SECOND FIVE-YEAR REVIEW REPORT
HERCULES, INC. (GIBBSTOWN PLANT) SUPERFUND SITE
GIBBSTOWN, NEW JERSEY

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

1/24/20

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ACO	Administrative Consent Order
AOC	Administrative Order on Consent
BERA	Baseline Ecological Risk Assessment
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
CY	Cubic Yards
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FYR	Five-Year Review
GWQS	New Jersey Groundwater Quality Standard
ICs	Institutional Controls
IRM	Interim Remedial Measure
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCB	Polychlorinated Biphenyl
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SCC	New Jersey Department of Environmental Protection Soil Cleanup Criteria
SVOC	Semi-Volatile Organic Compound
SWDA	Solid Waste Disposal Area
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
VOC	Volatile Organic Compound
WRA	Well Restriction Area

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of FYRs are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR for the Hercules, Inc. (Gibbstown Plant) site (Site) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Section 300.430(f)(4)(ii)) and considering EPA policy.

This is the second FYR for the Site. The triggering action for this statutory FYR is April 1, 2015, the signature date of the previous FYR report. The FYR has been conducted because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

The Site is being addressed under three operable units (OUs). OU1 focuses on the groundwater in the Former Plant Area, OU2 is associated with the soil in the Former Plant Area and the sediment and surface water in Clonmell Creek, and OU3 addresses an area of the Site designated as the Solid Waste Disposal Area (SWDA), in which tar material and miscellaneous solid waste were disposed. On January 25, 1996, a Record of Decision (ROD) was issued, selecting a remedy for OU3. The remedial action for OU3 has been implemented. This FYR will evaluate the remedy implemented for OU3. A ROD was issued on September 25, 2018, selecting a remedy for OU1 and OU2. Negotiations with the potentially responsible party for the performance of the remedial designs and remedial actions for OUs 1 and 2 are currently underway. See Appendix C – Site History, Geology/Hydrogeology and Land Use for details related to OU1 and OU2.

The FYR was led by Patricia Simmons Pierre, the EPA Remedial Project Manager. Other EPA participants included Joel Singerman (Central New York Remediation Section Chief), Lora Smith (Human Health Risk Assessor), Mindy Pensak (Ecological Risk Assessor), Michael Scorca and Hannah Greenberg (Hydrogeologists), and Pat Seppi (Community Involvement Coordinator).

Site Background

The Site is a former chemical manufacturing plant, situated on approximately 350 acres located off South Market Street in Gibbstown, Gloucester County, New Jersey. The Site property is bounded to the east by Paulsboro Refining Company, LLC, to the west by open land owned by E.I. du Pont de Nemours and Company (DuPont), to the north by the Delaware River, and to the south and southwest by residences. Area homes are served by municipal water supply wells.

Clonmell Creek flows northwest through the Site toward the Delaware River. On the Site property, the creek ranges from 75 to 120 feet (ft.) wide and 0.25 to 3 ft. deep and separates the two primary areas of the Site —the Former Plant Area and the SWDA. A Site map is provided in Figure 1 of Appendix A.

The Former Plant Area was the manufacturing portion of the Hercules Higgins Plant (Plant) during its operational period. It occupies approximately 80 acres and is located to the south of Clonmell Creek. Phenol and acetone were manufactured at the Plant from 1959 until 1970. After 1970, the Plant produced three primary products--cumene hydroperoxide; diisopropylbenzene hydroperoxide; and dicumyl peroxide. The Plant was decommissioned in 2010 and the Site is now predominantly vacant and unused, except for a groundwater treatment system, a former administrative building, two surface impoundments, and a few remaining building foundations and structures.

The SWDA is situated approximately 2,000 ft. north of Clonmell Creek and covers nearly five acres. It is surrounded by wetlands and sits adjacent to the Delaware River. A levee, regulated by the U.S. Army Corp of Engineers, separates the Delaware River from the SWDA. Historically, the SWDA and surrounding areas were used to dispose of lead fragments and tar generated from the production of aniline and wastes associated with the Plant's manufacturing activities.

Appendix B, attached, summarizes the documents utilized to prepare this FYR.

Appendix C, attached, summarizes the Site's history, geology/hydrogeology and land use. Additional details related to background, physical characteristics, geology/hydrogeology, land/resource use, and history related to the Site can be found at https://www.epa.gov/superfund/hercules-gibbstown, EPA's webpage for the Site.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Hercules, Inc. (Gibbstown Plant) Site		
EPA ID: NJD002349058		
Region: 2	**State:** NJ	**City/County:** Gibbstown/Gloucester

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead Agency: EPA
Author Name (Federal or State Project Manager): Patricia Simmons Pierre
Author Affiliation: EPA
Review Period: 4/1/2015 – 1/7/2020
Date of Site Inspection: 11/13/2019
Type of Review: Statutory
Review Number: 2
Triggering Action Date: 4/1/2015
Due Date *(five years after triggering action date)*: 4/1/2020

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

A remedial investigation (RI) was performed to determine the nature and extent of contamination in the SWDA. Soil and groundwater samples were collected throughout the SWDA as were samples of the tar materials disposed in the SWDA. In addition, surface water and sediment samples were collected from the North Ditch, a swale located north of the tar pits at the base of the levee, and Clonmell Creek (reference point to establish background concentrations), and biota samples were collected from the North Ditch[1] and reference area within Clonmell Creek. These samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals, cumene and cyanide. The tar was analyzed using the Toxicity Characteristics Leaching Procedure (TCLP).

Compounds detected in the tar included aniline, diphenylamine, phenols, metals (arsenic, chromium, copper, lead, nickel, and zinc), and SVOCs. TCLP results indicated that metal fragments exceeded the threshold for classification as hazardous waste due to leachable lead, SVOCs and metals exceeding New Jersey Department of Environmental Protection's (NJDEP's) Soil Cleanup Criteria (SCC) were detected in soil samples, and VOCs, SVOCs and metals were detected in groundwater samples above New Jersey Groundwater Quality Standards (GWQS).

Arsenic and several pesticides were detected in North Ditch surface water samples in exceedance of NJDEP's surface water quality criteria. However, based upon analytical results, surface water in the North Ditch was found to be comparable in quality to that of the Clonmell Creek reference sample. Elevated levels of cumene, diphenylamine, phenols, polycyclic aromatic hydrocarbons, PCBs and pesticides were detected in North Ditch sediments. In addition, fish tissue analyses indicated that both organic and inorganic contaminants were present, therefore, contaminants may be considered bioavailable.

The results of the RI sampling and analysis were used to conduct human health and ecological risk assessments in the SWDA.

