DuPont Corporate Remediation Group
Barley Mill Plaza - Bldg 19
4417 Lancaster Pike
Wilmington, DE 19805

February 15, 2007

Ms. Ronda L. Blayer
Waste Management Division
Michigan Department of Environmental Quality (MDEQ)
Constitution Hall – Atrium North
525 West Allegan Street
Lansing, Michigan 48933

**Remedial Investigation Work Plan for
Waste Management Units and Areas of Concern DuPont Montague Site
Montague, Michigan**

Dear Ms. Blayer:

We have enclosed the Remedial Investigation Work Plan for Waste Management Units (WMUs) and Areas of Concern (AOCs) at the DuPont Montague Site in Montague, Michigan. This work plan was discussed in our November 2006 document titled, "Prioritization of Waste Management Units and Areas of Concern", which was in response to the MDEQ letter of August 11, 2006.

This document presents the detailed field activities to be performed for each WMU and AOC identified as requiring additional investigation. DuPont looks forward to receiving your comments on this document. If you have any questions or comments regarding the enclosed document, please contact me at (302) 892-7601 or Philip Chen at (302) 892-0897.

Sincerely,

Thomas E Stilley

Thomas E. Stilley, PE
Project Director

cc: Patricia McGee – DuPont
File room (507756)

E.I. du Pont de Nemours and Company

REMEDIAL INVESTIGATION WORK PLAN FOR WASTE MANAGEMENT UNITS AND AREAS OF CONCERN DUPONT MONTAGUE SITE, MONTAGUE, MICHIGAN

Date: February 2007	Project No.:	507756 18984840

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

Barley Mill Plaza, Building 19
Wilmington, Delaware 19805

TABLE OF CONTENTS

1.0 Introduction....1

2.0 General Site Background....2
  2.1 Site Location....2
  2.2 Production History....2

3.0 Investigation Activities....3
  3.1 Northeast Landfill....3
    3.1.1 Objective of Proposed Field Activity....3
    3.1.2 Field Activities....4
    3.1.3 Data Assessment....4
  3.2 North Landfill....5
    3.2.1 Objective of Proposed Field Activity....5
    3.2.2 Field Activities....5
    3.2.3 Data Assessment....6
  3.3 Bury Pit Landfill....6
    3.3.1 Objective of Proposed Field Activity....6
    3.3.2 Field Activities....7
    3.3.3 Data Assessment....7
  3.4 Pierson Creek Landfill....8
    3.4.1 Objective of Proposed Field Activity....8
    3.4.2 Field Activities....8
    3.4.3 Data Assessment....9
  3.5 Mirror Lake Area....9
    3.5.1 Objective of Proposed Field Activity....10
    3.5.2 Field Activities....10
    3.5.3 Data Assessment....10
  3.6 Former Basin Sludge Area....10
    3.6.1 Objective of Proposed Field Activity....11
    3.6.2 Field Activities....11
    3.6.3 Data Assessment....11
  3.7 Former Hydrogen Chloride Storage Tanks....12
    3.7.1 Objective of Proposed Field Activity....12
    3.7.2 Field Activities....12
    3.7.3 Data Assessment....13
  3.8 Pierson Creek – Surface Water and Sediment....13
    3.8.1 Objective of Proposed Field Activity....13
    3.8.2 Field Activities....13
    3.8.3 Data Assessment....14
  3.9 Calcium Fluoride Basin....15
    3.9.1 Objective of Proposed Field Activity....15
    3.9.2 Field Activities....15
    3.9.3 Data Assessment....16

3.10 Former NPDES Surface Impoundment 16
3.10.1 Objective of Proposed Field Activity 16
3.10.2 Field Activities 17
3.10.3 Data Assessment....................17

4.0 Quality Assurance Related Field Activities....................19
4.1 QA/QC Samples....................19
4.2 Equipment Decontamination 19
4.3 Waste Management....................20

5.0 References....................21

TABLES

Table 1 Sampling Summary Table – Montague Investigation Work Plan
Table 2 Landfill Analytical Parameters List
Table 3 Freon and Neoprene Related Constituents
Table 4 Constituents Associated with the Site NPDES Permit
Table 5 Constituents Associated with the Semi-Annual Groundwater Sampling Program

FIGURES

Figure 1 Site Location Map
Figure 2 General Site Map
Figure 3 Waste Management Units and Areas of Concern
Figure 4 Northeast Landfill Map, Proposed Surficial Soil Sample Locations
Figure 5 North Landfill Map, Proposed Surficial Soil Sample Locations
Figure 6 Bury Pit Landfill Map, Proposed Surficial Soil Sample Locations
Figure 7 Pierson Creek Landfill Map, Proposed Surficial Soil Sample Locations
Figure 8 Mirror Lake Area Proposed Sample Location
Figure 9 Former Basin Sludge Area Proposed Sample Locations
Figure 10 Former HCl Tanks Proposed Sample Location Map
Figure 11 Proposed Creek Water and Creek Sediment Sample Locations
Figure 12 Proposed Wells Sampled for Calcium Fluoride Basin
Figure 13 Proposed Soil Sample Locations and Wells to Assess Former NPDES System

APPENDICES

Appendix A Comparison of Constituent Method Detection Limits to Regulatory Values
Appendix B MDEQ Memorandum No. 2 Attachments 5 and 6
Appendix C General Low Flow Groundwater Sampling Standard Operating Procedure
Appendix D General SOP for Equipment Decontamination

1.0 INTRODUCTION

The DuPont Montague Facility (facility) is a former chemical manufacturing facility that is subject to corrective action under Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), and its administrative rules. To date, 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, providing oversight as necessary, DuPont has been using the protection standards and relevant processes of MDEQ Part 201 as part of satisfying their corrective action obligations under Part 111.

The purpose of this document is to present the proposed Corrective Action Remedial Investigation field activities to address data gaps identified in the DuPont document *Prioritization of Waste Management Units and Areas of Concern, DuPont Montague* (referred to in this work plan as *prioritization document*; DuPont, 2006). The DuPont prioritization document addressed the MDEQ request for information pertaining to waste management units (WMUs) and areas of concern (AOCs) at the DuPont Montague facility (MDEQ letter dated August 11, 2006). The DuPont prioritization document assessed analytical data and historical documents associated with the MDEQ identified WMUs, and AOCs.

Based on the assessment, the prioritization document identified the following WMUs and AOCs as requiring further investigation:

- Northeast Landfill (Item 1 in MDEQ August 11, 2006 letter)
- North Landfill (Item 2 in MDEQ August 11, 2006 letter)
- Bury Pit Landfill (Item 3 in MDEQ August 11, 2006 letter)
- Pierson Creek Landfill (Item 4 in MDEQ August 11, 2006 letter)
- Mirror Lake Area (associated with Item 6 in the MDEQ August 11, 2006 letter)
- Former Basin Sludge Area (Item 5 in MDEQ August 11, 2006 letter)
- Former Hydrogen Chloride Storage Tanks (Item 11 in MDEQ August 11, 2006 letter)
- Pierson Creek (associated with Item 4 in the MDEQ August 11, 2006 letter)
- Calcium Fluoride Basin (Item 6 in MDEQ August 11, 2006 letter)
- Former National Pollutant Discharge Elimination System (NPDES) Surface Impoundments (Item 7 in MDEQ August 11, 2006 letter)

This document provides pertinent background information for each unit and describes the proposed field activities intended to address the data gaps that were identified in the prioritization document (DuPont, 2006).

2.0 GENERAL SITE BACKGROUND

This section presents information pertaining to the DuPont Montague facility location and production history. Information pertaining to area geology and investigation history has been documented previously (CH2MHill, 1991; DuPont, 1989; DuPont CRG, 2006).

2.1 Site Location

The DuPont Montague facility is a former chemical manufacturing facility located in Muskegon County, Michigan, approximately two miles southwest of the city of Montague (see Figure 1). The plant property consists of approximately 1,330 acres and is bounded by forested, residential, and former industrial properties. The property to the east was owned by Hooker Chemical; the current owner is the Occidental Chemical Company (Oxychem). The facility is approximately one mile north of White Lake and located approximately 1.5 miles east of Lake Michigan (see Figure 2).

2.2 Production History

DuPont purchased the Montague property in the 1940s. In 1955, the Montague facility was constructed and became fully operational in 1956. Initially, the DuPont Montague facility produced acetylene and neoprene. Later, various formulations of Freon® (chlorofluorocarbons) were manufactured at the site, and the acetylene and neoprene facilities were demolished.

In approximately 1955, an adjacent Union Carbide facility began manufacturing acetylene, which produced a lime by-product. The Union Carbide lime by-product was stored in a low-lying area located approximately 1,250 feet due south of the main DuPont operating area. From 1955 to 1957, DuPont manufactured its own acetylene on-site using a process that did not generate a lime by-product. In 1961, DuPont purchased Union Carbide's plant and operated it for approximately 11 additional years.

DuPont began manufacturing neoprene at the Montague facility in 1956 using acetylene and hydrochloric acid as the two main raw materials. In addition to neoprene, the facility produced various polymers by emulsion polymerization, including chlorinated monomers, chloroprene (CD), neoprene, and latex. These operations were terminated in 1972.

Freon refrigerants were manufactured at the DuPont Montague facility starting in 1965. Freon products included Freon 11, 12, 13, 22, and 113. Freon products were produced at this facility until 1995.

In 1996, the DuPont Montague facility ceased all operations; in 1998, the manufacturing facility was demolished. The only structures that remain support the site's groundwater pump and treat systems.

3.0 INVESTIGATION ACTIVITIES

The location of the WMUs and AOCs to be investigated are identified in Figure 3. This section presents the proposed field activities to address the data gaps identified in the prioritization document. As applicable, each section below will contain the following information:

- Background information summarizing the prioritization document (e.g., unit size, material, conclusion, and data gaps)
- Field activities purpose and objective
- Laboratory analysis to be performed
- Data assessment

A summary of the investigation activities for each unit can be found in Table 1.

To ensure appropriate laboratory methods will be used, regulatory values were compared to method detection limits. Reference tables containing method detection limits vs. regulatory values can be found in Appendix A.

Soil sampling activities will be performed following the MDEQ guidance documents found in Appendix B. Groundwater sampling activities will follow the low-flow groundwater sampling standard operating procedure (SOP) document found in Appendix C.

Additional details regarding each of the units discussed in this section can be found in the prioritization document (DuPont, 2006).

3.1 Northeast Landfill

The Northeast Landfill was operated from 1958 to 1965 receiving waste from the early acetylene and neoprene manufacturing processes. This landfill is approximately 1.2 acres in aerial extent and was constructed over native soils. The depth of the waste material varies from 5 to 20 feet in thickness. At the end of its operation, this landfill was covered with native soils (CH2MHill, 1991). Based on the CH2MHill (1991) lithologic logs, the thickness of the native soil cover is estimated to be approximately 2 feet.

A review of the available analytical data for subsurface landfill soils and associated groundwater concluded that the Northeast Landfill has sporadically impacted groundwater. Its impact on groundwater is limited in extent (DuPont, 2006).

3.1.1 Objective of Proposed Field Activity

The Northeast Landfill has an existing soil cover consisting of native soils (CH2MHill, 1991); however, visual observations indicate debris on the surface. The debris present is likely due to post landfill-operation investigation (i.e., test pitting) activities. To verify that no constituents of interest are present at the surface at concentrations exceeding applicable screening levels, soil samples will be collected to characterize surface soils proximate to debris material. Because this unit is located within an industrial area, screening levels will be selected to assess potential industrial exposure via drinking water, air, and direct contact.

3.1.2 Field Activities

To characterize the surface soils, biased soil samples will be collected from the Northeast Landfill as follows:

- ❑ At five locations where surface debris is apparent, a surface soil sample will be collected from 0 to 1 foot below ground surface (bgs) (see Figure 4). The locations will be adjusted in the field based on location of debris.
- ❑ The collected soil samples will be shipped to a State of Michigan certified laboratory for analysis. Soil samples will be analyzed for the Landfill Analytical Parameters List located in Table 2.
- ❑ Sample location coordinates will be determined using a hand-held GPS.

A table summarizing the information pertaining to the number of samples to be collected, sample collection tools, and analytical parameters can be found in Table 1.

3.1.3 Data Assessment

This landfill is located within an industrial site that is expected to remain industrial; therefore, only industrial screening levels are applicable. The following exposure pathways are potentially complete based on the land use of this site:

- ❑ Groundwater downgradient of the landfill may be used for industrial purposes only; no residential use of groundwater is anticipated due to pump and treat activities currently in operation and the city water connections recently installed to area residents by DuPont.
- ❑ If volatile compounds are present in the surface soil, vapors from the landfill may potentially be inhaled by workers.
- ❑ Workers may be exposed to wind-borne particulate materials from the landfill.
- ❑ Workers may have direct contact with landfill.

Based on the above, the analytical results obtained will be compared to the following:

- ❑ MDEQ Industrial Drinking-Water Protection Criteria & Risk Based Screening Levels (RBSLs)
- ❑ MDEQ Part 201[1] Direct Contact Criteria
- ❑ MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria & RBSLs
- ❑ MDEQ Part 201 Particulate Soil Inhalation Criteria & RBSLs
- ❑ MDEQ Part 201 Soil Saturation Concentration Screening Levels
- ❑ MDEQ Part 201 Statewide Default Background Levels

---

[1] MDEQ Part 201 information can be found in Operational Memorandum for the Part 201 ad Part 213 program (MDEQ, 2006).

- ❑ U.S. Environmental Protection Agency (EPA) Region 5 Ecological Screening Levels (EPA, 2003)

A table will be prepared that summarizes the constituents that exceed the exposure pathway screening levels.

3.2 North Landfill

The North Landfill was operated from 1960 to 1965. This landfill received waste from the early acetylene and neoprene manufacturing processes. This landfill is approximately 0.6 acres in aerial extent and was constructed over native soils. The depth of the waste material varies from 3 to 10 feet in thickness. At the end of its operation, this landfill was covered with native soils (CH2MHill, 1991). Based on the CH2MHill (1991) lithologic logs, the thickness of the native soil cover is estimated to be approximately 2 feet.

A review of the available analytical data for subsurface landfill soils and associated groundwater concluded that the North Landfill has not impacted the underlying groundwater at concentrations of concern (DuPont, 2006).

3.2.1 Objective of Proposed Field Activity

The North Landfill has an existing soil cover consisting of native soils (CH2MHill, 1991); however, visual observations indicate debris on the surface. The debris present is likely due to post landfill-operation investigation (i.e., test pitting) activities. To verify that no constituents of interest are present at the surface at concentrations exceeding applicable screening levels, soil samples will be collected to characterize surface soils proximate to debris material. Because this unit is located within an industrial area, screening levels will be selected to assess potential industrial exposure via drinking water, air, and direct contact.

3.2.2 Field Activities

To characterize the surface soils, biased soil samples will be collected from the North Landfill as follows:

- ❑ At three locations where surface debris is apparent, a surface soil sample will be collected from 0 to 1 foot bgs (see Figure 5). The locations will be adjusted in field based on location of debris.
- ❑ The collected soil samples will be shipped to a State of Michigan certified laboratory for analysis. Soil samples will be analyzed for the Landfill Analytical Parameters List located in Table 2.
- ❑ Sample location coordinates will be determined using a handheld GPS.

A table summarizing the information pertaining to the number of samples to be collected, sample collection tools, and analytical parameters can be found in Table 1.

3.2.3 Data Assessment

This landfill is located within an industrial site that is expected to remain industrial; therefore, only industrial screening levels are applicable. The following exposure pathways are potentially complete based on the land use of this site:

- ❏ Groundwater downgradient of the landfill may be used for industrial purposes only; no residential use of groundwater is anticipated due to pump and treat activities currently in operation and the city water connection recently installed to area residents by DuPont.
- ❏ If volatile compounds are present in the surface soil, vapors from the landfill may potentially be inhaled by workers.
- ❏ Workers may be exposed to wind-borne particulate materials from the landfill.
- ❏ Workers may have direct contact with landfill.

Based on the above, the analytical results obtained will be compared to the following:

- ❏ MDEQ Industrial Drinking-Water Protection Criteria & Risk Based Screening Levels (RBSLs)
- ❏ MDEQ Part 201 Direct Contact Criteria
- ❏ MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria & RBSLs
- ❏ MDEQ Part 201 Particulate Soil Inhalation Criteria & RBSLs
- ❏ MDEQ Part 201 Soil Saturation Concentration Screening Levels
- ❏ MDEQ Part 201 Statewide Default Background Levels
- ❏ EPA Region 5 Ecological Screening Levels (EPA, 2003)

A table will be prepared that summarizes the constituents that exceed the exposure pathway screening levels.

3.3 Bury Pit Landfill

The Bury Pit Landfill was operated from 1968 to 1985. Similar to the Northeast and North Landfills, this landfill received material from the early acetylene and neoprene manufacturing processes. This landfill is approximately 2.1 acres in aerial extent and was constructed over native soils. The depth of the material varies from 5 to 18 feet in thickness. At the end of its operation, this landfill was covered with native soils (CH2MHill, 1991). Based on the CH2MHill (1991) lithologic logs, the thickness of the native soil cover is estimated to be approximately 2 feet.

A review of the available analytical data for subsurface landfill soils and associated groundwater concluded that the Bury Pit Landfill has not impacted the underlying groundwater at concentrations of concern (DuPont, 2006).

3.3.1 Objective of Proposed Field Activity

The Bury Pit Landfill has an existing soil cover consisting of native soils (CH2MHill, 1991); however, visual observations indicate debris on the surface. The debris present is likely due to post landfill-operation investigation (i.e., test pitting) activities. To verify that no constituents of interest are present at the surface at concentrations exceeding applicable screening levels, soil samples will be collected to characterize surface soils proximate to debris material. Because this unit is located within an industrial area, screening levels will be selected to address potential industrial exposure via drinking water, air, and direct contact.

3.3.2 Field Activities

To characterize the surface soils, biased soil samples will be collected from the Bury Pit Landfill as follows:

- ❑ At six locations where surface debris is apparent, a surface soil sample will be collected from 0 to 1 foot bgs (see Figure 6). The locations will be adjusted in field based on location of debris.
- ❑ The collected soil samples will be shipped to a State of Michigan certified laboratory for analysis. Soil samples will be analyzed for the Landfill Analytical Parameters List located in Table 2.
- ❑ Sample location coordinates will be determined using a hand-held GPS.

A table summarizing the information pertaining to the number of samples to be collected, sample collection tools, and analytical parameters can be found in Table 1.

3.3.3 Data Assessment

This landfill is located within an industrial site that is expected to remain industrial; therefore, only industrial screening levels are applicable. The following exposure pathways are potentially complete based on the land use of this site:

- ❑ Groundwater downgradient of the landfill may be used for industrial purposes only; no residential use of groundwater is anticipated due to pump and treat activities currently in operation and the city water connection recently installed to area residents by DuPont.
- ❑ If volatile compounds are present in the surface soil, vapors from the landfill may potentially be inhaled by workers.
- ❑ Workers may be exposed to wind-borne particulate materials from the landfill.
- ❑ Workers may have direct contact with landfill.

Based on the above, the analytical results obtained will be compared to the following:

- ❑ MDEQ Industrial Drinking-Water Protection Criteria & Risk Based Screening Levels (RBSLs)
- ❑ MDEQ Part 201 Direct Contact Criteria
- ❑ MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria & RBSLs
- ❑ MDEQ Part 201 Particulate Soil Inhalation Criteria & RBSLs
- ❑ MDEQ Part 201 Soil Saturation Concentration Screening Levels

- ❑ MDEQ Part 201 Statewide Default Background Levels
- ❑ EPA Region 5 Ecological Screening Levels (EPA, 2003)

A table will be prepared that summarizes the constituents that exceed the exposure pathway screening levels.

3.4 Pierson Creek Landfill

The Pierson Creek Landfill was operated from 1965 to 1972, receiving liquid and solid wastewater treatment residues from fluorocarbon and neoprene manufacturing. This landfill is approximately 2 acres in aerial extent and was constructed over native soils. The depth of the waste material in this landfill varies from 0.5 to 6 feet. At the end of its operation, this landfill was covered with native soils (CH2MHill, 1991). Based on the CH2MHill (1991) lithologic logs, the thickness of the native soil cover is estimated to be approximately 2 feet.

A review of the available analytical data for subsurface landfill soils and associated groundwater concluded that the Pierson Creek Landfill is impacting the underlying groundwater system immediately downgradient of the landfill. However, constituent concentrations in monitoring wells further downgradient were either nondetect or below screening levels, suggesting that the constituents present in groundwater close to the landfill are attenuating.

3.4.1 Objective of Proposed Field Activity

The Pierson Creek Landfill has an existing soil cover consisting of native soils (CH2MHill, 1991); however, visual observations indicate debris on the surface. The debris present is likely due to post landfill-operation investigation (i.e., test pitting) activities. To verify that no constituents of interest are present at the surface at concentrations exceeding applicable screening levels, soil samples will be collected to characterize surface soils proximate to debris material. Because this unit is located within an industrial area, screening levels will be selected to address potential industrial exposure via drinking water, air, and direct contact.

3.4.2 Field Activities

To characterize the surface soils, biased soil samples will be collected from the Pierson Creek Landfill as follows:

- ❑ At six locations where surface debris is present, a surface soil sample will be collected from 0 to 1 foot bgs (see Figure 7). The locations will be adjusted in field based on location of debris.
- ❑ The collected soil samples will be shipped to a State of Michigan certified laboratory for analysis. Soil samples will be analyzed for the Landfill Analytical Parameters List located in Table 2.
- ❑ Sample location coordinates will be determined using a handheld GPS.

A table summarizing the information pertaining to the number of samples to be collected, sample collection tools, and analytical parameters can be found in Table 1.

3.4.3 Data Assessment

This landfill is located within an industrial site that is expected to remain industrial; therefore, only industrial screening levels are applicable. The following exposure pathways are potentially complete based on the land use of this site:

- Groundwater downgradient of the landfill may be used for industrial purposes only.
- Groundwater may vent to the downgradient Pierson Creek surface water.
- If volatile compounds are present in the surface soil, vapors from the landfill may potentially be inhaled by workers.
- Workers may be exposed to wind-borne particulate materials from the landfill.
- Workers may have direct contact with landfill.

Based on the above, the analytical results obtained will be compared to the following:

- MDEQ Industrial Drinking-Water Protection Criteria & Risk Based Screening Levels (RBSLs)
- MDEQ Part 201 Groundwater Surface Water Interface (GSI) Protection Criteria & RBSLs
- MDEQ Part 201 Direct Contact Criteria
- MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria & RBSLs
- MDEQ Part 201 Particulate Soil Inhalation Criteria & RBSLs
- MDEQ Part 201 Soil Saturation Concentration Screening Levels
- MDEQ Part 201 Statewide Default Background Levels
- EPA Region 5 Ecological Screening Levels (EPA, 2003).

A table will be prepared that summarizes the constituents that exceed the exposure pathway screening levels.

3.5 Mirror Lake Area

Mirror Lake is a small body of water that is located due south of the Lime Pile. Based on historical aerial photographs, it is estimated that this lake originally measured approximately 800 feet long by 300 feet at it widest point. The maximum water depth of this lake is estimated to be approximately 2 to 3 feet.

During the late-1960s or early-1970s, lime from the site’s lime pile was transported into Mirror Lake by erosion and overland flow. Based on aerial photographs, it is estimated that one third of Mirror Lake has been replaced with lime material.

In 1996, DuPont collected a sample of the lime deposit and water from Mirror Lake to determine if the water quality had been negatively impacted by lime material. The comparison of Mirror Lake water results to MDEQ Water Quality Criteria indicated that Mirror Lake constituent concentrations did not exceed screening levels. The comparison of the lime results to Protection of GSI Criteria indicated that the selenium concentration in the lime material could potentially impact Mirror Lake; however, the lake water sample did not indicate impact by selenium.

A 1997 letter from the MDEQ requested that DuPont collect a sample of lime material and analyze Synthetic Precipitation Leaching Procedure (SPLP) leachate for selenium to determine the potential for lime-related selenium to negatively impact Mirror Lake.

3.5.1 Objective of Proposed Field Activity

A sample of Mirror Lake lime material will be collected and analyzed for total selenium and SPLP selenium. The analytical results will be evaluated to determine the potential for the lime material to negatively impact Mirror Lake.

3.5.2 Field Activities

A sample of lime material will be collected from Mirror Lake as follows:

- ❑ A lime sample from surface to 6 inches bgs will be collected (see Figure 8 for proposed sample locations).
- ❑ The collected lime sample will be shipped to a State of Michigan certified laboratory and analyzed for total selenium and SPLP selenium.
- ❑ The coordinates associated with the lime sample location will be determined using a handheld GPS.

A summary of the information pertaining to sample collection can be found in Table 1.

3.5.3 Data Assessment

The SPLP Selenium analytical results will be compared to the MDEQ GSI criteria for selenium. A table summarizing screening level exceedances will be prepared.

3.6 Former Basin Sludge Area

The Former Basin Sludge Area is located north of the Lime Pile. This area was used during the early 1970s to contain various sludges and solid material generated from the neoprene operations. Waste material disposed in this area includes silicas, various salts, calcium carbonate, plastics, neoprene polymers, and other inert materials (DuPont, 1989).

A memo from the plant manager indicates that in 1976 this basin material was excavated and the excavation was backfilled (DuPont, 2006). No soil analytical results are available for this unit.

3.6.1 Objective of Proposed Field Activity

To verify that no residual constituents of interest are present at concentrations exceeding applicable screening levels, the native soils underlying the Former Basin Sludge Area will be sampled for laboratory analysis. An evaluation of the analytical results will be performed to determine if the Former Basin Sludge Area has negatively impacted the underlying native soils. Because this unit is located within an industrial site that is expected to remain industrial, only industrial screening levels are applicable.

3.6.2 Field Activities

Soil samples from below the Former Basin Sludge Area fill material will be collected as follows:

- Three soil samples will be collected from the native soil underlying the Former Basin Sludge Area (see Figure 9 for proposed sample locations).
- It is currently anticipated that, baring refusal, the native material will be accessed and sampled using a hand auger. If the hand auger is unable to attain the needed depth, an alternate method, such as a small excavator or Geoprobe®, will be used to collect the sample
- The collected soil samples will be shipped to a State of Michigan certified laboratory for analysis. Soil samples will be analyzed for constituents associated with Freon and neoprene (see Table 3 for the list of constituents).
- The coordinates associated with the Former Basin Sludge Area samples will be determined using a handheld GPS.

Information pertaining to the number of samples, method of sample location selection, estimated sample depth, sample collection tools, and analytical parameters can be found in Table 1.

