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Third Site Supplemental Sampling Work Plan Draft

Prepared for

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1. INTRODUCTION

On behalf of the Trustee of the Third Site Trust Fund, Geosyntec Consultants (Geosyntec) with the assistance Ramboll have prepared this Supplemental Sampling Work Plan for the Third Site (or Site) located at 985 S. US Highway 421 in Zionsville, Indiana (**Figure 1**). This work plan outlines the field activities required to close data gaps in the conceptual site model and further evaluate the groundwater flow and contaminant distribution in the area around and upgradient of MW-28.

1.1 Purpose

The purpose of the proposed work is to further evaluate the distribution of contaminants within the Upper Till and the Upper Sand and Gravel Unit and to better define the edges of the sand filled paleochannel. The data collected will aid in determining the appropriate strategy to address plume migration in the vicinity of MW-28. The investigation will focus on the area between MW-22 and south of Finley Creek along Highway 421 and in the vicinity of MW-28 (**Figure 1**). This work follows on from the pumping tests and groundwater sampling at the Site during October 2017 (Geosyntec, 2018) and subsequent groundwater modeling work conducted in 2018/2019 (Geosyntec 2019). The additional investigations in this area are planned to complete the conceptual site model and provide additional information for the Remedial Alternatives Analysis and remedial design. Results from the proposed investigations in this work plan will inform recommendations for potential future remedial actions.

1.2 Objectives

The specific objectives of the proposed work are to:

- Advance understanding of the Site geology and hydrogeology, specifically:
  - The margins of the inferred paleo-channel infilled by Upper Sand and Gravel Unit, specifically in the area between MW-22 and immediately south of Finley Creek and in the area of MW-28;
  - Improve the understanding of the hydrogeology in the Upper Till and the Upper Sand and Gravel unit; and,
  - Closing data gaps.
- Determine the distribution of Site impacts in the Upper Till and Upper Sand and Gravel Unit in this area through the collection of groundwater samples for the

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compounds of concern (COCs) and geochemical parameters to provide additional groundwater data.

1.3 Organization

This Work Plan is organized as follows:

1. Section 2 presents a summary of the Site background;
2. Section 3 describes the proposed investigation and sampling;
3. Section 4 presents the project schedule; and
4. Section 5 contains a list of all references.

2. BACKGROUND

2.1 Geology

The Site is underlain by four stratigraphic units (Geosyntec, 2016) and include (shallowest to deepest)

- Fill material with high clay content up to 10 feet thick
- Upper Till (1 to 10 feet thick) comprising clayey silt and silty clay with occasional lenses of sand and gravel or silty sand with lenses or pockets of gravelly sand up to 5 feet thick
- Upper Sand and Gravel (3 to 30 feet thick), comprising fine to coarse sand and gravel unit with some silt lenses
- Lower Till (120 to 130 feet thick), an aquitard composed predominantly of clayey silt and silty clay.

A mixed glacio-fluvial/colluvial depositional environment was inferred for the Upper Sand and Gravel unit, which likely formed as post-glacial deposits from meltwater outwash. A paleo-channel was identified as a deepening of the Upper Sand and Gravel unit to the south of the Third Site (Geosyntec, 2016). The extent of the paleo-channel was inferred from previously generated cross-sections (ENVIRON, 2014) and soil borings completed during the 2013 phase of investigation (**Figures 2 and 3**).

This supplemental investigation focuses on the Upper Till and Upper Sand and Gravel stratigraphic units.

2.2 Hydrogeology

Historical and current water level measurements indicate that the groundwater within the Upper Sand and Gravel Unit generally flows towards the southwest (**Figure 3**). Inferred differences in hydraulic gradient between the northern half of the Site (approximately 0.02 feet per feet) and the southern half of the Site and off-Site area (approximately 0.004 feet per feet) are attributed to an apparent increase in aquifer thickness and transmissivity downgradient of Bankert Pond.

The hydraulic conductivity in the Upper Sand and Gravel unit is between 5.8×10^{-3} and 1.9×10^{-2} centimeters per second (cm/s), based on the 25th and 75th percentiles of field measurements (Geosyntec, 2016). This range was corroborated in the modelling effort and independent flow tube/net analysis (Geosyntec 2019). Calculated groundwater flow velocities (based on effective porosity of 0.3 cm^3/cm^3 and hydraulic gradients between 0.004 and 0.02 feet per feet) are between 80 to 260 feet per year in the downgradient region of the Site and off-site area, and between 400 and 1,300 feet per year in the northern area of the Site.

The Upper Sand and Gravel unit is semi-confined by the overlying Upper Till. The hydraulic conductivity in the Upper Till is generally lower than the Upper Sand and Gravel unit and is between 6.8×10^{-4} and 7.3×10^{-3} cm/s (based on the 25th and 75th percentiles of field measurements (Geosyntec, 2016). The approximate water elevation in Bankert Pond is 875 ft mean sea level (msl). The elevation of the pond water was not affected by hydraulic testing performed previously in the containment area. The pond therefore is likely to be hydraulically isolated from the Upper Sand and Gravel unit.

A groundwater extraction pump and treat system comprising five extraction wells (EW-1, EW-2, EW-3, EW-4 and EW-5, **Figure 1**) and associated conveyance piping and equipment has been in operation at the Site since April 2, 2014.

Notable depressions in the groundwater potentiometric surface were observed around extraction wells EW-1, EW-4, and EW-5 during the September and December, 2015 water level gauging events and during the 2018 synoptic groundwater elevation survey at

the Site[1]. The potentiometric surface during operation of the pump and treat system during the October 2017 fieldwork is depicted in **Figure 4**.

2.3 Contaminant Distribution

VOC Plume 1 is located within the Upper Sand and Gravel unit and extends off-Site southwest of Highway 421. The dense non-aqueous phase liquid (DNAPL) area was identified as the primary source of VOC Plume 1 (ENVIRON, 2000). The source area has since been contained with the installation of a sealed sheet pile wall (**Figure 1**) that extends into the Lower Till (confining unit).

The primary source of VOC Plume 2 appears to be related to an area of historic truck parking and waste handling operations in the northern portion of the Site (ENVIRON, 2000). VOC Plume 2 is located within the Upper Till.

