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ExxonMobil Environmental Services

Corrective Action Plan

Former ExxonMobil Site #25553
143 Frederick Road, Thurmont, Maryland

MDE Case No. 9-0923-FR (1989-0923-FR)

23 January 2013

ARCADIS

Corrective Action Plan

Former ExxonMobil Site #25553
143 Frederick Road, Thurmont, Maryland

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23 January 2013

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Table of Contents

1. Introduction **1**

1.1 Site Description 1

1.2 Site Background 1

2. Conceptual Site Model **3**

2.1 Geology and Hydrogeology 3

2.2 Soil Quality 3

2.3 Phase Separated Hydrocarbons 3

2.4 Groundwater Quality 4

2.5 Historical Analytical Trends in Groundwater 5

3. Risk Based Evaluation Summary (from 2010 SCM) **7**

4. Previous Remedial Technology Evaluations **8**

4.1 Air Sparge 8

4.2 In-Situ Chemical Oxidation 8

4.3 Dual-Phase Extraction and Vacuum Truck Extraction 8

4.4 Soil Vapor Extraction 8

5. Corrective Actions **10**

5.1 Basis for Corrective Action 10

5.2 Sub-slab vapor sampling 10

5.3 Revised Groundwater Monitoring Program 10

6. Remedial Endpoints **12**

6.1 Liquid Phase Hydrocarbon Endpoint 12

6.2 Dissolved Phase Hydrocarbon Endpoint 12

7. Monitoring and Reporting Schedules **13**

7.1 Corrective Action Implementation and Schedule 13

7.2 Reporting Schedule 13

7.3 Schedule Summary 13

8. References **14**

Figures

1 Local Area Map

2 Site Map

3 Groundwater Elevation Contour Map and Analytical Data – Shallow (9 May 2011)

4 Groundwater Elevation Contour Map and Analytical Data – Bedrock (9 May 2011)

Appendices

A MDE Correspondence

B Soil Quality Information

C Historical Analytical Data Graphs

D Sub-Slab Soil Gas Sampling and Analysis Standard Operating Procedure

1. Introduction

ARCADIS U.S., Inc. (ARCADIS) on behalf of ExxonMobil Environmental Services (EMES) and ExxonMobil Corporation (ExxonMobil) is pleased to submit a Corrective Action Plan (CAP) for the former Exxon station located at 143 Frederick Road, Thurmont, Maryland. The Maryland Department of Environment (MDE) Case Number assigned to this site is 9-0923-FR. A site location map is included as **Figure 1**, and a site plan is included as **Figure 2**.

A Site Conceptual Model / Characterization Report (SCM) was submitted to MDE on 18 February 2010 (Kleinfelder 2010). Subsequently, a CAP dated 12 September 2011 was submitted to MDE and approved on 12 December 2011. The Report of Results dated 18 April 2012 for those CAP activities was also submitted to MDE. Correspondence from MDE is included as **Appendix A**.

1.1 Site Description

A bank and parking area currently occupy the former Exxon site. The area surrounding the property is a commercial and residential mix use. The property is bordered by Frederick Road to the east, a restaurant to the north, a Shell gasoline station to the south, and by US Route 15 to the west. Current site use is shown in **Figure 2**.

1.2 Site Background

In 1979 two underground storage tanks (USTs) located at the former Exxon Site failed testing and four gasoline USTs located on-site were removed. No product loss was reported. In 1985 site ceased gasoline retail operations and all USTs, dispensers, and associated piping were removed from the property. The site was relocated across the street to 140 Frederick Road.

In 1983 a MDE case was opened after dissolved hydrocarbons were found in the Thurmont Municipal supply well located approximated 350 northeast of site. Soil borings conducted during site investigation identified the abandoned tank field (across the street) as the potential source area. A product recovery system was installed and product recovery activities were initiated. In July 1988 through February 1990 and again in October 1992 soil vapor extraction (SVE) activities were conducted utilizing a catalytic oxidizer (Cat-Ox) to treat recovered soil vapors. In 1998 an independent groundwater treatment system was installed on recovery well RW-52 utilizing three 200

pound GAC units for groundwater treatment prior to discharge and in September 2000 a longer term SVE program was initiated.

A Work Plan for Additional Assessment was submitted to the MDE in October 2008 to refine the site characterization and evaluate potential modifications to the current remedial strategy. Site investigation activities were performed in 2009. These activities included a trial shut down of pumping on recovery well RW-52, groundwater monitoring, downhole geophysical survey, pump testing, and a dual phase extraction (DPE) pilot test. A SCM was submitted to MDE in February 2010.

Pilot testing based on the September 2011 CAP was completed in February 2012. The Report of Results from April 2012 indicated that DPE/TPE recovery methods were not likely to be an applicable technology at the site.

2. Conceptual Site Model

The geology and hydrogeology is based on investigative activities conducted by previous consultants and groundwater results are from the most recent sampling event conducted by ARCADIS in May 2011.

2.1 Geology and Hydrogeology

Previous subsurface investigations indicate mainly silt and clay overlying fractured limestone. Historical boring logs are included in **Appendix B**.

Previous site conceptual models identify groundwater bearing zones described as shallow, intermediate, and deep. Shallow groundwater has generally been reported at depths ranging from just below the ground surface up to 30 feet bgs. Intermediate groundwater appears to be present just above bedrock and ranges in depth from 30 to 50 feet bgs. Deep groundwater is characterized as groundwater below overburden and within the bedrock.

Depth to groundwater was measured during the most recent groundwater monitoring even in October 2012. Based on this gauging data, groundwater flow at the site appears to be to the southeast (**Figures 3 and 4**).

2.2 Soil Quality

As reported in the SCM report, soil analytical samples collected in 2006 and 2009 showed no constituent concentrations above MDE Non-Residential Cleanup Standards. A table from the 2010 SCM report summarizing historical soil analytical data is included in **Appendix B**.

2.3 Phase Separated Hydrocarbons

No phase separated hydrocarbons (PSH) have been detected in wells since May 2012 in well MW-55I. The detection of 0.01 ft of PSH in MW-55I in May 2012 is the only detection in any monitoring well since 2007 with the exception of MP-2. Well MP-2 has had no detections of PSH since August 2011.

2.4 Groundwater Quality

As reported in the most recent groundwater monitoring report, groundwater samples were collected in October 2012 and submitted to TestAmerica Laboratories of Nashville, Tennessee for analysis of for analysis of full list volatile organic compounds (VOCs) and fuel oxygenates using Environmental Protection Agency (EPA) Method 8260B, and total petroleum hydrocarbons – gasoline range organics (TPH-GRO) and total petroleum hydrocarbons – diesel range organics (TPH-DRO) by EPA Method 8015. Data for this event is shown on **Figures 3 and 4**.

Benzene, toluene, ethylbenzene, methyl tertiary butyl ether (MTBE), TPH-DRO, and TPH-GRO were detected at concentrations exceeding MDE Groundwater (GW) Clean-up Standards in samples collected from one or more wells:

- Benzene was detected at concentrations exceeding the MDE GW standard (5 µg/L) in 14 samples (MW-5, MW-13A, MW-14A, MW-38, MW-53S, MW-54S, MW-54D, MW-55S, MW-55I, MW-55D, RW-52, DPE-1, VW-1, and MP-2) with a maximum concentration of 14,300 µg/L in the sample collected from MW-53S.

- Toluene was detected at concentrations exceeding the MDE GW standard (1,000 µg/L) in three samples (MW-53S, MW-55I, and DPE-1) with a maximum concentration of 11,100 µg/L in the sample collected from MW-53S.

- Ethylbenzene was detected at concentrations exceeding the MDE GW standard (700 µg/L) in three samples (MW-53S, MW-55I, and DPE-1) with a maximum concentration of 1,580 µg/L in the sample collected from MW-53S.

- MTBE was detected at concentrations exceeding the MDE GW standard (20 µg/L) in two samples (MW-53S and MW-55I) with a maximum concentration of 344 µg/L in the sample collected from MW-53S.

- TPH-GRO was detected above the MDE GW standard (47 µg/L) in 18 samples (MW-6, MW-11, MW-13A, MW-14A, MW-38, MW-51, MW-53S, MW-54S, MW-54D, MW-55S, MW-55I, MW-55D, RW-52, MP-1, MP-2, DPE-1, VW-1, and VW-2) with a maximum concentration of 78,500 µg/L in the sample collected from MW-55I.

- TPH-DRO was detected above the MDE GW standard (47 µg/L) in 21 samples (MW-5, MW-11, MW-13A, MW-14A, MW-38, MW-46, MW-48, MW-50, MW-51,

MW-53S, MW-53I, MW-54S, MW-54D, MW-55S, MW-55I, MW-55D, DPE-1, MP-2, VW-1, VW-2, and VW-3) with a maximum concentration of 12,700 µg/L in the sample collected from MW-55I.

2.5 Historical Analytical Trends in Groundwater

Graphs of historical data were produced for benzene concentrations in samples from 15 wells that are considered representative of site conditions (MW-5, MW-14A, MW-48, MW-50, MW-51, MW-53I, MW-53S, MW-54D, MW-54S, MW-55I, MW-55S, RW-52, VW-1, VW-2, and MP-2). These wells can be analyzed in three categories based on historical benzene concentration levels: above 5,000 ug/L, above 1,000 ug/L, and remaining wells (including wells with non-detects). Historical analytical data graphs are included as **Appendix C**.

- Historical concentrations above 5,000 ug/L: MW-53S, MW-53I, and MW-55I. Two of these wells (MW-53S, MW-53I) are located just south east of the existing dispenser islands. The third well (MW-55I is located at the southeast property boundary. In the area of the MW-53 well cluster, concentrations are highest in the shallow zone as demonstrated by concentrations in MW-53S (screened from 22 to 27 ft bgs), which are higher than those in samples from MW-53I (screened from 33 to 38 ft bgs). Conversely, concentrations in the intermediate zone near MW-55I (screened from 31 to 36 ft bgs) are higher than in the shallow zone (MW-55S screened from 15 to 20 ft bgs). Concentrations in MW-53S and MW-55I are stable since 2007. Concentrations in MW-55I are declining.

- Historical concentrations above 1,000 ug/L: MW-54D, MW-55S, MP-2, VW-1. Two wells are screened shallow (VW-1 from 3 to 13 ft bgs and MP-2 from 7 to 27 ft bgs) and are located just south of the current dispenser islands. Constituent concentrations are high in the shallow zone near the dispensers as noted above for well MW-53S.

  The other two wells are located in the southeast section of the property. Well MW-55S is screened shallow (15 to 20 ft bgs) and higher constituent concentrations are observed in the intermediate zone (MW-55I) as discussed above. Well MW-54D is screened both intermediate and deep (31 to 42 ft bgs). Concentrations in the vicinity of the MW-54 cluster are higher in the intermediate zone than the shallow zone.

  Overall, concentrations in these wells are declining from historical highs.

- Remaining wells: MW-5, MW-14A, MW-48, MW-50, MW-51, MW-54S, RW-52, VW-2. Benzene concentrations in these wells have never been as high as the concentrations in the wells described previously. Additionally, concentrations in all of these wells are declining since 2005.

Overall, the highest concentrations are located in the shallow zone near the MW-53 well cluster and the intermediate zone near the MW-54 and MW-55 well cluster. Concentrations in those areas are stable, and concentrations are declining in remaining areas where concentrations are two to three magnitudes lower.

3. Risk Based Evaluation Summary (from 2010 SCM)

The SCM (Kleinfelder 2010) include an evaluation of risk to human health from site-related constituents. The following receptors were selected for further evaluation in the report

- On-site indoor workers (adults)
- Off-site residents (adults and youths)
- Off-site workers (adults)

Because constituent concentrations in soil are below Maryland Cleanup Standards, soil does not pose a risk to on-site receptors. There is no potential exposure to on-site groundwater because the site is serviced by municipal water. There is no exposure by off-site receptors to groundwater because there are no private or commercial supply wells within 1,000 feet of the site, and samples from monitoring well MW-37 (500 ft downgradient) continue to be non-detect. Therefore, the following exposure pathways were evaluated in the SCM:

- Inhalation by on-site indoor workers of volatilized adsorbed or dissolved phase hydrocarbons

Further evaluation indicated this exposure pathway was potentially complete based on evaluation of historical analytical data.

4. Previous Remedial Technology Evaluations

Remedial alternatives have previously been evaluated in the SCM (Kleinfelder 2010). These evaluations are summarized below, and the evaluations have been supplemented with new data as applicable.

4.1 Air Sparge

Air sparge remediation techniques inject air into the aquifer to strip volatile components from the soils. Soil vapors are then recovered via SVE. Air sparge technology is most effective in aquifers at intermediate to shallow depths with sandy / silty soils. Although site constituents appear to be in the intermediate and shallow zones, boring logs indicate clay lenses and discontinuous perched water in these zones. Based on the site lithology, air sparge techniques are not likely to be effective.

4.2 In-Situ Chemical Oxidation

In-situ chemical oxidation techniques use a chemical oxidizer that is injected into groundwater to chemically degrade the constituents of concern. The chemical reaction typically creates carbon dioxide and water, irreversibly destroying the contaminant. However, boring logs indicate clay lenses. Chemical oxidation is not recommended as a remedial technique with low permeability soils. Therefore, chemical oxidation is not likely to be effective.

4.3 Dual-Phase Extraction and Vacuum Truck Extraction

In November 2009, pilot tests were completed for dual-phase extraction (DPE) at DPE-1 and vacuum truck extraction (VTE) at MPE-2. No detectable vacuum influence was observed in neighboring wells during either pilot test and groundwater elevation influence was inconclusive. These results were confirmed during additional pilot testing completed in February 2012. Therefore, these techniques are not likely to be effective and have been removed from further consideration.

4.4 Soil Vapor Extraction

Soil vapor extraction (SVE) has been utilized at the site in various wells since 1990, most recently at wells MW-14A and MW-51. However, SVE has not proven to be effective at the site. Between 2005 and 2012, constituent concentrations in wells MW-14A and MW-51 have not demonstrated a declining trend. As part of the February

2012 DPE pilot test, the SVE system was shut down in order to prevent interference with the pilot test. Since then, quarterly sampling results have been evaluated for rebound following the system shutdown.

Beginning with May 2012 analytical results, data have shown that constituent concentrations in wells MW-14A and MW-51 have declined since the SVE system was shutdown. No rebound has been observed in samples from these wells. Therefore, SVE is not considered to be effective.

5. Corrective Actions

The follow sections summarize the basis for corrective action at the site and the proposed activities.

5.1 Basis for Corrective Action

The risk-based evaluation summary in Section 3 showed that the only potential receptor is on-site indoor workers who could be exposed to constituents through vapor intrusion into the convenience store. Based on this, proposed actions include sub-slab soil vapor sampling to determine actual concentration beneath the building and continued groundwater monitoring.

5.2 Sub-slab vapor sampling

In order to collect sub-slab vapor, two sub-slab sampling ports would be installed inside the convenience store building. The sampling ports would be located as follows:

- One sampling location located in the center of the building.
- One sampling location located on the west side of the building, near the groundwater impacts, but at least five feet from the building exterior.

The sampling point construction would be 0.375-in outer diameter stainless steel screen and piping installed approximately 3 inches below the bottom of the concrete slab. The sampling point would be sealed with concrete and allowed to set prior to sampling.

Sub-slab vapor samples would be collected quarterly for one year in conjunction with the quarterly groundwater monitoring and sampling. Sampling procedures would follow the ARCADIS Sub-Slab Soil Gas Sampling and Analysis standard operating procedure (**Appendix D**). Samples would be analyzed for VOCs using USEPA Method TO-15. Results would be reported in the quarterly monitoring reports.

5.3 Revised Groundwater Monitoring Program

ARCADIS proposes a revised groundwater sampling plan based on trends in the recent historical data. Historical data summarized in Section 2.5 demonstrate that the

site is adequately characterized and that the plume boundaries are delineated. The proposed groundwater monitoring program is:

- Semi-Annual (1Q and 3Q): Gauge and sample all on-site wells. Samples analyzed for VOCs including fuel oxygenates, TPH-GRO and TPH-DRO.

- Quarterly (2Q and 4Q): Gauge all on-site wells. Samples wells MW-5, MW-14A, MW-48, MW-50, MW-51, MW-53I, MW-53S, MW-54D, MW-54S, MW-55I, MW-55S, RW-52, VW-1, VW-2, and MP-2 and analyze for VOCs including fuel oxygenates.

The groundwater monitoring program will show that the constituent plume is stable or declining and is not migrating beyond the site boundaries as established by well MW-37.

6. Remedial Endpoints

Remedial activities will be considered complete when defined remedial endpoints are achieved. The baseline for comparison of remedial endpoints in the constituent mass as reported in the SCM (Kleinfelder 2010). The following sections describe the remedial endpoints for each phase of hydrocarbons.

6.1 Liquid Phase Hydrocarbon Endpoint

MDE regulations require that all LPH be removed to the maximum extent practicable. Measureable LPH has not been detected in site wells since August 2011, so this end point is considered to have been achieved.

6.2 Dissolved Phase Hydrocarbon Endpoint

The MDE OCP guidance indicates that to achieve the site goal for dissolved phase remediation, risks posed by the release must be removed, contamination migration must be prevented, and asymptotic trend in dissolved-phase contamination must be established.

The purpose of the sub-slab soil vapor sampling is to demonstrate that there are no unacceptable risks at the site. Soil vapor sampling will determine the risk to the only potentially complete pathway and receptor (on-site indoor workers).

The purpose of the continued groundwater monitoring program is to demonstrate that the plume is not moving off-site and that constituent concentrations are declining.

When an asymptotic trend is established in on-site groundwater concentrations, the site will be re-evaluated as to whether the dissolved phase hydrocarbon endpoint has been reached.

7. Monitoring and Reporting Schedules

The following schedules are proposed for the corrective action activities.

7.1 Corrective Action Implementation and Schedule

Remedial activities will begin to be implemented within 30 days of receiving final approval of the CAP. If the CAP is approved in March 2013, then remedial activities will begin by April 2013.

7.2 Reporting Schedule

All soil vapor and groundwater analytical results will be reported in the quarterly monitoring reports.

7.3 Schedule Summary

The following summarizes the project schedule assuming October 2011 CAP approval:

Date	Field Event/Report
March 2013	Receive CAP approval.
April-May 2013	Install sub-slab soil vapor sampling points
July 2013	Submit 2Q 2013 soil vapor and groundwater analytical data in quarterly monitoring report

8. References

ARCADIS, 2012. Fourth Quarter 2012 Groundwater Monitoring Report, Former Exxon Facility #25553, 143 Frederick Road, Thurmont, Maryland. 19 November 2012.

Kleinfelder, 2010. Conceptual Site Model / Characterization Report, Former Exxon Facility #25553, 143 Frederick Road, Thurmont, Maryland. 18 February 2010.

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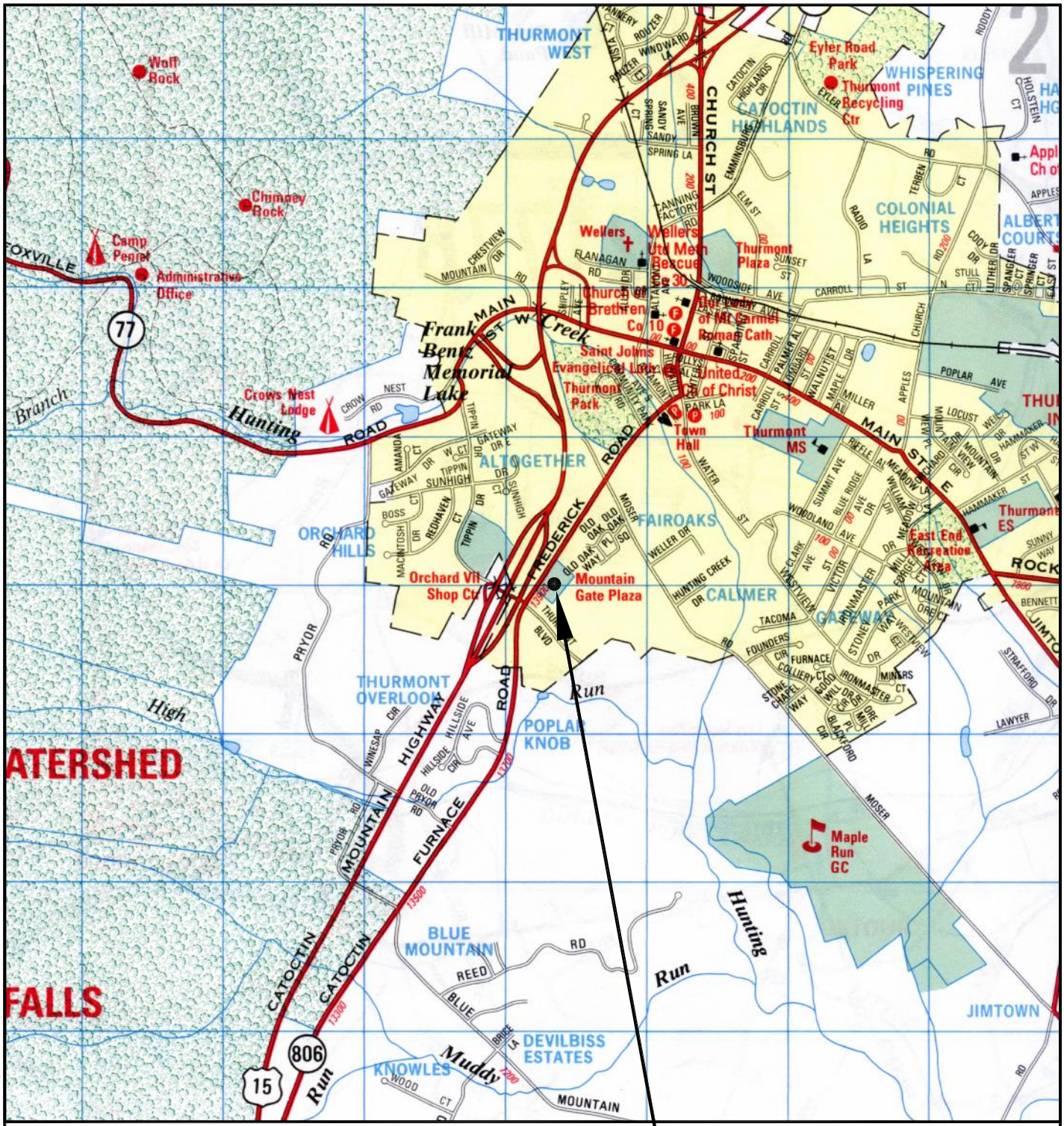
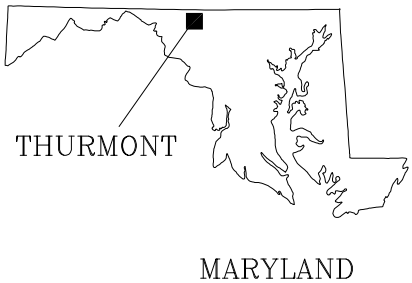
Figures



MAP SOURCE: ADC Frederick Co. MD. Street Map Book



FORMER EXXON FACILITY # 25553
143 FREDERICK RD
THURMONT, MD.

