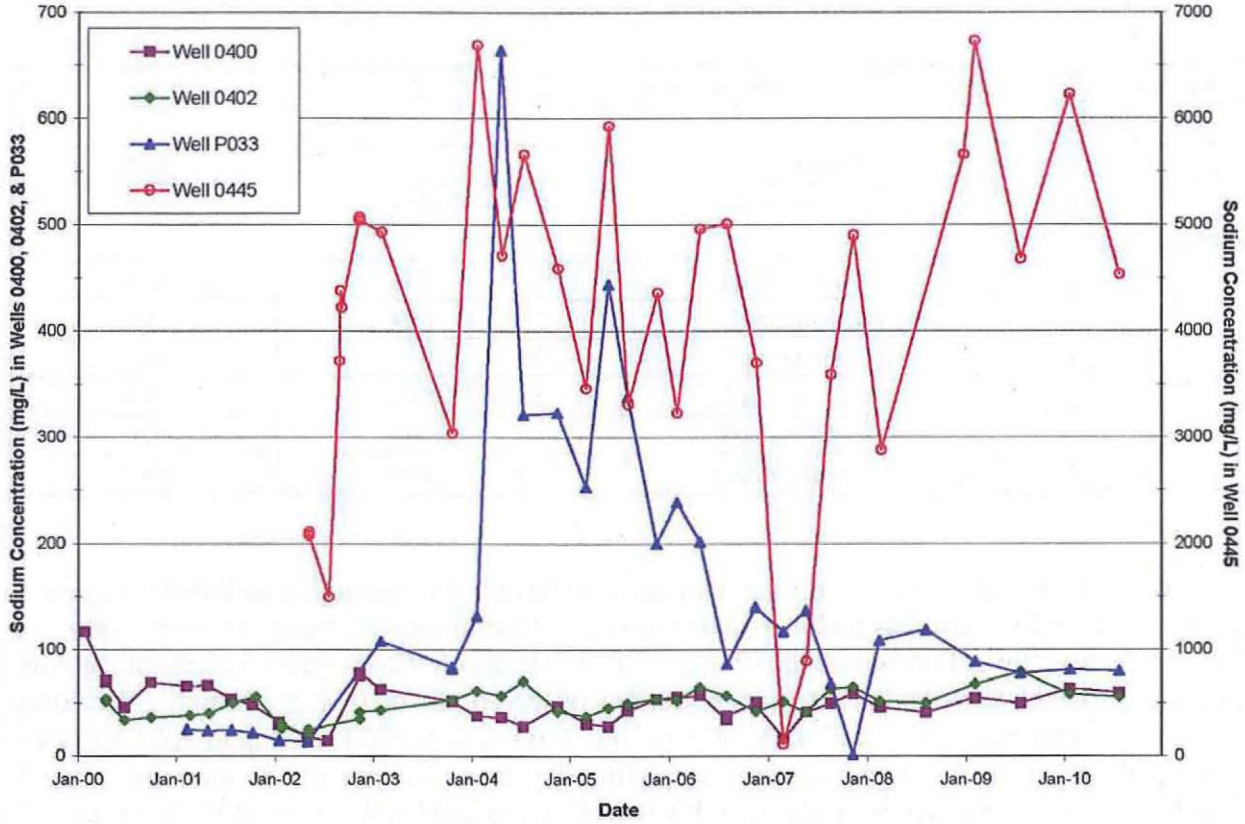

Figure 9. Sodium Concentrations—2000 through 2010

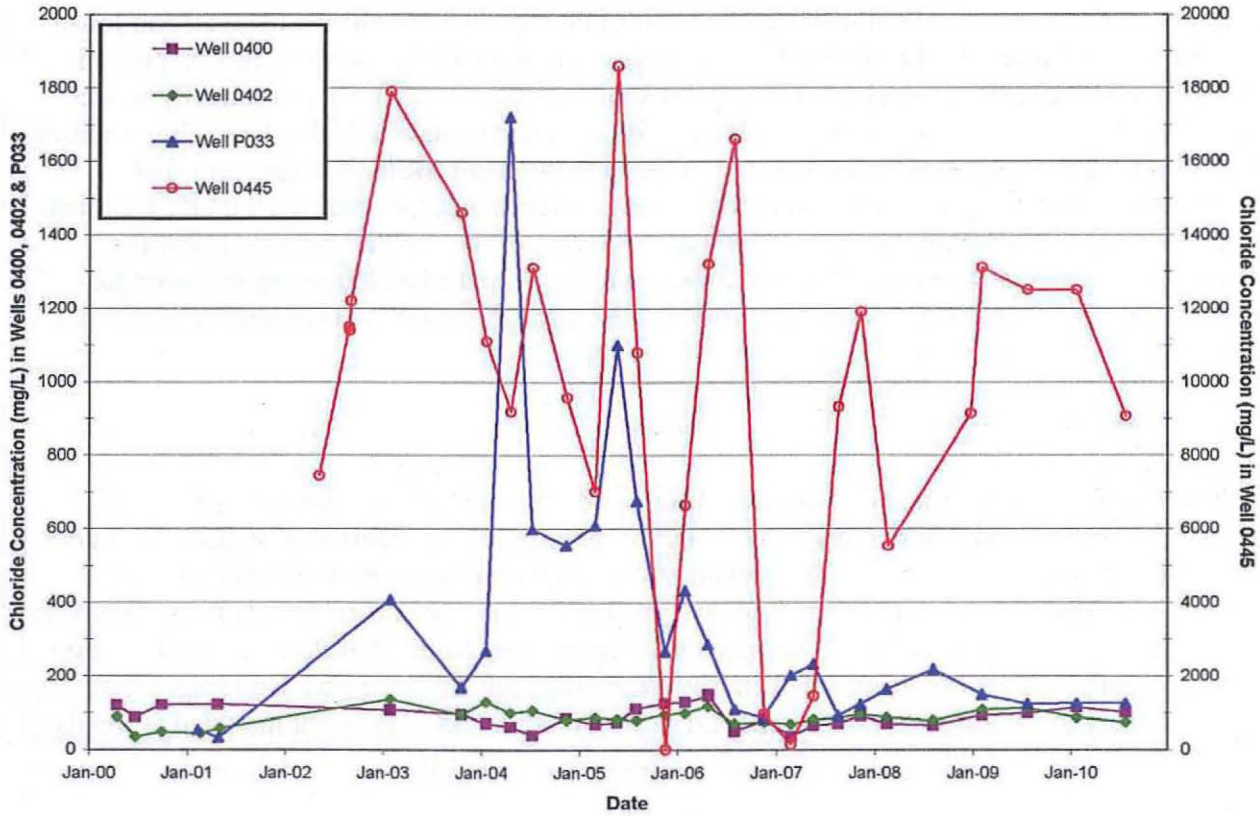

Figure 10. Chloride Concentrations—2000 through 2010

Trend analysis indicates increased levels of barium and combined Ra-226/228 in wells 0400, 04020, and 0445, as indicated by positive slopes. Barium concentrations decreased in well P033, as indicated by a negative slope. Statistically upward trends were calculated for both barium and Ra-226/228 in wells 0400 and 0402 (Table 8).

Table 8. Summary of Trend Analysis Results for Barium and Combined Radium in Phase I for 2010

Location	Analyte	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Interval (mg/L/yr)	
					Lower	Upper
0400	Barium	22	**Up**	0.008	0.006	0.011
0402		22	**Up**	0.005	0.003	0.007
0445		20	None	0.002	-1.1	0.95
P033		22	None	-0.006	-0.014	0.002
Location	**Analyte**	**No. of Samples**	**Trend**	**Slope (pCi/L/yr)**	**Confidence Interval (pCi/L/yr)**	
					Lower	**Upper**
0400	Ra-226/228	22	**Up**	0.15	0.02	0.32
0402		22	**Up**	0.12	0	0.31
0445		20	None	5.6	-0.08	11.2
P033		22	None	0	-0.17	0.15

mg/L/yr = milligram(s) per liter per year
pCi/L/yr = picocurie(s) per liter per year

Trend analysis indicates decreased chloride in wells 0402, 0445, and P033 and decreased sodium 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. Increasing chloride concentrations were indicated in well 0400, as indicated by a positive slope. Sodium also increased in wells 0400 and 0402. A statistically upward trend in sodium was calculated for well 0400.