Concentrations indicative of VOC Plume 1 and 2 are presented in **Figure 5** and are based on the combination of data from the Supplemental Data Collection Report Dissolved COC Plume (ENVIRON, 2014) and the Engineering Evaluation/Cost Analysis (ENVIRON, 2000). The maximum observed total volatile organic compound concentrations in VOC Plume 1 and 2 in March 2016 were 5,522 micrograms per liter (µg/L) and 291.6 µg/L, respectively while the chemical compositions of both VOC plumes consist primarily of the following chlorinated solvents:

- Trichloroethene (TCE);
- 1,1,1-Trichloroethane (TCA);
- cis-1,2-Dichloroethene (cis-1,2-DCE);
- trans-1,2-Dichloroethene (trans-1,2-DCE);
- Vinyl chloride (VC);
- 1,1-Dichloroethane (1,1-DCA); and
- 1,1-Dichloroethene (1,1-DCE).

Figure 5 also presents the locations of the existing groundwater monitoring and extraction wells located along the estimated axis of the groundwater VOC plumes, particularly to the west of the Highway 421. The groundwater analytical data collected

[1] Observed drawdown in the pumped wells may be exacerbated by well losses

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from the monitoring wells were supplemented with the collection of groundwater grab samples via a Waterloo Profiler (ENVIRON, 2014) to aid in the delineation of the width of VOC Plume 1.

3. SCOPE OF WORK

The investigation activities presented in this work plan include both adaptive field investigation activities using a direct push technology (DPT) drill rig as well as installation and water level gauging of temporary piezometers. The field investigation activities will be performed primarily by Ramboll with support and data interpretation from Geosyntec. Prior to the start of drilling activities underground utilities and/or installations will be marked. The exact location of the proposed DPT borings and groundwater grab sample depths and subsequent piezometer installations presented in this work plan (**Figure 6**) may be adjusted slightly based on access, subsurface or overhead obstructions and restrictions (e.g. above or below ground utilities), and real-time evaluation of geology/hydrogeology data from the DPT sampling tool.

The subsequent subsections provide a description of the scope of work recommended by Geosyntec.

3.1 Groundwater Sampling and Hydraulic Analysis Using Direct Push Sampling Equipment

Groundwater samples will be collected from the Upper Till and Upper Sand and Gravel units using DPT equipped with a groundwater profiling tool (Waterloo Advanced Profiling System, a.k.a. the Waterloo^{APS}). The Waterloo^{APS} is a direct push groundwater sampling tool owned by Cascade (previously owned by Stone Environmental) that is a proprietary modification of the Waterloo Profiling tool developed by Dr. John Cherry and his research team at the University of Waterloo. In addition to the collection of groundwater samples for chemical analysis, the Waterloo^{APS} has custom software that provides real-time visual display of the Index of Hydraulic Conductivity (IK) recorded versus depth to infer site stratigraphy and locate optimal sampling intervals. This software also displays hydraulic head at each sample depth, and the depth and rate of penetration while advancing the tooling. Additional information regarding the Waterloo^{APS} is included in Attachment 1.

A series of 12 borings will be advanced with the Waterloo^{APS} in three transects; one located between MW-20 and MW-33, and two transects west of Highway 421 in the

vicinity of MW-28 (**Figure 6**). The borings will extend from ground surface to the top of the Lower Till and will collect groundwater samples from the first water strike (in the Upper Till or Sand and Gravel layer depending on location) and thereafter approximately every 5 ft with depth. To ensure groundwater samples are collected from a discreet interval, samples will be collected starting at the shallowest depth interval and proceeding with depth. Boring locations may be altered slightly from those shown on **Figure 6**, or new locations may be added, based on the inferred stratigraphy results from the first and subsequent borings, in order to confirm the edges of the paleo-channel.

Groundwater samples collected from each location will be analyzed for VOCs by Pace Analytical of Indianapolis, Indiana using USEPA SW-846 Method 8260B.

Once the target depth interval is reached, a groundwater sample will be collected into laboratory provided bottles using a positive displacement nitrogen gas-drive pump. Prior to sample collection for VOCs analysis, physiochemical parameters including pH, specific conductance (SC), dissolved oxygen (DO), and oxidation/reduction potential (ORP) will be measured and recorded.

3.2 Temporary Piezometer Installation and Water Level Measurements

The DPT rig will be used to collect core for lithology description and comparison to the inferred stratigraphic analysis from the Waterloo^{APS} tool from the two locations shown on Figure 2 in yellow. These borings will then be instrumented with a temporary piezometer (TPZ) to collect representative water level data. Once the two TPZs have been installed, a synoptic round of water elevation measurements will be collected from:

- MW-20, MW-22, MW-23, MW-24, MW-25R, MW-28, MW-29, MW-32, MW-33, MW-34
- TPZ-1, TPZ-2, TPZ-5-1, TPZ-5-2, TPZ-5-3 and the two new TPZs TPZ-3 and TPZ-4

The results of the hydraulic profiling from the Waterloo^{APS} will be used for identifying the Upper Till, Upper Sand and Gravel, and Lower Till units. The proposed soil core will extend from ground surface to a maximum of 5 feet into the Lower Till (approximately 30-35 feet from ground surface in the vicinity of MW-33 and MW-23 and 40-45 ft bgs at west of MW-28). The borehole will be backfilled with grout to the base of Upper Sand and Gravel Unit in preparation for the TPZ installation.

The TPZ screen will be 10 feet in length and will be screened within the Upper Sand and Gravel Unit. If the thickness of the Upper Sand and Gravel Unit is less than 10 feet at that location, the screen will span the thickness of the Upper Sand and Gravel Unit. The TPZ will be constructed of 1-inch diameter PVC well casing with a 0.010 PVC screen. The TPZ will be installed with a sand pack consisting of 10 to 20-mesh sand. The TPZs will be abandoned by the driller at the completion of this supplemental sampling field event so no protective surface casing will be installed.

4. SCHEDULE

An anticipated schedule to complete the field investigation activities discussed in this work plan is presented below:

Task	**Timeframe**
Approval to proceed received from the EPA.	Week 0
Field preparation including scheduling, subcontractor contracting and Site access	5 weeks
Completion of Waterloo^{APS} profiling and TPZ installation, and gauging.	7 days - weather dependent
Compilation of field data report completed by Ramboll.	3 weeks
Analysis and generation of a report by Geosyntec that summarizes the finding of the results.	4 weeks
Total Number of Weeks to Completion Following Approval to Proceed	**13 weeks**

5. REFERENCES

ENVIRON. (2000). *Engineering Evaluation/Cost Analysis for Third Site, Zionsville, Indiana.* October 10, 2000: ENVIRON International Corporation.

