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Letter of Transmittal

To	Ronda L. Blayer, Michigan Department of Environmental Quality (MDEQ)	Page	1
CC	Sathya Yalgvigi Chemours, LLC D. Bridgford (MDEQ) D. Montgomery (MDEQ)		
Subject	Corrective Measures Study Work Plan Chemours Montague Works Montague, Michigan		
		Chemours #: 507756 AECOM #: 60426164	
From	George Gregory, AECOM		
Date	October 31, 2018		

Dear Ms. Blayer:

On behalf of The Chemours Company, AECOM is submitting this work plan, which presents the proposed approach to complete the remedy selection process for former waste management units and areas of concern at the Chemours Montague site.

If you have any questions or comments, please contact me (George.Gregory@AECOM.com) at 832-422-4423 or Sathya Yalvigi (Sathya.V.Yalvigi@chemours.com) at 302-773-4291.

Sincerely,

George E. Gregory III
Senior Geologist/Project Manager
AECOM

Corrective Measures Study Work Plan

Chemours Montague Works
Montague, Michigan

Submitted on behalf of:
The Chemours Company

Submitted by:
AECOM
Sabre Building
Suite 300
4051 Ogletown Road
Newark, DE 19713

Project Number: 60426164
Date: October 2018

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1.0 Site Introduction

AECOM, on behalf of The Chemours Company (Chemours), has prepared this *Corrective Measures Study Work Plan* for the Chemours Montague facility near Montague Michigan.

The Montague facility (site) is a former chemical manufacturing facility located in Muskegon County, Michigan (see Figure 1-1). This site is subject to corrective action under Part 111, Hazardous Waste Management, of the Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), and its administrative rules. Corrective action has been performed at the facility under the regulatory review of the Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division. The site investigations have been completed in accordance with the protection standards and relevant processes of MDEQ Part 201 to meet the corrective action obligations under Part 111 with MDEQ providing oversight, as necessary. Additional details of the project chronology and key site history are provided in Table 1-1.

1.1 Corrective Measures Study Approach

Consistent with EPA's Fact Sheet #3, *Final Remedy Selection for Results-Based RCRA Corrective Action* (EPA, 2000), a Corrective Measures Study (CMS) will be conducted to complete the remedy selection process. Specifically, the corrective measure technologies identified in this work plan have been based on site-specific conditions (extent, nature, and complexity of unit releases) and are considered appropriate, implementable technologies consistent with expected future land uses and the potential for human or ecological exposure. The technologies will be combined into corrective measure alternatives to be evaluated in the CMS against MDEQ's performance standards and other balancing criteria.

1.2 CMS Work Plan Objective

The objective of this CMS work plan is to identify potential corrective measure technologies to be evaluated further in the CMS, briefly describe the potential technologies, discuss how the remedies will be evaluated in the CMS, and specify how the CMS will be prepared consistent with the Resource Conservation and Recovery (RCRA) corrective action guidance and Voluntary Corrective Action Agreement between Chemours and MDEQ. In support of these objectives, this work plan also identifies corrective action objectives (CAOs) to guide the corrective measures evaluation, the approach to determine appropriate media cleanup standards, and recommendations for additional data collection activities to support the remedy evaluation.

1.3 Work Plan Organization

The remainder of this work plan is organized into the following sections:

- Section 2.0 describes the site and exposure setting for the Montague site.
- Section 3.0 summarizes the investigation findings and recommends corrective measure technologies for each of Waste Management Unit (WMU) and Area of Concern (AOC) to be addressed in the CMS.

- Section 4.0 summarizes the corrective action objectives and presents the technical approach for the media cleanup standards.
- Section 5.0 briefly describes the selected corrective measure technologies for screening.
- Section 6.0 details additional data collection activities to support CMS remedy evaluations.
- Section 7.0 presents the proposed outline for the CMS Report.
- Section 8.0 describes the overall project management for the CMS, including personnel and schedule.
- Section 9.0 contains the references cited in this work plan.

2.0 Facility Background

2.1 Site Location

The Chemours Montague facility is located in Muskegon County, Michigan, approximately two miles southwest of the city of Montague (see Figure 2-1). The plant property consists of approximately 1,330 acres and is bounded by forested, agricultural, residential, and former industrial properties. The property to the east is owned by Occidental Chemical Company (Oxychem). The former operating part of the facility is located about one mile north of White Lake and 1.5 miles east of Lake Michigan.

2.2 Site History

The Montague property was purchased by E. I. du Pont de Nemours (DuPont) in the 1940s. In 1955, DuPont built the Montague facility, and it became fully operational in 1956. Initially, the DuPont Montague facility produced acetylene and neoprene. Later, various formulations of Freon® (chlorofluorocarbons or CFCs) 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 (HCl) 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 products were manufactured at the DuPont Montague facility starting in 1965 until 1995. Freon products included trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorotrifluoromethane (CFC-13), chlorodifluormethane (CFC-22), and 1,1,2-trichlorotrifluoroethane (CFC-113).

In 1996, the 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 system. In 2015, The Chemours Company was created by DuPont as a separate business that owns and has the environmental liability for this site.

2.3 Hydrogeologic Setting

The Montague property is north of White Lake and east of Lake Michigan and portions of the property are adjacent to these lakes. Most of the property is nearly level with little topographic relief; however, there is considerable variation in ground surface elevation (40 to 50 feet) near Pierson Creek, Mirror Lake, White Lake, and the dunes near the Lake Michigan bluff.

Based on numerous past soil borings and monitoring wells, the upper-most 100 to 150 feet of sediment at the site is composed primarily of unconsolidated, sandy glacial outwash. With increased depth, layers of silts and clays become more common. These silts and clays are believed to be lake-deposited formation. The sand is typically characterized as well-sorted with occasional gravel layers leading to relatively high hydraulic permeability. Because the outwash sediments originated as glacial outwash, organic content is negligible, except in recent alluvial deposition such as in the vicinity of Pierson Creek and in Mirror Lake.

2.3.1 Site-Wide Groundwater Flow

Figure 2-2 is a site-wide potentiometric surface map. Blue arrows display the interpreted direction of groundwater flow from the main manufacturing area toward the south/southeast to White Lake. The groundwater velocity is approximately 2 feet per day (feet/day). The vertical groundwater gradient in the eastern two-thirds of the site is slightly downward from the site towards White Lake. Near White Lake, which acts as a discharge point, the vertical gradient is upward (DuPont CRG, 2006). Based on multiple measurements presented in past semiannual reports, the direction and velocity of flow are consistent.

West of the former manufacturing area and adjacent to Pierson Creek, groundwater flow is to the west, south-west due to the influence of the Pierson Creek valley. Because of its distance from the interceptor wells, groundwater flow in the vicinity of Pierson Creek follows its natural pattern, discharging to Pierson Creek. There are numerous shallow, spring-fed tributaries that discharge along the foot of the hillside at Pierson Creek, and an upward vertical hydraulic gradient exists in paired monitoring well clusters near the creek.

2.3.2 Groundwater Monitoring

Groundwater quality at the facility is monitored under the supervision of MDEQ (AECOM, 2015). Compliance monitoring wells were installed in the fourth quarter of 2009 and have been monitored since that time. The comparison criteria used to evaluate the final acute values (FAV) plume were provided by MDEQ in response to a DuPont request for a Mixing Zone Determination for groundwater containing site-related volatile organic compounds (VOCs) flowing towards White Lake. MDEQ granted by letter (August 3, 2007), the mixing zone determination along with groundwater to surface-water interface (GSI) criteria for site-related VOCs. The mixing zone only applies to the fringes of the impacted groundwater, and all water above the FAV is being captured by the pump-and-treat system. The system continues to meet all of its remedial objectives based on the ongoing monitoring.

2.3.3 Groundwater Pump-and-Treat System

The site groundwater extraction system consists of four interceptor wells that remove groundwater from the aquifer to provide containment of groundwater containing site-related constituents above FAVs. FAVs have been established as part of the site mixing zone determination and were provided in the MDEQ letter *Mixing Zone Implementation* dated August 22, 2012.

Extraction flow rates for the well system vary from 618 to 685 gallons per minute (gpm) (AECOM, 2017) from four wells (IW-08-142, IW-09-140, IW-06-140, and IW-07-144). Extracted groundwater is conveyed to the site's treatment system within the fenced portion of the property. The treatment system consists of an air stripper and vapor phase carbon system to collect the VOCs. A steam system is used to regenerate the carbon. A condenser system and decanter tank are used to recover VOCs from the regeneration.

Recovered VOCs are stored in the decanter tank for disposal. Treated groundwater is conveyed via pipeline to the site's National Pollutant Discharge Elimination System (NPDES)-permitted outfall in Lake Michigan.

As shown on Figure 2-2, there is a "modeled capture zone" that predicts the extent of groundwater within the sites pump-and-treat system (described in Section 2.4.2). The edge of the capture zone is displayed on the figure with a purple dashed line. The capture zone is a result of the hydraulic influence from the extraction wells. The modeled extent of the capture zone has been used to set the boundaries of the mixing zone because groundwater within the capture zone will not discharge to White Lake. As depicted in the figure, the boundary of the estimated FAV plume is within the modeled capture zone. This indicates that the system is successfully capturing the FAV plume.

2.4 Exposure Setting

Since 1998, the only activities at the site have been related to the groundwater pump-and-treat system and the recovery of the Lime Pile by Lime Specialties Incorporated. The Former Manufacturing Facility, Pierson Creek Landfill, and the Calcium Fluoride Basin are surrounded by 8-foot, chain-link perimeter fences. Surrounding the fenced areas, most of the remaining property is forested with roads for access to monitoring wells, the site production wells, and former landfills.

Planned future land use includes the following (see Figure 2-3):

- Restricted areas for possible redevelopment (industrial/manufacturing) on the former manufacturing area.
- Restricted areas for use in remediation (landfills, property used for the pump-and-treat system).
- Other portions of the site may be re-developed for unrestricted, recreational, or commercial land use.

Neighboring single-family residential homes are present surrounding the facility property; however, the majority of these homes are south of the property in developments along White Lake. To the northeast, the surrounding property is owned by Occidental Chemical Company (OXY). OXY has performed remedial actions notably the construction of a lined, 10-acre landfill and installation and operation of a groundwater pump-and-treat system. OXY has placed a restrictive covenant on property containing the containment vault, in areas of soil impact, and properties that overly the groundwater plume.[1]

As noted in the *Documentation of Environmental Indicators – Current Human Exposures under Control* (MDEQ 2013a), groundwater is not used for drinking water on-site and occurs at depths [greater than 15 feet below ground surface (bgs)] where direct contact during intrusive activities is unlikely to occur. Groundwater is also not used for drinking water downgradient of the site (between William Road on the west and Lake Shore Drive to the east) due to pump-and-treat activities currently in operation capturing Former Manufacturing Area groundwater and the municipal water connections installed to area residents.

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[1] *Hazardous Waste Cleanup: Occidental Chemical Company Facility – Montague, Michigan*. Retrieved 10/18/2018, from https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-occidental-chemical-company-facility-montague.

Three areas of the site are fenced: the former manufacturing area, the inactive Calcium Fluoride Basin, and the northern portion of the Pierson Creek Landfill. Some fencing is also present on the Lime Pile, and steel swing gates are maintained on the entrances two-track paths off of public roads. Private property signs are also present. Heavy vegetation reduces trespasser access to the site. However, trespasser access to the site is possible along the two-track paths on the site and the site does have to occasionally add barriers to ATVs cutting around the swing gates.

2.5 Previous Investigations

Investigations have been conducted at the facility to evaluate the nature and extent of site-related constituents at identified WMUs and AOCs. The investigations have been documented in the following reports:

- Remedial Investigation of Four Inactive Solid Waste Landfills – 1990/1991
- Phase IIA Remedial Investigation of Four Inactive Solid Waste Landfills – 1992
- Pierson Creek Landfill Expanded Hydrogeologic Assessment Field Report – 1994
- Field Investigation Report, Pre-Closure Activities – 1995
- Pre-Remedial Action Plan Investigation – 1996
- Montague Plume Characterization Field Activities and Data Analysis Report – 1999
- Phase I Supplemental Groundwater Investigation Field Report – 2002
- Prioritization of Waste Management Units and Areas of Concern – 2006 (This report summarized results from previous investigations.)
- Request to Implement – Enhanced Groundwater Pump-and-Treat System – 2006
- Mixing Zone Implementation – 2007
- 2010/2011 Remedial Investigation Report - June 2012
- Remedial Investigation Report - Addendum No. 1 Supplemental Investigation – Former Waste Neoprene Landfill and Former Basin Sludge Storage Area – 2014
- Remedial Investigation Report Addendum No. 2 - Pierson Creek Landfill Area – 2014
- Remedial Investigation Report - Addendum No. 3 - Supplemental Investigation – Bury Pit Landfill – 2014
- Ongoing semiannual reporting of groundwater monitoring (provides mixing zone compliance and plume trends)

3.0 WMUs and AOCs

This section summarizes the investigation findings and identifies CMS considerations for each of the units to be evaluated in the CMS.

In an August 11, 2006, letter, MDEQ identified 13 WMUs/AOCs subject to corrective action and further evaluation.

- Northeast Landfill
- North Landfill
- Bury Pit Landfill
- Pierson Creek Landfill
- Waste Neoprene Landfill
- Former Basin Sludge Storage Area
- Lime Pile
- Calcium Fluoride Basin
- Former National Pollutant Discharge Elimination System (NPDES) Surface Impoundments (also on list as Corrosive Hazardous Waste Tanks)
- Former Injection Well
- Railcar Unloading Areas (East and West)
- Former Hydrogen Chloride Storage Tanks
- Generator Accumulation Area for Solvents Condensed from Air Stripper

Two additional areas were included in the prioritization document due to their relationship to the MDEQ-identified WMUs/AOCs:

- Mirror Lake
- Pierson Creek

WMU or AOC locations are detailed in the figures referenced in Sections 3.0 and 4.0.

The following three WMUs/AOCs were listed in the MDEQ letter with a notation that they are not subject to further corrective action:

- Former PCB Spill Area
- Former Flammable Hazardous Waste Storage Area
- Former Hazardous Waste Storage Area

Table 3-1 lists the WMUs and AOCs and their respective status. All units have been investigated sufficiently that a determination as to whether the unit requires a CMS or if the unit is recommended for no further action. As shown on the table, 10 of the units are identified for a CMS, and six were recommended for no further action.

Note that on Table 3-1, the groundwater plume from the former manufacturing area is identified as a “unit.” It is the intent of the CMS work plan and subsequent CMS to evaluate groundwater near the former manufacturing area on a plume-wide basis and not attempt to distinguish individual WMUs. Therefore, the groundwater plume that extends to White Lake is considered to be a separate unit. The groundwater plume near Pierson Creek, however, will remain a part of the evaluation for the Pierson Creek Landfill because those constituents are clearly related to the Pierson Creek Landfill.

3.1 Northeast Landfill

3.1.1 Unit Description

The Northeast Landfill operated from 1958 to 1965. This landfill, which received waste from the early acetylene and neoprene manufacturing processes, is located north of the Former Manufacturing Area (see Figure 3-1). The landfill is approximately 1.2 acres and was constructed over native soils. Portions of the landfill have waste materials at the surface. The Northeast Landfill does not have a liner or leachate collection system.

Based on a photographic survey of the site and aerial photographs, the Northeast Landfill provides limited ecological habitat for terrestrial receptors. The landfill is a sparsely vegetated open field with some low lying grasses. North and west of the landfill is a forested area. To the east is Lamos Road and to the south is the former industrial area of the site.