3.6.3 Data Assessment

Based on the location of the Former Basin Sludge Area near the central portion of the site. The land use for this site is currently industrial and is expected to remain industrial. The groundwater in the area of the Former Basin Sludge Area is captured by the site pump and treat system. In addition, city-water connections were recently installed to area residents by DuPont. The site pump and treat system and the connected city water prevent the use of groundwater from the area of the former Basin Sludge as residential drinking water. The site pump and treat system also prevents groundwater in the area from impacting downgradient White Lake. Based on this information, it can be concluded that the pathway to potential receptors is not complete. However, as a conservative measure, DuPont will screen the Former Basin Sludge Area soil results against the MDEQ Industrial Drinking-Water Protection Criteria & RBSLs. A table summarizing screening level exceedances will be prepared.

3.7 Former Hydrogen Chloride Storage Tanks

Aqueous hydrogen chloride (HCl) was a by-product of the Freon manufacturing process. The aqueous HCl by-product was stored in the Freon Area and transferred to the Neoprene Area for use as a raw material in the chlorobutadiene production process. In addition to internal use, the aqueous HCl was sold as a product to other companies.

Discussions with current site personnel indicate that the hydrogen chloride liquid by-product was stored in two areas: the Freon production area (six tanks) and the railcar unloading area west (up to four tanks).

A review of facility incident reports notes multiple aqueous HCl releases historically occurred at this site. These releases were addressed by the facility; releases were either contained within the containment area or flushed to the HCl containment sump. However, the residual impact of these releases on the surrounding soil is uncertain.

3.7.1 Objective of Proposed Field Activity

To evaluate whether there is residual impact from historical releases of HCl to the surrounding soil, soil samples will be collected and analyzed for pH.

3.7.2 Field Activities

Historical releases of HCl occurred more than 10 years ago. Weathering from precipitation events over the years has likely influenced surficial soil. In determining whether soil near the tanks has been impacted by HCl releases, background soil samples will be collected and analyzed for pH as indicated below.

Soil samples from the area of the HCl tanks will be collected as follows:

- Two background soil samples will be collected for field pH analysis. Samples will be collected from the 1 to 2-foot interval. Sampling locations will be selected where there has been no influence from the tanks and soil type is similar to the tank sampling locations. If background soil pH is found to be near neutral, the pH concentration of 4 will to be used to determine if additional depth samples are needed in the area of the former HCl tanks. If the native pH concentration is found to be low, the appropriate pH to guide the need for deeper tank-related samples will be re-evaluated in the field.
- Ten tank-related sample locations have been identified (see Figure 10): one sample per HCl tank. The locations are situated either between the HCl tank and HCl sump (for the Freon Area) or between the HCl tank and railcar area (for the Railcar West Area).
- Soil samples will be collected from a depth of 1 to 2 feet bgs. The collected samples will be analyzed in the field for pH. If the pH result is 4 or lower, a sample from 2 to 4 feet bgs will be collected from the identified location. However, if the field pH is greater than 4, no additional sample depths will be required for that location.

- ❑ For confirmation purpose, select soil samples will be shipped to a State of Michigan certified laboratory for pH analysis.
- ❑ The coordinates associated with the tank sample locations will be determined using a handheld GPS.

Summary information pertaining to the number of samples, sample depth, sample collection tools, and analytical parameters can be found in Table 1.

3.7.3 Data Assessment

Unless background sample results indicate that background soils have low pHs, a pH value of 4 will be used for soil sample screening purposes. If the soil sample pH value is 4 or less, a deeper soil sample will be collected. If pH values are greater than 4, no further samples will be required for that location.

3.8 Pierson Creek – Surface Water and Sediment

Pierson Creek is a small tributary that feeds into White Lake. This creek is shallow and has a width that varies from approximately 3 to 12 feet. Pierson Creek flows southwest and empties into Sadony Bayou, which, in turn, discharges to White Lake.

In 1990, co-located surface-water and sediment samples were collected at four locations in Pierson Creek to determine the relationship between the Pierson Creek Landfill and the downgradient creek; the results of this study were inconclusive. Two constituents [bis(2-ethylhexyl)phthalate and lead] associated with the surface-water samples exceeded the identified screening levels. No sediment sample constituents exceeded screening levels.

3.8.1 Objective of Proposed Field Activity

To verify that groundwater migrating from the landfill is not currently impacting Pierson Creek or that reported releases from the NPDES wastewater line did not previously impact the creek, surface water and sediment from the creek will be collected and analyzed for landfill and NPDES related parameters.

3.8.2 Field Activities

Pierson Creek surface-water and sediment samples, and nearby monitor well groundwater samples will be collected for laboratory analysis. The samples will be collected as follows:

- ❑ Surface-Water and Sediment Samples:
  - Five Pierson Creek sample locations will be established; one creek location will be upstream near the northern property boundary, two creek locations will be west of the landfill and upgradient of the intersection of the NPDES wastewater line and Pierson Creek, one creek location will be west of the landfill and downgradient of NPDES wastewater line, and one location will be down-stream near the southern extent of the DuPont property (see Figure 11

  for locations). Sample location coordinates will be determined using a hand-held GPS

  - Surface-water samples will be collected using a peristaltic pump equipped with new silicon tubing. The water sample will be collected within the top half of the water column.
  - Sediment samples will be collected from the creek bottom using a clean Eckman Dredge Sampler or equivalent.
  - The collected water and sediment samples will be shipped to a State of Michigan certified laboratory for analysis. Sediment and water samples will be analyzed for the landfill constituent list and the constituents associated with the site NPDES permit (see Table 2 and Table 4). In addition, sediment samples will be analyzed for TOC and grain size; surface-water samples will be analyzed for pH and hardness.
  - Upon completion of sampling activities, a staff gauge will be installed at one of the sample locations downgradient of the landfill and surveyed in place for X, Y, and Z coordinates by a professional surveyor licensed with the State of Michigan. The staff gauge will be used to assist in determining the relationship between the creek and the surrounding groundwater.
  - Summary information pertaining to the number of samples, sample depth, sample collection tools, and analytical parameters can be found in Table 1.

- ☐ Monitor Well Groundwater Samples:
  - Monitor wells situated between Pierson Creek and the Pierson Creek Landfill will be sampled. The wells to be sampled include the following: PCL-3, PCL-4, PCL-5S&D, PCL-6, MW-208S&D, MW-209, MW-250 (see Figure 11 for locations).
  - All wells will be sampled using low flow sampling methodology.
  - The collected groundwater samples will be shipped to a State of Michigan certified laboratory for analysis. Samples will be analyzed for the landfill constituent list and the constituents associated with the site NPDES permit (see Table 2 and Table 4).
  - Depth to water (DTW) data will be collected from each well.

3.8.3 Data Assessment

The Pierson Creek Landfill monitor wells and a section of the Pierson Creek tributary are located within the property boundaries of this industrial site. From the downgradient site boundary, Pierson Creek feeds into White Lake. Based on this information, the analytical results obtained will be compared to the following screening levels:

- ☐ Surface-water results: MDEQ Water Quality Standards for the protection of human-health, non-consumption use, aquatic life, and wildlife; the lowest of these four values will be used.
- ☐ Sediment results: MDEQ Industrial Direct Contact, EPA Consensus Based Criteria (EPA, 2002), EPA Region 5 ESLs (EPA, 2003)
- ☐ Groundwater: MDEQ Industrial Drinking-Water Protection Criteria & RBSLs and MDEQ GSI Protection Criteria & RBSLs.

A table will be prepared that summarizes the constituents that exceed the exposure pathway screening levels.

3.9 Calcium Fluoride Basin

The Calcium Fluoride Basin consists of wastewater treatment residual solids that have been placed in a basin that is situated on top of a layer of lime material. Operated in the 1980s, this unit is approximately 5 acres and is underlain by a 10-foot thick bed of lime. The lime bed acts as a final neutralization step for any residual fluoride associated with the basin material. The basin is no longer in use. It is estimated that basin use ceased prior to 1990.

In 1990, the Calcium Fluoride Basin was sampled for characterization purposes. In 2006, DuPont assessed the 1990 basin characterization results and 10 years of groundwater data. Sample results from the Calcium Fluoride Basin exceed the MDEQ Direct Contact Criteria for arsenic. DuPont recommended that the arsenic concentrations be addressed as part of future unit closure activities (DuPont, 2006).

The groundwater data indicated that groundwater has not been impacted by the Calcium Fluoride Basin. However, two constituents that exceeded the MDEQ Industrial Drinking-Water Protection Criteria for soil, fluorine and fluoride, were not analyzed for in groundwater (DuPont, 2006).

3.9.1 Objective of Proposed Field Activity

To verify that no constituents of interest are present in groundwater at concentrations exceeding applicable screening levels, groundwater samples will be collected from Calcium Fluoride Basin monitor well LPW, interceptor well IW-3, and upgradient monitor well MW-210S. The groundwater samples collected will be analyzed for fluoride.

Fluorine will not be analyzed because it is no longer considered a constituent of interest. In developing this work plan, DuPont initiated discussions with Michigan-certified laboratories to identify an analytical method for fluorine in water. It was determined that a method is not currently available to analyze for fluorine, which is a gas, in soils or water. The method used to analyze for fluorine during the 1990 calcium fluoride basin characterization activities was not identified in the characterization document (WW Engineering & Science, 1991). Based on further review of the text and tables in the 1991 WW Engineering & Science document, DuPont has concluded that the fluorine detections identified are in error. The fluorine concentrations listed in Table 2 of the 1991 document should be identified as fluoride concentrations. Based on this assessment, DuPont believes that fluorine is not a Calcium Fluoride Basin constituent of concern.

3.9.2 Field Activities

Groundwater samples will be collected from monitoring wells MW-210S and LPW using low flow sampling methodology. A groundwater sample will be collected from interceptor well IW-3 using the interceptor well sampling spigot.

The collected groundwater samples will be shipped to a State of Michigan certified laboratory for analysis. Samples will be analyzed for fluoride (see Figure 12 for well locations).

3.9.3 Data Assessment

The Calcium Fluoride Basin is located near the central portion of the site, where potential exposure would be limited to workers. The land use for this site is currently industrial and is expected to remain industrial. The groundwater in the area of the Calcium Fluoride Basin is captured by the site pump and treat system. In addition, city-water connections were recently installed to area residents by DuPont. The site pump and treat system and the connected city water prevent the use of groundwater from the area of the Calcium Fluoride Basin as residential drinking water. The site pump and treat system also prevents groundwater in the area from impacting downgradient White Lake. Based on this information, it can be concluded that the pathway to potential receptors is not complete. However, as a conservative measure DuPont will screen the Former Basin Sludge Area soil results against the MDEQ Industrial Drinking-Water Protection Criteria & RBSLs. A table summarizing screening level exceedances will be prepared.

3.10 Former NPDES Surface Impoundment

The Former NPDES Surface Impoundment consisted of a series of settling basins that were used to treat wastewater associated with the Freon manufacturing activities. The wastewater was transported to the NPDES Impoundments by a concrete ditch system. This unit operated from the early 1960s until 1996 when facility operations were shut down.

In 1972, a 4- by 6-foot hole was found in the bottom of the central basin. This hole was repaired, and groundwater was pumped until it was determined that the impact was limited in extent (DuPont letter to the MDEQ dated August 19, 1996). However, in 1999, a groundwater investigation determined that the former NPDES impoundments had likely impacted groundwater and contributed to a groundwater plume.

A review of currently available groundwater data was unable to determine whether the former impoundments continue to act as a source of groundwater contamination. In addition, the former impoundments were fed by wastewater treatment ditches; the integrity of the ditch system is currently uncertain.

3.10.1 Objective of Proposed Field Activity

To determine whether the former impoundments continue to impact groundwater, and whether the ditch system has impacted soil, groundwater and soil samples will be collected. Groundwater samples collected downgradient will determine if the former impoundments are still a source of constituents to groundwater. To determine if soil has been impacted by the WWT ditches, subsurface soil samples will be collected

Over a two-year period, groundwater data will be collected from monitor wells downgradient of the Former NPDES Impoundments to determine if concentration trends over time can be identified.

Soil samples for laboratory analysis will be collected from native soils at a depth below the bottom elevation of the ditch. The soil samples results will be used to verify that no constituents of interest are present at concentrations exceeding applicable screening levels.

3.10.2 Field Activities

- ❏ Former NPDES Impoundment Groundwater Sampling Activities:
    - Collect groundwater samples from downgradient monitor wells MW-204-80, MW-204-40, MW-2 using low flow methodology (see Figure 13 for well locations).
    - The collected groundwater samples will be shipped to a State of Michigan certified laboratory for analysis. Samples will be analyzed for the site-wide groundwater constituent list associated with the Semi-Annual Groundwater Sampling program (see Table 5 for parameter list).
    - The sampling of these three wells will occur semi-annually for a two-year period. The data obtained will then be assessed for concentration trends.
- ❏ Ditch System Soil Sampling Activities:
    - Six soil samples will be collected from six borings (or excavations depending on access) installed adjacent to the ditch. The soil samples will be collected from native material that is situated at an elevation below the base of the ditch (see Figure 13 for potential locations).
    - The potential sample locations identified in Figure 13 will be adjusted towards areas where leaks in the ditch system may occur such as junctions, or areas that may be indicative of a potential leak such as sinkholes.
    - A small, powered, two-person auger will be used to install the borings adjacent to the ditch system. However, if the auger cannot be advanced due to the underlying fill material, a small excavator or Geoprobe will be used to obtain access to the native soil material.
    - It is currently estimated that the soil samples will be collected from a depth of 5 to 6 feet bgs. The grab soil samples will be collected from a hand auger, excavator bucket, or other device as dictated by the subsurface material.
    - Soil samples will be shipped to a State of Michigan certified laboratory for analysis. Samples will be analyzed for the constituent list associated with the site's Semi-Annual Groundwater Sampling program (see Table 5 for parameter list).
    - All sampling equipment, including the auger or excavator bucket, will be cleaned prior to installation at each location.
    - The X and Y coordinates for each sample location will be identified using a handheld GPS.

3.10.3 Data Assessment

Groundwater downgradient of the ditches may be used for industrial purposes only; no residential use of groundwater is anticipated due to the presence of the downgradient groundwater capture system. The ditch system soil sample results will be compared to

MDEQ Industrial Drinking-Water Protection Criteria & RBSLs, Statewide Default Background Levels, and MDEQ Part 201 Calculated Saturation Concentration Screening Levels. A table summarizing screening level exceedances will be prepared.

The two years of semi-annual groundwater analytical data associated with the NPDES Impoundment will be assessed to determine if concentration trends exist. If concentrations indicate an increasing trend, then it can be concluded that the Former NPDES Impoundment is a potential continuing source of constituents to groundwater.

4.0 QUALITY ASSURANCE RELATED FIELD ACTIVITIES

4.1 QA/QC Samples

To ensure that sample integrity is maintained, Quality Assurance/Quality Control (QA/QC) samples will be collected during this investigation. Field quality control samples will include field duplicates, trip blanks, matrix spike/matrix spike duplicates, and equipment rinsate blanks. The following quality control samples will be collected in the field and analyzed by the analytical laboratory:

- Field Duplicates: For each media, field duplicates will be collected at a minimum frequency of 1 per 10 samples or once per sampling event, whichever is more frequent.
- Trip Blanks: One trip blank will accompany each laboratory cooler that contains samples for volatile organic analysis.
- Matrix Spike/Matrix Spike Duplicates (MS/MSD): For each media, MS/MSD samples will be collected at a minimum frequency of 1 per 20 samples.
- Equipment Rinsate Blanks**:** For each sample type, an equipment rinsate blank will be collected from the field at a frequency of 1 per 20 field samples or once per sampling event, whichever is more frequent.

In addition, all laboratory samples will be shipped in laboratory-supplied containers under a chain-of-custody seal to a Michigan certified laboratory.

4.2 Equipment Decontamination

All sampling equipment will be either new or decontaminated prior to use. Equipment decontamination will be performed to limit the concern of cross contamination at the site.

The sampling equipment to be used for this project is anticipated to be small. This equipment will be cleaned using a chemical wash that will consist of the following steps:

1. Rinse with deionized/distilled water.
2. Scrub wash with non-phosphate detergent.
3. Rinse with deionized/distilled water.

If larger equipment is needed, such as a bucket-equipped excavator, the larger sampling equipment will be decontaminated using a pressurized steam cleaner.

A general SOP for equipment decontamination can be found in Appendix D.

All decontamination fluids will be contained for disposal at the site wastewater treatment system.

4.3 Waste Management

Based on the DuPont Montague Waste Management Plans (DuPont CRG, 2001, 2002, and 2005), all waste will be disposed of as follows:

- All chemical decontamination fluids and purged groundwater shall be contained and transported to the site’s wastewater treatment facility for disposal.
- All excavated soil will be returned to the boring from which it came.
- All PPE will be contained in plastic bags for disposal by the site.

5.0 REFERENCES

CH2MHill. 1991. *Remedial Investigation of Four Inactive Solid Waste Landfills at the DuPont Montague Facility, Montague Michigan*. January.

DuPont CRG. 2006. *Prioritization of Waste Management Units and Areas of Concern at the DuPont Montague Site, Montague Michigan.* November 2006.

DuPont CRG. 2006. *Request to Implement – Enhanced Groundwater Pump and Treat System for the DuPont Montague Site, Montague Michigan.* October 2006.

DuPont CRG. 2005. *Project Specific Waste Management Procedures for Monitoring Well Installation, DuPont Montague, Montague MI.* December.

DuPont CRG. 2002. *Project Specific Waste Management Procedures for Phase I Supplemental Groundwater Investigation Work Plan.* May.

DuPont CRG. 2001. *Groundwater Investigation Activities Waste Management Plan, Montague Michigan.* October.

DuPont CRG. 2000. *Montague Plume Characterization Field Activities and Data Analysis Report, DuPont Montague Facility, Montague Michigan.* July.

DuPont. 1989. *Facility Assessment of E.I. duPont de Nemours and Co., Montague Plant, Montague Michigan*. Engineering Services Division, Solid Waste and Geologic Engineering. June.

EPA. 2003. *RCRA Ecological Screening Levels Region 5*. August 22, 2003. http://www.epa.gov/reg5rcra/ca/ESL.pdf

EPA. 2002. *A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems, Volume III. EPA-950-B02-001-C.*

MDEQ 2006. Operational Memoranda for the Part 201 and Part 213 Programs. http://www.michigan.gov/deq/0,1607,7-135-3306_28608---,00.html

WW Engineering & Science. 1991. *Chemical and Physical Characterization of Calcium Fluoride Containing Sludge, Prepared for DuPont De Nemours & Company, Montague Michigan*. April 1991.

TABLES

TABLE 1
Sampling Summary Table - Montague Investigation Work Plan

Unit	Purpose	Number of Soil Sample Locations	Number of Wells Sampled or Surface Water Samples	Sample Location	Sample Depths	Sampling Instrument	Sample Analysis	Screening Criteria
Northeast Landfill	Characterize risk associated with landfill surface soil debris.	5	NA	Based on surficial debris material	0-1 ft BGS	Clean hand auger or shovel	Landfill Constituents (see Table 2 in this report)	See footnote * at bottom of table
North Landfill	Characterize risk associated with landfill surface soil debris.	3	NA	Based on surficial debris material	0-1 ft BGS	Clean hand auger or shovel	Landfill Constituents (see Table 2 in this report)	See footnote * at bottom of table
Bury Pit Landfill	Characterize risk associated with landfill surface soil debris.	6	NA	Based on surficial debris material	0-1 ft BGS	Clean hand auger or shovel	Landfill Constituents (see Table 2 in this report)	See footnote * at bottom of table
Pierson Creek Landfill	Characterize risk associated with landfill surface soil debris.	6	NA	Based on surficial debris material	0-1 ft BGS	Clean hand auger or shovel	Landfill Constituents (see Table 2 in this report)	See footnote * at bottom of table
Mirror Lake Area	Determine if there is the potential for selenium in lime material to negatively impact Mirror Lake.	1	NA	Lime crust at edge of Mirror Lake	0-0.5 ft BGS	Clean hand auger or shovel	Total and SPLP Selenium	MDEQ Part 201 Groundwater Surface Water Interface Protection Criteria
Former Basin Sludge Area	Determine if native soils have been impacted by the former sludge basin.	3	NA	With estimated former location of basin	5-6 ft BGS (anticipated depth of native soils)	Clean hand auger or Geoprobe or Excavator Bucket	Freon and Neoprene related constituents (see Table 3 in this report)	MDEQ Part 201 Industrial Drinking Water Protection criteria
Former Hydrogen Chloride Storage Tanks	Determine if residual HCL material associated with the HCL storage tanks have had an impact of concern on soil in the area.	10 tank related samples, plus 2 background samples	NA	One sample location per HCL Tank; plus 2 background samlpes.	1-2 ft BGS. Deeper samples will be collected if field screen of 1-2ft interval indicates a pH of 4 or lower.	Clean hand auger or shovel	pH	Unless background pH indicates a need to re-evaluate, if soil pH values of 4 or less are encountered then deeper samples will be collected. If pH is greater than 4, then no additional sampling will be required for that location.
Pierson Creek-water	Determine current constituent concentrations in Pierson Creek.	NA	5 (surface water)	3 locations down gradient of landfill, 1 location at northern and southern property boundary.	Water: Top half of water column	Peristaltic pump w/ silicon tubing	Constituents associated with the site Landfills and site NPDES permit (see Table 2 and Table 4 in this report) and pH, Hardness	MDEQ Water Quality Standards
Pierson Creek-sediment	Determine current constituent concentrations in Pierson Creek.	5 (sediment)	NA	See Pierson Creek-water	Sediment: Just below creek bottom	Clean Eckman Dredge sampler	Constituents associated with the site Landfills and site NPDES permit (see Table 2 and Table 4 in this report) and TOC	MDEQ Soil Direct Contact, EPA Consensus Based Criteria, EPA Region 5 ESLs (ref)
Pierson Creek-wells in area of creek	Determine current constituent concentrations in groundwater in area of Pierson Creek.	NA	9 (PCL-3, PCL-4, PCL-5S&D, PCL-6, MW-208S&D, MW-209, MW-250)	NA	NA	Low Flow sampling equipment	Constituents associated with the site Landfills and site NPDES permit (see Table 2 and Table 4 in this report)	MDEQ Part 201 Industrial Drinking Water Criteria, MDEQ Part 201 GSI Criteria

TABLE 1
Sampling Summary Table - Montague Investigation Work Plan

Unit	Purpose	Number of Soil Sample Locations	Number of Wells Sampled or Surface Water Samples	Sample Location	Sample Depths	Sampling Instrument	Sample Analysis	Screening Criteria
Calcium Fluoride Basin	Determine if the constituent fluoride is present in groundwater adjacent to the Calcium Fluoride Basin	NA	3 (MW-LPW, IW-3, MW-210S)	NA	NA	Low Flow sampling equipment or spigot if available.	Fluoride	MDEQ Part 201 Industrial Drinking Water Criteria,
Former NPDES Surface Impoundments	Determine if NPDES Impoundment is continuing to act as a source of groundwater contamination.	NA	3 (impoundments; wells MW-204-80, MW-204-40, MW-2)	NA	NA	Low Flow sampling equipment	Constituents associated with the Semi-Annual GW Sampling event (see Table 5 in this report)	Semi-annual groundwater results collected over 2 years will be assessed to determine if a concentration trend exists
Ditch associated with Former NPDES Surface Impoundments	Determine if the Ditch System has impacted surrounding soils	6 (ditch related)	NA	As applicable, sample locations will be adjusted towards areas where leaks in the ditch system may occur, or areas that may be indicative of a potential leak.	Ditch Sample - Collected adjacent to ditch from native soil at an elevation that is at or below ditch bottom.	Clean Auger or Geoprobe or excavator bucket with clean sampling trowel	Constituents associated with the Semi-Annual GW Sampling event (see Table 5 in this report)	MDEQ Part 201 Industrial Drinking Water Protection criteria

NA = Not Applicable

*MDEQ Part 201 Industrial Drinking Water Protection criteria, MDEQ Part 201 Direct Contact criteria; EPA Region 5 Ecological Screening Levels:
MDEQ Part 201 GSI Protection Criteria, MDEQ Part 201 Infinite Source Volatile Inhalation Criteria; MDEQ Part 201 Particulate Soil Inhalation Criteria;
MDEQ Part 201 Soil Saturation Concentration Screening Criteria, MDEQ Part 201 Statewide Default Background Levels.

