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

Prepared by

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

Pat Evangelista Digitally signed by Pat Evangelista Date: 2025.01.22 08:25:30 -05'00'

Pat Evangelista, Director
Superfund and Emergency Management Division

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ACO	Administrative Consent Order
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
BERA	Baseline Ecological Risk Assessment
CEA	Classification Exception Area
CMRA	Climate Mapping for Resilience and Adaptation Assessment
COC	Contaminant of Concern
CSIE	CSI Environmental, LLC
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
SLRV	Sea Level Rise Viewer
SVOC	Semi-Volatile Organic Compound
SWDA	Solid Waste Disposal Area
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
UU/UE	Unlimited Use and Unrestricted Exposure
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.

This is the third FYR for the Hercules, Inc. (Gibbstown Plant) site. The triggering action for this statutory review is the completion date of the previous FYR, which was January 24, 2020. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act 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.

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. This FYR will evaluate the remedy for OU3, which has been implemented. Construction of the remedies for OU1 and OU2 has not yet been initiated; therefore, these OUs are not subject to evaluation in this FYR.

The FYR was led by Patricia Simmons Pierre, the EPA Remedial Project Manager. Other EPA participants included Joel Singerman (Supervisor, Central New York Remediation Section), Lora Smith (Human Health Risk Assessor), Julie McPherson (Ecological Risk Assessor), Liana Agrios (Hydrogeologist), and Pat Seppi (Community Involvement Coordinator). The Potentially Responsible Party for the site was notified of the initiation of the FYR. The FYR began on May 28, 2024.

Site Background

The site is a former chemical manufacturing plant, situated on approximately 350 acres located off North 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, 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 Appendix A, Figure 1, attached.

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. The site property is now predominantly vacant and unused, except for a groundwater treatment system, a former administrative building, and remnant structures from the former plant operations, including two surface impoundments and several building foundations.

The SWDA is located 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, 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?** No	
REVIEW STATUS		
Lead Agency: EPA		
Author Name (Federal or State Project Manager): Patricia Simmons Pierre		
Author Affiliation: EPA		
Review Period: 5/28/2024 – 1/1/2025		
Date of Site Inspection: 11/12/2024		
Type of Review: Statutory		
Review Number: 3		
Triggering Action Date: 1/24/2020		
Due Date *(five years after triggering action date)*: 1/24/2025		

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, as well as samples of tar waste material were collected throughout the SWDA. In addition, surface water and fish tissue samples were collected from the North Ditch[1] and Clonmell Creek (as a reference to establish background concentrations). These areas of concern are depicted in Figure 2 of Appendix A. The 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 samples were 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, the 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 8×10^{-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.

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.

[1] The North Ditch is a swale located north of the tar pits and at the base of the levee. It 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).

The results of the ecological risk assessment indicated that contaminated surface water and sediment in the North Ditch may pose a risk to ecological receptors. Surface water results were compared to the Federal Chronic Ambient Water Quality Criteria. Lead was the only contaminant detected above its respective criteria (3.2 ug/l), with exceedances being observed at all four sampling locations. Sediment data were compared to NJDEP's proposed sediment cleanup criteria and the National Oceanic and Atmospheric Administration's screening level guidelines for sediment (Effects Range-Medium). Concentrations of the metals, chromium, lead, mercury, nickel, silver and zinc, the pesticides, 4,4'-DDD, 4,4'-DDE, and PCB–1254 exceeded their respective criteria. Sediment data also showed elevated concentrations of the VOC, cumene, the SVOCs, diphenylamine and phenol, pesticides, and PCBs. Fish tissue analysis indicated that both organic and inorganic contaminants were present in fish tissue, therefore, 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 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 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 Record of Decision (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 OU3 ROD identifies the GWQSs as the groundwater remediation goals for the SWDA. 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

In 1996, Hercules entered into an ACO with NJDEP to perform the work called for in the OU3 ROD. The remedial activities were performed from 2010 to 2012. 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 NJDEP non-residential direct soil remediation standard of 800 milligrams per kilogram (mg/kg) for lead. 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 in all other OU3 areas designated for soil excavation and consolidation.

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 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 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 to prohibit disturbance of the SWDA cap. In addition to the deed restriction, a CEA/WRA was established by NJDEP to restrict groundwater use in the SWDA and surrounding areas. The CEA/WRA identifies aluminum, arsenic, bis(2-ethylhexyl) phthalate, iron, lead, manganese, n-nitrosodiphenylamine, and sodium as the OU3 COCs. These are the chemicals that were present in the SWDA groundwater 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

Periodic groundwater monitoring reports for OU3 are submitted to EPA and NJDEP. 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. Monitoring reports were submitted quarterly from 2014 through 2016. Based on the concentration trends observed in the 2014-2016 monitoring data, in 2016, monitoring was discontinued for all parameters, except the eight COCs identified in the CEA/WRA. In accordance with the Operation and Maintenance (O&M) Plan which 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, monitoring for bis 2-

ethylhexyl phthalate was also discontinued in 2016. The monitoring frequency and reporting associated with the SWDA was reduced in 2017 from quarterly to semiannually; in 2021, the frequency was reduced to annually.

In accordance with the requirements of the CEA/WRA, groundwater quality data is 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 are submitted every two years (in 2021 and 2023 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). OU1 monitoring reports are submitted quarterly to EPA and NJDEP.

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.

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.

Climate Change

Potential impacts to the site area from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site. Refer to Appendix D for additional information.

III. PROGRESS SINCE THE LAST REVIEW

The protectiveness determination from the last FYR is summarized below in Table 3, below.

Table 3: Protectiveness Determinations/Statement from the 2020 FYR

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

There were no issues identified or recommendations made in the last FYR.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement and Site Interviews

On August 7, 2024, 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/superfund/R2-fiveyearreviews.

In addition to this notification, the EPA Community Involvement Coordinator for the site, Pat Seppi, posted a public notice on the EPA site webpage https://www.epa.gov/superfund/hercules-gibbstown and provided the notice to Gibbstown by email on November 7, 2024 with a request that the notice be posted in municipal offices and on the town webpage. This notice indicated that a FYR would be conducted at the site to ensure that the cleanup continues to be protective of people's health and the environment.

Once the FYR is completed, the results will be made available at the following repositories: Greenwich Public Library, 411 Swedesboro Road, Gibbstown, New Jersey, 08027 and the EPA Region 2, Superfund Records Center, 290 Broadway, 18th Floor, New York, NY 10007. In addition, the final report will be posted on the following website: https://www.epa.gov/superfund/hercules-gibbstown. Efforts will be made to reach out to local public officials to inform them of the results.

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.

A network of ten monitoring wells is associated with the OU3 remedial action: 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). During this FYR period, groundwater samples were collected semiannually from July 2019 through July 2021 and annually thereafter. The samples were analyzed for aluminum, arsenic, iron, lead, manganese, n-nitrosodiphenylamine and sodium.[2] The maximum concentrations detected during this FYR period are presented below in Table 4.