LOCAL AREA MAP

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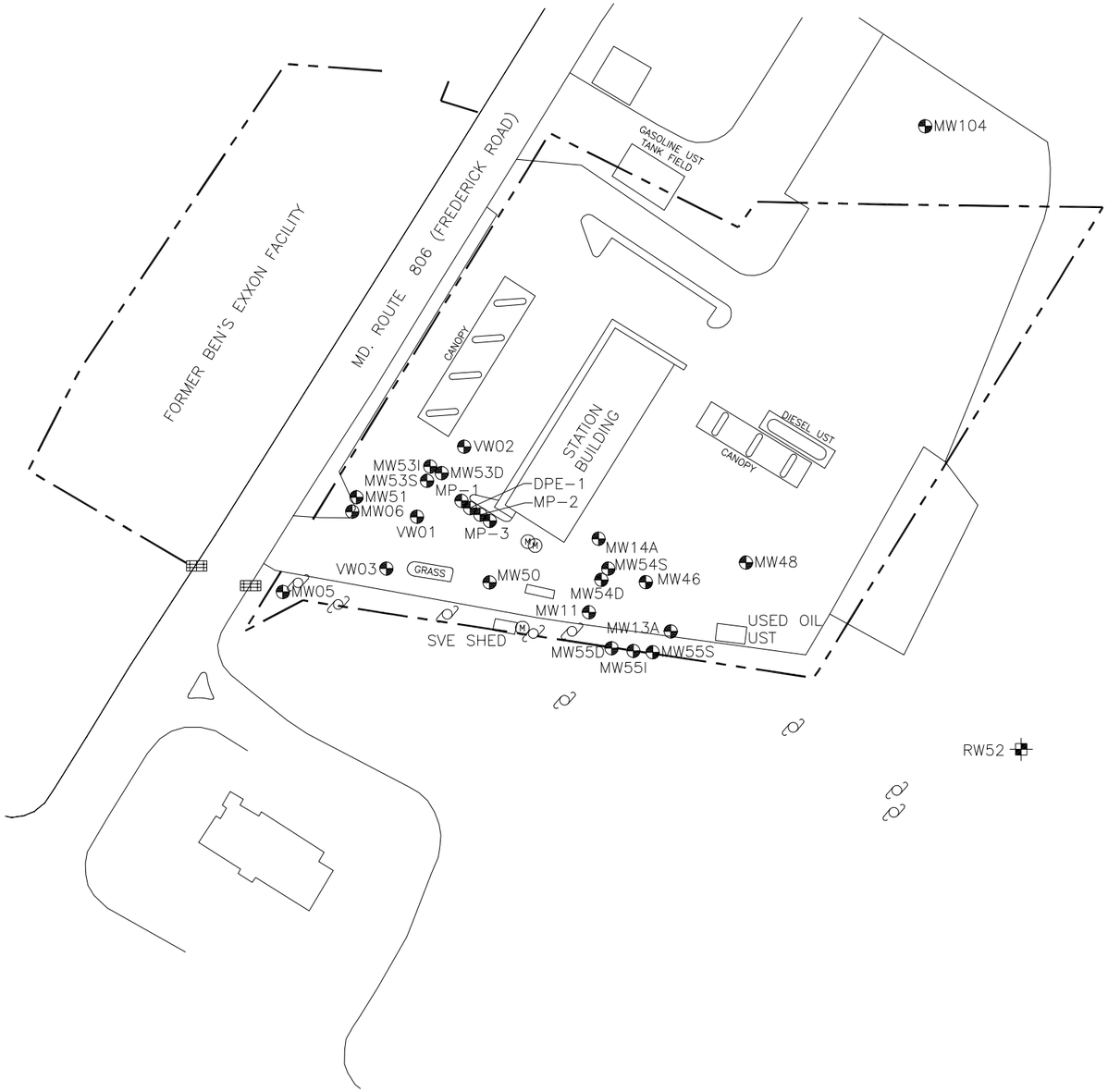
FIGURE 1

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENV\CAD\BALTIMORE\ACTIVE\00858551\0014\00002\143 Frederick RD-Site-Loc.dwg LAYOUT: 1 SAVED: 4/15/2011 10:11 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 4/29/2011 12:39 PM BY: GOFORTH, JOHN



INACTIVE

TEST WELL

.EGEND:

- MONITORING WELL
- RECOVERY WELL
- MUNICIPAL SUPPLY WELL
- UTILITY MANHOLE
- UTILITY POLE
- CATCH BASIN
- PROPERTY LINE

0 50 100

SCALE: FEET

FORMER EXXON FACILITY # 25553
143 FREDERICK RD
THURMONT, MD.

SITE MAP

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FIGURE
2

MW-51	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	108
TPH-GRO	230

VW-1	
10/8/2012	
Benzene	16.1
Toluene	4.83
Ethylbenzene	30.8
Total Xylenes	55.3
MTBE	<1
TPH-DRO	172
TPH-GRO	1,650

MW-53S	
10/8/2012	
Benzene	14,300
Toluene	11,100
Ethylbenzene	1,580
Total Xylenes	6,930
MTBE	344
TPH-DRO	2,420
TPH-GRO	75,600

VW-2	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	119
TPH-GRO	190

MP-1	
10/11/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	2.16
Total Xylenes	6.85
MTBE	<1
TPH-DRO	<94.3
TPH-GRO	262

MW-6	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	<94.3
TPH-GRO	301

MW-5	
10/8/2012	
Benzene	34.2
Toluene	<1
Ethylbenzene	3.43
Total Xylenes	<3
MTBE	<1
TPH-DRO	326
TPH-GRO	<100

DPE-1	
10/11/2012	
Benzene	1,120
Toluene	1,600
Ethylbenzene	1,250
Total Xylenes	4,880
MTBE	4.13
TPH-DRO	4,220
TPH-GRO	37,900

MP-2	
10/11/2012	
Benzene	86.5
Toluene	160
Ethylbenzene	133
Total Xylenes	436
MTBE	1.87
TPH-DRO	1,500
TPH-GRO	10,800

MW-54S	
10/8/2012	
Benzene	8.98
Toluene	<1
Ethylbenzene	5.9
Total Xylenes	9.89
MTBE	<1
TPH-DRO	754
TPH-GRO	662

VW-3	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	119
TPH-GRO	190

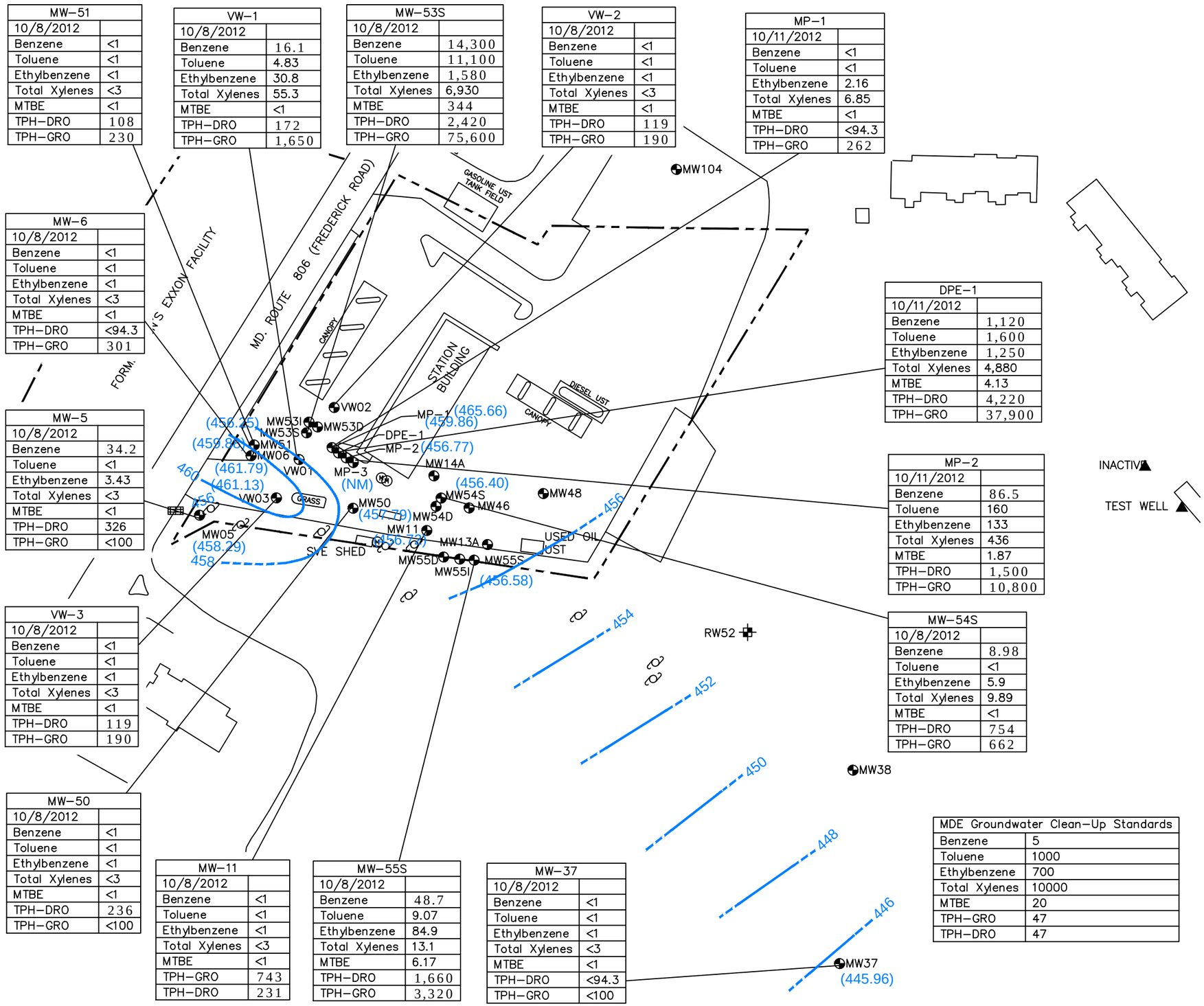
MW-50	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	236
TPH-GRO	<100

MW-11	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-GRO	743
TPH-DRO	231

MW-55S	
10/8/2012	
Benzene	48.7
Toluene	9.07
Ethylbenzene	84.9
Total Xylenes	13.1
MTBE	6.17
TPH-DRO	1,660
TPH-GRO	3,320

MW-37	
10/8/2012	
Benzene	<1
Toluene	<1
Ethylbenzene	<1
Total Xylenes	<3
MTBE	<1
TPH-DRO	<94.3
TPH-GRO	<100

MDE Groundwater Clean-Up Standards	
Benzene	5
Toluene	1000
Ethylbenzene	700
Total Xylenes	10000
MTBE	20
TPH-GRO	47
TPH-DRO	47



LEGEND:

- MONITORING WELL
- RECOVERY WELL
- MUNICIPAL SUPPLY WELL
- UTILITY MANHOLE
- UTILITY POLE
- CATCH BASIN
- PROPERTY LINE
- 452 — GROUNDWATER ELEVATION CONTOUR (FEET ABOVE MEAN SEA LEVEL)
- (455.38) GROUND WATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- NM NOT MEASURED
- INACTIVE
- TEST WELL

NOTES:

[254] – MDE Groundwater Clean-Up Standard

MDE – Maryland Department of the Environment

Boldface – results exceed MDE groundwater clean-up standards

MTBE – methyl tertiary butyl ether

TPH-GRO – total petroleum hydrocarbons – gasoline range organics

TPH-DRO – total petroleum hydrocarbons – diesle range organics

All results listed in µg/L

0 50 100

SCALE: FEET

FORMER EXXON FACILITY # 25553
143 FREDERICK RD
THURMONT, MD.

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP AND ANALYTICAL RESULTS 8 AND 11 OCTOBER 2012

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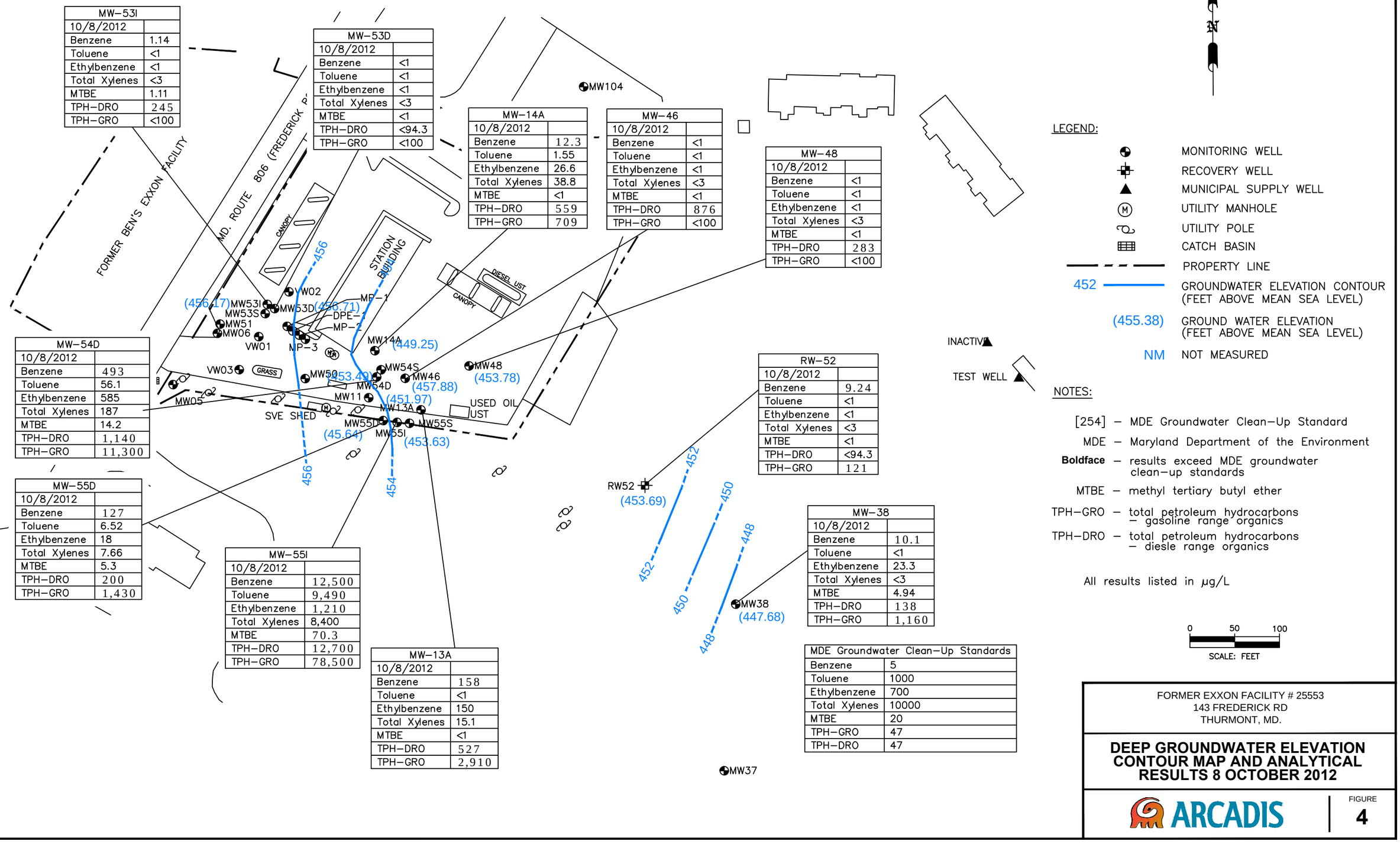
FIGURE 3



FORMER EXXON FACILITY # 25553
143 FREDERICK RD
THURMONT, MD.

DEEP GROUNDWATER ELEVATION CONTOUR MAP AND ANALYTICAL RESULTS 8 OCTOBER 2012

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FIGURE 4

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Appendix A

MDE Correspondence

MDE

MARYLAND DEPARTMENT OF THE ENVIRONMENT

Oil Control Program, Suite 620, 1800 Washington Blvd., Baltimore MD 21230-1719
410-537-3442 • 410-537-3092 (fax) 1-800-633-6101

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Robert M. Summers, Ph.D.
Secretary

December 16, 2011

Ms. Jewel G. Cox
ExxonMobil Environmental Services
Suite 106 #232
1016 West Poplar Avenue
Collierville TN 38017

RE: TECHNICAL MEETING NOTES AND CONDITIONAL PILOT TEST APPROVAL
Case No. 1989-0923-FR
Exxon Service Station No. 2-5553
143 Frederick Road, Thurmont
Frederick County, Maryland
Facility I.D. No. 7446

Dear Ms. Cox:

The Oil Control Program recently completed a review of the *Corrective Action Plan - September 12, 2011* (*CAP*) and the *Second Quarter Remedial Action Progress Report - August 8, 2011* for the above-referenced property. Groundwater samples collected in May 2011 continued to detect: benzene at 19,200 parts per billion (ppb); toluene at 26,000 ppb; ethylbenzene at 1,970 ppb; methyl tertiary-butyl ether (MTBE) at 761 ppb; total petroleum hydrocarbons/diesel-range organics (TPH/DRO) at 9,210 ppb; and TPH/gasoline-range organics (GRO) at 110,000 ppb. A soil vapor extraction (SVE) system continues to operate on monitoring wells MW-14A and MW-51.

The Department agrees with the geology as established in the *Site Conceptual Model/Characterization Report - February 18, 2010* (e.g., mainly silt and clay overlying fractured limestone). Conceptually and practically, remediation must be selected for optimum recovery within the established fractured limestone lithology. Pumping tests completed to date have confirmed the select connectivity and modified radius of influence one would expect to see in a highly fractured limestone environment. In addition, the select borehole geophysics collected confirmed the pockets that one would expect of a fractured limestone formation. When the data generated from this pending pilot test is reviewed, the Department fully expects that additional spot pilot testing may be required to fill in additional gaps in the field data. In addition, the Department fully expects that one "standard" remedial technology will not be feasible for this site as a whole, but slightly modified mini-targeted remedial options.

The highest concentrations of dissolved hydrocarbons appear to be localized to the front of the building in the vicinity of MW-53S, MP-1, MP-2, and MP-3. The Department and ExxonMobil have determined that future remedial activities should concentrate in this area of residual contamination and focus on polishing techniques with an end goal and time line for case closure. Based on that agreement, your environmental consultant proposed conducting an 8-hour pilot test utilizing a dual phase extraction (DPE) technology to evaluate the vacuum influence; air flow rate; extracted groundwater flow; petroleum mass removal rate, and influence of groundwater elevations. This pilot test will be conducted on DPE-1 due to its proximity to MP-1, MP-2, MP-3, and MW-53S. Prior to the event, pre-test baseline data including depth-to-water, wellhead pressure lower explosive readings (LEL), and distance between DPE-1 and the monitoring points will be collected. The information gained from the proposed pilot test will be used to prepare a *Corrective Action Plan Addendum* (*CAPA*).

The September 12, 2011 *Corrective Action Plan* proposes a reduction of quarterly groundwater sampling in select monitoring wells, specifically: MW-6, MW-11, MW-13A, MW-46, MW-53D, VW-3, MP-1, MP-3, and DPE-1. The reduction request is based on well locations to other existing wells, historical data, well condition, and age.

Based on our review of the case file and discussions held during a technical telephone conference on November 15, 2011, the Department hereby approves the *Corrective Action Plan* contingent upon the following modifications:

1. Continue sampling **all** monitoring wells and tank field observation pipes that do not exhibit liquid phase hydrocarbons (LPH) on a **quarterly basis** (**every three months**) and analyze for full-suite volatile organic compounds (VOCs), including fuel oxygenates, using EPA Method 8260 and for TPH/DRO and TPH/GRO using EPA Method 8015B.

2. Upon receipt of the post pilot test results and implementation of the amended corrective actions, the Oil Control Program will re-evaluate the request for reduction in monitoring well sampling.

3. All water purged during proposed testing procedures is of an unknown quality. Based on this, all purge water must be containerized and sampled prior to determining the proper method of disposal. If purge water is intended for discharge to the surface, an NPDES permit must be obtained. This permit authorizes the discharge of treated groundwater from oil contaminated groundwater sources to surface or groundwaters of the State (*see attached Fact Sheet and Permit Application*).

4. Based on the documented area geology, all site monitoring wells with the exception of MW-37, MW-38, and MW-104 must be measured and recorded during pilot test activities. Measurements must be made during each hour of the pump tests, including one hour prior to each test and two hours after.

5. Notify the Oil Control Program at least five (5) working days prior to beginning any work at this site so we have an opportunity to observe field activities.

6. **No later than January 31, 2012**, submit the results of the proposed pilot test to the Oil Control Program.

When submitting documentation to the Oil Control Program, provide three (3) hard copies and a digital copy on a labeled compact disc (CD) to the attention of the case manager at the above letterhead address. Reference the case number (9-0923-FR) on all documents submitted for this site. If you have any questions, please contact the case manager, Mr. Rob Hill, at 301-665-2857 (email: rhill@mde.state.md.us) or me at 410-537-3488 (email: sbull@mde.state.md.us).

Sincerely,

Susan R. Bull, Western Region Section Head
Remediation and State-Lead Division
Oil Control Program

RJH/nln

cc: Mr. William R. Kahl (ARCADIS)
Mr. George Keller (Frederick County Health Dept.)
Mr. Christopher H. Ralston
Mr. Horacio Tablada

ARCADIS

Appendix B

Soil Quality Information

TABLE 2

HISTORIC SOIL ANALYTICAL DATA

FORMER EXXON FACILITY #25553
143 FREDERICK ROAD
THURMONT, MARYLAND

SAMPLE #	COLLECTION YEAR	COLLECTION DEPTH (feet)	BENZENE (µg/kg)	TOLUENE (µg/kg)	ETHYL-BENZENE (µg/kg)	TOTAL XYLENES (µg/kg)	TOTAL BTEX (µg/kg)	MtBE (µg/kg)	TPH (mg/kg)	TPH-GRO (µg/kg)	TPH-DRO (µg/kg)	Acetone (µg/kg)	2-Butanone (MEK) (µg/kg)	n-Butylbenzene (µg/kg)	sec-Butylbenzene (µg/kg)	Isopropyl benzene (µg/kg)	p-Isopropyltoluene (µg/kg)	Napthalene (µg/kg)	n-Propyl benzene (µg/kg)	1,2,4-Tri methylbenzene (µg/kg)	1,3,5-Tri methylbenzene (µg/kg)
UST Field	1989	Unknown	ND	ND	ND	ND	BRL	NS	69	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-53	2006	3-5	10.1	11	2.7	21.4	45.2	ND	NS	35.2	48	83.9	ND	ND	ND	1.9	ND	ND	2.6	4.5	3.3
MW-53	2006	18-20	39.4	2,450	3,470	17,200	23,159	ND	NS	424	89	ND	ND	1,490	488	964	361	4,190	3,390	22,700	6,510
MW-54	2006	5-7	2	17.2	5.1	19.3	43.6	ND	NS	ND	NA	29.5	ND	ND	ND	ND	ND	ND	1.1	4.5	1.7
MW-54	2006	15-17	ND	ND	8.3	30.5	38.8	ND	NS	37.1	NA	ND	ND	120	32.1	23.1	24.9	6	128	2,070	299
MW-54	2006	25-27	51.8	1,090	1,870	966	3,978	ND	NS	396	NA	2,230	1,100	795	220	494	158	485	1,760	1,140	331
MW-55	2006	13-15	ND	ND	153	779	932	ND	NS	487	NA	ND	ND	417	61.8	117	63.9	749	422	2,790	948
MW-55	2006	21-23	6,510	81,700	35,700	163,000	286,910	ND	NS	2,020	NA	ND	ND	4,750	1,630	5,010	1,170	11,400	17,100	110,000	32,700
MW-55	2006	35-37	160	790	242,000	90,200	333,150	ND	NS	2,550	NA	ND	ND	6,500	2,270	6,710	1,700	14,200	23,900	157,000	46,600
SB-56	2006	13-15	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DPE-1	2009	19-21	17,700	192,000	74,300	325,000	609,000	290	NS	2,400	296	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

MW-53 formerly known as MW-101
MW-54 formerly known as MW-102
MW-55 formerly known as MW-103
SB-56 formerly known as MW-104
NS - Not sampled for that constituent
BTEX = Benzene, Toluene, Ethylbenzene and Xylenes
MTBE - Methyl Tert-Butyl Ether
TPH = Total Petroleum Hydrocarbons
TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics
TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics
Concentrations expressed in parts per billion (ppb)
Results reported on a dry weight basis.

KLEINFELDER
Bright People. Right Solutions.