3.1.2 Conclusions and Recommendations

Historical RI activities at the unit determined the nature and extent of the landfill materials and found that few constituents in the subsurface soil or waste material samples exceeded applicable MDEQ Part 201 screening criteria (MDEQ, 2013b) for non-residential land uses (commercial/industrial). The detected constituents were consistent with the landfilled materials. The data also indicated that there was a release of toluene to groundwater.

During the 2010/2011 RI, surface soil results indicated that no constituents of potential concern (COPCs) were present in the surface at concentrations exceeding applicable screening levels. None of the constituents detected exceeded applicable MDEQ Part 201 screening criteria for non-residential land uses (commercial/industrial). Few constituents exceeded ecological screening criteria; however, it was concluded that there is a low potential for adverse effects to terrestrial receptors.

Groundwater monitoring data indicated that the release of toluene to groundwater is limited to directly downgradient of the landfill (< 200 feet). Attenuation of toluene concentrations in groundwater downgradient of the area supports that degradation processes are occurring. In addition, groundwater passing under this landfill is within the capture zone of the pump-and-treat system. No further investigation of soil at the Northeast Landfill was recommended in the 2012 RI Report (URS, 2012).

3.2 North Landfill

3.2.1 Unit Description

The North Landfill operated from 1960 to 1965. This landfill, which received waste from the early acetylene and neoprene manufacturing processes, is located north of the Former Manufacturing Area (see Figure 3-2). This landfill is approximately 0.6 acres and was constructed over native soils. Portions of the landfill have waste materials at the surface. The North Landfill does not have a liner or leachate collection system.

Based on a photographic survey of the site and aerial photographs, the North Landfill provides limited ecological habitat for terrestrial receptors. The landfill is a sparsely vegetated open field with some low lying grasses. The area surrounding the landfill is primarily forested.

3.2.2 Conclusions and Recommendations

Historical RI activities at the unit determined the nature and extent of the landfill materials and found that none of the constituents detected in the subsurface soil samples exceeded applicable MDEQ Part 201 screening criteria for non-residential land uses (commercial/industrial). Semi-annual groundwater monitoring data did not indicate a release to groundwater.

During the 2010/2011 RI, surface soil results indicated that no COPCs were present in surface soil at concentrations exceeding applicable screening levels. None of the constituents detected exceeded applicable MDEQ Part 201 screening criteria for non-residential land uses (commercial/industrial). Copper was the only constituent that exceeded ecological screening criteria; however, it was concluded that there is a low potential for adverse effects to terrestrial receptors. The landfill is sparsely vegetated providing limited ecological habitat.

No further investigation of the North Landfill was recommended in the 2012 RI Report.

3.3 Bury Pit Landfill

3.3.1 Unit Description

The Bury Pit Landfill operated from 1968 to 1985. This landfill is approximately 2.1 acres and was constructed over native soils northwest of the Former Manufacturing Area (see Figure 3-3). Portions of the landfill have waste materials at the surface. The Bury Pit Landfill does not have a liner or leachate collection system.

Based on a photographic survey of the site and aerial photographs, the Bury Pit Landfill provides limited ecological habitat for terrestrial receptors. The landfill is a sparsely vegetated open field with some low lying grasses (see Appendices C and D). The area surrounding the landfill is primarily forested.

3.3.2 Conclusions and Recommendations

Historical RI activities at the unit determined the nature and extent of the landfill materials and found that none of the constituents detected in the subsurface soil samples exceeded applicable MDEQ Part 201 screening criteria for non-residential land uses (commercial/industrial). Semi-annual groundwater monitoring data did not indicate a release to groundwater.

During the 2010/2011 RI, surface soil results indicated that no COPCs were present in the surface at concentrations exceeding applicable screening levels. None of the constituents detected exceeded applicable MDEQ Part 201 screening criteria for non-residential land uses (commercial/industrial). Copper was the only constituent that exceeded ecological screening criteria; however, it was concluded that there is a low potential for adverse effects to terrestrial receptors. The landfill is sparsely vegetated providing limited ecological habitat. No further ecological investigation of the Bury Pit Landfill was recommended.

MDEQ requested additional lithologic data be collected at the Bury Pit, and this was completed in 2013 and documented in the *Remedial Investigation Report - Addendum No. 3 Supplemental Investigation – Bury Pit Landfill* (URS, 2014a).

As discussed above, open burning of trash and possibly waste solvents is reported to have occurred at the unit. Four site-specific furan congeners were analyzed in the

2010/2011 RI samples and the toxicity equivalence (TEQ) of 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD) was below screening criteria. However, based on the site history, additional analysis of the complete dioxin/furan analyte list (17 dioxin and furan congeners) in surface soil is recommended for this unit. Dioxin/furan sampling was recommended in the 2012 RI Report to be conducted as part of RAP planning activities. Samples are proposed to be collected from adjacent to the six locations sampled in 2011 (11BP-01 through 11BP-06).

3.4 Former Basin Sludge Storage Area

3.4.1 Unit Description

The Former Basin Sludge Area is located north of the Lime Pile (see Figure 3-4). 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 memorandum from the plant manager indicates that in 1976 this basin material was excavated and the excavation was backfilled (DuPont, 2006).

3.4.2 Conclusions and Recommendations

During the 2010/2011 RI, subsurface soil samples were collected at the unit to verify that no residual COPCs were present at concentrations exceeding applicable screening levels. Additional soil borings were performed in 2013, and there was only one exceedance of non-residential criteria for chloride, which was not a site COPC. Consistent with the 2010/2011 RI findings, residual impact to underlying soil is not indicated. No further investigation of the Former Basin Sludge Storage Area was recommended in the RI Report Addendum No. 1 (URS, 2014b).

3.5 Former Hydrogen Chloride Tank Areas

3.5.1 Unit Description

Aqueous 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. HCl liquid byproduct was stored in two areas: the Freon Production Area (six tanks)[2] and the Railcar Unloading Area West (up to four tanks) (see Figure 3-5).

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 was uncertain.

3.5.2 Conclusions and Recommendations

During the 2010/2011 RI, soil samples were collected from 10 locations to evaluate whether there is residual impact from historical releases of HCl to the surrounding soil.

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[2] These tanks were adjacent to the HCl Storage Tanks Area identified in Figure 3-1.

Soil pH in the soil samples collected beneath the limestone gravel cover was in the slightly alkaline to moderately alkaline range. Therefore, residual impact from historical releases of HCl to soil is not indicated.

No further investigation of the Former Hydrogen Chloride Tank Areas was recommended in the 2012 RI Report.

3.5.3 Unit Status

As noted above, results from the RI sampling confirmed that this unit has no residual impact. This unit does not require evaluation in the CMS, and approval of a no further action status is requested.

3.6 Former NPDES Surface Impoundment/Wastewater Ditch

3.6.1 Unit Description

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 location of the former impoundments is shown in Figure 3-6. The wastewater was transported to the NPDES impoundments by a concrete and wood-lined ditch system. This unit operated from the early 1960s until 1996 when facility operations were shut down. The ditch system is also located within the Former Manufacturing Area.

In 1972, a 4-foot by 6-foot hole was found in the concrete 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).

3.6.2 Conclusions and Recommendations

During the 2010/2011 RI, subsurface soil samples were collected from six locations to determine if the ditch system has impacted the adjacent soil. Integrity of the ditch system appears intact and a release to the adjacent soil is not indicated. No site-specific constituents were detected in the soil samples collected.

Groundwater samples were collected from three downgradient monitoring well locations to determine whether the former impoundments are a source of constituents to groundwater. Groundwater data collected from two rounds of sampling indicate the presence of one constituent tetrachloroethene (PCE) in groundwater slightly above screening criteria.

During the third and fourth semi-annual groundwater monitoring events downgradient of the former surface impoundment in 2012, there were no detections of site-related constituents and sampling was discontinued. No further investigation of the Former NPDES Impoundment/Wastewater Ditch was needed.

3.6.3 Unit Status

Results of the soil sampling near the ditch and two years (2011-2012) of semiannual groundwater sampling near the former surface impoundment indicated no residual impact by this unit. This unit does not require evaluation in the CMS and approval of a no further action status is requested.

3.7 Mirror Lake

3.7.1 Unit Description

Mirror Lake is a small body of water that is located due south of the Lime Pile (see Figure 3-7). 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 mid to late-1960s, 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 half of Mirror Lake has received lime material (see Figure 3-10). Erosion is no longer active as the south impoundment berm was repaired in the 1960s. There has been no apparent change in the extent of the lime sediment over the last four decades based on appearance in the aerial photographs. Since the May 1968 air photograph, the southward extent of lime material (visible as white areas in the air photographs) has remained the same in subsequent photographs.

During the RI data evaluation, the historical stability of the lime pile and lime sediment in Mirror Lake was evaluated by a review of historical aerial photographs ranging from 1938 to present. Figure 3-8 displays these photographs, which clearly show the lime pile and Mirror Lake over time. Emphasis in this figure is placed on the years when the Lime Pile was first built (1950s and 1960s) and recent years 1992 to 2010. The historical photographs show that Mirror Lake has varied considerably in extent and that part of the lake was partially filled in with sediment before the Lime Pile was built. Mirror Lake was at its greatest extent in the 1955 photograph. From the photographs, it is believed that the lake level of 1938 and 1950 was lower, exposing more of the flat bottom of Mirror Lake. Beginning with the 1962 photograph, the Lime Pile is visible, and lime sediment is visible in the northern one-third of Mirror Lake. In the 1968 photograph, the lime sediment appears to have reached is current extent. The southern extent of the lime sediment in Mirror Lake has not visibly changed since 1968, indicating that the lime sediment is stable. Mirror Lake, however, has continued to vary in size; most of the open water seen in the 1992 and 1998 photographs has disappeared in the 2005, 2006, 2009, and 2010 photographs. This variation in the extent of Mirror Lake is believed to be related to the water table elevation in the area, which is primarily controlled by the lake level in White Lake (and Lake Michigan) and precipitation.

3.7.2 Conclusions and Recommendations

During the 2010/2011 RI, a sample of Mirror Lake lime material was collected and analyzed for total and SPLP selenium, The purpose of the sampling was to determine the potential for lime-related selenium to negatively impact Mirror Lake. Based on the sampling conducted at the unit, selenium is not a COPC. In addition, the lime sediment now in Mirror Lake is stable with no apparent change in its lateral extent since the late 1960s. No further erosion of lime southward has occurred since that time.

In the 2012 RI Report, the recommended data collection was to collect information about the depth of the lime sediment (see Section 6.1).

3.8 Lime Pile

3.8.1 Unit Description

In approximately 1955, Union Carbide began manufacturing acetylene, which produced a lime by-product. The lime by-product was stored in a low-lying area located south of Wilkes Road, north of Mirror Lake. In the early 1960s, DuPont purchased Union Carbide’s acetylene plant and continued acetylene manufacturing until approximately 1972. Figure 3-9 displays the Lime Pile.

Historical leaching of the lime material had impacted the groundwater below and downgradient of the pile. Impact to groundwater from the Lime Pile included an increase in pH (range 11 to 12), and the presence of thiocyanate and sulfide. In the mid-1960s, to address lime-related groundwater conditions, DuPont installed a series of groundwater interceptor wells downgradient of the lime pile to collect, treat, and discharge impacted water. Chemours continues to operate this system and the interceptor wells successfully capture groundwater from the vicinity of the Lime Pile.

The Lime Pile was surveyed for volume in 2000. The entire complex of lime was estimated to be about 36 acres in extent and ranged in thickness from 5 feet to up to 53 feet. Not counting Mirror Lake and the Calcium Fluoride Basin, the Lime Pile is estimated at 29.14 acres (Synagro, 2000). Lime Specialties, Inc., was formed by DuPont in early 1988 to mine and market the lime for re-use, and this activity continues.

Also during the 2000 investigation, samples of lime were collected from borings and the analytical results were below MDEQ regulatory criteria. In addition, a 2002 bioassay testing for acute toxicity found a 48-hour EC50 of greater than 120 milligrams per liter (mg/L) of lime (highest dose tested).

3.8.2 Conclusions and Recommendations

Based on the past lime sampling, there is not a current exposure to unacceptable concentrations of site-related constituents. Groundwater impacts (alkalinity, sulfide and thiocyante) from the Lime Pile are contained by the pump-and-treat system. The Lime Pile does however present an aesthetic issue.

3.9 Calcium Fluoride Basin

3.9.1 Unit Description

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. The lime bed acted as a final neutralization step for any residual fluoride associated with the basin material.

The basin operated in the 1980s and is no longer in use. It is estimated that the basin ceased operations prior to 1990. This unit is approximately 5 acres (Eikon Planning and Design, 2000), is underlain by a 10-foot-thick lime bed (DuPont, 1989), and is surrounded by a chain-link fence. Figure 3-9 displays the basin location.

Based on a photographic survey of the site and aerial photographs, the Calcium Fluoride Basin provides limited ecological habitat for terrestrial receptors. The basin is a bare area with very little vegetation. To the east and south of the basin is the lime pile. To the north of the basin is the former industrial area of the site and to the west of the basin is a forested area.

3.9.2 Conclusions and Recommendations

Historical RI activities at the unit characterized basin materials and identified the highest arsenic concentrations measured in surface soil at the site (2,020 mg/kg). However, there is a low potential for exposure under current conditions. The 8-foot fence around the basin prohibits access for both trespassers and large terrestrial wildlife such as deer. Elevated concentrations of antimony, arsenic, and fluorine were detected in surface soils indicating that there is a potential for ecological risk to terrestrial receptors that can access the area; however, the limited ecological habitat present in the basin will lower the exposure potential.

During the 2010/2011 RI, groundwater samples were collected at the Calcium Fluoride Basin. A release of fluoride and other constituents to groundwater is not indicated.

No further investigation of the Calcium Fluoride Basin was recommended in the 2012 RI Report.

3.10 Pierson Creek Landfill

3.10.1 Unit Description

The Pierson Creek Landfill operated from 1965 to 1972. This landfill, which received liquid and solid wastewater treatment residues from CFC and neoprene manufacturing, is approximately 2 acres. The landfill was constructed over native soils and does not have a liner or leachate collection system.

Pierson Creek Landfill is located west of the Former Manufacturing Area in a remote portion of the site (see Figure 3-10). The landfill has an 8-foot chain-link fence around the perimeter to restrict access to trespassers and large terrestrial receptors. The landfill is a thickly wooded area. The thick vegetation in the area provides ecological habitat for terrestrial receptors such as birds, mammals, and soil invertebrates.

3.10.2 Conclusions and Recommendations

Historical RI activities at the unit determined the nature and extent of the landfill materials and identified several organic and inorganic constituents in subsurface soil and subsurface waste material samples above applicable MDEQ Part 201 drinking water protection and direct contact screening criteria for non-residential land uses (commercial/industrial). A release to underlying groundwater was also confirmed at the unit.

During the 2010/2011 RI, surface soil results indicated that similar to the historical data, organic and inorganic constituents were detected in the surface soil samples above applicable MDEQ Part 201 drinking water protection and direct contact screening criteria for non-residential land uses (commercial/industrial). Most exceedances were observed in location 10PCLSS-06, which was collected from a black silty clay, assumed to be waste material from the former surface impoundments. The potential for exposure to these constituents in the surface waste material (collected from a depth of 0 to 0.5 feet bgs) and in the subsurface is minimized by the surrounding fence.

The landfill is thickly vegetated providing ecological habitat for terrestrial receptors; however, the perimeter fence noted above limits the exposure to larger terrestrial wildlife. Based on the ecological screening, there is a generally low potential for ecological exposure to terrestrial receptors at the locations that were sampled during the 2010/2011 RI with the exception of location 10PCLSS-06; however, the extent of contamination in surface soil is not fully defined. As a result, there is some uncertainty with determining potential ecological exposure to terrestrial receptors from surface soils; therefore, additional investigation of this area is recommended to be conducted as part of CMS planning activities to fully define surface soil contamination and complete the ecological exposure evaluation for the Pierson Creek Landfill.

