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October 1, 2014

Mr. Sin-Kie Tjho
U.S. Environmental Protection Agency, Region 2
290 Broadway, 22nd Floor
New York, NY 10007-1866

Comprehensive RCRA Facility Investigation Report
DuPont Chambers Works Complex, Deepwater, NJ

Dear Mr. Tjho:

Enclosed is one hard copy and one electronic copy on CD of the *Comprehensive RCRA Facility Investigation Report*, which summarizes the nature and extent of site-related constituents of concern released from regulated units, solid waste management units (SWMUs), and other source areas at the Chambers Works Complex located in Deepwater, New Jersey. The report presents a comprehensive summary of data collected from prior RFI phases and associated investigations and integrates the data and information collected during the most recent 2013-2014 RFI data gap investigation. The comprehensive dataset is used to support recommendations of No Further Action (NFA) or Corrective Measures Study (CMS) for SWMUs and areas of concern (AOCs).

This RFI report completes the requirements of the RFI phase for the site. A robust conceptual site model (CSM) that integrates site-specific physical features, nature and extent of site-related constituents released to media, potential migration pathways, and potential receptor information is included. At the Chambers Works Complex, 96 SWMUs had been identified through the RFI process. In addition, eleven AOCs were identified in 2006. These AOCs are relatively large and cover a large portion of the manufacturing area, thus encompassing some of the previously identified SWMUs. Detailed fact sheets for the SWMUs and AOCs are included in Appendix A.

Following the RFI phase, corrective measures will be evaluated as the next phase under the RCRA program. A summary of the recommended CMS work is as follows.

- SWMU 39-1: The proposed remedy of MNA for groundwater will be implemented according to the recommendations provided in the *Garage Diesel Spill Groundwater Remedial Investigation and Remedial Action Selection Report*.

- SWMU 45-2: There were several metals in soil at concentrations exceeding the impact to groundwater and direct contact soil remediation standards. Remedial options will be evaluated to address potential receptor pathways in a manner consistent with future property use.

- Manufacturing Area-Wide Groundwater: Impacted groundwater exceeding NJGWIIA extends across the manufacturing area, encompassing areas beneath AOCs 1 through 10 (except for a small area of AOC 9) as well as most of SWMUs 8, 40, and AOC 11. The interceptor well system (IWS) will be a major component of the final corrective measure as well as continued groundwater monitoring and DNAPL recovery as part of the DNAPL recovery program. Additionally, the feasibility of remediating significant sources to groundwater will be evaluated, and further investigation of the vapor intrusion pathway will be conducted.

DuPont has submitted the Electronic Data Deliverable (EDD) to the New Jersey Department of Environmental Protection in three packages (NJD002385730: HB158732, HB158733, and HB158734). These packages include data from the most recent site investigations, including the Interior and the 2013-14 RFI Data Gap investigations.

If you have any questions or want to discuss further any aspect of the report, please call me at 856.540.2077.

Sincerely,

Edward J. Lutz

Edward J Lutz
Senior Consultant
Corporate Remediation – NJ

cc: Linda Range, NJDEP (1 hard copy, 3 electronic copies, and 3 sets of large drawings)
DuPont File
URS File Copy

Comprehensive RCRA Facility Investigation Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Date: October 2014 Project No.: 18985881.14001

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Acronym List

Acronym	Explanation
ACO	Administrative Consent Order
ADQM	Analytical Data Quality Management
AET	Apparent Effects Threshold
ANPRM	Advanced Notice of Proposed Rule Making
AOC	Area of Concern
AVS	Acid Volatile Sulfide
BEE	Baseline Ecological Evaluation
BEERA/ETRA	Bureau of Environmental Evaluation and Risk Assessment, Environmental Toxicology and Risk Assessment
BOD	Biological Oxygen Demand
bgs	Below Ground Surface
CA	Corrective Action
CEA	Classification Exception Area
CFATS	Chemical Facilities Anti-Terrorism Standards
CID	Case Inventory Document
CM	Conceptual Model
CMS	Corrective Measures Study
COPEC	Constituent of Potential Ecological Concern
COPC	Constituent of Potential Concern
CRG	DuPont Corporate Remediation Group
CSM	Conceptual Site Model
DCA	Dichloroethane
DCE	Dichloroethene
DCP	Dichloropropane
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDR	DuPont Data Review
DDT	Dichlorodiphenyltrichlroethane
delta-BHC	Delta-Benzene Hexachloride
DGW	Discharge to Groundwater
DHS	U.S. Department of Homeland Security
DI	Deionized
DNAPL	Dense Non-Aqueous Phase Liquid
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DRBC	Delaware River Basin Commission
DuPont	E.I. du Pont de Nemours and Company
Eco-SSL	Ecological Soil Screening Level
EDB	Ethylene Dibromide
EI	Environmental Indicator
EIR	Ecological Investigation Report
EPA	U.S. Environmental Protection Agency
EqP	Equilibrium Partitioning
ER-L	Effects Range-Low
ESC	Ecological Screening Criteria
ESNR	Environmentally Sensitive Natural Resource
FOC	Fractional Organic Carbon