1340 Charwood Road, Suite I
Hanover, MD 21076
(410) 850-0404

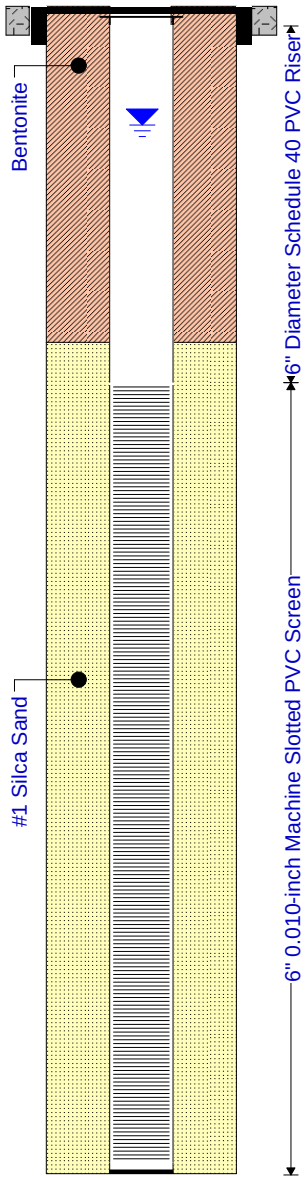
BORING LOG
Boring No. DPE-1

Project Name: Former Exxon Facility # 25553
Site Location: 140 & 143 Frederick Rd, Thurmont, MD
Kleinfelder Project No: 100736
Client: ExxonMobil
Drilling Company: Eichelberger
Driller: T. Coleman
Drill Rig Type: Schramm 450
Drilling Method: Air Rotary
Sampling Method: Split spoon/Direct Push

Start Date: 10-20-09
End Date: 10-27-09
Total Hole Depth: 29.5 feet
Hole Diameter: 12 inches
Depth to Bedrock: Not encountered
Surface Elevation: 0
Water Level (Initial): 3 feet
Water Level (Static): 3 feet
Logged By (Geol.): M. Bauer

Permit No.: NA
License No.: NA
Checked By:
Notes:

SUBSURFACE PROFILE			SAMPLE			
Depth (feet)	Graphic Log	Soil/Geologic Description (Unified Soil Classification System)	PID (ppm)	Recovery (in)	Well Construction	Depth (feet)
0		Ground Surface				0
0–5		Concrete ***Fill*** Concrete, brick, rock, sand, clay, crushed stone Water entering boring at 3 feet				
5–14		***Fill*** Large cobbles/boulders and concrete Silt, gravel, sand, cobbles, boulders *Logged from cuttings				
14–19		***MH*** SILT, some sand and gravel, brown, wet, firm	657	9		
19–21		***ML*** SILT, some sand and clay, trace fine gravel, brown, wet hard	1542	17		
21–29.5		Silt and clay, some gravel, cobbles, brown, wet *Logged from cuttings				
30		End of Borehole				30



PID - Photoionization Detector
NA - Not Applicable
NS - Not Sampled
NM - Not Measured
MU - Meter Units
PP - Pocket Penetrometer Reading (tons/sq. foot)

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(410) 850-0404

BORING LOG

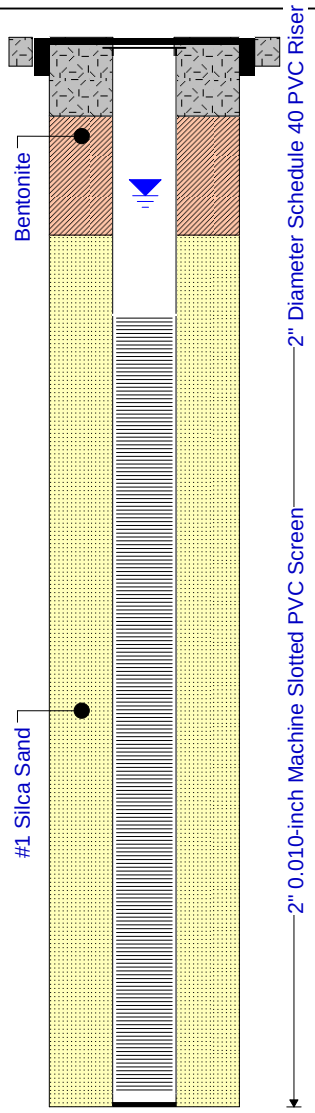
Boring No. MP-1

Project Name: Former Exxon Facility # 25553
Site Location: 140 & 143 Frederick Rd, Thurmont, MD
Kleinfelder Project No: 100736
Client: ExxonMobil
Drilling Company: Eichelberger
Driller: S. Taylor
Drill Rig Type: Schramm 450
Drilling Method: Hollow Stem Auger
Sampling Method: NA

Start Date: 10-20-09
End Date: 10-22-09
Total Hole Depth: 27 feet
Hole Diameter: 6 inches
Depth to Bedrock: Not encountered
Surface Elevation: NA
Water Level (Initial): 4 feet
Water Level (Static): 4 feet
Logged By (Geol.): M. Bauer

Permit No.: NA
License No.: NA
Checked By:
Notes:

SUBSURFACE PROFILE			SAMPLE			
Depth (feet)	Graphic Log	Soil/Geologic Description (Unified Soil Classification System)	PID (ppm)	Recovery (in)	Well Construction	Depth (feet)
0		Ground Surface				0
1		Concrete				1
2		***Fill*** Rocks, concrete, sand, clay				2
3		Water in the fill				3
4		***Fill*** Concrete and boulders				4
5		***ML*** Silty CLAY, cobbles, and boulders, wet				5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
25						25
26						26
27		End of Borehole				27
28						28
29						29
30						30



PID - Photoionization Detector
NA - Not Applicable
NS - Not Sampled
NM - Not Measured
MU - Meter Units
PP - Pocket Penetrometer Reading (tons/sq. foot)

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BORING LOG

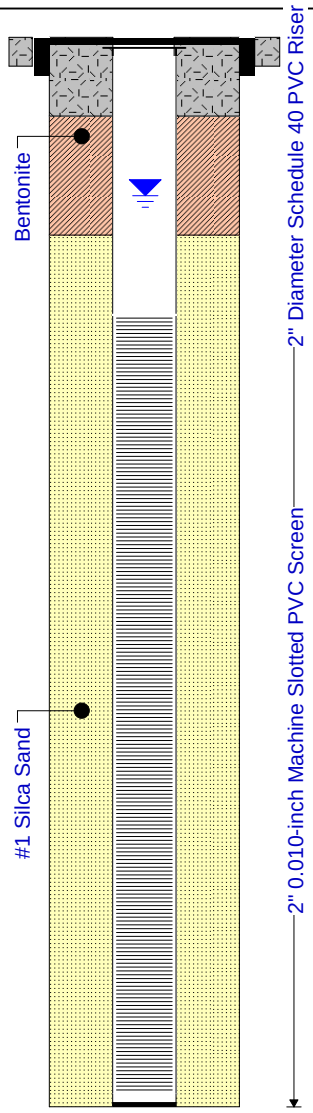
Boring No. MP-2

Project Name: Former Exxon Facility # 25553
Site Location: 140 & 143 Frederick Rd, Thurmont, MD
Kleinfelder Project No: 100736
Client: ExxonMobil
Drilling Company: Eichelberger
Driller: A. Coleman
Drill Rig Type: Schramm 450
Drilling Method: Air Hammer
Sampling Method: NA

Start Date: 10-20-09
End Date: 10-26-09
Total Hole Depth: 27 feet
Hole Diameter: 6 inches
Depth to Bedrock: Not encountered
Surface Elevation: NA
Water Level (Initial): 4 feet
Water Level (Static): 9 feet
Logged By (Geol.): M. Bauer

Permit No.:
License No.: NA
Checked By:
Notes:

SUBSURFACE PROFILE			SAMPLE			
Depth (feet)	Graphic Log	Soil/Geologic Description (Unified Soil Classification System)	PID (ppm)	Recovery (in)	Well Construction	Depth (feet)
0		Ground Surface				0
1		Concrete				1
2		***Fill*** Crushed stone, boulders, concrete, brick, gravel, sand, clay Water into boring at 4 feet				2
3						3
4						4
5						5
6						6
7		***ML*** Clayey SILT, cobbles, and boulders, wet *Logged from cuttings				7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
25						25
26						26
27		End of Borehole				27
28						28
29						29
30						30



PID - Photoionization Detector
NA - Not Applicable
NS - Not Sampled
NM - Not Measured
MU - Meter Units
PP - Pocket Penetrometer Reading (tons/sq. foot)

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(410) 850-0404

BORING LOG

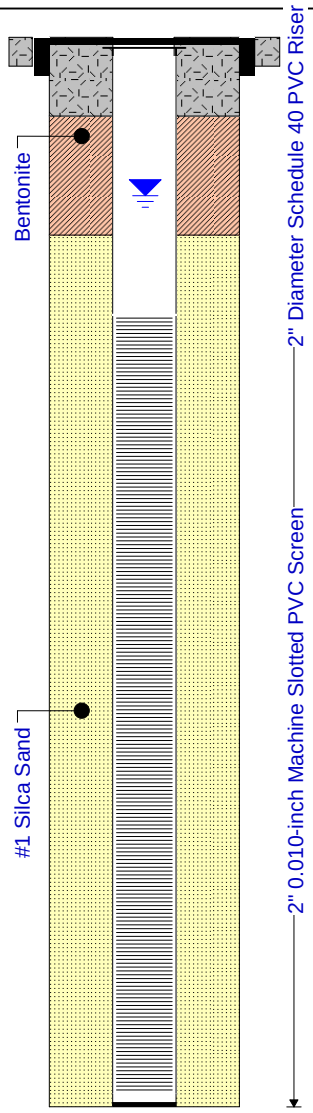
Boring No. MP-3

Project Name: Former Exxon Facility # 25553
Site Location: 140 & 143 Frederick Rd, Thurmont, MD
Kleinfelder Project No: 100736
Client: ExxonMobil
Drilling Company: Eichelberger
Driller: S. Taylor
Drill Rig Type: CME 75
Drilling Method: Hollow Stem Auger
Sampling Method: NA

Start Date: 10-21-09
End Date: 10-22-09
Total Hole Depth: 27 feet
Hole Diameter: 6 inches
Depth to Bedrock: Not encountered
Surface Elevation: NA
Water Level (Initial): 4 feet
Water Level (Static): 4 feet
Logged By (Geol.): M. Bauer

Permit No.: NA
License No.: NA
Checked By:
Notes:

SUBSURFACE PROFILE			SAMPLE			
Depth (feet)	Graphic Log	Soil/Geologic Description (Unified Soil Classification System)	PID (ppm)	Recovery (in)	Well Construction	Depth (feet)
0		Ground Surface				0
1		Concrete				1
2		***Fill*** Crushed stone, cobbles, sand, and clay Water into boring at 4 feet				2
3						3
4						4
5						5
6						6
7		***ML*** Clayey SILT, some gravel, dark brown, moist/wet *Logged from cuttings				7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
25						25
26						26
27		End of Borehole				27
28						28
29						29
30						30



PID - Photoionization Detector
NA - Not Applicable
NS - Not Sampled
NM - Not Measured
MU - Meter Units
PP - Pocket Penetrometer Reading (tons/sq. foot)

LITHOLOGY / NESTED WELL COMPLETION LOG - MW-53 S. I, & D

Groundwater & Environmental Services, Inc.

PROJECT ID - FORMER EXXON SERVICE STATION No. 2-5553, 143 FREDERICK RD., THURMONT, MD

GES JOB #: 0401417
START DATE: Oct-25-2006
COMPLETION DATE: Nov-11-2006
GES GEOLOGIST: William Bohrer & Brian McGrath
DRILLING COMPANY: SGS Environmental Services, Inc.
DRILLER: Wes Eichfeld
DRILL RIG: Foremost B-90
FIELD SCREENING METHOD: Photoionization Detector (PID)

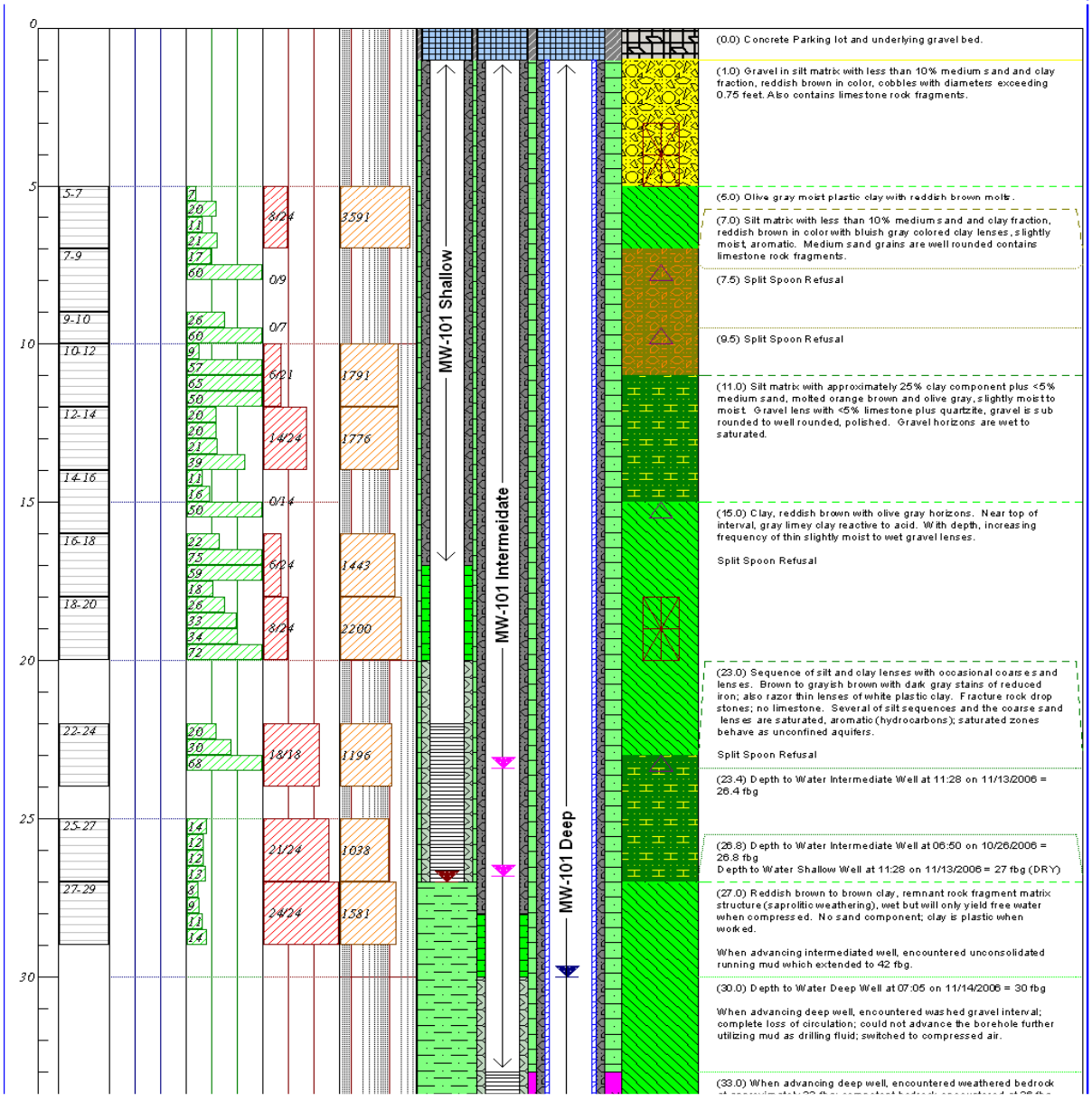
DEEPEST ADVANCE (fbg): 51.75
SURFACE ELEV (NAVD).: 469.09
NUMBER OF COMPLETIONS: 3
NESTED WELL ID(s): S. I, & D
TOP OF BEDROCK (fbg): 36
SPLIT SPOON LENGTH (inches): 24
SPLIT SPOON DIAMETER (inches): 3.0

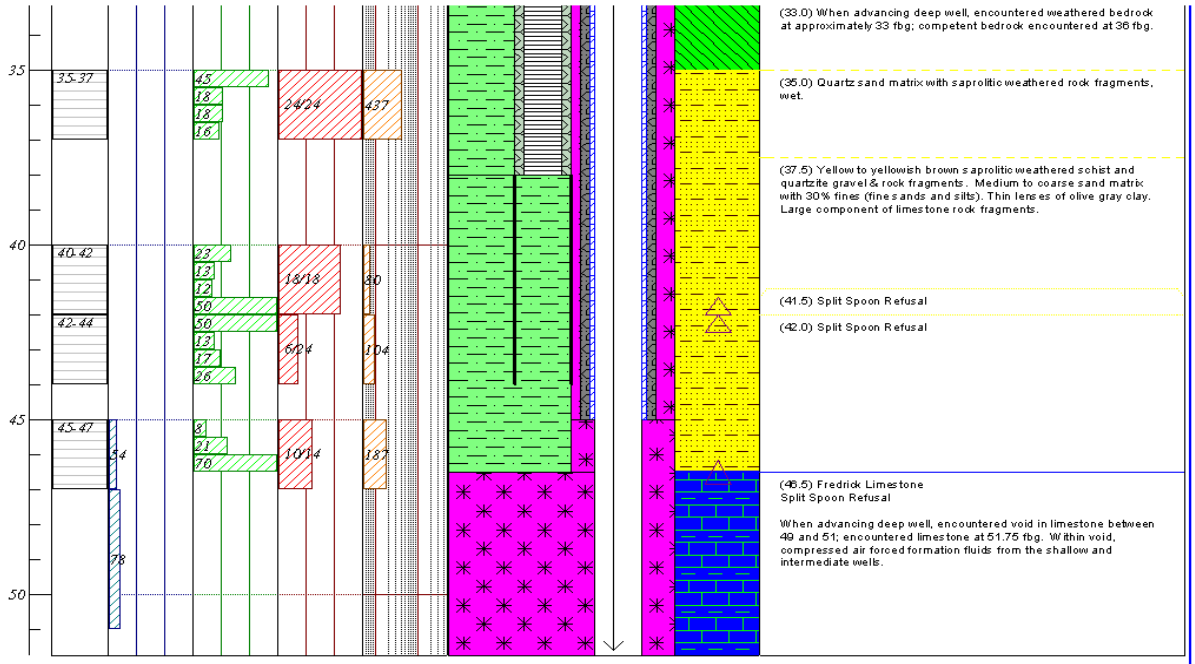
MONTIORING WELL COMPLETION PARAMETERS

SHALLOW WELL
TOTAL DEPTH (fbg): 27
SET SCREEN DEPTH (fbg): 27
SCREEN LENGTH (ft): 5
SCREEN SLOT SIZE: 20
SCREEN DIAMETER (inches): 4
BOREHOLE DIAMETER (inches): 6.25
TOP OF NUMBER 2 SAND (fbg): 20
TOP OF BENTONITE SEAL (fbg): 17

INTERMEDIATE WELL
TOTAL DEPTH (fbg): 44
SET SCREEN DEPTH (fbg): 38
SCREEN LENGTH (ft) 5
SCREEN SLOT SIZE: 20
SCREEN DIAMETER (inches): 4
BOREHOLE DIAMETER (inches): 6.25
TOP OF NUMBER 2 SAND (fbg): 30
TOP OF BENTONITE SEAL (fbg): 28

DEEP WELL
TOTAL DEPTH (fbg): 51.75
BOREHOLE DIAMETER (inches): 8.25
COMPLETION CASING ID (inches): 6
SET CASING DEPTH: (fbg): 45
TOP OF GROUTED ANNULUS (fbg): 1





EXPLANATION OF LITHOLOGY

Concrete Apron (Concrete & Crushed Rock Foundation)

Lawn

Gravel lens comprised of coarse to medium angular to sub rounded gravel (quartzite & schist derived from adjacent highlands), with <10% medium sand plus trace silt.

Lens of bimodal sand comprised of well rounded fine quartz with <20% sub angular medium sand and trace silts and/or clay.

Silt, 10% medium sand and clay plus trase limestone fragments.

Lens of clay and silts, moderate stratification, may include thin lenses of sand and/or gravel (storm deposit).

Clay

Fracture

Frederick Limestone - Upper Cambrian carbonates dominated by monotonously thick sequences of basin facies: Blue, graded, slabby, thin-bedded limestone and minor shale, interbedded with massive peloidal grainstones and beds of breccia up to 480 feet thick.

EXPLANATION OF GENERAL SYMBOLS

Water Table

Possible Water Zone

Split Spoon Refusal

Depth of Laboratory Soil Sample

EXPLANATION OF WELL CONSTRUCTION SYMBOLS

Road Box

Surface Casing

Overburden

Bentonite Seal

Grout

Screen

Bedrock

Well Pack

Comments

Na = Not Available, ID = Inside Diameter, fbg = feet blow grade, PID = Photoionization detector calibrated to 100 parts per million (ppm) isobutyl-benzene. Blows are equivalent to 140 pound hammer dropped 30 inches.

Overburden completed with 4-inch ID Schedule 40 polyvinyl-chloride (PVC) riser and No. 20 slot screen. Sand pack of No. 2 washed sand. NAVD = North American Vertical Datum (ft), TOC = Top of Casing (ft).

Four boreholes were advanced, the first one was abandoned (grouted to grade) when the auger severed at total depth of 49

The location is characterized by a steeply sloping bedrock interface which rises to the NE from 49 fbg to 36 fbg.

LITHOLOGY / NESTED WELL COMPLETION LOG - MW-54 S & D

Groundwater & Environmental Services, Inc.

PROJECT ID - FORMER EXXON SERVICE STATION No. 2-5553, 143 FREDERICK RD., THURMONT, MD

GES JOB #: 0401417
START DATE: Nov-06-2006
COMPLETION DATE: Nov-07-2006
GES GEOLOGIST: William Bohrer & Brian McGrath
DRILLING COMPANY: SGS Environmental Services, Inc.
DRILLER: Wes Eichfeld
DRILL RIG: Foremost B-90
FIELD SCREENING METHOD: Photoionization Detector (PID)

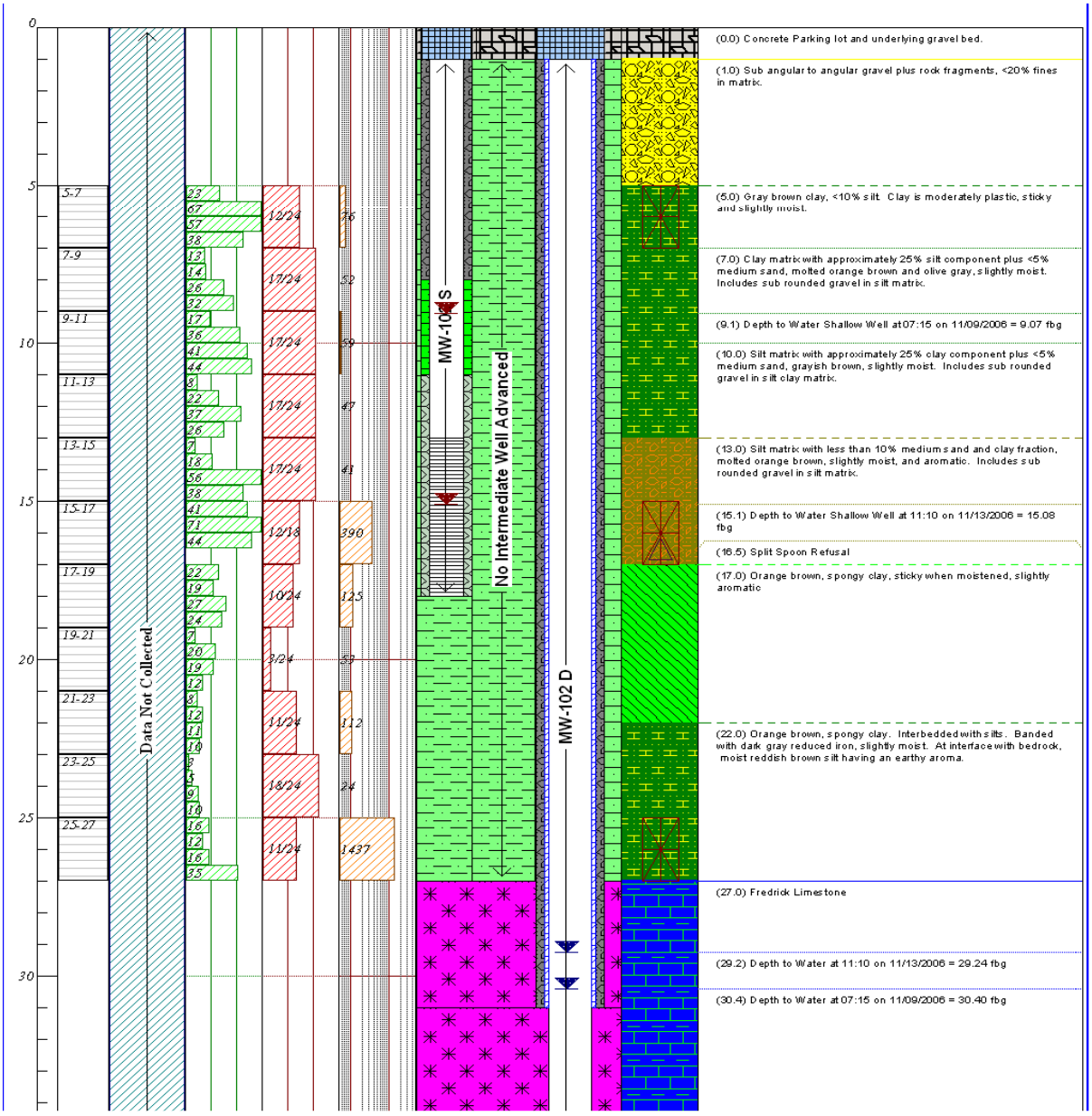
DEEPEST ADVANCE (fbg): 42
SURFACE ELEV (NAVD).: 467.84
NUMBER OF COMPLETIONS: 2
NESTED WELL ID(s): S & D
TOP OF BEDROCK (fbg): 27
SPLIT SPOON LENGTH (inches): 24
SPLIT SPOON DIAMETER (inches): 3.0

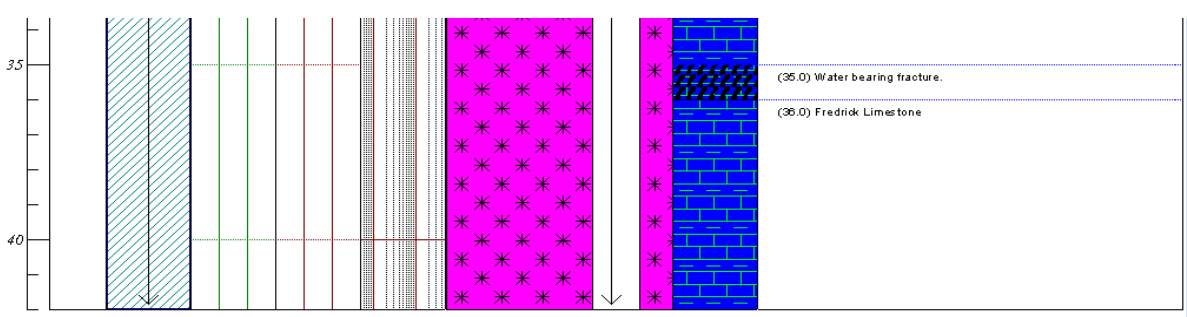
MONTIORING WELL COMPLETION PARAMETERS

SHALLOW WELL
TOTAL DEPTH (fbg): 18
SET SCREEN DEPTH (fbg): 18
SCREEN LENGTH (ft): 5
SCREEN SLOT SIZE: 20
SCREEN DIAMETER (inches): 4
BOREHOLE DIAMETER (inches): 8.75
TOP OF NUMBER 2 SAND (fbg): 11
TOP OF BENTONITE SEAL (fbg): 8

INTERMEDIATE WELL
TOTAL DEPTH (fbg): NA
SET SCREEN DEPTH (fbg): NA
SCREEN LENGTH (ft) NA
SCREEN SLOT SIZE: NA
SCREEN DIAMETER (inches): NA
BOREHOLE DIAMETER (inches): NA
TOP OF NUMBER 2 SAND (fbg): NA
TOP OF BENTONITE SEAL (fbg): NA

DEEP WELL
TOTAL DEPTH (fbg): 42
BOREHOLE DIAMETER (inches): 42
COMPLETION CASING ID (inches): 6
SET CASING DEPTH: (fbg): 31
TOP OF GROUTED ANNULUS (fbg): 1





EXPLANATION OF LITHOLOGY

Concrete Apron (Concrete & Crushed Rock Foundation)

Lawn

Gravel lens comprised of coarse to medium angular to sub rounded gravel (quartzite & schist derived from adjacent highlands), with <10% medium sand plus trace silt.