Table 9. Summary of Trend Analysis Results for Sodium and Chloride in Phase I for 2010

Location	Analyte	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Interval (mg/L/yr)	
					Lower	Upper
0400	Chloride	22	None	5.3	-2.0	11.1
0402		22	None	-1.6	-5.8	2.5
0445		22	None	-19.1	-1362	1006
P033		22	**Down**	-90.2	-152	-31.0
0400	Sodium	22	**Up**	3.5	1.1	5.8
0402		22	None	1.8	-1.4	4.6
0445		22	None	-75.0	-450	292
P033		22	**Down**	-49.5	-78.9	-24.6

mg/L/yr = milligrams per liter per year

4.3 Recommendations

The sampling frequency should be increased to quarterly in 2011 for the Phase I confirmatory sampling program for barium and radium, based on the evaluation of the data from 2010. The levels of combined Ra-226/228 continue to exceed the LOC of 75 pCi/L in well 0445, and upward trends in both barium and combined Ra-226/228 have been calculated for two of the downgradient BVA wells. Although sodium and chloride concentrations have begun to decrease in source well 0445 (indicating that the discharge of salt from the bedrock aquifer system may be diminishing since the salt was removed from the SST Building), it is warranted to monitor the rate that the levels are increasing in the BVA wells to ensure that the MCL of 5 pCi/L will not be exceeded in the future.

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 focusing 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 2010 was ponded water around wells 0353 and 0402. These wells are located alongside the area used as the clean soil stockpile for the Operable Unit 1 excavation subcontractor. This area was used again during 2009 as a clean soil stockpile, and drainage around these wells was poor.

Other deficiencies identified during 2010 were general maintenance issues, such as drainage and vegetation. A summary of the inspection performed in March 2010, including photos, is in Appendix C.

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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) (BWXT of Ohio 2002). Data validation was documented in quarterly reports prepared within 90 days of the end of each quarter (DOE 2010b, 2010c, 2010d, and 2011). All 2010 data, including data validation qualifiers, are summarized in Appendix B.

Under both programs, 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

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7.0 Summary

This report documents the groundwater sampling results for the Phase I MNA remedy sampling in 2010. Additionally, results associated with confirmatory monitoring for radium and barium in Phase I are included.

7.1 MNA Remedy

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

The distribution of TCE and *cis*-1,2-DCE in groundwater indicates that VOC impact is still associated with wells 0411 and 0443 and downgradient seep 0617. TCE levels in well 0411 have decreased since monitoring began in 1999, and concentrations have leveled off over the past few years. Low levels of the TCE breakdown product *cis*-1,2-DCE continue to be present at all three locations. Trend analysis indicates decreasing concentrations of TCE in well 0411 and seep 0617 and a statistical downward trend in TCE concentrations in well 0411. Concentrations at these three monitoring locations exceed the MCL of 5 μg/L. Trend analysis suggests that the MCL of 5 mg/L for TCE in well 0411 may be reached between 2022 and 2030. TCE data support 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 2010 data does not suggest that the monitoring program should be changed at this time. Semiannual sampling will continue in 2011.

7.2 Radium and Barium

Groundwater monitoring for barium and radium is performed to provide assurance that the understanding of the barium and radium in groundwater is correct. Sodium and chloride are monitored in conjunction with radium and barium because the salt is considered the mechanism that has resulted in elevated radium and barium levels 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 2010 show elevated combined Ra-226/228 and barium concentrations greater than the MCLs in source well 0445. Barium concentrations were below the LOC; however, combined Ra-226/228 levels exceeded the LOC. The levels of barium and radium in the bedrock groundwater have varied significantly. The concentrations of barium in well 0445 had been decreasing since 2004; however, starting in 2009, barium concentrations were higher than in previous years. Combined Ra-226/228 levels increased in 2010 as compared to previous years. It is possible that a change in sampling methods in late 2008 has caused the shift in data.

Combined Ra-226/228 and barium levels remain within background levels in the downgradient BVA wells. Levels of radium and barium are slightly higher in wells 0400 and 0402 than in well P033. Trend analysis indicates a slight upward trend in barium and combined Ra-226/228 concentrations in wells 0400 and 0402.

Sodium and chloride monitoring results indicate that the highest concentrations are 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 water that has been impacted by the salt within the bedrock aquifer is still discharging into the BVA. Evaluation of the sodium and chloride data with respect to the concentrations of barium and radium supports that the presence of elevated salt in the groundwater results in increased barium and radium.

Monitoring associated with the confirmatory sampling for barium and combined Ra-226/228 will continue in 2011. The evaluation of the 2010 data suggests that these locations be sampled quarterly to monitor the rate that the levels are increasing in the BVA wells to ensure that the MCL of 5 pCi/L for combined Ra-226/228 will not be exceeded in the future. The slight upward trends in barium concentrations and Ra-226/228 levels in BVA wells 0400 and 0402 will continue to be evaluated.