ENVIRON. (2013). *Investigation Report, Third Site Superfund Site,Zionsville, Indiana.* August 21, 2013: ENVIRON International Corporation.

ENVIRON. (2014). *Supplemental Data Collection Report Dissolved COC Plume, Third Site Superfund Site, Zionsville, Indiana.* November 14, 2014: ENVIRON International Corporation.

Geosyntec. (2016). *Draft Third Site Data Gap Investigation Work Plan (Revision 1).* Guelph Ontario: November 30, 2017; Geosyntec Consultants, Inc.

Geosyntec. (2018). *Third Site Pumping Test Report (Revision 1).* Guelph Ontario: May 14, 2018; Geosyntec Consultants, Inc.

Geosyntec. (2019). Hydraulic capture analysis at Third Site using a groundwater flow model. Guelph Ontario: March 22, 2019; Geosyntec Consultants, Inc.

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FIGURES

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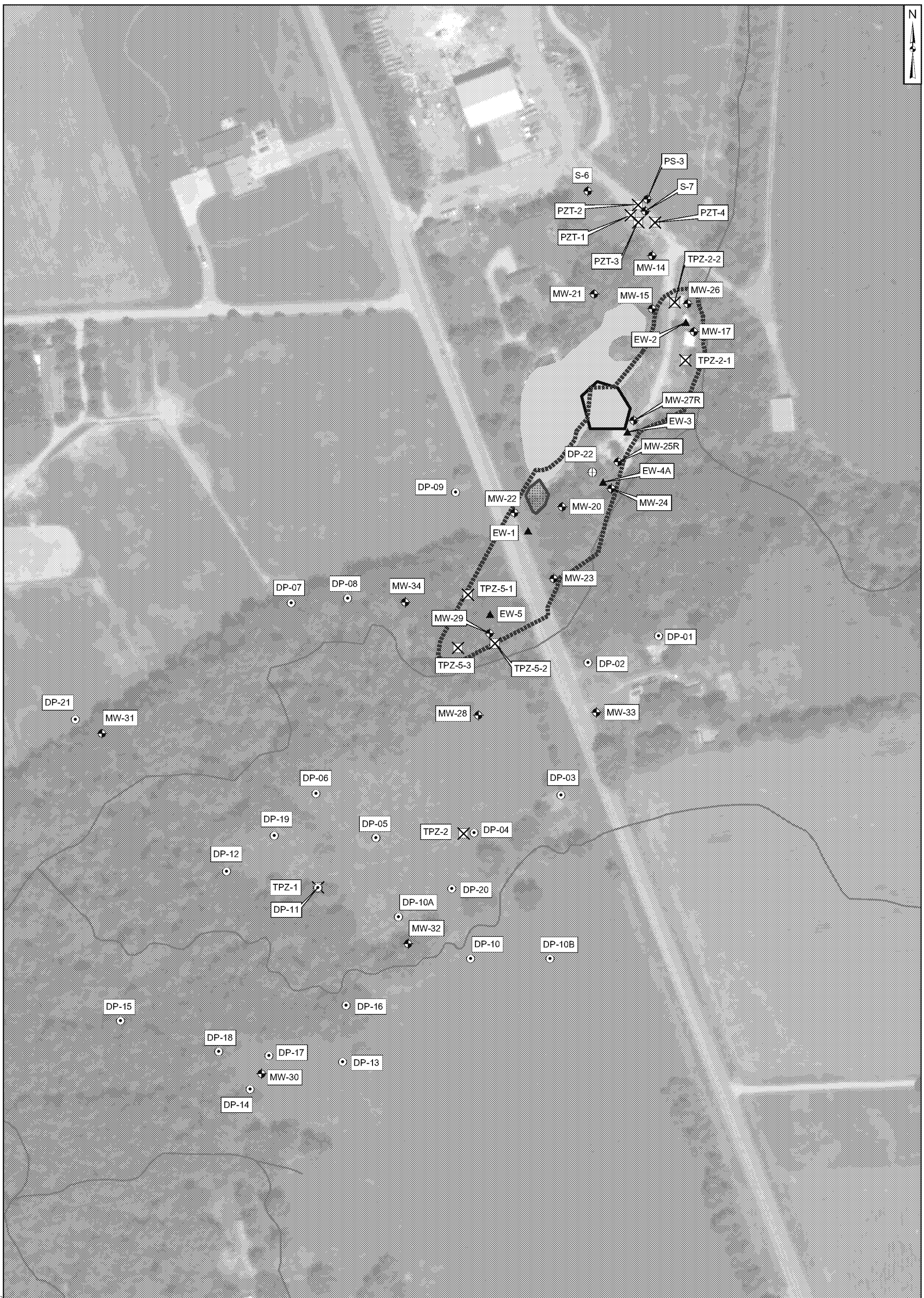

Legend

- Soil Boring
- Monitoring Well
- Extraction Well
- Previous Direct Push Sample
- Piezometer
- DNAPL Containment Area
- SVE Area 1
- SVE Area 2
- Third Site Area
- Bankert Pond
- Finley Creek

Notes:

1. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.