Current groundwater monitoring data indicates that the extent of the release in groundwater is limited to directly adjacent to the landfill in the upper aquifer. A potentially complete groundwater discharge pathway from the landfill to Pierson Creek is evident. However, an adverse impact to surface water and sediment in Pierson Creek is not apparent. Considerable additional investigation of the groundwater discharge pathway was performed consisting of a tree core sampling, seep sampling, shallow groundwater sampling near suspected discharge areas, and installation of CPTs and new wells west of Pierson Creek. Data collected confirmed that a shallow plume of VOCs (PCE) are discharging to Pierson Creek in a narrow area on the eastern side of the Pierson Creek valley. VOC extent was limited to the groundwater discharge points and small tributaries and did not extend into Pierson Creek itself.

Based on the findings summarized in the *Remedial Investigation Report Addendum No. 2 – Pierson Creek Landfill Area*, no further investigation is warranted (URS, 2014c).

3.11 Pierson Creek

3.11.1 Unit Description

Pierson Creek is not a WMU but is located approximately 250 feet west of the Pierson Creek Landfill. The NPDES permitted wastewater discharge line travels through this western segment of Chemours property. Treated water running through the NPDES wastewater line crosses over Pierson Creek on its way to being discharged into Lake Michigan.

Physically, Pierson Creek is a small perennial stream fed by numerous spring-fed tributaries. At the northern site boundary, the creek drains a rural, agricultural area extending approximately 5 miles north of the site. South of the site, the creek flows southwest and empties into Sadony Bayou approximately 0.5 mile downstream. The Creek ultimately drains into White Lake approximately 1 mile south of the site near the White Lake outlet to Lake Michigan.

Within the site property boundary, there are approximately five small tributaries that flow into the main channel of Pierson Creek. The width of the main channel ranged from approximately 3 to 12 feet, with a typical width of 8 feet. Water depth in the main channel ranged from about 4 to 8 inches and sediments are predominately composed of sand. The width of the tributaries ranged from 1 to 4 feet, with a typical width between 1 and 2 feet. Depth of water in the tributaries ranged from one to six inches and sediments vary from sand to silty muck. Within the creek and tributaries, there is little to no submerged or emergent aquatic vegetation; however the banks of the creek and tributaries are thickly vegetated with overhanging trees and herbaceous vegetation that shade the water.

3.12 Waste Neoprene Landfill

3.12.1 Unit Description

The Former Waste Neoprene Landfill is located due north of the Lime Pile (see Figure 3-4). The Former Waste Neoprene Landfill operated during the 1960s as a disposal unit for waste from site neoprene operations. This landfill was unlined and measured approximately 75 by 50 feet. In 1976, the neoprene waste material was removed, treated, and disposed of following appropriate regulations. The excavation was backfilled with lime and sand (DERS, 1997).

3.12.2 Conclusions and Recommendations

Historical sampling of native soil materials does not indicate that waste material remains. However, the analytical list utilized at the unit during the RI was limited and did not include constituents typically associated with neoprene (such as chlorinated butenes and copper). As a result, further investigation of this unit was recommended in the RI Report.

During 2013, additional soil boring samples were collected to address the specific data gaps identified in the RI Report and based on feedback from MDEQ. With the exception of chloride, none of the other constituents detected exceeded applicable screening criteria for residential or non-residential land uses (commercial/industrial). The chloride exceedance was observed at depth (5 to 10.5 feet bgs). Chloride was not detected above screening criteria in any other sample location.

No further investigation of the Former Neoprene Waste Landfill was recommended in the RI Report Addendum No. 1 (URS, 2014b).

3.13 Groundwater Plume from Former Manufacturing Area

Groundwater has been sampled for site-related constituents during historic investigations and on a routine basis since the 1990s. This data set was used to determine the horizontal and vertical extent of the groundwater plume that was released from within the former manufacturing area. Although the Lime Pile had historically contributed to groundwater impacts, the VOCs related to the Neoprene and Freon Manufacturing areas have been the focus of the investigations and monitoring.

As noted in Section 3.0, it is intended that this CMS evaluate groundwater near the former manufacturing area on a plume-wide basis and not attempt to distinguish individual WMUs or source areas of the plume.

Figure 3-11 displays a general map of the groundwater plume where concentrations exceed the FAV. The interpreted extents of the plume are based on the 2017 and 1H2018 sampling data. Six VOCs have been detected in groundwater samples above tap water criteria in this data set: PCE, trichloroethene, carbon tetrachloride, 1,2,2-trichlorotrifluoroethane (CFC-113), benzene, and toluene.

Groundwater from the plume area is not used on-site for drinking water purposes, and residential users downgradient of the site are on water provided by the City of Montague. Deed restrictions in areas near the plume would prohibit the use of groundwater as drinking water in the future. Furthermore, White Lake is not used for water-supply purposes near the site. Therefore, potential exposure via direct contact (ingestion or dermal contact) with groundwater for on-site industrial workers and off-site residents/workers is low.

4.0 Corrective Action Objectives

The overall corrective action goal for the Montague site is protection of human health and the environment. As documented in the CA 725 determination, the potential for exposures to impacted media (surface soil, subsurface soil, sediment, groundwater, and surface water) is not considered significant under current conditions.

Current land use at the site consists of former manufacturing areas, former landfills, and surrounding buffer land (see Figure 2-3). It is anticipated that future land use in the former manufacturing area and landfill areas will remain non-residential (industrial or commercial land use). Future land use in the surrounding buffer land may include re-development for residential, recreational, or commercial land use. Deed restrictions prohibiting the use of groundwater as drinking water would be necessary in a portion of the buffer land.

As indicated in Figure 2-3, the WMUs (and infrastructure related to the pump-and-treat system) to be evaluated in the CMS are located within portions of the site designated for non-residential land use. No corrective action units were identified in the surrounding buffer land.

At present the site engineering control measures such as fencing, existing cover systems, appropriate health and safety management plans for all on-going site activities, and the on-going groundwater pump and treat systems are providing overall protection of human health and the environment at the site. Based on these considerations, the corrective measures that are ultimately selected should satisfy the following CAOs:

- CAO 1: Establish and implement appropriate institutional controls in addition to the existing control in place to ensure future land use practices are protective of future land users and also prevent consumption of groundwater containing site-related constituents as drinking water.
- CAO 2: Continue to provide long-term protection of people and the environment by controlling exposure to hazardous constituents in and associated with waste materials at the AOCs and SWMUS identified in Section 3
- CAO 3: Continue to control or eliminate the potential sources of releases to groundwater from the AOCs and SWMUs identified in Section 3
- CAO 4: Continue to control or eliminate lime-related materials present in the Former Basin Sludge Storage Area, Waste Neoprene Landfill, Lime Pile, Mirror Lake, and Calcium Fluoride Basin.
- CAO 5: Continue site-wide groundwater monitoring to confirm effectiveness of the on-going pump-and-treat system. This system is preventing site-related constituents from adversely affecting potential receptors.

Media specific cleanup standards may be identified in the CMS. Media cleanup standards should be clear and reasonable, be protective of human health and the environment, and take into consideration site-specific conditions and foreseeable future land-use considerations. Table 4-1 lists each WMU and the corrective measure drivers identified for each such units.

5.0 Potential Corrective Measure Technologies

This section describes potential general categories of corrective measure technologies and presents SWMU-specific technology screening. The technology screening was based on ability to achieve the CAOs for each of AOCs and SWMUS under consideration. Technology screening considered site and media characteristics, waste characteristics, and technology limitations. The initial technology screening is dependent on conditions at each WMU area and the list of proposed technologies for screening is included as Table 5-1. This initial screening will be further evaluated during the CMS.

The technologies presented in this work plan were selected based on the constituents and media of concern identified in the RI for each unit. Media of concern were based on potentially complete human health exposure pathways, including those based on current as well as reasonably anticipated future land uses, and ecological risks to be addressed.

To achieve the CAOs defined in Section 4.0, the following general technology categories were screened for each WMU:

- Institutional controls
- Groundwater monitoring and MNA
- Groundwater containment via extraction well system
- Capping
- On-site treatment
- Off-site disposal
- On-site consolidation

The following sections describe these technology categories and how they may be incorporated to mitigate risks at the site WMUs.

5.1 Institutional Controls

Institutional controls involve restricting/limiting public exposure to the WMUs through the use of site access controls and land-use controls. Site access controls include physical restrictions (i.e., perimeter fencing with designated entrance access) and administrative controls (i.e., caution signs with site contact info, health and safety plan, and soil management plan). Land-use controls use traditional real estate law to document environmental covenants and limit future development of the land. Land-use controls would be executed through UECA and deed restrictions.

5.2 Groundwater Monitoring and Monitored Natural Attenuation (MNA)

Groundwater monitoring involves monitoring the water level and chemical constituents in groundwater wells. This monitoring would involve scheduled sampling/testing of upgradient and downgradient monitoring wells around selected WMUs for evaluation of potential groundwater impacts. This approach would also require a mixing zone determination be requested if the plume is discharging to surface water or migrating.

Analytical parameters will be tested for suspected contaminants and corresponding breakdown products. If groundwater data indicate that significant biotic or abiotic natural attenuation is taking place, MNA may be considered as a corrective measure. This approach will require a mixing zone for groundwater containing constituents that is discharging to surface water. For the CMS, this approach will be considered for the groundwater near Pierson Creek Landfill and the plume that extends toward White Lake.

5.3 Groundwater Containment and Treatment (Pump-and-Treat)

Groundwater containment is assumed to consist of maintaining hydraulic control via active (extraction wells) or passive (slurry walls, sheet pile barriers) means. The site has an existing system of four extraction wells that are successfully maintaining capture of the plume that extends toward White Lake. In addition, there is a treatment system to remove constituents from the water prior to discharge to Lake Michigan. For the CMS, the elements of the existing pump-and-treat system will be reviewed and modifications considered, if necessary

5.4 Capping

Capping involves placing a physical barrier (soil, geosynthetic material, or both) over the contaminants. Capping can be an effective corrective measure for large areas or contaminated soil consolidation areas to cover and eliminate direct exposure pathways and reduce infiltration. Monitoring and maintenance are required to ensure that the cover prevents contact with waste and contaminants in soil. Institutional controls are also needed to prevent future disturbance of the capped area. For this CMS, on-site consolidation will be evaluated for the units where waste remains in place (landfills).

5.5 On-Site Treatment

On-site treatment would be limited to areas impacted by organic compounds. For nitrates and explosive compounds, on-site treatment would be limited to bioremediation technologies. Prior to implementing treatment technologies, bench-scale studies would be conducted to define treatment specific parameters (quantity, quality, duration, etc.) and proper selection of biological compounds that would degrade or react with the contaminants. If the bioremediation approach generates wastes, then additional corrective measures technologies (i.e., capping or off-site disposal) may be implemented along with the treatment technology.

5.6 Off-Site Disposal

Off-site disposal involves excavation and removal of soil and/or waste materials from the site. The soil and/or wastes are then transported to an approved disposal facility. This technology requires delineation sampling, waste characterization, waste profile approval, excavation, confirmatory sampling, and off-site transport and disposal in accordance with local and federal regulations. Off-site disposal will be effective in areas with shallow soil contamination (like spills) where the limits have been accurately delineated and the depth of excavation would be limited.

5.7 On-Site Consolidation

On-site consolidation is a corrective measure that will be evaluated to reduce the contaminant footprint at the site and prevent direct contact. On-site consolidation of impacted soil or wastes within an integrated disposal area would be protective by removing contaminants from several WMUs and providing a cap to eliminate direct contact exposure and reducing infiltration. For this CMS, on-site consolidation will be evaluated for the units that have waste remaining in place. This approach will be most useful in WMUs with limited depths of excavation.

5.8 Proposed Technologies to be Screened for WMUs/AOCs

The following section summarizes specific considerations for each site unit and presents a listing of potential corrective measures technologies that will be evaluated.

5.8.1 Northeast Landfill

The medium of concern for the Northeast Landfill is the waste materials present in the soil and on the surface of this landfill. The areal extent of the Northeast Landfill in the CMS is approximately 1.2 acres with a waste thickness varying from 5 to 20 feet. There has been a release of toluene to groundwater, but the groundwater in this area is within the containment of the pump-and-treat system. Surface soil was found to not have COPCs above MDEQ Part 201 non-residential screening criteria.

Potential corrective measures technologies to be evaluated in the CMS to address potential human health exposure pathways include the following:

- Institutional controls [site access controls, deed restrictions, soil management plan, and Uniform Environmental Covenant Agreement (UECA)]
- Dig and haul to either off-site or to a consolidated on-site unit
- Capping with groundwater monitoring

5.8.2 North Landfill

The medium of concern for this WMU is the waste materials present in the soil and on the surface of this landfill. The areal extent of the North Landfill in the CMS is approximately 0.6 acres with a waste thickness varying from 3 to 10 feet. Surface soil was found to not have COPCs above MDEQ Part 201 non-residential screening criteria,

Potential corrective measures technologies to be evaluated in the CMS to address potential human health exposure pathways include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Limited dig and haul to either off-site or to a consolidated on-site unit
- Capping with groundwater monitoring

5.8.3 Bury Pit Landfill

The medium of concern for the Bury Pit Landfill is the waste materials present in the soil and on the surface of this landfill. The areal extent of the North Landfill in the CMS is approximately 3.8 acres with a waste thickness varying from 5 to 18 feet. Surface soil was found to not have COPCs above MDEQ Part 201 non-residential screening criteria, but additional soil sampling has been recommended for the unit.

Potential corrective measures technologies to be evaluated in the CMS to address potential human health exposure pathways include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)

- Limited dig and haul to either off-site or to a consolidated on-site unit
- Capping with groundwater monitoring

5.8.4 Basin Sludge Storage Area

Unlike the landfills described above, the Basin Sludge Storage Area does not have waste left in place. The areal extent of the former Basin Sludge Area in the CMS is approximately 0.41 acres. The RI indicated that only one location had a result above the MDEQ Part 201 non-residential screening criteria [6.21 milligrams per kilogram (mg/kg) arsenic]. However, lime material has eroded over the unit. The area is covered with a shallow layer (1 to 2 feet) of lime.

Because the southern part of the unit is covered by lime, the restoration of this area is dependent on the plans for the lime pile. After the lime pile is removed, soil in this area would be characterized.

Based on borings conducted in the RI, there is no sludge waste remaining in place although the area is covered with a shallow (1 to 2 feet) of lime.

Potential corrective measures technologies to be evaluated in the CMS to address the lime material include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Off-site Re-use of the lime by-product

5.8.5 Mirror Lake

As sampling indicated in the RI, the lime sediment in Mirror Lake does not contain hazardous COPCs; however, the lime sediment has filled in the north portion of the lake. The areal extent of the lime sediment in Mirror Lake is approximately 3.9 acres. Depth of lime is assumed to be approximately 2 feet.

The restoration of Mirror Lake is partly dependent on the plans for the lime pile. During removal of the lime pile, lime sediment in Mirror Lake could potentially be re-used or disposed along with lime from the main pile.

Potential corrective measures technologies to be evaluated in the CMS to address the aesthetic restoration of Mirror Lake risk include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Limited dig and haul of lime sediment to either off-site or to a consolidated on-site unit
- Off-site re-use of the lime by-product

5.8.6 Lime Pile

The medium of concern at the Lime Pile is the lime, which presents an aesthetic issue and in the past had released constituents to groundwater (such as sulfide and thiocyanate). Other metals were not detected at concentrations of concern. Currently, if any constituents were to leach from the Lime Pile, they would be captured by the pump-and-treat system. An additional consideration for the alternative analysis is the geotechnical stability of the pile and prevention of erosion onto adjacent areas.