Acronym	Explanation
g/cm^3	Grams per Cubic Centimeters
gpm	Gallons per Minute
GPRA	Government Performance Results Act
GWSL	Generic Groundwater Screening Level for the VI Pathway
HASP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments of 1984
IGWSCC	Impact to Groundwater Soil Cleanup Criteria
IH	Industrial Hygiene
INDOT	Indiana Department of Transportation
IRAWP	Interim Remedial Action Work Plan
IRM	Interim Remedial Measure
ITRC	Interstate Technology & Regulatory Council
IWS	Interceptor Well System
LCV	Lowest Chronic Values
LEL	Lowest Effects Levels
LNAPL	Light Non-Aqueous Phase Liquid
MDL	Method Detection Limit
mg/kg	Milligrams per Kilogram
mgd	Million Gallons Per Day
mL/min	Milliliters per Minute
MNA	Monitored Natural Attenuation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N.J.A.C.	New Jersey Administrative Code
NAPL	Non-Aqueous Phase Liquid
NFA	No Further Action
NGVD	National Geodetic Vertical Datum
NJGWIIA	New Jersey Groundwater Quality Class IIA Standards
NJIGWSRS	New Jersey Impact To Groundwater Soil Remediation Standards
NJNRDCSCC	New Jersey Nonresidential Direct Contact Soil Cleanup Criteria
NJNRDCSRS	New Jersey Non-Residential Direct Contact Soil Remediation Standards
NJNRSGSL	New Jersey Non-Residential Soil Gas Screening Level
NJSWQS	New Jersey Surface Water Quality Standards
NOAA	National Oceanographic and Atmospheric Administration
NOECs	No Observed Effect Concentrations
NRWQC	National Recommended Water Quality Criteria
ODCB	Orthodichlorobenzene
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PAR	Preliminary Assessment Report
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PEL	Permissible Exposure Limit
PFAS	Perfluoroalkyl Substance
PFC	Perfluorinated Compounds
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonate
PID	Photo-Ionization Detector
PPE	Personal Protective Equipment
ppm	Parts per Million
PQL	Practical Quantitation Limit

Acronym	Explanation
PRM	Potomac-Raritan-Magothy
PVC	Polyvinyl Chloride
PWDS	Process Water Ditch System
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAR	Remedial Action Report
RASR	Remedial Action Selection Report
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RIWP	Remedial Investigation Work Plan
RPD	Relative Percent Difference
SCV	Secondary Chronic Values
SEM	Simultaneously Extractable Metals
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TAS	Total Aqueous Solubility
TEL	Tetraethyl Lead
TCE	Trichloroethene
TOC	Total Organic Carbon
tPAH	Total Polycyclic Aromatic Hydrocarbon
URS	URS Corporation
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UST	Underground Storage Unit
UTL	Upper Tolerance Limit
UTL_{95}	95th Percent Upper Tolerance Limit
VI	Vapor Intrusion
VIG	Vapor Intrusion Guidance
VOC	Volatile Organic Compound
WRA	Well Restriction Area
WWTP	Wastewater Treatment Plant

Executive Summary

The purpose of this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report is to summarize the nature and extent of site-related constituents of concern released from regulated units, solid waste management units (SWMUs), and other source areas at the facility and to support development of a Corrective Measures Study (CMS) for the DuPont Chambers Works Complex (site) located in Deepwater, New Jersey. The report presents a comprehensive summary of data collected from prior RFI phases and associated investigations, and integrates the data and information collected during the most recent 2013-2014 RFI data gap investigation. The comprehensive dataset is used to support recommendations of No Further Action (NFA) or Corrective Measures Study (CMS) for SWMUs and areas of concern (AOCs).