The results of the baseline human health risk assessment indicated that contaminated soils, sediment and tar in the OU3 area of the Site posed an unacceptable risk to human health. The risk for a worker or adult trespasser with direct exposure to tar and tar/soils was estimated to be $8xl0^{-3}$. Benzidine was the chemical of concern primarily responsible for the potential risk associated with tar exposure. The Hazard Index, which reflects noncarcinogenic effects for a human receptor, was estimated to be 0.57 for all media combined which is below the threshold of 1.0, indicating that noncarcinogenic health effects are not a concern in the OU3 area of the Site.

[1] The North Ditch is a remnant segment of a network of man-made ditches, with no apparent inlet or outlet, which was used to drain wetlands (circa 1940). These areas of concern are depicted in Figure 2 of Appendix A.

Groundwater results indicated elevated concentrations of VOCs in the immediate vicinity of the SWDA. Because VOCs have not migrated to downgradient monitoring wells, VOC exceedances do not pose a threat to local water supply wells.

The results of the ecological risk assessment indicated that the contaminated sediment and surface water in the North Ditch may pose a risk to ecological receptors. Surface water results exceeded the NJDEP surface water quality criteria for arsenic (0.00022 micrograms per liter [µg/L]) in each of the North Ditch samples. In addition, concentrations of pesticides 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, and endrin aldehyde exceeded NJDEP surface water quality criteria. Sediment data showed elevated concentrations of the VOC cumene, SVOCs diphenylamine and phenol, pesticides, and PCBs. Fish tissue analysis indicated that both organic and inorganic contaminants were present in fish tissue and thus contaminants may be considered bioavailable.

Response Actions

In 1981, the U.S. Geological Survey released a report entitled "Water Quality Data for the Potomac-Raritan-Magothy (PRM) Aquifer System, Trenton to Pennsville, New Jersey" that documented the detection of benzene in a Site production well. Due to the presence of benzene in the groundwater, tar pits and other disposal areas on the northern portion of the property, the Site was added to the National Priorities List in December 1982.

In 1984, an interim remedial measure (IRM) involving the construction of a groundwater extraction and treatment system was implemented by Hercules Inc. (Hercules) to provide hydraulic containment of the groundwater impacted with Site-related contaminants. The system is still operating.

In 1986, Hercules entered into an Administrative Consent Order (ACO) with NJDEP to investigate the SWDA and other areas of the Site. Between 1987 and 1993, the OU3 RI was conducted in three phases. Phase I, which was completed over a one-year period beginning in 1987, included historical research to determine disposal practices, as well as soil and groundwater sampling to help delineate the SWDA. Phase II was conducted in 1989. It was intended to further refine understanding of the extent, distribution, and characteristics of the wastes in the tar pits and adjacent areas (Forested Area, Northwest Area and Access Road Area), as well as address potential impacts to soil and groundwater from these wastes. Phase III, initiated in 1993, included waste, soil, groundwater, sediment, surface soil and fish tissue sampling to further refine the conceptual site model.

Based upon the results of the OU3 RI, the following remedial action objectives (RAOs) were established:

- Eliminate the direct contact exposure hazard; and
- Minimize migration of contaminants to the surrounding environment.

Following the completion of a feasibility study (FS) to identify and evaluate remedial alternatives for the SWDA, on January 25, 1996, a ROD was issued, selecting a remedy for OU3. The major components of the selected remedy include:

- Screening and collection for recycling of lead fragments from within the SWDA;
- Consolidation of tar material and miscellaneous solid wastes under an impermeable cap consisting of a protective sub-layer and an impermeable synthetic liner beneath two ft. of clean soil and an upper vegetative layer;
- Placement of a 24-inch layer of clean, imported soil in the North Ditch;
- Implementation of engineering and institutional controls such as fencing and environmental use restrictions; and
- Establishment of a Classification Exception Area (CEA)/Well Restriction Area (WRA) for groundwater underneath and surrounding the SWDA.

The ROD identifies the GWQSs as the groundwater remediation goals for the Site. The contaminants of concern (COCs) related to OU3 were subsequently established in the CEA/WRA and are listed in Table 1, below.

Table 1: OU3 Remediation Goals

COC	Remediation Goal Micrograms/Liter (µg/L)
Aluminum	200
Arsenic	3
Bis (2-ethylhexyl) phthalate	3
Iron	300
Lead	5
Manganese	50
N-nitrosodiphenylamine	10
Sodium	50,000

Status of Implementation

On October 29, 1996, Hercules entered into an ACO with NJDEP to perform the work called for in the OU3 ROD. The remedial activities were completed between March 2010 and June 2012. A remedial action report was approved by the EPA on September 25, 2014. The OU3 remedial activities are discussed below.

Waste and Soil Consolidation

Approximately 1,170 cubic yards (CY) of material was excavated from adjacent areas and consolidated within the tar pits. Soil from the Forested Area containing lead fragments was screened prior to consolidation to remove lead fragments for recycling. In the Northwest Area, post-excavation confirmation sampling was performed to ensure removal of lead-impacted soils to the non-residential direct soil remediation standard of 800 milligrams per kilogram for lead. In all other OU3 areas designated for soil excavation and consolidation, sampling results obtained during the RI, periodic measurement of the excavation depth and visual inspection at the excavation surface were used to verify waste removal.

Cap Construction

Cap construction in the SWDA included the placement of structural fill, as needed, to establish intermediate grades, followed by six inches of select fill material to act as a subbase for the geosynthetics installation; a 60-millimeter high density polyethylene geosynthetic liner; a geocomposite drainage layer, consisting of a geonet and a single layer of geotextile; 18 inches of cover soil to prevent flow in the drainage layer from freezing and potentially damaging the geosynthetics and six inches of vegetative cover to promote reclamation of the wetland area.

Approximately 78,000 CY of soils from an on-Site borrow area were used to establish the cap grade and cover geosynthetics, including topsoil. A subsurface investigation of the borrow area soils was performed in November 2003; the results were summarized in a letter report ("Letter Report—Borrow Area Investigation, Solid Waste Disposal Area, Gibbstown, New Jersey," Cummings/Riter, March 2004). The analytical results were compared to the most conservative New Jersey SCC in effect at the time (residential direct-contact and impact to groundwater) and were found to meet these criteria.

North Ditch Soil Cover

In preparation for the soil cover in the Northwest Area, materials cleared and grubbed from the tar pit area and adjacent soil excavation areas during Site preparation activities were placed atop the sediments in the North Ditch to help provide a stable work platform (biomat). An eight-ounce woven geotextile was then laid over the biomat and a soil cover was placed over the fabric to a depth of at least two ft. After placement of the initial soil cover lift, the sediments were allowed to consolidate for approximately eight months and additional soil was subsequently placed to restore positive drainage. Finally, the area was seeded with a wildflower mixture to provide wildlife forage as the vegetative stabilization. More than 4,000 CY of soil from the on-Site borrow area were used to construct the two-foot North Ditch soil cover.