Lens of bimodal sand comprised of well rounded fine quartz with <20% sub angular medium sand and trace silts and/or clay.

Silt, 10% medium sand and clay plus trase limestone fragments.

Lens of clay and silts, moderate stratification, may include thin lenses of sand and/or gravel (storm deposit).

Clay

Fracture

Frederick Limestone - Upper Cambrian carbonates dominated by monotonously thick sequences of basin facies: Blue, graded, slabby, thin-bedded limestone and minor shale, interbedded with massive peloidal grainstones and beds of breccia up to 480 feet thick.

EXPLANATION OF GENERAL SYMBOLS

Water Table

Possible Water Zone

Split Spoon Refusal

Depth of Laboratory Soil Sample

EXPLANATION OF WELL CONSTRUCTION SYMBOLS

Road Box

Surface Casing

Overburden

Bentonite Seal

Grout

Screen

Bedrock

Well Pack

Comments

Na = Not Available, ID = Inside Diameter, fbg = feet blow grade, PID = Photoionization detector calibrated to 100 parts per million (ppm) isobutyl-benzene. Blows are equivalent to 140 pound hammer dropped 30 inches. Overburden completed with 4-inch ID Schedule 40 polyvinyl-chloride (PVC) riser and No. 20 slot screen. Sand pack of No. 2 washed sand. NAVD = North American Vertical Datum (ft), TOC = Top of Casing (ft). All completions included grout to grade above bentonite seal.

LITHOLOGY / NESTED WELL COMPLETION LOG - MW-55 S, I, & D

Groundwater & Environmental Services, Inc.

PROJECT ID - FORMER EXXON SERVICE STATION No. 2-5553, 143 FREDERICK RD., THURMONT, MD

GES JOB #: 0401417
START DATE: Oct-27-2006
COMPLETION DATE: Nov-03-2006
GES GEOLOGIST: William Bohrer & Brian McGrath
DRILLING COMPANY: SGS Environmental Services, Inc.
DRILLER: Wes Eichfeld
DRILL RIG: Foremost B-90
FIELD SCREENING METHOD: Photoionization Detector (PID)

DEEPEST ADVANCE (fbg): 142
SURFACE ELEV (NAVD).: 466.24
NUMBER OF COMPLETIONS: 3
NESTED WELL ID(s): S, I, & D
TOP OF BEDROCK (fbg): 35.5
SPLIT SPOON LENGTH (inches): 24
SPLIT SPOON DIAMETER (inches): 3.0

MONTIORING WELL COMPLETION PARAMETERS

SHALLOW WELL

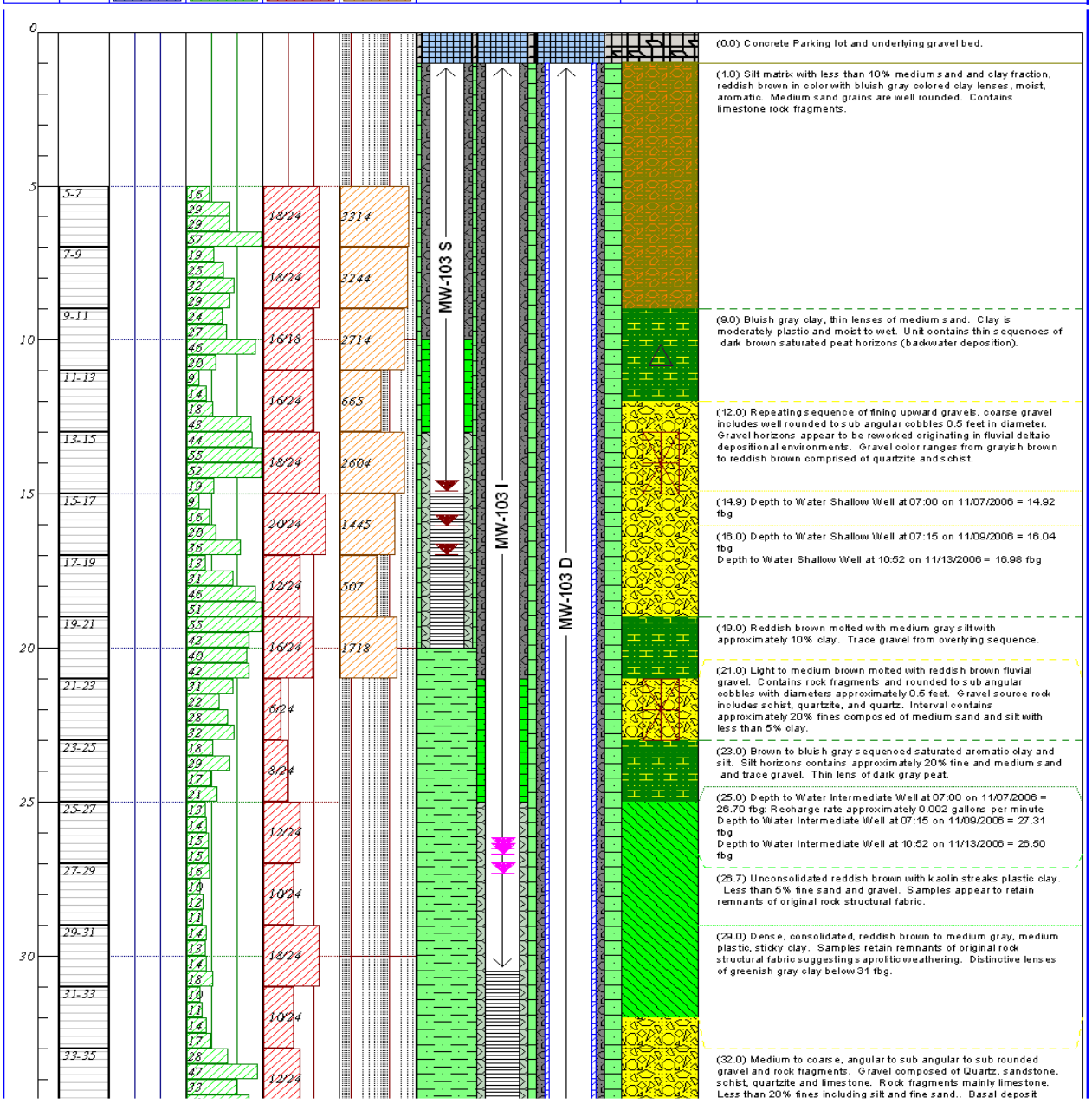
TOTAL DEPTH (fbg): 20
SET SCREEN DEPTH (fbg): 20
SCREEN LENGTH (ft): 5
SCREEN SLOT SIZE: 20
SCREEN DIAMETER (inches): 4
BOREHOLE DIAMETER (inches): 6.25
TOP OF NUMBER 2 SAND (fbg): 13
TOP OF BENTONITE SEAL (fbg): 10

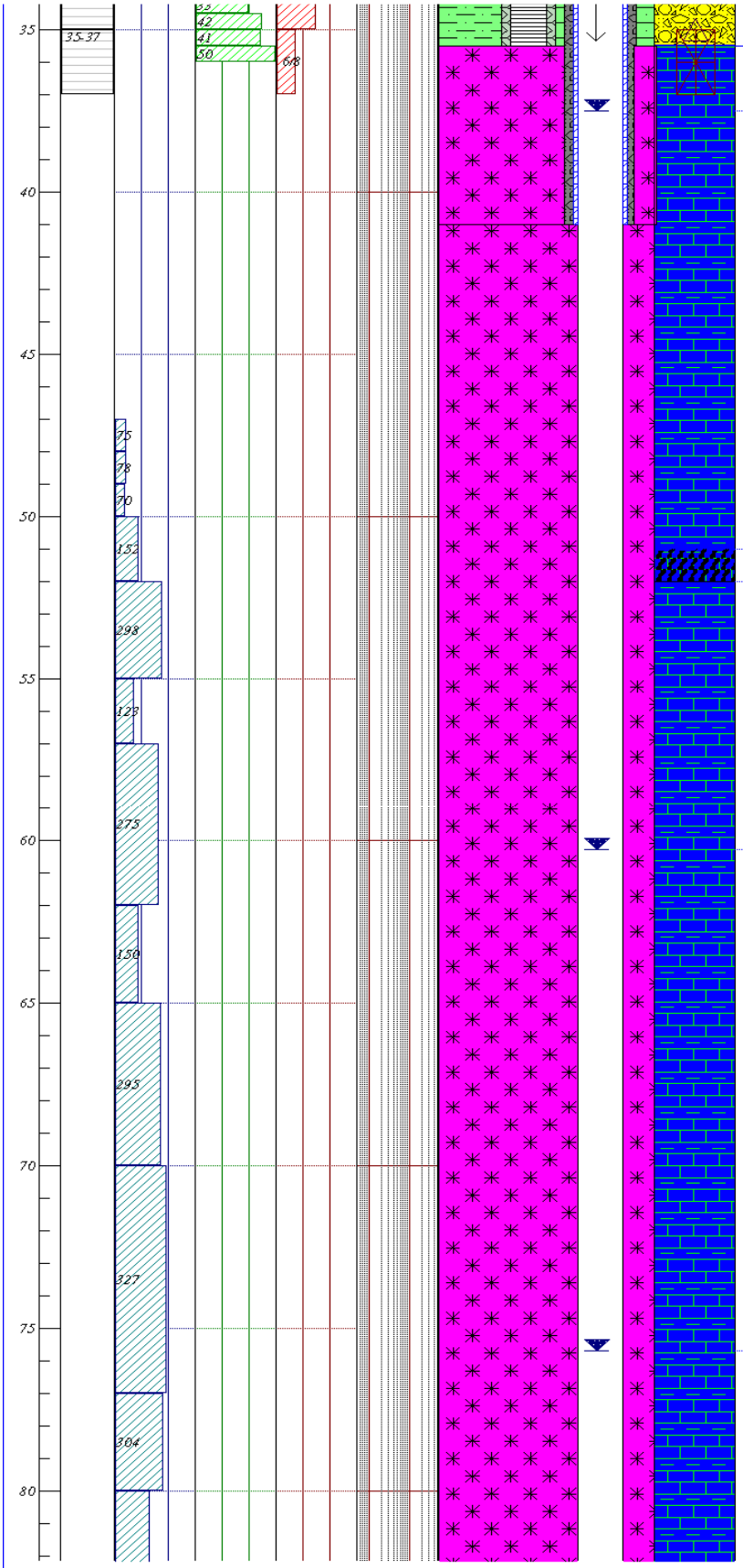
INTERMEDIATE WELL

TOTAL DEPTH (fbg): 35.5
SET SCREEN DEPTH (fbg): 35.5
SCREEN LENGTH (ft) 5
SCREEN SLOT SIZE: 20
SCREEN DIAMETER (inches): 4
BOREHOLE DIAMETER (inches): 6.25
TOP OF NUMBER 2 SAND (fbg): 25
TOP OF BENTONITE SEAL (fbg): 21

DEEP WELL

TOTAL DEPTH (fbg): 142
BOREHOLE DIAMETER (inches): 8.25
COMPLETION CASING ID (inches): 6
SET CASING DEPTH: (fbg): 41
TOP OF GROUTED ANNULUS (fbg): 2





Less than 20% fines including silt and fine sand.. Basal deposit above limestone bedrock.

(35.5) Fredrick Limestone

(37.5) Depth to Water at 10:52 on 11/13/2006 = 37.50 fbg: Recharge rate approximately 0.005 gallons per minute.

(51.0) Non water bearing fracture.

(52.0) Fredrick Limestone

(60.3) Depth to Water Deep Well at 07:15 on 11/09/2006 = 60.27 fbg: Recharge rate approximately 0.008 gallons per minute.

(75.7) Depth to Water Deep Well at 07:00 on 11/07/2006 = 75.68 fbg: Recharge rate approximately 0.01 gallons per minute.

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No. 1 Application No. _____ Permit No. FR-73-8857

Date Drilled Sept. 19, 1983 County Frederick Use monitor

Location Rt. 15, Thurmont, MD

Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224

Drilling Method air rotary Sampling Method cuttings

Hole Diameter 6.75" Total Depth 17'

Casing:

Type PVC Diameter 4" Length 1'

Screen:

Type PVC Slot .020 Diameter 4" Length 16'

Gravel Pack Size #1 Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt
				6"-1' Concrete, wet right under concrete, sealed off
				1'-17' Light brown silt, little fine sand, little coarse to fine gravel
			20 slot well screen	
10'				8'-12' Hard
				12'-15' soft
				15'-17' fractured limestone
20'				
30'				
40'				

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BORING LOG

Well No. 2 Application No. _____ Permit No. FR-73-8858
Date Drilled Sept. 19, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon co., U.S.A. Address Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 13'6"

Casing:
Type PVC Diameter 4" Length 1'

Screen:
Type PVC Slot 020 Diameter 4" Length 12'6"
Gravel Pack Size #1 Casing Seal Bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0"-6" Asphalt and gravel
				6"-1' Cement
				1'-2' Gray gravel, wet
				2'-14' Brown clayey silt, little coarse to fine gravel to cobbles, trace boulders
				Soft layers, no cobbles or boulders
			well screen	7'-14' Hard
10'				
20'				
30'				
40'				

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BORING LOG

Well No. 3 Application No. _____ Permit No. PR-73-8859
Date Drilled Sept. 19, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD
Drilling Method air rotary Sampling Method cuttings Total Depth 35'
Hole Diameter 6.75"

Casing:
Type PVC Diameter 4" Length 15'

Screen:
Type PVC Slot .020 Diameter 4" Length 20'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-35' Brown silt, little coarse to fine sand, trace+ cobbles
10'				10'-26' Trace boulders
20'			20 slot well screen	
30'				26'-35' soft
40'				

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BORING LOG

Well No. 4 Application No. _____ Permit No. FR-73-8860
Date Drilled Sept. 19, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method ~~cuttings~~
Hole Diameter 6.75" Total Depth 35'

Casing:
Type PVC Diameter 4" Length 15'

Screen:
Type PVC Slot .020 Diameter 4" Length 20'
Gravel Pack Size #1 Casing Seal ~~bentonite~~
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6"
				6"-27' Soft, brown clayey silt, little coarse to fine gravel, trace cobbles, trace boulders
10'				
				12'-27' Boulders
20'			2.0 Slot well screen	
				27'-35' Soft
30'				
40'				

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No. 5 Application No. _____ Permit No. FR-73-8861
Date Drilled Sept. 19, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 29'

Casing:
Type PVC Diameter 4" Length 11'

Screen:
Type PVC Slot .020 Diameter 4" Length 20'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Topsoil
				6"-4' Gray medium to fine sand, little silt
				4'-29' Brown medium to fine sand, little silt, little coarse to fine gravel, trace cobbles, trace boulders
10'				
20'			20 slot well screen	
30'				
40'				

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RING LOG

Permit No. FR-73-8862

Application No.

Ill No. 6

Date Drilled sept. 20, 1983 County Frederick Use monitor

Location Rt. 15, Thurmont, MD

Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224

Drilling Method air rotary Sampling Method cuttings

Hole Diameter 6.75" Total Depth 28'6"

Casing:

Type PVC Diameter 4" Length 18'6"

Screen:

Type PVC Slot 20 Diameter 4" Length 10'

Gravel Pack Size #1 Casing Seal bentonite

Static Water Level Geologic Formation

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" asphalt and gravel
				6"-5' Gray medium to fine sand, little silt
				5'-28'6" Light Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles and boulders
				Note: Strong gas odor
0'				
0'			well screen	
0'				
40'				

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BORING LOG

Well No 7 Application No _____ Permit No FR-73-8863

Date Drilled Sept. 20, 1983 County Frederick Use monitor

Location Rt. 15, Thurmont, MD

Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224

Drilling Method air rotary Sampling Method cuttings

Hole Diameter 6.75" Total Depth 32'

Casing:

Type PVC Diameter 4" Length 22'

Screen:

Type PVC Slot .020 Diameter 4" Length 10'

Gravel Pack Size #1 Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-2' Fill
				2'-6' Brown, medium to fine sand, little silt
				6'-32' Light brown clayey silt, little coarse to fine sand, trace coarse to fine gravel, trace cobbles, trace boulders
10'				
20'			well screen	
30'				
40'				

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RING LOG

Well No 8 Application No. _____ Permit No. FR-73-8864
Date Drilled Sept. 20, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon co., U.S.A. Address P.O. BOx 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 29'

Casing:
Type PVC Diameter 4" Length 21'

Screen:
Type PVC Slot .020 Diameter 4" Length 10'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
10'			well screen	0'-14' Brown clayey silt, little coarse to fine gravel, trace cobbles, trace boulders
20'				14'-25' Gray limestone
30'				25'-29' Cavern Note: Odor, much water
40'				

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BORING LOG

Well No 9 Application No _____ Permit No FR-73-8865
Date Drilled Sept. 20, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 23'

Casing:
Type PVC Diameter 4" Length 15'

Screen:
Type PVC Slot .020 Diameter 4" Length 10'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
10'			well screen	0'-23' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles, trace boulders. Rock at 22'6", water on top of rock Note: Odor at 6'
20'				
30'				

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BORING LOG

Well No. 10 Application No. _____ Permit No. FR-73-8866

Date Drilled Sept. 20, 1983 County Frederick Use monitor

Location Rt. 15, Thurmont, MD

Owner Exxon Co., U.S.A. Address P.O. BOX 5197, Baltimore, MD 21224

Drilling Method air rotary Sampling Method cuttings

Hole Diameter 6.75" Total Depth 31'

Casing:

Type PVC Diameter 4" Length 16'

Screen:

Type PVC Slot .020 Diameter 4" Length 15'

Gravel Pack Size #1 Casing Seal ~~bentonite~~

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-4' Gray medium to fine sand and silt
				4'-31' Brown clayey silt, little coarse to fine sand, fine gravel, trace cobbles, trace boulders
				27'-31' soft and moist
				note: gas odor
10'				
				20 slot well screen
20'				
30'				
40'				

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BORING LOG

Well No. 11 Application No. _____ Permit No. FR-73-8867
Date Drilled Sept. 21, 198 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 31'

Casing:
Type PVC Diameter 4" Length 16'

Screen:
Type PVC Slot .020 Diameter 4" Length 15'
Gravel Pack Size #1 Casing Seal Bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-4' Gray medium to fine sand, little silt
				4'-31' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles, trace boulders
				20'-31' soft note: odor
10'				
20'			20 slot well screen	
30'				
40'				

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BORING LOG

Well No. 12 Application No. _____ Permit No. FR-73-8868
Date Drilled Sept. 21, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 32'

Casing:
Type PVC Diameter 4" Length 17

Screen:
Type PVC Slot .020 Diameter 4" Length 15
Gravel Pack Size #1 Casing Seal ~~bentonite~~
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-4' Gray medium to fine sand, little silt note: odor
				4'-32' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel no soft spots clean at bottom
10'				
20'			20 slot well screen	
30'				
40'				

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No. 13 Application No. _____ Permit No. FR-73-8869
Date Drilled Sept. 21, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., Baltimore, MD Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 31'

Casing:
Type PVC Diameter 4" Length 18'

Screen:
Type PVC Slot .020 Diameter 4" Length 15'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
10'			well screen	0'-31' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel 17-31' soft 27-31' gas, blew water, very soft
20'				
30'				
40'				

Handex of Maryland, Inc., 360 Morgan Road P.O Box K Odenton Maryland 21113-0369 (301) 674-3100

FR-73-8869

BORING LOG

Well No 13A Application No _____ Permit No Same
Date Drilled 7/25/90 County Frederick Use monitoring
Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland
Owner Exxon Company, U.S.A. Address Houston, TX
Drilling Method air rotary Sampling Method _____
Hole Diameter 6.88" Total Depth 40'

Casing:
Type PVC Schedule 40 Diameter 4" Length 5'

Screen:
Type PVC Schedule 40 Slot .020" Diameter 4" Length 35'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	1'-6' Black fill
				6'-10' Light brown silt and sand
10'				10'-11' Hard sandstone
				11'-13' Tan silt and clay
				13'-17' Boulder
				17'-40' Brown silts with some gravel
20'			Screen	
30'				
40'				Logged By: B. Christian

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD. 21054 (301) 923-2990

BORING LOG

Well No. 14 Application No. _____ Permit No. FR-73-8870
Date Drilled Sept. 22, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. BOx 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 35'

Casing:
Type PVC Diameter 4" Length 20'

Screen:
Type PVC Slot 020 Diameter 4" Length 15'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-16' Brown clayey silt, little coarse to fine gravel
10'				
				16'-19' soft, trace cobbles and boulders
				19'-35' Rock gray limestone slight odor
20'			20 slot well screen	
30'				

Handex of Maryland, Inc., 360 Morgan Road P.O. Box K Odenton, Maryland 21113-0369 (301) 674-3100

BORING LOG

Well No. 14A Application No _____ Permit No. FR-73-8870
Date Drilled 7/25/90 County Frederick Use monitoring
Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland
Owner Exxon Company, U.S.A. Address Houston, TX
Drilling Method air rotary Sampling Method _____ Total Depth 35'
Hole Diameter 6.88"

Casing:
Type PVC Schedule 40 Diameter 4" Length 5'

Screen:
Type PVC Schedule 40 Slot .020" Diameter 4" Length 30'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-6" Asphalt and gravel 6"-16' Brown clayey silt, little coarse to fine gravel
10'				
				16'-19' Soft, trace cobbles and boulders
20'			Screen	19'-35' Rock gray limestone, slight odor
30'				
40'				Logged By: B. Christian

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HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD. 21054 (301) 923-2990

G LOG

Application No. _____ Permit No. FR-73-8871

15 County Frederick Use monitor

e Drilled Sept. 22, 1983

ation Rt. 15, Thurmont, MD

Exxon Co. U.S.A. Address P.O. BOX 5197, Baltimore, MD 21224

ling Method air rotary Sampling Method cuttings

le Diameter 6.75" Total Depth 27'

g: Diameter 4" Length 19'

pe PVC

reen: Slot .020 Diameter 4" Length 10'

e PVC Casing Seal bentonite

Pack Size #1 Geologic Formation _____

tic Water Level _____

RFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-17' Brown clayey silt, little coarse to fine sand, little cobbles, trace boulders
10'				
				17'-25' Red brown silty clay, trace coarse to fin sand, trace fine gravel
20'			20 slot well screen	
				25'-27' Rock Clean
30'				

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD. 21054 (301) 923-2990

BORING LOG

Well No. 16 Application No. _____ Permit No. FR-73-8872
Date Drilled Sept. 22, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 33'

Casing:
Type PVC Diameter 4" Length 18'

Screen:
Type PVC Slot .020 Diameter 4" Length 15'
Gravel Pack Size #1 Casing Seal ~~bentonite~~
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-6" Asphalt and gravel
				6"-33' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles, trace boulders no soft spots clean
10'				
20'				
30'			well screen	
40'				

HANDEX CORP., P.O. Box 261, 773 Annapolis Road, Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No. 17 Application No. _____ Permit No. FR-73-8873
Date Drilled Sept. 22, 1983 County Frederick Use monitor
Location Rt. 5, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. Box 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 15'

Casing:
Type PVC Diameter 4" Length 5'

Screen:
Type PVC Slot .020 Diameter 4" Length 10'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-1' Asphalt and gravel
				1'-15' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles, trace boulders
10'			20 slot well screen	
20'				15'-18' Brown coarse to fine gravel, little silt note: blew water pull back to 15'
30'				
40'				

HANDEX CORP., P.O Box 261, 773 Annapolis Road, Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No. 18 Application No. _____ Permit No. FR-73-8874
Date Drilled Sept. 22, 1983 County Frederick Use monitor
Location Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address P.O. BOx 5197, Baltimore, MD 21224
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6.75" Total Depth 29'

Casing:
Type PVC Diameter 4" Length 16'