8.0 References

BWXT of Ohio, 2002. *Mound Methods Compendium*, MD-80045, Issue 2.

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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.

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DOE (U.S. Department of Energy), 2010a. *Phase I Groundwater Monitoring Report Calendar Year 2009*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, March.

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DOE (U.S. Department of Energy), 2010c. *Data Validation Package – April, May, June 2010, 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), 2010d. *Data Validation Package – July, August, September 2010, 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), 2011. *Data Validation Package – October, November, December 2010, Mound, Ohio*, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, January.

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.

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Appendix A

Mound Specific Sampling Protocols

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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

2010 Phase I MNA and Confirmatory Sampling Data

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Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0400	Barium	1/27/2010	0.134	0.001	mg/L		F
0400	Barium	7/29/2010	0.116	0.001	mg/L		F
0402	Barium	1/28/2010	0.0613	0.001	mg/L		F
0402	Barium	7/30/2010	0.0679	0.001	mg/L		F
0445	Barium	1/27/2010	13.9	0.001	mg/L		FQ
0445	Barium	7/30/2010	10.9	0.001	mg/L		FQ
P033	Barium	1/28/2010	0.0974	0.001	mg/L		F
P033	Barium	7/29/2010	0.105	0.001	mg/L		F
0400	Chloride	1/27/2010	115	1.32	mg/L		F
0400	Chloride	7/29/2010	101	0.66	mg/L		F
0402	Chloride	1/28/2010	87	1.32	mg/L		F
0402	Chloride	7/30/2010	75.3	0.66	mg/L		F
0445	Chloride	1/27/2010	12500	132	mg/L		FQ
0445	Chloride	7/30/2010	9070	66	mg/L		FQ
P033	Chloride	1/28/2010	126	1.32	mg/L		F
P033	Chloride	7/29/2010	126	0.66	mg/L		F
0353	Chromium	1/27/2010	0.0203	0.001	mg/L		FQ
0400	Chromium	1/27/2010	0.522	0.001	mg/L		F
0402	Chromium	1/28/2010	0.0138	0.001	mg/L		F
0411	Chromium	1/27/2010	0.997	0.001	mg/L		FQ
0443	Chromium	1/27/2010	0.001	0.001	mg/L	U	F
0444	Chromium	1/27/2010	0.00247	0.001	mg/L	J	FQ
0445	Chromium	1/27/2010	0.001	0.001	mg/L	U	FQ
0617	Chromium	1/25/2010	0.001	0.001	mg/L	U	
P033	Chromium	1/28/2010	0.001	0.001	mg/L	U	F
0353	*cis*-1,2-Dichloroethene	1/27/2010	0.1	0.1	ug/L	U	FQ
0353	*cis*-1,2-Dichloroethene	7/29/2010	0.1	0.1	ug/L	U	FQ
0400	*cis*-1,2-Dichloroethene	1/27/2010	0.1	0.1	ug/L	U	F
0400	*cis*-1,2-Dichloroethene	7/29/2010	0.1	0.1	ug/L	U	F
0402	*cis*-1,2-Dichloroethene	1/28/2010	0.1	0.1	ug/L	U	F
0402	*cis*-1,2-Dichloroethene	7/30/2010	0.1	0.1	ug/L	U	F
0411	*cis*-1,2-Dichloroethene	1/27/2010	3.97	0.1	ug/L		FQ
0411	*cis*-1,2-Dichloroethene	7/29/2010	2.56	0.1	ug/L		FQ