Engineering Controls

Four chain-link vehicle gates were installed at locations within in the SWDA where the potential for unauthorized vehicular access is greatest. These locations are along the access road leading from the Former Plant Area; on the ramp from the Delaware River levee; immediately south of the SWDA cap to help prevent access by vehicles that might breach or circumvent the chain-link fence that surrounds the Former Plant Area; and between the levee and the SWDA because there are multiple vehicle access points to the levee upriver and downriver from the SWDA with unknown restrictions and enforcement

Wetland Mitigation

Wetland mitigation was achieved in July 2009 through the purchase of 2.33 wetland bank credits from the Nature Conservancy in New Jersey.

Institutional Controls Summary

Because waste remains under the SWDA cap, a deed restriction was recorded on June 26, 2014 in Gloucester County to prohibit disturbance of the SWDA cap. In addition to the deed restriction, on September 25, 2014, a CEA/WRA was established by NJDEP to restrict groundwater use in the SWDA and surrounding areas. The CEA/WRA identifies the following chemicals as the OU3 COCs: aluminum; arsenic; bis(2-ethylhexyl) phthalate; iron; lead; manganese; n-nitrosodiphenylamine; and sodium. These are the chemicals that were present in the SWDA at concentrations exceeding GWQS at the time the CEA/WRA was established.

Table 2, below, summarizes the planned and/or implemented institutional controls.

Table 2: Summary of Planned and/or Implemented Institutional Controls

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Parcel(s) Impacted	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Land Use	Yes	Yes	SWDA	To prohibit disturbance of the cap installed in the SWDA	Deed Restriction recorded by the Gloucester County Clerk on June 26, 2014
Groundwater	Yes	Yes	SWDA and surrounding areas	To restrict groundwater use in the SWDA and surrounding areas	Classification Exception Area/Well Restriction Area established by NJDEP on September 25, 2014

System Operations, Monitoring and Maintenance

System Operations

As was noted above in the "Response Action Summary" section, an IRM associated with OU1 and involving the construction of a groundwater extraction and treatment system was completed by Hercules to provide on-Site containment of groundwater impacted with Site-related contaminants. Operation of this system is ongoing and will continue until a new system is constructed in accordance with the OU1 remedy selected in the 2018 ROD.

Monitoring

Groundwater monitoring associated with OU3 was conducted in the SWDA quarterly from 2014 through 2016. During that period, groundwater samples were analyzed for TAL metals and TCL VOCs, SVOCs and tentatively-identified compounds. The following field parameters were also measured.

- Temperature
- pH
- Specific conductance

- Oxidation-reduction potential
- Dissolved oxygen
- Turbidity

Groundwater monitoring reports for OU3 were submitted to EPA and NJDEP quarterly from 2014 through 2016. These reports contain, among other things, an explanation of the maintenance and monitoring activities performed in connection with the SWDA and the analytical results obtained during the reporting period.

Based on the concentration trends observed in the 2014-2016 monitoring data, in March 2016, monitoring was discontinued for all parameters, except the eight COCs identified in the ROD. In accordance with the Operation and Maintenance (O&M) Plan, monitoring for bis (2-ethylhexyl) phthalate was discontinued in April 2016 because it had not been detected in any of the SWDA wells since October 2015.[2] The monitoring frequency and reporting associated with the SWDA was reduced in March 2017 from quarterly to semiannually.

In accordance with the requirements of the CEA/WRA, groundwater quality data was evaluated annually to determine whether the groundwater concentrations have achieved federal Maximum Contaminant Levels, as well as GWQS, and NJDEP Remedial Action Protectiveness/Biennial Certification Forms were submitted every two years (in 2017 and 2019 for this FYR period).

Groundwater monitoring associated with the interim remedy for OU1 is conducted quarterly to evaluate groundwater quality and verify groundwater capture along the downgradient property line (in the southwestern area of the property).

Maintenance

Routine maintenance activities related to the SWDA cap include inspection for signs of cover failure or maintenance requirements, clearing of the riprap storm water channel, cover and vegetation repair and mowing. Visual inspections are performed semi-annually to verify that there has been no disturbance to the cap, and the cap is examined for evidence of settlement, cracking, excessive ponding and erosion.

Potential Site impacts from climate change have been assessed and the performance of the OU3 remedy is currently not at risk due to the expected effects of climate change in the region and near the Site.

III. PROGRESS SINCE THE LAST REVIEW

The protectiveness determinations and status of the recommendations from the last FYR are summarized below in Tables 3 and 4, respectively.

[2] The O&M Plan indicates that sampling and analysis for an individual COC may be discontinued when the concentration of that contaminant is less than or equal to its applicable GWQS for two consecutive monitoring events.

Table 3: Protectiveness Determinations/Statements from the 2015 FYR		
Operable Unit	**Protectiveness Determination**	**Protectiveness Statement**
03	Short-term Protective	The OU3 remedy protects human health and the environment in the short-term because unacceptable exposure to contaminants has been interrupted by the soil remedial actions and the designation of this area as a groundwater classification exception area/well restriction area. In order for the remedy to be protective in the long-term, post-excavation soil data, along with surface soil data that represent the areas located outside of the cap, should be evaluated in a quantitative ecological risk assessment to confirm that there is no residual risk to ecological receptors from these areas.

Table 4: Status of Recommendations from the 2015 FYR		
Issue	**Recommendations and Follow-Up Actions**	**Status**
The ecological risk to the terrestrial portions of the OU3 area was only qualitatively assessed because it was determined during the remedial investigation that the area provided little habitat or forage value to wildlife.	Post-excavation soil data, along with surface soil data that represent the areas located outside of the cap, should be evaluated in a quantitative ecological risk assessment to confirm that there is no residual risk to ecological receptors from these areas.	Completed December 1, 2016

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement and Site Interviews

On October 1, 2019, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies Superfund sites in New York, New Jersey and Puerto Rico, including the Hercules, Inc. (Gibbstown Plant) site. The announcement can be found at the following web address: https://www.epa.gov/aboutepa/fiscal-year-2020-five-year-reviews.
In addition to this notification, a notice of the commencement of the FYR was sent to local public officials. The notice was provided to Gibbstown by email on November 22, 2019, with a request that the notice be posted in municipal offices and on the town webpage. The purpose of the public notice was to inform the community that the EPA would be conducting a FYR to ensure that the remedy implemented at the Site remains protective of public health and is functioning as designed. In addition, the notice included contact information, including addresses and telephone numbers, for questions related to the FYR process or the Site.