The areal extent of the Lime Pile is estimated to be 29.14 acres. Depth of lime based on the borings done in 2000 varied from 5 to 53 feet. The base of the lime pile is understood to be native sand soils, but this may also include tree stumps and fallen timber as the Lime Pile footprint was expanded during its years of construction/accumulation.

Potential corrective measures technologies to be evaluated in the CMS to address the restoration of the Lime Pile area include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Capping of the Lime Pile with downgradient monitoring
- Off-site re-use of the lime by-product

5.8.7 Calcium Fluoride Basin

The medium of concern for the Calcium Fluoride Basin is the waste material in the impoundment. The impoundment was intended to precipitate calcium fluoride by discharging water high in fluorides onto a part of the lime pile. In addition to fluoride however, the water also had arsenic, which has deposited in the lime as well. The areal extent of the Calcium Fluoride Basin is approximately 7.5 acres. Past borings indicate that between 7 and 13.5 feet of lime are present.

As discussed in the RI report, arsenic concentrations in the impoundment exceeded MDEQ Part 201 non-residential screening criteria in the surface material on the impoundment. There is no soil cover over the unit. A perimeter fence is present and maintained by Chemours and Lime Specialties Inc. Lime Pile reclamation activities have removed lime adjacent to the Calcium Fluoride Basin and there is a topographic difference between the Calcium Fluoride Basin (higher elevation) and the Lime Pile (lower elevation). As lime removal continues, this difference will increase and geotechnical stability of the impoundment will need to be considered.

Potential corrective measures technologies to be evaluated in the CMS to address potential human health and ecological exposure pathways include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Dig and haul to either off-site or to a consolidated on-site unit
- Capping with groundwater monitoring
- On-site treatment (e.g., stabilization) with a cap

5.8.8 Pierson Creek Landfill

The two media of concern for the Pierson Creek Landfill are the waste materials present in the footprint of the landfill and the constituents that have been released to groundwater that discharges to Pierson Creek. Surface and subsurface soil and groundwater contain COPCs above MDEQ Part 201 non-residential screening criteria.

The areal extent of the Pierson Creek Landfill is approximately 3.2 acres. The landfill consists of two contiguous waste disposal areas: the first is wastewater sludge that is in the fenced impoundment (approximately 2 acres). This wastewater sludge material has a soil cover of irregular depth (between 0 and 1 foot) and a waste thickness of up to 6 feet. The second part of the Pierson Creek Landfill (approximately 1.2 acres) contains a green material understood to be spent catalyst. Based on the groundwater monitoring data, only the wastewater sludge has released constituents (primarily PCE).

Potential corrective measures technologies to be evaluated in the CMS to address potential human health and ecological exposure pathways include the following:

- Institutional controls (site access controls, groundwater restrictions, deed restrictions, soil management plan, and UECA)
- Monitored natural attenuation (MNA) combined with a mixing zone determination (groundwater only)
- Capping with groundwater monitoring
- On-site treatment (e.g., stabilization to prevent migration of COPCs) with a cap
- Dig and haul to either off-site or to an on-site unit

5.8.9 Pierson Creek

The media of concern in the vicinity of Pierson Creek Landfill is groundwater, surface water (tributaries to Pierson Creek), and sediment (near seeps of groundwater discharging to surface water).

Potential corrective measures technologies to be evaluated in the CMS to address potential human health and ecological exposure pathways include the following:

- Institutional controls (site access controls, groundwater use restrictions, deed restrictions, and UECA)
- MNA combined with a mixing zone determination

5.8.10 Former Waste Neoprene Landfill

The Former Waste Neoprene Landfill is covered by the northern edge of the Lime Pile. Based on borings conducted in 2013, the Former Waste Neoprene Landfill is covered with between 1 and 5 feet of lime. Although the unit was reportedly excavated in 1976, fragments of neoprene waste were encountered during the 2013 borings suggesting that some material might remain under the lime. The areal extent of the Former Waste Neoprene Landfill is approximately 0.18 acres.

This unit is currently covered by lime, and the restoration of this area is dependent on the plans for the lime pile. After the lime pile is removed, remaining neoprene waste would be removed, and the soil in this area would be characterized.

Potential corrective measures technologies to be evaluated in the CMS to address the lime material include the following:

- Institutional controls (site access controls, deed restrictions, soil management plan, and UECA)
- Limited dig and haul to either off-site or to a consolidated on-site unit
- Off-site re-use of the lime by-product

5.8.11 Groundwater Plume from Former Manufacturing Area

Groundwater is a medium of concern downgradient of the former manufacturing area. The existing monitoring well network is sufficient to evaluate releases identified in site groundwater and provide appropriate monitoring at the site boundary. This site-wide groundwater monitoring program will be carried forward and evaluated in the CMS to confirm its adequacy. Similarly, there is an existing pump-and-treat system that is successfully containing the portions of the plume that exceed FAV criteria. This existing extraction system will also be carried forward and evaluated in the CMS.

Potential corrective measures technologies to be evaluated in the CMS include the following:

- Institutional controls (site access controls, groundwater use restrictions, deed restrictions, and UECA)
- Groundwater containment (active systems – such as the existing pump-and-treat system and passive containment systems such as slurry walls/sheet piling)
- MNA combined with a mixing zone determination

6.0 CMS Data Collection Activities

To support corrective measure alternative evaluations in the CMS, the following additional data collection activities have been identified. The purpose of this section is to outline the objectives and approach for these activities. Based on the results of the investigations, additional studies may be warranted. Additional studies will be identified in the project progress reports.

6.1 Objective 1: Determine if Dioxins/Furans Are Present at Bury Pit Landfill

Based on the reports that open burning once occurred in the Bury Pit Landfill area, a soil sampling memorandum will be written and submitted to MDEQ describing locations, sampling procedures and analytical methods to determine if dioxins and furans are present in the surface and subsurface soil at the Bury Pit Landfill.

This information was recommended in the 2012 RI Report. Specifically, the recommendation was that surface samples be collected from adjacent to the six locations sampled in 2011 (11BP-01 through 11BP-06). These samples will be analyzed for the complete dioxin/furans list (17 dioxins and furan congeners). This information will be used to support corrective measures alternatives evaluated in the CMS.

6.2 Objective 2: Confirm that the Footprint of the Bury Pit Landfill did not extend north of its assumed extent

Old aerial photographs suggest that there were older paths to the north of the Bury Pit Landfill. A preliminary walk conducted May 16, 2018 revealed low piles of heavily weathered cinderblocks that resemble debris from old homes. Additional review of the area is recommended. If nothing beyond the old debris is found, it will be assumed that the parcel can be treated as residential. If evidence of past waste management activities is noted, then additional sampling will be planned for surface and subsurface soil analyzing for the constituents related to the Bury Pit Landfill. If additional sampling is planned, a sampling memorandum will be written and submitted to MDEQ for approval prior to the work.

6.3 Objective 3: Assess Depth of Lime Sediment in Mirror Lake

In an inventory calculation of lime material made in 2000, it was estimated that two feet of lime sediment is present in the northern half of Mirror Lake. This estimate could be used in the CMS; however, a more accurate estimate of depth across the area would allow for a more accurate assessment of potential excavation depths and volumes.

A soil sampling memorandum will be written and submitted to MDEQ describing locations, sampling procedures, and analytical methods to determine depth of lime, moisture content, and bulk density. This information will be used to evaluate potential corrective measures alternatives in the CMS.

7.0 CMS Report Outline

The CMS report will be developed following the proposed outline below:

- Introduction/purpose
- Description of current conditions
- Media cleanup standards
- Development of corrective measures alternatives (WMU specific)
- Evaluation of final corrective measures alternatives (WMU specific), considering the following:
  - Protection of human health and the environment.
  - Attainment of media cleanup standards set by EPA/MDEQ
  - Control of the source of releases
  - Compliance with applicable standards
  - Other factors such as long-term reliability and effectiveness; reduction in the toxicity, mobility, or volume of wastes; short-term effectiveness; implementability; regulatory acceptance; community acceptance; and costs
- Cost estimate(s)
- Recommendation of final corrective measures alternative(s)

8.0 CMS Project Management and Schedule

This section describes the overall project management for the CMS phase of this program, including the following:

- Project management team, including lines of communication and personnel qualifications
- Schedule
- Progress reports

8.1 Project Management

The project management team will include Chemours and AECOM personnel as indicated in Figure 8-1. Several of the key personnel and technical experts have worked on this site throughout the investigation phase. Key personnel roles and responsibilities are described in the following paragraphs.

8.1.1 Sathya Yalvigi – Chemours CRG Project Director

Sathya Yalvigi is the Chemours Project Director. He is responsible for managing and directing activities required to implement the corrective action program. His responsibilities include regulatory communications, establishing project work teams, and supervising and directing project activities and regulatory submittals. Mr. Yalvigi has a Master's degree in civil/environmental engineering and has over 28 years of environmental experience. He has been the project director at the Montague site since 2015.

8.1.2 George Gregory – AECOM Project Manager

George Gregory is the AECOM Project Manager responsible for managing and directing AECOM project teams assigned to accomplish corrective action field investigations, studies, remedial actions, and monitoring programs at the Montague site. He will be responsible for managing and directing the resources involved with the CMS. Mr. Gregory has a Bachelor of Science degree in geosciences and has 26 years of environmental experience. He has been the AECOM project manager for the Montague site since 2008.

8.1.3 Joseph McCarthy – AECOM Lead Project Engineer

Joseph McCarthy is the AECOM lead project engineer for the CMS phase of the project. He will be responsible for technical direction and oversight of the alternative screening and evaluations conducted for the CMS. Mr. McCarthy has a Bachelor of Science degree in chemical engineering and Master of Science degree in civil engineering. He has over 36 years of experience in engineering and environmental management.

8.2 Schedule

A proposed CMS schedule has been included as Figure 8-1 of this work plan.

Tasks included in this schedule extend slightly past the submittal of the CMS to the Corrective Measures Implementation (CMI) Work Plan and are as follows:

- An agreement will be developed by MDEQ and Chemours. This agreement will set expectations for future land use, establish preliminary RAOs, describe the CMS deliverables, and provide a conceptual schedule for the CMS.
- Coincident with the agreement, the technology screening will be developed with MDEQ to streamline the selection of potential remedial actions. Upon approval of this CMS work plan, the technology screening will begin.
- Both the agreement and the technology screening are proposed to be completed during the fourth quarter of 2018.
- The Corrective Measures Study (CMS) Report will be written starting in the first quarter of 2019. Allowing for revisions with MDEQ, it is expected that the CMS Report will be completed by approximately the end of the third quarter of 2019. During the CMS, the lime sediment measurement at Mirror Lake and the dioxin/furan sampling at the Bury Pit Landfill will be performed. The extent of the Bury Pit Landfill will be reconfirmed at this time as well. This information will be incorporated into the decision-making of the CMS.
- After approval of the CMS Report, MDEQ will publish the final remedy decision with a request for public comment. This is estimated to be done during the fourth quarter of 2019.
- After MDEQ issues the final remedy, a CMI Work Plan will be written that describes the remedial actions and provides a schedule for the remedial actions. This will be done in the first quarter of 2020.

Project tasks and completion dates may change as data are evaluated, which in turn may affect this initial schedule. If any schedule updates are required, the updates will be communicated to MDEQ and documented in the monthly progress reports.

8.3 Progress Reports

To provide updates to MDEQ on progress, monthly progress reports will be submitted during the CMS (last day of each month) and will include the following:

- Percent (or tasks) of the CMS that is complete
- Summaries of findings in reporting period
- Summaries of all changes to the CMS
- Summaries of contacts with local community, public interest groups, or state
- Summaries of all contacts regarding access to off-site property (if applicable)
- Summaries of all problems encountered
- Actions being taken to rectify problems
- Changes in relevant personnel
- Projected work for next reporting period
- Where applicable, copies of daily reports, inspection reports, laboratory data, monitoring data, etc.

9.0 References

AECOM. 2015. *Sampling and Analysis Plan for Groundwater Monitoring*. May 2015.

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Tables

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
1940s	DuPont purchases much of the site property.
1956	DuPont completes construction of the neoprene and acetylene plants. DuPont begins manufacture of neoprene using hydrochloric acid and acetylene. The neoprene unit also produced chlorinated monomers, chloroprene and latex. The initial acetylene process used by DuPont (1955-1957) unlike the neighboring Union Carbide acetylene plant did not produce lime by-product.
1958	DuPont begins using the Northeast Landfill for disposal of neoprene and acetylene manufacturing-related wastes.
1960	DuPont begins using the North Landfill. Wastes disposed were from the neoprene and acetylene manufacturing processes.
1961	DuPont purchases neighboring Union Carbide acetylene facility (This process generated hydrated lime as a by-product. The by-product was accumulated in the Lime Pile).
1963	Interceptor well IW-01 installed and begins extracting groundwater to capture constituents from the Lime Pile.
1965	DuPont begins manufacture of Freon® chlorofluorocarbons (CFCs). Production included CFC-11, -12, 13, 22, and 113. Waste disposal ceases at both the North and Northeast Landfills. DuPont begins using the Pierson Creek Landfill. Wastes disposed were from the neoprene and Freon® manufacturing processes.
1968	DuPont begins using the Bury Pit Landfill for disposal of site-related wastes.
1971	DuPont installs (August) a 6,514 foot deep injection well (Disposal Well #1) for the disposal of excess hydrochloric acid from the Freon® unit. This was necessary since previously, excess hydrochloric acid from the Freon® unit could be used in the Neoprene process.
1972	DuPont ceases production of neoprene. Waste disposal ceases at the Pierson Creek Landfill.
1982	Interceptor wells IW-03 and IW-04 installed downgradient of the Railcar Unloading Area. DuPont begins operation of a site pump and treat system for extracting groundwater downgradient of the Lime Pile and rail car transfer area. DuPont plugs and abandons Disposal Well #1 (the former acid injection well).
1985	Waste disposal ceases at the Bury Pit Landfill. Interceptor well IW-05 installed downgradient of the Lime Pile and added to the pump-and-treat system.
1988	DuPont established the independent entity Lime Specialties Inc. (LSI) to mine and market the lime material from the Lime Pile.

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
1989	EPA conducts (Nov) Visual Site Inspection of facility. DuPont Engineering Services Division, Solid Waste and Geologic Engineering (ESD, SWGE) submits (Jun) *Facility Assessment of E.I. du Pont de Nemours and Co., Montague Plant, Montague Michigan*. Engineering Services Division.
1990	CH2M Hill conducts Phase I Remedial Investigation.
1991	CH2M Hill submits (January) on behalf of DuPont, the *Remedial Investigation of Four Inactive Solid Waste Landfills* report. The subject landfills were the Northeast, North, Bury Pit, and Pierson Creek landfills. WW Engineering & Science issues (April) *Chemical and Physical Characterization of Calcium Fluoride Containing Sludge*.
1992	CH2M Hill submits (April) on behalf of DuPont, the *Phase IIA Remedial Investigation of Four Inactive Solid Waste Landfills* report.
1995	DuPont ceases production of Freon®.
1996	All operations at the Montague facility ended.
1998	Manufacturing plants demolished. Only structures left were related to the groundwater pump-and-treat system.
2000	MDEQ issues (Jan 7) closure certification acceptance letters. These letters document that the former hazardous waste storage areas were closed in accordance with applicable cleanup criteria. Letter noted that twelve WMUs and AOCs remained subject to corrective action and required further investigation. Eikon Planning and Design issue the report *Lime Pile Investigation Report, E.I. DuPont de Nemours and Co., Montague Works Facility*.
October 2003	DuPont submits the *Phase I Supplemental Groundwater Investigation Field Report*. Purpose of that work was to establish the east and west limits of the groundwater plume near White Lake. Report documented CPT field investigation conducted Dec 3-11, 2002 and sampling of residential wells (Jul-Aug 2003) along Lake Shore Drive.
December 2003	DuPont submits (Dec 5) the letter *Request to Alter Site Groundwater Monitoring Program for the DuPont Montague Site* to MDEQ.
February 2004	MDEQ (Ronda Blayer) issues (Feb 27) conditional approval letter to DuPont (Thomas Stilley) for *Request to Alter Site Groundwater Monitoring Program for the DuPont Montague Site*. Single condition of the letter was that wells that were being removed from the monitoring program would not be abandoned without written approval from MDEQ.
August 2006	MDEQ issues (Aug 11) the document *Corrective Action Work: DuPont E I De Nemours and Company, Montague Michigan*. This document requested four items: a site map showing the remaining WMUs/AOCs, a request to implement the proposed enhanced groundwater pump-and-treat system, a prioritization document for remaining WMUs/AOCs to be investigated, and a general schedule for conducting the investigations.
September 2006	DuPont submitted a groundwater flow model report to MDEQ that evaluated options for revising the groundwater pump-and-treat system.