[2] This list includes the COCs identified in the CEA/WRA and O&M Plan, with the exception of bis (2-ethylhexyl) phthalate. As discussed above in the System Operations, Monitoring and Maintenance section, monitoring for this COC was discontinued in April 2016.

Table 4: Maximum Concentrations Detected During Current Five-Year Review Period				
COC	**Location**	**Concentration (µg/L)**	**Remediation Goal GWQS (µg/L)**	**Sampling Date**
Aluminum	MW-40	2,300	200	July 2021
Arsenic	MW-40	330	3	July 2021
Iron	MW-40	290,000	300	July 2021
Lead	MW-40	830	5	July 2021
Manganese	MW-12	2,200	50	July 2023
N-nitrosodiphenylamine	MW-42	49	10	July 2019
Sodium	MW-43	170,000	50,000	January 2020

Overall, arsenic, iron, manganese, and sodium have been consistently detected at concentrations exceeding their applicable NJGWQS's in the majority of the SWDA wells since the post-remediation monitoring program began in October 2014. Lead and n-nitrosodiphenylamine have had consistent detections above their respective regulatory criteria in select wells.

During the review period, monitoring wells MW-42 and MW-43 continued to have regular detections of n-nitrosodiphenylamine above the 10 µg/L GWQS, with maximum detections of 49 µg/L and 47 µg/L, respectively, in July 2019. Lead was detected above its GWQS of 5 µg/L most often in monitoring wells MW-40 and MW-40B, with a few sporadic exceedances in other wells. The maximum lead concentration reported during the review period was 830 µg/L in monitoring well MW-40 (July 2021), and the 3 µg/L GWQS for arsenic was exceeded in monitoring well MW-40, with a maximum concentration of 330 µg/L being reported in July 2021. However, the concentrations of lead and arsenic in this well sharply declined to 72 µg/L and 46 µg/L, respectively, during the following July 2022 sampling event (see Figure 4 and Figure 5 of Appendix A). Elevated lead and arsenic concentrations were likely caused by high turbidity levels in the samples (turbidity readings were greater than 1,000 NTUs during the July 2021 sampling event).

Aluminum was detected above its GWQS of 200 µg/L at least once during the review period in a majority of the SWDA monitoring wells, with a maximum concentration of 2,300 µg/L reported in monitoring well MW-40 (July 2021). Maximum concentrations of iron (290,000 µg/L in monitoring well MW-40) and manganese (2,200 µg/L in monitoring well MW-12) were also observed in July 2021 well above their respective GWQSs of 300 µg/L and 50 µg/L. Exceedances of the 50,000 µg/L GWQS for sodium were also reported in most monitoring wells, with a maximum concentration of 170,000 µg/L reported in monitoring well MW-43 (January 2020). Elevated concentrations of these metals are likely due to naturally occurring conditions in the marsh area surrounding the SWDA. Brackish conditions in the A-level water bearing unit may also be contributing to elevated sodium concentrations.

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), statistically significant trends were identified in select wells. Lead was observed to be increasing in monitoring well MW-40, while an increasing trend for n-nitrosodiphenylamine was observed in monitoring wells MW-14, MW-41, and MW-42. An increasing trend for arsenic was also observed in monitoring wells MW-14, MW-42, and MW-43, however, arsenic appeared

to be decreasing in monitoring well MW-40B. Lead and arsenic will continue to be monitored along with turbidity to ensure that high turbidity levels are not impacting the sampling results for metals.

Iron was observed to be increasing in monitoring wells MW-15, MW-41, and MW-43 and aluminum decreased in monitoring well MW-42. Increasing trends for manganese were observed in monitoring wells MW-14, MW-41, and MW-43 and for sodium in monitoring well MW-43. Iron, aluminum, manganese, and sodium concentrations are related to naturally occurring conditions in the marsh and will continue to be monitored. 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.

Site Inspection

A site inspection was conducted on November 12, 2024. In attendance were Patricia Simmons Pierre of the EPA, Mackenzie Smith of the NJDEP, Trey Richardson of Ashland LLC[3] (Ashland), and James Ferris and Craig Stevens of CSI Environmental, LLC (CSIE). 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 Trey Richardson, Ashland's Project Manager, and James Ferris, Senior Project Manager for CSIE, 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 the review period and that the remedy is functioning as expected.

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/WRA for groundwater

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

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. Although several inorganics were associated with increasing statistical trends, the results throughout the review period fluctuated at times likely due to seasonal variations or turbidity in the samples. In addition, several inorganics such as iron, aluminum, manganese, and sodium concentrations are related to naturally occurring conditions in the marsh. Monitoring will continue into the next FYR period. Overall, the OU3 remedy is functioning as intended by the ROD.

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 the publication of much of the risk assessment guidance for Superfund; 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. Aluminum, arsenic, bis (2-ethylhexyl) phthalate, iron, lead, manganese, n-nitrosodiphenylamine, and sodium were identified in the CEA/WRA as COCs in the SWDA groundwater; lead was the only COC identified in the surface water of the North Ditch (closed system); and cumene, phenol, diphenylamine, chromium, mercury, nickel, silver and zinc were identified as COCs in the North Ditch sediments.

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, 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.

Soils related to the OU3 SWDA remedy are inaccessible under the impermeable cap. Therefore, the OU3 remedy attains the RAOs of mitigating direct contact and minimizes migration of contaminants from the tar and other mixed solid wastes to the surrounding environment.

At the time the ROD was issued, the State of New Jersey was utilizing its SCC. NJDEP has since promulgated Soil Remediation Standards (SRS), which supersede the SCC. While soil Applicable or Relevant and Appropriate Requirements (ARARs) have changed since the ROD was issued, the remedy remains protective because the direct contact pathway has been interrupted with an impermeable cap.

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 continue to be exceeded within the SWDA, the groundwater is not being used for potable purposes.

Soil vapor intrusion is evaluated when soils and/or groundwater are known or suspected to contain VOCs. Because the landfill is capped and there are no buildings within the SWDA, this pathway is incomplete for OU3. However, because 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. Sub-slab 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, potential effects to aquatic plants, invertebrates and terrestrial animals from exposure to lead contamination in the SWDA are negligible, and that no further evaluation of ecological exposure to lead in the SWDA 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 further 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

Table 5, below, presents the OU3 protectiveness statement.[4]

Table 5: 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.

[4] Construction of the remedies for OU1 and OU2 has not yet been initiated; therefore, these OUs are not subject to evaluation in this FYR. In addition, no sitewide protectiveness statement is provided.