Table 2
Landfill Constituent List

Analyte
1,1,1-TRICHLOROETHANE
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON113)
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE (FREON 114a)
1,1-DICHLORO-2,2,2-TRIFLUOROETHANE (FLUOROCARBON 123)
1,1-DICHLOROETHANE
1,2,4-TRICHLOROBENZENE
2,4-DIMETHYLPHENOL
2-METHYLNAPHTHALENE
2-METHYLPHENOL (O-CRESOL)
3- AND 4- METHYLPHENOL
4-CHLORO-3-METHYLPHENOL
ACENAPHTHENE
ACENAPHTHYLENE
ACETALDEHYDE
ACETONE
ACETOPHENONE
AMMONIA
ANTHRACENE
ANTIMONY
ARSENIC
BARIUM
BENZENE
BENZO(A)ANTHRACENE
BENZO(B)FLUORANTHENE
BENZO(G,H,I)PERYLENE
BENZO[A]PYRENE
BENZYL ALCOHOL
BERYLLIUM
BIS(2-ETHYLHEXYL)PHTHALATE
CADMIUM
CARBON TETRACHLORIDE
CHLORIDE
CHLOROFORM
CHLOROPRENE
CHROMIUM
CHRYSENE
CIS-1,2 DICHLOROETHENE
COBALT
COPPER
CYANIDE
DIBENZOFURAN
DICHLORODIFLUOROMETHANE (FREON 12)
DI-N-BUTYL PHTHALATE
ETHYLBENZENE
FLUORANTHENE
FLUORENE
FLUORIDE
CHLORODIFLUOROMETHANE (FREON 22)
HEXACHLOROBUTADIENE

Table 2
Landfill Constituent List

Analyte
HEXACHLORODIBENZOFURAN
INDENO (1,2,3-CD) PYRENE
LEAD
MERCURY
METHYL METHACRYLATE
METHYLENE CHLORIDE
NAPHTHALENE
N-DIOCTYL PHTHALATE
NICKEL
N-NITROSODIETHYLAMINE
N-NITROSODIMETHYLAMINE
N-NITROSODIPHENYLAMINE
PHENANTHRENE
PYRENE
SELENIUM
SILVER
STYRENE
SULFIDE
TETRACHLOROETHYLENE
TETRAHYDROFURAN
THALLIUM
TIN
TOLUENE
TRANS-1,2-DICHLOROETHYLENE
TRICHLOROETHENE
TRICHLOROFLUOROMETHANE (FREON 11)
VANADIUM
VINYL CHLORIDE
XYLENES
ZINC

Table 3
Freon and Neoprene Related Constituents

1,3 DICHLORO-2-BUTENE
N-NITROSODIPHENYLAMINE
1,1,1-TRICHLOROETHANE
1,1-DICHLOROETHANE
1,2-DICHLOROETHYLENE
ANTIMONY
ARSENIC
BENZENE
BERYLLIUM
BIS(2-ETHYLHEXYL)PHTHALATE
CADMIUM
CARBON TETRACHLORIDE
CHLOROFORM
CHLOROPRENE
CHROMIUM
COPPER
TRICHLOROFLUOROMETHANE (FREON 11)
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON 113)
DICHLORODIFLUOROMETHANE (FREON 12)
CHLORODIFLUOROMETHANE (FREON 22)
LEAD
MERCURY
NICKEL
N-NITROSODIPHENYLAMINE
TETRACHLOROETHYLENE
PHENANTHRENE
SELENIUM
SILVER
TRICHLOROETHYLENE
TETRAHYDROFURAN
TOLUENE
VINYL CHLORIDE
ZINC

Table 4
Constituents Associated with the Site NPDES Permit

1,1-DICHLORO-2,2,2-TRIFLUOROETHANE (FLUOROCARBON 123)
1,2-TRANS DICHLORETHYLENE
1,1,1-TRICHLOROETHANE
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON 113)
1,1,2-TRICHLOROETHANE
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE (FREON 114a)
1,1-DICHLOROETHANE
1,1-DICHLOROETHYLENE
1,2,4-TRICHLOROBENZENE
1,2-DICHLOROBENZE
1,2-DICHLOROETHANE
1,2-DICHLOROPROPANE
1,3-DICHLOROBENZENE
1,3-DICHLOROPROPYLENE
1,4-DICHLOROBENZENE
2,4 DINITROPHENOL
2,4-DICHLOROPHENOL
2,4-DIMETHYPHENOL
2,4-DINITROTOLUENE
2,6-DINITROTOLUENE
2-CHLOROPHENOL
2-NITROPHENOL
3,4-BENZOFLUORANTHENE
4,6-DINITRO-O-CRESOL
4-NITROPHENOL
ACENAPHTHENE
ACENAPHTHYLENE
ACRYLONITRILE
AMMONIA
ANTHRACENE
BENZENE
BENZO(A)ANTHRACENE
BENZO(A)PYRENE
BENZO(K)FLUORANTHENE
BIS(2-ETHYLHEXYL)PHTHALATE
CARBON TETRACHLORIDE
CHLORIDES
CHLOROBENZENE
CHLORODIFLUOROMETHANE (FREON 22)
CHLOROETHANE
CHLOROM
CHRYSENE
DICHLORODIFLUOROMETHANE (FREON 12)
DIETHYL PHTHALATE
DIMETHYL PHTHALATE
DI-N-BUTYL PHTHALATE

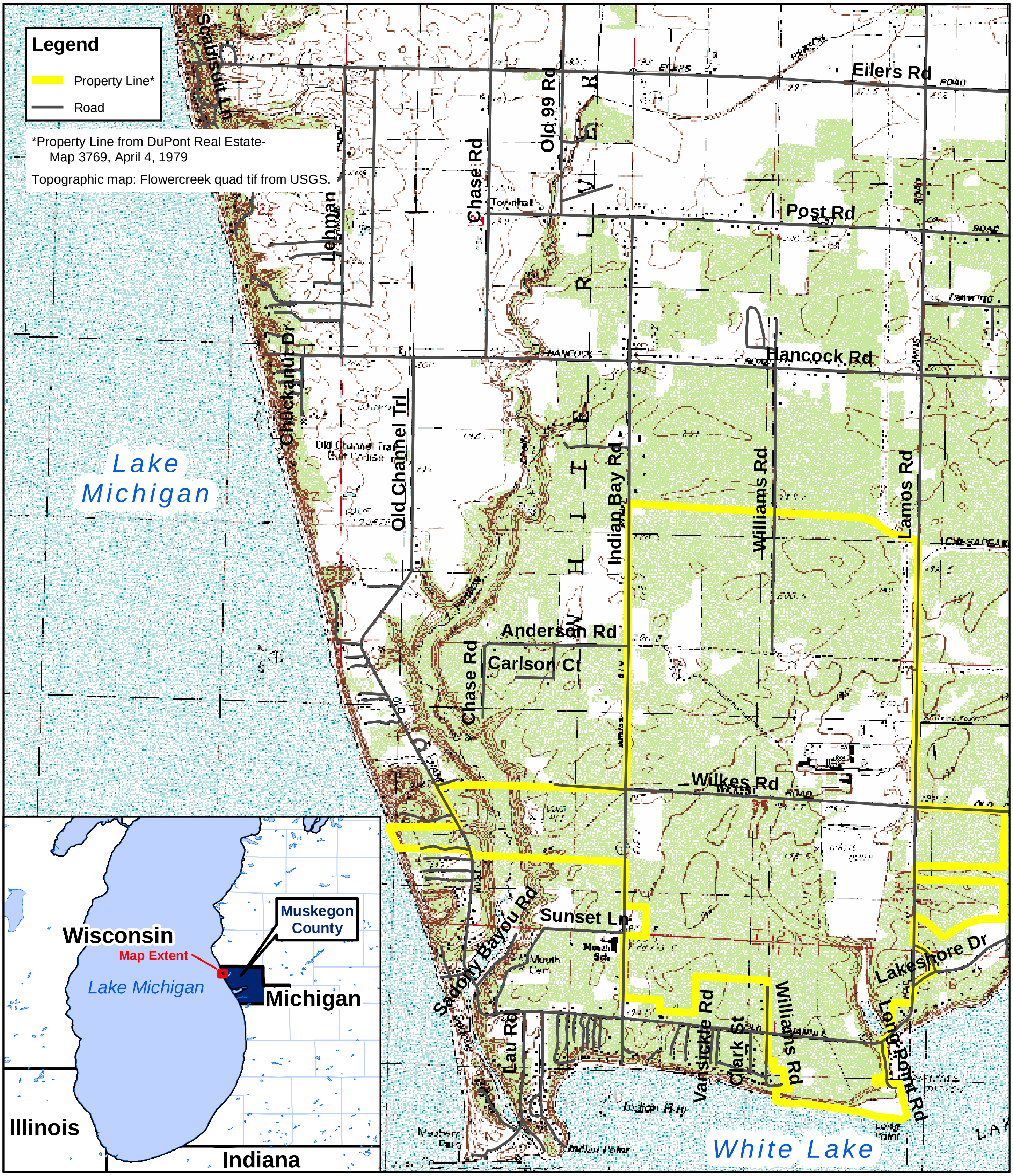
Table 4
Constituents Associated with the Site NPDES Permit

ETHYLBENZENE
FLUORANTHENE
FLUORENE
HEXACHLOROBENZENE
HEXACHLOROBUTADIENE
HEXACHLOROETHANE
METHYL CHLORIDE
METHYLENE CHLORIDE
NAPHTHALENE
NITROBENZENE
pH
PHENANTHRENE
PHENOL
PYRENE
SULFATES
TETRACHLOROETHYLENE
TOTAL ARSENIC
TOTAL CHROMIUM
TOTAL COPPER
TOTAL LEAD
TOTAL MERCURY
TOTAL NICKEL
TOTAL ZINC
TOULENE
TRICHLOROETHYLENE
TRICHLOROFLUOROMETHANE (FREON 11)
VINYL CHLORIDE

Table 5
Constituents Associated with the Semi-Annual Groundwater Sampling Program

1,1-DICHLOROETHANE
DICHLORODIFLUOROMETHANE (FREON 12)
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON 113)
1,1,1-TRICHLOROETHANE
BENZENE
CARBON TETRACHLORIDE
CHLOROFORM
CIS-1,2-DICHLOROETHYLENE
METHYLENE CHLORIDE
TETRACHLOROETHYLENE
TRICHLOROETHYLENE
TOLUENE
TRANS-1,2-DICHLOROETHYLENE
TRICHLOROFLUOROMETHANE (FREON 11)

FIGURES



CORPORATE REMEDIATION GROUP

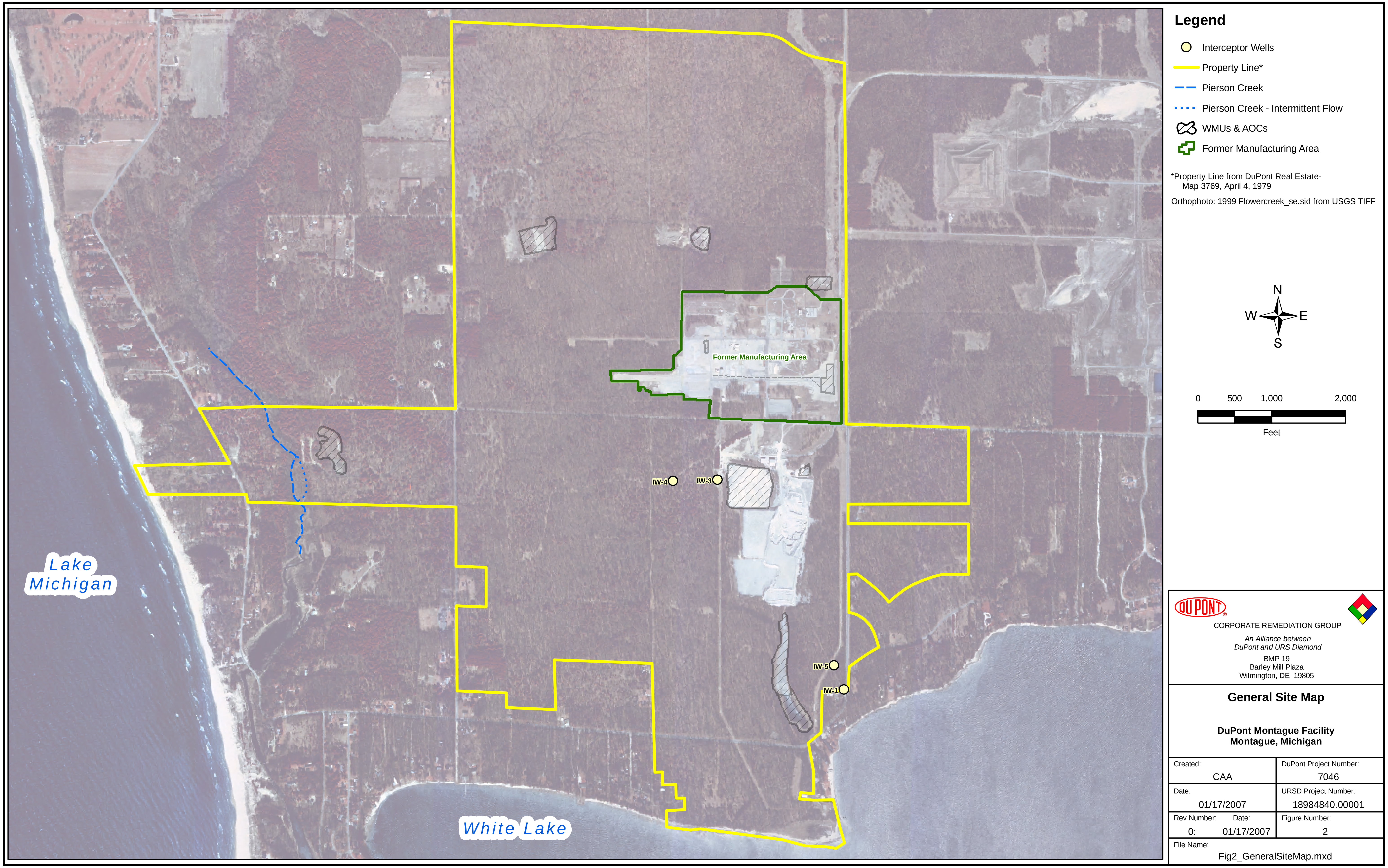
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Site Location Map

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/17/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/17/2007	Figure Number: 1
File Name: Fig1_SiteLocationMap.mxd	



CORPORATE REMEDIATION GROUP

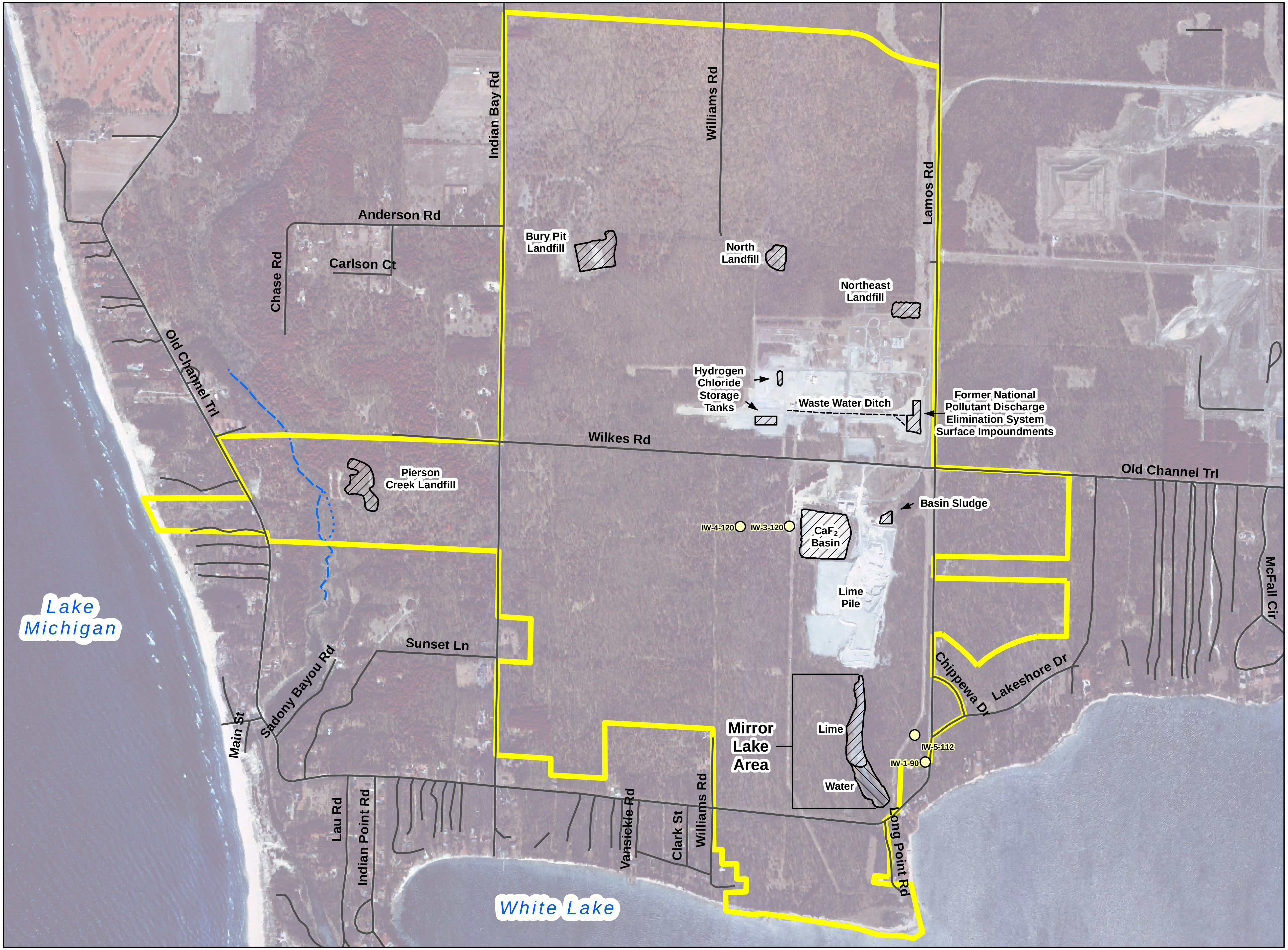
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

General Site Map

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/17/2007	URSD Project Number: 18984840.00001
Rev Number: Date: 0: 01/17/2007	Figure Number: 2
File Name: Fig2_GeneralSiteMap.mxd	

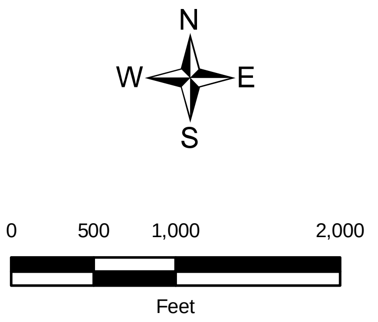


Legend

○ Interceptor Well
Property Line*
Road
Pierson Creek
Pierson Creek - Intermittent Flow
WMUs & AOCs

*Property Line from DuPont Real Estate-
Map 3769, April 4, 1979

Orthophoto: 1999 Flowercreek_se.sid from USGS TIFF



DUPONT

CORPORATE REMEDIATION GROUP

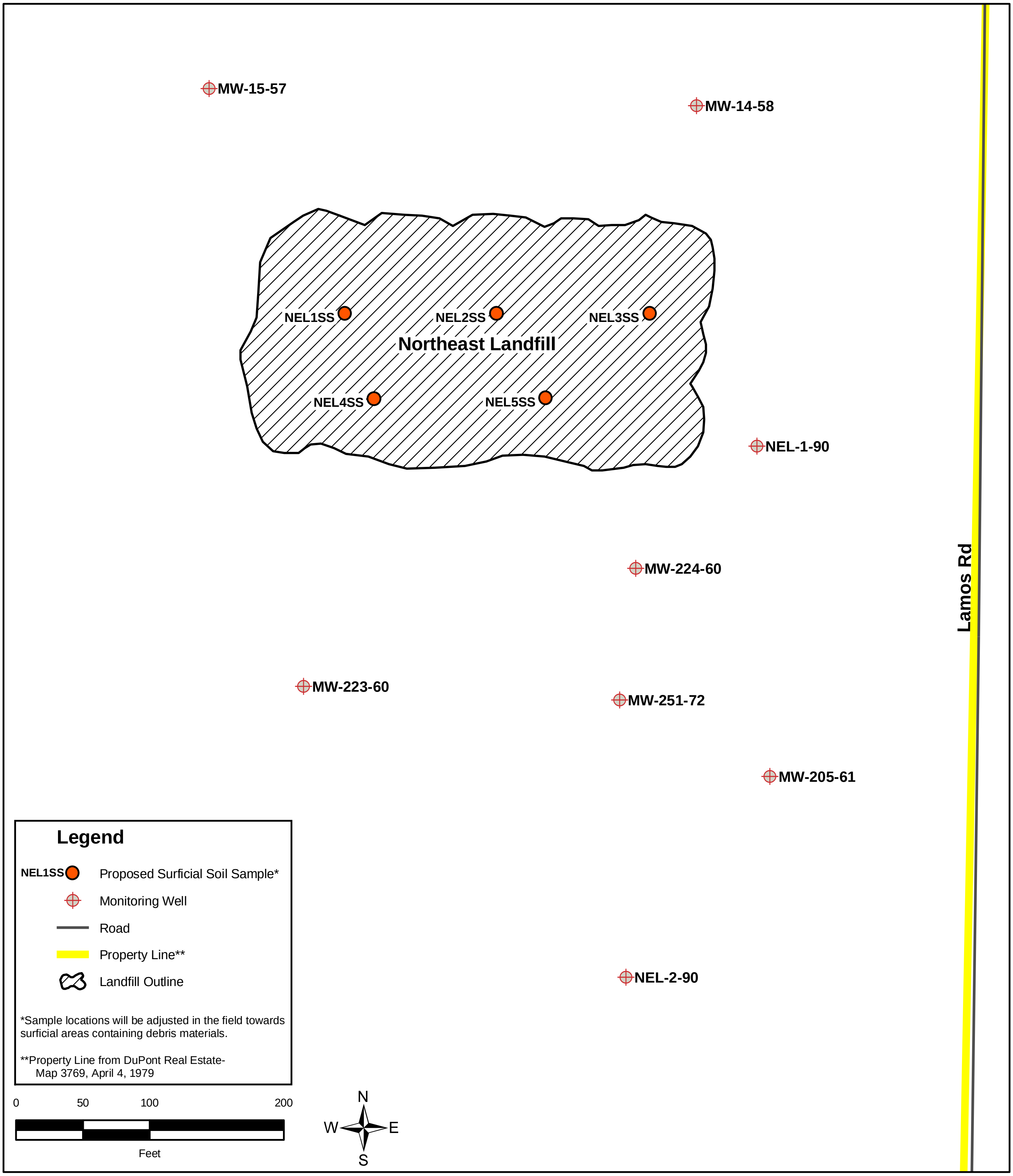
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Waste Management Units and Areas of Concern to be Investigated

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/17/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/17/2007	Figure Number: 3
File Name: Fig3_WMUs_AOCs.mxd	



CORPORATE REMEDIATION GROUP

An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Northeast Landfill Map Proposed Surficial Soil Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA

DuPont Project Number: 7046

Date: 01/15/2007

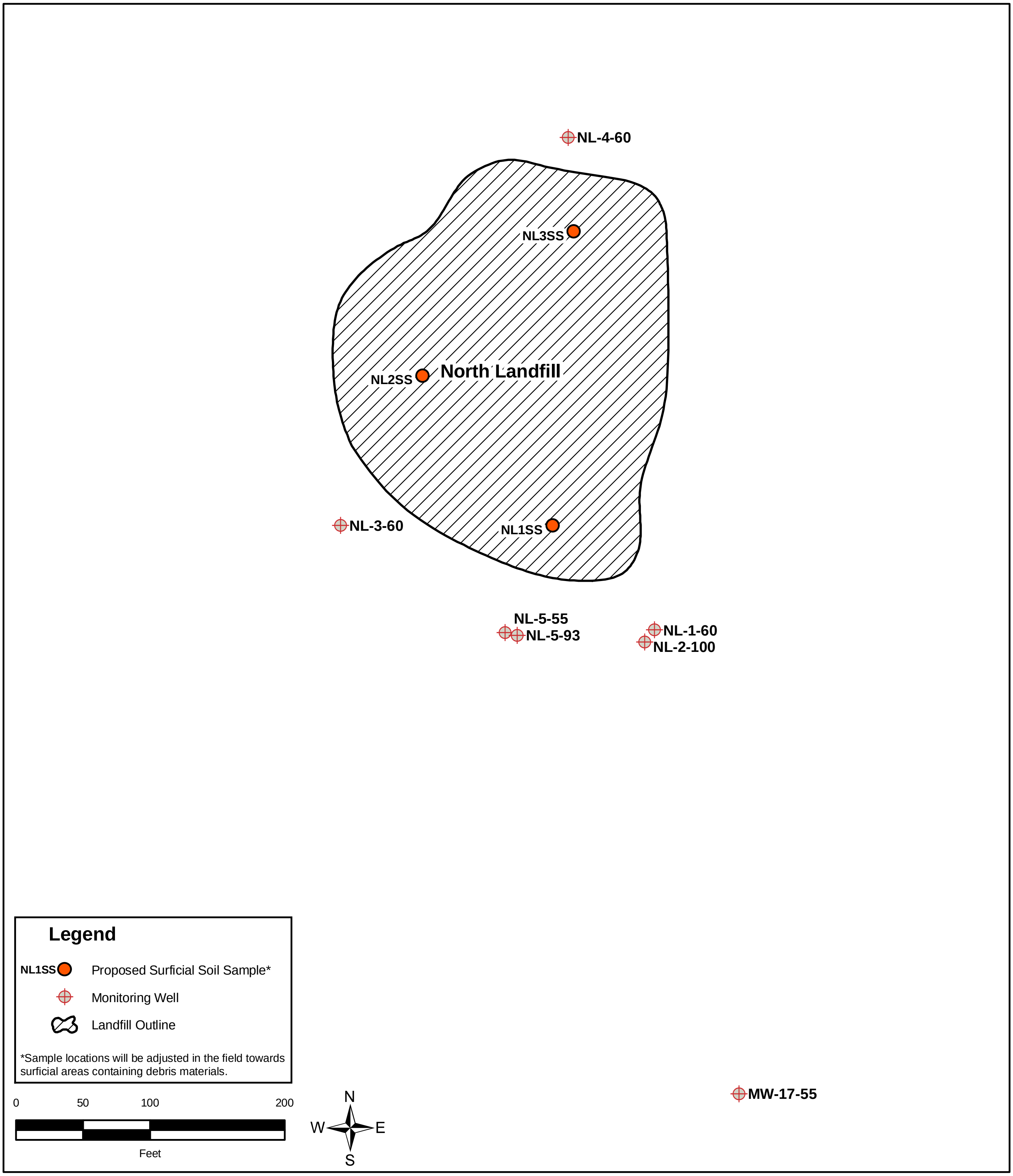
URSD Project Number: 18984840.00004

Rev Number: 1:

Date: 02/12/2007

Figure Number: 4

File Name: Fig4_NELandfill_ProposedSurficialSoilSampleLocs.mxd



CORPORATE REMEDIATION GROUP

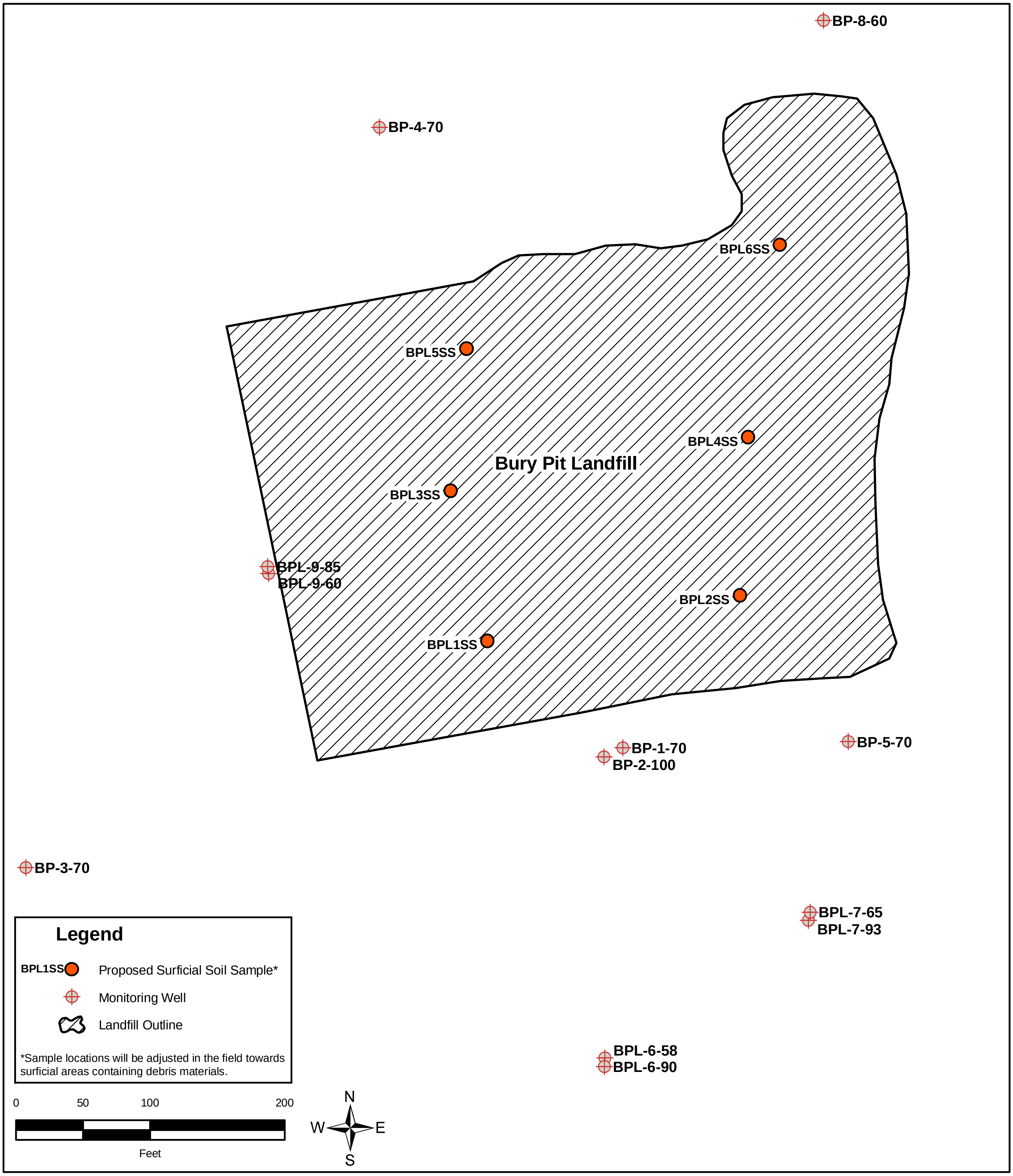
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