Once the FYR is completed, the results will be made available on EPA's webpage for the Site, https://www.epa.gov/superfund/hercules-gibbstown and at the Site repositories, which are the Greenwich Public Library, 411 Swedesboro Road, Gibbstown, New Jersey, 08027 and the USEPA Region 2, Superfund Records Center, 290 Broadway, 18th Floor, New York, NY 10007.

Data Review

A long-term groundwater monitoring program was developed to observe potential impacts of the tar and other soil contaminants on the groundwater in OU3, and to evaluate the effectiveness of the OU3 containment remedy and the need to continue the CEA/WRA in this area. This monitoring program is documented in the O&M Plan, which is included as Appendix V in the September 2014 Remedial Action Report. In accordance with the O&M Plan, implementation of the groundwater monitoring program commenced in late 2014.

The network of monitoring wells sampled in connection with the OU3 remedial action consists of ten wells, MW-12, MW-13, MW-14, MW-15, MW-40, MW-40B, MW-40C, MW-41, MW-42, and MW-43 (see Figure 3 of Appendix A). Groundwater samples were collected and analyzed on a quarterly basis until 2017, when the monitoring frequency was decreased to semiannual events.

During this FYR period, samples were analyzed for aluminum, arsenic, bis (2-ethylhexyl) phthalate,[3] iron, lead, manganese, n-nitrosodiphenylamine and sodium, the COCs identified in the CEA/WRA and O&M Plan. Sampling results indicate that all COCs, except bis (2-ethylhexyl) phthalate, exceeded their respective GWQS in at least one well. The maximum concentrations detected during this FYR period are presented below in Table 5.

Table 5: Maximum Concentrations Detected During Current FYR Period

COC	Location	Concentration	Remediation Goal GWQS (µg/L)	Sampling Date
Aluminum	MW-40C	1,300	200	February 2015
Arsenic	MW-42	100	3	January 2019
Iron	MW-42	360,000	300	January 2019
Lead	MW-40	110	5	July 2017
Manganese	MW-14	2,500	50	February 2015
N-nitrosodiphenylamine	MW-43	160	10	April 2015
Sodium	MW-43	150,000	50,000	January 2019

Arsenic, iron, manganese, and sodium were consistently detected at concentrations exceeding their applicable GWQS in most wells. Two monitoring wells, MW-42 and MW-43, had regular detections of n-nitrosodiphenylamine above its GWQS. Lead was detected above its GWQS most often in monitoring wells MW-40 and MW-40B, with a few sporadic exceedances in other wells. Aluminum was detected above its GWQS at least once in all monitoring wells, except MW-14 and MW-15, which have been below the GWQS since 2012.

Aluminum was observed to be increasing in monitoring wells MW-13, MW-15, MW-40B, and MW-43, and an increase in arsenic was observed in monitoring well MW-13. Iron and manganese increased in monitoring wells MW-41 and MW-42, which could be related to chemically reducing conditions in the aquifer, potentially enhanced by the restriction of infiltration of water due to the low-permeability cap constructed over the waste. Sodium was observed to be increasing in

[3] As discussed above in the System Operations, Monitoring and Maintenance section, monitoring for this COC was discontinued in April 2016.

monitoring wells MW-41 and MW-43 and decreasing in monitoring well MW-14, and manganese was observed to be decreasing in monitoring well MW-15.

A statistical trend analysis (Mann-Kendall method) of the data collected from the SWDA wells during this FYR period was performed. While COC concentrations exhibited considerable variability at most of the SWDA monitoring wells, with some demonstrating seasonal fluctuations, there was insufficient evidence of statistically significant trends. It is expected that the cap will minimize any further leaching of contaminants from the tar material into the groundwater, and, as a result, groundwater quality in the vicinity of the SWDA will improve over the long term.

The 2015 FYR report recommended that post-excavation soil data, along with surface soil data that represent the areas located outside of the cap (the Northwest Area, Forested Area and Access Road) be evaluated in a quantitative ecological risk assessment to confirm that there is no residual risk to ecological receptors from these areas. The results of this evaluation are presented in the 2016 report entitled *Screening Level and Baseline Ecological Risk Assessment* (BERA) *for the Solid Waste Disposal Area,* prepared by RBR Consulting, Inc. on behalf of the PRP. The report concluded that there is negligible potential for adverse effects to aquatic plants, invertebrates and terrestrial animals from exposure to lead contamination in the SWDA, and that no further evaluation of ecological exposure to lead in the SWDA is warranted.

Site Inspection

A Site inspection was conducted on November 13, 2019. In attendance were Patricia Simmons Pierre of the EPA, Greg Bakeman of the NJDEP, John Hoffman of Ashland, LLC[4] (Ashland), Bruce Geno of Cummings Riter Consultants, Inc. and James Ferris, Craig Stevens and John Elstner, all of CSI Environmental, LLC (CSI). The purpose of the inspection was to verify that there has been no disturbance to the cap and assess the protectiveness of the remedy.

The inspection revealed that the fence around the perimeter of the Site is intact, the gates preventing vehicle access to the SWDA cap area are locked and intact, the monitoring wells are in good condition and maintenance activities are being performed according to schedule. No issues impacting the current or future protectiveness of the remedy were identified during the Site visit.

Interviews

During the FYR process, interviews were conducted with John Hoffman, Ashland's Project Manager, and James Ferris, Senior Project Manager for CSI, Ashland's consultant, regarding Site background information, operations and monitoring activities. The purpose of the interviews was to document any perceived problems or successes with the remedy that has been implemented to date.

The interviews revealed that no significant problems were encountered with the Site operations and monitoring activities conducted during this review period and that the remedy is functioning as expected.

[4] Hercules merged into Ashland, Inc. in 2008 and Ashland, Inc. became Ashland, LLC in 2016.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

The OU3 ROD calls for the excavation of impacted soils and subsequent consolidation with tar material beneath a low-permeability cap, screening and collection for recycling of lead fragments from within the SWDA and surrounding areas, installation of a fence around the capped area, placement of two-foot soil cover in the North Ditch, preparation of a CEA for groundwater associated with the SWDA and annual evaluation, wetland mitigation and restoration and semiannual visual inspections. The SWDA cap, North Ditch soil cover, Site perimeter fence and vehicle gates prevent direct contact with the tar material, contaminated soil and miscellaneous solid waste. The cap and the CEA/WRA prohibiting groundwater use in the SWDA and surrounding areas serve to minimize migration of contaminants from the tar and other solid waste mixed with the tar and tar derivatives to the surrounding environment.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The 1993 OU3 risk assessment was completed prior to much of the Risk Assessment Guidance for Superfund (currently used by EPA) being published. However, the process that was used remains valid. The main sources of environmental concern in the SWDA were the tar pits and lead fragments. Soil beneath the tar pits contains benzidine, benzo(a)pyrene, diphenylamine, phenols and metals. Benzidine was the risk driver for human health risk associated with tar exposures. Lead was found in solid fragments and was leachable. The groundwater COCs identified in the ROD were cumene, 2,4-dinitrotoluene and 2,6-dinitrotoluene; lead was the only COC in the surface water of the North Ditch (closed system); COCs identified in the sediments of the North Ditch were cumene, phenol, diphenylamine, chromium, mercury, nickel, silver and zinc.