APPENDIX A – FIGURES

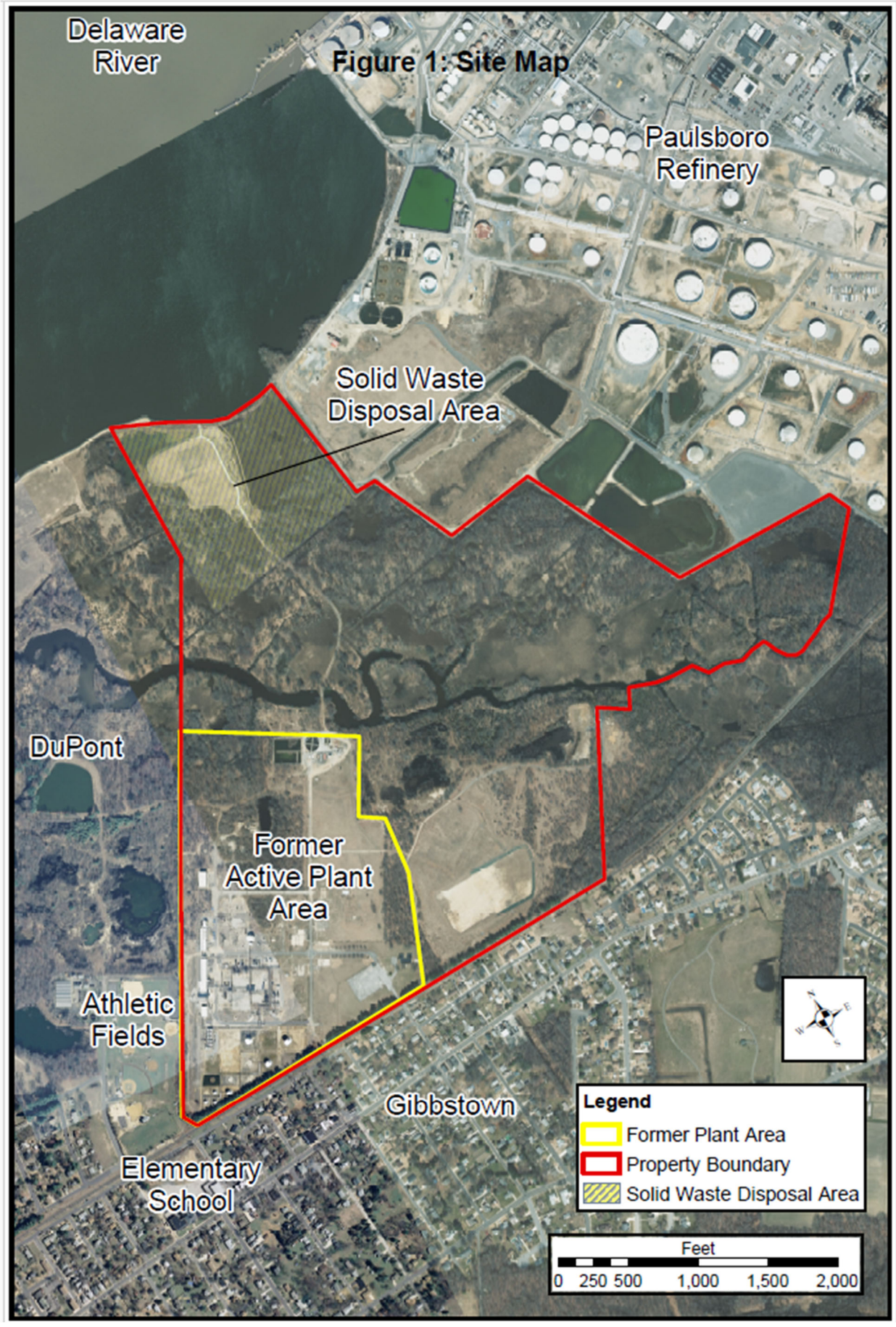

Delaware River
Figure 1: Site Map
Paulsboro Refinery
Solid Waste Disposal Area
DuPont
Former Active Plant Area
Athletic Fields
Gibbstown
Elementary School
Legend
Former Plant Area
Property Boundary
Solid Waste Disposal Area
Feet
0 250 500 1,000 1,500 2,000

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

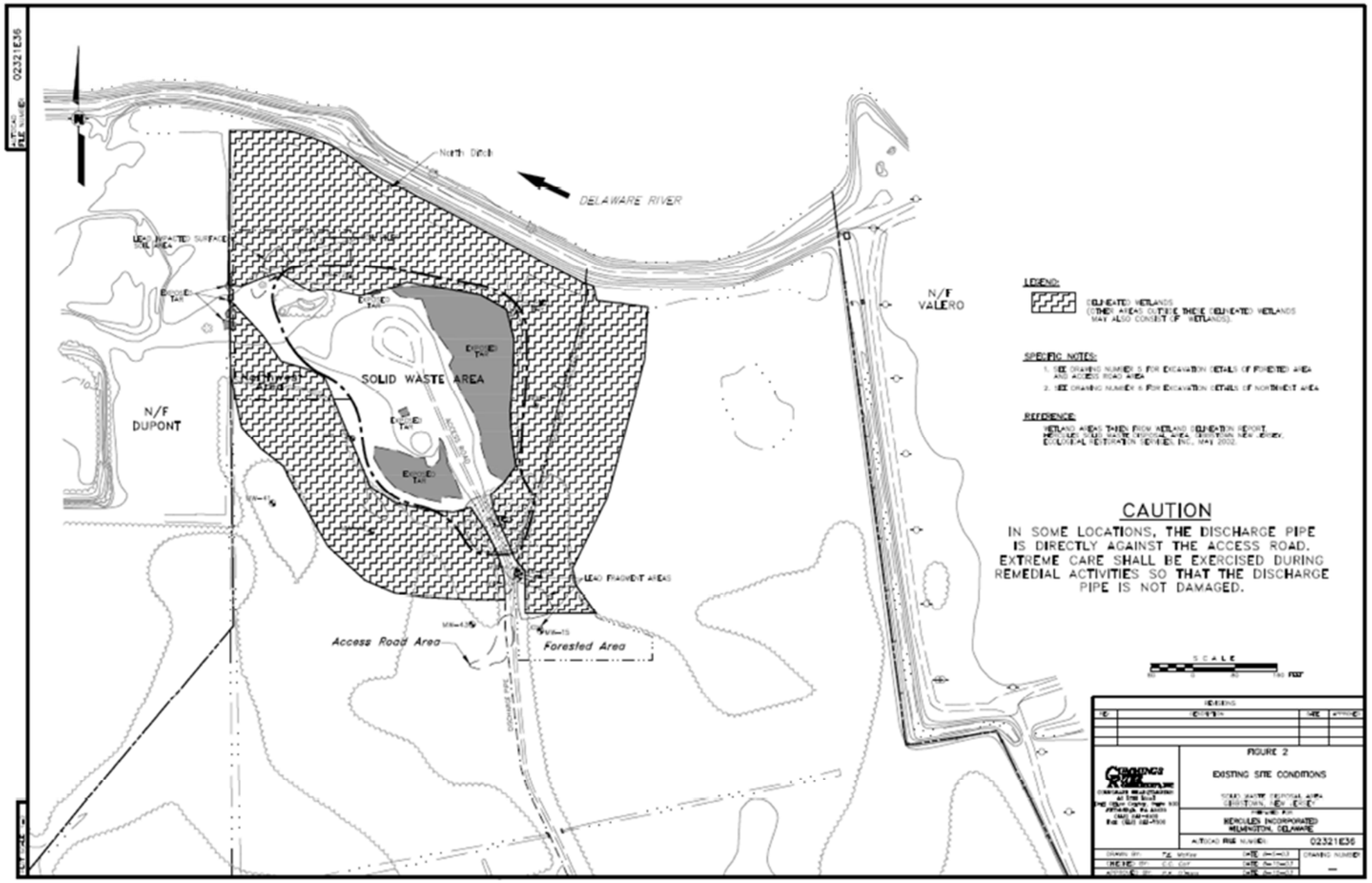


Figure 3: Operable Unit 3 Area (Post-Remedial Action)

