Remedial Action Completion Report Cover Sheet

CHAPTER 245
STORAGE TANK ACT

☐ **Site Characterization Report – Section 245.310(b)**

☐ **Site Characterization Report – Site-Specific Standard**

☐ **Site Characterization Report – Statewide Health or Background Standard**

☐ **Site Characterization Report PLUS – Statewide Health Standard**

☐ **Remedial Action Plan – Statewide Health or Background Standard**

☐ **Remedial Action Plan – Site-Specific Standard**

☐ **Remedial Action Progress Report**

☐ **Remedial Action Completion Report – Statewide Health or Background Standard**

☒ **Remedial Action Completion Report – Site-Specific Standard**

☐ **Post-Remediation Care Plan Report**

☐ **Environmental Covenant**

(check all that apply to the enclosed submission)

Leidos, Inc.
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November 23, 2015

Ms. Pamela S. Trowbridge, P.G.
Pennsylvania Department of Environmental Protection
Environmental Cleanup and Brownfields Program
Southcentral Region
909 Elmerton Avenue
Harrisburg, PA 17110

Subject: **Remedial Action Completion Report**
Groundwater Attainment Demonstration
Former York Naval Ordnance Plant, York, Pennsylvania
Former Building 45/50 Unleaded Gasoline UST Release - Tank 009
PADEP Facility I.D. No. 67-00823
USTIF Claim No. 2010-0106(M)
Leidos Project 301425.TM.100044.4000.0100

Dear Ms. Trowbridge:

On behalf of Harley-Davidson Motor Company Operations, Inc. (Harley-Davidson), Leidos, Inc. (Leidos) submits this Remedial Action Completion Report (RACR) to the Pennsylvania Department of Environmental Protection (PADEP) to address an unleaded gasoline release from an underground storage tank (UST)—Tank 009—at the former York Naval Ordnance Plant (fYNOP) (**Figure 1**). This work was conducted in accordance with the PADEP Storage Tank Act, Corrective Action Program (Chapter 245). This RACR includes the eighth (8th) consecutive quarter of groundwater monitoring and an attainment demonstration for the chosen unleaded gasoline Site-Specific Standards (SSSs) in soil and the Statewide Health Standards (SHSs) in groundwater in accordance with the recommendations presented in the September 9, 2013, Remedial Action Plan (RAP), approved by PADEP on November 22, 2013.

1.0 INTRODUCTION

1.1 Location

The fYNOP site is located on two properties at 1425-1445 Eden Road, Springettsbury Township, York, Pennsylvania, as shown on **Figure 1**. Most of the fYNOP site is currently occupied by the Harley-Davidson facility. In mid-2012, fifty-eight acres of the 230-acre site were transferred to the York County Industrial Development Authority (YCIDA), which plans to redevelop that portion of the property. The site is bordered on the south by Route 30 (Arsenal Road); on the west by Eden Road, a railroad line, and

Codorus Creek; and on the east and north by residential properties (**Figure 1**). The study area spans a section of the property border between Harley-Davidson and YCIDA (**Figure 2**). Tank 009 was formerly located in the North Plant Area (NPA) of the fYNOP (on property now owned by YCIDA), to the west of Buildings 45 and 50 (Harley-Davidson maintenance and garage buildings) that were demolished in July 2010.

1.2 Background

The property where the fYNOP stood was originally farmland. The site was initially developed in 1941 by the York Safe and Lock Company, a United States Navy contractor, for the manufacture, assembly, and testing of 40-millimeter (mm) twin and quadruple gun mounts, complete with guns. In 1944, the Navy took possession of the York Safe and Lock Company facility. The Navy owned and operated the facility as the York Naval Ordnance Plant (YNOP) until 1964, switching operations after World War II to overhaul war service weapons and to manufacture rocket launchers, 3-inch/50-caliber guns, 20-mm aircraft guns, and power-drive units for 5-inch/54-caliber guns. In 1964, the Navy sold the YNOP to American Machine & Foundry Company (AMF), who continued similar manufacturing. In 1969, AMF merged with Harley-Davidson. In 1973, Harley-Davidson moved its motorcycle assembly operations to the AMF York facility. In 1981, AMF sold the York facility to Harley-Davidson.

Since 1986, environmental investigation, characterization, and remediation activities have been performed at the fYNOP by Harley-Davidson, with review and input from the United States Army Corps of Engineers (USACE). In 2005, Harley-Davidson submitted a Notice of Intent to Remediate (NIR) the site.

In January 2010, Harley-Davidson announced the sale of approximately 58 acres of its property to the YCIDA. The remainder of the property (i.e., the East Campus) was consolidated into one facility. This property is now referred to as the “West Campus,” and the sale closed in 2012. The boundary between the West Campus and the East Campus crosses through the study area (**Figure 2**).

Harley-Davidson demolished the unused buildings on the West Campus to allow for future development. Harley-Davidson retained the East Campus and constructed a new manufacturing facility. In the process of redevelopment, Tank 009, a 10,000-gallon gasoline UST system, was removed in July 2010 from west of Buildings 45 and 50. A gasoline release was discovered at the dispenser for Tank 009 (**Figure 2**). Tank 009 replaced Tank 4 (T-4), which was located approximately 35 feet to the south of the Tank 009 dispenser prior to 1991. In both cases, contaminated soil was removed during closure of these USTs, but residual hydrocarbon concentrations remained in the subsurface soils.

1.3 Site Characterization

A site characterization was conducted by the installation and sampling of 13 soil borings and 9 monitoring wells. Detailed geologic analysis, hydraulic conductivity tests, and sampling were completed to characterize the over 67 feet of relatively low hydraulic conductivity heterogeneous unconsolidated materials. Light non-aqueous phase liquid (LNAPL) was removed to the maximum extent practicable.

In December 2012, a Supplemental site characterization report (SCR) was submitted to the PADEP that concluded no additional investigation or active remediation was necessary and a SSS is applicable for the soil. Further, a fate-and-transport analysis projected the current and future (30-year) dissolved-phase unleaded gasoline constituents in groundwater to meet the SHSs. Eight quarters of attainment sampling of MW-125 and MW-160 and a post-remedial care (PRC) plan were recommended. On March 28, 2013, PADEP approved the Supplemental SCR and recommendations**.**

1.4 Remedial Action Plan

Laboratory analyses of soil samples collected with the removal of Tank 009 and during the site characterization activities documented concentrations of unleaded gasoline parameters exceeding the Nonresidential Soil-to-Groundwater MSCs. The maximum detected concentrations were the recommended SSSs for constituents present in soil:

- Benzene: 0.950 milligrams per kilogram (mg/kg);
- Naphthalene: 43.7 mg/kg;
- 1,2,4-Trimethylbenzene: 417 mg/kg; and
- 1,3,5-Trimethylbenzene: 127 mg/kg.

Groundwater samples collected during the Tank 009 site characterization activities detected dissolved-phase benzene concentrations exceeding the PADEP Nonresidential Used Aquifer MSC in MW-160, approximately 150 feet downgradient from the source. Fate-and-transport modeling showed no potential for exceeding the groundwater SHSs at the point of compliance (POC)—the downgradient property line at Eden Road approximately 1,650 feet from Tank 009. Thus, the detected soil concentrations were not sufficiently high to cause groundwater to exceed the MSCs at the POC. The applicable remedial alternatives were reviewed, and PADEP concurred with pathway elimination and institutional controls as an effective remedial alternative.

1.5 RAP Implementation

RAP implementation included eight consecutive quarters (two years) of groundwater sampling at the compliance wells, MW-160 and MW-125, to confirm attainment of groundwater SHSs. This attainment sampling would affirm the soil SSSs. Groundwater attainment sampling was performed using PADEP-approved procedures, and the results were documented in quarterly remedial action progress reports (RAPRs) dated:

- January 28, 2014;
- May 23, 2014;
- July 18, 2014;
- November 21, 2014;
- January 21, 2015;

- August 10, 2015.
- May 22, 2015; and

The last attainment sampling event performed by Leidos took place on September 22, 2015, and is described in the following section of this report.

2.0 ATTAINMENT SAMPLING

2.1 Well Gauging

Gauging of monitoring wells within the study area was performed by Leidos on September 22, 2015. In contrast with the previous quarter, groundwater elevations in the monitoring wells fell slightly and are below their two-year mean groundwater elevations. A trace of LNAPL was observed at MW-119 and approximately 5 milliliters (mL) of product was removed.

Depth-to-groundwater was subtracted from top-of-casing (TOC) elevations to calculate the groundwater elevation at each well (**Table 1**). A groundwater elevation contour map for wells gauged on September 22, 2015, is presented on **Figure 2**. The hydraulic gradient indicated is consistent with previous measurements at approximately 0.04 southwest from the area of the former dispenser for Tank 009. In general, the hydraulic gradient has averaged 0.05 southwest from MW-119 toward MW-125 and MW-160 over the past two years of monitoring.

2.2 Groundwater Sampling

On September 22, 2015, the eight (8^{th}) consecutive quarter of groundwater attainment samples was collected by Leidos from the compliance wells, MW-125 and MW-160. Prior to sampling, the wells were purged with a submersible pump at a relatively low purge rate (i.e., less than 0.25 gallons per minute [gpm]) to minimize the drawdown of the groundwater level. The pump was decontaminated before use at each well by washing with a Liqui-Nox®/potable water solution and a potable water rinse.

During purging, water quality field parameters (temperature, pH, conductivity, dissolved oxygen, and turbidity) were measured and recorded. Upon stabilization of the field parameters during purging, groundwater samples were collected directly from the dedicated pump discharge tubing into laboratory-provided 40 mL volatile organic analysis (VOA) vials containing preservative (i.e., hydrochloric acid). Additionally, a quality assurance/quality control (QA/QC) sample, consisting of a laboratory-provided trip blank, accompanied the groundwater samples.

Upon sample collection, labels were affixed to the sample containers, and they were placed into a cooler with ice and a chain-of-custody (COC). The groundwater and QA/QC samples were submitted to TestAmerica for laboratory analysis of the PADEP Short List of Petroleum Products (unleaded gasoline) using United States Environmental Protection Agency (EPA) Method 8260C. All samples arrived at the laboratory in good condition and were analyzed within holding times. The analytical results for the

samples are summarized in **Table 2** and on **Figure 3**. Copies of the laboratory analysis reports for the attainment samples are provided in **Appendix A** on the attached CD.

2.3 Groundwater Sampling Results

The following are the significant findings of the September 22, 2015, groundwater sample results:

1. The benzene concentration of 270 micrograms per liter (µg/L) in the sample from MW-160 exceeded the PADEP Nonresidential Used Aquifer Medium Specific Concentration (MSC) of 5 µg/L. This result was lower than the previous four quarters of sampling, ending a slight increasing trend since the SCR that peaked at 660 µg/L in June 2015 (**Figure 4**).