While the risk assessment triggered the need to take action, in 2014, at the time the CEA/WRA was established (after years of monitoring), only the following chemicals were present in the SWDA groundwater in exceedance of the groundwater Applicable or Relevant and Appropriate Requirements (ARARs) (GWQSs): bis (2-ethylhexyl) phthalate; n-nitrosodiphenylamine; aluminum; arsenic; iron; lead; manganese; and sodium.

Exposure pathways evaluated, as indicated in the ROD, included:

- Inhalation of VOCs and direct contact with and ingestion of compounds detected in groundwater at the source area;
- Dermal contact with and incidental ingestion of surface soil and tar; and
- Dermal contact with and incidental ingestion of surface water and sediments at the North Ditch.

Inhalation of surface soil and tar was not considered an exposure pathway as VOCs generally were not detected in tar or surface soil samples, and field screening instruments used during intrusive sampling events did not detect VOCs.

The potentially exposed populations evaluated in the risk assessment included an occasional employee and an adult trespasser. Younger children were not considered part of the potentially exposed population due to the limited access and terrain in the immediate vicinity of the SWDA cap (Clonmell Creek and surrounding wetlands).

As part of the remedy, soils in the SWDA were screened and lead fragments were collected for recycling and the tar material along with miscellaneous solid wastes were consolidated under an impermeable cap. Though not posing an unacceptable human health risk, the North Ditch was covered with two ft. of clean fill eliminating the direct contact and incidental ingestion pathways. Additionally, a perimeter fence was installed as part of the ROD to prevent exposure of individuals to the contaminated soils. During a recent site visit, the fence was examined and remains intact. There was evidence of trespassing prior to the first FYR and the Site continues to be monitored by a security company. Soils related to the OU3 SWDA remedy are inaccessible under the impermeable cap and are therefore protective of human health. The OU3 remedy attains the RAO of mitigating direct contact with the tar material and miscellaneous solid waste and eliminating exposure to other solid wastes mixed with the tars and tar derivatives.

At the time of the ROD, the State of New Jersey was utilizing its SCC. NJDEP has since promulgated Soil Remediation Standards, which supersede the SCC. While soil ARARs have changed since the time of the ROD, the remedy remains protective because the direct contact pathway has been interrupted with the impermeable cap and further with the installation of a fence.

Groundwater is not used for potable purposes in the area surrounding the SWDA. Additionally, a CEA/WRA was established for the SWDA in September of 2014. While data collected during this FYR period indicate that ARARs are not being met within the SWDA, the groundwater is not being used for potable purposes and the remedy remains protective of human health.
The excavation of contaminated media and consolidation under the cap achieves the RAO of minimizing migration of contaminants from the tar and other solid waste mixed with the tar and tar derivatives to the surrounding environment.

Soil vapor intrusion is evaluated when soils and/or groundwater are known or suspected to contain VOCs. Since the landfill is capped and there are no buildings within the SWDA, this pathway is incomplete for OU3. However, since the soil and groundwater in the Former Plant Area are contaminated with VOCs, in 2011, vapor intrusion sampling was conducted in the residences situated adjacent to the southern property boundary of the Site. Subslab and indoor air samples were screened against EPA Regional Screening Levels for residential air. Site-related VOCs (cumene and benzene) fell within or below the acceptable risk range for these carcinogens (10^{-4} to 10^{-6}). No additional monitoring was necessary based on these results and because a clean lens of water underlies the homes.

The ecological risk assessment methodology used to evaluate the risk from contaminated sediments and surface water in the North Ditch do not reflect current practices. However, the placement of a vegetative mat and a two-foot soil cover in this area adequately eliminates the ingestion and direct contact pathways, therefore mitigating the risk to ecological receptors. The 2015 FYR concluded that the ecological risk associated with exposure to the soils in terrestrial portions of the SWDA was not appropriately evaluated at the time of the remedy. The results of a

subsequent BERA conducted in 2016 found that, based on current conditions, the risk to ecological receptors from the soils in the SWDA is negligible and that no further evaluation of ecological exposure is warranted.

No additional sources of contamination, COCs, exposed populations or exposure pathways have been identified since the last FYR. There have been no other changes in Site conditions that could affect the protectiveness of the remedy.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no information that calls into question the protectiveness of the selected remedy.

VI. ISSUES/RECOMMENDATIONS

There are no issues identified in this FYR that affect the protectiveness of the remedy.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement	
Operable Unit: 03	*Protectiveness Determination:* Protective
Protectiveness Statement: The OU3 remedy is protective of human health and the environment.	

VIII. NEXT REVIEW

The next FYR report for the Site is required five years from the completion date of this review.

