Remedial Investigation Report Addendum No. 2 - Pierson Creek Landfill Area DuPont Montague Facility Montague, Michigan

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Executive Summary

This report documents the findings from the supplemental investigations conducted near the Pierson Creek Landfill in June, September, and October 2013 at the E.I. du Pont de Nemours and Company (DuPont) Montague facility. The report also presents the conceptual model for groundwater flow and the potential transport of Pierson Creek Landfill-related constituents from the Landfill to Pierson Creek.

The purpose of the 2013 supplemental remedial investigation (RI) activities for the Pierson Creek Area was to address specific data gaps identified in the *DRAFT 2010/2011 Remedial Investigation Report* (RI Report) (URS, 2012). Specifically, the data collection focused on identifying the horizontal extent of groundwater impact and subsequent discharge via springs or direct discharge to the creek and understanding the groundwater flow and transport in the vicinity of Pierson Creek hydraulically downgradient of Pierson Creek Landfill. In addition, upstream surface-water and sediment data collected from the Pierson Creek main channel were collected to provide a better understanding of potential upstream influences and to evaluate whether there are potential impacts from groundwater discharge. As requested by Michigan Department of Environmental Quality (MDEQ), additional lithologic data profiling and vertical soil sampling was conducted to better determine the potential for stratified flow near Pierson Creek.

Key findings from the investigation are as follows:

- The extent of Pierson Creek Landfill-related constituents have been delineated, and this extent is limited to shallow groundwater between the landfill and the groundwater seeps along the eastern side of the Pierson Creek floodplain. Pierson Creek Landfill-related constituents were also detected in surface water samples collected from tributaries hydraulically downgradient of the landfill, however none of the constituents were elevated in downstream surface-water samples from the main channel of Pierson Creek.
- The lithology is stratified, and there is a consistently upward hydraulic gradient preventing downward flow of groundwater containing Pierson Creek Landfill-related constituents. There is no impact to the deeper portions of the aquifer. Several monitoring wells screen various intervals of the aquifer between the landfill and Pierson Creek, and these wells are sufficient to monitor the aquifer.
- Groundwater flows consistently west-southwest from the landfill towards and into Pierson Creek. Groundwater seeps containing Pierson Creek Landfill-related constituents also flow into the tributaries and subsequently into the main channel of Pierson Creek.
- Screening of the additional surface-water and sediment data collected within the main channel of Pierson Creek and in three of its tributaries indicates that exposure to Pierson Creek Landfill-related constituents does not pose a potential concern for human health or populations of aquatic receptors in Pierson Creek near and downstream of the landfill.

Based on the findings of this investigation, no further investigation is warranted and Pierson Creek Landfill Area will be evaluated as part of the remedial action plan (RAP).

1.0 Introduction

The DuPont Montague facility (site) is a former chemical manufacturing facility located in Muskegon County, Michigan (see Figure 1-1). This site is subject to corrective action under Part 111, Hazardous Waste Management, of the Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), and its administrative rules. To date, E.I. du Pont de Nemours and Company (DuPont) has been conducting corrective action at the facility on a voluntary basis with the Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division. The site investigations have been completed in accordance with the protection standards and relevant processes of MDEQ Part 201 to meet the corrective action obligations under Part 111 with MDEQ providing oversight, as necessary.

1.1 Remedial Investigation Background

A remedial investigation (RI) was conducted at the facility in October 2010 and in June and July 2011 (referred to here as the 2010/2011 RI). The purpose of the 2010/2011 RI was to address data gaps identified in the November 2006 *Prioritization of Waste Management Units and Areas of Concern, DuPont Montague* (referred to in this report as the *Prioritization Document*; DuPont, 2006). Activities conducted during the 2010 and 2011 fieldwork were proposed in the *Remedial Investigation Work Plan for Waste Management Units and Areas of Concern, DuPont Montague Site* (2007 RI Work Plan) submitted, February 2007.

Findings from the 2010-2011 investigations were documented in the *DRAFT 2010/2011 Remedial Investigation Report* (RI Report) (URS, 2012), which was submitted to MDEQ in June 2012. The RI Report recommended additional investigations to address data gaps identified in four areas: Bury Pit Landfill, Pierson Creek Landfill (surface soil and groundwater), Waste Neoprene Landfill, and Pierson Creek.

A *2013 Supplemental Remedial Investigation Sampling Plan* (2013 Sampling Plan) (URS, 2013) to address the Pierson Creek Landfill (groundwater), Pierson Creek, and the Waste Neoprene Landfill was submitted to MDEQ in May 2013. The 2013 Sampling Plan was implemented in June 2013. In addition to this sampling, MDEQ requested additional soil sampling at the former Basin Sludge Storage Area and also requested further lithologic data and vertical soil sampling adjacent to the Pierson Creek Landfill and Bury Pit Landfill. The fieldwork for the additional requests was completed in September, October, and November 2013. The Bury Pit Landfill will be addressed in a separate data summary report to be submitted by June 1, 2014.

1.2 Purpose

The Supplemental Remedial Investigation provided the information necessary to resolve the data gaps previously identified and provided a better understanding of the site conceptual model for the Pierson Creek Landfill Area. The Pierson Creek Landfill Area is defined as the area beneath Pierson Creek Landfill and between the landfill and Pierson

Creek where groundwater containing constituents from the landfill (Pierson Creek Landfill-related constituents) may migrate via groundwater flow to seeps that discharge into tributaries and potentially into Pierson Creek.

The purpose of this report is to summarize the objectives, technical approach, results, and conclusions for the supplemental investigation associated with the Pierson Creek Landfill Area (groundwater), Pierson Creek, and the lithologic and vertical soil data. In addition, the site conceptual model for this area is presented.

2.0 Background

During the 2010/2011 RI, several Pierson Creek Landfill-related constituents were detected in groundwater downgradient of the Pierson Creek Landfill, as well as in surface water or sediment in the tributaries to Pierson Creek. The similarities in the site-related constituents detected in surface water, sediment, and groundwater had indicated a potential groundwater discharge pathway from the landfill to the creek. Although the general characteristics of groundwater flow near Pierson Creek were documented, the horizontal extent of groundwater impact and potential subsequent discharge, via springs or direct discharge to the creek, had not been determined.

Consequently, the collection of additional data was recommended in the RI Report to better refine the conceptual model for groundwater discharging into Pierson Creek. Data gaps were identified regarding groundwater flow and transport in the vicinity of Pierson Creek hydraulically downgradient of Pierson Creek Landfill; the potential of upstream influences; and, the potential for impacts from groundwater discharge to Pierson Creek.

To address the groundwater flow and transport data gaps identified above, tree core sampling was completed in September 2012 in the Pierson Creek Area. During the investigation, tree cores were sampled from 45 locations and analyzed for chlorofluorocarbon (CFC)-113, carbon tetrachloride, chloroform, cis-1,2-dichloroethene, 1,1,1-trichloroethane, tetrachloroethene (PCE), and trichloroethene (TCE). The results from the tree core sampling, which were communicated with MDEQ in a February 20, 2013 call, supported the following conclusions:

- Tree core results (especially PCE) conform to the hydrogeologic conceptual model presented in the RI Report, indicating that volatile organic compounds (VOCs) are primarily to the west of Pierson Creek Landfill.
- It appears that some vapor transport occurs from Pierson Creek Landfill to the upgradient and cross gradient trees.
- Groundwater discharges at the toe of the landfill slope and VOC concentrations in tree core samples decrease with distance from the toe of the landfill slope.
- There is no clear connection from Pierson Creek Landfill and a northwestern flow path toward Pierson Creek based on the tree core data.

To address the remaining data gaps at the Pierson Creek Landfill, the 2013 Sampling Plan was submitted to MDEQ in May 2013. The sampling plan proposed the collection of additional groundwater, surface-water, and sediment samples.

After submission of the sampling plan, MDEQ requested and DuPont agreed to also collect additional data to evaluate the potential for stratified flow during a July 9, 2013 conference call. The proposed tasks were described in slides provided by email to MDEQ after the meeting.

2.1 Pierson Creek Landfill Area Investigation Objectives

As identified in the 2013 Sampling Plan, the objectives for the Pierson Creek Area investigation were as follows:

- Sample groundwater from locations along the toe of the slope to the east and west of Pierson Creek to delineate Pierson Creek Landfill-related constituents in shallow groundwater in the vicinity of identified groundwater seeps and springs.
- Collect additional surface-water and sediment data within the main channel of Pierson Creek and in three of its tributaries, to further evaluate Pierson Creek Landfill-related constituent concentrations along the length of the creek within the site property boundaries.

Based on input from MDEQ in June 2013, an addition objective as added: determine if the aquifer has the potential for stratified flow.

2.2 Report Organization

The remainder of this report is organized as follows:

- Section 3.0 summarizes the field activities performed and methods used.
- Section 4.0 provides the investigation results.
- Section 5.0 summarizes the conclusions and recommendations.
- Section 6.0 provides a list of documents referenced in this report.

3.0 Field Investigation Activities

This section details the scope of activities performed to meet the objectives identified in Section 2.1.

3.1 Pierson Creek Tree Core Sampling – September 2012

As noted earlier in Section 2, the results from the September 2012 tree core sampling were communicated to MDEQ during a February 20, 2013 conference call. This report formally presents the tree core sampling efforts and results that were used to aid in the determination of the nature and extent of impacted groundwater within the Pierson Creek Landfill Area.

The following sampling efforts were performed:

- Tree cores were collected using an increment borer from 45 trees within the Pierson Creek Landfill Area. Locations were documented with a global positioning system (GPS).
- Tree core samples were stored on ice in 20 milliliter (ml) vials prior to shipment to Missouri University of Science and Technology.
- At the university, the headspace within the vials was allowed to equilibrate for 48 additional hours with the core samples, and the headspace vapor was analyzed for target VOCs.
- Results were normalized relative to the mass of the cores and reported in units of micrograms of VOC/liters of headspace/milligrams of biomass ($\mu g_{VOC}/l_{headspace}/mg_{biomass}$).

The data report from Missouri University of Science and Technology, which performed the tree core analyses, is included as Appendix A.

The findings from the tree core sampling (summarized in Section 2.0) showed that the landfill VOC concentrations decreased with distance from the landfill. Most of the VOC detections were primarily to the west of the Pierson Creek Landfill. These findings were considered when the locations for groundwater sampling points were selected.

3.2 Groundwater Elevation Measurements

3.2.1 June 2013

On June 17, 2013, groundwater elevations were measured in available monitoring wells at the Pierson Creek Landfill area. Elevations were also collected in the vicinity of the Bury Pit Landfill. Results from these measurements are provided in Table 3-1.

3.2.2 November 2013

The elevations of groundwater seeps and springs were surveyed by Driesenga Engineers on November 13, 2013, and groundwater elevations were measured in available Pierson Creek Landfill area wells on November 18, 2013. Some locations (2013GW-04, 2013GW-11, and 2013GW-14) were not surveyed because the groundwater table was not observed to be at the surface. The purpose of surveying ground surface at the seeps was to provide additional data points for the potentiometric surface map and to document more precisely where these seeps are present. The results from these measurements are provided in Table 3-2. The survey report is included as Appendix B.

3.3 Pierson Creek Groundwater Sampling – June 2013

Groundwater samples were collected along the eastern side and western side of the Pierson Creek valley to delineate Pierson Creek Landfill-related constituents in shallow groundwater in the vicinity of identified groundwater seeps and springs. These samples were collected during the same time period as the surface-water sampling described in Section 3.5.

During June 18 through 20, 2013, 14 groundwater samples were collected at locations shown in Figure 3-1. At each of these locations, a drive-point well screen was advanced by manually pushing or by hammering with a fence-post driver to a depth sufficient to collect a sample from the upper 2 feet of the aquifer. Typically, this depth was between 2 and 3 feet deep. The drive point screen typically used was a 5-foot screen constructed of schedule 40 polyvinyl chloride (PVC) with 0.01-inch factory milled slots, but a 3-foot, stainless steel mesh screen with 1/8-inch staggered perforations was also used at locations 2013GW-03, 2013GW-04, and 2013GW-10 (where observation of the surface soil suggested that the deeper soil might be fine enough to enter the 0.01 slot PVC screen). Coordinates of each location were recorded in latitude longitude using a handheld GPS unit, and then converted to Michigan South, State Plane coordinate system. Photographs of each location were also taken and are included as Appendix C.

Groundwater samples were collected from each well point after purging with a peristaltic pump. Clean (new) polyethylene tubing was used for each location. During purging, water quality field measurements (pH, temperature, dissolved oxygen, specific conductivity, and oxidation-reduction potential) were measured and recorded. Field data sheets are included as Appendix D, and the parameter results are summarized in Table 3-3. Some locations did not produce sufficient volume for all analytical parameters. These locations were noted in the field data sheets.

Groundwater samples were placed on ice and shipped to Eurofins Lancaster Laboratories, Inc. in Lancaster, Pennsylvania, a State of Michigan-certified laboratory. The list of specific analytes selected for this investigation was determined based on a review of the groundwater, surface-water, and sediment results in the RI Report.

The analyte list was composed of the following constituents:

- All VOCs detected in Pierson Creek Landfill groundwater samples or Pierson Creek surface-water and sediment samples during the 2010/2011 RI or the third quarter 2012 compliance groundwater sampling. These detections included

17 VOCs that were originally analyzed as part of the 2007 RI Work Plan (Table 2 Landfill Constituent List and Table 4 Constituents Associated with the Site NPDES Permit).

- Metals detected in sediment samples collected during the 2010/2011 RI that exceeded ecological screening criteria.
- Wet chemistry compounds detected in groundwater, surface-water, or sediment samples during the 2010/2011 RI or the third quarter 2012 compliance groundwater sampling. These detections included ammonia, chloride, fluoride, and sulfate, and were used as indicators of groundwater flow.

3.4 Pierson Creek Landfill Soil Boring and Gamma Logging – October 2013

In September-October 2013, a deep soil boring was collected next to Pierson Creek Landfill. Gamma logging was performed on this boring and on six nearby existing wells. This was done to collect lithologic data to better determine the potential for stratified flow near Pierson Creek.

3.4.1 Soil Boring

Deep soil boring 2013SBPC-01 is shown in Figure 3-1 along with the groundwater sample locations and monitoring wells. This boring was completed to a depth of 117 feet below ground surface (bgs) using a truck-mounted rotosonic rig. This boring was drilled approximately 70 feet southwest of the landfill, along an access road below the berm (because the berm was too narrow to access with the truck). The intent of this boring was to determine if there are low permeability intervals (silts or clays) that would cause vertical stratification of groundwater flow near the landfill. In addition, soil samples would confirm if landfill-related VOCs were present in particular intervals and provide data related to vertical extent of those VOCs.

During the drilling, measurements for organic vapors were made using a photoionization detector (PID) at various depths to screen for VOCs. Soil samples were collected for VOC analysis based on those field PID readings (detections) and the visible lithologic changes. The samples were analyzed for the same 17 VOCs analyzed for groundwater, as described in Section 3.3.

Appendix E contains the completed boring log for 2013SBPC-01 along with all logs from monitoring wells near the Pierson Creek Landfill.

3.4.2 Gamma Logging

Natural gamma logging differentiates between intervals of high and low natural gamma radioactivity. This is a helpful indication of overall lithology because clays have a higher natural gamma activity than silica sand. URS supervised the logging of wells near Pierson Creek Landfill to collect additional information about potential stratifying intervals that could impede vertical hydraulic communication in the aquifer.

Five monitoring wells and one soil boring were logged for natural gamma activity in the vicinity of Pierson Creek Landfill by Geosphere Incorporated. Note that the Geosphere report (contained in Appendix F) references the well IDs that were present on the well labels. These wells are shown in Figure 3-1 along with other nearby monitoring wells.

Geosphere IDs correspond to the revised well IDs as follows.

Geosphere ID	Location ID	Total Depth of Well Log
PCL1-D	PCL-001-067	70 feet from top of casing
PCL2-D	PCL-002-070	70 feet from top of casing
PCL5-D	PCL-005-078	79.5 feet from top of casing
PCL6-D	PCL-006-077	77.5 feet from top of casing
PCL205	MW-209-067	not completed – casing bent
PCL208	MW-208-083	82 feet from top of casing
SBPC-01-2013	SBPC-01-2013	117 feet from top of casing

3.5 Pierson Creek Surface Water and Sediment – June 2013

Sediment and surface-water sampling was completed in June 2013 to provide a better understanding of potential upstream influences and to evaluate whether there are potential impacts to Pierson Creek from groundwater discharge. As noted in the 2013 Sampling Plan, the objective of this sampling was to collect surface-water and sediment samples to further evaluate Pierson Creek Landfill-related constituent concentrations within the tributaries and along the length of Pierson Creek within the site property boundaries.

Pierson Creek surface-water and sediment samples were collected for laboratory analysis, as follows:

- Co-located surface-water and sediment samples were collected at 11 Pierson Creek sample locations; seven sampling locations are in the main channel of Pierson Creek (SW/SED-01 through SW/SED-07), and four sampling locations are in the tributaries to the east of Pierson Creek (SW/SED-08 through SW/SED-011) (see Figure 3-2). One main channel sample location (SW/SED-01) is located upstream of any potential influence of groundwater from near Pierson Creek Landfill, four main channel sampling locations (SW/SED-02 through SW/SED-05) are located near the Landfill and two main channel locations (SW/SED-06 and SW/SED-07) are located downstream of the Pierson Creek Landfill. Sample location coordinates were determined using a handheld GPS unit.
- Surface-water samples were collected prior to sediment samples using a peristaltic pump equipped with new, dedicated tubing. The surface-water samples were collected within the top half of the water column. An appropriate volume was filtered with a dedicated capsule-type, high capacity, 0.45 micron (µm) filter to analyze for dissolved phase constituents.
- Sediment samples were collected from the creek and tributaries using a decontaminated petite Ponar dredge sampler.
- Surface-water and sediment samples were shipped to Eurofins Lancaster Laboratories for analysis. Samples were analyzed for VOCs, select metals, and

inorganics, as described in Section 3.3. Additionally, media-specific parameters were analyzed, including total organic carbon and grain size from sediment samples and hardness from surface-water samples.

- *In-situ* water quality field measurements (i.e., pH, temperature, dissolved oxygen, specific conductivity, turbidity, and oxidation-reduction potential) were measured at each sample location approximately 1 foot above the substrate, where practical. Field data sheets containing water quality measurements are included in Appendix G.

4.0 Investigation Results

The following section presents an evaluation of the conceptual groundwater flow and the potential migration of constituents in groundwater from the Pierson Creek Landfill. Groundwater, surface water, sediment, and soil results from the June and September-October 2013 field events are presented in the tables and figures referenced in the text. Laboratory analytical reports for the June and September-October 2013 field events are included as Appendices H (groundwater data), I (surface-water and sediment data), and J (soil data).

4.1 Data Quality Assessment and Data Evaluation

4.1.1 Data Quality Assessment

Analytical data collected during the 2013 field investigation were reviewed in accordance with the DuPont In-House Data Review (DDR) process to determine data usability. The DDR process consisted of an evaluation of the data based on hold times, blank contamination, matrix spike (MS)/matrix spike duplicate (MSD) recoveries, MS/MSD relative percent differences, laboratory control spike/control spike duplicate (LCS/LCSD) recoveries, LCS/LCSD relative percent differences, and surrogate recoveries.

Based on the quality assurance (QA)/quality control (QC) data review, the sampling results presented within this section are considered usable for the project objectives with some of the following data qualifiers:

- B – Not detected substantially above the level reported in the laboratory or field blanks.
- J – Analyte present; reported value may not be accurate or precise.
- U – Not detected at the stated reporting limit.
- UJ – Not detected. Reporting limit may not be accurate or precise.

The DDR Report Narrative included in Appendices H, I, and J lists the qualified samples and the reasons for qualification. As detailed in the DDR narrative reports, no significant QC problems were noted during the data review. Overall, the data are acceptable for use with minor qualifications added during the data review process.

Some of the groundwater and surface-water data were qualified due to detections in the equipment blank, detections in the method blank, or results detected between the method detection limit (MDL) and the practical quantitation limit (PQL). The acetaldehyde reporting limit for some groundwater and surface-water samples was elevated due to interference from the sample matrix.

Some of the sediment samples were qualified due to imprecision between the laboratory replicate and the parent sample, MS/MSD that did not meet criteria, LCS/LCSD that did not meet criteria, or results detected between the MDL and PQL. The ammonia reporting limit for some sediment samples was elevated due to interference from the sample matrix.

4.1.2 Data Evaluation

The first step in the data evaluation process was to determine whether there was a release of Pierson Creek Landfill-related constituents from the landfill into groundwater and whether these constituents are migrating to Pierson Creek. If there is evidence of a release, then a screening level assessment is completed to determine if the concentrations detected in the various media (groundwater, surface water, and sediment) present a potential concern for either humans or the environment. These initial steps were completed as part of the 2010/2011 RI and documented in the RI Report (URS, 2012).

For the screening level assessment, the detected constituent concentrations are compared to applicable Generic Cleanup Criteria as defined in the Part 201 Administrative Rules (R 299.1 to R 299.50)[1]. Each set of generic criteria correspond to a specific exposure or migration pathway, including drinking water, direct contact, inhalation, groundwater protection, groundwater to surface-water interface, or protection of ecological receptors. This quantitative comparison (i.e., data screening) was used in this report to determine whether potential releases from Pierson Creek Landfill groundwater to Pierson Creek surface water and sediment present a potential concern for human health or the environment and if further investigation or other considerations are necessary.

The following screening levels were used during the evaluation presented herein. Exceedances of these screening levels do not in of themselves indicate that an unacceptable exposure exists. Rather, exceedances of the screening levels identify constituents of potential concern (COPCs) and indicate the need to further evaluate potential human and/or ecological exposure to these COPCs.

Groundwater

Groundwater is not used for drinking water at the DuPont facility. However, as a conservative measure, constituents detected in groundwater were compared to MDEQ Non-Residential Drinking Water Criteria. Constituents detected in groundwater were also compared to MDEQ Groundwater to Surface-Water Interface (GSI) Criteria.

Surface Water

Ecological

Surface-water ecological screening criteria used in the data evaluation were obtained from the following sources listed below in order of preference:

- MDEQ Rule 57 Water Quality Values – minimum of the wildlife (WV) and final chronic values (FCV).
- National Recommended Water Quality Criteria (EPA, 2009)

Ecological screening values for cadmium, lead, and fluoride were calculated based on an average hardness of 167 milligrams (mg) $CaCO_3$/L for Pierson Creek main channel

[1] The Part 201 Generic Cleanup Criteria have been renamed Cleanup Criteria Requirements for Response Activity. The effective date of the most recent criteria is December 30, 2013.

samples and 201 mg $CaCO_3$/L for tributary samples. The lower, more conservative value was used in the screening.