This RFI report completes the requirements of the RFI phase for the site. A robust conceptual site model (CSM) that integrates site-specific physical features, nature and extent of site-related constituents released to media, potential migration pathways, and potential receptor information is included. At the Chambers Works Complex, 96 SWMUs had been identified through the RFI process. In addition, 11 AOCs were identified in 2006. These AOCs are relatively large and cover a large portion of the manufacturing area, thus encompassing some of the previously identified SWMUs. Detailed fact sheets for the SWMUs and AOCs are included in Appendix A.

The DuPont Chambers Works Complex comprises the former Carneys Point Works in the northern area of the site and the Chambers Works manufacturing area in the southern area of the site. In Carneys Point, all but one of the 28 SWMUs are recommended for an NFA. SWMU 45-2 is recommended to be carried forward to the CMS phase. Carneys Point groundwater has been characterized. The primary constituents of concern in Carneys Point are metals, primarily arsenic and lead, and polycyclic aromatic hydrocarbons.

In the manufacturing area, there are 68 SWMUs. Six SWMUs are not considered in this report because these SWMUs are either RCRA Part B Operating Units or are managed by the United States Army Corps of Engineers (USACE). All of the remaining SWMUs in the manufacturing area are recommended for an NFA, with the exception of SWMUs 8, 39-1, and 40, which are recommended for a CMS for groundwater. All of the AOCs in the manufacturing area (AOCs 1 through 11) are recommended for an NFA for soil; however, groundwater across the manufacturing area is recommended to be carried forward to the CMS phase. It is recommended that the CMS activities for SWMUs 8 and 40 also be included in the CMS for manufacturing area-wide groundwater. The CMS for manufacturing area-wide groundwater will address impacted groundwater as well as evaluate the feasibility of remediating significant sources to groundwater identified in this report. Significant sources to groundwater are primarily dense non-aqueous phase liquid (DNAPL) source zones, which are present below the water table to a depth of up to 30 feet below ground surface. DNAPL source zones were identified by evaluating multiple lines of evidence including visual observations and soil and groundwater concentrations. The primary constituents of concern are volatile and semi-volatile organic compounds including mono- and dichlorobenzenes, benzene, tetrachloroethene, and aniline and metals including arsenic and lead.

Groundwater at the site (both Carneys Point and the manufacturing area) is part of the site-wide Classification Exception Area (CEA) and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place. The containment and monitoring programs will continue to be documented in the semi-annual discharge to groundwater (DGW) reports.

Potentially complete exposure pathways were evaluated for potential receptors (on-site industrial workers, on-site construction/excavation workers and recreational users of the Delaware River) identified based on current and reasonably anticipated future land use. Based on an evaluation of site-specific exposure conditions, no significant potentially complete exposure pathways for human health were identified at this time, including vapor intrusion and groundwater discharge to the Delaware River. However, additional investigation of the vapor intrusion pathway is recommended.

Ecological evaluations were completed earlier in the RFI process. Evaluation of potential migration pathways was also included and considered historical process discharges, stormwater runoff, and a potential groundwater to surface-water connection from the B aquifer to surface-water bodies. On-site, unacceptable risks to ecological receptors were not identified in any exposure area evaluated in Carneys Point or the manufacturing area and support the recommendation of no further ecological investigation or remedial action at the site on the basis of ecological risk.

This report demonstrates that the RFI phase has been completed for the site. The Chambers Works SWMUs and AOCs have been investigated, and the nature and extent of releases have been characterized. Remedial actions have been performed as recommended for many SWMUs. Based on the data collected and the remedial work that has been completed, recommendations for each SWMU and AOC and supporting data are included in this report. Following the RFI phase, the following corrective measures will be evaluated as the next phase under the RCRA program:

- SWMU 39-1: The proposed remedy of monitored natural attenuation (MNA) for groundwater will be implemented according to the recommendations provided in the *Garage Diesel Spill Groundwater Remedial Investigation and Remedial Action Selection Report.*
- SWMU 45-2: There were several metals in soil at concentrations exceeding the impact to groundwater and direct contact soil remediation standards. Remedial options will be evaluated to address potential receptor pathways in a manner consistent with future property use.
- Manufacturing Area-Wide Groundwater: Impacted groundwater exceeding New Jersey Groundwater Quality Class IIA Standards (NJGWIIA) extends across the manufacturing area, encompassing areas beneath AOCs 1 through 10 (except for a small area of AOC 9) as well as most of SWMUs 8, 40, and AOC 11. The interceptor well system (IWS) will be a major component of the final corrective measure as well as continued groundwater monitoring and DNAPL recovery as part of the DNAPL recovery program. Additionally, the feasibility of remediating significant sources to groundwater will be evaluated, and further investigation of the vapor intrusion pathway will be conducted.

1.0 Introduction and Purpose of Report

URS Corporation (URS), on behalf of E.I. du Pont de Nemours and Company (DuPont), has prepared this Comprehensive Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for the DuPont Chambers Works Complex (the site) located in Deepwater, New Jersey (see Figure 1-1). DuPont has been conducting RCRA corrective action activities at the site under the jurisdiction of the U.S. Environmental Protection Agency (EPA) through the Hazardous and Solid Waste Amendments of 1984 (HSWA) permit no. NJD002385730 (effective November 7, 1988). In addition, remedial activities at the site have been conducted according to the terms of the amended 1988 Administrative Consent Order (ACO) between DuPont and the New Jersey Department of Environmental Protection (NJDEP) and the HSWA permit.

After submission and approval of the *Preliminary Assessment Report* [DuPont Corporate Remediation Group (CRG), 2006a] and the *Phase IV Supplemental RFI Report* (DuPont CRG, 2007a), both interior and perimeter investigation of the site has continued. In 2013, a data gap analysis was performed for site solid waste management units (SWMUs) and areas of concern (AOCs). Data gaps identified were included in the *RFI Data Gap Sampling Plan* (URS, 2013a). The plan was approved by NJDEP in December 2013. The data gap field investigation was completed in February 2014.

The purpose of an RFI is to determine the nature and extent of releases of hazardous wastes or hazardous constituents from regulated units, solid waste management units, and other source areas at the facility, and to support the Corrective Measures Study (CMS). The RFI data are also used to support the EPA environmental indicator determinations. An RFI may include the collection of site-specific data to evaluate potential exposure pathways for human and/or ecological receptors.

This RFI report presents a comprehensive summary of data collected from prior RFI phases and associated investigations, and integrates the data and information collected during the most recent 2013-14 RFI data gap investigation. This comprehensive dataset is used to support recommendations of No Further Action (NFA) or CMS for SWMUs and AOCs. The overall goal of this RFI report is to demonstrate that the RFI phase has been completed for the site. In addition, this report presents a robust conceptual site model (CSM) that integrates site-specific physical features, nature and extent of site-related constituents released to media, potential migration pathways, and potential receptor information.

1.1 Background on RFI Process at the Chambers Works Complex

Historically, the RFI at the site was conducted using a phased approach to evaluate and prioritize SWMUs. Remedial actions could then be focused on SWMUs that presented a greater risk to human health or the environment. The phased approach enabled three overlapping sets of objectives to be addressed:

- Achieve site stabilization
- Further advance the site through the RCRA Corrective Action Process.

- Address high priority SWMUs on an accelerated schedule, outside of the phased RFI process.

The overall site strategy has been to achieve stabilization such that there are no unacceptable risks to human health or the environment. Stabilization is achieved when potential exposure routes to site-related constituents are controlled or remediated. This strategy is validated by achieving NFA status for SWMUs (and the subsequently identified AOCs) and by continued site-wide groundwater control.

The interceptor well system (IWS) is the primary pump-and-treat system for site-wide groundwater control. The IWS has been in operation since 1970 and is currently pumping and treating groundwater at an average rate of one million gallons per day (mgd) to maintain groundwater containment. The IWS will be a major component of the final corrective measure for the site. More detail regarding interim measures and on-going groundwater containment and monitoring for site stabilization are provided in Section 2.5.