Screen:
Type PVC Slot .020 Diameter 4" Length 15'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-15' Brown clayey silt, little coarse to fine sand, little coarse to fine gravel, trace cobbles, trace boulders
10'				
			well screen	15'-22' Gravel coarse to fine, little silt
20'				
				22'-29' Dark brown silt, wet clay soft clean
30'				

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BORING LOG

Permit No. FR-73-8875
Application No. _____
Use monitor
County _____
Date Drilled 10-8-83
Location Ben's Exxon, 143 Frederick Rd., Rt. 15, Thurmont, Md.
Owner Exxon co. U.S.A. Address 1270 Kuhn Rd., Boiling Springs, Pa.
Drilling Method air rotary Sampling Method cuttings Total Depth 35'
Hole Diameter 6-7/8"

Casing: Type PVC Diameter 4" Length 7'

Screen: Type PVC Slot .020 Diameter 4" Length 28'
Gravel Pack Size _____ Casing Seal bentonite
Static Water Level _____ Geologic Formation sedimentary

DEPTH IN FEET BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-1'6" Red brown packed clay and gravel
				1'6"-4' Boulders
				4'-6' Grey-brown sandy silt and medium to coars grain gravel
				6'-8'6" Boulders, some grey-brown clayey silt and red-brown clay
10'				8'-11' Medium to coarse grain gravel, little sedimentary brown sand, some boulders
				11'-14' Boulders
				14'-27' Red-brown sand with medium to coarse grai gravel and boulders Note: Strong gas odor at 19'
20'			20 slot well screen	
30'				27'-29' Boulders
				29'-31' Soft material, very little blowing out
				31'-35' Boulders, nothing blowing out. Note: Very strong gas smell
40'				Note: When breaking off first rod, water gushed out under very high pressure

Handex

HANDEX CORP., P.O. Box 261, 773 Annapolis Road Gambrills MD 21054 (301) 923-2990

BORING LOG

Well No. 20 Application No. _____ Permit No. FR-73-8876
Date Drilled 10-8-83 County _____ Use monitor
Location Ben's Exxon, 143 Frederick Rd., Rt. 15, Thurmont, Md.
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, Pa.
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6-7/8" Total Depth 32'

Casing:
Type PVC Diameter 4" Length 12'

Screen:
Type PVC Slot .020 Diameter 4" Length 20'
Gravel Pack Size _____ Casing Seal bentonite
Static Water Level _____ Geologic Formation ~~sedimentary~~

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-1' Topsoil
				1'-8' Brown sandy silt and medium to coarse grain gravel
				8'-18' Boulders and grey clayey sand, some mediu to coarse grain gravel
				18'-23' Boulders
				23'-32' Fine to medium grain gravel and brown silt, some boulders
10'				
20'				
30'				
40'				

20 slot well screen

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BORING LOG

Well No. 21 Application No. _____ Permit No. FR-73-8877
Date Drilled 10-10-83 County _____ Use monitor
Location 143 Frederick Rd., Rt. 15, Thurmont, Md.
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, Pa.
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 6-7/8" Total Depth 50'

Casing:
Type PVC Diameter 4" Length 12'

Screen:
Type PVC Slot .020 Diameter 4" Length 40'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation sedimentary

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-1' Topsoil
				1'-5' Brown sandy silt and medium to coarse grain gravel
				5'-7' Brown sandy silt, boulders, some gravel
				7'-15' Grey clayey sand, medium grain, and medium to coarse grain gravel
15'				
				15'-17' Grey clayey silt, little medium to coarse grain gravel
				17'-23' Boulders and medium to coarse grain gravel some grey clayey sand
				23'-25' Fine to medium grain gravel and brown silt
				25'-34' Fine to medium brown silt, little boulder
30'				
				34'-36' Boulders and brown silt
				36'-42' Brown clayey silt and gravel
				42'-44' Boulders
45'				
				44'-50' Added 10' rod, went back down and water gushed out boulders and mud
			20 slot well screen	
60'				

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BORING LOG

Well No. 23 Application No. _____ Permit No. FR-73-8879
Date Drilled 10-13-83 County _____ Use _____
Location Ben's Exxon, Rt. 15, Thurmont, MD (150' in easement from trans. pole at
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, (well #5) PA
Drilling Method in hole hammer Sampling Method _____ Total Depth 50'
Hole Diameter 8"

Casing:
Type PVC Diameter 4" Length 11'

Screen:
Type PVC Slot 50 Diameter 4" Length 40'
Gravel Pack Size #1 Casing Seal ~~bentonite~~
Static Water Level 26' Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				Brown clay and boulders, trace gravel 0'-10'
				Brown clay 10'-22'
20'				
				22'-43' Hard Gray limestone (water)
			50 slot well screen	
40'				
				43'-47' Soft brown limestone and sand-(water)
				47'-50' Hard gray limestone-(dry)
60'				
80'				

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BORING LOG

Well No. 24 Application No. _____ Permit No. FR-73-8880
Date Drilled 10-13-83 County _____ Use Ben's Exxon
Location Driveway easement on Mosser Rd. opposite city well #4 Rt. 15, Thurmont MI Address 1270 Kuhn Rd., Boiling Springs, PA
Owner Exxon Co., U.S.A. Sampling Method _____
Drilling Method in hole hammer Total Depth 52'
Hole Diameter 8"

Casing:
Type PVC Diameter 4" Length 11'6"

Screen:
Type PVC Slot _____ Diameter 4" Length 40'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level 22'8" Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
20'			well screen	0'-30' Layers of clay, sand, mud and boulders Trace seepage of water 5'6"
40'				30'-38' Hard gray limestone
60'				38'-52' Water, soft limestone with lenses of sand and gravel
80'				

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BORING LOG

Well No. 25 Application No. _____ Permit No. FR-73-8881

Date Drilled 10-14-83 County _____ Use _____

Location Ben's Exxon, Rt. 15, Thurmont, MD(1st well in easement behind const. yard

Owner Exxon Oil Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, Pa.

Drilling Method in hole hammer Sampling Method _____

Hole Diameter 8" Total Depth 68'

Casing:

Type None Diameter _____ Length _____

Screen:

Type None Slot _____ Diameter _____ Length _____

Gravel Pack Size None Casing Seal None

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-19' Hard, dry, brown clay and boulders, trace gravel
20'				19'-43' Hard gray limestone
40'				43'-45' Softer brown rock
				45'-63' Hard gray limestone
60'				63'-68' Softer brown rock
80'				

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BORING LOG

Well No. 25 Application No _____ Permit No. FR-73-8881
Date Drilled 10-14-83 County _____ Use _____
Location Ben's Exxon, Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA
Drilling Method in hole hammer Sampling Method _____ Total Depth 155'
Hole Diameter 8"

Casing:
Type None Diameter _____ Length _____

Screen:
Type None Slot _____ Diameter _____ Length _____
Gravel Pack Size None Casing Seal _____
Static Water Level None Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
40'				
80'				68'-110' Hard Gray limestone Note: Let hole sit for 20 Minutes at 110', No water
120'				110'-123' Gray limeatone, small amount of water between 110'-123'
160'				123'-155' Hard dry limestone, gray

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BORING LOG

Well No. 26 Application No. _____ Permit No. FR-73-8882

Date Drilled 10-15-83 County _____ Use monitor

Location Ben's Exxon, Rt. 15, Thurmont, MD (in wood easement ½ between creek and

Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd. Boiling Springs, Pa. #5)

Drilling Method in hole hammer Sampling Method _____

Hole Diameter 8" Total Depth 51'

Casing:

Type PVC Diameter 4" Length 11'

Screen:

Type PVC Slot 50 Diameter 4" Length 40'

Gravel Pack Size #1 Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-18' Brown clay and cobbles
20'				18'-28' Brown clay, some gravel
40'			50 slot well screen	28'-51' Hard gray limestone
60'				

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BORING LOG

Well No. 27 Application No. _____ Permit No. FR-73-8883

Date Drilled 10-15-83 County _____ Use monitor

Location Ben's Exxon, Rt. 15, Thurmont, MD (midway down power line easement) Address 1270. Kuhn Rd., Boiling Springs, PA 17007

Owner Exxon Co., U.S.A. Sampling Method _____

Drilling Method in hole hammer Total Depth 50'

Hole Diameter 8"

Casing:

Type P.V.C. Diameter 4" Length 10'

Screen:

Type P.V.C. Slot 50 Diameter 4" Length 40'

Gravel Pack Size #1 Casing Seal _____

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-27' Brown clay and cobbles, mud
				Note: water and strong odor at 24'
20'				
			50 slot well screen	
40'				27'-50' Hard gray limestone
60'				

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RING LOG

Permit No. FR-73-8884

No. 28 Application No. Use monitor

Date Drilled 10-16-83 County

ation Ben's Exxon, Rt. 15, Thurmont, MD (next to creek in power line easement

ner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA 17007

Drilling Method in hole hammer Sampling Method Total Depth 50'

Hole Diameter 6"

sing:

Type PVC Diameter 4" Length 0'

Screen:

Type PVC Slot 50 Diameter 4" Length 33'

vel Pack Size #1 Casing Seal bentonite

Static Water Level Geologic Formation

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-30' Brown wet clay and gravel and cobbles note: some water at 28' Note: strong odor at 30'
20'				
			50 slot well screen	30'-33' Hard limestone 33'-37' Gravel, some clay 37'-50' Gravel, some clay, lens of limestone Note: well blew in to 33'
40'				
60'				

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BORING LOG

Well No. 28 Application No. (redrilled) Permit No. FR-73-8884
Date Drilled Aug 18-19, 1987 County Frederick Use monitor
Location Exxon S/S, 143 Frederick Road, Thurmont, Maryland
Owner Exxon Company, USA Address Houston, Texas
Drilling Method air rotary Sampling Method cuttings Total Depth 56'6"
Hole Diameter 12" to 20', 10" to 27', 8" to 41'; 6" to 56'

Casing: Type PVC Flush Joint Diameter 4" Length 10'

Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 50'
Gravel Pack Size 1/8" pea gravel Casing Seal granular bentonite 2'6"-4'
Static Water Level 12' Geologic Formation

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-27' LIMESTONE and quartzite GRAVEL, cobbles and boulders, brown sandy and clayey matrix poor return of drill cuttings, caving at 20' and 24' Wet at 12', slight gasoline odor
20'				
			Well Screen	27'-30' LIMESTONE, (hard) 30'-32'6" Brown LIMESTONE with solution channels, increased water yield, increased gasoline odor 32'6"-36' Fractured LIMESTONE
40'				36'-56' Grey LIMESTONE (hard) 41'-54' Drilled within previous borehold
60'				NOTE: Well yield estimated greater than 30gpm Well extends 3'6" above grade
80'				

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BORING LOG

Well No. 29 Application No. _____ Permit No. FR-73-8885

Date Drilled 10-16-83 County _____ Use _____

Location Ben's Exxon, Rt. 15, Thurmont, MD (in wooded easement closest to #5)

Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA 17007

Drilling Method in hole hammer Sampling Method _____ Total Depth 50'

Hole Diameter 6"

Casing:

Type PVC Diameter _____ Length 0'

Screen:

Type PVC Slot 50 Diameter 4" Length 4'

Gravel Pack Size _____ Casing Seal _____

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-20' Brown clay and cobbles, some gravel
20'				20'-30' Brown clay, wet
				30'-33' Fractured limestone, water
				33'-40' Opening
40'				40'-48' Clay and gravel
				48'-50' Limestone
60'				Note: Well blew in to 40' while setting casing

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BORING LOG

Well No. 30 Application No. _____ Permit No. FR-73-8886
Date Drilled 10-16-83 County _____ Use _____
Location Ben's Exxon, Rt. 15, Thurmont, MD (in sewer easement)
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA 17007
Drilling Method in hole hammer Sampling Method _____ Total Depth 50'
Hole Diameter 6"

Casing:
Type PVC Diameter 4" Length 10'

Screen:
Type PVC Slot 50 Diameter 4" Length 40'
Gravel Pack Size #1 Casing Seal ~~bentonite~~
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-20' Dark brown clay and cobbles, some water
20'			50 slot well screen	20'-38' Hard limestone
				38'-44' Soft rock, some gravel, water opening
40'				44'-50' Hard limestone
60'				

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BORING LOG

Well No. 31 Application No. _____ Permit No. FR-73-8887

Date Drilled 10-16-83 County _____ Use monitor

Location Ben's Exxon, RT. 15, Thurmont, MD (in yard next to well #18)

Owner Exxon Co. U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA

Drilling Method in hole hammer Sampling Method _____ Total Depth 56'

Hole Diameter 6"

Casing:

Type PVC Diameter 4' Length 16'

Screen:

Type PVC Slot 50 Diameter 4' Length 40'

Gravel Pack Size #1 Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-20' Brown clay and gravel
20'				20'-26' Gravel bed
				26'-47' Gray limestone
			50 slot well screen	47'-49' Soft clay, water
40'				49'-56' Limestone
60'				

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BORING LOG

Well No. 32 Application No. _____ Permit No. FR-73-8888
Date Drilled 10-16-83 County _____ Use monitor
Location Ben's Exxon, Rt. 15, Thurmont, MD
Owner Exxon CO., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, PA
Drilling Method in hole hammer Sampling Method _____ Total Depth 50'
Hole Diameter 6"

Casing:
Type PVC Diameter 4" Length 12'

Screen:
Type PVC Slot 50 Diameter 4" Length 40'
Gravel Pack Size #1 Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-15' Brown clay and cobbles
				15'-22' Brown clay, some gravel
20'				
				22'-50' Limestone, little water
40'				
			50 slot well screen	
60'				

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BORING LOG

Well No. 34 Application No. _____ Permit No. FR-81-1600

Date Drilled 8-6-84 County Frederick Use monitor

Location Ben's Exxon, Thurmont, Md.

Owner Exxon Address 1270 Kuhn Rd. R.D. 2, Boiling Springs, Pa.

Drilling Method Air Rotary Sampling Method from cuttings

Hole Diameter 7 inches Total Depth 25 ft.

Casing:
Type PVC (no glue) Diameter 4" Length 5 ft.

Screen:
Type PVC (no glue) Slot .020 Diameter 4" Length 20 ft.

Gravel Pack Size #1 Casing Seal BENTONITE

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-8" Dark brown silty Top Soil
				8"-11' Light brown coarse to fine (+) SAND, little (-) silt, some medium to fine quartz gravel, shale fragments and limestone fragments, Fill?
10			well screen	11'-24' Brown Clayey SILT trace(-), medium to fine Sand, little fine angular limestone fragments, soft, occassional limestone cobbles, cuttings wet 17' to 18' boulder
20				24'-25' Gray and light gray fractured limestone, hard bottom of screen set at 25', rapid recovery

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BORING LOG

Permit No. FR-81-1601

Well No. 35 Application No. _____ Use monitor

Date Drilled 8-6-84 County Frederick

Location Ben's Exxon, Thurmont, Md.

Owner Exxon Address 1270 Kuhn Rd. R.D. 2, Boiling Springs, Pa.

Drilling Method Air Rotary/Down hole ham. Sampling Method from cuttings

Hole Diameter 7 inches Total Depth 30 ft.

Casing: Type PVC (no glue) Diameter 4 in. Length 12 ft.

Screen: Type PVC (no glue) Slot .020 Diameter 4 in. Length 20 ft.

Gravel Pack Size #1 Casing Seal BENTONITE

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN (2 ft)	IDENTIFICATION OF SOILS/REMARKS
				0-8' Light brown Clayey SILT trace, fine limestone and quartz fragments
				8'-16' Dark brown Silty CLAY trace(-), limestone fragments, soft, cuttings moist to wet
10				
				16'-30' Light gray and gray fractured limestone, hard
20				
				bottom of screen set at 30' moderate recovery rate
30				

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BORING LOG

Well No. 36 Application No. _____ Permit No. FR-81-1602

Date Drilled 8-7-84 County Frederick Use monitor

Location Ben's Exxon, Thurmont, Md. Address 1270 Kuhn Rd. R.D. 2, Boiling Springs, Pa.

Owner Exxon Sampling Method - from cuttings

Drilling Method Air Rotary Total Depth 18 ft

Hole Diameter 7 inches

Casing: Type PVC (no glue) Diameter 4 in. Length 5 ft.

Screen: Type PVC (no glue) Slot .020 Diameter 4 in. Length 15 ft.

Gravel Pack Size #1 Casing Seal BENTONITE

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-8' Light brown and brown clayey SILT little to trace, coarse to fine Sand, some angular limestone fragments, trace quartz gravel and sandstone fragments, occassional limestone cobbles, cuttings wet at 11'
10			well screen	
20				bottom of screen set at 18', rapid recovery

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BORING LOG

Well No. .37 Application No. _____ Permit No. FR-81-1603

Date Drilled 8-7-84 County Frederick Use monitor

Location Ben's Exxon, Thurmont, Md.

Owner Exxon Address 1270 Kuhn Rd. R.D. 2, Boiling Springs, Pa.

Drilling Method Air Rotary Sampling Method from cuttings

Hole Diameter 7 inches Total Depth 25 ft.

Casing: Type PVC (no glue) Diameter 4 in. Length 7 ft.

Screen: Type PVC (no glue) Slot .020 Diameter 4 in. Length 20 ft.

Gravel Pack Size #1 Casing Seal BENTONITE

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-17' Light brown Clayey SILT little to trace, coarse to fine Sand, some angular limestone fragments, trace to little quartz gravel and sandstone fragments, occassional limestone cobbles, cuttings wet at 10', possible very slight gasoline odor
10			well screen	
				17'-25' Dark brown Silty CLAY trace(-), limestone fragments, soft
20				bottom of screen set at 25', rapid recovery

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RING LOG

ll No. 38 Application No _____ Permit No _____

Date Drilled 8-7-84 County Frederick Use monitor

cation Ben's Exxon, Thurmont, Md.

ner Exxon Address 1270 Kuhn Rd, R.D. 2, Boiling Springs, Pa.

Drilling Method Air Rotary Sampling Method from cuttings

Hole Diameter 7 inches Total Depth 25 ft.

sing:

Type PVC (no glue) Diameter 4 in Length 7 ft.

Screen:

Type PVC (no glue) Slot .020 Diameter 4 in Length 20 ft.

avel Pack Size #1 Casing Seal BENTONITE

Static Water Level _____ Geologic Formation _____

EPTH ELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-14' Light brown and brown Clayey Silt and angular limestone fragments, trace coarse to fine Sand, trace to little quartz gravel and sandstone fragments, occassional limestone cobbles, cuttings wet at 9'
10				
				14'-23' Dark brown Silty CLAY trace(-), limestone fragments, soft
20				
				23'-25' Gray and light gray limestone, hard
				bottom of screen set at 25', rapid recovery

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ORING LOG 40 Application No. _____ Permit No. FR-81-1984

No. _____ County Frederick Use monitor

Drilled 2-14-85 Address 1270 Kuhn Rd., Boiling Springs, PA 17007

ocation Ben's Exxon, Rt. 15, Thurmont, Maryland Sampling Method split spoon

er Exxon Total Depth 21'

ng Method Air Rotary

ole Diameter 7"

asing: Diameter 4" Length 8'

ype PVC

reen: Slot .020 Diameter 4" Length 15'

Type PVC Casing Seal Bentonite & Portland

el Pack Size #1 Geologic Formation _____

c Water Level _____

DEPTH W. ACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-6" Topsoil 6"-21' multi-colored washed, rounded medium to fine gravel, little coarse to fine sand
			well screen	

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RING LOG

Application No. _____ Permit No. FR-81-1985

Well No 41 County Frederick Use monitor

Date Drilled 2-14-85 Location Ben's Exxon, Rt. 15, Thurmont, Maryland

Owner Exxon Address 1270 Kuhn Rd., Boiling Springs, PA 17007

Drilling Method Air Rotary Sampling Method split spoon

Hole Diameter 7" Total Depth 25

Casing: Type PVC Diameter 4" Length 5'

Screen: Type PVC Slot .020 Diameter 4" Length 20'

Gravel Pack Size #1 Casing Seal Bentonite & Portland

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-6" topsoil
				6"-10' Dark Brown silty clay, trace medium to fine sand, trace coarse to fine gravel, trace cobbles
10			well screen	10'-23' light Brown clayey silt, trace fine sand
20				

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DRING LOG

Well No. 43 Application No. _____ Permit No. F(2-81-1987

Date Drilled 2-15-85 County Frederick Use monitor

Location Ben's Exxon, Rt. 15, Thurmont, Maryland

Owner Exxon Address 1270 Kuhn Rd., Boiling springs, PA 17007

Drilling Method Air Rotary Sampling Method split spoon

Hole Diameter 7" Total Depth 25'

Casing:

Type PVC Diameter 4" Length 10'

Screen:

Type PVC Slot .020 Diameter 4" Length 15'

Gravel Pack Size #1 Casing Seal Bentonite and Portland

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-6" Topsoil 6"-13' dark Brown silty clay, trace medium to fine sand, trace coarse to fine gravel, trace cobbles
10				
				13'-23' light Brown clayey silt, trace fine sand
25			well screen	

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NG LOG

ell No. 45 Application No. _____ Permit No. FR-81-1989

te Drilled 2-15-85 County Frederick Use monitor

on Ben's Exxon, Rt. 15, Thurmont, Maryland

vner Exxon Address 1270 Kuhn Rd., Boiling springs, PA 17007

illing Method Air Rotary Sampling Method split spoon

Diameter 7" Total Depth 22'

sing:

Type PVC Diameter 4" Length 4'

n:

pe PVC Slot .020 Diameter 4" Length 20'

avel Pack Size #1 Casing Seal Bentonite and Portland

atio Water Level _____ Geologic Formation _____

DEPTH BELOW BEARS	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0-6" topsoil
				6"-14' dark Brown silty clay, trace medium to fine sand, trace coarse to fine gravel, trace cobbles
10			well screen	
				14'-22' Reddish -Brown clayey silt, little fine sand
20				

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BORING LOG

Well No. 46 Application No. _____ Permit No. FR-88-1449

Date Drilled 6/11/90 County Frederick Use monitor

Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland

Owner Exxon Company, U.S.A. Address Houston, TX

Drilling Method air rotary Sampling Method _____

Hole Diameter 6" Total Depth 33'6"

Casing:

Type PVC Schedule 40 Diameter 4" Length 5'

Screen:

Type PVC Schedule 40 Slot .020" Diameter 4" Length 28'6"

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-5" Concrete 5"-8" Stone fill 8"-12' Brown silt, some gravel, organic material, slight product odor 2'-5'
10'				
				12'-15' Light brown silt, some clay, gravel
				15'-18' Light brown silt, some sand, less gravel, less clay, moist at 14', wet at 18'
20'				18'-34'6" Light reddish brown clay, some sand, some gravel (interbedded phyllite and sandstone bedrock)
			Screen	
30'				
40'				

Note: Free product in well upon completion

Logged By: T. Keffer

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BORING LOG

Well No. 47 Application No. _____ Permit No. FR-88-1450
Date Drilled 7/25/90 County Frederick Use monitor
Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland
Owner Exxon Company, U.S.A. Address Houston, TX
Drilling Method air rotary Sampling Method _____ Total Depth 40'
Hole Diameter 6.88"

Casing:
Type PVC Schedule 40 Diameter 4" Length 5'

Screen:
Type PVC Schedule 40 Slot .020" Diameter 4" Length 35'
Gravel Pack Size #1 Morie Casing Seal bentonite & grout
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-4' Olive rock
				4'-13' Brown silty sand and Olive rock fragments
10'				
				13'-20' Brown silt and cobbles, trace boulders
20'			Screen	20'-26' Hard Limestone
				26'-34' Hard Limestone with fractures
30'				
				34'-40' Hard Limestone
40'				Logged By: B. Christian

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ING LOG

No. 48 Application No _____ Permit No FR-88-1451

Date Drilled 7/25/90 County Frederick Use monitor

Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland

Owner Exxon Company, U.S.A. Address Houston, TX

Drilling Method air rotary Sampling Method _____

Hole Diameter 6.88" Total Depth 40'6"

ing: Type PVC Schedule 40 Diameter 4" Length 5'

Screen: Type PVC Schedule 40 Slot .020" Diameter 4" Length 35'6"

Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

TH OW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN		IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-1'	Concrete and fill
				1'-5'	Black silt with trace gravel
				5'-8'	Cobbles and brown silt
				8'-9'	Brown clay with silt
				9'-10'	Brown silt and clay with gravel
10'				10'-20'	Light brown silt with gravel
20'			Screen	20'-22'	Red Clay
				22'-40'	Hard black limestone, no fractures
30'					
40'					

Logged By: B. Christian

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RING LOG

No 49 Application No. _____ Permit No. FR-88-1453

Date Drilled 7/30/90 County Frederick Use monitor

Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland

Driller Exxon Company, U.S.A. Address Houston, TX

Drilling Method air rotary Sampling Method _____ Total Depth 25'

Hole Diameter 6.88"

ing: Type PVC Schedule 40 Diameter 4" Length 5'

Screen: Type PVC Schedule 40 Slot .020" Diameter 4" Length 20'

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

TH OW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-1' Concrete and fill
				1'-20' Light brown silt and clay
10'				
			Screen	
20'				20'-25' Limestone
30'				

Note: Product odor at 22'

Logged By: Brent Christian

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BORING LOG

Well No 50 Application No _____ Permit No _____
Date Drilled 7/31/90 County Frederick Use monitor
Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland
Owner Exxon Company, U.S.A. Address Houston, TX
Drilling Method air rotary Sampling Method _____
Hole Diameter 6.88" Total Depth 28'

Casing:
Type PVC Schedule 40 Diameter 4" Length 4'

Screen:
Type PVC Schedule 40 Slot .020" Diameter 4" Length 24'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-1' Concrete and fill
				1'-5' Brown silt and clay with Gravel
				5'-12' Light gray clay and silt
10'				
				12'-13' Light gray clay and silt with gravel
				13'-14' Cobbles
				14'-15' Gray silty clay with gravel
			Screen	15'-17' Boulder
				17'-20' Red silty clay
20'				20'-35' Cobbles and red silt
30'				
40'				

Logged By: Brent Christian

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BORING LOG

Well No. 51 Application No _____ Permit No. FR-88-1452
Date Drilled 8/01/90 County Frederick Use monitor
Location Exxon Station, 143 Frederick Rd. Thurmont, Maryland
Owner Exxon Company, U.S.A. Address Houston, TX
Drilling Method air rotary Sampling Method _____
Hole Diameter 6.88" Total Depth 24'

Casing:
Type PVC Schedule 40 Diameter 4" Length 4'

Screen:
Type PVC Schedule 40 Slot .020" Diameter 4" Length 20'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-1' Concrete and crushed stone
				1'-3' Light brown silt and clay with gravel
				3'-4' Rust colored clay and silt
			Screen	4'-5' Crushed rock
				5'-6' Brown silt and sand, some gravel
				6'-7' Black silt and clay, no gravel
				7'-8' Olive colored silt and clay
				8'-10' Light brown sand and silt
10'				10'-25' Light brown silt, small amount of gravel
20'				
				25'-30' Cobbles
30'				

Note: Well bridged to 24'

Logged By: B. Christian

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BORING LOG

Well No. 1 Application No. _____ Permit No. FR-81-5042

Date Drilled 06-3-87 County Frederick Use vent

Location 143 Frederick Road, Thurmont, Md.