The MDEQ Rule 57 Water Quality Values include cold-water and warm-water FCVs for un-ionized ammonia; the cold-water benchmark was used for screening. Given that surface-water samples were analyzed for total ammonia, the percent of un-ionized ammonia was used to adjust the total ammonia concentrations. The percent of un-ionized ammonia is a function of water pH and temperature and can be calculated using the equations provided by Emerson et al. (1975) and tabulated by EPA (1979). Field measurements of pH and temperature were used in EPA (1979) Table A-1 to identify the percent of un-ionized ammonia.

As part of the ecological screening, potential risks associated with ecological exposure to constituents in surface water were expressed as a hazard quotient (HQ), which represents the ratio of the measured maximum concentration in surface water to the ecological screening criteria.

$$HQ = \frac{Maximum\ Concentration}{Screening\ Criteria}$$

Human Health

Pierson Creek and its tributaries do not provide any recreational value (boating, swimming, or fishing), and any wading activities would be limited to occasional trespassing. However, constituents detected in surface water in Pierson Creek were conservatively compared to MDEQ Rule 57 Water Quality Values protective of human health (non-drinking water) to evaluate potential trespasser exposure.

Sediment

Ecological

Sediment ecological screening criteria used in the data evaluation were obtained from the following sources listed below in order of preference. These sources are based on the MDEQ Site Characterization and Remediation Verification Memorandum for Sediments (MDEQ, 2006).

- EPA Region 5 Ecological Screening Levels (ESLs) (EPA, 2003)
- Threshold Effects Concentrations – Lowest Effect Level (LEL) (MacDonald et al., 2000)
- EPA Region 3 Biological Technical Assistance Group (BTAG) Ecological Risk Assessment Freshwater Sediment Screening Benchmarks (EPA, 2006)

As part of the ecological screening, potential risks associated with ecological exposure to constituents in sediment were also expressed as an HQ, which represents the ratio of the measured maximum concentration in sediment to the ecological screening criteria.

$$HQ = \frac{Maximum\ Concentration}{Screening\ Criteria}$$

For detected VOCs, further screening was performed. Data were compared to conservative sediment quality benchmarks (SQBs) that were calculated based on the equilibrium partitioning (EqP) approach (EPA, 2008a). Consistent with EPA (2008a), measured concentrations of VOCs were only compared to SQBs where site-specific organic carbon concentrations were ≥0.2%, dry weight. For weakly hydrophobic VOCs (i.e., those with log K_{ocS} < 2.0), the Fuchsman Modification was applied to the EqP approach to account for the contribution of dissolved chemical to the total chemical concentration in sediment (Fuchsman, 2003). Station-specific SQBs were calculated based on conservative MDEQ chronic water quality values using station-specific total organic carbon concentrations and estimated organic carbon partitioning coefficients.

Human Health

MDEQ does not have established screening criteria for potential human exposure to sediments. As a result, concentrations detected in the tributaries and Pierson Creek sediment were screened against MDEQ Residential and Non-Residential Direct Contact soil values to evaluate potential trespasser exposure. This presents a conservative comparison since these criteria are based on a daily exposure throughout the year rather than intermittent or occasional exposure which would occur during trespassing. As noted earlier, Pierson Creek and its tributaries are not used for any recreational purpose.

4.2 Groundwater Migration Pathway Evaluation

4.2.1 Groundwater Flow Direction

Figures 4-1 and 4-2 display potentiometric measurements collected in June and November 2013, respectively. These potentiometric data were also used on two cross sections of the Pierson Creek Landfill Area, which are shown as Figures 4-3 and 4-4. The location of each cross section is illustrated in the inset maps to the lower left of Figures 4-3 and 4-4.

The following observations are made based on these figures:

- Groundwater flow direction in both events was to the west-southwest on the eastern side of Pierson Creek.
- A strong upward hydraulic gradient was measured near the creek at the MW-208 cluster in both events. This indicates discharge of groundwater to tributaries of Pierson Creek.
- East of the Pierson Creek Landfill, potentiometric data from wells MW-207-055 and PCL-02-070 show a slight downward gradient.

- The potentiometric surface on the western side of Pierson Creek (and the groundwater seeps along the western edge of the floodplain) indicates that groundwater is also discharging into the creek from the western side of Pierson Creek.

The flow direction of groundwater at Pierson Creek Landfill is related to the creek and topography. Where the potentiometric surface is at or above ground surface, discharge of groundwater occurs. This has been visually observed at several locations near Pierson Creek, and the November 2013 potentiometric surface map includes surveyed elevations of groundwater seeps. Note that locations 2013GW-04, 2013GW-11, and 2013GW-14 did not have active groundwater seeps and are therefore marked as not having been measured (NM).

There is a difference in vertical hydraulic gradients between the eastern and western sides of Pierson Creek Landfill. There is a downward gradient to the east of the landfill, indicating that rainfall is recharging the aquifer in the “upland” area to the east of the landfill (see Figure 4-4). To the west of the landfill, the upward gradient next to the flood plain of Pierson Creek indicates the discharge of groundwater. The potentiometric contours and groundwater flow arrows on both Figures 4-3 and 4-4 display the upward flow of groundwater toward Pierson Creek.

4.2.2 Lithology

As shown in Figure 4-4, the boring log for 2013SBPC-01 showed considerable variability in the lithology encountered. Although most of the boring log shows well-graded tan sand, the following low-permeability intervals were identified:

- 24 to 32 feet: tan, silty clay
- A two-inch clay lens at 35 feet
- 42 to 52 feet: sandy silt to silty clay
- A two-inch clay seam at 54 feet
- 77 to 81.5 feet: interbedded sandy and clayey silt
- 94 to 97 feet: sandy silt-silty clay
- 105 to 106 feet: dark gray clay
- 107 to 117 feet: dark gray clay

Compared to previously conducted lithologic logs (also provided in Appendix E), soil boring 2013SBPC-01 has more detail especially regarding thin clays and silts. This disparity in available detail is likely due to the difference in the drilling method used (rotosonic vs typically hollow stem auger). However, these older well logs do provide some evidence of low permeability intervals (e.g., clayey sand at 46 to 54 feet bgs in MW-207-055; trace of clay at 49 feet in MW-208-083; and silt and clay at 35 to 41 feet in MW-209-067).

Like the visual log, the natural gamma log for soil boring 2013SBPC-01 (in Appendix E) also displays considerable variability. The geophysicists’ interpreted lithology is provided at the right-hand side of the log and confirms the visual observations that the lithology is predominantly sand; however, interbedded layers of silt and clay are present at depths similar to those observed in the visual log.

Because the low permeability units are of varying thickness and texture, their individual influence on vertical flow is expected to vary, but the overall effect of these low-permeability intervals is to vertically stratify groundwater flow, separating flow in shallower sand intervals from the flow in deeper intervals. This will minimize any downward movement of constituents that are migrating from the landfill. As noted in Section 4.2.1, the potentiometric surface measurements near Pierson Creek demonstrate an upward gradient, confirming that shallow groundwater discharges to seeps.

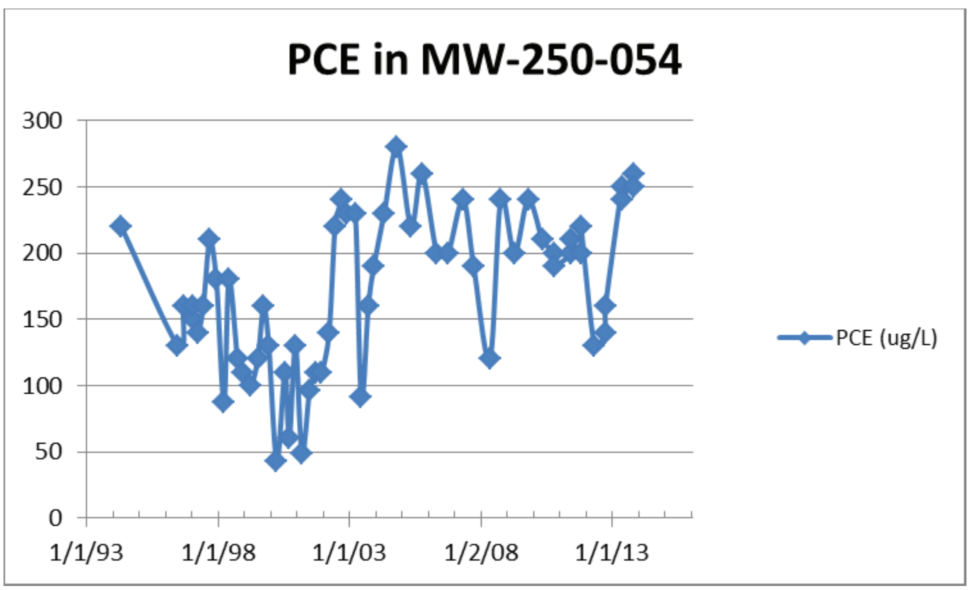
4.2.3 Nature and Extent

This section presents historical and current data from the Pierson Creek Landfill area that have been evaluated to understand the nature and extent of constituents related to the landfill.

Historical Data

MW-250-054 has been monitored since the 1990s and is immediately downgradient of the Pierson Creek Landfill (see Figure 4-1 and 4-2). The well screen interval is constructed in the upper portion of the sand aquifer near the water table (see Figure 4-3).

The following chart displays concentration results for PCE in groundwater samples from MW-250-054. These data show how PCE has varied over a range of approximately 50 to 275 micrograms per liter (µg/L). Considering the time period of the data set (20 years), the PCE concentration is relatively stable. Concentrations detected recently are similar to those collected over the past 20 years. Data for this chart and other wells shown on Figure 4-3 are from Attachment 3 of the *Second Half Semiannual 2013 Groundwater Monitoring Results* (URS, 2014).



Other VOC constituents have been detected in groundwater samples from MW-250-054. These concentrations are lower than the results for PCE, but they have shown similar stability in concentration (e.g., TCE, ranging from 5 to 31 µg/L; CFC-113, ranging from 9 to 50 µg/L). Chloroform and 1,1,1-trichloroethane have also been detected frequently but typically at low concentrations near the reporting limits.

In contrast to the consistent presence of VOCs in MW-250-054, historical results from PCL-006-077 have been largely non-detect. The most recent detection of VOCs in PCL-006-077 without laboratory qualifications was in March 2001 (PCE at 6 µg/L and CFC-113 at 46 µg/L). Since that sampling event, there have been 30 quarterly and semi-annual samples collected from this well, and there have been only three detections of PCE (estimated results ranging from 2 to 5 µg/L). Despite well PCL-006-077 being west and downhill of MW-250-054, this well is not hydraulically downgradient of MW-250-054. As shown on Figure 4-3, the well screen of PCL-006-077 is in a deeper portion of the aquifer (approximately 40 feet below the water table). The potentiometric surface measured in PCL-006-077 is higher than that measured in MW-250-054, demonstrating that the upward hydraulic gradient and the stratified lithology are preventing landfill-related constituents from migrating downward.

Tree Core Sampling

Figures 4-5 through 4-8 display posted results from tree core sampling described in Section 3.1. Results from the tree core data are also contained in Table 4-1. Each sampling location is represented with color dots to help visually recognize geographic patterns in the results. Results are posted in parts per trillion (ppt). Tree core results give a qualitative delineation of VOCs in the root zone of the tree from which the core was collected.

Figure 4-5 displays the results for PCE. Results from tree cores that were collected in the footprint of the landfill are highest in PCE. There is a noticeable decreasing trend in concentrations with distance from the landfill. The highest tree core PCE result was from location “TC-07,” which was from a large pine tree close to monitoring well MW-250-054.

Figure 4-6 presents the posted results for TCE. Similar to the results for PCE, the highest TCE results were found in the footprint of the landfill, with very low (2.1 to 19.3 ppt) results found in four of the locations west (hydraulically downgradient) of the northern portion of Pierson Creek Landfill.

Figure 4-7 displays the results of carbon tetrachloride. Quantified detections ranged from 0.02 to 0.33 ppt (the MQL for carbon tetrachloride was much lower than the MQL for other VOCs). Unlike the results for PCE or TCE, there does not seem to be a geographic pattern, and discussions with the laboratory suggest that these concentrations are likely related to the global atmospheric background for carbon tetrachloride, which, according to EPA has a very long atmospheric residence time and has a measured atmospheric concentration of 0.61 $\mu g/m^3$ [see Table 2-6 in *Estimation of Background Concentration for NATA 2002* (EPA, 2008b)].

Chloroform results are posted in Figure 4-8. Similar to the results for PCE and TCE, the highest chloroform results are in two locations in the footprint of Pierson Creek Landfill.

Groundwater and Surface-Water Sampling near Seeps

Figures 4-9 through 4-12 present results of representative constituents from the shallow groundwater push points and surface-water samples collected in June 2013. Complete results from these samples are included in Tables 4-2 and 4-3. Laboratory analytical reports for the groundwater and surface-water samples are included as Appendices H and I, respectively.

Figure 4-9 displays concentration results for chloride. Chloride is not a COPC, but it is useful as an indicator for deducing the flow of groundwater because it is highly water soluble, does not migrate as a vapor, and is not retarded by most aquifer matrices. For this reason, chloride can be used to infer the direction of water flow from the landfill. Based on the distribution of chloride results, the following conclusions were made:

- Chloride concentrations in groundwater seep samples exhibit a pattern suggesting localized influence by Pierson Creek Landfill. In locations hydraulically downgradient of the landfill (2013GW-01, -02, -08, -13), chloride ranged from 6,400 to 16,500 µg/L.
- In locations that are not hydraulically downgradient of Pierson Creek Landfill, chloride ranged from an estimated 1,000 µg/L in 2013GW-07 to 3,200 µg/L at 2013GW-03. It is believed that this range represents the approximate background concentration of chloride in the shallow groundwater.
- Chloride concentrations in the tributaries ranged from 4,400 to 8,000 µg/L (higher than the “background” concentration but lower than most of the seeps that are influenced by the landfill). Chloride was detected in one sediment sample [an estimated detection of 26.3 milligrams per kilogram (mg/kg)] at 2013SED-09, which is in a tributary hydraulically downgradient of the landfill.
- Surface-water chloride concentrations in the main channel of Pierson Creek ranged from 12,900 to 15,700 µg/L. The highest chloride result in the main channel of Pierson Creek was collected from 2013SW-01 near the upstream site boundary. Chloride concentrations in the main channel of Pierson Creek were no higher downstream of the landfill than upstream, indicating that the landfill is not a significant source of chloride to Pierson Creek.

Figure 4-10 displays concentration results for sulfate. Like chloride, sulfate is a useful indicator parameter. However, sulfate is not as water soluble as chloride and can react in aquifer sediments (reduced to sulfide under reducing conditions for instance). Results in Figure 4-10 show a similar pattern to those noted for chloride:

- The highest sulfate results were from groundwater seeps downgradient of Pierson Creek Landfill (between the creek and landfill) that are discharging at the eastern side of the floodplain (2013GW-08 and 2013GW-13). Sulfate was detected in several sediment samples, but the highest (405 mg/kg) was found at the tributary location 2013SED-09. These results suggest a localized influence by Pierson Creek Landfill.
- In groundwater samples from locations not hydraulically downgradient of Pierson Creek Landfill (such as 2013GW-03, 2013GW-05, and 2013GW-07), sulfate results tended to be lower than those downgradient of Pierson Creek Landfill.

Sulfate concentrations were also lower at locations 2013GW-09, 2013GW-10, and 2013GW-11, which are hydraulically cross-gradient from the landfill.

- The sulfate concentration in the main channel of Pierson Creek nearest to Pierson Creek Landfill (2013SW-04: 23,400 µg/L) was slightly higher than the upstream sample (2013SW-01: 20,100 µg/L). Further downstream, at locations 2013SW-06 and 2013SW-07, the sulfate concentrations were similar to the upstream sample, indicating that the landfill is not a significant source of sulfate to Pierson Creek.

Figure 4-11 displays concentration results for PCE, which is the most commonly detected VOC in well MW-250-054. In this figure, two sets of data are shown: the May 2013 semiannual data from monitoring wells MW-250-054, PCL-006-077, and MW-208-020 and the June 2013 groundwater and surface-water samples. Results from the May and June sampling event were also posted on the cross section Figures 4-3 and 4-4. For the cross sections, results for CFC-113, PCE, TCE, and cis 1,2-dichloroethene are posted for each location.

Notable findings based on these figures are as follows:

- Sufficient samples have been collected to delineate the extent of PCE in shallow groundwater. Therefore, Figure 4-11 includes a dashed, black line to indicate the interpreted extent of PCE exceeding 5 µg/L, which is the MDEQ Non-Residential Drinking Water Criteria. The vertical extent of PCE exceeding 5 µg/L is also shown in Figure 4-3 as yellow shading.
- The highest concentration of PCE and other VOCs was detected in well MW-250-054, which is screened near the water table and is directly downgradient of the landfill. No VOCs were detected in well PCL-006-077 because it is screened in a deeper part of the aquifer. This deeper interval is not hydraulically downgradient of the landfill because there is an upward hydraulic gradient.
- The only other unqualified detection of PCE was in the shallow groundwater sample 2013GW-08, which was collected from near a seep at the foot of the hill west of MW-250-054 (see Figure 4-3). Based on the direction of groundwater flow, 2013GW-08 is hydraulically downgradient of well MW-250-054.
- Estimated concentrations of PCE were detected to the northwest of the Pierson Creek Landfill (2013GW-09, 2013GW-10, and 2013SW-08) and to the southwest of the landfill (MW-208-020, 2013GW-01, and 2013GW-13). These PCE results are two orders of magnitude lower than those detected at MW-250-054 and represent samples from the lateral edge of the groundwater containing PCE above the MDEQ Non-Residential Drinking Water Criteria. The only detection of PCE in sediment (see Table 4-6) was an estimated result of 9 micrograms per kilogram (µg/kg) collected from 2013SED-09, located in the tributary closest to the landfill.
- All three samples from near seeps on the western side of Pierson Creek were below detection limits for PCE and all other VOCs. All surface-water samples from the main channel of Pierson Creek were also below detection limits for PCE. As noted above, only one detection of PCE was found in the tributary surface water samples at location 2013SW-08 (estimated at 1 µg/L).

Figure 4-12 presents results for ammonia, which was the only inorganic analyte that exceeded ecological screening criteria for surface water during the 2010/2011 RI. Findings are the following:

- The results for ammonia do not suggest Pierson Creek Landfill is a significant source of ammonia to the main channel of Pierson Creek.
- In groundwater and tributary samples hydraulically downgradient of Pierson Creek Landfill (and where there was relatively elevated chloride and sulfate), the range of ammonia was 220 µg/L or less. The only sediment sample to have detectable ammonia was 2013SED-09, which is located in a tributary downgradient of the landfill (estimated result of 487 mg/kg).
- The highest ammonia results in groundwater seeps were from locations not hydraulically downgradient of the landfill. Location 2013GW-10 was north and cross gradient from the landfill, and 2013GW-03 was on the western side of Pierson Creek. The highest ammonia result detected in surface water was at location 2013SW-03, downstream of 2013GW-03.
- The variability of groundwater and surface-water concentrations of ammonia between sampling locations influenced by the Pierson Creek Landfill and those that are not suggests that the landfill is not a significant source of ammonia to Pierson Creek.

In addition to the constituent results posted in figures and described above, Table 4-2 also shows detections for four VOCs (chloroform, CFC-113, acetone, and acetaldehyde). All but one of those VOC results (26 µg/L acetone at 2013GW-04) were low, “J”-qualified concentrations. Also shown in Table 4-2 are the results from the filtered and unfiltered metals analysis. Push point samples that exhibited visible turbidity had noticeably higher unfiltered concentrations of metals (such as lead and mercury) than in the filtered samples.

4.2.4 Vertical Soil Sampling

Table 4-4 presents the complete soil VOC results collected from soil boring 2013SBPC-01. Six VOCs were detected above reporting limits (acetaldehyde, acetone, benzene, methylene chloride, PCE, and toluene); however, of those detections, only toluene had two results above the practical quantification limit. All other results were estimated values. This location was selected based on its proximity to the Pierson Creek Landfill and the potential to detect VOCs that may be migrating from the landfill. The lack of VOC detections indicates that the southwestern corner of the landfill is not a place where significant migration is occurring. Laboratory analytical reports for the soil samples collected from boring 2013SBPC-01 are included as Appendix J.

4.3 Tributaries and Pierson Creek Surface-Water and Sediment Data Evaluation

4.3.1 Groundwater Migration to Surface Water and Sediment

As described in Section 4.2 regarding the nature and extent of constituents, only the uppermost interval of groundwater directly downgradient of the Pierson Creek Landfill contains Pierson Creek Landfill-related constituents above MDEQ Non-Residential Drinking Water Criteria. This groundwater discharges to seeps along the east side of the Pierson Creek floodplain. These groundwater seeps feed into tributaries, which then flow into the main channel of Pierson Creek. Although some Pierson Creek Landfill-related constituents were detected in the tributaries, they are present at much lower concentrations than in groundwater. Few constituents were detected in sediment samples collected in June 2013, but when detected, sediment concentrations in tributary samples were one to two orders of magnitude greater than concentrations measured in Pierson Creek main channel sediment. None of the Pierson Creek Landfill-related constituents were elevated in the downstream surface water or sediment samples of the main channel of Pierson Creek compared to the upstream samples.

4.3.2 Screening Assessment

Constituent concentrations detected in sediment and surface-water samples were compared to conservative screening levels to determine whether the concentrations present are a potential concern for human health and the environment. The results of the screening are provided below.

4.3.3 Ecological Screening

Surface-water and sediment data were compared to ecological screening criteria as discussed in Section 4.1.2. The following presents the results of the ecological screening evaluation. Laboratory analytical reports for surface water and sediment are included as Appendix I.

Surface Water

As presented in Table 4-4, concentrations of the detected VOCs (acetaldehyde and PCE), metals (arsenic, cadmium, and lead), ammonia, and chloride were below respective ecological screening criteria (see Table 4-5). In addition, as previously presented in Section 4.2.3, Pierson Creek Landfill is not a significant source of ammonia and chloride; upstream concentrations were greater than those detected downstream.

No ecological screening value for sulfate in surface water was available from the identified benchmark sources (see Section 4.1.2 and Table 4-5). This constituent was analyzed primarily as an indicator constituent for determining groundwater flow. Sulfate concentrations in the downstream surface-water samples were the same as the concentration from the upstream sampling location (see Table 4-4). As detailed in Section 4.2.3, results of the groundwater seep and surface-water sampling evaluation indicate that the Pierson Creek Landfill has had no significant influence on surface-water sulfate concentrations in the main channel of Pierson Creek.