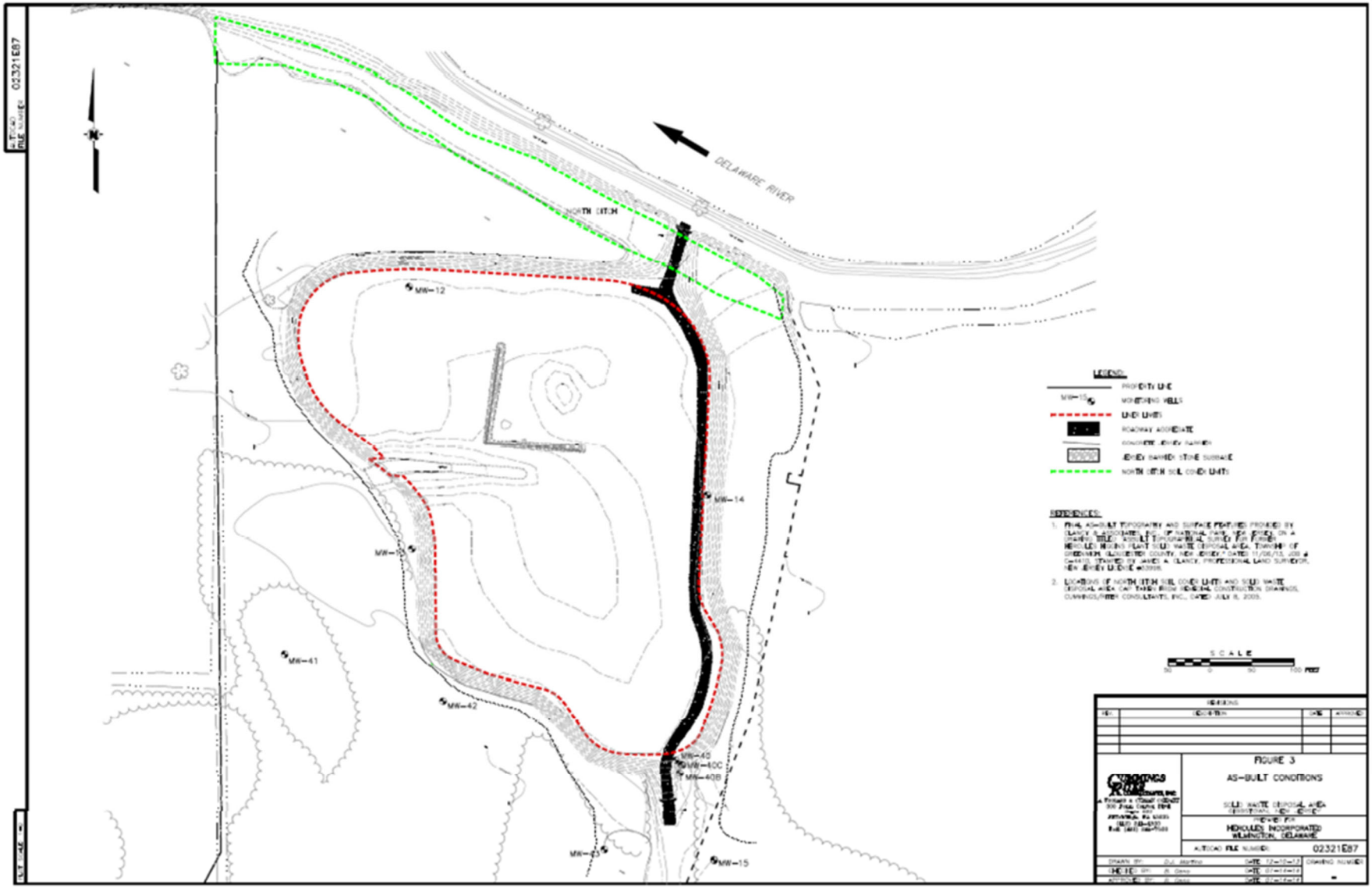


Figure 4: Historic Lead Detections
SWDA Groundwater Monitoring, Hercules, Inc. (Gibbstown)