APPENDIX A – Figures

Figure 1: Site Map

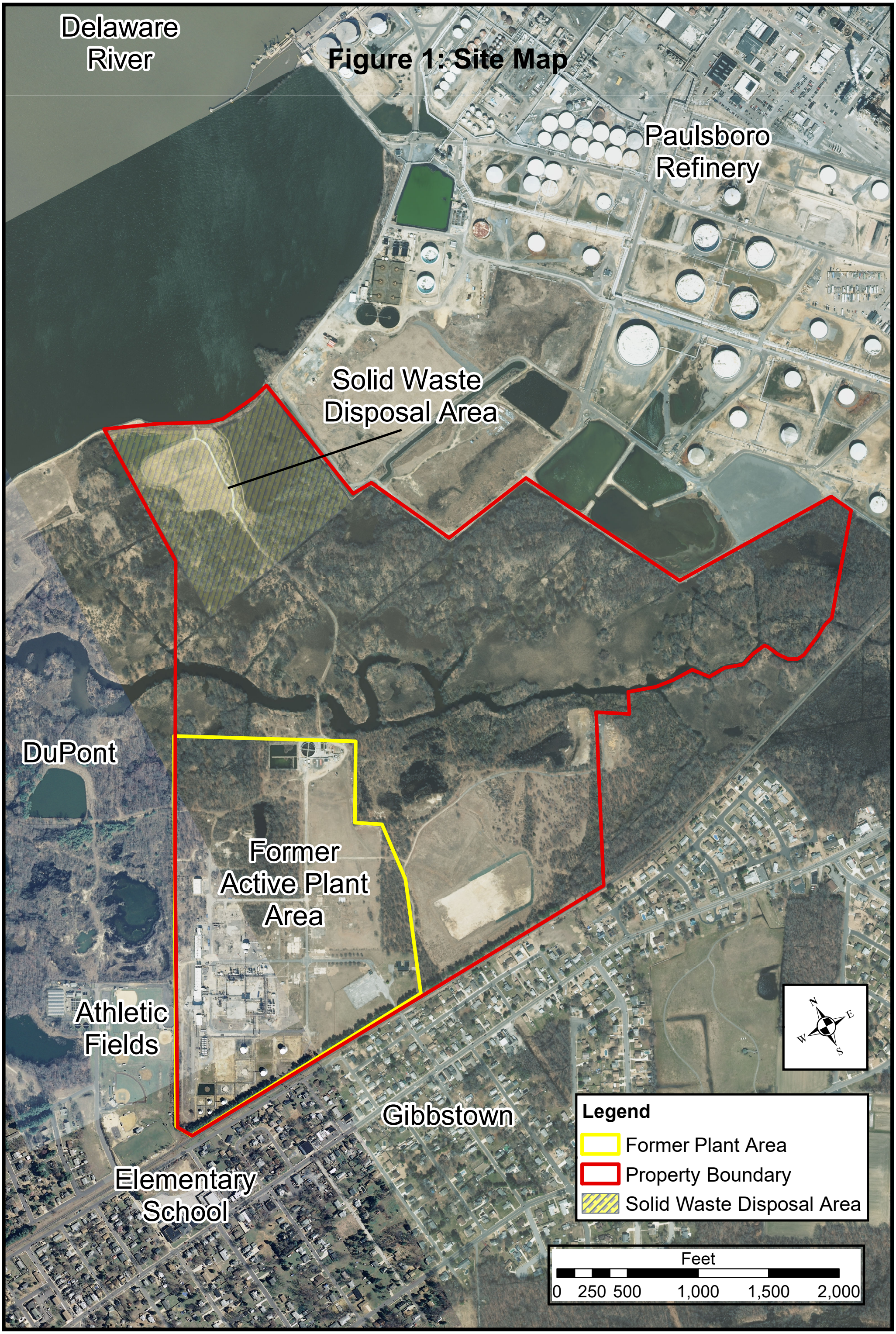


Figure 2: Operable Unit 3 Area (Pre-Remedial Action)

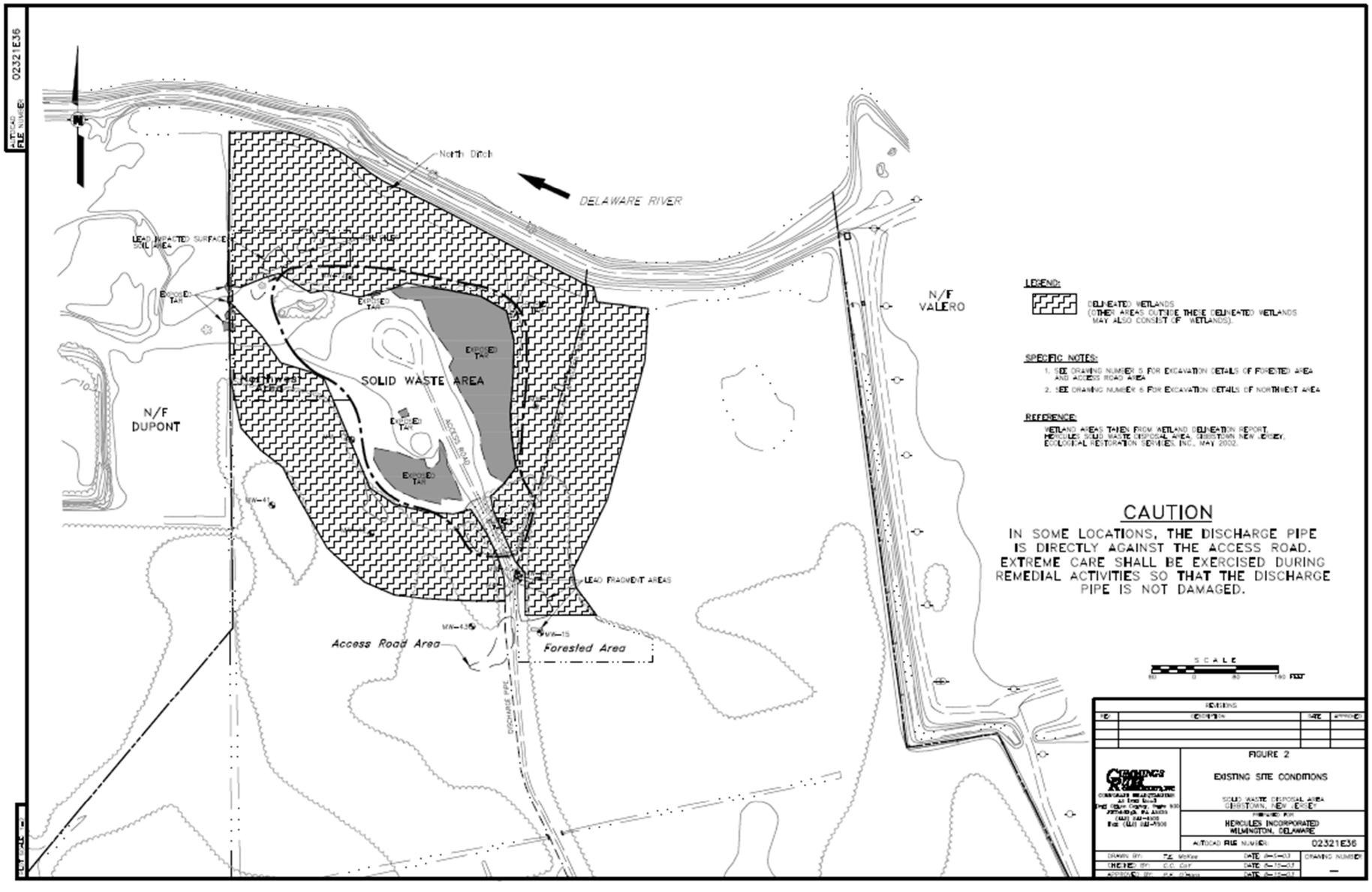
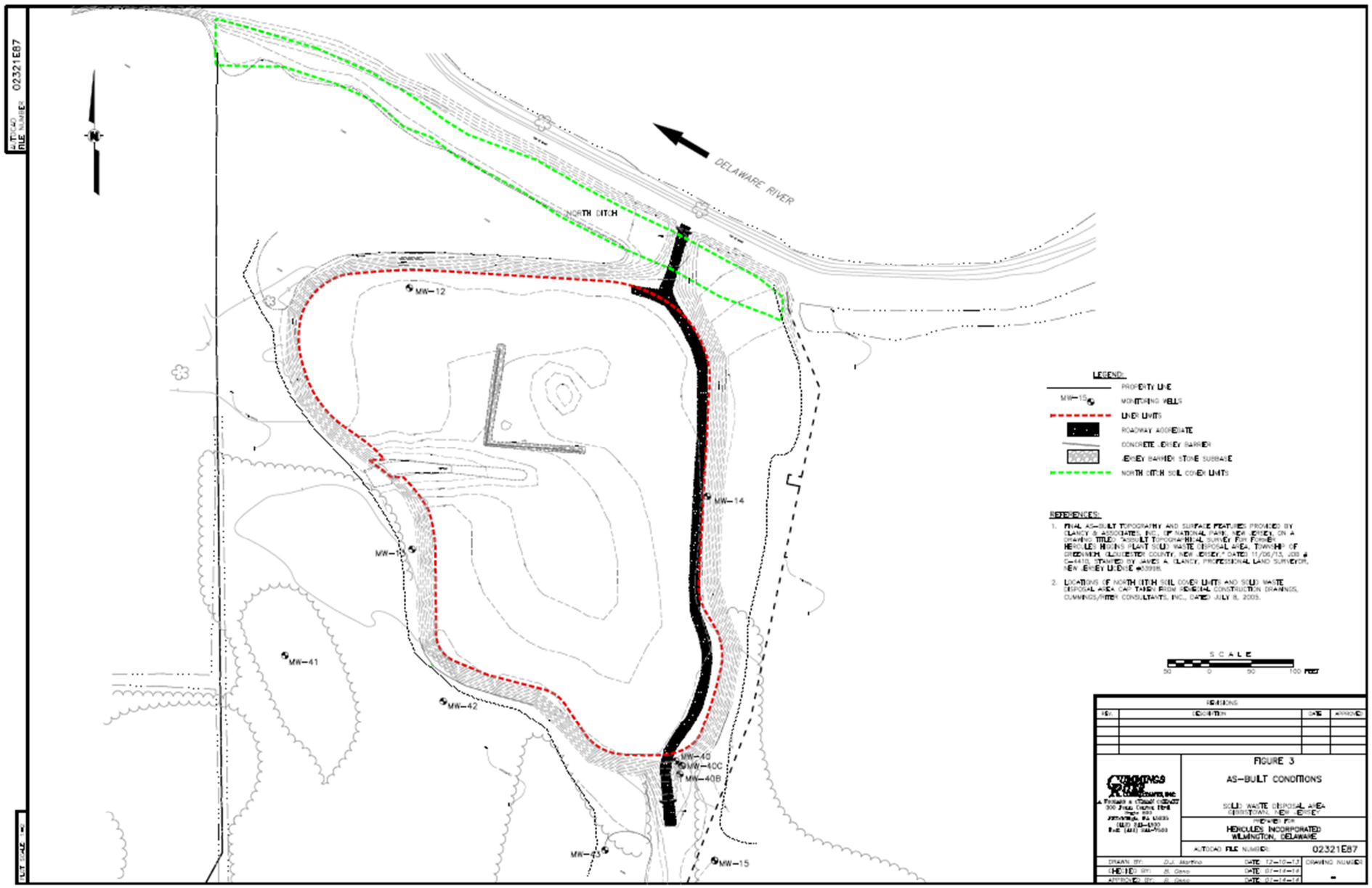