2. Benzene in MW-160 remained below the 15,000 µg/L concentration in MW-119, determined as the source concentration in the December 2012 Supplemental SCR to not exceed the MSC at the POC.

3. The MW-160 benzene concentration trend appeared independent of groundwater elevations. Thus, the June 2015 benzene peak is interpreted as either passage of concentrations from the source to this downgradient well or a sampling relic. The recent benzene concentration decline indicates the unleaded gasoline plume has essentially stabilized.

4. All other analyzed compounds from MW-160 were either not detected or were at concentrations less than their respective MSCs.

5. The sample from MW-125 had concentrations for all analyzed parameters less than their Nonresidential Used Aquifer MSCs.

2.4 Groundwater Fate-and-Transport Assessment

In accordance with Chapter 245.313(b)(4)iii, the groundwater attainment monitoring data were evaluated to assess the validity of the SCR's fate-and-transport model. The reason for this was the model output as presented in the SCR varied from the groundwater attainment sampling field data (**Figure 5**). The attainment sampling results were reviewed with the fate-and-transport predictions to determine if the MW-160 benzene concentrations, peaking to 660 µg/L in June 2015, change the assessment that the SHS will be met at the POC now and 30 years in the future. All the other dissolved-phase hydrocarbon parameters in groundwater met the SHS at the compliance wells during the attainment sampling period. For this reason, no review of any other chemicals of concern except benzene was necessary.

Quick Domenico (QD) fate-and-transport modeling was conducted for the SCR to assess the potential hydrocarbon migration extent from the Tank 009 dispenser release southwest to MW-160 and MW-125 and further toward the POC. Conservative site-specific input parameters were used in the QD model, including a continuous source of residual hydrocarbons without natural reductions in the mass over time.

Additionally, the QD model in the SCR assumed homogeneous subsurface materials, which is not entirely the case for the site. These limitations and natural variations in the subsurface were deemed responsible for the deviation of the QD predictions from the attainment sample results.

Leidos varied the model conditions in order to replicate the attainment sample results and to determine the most likely source of deviations from the SCR's assumed conditions (**Appendix B**). Based on this, the validity of the QD model to make projections was assessed. In this process, the previously established dispersivity (x, y, and z), Lambda, source dimensions, bulk density, organic carbon partitioning coefficient (Koc), fractional organic carbon (foc), and hydraulic conductivity (K) were unchanged from the original model. The SCR model assumed 20 years after the release date, so time was incremented to 22 years for the current day modeling to complete the assessments. The results of modifying the following model input parameters within various ranges or limits are presented herein:

- **Source Concentration** – Based on the maximum MW-119 benzene concentration in October 2011, the source concentration was assumed to be 15,000 µg/L for the SRC fate-and-transport model. Minor thicknesses of LNAPL in MW-119 after October 2011 precluded further sampling in the source area. An increase of the assumed source concentration to 30,000 µg/L benzene for the model simulation was tried to replicate the maximum benzene concentration in MW-160, but the resultant benzene concentration gradient was not supported by the field data (**Figure 6**).

- **Hydraulic Gradient** – Based upon groundwater elevations throughout the attainment sampling period, the hydraulic gradient from MW-119 to MW-160 was 0.05 feet per foot (ft/ft). Variations in the hydraulic gradient to the degree observed over the course of the attainment sampling did not account for the variance from the model experienced by the MW-160 benzene (**Figure 7**).

- **Effective Porosity** – The analysis of soil samples from the unconsolidated materials was used to estimate an effective porosity of 20 percent (0.2) for the SCR. For the reevaluation, effective porosity was reduced to 10 percent and run with the same 15,000 µg/L benzene concentration at the source. Under this revised condition, the model most accurately replicated the 660 µg/L maximum benzene observed in MW-160 (**Figure 8**).

The change in the effective porosity to 10% and better match of the model to the field data indicated that the reason for the variance was the initial choice of effective porosity for the model conditions. Given the fine-grained texture of the limestone residuum (saprolite), a 10% effective porosity is more reasonable to use in the fate-and-transport modeling and matched the field data well. Projection of the field data downgradient (red line) and the revised model indicate that the benzene concentration will meet the 5 µg/L MSC at less than 1,650 feet distance (i.e., the distance to the POC).

3.0 ATTAINMENT DEMONSTRATION

3.1 Groundwater

The SCR provided adequate spatial monitoring of the site between the Tank 009 dispenser release and the POC by compliance wells (MW-125 and MW-160). Eight consecutive quarterly groundwater attainment samples and the fate-and-transport modeling did not detect concentrations of regulated substances at the compliance wells that show potential for exceeding the Nonresidential Used Aquifer MSCs for unleaded gasoline parameters at the POC in the foreseeable future. These samples were reported in quarterly RAPRs that accomplished the goals in the RAP and demonstrated attainment of the SHSs for the detected groundwater constituents listed in **Table 2**.

3.2 Soil

Because of the demonstration of SHS compliance by groundwater and the incorporation of gasoline constituents at depths in the subsurface that would preclude exposure, the SSSs are met for all gasoline constituents in soil. Dissolved-phase gasoline is not expected to migrate from the soils to the groundwater to the degree that groundwater exceeds the SHS at the POC. Free-phase gasoline is depleted in volume, and the fine-grained soils prevent free-phase migration from the immediate vicinity of MW-119. No exposure by direct contact with gasoline in soil is possible because of depth.

3.3 Narrative of Site Use and Remediation

The Property has over 70 years of industrial history, starting as an agricultural field and later hosting defense industry and various manufacturing, including motorcycle assembly operations. Prior owner/operators and Harley-Davidson manufactured equipment and had releases of various regulated chemicals at the Property, which are currently being addressed under Chapter 250 and the OneCleanup Program.

This RACR relates to gasoline from a UST under the Corrective Action Program (Chapter 245). Remediation has consisted of soil excavation and minor free-phase hydrocarbon removal. Based on the results of soil and groundwater sampling at the Property, there are no complete exposure pathways at the Property with the potential to affect human health or the environment. Taking into consideration the planned continued use of the Property as an industrial facility (i.e., nonresidential land use) served with public water, no complete exposure pathways will exist at the Property in the future.

3.4 Post-Remediation Care Plan

The proposed PRC Plan will consist of the imposition of institutional controls, in the form of an environmental covenant (EC) that will preclude residential use of the Property and for water supply in the future. An EC is anticipated to be prepared in conjunction with the larger ongoing remedial action for the entire OneCleanup site, which will be completed at a later date and will encompass the area impacted by

Tank 009. The EC will assure the maintenance of this type of land use and exposure prevention in the future.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are presented based upon the site characterization, remedial action, and attainment activities taken to address the release of gasoline from Tank 009 and nearby UST T-4. These releases were manifested in residual hydrocarbons remaining in the subsurface soil and groundwater. The release from Tank 009 impacted soils and groundwater in a relatively small area underneath and to the south and southwest of the former dispenser. The following outlines the conclusions drawn from the above-described activities and evaluations:

- Unleaded gasoline parameters were detected in soil samples at concentrations less than the Nonresidential Direct Contact MSC for subsurface soil (2 to 15 feet below grade [fbg]) but greater than the Nonresidential Soil-to-Groundwater Used Aquifer MSCs.

- LNAPL was detected in MW-119 at the former Tank 009 dispenser location in negligible volumes and recovered to the maximum extent practicable. The residuals associated with this area represent a source of dissolved-phase impact to groundwater.

- The magnitude and extent of dissolved-phase unleaded gasoline parameters in shallow groundwater were effectively delineated, and attainment sampling indicated that the dissolved-phase unleaded gasoline plume has essentially stabilized.

- The future dissolved-phase hydrocarbon migration was reevaluated with an adjusted fate-and-transport model with an effective porosity estimate more representative of the fine-grained subsurface matrix. This model and the field data demonstrated no propensity of the dissolved-phase hydrocarbons to migrate to the downgradient POC in 30 years.

- The gasoline release does not pose a threat to construction workers by direct contact or public and private water supply wells. A local water use ordinance requires connection to public water; however, the ordinance does not completely eliminate the potential future use of groundwater.

- Further evaluation of the vapor intrusion (VI) pathway in the study area was done, which indicated that none of the soil gas samples detected any target constituent concentrations exceeding a soil gas MSC; therefore, the VI pathway is not a concern.

- The release does not pose a risk to ecological receptors.

Attainment of the SSS for soil and SHS for groundwater has been accomplished by eight quarters of compliant attainment sampling at MW-125 and MW-160 in recognition of their being between the source and the POC. No additional monitoring wells, subsurface investigation, active remediation, or

groundwater sampling is necessary. A PRC plan consisting of an EC will be prepared for the entire site at large and will complete the remedial action for Tank 009.

Harley-Davidson and Leidos appreciate PADEP's continued support and assistance on this project. Please contact the undersigned at (717) 901-8843 if you have any questions.