North Landfill Map
Proposed Surficial Soil Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 1: Date: 02/12/2007	Figure Number: 5
File Name: Fig5_NorthLandfill_ProposedSurficialSoilSampleLocs.mxd	



CORPORATE REMEDIATION GROUP

An Alliance between
DuPont and URS Diamond

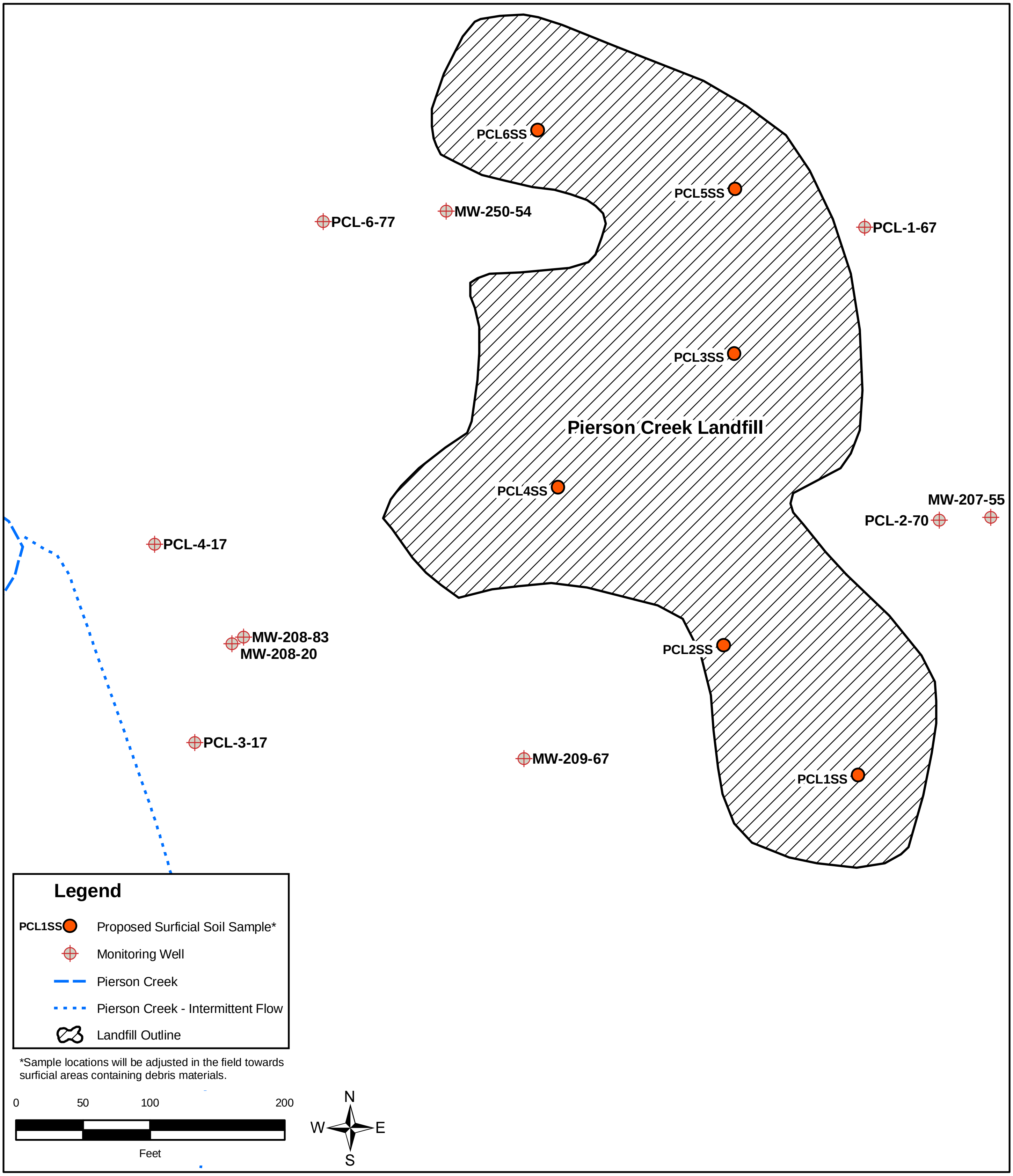
BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Bury Pit Landfill Map
Proposed Surficial Soil
Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: Date: 1: 02/12/2007	Figure Number: 6

File Name:
Fig6_BuryPitLandfill_ProposedSurficialSoilSampleLocs.mxd



*Sample locations will be adjusted in the field towards surficial areas containing debris materials.

CORPORATE REMEDIATION GROUP

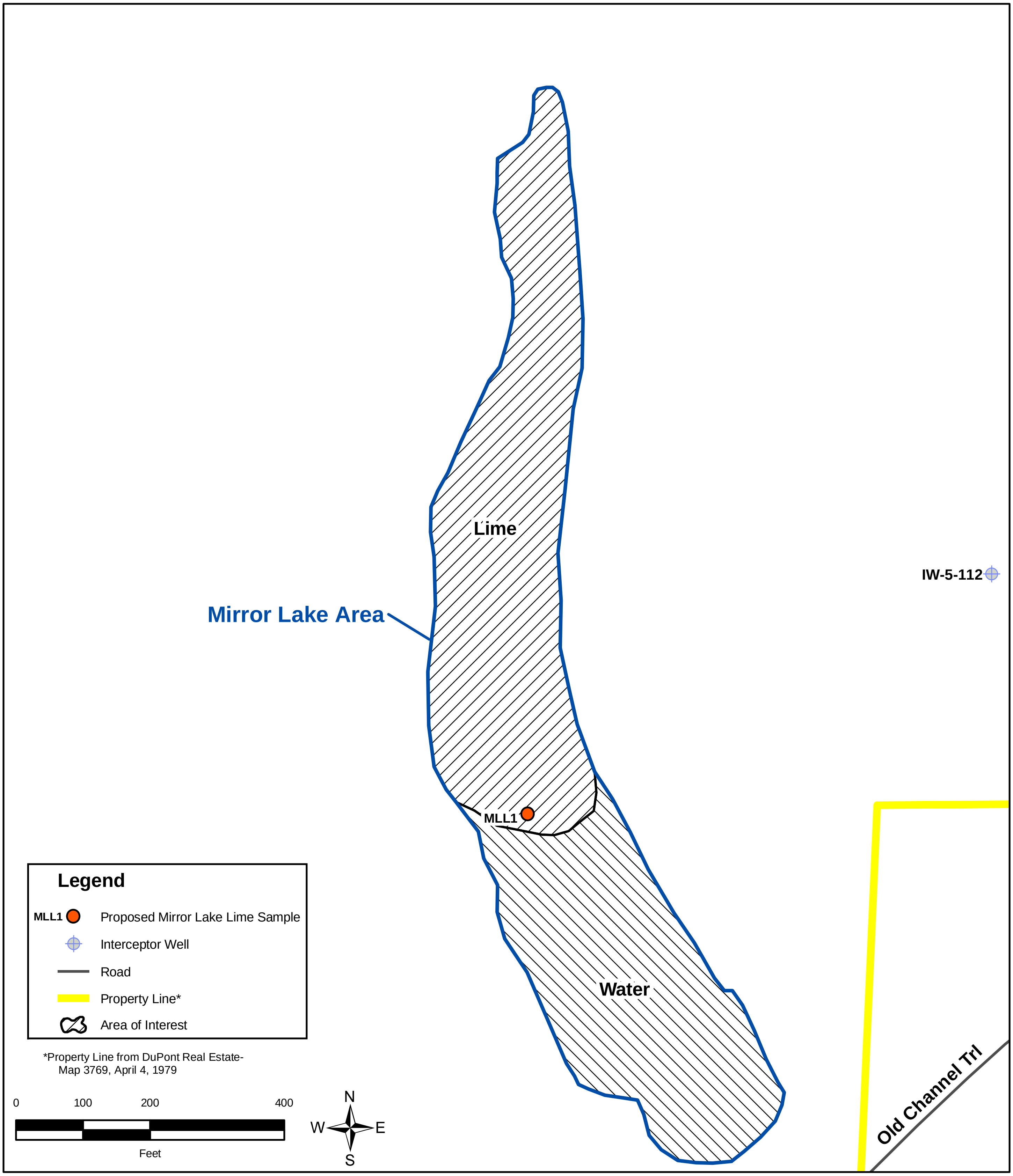
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Pierson Creek Landfill Map
Proposed Surficial Soil Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 1: Date: 02/12/2007	Figure Number: 7
File Name: Fig7_PCrkLandfill_ProposedSurficialSoilSampleLocs	



CORPORATE REMEDIATION GROUP

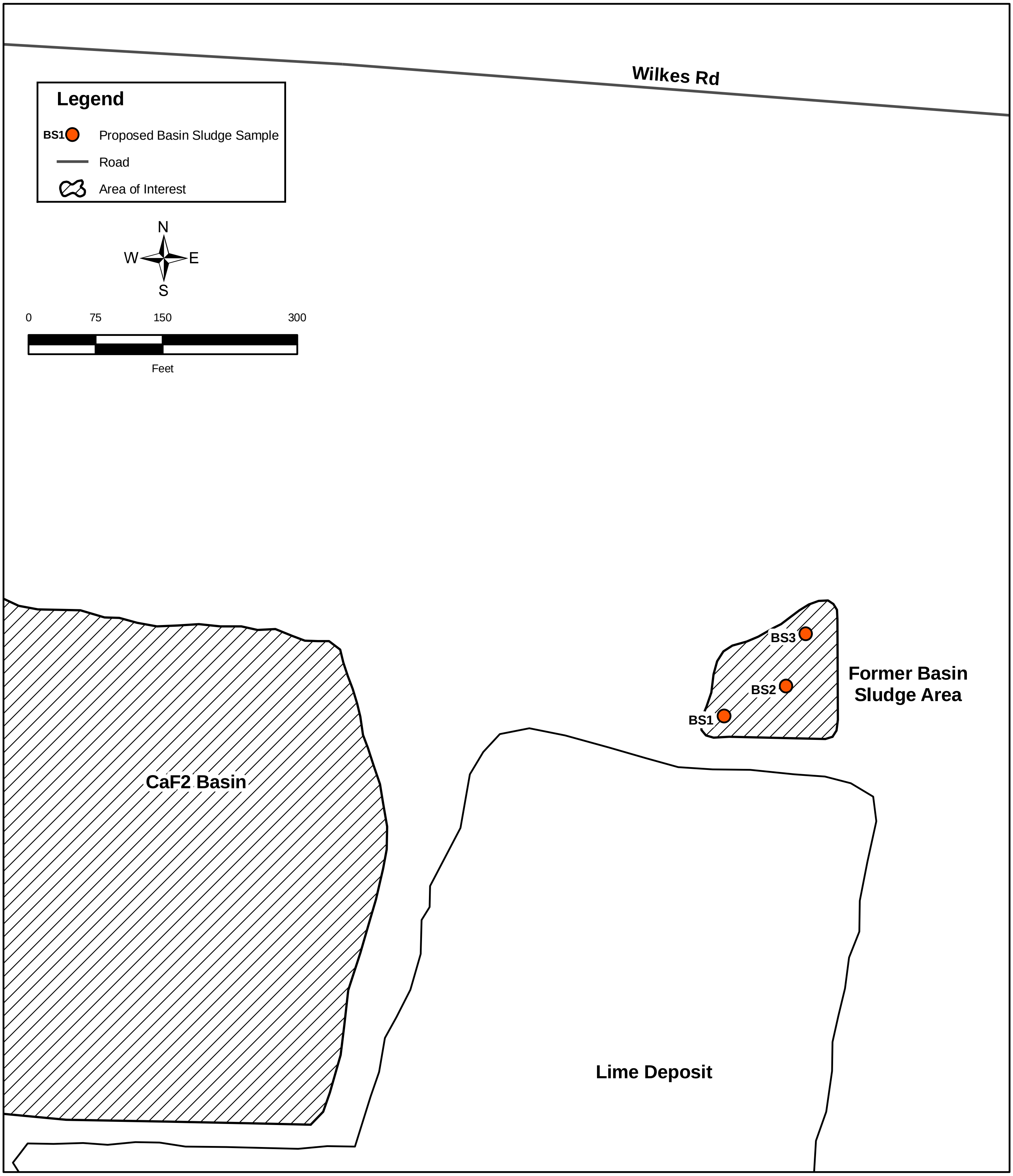
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Mirror Lake Area
Proposed Lime Sample Location

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/15/2007	Figure Number: 8
File Name: Fig8_MirrorLakeLimeSampleLoc.mxd	



CORPORATE REMEDIATION GROUP

An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Former Basin Sludge Area Proposed Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA

DuPont Project Number: 7046

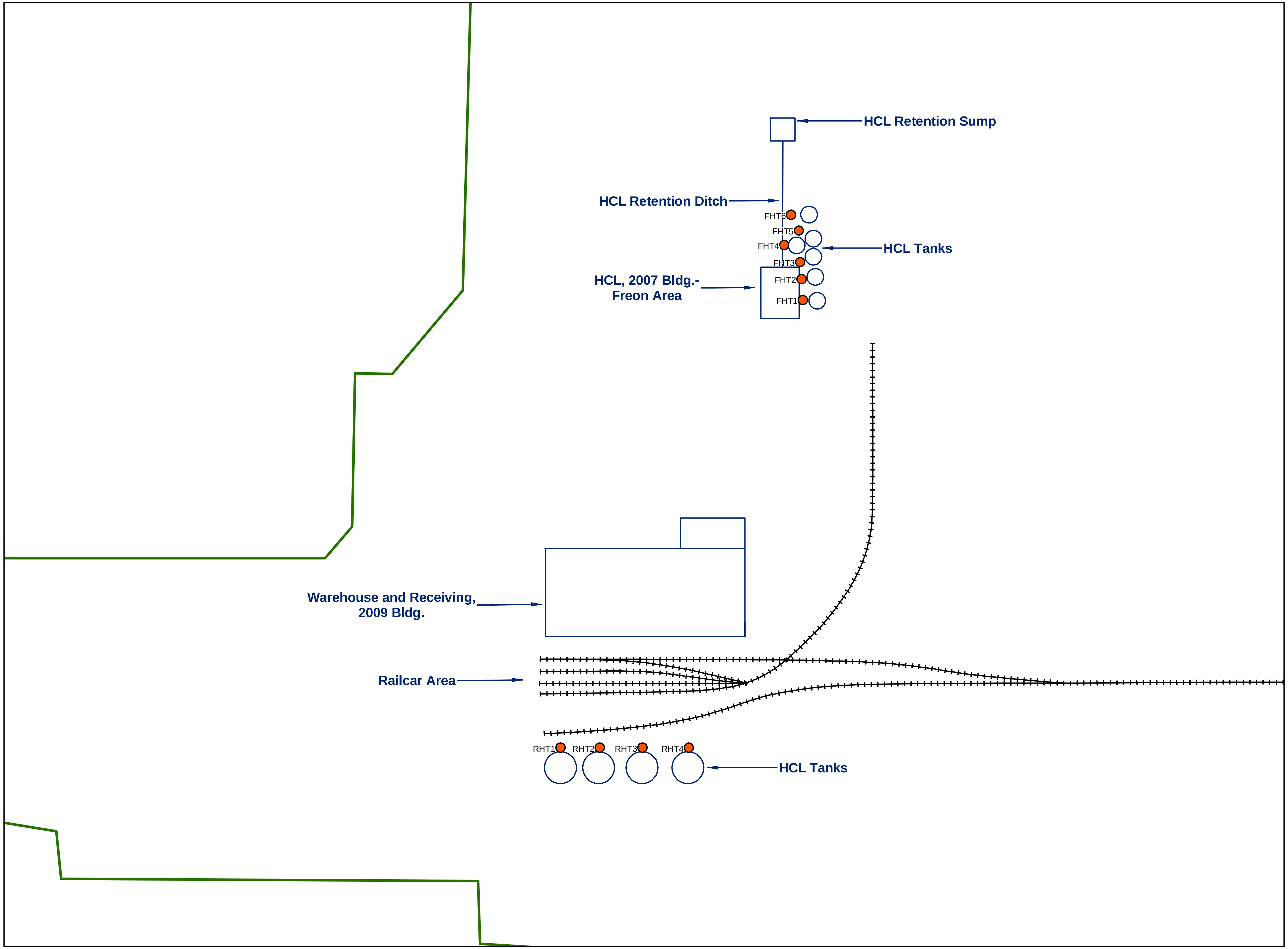
Date: 01/15/2007

URSD Project Number: 18984840.00004

Rev Number: 1: Date: 02/12/2007

Figure Number: 9

File Name: Fig9_BasinSludgeSampleLoc.mxd



DuPont

CORPORATE REMEDIATION GROUP

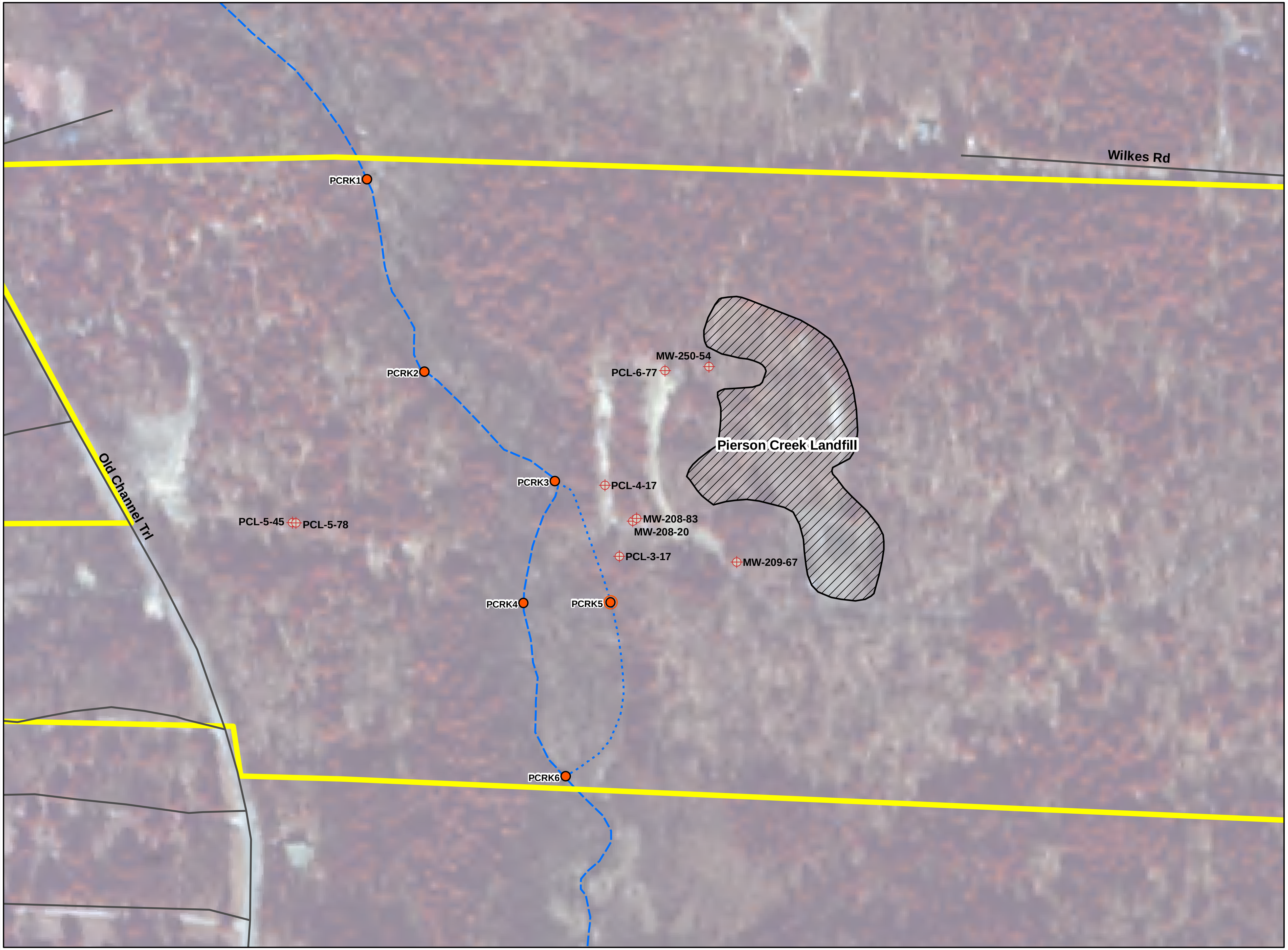
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Former HCL Tanks
Proposed Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/15/2007	Figure Number: 10
File Name: Fig10_HCLTanksSampLoc.mxd	



Legend

PCRK1 ●	Proposed Creek Sample
PCRK5 ◉	Proposed Intermittent Creek Sample*
PCRK5 ⊕	Proposed Well To Be Sampled
—	Road
- -	Pierson Creek
·····	Pierson Creek - Intermittent Flow
▬	Property Line**
▨	Landfill Outline

*Potential sample dependent upon whether Intermittent Stream is flowing.

**Property Line from DuPont Real Estate-
Map 3769, April 4, 1979

Orthophoto: 1999 Flowercreek_se.sid from USGS TIFF

N
W E
S

0 100 200 400
Feet

CORPORATE REMEDIATION GROUP

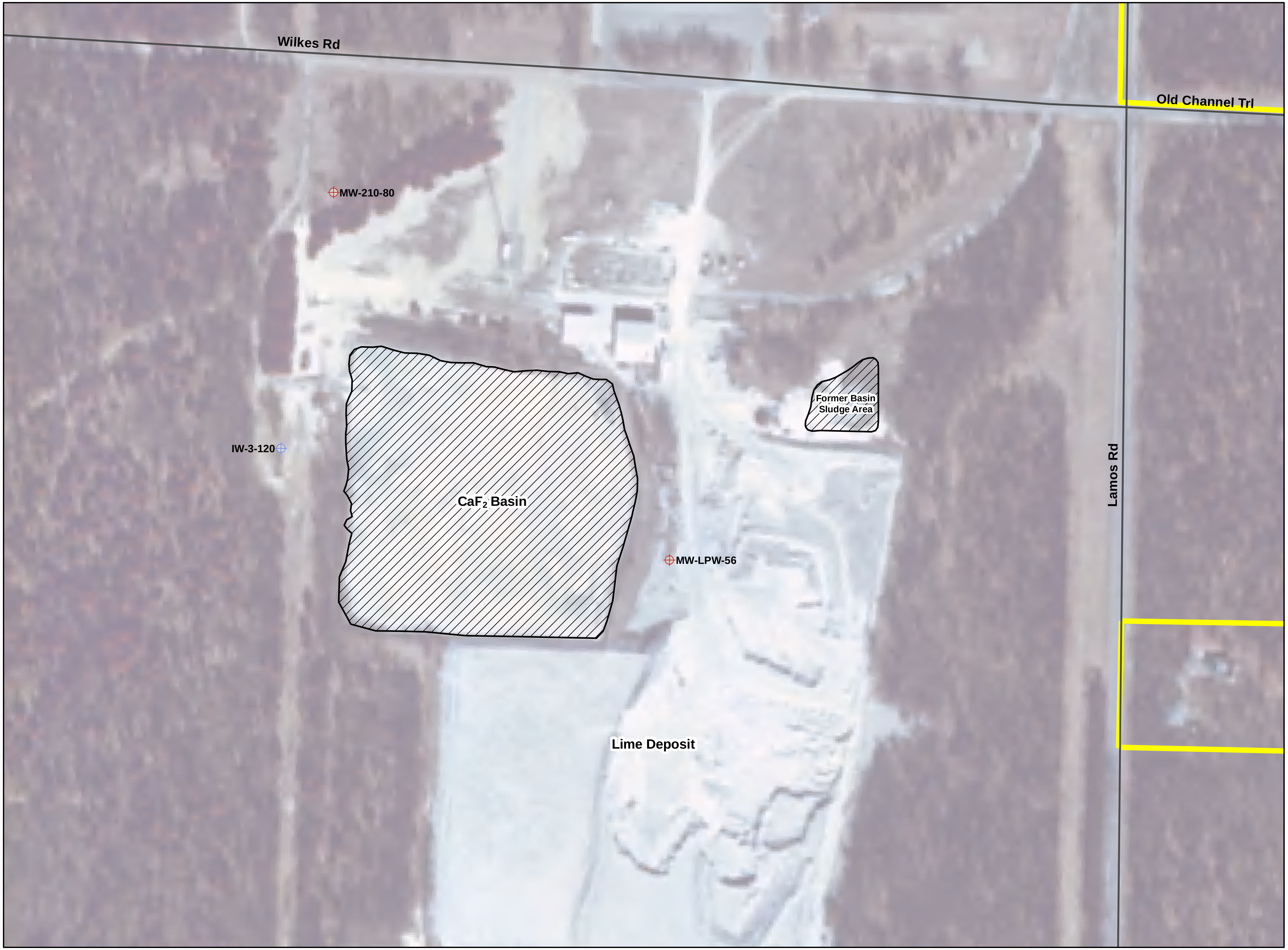
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Proposed Creek Water and Creek Sediment Sample Locations

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/15/2007	Figure Number: 11
File Name: Fig11_CrkWaterCrkSedSampLoc.mxd	

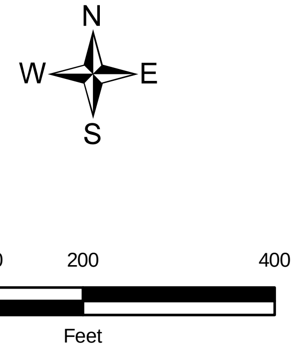


Legend

MW-210-80 ⊕	Proposed Monitoring Well To Be Sampled
IW-3-120 ⊕	Proposed Interceptor Well To Be Sampled
—	Road
🟨	Property Line*
▨	Surface Feature Outline