Owner Exxon Company, USA Address Houston, Texas

Drilling Method Air Rotary Sampling Method cuttings Total Depth 13'6"

Hole Diameter 8-5/8"

Casing: Type PVC Flush Joint Diameter 4" Length 2'

Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 10'

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0"-7" Concrete
				7"-3'5" Medium grey to dark grey SILT and coarse to medium GRAVEL
				3'5"-12' Red brown silty CLAY, some fine sand
5'				
10'			Well Screen	
				12'-13'6" Dark grey to medium grey LIMESTONE
15'				NOTE: Well set 1'6" below grade
20'				

HANDEX CORP., 360 Morgan Road P O Box 522 Odenton, Maryland 21113 (301) 674-3100

BORING LOG

Well No 2 Application No. _____ Permit No. FR-81-5043
Date Drilled 06-3-87 County Frederick Use vent
Location 143 Frederick Road, Thurmont, Md.
Owner Exxon Company, USA Address Houston, Texas
Drilling Method Air Rotary Sampling Method cuttings
Hole Diameter 8-5/8" Total Depth 13'6"

Casing:
Type PVC Flush Joint Diameter 4" Length 2'

Screen:
Type PVC Flush Joint Slot 20 Diameter 4" Length 10'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-7" Concrete
				7"-10' Dark grey to medium grey SILT, some medium gravel
5'				
			Well Screen	10'-12' Red to redbrown silty CLAY
10'				
				12'-13'6" Dark grey to medium grey LIMESTONE
15'				
				NOTE: Well set 1'6" below grade
20'				

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RING LOG

Permit No. FR-81-5044

Well No. 3 Application No. _____ Use vent

Date Drilled 06-3-87 County Frederick

Location 143 Frederick Road, Thurmont, Md.

Owner Exxon Company, USA Address Houston, Texas

Drilling Method Air Rotary Sampling Method cuttings

Hole Diameter 8-5/8" Total Depth 13'6"

Casing: Type PVC Flush Joint Diameter 4" Length 2'

Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 10'

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-6" Concrete 6"-5' Dark grey SILT, some medium gravel
5'				5'-13'6" Red to red brown silty CLAY
10'			Well Screen	
15'				

NOTE: Well set 1'6" below grade

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BORING LOG

Well No. 4 Application No. _____ Permit No. FR-81-5045

Date Drilled 06-3-87 County Frederick Use vent

Location 143 Frederick Road, Thurmont, Md.

Owner Exxon Company, USA Address Houston, Texas

Drilling Method Air Rotary Sampling Method cuttings Total Depth 13'6"

Hole Diameter 8-5/8"

Casing:
Type PVC Flush Joint Diameter 4" Length 2'

Screen:
Type PVC Flush Joint Slot 20 Diameter 4" Length 10'

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-3' Tan to redbrown silty CLAY
			Casing	3'-13'6" Red to redbrown silty CLAY
5'				
			Well Screen	NOTE: Well set 1'6" below grade slight odor at 3' strong odor at 10'
10'				
15'				
20'				

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BORING LOG

Well No. 5 Application No. _____ Permit No. FR-81-5046
Date Drilled 06-3-87 County Frederick Use vent
Location 143 Frederick Road, Thurmont, Md.
Owner Exxon Company, USA Address Houston, Texas
Drilling Method Air Rotary Sampling Method cuttings Total Depth 13'6"
Hole Diameter 8-5/8"
Casing: Type PVC Flush Joint Diameter 4" Length 2'
Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 10'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-5" Concrete
				5"-2' Green brown SILT, trace sand
5'				5'-11' Red brown SILT, some very fine sand
10'			Well Screen	11'-13'6" Brown to redbrown SILT, some sand
15'				NOTE: Well set 1'6" below grade

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BORING LOG

Well No. 6 Application No. _____ Permit No. FR-81-5047
Date Drilled 06-3-87 County Frederick Use vent
Location 143 Frederick Road, Thurmont, Md.
Owner Exxon Company, USA Address Houston, Texas
Drilling Method Air Rotary Sampling Method cuttings Total Depth 13'6"
Hole Diameter 8-5/8"

Casing: Type PVC Flush Joint Diameter 4" Length 2'

Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 10'
Gravel Pack Size #1 Morie Casing Seal bentonite
Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-5" Asphalt 5"-4' Medium grey to dark grey SILT, some coarse to medium gravel
5'				4'-13'6" Brown to red brown SILT, trace sand
10'			Well Screen	
15'				NOTE: Well set 1'6" below grade
20'				

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BORING LOG

Well No. 7 Application No. _____ Permit No. FR-81-5048

Date Drilled 06-3-87 County Frederick Use vent

Location 143 Frederick Road, Thurmont, Md. Address Houston, Texas

Owner Exxon Company, USA Sampling Method cuttings

Drilling Method Air Rotary Total Depth 13'6"

Hole Diameter 8-5/8"

Casing: Type PVC Flush Joint Diameter 4" Length 2'

Screen: Type PVC Flush Joint Slot 20 Diameter 4" Length 10'

Gravel Pack Size #1 Morie Casing Seal bentonite

Static Water Level _____ Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-5" Asphalt 5"-5' Medium grey to dark grey SILT, some coarse to medium gravel
5'				5'-11' Brown to redbrown SILT, trace sand
10'			Well Screen	11'-13'6" Red to dark brown SILT
15'				NOTE: Well set 1'6" below grade
20'				

HANDEX CORP., P.O. Box 261, 773 Annapolis Road Gambrills, MD 21054 (301) 923-2990

BORING LOG

Well No 22 Application No. _____ Permit No. FR-73-8878
Date Drilled 10/10-10/11/83 County _____ Use _____
Location Ben's Exxon, Rt. 15, Thurmont, MD
Owner Exxon Co., U.S.A. Address 1270 Kuhn Rd., Boiling Springs, Pa. 17007
Drilling Method air rotary Sampling Method _____ Total Depth _____
Hole Diameter 6"

Casing:
- Type None Diameter _____ Length _____

Screen:
Type None Slot _____ Diameter _____ Length _____
Gravel Pack Size _____ Casing Seal _____
Static Water Level None Geologic Formation _____

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
				0'-20' Brown Clay and cobbles, some gravel
20'				20'-43' Hard Gray Limestone
40'				43'-50' Softer Brown formation
				50'-74' Hard gray limestone, no water
60'				
				Note: Abandoned well
80'				

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BORING LOG

Renamed RW-52

Well No. 28 Application No (redrilled) Permit No. FR-73-8884
Date Drilled Aug 18-19, 1987 County Frederick Use monitor
Location Exxon S/S, 143 Frederick Road, Thurmont, Maryland
Owner Exxon Company, USA Address Houston, Texas
Drilling Method air rotary Sampling Method cuttings
Hole Diameter 12" to 20', 10" to 27', 8" to 41'; 6" to 56' Total Depth 56'6"

Casing:
Type PVC Flush Joint Diameter 4" Length 10'

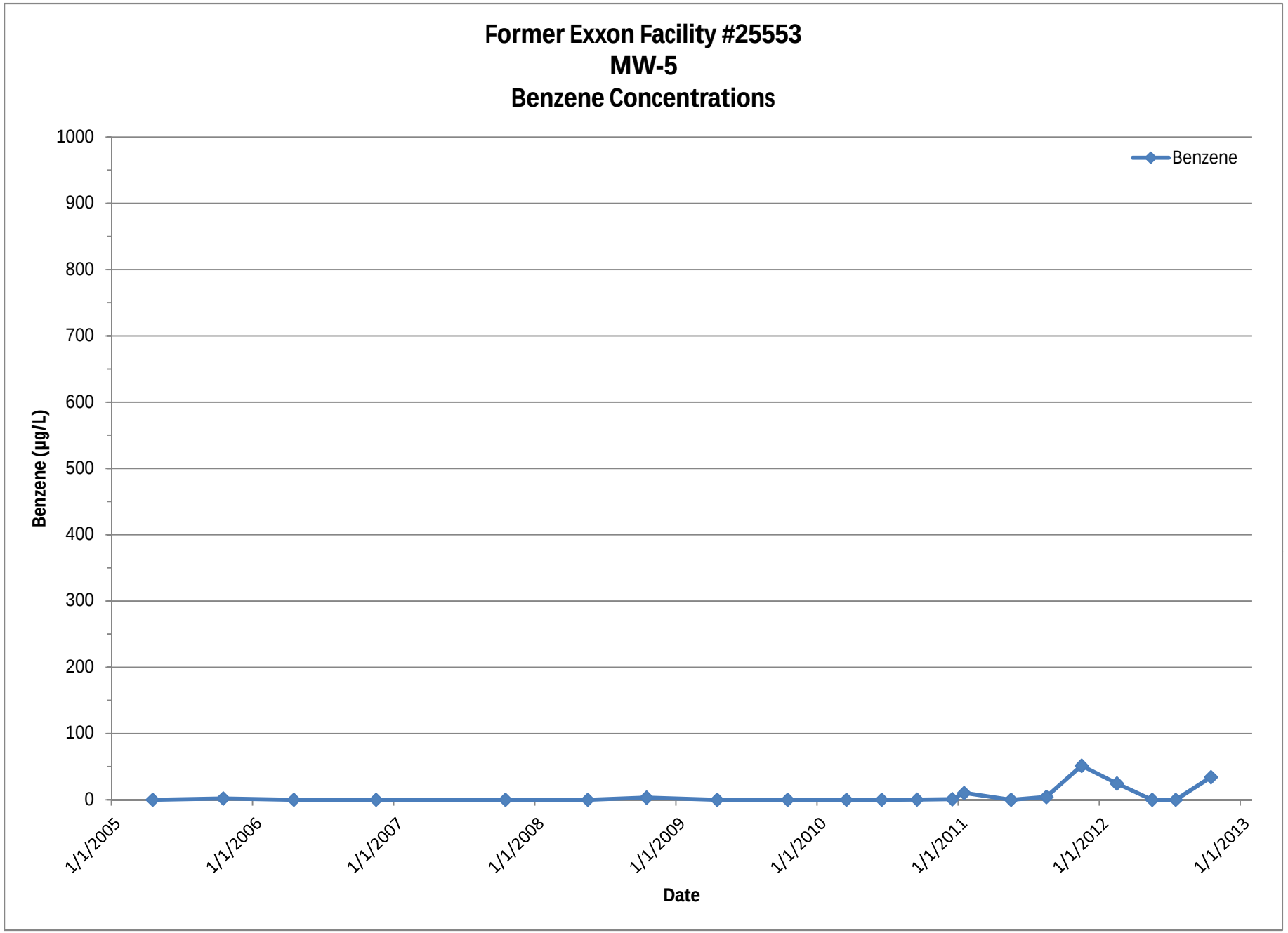
Screen:
Type PVC Flush Joint Slot 20 Diameter 4" Length 50'
Gravel Pack Size 1/8" pea gravel Casing Seal granular bentonite 2'6"-4'
Static Water Level 12' Geologic Formation

DEPTH BELOW SURFACE	SAMPLE NUMBER	BLOWS PER 6" ON SAMPLER	WELL DESIGN	IDENTIFICATION OF SOILS/REMARKS
			Casing	0'-27' LIMESTONE and quartzite GRAVEL, cobbles and boulders, brown sandy and clayey matrix poor return of drill cuttings, caving at 20' and 24' Wet at 12', slight gasoline odor
20'				
			Well Screen	27'-30' LIMESTONE, (hard) 30'-32'6" Brown LIMESTONE with solution channels, increased water yield, increased gasoline odor 32'6"-36' Fractured LIMESTONE
40'				36'-56' Grey LIMESTONE (hard) 41'-54' Drilled within previous borehold
60'				NOTE: Well yield estimated greater than 30gpm Well extends 3'6" above grade
80'				