Respectfully submitted,

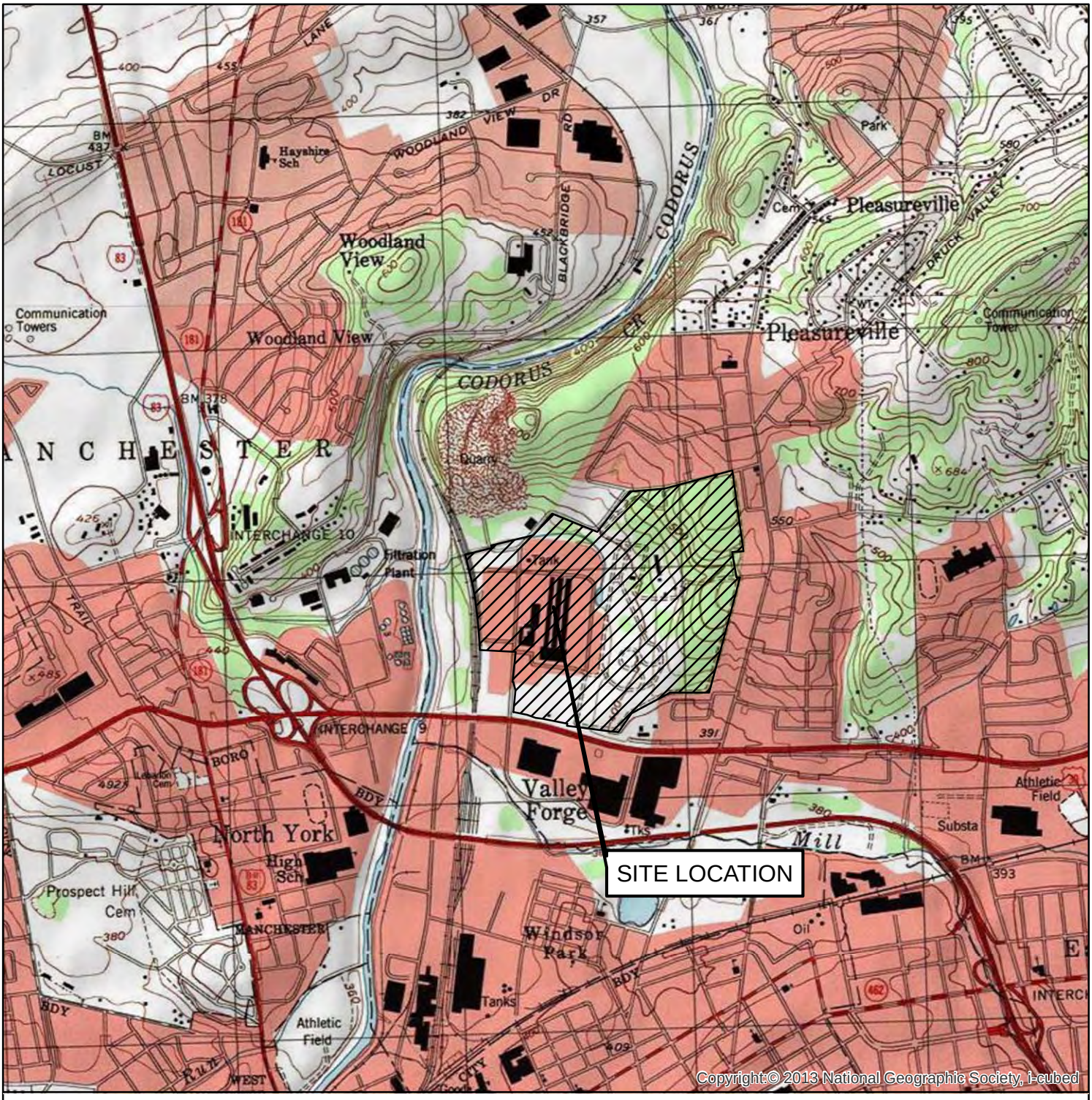
Leidos, Inc.

Kent V. Littlefield, P.G.
Senior Hydrogeologist

Rodney G. Myers, CHMM
Senior Project Manager

KVL:pr
Attachments
cc: Sharon R. Fisher, Harley-Davidson
Ralph T. Golia, P.G., AMO Environmental Decisions
Gregory Bowman, PADEP, Storage Tank Section
Blanda Nace, YCIDA
Linda Melvin, ICF International – USTIF

FIGURES



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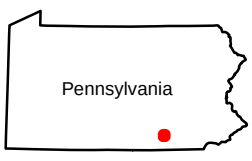

QUADRANGLE LOCATION

FORMER YORK NAVAL ORDNANCE PLANT

1425 EDEN ROAD, YORK, PENNSYLVANIA

Site Location Map

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job no.	2603200245/2000/100			file no.	Site_Map_20131231

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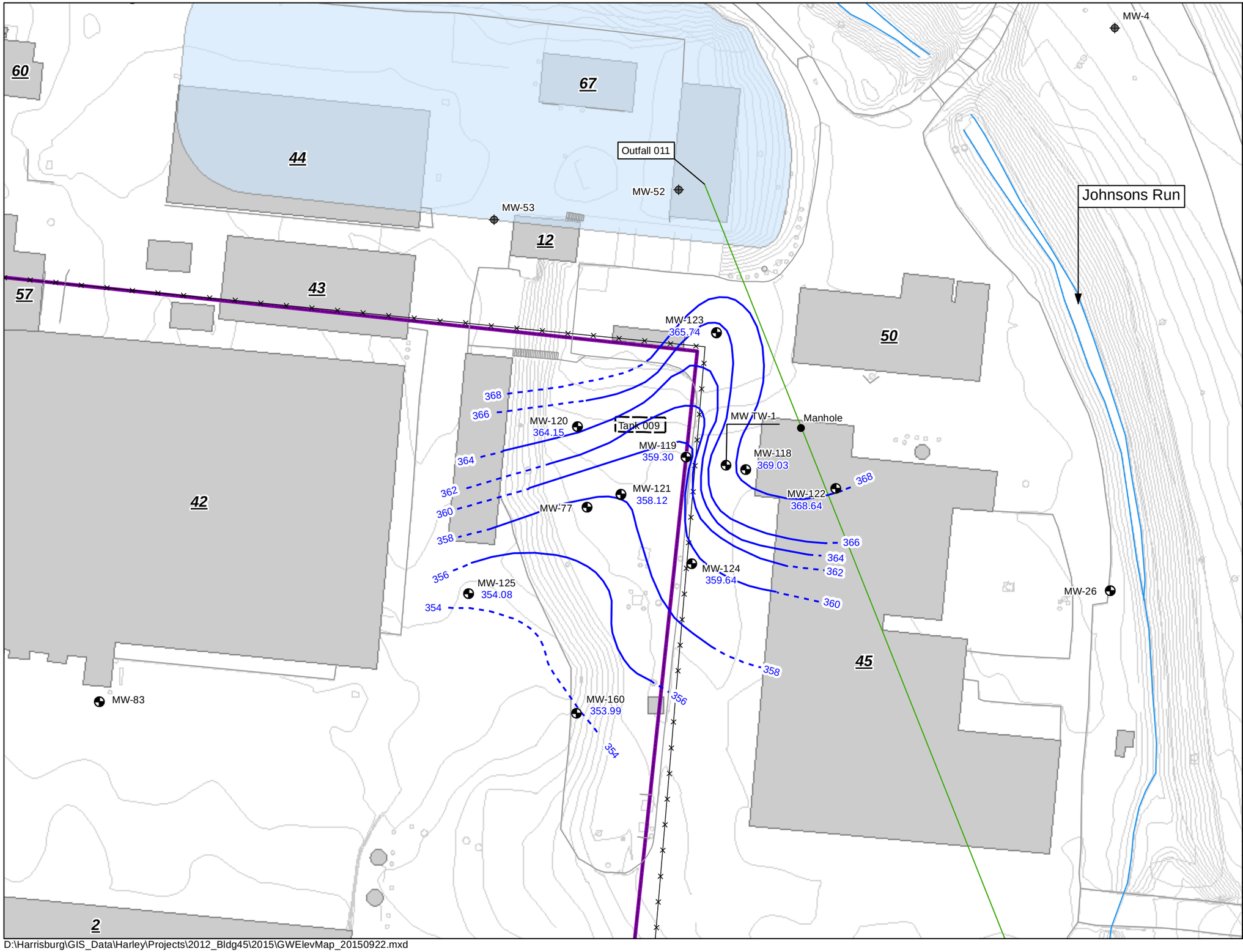
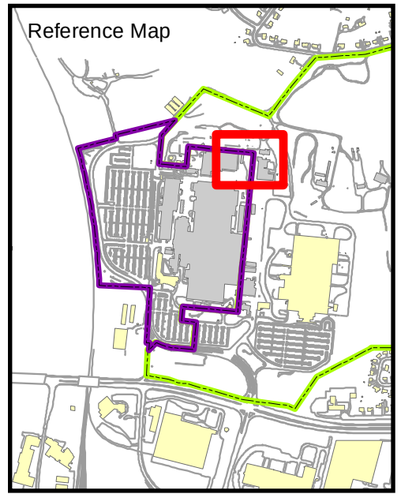


Legend

- Tank 009 (Removed July 2010)
- 45 Demolished Buildings
- Stormwater Detention Basin
- Roads and Curbs
- Fence Line
- West Campus Boundary
- Approximate Stormwater Line
- Monitoring Well
- Abandoned Well
- Groundwater Elevation Contour (Dashed where inferred)
- 356 Groundwater Elevation
- MW-118 / 369.03 Monitoring Well Identification and Groundwater Elevation



NOTES:

1. *Base data (Buildings, Building Boundaries, Roads and Curbs, underground utilities and Contour Lines, from NuTec Survey conducted in 2006).*
2. *Monitoring Wells and Underground Storage Tank features from Leidos site measurements.*

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0 25 50 100 Feet

Former York Naval Ordnance Plant
1425 Eden Rd York, Pa 17402

Groundwater Elevation Contour Map
September 22, 2015

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date 10/06/2015	date	date	
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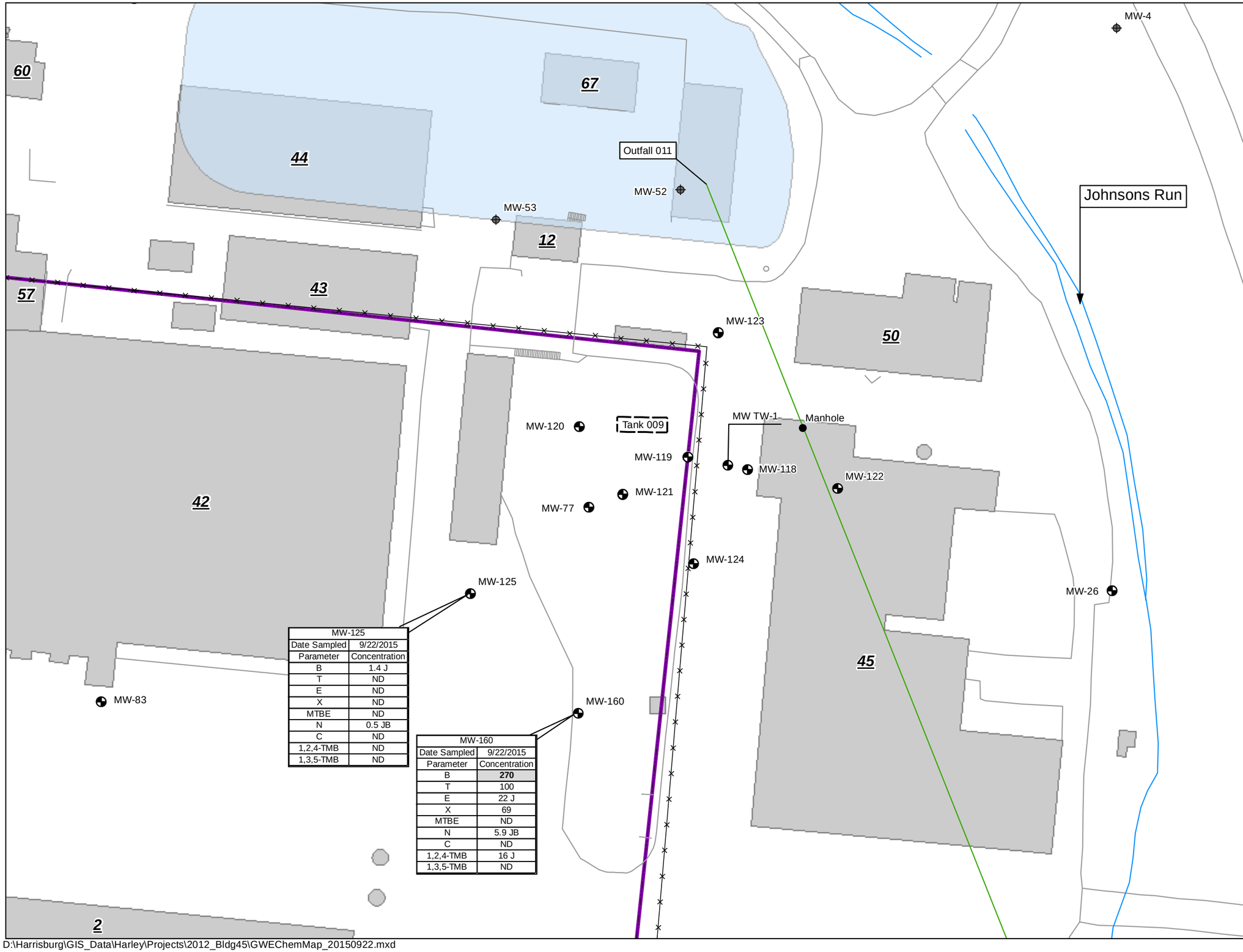