200 100 0 200 Feet

Site Map and Monitoring Well Network

Third Site
985 South U.S. Highway 421
Zionsville, Indiana

Geosyntec consultants

Guelph | April 2019

Figure 1

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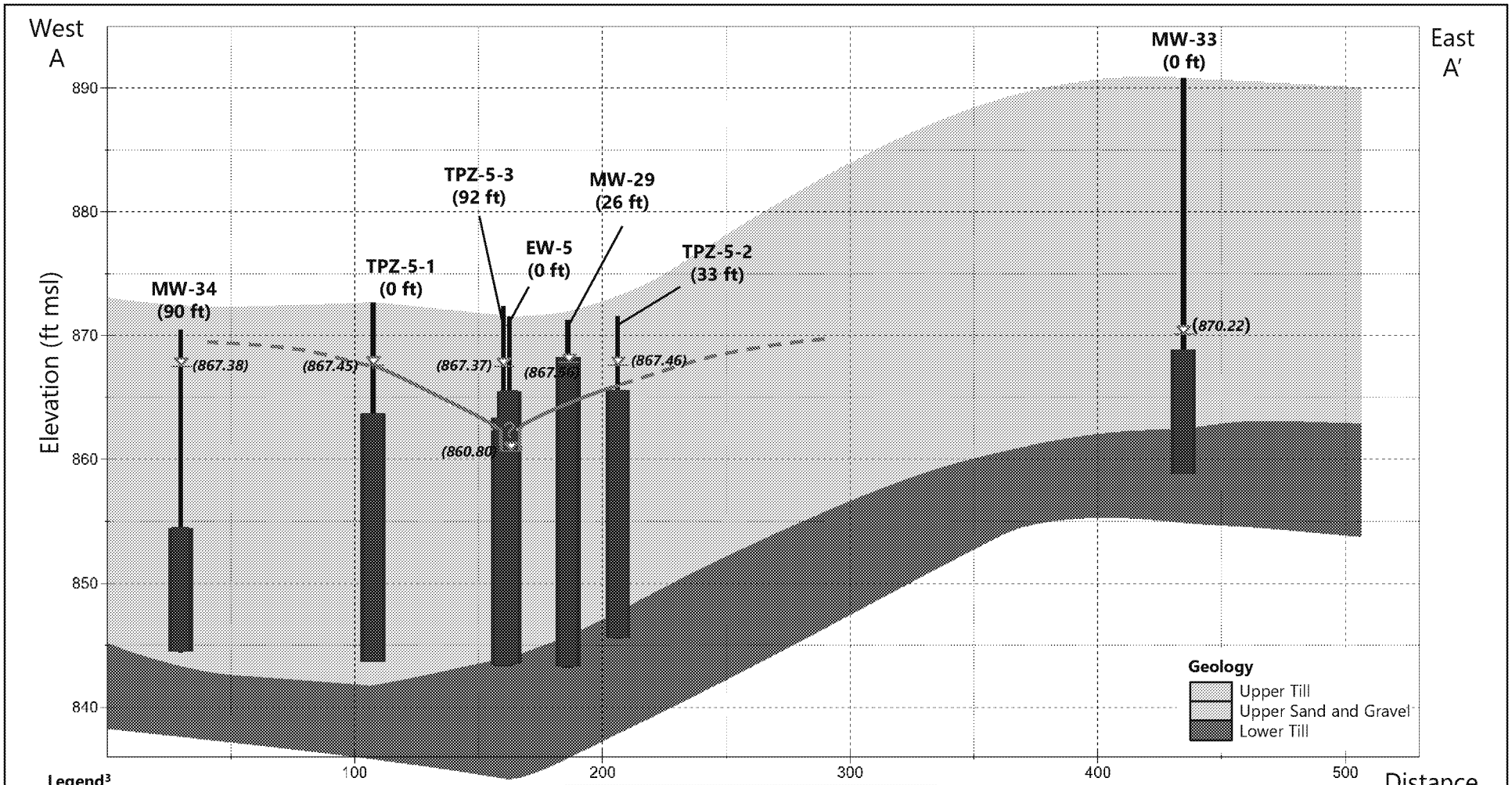
Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302



Legend[3]

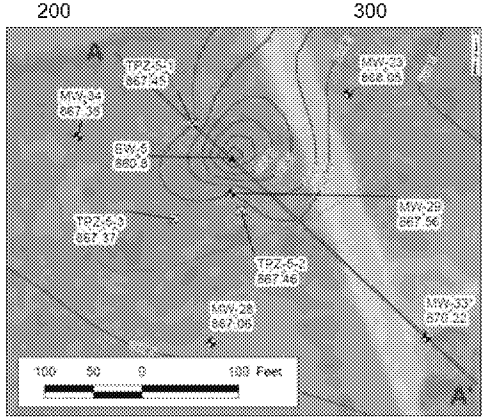
- Well Screen Interval
- Groundwater Elevation at Well
- Groundwater Elevation along A-A'
- Inferred Groundwater Elevation along A-A'

Notes

ft - feet

ft msl – feet mean sea level

1. Geology shown is the interpolation on the cross-section line and not on the projected locations.
2. Locations within 100 feet of cross-section line are projected (distances from cross-section line are posted).
3. Groundwater elevations are based on Operating Extraction System conditions (October 9 2017).



Hydrogeological Cross-Section A-A'