Sediment

As presented in Table 4-7, concentrations of PCE and four of the detected metals (antimony, arsenic, cadmium, and lead) were below ecological screening criteria. As described above in Section 4.1.2, detected concentrations of PCE were also to be compared to station-specific SQBs. Only one sample (2013SED-09) had sufficiently high total organic carbon to calculate the SQB; the concentration of PCE in sediment at this location did not exceed the no effect concentration SQB (see Table 4-8). Therefore, the presence of PCE, antimony, arsenic, cadmium and lead in sediment does not pose an adverse risk to aquatic receptors.

Mercury was detected in sediment from two of the 11 sampling locations. At one of these locations, 2013SED-09, the detected concentration (0.189J mg/kg) approximated the screening level (0.0174 mg/kg). Mercury was not detected in the groundwater samples, except for one location and also not detected in any of the surface water samples. The location of the groundwater detection did not coincide with those detected in the tributary sediment. Based on these data, it does not appear that mercury has been released from the Pierson Creek Landfill. The mercury concentrations in sediment are comparable to the ecological screening criterion (HQ=1.1) (see Table 4-7). Therefore, based on this evaluation, mercury is not considered an analyte of potential concern for the Pierson Creek Landfill or Pierson Creek.

Acetone was detected in sediment at concentrations that exceeded generic ecological screening criteria in three samples collected from the tributaries (see Table 4-7). Acetone concentrations were also compared to station-specific SQBs (see Table 4-8). Acetone concentrations in two samples (2013SED-08 and 2013SED-09) did not exceed respective station-specific SQBs. A station-specific SQB could not be calculated for 2013SED-10 due to the low total organic carbon content. However, the acetone concentration in that sediment sample, 20 µg/kg, only slightly exceeded the generic benchmark of 9.9 µg/kg (HQ=2).

Acetone was not detected in the groundwater, except at three locations (2013GW-04, 2013GW-10, and 2013GW-12); and was not detected in any of the surface water samples. The location of the groundwater concentrations did not coincide with the sediment locations. The concentrations in groundwater were well below the GSI criteria, indicating that these concentrations will not impact surface water quality. Based on this data evaluation, it does not appear that acetone has been released from the Pierson Creek Landfill. In addition, detections of acetone in sediment samples are likely an artifact of sampling and laboratory analytical methods (acetone has been documented to be generated in the low-level VOC preservation method[2]). Therefore, based on this evaluation, acetone is not considered an analyte of potential for the Pierson Creek Landfill or Pierson Creek.

[2] *Final Policy: Preservation of Soil Samples*, New Hampshire Department of Environmental Services. March 2000. http://des.nh.gov/organization/divisions/waste/hwrb/documents/voc.pdf

Acetaldehyde was detected in four sediment samples; however, no generic sediment screening value was available for this constituent. Two of these locations (2013SED-01 and 2013SED2) were located in upstream Pierson Creek at similar concentrations (830J µg/kg and 800J µg/kg). Acetaldehyde was also detected in a tributary sample (2013SED-11) downstream of the landfill at a similar concentration (750 µg/kg). While 2013SED-09 had a concentration of 3,000J µg/kg acetaldehyde, the other tributary sample and main stem sample collected downstream of this location were non-detect for acetaldehyde. Acetaldehyde was detected in four groundwater samples at various locations which did not coincide with the detections in sediment. In surface water, it was only detected in samples from the two most northern main stem sampling locations at the detection limit.

Acetaldehyde is a ubiquitous, naturally-occurring product of hydrocarbon oxidation reactions and higher plant respiration [National Toxicology Program (NTP), 2011]. It is found in numerous plant products, including many edible fruits and vegetables (NTP, 2011). The Henry's Law constant and high vapor pressure indicate that acetaldehyde will volatilize easily from soil or water (EPA, 1994). Environment Canada (EC) (1999) indicates that significant biotic and abiotic degradation of acetaldehyde is expected, and EPA (1994) indicates that there is little potential for the bioaccumulation and bioconcentration of acetaldehyde in biota based on the estimated low K_{OW} and bioconcentration values.

Based on this data evaluation, it is believed that acetaldehyde is likely naturally occurring and not the result of a release from the Pierson Creek Landfill. Acetaldehyde was detected in the sediment and surface water entering the site from upstream. While it was detected in various media, the detections were infrequent and no spatial patterns were evident. Acetaldehyde was not detected in groundwater at a concentration exceeding the GSI criterion. Also, it is not expected to be persistent in the environment or bioaccumulate. Therefore, based on this evaluation, acetone is not considered an analyte of potential concern for the Pierson Creek Landfill or Pierson Creek.

4.3.4 Human Health Screening

Detections in surface water and sediment were also compared to human health screening criteria as discussed in Section 4.1.2 (see Tables 4-9 and 4-10). No exceedances were noted in surface water or sediment. While there are no human health surface-water screening criteria for ammonia, chloride and sulfate, concentrations of these constituents were similar to the upstream locations and therefore not associated with a release from the landfill. In the absence of MDEQ Rule 57 Water Quality Values, concentrations of these analytes were compared to MDEQ Non-Residential Drinking Water Criteria. No exceedances of these conservative values were noted.

As discussed in Section 4.1.2, the potential for exposure is low and is limited to occasional trespassing. Pierson Creek does not provide any recreational value.

5.0 Conclusions and Recommendations

As detailed in Section 1, the purpose of the 2013 RI activities at the Pierson Creek Area was to address specific data gaps identified in the RI Report and based on feedback from MDEQ regarding the conceptual model for groundwater discharging into Pierson Creek and groundwater constituent delineation. Based on the results of the investigation, the data gaps have been addressed, and the following conclusions are provided:

- The extent of Pierson Creek Landfill-related constituents have been delineated, and this extent is limited to shallow groundwater between the landfill and the groundwater seeps along the eastern side of the Pierson Creek floodplain. Pierson Creek Landfill-related constituents were also detected in surface water samples collected from tributaries hydraulically downgradient of the landfill, however none of the constituents were elevated in downstream surface-water samples from the main channel of Pierson Creek.
- The lithology is stratified, and there is a consistently upward hydraulic gradient preventing downward flow of groundwater containing Pierson Creek Landfill-related constituents. There is no impact to the deeper portions of the aquifer. Several monitoring wells screen various intervals of the aquifer between the landfill and Pierson Creek, and these wells are sufficient to monitor the aquifer.
- Groundwater flows consistently west-southwest from the landfill towards and into Pierson Creek. Groundwater seeps containing Pierson Creek Landfill-related constituents also flow into the tributaries and subsequently into the main channel of Pierson Creek.
- Screening of the additional surface-water and sediment data collected within the main channel of Pierson Creek and in three of its tributaries indicates that exposure to Pierson Creek Landfill-related constituents does not pose a potential concern for human health or populations of aquatic receptors in Pierson Creek near and downstream of the landfill.

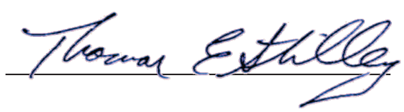
Based on the findings of this investigation, no further investigation is warranted and Pierson Creek Landfill Area will be evaluated as part of the remedial action plan (RAP).

6.0 Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Thomas E. Stilley

Title: Project Director

Signature: 

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Tables

Table 3-1
Groundwater Elevation Measurements - June 17, 2013
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Well ID	X-Coord	Y-Coord	Date Measured	Water Level (ft TOC)	Top of Casing Elevation (ft MSL)	June 17, 2013 Potentiometric Surface Elevation (ft MSL)
PCL-001-067	12577107.61	696679.82	6/17/2013	57.31	652.50	595.19
PCL-002-070	12577163.31	696461.70	6/17/2013	57.19	651.16	593.97
PCL-003-017	12576608.57	696295.61	6/17/2013	9.02	594.95	585.93
PCL-004-017	12576578.41	696443.72	6/17/2013	3.65	591.98	588.33
PCL-005-045	12575924.43	696366.05	6/17/2013	36.27	621.09	584.82
PCL-005-078	12575932.17	696364.95	6/17/2013	32.74	619.40	586.66
PCL-006-077	12576703.94	696684.13	6/17/2013	28.63	623.44	594.81
MW-207-055	12577201.82	696463.41	6/17/2013	49.00	651.07	602.07
MW-208-020	12576636.07	696369.17	6/17/2013	12.91	601.75	588.84
MW-208-083	12576644.66	696374.32	6/17/2013	10.65	604.09	593.44
MW-209-067	12576853.76	696283.70	6/17/2013	40.27	632.48	592.21
MW-250-054	12576795.62	696691.87	6/17/2013	44.02	639.24	595.22

Notes:
ft TOC: Feet below top of casing
ft MSL: Elevation in feet above mean sea level

Table 3-2
Groundwater Elevation Measurements - November 2013
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Well ID	X-Coord	Y-Coord	Date Measured	Water Level (ft TOC)	Top of Casing Elevation (ft MSL)	Nov 18, 2013 Potentiometric Surface Elevation (ft MSL)	Notes
PCL-001-067	12577107.61	696679.82	11/18/2013	56.95	652.50	595.55	
PCL-002-070	12577163.31	696461.70	11/18/2013	56.85	651.16	594.31	
PCL-003-017	12576608.57	696295.61	11/18/2013	8.73	594.95	586.22	
PCL-004-017	12576578.41	696443.72	11/18/2013	3.36	591.98	588.62	
PCL-005-045	12575924.43	696366.05	11/18/2013	36.24	621.09	584.85	
PCL-005-078	12575932.17	696364.95	11/18/2013	32.89	619.40	586.51	
PCL-006-077	12576703.94	696684.13	11/18/2013	28.33	623.44	595.11	
MW-207-055	12577201.82	696463.41	11/18/2013	47.54	651.07	603.53	
MW-208-020	12576636.07	696369.17	11/18/2013	12.89	601.75	588.86	
MW-208-083	12576644.66	696374.32	11/18/2013	10.29	604.09	593.80	
MW-209-067	12576853.76	696283.70	11/18/2013	NM	632.48	NM	Bent
MW-250-054	12576795.62	696691.87	11/18/2013	45.18	639.24	594.06	

Groundwater Seep ID	X-Coord	Y-Coord	Date Measured	Water Level (ft TOC)	Top of Casing Elevation (ft MSL)	Nov 13, 2013 Surveyed Elevations (ft MSL)	Notes
2013GW-01	12576625.20	696178.84	11/13/2013	NA	NA	581.27	WATER
2013GW-02	12576539.05	696590.18	11/13/2013	NA	NA	583.88	MUD
2013GW-03	12576210.22	696668.74	11/13/2013	NA	NA	583.54	MUD
2013GW-05	12576274.51	696068.47	11/13/2013	NA	NA	583.60	MUD
2013GW-06	12576596.56	696796.16	11/13/2013	NA	NA	589.56	MUD
2013GW-07	12576283.04	696355.76	11/13/2013	NA	NA	584.03	MUD
2013GW-08	12576547.30	696680.41	11/13/2013	NA	NA	583.98	MUD
2013GW-09	12576578.78	696956.10	11/13/2013	NA	NA	588.83	MUD
2013GW-10	12576535.69	697053.66	11/13/2013	NA	NA	587.79	WATER
2013GW-12	12576490.58	696499.91	11/13/2013	NA	NA	582.53	MUD
2013GW-13	12576544.59	696504.53	11/13/2013	NA	NA	583.79	MUD
2010SWPCK-01	12576450.24	697192.29	11/13/2013	NA	NA	585.54	WATER

Notes:
ft TOC: Feet below top of casing
ft MSL: Elevation in feet above mean sea level
NM: Not measured
The casing of MW-209-067 was found to be bent during the September-October 2013 field event (hillside shifting). No longer considered accurate.
NA: Not applicable. Elevation of groundwater seeps estimated based on elevation of mud or water from spring.

Table 3-3
Summary of Field Purge Parameters
June 2013 Pierson Creek Groundwater Sampling
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Sample / Well ID	Date Sampled	Time Sampled	pH	Temp (°C)	Specific Conductance (μmhos/cm)	Dissolved Oxygen (mg/l)	Redox (mv)	Color	Comments
2013GW Sampling									
2013GW-01	6/18/2013	1130	6.03	9.67	420	8.90	67	Clear	excellent flow
2013GW-02	6/19/2013	915	6.84	10.48	392	8.20	188	Clear	moderate recovery
2013GW-03	6/20/2013	1045	7.07	11.94	294	4.72	115	lt brown	moderate recovery
2013GW-04	6/18/2013	1430	7.08	16.70	337	8.93	156	lt gray	very poor recovery
2013GW-05	6/20/2013	955	6.66	11.98	111	9.45	198.5	lt brown	excellent flow
2013GW-06	6/19/2013	1500	5.90	15.00	62	5.60	105	lt brown	slow producing
2013GW-07	6/20/2013	845	6.15	12.80	176	7.26	191.4	lt brown	poor recovery
2013GW-08	6/19/2013	1040	6.56	10.26	508	6.08	173	Clear	excellent flow
2013GW-09	6/19/2013	1615	5.20	13.32	122	3.02	131	lt brown	slow producing
2013GW-10	6/19/2013	1130	6.80	11.65	112	5.13	-118	lt yellow-brown	moderate recovery; bubbles on surface of sample
2013GW-11	6/18/2013	945	5.03	12.97	185	7.54	83.3	lt brown	very poor recovery
2013GW-12	6/20/2013	1430	6.72	14.68	217	8.93	54	lt gray	poor recovery
2013GW-13	6/19/2013	830	4.74	11.05	587	4.80	284	clear	moderate recovery
2013GW-14	6/20/2013	1355	6.73	13.08	340	6.56	143.7	lt brown	very poor recovery
EB-061913-GW	6/19/2013	1100	NA	NA	NA	NA	NA	NA	
EB-062013-GW	6/20/2013	1500	NA	NA	NA	NA	NA	NA	

Notes:
Personnel: G. Gregory & S. DeVries
C: degrees centigrade
μmhos/cm: micromhos per centimeter
mg/L: milligrams per liter
mv: millivolts
NA: Data Not Recorded or Not Applicable

Table 4-1
Results from Tree Core Sampling
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Location ID	X-coord	Y-coord	Tree #	CFC-113	cis 1,2-dichloro ethene	Chloroform	1,1,1-trichloro ethane	Carbon Tetrachloride	Trichloro ethene	Tetrachloro ethene	Diameter (in)	Tree Type
2012TC-01	12577024	696687	1	16.8	<MQL	1,893.74	29.4	<MQL	229.6	792	7	Oak
2012TC-02	12576974	696620	2	<MQL	<MQL	50.68	<MQL	0.146	5.0	2,427	9	Oak
2012TC-03	12576989	696526	3	14.7	<MQL	30.35	3.4	0.265	<MQL	3,905	6.25	Poplar
2012TC-04	12576975	696430	4	13.3	<MQL	79.22	<MQL	0.220	<MQL	89	7.25	Oak
2012TC-05	12576913	696862	5	<MQL	<MQL	27.49	<MQL	0.127	<MQL	232	25.75	Hemlock
2012TC-06	12576882	696780	6	<MQL	<MQL	153.08	<MQL	0.136	463.1	1,595	8	Oak
2012TC-07	12576823	696700	7	<MQL	<MQL	3.88	<MQL	<MQL	<MQL	13,917	22.25	White Pine
2012TC-08	12576827	696603	8	<MQL	<MQL	19.19	<MQL	0.165	<MQL	14	12	Oak
2012TC-09	12576785	696499	9	<MQL	<MQL	392.63	19.5	0.330	49.5	2,999	18.25	Poplar
2012TC-10	12576921	696378	10	<MQL	<MQL	47.06	4.0	0.185	<MQL	844	21	Hemlock
2012TC-11	12576925	696263	11	<MQL	<MQL	7.88	<MQL	0.141	<MQL	0.68	15.25	Maple
2012TC-12	12576855	696974	12	<MQL	<MQL	7.22	<MQL	<MQL	<MQL	5.15	28.75	Hemlock
2012TC-13	12576759	696835	13	<MQL	<MQL	4.42	<MQL	0.020	<MQL	46	14.5	Hemlock
2012TC-14	12576704	696726	14	<MQL	<MQL	14.31	<MQL	0.065	<MQL	57	17.25	Hemlock
2012TC-15	12576681	696555	15	<MQL	<MQL	12.00	<MQL	0.305	<MQL	224	9.25	Hemlock
2012TC-16	12576689	696451	16	<MQL	<MQL	20.36	1.7	0.213	<MQL	73	16.75	Beech
2012TC-17	12576715	696341	17	<MQL	<MQL	8.27	<MQL	0.214	<MQL	92	12.75	Beech
2012TC-18	12576825	696277	18	<MQL	<MQL	7.25	<MQL	0.158	<MQL	342	14.5	Hemlock
2012TC-19	12576695	696921	19	<MQL	<MQL	8.31	<MQL	0.091	<MQL	9.26	12	Hemlock
2012TC-20	12576711	696810	20	<MQL	<MQL	10.00	<MQL	0.218	14.4	888	15.25	Beech
2012TC-21	12576601	696759	21	<MQL	<MQL	26.58	<MQL	<MQL	<MQL	30	21.5	Hemlock
2012TC-22	12576556	696589	22	<MQL	<MQL	28.01	<MQL	0.246	<MQL	2.14	13	Beech
2012TC-25	12576558	696463	25	<MQL	<MQL	13.72	<MQL	0.049	<MQL	3.68	22	Hemlock
2012TC-26	12576633	696324	26	<MQL	<MQL	22.92	2.3	0.257	<MQL	1,267	14.5	Poplar
2012TC-27	12576692	696207	27	<MQL	<MQL	8.40	<MQL	0.187	<MQL	1.25	15.75	Beech
2012TC-28	12576624	696950	28	<MQL	<MQL	24.30	<MQL	0.216	<MQL	2.23	28.75	Beech
2012TC-29	12576641	696810	29	<MQL	<MQL	<MQL	<MQL	0.162	<MQL	5.24	15.75	Hemlock
2012TC-30	12576536	696758	30	<MQL	<MQL	59.06	<MQL	0.020	9.2	4.46	18.25	Hemlock
2012TC-31	12576442	696661	31	<MQL	<MQL	45.57	<MQL	0.249	<MQL	0.98	9.25	Ash
2012TC-32	12576443	696421	32	<MQL	<MQL	41.26	<MQL	0.235	<MQL	1.16	18.75	Ash
2012TC-33	12576535	696191	33	<MQL	<MQL	33.84	<MQL	0.230	<MQL	1.00	15.5	Ash
2012TC-34	12576664	696096	34	<MQL	<MQL	23.76	<MQL	0.120	<MQL	2.70	9	Hemlock
2012TC-35	12576392	697013	35	<MQL	<MQL	11.46	<MQL	0.241	<MQL	0.74	18.5	Poplar
2012TC-36	12576589	696853	36	<MQL	<MQL	23.69	<MQL	0.220	19.3	43.03	16.75	Ash
2012TC-37	12576408	696785	37	<MQL	<MQL	63.23	<MQL	0.082	2.1	2.11	19.25	Hemlock
2012TC-38	12576365	696625	38	<MQL	<MQL	23.25	<MQL	0.177	<MQL	<MQL	16.75	Oak
2012TC-39	12576338	696411	39	<MQL	<MQL	13.57	<MQL	0.180	<MQL	0.77	16.25	Hemlock
2012TC-40	12576504	696140	40	<MQL	<MQL	11.80	<MQL	0.223	<MQL	1.38	13.75	Ash
2012TC-41	12576567	696002	41	<MQL	<MQL	9.99	<MQL	0.172	<MQL	1.25	9.25	Ash
2012TC-43	12576210	697020	43	<MQL	<MQL	7.48	<MQL	0.211	<MQL	1.64	12.25	Ash

Table 4-1
Results from Tree Core Sampling
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Location ID	X-coord	Y-coord	Tree #	CFC-113	cis 1,2-dichloro ethene	Chloroform	1,1,1-trichloro ethane	Carbon Tetrachloride	Trichloro ethene	Tetrachloro ethene	Diameter (in)	Tree Type
2012TC-44	12576291	696773	44	<MQL	<MQL	18.32	<MQL	0.197	<MQL	0.77	6.5	Ash
2012TC-45	12576982	696574	45	<MQL	<MQL	7.78	<MQL	0.022	<MQL	2,054	11	White Pine
2012TC-46	12577119	696677	46	<MQL	<MQL	<MQL	<MQL	<MQL	<MQL	346	17.25	Oak
2012TC-47	12577174	696454	47	<MQL	<MQL	<MQL	<MQL	<MQL	<MQL	5.85	17.75	Oak
2012TC-48	12577073	696861	48	<MQL	<MQL	53.63	<MQL	0.282	<MQL	149	16.5	Hemlock
2012TC-49	12577066	697009	49	<MQL	<MQL	<MQL	<MQL	0.175	<MQL	<MQL	18	Oak

Notes:
Analyte core concentrations are in parts per trillion (ppt) (i.e., ng analyte/L sap water).
MQL: Method quantitation limit