*Property Line from DuPont Real Estate-
Map 3769, April 4, 1979

Orthophoto: 1999 Flowercreek_se.sid from USGS TIFF



CORPORATE REMEDIATION GROUP

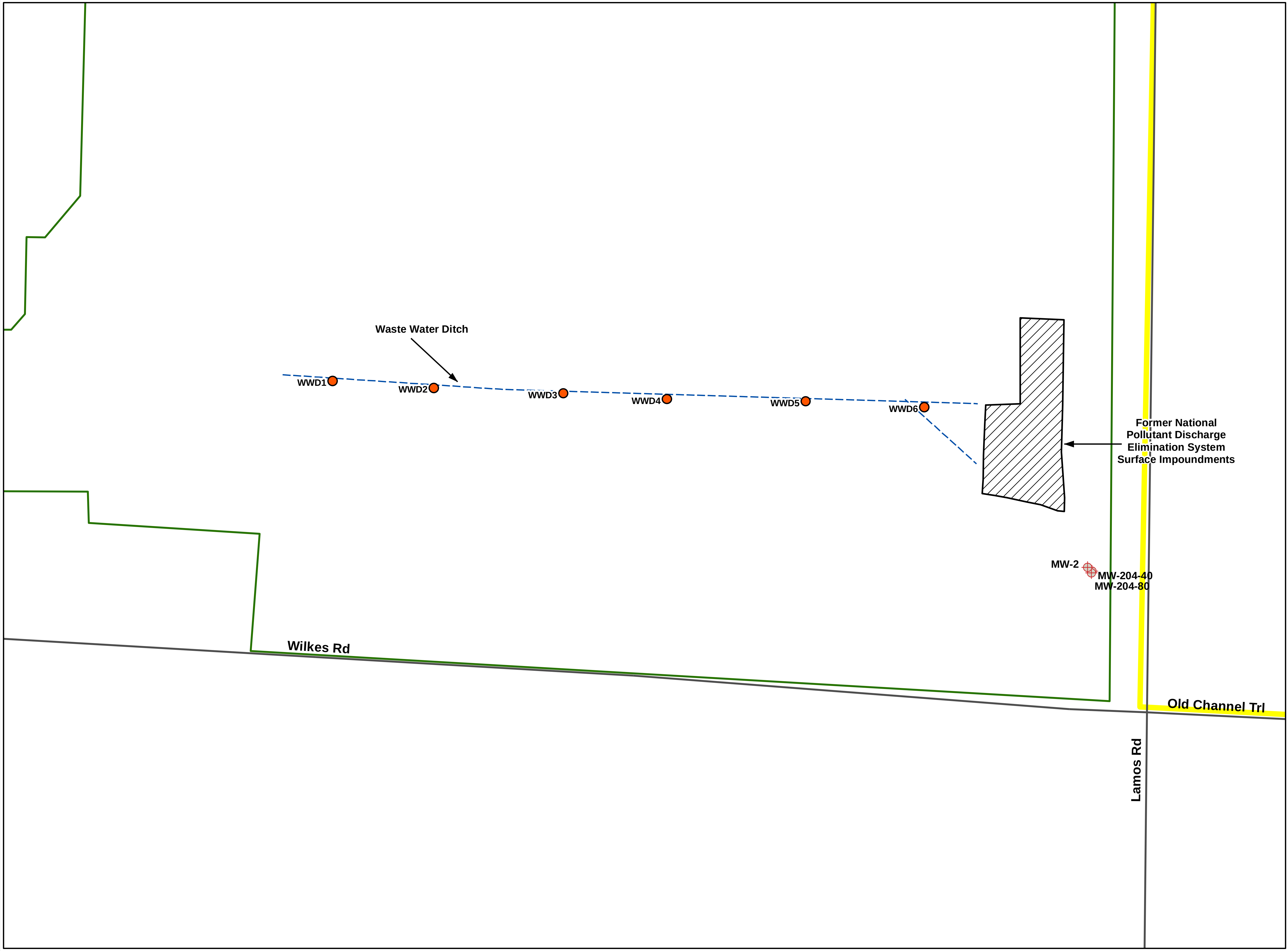
An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Wells to be Sampled for Calcium Fluoride Basin

DuPont Montague Facility
Montague, Michigan

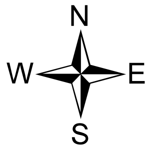
Created: CAA	DuPont Project Number: 7046
Date: 01/15/2007	URSD Project Number: 18984840.00004
Rev Number: 1: Date: 02/12/2007	Figure Number: 12
File Name: Fig12_WellsSmpldForCaF2Basin.mxd	

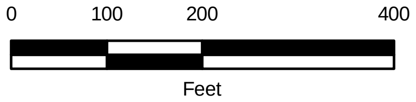


Legend

WWD1 ● Proposed Subsurface Soil Sample*
MW-2 ⊕ Proposed Monitoring Well to be Sampled**
Waste Water Ditch
Road
Property Line***
Surface Feature Outline
Boundary of Former Manufacturing Area

*Subsurface Soil Samples to Assess Waste Water Ditch
**Monitoring Wells to Assess Former NPDES Impoundment.
***Property Line from DuPont Real Estate-
Map 3769, April 4, 1979
Orthophoto: 1999 Flowercreek_se.sid from USGS TIFF





CORPORATE REMEDIATION GROUP

An Alliance between
DuPont and URS Diamond

BMP 19
Barley Mill Plaza
Wilmington, DE 19805

Proposed Soil Sample Locations and Wells to Assess Former NPDES System

DuPont Montague Facility
Montague, Michigan

Created: CAA	DuPont Project Number: 7046
Date: 01/18/2007	URSD Project Number: 18984840.00004
Rev Number: 0: Date: 01/18/2007	Figure Number: 13

File Name:
Fig13_SubSSLocsForWstWtrDitch.mxd

APPENDICES

APPENDIX A

COMPARISON OF CONSTITUENT METHOD DETECTION LIMITS TO REGULATORY VALUES

Appendix A
FOOT NOTES

FOOTNOTES

FOR THE PART 201 CRITERIA/
PART 213 RISK-BASED SCREENING LEVELS
RRD OPERATIONAL MEMORANDUM No. 1

SYMBOL	DEFINITION
FF	The chloride GSI criterion shall be 125 mg/l when the discharge is to surface waters of the state designated as public water supply sources or 50 mg/l when the discharge is to the Great Lakes or connecting waters. 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
G	Groundwater surface water interface (GSI) criterion depends on the pH or water hardness, or both, of the receiving surface water. The final chronic value (FCV) for the protection of aquatic life shall be calculated based on the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg CaCO3/L, use 400 mg CaCO3/L for the FCV calculation. The FCV formula provides values in units of ug/L or ppb. The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV), and the surface water human non-drinking water value (HNDV). The soil GSI protection criteria for these hazardous substances are the greater of the 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in the MDEQ footnote.
ID	“ID” means insufficient data to develop criterion.
M	Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit.
NA	“NA” means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.
NLL	“NLL” means hazardous substance is not likely to leach under most soil conditions
NLV	means hazardous substance is not likely to volatilize under most conditions
X	The GSI criterion shown in the generic cleanup criteria tables is not protective for surface water that is used as a drinking water source. For a groundwater discharge to the Great Lakes and their connecting waters or discharge in close proximity to a water supply intake in inland surface waters, the generic GSI criterion shall be the surface water human drinking water value (HDV) listed in the table in this footnote, except for those HDV indicated with an asterisk. For HDV with an asterisk, the generic GSI criterion shall be the lowest of the HDV, the WV, and the calculated FCV. See formulas in footnote (G). Soil protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria for compounds with an asterisk shall be the greater of 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in the MDEQ
(S)	Criterion defaults to the hazardous substance-specific water solubility limit.

Appendix A
Surface Water Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	MDEQ Surface Water Quality Criteria
1,1,1-TRICHLOROETHANE	ug/l	0.8	89
1,1,2-TRICHLOROETHANE	ug/l	0.8	330
1,1,2-TRICHLOROTRIFLUOROETHANE		library search	32
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE		library search	
1,1-DICHLORO-2,2,2-TRIFLUOROETHANE		library search	
1,1-DICHLOROETHANE	ug/l	1	740
1,1-DICHLOROETHYLENE	ug/l	0.8	130
1,2,4-TRICHLOROBENZENE	ug/l	1	30
1,2-DICHLOROBENZENE	ug/l	1	13
1,2-DICHLOROETHANE	ug/l	1	360
1,2-DICHLOROPROPANE	ug/l	1	230
1,3-DICHLOROBENZENE	ug/l	1	28
1,3-DICHLOROPROPYLENE	ug/l	1	
1,4-DICHLOROBENZENE	ug/l	1	16
2,4 DINITROPHENOL	ug/l	20	19
2,4-DICHLOROPHENOL	ug/l	1	19
2,4-DIMETHYLPHENOL	ug/l	3	380
2,4-DINITROTOLUENE	ug/l	1	
2,6-DINITROTOLUENE	ug/l	1	
2-CHLOROPHENOL	ug/l	1	24
2-METHYLNAPHTHALENE	ug/l	1	1,000
2-METHYLPHENOL (O-CRESOL)	ug/l	1	82
2-NITROPHENOL	ug/l	1	
3- and 4-METHYLPHENOL	ug/l	2	
4,6-DINITRO-O-CRESOL	ug/l	5	
4-CHLORO-3-METHYLPHENOL	ug/l	1	7.4
4-NITROPHENOL	ug/l	10	60
ACENAPHTHENE	ug/l	1	38
ACENAPHTHYLENE	ug/l	1	
ACETALDEHYDE	ug/l	20	130
ACETONE	ug/l	6	1,700
ACETOPHENONE	ug/l	2	
ACRYLONITRILE	ug/l	4	5
AMMONIA	ug/l	30	29
ANTHRACENE	ug/l	1	2,400
ANTIMONY	ug/l	0.038	130
ARSENIC	ug/l	0.67	150
BARIUM	ug/l	0.62	437.7883
BENZENE	ug/l	0.5	200
BENZO(A)ANTHRACENE	ug/l	1	
BENZO(B)FLUORANTHENE	ug/l	1	
BENZO(G,H,I)PERYLENE	ug/l	1	
BENZO(K)FLUORANTHENE	ug/l	1	
BENZO[A]PYRENE	ug/l	1	
BENZYL ALCOHOL	ug/l	5	
BERYLLIUM	ug/l	0.94	2.392909
BIS(2-ETHYLHEXYL)PHTHALATE	ug/l	2	32
CADMIUM	ug/l	0.91	2.23795

Appendix A
Surface Water Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	MDEQ Surface Water Quality Criteria
CARBON TETRACHLORIDE	ug/l	1	45
CHLORIDE	ug/l	400	
CHLOROBENZENE	ug/l	0.8	47
CHLORODIFLUOROMETHANE (FREON 22)		library search	
CHLOROETHANE	ug/l	1	1100
CHLOROFORM	ug/l	0.8	630
CHLOROPRENE	ug/l	1	
CHROMIUM	ug/l	2.3	74.11452
CHRYSENE	ug/l	1	
CIS-1,2 DICHLOROETHENE	ug/l	0.8	620
CIS-1,4-DICHLORO-2-BUTENE	ug/l	4	
COBALT	ug/l	2.1	100
COPPER	ug/l	2.2	8.955751
CYANIDE	ug/l	5	5.2
DIBENZOFURAN	ug/l	1	4
DICHLORODIFLUOROMETHANE	ug/l	2	90,000
DIETHYL PHTHALATE	ug/l	2	110
DIMETHYL PHTHALATE	ug/l	2	
DI-N-BUTYL PHTHALATE	ug/l	2	9.7
ETHYLBENZENE	ug/l	0.8	18
FLUORANTHENE	ug/l	1	1.6
FLUORENE	ug/l	1	12
FLUORIDE	ug/l	30	
HEXACHLOROBENZENE	ug/l	0.034	0.0003
HEXACHLOROBUTADIENE	ug/l	0.1	0.053
HEXACHLORODIBENZOFURAN		library search	
HEXACHLOROETHANE	ug/l	1	
INDENO (1,2,3-CD) PYRENE	ug/l	1	
LEAD	ug/l	0.047	10.29788
MERCURY	ug/l	0.056	0.0013
METHYL CHLORIDE	ug/l	1	7300
METHYL METHACRYLATE	ug/l	1	
METHYLENE CHLORIDE	ug/l	2	1,500
NAPHTHALENE	ug/l	1	13
N-DIOCTYL PHTHALATE	ug/l	2	300
NICKEL	ug/l	5.6	52.00654
NITROBENZENE	ug/l	1	180
N-NITROSODIETHYLAMINE	ug/l	2	
N-NITROSODIMETHYLAMINE	ug/l	2	
N-NITROSODIPHENYLAMINE	ug/l	2	
PH	ug/l	10	
PHENANTHRENE	ug/l	1	2.4
PHENOL	ug/l	1	450
PYRENE	ug/l	1	15
SELENIUM	ug/l	0.5	5
SILVER	ug/l	0.023	0.06
STYRENE	ug/l	1	80
SULFATES	ug/l	1500	

Appendix A
Surface Water Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	MDEQ Surface Water Quality Criteria
SULFIDE	ug/l	530	
TETRACHLOROETHYLENE	ug/l	0.8	60
TETRAHYDROFURAN	ug/l	4	11,000
THALLIUM	ug/l	0.037	3.7
TIN	ug/l	8.4	
TOLUENE	ug/l	0.7	270
TRANS-1,2-DICHLOROETHENE	ug/l	0.8	1,500
TRANS-1,4-DICHLORO-2-BUTENE	ug/l	15	
TRICHLOROETHENE	ug/l	1	200
TRICHLOROFLUOROMETHANE	ug/l	2	
VANADIUM	ug/l	1.5	12
VINYL CHLORIDE	ug/l	1	13
XYLENES	ug/l	1	41
ZINC	ug/l	8.1	118.139

Blank cell indicates no criteria

Volatile Analysis = SW846 Method 8260 (acetaldehyde = Method 83515)

Semi Volatile Analysis = SW846 Method 8270

Metals Analysis = SW846 Methods 6020(ICP);6010(Trace);7470A(cold vapor)

Wet Chemistry:

CYANIDE (SW 9012)
AMMONIA (EPA 350.3)
CHLORIDE (EPA 325.3)
FLUORIDE (EPA 340.2)
SULFIDE (EPA 376.1)
pH (EPA 150.1)
SULFATE (EPA 375.4)

Appendix A
Sediment Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	EPA Region 5 Eco Screening Levels - Sediment
1,1,1-TRICHLOROETHANE	ug/kg	1.0	213
1,1,2-TRICHLOROETHANE	ug/kg	1.0	518
1,1,2-TRICHLOROTRIFLUOROETHANE		library search	
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE		library search	
1,1-DICHLORO-2,2,2-TRIFLUOROETHANE		library search	
1,1-DICHLOROETHANE	ug/kg	1.0	0.575
1,1-DICHLOROETHYLENE	ug/kg	1.0	19.4
1,2,4-TRICHLOROBENZENE	ug/kg	33	5,062
1,2-DICHLOROBENZENE	ug/kg	33	294
1,2-DICHLOROETHANE	ug/kg	1.0	260
1,2-DICHLOROPROPANE	ug/kg	1.0	333
1,3-DICHLOROBENZENE	ug/kg	1.0	1315
1,3-DICHLOROPROPYLENE	ug/kg	1	
1,4-DICHLOROBENZENE	ug/kg	33	318
2,4 DINITROPHENOL	ug/kg	670	6.21
2,4-DICHLOROPHENOL	ug/kg	33	81.7
2,4-DIMETHYLPHENOL	ug/kg	67	304
2,4-DINITROTOLUENE	ug/kg	67	14.4
2,6-DINITROTOLUENE	ug/kg	33	39.8
2-CHLOROPHENOL	ug/kg	33	31.9
2-METHYLNAPHTHALENE	ug/kg	0.67	20.2
2-METHYLPHENOL (O-CRESOL)	ug/kg	67	55.4
2-NITROPHENOL	ug/kg	33	
3-METHYLPHENOL	ug/kg	67	3,490
4,6-DINITRO-O-CRESOL	ug/kg	170	104
4-CHLORO-3-METHYLPHENOL	ug/kg	67	
4-METHYLPHENOL	ug/kg	67	20.2
4-NITROPHENOL	ug/kg	170	13.3
ACENAPHTHENE	ug/kg	0.67	6.71
ACENAPHTHYLENE	ug/kg	0.33	5.87
ACETALDEHYDE	ug/kg	200	
ACETONE	ug/kg	7.0	9.9
ACETOPHENONE	ug/kg	67	
ACRYLONITRILE	ug/kg	4.0	1.2
AMMONIA		not applicable for solid matrix	
ANTHRACENE	ug/kg	33	57.2
ANTIMONY	ug/kg	5	
ARSENIC	ug/kg	17	9,790
BARIUM	ug/kg	23	
BENZENE	ug/kg	0.50	142
BENZO(A)ANTHRACENE	ug/kg	33	108
BENZO(B)FLUORANTHENE	ug/kg	33	10,400
BENZO(G,H,I)PERYLENE	ug/kg	33	170
BENZO(K)FLUORANTHENE	ug/kg	33	240
BENZO[A]PYRENE	ug/kg	33	150

Appendix A
Sediment Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	EPA Region 5 Eco Screening Levels - Sediment
BENZYL ALCOHOL	ug/kg	170	1.04
BERYLLIUM	ug/kg	68	
BIS(2-ETHYLHEXYL)PHTHALATE	ug/kg	67	182
CADMIUM	ug/kg	3.8	990
CARBON TETRACHLORIDE	ug/kg	1.0	1,450
CHLORIDE		not applicable for solid matrix	
CHLOROBENZENE	ug/kg	1.0	291
CHLORODIFLUOROMETHANE (FREON 22)		library search	
CHLOROETHANE	ug/kg	2.0	
CHLOROFORM	ug/kg	1.0	121
CHLOROPRENE	ug/kg	1.0	
CHROMIUM	ug/kg	31	43,400
CHRYSENE	ug/kg	33	1,660
CIS-1,2 DICHLOROETHENE	ug/kg	1.0	
CIS-1,4-DICHLORO-2-BUTENE	ug/kg	4.0	
COBALT	ug/kg	130	50,000
COPPER	ug/kg	180	31,600
CYANIDE	ug/kg	180	0.1
DIBENZOFURAN	ug/kg	33	449
DICHLORODIFLUOROMETHANE	ug/kg	2.0	
DIETHYL PHTHALATE	ug/kg	67	295
DIMETHYL PHTHALATE	ug/kg	67	
DI-N-BUTYL PHTHALATE	ug/kg	67	1,114
ETHYLBENZENE	ug/kg	1.0	175
FLUORANTHENE	ug/kg	33	423
FLUORENE	ug/kg	33	77.4
FLUORIDE		not applicable for solid matrix	
HEXACHLOROBENZENE	ug/kg	0.21	20
HEXACHLOROBUTADIENE	ug/kg	2	26.5
HEXACHLORODIBENZOFURAN		library search	
HEXACHLOROETHANE	ug/kg	33	584
INDENO (1,2,3-CD) PYRENE	ug/kg	33	200
LEAD	ug/kg	15	35,800
MERCURY	ug/kg	11	174
METHYL CHLORIDE	ug/kg	2.0	
METHYL METHACRYLATE	ug/kg	1.0	168
M-XYLENE	ug/kg	1.0	433
NAPHTHALENE	ug/kg	33	176
N-DIOCTYL PHTHALATE	ug/kg	67	40,600
NICKEL	ug/kg	610	22,700
NITROBENZENE	ug/kg	33	145
N-NITROSODIETHYLAMINE	ug/kg	67	22.8
N-NITROSODIMETHYLAMINE	ug/kg	67	
N-NITROSODIPHENYLAMINE	ug/kg	33	

Appendix A
Sediment Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	EPA Region 5 Eco Screening Levels - Sediment
PHENANTHRENE	ug/kg	33	204
PHENOL	ug/kg	33	49.1
PYRENE	ug/kg	33	195
SELENIUM	ug/kg	37	
SILVER	ug/kg	170	500
STYRENE	ug/kg	1.0	254
SULFIDE		not applicable for solid matrix	
TETRACHLOROETHYLENE	ug/kg	1.0	990
TETRAHYDROFURAN	ug/kg	4.0	
THALLIUM	ug/kg	0.94	
TIN	ug/kg	760	
TOLUENE	ug/kg	1.0	1,220
TRANS-1,2-DICHLOROETHENE	ug/kg	1.0	654
TRANS-1,4-DICHLORO-2-BUTENE	ug/kg	10	
TRICHLOROETHENE	ug/kg	1.0	112
TRICHLOROFLUOROMETHANE	ug/kg	2.0	
VANADIUM	ug/kg	160	
VINYL CHLORIDE	ug/kg	1.0	202
XYLENES	ug/kg	1	433
ZINC	ug/kg	660	121,000

Blank cell indicates no criteria

Volatile Analysis = SW846 Method 8260 (acetaldehyde = Method 83515)

Semi Volatile Analysis = SW846 Method 8270

Metals Analysis = SW846 Methods 6020(ICP);6010(Trace);7470A(cold vapor)

Wet Chemistry:

CYANIDE (SW 9012)
AMMONIA (EPA 350.3)
CHLORIDE (EPA 325.3)
FLUORIDE (EPA 340.2)
SULFIDE (EPA 376.1)
pH (EPA 150.1)
SULFATE (EPA 375.4)

Appendix A
Groundwater Constituent Detection Limits and Associated Regulatory Values

Analyte	Unit	Method Detection Limit	#2 MDEQ Part 201 Indust & Commercial DW Criteria	#3 MDEQ Part 201 GSI Criteria
1,1,1-TRICHLOROETHANE	ug/l	0.8	200	200
1,1,2-TRICHLOROETHANE	ug/l	0.8	5	330
1,1,2-TRICHLOROTRIFLUOROETHANE		library search	170,000	32
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE		library search		
1,1-DICHLORO-2,2,2-TRIFLUOROETHANE		library search		
1,1-DICHLOROETHANE	ug/l	1	2,500	740
1,1-DICHLOROETHYLENE	ug/l	0.8	7	65
1,2,4-TRICHLOROBENZENE	ug/l	1	70	30
1,2-DICHLOROBENZENE	ug/l	1	600	16
1,2-DICHLOROETHANE	ug/l	1	5	360
1,2-DICHLOROPROPANE	ug/l	1	5	290
1,3-DICHLOROBENZENE	ug/l	1	19	38
1,3-DICHLOROPROPYLENE	ug/l	1	35	NA
1,4-DICHLOROBENZENE	ug/l	1	75	13
2,4 DINITROPHENOL	ug/l	20		
2,4-DICHLOROPHENOL	ug/l	1	210	19
2,4-DIMETHYLPHENOL	ug/l	3	1,000	380
2,4-DINITROTOLUENE	ug/l	1	32	NA
2,6-DINITROTOLUENE	ug/l	1		
2-CHLOROPHENOL	ug/l	1	130	22
2-METHYLNAPHTHALENE	ug/l	1	750	ID
2-METHYLPHENOL (O-CRESOL)	ug/l	1		
2-NITROPHENOL	ug/l	1	58	ID
3-METHYLPHENOL	ug/l	2		
4,6-DINITRO-O-CRESOL	ug/l	5	20(M);7.3	NA
4-CHLORO-3-METHYLPHENOL	ug/l	1	420	7.4
4-METHYLPHENOL	ug/l	2		
4-NITROPHENOL	ug/l	10		
ACENAPHTHENE	ug/l	1	3,800	19
ACENAPHTHYLENE	ug/l	1	150	ID
ACETALDEHYDE	ug/l	20	2,700	130
ACETONE	ug/l	6	2,100	1,700
ACETOPHENONE	ug/l	2	4,400	ID
ACRYLONITRILE	ug/l	4	11	4.9
AMMONIA	ug/l	30	10,000	CC
ANTHRACENE	ug/l	1	43	ID
ANTIMONY	ug/l	0.038	6	130
ARSENIC	ug/l	0.67	10	150
BARIUM	ug/l	0.62	2,000	G,X
BENZENE	ug/l	0.5	5	200
BENZO(A)ANTHRACENE	ug/l	1	8.5	ID
BENZO(B)FLUORANTHENE	ug/l	1	1.5	ID
BENZO(G,H,I)PERYLENE	ug/l	1	1(M);0.26(S)	NA
BENZO(K)FLUORANTHENE	ug/l	1	1.0(M);0.8(S)	NA
BENZO[A]PYRENE	ug/l	1	5	ID
BENZYL ALCOHOL	ug/l	5	29,000	NA

Appendix A
Groundwater Constituent Detection Limits and Associated Regulatory Values

Analyte	Unit	Method Detection Limit	#2 MDEQ Part 201 Indust & Commercial DW Criteria	#3 MDEQ Part 201 GSI Criteria
BERYLLIUM	ug/l	0.94	4	G
BIS(2-ETHYLHEXYL)PHTHALATE	ug/l	2	6	32
CADMIUM	ug/l	0.91	5	G,X
CARBON TETRACHLORIDE	ug/l	1	5	45
CHLORIDE	ug/l	400	250,000	FF
CHLOROBENZENE	ug/l	0.8	100	47
CHLORODIFLUOROMETHANE (FREON 22)		library search		
CHLOROETHANE	ug/l	1	1700	ID
CHLOROFORM	ug/l	0.8	80	170
CHLOROPRENE	ug/l	1		
CHROMIUM	ug/l	2.3	100	11
CHRYSENE	ug/l	1	1.6	ID
CIS-1,2 DICHLOROETHENE	ug/l	0.8	70	620
CIS-1,4-DICHLORO-2-BUTENE	ug/l	4		
COBALT	ug/l	2.1	100	100
COPPER	ug/l	2.2	1,000	G
CYANIDE	ug/l	5	200	5.2
DIBENZOFURAN	ug/l	1	ID	4
DICHLORODIFLUOROMETHANE	ug/l	2	4,800	ID
DIETHYL PHTHALATE	ug/l	2	16000	110
DIMETHYL PHTHALATE	ug/l	2	210000	NA
DI-N-BUTYL PHTHALATE	ug/l	2	2,500	9.7
ETHYLBENZENE	ug/l	0.8	74	18
FLUORANTHENE	ug/l	1	210	1.6
FLUORENE	ug/l	1	2,000	12
FLUORIDE	ug/l	30		
HEXACHLOROBENZENE	ug/l	0.034	1	0.2(M);0.0003
HEXACHLOROBUTADIENE	ug/l	0.1	42	0.05
HEXACHLORODIBENZOFURAN		library search		
HEXACHLOROETHANE	ug/l	1	21	6.7
INDENO (1,2,3-CD) PYRENE	ug/l	1	2(M);0.022(S)	ID
LEAD	ug/l	0.047	4	G,X
MERCURY	ug/l	0.056	2	0.0013
METHYL CHLORIDE	ug/l	1	1100	ID
METHYL METHACRYLATE	ug/l	1		
METHYLENE CHLORIDE	ug/l	2	5	940
NAPHTHALENE	ug/l	1	1,500	13
N-DIOCTYL PHTHALATE	ug/l	2	380	ID
NICKEL	ug/l	5.6	100	G
NITROBENZENE	ug/l	1	9.6	180
N-NITROSODIETHYLAMINE	ug/l	2		
N-NITROSODIMETHYLAMINE	ug/l	2		
N-NITROSODIPHENYLAMINE	ug/l	2	1,100	NA
PH	ug/l	10		
PHENANTHRENE	ug/l	1	150	2.4
PHENOL	ug/l	1	13000	210