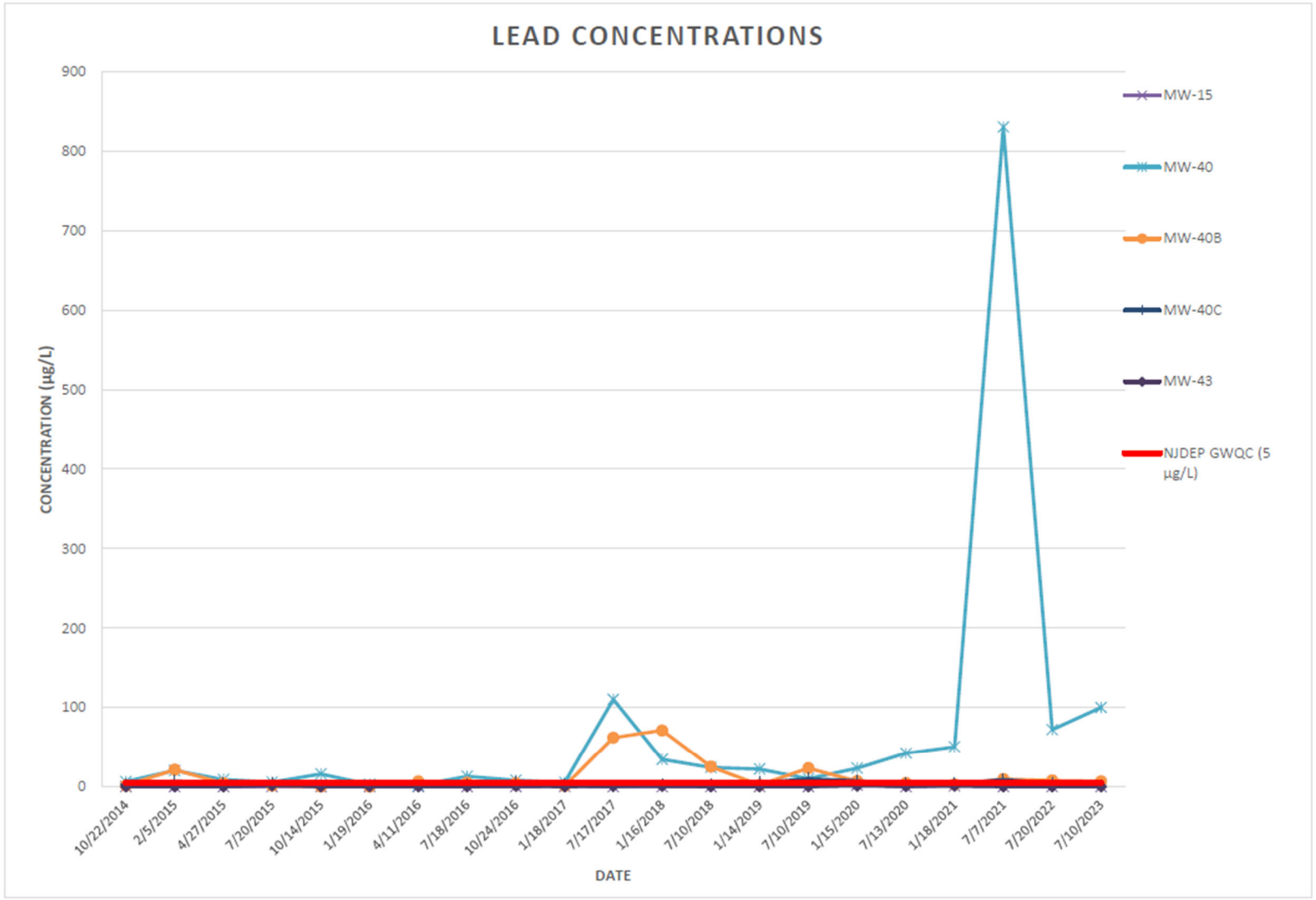
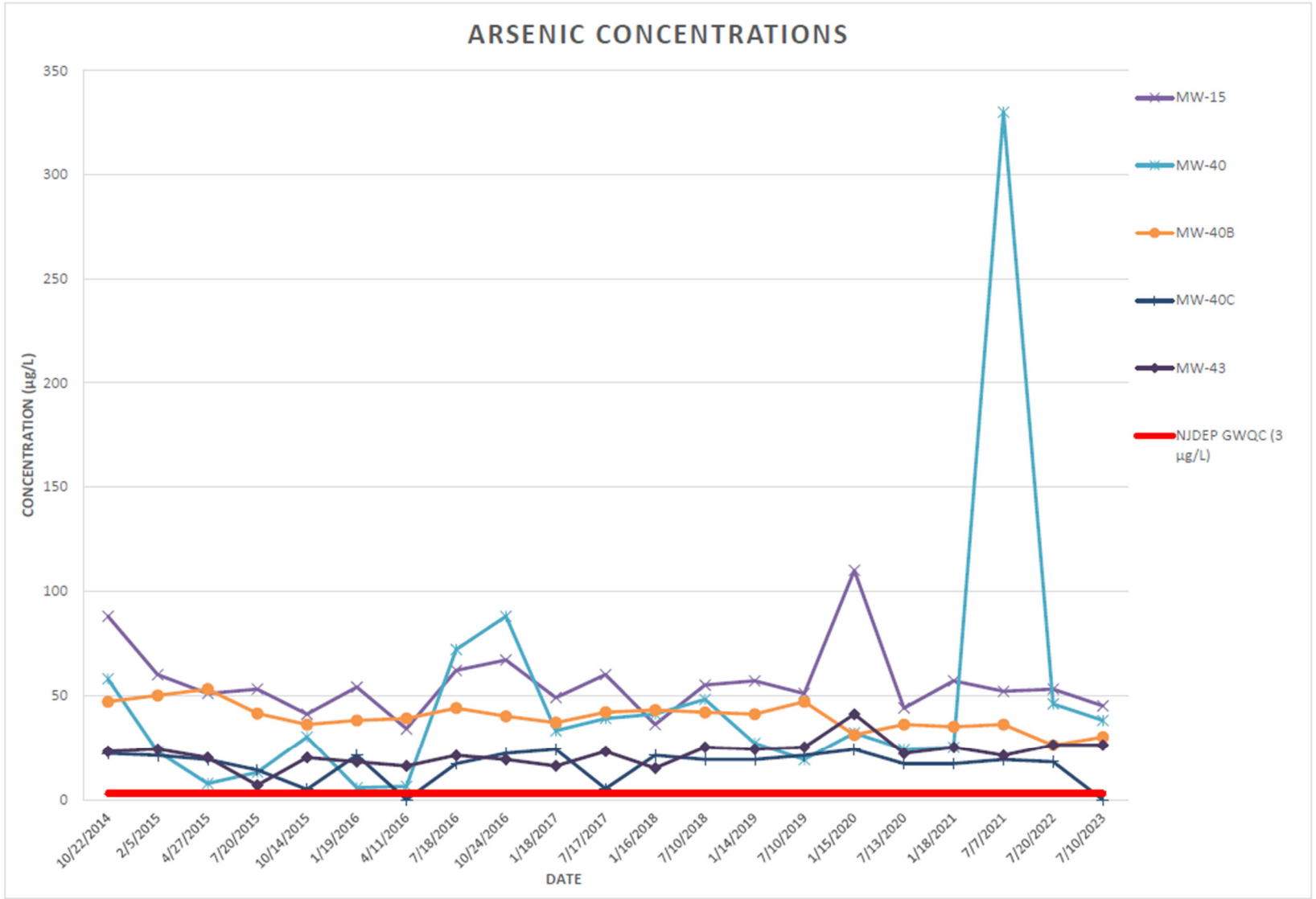


Figure 5: Historic Arsenic Detections
SWDA Groundwater Monitoring, Hercules, Inc. (Gibbstown Plant)



APPENDIX B – REFERENCES

Document Title and Author	Date
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 (OU1 and OU2), EPA	September 2018
Second Five-Year Review Report, Hercules, Inc. (Gibbstown Plant) Superfund Site, Gibbstown, New Jersey, EPA	January 2020
Hercules, Inc. (Gibbstown) Solid Waste Disposal Area Semiannual Groundwater Monitoring Reports, CSI Environmental, LLC	2019 - 2021
Hercules, Inc. (Gibbstown) Solid Waste Disposal Area Annual Groundwater Monitoring Reports, CSI Environmental, LLC	2022 - 2023
Hercules, Inc. (Gibbstown) Quarterly Groundwater Monitoring Reports for Operable Unit One, CSI Environmental, LLC	2020 - 2024

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.[5]

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)[6], such as fencing and environmental use restrictions, respectively; and the establishment of a Classification Exception Area (CEA)/Well Restriction Area (WRA)[7] 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

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

[6] 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.

[7] 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.

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 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. In August 2020, EPA and the PRP entered into a consent decree related to the performance of the remedial design and remedial action for OUs 1 and OU2; 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 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 2 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.

APPENDIX D − CLIMATE CHANGE EVALUATION

In accordance Region 2 practice, three climate change tools were utilized to assess the Hercules, Inc. site (Site). Screenshots from each of the tools used are included below.