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0443	*cis*-1,2-Dichloroethene	1/27/2010	0.451	0.1	ug/L	J	F
0443	*cis*-1,2-Dichloroethene	7/29/2010	0.28	0.1	ug/L	J	F
0444	*cis*-1,2-Dichloroethene	1/27/2010	0.1	0.1	ug/L	U	FQ
0444	*cis*-1,2-Dichloroethene	7/30/2010	0.1	0.1	ug/L	U	FQ
0445	*cis*-1,2-Dichloroethene	1/27/2010	0.1	0.1	ug/L	U	FQ
0445	*cis*-1,2-Dichloroethene	7/30/2010	0.1	0.1	ug/L	U	FQ
0617	*cis*-1,2-Dichloroethene	1/25/2010	0.724	0.1	ug/L	J	
0617	*cis*-1,2-Dichloroethene	7/30/2010	1.97	0.1	ug/L		
P033	*cis*-1,2-Dichloroethene	1/28/2010	0.1	0.1	ug/L	U	F
P033	*cis*-1,2-Dichloroethene	7/29/2010	0.1	0.1	ug/L	U	F
0353	Dissolved Oxygen	1/27/2010	1.26		mg/L		FQ
0353	Dissolved Oxygen	7/29/2010	1.6		mg/L		FQ
0400	Dissolved Oxygen	1/27/2010	2.61		mg/L		F
0400	Dissolved Oxygen	7/29/2010	3.36		mg/L		F
0402	Dissolved Oxygen	1/28/2010	4.69		mg/L		F
0402	Dissolved Oxygen	7/30/2010	4.43		mg/L		F
0411	Dissolved Oxygen	1/27/2010	1.44		mg/L		FQ
0411	Dissolved Oxygen	7/29/2010	5.07		mg/L		FQ
0443	Dissolved Oxygen	1/27/2010	1.48		mg/L		F
0443	Dissolved Oxygen	7/29/2010	8.22		mg/L		F
0444	Dissolved Oxygen	1/27/2010	0.85		mg/L		FQ
0444	Dissolved Oxygen	7/30/2010	2.65		mg/L		FQ
0445	Dissolved Oxygen	1/27/2010	6.8		mg/L		
0445	Dissolved Oxygen	7/30/2010	1.6		mg/L		FQ
0617	Dissolved Oxygen	1/25/2010	7.66		mg/L		
0617	Dissolved Oxygen	7/30/2010	5.99		mg/L		
P033	Dissolved Oxygen	1/28/2010	1.07		mg/L		F
P033	Dissolved Oxygen	7/29/2010	1.23		mg/L		F
0353	Nickel	1/27/2010	0.164	0.0015	mg/L		FQ
0400	Nickel	1/27/2010	0.144	0.0015	mg/L		F
0402	Nickel	1/28/2010	0.0024	0.0015	mg/L	J	F
0411	Nickel	1/27/2010	0.0382	0.0015	mg/L		FQ
0443	Nickel	1/27/2010	0.0015	0.0015	mg/L	U	F

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0444	Nickel	1/27/2010	0.0015	0.0015	mg/L	U	FQ
0445	Nickel	1/27/2010	0.00976	0.0015	mg/L	J	FQ
0617	Nickel	1/25/2010	0.0015	0.0015	mg/L	U	
P033	Nickel	1/28/2010	0.0015	0.0015	mg/L	U	F
0353	Oxidation Reduction Potential	1/27/2010	78		mV		FQ
0353	Oxidation Reduction Potential	7/29/2010	108.9		mV		FQ
0400	Oxidation Reduction Potential	1/27/2010	69.1		mV		F
0400	Oxidation Reduction Potential	7/29/2010	114.4		mV		F
0402	Oxidation Reduction Potential	1/28/2010	137.9		mV		F
0402	Oxidation Reduction Potential	7/30/2010	136.7		mV		F
0411	Oxidation Reduction Potential	1/27/2010	54		mV		FQ
0411	Oxidation Reduction Potential	7/29/2010	120.4		mV		FQ
0443	Oxidation Reduction Potential	1/27/2010	110.3		mV		F
0443	Oxidation Reduction Potential	7/29/2010	134.6		mV		F
0444	Oxidation Reduction Potential	1/27/2010	106.2		mV		FQ
0444	Oxidation Reduction Potential	7/30/2010	43.65		mV		FQ
0445	Oxidation Reduction Potential	1/27/2010	-15.1		mV		
0445	Oxidation Reduction Potential	7/30/2010	27.8		mV		FQ
0617	Oxidation Reduction Potential	1/25/2010	202		mV		
0617	Oxidation Reduction Potential	7/30/2010	135.8		mV		
P033	Oxidation Reduction Potential	1/28/2010	115.9		mV		F
P033	Oxidation Reduction Potential	7/29/2010	105.2		mV		F
0353	pH	1/27/2010	7.16		s.u.		FQ
0353	pH	7/29/2010	7.23		s.u.		FQ
0400	pH	1/27/2010	7.1		s.u.		F
0400	pH	7/29/2010	7.22		s.u.		F
0402	pH	1/28/2010	7.26		s.u.		F
0402	pH	7/30/2010	7.34		s.u.		F
0411	pH	1/27/2010	7.2		s.u.		FQ
0411	pH	7/29/2010	7.15		s.u.		FQ
0443	pH	1/27/2010	7.05		s.u.		F
0443	pH	7/29/2010	7.1		s.u.		F
0444	pH	1/27/2010	7.26		s.u.		FQ