Appendix A
Groundwater Constituent Detection Limits and Associated Regulatory Values

Analyte	Unit	Method Detection Limit	#2 MDEQ Part 201 Indust & Commercial DW Criteria	#3 MDEQ Part 201 GSI Criteria
PYRENE	ug/l	1	140	ID
SELENIUM	ug/l	0.5	50	5
SILVER	ug/l	0.023	98	0.2(M);0.06
STYRENE	ug/l	1	100	80
SULFATES	ug/l	1500		
SULFIDE	ug/l	530		
TETRACHLOROETHYLENE	ug/l	0.8	5	45
TETRAHYDROFURAN	ug/l	4	270	11,000
THALLIUM	ug/l	0.037	2	3.7
TIN	ug/l	8.4		
TOLUENE	ug/l	0.7	790	140
TRANS-1,2-DICHLOROETHENE	ug/l	0.8	100	1,500
TRANS-1,4-DICHLORO-2-BUTENE	ug/l	15		
TRICHLOROETHENE	ug/l	1	5	200
TRICHLOROFLUOROMETHANE	ug/l	2	7,300	NA
VANADIUM	ug/l	1.5	62	12
VINYL CHLORIDE	ug/l	1	2	15
XYLENES	ug/l	1	280	35
ZINC	ug/l	8.1	5,000	G

Blank cell indicates no criteria

Volatile Analysis = SW846 Method 8260 (acetaldehyde = Method 83515)
Semi Volatile Analysis = SW846 Method 8270
Metals Analysis = SW846 Methods 6020(ICP);6010(Trace);7470A(cold vapor)
Wet Chemistry:
CYANIDE (SW 9012)
AMMONIA (EPA 350.3)
CHLORIDE (EPA 325.3)
FLUORIDE (EPA 340.2)
SULFIDE (EPA 376.1)
pH (EPA 150.1)
SULFATE (EPA 375.4)

Appendix A
Soil Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	#21 MDEQ Part 201 Indust DW Protect	#12 MDEQ Part 201 GSI Protection	#27 MDEQ Part 201 Indust Direct Contact	#10 MDEQ Part 201 Statewide Default Background Levels	#23 MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria and RBSLs	#26 MDEQ Part 201 Particulate Soil Inhalation Criteria and RBSLs	#30 MDEQ Part 201 Soil Saturation Concentration Screening Levels	EPA Region 5 Eco Screening Levels - Soil
1,1,1-TRICHLOROETHANE	ug/kg	1	4,000	4,000	460,000	NA	4,500,000	29,000,000,000	460,000	29,800
1,1,2-TRICHLOROETHANE	ug/kg	1	100	6600	840000	NA	57,000	250,000,000	920,000	28,600
1,1,2-TRICHLOROTRIFLUOROETHANE		library search	550,000	1,700	550,000	NA	210,000,000	2,300,000,000,000	550,000	
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE		library search								
1,1-DICHLORO-2,2,2-TRIFLUOROETHANE		library search								
1,1-DICHLOROETHANE	ug/kg	1	50,000	15,000	890,000	NA	2,500,000	15,000,000,000	890,000	20,100
1,1-DICHLOROETHYLENE	ug/kg	1	140	1300	570000	NA	3,700	78,000,000	570,000	8,280
1,2,4-TRICHLOROBENZENE	ug/kg	33	4,200	1,800	1,100,000	NA	34,000,000	11,000,000,000	1,100,000	5,062
1,2-DICHLOROBENZENE	ug/kg	33	14000	360	210000	NA	46,000,000	44,000,000,000	210,000	2,960
1,2-DICHLOROETHANE	ug/kg	1	100	7200	420000	NA	21,000	150,000,000	1,200,000	21,200
1,2-DICHLOROPROPANE	ug/kg	1	100	5800	550000	NA	30,000	120,000,000	550,000	32,700
1,3-DICHLOROBENZENE	ug/kg	1	480	1100	170000	NA	ID	ID	170,000	37,700
1,3-DICHLOROPROPYLENE	ug/kg	1	700	NA	240000	NA	60,000	590,000,000	620,000	
1,4-DICHLOROBENZENE	ug/kg	33	1700	290	1900000	NA	260,000	570,000,000	NA	546
2,4 DINITROPHENOL	ug/kg	670								61
2,4-DICHLOROPHENOL	ug/kg	33	4200	380	1800000	NA	NLV	2,300,000,000	1,800,000	87,500
2,4-DIMETHYLPHENOL	ug/kg	67	20,000	7,600	36,000,000	NA	NLV	2,100,000,000	NA	10
2,4-DINITROTOLUENE	ug/kg	67	640	NA	220000	NA	NLV	20,000,000	NA	1,280
2,6-DINITROTOLUENE	ug/kg	33								33
2-CHLOROPHENOL	ug/kg	33	2600	440	4500000	NA	ID	ID	19,000,000	243
2-METHYLNAPHTHALENE	ug/kg	0.67	170,000	ID	26,000,000	NA	ID	ID	NA	3,240
2-METHYLPHENOL (O-CRESOL)	ug/kg	67								40,400
2-NITROPHENOL	ug/kg	33	1200	ID	2000000	NA	NLV	ID	NA	1,600
3-METHYLPHENOL	ug/kg	67								3,490
4,6-DINITRO-O-CRESOL	ug/kg	170	830(M);400	NA	260000	NA	NLV	ID	NA	144
4-CHLORO-3-METHYLPHENOL	ug/kg	67	16,000	280	15,000,000	NA	NLV	ID	NA	7,950
4-METHYLPHENOL	ug/kg	67								163,000
4-NITROPHENOL	ug/kg	170								5,120
ACENAPHTHENE	ug/kg	0.67	880,000	4,400	130,000,000	NA	97,000,000	6,200,000,000	NA	682,000
ACENAPHTHYLENE	ug/kg	0.33	17,000	ID	5,200,000	NA	2,700,000	1,000,000,000	NA	682,000
ACETALDEHYDE	ug/kg	200	54,000	2,600	95,000,000	NA	210,000	260,000,000	110,000,000	
ACETONE	ug/kg	7.0	42,000	34,000	73,000,000	NA	160,000,000	170,000,000,000	110,000,000	2,500
ACETOPHENONE	ug/kg	67	88,000	NA	1,100,000	NA	52,000,000	14,000,000,000	1,100,000	300,000
ACRYLONITRILE	ug/kg	4	220	100(M,X);98	74000	NA	17,000	58,000,000	8,300,000	24
AMMONIA		not applicable for solid matrix	ID	CC	ID	NA	ID	2,900,000,000	10,000,000	
ANTHRACENE	ug/kg	33	41,000	ID	730,000,000	NA	1,600,000,000	29,000,000,000	NA	1,480,000
ANTIMONY	ug/kg	5	4,300	94,000	670,000	NA	NLV	5,900,000	NA	142
ARSENIC	ug/kg	17	4,600	70,000	37,000	5,800	NLV	910,000	NA	5,700
BARIUM	ug/kg	23	1,300,000	G,X	130,000,000	75,000	NLV	150,000,000	NA	1,040
BENZENE	ug/kg	0.5	100	4,000	400,000	NA	45,000	470,000,000	400,000	255
BENZO(A)ANTHRACENE	ug/kg	33	NLL	NLL	80,000	NA	NLV	ID	NA	5,210
BENZO(B)FLUORANTHENE	ug/kg	33	NLL	NLL	80,000	NA	ID	ID	NA	59,800

Appendix A
Soil Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	#21 MDEQ Part 201 Indust DW Protect	#12 MDEQ Part 201 GSI Protection	#27 MDEQ Part 201 Indust Direct Contact	#10 MDEQ Part 201 Statewide Default Background Levels	#23 MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria and RBSLs	#26 MDEQ Part 201 Particulate Soil Inhalation Criteria and RBSLs	#30 MDEQ Part 201 Soil Saturation Concentration Screening Levels	EPA Region 5 Eco Screening Levels - Soil
BENZO(G,H,I)PERYLENE	ug/kg	33	NLL	NLL	7,000,000	NA	NLV	350,000,000	NA	119,000
BENZO(K)FLUORANTHENE	ug/kg	33	NLL	NLL	800000	NA	NLV	ID	NA	148,000
BENZO[A]PYRENE	ug/kg	33	NLL	NLL	8,000	NA	NLV	1,900,000	NA	1,520
BENZYL ALCOHOL	ug/kg	170	580,000	NA	5,800,000	NA	NLV	150,000,000,000	5,800,000	65,800
BERYLLIUM	ug/kg	68	51,000	G	1,600,000	NA	NLV	590,000	NA	1,060
BIS(2-ETHYLHEXYL)PHTHALATE	ug/kg	67	NLL	NLL	10,000,000	NA	NLV	890,000,000	10,000,000	925
CADMIUM	ug/kg	3.8	6,000	G,X	2,100,000	1,200	NLV	2,200,000	NA	2.22
CARBON TETRACHLORIDE	ug/kg	1	100	900	390,000	NA	12,000	170,000,000	390,000	2,980
CHLORIDE		not applicable for solid matrix	5,000,000	2,500,000	500,000	NA	NLV	ID	NA	
CHLOROBENZENE	ug/kg	1	2000	940	260000	NA	920,000	2,100,000,000	260,000	13,100
CHLORODIFLUOROMETHANE (FREON 22)		library search								
CHLOROETHANE	ug/kg	2	34000	ID	950000	NA	36,000,000	290,000,000,000	950,000	
CHLOROFORM	ug/kg	1	1,600	3,400	1,500,000	NA	150,000	1,600,000,000	1,500,000	1,190
CHLOROPRENE	ug/kg	1								3
CHROMIUM	ug/kg	31	30,000	3,300	9,200,000	NA	NLV	240,000	NA	400
CHRYSENE	ug/kg	33	NLL	NLL	8,000,000	NA	ID	ID	NA	4,730
CIS-1,2 DICHLOROETHENE	ug/kg	1	1,400	12,000	640,000	NA	210,000	1,000,000,000	640,000	
CIS-1,4-DICHLORO-2-BUTENE	ug/kg	4								
COBALT	ug/kg	130	2,000	2,000	9,000,000	6,800	NLV	5,900,000	NA	140
COPPER	ug/kg	180	5,800,000	G	73,000,000	32,000	NLV	59,000,000	NA	5,400
CYANIDE	ug/kg	180	4,000	100	250,000	390	NLV	250,000	NA	1,330
DIBENZOFURAN	ug/kg	33	ID	1,700	ID	NA	ID	ID	NA	
DICHLORODIFLUOROMETHANE	ug/kg	2	270,000	ID	1,000,000	NA	63,000,000	1,500,000,000,000	1,000,000	39,500
DIETHYL PHTHALATE	ug/kg	67	320,000	2,200	740,000	NA	NLV	1,500,000,000	740,000	24,800
DIMETHYL PHTHALATE	ug/kg	67	790000	NA	790000	NA	NLV	1,500,000,000	790,000	734,000
DI-N-BUTYL PHTHALATE	ug/kg	67	760,000	11,000	760,000	NA	NLV	1,500,000,000	760,000	150
ETHYLBENZENE	ug/kg	1	1,500	360	140,000	NA	2,400,000	13,000,000,000	140,000	5,160
FLUORANTHENE	ug/kg	33	730,000	5,500	130,000,000	NA	890,000,000	4,100,000,000	NA	122,000
FLUORENE	ug/kg	33	890,000	5,300	87,000,000	NA	150,000,000	4,100,000,000	NA	122,000
FLUORIDE		not applicable for solid matrix								
HEXACHLOROBENZENE	ug/kg	0.21	1800	350	37000	NA	56,000	8,500,000	NA	199
HEXACHLOROBUTADIENE	ug/kg	2	72,000	91	350,000	NA	460,000	180,000,000	350,000	40
HEXACHLORODIBENZOFURAN		library search								
HEXACHLOROETHANE	ug/kg	33	1200	1800	730000	NA	660,000	100,000,000	NA	596
INDENO (1,2,3-CD) PYRENE	ug/kg	33	NLL	NLL	80,000	NA	NLV	ID	NA	109,000
LEAD	ug/kg	15	700,000	G,X	900,000	21,000	NLV	44,000,000	NA	53.7
MERCURY	ug/kg	11	1,700	50(M)1.2	580,000	130	62,000	8,800,000	NA	100
METHYL CHLORIDE	ug/kg	2	22000	ID	1100000	NA	120,000	2,600,000,000	1,100,000	10,400
METHYL METHACRYLATE	ug/kg	1								984,000
METHYLENE CHLORIDE	ug/kg	2	100	19,000	2,300,000	NA	700,000	8,300,000,000	2,300,000	4,050
NAPHTHALENE	ug/kg	33	100,000	870	52,000,000	NA	350,000	88,000,000	NA	99.4
N-DIOCTYL PHTHALATE	ug/kg	67	140,000,000	ID	20,000,000	NA	NLV	ID	140,000,000	709,000

Appendix A
Soil Constituent Detection Limits and Associated Regulatory Values

Analyte	Units	Method Detection Limit	#21 MDEQ Part 201 Indust DW Protect	#12 MDEQ Part 201 GSI Protection	#27 MDEQ Part 201 Indust Direct Contact	#10 MDEQ Part 201 Statewide Default Background Levels	#23 MDEQ Part 201 Infinite Source Volatile Soil Inhalation Criteria and RBSLs	#26 MDEQ Part 201 Particulate Soil Inhalation Criteria and RBSLs	#30 MDEQ Part 201 Soil Saturation Concentration Screening Levels	EPA Region 5 Eco Screening Levels - Soil
NICKEL	ug/kg	610	100,000	G	150,000,000	20,000	NLV	16,000,000	NA	13,600
NITROBENZENE	ug/kg	33	330(M);190	3600	340000	NA	64,000	21,000,000	490,000	1,310
N-NITROSODIETHYLAMINE	ug/kg	67								69
N-NITROSODIMETHYLAMINE	ug/kg	67								0.0321
N-NITROSODIPHENYLAMINE	ug/kg	33	22,000	NA	7,800,000	NA	NLV	ID	NA	545
PHENANTHRENE	ug/kg	33	160,000	5,300	5,200,000	NA	190,000	2,900,000	NA	45,700
PHENOL	ug/kg	33	260000	4200	12000000	NA	NLV	18,000,000,000	12,000,000	120,000
PYRENE	ug/kg	33	480,000	ID	84,000,000	NA	780,000,000	2,900,000,000	NA	78,500
SELENIUM	ug/kg	37	4,000	400	9,600,000	410	NLV	59,000,000	NA	27.6
SILVER	ug/kg	170	13,000	100(M);27	9,000,000	1,000	NLV	2,900,000	NA	4,040
STYRENE	ug/kg	1	2,700	2,200	520,000	NA	3,300,000	6,900,000,000	520,000	4,690
SULFIDE		not applicable for solid matrix								4
TETRACHLOROETHYLENE	ug/kg	1	100	900	88,000	NA	600,000	6,800,000,000	88,000	9,920
TETRAHYDROFURAN	ug/kg	4	5,400	220,000	9,500,000	NA	15,000,000	170,000,000,000	120,000,000	
THALLIUM	ug/kg	0.94	2,300	4,200	130,000	NA	NLV	ID	NA	56.9
TIN	ug/kg	760								7,620
TOLUENE	ug/kg	1	16,000	2,800	250,000	NA	3,300,000	12,000,000,000	250,000	5,450
TRANS-1,2-DICHLOROETHENE	ug/kg	1	2,000	30,000	1,400,000	NA	330,000	2,100,000,000	1,400,000	784
TRANS-1,4-DICHLORO-2-BUTENE	ug/kg	10								
TRICHLOROETHENE	ug/kg	1	100	4,000	500,000	NA	260,000	2,300,000,000	500,000	12,400
TRICHLOROFLUOROMETHANE	ug/kg	2	150,000	NA	560,000	NA	110,000,000	1,700,000,000,000	560,000	16,400
VANADIUM	ug/kg	160	990,000	190,000	5,500,000	NA	NLV	ID	NA	1,590
VINYL CHLORIDE	ug/kg	1	40	300	34,000	NA	29,000	890,000,000	490,000	646
XYLENES	ug/kg	1	5,600	700	150,000	NA	54,000,000	130,000,000,000	150,000	10,000
ZINC	ug/kg	660	5,000,000	G	630,000,000	47,000	NLV	ID	NA	6,620

RBSL = Risk Based Screening Levels

Blank cell indicates no criteria

Volatile Analysis = SW846 Method 8260 (acetaldehyde = Method 83515)

Semi Volatile Analysis = SW846 Method 8270

Metals Analysis = SW846 Methods 6020(ICP);6010(Trace);7470A(cold vapor)

Wet Chemistry:

CYANIDE (SW 9012)

AMMONIA (EPA 350.3)

CHLORIDE (EPA 325.3)

FLUORIDE (EPA 340.2)

SULFIDE (EPA 376.1)

pH (EPA 150.1)

SULFATE (EPA 375.4)

APPENDIX B

MDEQ MEMORANDUM NO. 2 ATTACHMENTS 5 AND 6

Remediation and Redevelopment Division

Michigan Department of Environmental Quality

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 5
COLLECTION OF SAMPLES FOR COMPARISON TO GENERIC CRITERIA

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes “facility” as defined by Part 201 and “site” as defined by Part 213
Low Flow:	Minimal drawdown groundwater sampling procedures as described in the United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, December, 1995, EPA Groundwater Issue
Response Actions:	Includes “response activities” as defined by Part 201 and “corrective action” as defined by Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for collection of groundwater and soil samples for comparison to generic criteria for site assessment, site investigation, and response actions under Part 201, Part 211, and Part 213.

Generic cleanup criteria for groundwater and soil have been developed pursuant to Sections 20120a(1) and 21304a of NREPA (see RRD Operational Memorandum No. 1). These criteria are the risk-based values the department has determined to be protective of the public health, safety, or welfare and the environment. The evaluation of sampling data to establish compliance with cleanup criteria under the provisions of Part 201, Part 211, and Part 213 requires data that reliably establish a representative concentration of the hazardous substance in a given environmental medium. The representativeness of the data can be maximized by using proven accurate and reproducible techniques and verified by using appropriate quality assurance and control procedures in the field and laboratory. This operational memorandum designates sampling, analysis, and quality assurance and control protocols for consistent data collection to facilitate gathering the information necessary for the department to determine compliance with the applicable provisions of Part 201, Part 211, or Part 213. Additional guidance regarding sampling strategies and methodology is available in RRD Operational Memorandum No. 4.

CALIBRATION OF FIELD EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data should be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment used for field sampling should be examined to certify that it is in operating condition. This includes checking the manufacturing's operating manual and the instructions for each instrument to ensure that all maintenance requirements are being observed. Calibration of field instruments should be performed in accordance with the manufacturer’s recommendations and guidelines and at the intervals specified by the manufacturer or more frequently as conditions dictate. At a minimum, equipment should be calibrated prior to each sampling event. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it should not be used in the field until it is serviced and calibrated.

COLLECTION OF SOIL SAMPLES FOR COMPARISON TO THE GENERIC CRITERIA

General Considerations

The soil and groundwater terminology used for this discussion include the following:

- Unsaturated/Vadose Zone: a subsurface zone above the capillary fringe in which the soil pores are only partially filled with water. The moisture content is less than the porosity.
- Saturated Zone: contains two components
    - Capillary Fringe: a subsurface zone above the water table in which the soil pores are filled with water and the pressure heads are less than atmospheric.
    - Water Table: the water level surface below the ground at which a well screened in an unconfined aquifer would fill with water.
- Smear Zone: the vertical area over which groundwater fluctuates (thereby the contaminated water will smear floating and dissolved contamination into the soils in the zone).

Soil samples must be representative of the soils located in the area affected by the release of hazardous substances. The exposure assumptions for soil pathways are based on dry soil. For comparison to the applicable generic soil criteria soil samples must be collected from the vadose zone. The results must be reported by the laboratory on a dry weight basis (adjusted for the vadose zone soil moisture content). Soil analytical methods cannot be applied to saturated soils because they do not provide representative results.

Neither soil nor water sample analyses methods are appropriate for comparison of saturated “soils” samples to generic soil or groundwater cleanup criteria. The cleanup criteria are based upon exposure assumptions appropriate only for soil or water, individually, and are not applicable to exposure to saturated “soil” as a mixture of soil and water.

Contaminants present in the unsaturated soil zone shall be evaluated by comparison of soil sample analyses to the applicable soil criteria. If contaminants are present in a saturated soil zone a monitoring well should be properly installed and the groundwater sampled. These groundwater sample results shall be compared to the applicable groundwater criteria. If free product is suspected and/or a smear zone exists near the water table, a monitoring well shall be appropriately installed so that the water table is bisected by the well screen. Additional guidance regarding monitor well construction is available in RRD Operational Memorandum No. 4.

While analysis of saturated “soil” samples cannot be used to demonstrate compliance with generic cleanup criteria, laboratory analyses or field instrument readings of saturated soils may be of qualitative value for remedial evaluation and design purposes. For example indications of high concentrations in saturated soils may indicate a need to prevent construction worker exposure to shallow saturated soils. This information may also assist in determining the nature of the contaminant and in treatment evaluations. If such data are included as part of response actions under Part 201 or Part 213 rationale for the use must be provided.

If the water surface elevation drops significantly from the time that the original soil investigation was performed, samples should be collected from any former “smear zone” prior to site closure.

Evaluating Exposure Due To Lead In Soil

The amount of lead in soil has historically been evaluated by analyzing lead concentrations in the total soil sample. However, recent evidence indicates that the fine soil fraction, defined as less than 250 microns in size, is more appropriate for comparison to soil direct contact criteria (DCC) and particulate inhalation criteria (PSIC). Exposure to lead in ingested soil and dust is best represented by the lead concentration in the particle size fraction that sticks to hands or that is most likely to accumulate in the indoor environment as a result of wind-blown soil deposition and transport of soil on clothes, shoes, pets, toys and other objects. Additionally, exposure to lead in inhaled soil and dust is best represented by the lead concentration in the particle size fraction likely to enter the respiratory system and become lodged in the alveoli. The particle size fraction of soil and dust likely to be ingested or inhaled is the fine soil fraction. Generally the fine fraction has the higher concentration of lead, but it is possible that the coarse fraction may contain more lead. Therefore, when collecting soils for facility evaluation, both fine and coarse fraction analyses are necessary to determine lead exposure. MDEQ Laboratory SOP #213 provides appropriate procedures for sample preparation. To assure protectiveness, the concentration of lead in each fraction must be compared to the direct contact criteria separately. Only the concentration of lead in the fine fraction must be compared to particulate soil inhalation criteria. The concentration the total lead concentration must be compared to other lead soil criteria. For response actions under Part 201 and Part 213, if the direct contact and particulate inhalation pathways have been appropriately documented to be “not relevant” it is not necessary to analyze the fractions separately.

COLLECTION OF GROUNDWATER SAMPLES FOR COMPARISON TO THE GENERIC CRITERIA

General Considerations

Groundwater samples collected for analyses must be representative of the water moving in the aquifer, in the contaminant plume or in the target zone where contaminants are expected to be located or to migrate. Groundwater samples must represent the contaminant concentrations, including dissolved and naturally suspended particles. Stagnant water in monitor well casings is not representative of the groundwater. Purging of the stagnant water in monitor well casings is necessary but must minimize changes in groundwater chemistry to yield water samples that are representative of the groundwater. Indicator parameters including temperature, pH, dissolved oxygen, specific conductivity and turbidity must be monitored during the purging process to determine stabilization between the well casing waters and the formation waters. Turbidity is the most conservative indicator of stabilization as it is often the last to stabilize. Turbidity in groundwater samples may be naturally occurring, caused by the contamination, or a result of sampling disturbances such as accidental inclusion of aquifer matrix materials from disturbances or mixing that may occur while sampling. Knowledge of site geology, well design, and sampling methodology is helpful in determining the source of turbidity and the method of sampling. Turbidity due to sampling disturbances should be eliminated or minimized while naturally occurring turbidity or turbidity due to contamination should not.

A sampling methodology must be used that accounts for the effects of aquifer heterogeneities while minimizing alterations in water chemistry that could result from sampling disturbances. The MDEQ will accept properly conducted purging methods designed to minimize drawdown by controlling the flow from the well while monitoring stabilization indicator parameters, commonly referred to as Low-Flow methods. Available Low-Flow procedures include United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, December 1995, EPA Ground Water Issue, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, Robert Puls and Michael Barcelona (http://www.epa.gov/ahaazvuc/download/issue/lwflw2a.pdf) and *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, United States Environmental Protection Agency Region 1, July 30, 1996, Revision 2 (http://www.epa.gov/region01/measure/well/wellmon.html). If another sampling methodology is used, documentation must be submitted to the MDEQ with the data that demonstrates why it is as representative of aquifer conditions as low-flow methodologies. Careful use of the Low-Flow methods is essential in collection of groundwater samples from wells that contain non-aqueous phase liquids, as these substances may be stratified in the monitoring well. Where non-aqueous phase liquid is present, refer to additional guidance for sampling strategies for non-aqueous phase liquids available in RRD Operational Memorandum No. 4, Attachment 5.

Collection of Inorganic Groundwater Samples

Traditionally, the standard practice for collecting metals samples from monitoring wells to evaluate the drinking water pathway had prescribed that samples be filtered with a 0.45 micron filter before inorganic analysis. The practice minimizes the potential for artificially elevated particulate loading resulting in overestimation of metal concentrations. However, U.S. EPA has determined that contaminant concentrations and the potential human health risk may be drastically underestimated for filtered samples (*Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, U.S. EPA Region 1, July 30, 1996, Rev 2). Use of the Low-Flow sampling methodologies minimizes sampling disturbances, improves the data quality, and is the method recommended by the MDEQ.

Inorganic constituents must be measured as totals (i.e., unfiltered with appropriate preservation) unless groundwater samples cannot be collected without adequately minimizing the influence of sampling disturbances, in which case filtering may be necessary prior to preservation. The intent of the field-filtration is only to eliminate or minimize sampling disturbances or interference. Any necessary filtration should be accomplished using a filter with a large enough pore size to allow naturally suspended particles to pass through the filter. Some preliminary testing may be required to determine the appropriate filter size. Site-specific conditions may require that both a filtered and unfiltered sample be collected to adequately evaluate the contaminant concentrations. Documentation for the use of filtration and the evaluation of appropriate filter sizes must be provided to the MDEQ with the data.