Third Site Superfund Site
985 South U.S. Highway 421
Zionsville, Indiana

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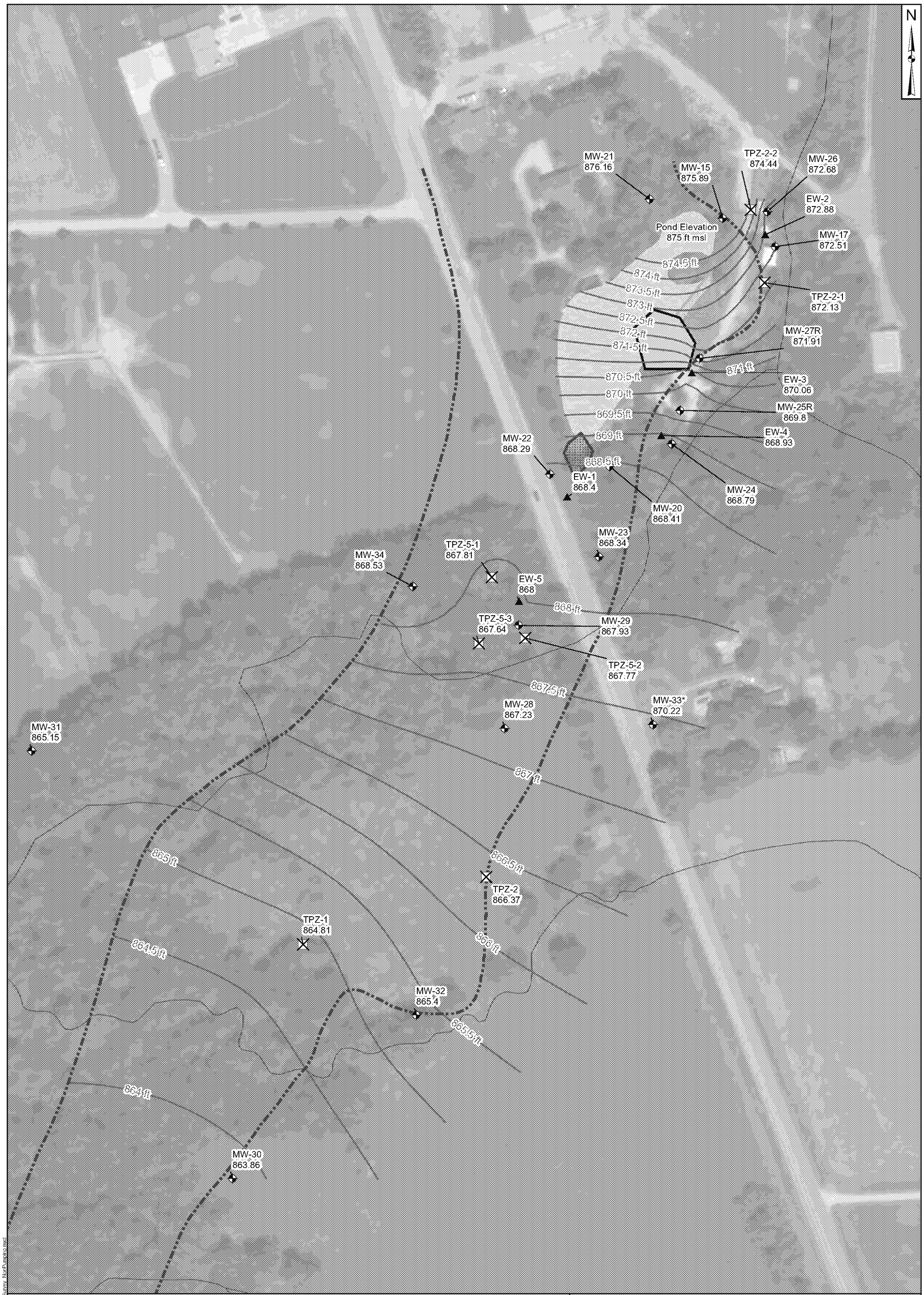
Figure 2

internal info: path, date revised, author



Legend

Groundwater Elevation when Pump & Treat System is Not Operatingl (ft msl)

- Monitoring Well
- Extraction Well
- Piezometer
- Approximate Position of the Paleolithic Channel
- Groundwater Contour (ft msl)
- DNAPL Containment Area
- SVE Area 1
- SVE Area 2
- Bankert Pond
- Creek

Notes:
DNAPL - dense non-aqueous phase liquid
ft msl - feet mean sea level
SVE - soil vapor extraction

* - Elevation excluded from groundwater contour interpolation due to geology contraints

1. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.

Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302

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Groundwater Flow Regime Upper Sand and Gravel Unit (Non-Operational Extraction System - Oct 16, 2017)

Third Site
985 South U.S. Highway 421
Zionsville, Indiana

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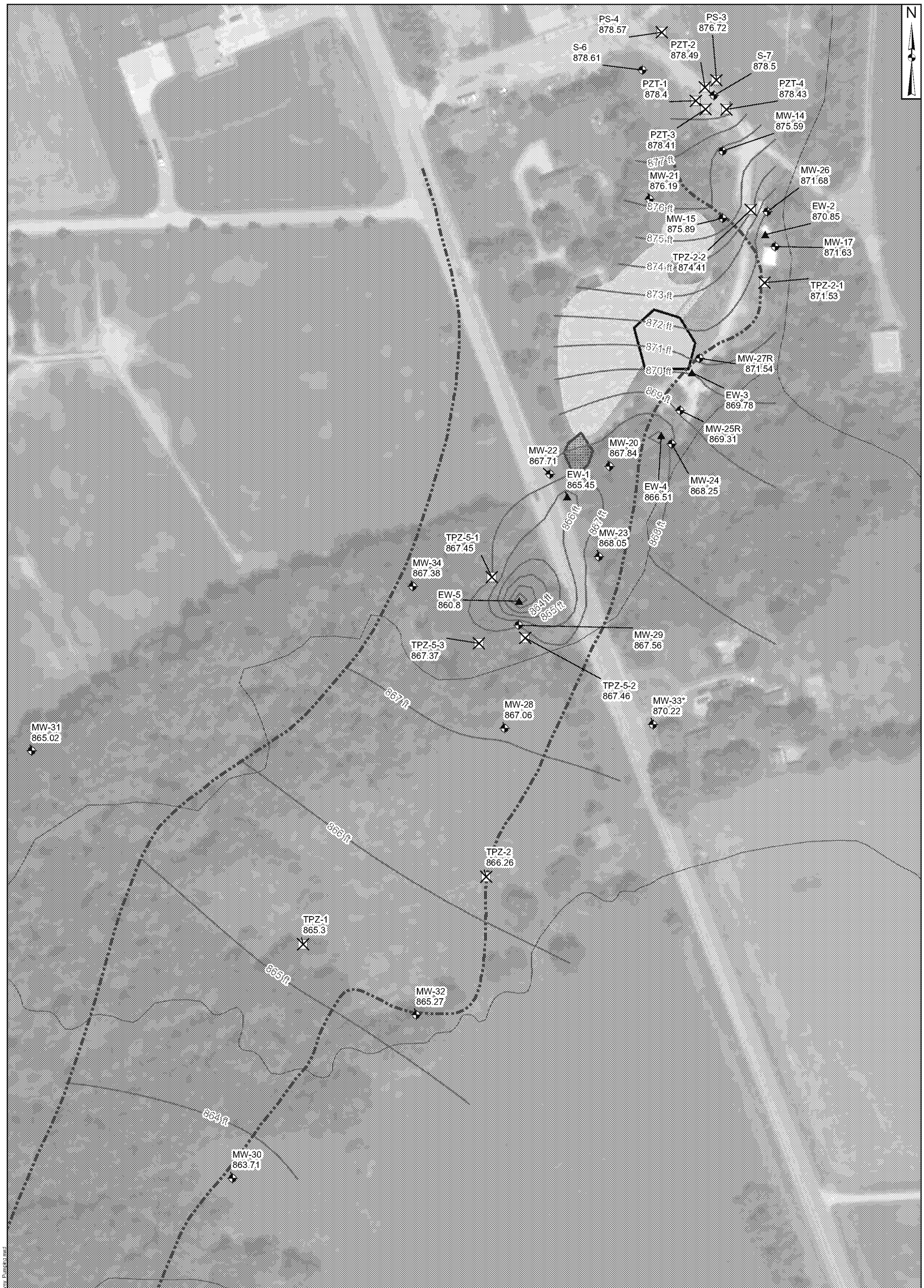
Figure 3