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
October 2006	DuPont submitted (Oct 13) a formal request to Michigan Department of Environmental Quality (MDEQ) to implement the enhanced groundwater pump-and-treat system.
November 2006	DuPont submits the report *Prioritization of Waste Management Units and Areas of Concern* to MDEQ.
February 2007	DuPont (Thomas Stilley) submits (Feb 15) the *Remedial Investigation Work Plan for Waste Management Units and Areas of Concern* to MDEQ (Ronda Blayer).
August 2007	Michigan Environmental Resource Management Division (ERMD) issue (Aug 3) letter for the requirements for the Compliance Monitoring Program for the White Lake mixing zone. MDEQ forward these to DuPont (Thomas Stilley) for implementation.
August 2008	Construction activities associated with the enhanced groundwater pump-and-treat system were completed in August 2008, and the enhanced system started operation on August 21, 2008. Changes made to the pumping system in 2008.
October 2008	URS (Phil Chen) issues (Oct 14) letter to MDEQ (Dale Bridgford) presenting DuPont's proposed process to evaluate flow-weighted mean groundwater concentrations that flow toward White Lake in the mixing zone.
February 2009	DuPont submits (Feb 13) *Evaluation of Potential Groundwater Volatilization to Indoor Air* to MDEQ (Ronda Blayer). The evaluation determined indoor air impacts from groundwater are not a concern at any areas of the site.
September 2009	Performed cone penetrometer testing (CPT) groundwater sampling at Montague's White Lake Property in September 2009. This work defined the edges of extent for 1,1,2-trichlorotrifluoroethane (CFC-113), tetrachloroethylene (PCE), and carbon tetrachloride (CT) adjacent to White Lake. Based on the CPT study, locations for the mixing zone compliance wells were selected.
October-November 2009	Installed the White Lake mixing zone compliance monitoring wells (LTP-01, -02, and -03 well clusters and the WLP-02, -03, and -04) and the purge performance well (WLP-05-100).
December 2009	First quarterly mixing zone compliance sampling event.
October 2010	URS performs (Oct 10-15) groundwater, surface water and sediment sampling activities at Pierson Creek, related to the 2007 RI Work Plan.
February 2011	MDEQ (Dale Bridgford) issues (Feb 1) the memo *Mixing Zone Implementation* to (DuPont) Thomas Stilley. This letter clarified mixing zone concentration and mass flux limits for CFC-113, PCE, and carbon tetrachloride.
June 2011	URS performs (Jun 20-28) surface soil sampling activities at Pierson Creek Landfill, Northeast Landfill, Bury Pit Landfill, Basin Sludge Storage Area, former HCl Storage Tank Area, former process trench, and the former rail unloading areas related to the 2007 RI Work Plan.
July 2011	URS (George Gregory) submits (Jul 29) on behalf of DuPont the *Initial Mixing Zone Compliance Monitoring Report* to MDEQ (Ronda Blayer). This evaluation presented the first five quarters of results from the Mixing Zone Compliance wells.

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
March 2012	DuPont submits (Mar 12) a *Pollutant Minimization Plan (PMP)* to the MDEQ Water Resources Division (WRD). The PMP requested a change in sampling frequency for mercury in the treatment system influent and in the NPDES outfall.
May 2012	MDEQ (Luis Saldivia) issues approval letter to DuPont (Thomas Stilley) entited *Pollutant Minimization Plan (PMP) for Total Mercury 2012 Annual Report and Reduced Monitoring Request (National Pollutant Discharge Elimination System (NPDES)*).
June 2012	URS issues (Jun 29) on behalf of DuPont, the *Draft 2010/2011 Remedial Investigation Report* to MDEQ (Ronda Blayer).
August 2012	MDEQ provided updated Mixing-Zone based Groundwater Surface Water Interface (GSI) criteria by letter on August 22, 2012. Updated Mixing-Zone based GSI received on August 22, 2012.
October 2012	Well screen of IW-01-090 failed.
December 2012	Abandoned IW-01-090 and installed IW-08-142 as its replacement. IW-08-142 was brought online on December 18, 2012.
March 2013	DuPont (Thomas Stilley) submits (Mar 29) application to Michigan Department of Environmental Quality (David Timm) to renew NPDES permit #MI0000844 for the Montague Groundwater Control Unit (GWCU)
May 2013	URS issues on behalf of DuPont, 2013 *Supplemental Remedial Investigation Sampling Plan* to MDEQ. This plan was for groundwater sampling near areas of seepage to Pierson Creek and for deep soil sampling near the Waste Neoprene Landfill.
June 2013	URS conducts sampling at Pierson Creek and the former Waste Neoprene Landfill per the May 2013 *Supplemental Remedial Investigation Sampling Plan*.
September-October 2013	URS conducts deep borings at Pierson Creek Landfill and at the Bury Pit Landfill as well as soil sampling at the former Basin Sludge Storage Area.
March 2014	URS (George Gregory) issues (Mar 19) on behalf of DuPont the *Remedial Investigation Report - Addendum No. 1 Supplemental Investigation – Former Waste Neoprene Landfill and Former Basin Sludge Storage Area*.
May 2014	DuPont (Thomas Stilley) submits (May 16) the *Remedial Investigation Report - Addendum No. 2 Supplemental Investigation – Pierson Creek Landfill Area*. DuPont (Thomas Stilley) submits (May 30) the *Remedial Investigation Report - Addendum No. 3 Supplemental Investigation – Bury Pit Landfill*.
February 2015	Effective February 1, 2015, the Performance Chemicals reporting segment of E. I. du Pont de Nemours and Company (DuPont) completed a name and ownership change to The Chemours Company TT LLC (Chemours). Chemours operated as a wholly owned subsidiary of DuPont until June 30, 2015. Effective July 1, 2015, The Chemours Company became a wholly independent publicly traded company; therefore, on this date, the site is now under the operational control of Chemours.

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
April 2015	AECOM (George Gregory) submits (Apr 24) the technical memorandum *Proposed Revision to Monitoring Program* to MDEQ (Ronda Blayer). The technical memo presented a proposal for modification to the groundwater compliance sampling and analysis program.
May 2015	AECOM submits (May 19) on behalf of Chemours *Proposed Pierson Creek Area CPT Groundwater Sampling Program*.
June 2015	MDEQ issues (Jun 1) conditional approval letter entitled *Approval of Investigation Workplan for Pierson Creek Area*. Only condition was a request to add ammonia and the metals arsenic, and lead (both filtered and unfiltered) to the list of constituents for the CPT sampling.
October 2015	AECOM and Stratigraphics perform (Oct 5-7) CPT groundwater sampling on the west side of Pierson Creek. Two locations were planned, but one of these could not be penetrated with the CPT due to a hardpan near the top of the water table.
August 2016	Well screen IW-05-112 failed (Aug 25) during well cleaning. Well filled with sand after screen failure.
Late 2016 - Early 2017	Readjustments made to flow rates to mitigate the effect of IW-05-112 being unusable. Initial change (late 2016-early 2017) was to increase IW-06-140 slightly. By March of 2017, more of the flow was rebalanced to come from IW-07-144.
May 2017	MDEQ (Ronda Blayer) issues (May 15) *Conditional Approval of the April 2015 Sampling and Analysis Plan* to Chemours (Sathya Yalvigi). Primary condition was that Chemours would adhere to a monitoring frequency provided by MDEQ in the letter.
June 2017	AECOM performs (Jun 6-7) annual groundwater sampling event per the 2015 SAP as modified by the MDEQ in the Conditional Approval Letter. AECOM issues (Jun 23) on behalf of Chemours *Proposed Pierson Creek Area Well Cluster PCL-007*. This technical memo presented the scope to install a three-well cluster on the western side of Pierson Creek to confirm that constituents of concern (COCs) from the Pierson Creek Landfill have not crossed under Pierson Creek toward Lake Michigan. IW-05-112 was plugged and abandoned. IW-09-140 was drilled and connected to the pump-and-treat system with start up on Jun 27, 2017.
August 2017	MDEQ (Ronda Blayer) issues email to Chemours (Sathya Yalvigi) and AECOM (George Gregory) approving the scope of work proposed in the memo *Proposed Pierson Creek Area Well Cluster PCL-007* dated June 23, 2017.
September 2017	Cascade Drilling and AECOM install (Sep 26-28) monitoring wells PCL-007-070, -094, and -112.
October 2017	AECOM performs semi-annual groundwater sampling event. In addition to the wells scheduled to be sampled per the SAP, the first groundwater samples were collected from the new interceptor well (IW-09-140) and the new Pierson Creek three-well cluster (PCL-007).

Table 1-1
Chronology of Key Site History and Corrective Action
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Date	Description/Action
March 2018	AECOM issues (Mar 9) *2017 Groundwater Monitoring Result*. This report documented the data collected during 2017, provided an update of the pump-and-treat system operation, and provided trend analysis of the site groundwater conditions.
April 2018	MDEQ (Dale Bridgford) issues (Apr 5) email to AECOM (George Gregory) and Chemours (Sathya Yalvigi) requesting that a plan for sampling groundwater and the NPDES outfall be developed for Per- and Polyfluoroalkyl Substances (PFAS).
May 2018	Site meeting held (May 16) to discuss the site status, future land use, proposed CMS process and the plan for PFAS sampling. AECOM performs (May 21-24) groundwater sampling event. Semiannual, annual, and biennial frequency wells were sampled during this event.
June 2018	AECOM issues (Jun 26) technical memo *First Half 2018 Groundwater Monitoring Data*. This technical memo presented the results from the May 2018 groundwater sampling event.
August 2018	AECOM issues (Aug 8) on behalf of Chemours *Proposed Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS).* MDEQ (Dale Bridgford) issues (Aug 15) email to AECOM (George Gregory) approving the scope of work proposed in the memo *Proposed Pierson Creek Area Well Cluster PCL-007* dated Jun 23, 2017. AECOM performs (Aug 22-23) groundwater sampling event for PFAS constituents.
October 2018	AECOM issues (Oct 2) on behalf of Chemours *Per- and Polyfluoroalkyl Substances (PFAS) Sampling Results*. This technical memo presented the results, which indicated that very low concentrations of three PFAS compounds were detected below drinking water criteria and that no additional sampling was recommended.

Table 3-1
Status of Site Investigation
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

WMU/AOC[1]	Site Investigation		Corrective Measures Study	
	No Further Investigation	Reports documenting data	No Further Actions Needed	Proceed to CMS
Northeast Landfill	✓	2012 Investigation Report		✓
North Landfill	✓	2012 Investigation Report		✓
Bury Pit Landfill	✓	2014 Addendum No. 3		✓
Pierson Creek Landfill	✓	2014 Addendum No. 2		✓
Pierson Creek	pending MDEQ	2017 Annual Report[2]		✓
Former Basin Sludge Storage Area	✓	2014 Addendum No. 1		✓
Waste Neoprene Landfill	✓	2014 Addendum No. 1		✓
Lime Pile	✓	2006 Prioritization Report		✓
Mirror Lake	✓	2012 Investigation Report		✓
Calcium Fluoride Basin	✓	2006 Prioritization Report		✓
Railcar Unloading Area East	✓	2012 Investigation Report	✓	
Railcar Unloading Area West	✓	2012 Investigation Report	✓	
Former HCl Storage Tanks	✓	2012 Investigation Report	✓	
HCl Injection Well	✓	2006 Prioritization Report	✓	
Former NPDES Surface Impoundment/Wastewater Dit	✓	2012 Investigation Report	✓	
Condensate Accumulation Area	✓	2006 Prioritization Report	✓	
Groundwater plume from Former Manufacturing Area (interceptor well system operating)	✓	2012 Investigation Report and groundwater monitoring reports.		✓

Notes:

✓: Proposed path forward is denoted with a checkmark.

2006 Prioritization Report:	*Prioritization of Waste Management Units and Areas of Concern. November 2006*
2012 RI Report:	*Draft 2010/2011 Remedial Investigation Report.* June 29, 2012.
2014 Addendum No. 1	*Remedial Investigation Report - Addendum No. 1 Supplemental Investigation – Former Waste Neoprene Landfill and Former Basin Sludge Storage Area.* March 19, 2014.
2014 Addendum No. 2	*Remedial Investigation Report - Addendum No. 2 Supplemental Investigation – Pierson Creek Landfill Area*. May 16, 2014.
2014 Addendum No. 3	*Remedial Investigation Report - Addendum No. 3 Supplemental Investigation – Bury Pit Landfill*. May 30, 2014.
2017 Annual Report	*2017 Groundwater Monitoring Results*. March 9, 2018.

1: Note that the site has not used an ID system to differentiate WMUs (units in which wastes were handled) or AOCs (areas in which site-related constituents have been found).

2: Had been asked by MDEQ to demonstrate that PCL-007 well has not been compromised.

Table 4-1
Corrective Action Drivers
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Unit	Exposure or Migration Pathway			Site Restoration	Notes
	Direct Contact	Migration to Groundwater	Discharge to Surface Water		
Northeast Landfill	✓	✓			**Waste items exposed at the surface in these landfills.**
North Landfill	✓				
Bury Pit Landfill	✓				
Pierson Creek Landfill	✓	✓	✓		**Groundwater discharge to Pierson Creek**
Pierson Creek	✓				
Former Basin Sludge Storage Area				✓	**These units are under or are related to the Lime pile.**
Waste Neoprene Landfill				✓	
Lime Pile		✓		✓	
Mirror Lake		✓		✓	
Calcium Fluoride Basin	✓			✓	
Groundwater plume from Former Manufacturing Area	✓		✓		**Extraction system already in place.**

Notes:

✓: Confirmed or potential concern at this unit.