Table 4-2
Results from Groundwater Push Point Sampling – June 2013
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Parameter Name	Nonresidential Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Units	Location ID / Sample Date / Sample Purpose	2013GW-01 06/18/2013 Field Sample	2013GW-01 06/18/2013 Field Duplicate	2013GW-02 06/19/2013 Field Sample	2013GW-03 06/20/2013 Field Sample	2013GW-04 06/18/2013 Field Sample	2013GW-05 06/20/2013 Field Sample	2013GW-06 06/19/2013 Field Sample	2013GW-07 06/20/2013 Field Sample	2013GW-08 06/19/2013 Field Sample	2013GW-09 06/19/2013 Field Sample	2013GW-10 06/19/2013 Field Sample	2013GW-11 06/18/2013 Field Sample
Volatile Organic Compounds (VOCs)																
1,1,1-TRICHLORO ETHANE	200	89	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	0.8J	<0.8U	<0.8U	<0.8U
1,1,2-TRICHLORO TRIFLUOROETHANE (CFC-113)	170,000	32	UG/L	Unfiltered	3J	3J	<2U	<2U	<2U	<2U	<2U	<2U	7J	<2U	<2U	<2U
1,1-DICHLORO ETHANE	2500	740	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
ACETALDEHYDE	2700	130	UG/L	Unfiltered	<20U	<20U	<20U	<20U	<200U	<100U	120J	<20U	<20U	<100U	110J	50J
ACETONE	2,100	1,700	UG/L	Unfiltered	<6U	<6U	<6U	<6U	26	<6U	<6U	<6U	<6U	<6U	16J	<6U
BENZENE	5	200	UG/L	Unfiltered	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U
CARBON TETRACHLORIDE	5	45	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
CHLOROFORM	80	350	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	1J	<0.8U	<0.8U	<0.8U
CIS-1,2 DICHLOROETHENE	70	620	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
DICHLORODIFLUOROMETHANE	4800	ID	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
METHYLENE CHLORIDE	5	1500	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
TETRACHLORO ETHENE	5	60	UG/L	Unfiltered	1J	1J	5J	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	16	2J	2J	<0.8U
TETRAHYDRO FURAN	270	11000	UG/L	Unfiltered	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U
TOLUENE	790	270	UG/L	Unfiltered	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U
TRANS-1,2-DICHLOROETHENE	100	1500	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
TRICHLORO ETHENE	5	200	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
TRICHLOROFLUORO METHANE	7300	NA	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
Metals																
ANTIMONY	6	130	UG/L	Unfiltered	<0.34U	<0.34U	<0.34U	<0.34U	1.1	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U
ARSENIC	10	10	UG/L	Unfiltered	1.7J	1.7J	2.2	1.2J	14.2	7.2	6	5.1	5.4	12.1	1.1J	1.5J
CADMIUM	5	4 G	UG/L	Unfiltered	<0.76U	<0.76U	<0.76U	<0.76U	2.6J	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U
LEAD	4	39 G	UG/L	Unfiltered	0.37J	0.52J	0.8J	5.7	123	4.5	13.1	7.5	0.85J	13.1	97.8	11.9
MERCURY	2	0.0013	UG/L	Unfiltered	<0.06U	<0.06U	<0.06U	<0.06U	0.42	0.13J	0.14J	0.12J	<0.06U	0.11J	<0.06U	0.19J
ANTIMONY	6	130	UG/L	Filtered	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U
ARSENIC	10	10	UG/L	Filtered	1.8J	1.8J	2.2	0.57J	4.5	2.7	5	0.55J	4	10.3	0.7J	0.46J
CADMIUM	5	4 G	UG/L	Filtered	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U
LEAD	4	39 G	UG/L	Filtered	<0.085U	<0.085U	<0.085U	0.31J	6.4	1.5	5.9	0.24J	<0.085U	10.6	50.7	0.82J
MERCURY	2	0.0013	UG/L	Filtered	<0.06U	<0.06U	<0.06U	<0.06U	<0.06U	<0.06U	<0.06U	<0.06U	<0.06U	0.094J	<0.06U	<0.06U
Miscellaneous																
AMMONIA	10,000	(CC)	UG/L	Unfiltered	60J	140J	220	720	NC	110J	220	100J	140J	200	770	340
CALCIUM	NA	NA	UG/L	Unfiltered	58700	59400	57100	42200	75400	20000	10600	37100	73900	19200	13600	30700
CHLORIDE	250,000	(FF)	UG/L	Unfiltered	8700	8300	6400	3200	11700	1500J	1100J	1000J	11400	2800	1800J	1400J
FLUORIDE	2,000	ID	UG/L	Unfiltered	<400	<400	<400	<400	<400	<400	<400	<400	<400	<400	<400	<400
MAGNESIUM	110,000	NA	UG/L	Unfiltered	20600	20900	19600	14800	19700	3260	3860	2890	23800	5960	4020	10600
SULFATE	250,000	NA	UG/L	Unfiltered	25300	24900	25800	11100	4900J	13700	12300	8800	53500	14300	8200	8900

Notes:
From: Table 1. Groundwater: Residential and Non-Residential Part 201 Generic Cleanup Criteria and Screening Levels/Part 213 Risk-Based Screening Levels (December 30, 2013).
Screening Criteria Footnotes:
"ID" means insufficient data to develop criterion.
G - Groundwater surface water interface (GSI) criterion based on site-specific hardness value of 222 mg/L
"NA" means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.
CC - The generic GSI criteria are based on the toxicity of unionized
ammonia (NH3); the criteria are 29 ug/L and 53 ug/L for cold water and warm water surface water, respectively.
FF - Chloride GSI criteria shall not apply for surface waters of the state that are not designated as a public water supply source, however, the total dissolved solids criterion is applicable.

U: Analyte not detected above reporting limit
J: Estimated result detected above reporting limit but below practical quantitation limit
UG/L: micrograms per liter
NC: Not collected - insufficient volume

Table 4-2
Results from Groundwater Push Point Sampling – June 2013
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Parameter Name	Nonresidential Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Units	Location ID / Sample Date / Sample Purpose	2013GW-12 / 06/20/2013 / Field Sample	2013GW-13 / 06/19/2013 / Field Sample	2013GW-14 / 06/20/2013 / Field Sample
Volatile Organic Compounds (VOCs)							
1,1,1-TRICHLORO ETHANE	200	89	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U
1,1,2-TRICHLORO TRIFLUOROETHANE (CFC-113)	170,000	32	UG/L	Unfiltered	<2U	3J	<2U
1,1-DICHLORO ETHANE	2500	740	UG/L	Unfiltered	<1U	<1U	<1U
ACETALDEHYDE	2700	130	UG/L	Unfiltered	60J	<20U	NC
ACETONE	2,100	1,700	UG/L	Unfiltered	7J	<6U	<6U
BENZENE	5	200	UG/L	Unfiltered	<0.5U	<0.5U	<0.5U
CARBON TETRACHLORIDE	5	45	UG/L	Unfiltered	<1U	<1U	<1U
CHLOROFORM	80	350	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U
CIS-1,2 DICHLOROETHENE	70	620	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U
DICHLORODIFLUOROMETHANE	4800	ID	UG/L	Unfiltered	<2U	<2U	<2U
METHYLENE CHLORIDE	5	1500	UG/L	Unfiltered	<2U	<2U	<2U
TETRACHLORO ETHENE	5	60	UG/L	Unfiltered	<0.8U	1J	<0.8U
TETRAHYDRO FURAN	270	11000	UG/L	Unfiltered	<4U	<4U	<4U
TOLUENE	790	270	UG/L	Unfiltered	<0.7U	<0.7U	<0.7U
TRANS-1,2-DICHLOROETHENE	100	1500	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U
TRICHLORO ETHENE	5	200	UG/L	Unfiltered	<1U	<1U	<1U
TRICHLOROFLUORO METHANE	7300	NA	UG/L	Unfiltered	<2U	<2U	<2U
Metals							
ANTIMONY	6	130	UG/L	Unfiltered	<0.34U	<0.34U	<0.34U
ARSENIC	10	10	UG/L	Unfiltered	3.2	7.4	2.6
CADMIUM	5	4 G	UG/L	Unfiltered	<0.76U	<0.76U	<0.76U
LEAD	4	39 G	UG/L	Unfiltered	20.6	2.6	13.2
MERCURY	2	0.0013	UG/L	Unfiltered	0.091J	<0.06U	0.073J
ANTIMONY	6	130	UG/L	Filtered	<0.34U	<0.34U	<0.34U
ARSENIC	10	10	UG/L	Filtered	0.59J	7	0.71J
CADMIUM	5	4 G	UG/L	Filtered	<0.76U	<0.76U	<0.76U
LEAD	4	39 G	UG/L	Filtered	0.81J	0.18J	0.55J
MERCURY	2	0.0013	UG/L	Filtered	<0.06U	<0.06U	<0.06U
Miscellaneous							
AMMONIA	10,000	(CC)	UG/L	Unfiltered	NC	100J	NC
CALCIUM	NA	NA	UG/L	Unfiltered	35900	86700	127000
CHLORIDE	250,000	(FF)	UG/L	Unfiltered	3900	16500	6600
FLUORIDE	2,000	ID	UG/L	Unfiltered	<400	<400	<400
MAGNESIUM	110,000	NA	UG/L	Unfiltered	13200	32400	15400
SULFATE	250,000	NA	UG/L	Unfiltered	11300	88900	17100

Notes:
From: Table 1. Groundwater: Residential and Non-Residential Part 201 Generic Cleanup Criteria and Screening L
Screening Criteria Footnotes:
"ID" means insufficient data to develop criterion.
G - Groundwater surface water interface (GSI) criterion based on site-specific hardness value of 222 mg/L
"NA" means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.
CC - The generic GSI criteria are based on the toxicity of unionized
ammonia (NH_3); the criteria are 29 ug/L and 53 ug/L for cold water and warm water surface water, respectively.
FF - Chloride GSI criteria shall not apply for surface waters of the state that are not designated as a public water supply source, however, the total dissolved solids criterion is applicable.

U: Analyte not detected above reporting limit
J: Estimated result detected above reporting limit but below practical quantitation limit
UG/L: micrograms per liter
NC: Not collected - insufficient volume

Table 4-3
Surface-Water Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Parameter Name	Units		Upstream Pierson Creek		Main Channel Pierson Creek (Near Pierson Creek Landfill)				Downstream Pierson Creek		Tributaries Near Landfill			
		Location ID	2013SW-01	2013SW-01	2013SW-02	2013SW-03	2013SW-04	2013SW-05	2013SW-06	2013SW-07	2013SW-08	2013SW-09	2013SW-10	2013SW-11
		Sample Date	06/19/2013	06/19/2013	06/19/2013	06/19/2013	06/18/2013	06/18/2013	06/18/2013	06/18/2013	06/19/2013	06/19/2013	06/18/2013	06/18/2013
		Sample Purpose	Field Sample	Field Duplicate	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Volatile Organic Compounds (VOCs)														
1,1,1-TRICHLOROETHANE	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
1,1-DICHLOROETHANE	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
ACETALDEHYDE	UG/L	Unfiltered	<40U	40J	43J	<40U	<20U	<20U	<20U	<20U	<20U	<20U	<20U	<20U
ACETONE	UG/L	Unfiltered	<6U	<6U	<6U	<6U	<6U	<6U	<6U	<6U	<6U	<6U	<6U	<6U
BENZENE	UG/L	Unfiltered	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U	<0.5U
CARBON TETRACHLORIDE	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
CHLOROFORM	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
CIS-1,2 DICHLOROETHENE	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
DICHLORODIFLUOROMETHANE	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
METHYLENE CHLORIDE	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
TETRACHLOROETHENE	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	1J	<0.8U	<0.8U	<0.8U
TETRAHYDROFURAN	UG/L	Unfiltered	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U	<4U
TOLUENE	UG/L	Unfiltered	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U	<0.7U
TRANS-1,2-DICHLOROETHENE	UG/L	Unfiltered	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U	<0.8U
TRICHLOROETHENE	UG/L	Unfiltered	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
TRICHLOROFLUOROMETHANE	UG/L	Unfiltered	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
Metals														
ANTIMONY	UG/L	Unfiltered	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U
ARSENIC	UG/L	Unfiltered	1.6J	1.5J	1.4J	1.8J	1.5J	1.4J	1.4J	1.3J	<0.42U	1.6J	1.1J	<0.42U
CADMIUM	UG/L	Unfiltered	3.3J	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U
LEAD	UG/L	Unfiltered	2.5	2.6	2.3	2.2	1.8	1.3	1.1	1.7	0.18J	0.31J	0.15J	0.32J
MERCURY	UG/L	Unfiltered	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U
ANTIMONY	UG/L	Filtered	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U	<0.34U
ARSENIC	UG/L	Filtered	0.8J	0.77J	0.48J	0.77J	0.8J	0.79J	0.84J	0.88J	<0.42U	1.6J	0.72J	<0.42U
CADMIUM	UG/L	Filtered	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U	<0.76U
LEAD	UG/L	Filtered	<0.085U	0.24J	<0.085U	<0.085U	<0.085U	0.11J	<0.085U	<0.085U	<0.085U	<0.085U	<0.085U	<0.085U
MERCURY	UG/L	Filtered	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U	<0.07U
Miscellaneous														
AMMONIA (TOTAL)	UG/L	Unfiltered	230	210	230	460	180J	180J	160J	200	150J	140J	70J	80J
UN-IONIZED AMMONIA (CALCULATED)	UG/L	Unfiltered	4.853	4.431	5.129	0.1014	10.258	2.466	3.978	1.2928	0.448	0.01554	0.5831	0.006032
CALCIUM	UG/L	Unfiltered	44300	44300	45500	46000	43800	43500	45100	43100	50900	56400	50300	49200
CHLORIDE	UG/L	Unfiltered	15700	15800	14600	15300	15200	13600	12900	14400	4400	7000	7000	8000
FLUORIDE	UG/L	Unfiltered	<400U	<400U	<400U	<400U	<400U	<400U	<400U	<400U	<400U	<400U	<400U	<400U
MAGNESIUM	UG/L	Unfiltered	13900	13800	14400	14400	12900	13000	14000	13100	16700	17800	17200	18100
SULFATE	UG/L	Unfiltered	20100	21000	20900	21100	23400	22100	20000	20100	12400	26700	20100	18000
Water Quality Parameters														
TOTAL HARDNESS AS CACO3	UG/L	Unfiltered	168000	167000	173000	174000	163000	162000	170000	162000	196000	214000	196000	197000

Notes:
U: Analyte not detected above reporting limit
J: Estimated result detected above reporting limit but below practical quantitation limit
UG/L: micrograms per liter
NC: Not collected - insufficient volume

Table 4-4
Results from Soil Boring 2013SBPC-01 - September/October 2013
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Parameter Name	Location ID	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01	2013SBPC-01
	Sample Depth (ft BGS)	10	16	26	26	36	55	76	85	95	100
	Sample Date	09/30/2013	09/30/2013	09/30/2013	09/30/2013	09/30/2013	09/30/2013	09/30/2013	10/01/2013	10/01/2013	10/01/2013
	Sample Purpose	Field Sample	Field Sample	Field Sample	Field Duplicate	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Volatile Organic Compounds (VOCs)											
1,1,1-TRICHLORO ETHANE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
1,1,2-TRICHLORO TRIFLUOROETHANE (CFC-113)	UG/KG	<2U	<3U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
1,1-DICHLOROETHANE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
ACETALDEHYDE	UG/KG	<1000U	1300J	<1300U	<1200U	1600J	<1300U	1800J	1800J	<1200U	1500J
ACETONE	UG/KG	8J	<9U	13J	11J	<8U	<8U	<8U	<9U	14J	<9U
BENZENE	UG/KG	<0.6U	2J	<0.6U	<0.6U	3J	2J	1J	1J	5J	2J
CARBON TETRACHLORIDE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
CHLOROFORM	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
CIS-1,2 DICHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
DICHLORODIFLUOROMETHANE	UG/KG	<2U	<3U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U
METHYLENE CHLORIDE	UG/KG	<2U	<3U	<2U	<2U	<2U	<2U	<2U	4J	<2U	<2U
TETRACHLOROETHENE	UG/KG	<1U	2J	3J	3J	<1U	<1U	<1U	<1U	<1U	<1U
TETRAHYDROFURAN	UG/KG	<4U	<5U	<5U	<4U	<5U	<5U	<5U	<5U	<4U	<5U
TOLUENE	UG/KG	<1U	6J	<1U	<1U	7	5J	3J	4J	10	5J
TRANS-1,2-DICHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
TRICHLORO ETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U
TRICHLOROFLUOROMETHANE	UG/KG	<2U	<3U	<2U	<2U	<2U	<2U	<2U	<2U	<2U	<2U

Notes:
U: Analyte not detected above reporting limit
J: Estimated result detected above reporting limit but below practical quantitation limit
UG/KG: micrograms per kilogram

Table 4-5
Ecological Screening Summary of Surface-Water Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

	Units	Unfiltered/ Filtered	Number of Samples	Number of Detections	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Concentration	Ecological Screening Value	Screening Value Source	Number of Exceedances	Hazard Quotient (HQ)
Volatile Organic Compounds (VOCs)													
1,1,1-TRICHLOROETHANE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		89	MDEQ FCV	0	<1
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/L	Unfiltered	11	0	2	2	--	--		32	MDEQ FCV	0	<1
1,1-DICHLOROETHANE	UG/L	Unfiltered	11	0	1	1	--	--		740	MDEQ FCV	0	<1
ACETALDEHYDE	UG/L	Unfiltered	11	1	20	40	43	43	RI0613-2013SW-02	130	MDEQ FCV	0	<1
ACETONE	UG/L	Unfiltered	11	0	6	6	--	--		1700	MDEQ FCV	0	<1
BENZENE	UG/L	Unfiltered	11	0	0.5	0.5	--	--		200	MDEQ FCV	0	<1
CARBON TETRACHLORIDE	UG/L	Unfiltered	11	0	1	1	--	--		77	MDEQ FCV	0	<1
CHLOROFORM	UG/L	Unfiltered	11	0	0.8	0.8	--	--		630	MDEQ FCV	0	<1
CIS-1,2 DICHLOROETHENE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		620	MDEQ FCV	0	<1
DICHLORODIFLUOROMETHANE	UG/L	Unfiltered	11	0	2	2	--	--		NV	--	0	<1
METHYLENE CHLORIDE	UG/L	Unfiltered	11	0	2	2	--	--		1500	MDEQ FCV	0	<1
TETRACHLOROETHENE	UG/L	Unfiltered	11	1	0.8	0.8	1	1	RI0613-2013SW-08	190	MDEQ FCV	0	<1
TETRAHYDROFURAN	UG/L	Unfiltered	11	0	4	4	--	--		11000	MDEQ FCV	0	<1
TOLUENE	UG/L	Unfiltered	11	0	0.7	0.7	--	--		270	MDEQ FCV	0	<1
TRANS-1,2-DICHLOROETHENE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		1500	MDEQ FCV	0	<1
TRICHLOROETHENE	UG/L	Unfiltered	11	0	1	1	--	--		200	MDEQ FCV	0	<1
TRICHLOROFLUOROMETHANE	UG/L	Unfiltered	11	0	2	2	--	--		NV	--	0	<1
Metals													
ANTIMONY	UG/L	Unfiltered	11	0	0.34	0.34	--	--		240	MDEQ FCV	0	<1
ARSENIC	UG/L	Unfiltered	11	9	0.42	0.42	1.1	1.8	RI0613-2013SW-03	150	MDEQ FCV	0	<1
CADMIUM	UG/L	Unfiltered	11	1	0.76	0.76	3.3	3.3	RI0613-2013SW-01	3.7	MDEQ FCV	0	<1
LEAD	UG/L	Unfiltered	11	11	--	--	0.15	2.5	RI0613-2013SW-01	43.7	MDEQ FCV	0	<1
MERCURY	UG/L	Unfiltered	11	0	0.07	0.07	--	--		0.91	MDEQ FCV	0	<1
ANTIMONY	UG/L	Filtered	11	0	0.34	0.34	--	--		240	MDEQ FCV	0	<1
ARSENIC	UG/L	Filtered	11	9	0.42	0.42	0.48	1.6	RI0613-2013SW-09	150	MDEQ FCV	0	<1
CADMIUM	UG/L	Filtered	11	0	0.76	0.76	--	--		3.3	MDEQ FCV	0	<1
LEAD	UG/L	Filtered	11	1	0.085	0.085	0.11	0.11	RI0613-2013SW-05	31.3	MDEQ FCV	0	<1
MERCURY	UG/L	Filtered	11	0	0.07	0.07	--	--		0.77	MDEQ FCV	0	<1
Miscellaneous													
AMMONIA (total)	UG/L	Unfiltered	11	11	--	--	70	460	RI0613-2013SW-03	NV	--	0	<1
UNIONIZED AMMONIA (calculated)	UG/L	Unfiltered	11	11	--	--	0.006	10.3	RI0613-2013SW-03	29	MDEQ FCV	0	<1
CHLORIDE	UG/L	Unfiltered	11	11	--	--	4400	15700	RI0613-2013SW-01	230000	NRWQC	0	<1
FLUORIDE	UG/L	Unfiltered	11	0	400	400	--	--		8.5	MDEQ FCV	0	<1
SULFATE	UG/L	Unfiltered	11	11	--	--	12400	26700	RI0613-2013SW-09	NV	--	0	--
Water Quality Parameters													
TOTAL HARDNESS AS CACO3	UG/L	Unfiltered	11	11	--	--	162000	214000	RI0613-2013SW-09	NA	--	NA	--

Notes:
NA: Not Applicable
NV: Screening value not available
MDEQ screening values are the minimum of the wildlife (WV) and final chronic values (FCV)
Ecological screening values for cadmium, lead, and fluoride were calculated based on an average hardness of 167 mg $CaCO_3$/L for Pierson Creek main stem samples and 201 mg $CaCO_3$/L for tributary samples.
The lower value is used in the screening.
Un-ionized ammonia was calculated using the pH and temperature measured during sampling and EPA (1979) tables of percent un-ionized ammonia.
UG/L: micrograms per liter