Legend

Groundwater Elevation when Pump & Treat System is Operational (ft msl)

- Monitoring Well
- Extraction Well
- Piezometer
- Approximate Position of the Paleolithic Channel
- Groundwater Contour (ft msl)
- DNAPL Containment Area
- SVE Area 1
- SVE Area 2
- Bankert Pond
- Creek

Notes:
DNAPL - dense non-aqueous phase liquid
ft msl - feet mean sea level
SVE - soil vapor extraction
* - Elevation excluded from groundwater contour interpolation due to geology contraints

1. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.
2. Groundwater elevations at MW-15 and MW-21 are calculated based on survey elevations listed in the Supplemental Predesign Investigation Technical Memorandum dated November 9, 1988.

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Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302

200 100 0 200 Feet

Groundwater Flow Regime Upper Sand and Gravel Unit (Operating Extraction System - Oct 9, 2017)

Third Site
985 South U.S. Highway 421
Zionsville, Indiana

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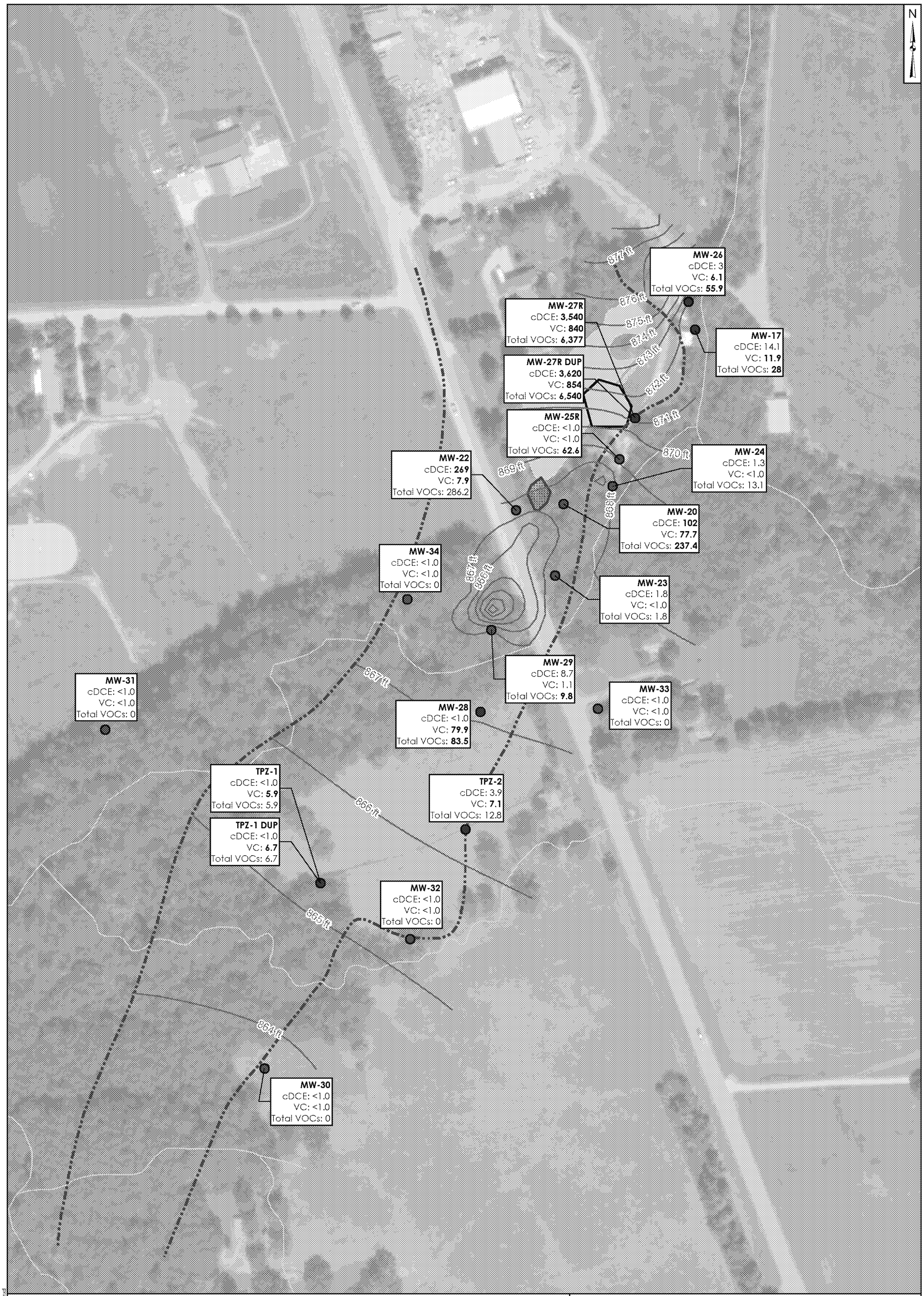
Figure 4



Legend

Sampling Locations

- Above Shut Down Criteria
- Below Shut Down Criteria
- DNAPL Containment Area
- SVE Area 1
- SVE Area 2
- Bankert Pond
- Approximate Position of the Paleolithic Channel
- Groundwater Contour (ft msl)
- Creek

Notes:
µg/L - micrograms per liter
cDCE - cis-1,2-dichloroethene
DNAPL - dense non-aqueous phase liquid
SVE - soil vapor extraction
Total VOCs - Total Volatile Organic Compounds
VC - Vinyl Chloride

1. All Analytical data are in micrograms per liter (µg/L)
2. Groundwater Action Levels (GAL) for cDCE and VC are 70 µg/L and 2 µg/L respectively.
3. Bolded concentrations are above other the GAL or Total VOC Pump and Treat (P&T) Shut Down Criteria.
4. Groundwater Action Levels (GAL) to be achieved after completion of monitored natural attenuation from Enforcement Action Memorandum dated May 11, 2001; Equivalent to MCL/IDEM Tier I Default Criteria of Table 2-7-C of the October 2000 EE/CA and Table 4 of the Design Report.
5. P&T Shut Down Criteria from Table 4 of the March 2004 Design Report. Values represent 10% of total VOC concentrations presented in Table 2-5 of the October 2000 EE/CA. For MW-27, MW-28, and MW-29, values provided represent 10% of total VOC concentrations from the 2012 sampling event (the most recent pre-pumping event). Please note that the GALs are the ultimate cleanup criteria after 10 years monitored natural attenuation as indicated in Note 2. As such, per Table 4 of the Design Report, P&T shutdown criteria are met when the wells in the plume either meet the GAL or show a 90% reduction in total VOC.
6. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.