At the request of NJDEP, a comprehensive program was developed for long-term remediation at the site and for addressing the potential discharge of impacted groundwater and surface water to the Delaware River and its tributaries. The overall approach proposed for long-term remediation was to identify significant sources to groundwater and surface water, and to evaluate the feasibility of remediating those significant sources. The July 1, 2005 letter to NJDEP included a comprehensive schedule that entailed both long-term and short-term projects. Optimization of groundwater recovery and enhanced groundwater monitoring were also presented in this comprehensive program.

The *Preliminary Assessment Report* (DuPont CRG, 2006a) (PAR) identified specific potential sources within the active Chambers Works manufacturing area where particular types of production processes were located. Eleven AOCs were recommended for further investigation. These AOCs are relatively large and cover nearly the entire southeastern portion of the site, thus encompassing previously identified SWMUs. However, the AOCs also included areas outside of the SWMUs that may contain potential sources. The PAR was approved by EPA (EPA, 2008), and the 11 AOCs were added to the HSWA permit becoming part of the RCRA Corrective Action Program. Since the PAR approval, the primary focus of investigation has been the 11 AOCs in the manufacturing area, specifically on the characterization of sources to groundwater and potential migration pathways. Also, follow-on investigation of SWMUs has been performed as needed. In some cases, additional investigation related to a SWMU that is located within an AOC was incorporated into the AOC investigation. These investigations continued through the 2013-14 RFI data gap investigation.

After submission of the PAR, NJDEP, EPA, and DuPont agreed that completion of the remedial investigation activities at the site should be pursued in an expedited manner. Therefore, with EPA and NJDEP approval, DuPont proceeded with the remedial investigation phases while maintaining open communication and soliciting feedback from the EPA and NJDEP at key milestones without using the traditional formal work plan and review cycle. Communications were facilitated through report submittals and status meetings where interim findings were reviewed and future investigation approaches were discussed. DuPont also provided informal sampling plans (such as the most recent *RFI Data Gap Sampling Plan*) prior to beginning new phases of field investigation.

1.2 Comprehensive RFI Report Content

This report consists of ten sections as follows:

- Section 1 presents the introduction and report purpose.
- Section 2 provides summaries of the site history and background, the RFI history, the investigations since the last RFI report, ecological and human health evaluations, and remedial actions and monitoring activities. This section also documents the SWMU and AOC investigations or activities that have been completed to support NFA or CMS recommendations for each area and documents the SWMUs and AOCs where additional investigation was required in accordance with data gaps identified in the *RFI Data Gap Sampling Plan* (URS, 2013a).
- Section 3 provides summaries of the local environmental setting, including descriptions of the topography and surface-water features, climate, geology, and hydrogeology.
- Section 4 provides a summary of the 2013-14 RFI data gap and 2014 Vapor Intrusion field investigation activities and results. This section includes detailed descriptions of the drilling and monitoring well installation activities as well as slug testing and soil, groundwater, and dense non-aqueous phase liquid (DNAPL) and vapor intrusion sampling, analyses, and results.
- Section 5 integrates historical data and the new 2013-14 data for a comprehensive presentation of the site-specific geology and hydrogeology including a summary of the hydrogeological units and their characteristics, a demonstration of groundwater containment, and an estimate of the groundwater flow budget within the site aquifers.
- Section 6 integrates historical data and recent 2013-14 data for a comprehensive presentation of constituents that exceed criteria in soil, sediment, surface water, and groundwater for the Carneys Point SWMUs and associated areas. A conceptual model (CM) that integrates the site-specific geology, hydrogeology, and nature and extent of exceedances is presented.
- Section 7 integrates historical data and recent 2013-14 data for a comprehensive presentation of constituents that exceed criteria in soil, sediment, surface water, and groundwater for the manufacturing area SWMUs, AOCs, and associated areas. Characterization of the composition and distribution of DNAPL across the manufacturing area is presented. Conceptual models that integrate the site-specific geology, hydrogeology, and distribution of DNAPL constituents are developed for different areas of the site and collectively address the SWMUs and AOCs. These conceptual models identify sources and migration pathways.
- Section 8 provides the CSM. The CSM uses the CMs from Sections 6 and 7 to define complete pathways to potential human and ecological receptors on a site-wide basis.