ARCADIS

Appendix C

Historical Analytical Data Graphs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MW-5
Benzene Concentrations
Benzene
Benzene (µg/L)
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900
800
700
600
500
400
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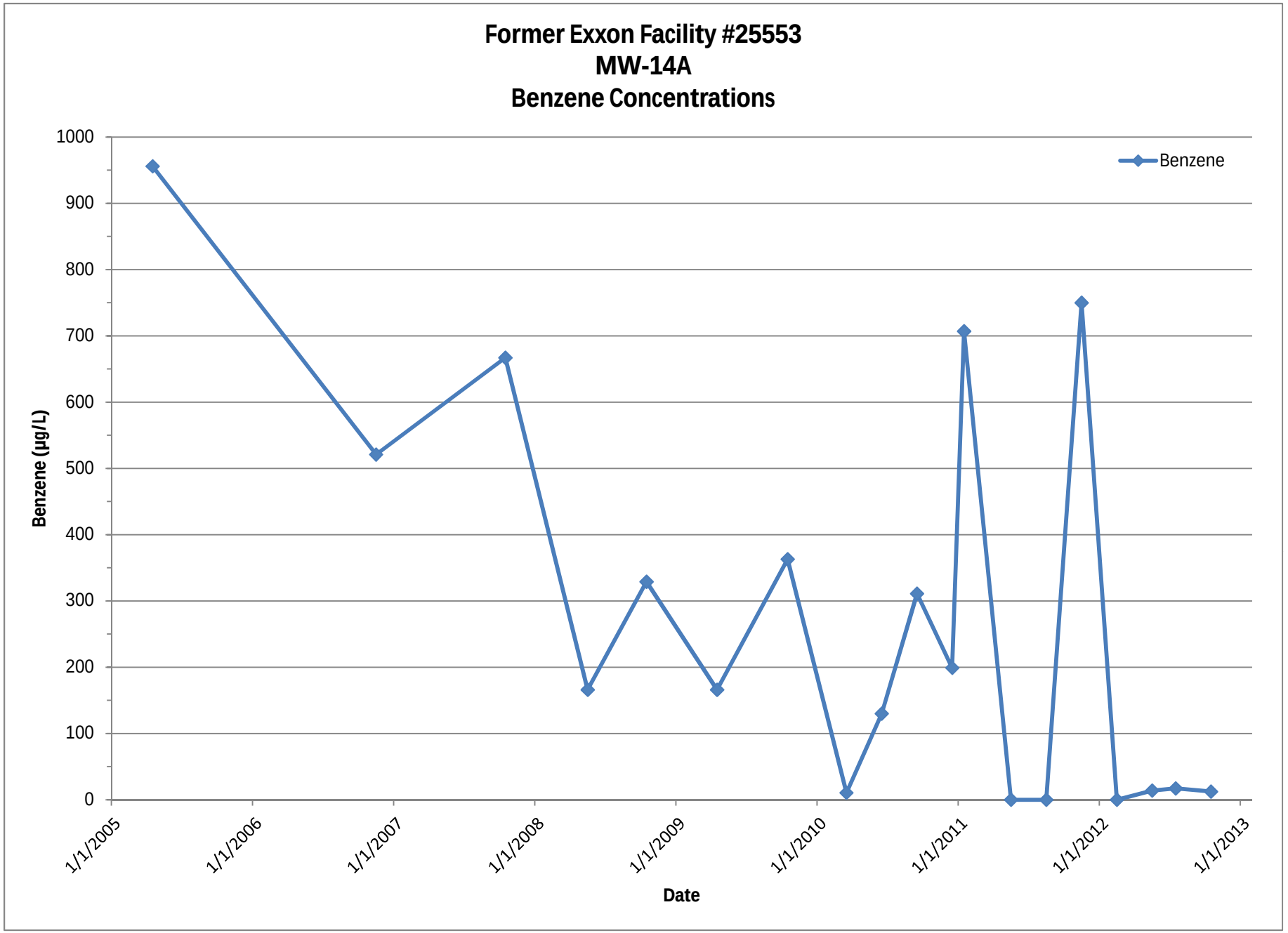
200
100
0
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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MW-14A
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Benzene (µg/L)
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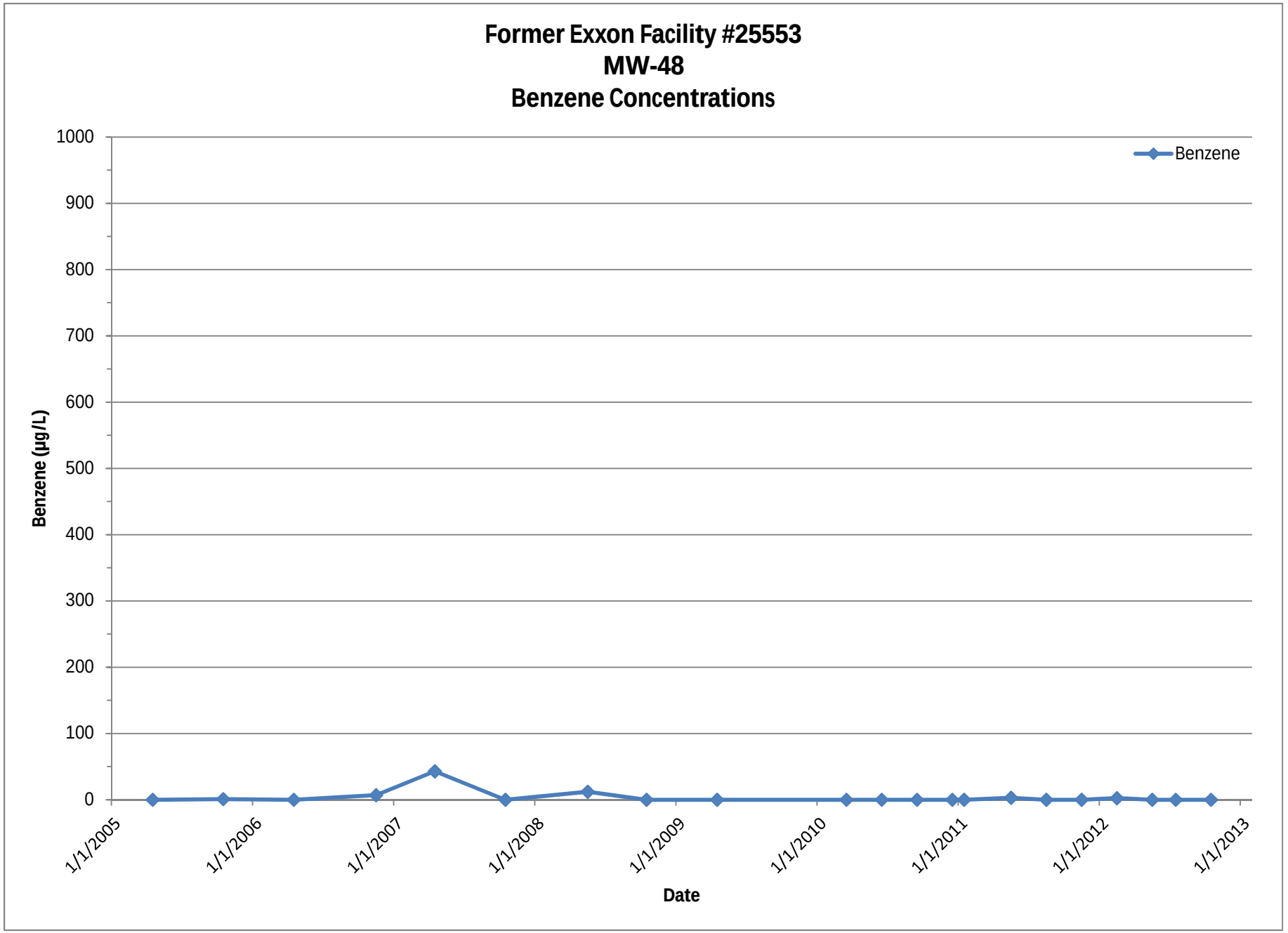
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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800
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600
500
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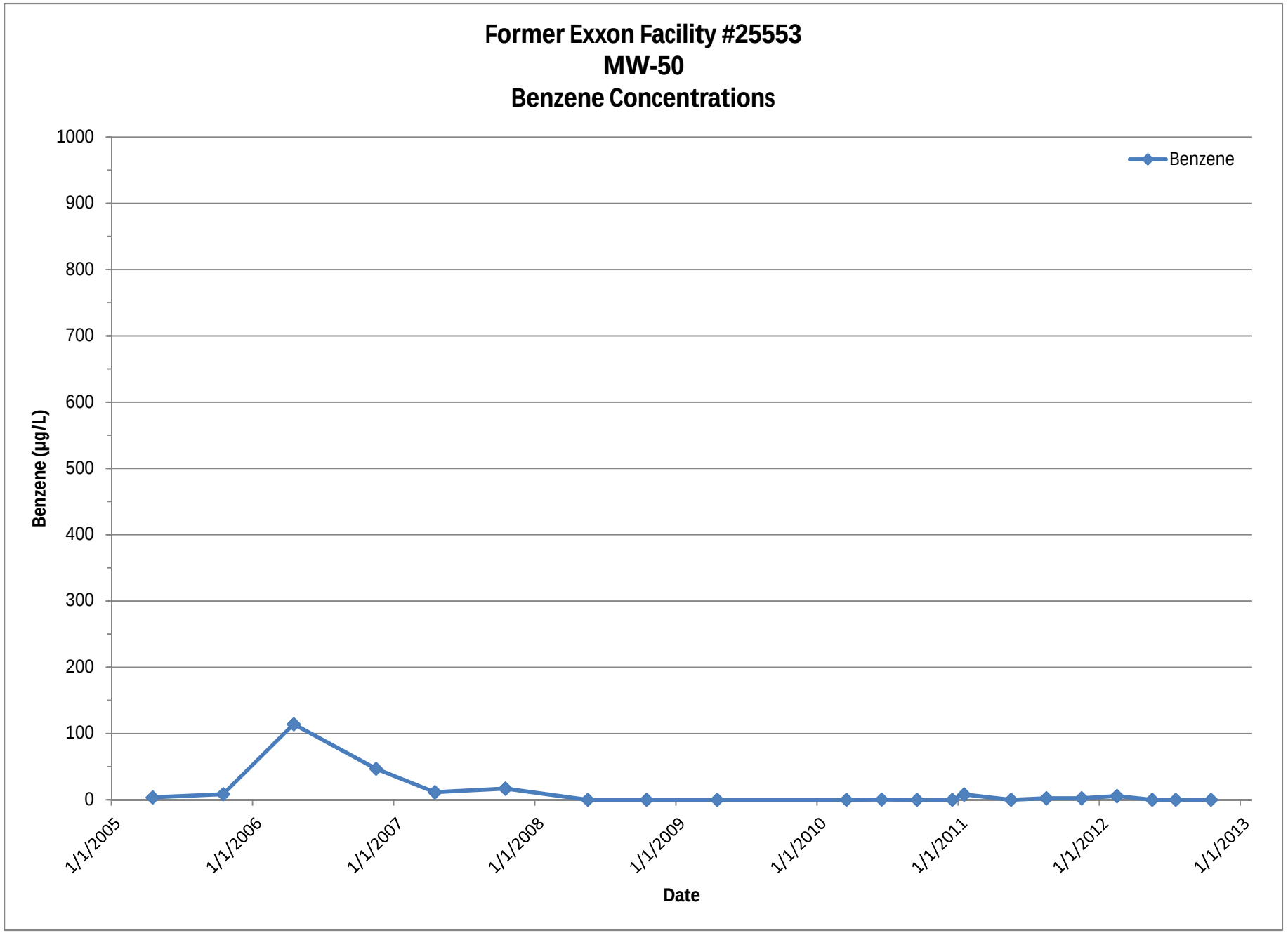
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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Benzene Concentrations
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900
800
700
600
500
400
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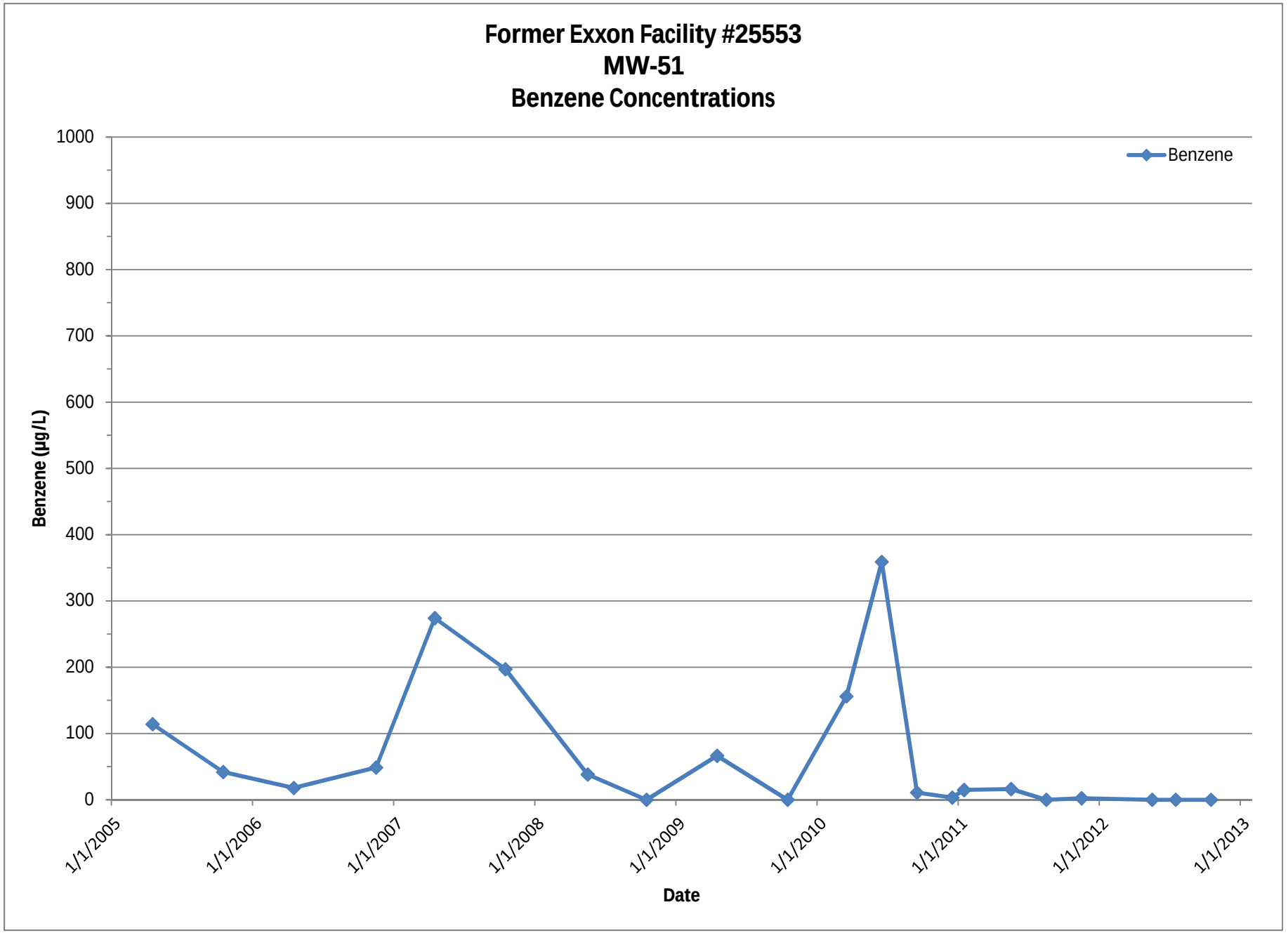
200
100
0
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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Benzene Concentrations
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600
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1/1/2005
1/1/2006
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1/1/2009
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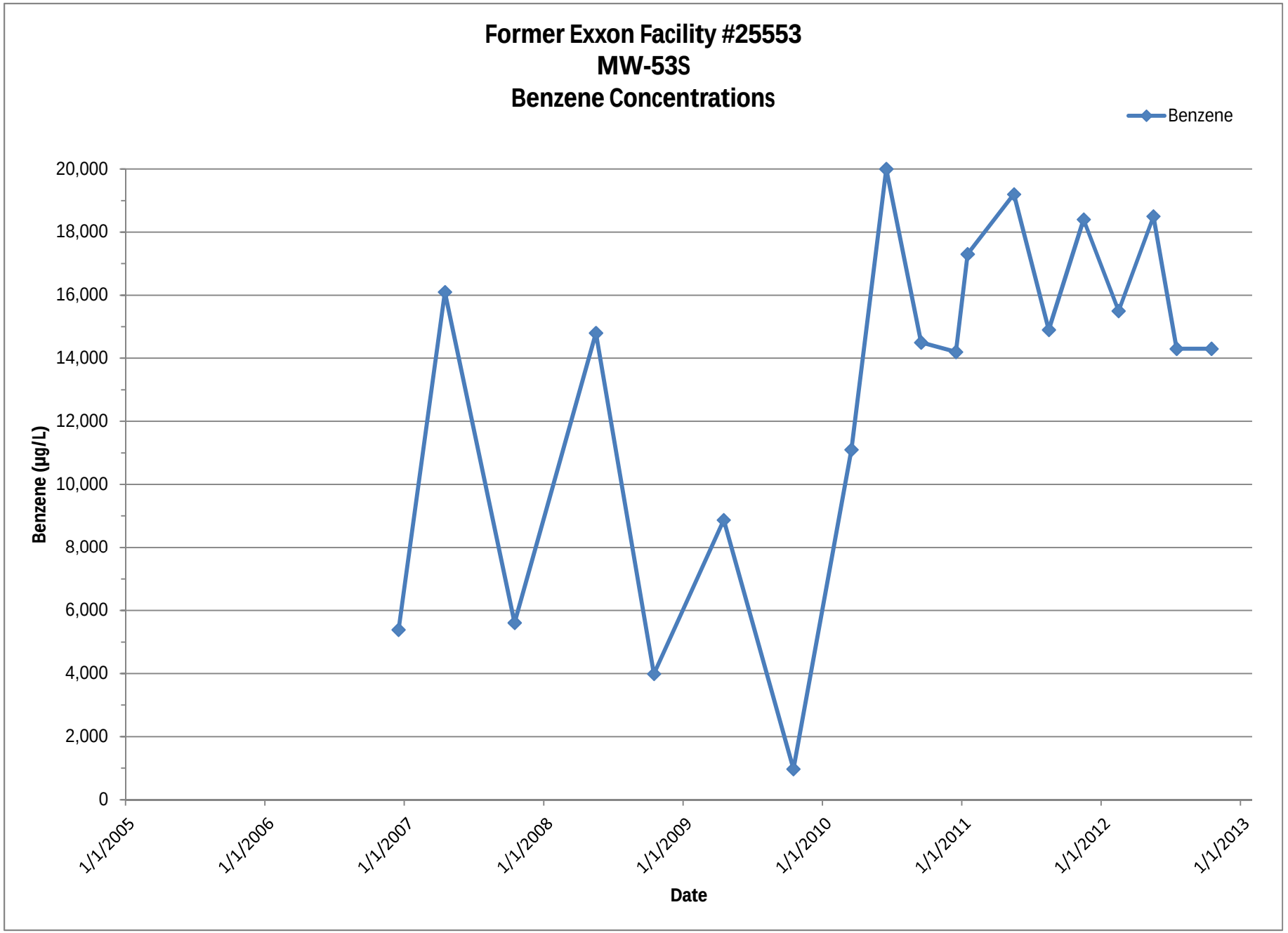
1/1/2013
Date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Benzene Concentrations
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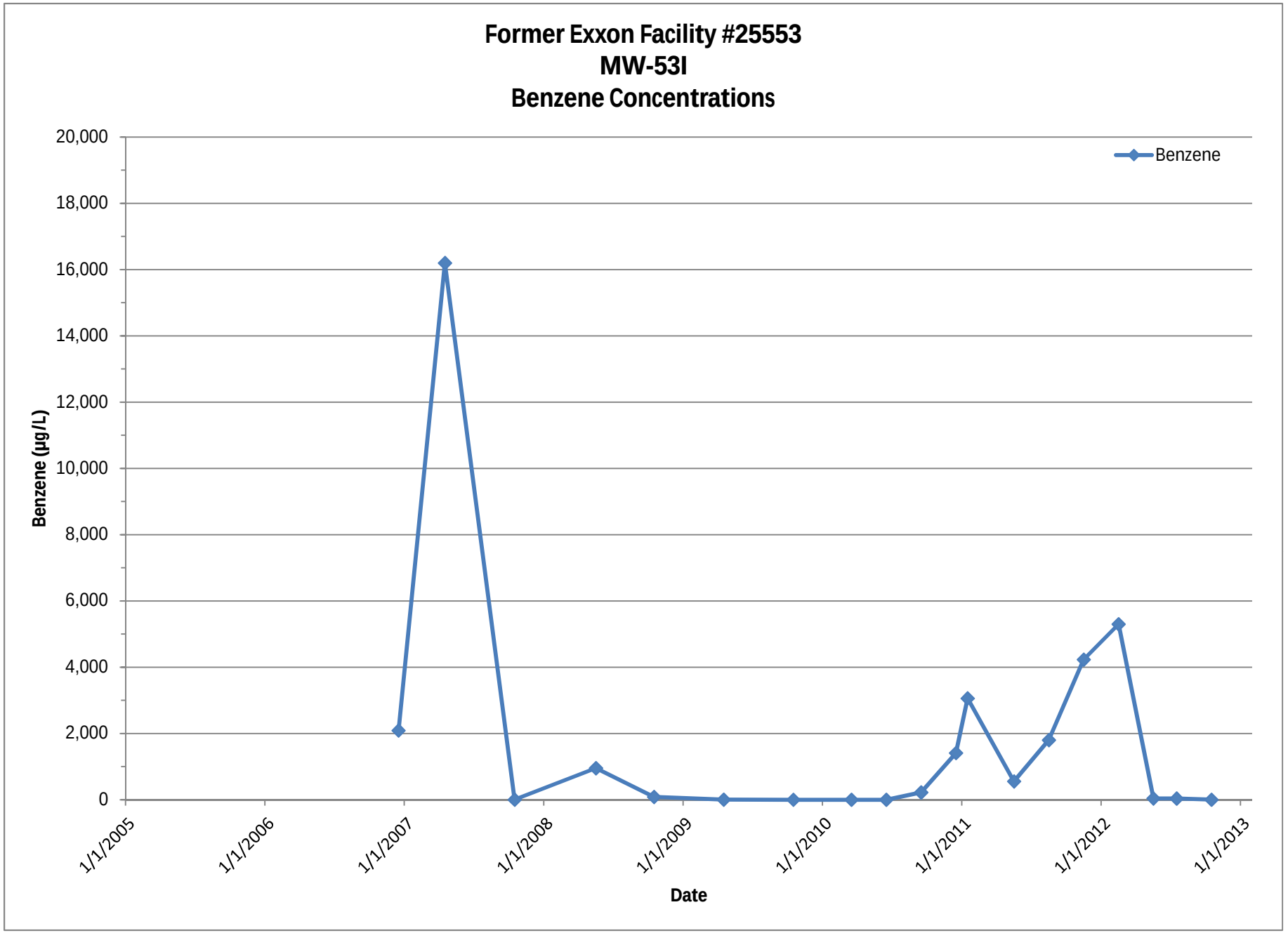
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Benzene (µg/L)
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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Benzene (µg/L)
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1/1/2005
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1/1/2008
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1/1/2010
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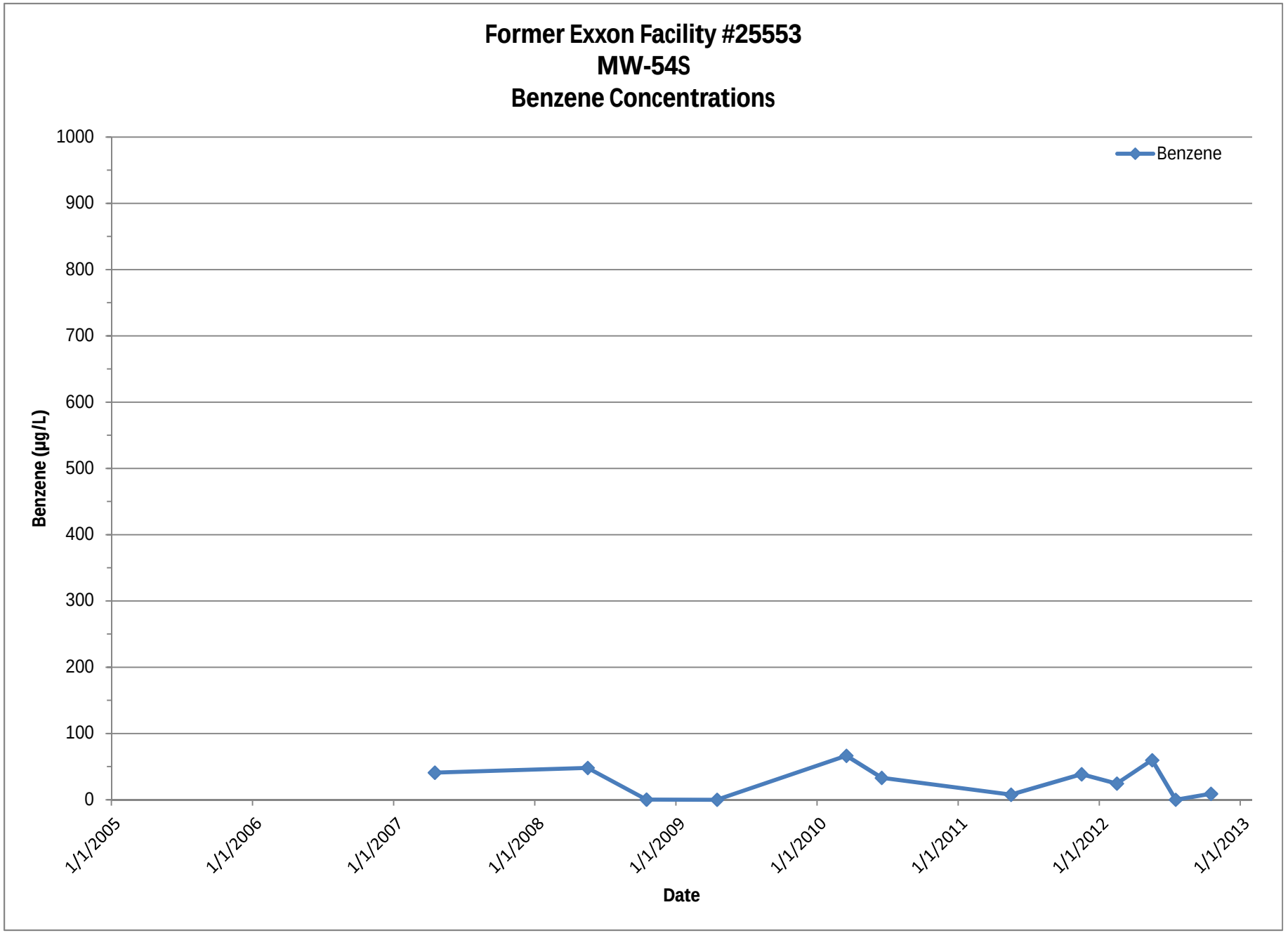
1/1/2013
Date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MW-54S
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Benzene (µg/L)
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900
800
700
600
500
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1/1/2005
1/1/2006
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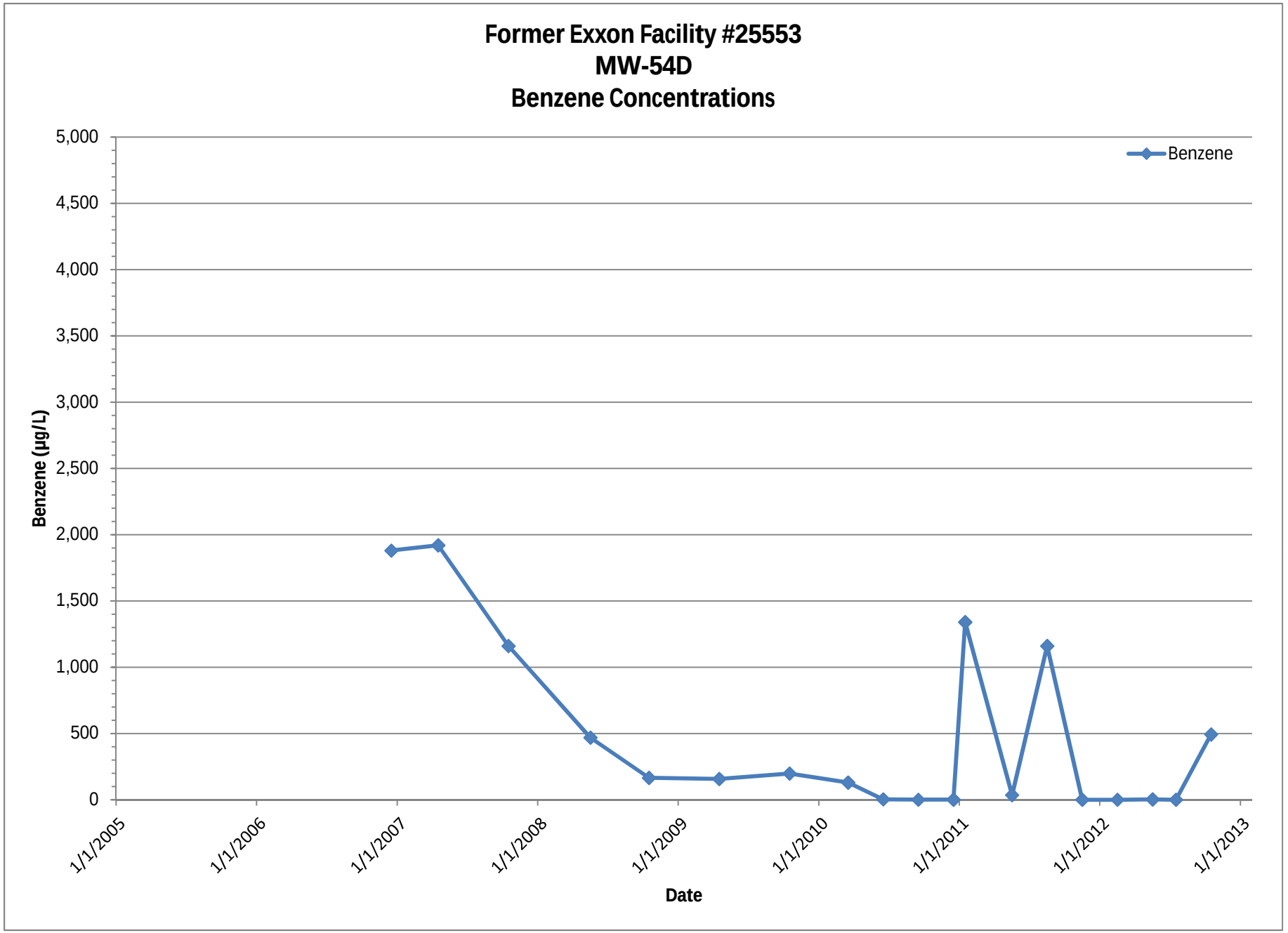
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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MW-54D
Benzene Concentrations
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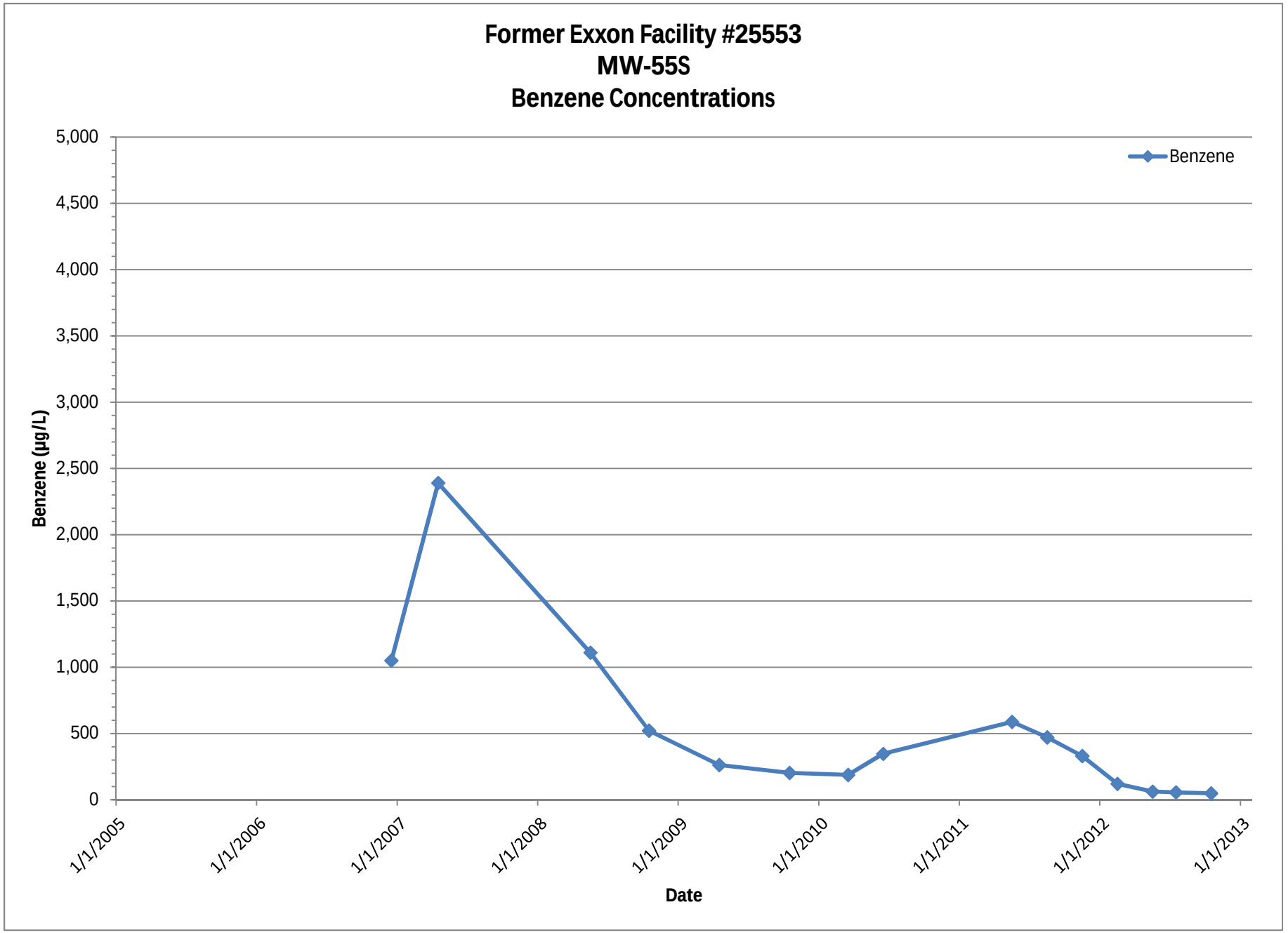
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Benzene (µg/L)
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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MW-55S
Benzene Concentrations
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Benzene (µg/L)
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4,000
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1/1/2005
1/1/2006
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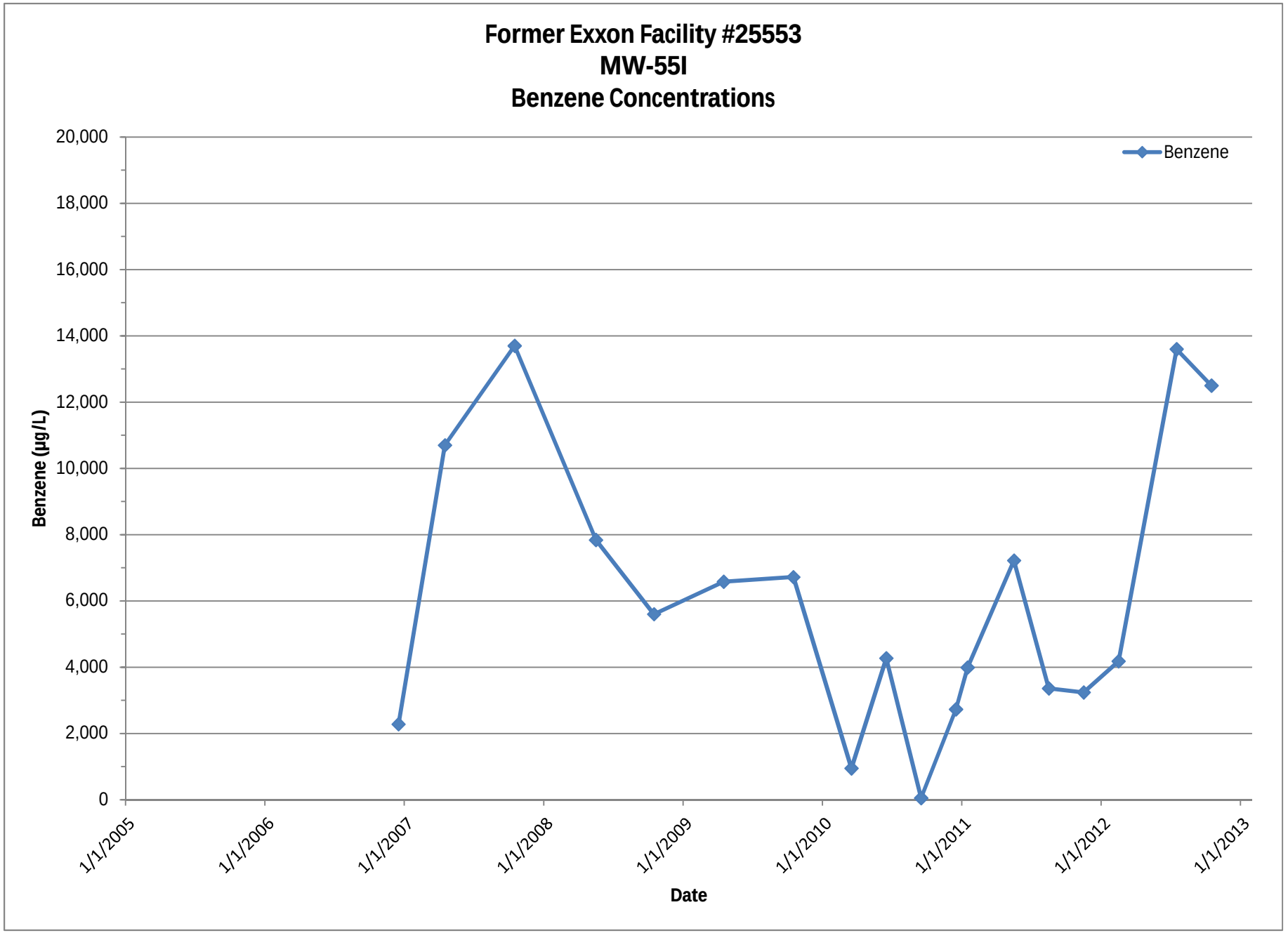
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date