200 100 0 200 Feet

Groundwater Analytical Data
(Operating Extraction System Groundwater Contours)

Third Site
985 South U.S. Highway 421
Zionsville, Indiana

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Figure 5

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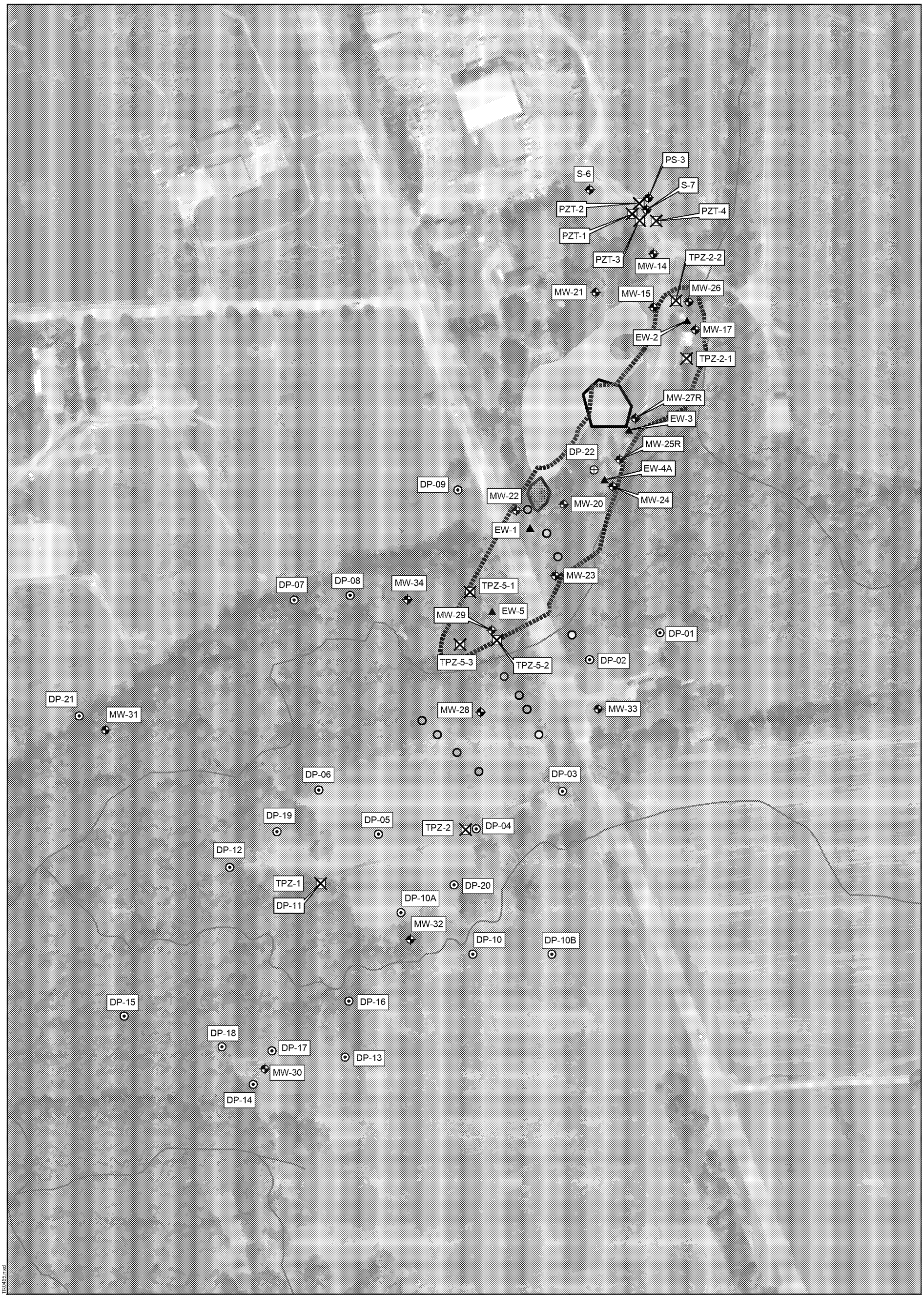
Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302



Legend

- Soil Boring
- Monitoring Well
- Extraction Well
- Previous Direct Push Sample
- Piezometer
- Waterloo^{APS} Location – Investigate hydraulic conductivity (hydrostratigraphic logging) and depth discrete groundwater sampling
- Waterloo^{APS} Location - Completed as Temporary Piezometer
- DNAPL Containment Area
- SVE Area 1
- SVE Area 2
- Third Site Area
- Bankert Pond
- Finley Creek

Notes:
1. Basemap Source: ESRI, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo.

200 100 0 200 Feet

Proposed Supplemental Sampling Plan

Third Site
985 South U.S. Highway 421
Zionsville, Indiana

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Figure 6

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Coordinate System: NAD 1927 StatePlane Indiana West FIPS 1302

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ATTACHMENT 1: Waterloo^{APS}