Table 4-6
Sediment Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Parameter Name		Upstream Pierson Creek	Main Channel Pierson Creek (Near Pierson Creek Landfill)					Downstream Pierson Creek		Tributaries Near Landfill			
	Location ID	2013SED-01	2013SED-02	2013SED-03	2013SED-04	2013SED-04	2013SED-05	2013SED-06	2013SED-07	2013SED-08	2013SED-09	2013SED-10	2013SED-11
	Sample Date	06/19/2013	06/19/2013	06/19/2013	06/18/2013	06/18/2013	06/18/2013	06/18/2013	06/18/2013	06/19/2013	06/19/2013	06/18/2013	06/18/2013
	Sample Purpose	Field Sample	Field Sample	Field Sample	Field Sample	Field Duplicate	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Volatile Organic Compounds (VOCs)													
1,1,1-TRICHLOROETHANE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/KG	<2U	<2U	<2U	<2U	<2U	<2U	<3U	<3U	<10U	<17U	<3U	<2U
1,1-DICHLOROETHANE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
ACETALDEHYDE	UG/KG	830J	800J	<700U	<720U	<710U	<730U	<730U	<730U	<20,000U	3,000J	<750U	750J
ACETONE	UG/KG	<9U	<8U	<8U	<8U	<8U	<8U	<9U	<9U	150	400	20J	<9U
BENZENE	UG/KG	<0.6U	<0.6U	<0.6U	<0.6U	<0.6U	<0.6U	<0.6U	<0.6U	<2U	<4U	<0.7U	<0.6U
CARBON TETRACHLORIDE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
CHLOROFORM	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
CIS-1,2 DICHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
DICHLORODIFLUOROMETHANE	UG/KG	<2U	<2U	<2U	<2U	<2U	<2U	<3U	<3U	<10U	<17U	<3U	<2U
METHYLENE CHLORIDE	UG/KG	<2U	<2U	<2U	<2U	<2U	<2U	<3U	<3U	<10U	<17U	<3U	<2U
TETRACHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	9J	<1U	<1U
TETRAHYDROFURAN	UG/KG	<5U	<5U	<5U	<5U	<5U	<5U	<5U	<5U	<19U	<33U	<6U	<5U
TOLUENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
TRANS-1,2-DICHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
TRICHLOROETHENE	UG/KG	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<1U	<5U	<8U	<1U	<1U
TRICHLOROFLUOROMETHANE	UG/KG	<2U	<2U	<2U	<2U	<2U	<2U	<3U	<3U	<10U	<17U	<3U	<2U
Metals													
ANTIMONY	MG/KG	<0.103U	<0.0974U	<0.0992U	<0.103U	<0.0999U	<0.104U	<0.104U	<0.103U	<0.279U	0.509J	<0.104U	<0.101U
ARSENIC	MG/KG	0.407J	0.348J	0.391J	0.349J	0.371J	0.321J	0.376J	0.403J	1.91	5.86	0.470J	0.525
CADMIUM	MG/KG	<0.0913U	<0.0861U	<0.0876U	<0.0913U	<0.0883U	<0.0921U	<0.0915U	<0.0914U	0.422J	0.696J	0.103J	<0.0892U
LEAD	MG/KG	1.16	0.503	0.651	0.577	0.629	0.423	0.512	0.618	12.3	34.9	1.59	0.934
MERCURY	MG/KG	<0.0114U	<0.0117U	<0.0113U	<0.0116U	<0.0111U	<0.0116U	<0.0121U	<0.0116U	0.109J	0.189J	<0.0121U	<0.0115U
Miscellaneous													
AMMONIA	MG/KG	<521U	<501U	<505U	<511U	<504U	<515U	<517U	<516U	<1410U	487J	<532U	<504U
CHLORIDE	MG/KG	<6.1U	<5.9U	<5.9U	<5.9U	<5.9U	<6.0U	<6.1U	<6.0U	<16.6U	26.3J	<6.2U	<5.9U
FLUORIDE	MG/KG	<0.97U	<0.94U	<0.94U	<0.95U	<0.94U	<0.96U	<0.97U	<0.95U	<2.6U	3.9J	<0.99U	<0.94U
SULFATE	MG/KG	8.8J	8.0J	<5.9U	7.9J	6.1J	7.7J	10.1J	10.4J	67.6	405	77.6	48.1
Other Parameters													
TOTAL ORGANIC CARBON	MG/KG	<123U	<118U	<119U	<120U	<118U	<121U	<122U	124J	48700	68200	910	<118U
PERCENT MOISTURE	%	18.4	15.1	15.8	16.8	15.6	17.5	17.8	17.7	69.8	79.3	20.1	15.6

Notes:
U: Analyte not detected above reporting limit
J: Estimated result detected above reporting limit but below practical quantitation limit
UG/KG: micrograms per kilogram
MG/KG: milligrams per kilogram

Table 4-7
Ecological Screening Summary of Sediment Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Parameter Name	Units	Number of Samples	Number of Detections	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Concentration	Ecological Screening Value	Screening Value Source	Number of Exceedances	Hazard Quotient (HQ)
Volatile Organic Compounds (VOCs)												
1,1,1-TRICHLOROETHANE	UG/KG	11	0	1	8	--	--		213	EPA Region 5 ESL	0	<1
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/KG	11	0	2	17	--	--		NV	--	0	<1
1,1-DICHLOROETHANE	UG/KG	11	0	1	8	--	--		0.575	EPA Region 5 ESL	0	<1
ACETALDEHYDE	UG/KG	11	4	700	20000	750	3000	RI0613-2013SED-09	NV	--	0	<1
ACETONE	UG/KG	11	3	8	9	20	400	RI0613-2013SED-09	9.9	EPA Region 5 ESL	3	**40.4**
BENZENE	UG/KG	11	0	0.6	4	--	--		142	EPA Region 5 ESL	0	<1
CARBON TETRACHLORIDE	UG/KG	11	0	1	8	--	--		1450	EPA Region 5 ESL	0	<1
CHLOROFORM	UG/KG	11	0	1	8	--	--		121	EPA Region 5 ESL	0	<1
CIS-1,2 DICHLOROETHENE	UG/KG	11	0	1	8	--	--		NV	--	0	<1
DICHLORODIFLUOROMETHANE	UG/KG	11	0	2	17	--	--		NV	--	0	<1
METHYLENE CHLORIDE	UG/KG	11	0	2	17	--	--		159	EPA Region 5 ESL	0	<1
TETRACHLOROETHENE	UG/KG	11	1	1	5	9	9	RI0613-2013SED-09	990	EPA Region 5 ESL	0	<1
TETRAHYDROFURAN	UG/KG	11	0	5	33	--	--		NV	--	0	<1
TOLUENE	UG/KG	11	0	1	8	--	--		1220	EPA Region 5 ESL	0	<1
TRANS-1,2-DICHLOROETHENE	UG/KG	11	0	1	8	--	--		654	EPA Region 5 ESL	0	<1
TRICHLOROETHENE	UG/KG	11	0	1	8	--	--		112	EPA Region 5 ESL	0	<1
TRICHLOROFLUOROMETHANE	UG/KG	11	0	2	17	--	--		NV	--	0	<1
Metals												
ANTIMONY	MG/KG	11	1	0.0974	0.279	0.509	0.509	RI0613-2013SED-09	2	EPA Region 3 BTAG	0	<1
ARSENIC	MG/KG	11	11	--	--	0.321	5.86	RI0613-2013SED-09	9.79	EPA Region 5 ESL	0	<1
CADMIUM	MG/KG	11	3	0.0861	0.0921	0.103	0.696	RI0613-2013SED-09	0.99	EPA Region 5 ESL	0	<1
LEAD	MG/KG	11	11	--	--	0.423	34.9	RI0613-2013SED-09	35.8	EPA Region 5 ESL	0	<1
MERCURY	MG/KG	11	2	0.0113	0.0121	0.109	0.189	RI0613-2013SED-09	0.174	EPA Region 5 ESL	1	1
Miscellaneous												
AMMONIA	MG/KG	11	1	501	1410	487	487	RI0613-2013SED-09	NA	--	NA	--
CHLORIDE	MG/KG	11	1	5.9	16.6	26.3	26.3	RI0613-2013SED-09	NA	--	NA	--
FLUORIDE	MG/KG	11	1	0.94	2.6	3.9	3.9	RI0613-2013SED-09	NA	--	NA	--
SULFATE	MG/KG	11	10	5.9	5.9	7.7	405	RI0613-2013SED-09	NA	--	NA	--
Other Parameters												
TOTAL ORGANIC CARBON	MG/KG	11	4	118	123	124	68200	RI0613-2013SED-09	NA	--	NA	--
PERCENT MOISTURE	%	11	11	--	--	15.1	79.3	RI0613-2013SED-09	NA	--	NA	--

Notes:
NA: Not Applicable
NV: Screening value not available
ESL: Ecological screening level
UG/KG: micrograms per kilogram
MG/KG: milligrams per kilogram

Table 4-8
Sediment Data Comparison to Station-Specific Sediment Quality Benchmarks - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Works
Montague, Michigan

Parameter Name	Sample Location	Concentration in Sediment (mg/kg)	Sediment TOC[1] (mg/kg)	log K_{ow} [2]	log K_{oc} [3]	MW[2]	Final Chronic Value[4] (µg/L)	*f*TOC	*f*Solids	Sediment Quality Benchmark (mg/kg)
										NEC[5]
ACETALDEHYDE	2013SW/SED-09	**3.0**	68200	-0.17	-0.17	44.05	130	0.0682	0.207	0.50
ACETONE	2013SW/SED-08	0.150	48700	-0.23	-0.23	58.08	1700	0.0487	0.302	3.98
	2013SW/SED-09	0.400	68200	-0.23	-0.23	58.08	1700	0.0682	0.207	6.58
TETRACHLOROETHENE	2013SW/SED-09	0.009	68200	2.97	2.92	165.83	190	0.0682	0.207	11.50

Notes:
1, Data were only compared to sediment quality benchmarks (SQBs) where site-specific total organic carbon (TOC) concentrations were ≥ 0.2%, dry weight (EPA, 2008)
2, Log K_{ow} and molecular weight (MW) from EPA's Ecological Structure Activity Relationships (ECOSAR) Class Program v. 1.11, June 2012.
3, Log K_{oc} calculated based on formula provided by EPA (2008).
4, MDEQ Rule 57 Water Quality Values
5, NEC - No effect concentration
Bold indicates an exceedance of the sediment quality benchmark
Kow: Octanol-water partitioning coefficient
Koc: Organic carbon partitioning coefficient
mg/kg: milligrams per kilogram
µg/L: micrograms per liter

Table 4-9
Human Health Screening Summary of Surface-Water Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Parameter Name	Units	Unfiltered/ Filtered	Number of Samples	Number of Detections	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Concentration	MDEQ Rule 57 WQV Screening Criteria	Number of Exceedances
Volatile Organic Compounds (VOCs)											
1,1,1-TRICHLOROETHANE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		NV	-
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/L	Unfiltered	11	0	2	2	--	--		1834000	0
1,1-DICHLOROETHANE	UG/L	Unfiltered	11	0	1	1	--	--		400000	0
ACETALDEHYDE	UG/L	Unfiltered	11	1	20	40	43	43	RI0613-2013SW-02	93000	0
ACETONE	UG/L	Unfiltered	11	0	6	6	--	--		450000	0
BENZENE	UG/L	Unfiltered	11	0	0.5	0.5	--	--		310	0
CARBON TETRACHLORIDE	UG/L	Unfiltered	11	0	1	1	--	--		38	0
CHLOROFORM	UG/L	Unfiltered	11	0	0.8	0.8	--	--		11000	0
CIS-1,2 DICHLOROETHENE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		36000	0
DICHLORODIFLUOROMETHANE	UG/L	Unfiltered	11	0	2	2	--	--		90000	0
METHYLENE CHLORIDE	UG/L	Unfiltered	11	0	2	2	--	--		2600	0
TETRACHLOROETHENE	UG/L	Unfiltered	11	1	0.8	0.8	1	1	RI0613-2013SW-08	60	0
TETRAHYDROFURAN	UG/L	Unfiltered	11	0	4	4	--	--		26000	0
TOLUENE	UG/L	Unfiltered	11	0	0.7	0.7	--	--		51000	0
TRANS-1,2-DICHLOROETHENE	UG/L	Unfiltered	11	0	0.8	0.8	--	--		19000	0
TRICHLOROETHENE	UG/L	Unfiltered	11	0	1	1	--	--		370	0
TRICHLOROFLUOROMETHANE	UG/L	Unfiltered	11	0	2	2	--	--		NV	-
Metals											
ANTIMONY	UG/L	Unfiltered	11	0	0.34	0.34	--	--		130	0
ARSENIC	UG/L	Unfiltered	11	9	0.42	0.42	1.1	1.8	RI0613-2013SW-03	10	0
CADMIUM	UG/L	Unfiltered	11	1	0.76	0.76	3.3	3.3	RI0613-2013SW-01	130.0	0
LEAD	UG/L	Unfiltered	11	11	--	--	0.15	2.5	RI0613-2013SW-01	190.0	0
MERCURY	UG/L	Unfiltered	11	0	0.07	0.07	--	--		0.0018	0
ANTIMONY	UG/L	Filtered	11	0	0.34	0.34	--	--		130	0
ARSENIC	UG/L	Filtered	11	9	0.42	0.42	0.48	1.6	RI0613-2013SW-09	10	0
CADMIUM	UG/L	Filtered	11	0	0.76	0.76	--	--		130.0	0
LEAD	UG/L	Filtered	11	1	0.085	0.085	0.11	0.11	RI0613-2013SW-05	190.0	0
MERCURY	UG/L	Filtered	11	0	0.07	0.07	--	--		0.0018	
Miscellaneous											
AMMONIA	UG/L	Unfiltered	11	11	--	--	70	460	RI0613-2013SW-03	NV (10,000)	-
CHLORIDE	UG/L	Unfiltered	11	11	--	--	4400	15700	RI0613-2013SW-01	NV (250,000)	-
FLUORIDE	UG/L	Unfiltered	11	0	400	400	--	--		NV	-
SULFATE	UG/L	Unfiltered	11	11	--	--	12400	26700	RI0613-2013SW-09	NV (250,000)	-
Water Quality Parameters											
TOTAL HARDNESS AS CACO3	UG/L	Unfiltered	11	11	--	--	162000	214000	RI0613-2013SW-09	NA	

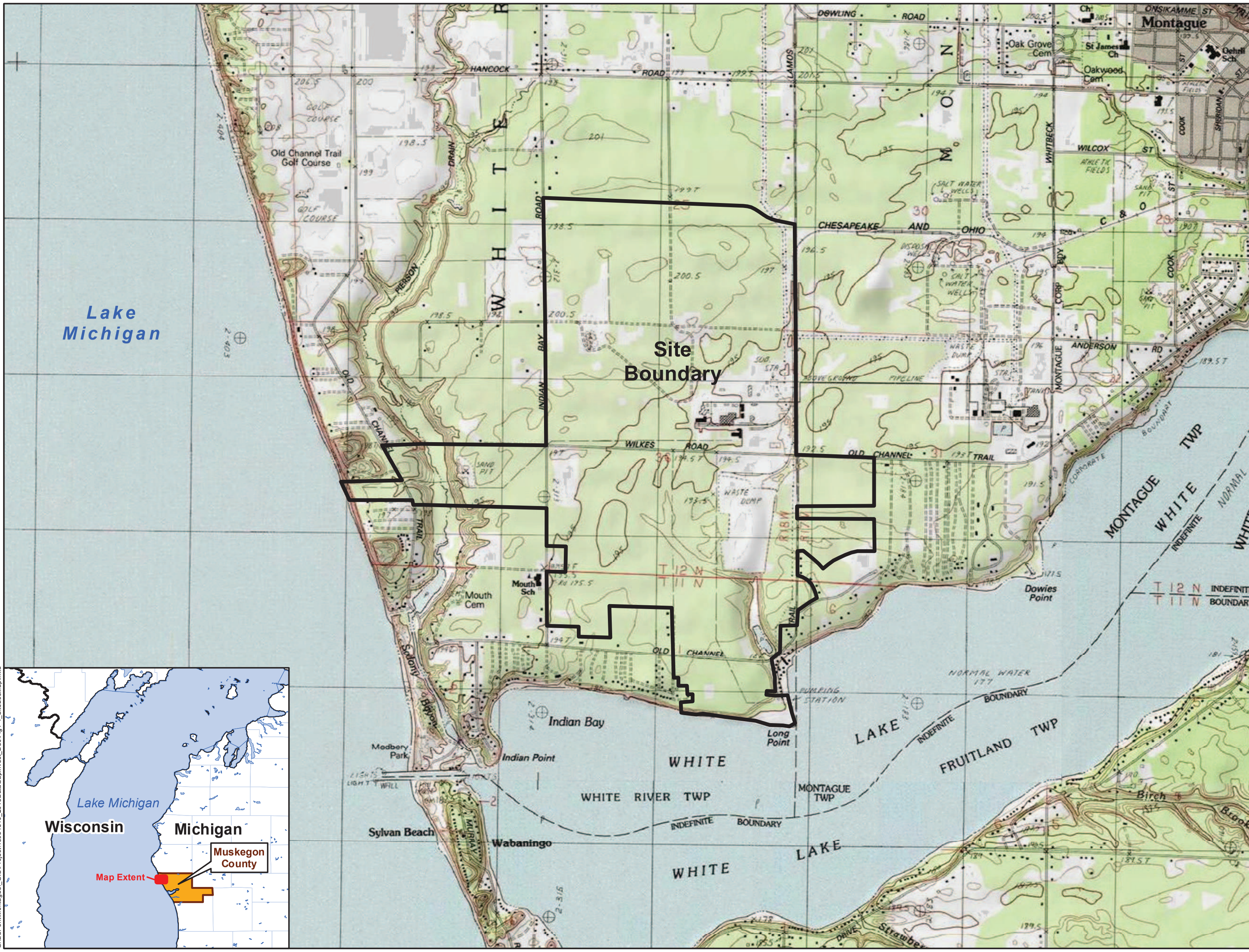
Notes:
Water Quality Value (WQV) shown is lower of values protective of human health (carcinogen and non-carcinogen) for non drinking water
Values in parantheses are Non-Residential Drinking Water values.
UG/L: micrograms per liter
NV: Screening value not available

Table 4-10
Human Health Screening Summary of Sediment Data - Pierson Creek and Tributaries
Remedial Investigation Report
Addendum No. 2 - Pierson Creek
DuPont Montague Site
Montague, Michigan

Parameter Name	Units	Number of Samples	Number of Detections	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum	Cleanup Criteria Requirements for Response Activity[1] Direct Contact			
									Residential	Number of Exceedances	Non-Residential	Number of Exceedances
Volatile Organic Compounds (VOCs)												
1,1,1-TRICHLOROETHANE	UG/KG	11	0	1	8	--	--		5.00E+08	0	1.00E+09	0
1,1,2-TRICHLOROTRIFLUOROETHANE (CFC-113)	UG/KG	11	0	2	17	--	--		1.00E+09	0	1.00E+09	0
1,1-DICHLOROETHANE	UG/KG	11	0	1	8	--	--		890000	0	890000	0
ACETALDEHYDE	UG/KG	11	4	700	20000	750	3000	RI0613-2013SED-09	2.90E+07	0	9.50E+07	0
ACETONE	UG/KG	11	3	8	9	20	400	RI0613-2013SED-09	2.30E+07	0	7.30E+07	0
BENZENE	UG/KG	11	0	0.6	4	--	--		180000	0	840000	0
CARBON TETRACHLORIDE	UG/KG	11	0	1	8	--	--		96000	0	440000	0
CHLOROFORM	UG/KG	11	0	1	8	--	--		1.20E+06	0	5.50E+06	0
CIS-1,2 DICHLOROETHENE	UG/KG	11	0	1	8	--	--		2.50E+06	0	8.00E+06	0
DICHLORODIFLUOROMETHANE	UG/KG	11	0	2	17	--	--		5.20E+07	0	1.00E+06	0
METHYLENE CHLORIDE	UG/KG	11	0	2	17	--	--		1.30E+06	0	5.80E+06	0
TETRACHLOROETHENE	UG/KG	11	1	1	5	9	9	RI0613-2013SED-09	200000	0	930000	0
TETRAHYDROFURAN	UG/KG	11	0	5	33	--	--		2.90E+06	0	9.50E+06	0
TOLUENE	UG/KG	11	0	1	8	--	--		5.00E+07	0	1.60E+08	0
TRANS-1,2-DICHLOROETHENE	UG/KG	11	0	1	8	--	--		3.80E+06	0	1.20E+07	0
TRICHLOROETHENE	UG/KG	11	0	1	8	--	--		500000	0	660000	0
TRICHLOROFLUOROMETHANE	UG/KG	11	0	2	17	--	--		7.90E+07	0	2.60E+08	0
Metals												
ANTIMONY	MG/KG	11	1	0.0974	0.279	0.509	0.509	RI0613-2013SED-09	180	0	670	0
ARSENIC	MG/KG	11	11	--	--	0.321	5.86	RI0613-2013SED-09	7.6	0	37	0
CADMIUM	MG/KG	11	3	0.0861	0.0921	0.103	0.696	RI0613-2013SED-09	550	0	2100	0
LEAD	MG/KG	11	11	--	--	0.423	34.9	RI0613-2013SED-09	400	0	900	0
MERCURY	MG/KG	11	2	0.0113	0.0121	0.109	0.189	RI0613-2013SED-09	160	0	580	0
Miscellaneous												
AMMONIA	MG/KG	11	1	501	1410	487	487	RI0613-2013SED-09	NV	-	NV	-
CHLORIDE	MG/KG	11	1	5.9	16.6	26.3	26.3	RI0613-2013SED-09	500	0	500	0
FLUORIDE	MG/KG	11	1	0.94	2.6	3.9	3.9	RI0613-2013SED-09	NV	-	NV	-
SULFATE	MG/KG	11	10	5.9	5.9	7.7	405	RI0613-2013SED-09	NV	-	NV	-
Other Parameters												
TOTAL ORGANIC CARBON	MG/KG	11	4	118	123	124	68200	RI0613-2013SED-09	NA	-	NA	-
PERCENT MOISTURE	%	11	11	--	--	15.1	79.3	RI0613-2013SED-09	NA	-	NA	-

Notes:
1, Formerly the Part 201 Generic Cleanup Criteria and Screening Levels. Effective date December 30, 2013.
Values greater than 1,000,000 shown as scientific notation
--: Does not apply
NA: Not Applicable
NV: Screening value not available
UG/KG: micrograms per kilogram
MG/KG: milligrams per kilogram

Figures



Legend

— Site Boundary

NOTES:
USGS Topographic Map Copyright:© 2011 National Geographic Society, i-cubed

Map Scale: 1:24,000
Map Projection: NAD83 State Plane Michigan South (ft)

0 1,000 2,000 4,000
Feet

1 inch = 2,000 feet

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SITE LOCATION MAP

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: CAD	DATE: 12/18/2013
DRAWN BY: CAD	FIGURE NUMBER: 1-1
DATA QUALITY CHECK BY: GEG	