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0444	pH	7/30/2010	7.4		s.u.		FQ
0445	pH	1/27/2010	6.35		s.u.		
0445	pH	7/30/2010	7.14		s.u.		FQ
0617	pH	1/25/2010	5.86		s.u.		
0617	pH	7/30/2010	7.2		s.u.		
P033	pH	1/28/2010	7.35		s.u.		F
P033	pH	7/29/2010	7.17		s.u.		F
0400	Radium-226	1/27/2010	0.533	0.311	pCi/L		JF
0400	Radium-226	7/29/2010	2.84	0.432	pCi/L		F
0402	Radium-226	1/28/2010	0.364	0.392	pCi/L	U	F
0402	Radium-226	7/30/2010	2.26	0.552	pCi/L		F
0445	Radium-226	1/27/2010	72.1	0.576	pCi/L		FQ
0445	Radium-226	7/30/2010	69.7	0.623	pCi/L		FQ
P033	Radium-226	1/28/2010	0.557	0.563	pCi/L	U	F
P033	Radium-226	7/29/2010	1.2	0.647	pCi/L		FJ
0400	Radium-228	1/27/2010	0.622	0.769	pCi/L	U	F
0400	Radium-228	7/29/2010	0.485	0.725	pCi/L	U	F
0402	Radium-228	1/28/2010	0.541	0.599	pCi/L	U	F
0402	Radium-228	7/30/2010	0.788	0.774	pCi/L		FJ
0445	Radium-228	1/27/2010	50.5	0.494	pCi/L		FQ
0445	Radium-228	7/30/2010	49.8	1.91	pCi/L		FQ
P033	Radium-228	1/28/2010	0.853	0.774	pCi/L		JF
P033	Radium-228	7/29/2010	0.0932	0.813	pCi/L	U	F
0400	Sodium	1/27/2010	63.4	0.1	mg/L		F
0400	Sodium	7/29/2010	59.7	0.1	mg/L		F
0402	Sodium	1/28/2010	58.1	0.1	mg/L		F
0402	Sodium	7/30/2010	55.6	0.1	mg/L		F
0445	Sodium	1/27/2010	6230	5	mg/L		FQ
0445	Sodium	7/30/2010	4530	2	mg/L		FQ
P033	Sodium	1/28/2010	81.5	0.1	mg/L		F
P033	Sodium	7/29/2010	80.1	0.1	mg/L		F
0353	Specific Conductance	1/27/2010	1374		umhos/cm		FQ
0353	Specific Conductance	7/29/2010	1390		umhos/cm		FQ

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0400	Specific Conductance	1/27/2010	1289		umhos/cm		F
0400	Specific Conductance	7/29/2010	1262		umhos/cm		F
0402	Specific Conductance	1/28/2010	1191		umhos/cm		F
0402	Specific Conductance	7/30/2010	1186		umhos/cm		F
0411	Specific Conductance	1/27/2010	1545		umhos/cm		FQ
0411	Specific Conductance	7/29/2010	1585		umhos/cm		FQ
0443	Specific Conductance	1/27/2010	1442		umhos/cm		F
0443	Specific Conductance	7/29/2010	1549		umhos/cm		F
0444	Specific Conductance	1/27/2010	1205		umhos/cm		FQ
0444	Specific Conductance	7/30/2010	1464		umhos/cm		FQ
0445	Specific Conductance	1/27/2010	19950		umhos/cm		
0445	Specific Conductance	7/30/2010	36630		umhos/cm		FQ
0617	Specific Conductance	1/25/2010	972		umhos/cm		
0617	Specific Conductance	7/30/2010	1840		umhos/cm		
P033	Specific Conductance	1/28/2010	1301		umhos/cm		F
P033	Specific Conductance	7/29/2010	1377		umhos/cm		F
0353	Temperature	1/27/2010	9.5		C		FQ
0353	Temperature	7/29/2010	20.41		C		FQ
0400	Temperature	1/27/2010	11.4		C		F
0400	Temperature	7/29/2010	14.12		C		F
0402	Temperature	1/28/2010	11.24		C		F
0402	Temperature	7/30/2010	12.51		C		F
0411	Temperature	1/27/2010	11.36		C		FQ
0411	Temperature	7/29/2010	16.56		C		FQ
0443	Temperature	1/27/2010	11.55		C		F
0443	Temperature	7/29/2010	16.28		C		F
0444	Temperature	1/27/2010	11.22		C		FQ
0444	Temperature	7/30/2010	17.25		C		FQ
0445	Temperature	1/27/2010	10.54		C		
0445	Temperature	7/30/2010	18.23		C		FQ
0617	Temperature	1/25/2010	7.8		C		
0617	Temperature	7/30/2010	18.62		C		
P033	Temperature	1/28/2010	11.83		C		F