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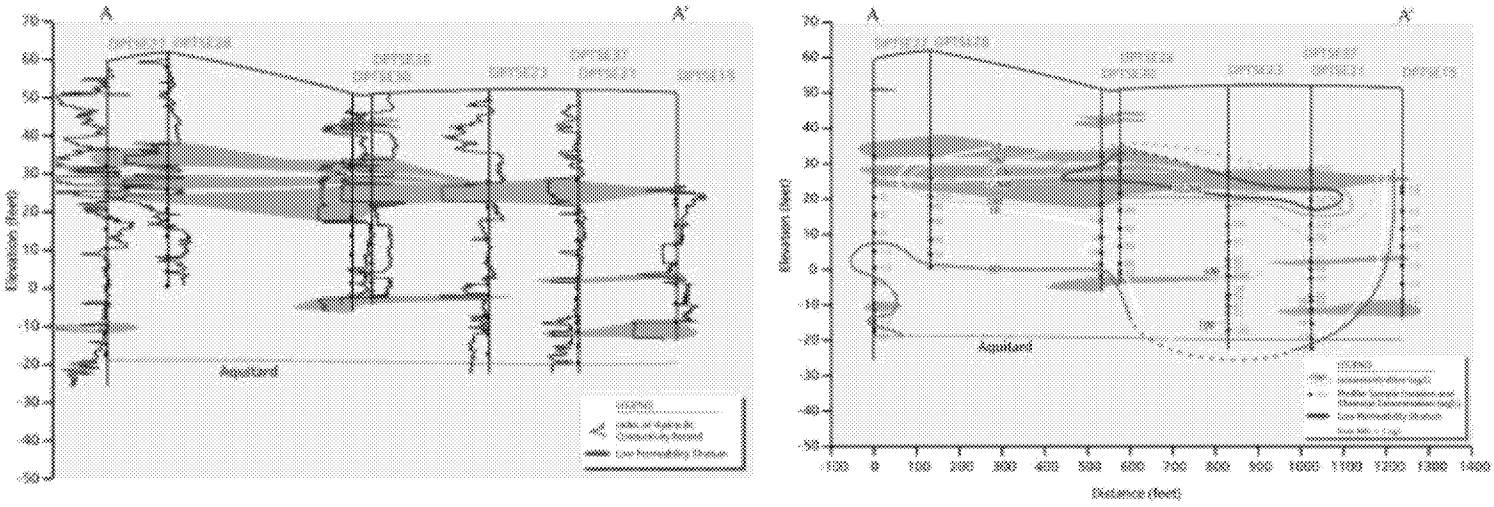
WATERLOO^{APS} TM

VERTICAL AQUIFER PROFILING WITH WATERLOO ADVANCED PROFILING SYSTEM

The Waterloo Advanced Profiling System (Waterloo^{APS}) is the next generation of the Waterloo Profiler that was originally introduced to investigation and remediation professionals in 1994.

Waterloo APS™
ADVANCED PROFILING SYSTEM

Developed and tested extensively at the University of Waterloo, the Waterloo Profiler transferred High-Resolution Site Characterization (HRSC) capability from the groundwater research community to industry. Built around this tool, WaterlooAPS is a complete subsurface data collection platform, combining the same high-quality, discrete sampling capability with continuous, real-time hydrosratigraphic logging. This system has been utilized worldwide for the past 14 years in a broad array of environments. Using hybrid drive methods, the WaterlooAPS has achieved depths of 600 feet below ground surface. The profiler uses a KPRO system (hydraulic conductivity profiling), a tool that provides a real-time continuous Index of Hydraulic Conductivity (IK) to determine the stratigraphy and best depths for sample collection.



Real-time hydrostratigraphic profiling in the same push with discrete depth sampling, without withdrawing the tool between samples, allows for very efficient high-resolution groundwater contamination investigation. In this figure the I_k allowed the investigator to identify and sample sand lenses within a clay unit that serve as major contaminant transport pathways.

REAL-TIME HYDROSTRATIGRAPHIC LOGGING AND SAMPLING IN A SINGLE PUSH

The KRPO system incorporated into the Waterloo^{APS} is the original injection logging hydraulic profiling tool. As the tool advanced, clean water is injected into the formation while depth, pressure and flow rate are monitored. From these data, a real-time continuous log of the Index of Hydraulic Conductivity is calculated. It is not necessary to drive the tool once to log the hydrostratigraphy and again to sample – both are accomplished in a single push.

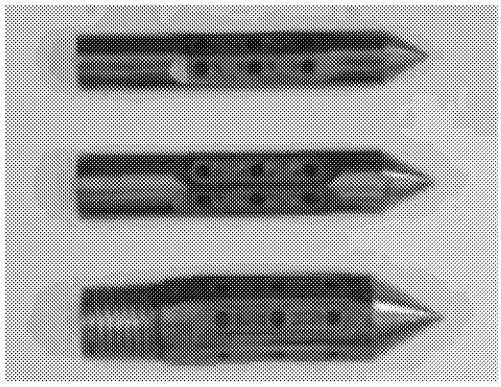
SAVING TIME AND MONEY

The integrated KRPO hydrostratigraphic profiling system saves time and money in three important ways:

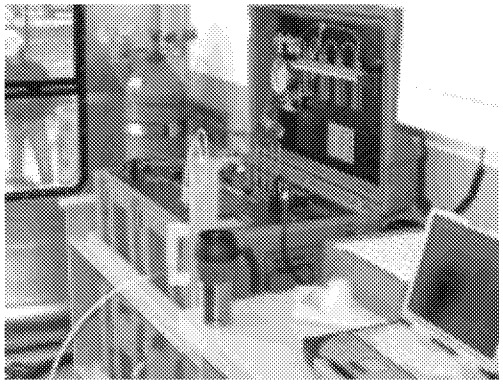
- KPRO helps us select depths at which to collect samples based on changes in stratigraphic as opposed to random or predetermined "blind" intervals. The I_k and sample collection are accomplished in a single push to obtain data more quickly and cost effectively.
- It enables a better understanding of the site's hydrostratigraphy for the creation of more accurate conceptual site models, and flow and transport models.
- It identifies impermeable zones so time is not water trying to collect water samples in suboptimal locations. Low permeability zones can, and should, be sampled high-resolution soil sampling techniques.

MULTIPLE MODELS FOR VARIOUS HYDOGEOLOGIC CONDITIONS

1. Waterloo^{APS} 224 – a 2.25-inch OD version of the most robust model, build to be used with the Geoprobe 8040 rigs for maximal depth penetration. The tip has more open area for higher sampling rates and reduced clogging. The 225 can be used with either a peristaltic pump or with the downhole nitrogen drive positive displacement pump.
2. Waterloo^{APS} 175 – the 1.75-inch OD version is the same diameter as the original Waterloo Profiler but utilizes more durable direct push rod and has the unique APS tip design.



One of these three profiling tip models is right for most conditions.



The KPRO system provides an integrated, high quality, high-resolution data collection system.