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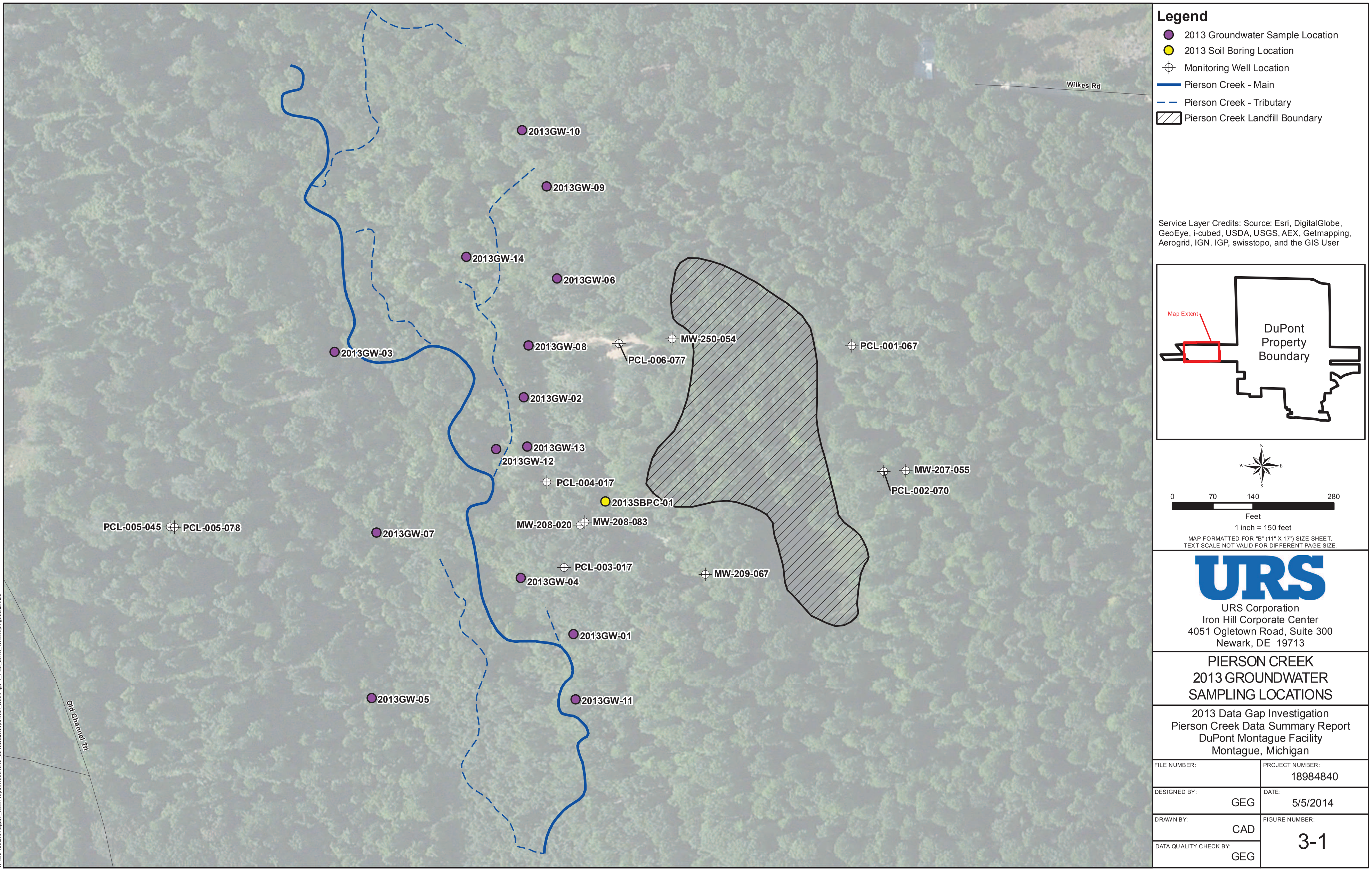

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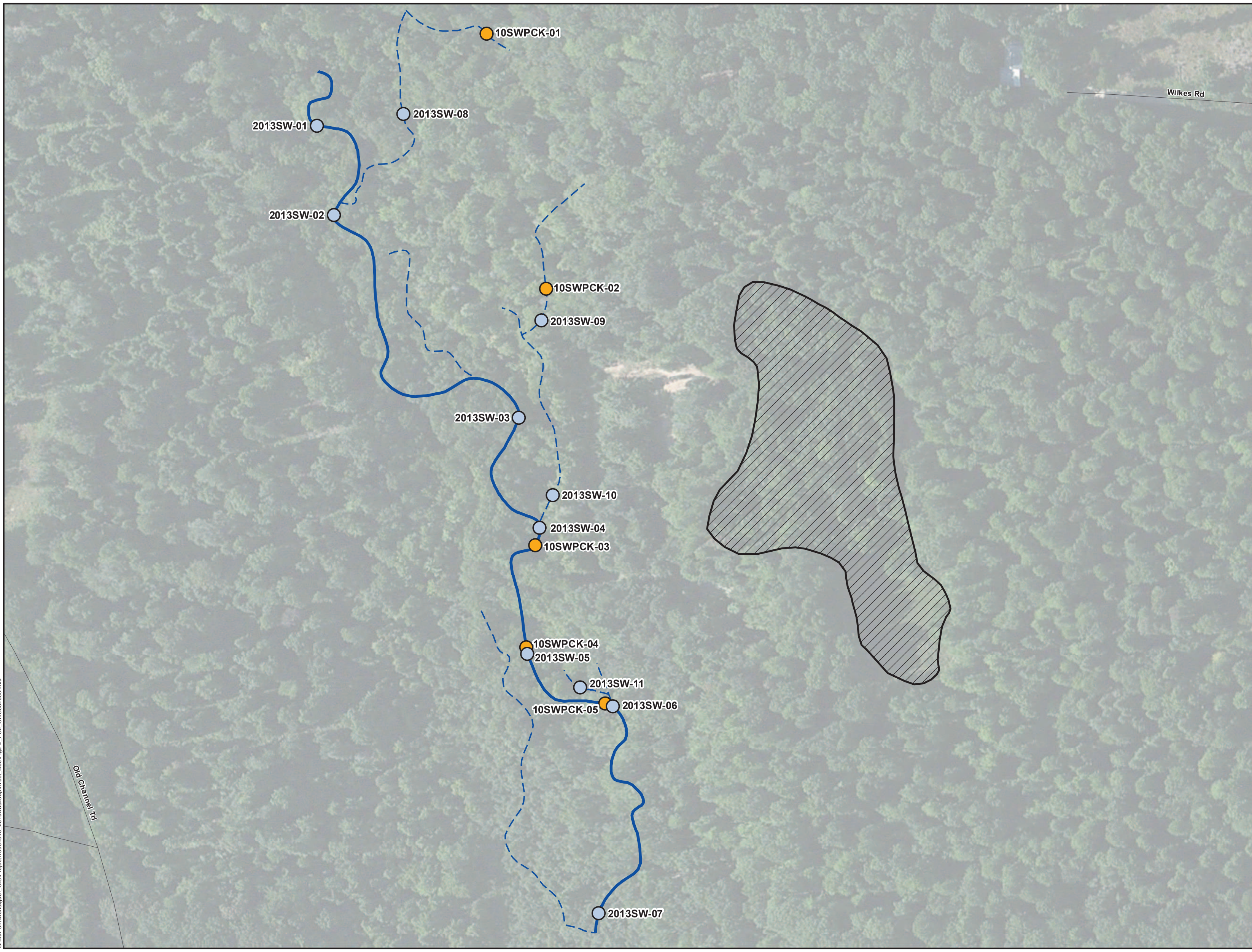
PIERSON CREEK
2013 GROUNDWATER
SAMPLING LOCATIONS

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

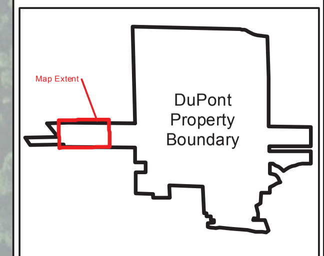
FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 3-1
DATA QUALITY CHECK BY: GEG	



Legend

- 2013 Surface Water/Sediment Sample Location
- 2010 Surface Water/Sediment Sample Location
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User



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1 inch = 150 feet
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PIERSON CREEK SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG/BR/CYC	DATE: 5/3/2014
DRAWN BY: CAD	FIGURE NUMBER: 3-2
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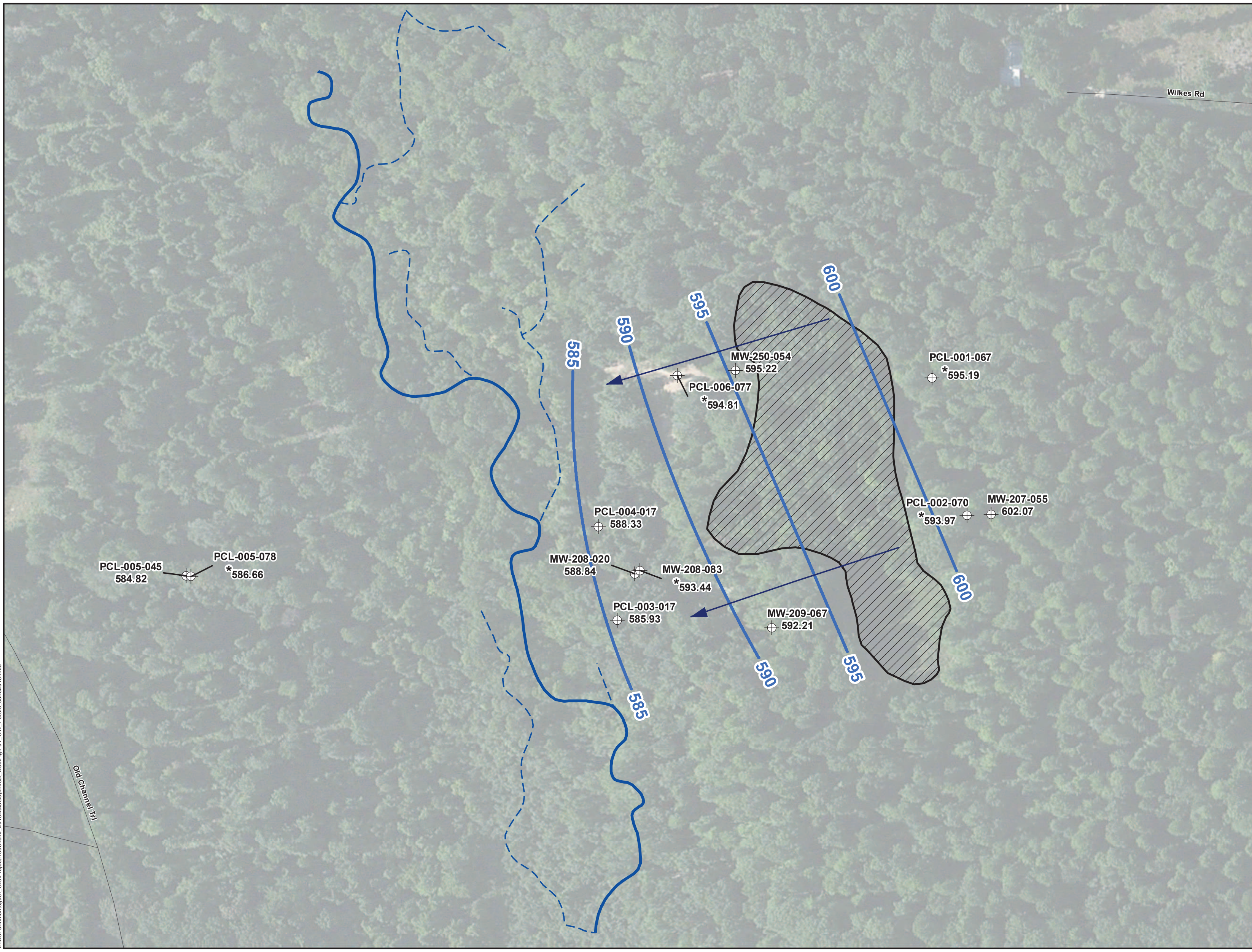

Legend

- Monitoring Well Location
- Potentiometric Elevation Contour
- Groundwater Flow Direction
- Road Centerline
- Pierson Creek - Main
- Pierson Creek - Tributary
- Pierson Creek Landfill Boundary

Potentiometric Surface Elevations (ft MSL) taken June 17, 2013.

Isopleth lines are interpreted using shallow data where possible. Data marked with * are from deeper screened wells and not used for determining isopleth lines.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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GROUNDWATER POTENTIOMETRIC SURFACE - JUNE 2013

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/16/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-1
DATA QUALITY CHECK BY: GEG	

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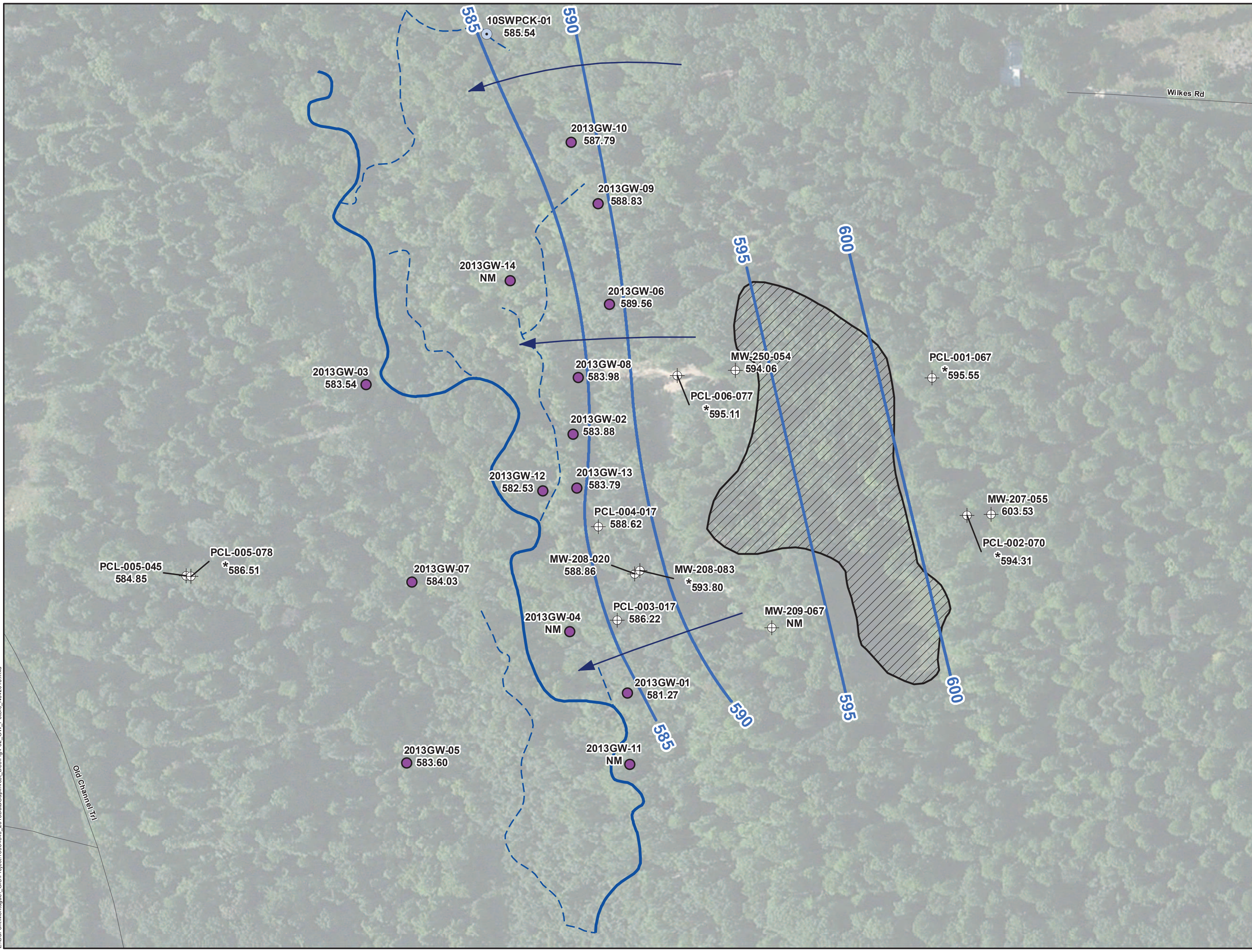
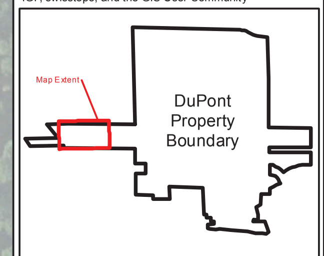


Legend

- 2013 Groundwater Sample Location
- Monitoring Well Location
- Potentiometric Elevation Contour
- Groundwater Flow Direction
- Road Centerline
- Pierson Creek - Main
- Pierson Creek - Tributary
- Pierson Creek Landfill Boundary

Potentiometric Surface Elevations (ft MSL) taken at wells November 18, 2013.
Elevations of springs/seeps measured by Driesenga Engineering November 13, 2013
Isopleth lines are interpreted using shallow data where possible. Data marked with * are from deeper screened wells and not used for determining isopleth lines.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



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GROUNDWATER POTENTIOMETRIC SURFACE - NOVEMBER 2013

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/16/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-2
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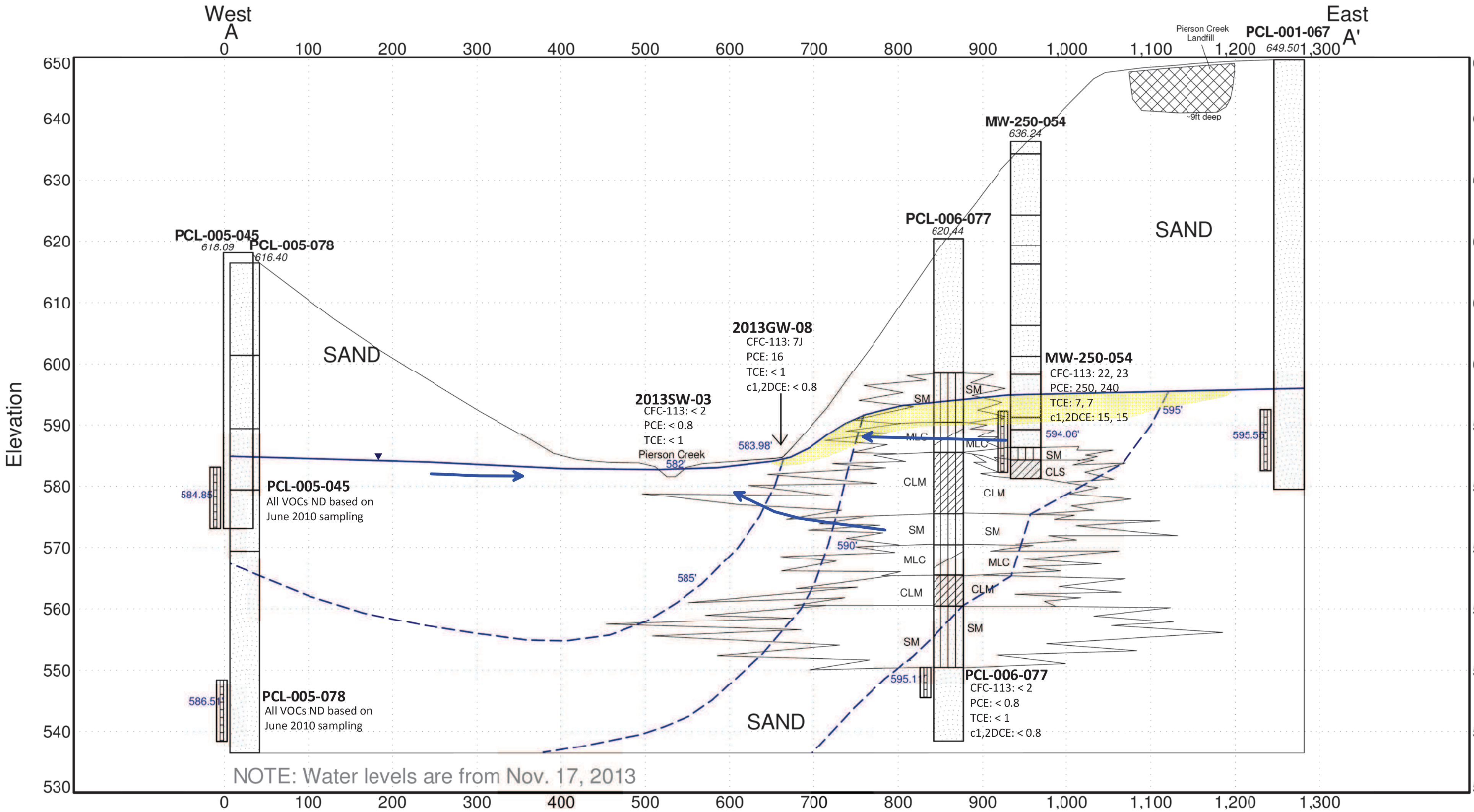
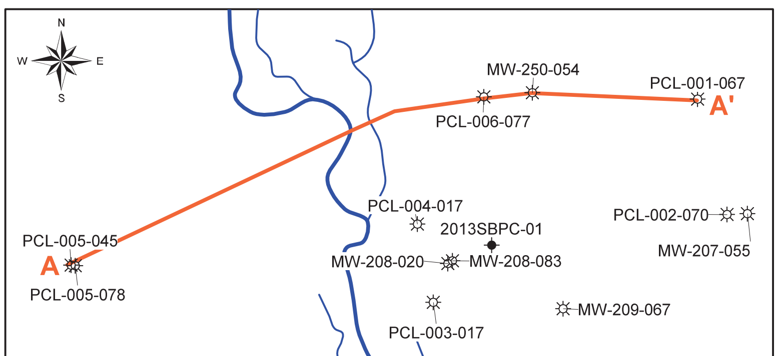
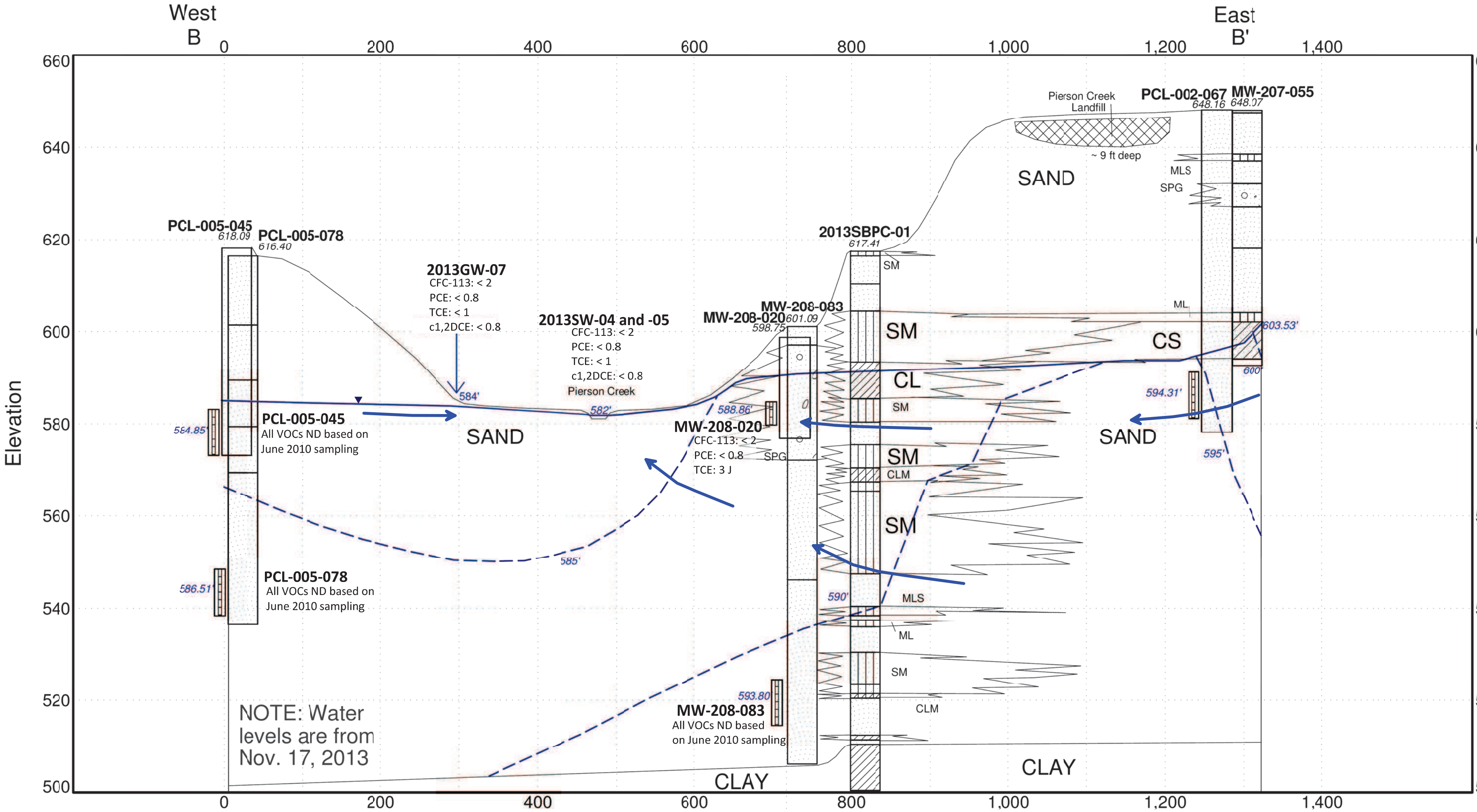


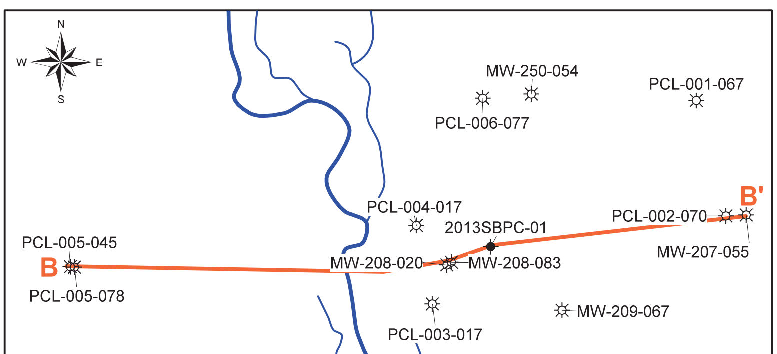
NOTE:
Results are in units ug/L.
2013GW and SW samples collected 6/2013.
Monitoring well samples collected 5/2013.
J = Result is estimated.
U = Analyte not detected
CFC-113: 1,1,2trichlorofluoroethane
PCE: Tetrachloroethene
TCE: Trichloroethene
c1,2-DCE: cis 1,2-dichloroethene
Yellow shading represents interpreted extent of PCE exceeding 5 ug/L.