Former Exxon Facility #25553
MW-55I
Benzene Concentrations
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Benzene (µg/L)
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14,000
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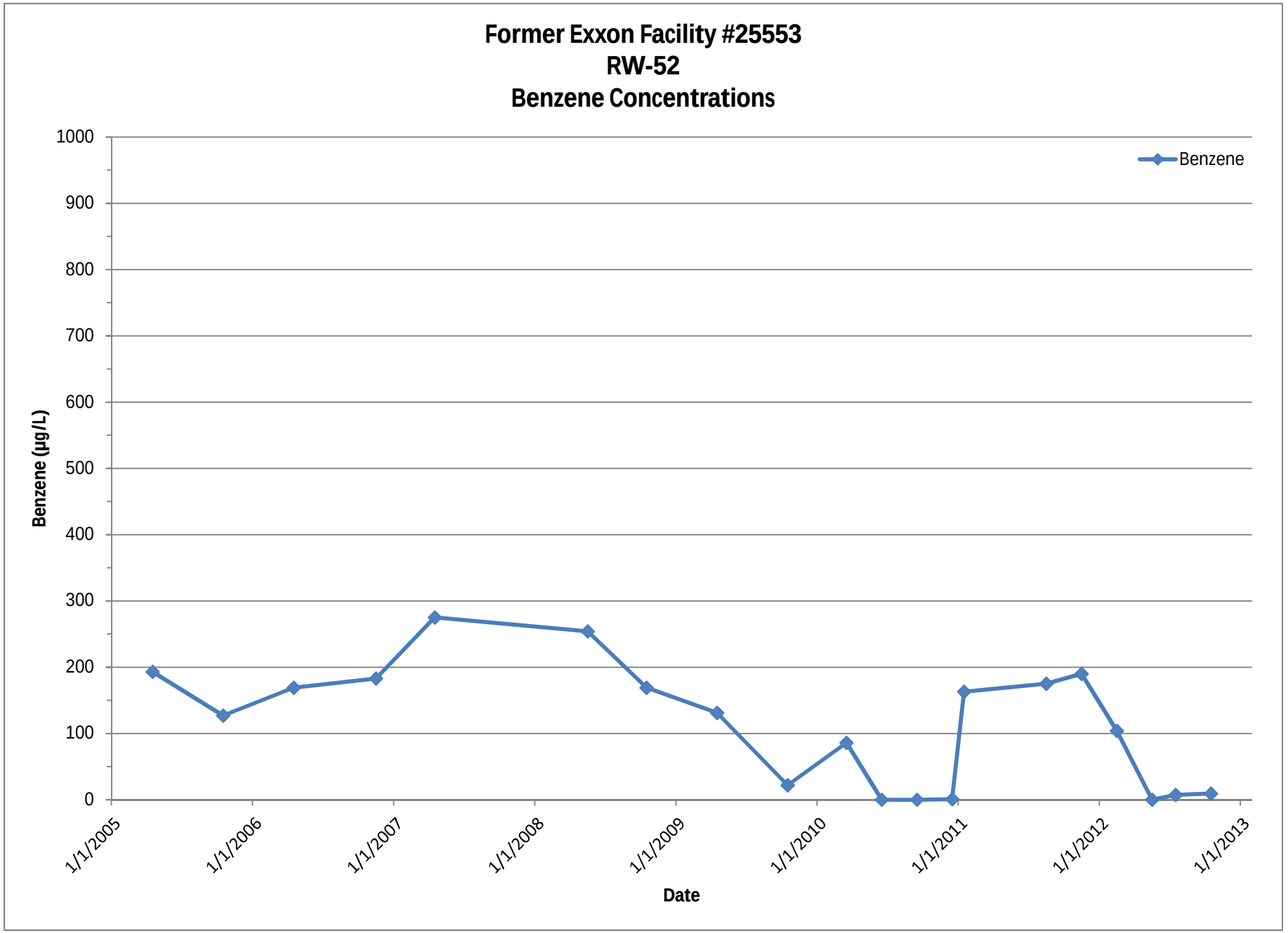
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date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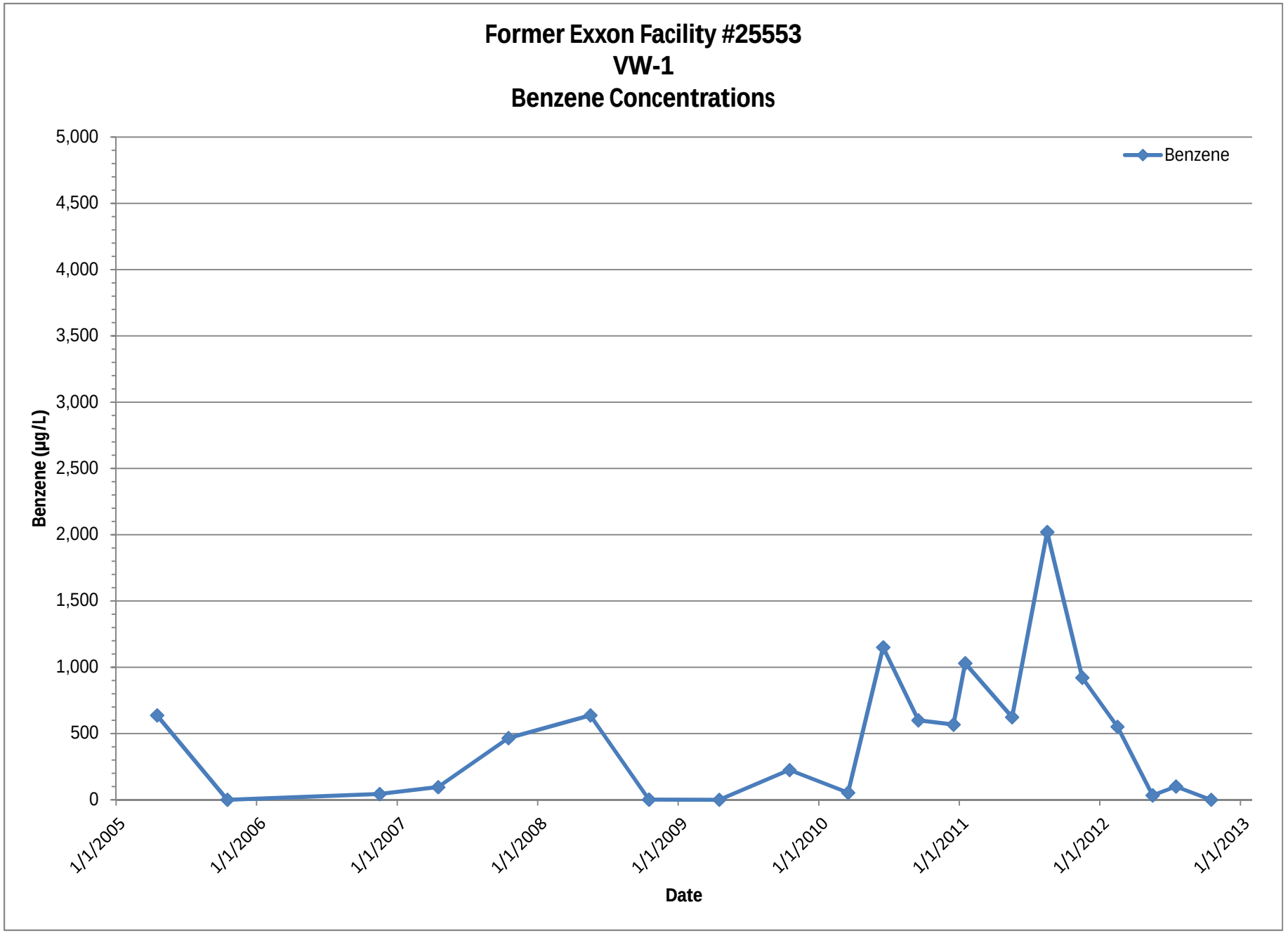
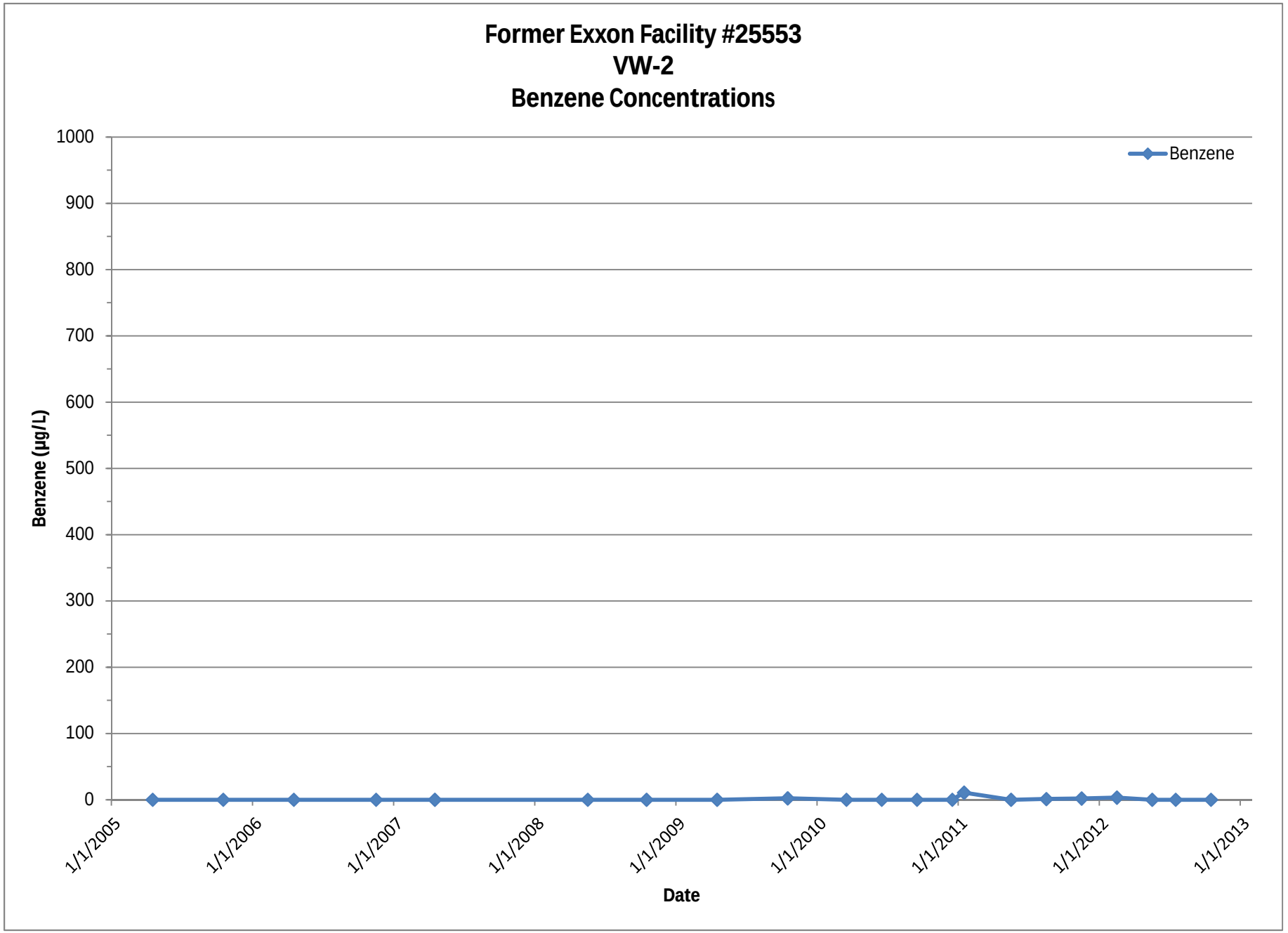
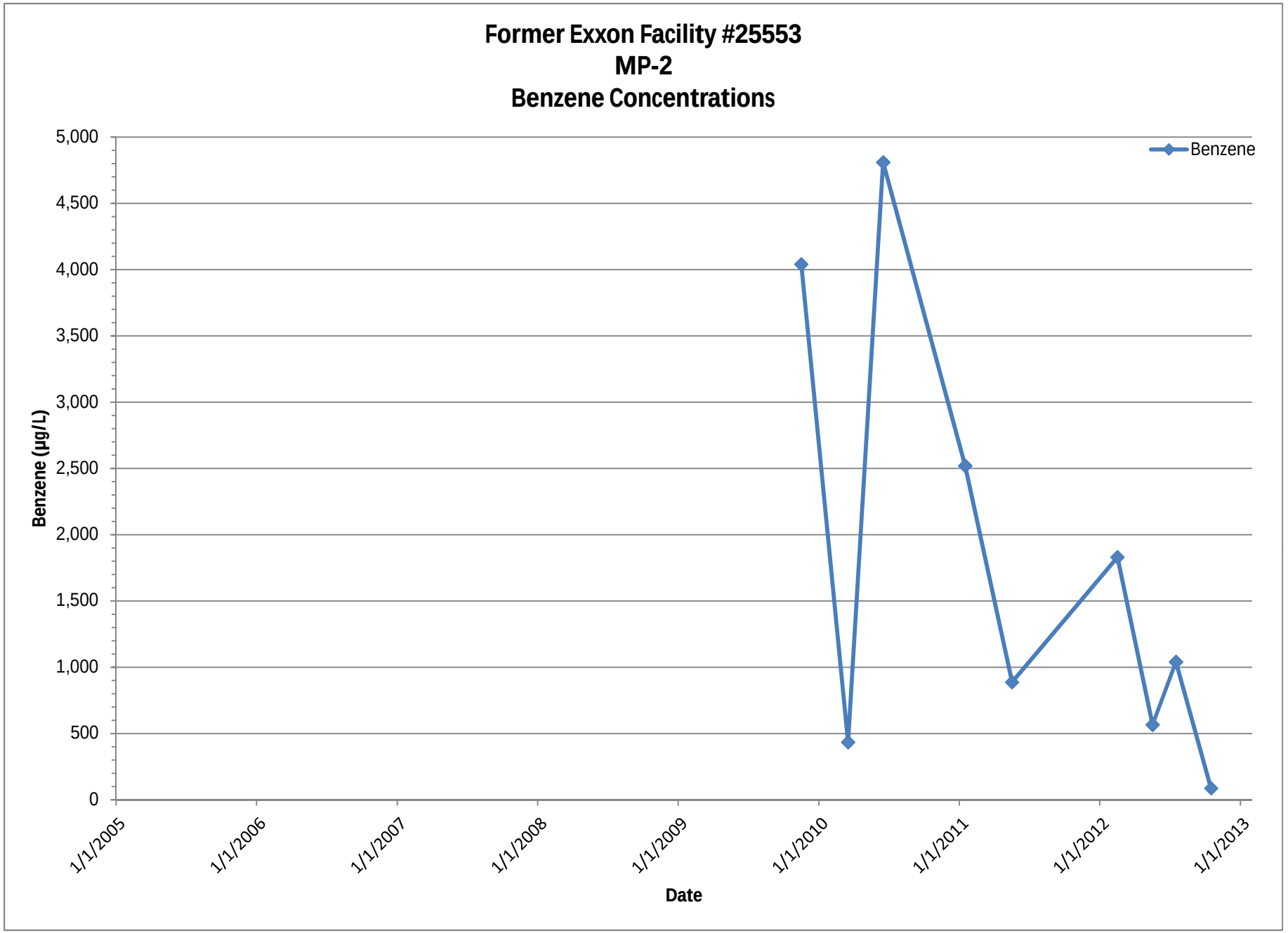
RW-52
Benzene Concentrations
Benzene
Benzene (µg/L)
1000
900
800
700
600
500
400
300
200
100
0
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date


Former Exxon Facility #25553
VW-1
Benzene Concentrations
Benzene
Benzene (µg/L)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date


Former Exxon Facility #25553
VW-2
Benzene Concentrations
Benzene
1000
900
800
700
600
500
400
300
200
100
0
Benzene (µg/L)
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date


Former Exxon Facility #25553
MP-2
Benzene Concentrations
Benzene
Benzene (µg/L)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Date

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Appendix D

Sub-Slab Soil Gas Sampling and Analysis Standard Operating Procedure

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Imagine the result

Sub-Slab Soil-Gas Sampling and Analysis Using USEPA Method TO-15 – Permanent Probe Approach

Rev. #: 1

Rev Date: November 14, 2008

Approval Signatures

Prepared by: _____ Date: 11/14/08
Mitch Wacksman

Reviewed by: _____ Date: 11/14/08
(Technical Expert) Christopher Lutes

I. Scope and Application

This document describes the procedures to install a sub-slab sampling port and collect sub-slab soil-gas samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and detailed instructions for installing sub-slab soil-gas probes and collecting soil-gas samples for VOC analysis.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading sub-slab soil-gas sample collection activities must have previous sub-slab soil-gas sampling experience.

III. Equipment List

The equipment required to install a permanent sub-slab vapor probe is presented below:

- Electric impact drill;
- 5/8-inch and 1-inch-diameter concrete drill bits for impact drill;
- Stainless steel vapor probe (typically 3/8-inch outside diameter [OD], 2- to 2.5-inch long (length will ultimately depend on slab thickness), 1/8-inch inside diameter [ID] pipe, stainless steel pipe nipples with 0.5-inch OD stainless steel coupling, and recessed stainless steel plugs per DiGiulio et. al., 2003);
- Photoionization detector (PID);
- Teflon tubing; and

- Quick-setting hydraulic cement powder
- Kneeling pad

The equipment required for soil-gas sample collection is presented below:

- Stainless steel SUMMA® canisters (order at least one extra, if feasible);
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible);
- 1/4-inch ID tubing (Teflon®, or similar);
- Twist-to-lock fittings;
- Stainless steel "T" fitting (if collecting duplicate [i.e., split] samples);
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min) with vacuum gauge;
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge;
- Tracer gas source (e.g., helium);
- PID;
- Appropriate-sized open-end wrench (typically 9/16-inch and ½");
- Chain-of-custody (COC) form;
- Sample collection log (attached); and
- Field notebook

IV. Cautions

Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to properly seal around the vapor probe at slab surface to prevent leakage of atmosphere into the soil vapor probe during purging and sampling. Temporary points are fit snug into the pre-drilled hole using Teflon® tape and a hydrated bentonite seal at the surface. Permanent points are fit snug using quick-setting hydraulic cement powder.

A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For sub-slab vapor probe installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment.

VI. Procedure

Permanent Vapor Probe Installation

Permanent sub-slab soil vapor probes are installed using an electric drill and manual placement of the probe. Drill a 1-inch-diameter hole, approximately 1-inch deep, in the concrete and then use the 5/8-inch-diameter drill to advance the hole to approximately 3 inches below the base of the floor slab. The vapor probe is inserted into the hole and grouted with a quick-setting hydraulic cement powder. The vapor probe is equipped with a recessed threaded cap and stainless steel threaded fitting or compression fitting to allow collection of a soil gas sample through the stainless steel tubing. The vapor probe and tubing will be purged with a portable sampling pump prior to collecting the soil gas sample.

1. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).

2. Drill a 5/8-inch-diameter hole through the slab using the electric drill. (Optional: Although not required, use a source of dust control/suppressant during drilling operations.)

3. Advance the hole to approximately 3 inches beneath the bottom of the slab.

4. Overdrill the upper 1 inch of slab to a hole diameter of 1 inch.

5. Insert the vapor probe so that it sits flush with the top of the slab.

6. Use a quick-setting hydraulic cement to grout the probe in-place and allow the grout to set.

7. Purge the soil vapor probe and tubing with a portable sampling pump prior to collecting the soil-gas sample (see sample collection section below).

8. Proceed to soil-gas sample collection.

9. When sub-slab soil-gas sampling is complete, plug the soil vapor probe opening with a stainless steel plug. Ensure that the probe is well sealed and will not pose a tripping hazard

Sub-Slab Soil-Gas Sample Collection

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):

    a. wind speed and direction;

    b. ambient temperature;

    c. barometric pressure; and

    d. relative humidity.

2. Connect a short piece of Teflon tubing to the sub-slab sampling port using a swage lock fitting.

3. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the vapor probe and sampling line using a portable pump [purge volume = 1.5 Pi r2h] at a rate of approximately 100 mL/min. Measure organic vapor levels with the PID. Lower flow rates maybe necessary if the slab is built directly on clay to avoid excessive vacuum.

4. If necessary, check the seal established around the soil vapor probe by using a tracer gas (e.g., helium) or other method established in the state guidance documents. [Note: Some states (e.g., New York) may not require use of a tracer gas in connection with sub-slab sampling. Refer to the Administering Tracer Gas SOP, adapted from NYSDOH 2005, for how to use a tracer gas.]

5. Remove the brass on stainless steel plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and on the COC form the flow controller number with the appropriate SUMMA® canister number.

6. Connect the Teflon sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister pressure.

7. Connect the other end of the polyethylene tubing to the sub-slab sampling port.

8. Open the SUMMA® canister valves. Record in the field notebook the time sampling began and the canister pressure.

9. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval (e.g., 30 to 60 minutes).

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).

3. Record the date and local time (24-hour basis) of valve closing in the field notebook, sample collection log (attached), and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).

7. Complete the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure [e.g., two walls, corner of room]), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Soil-gas sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

X. References

DiGiulio et. al. 2003. Draft Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA TO-15 to Support Vapor Intrusion Investigations. http://www.cdphe.state.co.us/hm/indoorair.pdf (Attachment C)

New York State Department of Health (NYSDOH). 2005. DRAFT "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" February 23, 2005.

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Sub-Slab Sample Collection Log

Sample ID:	

Client:		**Boring Equipment:**	
Project:		**Sealant:**	
Location:		**Tubing information:**	
Project #:		**Miscellaneous Equipment:**	
Samplers:		**Subcontractor:**	
Sample Point Location:		**Moisture Content of Sampling Zone (circle one):**	Dry / Moist
Sampling Depth:		**Approximate Purge Volume and Method:**	
Time of Collection:			

Instrument Readings:

Time	Canister Pressure (inches of HG)	Temperature (F or C)	Relative Humidity (%)	Air Speed (ft/min)	Pressure Differential (inches of H20)	PID (ppm or ppb)

SUMMA Canister Information:

Size (circle one): 1 L 6 L

Canister ID:

Flow Controller ID: _____

General Observations/Notes:

Approximating One-Well Volume (for purging): When using 1¼-inch "Dummy Point" and a 6-inch sampling interval, sampling space will have a volume of approximately 150 mL. Each foot of ¼-inch tubing will have a volume of approximately 10 mL.

Please record current weather information including wind speed and direction, ambient temperature, barometric pressure and relative humidity via a suitable information source (e.g., weatherunderground.com).