Figure 3: Operable Unit 3 Area (Post-Remedial Action)



APPENDIX B – Reference List

Administrative Consent Order – Hercules, Inc. (Gibbstown Plant), entered into by NJDEP and Hercules, Inc., July 1986

Phase I Investigation Results – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., March 1988

Addendum to Phase I Investigation Results – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., September 1988

Phase II Remedial Investigation Results – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., June 1989

Addendum to Phase II Remedial Investigation Results – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., June 1990

Phase III Remedial Investigation Results – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., February 1993

Final Revised Feasibility Study – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., October 1993

Revised Phase III Risk Assessment Report – Solid Waste Disposal Area, Higgins Plant, ERM, Inc., December 1993

Superfund Record of Decision: Hercules, Inc. (Gibbstown Plant), NJDEP, January 1996

Administrative Consent Order – Hercules, Inc. (Gibbstown Plant), entered into by NJDEP and Hercules, Inc., October 1996

Remedial Design Report – Solid Waste Disposal Area, Gibbstown, New Jersey, Cummings Riter Consultants, Inc., June 2002, revised July 2005

Administrative Settlement Agreement and Order on Consent – Hercules, Inc. (Gibbstown Plant) Site, entered into by EPA and Hercules, Inc., September 2009

Remedial Action Report – Solid Waste Disposal Area, Gibbstown, New Jersey, Cummings Riter Consultants, Inc., September 2014

Classification Exception Area/Well Restriction Area – Hercules, Inc. Gibbstown Superfund Site, Solid Waste Disposal Area (OU-3), NJDEP, September 2014

Screening Level and Baseline Ecological Risk Assessment – Solid Waste Disposal Area, Former Hercules Higgins Plant, Gibbstown, New Jersey, RBR Consulting, Inc., December 2016

Record of Decision, Hercules, Inc. (Gibbstown Plant) Superfund Site, EPA, September 2018

Quarterly Groundwater Monitoring Reports for Operable Unit One, CSI Environmental, LLC, 2015 – 2019

Semiannual Groundwater Monitoring Reports for Operable Unit Three, CSI Environmental, LLC, 2015 – 2019

APPENDIX C – Site History, Geology/Hydrogeology and Land Use

Site History

Before the property was transferred to Hercules Incorporated (Hercules) in 1952, E.I. du Pont de Nemours and Company (DuPont) reportedly used the area now designated as the Solid Waste Disposal Area (SWDA) and surrounding areas to dispose of lead fragments and tar generated from the production of aniline. In 1952, Hercules acquired title to the Site property from DuPont. Construction of the manufacturing plant began in 1953 and the plant was fully operational by 1959. Phenol and acetone were manufactured at the facility until 1970. After 1970, the plant produced three primary products—cumene hydroperoxide, diisopropylbenzene, and dicumyl peroxide, which are compounds used in phenol and acetone production. Hercules used the SWDA from 1955 until 1974 to dispose of wastes generated from its manufacturing activities. In 2008, Ashland, LLC (Ashland), then known as Ashland, Inc., acquired Hercules, with Hercules continuing to exist as a subsidiary of Ashland.

In 2010, Hercules decommissioned the plant and all the aboveground structures were demolished, except for a groundwater treatment system, a former administration building, and two surface impoundments. Significant subsurface sewer lines, process piping, and utilities associated with the former manufacturing facility remain in portions of the Active Process Area and Inactive Process Area. These structures were abandoned in place and filled with concrete.