NOTE:
Inset map displays location of cross section.

Cross Section Pierson Creek A - A'		
DuPont - Montague Montague, MI		
PROJECT # 18984840	DATE Mar 2014	FIGURE 4-3





NOTE:
Inset map displays location of cross section.

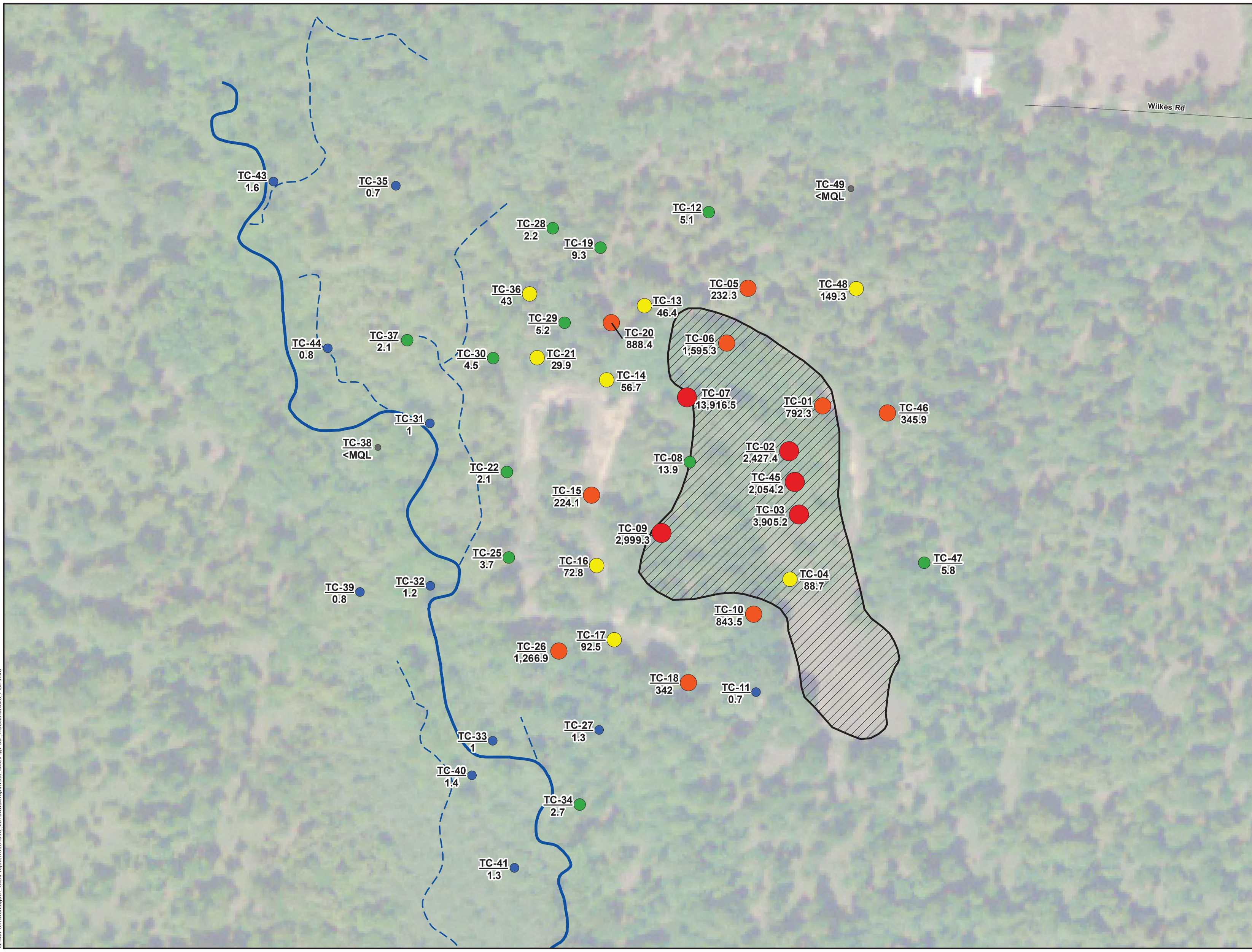
NOTE:
Results are in units ug/L.
2013GW and SW samples collected 6/2013.
Monitoring well samples collected 5/2013.
J = Result is estimated.
U = Analyte not detected
CFC-113: 1,1,2trichlorofluoroethane
PCE: Tetrachloroethene
TCE: Trichloroethene
c1,2-DCE: cis 1,2-dichloroethene

Cross Section Pierson Creek B - B'

DuPont - Montague

Montague, MI

PROJECT #	DATE	FIGURE
18984840	Mar 2014	4-4



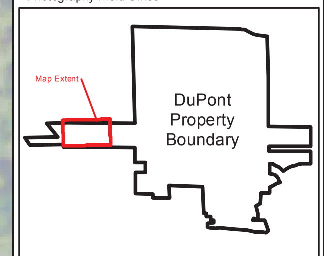
Legend

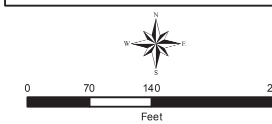
PCE Results (ppt)

- <MQL (<0.2)
- 0.2 - 2
- 2.1 - 20
- 20.1 - 200
- 200.1 - 2,000
- >2,000
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Tree core samples were taken September, 2012. Results in ppt (parts per trillion).

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office





1 inch = 140 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET. TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

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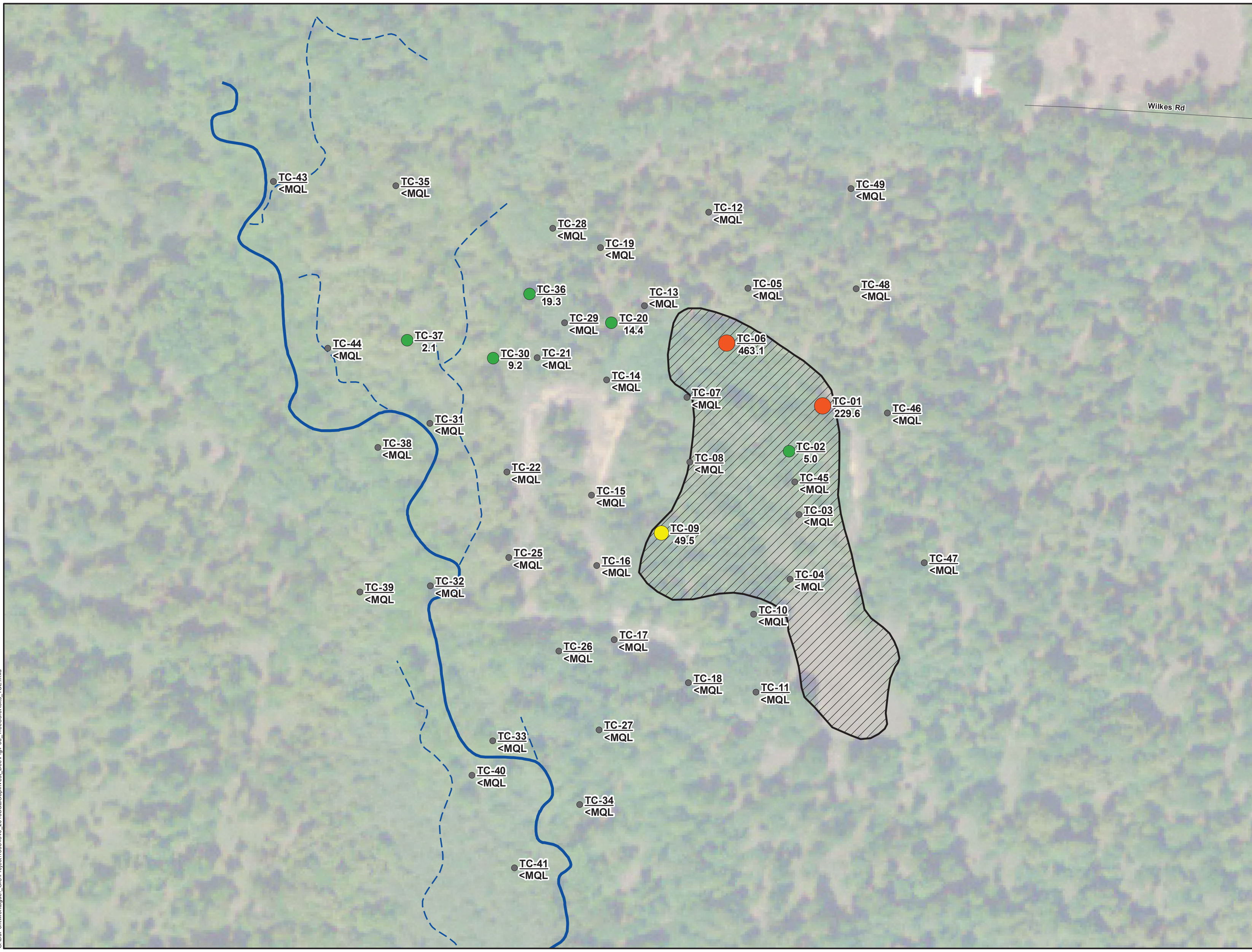
Newark, DE 19713

TREE CORE SAMPLING RESULTS - TETRACHLOROETHENE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-5
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-05_TreeCoreRslts_PCE.mxd



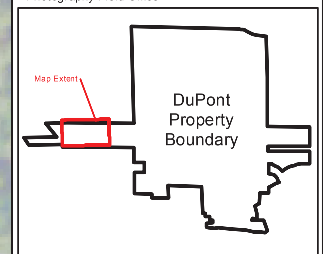
Legend

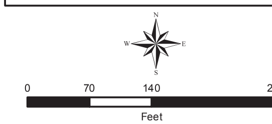
TCE Results (ppt)

- <MQL (<0.2)
- 0.2 - 2
- 2.1 - 20
- 20.1 - 200
- 200.1 - 2,000
- >2,000
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Tree core samples were taken September, 2012. Results in ppt (parts per trillion).

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office





1 inch = 140 feet

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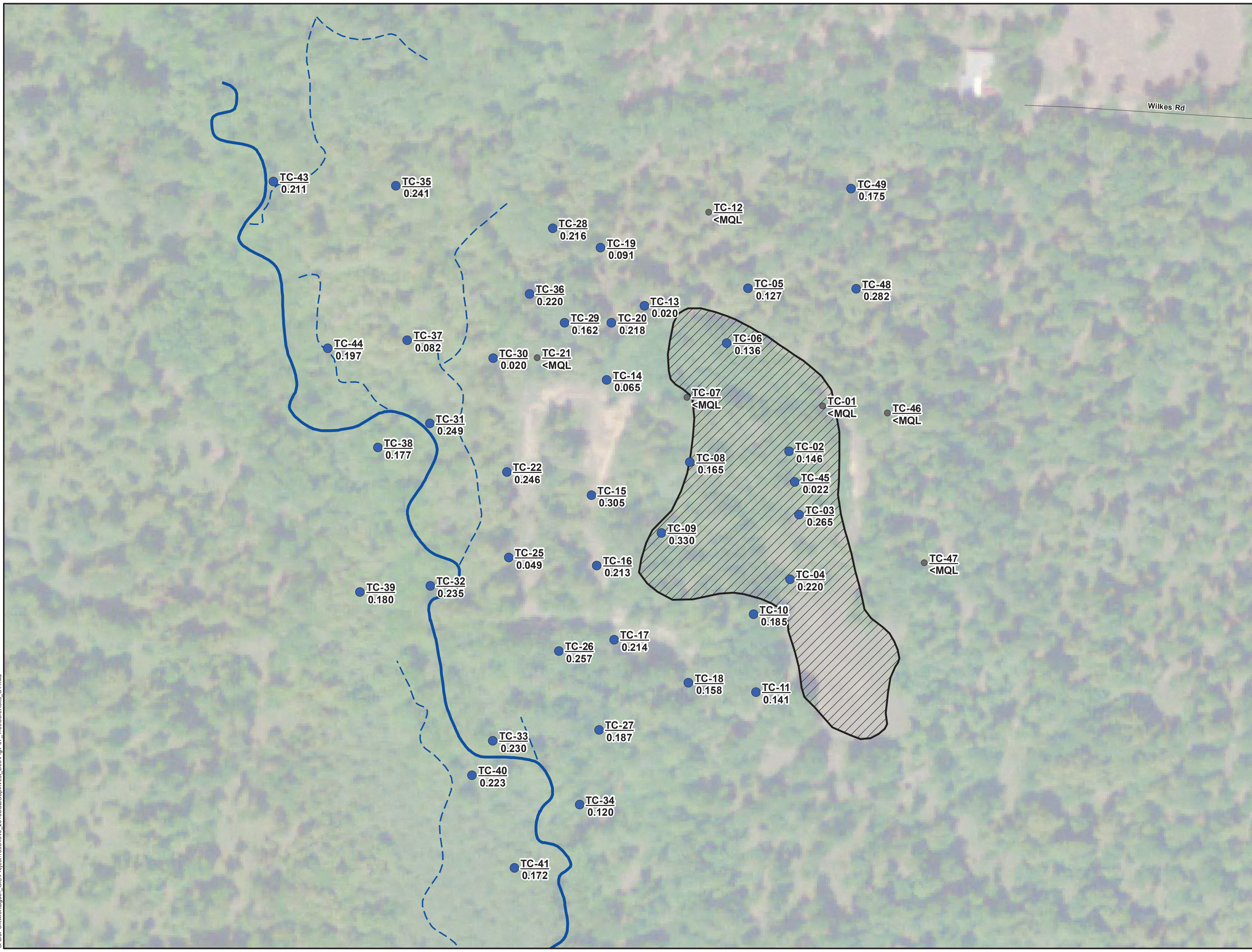
TREE CORE SAMPLING RESULTS - TRICHLOROETHENE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-6
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-06_TreeCoreRslts_TCE.mxd



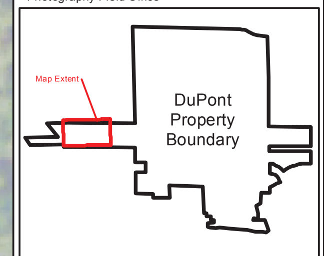
Legend

CT Results (ppt)

- <MQL
- MQL - 2
- 2.1 - 20
- 20.1 - 200
- 200.1 - 2,000
- >2,000
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Tree core samples were taken September, 2012.
Results in ppt (parts per trillion).

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



N E S W

0 70 140 280
Feet
1 inch = 140 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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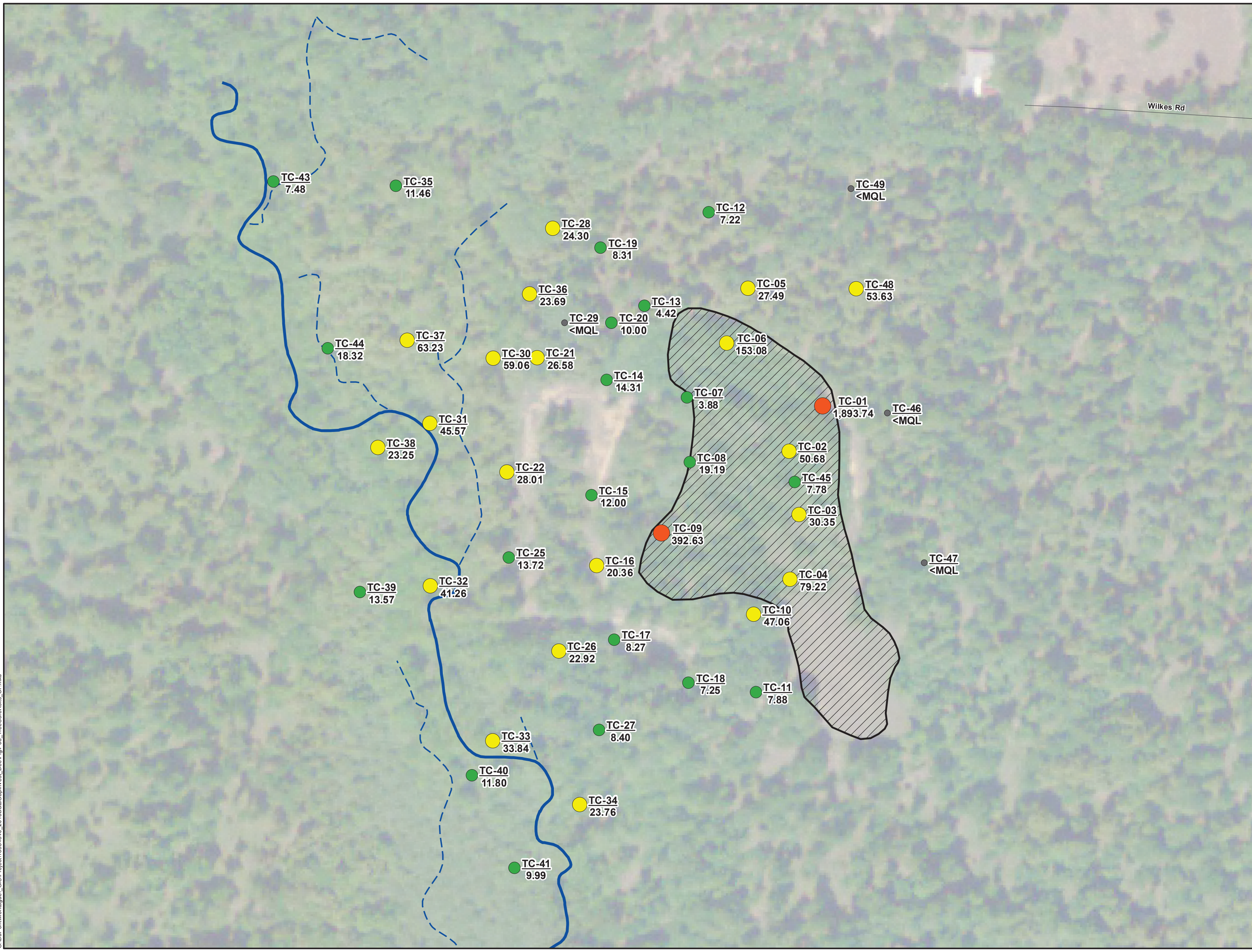
TREE CORE SAMPLING RESULTS - CARBON TETRACHLORIDE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/9/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-7
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-07_TreeCoreRslts_CT.mxd



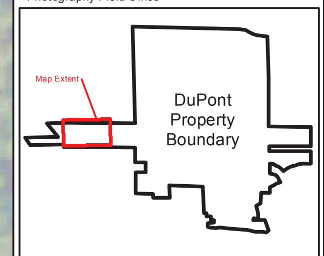
Legend

CF Results (ppt)

- <MQL (<0.2)
- 0.2 - 2
- 2.1 - 20
- 20.1 - 200
- 200.1 - 2,000
- >2,000
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Tree core samples were taken September, 2012. Results in ppt (parts per trillion).