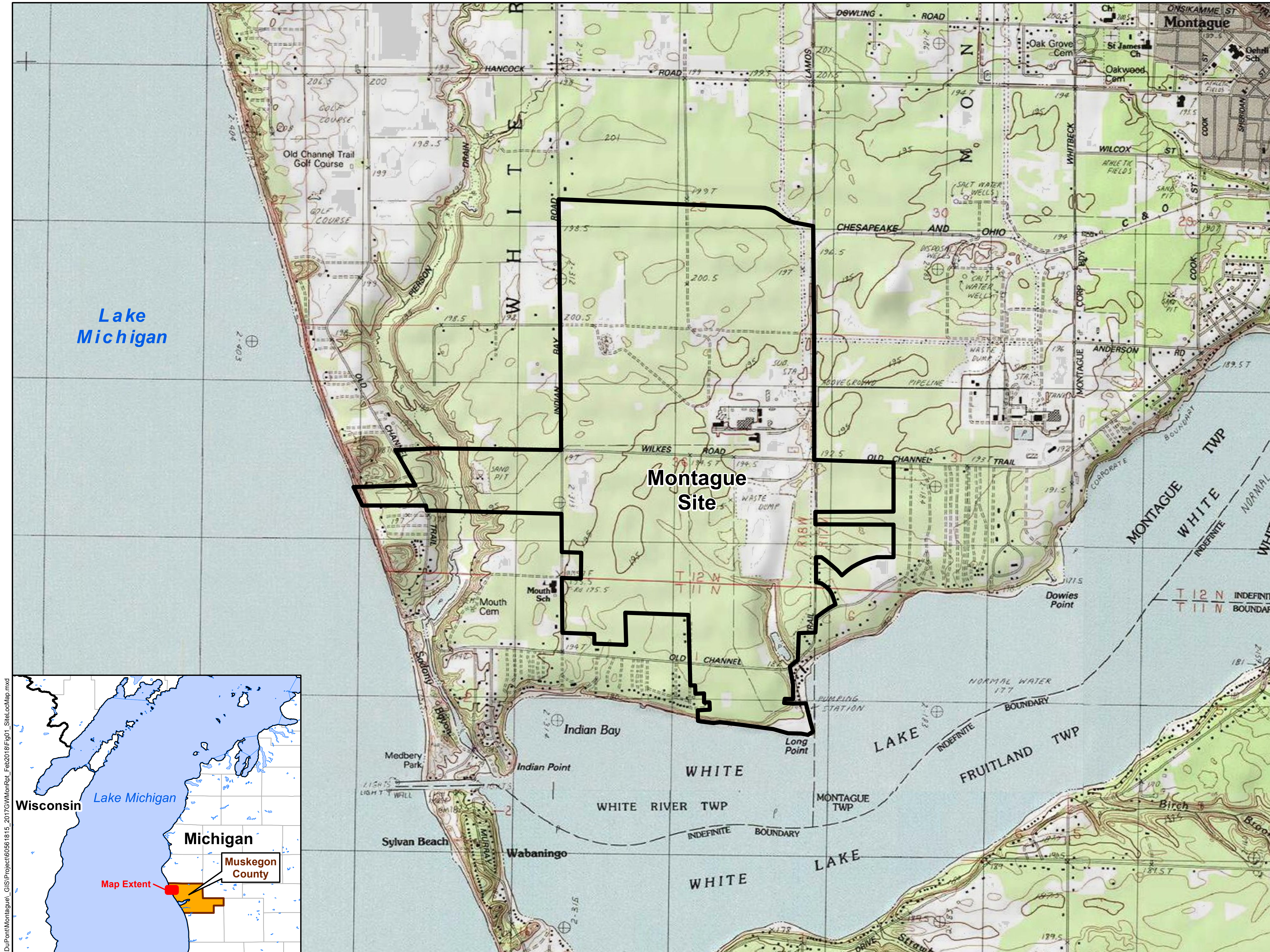
Table 5-1
Proposed Technology Screening
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

Unit	Technology Catagories							
	Institutional Controls	Groundwater Monitoring and Monitored Natural Attenuation	Groundwater Containment	Capping	On-Site Treatment	Off-Site Disposal	Off-Site Re-Use	On-Site Consolidation
Northeast Landfill	✓	✓		✓	✓	✓		✓
North Landfill	✓			✓	✓	✓		✓
Bury Pit Landfill	✓			✓	✓	✓		✓
Pierson Creek Landfill	✓	✓		✓	✓	✓		✓
Pierson Creek	✓	✓						
Former Basin Sludge Storage Area	✓			✓			✓	✓
Waste Neoprene Landfill	✓			✓			✓	✓
Lime Pile	✓			✓			✓	
Mirror Lake	✓			✓		✓	✓	
Calcium Fluoride Basin	✓			✓	✓	✓		✓
Groundwater plume from Former Manufacturing Area	✓	✓	✓					

Notes:

✓: Potential treatment option at this unit. Technology will be screened to determine if it should be considered in the Feasability Study.

Figures



Legend

Site Boundary

NOTES:
USGS Topographic Map Copyright:© 2013 National Geographic Society, i-cubed

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

0 1,000 2,000 4,000
Feet

1 inch = 2,000 feet

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

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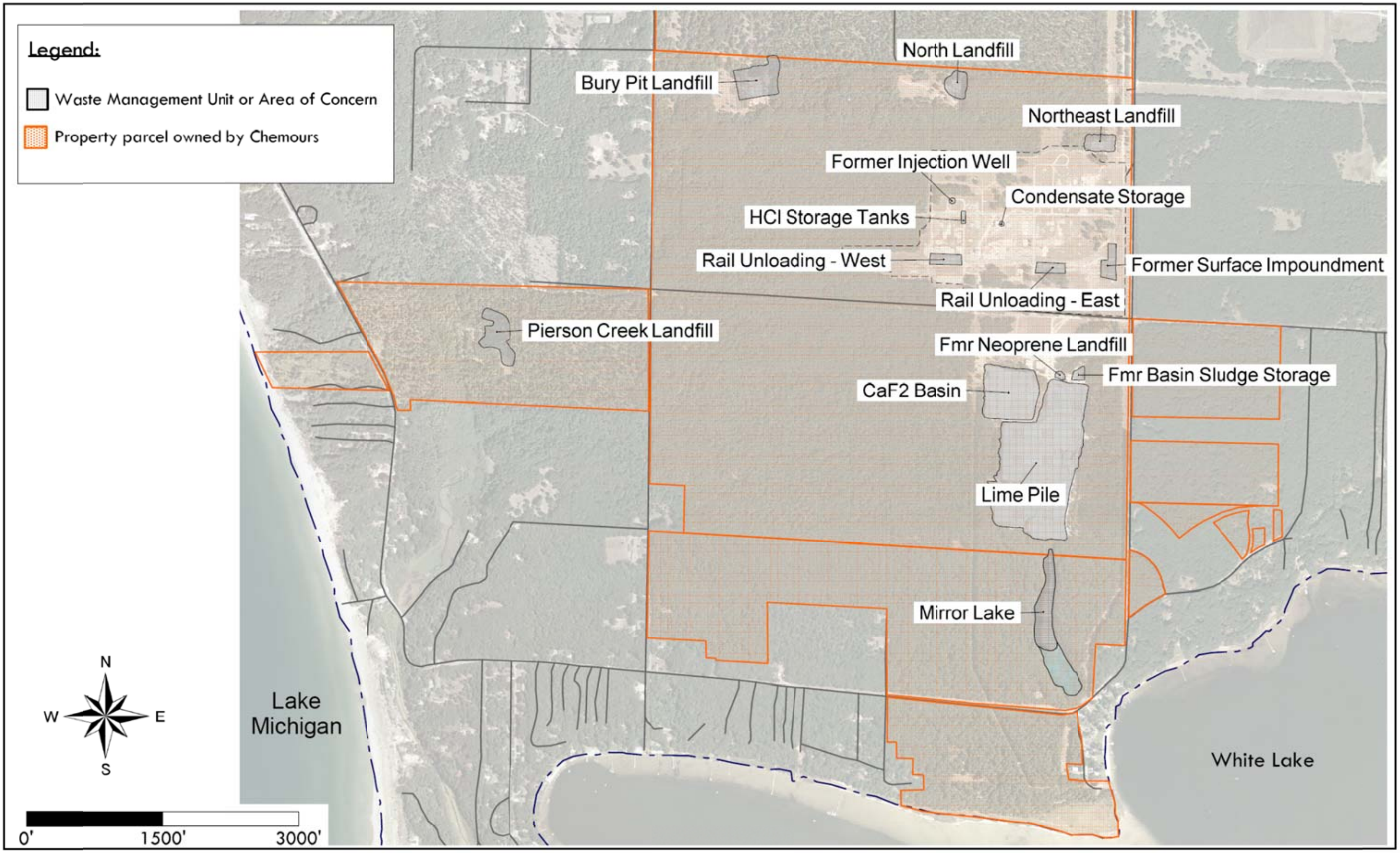
SITE LOCATION MAP

Corrective Measures Study Work Plan
Chemours Montague Facility
Montague, Michigan

TASK NUMBER: 201850	PROJECT NUMBER: 60561815
DESIGNED BY: C. DUFFY	DATE: 09/14/2018
DRAWN BY: C. DUFFY	FIGURE NUMBER: 1-1
DATA QUALITY CHECK BY: G. GREGORY	



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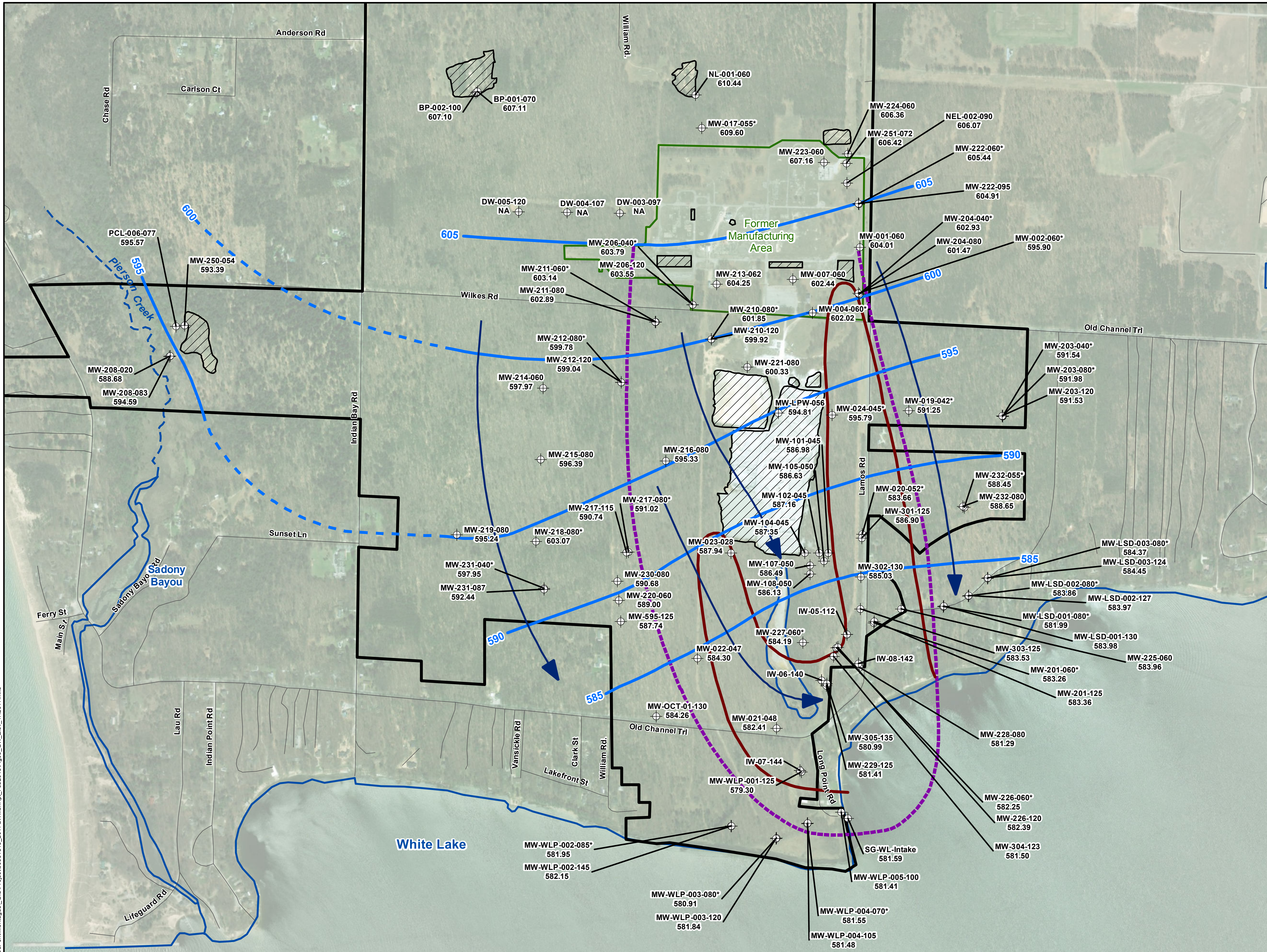
Newark, DE 19713

TITLE:
WMU/AOC Map
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN: GEG	APPD:	PROJECT NO: 60426635	
CHKD: JMM	REV:	FIGURE NO: 2-1	
DATE: 10/23/2018			



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Legend

- Groundwater Monitoring Location with Well ID and Elevation (in feet)
- Potentiometric Surface Contour (in feet)
- Estimated Potentiometric Surface Contour (in feet)
- Groundwater Flow Direction (Approximate)
- Limit of FAV Plume (Approximate)
- Modeled Capture Zone
- Chemours Property Line
- Road Centerline
- Pierson Creek
- Surface Water Feature
- Waste Management Unit (WMU) or Area of Concern (AOC)
- Former Manufacturing Area

NOTES:
Elevations measured in June 2017.
NA - Not available
Deeper well data used to interpret contours.
*Well not used in contouring.
2015 Vivid - USA Imagery Source: DigitalGlobe

Area Map

N W E S

0 500 1,000 2,000
Feet
1 inch = 1,000 feet

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

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POTENTIOMETRIC SURFACE MAP (1H2017)

Corrective Measures Study Work Plan
Chemours Montague Facility
Montague, Michigan

TASK NUMBER: 201850	PROJECT NUMBER: 60426164
DESIGNED BY: G. GREGORY	DATE: 10/10/2018
DRAWN BY: C. DUFFY	FIGURE NUMBER: 2-2
DATA QUALITY CHECK BY: N. WENDEL	

Legend:

Waste Management Unit or Area of Concern

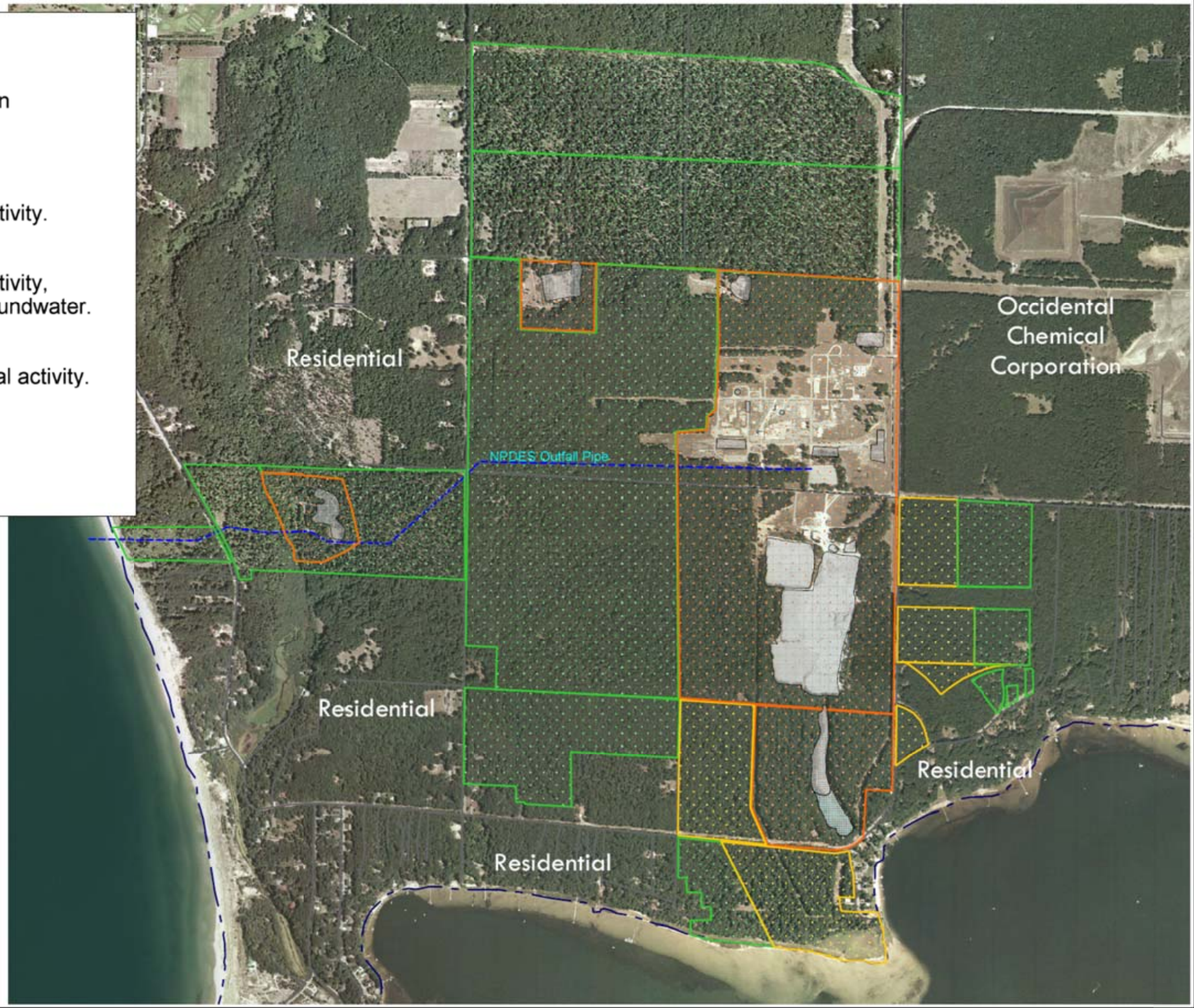
Property parcels owned by Chemours:

No past waste management or industrial activity. Potential for unrestricted re-development.