Collection of Organic Groundwater Samples

Samples to be analyzed for organic substances should not be filtered regardless of sample turbidity except as described in the next paragraph. When response action under Part 201 or Part 213 requires evaluation of the dermal contact with groundwater for contaminants listed in R 299.5750 footnote (AA) an additional set of groundwater samples should be collected for organic substances analysis which should be filtered for analysis of the dissolved phase. The groundwater contact criteria equation estimates the dermal adsorption of hazardous substances that are in the dissolved phase. Therefore, when analyzing for contaminants that strongly adsorb to soil particles, those samples should be filtered so that contaminants in the dissolved phase can be estimated. Filters of appropriate material should be used to ensure the filter does not absorb dissolved contaminants that are not attached to particulates. Glass filters with no binders are acceptable and recommended. Some preliminary testing may be required to determine the appropriate filter medium and pore size. Documentation of the evaluation of appropriate filter medium and size must be provided to the MDEQ with the data.

GENERAL QUALITY ASSURANCE AND QUALITY CONTROL

In order to insure that representative data is used to evaluate facilities, quality assurance and quality control (QA/QC) procedures must be implemented to assure that the precision, accuracy, and representativeness of the data are known and documented. This includes appropriate sample distribution to evaluate the extent of contamination; appropriate sample collection, preservation, shipping, and analysis methodology; collection and analysis of collocated, replicate and split duplicate samples for evaluation of precision; and collection and analysis of field, equipment, and trip blanks as well as matrix spike, matrix spike/duplicate, and laboratory spike samples for analysis of accuracy. Sample distribution and collection are more completely discussed in Operational Memorandum No. 4. Sample handling, preservation, and holding times are discussed in Attachment 4 of this Operational Memorandum. Collection of duplicate, blank and spike samples is discussed below.

Collection of Duplicate Samples to Evaluate Precision

Precision estimates the reproducibility of measurements under a given set of conditions and is reflected in the field duplicate samples and laboratory duplicates analysis. Overall precision for a sampling set is a mixture of field sampling techniques and laboratory techniques. Three types of duplicate samples are relevant to this document: collocated, replicates, and split samples. Collocated samples should be collected and used to estimate the overall precision of a data collection activity. Sampling error can be estimated by inclusion of both collocated and replicated versions of the same samples. Definitions of these samples are listed below:

- Collocated samples are independent samples collected at the same location and at the same time and, for the purpose of these site assessments, processed and analyzed by the same laboratory. Collocated samples are not mixed together and then split into two or more samples. They are two separate samples from an identical site location. They provide a good estimate of precision information for the entire system, including transportation, sampling technique, homogeneity of the site, and laboratory analysis. Examples of collocated samples are samples taken from a moving stream, side by side soil core samples (nesting), two air quality samples taken from one common sample manifold, and two water samples taken from essentially the same point in a lake or lagoon. Collocated samples are used to estimate the overall precision of a data collection activity. Sampling error can be estimated by including a replicate sample with a collocated sample.

- Replicate samples are samples that have been divided into two or more portions at the same step in the measurement process. Examples of replicate samples include two samples taken from a single purged well, samples collected in a common container and then put into separate containers or a soil sample which is thoroughly mixed in a tray and divided into separate containers. Replicate samples are processed and analyzed by the same laboratory.
- Split samples are replicate samples divided into two portions, sent to different laboratories, and subjected to the same environmental conditions and steps in measurement process. They serve as an oversight function in assessing the analytical portion of a measurement system. Samples are often split between the MDEQ and a facility owner or liable party.

Collection of Blank and Spike Samples to Evaluate Accuracy

Accuracy estimates the bias in a measurement system. Accuracy is difficult to estimate for the entire data collection activity. Sources of error include: sampling procedure; field contamination; preservation handling; sample matrix; sample preparation; and analytical techniques. Sampling accuracy can be audited through field, equipment, and trip blanks, while analytical (or laboratory) accuracy can be audited through spike samples and the surrogate recovery results.

A field blank is prepared by pouring distilled/deionized water directly into sample containers. This preparation is performed in the area where sample handling and preservation operations occur. The field blank sample is handled and shipped in the same manner as other analytical samples. Field blank sample analytical results are used to evaluate sample handling, preservation, and shipping procedures.

An equipment blank can be prepared by pouring distilled/deionized water through or over a piece of sampling equipment and collecting rinsate in a sample container. Results of equipment blank analysis are used to evaluate field decontamination procedures and to determine the likelihood of cross contamination.

A trip blank, which normally applies only to volatiles, is a sample that is prepared before any sampling is performed. This sample is shipped from the warehouse to the field and then to the laboratory. Results of trip blank analysis are used to evaluate possible contamination of containers/samples from the time the sample containers are prepared through the field event to the time the samples are received and analyzed at the laboratory.

Laboratory blanks are used to estimate variabilities caused by technique, in-house contamination, and other laboratory problems. Laboratory blanks are prepared by the laboratory.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples and surrogates are samples that are spiked in the laboratory. MS/MSD samples for organic and inorganic water analyses require an extra sample volume. The actual MS/MSD sample is prepared by the laboratory to evaluate accuracy.

Field background, or upgradient samples may need to be collected on a site-specific basis and should be collected from a clean location and shipped with other samples from the site. These samples should be submitted to the laboratory as routine field samples and should not be defined as blanks.

To provide adequate QA/QC for site investigations, the following duplicate, blank and matrix spike samples should be taken. Duplicate and field blank samples should be taken at critical sampling locations, but not at the same location from which the matrix spike/duplicate sample is obtained. They should be sent to the laboratory as blind samples. Reduced QA/QC evaluations may be implemented on a case by case basis with approval of the MDEQ RRD Project Manager.

	Duplicate Samples[1]				**Blank Samples[1]**		
QA/QC Sample Type	**Collocated**	**Replicate**	**Split**	**MS/MSD**	**Field**	**Equipment**	**Trip**
Recommended Number of QA/QC Samples	1 per 10 or fewer samples per matrix[2] and analytical group[3], at least 1 per day	When used: 1 per matrix and analytical group per day	When used: 1 per 1 for samples that will be split	1 per 20 or fewer samples per matrix and analytical group, at least 1 per day	1 per 20 or fewer samples per matrix and analytical group, at least 1 per day	1 per 10 or fewer samples per matrix and analytical group, at least 1 per day	1 per every volatile organic sample shipping container
QA/QC Sample Collection	Individual samples taken from the same location not mixed together and then split.	One sample divided into two or more portions then analyzed by the same laboratory	Replicate samples sent to different labs for analysis	Water samples require double volumes. Samples should be taken at critical locations but different from the field blank.	Fill the sample containers with deionized or distilled water in the area where sample handling and preserving operations occur. Handle and ship the field blank sample as other samples.	Pour deionized or distilled water over or through the sampling equipment and collect rinsate in the sample container. Handle and ship the field blank sample as other samples.	Fill the sample container with deionized water. This in prepared before any sampling is performed and travels to the field and the laboratory with the other sample containers.

[1] Normally no blank or duplicate is required for samples of waste containers or other high concentration samples.

[2] soil, groundwater, surface water, sediment, or drinking water, etc.

[3] volatile organics, semi-volatiles. pesticides/PCBs, metals, cyanide, etc.

Note: Where method 8260+ volatile analysis for soils, sediments, sludges, and waste container samples is done, methanol blank samples should be collected by the laboratory for each methanol lot used. These lots should be tracked in the field and reported on the laboratory receipt form so laboratory correlations can be made.

SAMPLE CHAIN OF CUSTODY

An essential part of any sampling and analytical scheme is ensuring the integrity of the sample from collection to data reporting. The possession and handling of samples should be traceable from the time of collection through analysis and final disposition. This documentation, referred to as chain of custody, is particularly necessary if there is any possibility that the analytical data or conclusions based upon analytical data will be used in litigation. Regardless of the potential for litigation, these procedures are useful for routine control of sample flow.

A sample is under your custody if it is in your possession; is in your view, after being in your possession; was in your possession and you placed them in a secured location; or is in a designated secure area.

As few people as possible should handle the samples. The field sampler/sampling crew should track the chain of custody in the field on the individual sample data collection sheets and chain of custody tracking reports before shipment. Samples should be collected following the appropriate sampling procedures and documented on the sample data sheet. The equipment used to collect samples should be noted, along with the time of sampling, sample location, type and description, depth at which the sample was collected, and any other pertinent remarks. All bottles and jars should be properly labeled with sample number, date and time of collection, and location. Sample labels and tags should be affixed to the each sample container prior to or at the time of sampling. Sample seals should be used to detect any unauthorized tampering with samples from the time of sample collection to the time of analysis.

A record should be kept of data-collecting activities performed. A field logbook is a useful tool for keeping such records. Entries into the logbook may contain a variety of information such as site contacts, phone numbers, assigned laboratories, addresses, etc. Documentation of on site weather conditions and activities that take place during sampling events should be described in as much detail as possible so that persons going to the site can re-construct a particular situation without reliance on memory. The record for each sampling event should include the date, start time, names of all persons present, level of personal protection being used, and the signature of the person recording the information. Measurements made and samples collected should be recorded. All entries in field logbooks should be made in ink and no erasures made. If an incorrect entry is made, the information should be crossed out with a single strike mark. When a sample is collected, or a measurement is made, a detailed description of the location of sample collection (such as a map point which includes compass and distance measurements or Global Positioning System location information) should be recorded. Equipment used to make measurements should be identified, along with the date of calibration.

A chain of custody record should be filled out and should accompany every sample container shipped or delivered to the laboratory. This record becomes especially important if the sample data could be introduced as evidence in litigation. For each sample in the container, the chain of custody record should include the sample number, signature of the collector, date and time of collection, place and address of collection, sample matrix, and signature and inclusive dates of possession for each person involved in the chain of possession from the point of sample collection through sample analysis.

The following document is rescinded with the issuance of this attachment:

- Storage Tank Division Informational Memorandum 16, Policy regarding the appropriate use of saturated soil sampling results under the Leaking Underground Storage Tank (LUST) Program, dated October 21, 1998.

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

Remediation and
Redevelopment Division
Michigan Department of Environmental Quality

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS – ATTACHMENT 6
SAMPLING METHODS FOR VOLATILE ORGANIC COMPOUNDS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Contact time:	The time from when the sample was preserved with methanol to the time the aliquot was taken for analysis, or the time the sample was in contact with the methanol prior to analysis.
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes “facility” as defined by Part 201 and “site” as defined by Part 213
Method 5035A:	U.S.EPA Method 5035, "Closed-System Purge-and-Trap and Extraction for Volatiles Organics in Soil and Waste Samples," Test Method for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, USEPA, Office of Solid Waste and Emergency Response, Dec 1996, Third Edition.
Method 5021A:	U.S.EPA Method 5021A, “Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis”, Test Method for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S.EPA, Office of Solid Waste and Emergency Response, Dec 1996, Third Edition.
Response Actions:	Includes “response activities” as defined by Part 201 and “corrective action” as defined by Part 213
Sonication:	The procedure for mixing the soil with methanol using sound waves.

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for the collection and preservation of soil samples using the procedures in U.S.EPA Methods 5035A and 5021A for analysis to determine concentrations volatile organic compounds (VOCs). This attachment is applicable for site assessments, site investigations, and response activities under Part 201, Part 211, and Part 213.

To produce reliable representative analytical results, the MDEQ implemented the use of the methanol preservation procedures for the preservation of soil samples collected for analysis to determine concentrations of VOCs on April 30, 1998.

INTRODUCTION

The requirements for collection and preservation of samples are based on the latest revisions of U.S. EPA Methods 5035A and 5021A. The applicable contaminants that can be measured are listed within the methods. Other contaminants may be included if method performance data exists for the contaminant that demonstrates the accuracy, precision and detection that can be measured.

Guidance on applicable target detection limits (TDLs) and available analytical methods are included in RRD Operational Memorandum No. 2, Attachment 1.

USE OF PROCEDURES WITHIN METHODS 5035A and 5021A

Method 5035A includes several procedures for the collection and preparation of soils for VOCs analysis. These include high concentration methods (methanol preservation), sealed samplers using soil coring devices, and the low concentration soil method using sealed containers for direct attachment to the analytical instrument. Method 5021A provides for the sample preparation of both waters and soils using sealed containers.

Method 5035A, High Concentration Method – Option 1, Methanol Preservation

The MDEQ accepts results generated using the high concentration soil method of Method 5035A for site assessment, site investigations, and response activities, provided the requirements listed below are followed and documented:

- Samples are preserved with methanol in the field using a procedure consistent with that provided in this document.
- At least ten grams of soil are collected.
- The ratio of methanol volume to soil weight is equal to or greater than one.
- Samples are sonicated for at least 20 minutes.
- An aliquot of methanol is taken immediately after sonication, and stored for analysis.
- The sample with methanol is not used for analysis of volatiles once the aliquot of methanol is taken.
- The laboratory standard operating procedures provide the information listed within this document's section entitled Laboratory Related Procedures and Documentation.
- Operational Memorandum No. 2, Attachment 1, Target Detection Limits and Available Methods direction has been followed.

Method 5035A, High Concentration Method – Option 2, Bulk Sampling

The bulk sampling procedure in Method 5035A does not produce a reliable representative sample because it is susceptible to volatilization and biodegradation. Therefore, the MDEQ does not accept results generated using bulk sampling procedures, unless acceptable justification is provided that documents the nature of the sample prevents sampling by the procedures described as acceptable in this document.

Method 5035A, Low Concentration Method

The MDEQ accepts results generated using the low concentration soil method of Method 5035A, for site assessment, site investigations, and response activities, provided the requirements listed below are followed and documented:

- The sealed containers are attached directly to the instrumentation.

- The preservation is applied correctly to the various soil types.
- Information that validates the use of the method with the appropriate type of soil is provided.
- Information that demonstrates the effectiveness of the sealed containers ability to prevent the exposure of the sample to environmental conditions is provided.

The low concentration preservation procedure may not be appropriate for all soil types. For example, calcareous soils cannot be sampled by the low concentration method when sodium bisulfate is used because a chemical reaction occurs that adversely affects the results. Soil samples must be tested in the field prior to collecting the samples for analyses, as discussed in Method 5035A, to determine if the acidic preservation for the low concentration procedure can be used. If the acidic preservation cannot be used, alternate procedures for preservation in Method 5035A should be used. The preferable alternate procedure is to extrude the samples into empty sealed vials and freeze on site to < -7 Cº. Care must be taken to not freeze the vials below -20 Cº to avoid potential problems with vial seals.

Method 5021A, Headspace Analysis using Sealed Containers

The MDEQ accepts results generated using the sample collection and preservation methods of Method 5021A for site assessment, site investigations, and response activities, provided the same requirements for Method 5035A, Low Concentration Method are documented. The preferred analytical method is Method 8260B (see RRD Operational Memorandum No. 2, Attachment 1). This sample and collection procedure is highly recommended for the analyses of contaminants that are very soluble in water.

Method 5035A, Soil Coring Devices (used to transfer samples to the laboratory)

The MDEQ requires the use of soil coring devices to evaluate the leaching of volatiles from soils, as provided in Operational Memorandum No. 2, Attachment 2, Soil Leaching Methods. The requirements in Attachment 2 must be met.

The MDEQ does not recommend the use of soil coring devices for initial site characterization where the objectives include establishing the contaminants of concern; or for response activities where the objectives are to demonstrate final compliance with cleanup criteria. The MDEQ may accept results using the soil coring devices, providing the following requirements are documented:

- Scientific studies exist that demonstrate the device to be effective for the use intended. The manufacturer of the device should be contacted regarding studies that prove them effective.
- The party proposing the use of the soil coring devices must demonstrate the effectiveness of the devices to retain volatile chemicals, for the specific chemicals of concern at the facility. Demonstration of the effectiveness of the devices proposed to be used can be accomplished using duplicate sampling. The demonstration must include duplicate samples collected using methanol preservation in the field. Duplicate samples must be collected for a minimum of one sample, or for at least one of every five samples collected.
- Written protocols must be established regarding the use of the devices to collect samples, and to preserve samples at the laboratory. These protocols must be provided to the MDEQ.
- Confirmation samples must be collected using methanol preservation in the field, equivalent to the standard operating procedure of this document. Confirmation samples must be collected for a minimum of two samples, or for at least two from every ten samples collected.
- All requirements of Method 5035A regarding the use of the samplers must have been met.

OXYGENATES

Oxygenates refer to methyl(tert)butylether (MTBE), t-Butyl alcohol (TBA), Di-isopropyl ether (DIPE), Ethyl(tert)butylether (ETBE), Ethyl alcohol, Methyl alcohol, and Tertiaryamylmethylether (TAME), and the oxygenated ethers refer to MTBE, DIPE, ETBE and TAME. When any of the oxygenated ethers are required for analysis, and high temperature purging is used in the analysis, samples collected must have the pH adjusted to > 10 in the field using Trisodium phosphate dodecahydrate (TSP), or two samples can be collected and the laboratory instructed to neutralize one prior to the analysis for oxygenated ethers. The laboratory should be contacted regarding its procedure for the analysis of oxygenated ethers to determine if high temperature purging is used. Methods 5035A and 5021A can be used for sampling for oxygenates, provided the requirements in this document are met. Method 5021A is highly recommended.

Questions concerning this document should be directed to Mr. A. Ralph Curtis, Toxicology Unit, RRD, at 517-373-8389, or email to mailto:mcurtisar@michigan.gov.

The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division procedure for the Collection and Methanol Preservation of Soils for Volatile Organics, dated May 1, 2000.
- Storage Tank Division procedure for the Collection and Preservation of Soil Samples for Volatile Organic Analysis, dated May 18, 2000.
- Storage Tank Division Informational Memo No. 13 “Implementation of Environmental Protection Agency (EPA) SW-846 Method 5035 Closed-System Purge and Trap and Extraction for Volatile Organics in Soils and Waste Samples”, dated September 4, 1998.

APPENDAGE:

Standard Operating Procedure for Methanol Preservation in the Field

---

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

STANDARD OPERATING PROCEDURE for METHANOL PRESERVATION IN THE FIELD

SUMMARY

Soil samples are collected using conventional procedures, including auger and split spoon techniques. Sub-samples are then taken using syringe-type coring devices and immediately transferred into pre-weighed VOC vials containing reagent grade methanol sufficient to obtain an estimated ratio of 1:1 with the soil. The samples are transferred to the laboratory. Upon receipt at the laboratory, the following steps are taken as soon as is practical:

An accurate sample weight is determined.
The sample container is swirled gently to break up soil clumps.
The sample is sonicated for 20 minutes.
An aliquot taken and stored for analyses using Method 8260B.

Method 5035A uses a 2:1 ratio of methanol volume to soil weight. This ratio is acceptable contingent that the requirements in Operational Memorandum No. 2, Attachment 1, Target Detection Limits and Available Methods, are met.

LABORATORY RELATED PROCEDURES AND DOCUMENTATION

Procedures - The laboratory selected should have written standard operating procedures that address the provision of sampling supplies intended for methanol preservation of samples, sample receipt checks, sample preparation steps and documentation, sample collection requirements, and analyses. The laboratory should first be contacted regarding specific requirements. The laboratory's standard operating procedure governing the sample preparation should specify the contact time routinely applied, and when this time period is not met, this must be narrated with the results. The following documentation must be included:

- Copies of the certifications of the methanol used.
- Percent moisture in the samples (determined using separate vial/container with just soil).
- Dates samples were collected, and preserved if not immediately performed upon collection.
- Dates samples were received at the laboratory.
- Sample weights.
- Sample moisture (soils and sediments).
- Actual ratios of methanol to soil.
- Sonication dates/times.
- Minutes of sonications if different from 20 minutes.
- Dates/times aliquots were taken for analysis, if not taken immediately after sonification.
- The dates of the analysis.

MDEQ LABORATORY SPECIFICATIONS FOR SAMPLE COLLECTION

The following specifications apply for sample collection kit provided by the MDEQ laboratory. Other laboratories may have similar kits with specifications. Contact the laboratory selected.

Target Soil Weight = 10 grams
Allowed Weight = 9 to11 grams
Size of VOC Sampling Vials = 40 ml

Methanol Volume (provided in tubes) = 10 ml
Soil Coring Device (Syringe Sampler) Size = 10 ml
Green Sticker to Warn of Hazardous Waste
Wide Mouth Jars (4 oz. and 8 oz.)

HEALTH AND SAFETY

Material Safety and Data Sheets (MSDSs) providing health and safety data, and emergency procedures should accompany staff in the field. Methanol ampoules, tubes, and vials must be provided to field staff inside protective containers to hold any spillage. Methanol is a toxic and flammable liquid. Handle with proper safety precautions. Wear safety glasses and protective gloves. Nitrile Rubber or Viton gloves are recommended. Avoid inhalation. Store and handle in a ventilated area, away from sources of ignition and extreme heat. Store methanol in a cool place, preferably in sample coolers on ice. This is especially important for methanol in tubes, where pressure buildup due to extreme heat may result in rupture. Vials should be opened and closed quickly during collection. In the event of eye contact, immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately.

SHIPPING

The shipping of methanol is regulated by the U.S. Department of Transportation (DOT), Title 49 of the Code of Federal Regulations. The DOT number is UN 1230. The amount of methanol used for sample preservation falls under the exemption for small quantities. Requirements for shipment of samples by common carrier are as follows:

Maximum volume of methanol in a sample container cannot exceed 30 ml.
The sample container cannot be full of methanol.
Sufficient absorbent material must be used in the container to completely absorb sample content.
Each cooler must have less than 500 ml of methanol.
The cooler or package weight must not exceed 64 pounds.
Each cooler must be identified as containing less than 500 ml methanol.

APPARATUS AND MATERIALS NEEDED FOR SAMPLE COLLECTION

Absorbent Material – If the samples are to be shipped by common carrier, vermiculite or similar material, sufficient to completely absorb the methanol for each sample.

Calibration Weight - Near or equal to the target sample weight.

Certified Methanol – Methanol certified for purge and trap gas chromatography is analytically verified prior to sampling (by lot). In this procedure the methanol is provided in sealed ampoules. Some labs may provide methanol in the sampling vial.

Field Balance - Capable of holding sampling vial and syringe on the wide mouth jar used to prevent balance contamination, and measurement within + 0.2 grams.

Hazardous Waste Warning Label - Suitable vial labels to warn personnel of the presence of methanol as a preservative.

Methanol Sampling Kit/Method 5035A Sampling Kit:

Protective Wear - Nitrile rubber or Viton gloves. Splash proof safety goggles.

Plastic Bags - Air tight seals, capable of holding three sample VOC vials, and sub-coring device.

Protocol to be used for the collection of samples.

Sub-Coring Device - A syringe type device, whose material has been tested and found free of contaminants,. This device is used to sub-sample the targeted amount of soil, for transfer into methanol in the field.

Wide Mouth Jar (for holding methanol tubes) - Of suitable size to allow temporary storage and shipment of the methanol tubes.

Wide Mouth Jar (for preventing balance contamination) - Of suitable size to allow temporary storage of the syringe type sampler and VOC sample vial on the field balance.

Volatile Organic Compound (VOC) Syringe Labels - Methanol resistant labels.

VOC Vials - Vials with Teflon^{TM} lined septa, pre-weighed, with methanol resistant labels.

SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Containers - Sample containers are VOC Vials with Teflon™ lined septa of suitable size to hold the soil plus methanol, supplied with methanol resistant labels.

Preservation – Samples are preserved in the field approximately one to one ratio of soil weight to methanol volume, using pre-weighed vials and a field balance. The exact sample weights and ratios are determined at the laboratory. More methanol is added to make the ratio one to one when possible. When weights are less than the specified minimum, the reporting limit is increased. The maximum and minimum limits for the weights of soils specified by the MDEQ laboratory are provided in the section of this document entitled “Specifications for the Collection of Samples Using Methanol Preservation.”

Holding Times - The maximum allowable holding time is 14 days from sample collection to analysis. If the maximum allowable holding time is exceeded, interpret the results as minimum concentrations of the measured compounds.

QUALITY CONTROL

Field Blanks

Use - Field blanks are used to determine sample contamination that may occur during the storage, transportation, sampling, and analysis of samples. A field blank is a sample vial containing a pre-measured quantity of VOC-free methanol, obtained from the laboratory or prepared in a contaminant free environment.

Frequency - The number of field blanks depends upon project objectives and the field activities being performed at specific locations. It is recommended that a field blank be created at each location where activities may result in significant VOCs released into the environment, or for every 20 samples, whichever is more.

Interpretation – Positive results may indicate contamination from the methanol, the sample container, from the air at the site, from diffusion of air containing volatiles into the blank during transport to the laboratory, or from the laboratory environment. Compare field blank results with trip blank results and laboratory method blanks to isolate the cause. Sample results that approach the field blank results may be unusable.

Trip Blanks

Use - Methanol trip blanks are used to determine if contamination is occurring from the methanol, storage, transportation, or the field.

Frequency - One trip blank should be used per cooler.

Interpretation – Positive trip blanks can be attributed to the methanol, sample vial material, and the environment in the cooler or sample transport container. Trip blanks should be prepared at, and provided by, the laboratory in order to make this interpretation. If consistent positive results are obtained, contact the laboratory and have a trip blank prepared at the laboratory and immediately analyzed to attempt isolation of the cause.

Methanol

Only purge and trap grade methanol verified to be suitable for methanol preservation should be used. Field staff should maintain documentation of the methanol lot numbers for all associated samples. If consistently high levels of compounds are measured in methanol field blanks associated with a specific lot number, request the laboratory to verify the quality of the methanol lot used to preserve the samples.

Contamination

Contamination by airborne VOCs in the air is possible by diffusion through the vial septum during shipment, storage, collection, and analysis. To control such contamination:

Use appropriate VOC sample vials.
Avoid sources that generate VOCs such as petroleum products, especially auto exhaust fumes.
Keep sample containers in coolers as much as possible.
Collect samples quickly.
Use methanol provided in sealed ampoules, tubes, or VOC vials.

Attempt to isolate the source of contamination and incorporate appropriate procedures to avoid similar circumstances.

FIELD BALANCE CALIBRATION CHECK

The field balance calibration should be checked prior to each sampling event, and whenever necessary because of handling in the field. Record this check in the field notebook.

CORRECTIONS FOR SAMPLES WITH HIGH WATER CONTENT

Concentrations of volatile compounds in soils must be reported on a dry weight basis, using the moisture content of the soil to adjust results. Routine procedures by the laboratories include this correction. Laboratories may not routinely correct results because of the effects due to the miscibility of the methanol with the water in the sample. The effects are to bias the results low, and if the moistures in the samples are high, these biases may be significant. The effects of this biases upon results should be considered when soils are sampled, and if necessary the laboratory instructed to correct results accordingly.

ELEVATED REPORTING LIMITS DUE TO HIGH MOISTURE

For samples with excess moisture, reporting limits may need to be elevated higher than levels routinely reported by the laboratory. Elevated reporting limits may be acceptable if they do not exceed applicable criteria. Historical site information and published information can be used to ascertain the range of moisture levels that can be expected. This can be used to determine if the biases are significant. Additional guidance regarding elevated reporting limits is available in RRD Operational Memorandum No. 2, Attachment 1.