The first tool, the Climate Mapping for Resilience and Adaptation Assessment (CMRA) Tool (see CMRA - Climate Mapping For Resilience and Adaptation (arcgis.com)) examined five climate hazards (extreme heat, drought, wildfire, flooding, and costal inundation) for Gloucester County, the county in which the Site is located. According to the CMRA tool, the National Risk Index Rating for extreme heat, flooding and coastal inundation are "Relatively Moderate" (see Figures D-1 through D-3). However, no impacts from these hazards to the Site area or to the implementation or performance of the OU3 remedy have been observed. In addition, although the Site sits adjacent to the Delaware River, the remediated area is significantly elevated above the surrounding area, which makes it less vulnerable to impacts from flooding and coastal inundation. The CMRA tool reported the risks for drought and wildfire, shown in Figures D-4 and D-5, respectively, as "Relatively Low."

The second tool is called the NOAA Sea Level Rise Viewer (SLRV). This tool assessed the potential for impacts to the Site vicinity from sea level rise and coastal flooding. Figure D-6 from the SLRV shows that based on the tide gauge located nearest to the Site (in Philadelphia, PA), an 8-ft. increase in the current mean higher high water (MHHW) level would result in a high risk of impacts from sea level rise to the Site vicinity (shown by the red dot). According to the 2022 *NOAA Sea Level Rise Technical Report*, under a high scenario, the maximum projected rise in the MHHW level (based on the closest NOAA tide gauge) is 6.59 ft by the year of 2100. However, as previously mentioned, because the remediated area of OU3 is considerably elevated above the surrounding area, it is not likely to experience climate impacts due to a rise in the sea level. Nevertheless, changes in sea level rise projections will continue to be monitored.

The final tool is called the USGS U.S. Landslide Inventory (see https://www.usgs.gov/tools/us-landslide-inventory-and-susceptibility-map). As shown by Figure D-7, there have been no landslides recorded in the vicinity of the Site.

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.

FIGURE D-1

Gloucester County, New Jersey

Total Population
291,165

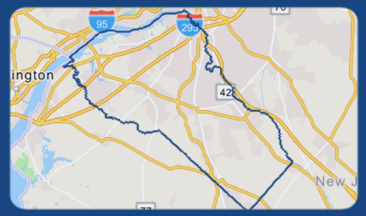
% Population with Income Below Poverty
7%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
4.58%

National Risk Index Rating
Relatively Moderate
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters



U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Temperature thresholds:							
Annual days with maximum temperature > 90°F	**16 days** 16 - 23	**37 days** 22 - 51	**40 days** 25 - 56	**47 days** 26 - 65	**56 days** 30 - 77	**57 days** 34 - 80	**88 days** 43 - 110
Annual days with maximum temperature > 95°F	**4 days** 3 - 5	**11 days** 5 - 19	**12 days** 6 - 21	**16 days** 7 - 28	**22 days** 8 - 37	**23 days** 9 - 43	**51 days** 12 - 77
Annual days with maximum temperature > 100°F	**0 days** 0 - 0	**2 days** 0 - 5	**2 days** 1 - 5	**3 days** 1 - 9	**6 days** 1 - 13	**6 days** 1 - 9	**21 days** 2 - 45
Annual days with maximum temperature > 105°F	**0 days** 0 - 0	**0 days** 0 - 1	**0 days** 0 - 1	**0 days** 0 - 2	**1 days** 0 - 4	**1 days** 0 - 4	**6 days** 0 - 20
Annual temperature:							
Annual single highest maximum temperature °F	**97 °F** 96 - 98	**100 °F** 98 - 103	**101 °F** 98 - 103	**102 °F** 98 - 105	**103 °F** 99 - 107	**103 °F** 100 - 107	**108 °F** 100 - 113
Annual highest maximum temperature averaged over a 5-day period °F	**92 °F** 92 - 93	**96 °F** 93 - 98	**96 °F** 94 - 98	**97 °F** 94 - 101	**98 °F** 95 - 102	**98 °F** 95 - 103	**103 °F** 96 - 109
Cooling degree days (CDD)	**1151 degree-days** 1094 - 1224	**1,494 degree-days** 1,268 - 1,787	**1,533 degree-days** 1,290 - 1,766	**1,680 degree-days** 1,337 - 2,057	**1,845 degree-days** 1,432 - 2,219	**1,871 degree-days** 1,505 - 2,323	**2,531 degree-days** 1,741 - 3,114

N/A = Data Not Available for the selected area

FIGURE D-2

Gloucester County, New Jersey

Total Population
291,165

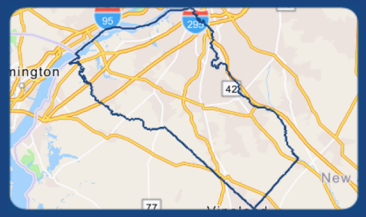
% Population with Income Below Poverty
7%

Building Codes Hazard Resistance
Resistant

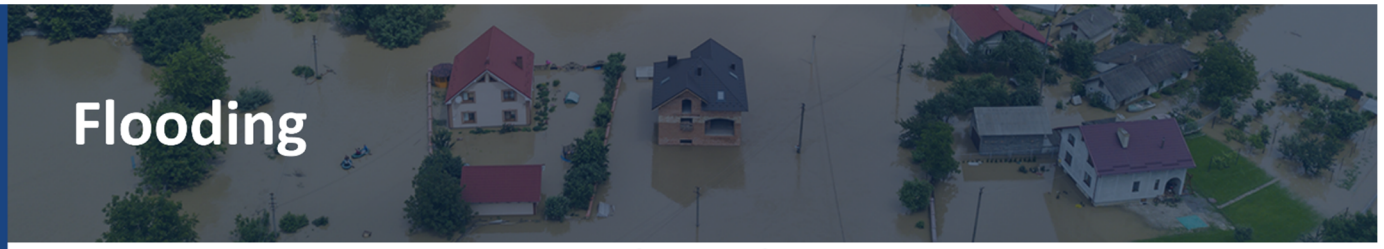
% Population Disadvantaged
4.58%

National Risk Index Rating
Relatively Moderate
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters



U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD



Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Annual average total precipitation	**45"** 43 - 47	**47"** 44 - 53	**48"** 43 - 53	**48"** 44 - 55	**49"** 45 - 54	**49"** 44 - 55	**50"** 44 - 57
Days per year with precipitation (wet days)	**176 days** 171 - 181	**175 days** 166 - 185	**175 days** 163 - 183	**175 days** 161 - 188	**174 days** 160 - 188	**175 days** 160 - 188	**172 days** 146 - 190
Maximum period of consecutive wet days	**10 days** 9 - 11	**11 days** 9 - 12	**11 days** 9 - 12	**11 days** 9 - 13	**11 days** 9 - 12	**11 days** 9 - 13	**11 days** 9 - 13
Annual days with:							
Annual days with total precipitation > 1inch	**7 days** 6 - 8	**8 days** 6 - 10	**8 days** 7 - 10	**8 days** 7 - 11	**9 days** 7 - 10	**9 days** 7 - 10	**10 days** 7 - 12
Annual days with total precipitation > 2 inches	**1 days** 1 - 1	**1 days** 1 - 1	**1 days** 1 - 1	**1 days** 1 - 2	**1 days** 1 - 2	**1 days** 1 - 2	**1 days** 1 - 2
Annual days with total precipitation > 3 inches	**0 days** 0 - 0	**0 days** 0 - 0	**0 days** 0 - 0	**0 days** 0 - 0	**0 days** 0 - 1	**0 days** 0 - 0	**0 days** 0 - 1
Annual days that exceed 99th percentile precipitation	**7 days** 5 - 8	**8 days** 6 - 10	**8 days** 7 - 10	**9 days** 7 - 10	**9 days** 7 - 11	**9 days** 7 - 11	**11 days** 8 - 13
Days with maximum temperature below 32 °F	**13 days** 11 - 15	**8 days** 2 - 11	**7 days** 2 - 11	**6 days** 1 - 10	**5 days** 2 - 8	**4 days** 1 - 8	**1 days** 0 - 4