- Section 9 provides conclusions and recommendations for each SWMU and AOC. A recommendation of NFA is presented where the site investigation phase for the SWMU or AOC has been completed, site conditions have been determined to be protective, and NFA is recommended. A recommendation of CMS is presented where the investigation phase for the SWMU or AOC has been completed but additional action is required to select the appropriate corrective measure to achieve site stabilization and protectiveness.
- Section 10 lists the references cited in this report.

2.0 Site History and Background

This section presents a brief summary of the manufacturing history and the investigations completed under the RFI program. A summary of interim measures and on-going remedial actions is also presented. Detailed investigation and remedial action summaries for each SWMU and AOC are provided in the fact sheets in Appendix A.

2.1 Site Location and Manufacturing History

The DuPont Chambers Works Complex covers 1,455 acres in Deepwater, Salem County, New Jersey (see Figure 1-1). The site is located along the eastern shore of the Delaware River in Carneys Point and Pennsville Townships, New Jersey (see Figure 1-1). The site comprises the former Carneys Point Works in the northern area of the site and the Chambers Works manufacturing area in the southern area of the site with Henby Creek generally separating the two (see Figure 2-1). The site is adjacent to the Salem Canal to the south with the Calpine (formerly Atlantic Electric) Power Plant to the south of the canal; light industrial, residential, and recreational areas to the east; residential areas to the north; and the Delaware River to the west.

Historically, manufacturing operations included the development of over 1,200 chemical products. Site operations began in 1892 when the Carneys Point smokeless gunpowder plant was constructed at the northern end of Carneys Point and produced nitrocellulose and gunpowder. Off-quality nitrocellulose was the primary waste in this area. By 1979, operations had ceased, and most of the Carneys Point buildings were razed leaving behind only building foundations.

Site operations began in the manufacturing area around 1914. In 1917, dye and specialty chemical manufacturing began. F*reon*® and tetraethyl lead production began in the 1920s, followed by aromatic chemical manufacturing in the 1940s and elastomers production in the 1960s. By the early 1980s, the dye manufacturing divisions were shut down, leaving only chemical manufacturing.

Today, the Chambers Works manufacturing area produces more than 500 different finished products, which are used to make clothing and textiles, computer chips, personal care products, agricultural chemicals, paint, and unique types of rubber, greases, and oils to meet the special needs of other manufacturing industries. There are over 135 buildings in use, which are highlighted in Figure 2-1. There are several active waste handling areas, including the RCRA permitted secure landfill (Secure C Landfill) and the wastewater treatment plant (WWTP). A U.S. Generating Company co-generation facility is located east of the site's WWTP.

2.2 RFI History – SWMUs and AOCs

A chronological list of major site investigation documents related to the corrective action program is summarized below:

- Current Conditions Report (DuPont Environmental Remediation Services, 1992)
- Phase I RFI Report (DuPont Environmental Remediation Services, 1995)

- Phase II RFI Report (DuPont CRG, 1998)
- Phase III RFI Report (DuPont CRG, 2002)
- Environmental Indicators CA725 (DuPont CRG, 2003) and CA750 (DuPont CRG, 2004)
- SWMU 8 Remedial Investigation Report (DuPont CRG, 2005a)
- Phase IV RFI Report (DuPont CRG, 2005b)
- Preliminary Assessment Report (DuPont CRG, 2006a)
- Phase IV Supplemental RFI Report (DuPont CRG, 2007a)
- Delaware River Groundwater to Surface-Water Investigation Report (DuPont CRG, 2008)
- Perimeter Investigation Report (URS, 2010a)
- Interior Investigation Technical Memorandum (URS, 2013a)

These reports provide the general sequence of the investigation history of the site SWMUs and AOCs. There are many additional reports that document supporting or follow-on investigation and remedial activities related to specific SWMUs or AOCs, and these are referenced in the fact sheets. Ecological and human health evaluations were performed, and a summary is provided in Section 2.4. A summary of remedial action or interim measures that have been initiated or completed for specific SWMUs and AOCs as well as for site-wide programs is provided in Section 2.5.

To date, 96 SWMUs and 11 AOCs have been identified at the site. Figures 2-2 (Carneys Point) and 2-3 (Chambers Works manufacturing area) identify the SWMUs consistent with the SWMUs identified in the HSWA permit and identified in the last RFI Report – the *Phase IV Supplemental RFI Report* (DuPont CRG, 2007a). Figure 2-4 identifies the 11 AOCs consistent with the boundaries identified in the PAR (DuPont CRG, 2006a) and approved by EPA in 2009.