OTHER METHANOL PRESERVATION PROCEDURES

Variations to the field procedure in this method may be used if approved in advance by the MDEQ. Important considerations are:

- Samples must be preserved in the field, a target ratio of 1:1 for the weight of the soil to the volume of methanol should be used.
- Samples must be sonicated for 20 minutes at the laboratory.
- A methanol aliquot must be taken and stored for analysis immediately after sonication that is sufficient for initial analysis, and analysis of any subsequent dilutions.
- Sufficient documentation to validate the data must be provided to the MDEQ.

FIELD SAMPLING PROCEDURE

1. Make arrangements with the laboratory to obtain appropriate Methanol Preservation Sampling Kits.
2. Record the tracking or lot number(s) for the methanol in the field notebook. If more than one lot is used, each lot must be associated with the samples for which it was used.
3. Prior to collection, check the calibration of the balance. See “Field Balance Calibration Check” on page 10 of this document.
4. Prior to collection prepare a temperature blank sample using tap water and a VOC vial.
5. Prior to collection prepare a sufficient quantity of methanol field blanks, i.e., at least one per cooler and one per methanol lot as follows:

   a) Select an area free of VOC sources.
   b) Remove a methanol tube from the wide mouth jar.
   c) Use scissors to cut off the top, and place the methanol into one of the pre-weighed sample vials.
   d) Place the cap on the vial and tighten it. Avoid over-tightening.
   e) Place a green sticker on the top of the cap.
   f) Record the identification of the vial as "Methanol Field Blank" on both the vial label and in the field notebook.

6. Calibrate the syringe to estimate the amount of soil needed to meet the target weight, and use that syringe as a comparison for how much sample is needed.

   Calibration is performed using steps 10 - 17 below, using the syringe only, and part of the soil that is to be collected. The soil used for calibration cannot be used as the sample. It must be extruded from the sampler and discarded at the site before collecting the sample. The sampler does not have to be cleaned between calibration using this step, and collection of the sample.

7. Place the wide mouth glass jar, used to prevent balance contamination, on the balance.
8. Record the location, date, and time of sampling in the field log book. Do not place any labels, stickers, tape, etc. on the pre-weighed sample vials.
9. For methanol field blanks, remove the cap from a methanol field blank which was prepared in Step 5 above, place the opened vial in the collection area for the approximate time it takes to collect a sample, and then cap the methanol field blank for storage and transport to the laboratory.
10. Place a pre-weighed VOC vial and syringe in the wide mouth jar on the balance.
11. Record the weight in the field log book. If the balance features re-zeroing, zero the balance.
12. Remove the syringe. If a cap is provided, remove the cap and place it in the jar.
13. Insert the open end of the syringe into a fresh face of undisturbed soil, and fill it as appropriate according to the calibration of the syringe (Step 6).
14. If necessary, use your gloved finger (decontaminate before next sample), or other appropriate instrument, and push the soil deeper into the syringe sampler.
15. If a cap was provided, immediately cap the end of the syringe.

16. Place the syringe in the jar on the balance. Read the weight, and if necessary, subtract the weight of the syringe, vial, and jar, as appropriate, to determine the weight of the soil.
17. If the weight of the sample is determined to be more than the maximum amount allowed, extrude enough soil to obtain the target amount within the specified tolerance, and re-weigh. See the table in this document, “Specifications for the Collection of Samples Using Methanol Preservation” for the applicable target sample size and tolerance.
18. If the weight of the sample is less than the minimum amount allowed, re-sample and repeat steps starting with Step 7.
19. Record the soil weight in the field notebook. DO NOT RECORD the weight on the sample vial label.
20. Remove the cap from the sample vial, and place it in the jar on the balance, with the septum upwards.
21. If the required amount of methanol is not included with the pre-weighed vial, immediately remove a methanol tube from the wide mouth glass storage jar, holding the tube upright use scissors to cut (plastic) off one end, and pour the methanol into the sample vial, taking care to avoid spillage.
22. Insert the open end of the syringe sampler into the mouth of the vial, and carefully extrude the soil, taking care to avoid spillage. Loss of several drops will not make a significant difference in the results. If a significant amount is spilled, a new sample must be collected, or the sample must be appropriately flagged to indicate estimated results.
23. Using a clean brush, paper towel, or other suitable material, thoroughly wipe excess soil particles from the threads and vial body. Particles left on the threads will prevent a good seal.
24. Place the VOC cap on the sample vial. The cap must be tight; however, over-tightening should be avoided.
25. Gently swirl the sample and methanol for about 10 seconds to break up the soil. DO NOT SHAKE.
26. Place the sample in a plastic bag on ice in a cooler.
27. Attach a green sticker on the plastic bag to indicate a hazardous waste.
28. Using the syringe sampler, take another sample from the soil.
29. Cap and label the syringe with the sample identification.
30. Place the syringe with the sample in the plastic bag. This sample is for dry weight determination.
31. Decontaminate the jar/balance using decontamination procedures appropriate for the type and level of contamination.
32. Unused methanol must be returned to the laboratory for disposal.

APPENDIX C

GENERAL LOW FLOW GROUNDWATER SAMPLING STANDARD OPERATING PROCEDURE

02/13/07

General Low Flow Groundwater Sampling Standard Operating Procedure

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide guidelines for purging monitoring wells and collecting groundwater samples for chemical analysis using low flow techniques. Low flow techniques allow samples to be collected with minimal alterations to water chemistry through low water-level drawdowns and low pumping rates (ideally less than 500 ml/minute).

2. PROCEDURE

2.1 Equipment

The following equipment is needed for low flow purging/sampling:

A. Extraction Device – Adjustable-rate, submersible or bladder pumps are preferred, but a peristaltic pump may also be used.
B. Tubing – Choose the appropriate tubing for the sampling requirements. Tubing with an inner diameter of 1/4 inch or 3/8 inch is preferred, as it will help insure that the tubing remains liquid-filled when operating at very low pumping rates.
C. Water Level Measuring Device – Capable of measuring to 0.01-foot accuracy.
D. Flow Measuring Supplies – Must have a way to measure purge flow rate (i.e. a graduated cylinder and a stopwatch).
E. Power Source – Needed to run pump (generator, battery, air source, etc.).
F. Field Parameter Monitoring Instruments – Meters to measure required field parameters.
G. Flow Cell – Must have openings in the cap for inserting meter probes, must have a volume of less than 1 liter (500 ml is preferred), and must be constructed to prevent air bubbles from becoming trapped in the cell. Certain types of water quality meters come with a flow cell made by the manufacturer.
H. Decontamination Supplies – Including a non-phosphate detergent (Alconox) and de-ionized water.
I. Sample Bottles – Including those for QA/QC samples (field blanks, equipment blanks, MS/MSDs, duplicate samples, etc.), along with any other necessary sampling supplies (filters, extra bottles, ice, labels, etc.)
J. Paperwork – Including logbook, well location map, field data/notes from last sampling event, chains-of-custody, HASP, WMP, SOW, PSA, all required permits, and any other necessary forms or paperwork.
K. Keys – Keys to unlock the wells, as well as for any gates, chains, or other locks that may need to be opened during the sampling event.
L. PID – A Photo Ionization Detector (if needed) to detect levels of VOCs.

02/13/07

General Low Flow Groundwater Sampling
Standard Operating Procedure

2.2 Pre-Sampling Activities

A round of water level and total well depth measurements should be performed for all wells (in the shortest amount of time possible) before beginning any purging or sampling activities. During the round of water levels, it is also advisable to check for any problems that might interfere with the sampling event (and possibly require different or specialized equipment). These could include any damage to a well or well cap, overgrowth, treacherous site conditions (snow, ice, mud, etc.), or hard to reach locations.

At each well, before collecting any samples, it is important to fill out the field logbook with the site/job name, the date, the time of day, the well ID, the weather, the analyses to be sampled, the names of field personnel, and any other important observations. During purging and sampling, record all measurements and times (water levels, flow rates, purge start/stop time, sample time, field parameter measurements, PID measurements, etc.) in the field logbook.

2.3 Purging and Sampling Procedure

To prevent cross-contamination, wells should be sampled in order of increasing (least to most) contamination (known or anticipated) or as specified in the workplan.

A. Open the Well Cap – Be sure to watch out for pinch points and wear proper hand protection at all times. Immediately upon opening the well, measure the breathing zone and the inside of the well casing with a PID (if necessary). Record these measurements.

B. Install the Pump – Attach the appropriate tubing to the pump and lower the pump, tubing and electrical line slowly into the well to the middle of the zone to be sampled. The pump intake should be kept at least two feet above the bottom of the well to minimize disturbance of particles that may be present at the bottom of the well. Secure the tubing to the outside of the well casing with rope or duct tape, if necessary, to ensure that the pump remains at the proper depth.
Attach a flow cell to the end of the tubing. Insert meter probes into the flow cell.
If a gasoline generator will be used to operate the pump, it should be placed downwind at least 30 feet away from the well, so as not to contaminate the samples with exhaust fumes.

C. Measure the Water Level – Do this before starting the pump.

D. Purge the Well – Start the pump at its lowest setting, and slowly increase the speed until discharge occurs. The pumping rate should be reduced to the minimum capabilities of the pump. Collect discharge water into a bucket. Monitor and record the water level.
When the water level has stabilized, begin to monitor field parameters. The meter probes must be submerged in water at all times. Field parameter measurements should be taken every 3 to 5 minutes, making sure that an amount of water equal to at least three times the volume of the flow cell is discharged between each set of field parameter measurements. Record measurements in the field logbook.

Purging is considered complete (and sampling may begin) when the field parameters have stabilized. Stabilization occurs when at least three consecutive readings (taken at 5 to 6 minute intervals) are within the following limits:

~ Turbidity – Within 10% for values greater than 1 NTU
~ DO – Within 10%
~ Specific Conductance – Within 3%
~ Temperature – Within 3%
~ pH – ± 0.1 unit
~ ORP (Redox) – ± 10 millivolts

All discharge water must be collected and properly disposed (in accordance with the Waste Management Plan).

E. Collect Samples – Remove the tubing from the flow cell before sampling (water to be collected for samples must not have passed through the flow cell). Put on a clean pair of gloves. Fill all sample bottles and all quality control sample bottles by allowing the pump discharge to flow slowly down the inside of the container with minimal turbulence. The sample bottles must be filled in the following order, which takes the volatilization sensitivity of ground water samples into consideration:

1.) Volatile Organics (VOA)
2.) Purgeable Organic Carbons (POC)
3.) Purgeable Organic Halogens (POX)
4.) Total Organic Halogens (TOX)
5.) Total Organic Carbon (TOC)
6.) Base Neutrals/Acid Extractables
7.) TPHC/Oil & Grease
8.) PCBs/Pesticides
9.) Total Metals
10.) Dissolved Metals*
11.) Phenols
12.) Cyanide
13.) Sulfate and Chloride
14.) Turbidity
15.) Nitrate and Ammonia
16.) Preserved Inorganics
17.) Radionuclides
18.) Non-Preserved Inorganics
19.) Bacteria

*Filter Samples (if necessary) – If dissolved samples are needed, the water must be filtered with an appropriate filter (0.45 μm is frequently used). Pre-rinse the filter with approximately 25 to 50 ml of groundwater before collecting the sample. Preserve the filtered water sample immediately.

F. Equipment blanks are only required for equipment that will not be dedicated to the well for future sampling events. At least 1 equipment blank is required for each day that non-dedicated equipment is used. The analytical laboratory that is performing the groundwater analysis will provide demonstrated analyte-free water. This water must be passed through the tubing and sampling equipment and collected. If sampling equipment is dedicated to a well for multiple rounds of sampling, no equipment blanks are required. In this case, if field conditions warrant, a field blank may be collected. Field blanks are collected by pouring analyte-free water directly into the sample bottle. The equipment blank or field blank will be analyzed for all the same parameters as the ground water samples. Note in the field book at which well the equipment or field blank was taken.

G. Fill out the chain-of-custody (C-O-C) for the sample. See the Chain-of-Custody Standard Operating Procedure for instructions on filling out a C-O-C.

H. Dry Well – Wells with a low recharge rate may become dewatered during purging. When this occurs, the well should be sampled as soon as it has recovered sufficiently to produce enough water to fill the sample bottles. Calculate the recharge rate of the well by measuring how long (in ft/sec or ft/min) it takes for the water level to rise a set distance (0.1 ft or 1.0 ft). Multiply this by the appropriate conversion factor for the casing diameter of the well (0.163 gal/ft for a 2” casing, 0.653 gal/ft for a 4” casing) to get the recharge rate in gal/min. When the well has sufficiently recharged, samples may be collected even if the indicator field parameters have not stabilized.

I. Remove Pump and Tubing – After samples have been collected, the tubing may be dedicated to the well for the next sampling event (hang the tubing inside the well) or may be properly discarded.

J. Close the Well – Make sure it is securely locked.

2.4 Decontamination

All non-disposable sampling equipment must be decontaminated prior to use in the first well and after each well is sampled. Use de-ionized water and a non-phosphate detergent solution (such as Alconox) for decontamination. Two-inch submersible pumps require at least a 10-gallon flush with de-ionized water during the decontamination procedure.

3. REFERENCES

The following sources were used in developing this guideline:

DuPont CRG, April 2001, Standard Operating Procedure for Groundwater Well Purging Using Micro Purging Techniques, Guideline No. 1202a.

N.J. Department of Environmental Protection, January 1996 Draft, Low Flow Purging and Sampling Procedure for the Collection of Ground Water Samples.

N.J. Department of Environmental Protection and Energy, May 1992, Field Sampling Procedures Manual.

General Low Flow Groundwater Sampling Standard Operating Procedure

U.S. E.P.A. Region I, July 1996, Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells, Revision 2.

U.S. E.P.A. Region II, Ground Water Sampling Procedure: Low Stress (Low Flow) Purging and Sampling.

APPENDIX D

GENERAL SOP FOR EQUIPMENT DECONTAMINATION

STANDARD OPERATING PROCEDURES FOR DECONTAMINATION OF EQUIPMENT

Date: July 2006

Project No.: 18984759.06004

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

Barley Mill Plaza, Building 19
Wilmington, Delaware 19805

TABLE OF CONTENTS

1.0 Purpose 1

2.0 Specifications for Cleaning Materials 1
  2.1 Handling and Containers for Cleaning Solutions 2
  2.2 Disposal of Solvent Cleaning Solutions 2

3.0 Equipment Contaminated with Concentrated Wastes 3
  3.1 Safety Procedures for Field Cleaning Operations 3
  3.2 Handling of Cleaned Equipment 3

4.0 Specifications for Decontamination Pads 3

5.0 Decontamination Procedures 4
  5.1 Field Equipment Cleaning Procedures 4
    5.1.1 "Classic Parameter" Sampling Equipment 5
    5.1.2 Sampling Equipment for the Collection of Trace Organic and Inorganic Compounds 5
    5.1.3 Well Sounders or Tapes 6
    5.1.4 Bladder Pump Cleaning Procedure 6
    5.1.5 Goulds® Pump Cleaning Procedure 6
    5.1.6 Grundfos® Redi-Flo2® Pump 7
    5.1.7 Fultz® Pump Cleaning Procedure 7
  5.2 Emergency Disposable Sample Container Cleaning 8
  5.3 Downhole Drilling Equipment 8
    5.3.1 Introduction 8
    5.3.2 Preliminary Cleaning and Inspection 8
    5.3.3 Drill Rig Field Cleaning Procedure 9
    5.3.4 Field Cleaning Procedure for Drilling Equipment 9

6.0 References 10

1.0 PURPOSE

The purpose of these procedures is to ensure contaminants of concern are removed from sampling, drilling, and other field equipment to concentrations that do not impact study objectives using a standard cleaning procedure.

These procedures apply to all field projects using any non-dedicated sampling equipment. Implementation is the responsibility of all field personnel and is to be directed by the DuPont Site Representative (DSR).

Cleaning procedures in this document are intended for use by field personnel for cleaning sampling and other equipment in the field. Emergency field sample container cleaning procedures are also included; however, they should not be used unless absolutely necessary.

2.0 SPECIFICATIONS FOR CLEANING MATERIALS

Specifications for standard cleaning materials referred to in this document are as follows:

- Soap shall be a standard brand of phosphate-free laboratory detergent such as Alconox®. Use of other detergent must be justified and documented in the field logbooks and inspection or investigative reports.
- Solvent shall be pesticide-grade acetone. Use of a solvent other than pesticide-grade acetone for equipment cleaning purposes must be justified in the study plan, and its use must be documented in field logbooks and inspection or investigation reports.
- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.
- Analyte free water (deionized water) is tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. Analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.
- Organic/analyte free water is defined as tap water that has been treated with activated carbon and deionizing units. A portable system to produce organic/analyte free water under field conditions is available. At a minimum, the finished water must meet the analytical criteria of analyte free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the applicable U.S. Environmental Protection Agency (EPA)

regional laboratory for a given set of analyses. Organic/analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure as described in the following sections. Methanol may be used for stubborn organic residues that do not respond to acetone. Because these solvents are not miscible with water, the equipment must be completely dry prior to use. Solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination.

2.1 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. The following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
- Solvent must be stored in the unopened original containers until used. They may be applied using the low-pressure nitrogen system fitted with a Teflon® nozzle, or using Teflon squeeze bottles.
- Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
- Analyte free water must be stored in clean glass, stainless steel, or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.
- Organic/analyte free water must be stored in clean glass, Teflon, or stainless steel containers prior to use. It may be applied using Teflon squeeze bottles, or with the portable system.

Note: Hand pump sprayers generally are not acceptable storage or application containers for the above materials (with the exception of tap water). This also applies to stainless-steel sprayers. All hand sprayers have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

2.2 Disposal of Solvent Cleaning Solutions

Solvent rinsates should be collected in separate containers for proper disposal and should be included in the waste management plan. Alcohol (i.e., methanol) wastes may evaporate.

3.0 EQUIPMENT CONTAMINATED WITH CONCENTRATED WASTES

Equipment used to collect samples of hazardous materials or toxic wastes or materials from hazardous waste sites, RCRA facilities, or in-process waste streams should be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. More stringent procedures may be required at the discretion of the field investigators.

3.1 Safety Procedures for Field Cleaning Operations

Some of the materials used to implement the cleaning procedures outlined in this document can be harmful if used improperly. Caution should be exercised by all field investigators, and all applicable safety procedures should be followed. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- ❑ Safety glasses with splash shields or goggles, and latex gloves will be worn during all cleaning operations.
- ❑ Solvent rinsing operations will be conducted in the open (never in a closed room).
- ❑ No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

3.2 Handling of Cleaned Equipment

- ❑ After field cleaning, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination.
- ❑ In addition, the equipment should be moved away (preferably up wind) from the cleaning area to prevent recontamination.
- ❑ If the equipment is not to be immediately re-used, it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination.
- ❑ The area where the equipment is kept prior to re-use must be free of contaminants.

4.0 SPECIFICATIONS FOR DECONTAMINATION PADS

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- ❑ The pad should be constructed in an area known or believed to be free of surface contamination.
- ❑ The pad should not leak excessively.

- ❑ If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
- ❑ Sawhorses or racks constructed to hold equipment while being cleaned should be high enough aboveground to prevent equipment from being splashed.
- ❑ Water should be removed from the decontamination pad frequently.
- ❑ A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.
- ❑ At the completion of site activities, the decontamination pad should be deactivated.
- ❑ The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal.
- ❑ No solvent rinsates will be placed in the pit.
- ❑ Solvent rinsates should be collected in separate containers for proper disposal. For proper handling and disposal of these materials, contact your waste management consultant.
- ❑ If the decontamination pad has leaked excessively, soil sampling may be required.

5.0 DECONTAMINATION PROCEDURES

Decontamination procedure requirements vary depending on equipment and contaminants of concern.

Sampling and field equipment cleaned in accordance with the following procedures must meet the minimum requirements for **Data Quality Objectives (DQO)** definitive data collection. Alternative field decontamination procedures (e.g., Ultra Clean procedures) may be substituted when samples are to be analyzed for data uses at a lower DQO level. Deviations from these procedures should be documented in the approved study plan, field records, and investigative reports.

5.1 Field Equipment Cleaning Procedures

Sufficient clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning. However, this is not possible for some specialized items such as portable power augers (Little Beaver®), well drilling rigs, soil coring rigs, and other large pieces of field equipment.

In addition, particularly during large-scale studies, it is not practical or possible to transport all of the precleaned field equipment required into the field. In these instances, sufficient pre-cleaned equipment should be transported to the field to perform at least one days work. The following procedures are to be utilized when equipment must be cleaned in the field.

5.1.1 "Classic Parameter" Sampling Equipment

"Classic Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, etc. The following items are to be applied to routine operations involving classic parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc.

- ☐ Equipment may be cleaned with the sample or analyte-free water between sampling locations.
- ☐ A brush may be used to remove deposits of material or sediment, if necessary.
- ☐ If analyte-free water is not available, samplers should be flushed at the next sampling location with the substance (water) to be sampled, but before the sample is collected.
- ☐ Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

These procedures are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses. Those procedures are provided in the following section.

5.1.2 Sampling Equipment for the Collection of Trace Organic and Inorganic Compounds

The following procedures are to be used for all sampling equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

1. Clean equipment with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high-pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least 2 feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with analyte free water.
4. Rinse thoroughly with solvent (e.g. Acetone). Do not solvent rinse PVC or plastic items. Alternatively, for stainless-steel and rigid PVC, hot water detergent wash

is as effective as solvent. If analysis for trace metals is required (especially during soil sampling), dilute nitric acid (10%) must be used. For the carbon steel tips of hand augers, lower the concentration to 1% so as to not leach metals from the auger itself.

6. Rinse thoroughly with organic/analyte free water. If organic/analyte free water is not available, equipment should be allowed to completely dry. Do not apply a final rinse with analyte water. Organic/analyte free water can be generated on-site utilizing the portable system.
7. If necessary, use paper towels to remove excess water and any residual material from pumps.
8. Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

5.1.3 Well Sounders or Tapes

1. Wash with soap and tap water.
2. Rinse with tap water.
3. Rinse with analyte free water.

5.1.4 Bladder Pump Cleaning Procedure

Bladder pumps used in well-to-well sampling should have disposable bladders. Bladders must be replaced, and the pump and all o-rings and other parts that come into contact with sample water should be decontaminated according to the above procedures.

5.1.5 Goulds® Pump Cleaning Procedure

CAUTION: During cleaning,always disconnect the pump from the generator.

The Goulds pump should be cleaned prior to use and between each monitoring well.

The following procedure is required:

1. Using a brush, scrub the exterior of the contaminated hose,and pump with soap and tap water.
2. Rinse the soap from the outside of the pump and hose with tap water.
3. Rinse the tap water residue from the outside of pump and hose with analyte-free water.
4. Place the pump and hose in a clean plastic bag.

5.1.6 Grundfos® Redi-Flo2® Pump

The Redi-Flo2® pump should be decontaminated prior to use and between each monitoring well. The following procedure should be followed:

CAUTION: Make sure the pump is not plugged in.

1. Using a brush, scrub the exterior of the pump and electrical cord with soap and tap water. Do not wet the electrical plug.
2. Submerge the pump in water and turn on.
3. Dispose of the soap/water mixture.
4. Rinse with tap water.
5. Rinse with analyte free water.
6. Place the equipment in a clean plastic bag or tote.

In the field, personnel require two tubs to contain water—one for decontamination water and one for collecting equipment blanks. These tubs can be simple PVC totes, or coolers that are themselves decontaminated.

CAUTION: Do not use metal drums or garbage cans in order to avoid electric shock.

5.1.7 Fultz® Pump Cleaning Procedure

CAUTION: To avoid damaging the Fultz pump, never run pump when dry and never switch directly from the forward to the reverse mode without pausing in the "OFF" position.

The Fultz pump should be cleaned prior to use and between each monitoring well. The following procedure is required:

1. Pump a sufficient amount of soapy water through the hose to flush out any residual purge water.
2. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water.
3. Rinse the soap from the outside of the hose with tap water.
4. Rinse the hose with analyte-free water and recoil onto the spool.
5. Pump a sufficient amount of tap water (approximately one gallon) through the hose to flush out all the soapy water.
6. Pump a sufficient amount of analyte-free water through the hose to flush out the tap water, then purge with the pump in the reverse mode.
7. Rinse the outside of the pump housing and hose with analyte-free water (approximately 1/4 gal.).

8. Place pump and reel in clean plastic bag.

5.2 Emergency Disposable Sample Container Cleaning

New one-pint or one-quart mason jars may be used to collect samples for analyses of organic compounds and metals in waste and soil samples during an emergency. These containers would also be acceptable on an emergency basis for the collection of water samples for extractable organic compounds, pesticides, and metals analyses. These jars cannot be used for the collection of water samples for volatile organic compound analyses. The rubber sealing ring should not be in contact with the jar and aluminum foil should be used, if possible, between the jar and the sealing ring. If possible, the jar and aluminum foil should be rinsed with pesticide-grade isopropanol and allowed to air dry before use. Several empty bottles and lids should be submitted to the laboratory as blanks for quality control purposes.

5.3 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses, and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

5.3.1 Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section 4.0.

Tap water (potable) brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank of sufficient size so that drilling activities can proceed without having to stop and obtain additional water. A steam cleaner and/or high-pressure hot water washer capable of generating a pressure of at least 2,500 PSI and producing hot water and/or steam (200 F plus), with a soap compartment, should be obtained.

5.3.2 Preliminary Cleaning and Inspection

The drill rig should be clean of any contaminants that may have been transported from another hazardous waste site, to minimize the potential for cross-contamination. Further, the drill rig itself should not serve as a source of contaminants. In addition, associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- ❑ All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc. that cannot be removed by steam cleaning (soap and high-pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on-site, or well away from the decontamination pad and areas to be sampled.

- ☐ Any portion of the drill rig, backhoe, etc. that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high-pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material that may have come from other hazardous waste sites before being brought on site.
- ☐ Printing and/or writing on well casing, tremie tubing, etc. should be removed before use. Emery cloth or sandpaper can be used to remove the printing and/or writing. Most well material suppliers can supply materials without the printing and/or writing if specified when ordered.
- ☐ The drill rig and other equipment associated with the drilling and sampling activities should be inspected to ensure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.
- ☐ PVC or plastic materials such as tremie tubes should be inspected. Items that cannot be cleaned are not acceptable and should be discarded.

5.3.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high-pressure hot water) between boreholes.

5.3.4 Field Cleaning Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be cleaned as outlined in Section 5.1.

1. Clean with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high-pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least 2 feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc. that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
2. Rinse thoroughly with tap water.
3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place. When there is concern for low level contaminants, it may be necessary to clean

this equipment between borehole drilling and/or monitoring well installation using the procedure outlined above.

6.0 REFERENCES

2005. New Jersey Department of Environmental Protection Field Sampling Procedures Manual. NJDEP. Trenton, NJ.

Undated. Letter. Ed Bishop of Grundfos® Pumps to New Jersey Department of Environmental Protection. Tobaccoville, NC.