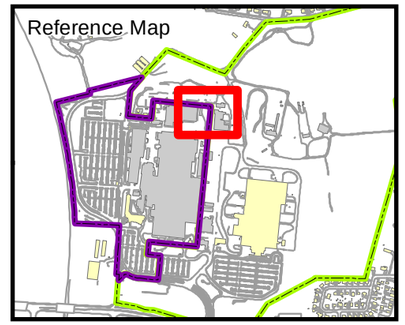
MW-125	
Date Sampled	9/22/2015
Parameter	Concentration
B	1.4 J
T	ND
E	ND
X	ND
MTBE	ND
N	0.5 JB
C	ND
1,2,4-TMB	ND
1,3,5-TMB	ND

MW-160	
Date Sampled	9/22/2015
Parameter	Concentration
B	**270**
T	100
E	22 J
X	69
MTBE	ND
N	5.9 JB
C	ND
1,2,4-TMB	16 J
1,3,5-TMB	ND

Legend

- Tank 009 (Removed July 2010)
- 45 Demolished Buildings
- Stormwater Detention Basin
- Roads and Curbs
- Fence Line
- West Campus Boundary
- Approximate Stormwater Line
- Monitoring Well
- Abandoned Well

Reference Map



B: Benzene
T: Toluene
E: Ethylbenzene
X: Total Xylenes
MTBE: Methyl Tert-Butyl Ether
N: Naphthalene
C: Cumene
1,2,4-TMB: 1,2,4 - Trimethylbenzene
1,3,5-TMB: 1,3,5 - Trimethylbenzene

B: Compound was found in the blank and sample.
J: Laboratory reported concentration as an approximate value.
MSC: Medium Specific Concentration
ND: Not Detected
PADEP: Pennsylvania Department of Environmental Protection
All results reported in micrograms per liter (µg/L)

Bold/Shaded concentrations are greater than a PADEP Non-Residential MSC

NOTES:
1. *Base data (Buildings, Building Boundaries, Roads and Curbs, underground utilities and Contour Lines, from NuTec Survey conducted in 2006).*
2. *Monitoring Wells and Underground Storage Tank features from Leidos site measurements.*

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0 25 50 100 Feet

Former York Naval Ordnance Plant
1425 Eden Rd York, Pa 17402

Groundwater Quality Analytical Data September 22, 2015

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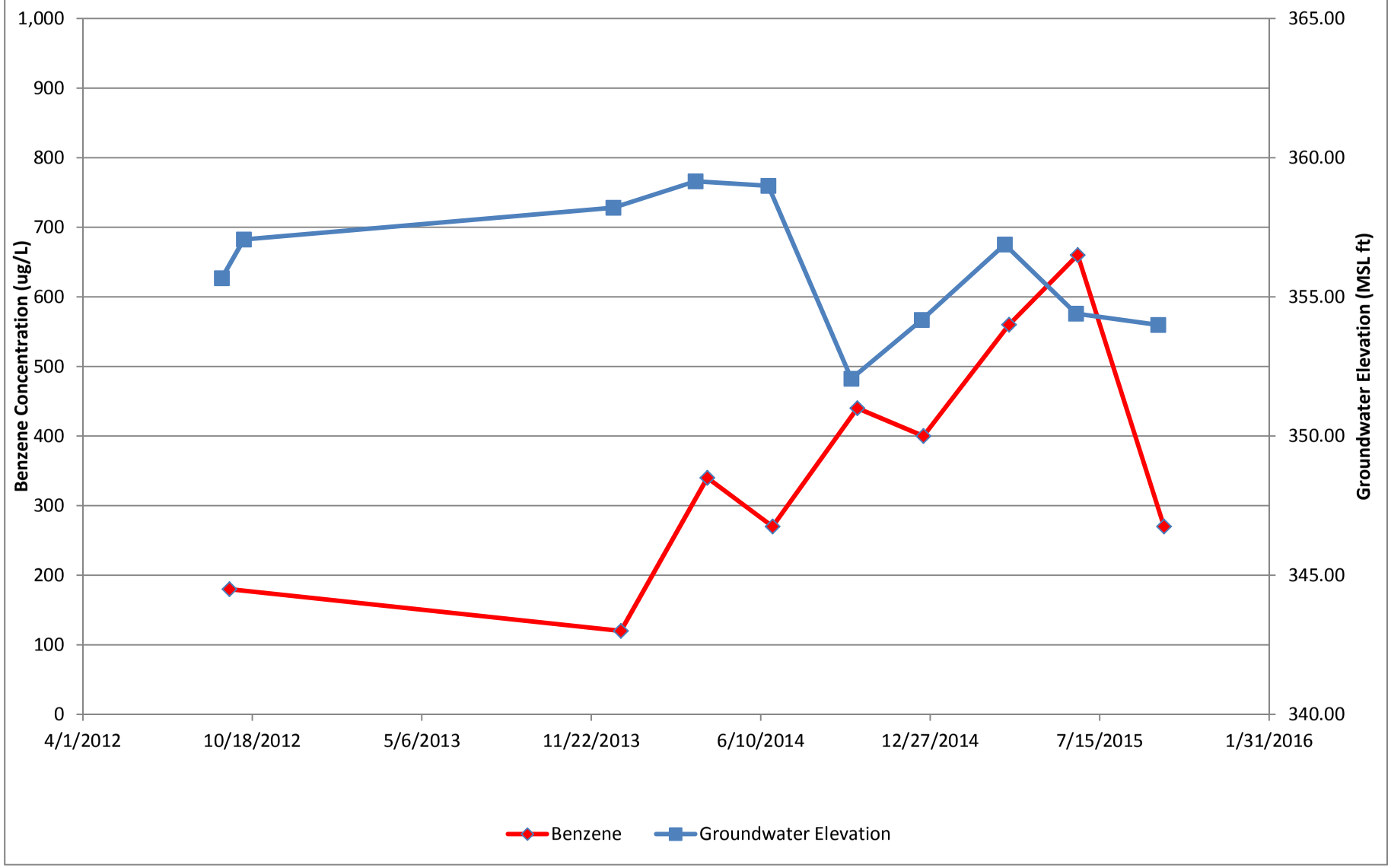
Figure 4 - Trend of Benzene Concentrations in MW-160
Former Building 45/50 Unleaded Gasoline UST Release - Tank 009
PADEP Facility I.D. No. 67-00823



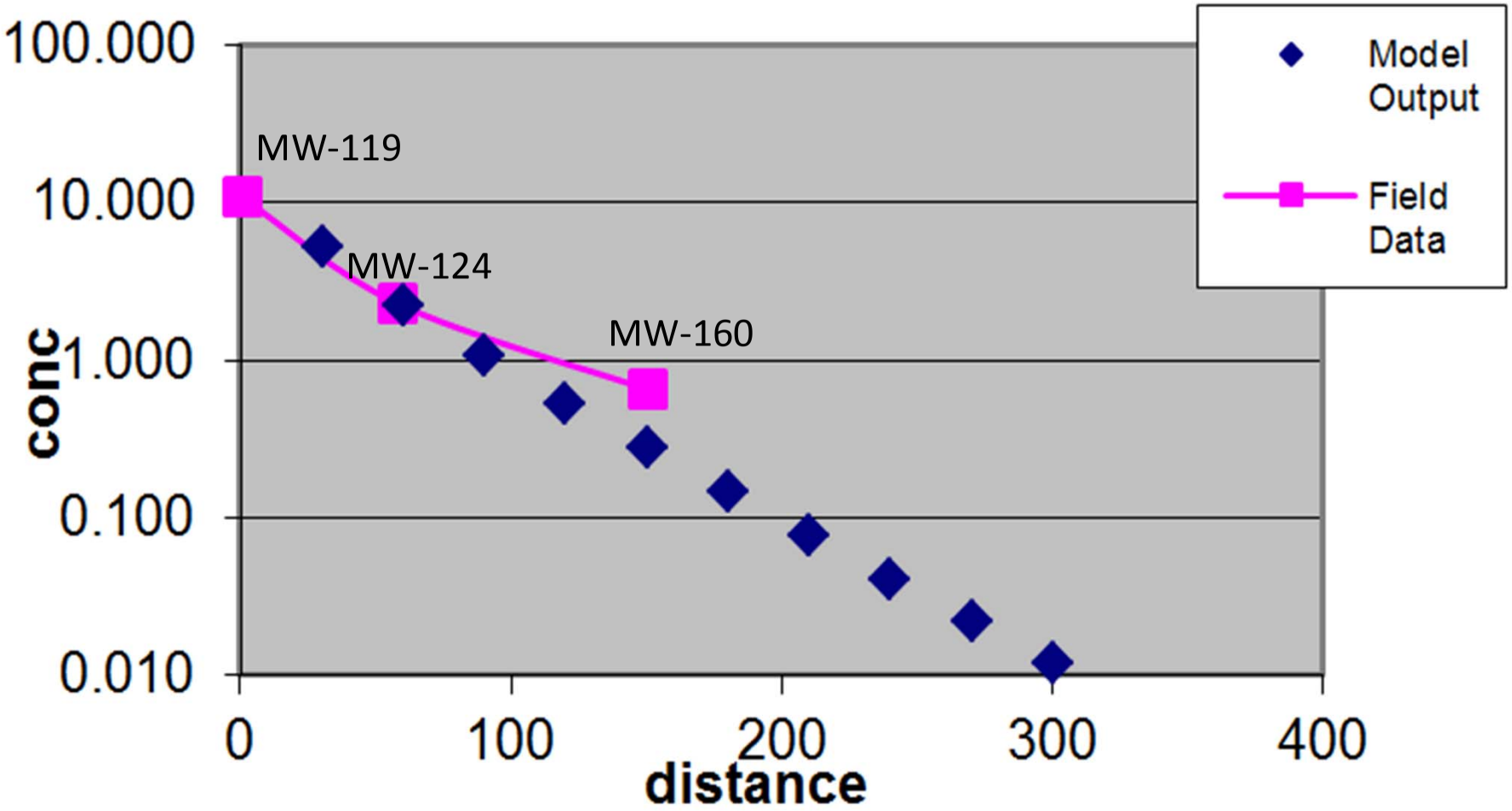


Figure 5 – Benzene concentration with distance plotted by the New Quick Domenico model (blue diamonds) versus field data (pink squares) from the source at MW-119 past MW-124. The model output trend varies from the field data because of the maximum concentration detected in June 2015 at MW-160. The reason for the variance was assessed by variation of input parameter to confirm that the benzene concentration will meet the 5 microgram per liter (ug/L) MSC at less than 1,650 feet distance **(Appendix B)**.