After the PAR was approved in 2009, investigations focused on the 11 AOCs in the manufacturing area, specifically on the characterization of sources to groundwater in the manufacturing area and potential migration pathways to surface water and sediment, which included groundwater to surface-water discharge from the site perimeter to the Delaware River. Three reports that document the site investigation activities relevant to the 11 AOCs are the *Delaware River Groundwater to Surface-Water Investigation Report* (DuPont CRG, 2008), the *Perimeter Investigation Report* (URS, 2010a), and the *Interior Investigation Technical Memorandum* (URS, 2013b).

2.2.1 Delaware River Groundwater to Surface-Water Investigation Report

Investigation completed in areas along the site perimeter adjacent to the Delaware River indicated that B aquifer groundwater in AOCs 1, 2, and 3 is not entirely contained by the IWS. The investigation focused on the potential discharge of constituents by evaluating the sea-wall, the B aquifer outcropping and sub-cropping characteristics, near-shore sediment characteristics, and groundwater and surface-water quality. Results indicated that groundwater is not adversely impacting surface water, but the report recommended that sediment and surface-water sampling be performed for the Delaware River. This work was completed and is described in Section 2.4.

2.2.2 Perimeter Investigation Report

Potential source areas above and below the water table along the site perimeter were identified and characterized with emphasis on the potential for off-site groundwater migration. The perimeter investigation was conducted along the property boundary for the entire site. For the perimeter around the Carneys Point area and along the eastern property line, no further investigation was recommended (see Figure 2-5). For the perimeter along the southern property line adjacent to the Salem Canal (southern portions of AOCs 6, 9, and 10), the B aquifer is contained by a sheet pile barrier and the IWS, and no further investigation was recommended. For AOC 11, which was within the perimeter investigation along the Delaware River, portions of the B aquifer are contained by the IWS, and no further investigation was recommended. Finally, for the perimeter along the western portions of AOCs 1, 2, and 3 where the B aquifer is not contained by the IWS, three groundwater plumes associated with AOCs 1, 2, and 3 were characterized, and subsequently a remedial alternatives evaluation was conducted to select an appropriate remedy as documented in the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report* (Geosyntec, 2012).

2.2.3 Interior Investigation Technical Memorandum and RFI Data Gap

The investigation activities and findings for the interior portions of the manufacturing area, which includes AOCs 1 through 10, with an emphasis on the vadose zone and B aquifer were documented. Data were compiled and presented, but the evaluation and update of conceptual models and recommendations for the AOCs were deferred to this comprehensive RFI report. Additional characterization of SWMUs 1 through 4, 7, 20, 45-2, and 55-6 is also documented in this report. A detailed evaluation of a portion of AOC 6, known as the Triangle area, used data collected as part of the interior investigation to develop a DNAPL conceptual model for the Triangle area (URS, 2013c).

Investigation of the interior AOCs continued as part of the *RFI Data Gap Sampling Plan* (URS, 2013a) with an emphasis on the C and D aquifers. Additionally, the vadose zone and B aquifer findings for the manufacturing area interior were assessed, and identified data gaps were also included in the sampling plan. Prior to the 2013-14 RFI Data Gap sampling effort, the investigation history and findings for each SWMU were reviewed to determine if the investigation phase was complete. Data gaps were identified and incorporated into the *RFI Data Gap Sampling Plan*.

2.2.4 E Aquifer Investigation History

Investigation of the E aquifer was documented in the Phase IV RFI (DuPont CRG, 2005b) and the Phase IV Supplemental Report (DuPont CRG, 2005a). Based on these investigations, it was concluded that the E aquifer is impacted only where leaky well casings allowed downward migration of site-related constituents from the overlying aquifers. To address this issue, several suspect or known leaky wells were abandoned. However, wells L09-M01D (an E aquifer well) and L09-M01E, which were identified for abandonment could not be abandoned due to safety issues related to a regional power line. Pumping from well J05-W01E began in August 1995 to contain E aquifer groundwater along the southern boundary of the site in response to minor detections of site constituents in that area. The J05-W01E pumping program was designed to augment the containment of E aquifer groundwater at Chambers Works, which was maintained by water supply well R15-W01E. Monitoring of the E aquifer is included in the Discharge to Groundwater (DGW) program.