N/A = Data Not Available for the selected area

FIGURE D-3

Gloucester County, New Jersey

Total Population
291,165

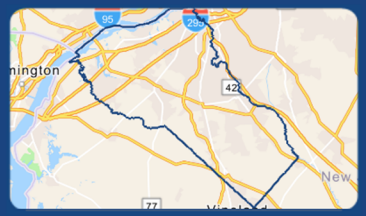
% Population with Income Below Poverty
7%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
4.58%

National Risk Index Rating
Relatively Moderate
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters



U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

Coastal Inundation

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Sea level rise:							
Percent of selected county impacted by global sea level rise	N/A	0%	0%	1%	1%	2%	2%

For more information on sea level changes, see the Interagency Sea Level Rise Scenario Tool

N/A = Data Not Available for the selected area

FIGURE D-4

Gloucester County, New Jersey

Total Population
291,165

% Population with Income Below Poverty
7%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
4.58%

National Risk Index Rating
Relatively Low
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Average annual total precipitation	**45"** 43 - 47	**47"** 44 - 53	**48"** 43 - 53	**48"** 44 - 55	**49"** 45 - 54	**49"** 44 - 55	**50"** 44 - 57
Days per year with precipitation (wet days)	**176 days** 171 - 181	**175 days** 166 - 185	**175 days** 163 - 183	**175 days** 161 - 188	**174 days** 160 - 188	**175 days** 160 - 188	**172 days** 146 - 190
Days per year with no precipitation (dry days)	**189 days** 184 - 194	**190 days** 180 - 199	**190 days** 182 - 203	**190 days** 177 - 204	**191 days** 177 - 205	**190 days** 177 - 205	**193 days** 175 - 219
Maximum number of consecutive dry days	**12 days** 11 - 13	**12 days** 11 - 14	**12 days** 11 - 14	**12** days 11 - 14	**12 days** 11 - 15	**13 days** 11 - 15	**13 days** 11 - 16
Temperature thresholds:							
Annual days with maximum temperature > 90 °F	**16 days** 16 - 23	**37 days** 22 - 51	**40 days** 25 - 56	**47 days** 26 - 65	**56 days** 30 - 77	**57 days** 34 - 80	**88 days** 43 - 110
Annual days with maximum temperature > 100 °F	**0 days** 0 - 0	**2 days** 0 - 5	**2 days** 1 - 5	**3 days** 1 - 9	**6 days** 1 - 13	**6 days** 1 - 9	**21 days** 2 - 45

N/A = Data Not Available for the selected area

FIGURE D-5

Gloucester County, New Jersey

Total Population
291,165

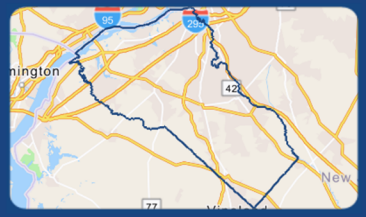
% Population with Income Below Poverty
7%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
4.58%

National Risk Index Rating
Relatively Low
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters



U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Days per year with no precipitation (dry days)	**189 days** 184 - 194	**190 days** 180 - 199	**190 days** 182 - 203	**190 days** 177 - 204	**191 days** 177 - 205	**190 days** 177 - 205	**193 days** 175 - 219
Maximum number of consecutive dry days	**12 days** 11 - 13	**12 days** 11 - 14	**12 days** 11 - 14	**12 days** 11 - 14	**12 days** 11 - 15	**13 days** 11 - 15	**13 days** 11 - 16
Days per year with precipitation (wet days)	**176 days** 171 - 181	**175 days** 166 - 185	**175 days** 163 - 183	**175 days** 161 - 188	**174 days** 160 - 188	**175 days** 160 - 188	**172 days** 146 - 190
Temperature thresholds:							
Annual days with maximum temperature > 90°F	**16 days** 16 - 23	**37 days** 22 - 51	**40 days** 25 - 56	**47 days** 26 - 65	**56 days** 30 - 77	**57 days** 34 - 80	**88 days** 43 - 110
Annual days with maximum temperature > 100°F	**0 days** 0 - 0	**2 days** 0 - 5	**2 days** 1 - 5	**3 days** 1 - 9	**6 days** 1 - 13	**6 days** 1 - 9	**21 days** 2 - 45