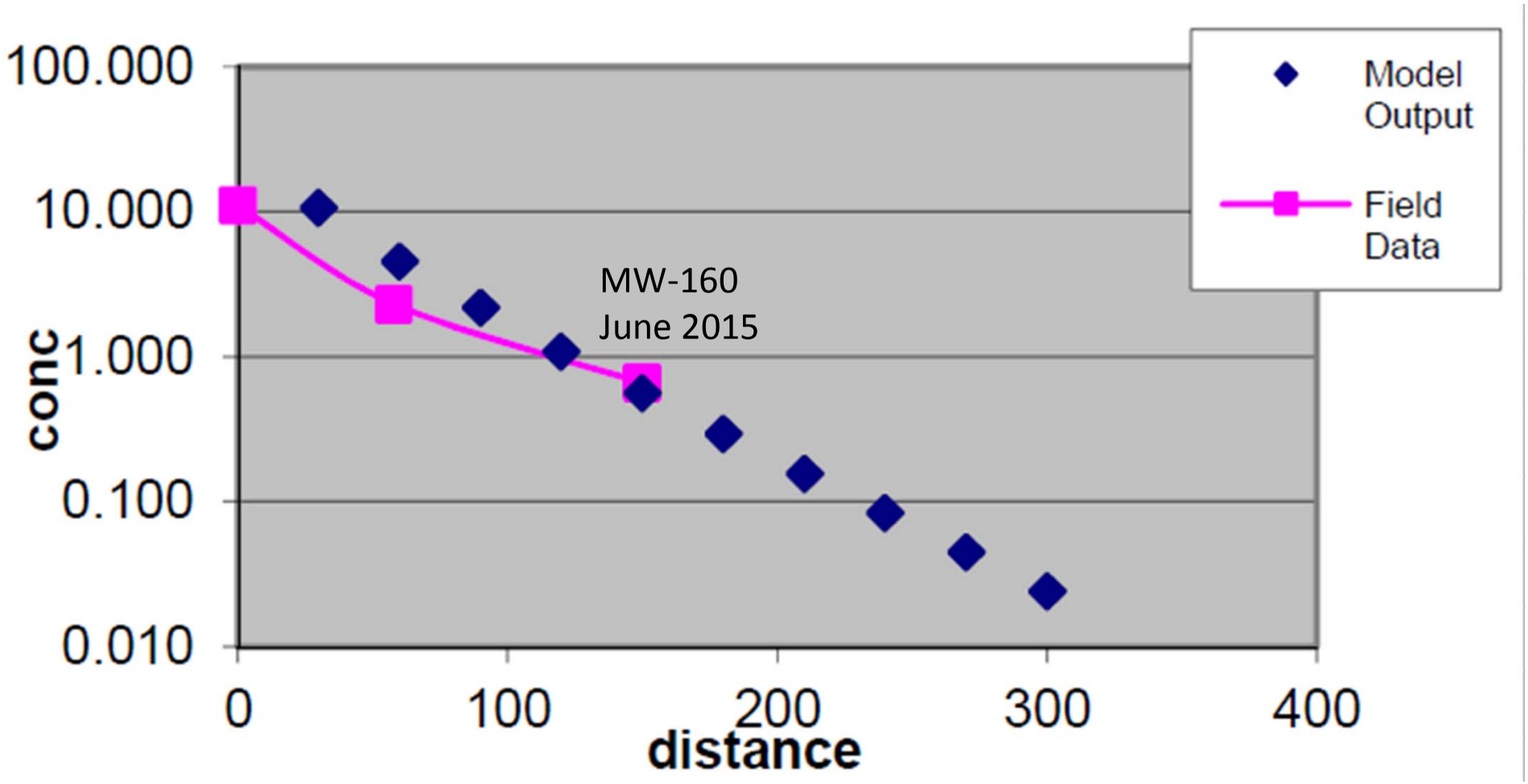
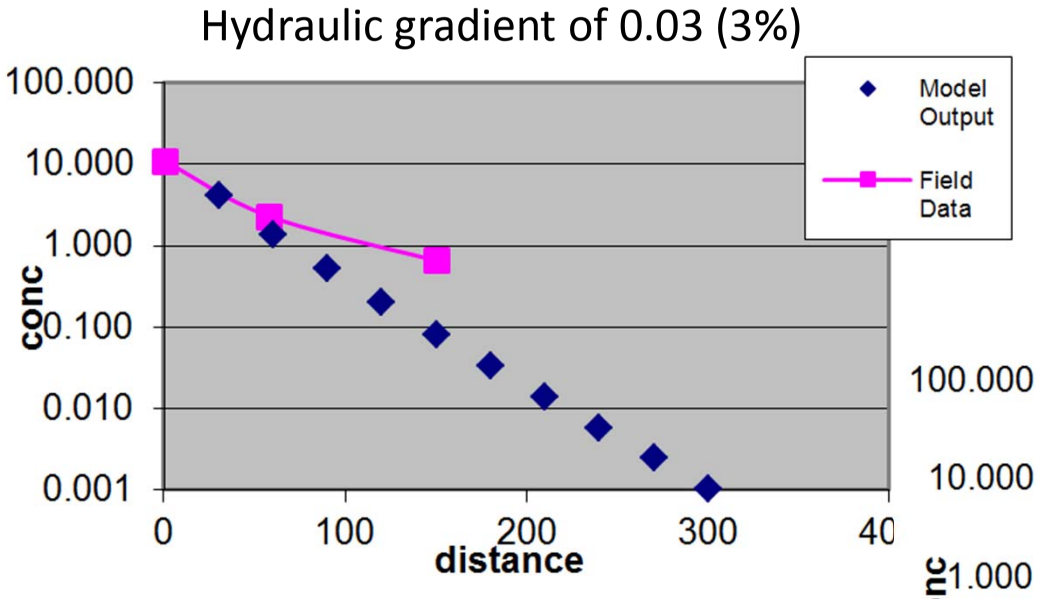
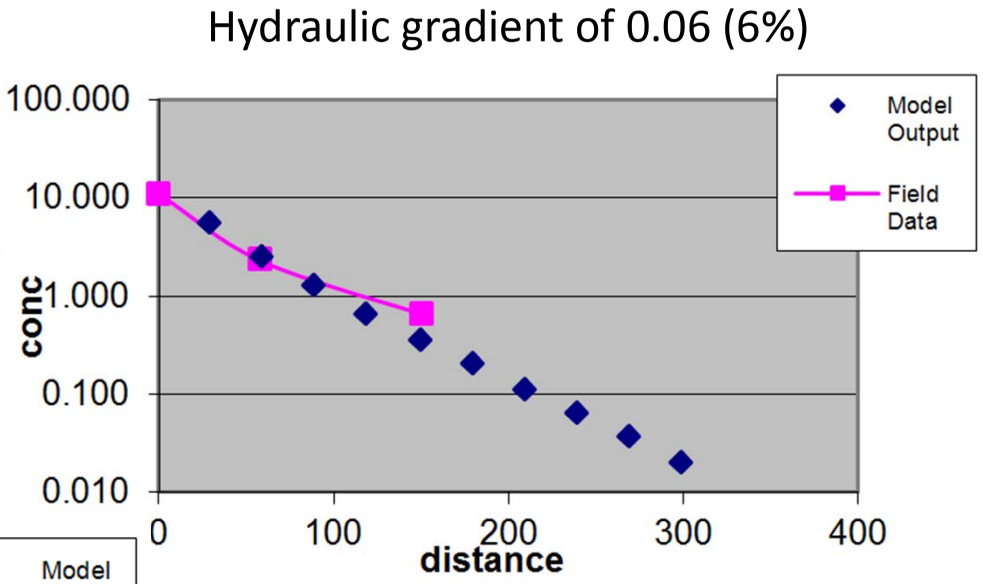


Figure 6 - Benzene concentration with distance plot by the New Quick Domenico model with an assumed source concentration of 30,000 µg/L benzene. Although the the model simulation replicated the June 2015 benzene concentration of 660 ug/L in MW-160, the benzene concentration gradient established by the field data was not well replicated. In effect, a higher source concentration was not likely based on the field data.





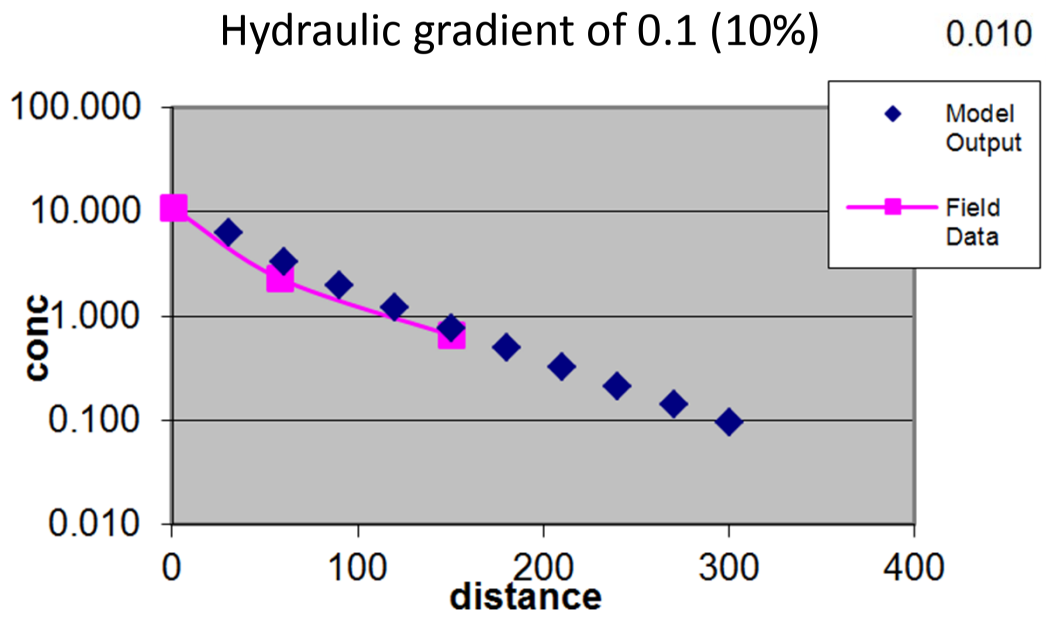


Figure 7 - Benzene concentration with distance plots by the New Quick Domenico modelwith the variation in the hydraulic gradients. The range of hydraulic gradient (3% to 6%) showed an influence on the concentration gradient, but a gradient of 0.1 (10%) was necessary to replicate the June 2015 benzene concentration in MW-160. Because a 10% hydraulic gradient was never measured, this was deemed not the source for the model variance from the field data.