In 1981, the U.S. Geological Survey released a report documenting the detection of benzene in a Site production well. Based upon this finding, Hercules, under New Jersey Department of Environmental Protection (NJDEP) oversight, conducted additional groundwater studies, which led to the discovery of other Site-related chemicals in groundwater at the Site. Because of the contamination identified in the groundwater and the tar and other debris disposed of in the SWDA, the Site was added to the National Priorities List on September 8, 1983.

In 1984, as an interim remedy, Hercules installed a groundwater extraction and treatment system to prevent contaminated groundwater from migrating off-property. The system was upgraded in 2008 and continues to operate.[1]

In 1986, Hercules entered into an Administrative Consent Order with NJDEP to perform a remedial investigation and feasibility study (RI/FS) in the SWDA and adjacent areas. Based upon the results of the RI, conducted between 1987 and 1993, NJDEP issued a Record of Decision (ROD) in 1996, selecting a remedy for the SWDA and adjacent areas, which comprise OU3 of the Site. The major components of the remedy include consolidation of tar material and miscellaneous solid wastes under an impermeable cap; implementation of engineering controls and institutional controls (ICs)[2], such as fencing and environmental use restrictions, respectively; and the

[1] The system was to operate until a final OU1 groundwater remedy was selected.

[2] ICs are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a remedy.

establishment of a Classification Exception Area (CEA)/Well Restriction Area (WRA)[3] for groundwater beneath and surrounding the SWDA. The OU3 remedial action was completed in 2014. Routine maintenance of the SWDA is performed by Hercules.

Under NJDEP oversight, Hercules initiated an RI/FS in 1987 to determine the nature and extent of contamination associated with the first and second operable units (OU1 and OU2). EPA assumed the lead for OU1 and OU2 in 2008. In 2009, EPA entered into an Administrative Settlement Agreement and Order on Consent (AOC) with Hercules for the completion of the RI/FS.

Based upon the results of the OU1 and OU2 RI/FS, EPA issued a ROD in 2018, selecting a remedy for these areas of the Site. The major components of the remedy include excavation of lead-contaminated soil with off-Site disposal; excavation of volatile organic compound (VOC)-contaminated soil located 0-4 ft. below the ground surface (bgs) and on-Site treatment with ex-situ bioremediation; in-situ treatment of VOC-contaminated soil situated below 4 ft. bgs with enhanced biodegradation; hydraulic dredging of contaminated sediment and on-Site treatment with phytoremediation; on-Site reuse of treated soil and sediment; extraction of contaminated groundwater with on-Site treatment and discharge to groundwater; long-term groundwater monitoring; and institutional controls (ICs) to restrict groundwater use, prevent soil disturbances in the in-situ soil treatment areas, and require that future buildings on the Site either be subject to a vapor intrusion evaluation or be built with vapor intrusion mitigation systems until the remediation goals are met. The design for the OU1 and OU2 remedy is currently underway.

Site Geology/Hydrogeology

The Site is located within the Atlantic Coastal Plain physiographic province. This geologic province is characterized by the presence of thick unconsolidated sand, silt, gravel, and clay layers. The major stratigraphic units present in the area are, from oldest to youngest, Precambrian Age (greater than 600 million years old) bedrock, Cretaceous Age (135 to 60 million years old) deposits of the Potomac-Raritan-Magothy (PRM) Formation, Pleistocene Age (500,000 to 11,000 years old) deposits (that may include sediments belonging to the Trenton Gravel, Van Sciver Lake beds formation and the Spring Lake beds formation) and Holocene (11,000 years old to present) alluvial deposits on the Delaware River floodplain.

The PRM Formation constitutes the regional aquifer system supplying water resources to Greenwich Township and the surrounding area. It is generally considered to consist of three aquifers (Upper Middle, Lower Middle and Lower), which are separated by two confining units. At the Site, Pleistocene and Holocene alluvial deposits overlie the top of the PRM. The shallow (A-Level) monitoring well network is screened into these deposits, the medium depth (B-Level) monitoring well network is screened in the Upper Middle PRM aquifer and the deepest monitoring wells are screened into the C-Level unit, which correlates to the Lower Middle PRM aquifer.

Regional groundwater (B-Level and C-Level) generally flows from north to south, exhibiting some influence from conditions in the Delaware River. Groundwater flow in the A-Level also flows

[3] A CEA/WRA serves as an IC by providing notice that there is ground water pollution in a localized area caused by a discharge at a contaminated site and restricting well installation in the affected aquifer.

from north to south, with several water table mounds in evidence where recharge is higher and/or hydraulic conductivity is lower. The depth to groundwater in the Former Plant Area ranges from 6 to 14 ft.

An unlined stormwater retention pond, referred to as the "Stormwater Catchment Basin," is located within the Former Plant Area, about 600 ft. south of Clonmell Creek. The Stormwater Catchment Basin ranges in width from approximately 64 ft. on its south end to 125 ft. on the north, and 0.25 to 3 ft. deep, dependent upon precipitation levels. Historically, storm water collected in the area now known as the "Stormwater Catchment Basin" and flowed through the 002 outfall, which was a NJDEP-permitted discharge point, into an adjacent drainageway before discharging into Clonmell Creek. There has been no hydraulic connection between the Stormwater Catchment Basin and Clonmell Creek since 1991.

The geology underlying the SWDA consists of a surficial peat/clay and underlying Sand unit. The area of the Site located north of Clonmell Creek (including the SWDA) is within the 100-year floodplain of the Delaware River. The depth to groundwater in this area is approximately two ft.

Land and Resource Use

The Site property is zoned for industrial use and is bounded to the east by Paulsboro Refining Company, LLC, to the west by open land owned by DuPont, to the north by the Delaware River, and to the south and southwest by residences. Area homes are served by municipal water supply wells.

In 1952, Hercules acquired title to the Site property, approximately 350 acres of unimproved land, from DuPont. Construction of the Hercules Higgins Plant began in 1953, and the plant was fully operational by 1959. Phenol and acetone were manufactured at the 80-acre facility until 1970. After 1970, the plant produced three primary products--cumene hydroperoxide; diisopropylbenzene hydroperoxide and dicumyl peroxide.

Prior to transferring the Site property to Hercules, DuPont used the area now designated as the SWDA and surrounding areas to dispose of lead fragments and tar generated from the production of aniline. From 1955 until 1974, Hercules used the SWDA to dispose of wastes generated from its manufacturing activities.

The plant was decommissioned in 2010 and the Site is now predominantly vacant and unused. The structures remaining on-Site include a groundwater treatment system, a former administrative building, two surface impoundments and a few remaining foundations and structures. The land use designation for the Site property is not anticipated to change in the future.