No past waste management or industrial activity, but site-related constituents detected in groundwater. Restrictions to use of groundwater.

Past or current waste management/industrial activity. Would require institutional controls.

Photograph Source:
High Resolution Orthoimage GeoTIFF,
Grand Rapids, MI, August 2005.



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AECOM

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Newark, DE 19713

TITLE:
Land Use Map
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN:	APPD:	PROJECT NO:
GEG		60426635
CHKD: JMM	REV:	FIGURE NO: 2-3
DATE: 10/26/2018		

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Newark, DE 19713

TITLE:
Northeast Landfill
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN: GEG	APPD:	PROJECT NO: 60426635
CHKD: JMM	REV:	FIGURE NO: 3-1
DATE: 10/23/2018		

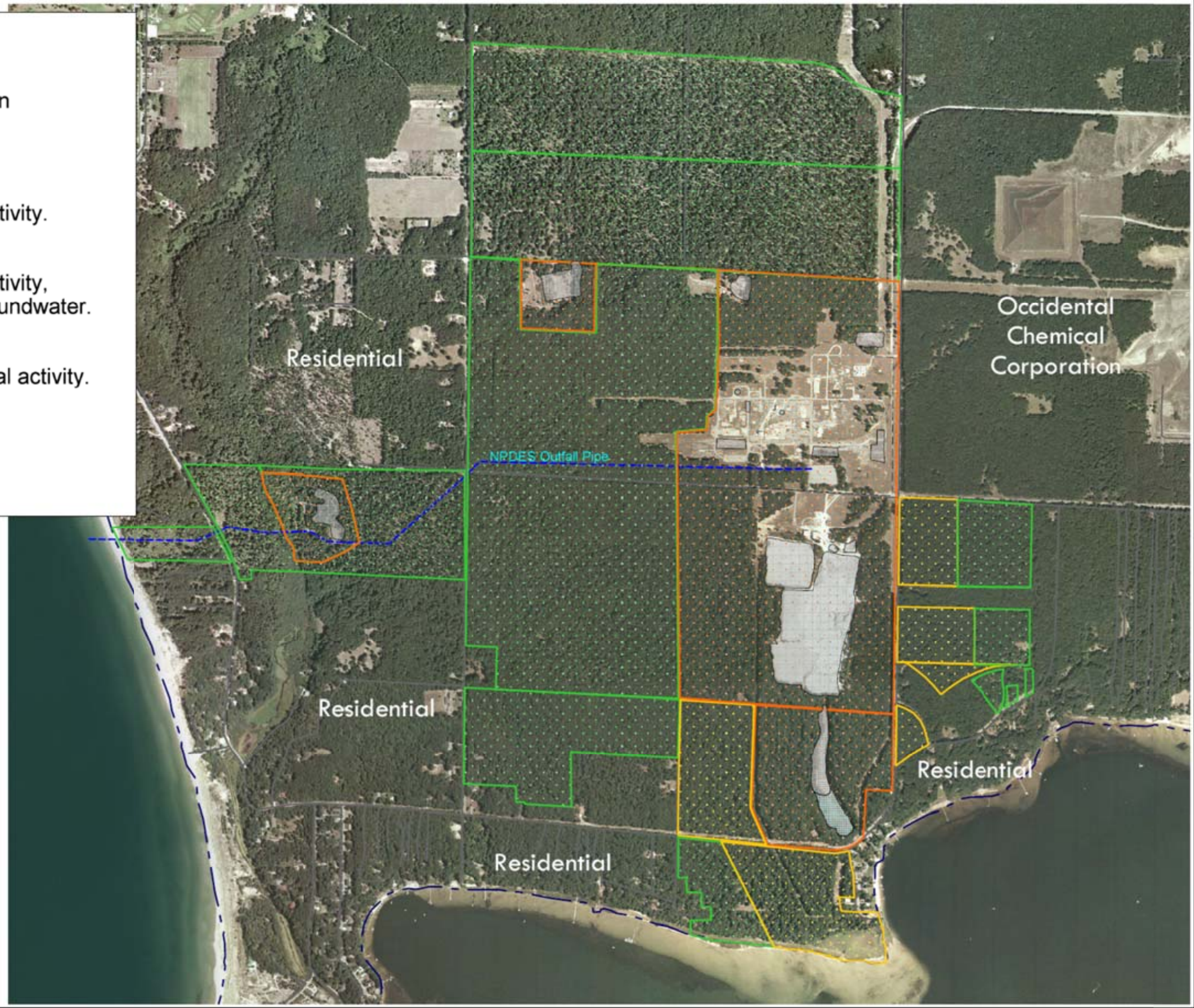
Legend:

Waste Management Unit or Area of Concern

Property parcels owned by Chemours:

- No past waste management or industrial activity. Potential for unrestricted re-development.
- No past waste management or industrial activity, but site-related constituents detected in groundwater. Restrictions to use of groundwater.
- Past or current waste management/industrial activity. Would require institutional controls.

Photograph Source:
High Resolution Orthoimage GeoTIFF,
Grand Rapids, MI, August 2005.



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0' 2000' 4000'

AECOM Sabre Building, Suite 300 4051 Ogletown Road Newark, DE 19713	TITLE: Land Use Map Corrective Measures Study Work Plan Chemours Montague Site Montague, Michigan	DWN: GEG APPD: CHKD: JMM REV: DATE: 10/26/2018	PROJECT NO: 60426635 FIGURE NO: 2-3

Legend:

Monitoring Well

Extraction Well

Notes:

Extent of unit is approximate.
Date Active: 1968 to 1985
Area: 3.8 acres
Waste: 5 to 18 feet
Fenced? No.
Soil cover? Native sandy soil
Vegetated? Partially - grass and trees

Photograph Source:
USGS High Resolution Orthoimage
Muskegon County, Michigan, 2008.

AECOM Sabre Building, Suite 300 4051 Ogletown Road Newark, DE 19713	TITLE: Bury Pit Landfill Corrective Measures Study Work Plan Chemours Montague Site Montague, Michigan	DWN: GEG APPD: CHKD: JMM REV: DATE: 10/23/2018	PROJECT NO: 60426635 FIGURE NO: 3-3

AECOM
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Newark, DE 19713

TITLE:
Former Basin Sludge Area and Waste Neoprene Landfill
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN:	APPD:	PROJECT NO:
GEG		60426635
CHKD: JMM	REV:	FIGURE NO:
DATE: 10/23/2018		3-4

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Newark, DE 19713

TITLE:	Former Hydrogen Chloride Tank Areas Corrective Measures Study Work Plan Chemours Montague Site Montague, Michigan
DWN:	GEG
APPD:	
CHKD:	JMM
REV:	
DATE:	10/23/2018
PROJECT NO:	60426635
FIGURE NO:	3-5

Legend:

Monitoring Well

Extraction Well

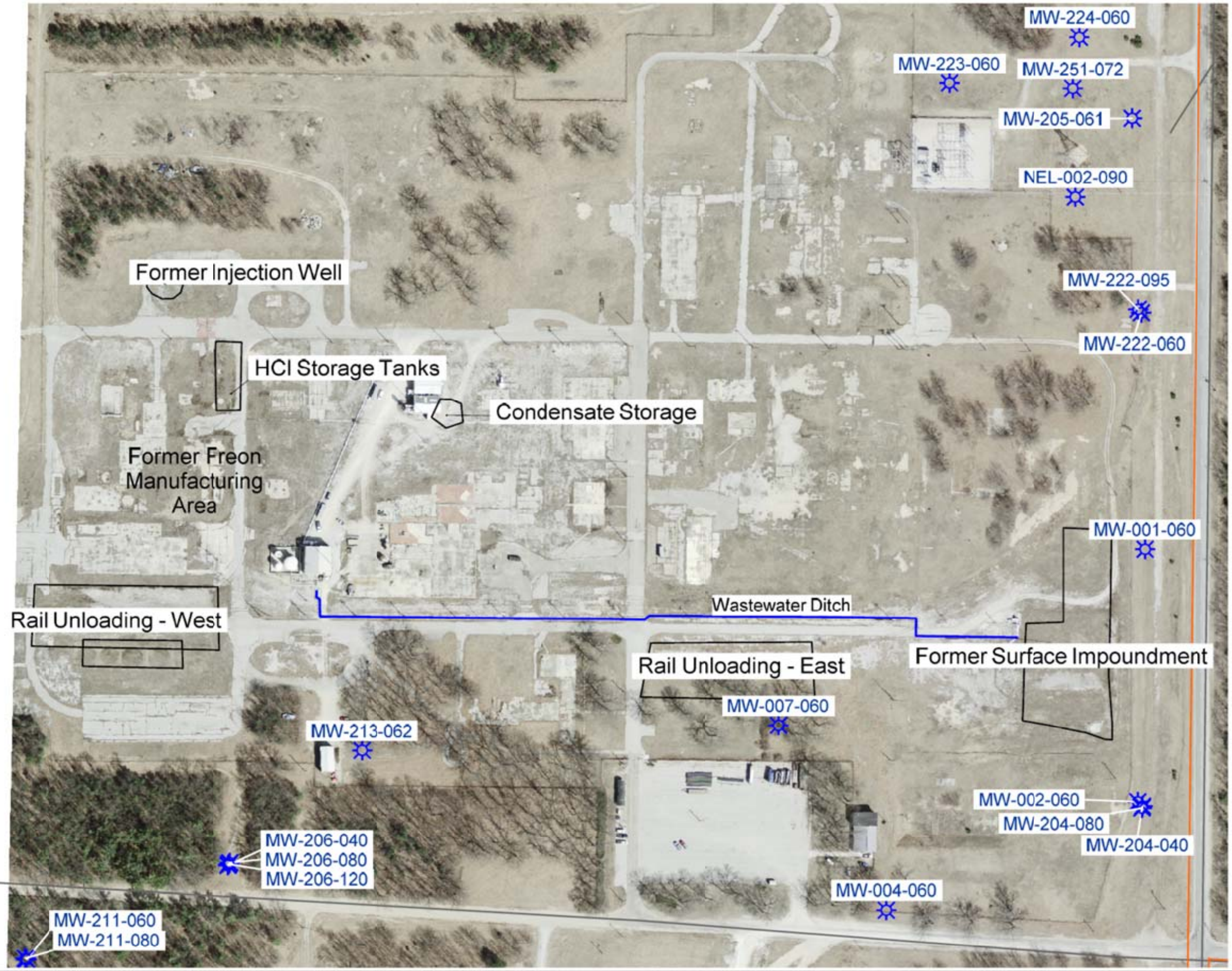
Notes:

Unit extents are approximate.

Surface Impoundments
Year removed: after 1998
Area: 0.14 acres
Waste: removed
Fenced? Within site perimeter
Soil cover? yes
Vegetated? grass-covered

Waste Water Ditch
Year removed: NA
Length: approx. 1400 feet
Waste: NA
Fenced? Within site perimeter

Photograph Source:
USGS High Resolution Orthoimage
Muskegon County, Michigan, 2008.



N
W E
S

0' 300' 600'

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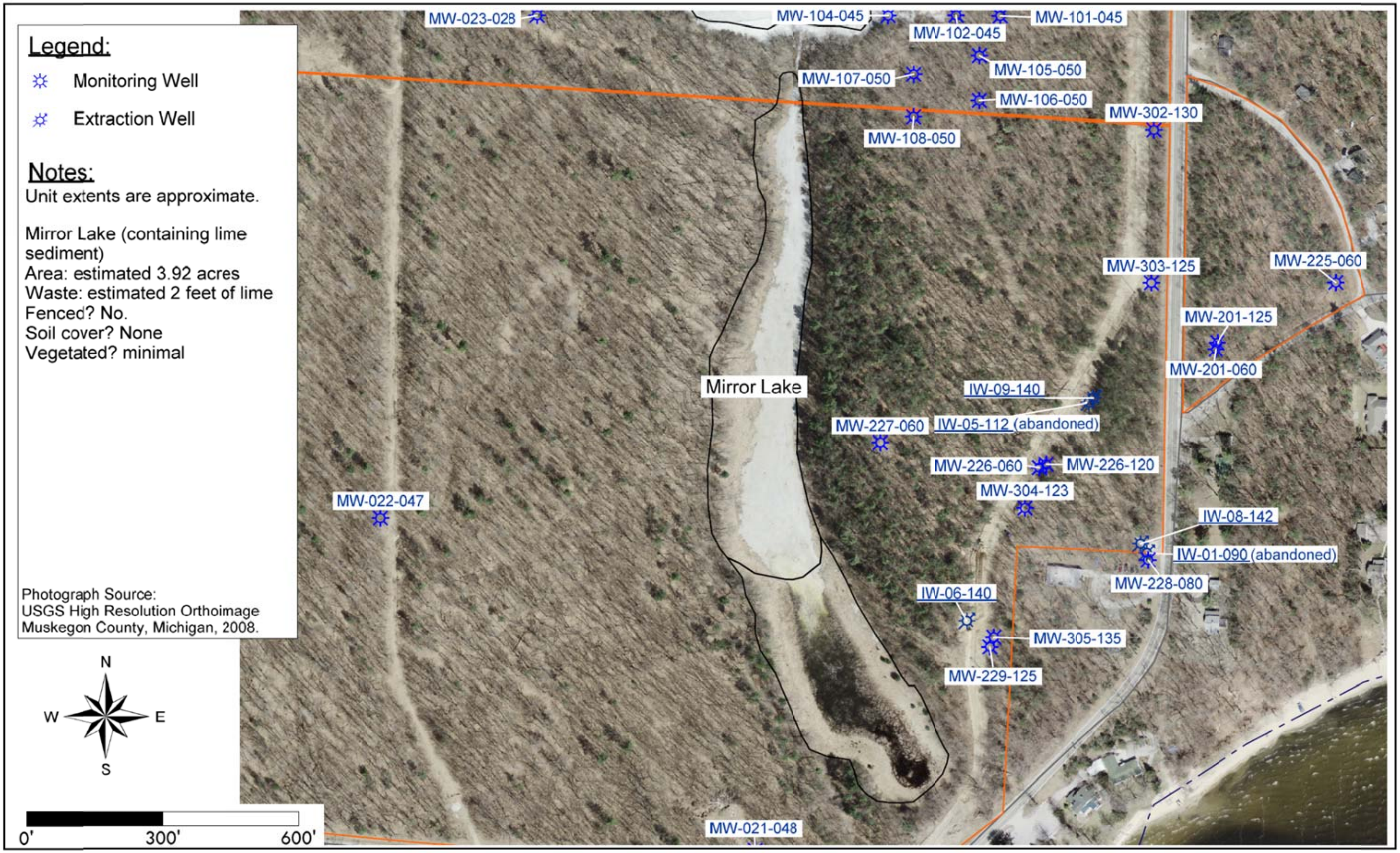
TITLE:
Former NPDES Surface Impoundment/Wastewater Ditch
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN:	APPD:	PROJECT NO:
GEG		60426635
CHKD: JMM	REV:	FIGURE NO:
DATE: 10/23/2018		3-6