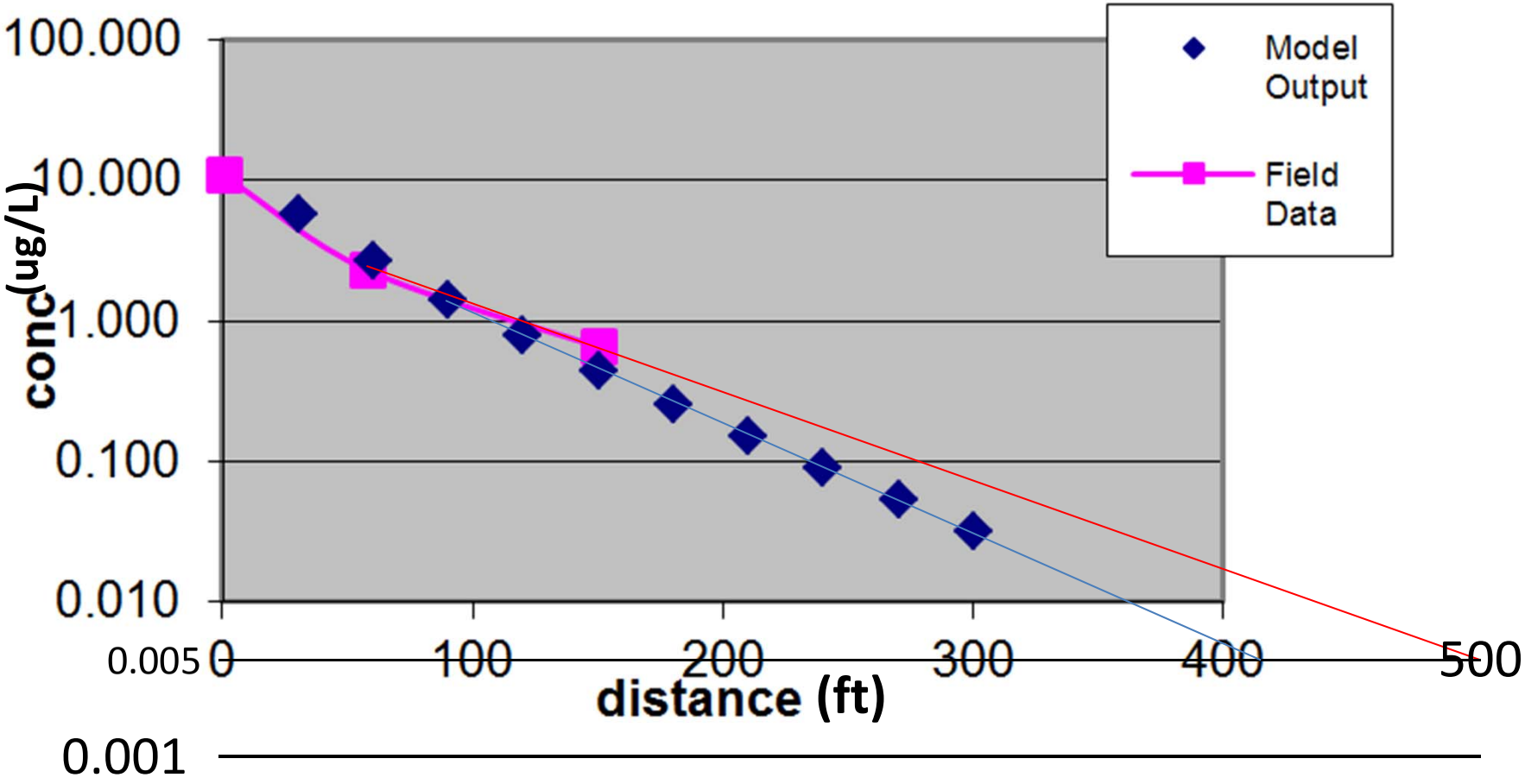


Figure 8 – Benzene concentration with distance plot by the New Quick Domenico model using an effective porosity for the model conditions at 10%, which is valid for the fine-grained matrix of the aquifer **(Appendix B).** This simulation matched the field data better despite the single elevated benzene concentration in MW-160 in June 2015. Projection of the field data downgradient (red line) indicates that the benzene concentration will meet the 5 microgram per liter (ug/L) MSC at less than 1,650 feet distance from the source to the POC.

TABLES

Table 1
Monitoring Well Gauging Data and Groundwater Elevations
Former Building 45/50 Unleaded Gasoline Release - Tank 009
Harley-Davidson Motor Company Operations, Inc.
1425 Eden Road, York, York County, Pennsylvania
PADEP Facility ID No. 67-00823
Leidos Project Number 301425.TM.100044.4000.0100

Location	Monitoring Well Installation Date	TOC Elevation (Feet)	Well Diameter (inches)	Total Drilled Depth (fbg)	Screened Interval (fbg)	Top of Well Screen Elevation (feet)	Date	SWL (fbtoc)	SWL Elevation (feet)
MW-118	8/15/2011	377.44	2	25	8 - 23	369.11	6/27/2012	7.50	369.94
							7/2/2012	7.59	369.85
							7/5/2012	7.49	369.95
							7/10/2012	7.59	369.85
							7/20/2012	7.03	370.41
							7/25/2012	7.62	369.82
							8/1/2012	7.45	369.99
							8/6/2012	7.55	369.89
							8/17/2012	7.25	370.19
							8/24/2012	7.22	370.22
							8/30/2012	7.51	369.93
							9/12/2012	7.50	369.94
							10/8/2012	7.38	370.06
							12/18/2013	NM	NM
							3/25/2014	7.28	370.16
							6/19/2014	7.35	370.09
							9/25/2014	8.45	368.99
							12/17/2014	8.69	368.75
							3/25/2015	8.35	369.09
							6/17/2015	8.62	368.82
							9/22/2015	8.41	369.03
MW-119	8/17/2011	377.03	2	27	5 - 25	372.20	6/27/2012	16.28	360.75
							7/2/2012	16.75	360.28
							7/5/2012	16.72	360.31
							7/10/2012	17.33	359.70
							7/20/2012	17.30	359.73
							7/25/2012	16.84	360.19
							8/1/2012	16.60	360.43
							8/6/2012	16.67	360.36
							8/17/2012	16.38	360.65
							8/24/2012	16.65	360.38
							8/30/2012	16.54	360.49
							9/12/2012	16.43	360.60
							10/8/2012	14.99	362.04
							12/18/2013	14.46	362.57
							3/25/2014	12.11	364.92
							6/19/2014	12.52	364.51
							9/25/2014	19.84	*357.42
							12/17/2014	18.62	*358.60
							3/25/2015	14.81	362.22
							6/17/2015	16.94	360.09
							9/22/2015	17.73	359.30
MW-120	8/17/2011	377.63	2	40	6 - 39	371.30	6/27/2012	9.43	368.20
							7/2/2012	10.50	367.13
							7/5/2012	11.14	366.49
							7/10/2012	12.22	365.41
							7/20/2012	13.20	364.43
							7/25/2012	13.29	364.34
							8/1/2012	13.60	364.03
							8/6/2012	15.73	361.90
							8/17/2012	14.13	363.50
							8/24/2012	14.39	363.24
							8/30/2012	14.41	363.22
							9/12/2012	14.44	363.19
							10/8/2012	10.32	367.31
							12/18/2013	7.72	369.91
							3/25/2014	6.58	371.05
							6/19/2014	7.63	370.00
							9/25/2014	16.33	361.30
							12/17/2014	16.06	361.57
							3/25/2015	7.50	370.13
							6/17/2015	9.25	368.38
							9/22/2015	13.48	364.15

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Leidos Project Number 301425.TM.100044.4000.0100

Location	Monitoring Well Installation Date	TOC Elevation (Feet)	Well Diameter (inches)	Total Drilled Depth (fbg)	Screened Interval (fbg)	Top of Well Screen Elevation (feet)	Date	SWL (fbtoc)	SWL Elevation (feet)
MW-121	8/18/2011	376.31	2	36	7 - 35	369.08	6/27/2012	16.61	359.70
							7/2/2012	17.19	359.12
							7/5/2012	17.38	358.93
							7/10/2012	17.94	358.37
							7/20/2012	15.63	360.68
							7/25/2012	17.71	358.60
							8/1/2012	17.47	358.84
							8/6/2012	17.47	358.84
							8/17/2012	17.17	359.14
							8/24/2012	17.50	358.81
							8/30/2012	17.34	358.97
							9/12/2012	17.07	359.24
							10/8/2012	14.72	361.59
							12/18/2013	14.54	361.77
							3/25/2014	11.19	365.12
							6/19/2014	12.05	364.26
							9/25/2014	20.45	355.86
							12/17/2014	19.33	356.98
							3/25/2015	14.39	361.92
							6/17/2015	17.01	359.30
							9/22/2015	18.19	358.12
MW-122	6/20/2012	377.61	2	30	7 - 30	370.61	6/27/2012	8.98	368.63
							7/2/2012	8.93	368.68
							7/5/2012	8.90	368.71
							7/10/2012	8.93	368.68
							7/20/2012	8.75	368.86
							7/25/2012	8.78	368.83
							8/1/2012	8.52	369.09
							8/6/2012	8.43	369.18
							8/17/2012	8.34	369.27
							8/24/2012	8.40	369.21
							8/30/2012	8.36	369.25
							9/12/2012	8.30	369.31
							10/8/2012	7.65	369.96
							12/18/2013	8.45	369.16
							3/25/2014	7.98	369.63
							6/19/2014	7.84	369.77
							9/25/2014	9.43	368.18
							12/17/2014	9.31	368.30
							3/25/2015	8.91	368.70
							6/17/2015	8.79	368.82
							9/22/2015	8.97	368.64
MW-123	6/20/2012	379.64	2	30	7 - 30	372.64	6/27/2012	12.18	367.46
							7/2/2012	12.37	367.27
							7/5/2012	12.33	367.31
							7/10/2012	12.54	367.10
							7/20/2012	12.53	367.11
							7/25/2012	12.55	367.09
							8/1/2012	12.37	367.27
							8/6/2012	12.44	367.20
							8/17/2012	12.28	367.36
							8/24/2012	12.46	367.18
							8/30/2012	12.47	367.17
							9/12/2012	12.47	367.17
							10/8/2012	11.85	367.79
							12/18/2013	12.58	367.06
							3/25/2014	11.32	368.32
							6/19/2014	11.29	368.35
							9/25/2014	14.83	364.81
							12/17/2014	14.94	364.70
							3/25/2015	13.57	366.07
							6/17/2015	13.72	365.92
							9/22/2015	13.90	365.74