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
P033	Temperature	7/29/2010	15.12		C		F
0353	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0353	Tetrachloroethene	7/29/2010	0.2	0.2	ug/L	U	FQ
0400	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	F
0400	Tetrachloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0402	Tetrachloroethene	1/28/2010	0.2	0.2	ug/L	U	F
0402	Tetrachloroethene	7/30/2010	0.2	0.2	ug/L	U	F
0411	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0411	Tetrachloroethene	7/29/2010	0.2	0.2	ug/L	U	FQ
0443	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	F
0443	Tetrachloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0444	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0444	Tetrachloroethene	7/30/2010	0.2	0.2	ug/L	U	FQ
0445	Tetrachloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0445	Tetrachloroethene	7/30/2010	0.2	0.2	ug/L	U	FQ
0617	Tetrachloroethene	1/25/2010	0.2	0.2	ug/L	U	
0617	Tetrachloroethene	7/30/2010	0.2	0.2	ug/L	U	
P033	Tetrachloroethene	1/28/2010	0.2	0.2	ug/L	U	F
P033	Tetrachloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0353	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0353	*trans*-1,2-Dichloroethene	7/29/2010	0.2	0.2	ug/L	U	FQ
0400	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	F
0400	*trans*-1,2-Dichloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0402	*trans*-1,2-Dichloroethene	1/28/2010	0.2	0.2	ug/L	U	F
0402	*trans*-1,2-Dichloroethene	7/30/2010	0.2	0.2	ug/L	U	F
0411	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0411	*trans*-1,2-Dichloroethene	7/29/2010	0.2	0.2	ug/L	U	FQ
0443	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	F
0443	*trans*-1,2-Dichloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0444	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0444	*trans*-1,2-Dichloroethene	7/30/2010	0.2	0.2	ug/L	U	FQ
0445	*trans*-1,2-Dichloroethene	1/27/2010	0.2	0.2	ug/L	U	FQ
0445	*trans*-1,2-Dichloroethene	7/30/2010	0.2	0.2	ug/L	U	FQ

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0617	*trans*-1,2-Dichloroethene	1/25/2010	0.2	0.2	ug/L	U	
0617	*trans*-1,2-Dichloroethene	7/30/2010	0.2	0.2	ug/L	U	
P033	*trans*-1,2-Dichloroethene	1/28/2010	0.2	0.2	ug/L	U	F
P033	*trans*-1,2-Dichloroethene	7/29/2010	0.2	0.2	ug/L	U	F
0353	Trichloroethene	1/27/2010	0.11	0.11	ug/L	U	FQ
0353	Trichloroethene	7/29/2010	0.11	0.11	ug/L	U	FQ
0400	Trichloroethene	1/27/2010	0.11	0.11	ug/L	U	F
0400	Trichloroethene	7/29/2010	0.11	0.11	ug/L	U	F
0402	Trichloroethene	1/28/2010	0.11	0.11	ug/L	U	F
0402	Trichloroethene	7/30/2010	0.11	0.11	ug/L	U	F
0411	Trichloroethene	1/27/2010	10.1	0.11	ug/L		FQ
0411	Trichloroethene	7/29/2010	9.62	0.11	ug/L		FQ
0443	Trichloroethene	1/27/2010	7.47	0.11	ug/L		F
0443	Trichloroethene	7/29/2010	5.3	0.11	ug/L		F
0444	Trichloroethene	1/27/2010	0.11	0.11	ug/L	U	FQ
0444	Trichloroethene	7/30/2010	0.11	0.11	ug/L	U	FQ
0445	Trichloroethene	1/27/2010	0.11	0.11	ug/L	U	FQ
0445	Trichloroethene	7/30/2010	0.11	0.11	ug/L	U	FQ
0617	Trichloroethene	1/25/2010	2.89	0.11	ug/L		
0617	Trichloroethene	7/30/2010	8.14	0.11	ug/L		
P033	Trichloroethene	1/28/2010	0.11	0.11	ug/L	U	F
P033	Trichloroethene	7/29/2010	0.11	0.11	ug/L	U	F
0353	Turbidity	1/27/2010	15.2		NTU		FQ
0353	Turbidity	7/29/2010	11.2		NTU		FQ
0400	Turbidity	1/27/2010	47.1		NTU		F
0400	Turbidity	7/29/2010	32.8		NTU		F
0402	Turbidity	1/28/2010	13.1		NTU		F
0402	Turbidity	7/30/2010	7.3		NTU		F
0411	Turbidity	1/27/2010	58.1		NTU		FQ
0411	Turbidity	7/29/2010	2.67		NTU		FQ
0443	Turbidity	1/27/2010	1.34		NTU		F
0443	Turbidity	7/29/2010	49.9		NTU		F
0444	Turbidity	1/27/2010	305		NTU		FQ