N/A = Data Not Available for the selected area

FIGURE D-6

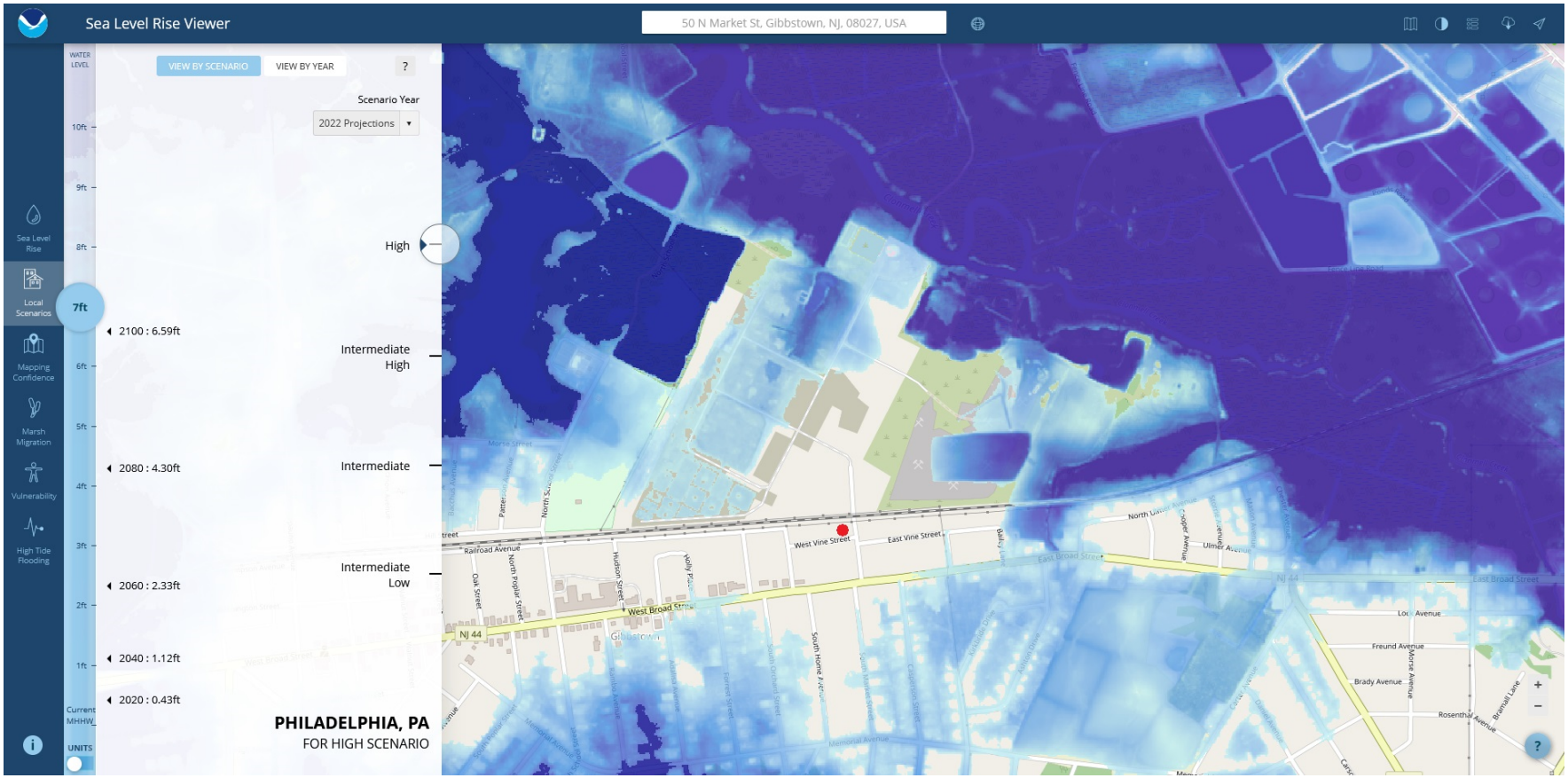
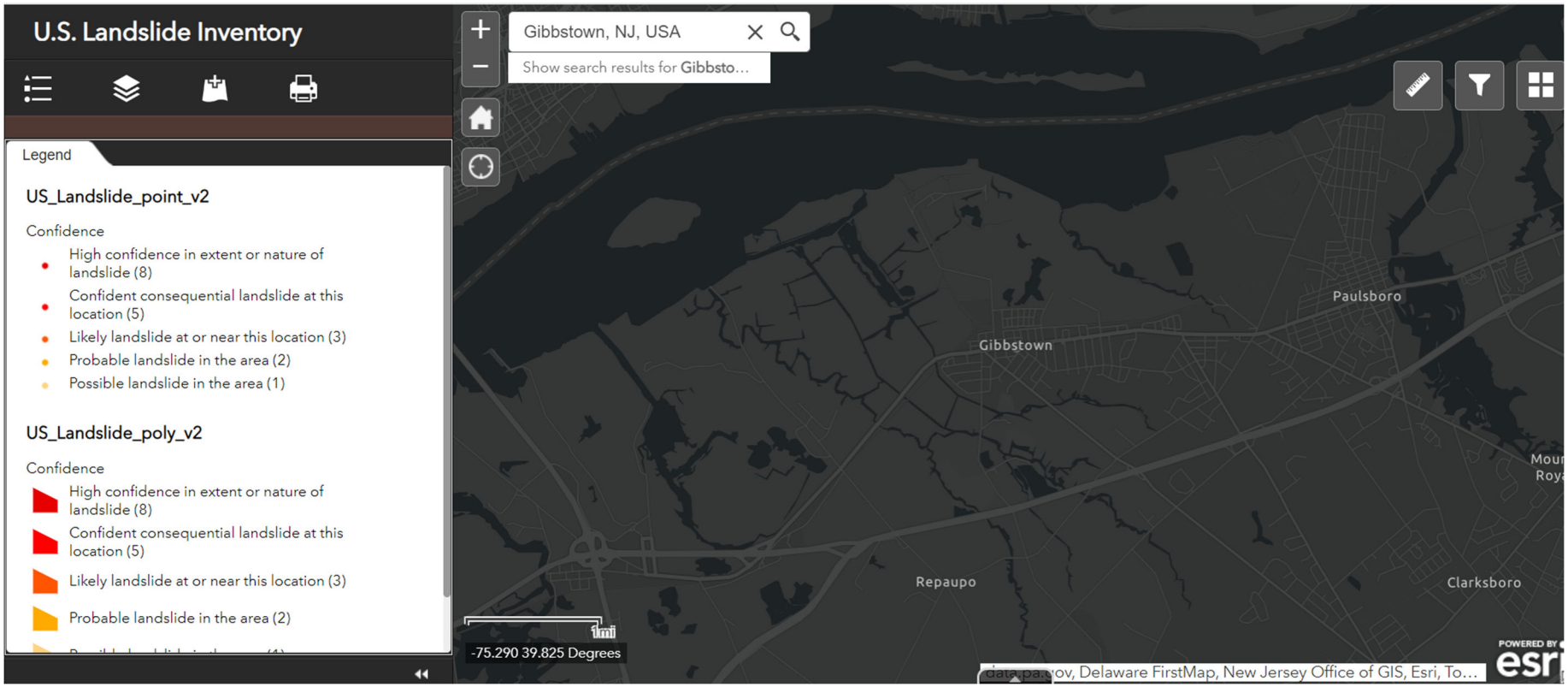

Sea Level Rise Viewer
50 N Market St, Gibbstown, NJ, 08027, USA
VIEW BY SCENARIO
VIEW BY YEAR
Scenario Year
2022 Projections
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
7ft
2100 : 6.59ft
2080 : 4.30ft
2060 : 2.33ft
2040 : 1.12ft
2020 : 0.43ft
High
Intermediate High
Intermediate
Intermediate Low
PHILADELPHIA, PA
FOR HIGH SCENARIO
West Vine Street
East Vine Street
West Broad Street
East Broad Street
Railroad Avenue
NJ 44
Freund Avenue
Brady Avenue
Rosenthal Avenue

FIGURE D-7


U.S. Landslide Inventory
Legend
US_Landslide_point_v2
Confidence
High confidence in extent or nature of landslide (8)
Confident consequential landslide at this location (5)
Likely landslide at or near this location (3)
Probable landslide in the area (2)
Possible landslide in the area (1)
US_Landslide_poly_v2
Confidence
High confidence in extent or nature of landslide (8)
Confident consequential landslide at this location (5)
Likely landslide at or near this location (3)
Probable landslide in the area (2)
Gibbstown, NJ, USA
Show search results for Gibbsto...
Paulsboro
Gibbstown
Repaupo
Clarksboro
1mi
-75.290 39.825 Degrees
Delaware FirstMap, New Jersey Office of GIS, Esri, To...
esri