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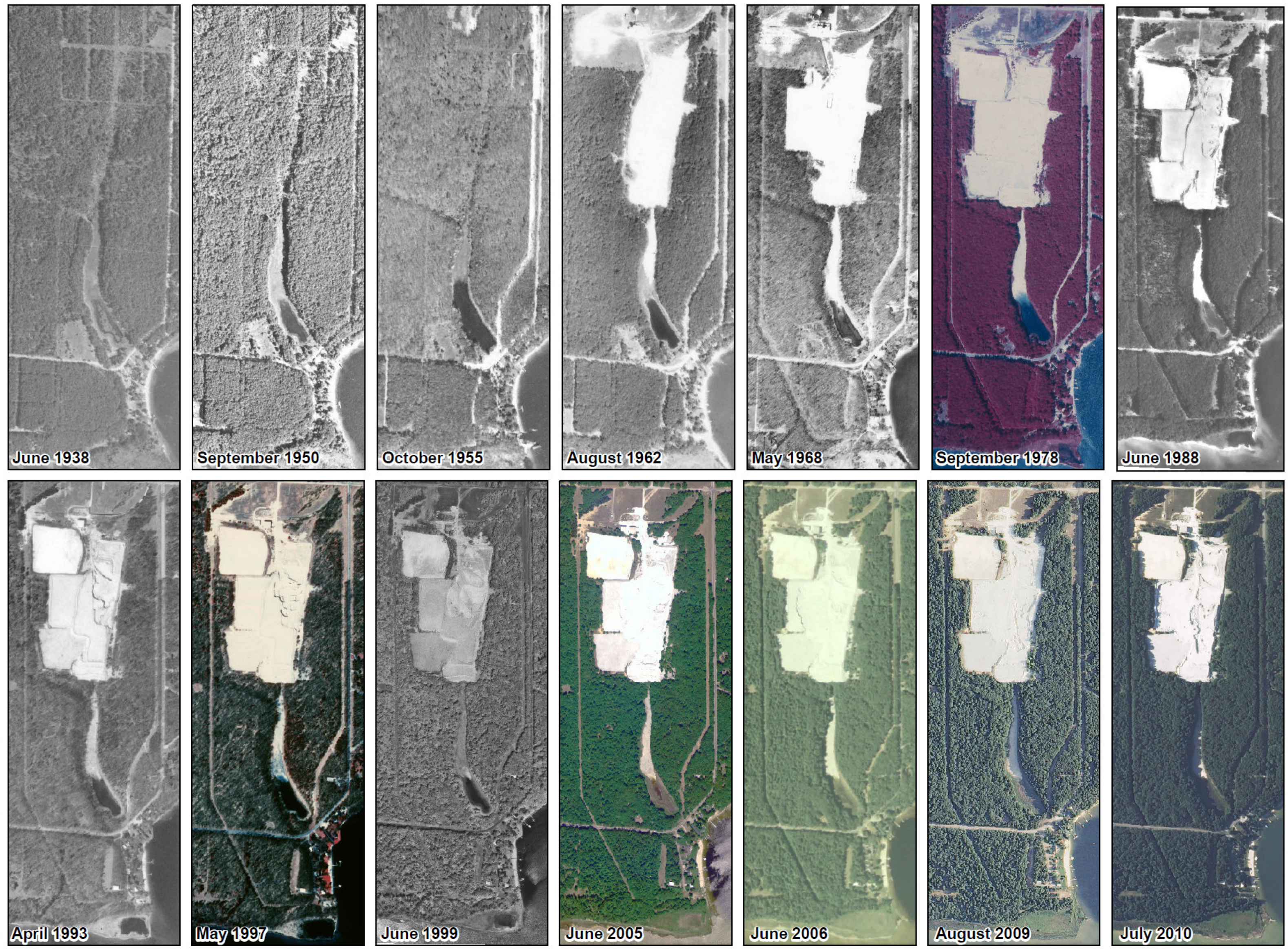
TITLE: Mirror Lake Corrective Measures Study Work Plan Chemours Montague Site Montague, Michigan	DWN: GEG	APPD:	PROJECT NO: 60426635
	CHKD: JMM	REV:	FIGURE NO: 3-7
	DATE: 10/23/2018		

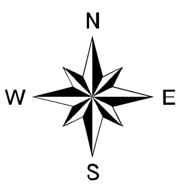
Notes:

1938, 1950, 1955, 1962, & 1968
Aerial credit:
Michigan State University
Aerial Imagery Archive.

1978, 1988, 1992, 1998, & 1999
Aerial credit:
Michigan Department of Natural
Resources (MI DNR).

2005, 2006, 2009, & 2010
Aerial credit:
National Agriculture Imagery
Program (NAIP).





0 1,125 2,250
Feet

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TITLE:	DWN:	APPD:	PROJECT NO:
Historic Aerial Photography Timeline Mirror Lake Corrective Measures Study Work Plan Chemours Montague Site Montague, Michigan	GEG		60426635
	CHKD: JMM	REV:	FIGURE NO: 3-8
	DATE: 10/23/2018		

Legend:

- Monitoring Well
- Extraction Well

Notes:

Unit extents are approximate.

Mirror Lake (containing lime sediment)
Area: estimated 3.92 acres (2.5 acres in 2000 Synagro Report)
Lime thickness: estimated 2 feet
Fenced? No.
Soil cover? None
Vegetated? minimal

Lime Pile
Area: 29.14 acres
Lime thickness: 5-53 feet (per 2000 Synagro Report)
Fenced? No.
Soil cover? None
Vegetated? minimal

Photograph Source:
USGS High Resolution Orthoimage
Muskegon County, Michigan, 2008.

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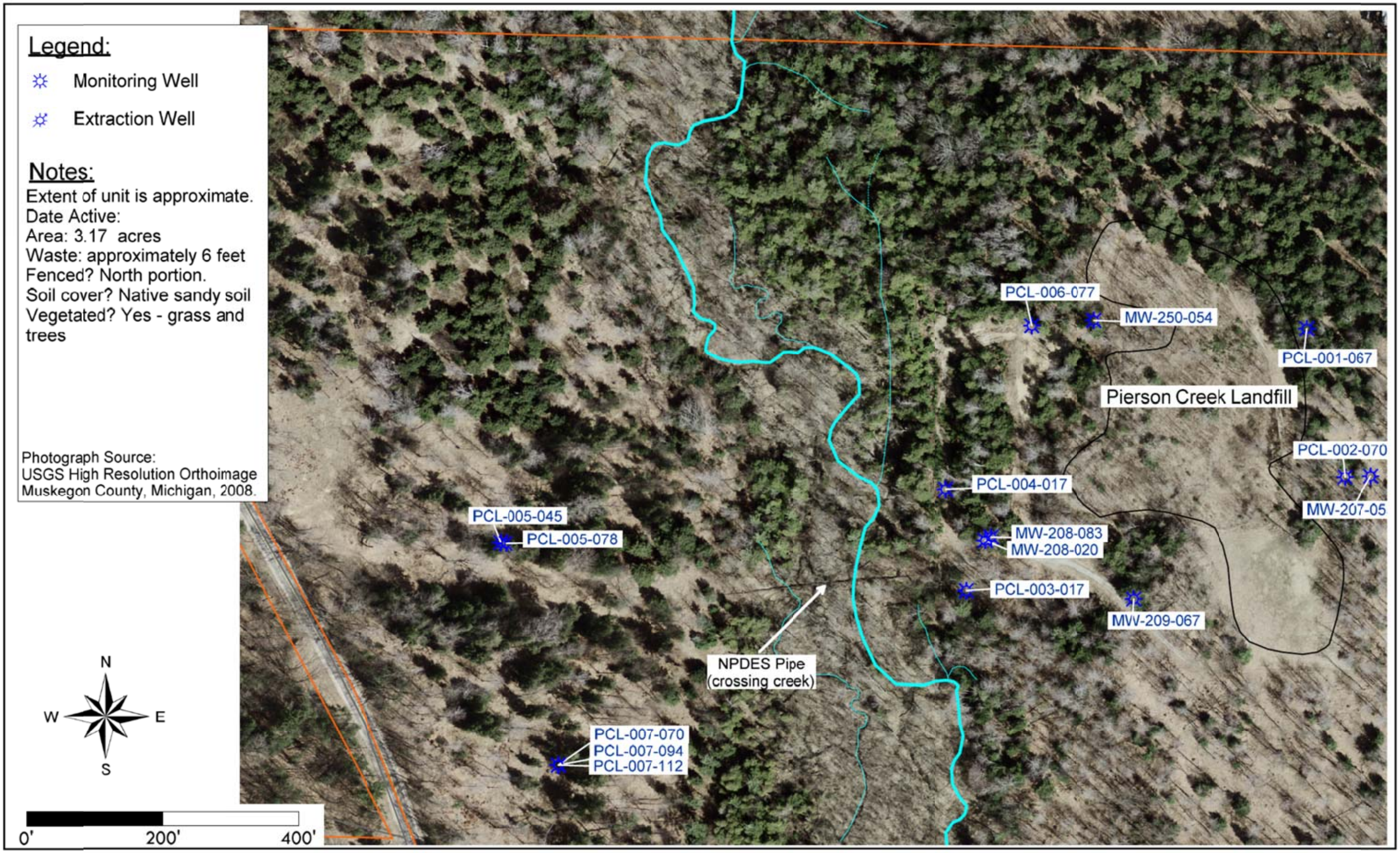
TITLE:
Calcium Fluoride Basin and Lime Pile
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN:	APPD:	PROJECT NO:
GEG		60426635
CHKD: JMM	REV:	FIGURE NO: 3-9
DATE: 10/23/2018		



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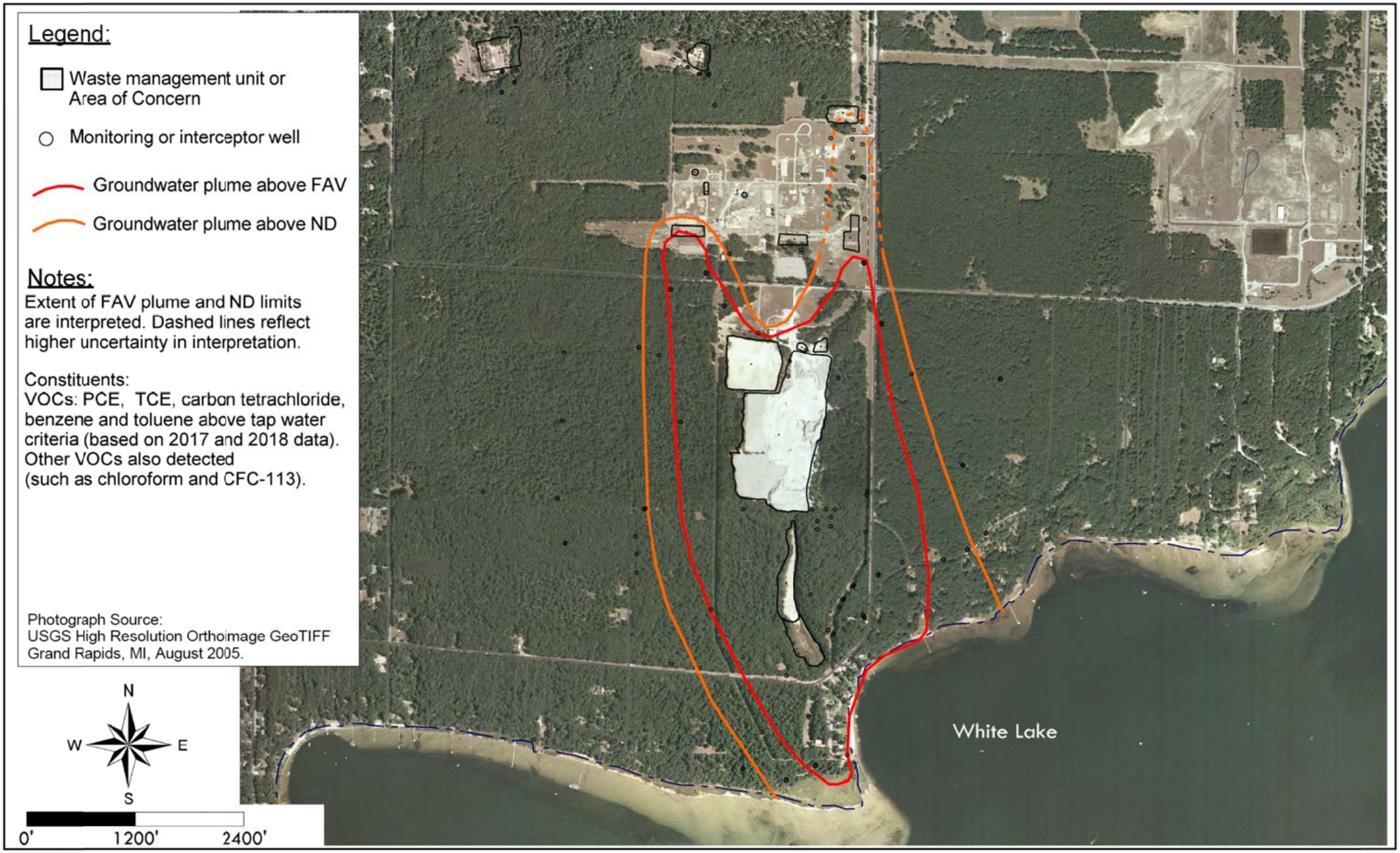
TITLE:
Pierson Creek Landfill
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN: GEG	APPD:	PROJECT NO: 60426635
CHKD: JMM	REV:	FIGURE NO: 3-10
DATE: 10/23/2018		



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TITLE:
Groundwater Plume from Former Manufacturing Area
Corrective Measures Study Work Plan
Chemours Montague Site
Montague, Michigan

DWN: GEG	APPD:	PROJECT NO: 60426635	
CHKD: JMM	REV:	FIGURE NO: 3-11	
DATE: 10/25/2018			

Figure 8-1
CMS Schedule
Corrective Measures Work Plan
Chemours Montague Site
Montague, Michigan

	4Q2018			1Q2019			2Q2019			3Q2019			4Q2019			1Q2020		
	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
CMS Work Plan Submited	♦																	
CMS Work Plan Approval			♦															
Preliminary Technology Screening			♦															
Voluntary Corrective Action Agreement			♦															
Data gaps fieldwork - dioxin/furan sampling at Bury Pit																		
Data gaps fieldwork - confirmation of Bury Pit footprint																		
CMS Report - Alternatives Development																		
Data gaps fieldwork - Mirror Lake Lime thickness																		
CMS Report - Generation of CMS Report								♦										
Joint Chemours-MDEQ Meeting to discuss alternatives screened								♦										
CMS Report - review by MDEQ										♦								
CMS Report - Revised												♦						
MDEQ publishes develops and issues final remedy decision															♦			
CMI Work plan (after final remedy decision)																		♦