Location ID	Analyte	Sample Date	Result	DL	Units	Lab Qualifier	Validation Qualifer
0444	Turbidity	7/30/2010	112		NTU		FQ
0445	Turbidity	1/27/2010	4.9		NTU		
0445	Turbidity	7/30/2010	17.9		NTU		FQ
0617	Turbidity	1/25/2010	78.9		NTU		
P033	Turbidity	1/28/2010	3		NTU		F
0353	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	FQ
0353	Vinyl Chloride	7/29/2010	0.2	0.2	ug/L	U	FQ
0400	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	F
0400	Vinyl Chloride	7/29/2010	0.2	0.2	ug/L	U	F
0402	Vinyl Chloride	1/28/2010	0.2	0.2	ug/L	U	F
0402	Vinyl Chloride	7/30/2010	0.2	0.2	ug/L	U	F
0411	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	FQ
0411	Vinyl Chloride	7/29/2010	0.2	0.2	ug/L	U	FQ
0443	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	F
0443	Vinyl Chloride	7/29/2010	0.2	0.2	ug/L	U	F
0444	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	FQ
0444	Vinyl Chloride	7/30/2010	0.2	0.2	ug/L	U	FQ
0445	Vinyl Chloride	1/27/2010	0.2	0.2	ug/L	U	FQ
0445	Vinyl Chloride	7/30/2010	0.2	0.2	ug/L	U	FQ
0617	Vinyl Chloride	1/25/2010	0.2	0.2	ug/L	U	
0617	Vinyl Chloride	7/30/2010	0.2	0.2	ug/L	U	
P033	Vinyl Chloride	1/28/2010	0.2	0.2	ug/L	U	F
P033	Vinyl Chloride	7/29/2010	0.2	0.2	ug/L	U	F

Appendix C

March 2010 Monitoring Well Inspection Summary

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Phase I

Well 0319

This well was part of the confirmatory sampling program for chromium and nickel. This portion program was discontinued in 2007, and the well is no longer sampled. It is recommended that this well be considered for abandonment.

Well 0353

- The area around the well needs regrading and cleaning up to reduce ponding of water and mud buildup on the protective pad.
- The protective casing should be repainted and the bollards touched up.

Well 0400 • The protective casing should be repainted and the bollards touched up.	
Well 0402 • The area around the well needs regrading and cleaning up to reduce ponding of water and mud buildup on the protective pad. • Straw bales or silt fencing should be installed along the upgradient edge of the well to divert surface water flow and sediment accumulation until final grading in the area is completed. • The protective casing should be repainted and the bollards touched up.	

Well 0411 • The area around the well needs cleaning up to reduce sediment buildup on the protective pad. • The protective casing should be repainted and the bollards touched up.	
Well 0442 This well was part of the confirmatory sampling program for chromium and nickel. This portion program was discontinued in 2009, and the well is no longer sampled. It is recommended that this well be considered for abandonment.	

Well 0443 • The protective casing should be repainted and the bollards touched up.	
Well 0444 • The protective casing should be repainted and the bollards touched up.	

Well 0445 • The protective casing should be repainted and the bollards touched up.	
Well P033 • The lid to the flush mount completion should be repainted.	

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