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Harley-Davidson Motor Company Operations, Inc.
1425 Eden Road, York, York County, Pennsylvania
PADEP Facility ID No. 67-00823
Leidos Project Number 301425.TM.100044.4000.0100

Location	Monitoring Well Installation Date	TOC Elevation (Feet)	Well Diameter (inches)	Total Drilled Depth (fbg)	Screened Interval (fbg)	Top of Well Screen Elevation (feet)	Date	SWL (fbtoc)	SWL Elevation (feet)
MW-124	6/21/2012	376.37	2	34	8 - 34	368.37	6/27/2012	14.87	361.50
							7/2/2012	15.50	360.87
							7/5/2012	15.56	360.81
							7/10/2012	16.21	360.16
							7/20/2012	16.31	360.06
							7/25/2012	15.79	360.58
							8/1/2012	15.66	360.71
							8/6/2012	15.68	360.69
							8/17/2012	14.94	361.43
							8/24/2012	15.29	361.08
							8/30/2012	15.14	361.23
							9/12/2012	14.94	361.43
							10/8/2012	13.54	362.83
							12/18/2013	15.39	360.98
							3/25/2014	11.93	364.44
							6/19/2014	12.14	364.23
							9/25/2014	18.42	357.95
							12/17/2014	17.45	358.92
							3/25/2015	15.49	360.88
							6/17/2015	16.13	360.24
							9/22/2015	16.73	359.64
MW-125	6/21/2012	366.56	2	24	4 - 24	362.56	6/27/2012	11.37	355.19
							7/2/2012	11.59	354.97
							7/5/2012	11.89	354.67
							7/10/2012	12.32	354.24
							7/20/2012	11.31	355.25
							7/25/2012	11.31	355.25
							8/1/2012	10.78	355.78
							8/6/2012	10.21	356.35
							8/17/2012	10.58	355.98
							8/24/2012	11.14	355.42
							8/30/2012	10.86	355.70
							9/12/2012	NM	NM
							10/8/2012	6.21	360.35
							12/18/2013	7.62	358.94
							3/25/2014	7.24	359.32
							6/19/2014	7.39	359.17
							9/25/2014	14.59	351.97
							12/17/2014	11.88	354.68
							3/25/2015	9.31	357.25
							6/17/2015	12.03	354.53
							9/22/2015	12.48	354.08
MW-160	9/4/2012	374.71	2	38	7.5 - 37.5	367.21	9/12/2012	19.04	355.67
							10/8/2012	17.65	357.06
							12/18/2013	16.51	358.20
							3/25/2014	15.56	359.15
							6/19/2014	15.72	358.99
							9/25/2014	22.65	352.06
							12/17/2014	20.54	354.17
							3/25/2015	17.83	356.88
							6/17/2015	20.31	354.40
							9/22/2015	20.72	353.99

Table 1
Monitoring Well Gauging Data and Groundwater Elevations
Former Building 45/50 Unleaded Gasoline Release - Tank 009
Harley-Davidson Motor Company Operations, Inc.
1425 Eden Road, York, York County, Pennsylvania
PADEP Facility ID No. 67-00823
Leidos Project Number 301425.TM.100044.4000.0100

Location	Monitoring Well Installation Date	TOC Elevation (Feet)	Well Diameter (inches)	Total Drilled Depth (fbg)	Screened Interval (fbg)	Top of Well Screen Elevation (feet)	Date	SWL (fbtoc)	SWL Elevation (feet)
MW-26	5/20/1987	379.44	2	62	11 - 61	368.44	6/27/2012	25.02	354.42
							7/2/2012	25.32	354.12
							7/5/2012	25.56	353.88
							7/10/2012	26.04	353.40
							7/20/2012	25.11	354.33
							7/25/2012	25.31	354.13
							8/1/2012	24.68	354.76
							8/6/2012	24.28	355.16
							8/17/2012	24.25	355.19
							8/24/2012	24.86	354.58
							8/30/2012	24.71	354.73
							9/12/2012	NM	NM
							10/8/2012	23.68	355.76
							12/18/2013	22.75	356.69
							3/25/2014	20.91	358.53
							6/19/2014	21.40	358.04
							9/25/2014	28.15	351.29
							12/17/2014	26.22	353.22
							3/25/2015	23.93	355.51
							6/17/2015	25.83	353.61
							9/22/2015	26.18	353.26
MW-77	6/10/1998	379.48	2	67	40 - 65	339.48	6/27/2012	24.29	355.19
							7/2/2012	24.72	354.76
							7/5/2012	24.93	354.55
							7/10/2012	25.42	354.06
							7/20/2012	24.96	354.52
							7/25/2012	24.83	354.65
							8/1/2012	24.35	355.13
							8/6/2012	24.13	355.35
							8/17/2012	24.15	355.33
							8/24/2012	24.53	354.95
							8/30/2012	24.40	355.08
							9/12/2012	24.20	355.28
							10/8/2012	23.04	356.44
							12/18/2013	22.22	357.26
							3/25/2014	20.51	358.97
							6/19/2014	20.81	358.67
							9/25/2014	27.65	351.83
							12/17/2014	25.87	353.61
							3/25/2015	23.21	356.27
							6/17/2015	25.19	354.29
							9/22/2015	24.95	354.53

Notes:

fbtoc - feet below top of well casing
TOC - top of casing
fbg - feet below grade
N/A - not applicable
NM - not measured
SWL - static water level
*- Groundwater elevation corrected for the presence of product using a specific gravity of 0.75 for gasoli

Table 2
Groundwater Sample Analytical Results
Former Building 45/50 Unleaded Gasoline Release - Tank 009
Harley-Davidson Motor Company Operations, Inc.
1425 Eden Road, York, York County, Pennsylvania
PADEP Facility ID No. 67-00823
Leidos Project Number 301425.TM.100044.4000.0100

Sample Location	Sample ID	Date Sample Collected	Date Sample Analyzed	Analysis Method 8260B								
				Benzene	Toluene	Ethylbenzene	Total Xylenes	Methyl Tertiary Butyl Ether (MTBE)	Naphthalene	Isopropylbenzene (Cumene)	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene
MW-77	HD-MW-77-01-0	6/24/2011	7/7/2011	**1,500**	56	80	74 J	**520**	NA	NA	NA	NA
	HD-MW-77-01-0	8/1/2012	8/7/2012	**2,000**	110	140	130 J	**540**	41 J	24 J	33 J	13 J
MW-118	HD-MW-118-01-0	8/25/2011	9/9/2011	**120 H**	560 H	630 H	1,900 H	<50 H	42 J H	130 H	**460 H**	**130 H**
	HD-MW-118-01-0	9/30/2011	10/11/2011	**120**	520	**1,000**	2,800	<100	**130**	88 J	**790**	**250**
	HD-MW-118-01-0	8/1/2012	8/15/2012	**39 J**	110	**600**	1,400	<50	22 JB	78	**600**	**210**
MW-119	HD-MW-119-01-0	8/25/2011	9/9/2011	**6,100 H**	**6,300 H**	510 J H	1,900 H	<630 H	**280 J H**	<630 H	**170 J H**	<630 H
	HD-MW-119-01-0	9/30/2011	10/11/2011	**11,000**	**18,000**	**2,600**	10,000	<500	**240 J**	<500	**1,300**	**480 J**
	HD-MW-119-01-0	8/1/2012	NS/FP	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**	**NS/FP**
MW-120	HD-MW-120-01-0	8/25/2011	9/7/2011	2.2 J	0.94 J	<5.0	<15.0	14.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-120-01-0	9/30/2011	10/11/2011	<5.0	<5.0	<5.0	<15.0	1.1 J	<5.0	<5.0	<5.0	<5.0
	HD-MW-120-01-0	8/1/2012	8/6/2012	**7.0**	<5.0	<5.0	<15.0	6.8	<5.0	<5.0	<5.0	<5.0
MW-121	HD-MW-121-01-0	8/25/2011	9/8/2011	**390**	**3,700 E**	**990**	3,600	**45 J**	26 J	120	**430**	**120**
	HD-MW-121-01-0	9/30/2011	10/11/2011	**430**	**4,900**	**1,000**	3,700	**56 J**	<250	45 J	**330**	**140 J**
	HD-MW-121-01-0	8/1/2012	8/7/2012	**480 J**	**6,900**	**1,900**	7,600	**35**	<500	89	**980**	**230**
MW-122	HD-MW-122-01-0	7/2/2012	7/6/2012	<5.0	<5.0	<5.0	<15.0	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-122-01-0	8/1/2012	8/15/2012	<5.0	<5.0	<5.0	<15.0	<5.0	1.1 JB	<5.0	<5.0	<5.0
MW-123	HD-MW-123-01-0	7/2/2012	7/6/2012	<5.0	<5.0	<5.0	<15.0	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-123-01-0	8/1/2012	8/15/2012	<5.0	<5.0	<5.0	<15.0	<5.0	2.8 JB	<5.0	<5.0	<5.0
MW-124	HD-MW-124-01-0	7/2/2012	7/6/2012	**1,400**	**4,000**	660	3,800	**39**	**1,600**	57	**550**	**240**
	HD-MW-124-01-0	8/1/2012	8/15/2012	**2,300**	**8,400**	**960**	9,500	**44 J**	**540 B**	36 J	**1,200**	**490**
MW-125	HD-MW-125-01-0	7/2/2012	7/6/2012	<5.0	<5.0	<5.0	<15.0	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	8/1/2012	8/6/2012	<5.0	<5.0	<5.0	<15.0	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	12/18/2013	12/27/2013	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	3/25/2014	4/7/2014	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	6/19/2014	6/24/2014	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	9/25/2014	10/2/2014	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	12/17/2014	12/19/2014	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	3/25/2015	3/30/2015	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	6/17/2015	6/19/2015	<5.0	<5.0	0.97 J	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-125-01-0	9/22/2015	9/29/2015	1.4 J	<5.0	<5.0	<10	<5.0	0.5 JB	<5.0	<5.0	<5.0
MW-160	HD-MW-160-01-0	9/12/2012	9/21/2012	**180**	17	12	20	<5.0	4.3 J	1.2 J	3.4 J	<5.0
	HD-MW-160-01-0	12/18/2013	12/27/2013	**120**	5.8	6.3	<10	<5.0	<5.0	<5.0	<5.0	<5.0
	HD-MW-160-01-0	3/25/2014	4/8/2014	**340**	61	23 J	51	<25	<25	4.1 J	17 J	<25
	HD-MW-160-01-0	6/19/2014	6/24/2014	**270**	59	22	48	<5.0	<5.0	2.5 J	20	6.0
	HD-MW-160-01-0	9/25/2014	10/2/2014	**440**	190	35 J	190	<50	<50	<50	<50	<50
	HD-MW-160-01-0	12/17/2014	12/19/2014	**400**	76	39	51	<5.0	3.8 J	5.5	25	<5.0
	HD-MW-160-01-0	3/25/2015	3/30/2015	**560**	64	38	34	1.7 J	5.2	4.1 J	14	<5.0
	HD-MW-160-01-0	6/17/2015	6/19/2015	**660**	230	76	220	<50	14 JB	<50	38 J	<50
	HD-MW-160-01-0	9/22/2015	9/29/2015	**270**	100	22 J	69	<25	5.9 JB	<25	16 J	<25
PADEP Non-Residential Groundwater MSCs				5	1,000	700	10,000	20	100	3,500	62	53
PADEP Default Non-Residential Volatilization to Indoor Air Screening Values for Groundwater				5,900	NOC	45,000	NOC	640,000	NOC	NOC	12,000	10,000