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



0 70 140 280
Feet
1 inch = 140 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET. TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

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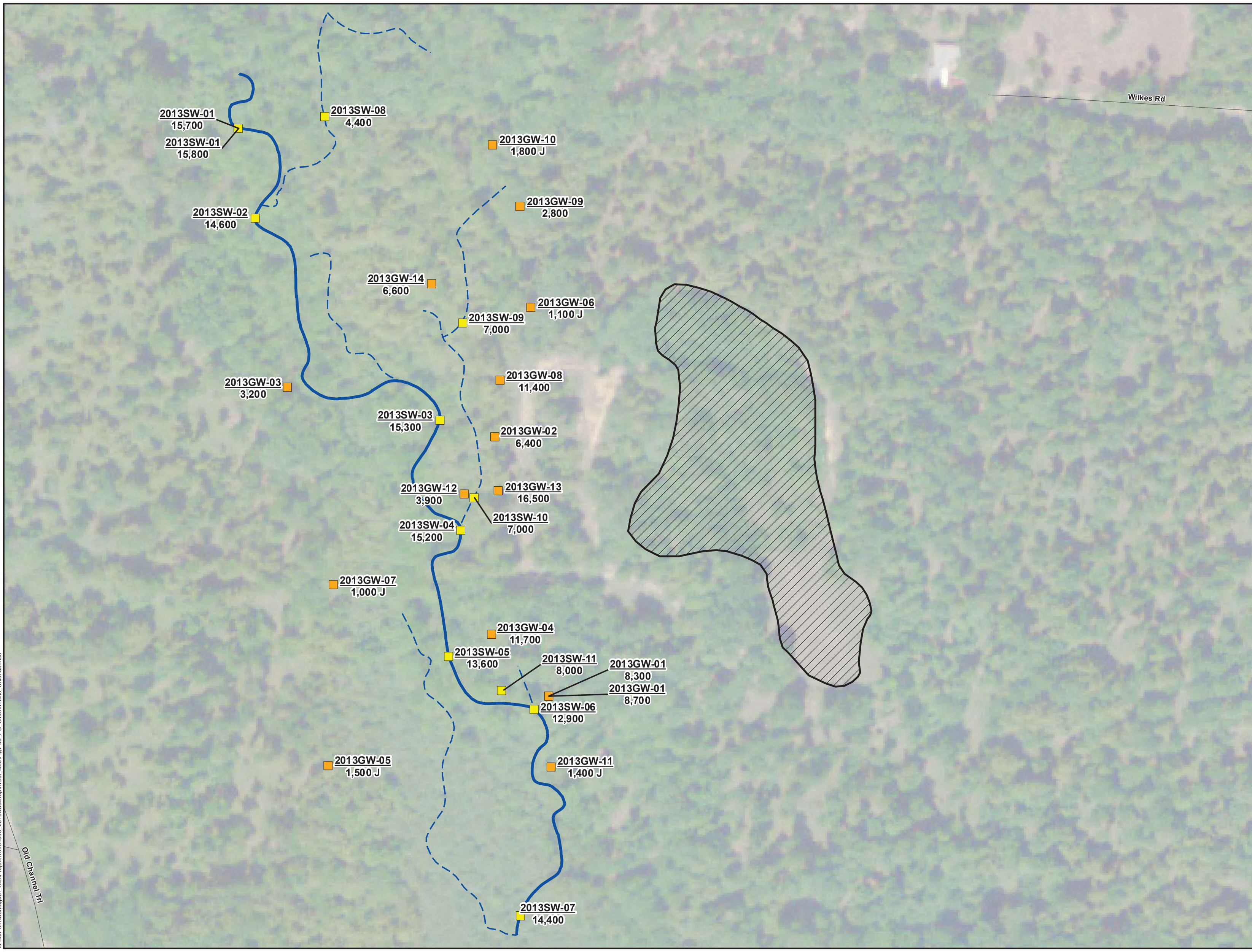
TREE CORE SAMPLING RESULTS - CHLOROFORM

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-8
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-08_TreeCoreRslts_CF.mxd

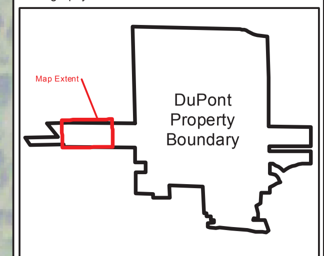


Legend

- 2013 Groundwater Sample Location with ID and Result*
- 2013 Surface Water Sample Location with ID and Result*
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Notes:
*Results are in units ug/L.
Samples were taken in June 2013.
J = Result is estimated.
MDEQ = Michigan Department of Environmental Quality
MDEQ_2 for Chloride is 250,000 ug/L.

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



0 75 150 300
Feet
1 inch = 150 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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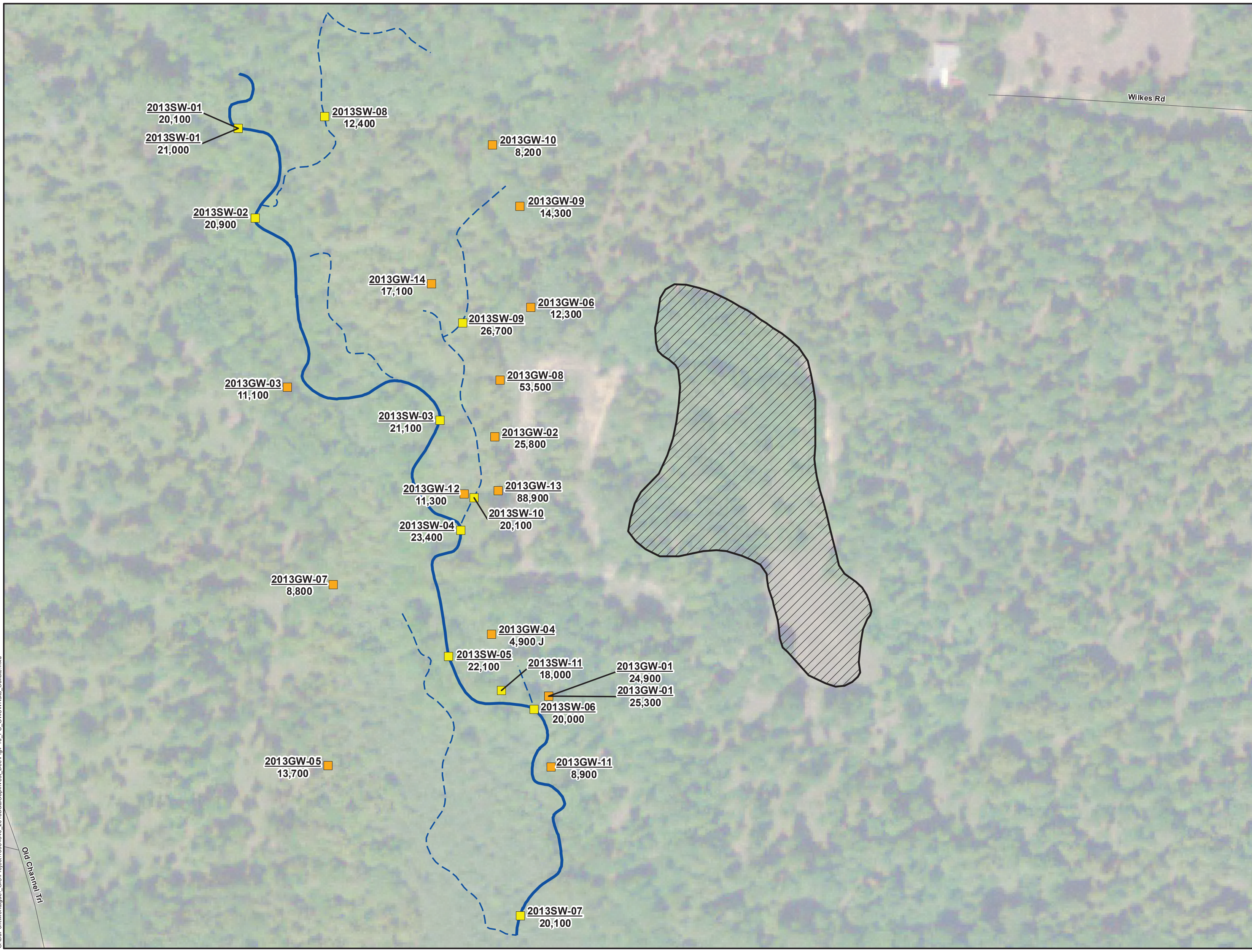
PIERSON CREEK GROUNDWATER AND SURFACE WATER RESULTS - CHLORIDE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-9
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-09_PC_GWSWRslts_Chloride.mxd



Legend

- 2013 Groundwater Sample Location with ID and Result*
- 2013 Surface Water Sample Location with ID and Result*
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Notes:
*Results are in units ug/L.
Samples were taken in June 2013.
J = Result is estimated.
MDEQ = Michigan Department of Environmental Quality
MDEQ_2 for Sulfate is 250,000 ug/L.

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office

1 inch = 150 feet

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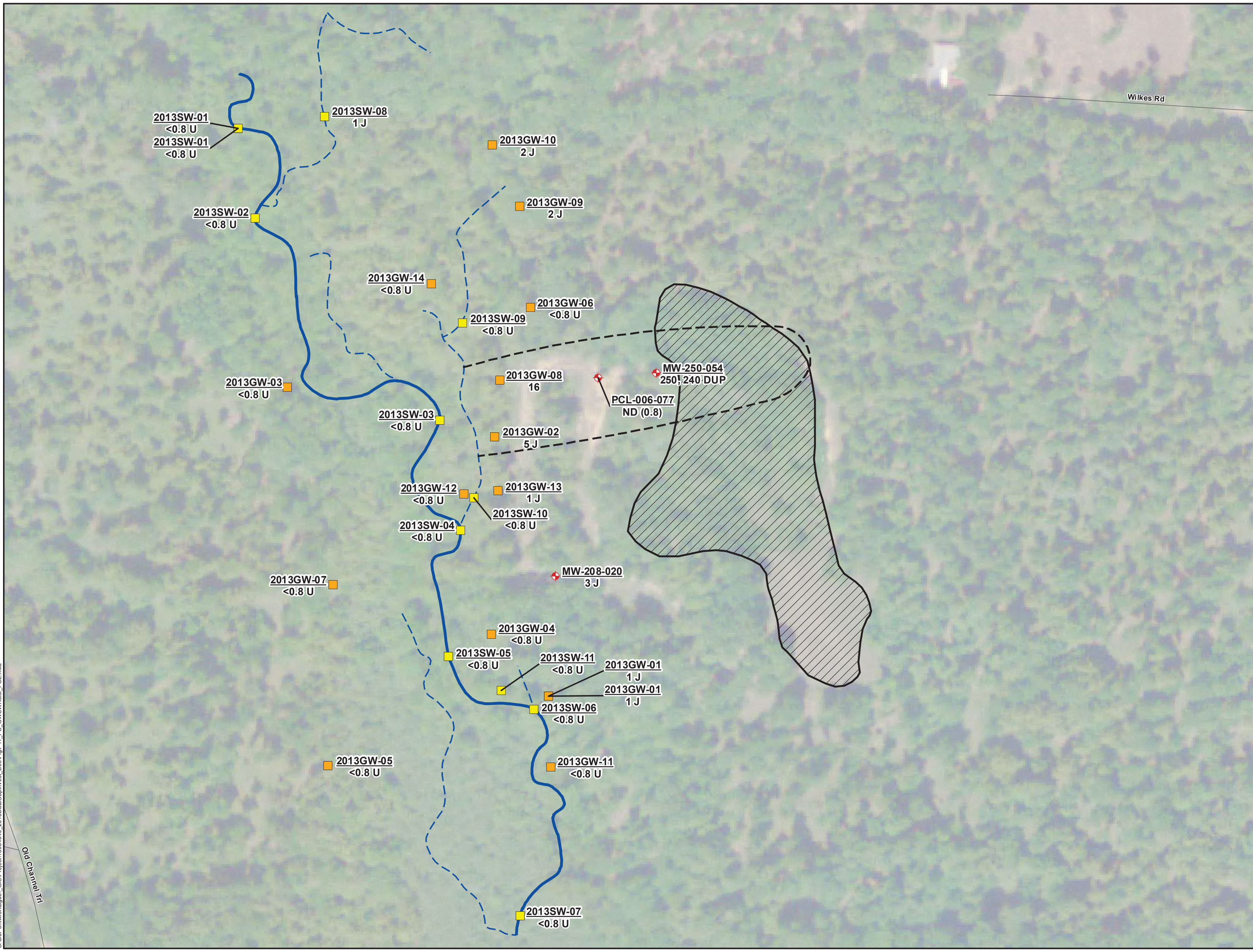
PIERSON CREEK GROUNDWATER AND SURFACE WATER RESULTS - SULFATE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-10
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-10_PC_GWSWRslts_Sulfate.mxd

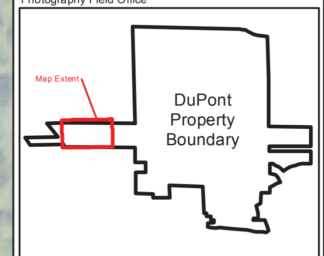


G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-11_PC_GWSWRslts_PCE.mxd

Legend

- 2013 Groundwater Sample Location with ID and Result*
- 2013 Surface Water Sample Location with ID and Result*
- Monitoring Well with ID and Result*
- Interpreted Extent of PCE Exceeding MDEQ Non-Residential Drinking Water Criteria (5 ug/L)
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Notes:
*Results are in units ug/L.
Samples were taken in June 2013.
Monitoring well samples were taken in May 2013.
J = Result is estimated.
U = Analyte not detected above the limit shown.
MDEQ = Michigan Department of Environmental Quality
MDEQ_2 for Tetrachloroethene is 5 ug/L.
2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



0 75 150 300
Feet
1 inch = 150 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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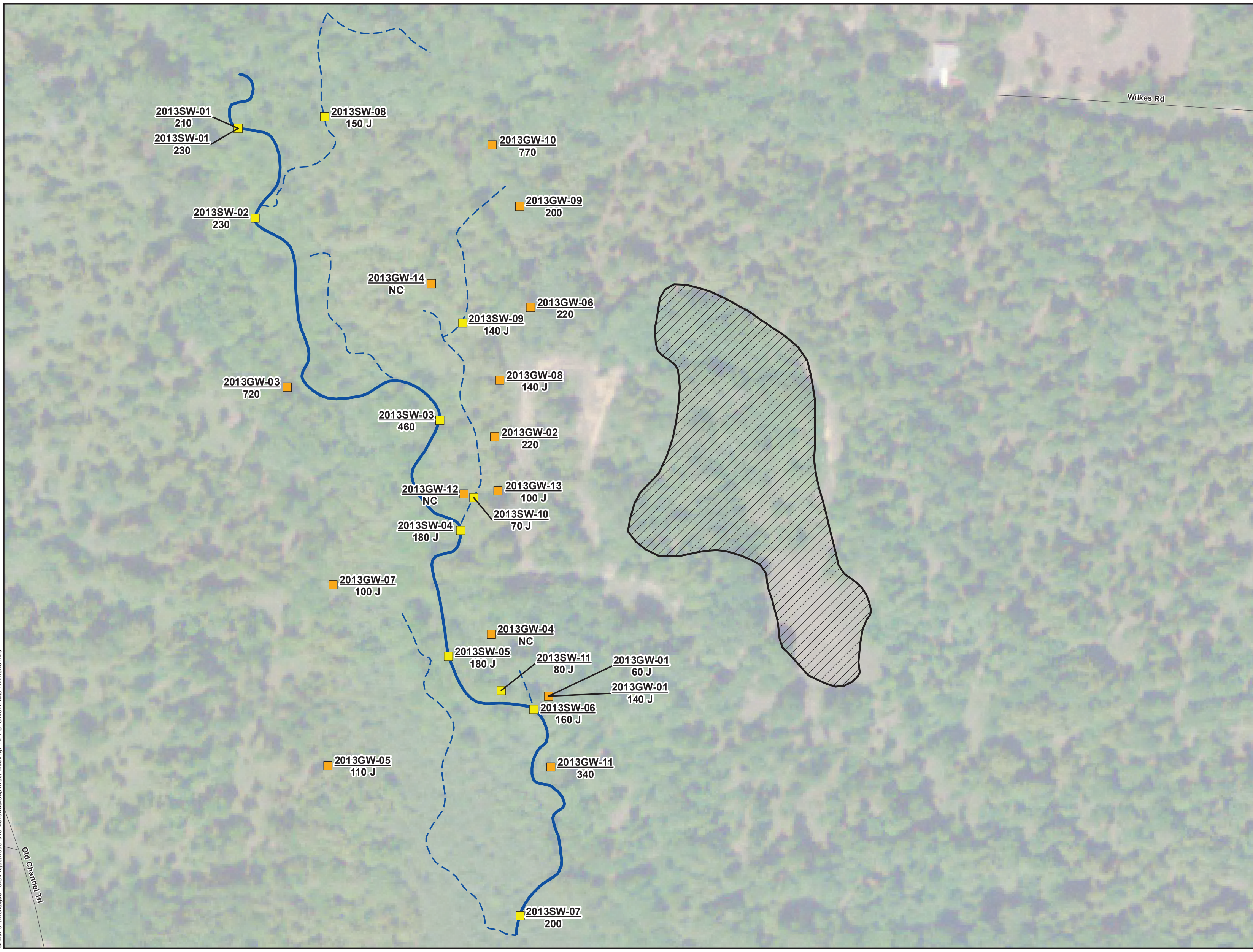
PIERSON CREEK GROUNDWATER AND SURFACE WATER RESULTS - TETRACHLOROETHENE

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-11
DATA QUALITY CHECK BY: GEG	

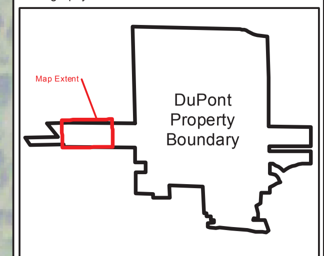


Legend

- 2013 Groundwater Sample Location with ID and Result*
- 2013 Surface Water Sample Location with ID and Result*
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Notes:
*Results are in units ug/L.
Samples were taken in June 2013.
J = Result is estimated.
NC = Not Collected; Insufficient water.
MDEQ = Michigan Department of Environmental Quality
MDEQ_2 for Ammonia is 10,000 ug/L.

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



0 75 150 300
Feet
1 inch = 150 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET. TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

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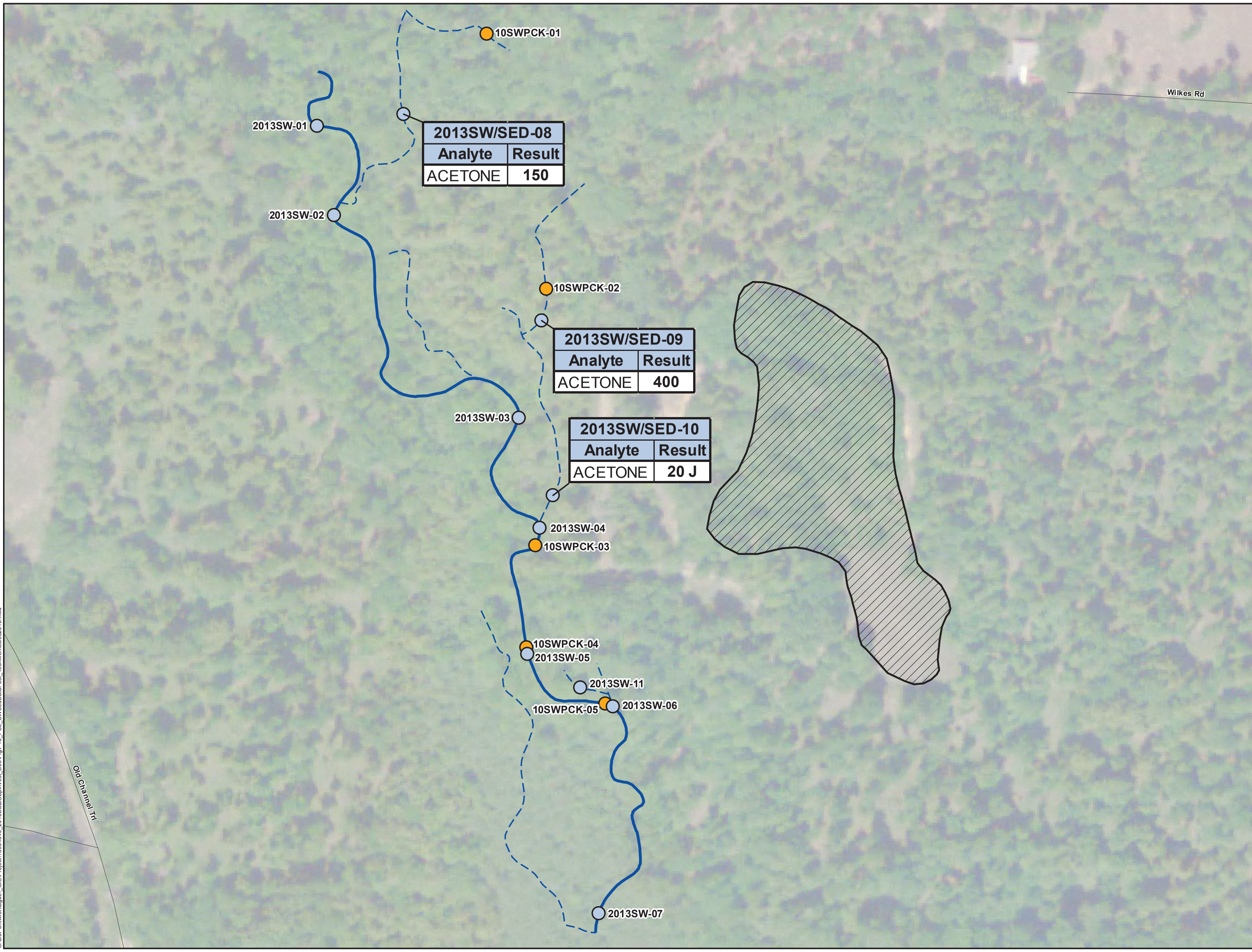
PIERSON CREEK GROUNDWATER AND SURFACE WATER RESULTS - AMMONIA

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-12
DATA QUALITY CHECK BY: GEG	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-12_PC_GWSWRslts_Ammonia.mxd

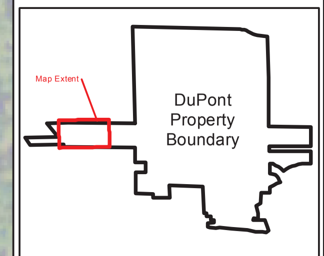


Legend

- 2013 Surface Water/Sediment Sample Location
- 2010 Surface Water/Sediment Sample Location
- Pierson Creek - Main
- Pierson Creek - Tributary
- Road Centerline
- Pierson Creek Landfill Boundary

Bold values indicate an exceedance of a conservative ecological screening benchmark.
Sediment concentration results are in parts per billion (ppb) (ug/kg).
J = value is estimated.

2005 Aerial Credit: Remote Sensing & GIS Research and Outreach Services (RS&GIS), USDA-FSA Aerial Photography Field Office



0 75 150 300
Feet
1 inch = 150 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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PIERSON CREEK SEDIMENT SAMPLING EXCEEDANCES

2013 Data Gap Investigation
Pierson Creek Data Summary Report
DuPont Montague Facility
Montague, Michigan

FILE NUMBER:	PROJECT NUMBER: 18984840
DESIGNED BY: GEG/BR/CYC	DATE: 5/5/2014
DRAWN BY: CAD	FIGURE NUMBER: 4-13
DATA QUALITY CHECK BY: GEG/BR/CYC	

G:\DuPontMontague_GIS\Project\18984840_2013DataGapInvest_Dec\Fig4-13_PCL_SWSedDataPost_TechMemoDec2013.mxd