Notes:
All results reported in micrograms per liter (µg/L)
E - Result exceeded calibration range
H - Sample was prepped or analyzed beyond the specified holding time
J - Result is less than the reporting limit (RL) but greater than or equal to the method detection limit (MDL) and the concentration is an approximate value
B - Compound was found in both the method blank and sample.
NS/FP - Not Sampled, Free Product observed.
MSCs - Medium Specific Concentrations
NOC - Not of concern, value above constituent water solubility
PADEP - Pennsylvania Department of Environmental Protection
QA/QC - Quality Assurance/Quality Control
Results that are bold/shaded are greater than PADEP nonresidential MSCs and/or indoor air screening values

APPENDIX A

Groundwater Sample Analytical Report
(Provided on Accompanying CD)

APPENDIX B

Groundwater Fate-and-Transport Models

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Harley-Davisdon Motor Company, Inc.		
Date:	10/27/2015	Prepared by:	KVL
		Contaminant:	Benzene - 22 Years original model vs. current concentration

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987)
Modified to Include Retardation

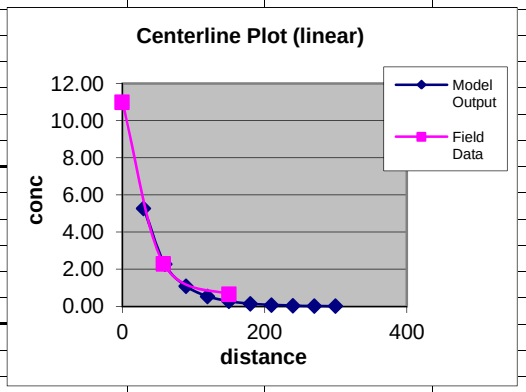
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
15	5.00E+01	5.00E+00	1.00E-03	0.00096	30	10	7,300

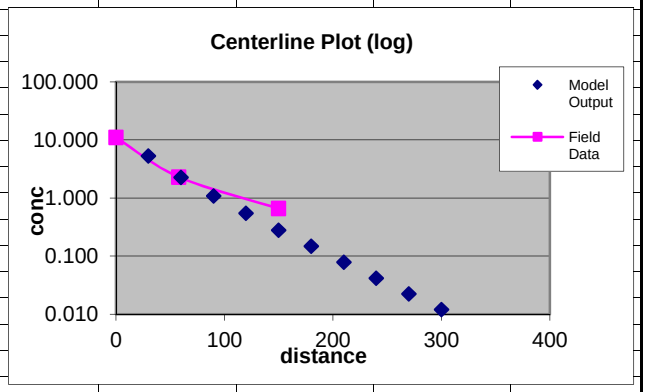
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.00E-01	0.05	0.2	1.85	58	1.60E-03	1.8584	0.026904864

Point Concentration

x(ft)	y(ft)	z(ft)
1,650	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1650	0	0
at	7300	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	300
Width (ft)	100

	30	60	90	120	150	180	210	240	270	300
100	0.000	0.001	0.006	0.011	0.012	0.010	0.008	0.006	0.004	0.002
50	0.186	0.358	0.302	0.204	0.127	0.076	0.044	0.025	0.014	0.008
0	5.279	2.269	1.084	0.544	0.280	0.147	0.078	0.042	0.022	0.012
-50	0.186	0.358	0.302	0.204	0.127	0.076	0.044	0.025	0.014	0.008
-100	0.000	0.001	0.006	0.011	0.012	0.010	0.008	0.006	0.004	0.002
Field Data: Centerline C Concentration				11	2.3	0.66				
Distance from Source				0.1	58	150				

Appendix B - Benzene modeled for 22 years. All other parameters unchanged.

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Harley-Davisdon Motor Company, Inc.		
Date:	10/27/2015	Prepared by:	KVL
		Contaminant:	Benzene - 22 Years with 30,000 ug/L source concentration

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987)
Modified to Include Retardation

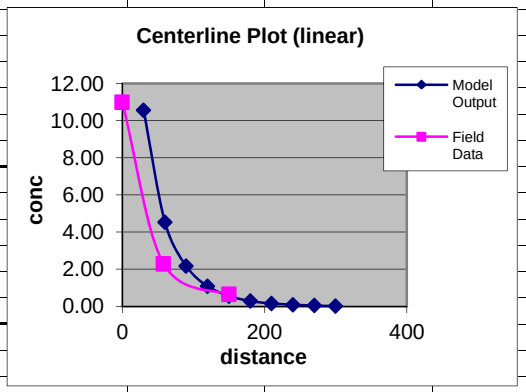
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
30	5.00E+01	5.00E+00	1.00E-03	0.00096	30	10	7,300

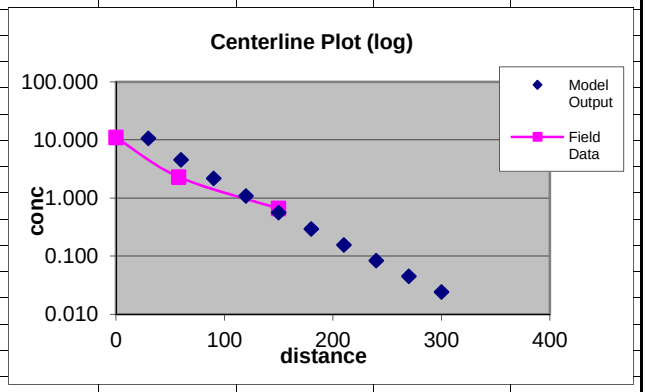
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.00E-01	0.05	0.2	1.85	58	1.60E-03	1.8584	0.026904864

Point Concentration

x(ft)	y(ft)	z(ft)
1,650	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1650	0	0
at	7300	days =	0.000
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	300
Width (ft)	100

	30	60	90	120	150	180	210	240	270	300
100	0.000	0.003	0.013	0.021	0.023	0.020	0.016	0.011	0.007	0.005
50	0.371	0.716	0.603	0.409	0.254	0.151	0.088	0.051	0.029	0.016
0	10.558	4.538	2.168	1.087	0.561	0.294	0.156	0.084	0.045	0.024
-50	0.371	0.716	0.603	0.409	0.254	0.151	0.088	0.051	0.029	0.016
-100	0.000	0.003	0.013	0.021	0.023	0.020	0.016	0.011	0.007	0.005
Field Data: Centerline C	Concentration			11	2.3	0.66				
	Distance from Source			0.1	58	150				

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Harley-Davisdon Motor Company, Inc.						
Date:	10/27/2015	Prepared by:	KVL				
		Contaminant:	Benzene - 22 Years with adjusted effective porosity				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
15	5.00E+01	5.00E+00	1.00E-03	0.00096	30	10	8,030

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.00E-01	0.05	0.1	1.85	58	1.60E-03	2.7168	0.036808009

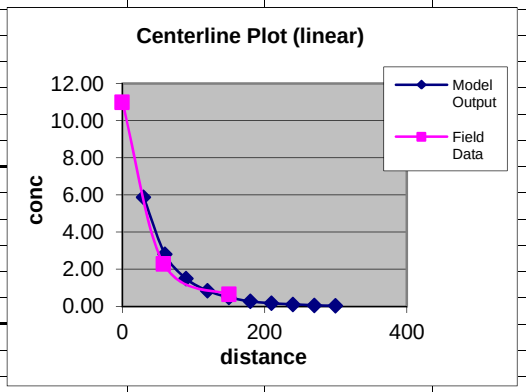
NEW QUICK_DOMENICO.XLS

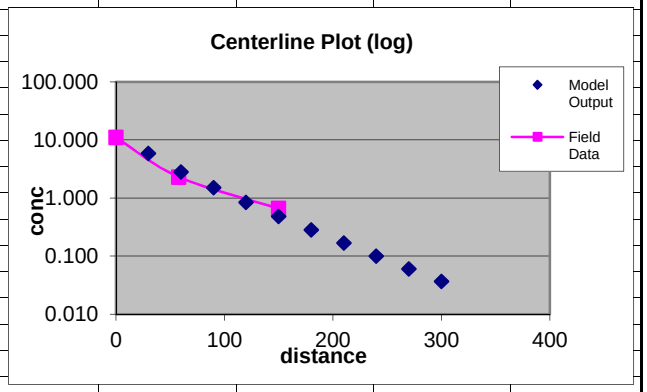
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
1,650	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1650	0	0
at	8030	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 300

Width (ft) 100

	30	60	90	120	150	180	210	240	270	300
100	0.000	0.002	0.009	0.017	0.020	0.020	0.017	0.013	0.010	0.007
50	0.207	0.444	0.417	0.315	0.218	0.145	0.094	0.060	0.038	0.024
0	5.880	2.815	1.498	0.837	0.481	0.282	0.167	0.100	0.060	0.036
-50	0.207	0.444	0.417	0.315	0.218	0.145	0.094	0.060	0.038	0.024
-100	0.000	0.002	0.009	0.017	0.020	0.020	0.017	0.013	0.010	0.007
Field Data:	Centerline C Concentration			11	2.3	0.66				
	Distance from Source			0.1	58	150				

Appendix B - Benzene modeled for 22 years. Effective porosity 10 percent.