2.3 SWMU and AOC Status

Figures 2-2 and 2-3 indicate the status of the 96 SWMUs prior to the 2013-14 RFI data gap investigation. Green-shaded SWMUs (84 total) have a status of NFA, which means that the site investigation phase or remedial action phase for the SWMU was completed and NFA was recommended. Yellow-shaded SWMUs (SWMUs 8, 39-1, 40, and 45-2) have a status of CMS, which means that the investigation phase for the SWMU was completed but additional action is required to achieve or demonstrate site stabilization. Blue-shaded SWMUs (SWMUs 55-1 and 55-4) were investigated as part of the 2013-14 RFI data gap investigation to fill data gaps identified for these SWMUs. Additionally, there are six SWMUs that are shaded purple: five of these SWMUs (18, 23, 24, 27, and 29) are RCRA Part B operating units and the sixth, SWMU 33, is being investigated by the United States Army Corps of Engineers (USACE) due to historical Manhattan Project activities. These six SWMUs are not addressed in this report.

Figure 2-4 indicates the status of the 11 AOCs prior to the 2013-14 RFI data gap investigation. AOCs 1 through 10 are shaded blue to indicate that these AOCs were investigated as part of the 2013-14 data gap investigation. AOC 11 is shaded green to indicate that the investigation phase for this AOC was completed.

As part of the Declaration of Environmental Restrictions (DER) for the site, a set of fact sheets were submitted to EPA and NJDEP in 1999 to support a NFA determination for 13 SWMUs. Subsequent discussions between DuPont, NJDEP, and EPA resulted in a modified fact sheet format. DuPont submitted a Remedial Action Report (RAR) Summary containing fact sheets for 17 SWMUs in March 2002. The RAR was approved, a deed notice was recorded with Salem County to set restrictions for these 17 SWMUs, and finally a NFA and covenant not to sue letter (October 21, 2002) was received from NJDEP for the 17 SWMUs. Seven of the 17 SWMUs have constituent concentrations greater than New Jersey Non-Residential Direct Contact Soil Remediation Standards (NJNRDCSRS); therefore, monitoring is required. Engineering controls in place are inspected throughout the year and reported semi-annually. A New Jersey Remedial Action Permit Application was submitted for these SWMUs in April 2013.

Since 2002, fact sheets were developed for all SWMUs to summarize previous investigations, findings, and remedial activities. These fact sheets have continued to be updated as investigations and remedial actions continued or were completed. The fact sheets contain a summary of the SWMU history and photographs, remedial actions implemented, constituent characterization, institutional controls, engineering controls, an exposure assessment summary, justification for NFA (as applicable), restrictions, maintenance and inspection requirements, references to support the complete RFI history for the SWMU, and a fact sheet date with revisions as appropriate.

Fact sheets for the 90 SWMUs and 11 AOCs are provided in Appendix A. The fact sheets for SWMUs 55-1 and 55-4 and AOCs 1 through 10 (all of which were part of the 2013-14 RFI data gap investigation) rely on information presented in later sections of this report. Fact sheets have not been generated for the five Part B operating units (SWMUs 18, 23, 24, 27, and 29) or for SWMU 33.

2.4 Ecological and Human Health Evaluations

The following subsections provide a brief summary of the ecological and human health evaluations that have been performed for the site. Although the objectives of this report focus on RFI recommendations for on-site SWMUs and AOCs, discussion of both on-site and off-site ecological investigations is provided for reference.

2.4.1 Ecological

Baseline Ecological Evaluations (BEEs) and ecological investigations were conducted to determine the need for further ecological investigation based on potential ecological exposure to site-related constituents in on-site areas and areas adjacent to the site (DuPont CRG, 2006b: DuPont CRG, 2007b; URS, 2009): site-wide, the Salem Canal, and the Delaware River. BEEs and ecological investigations were conducted in accordance with the NJDEP Technical Requirements for Site Remediation (N.J.A.C. 7:26E). The following sections summarize ecological investigations conducted in each area of the site.

Site-Wide

A site-wide BEE was conducted to evaluate the need for further ecological investigations at the site (DuPont CRG, 2006b). The site-wide BEE concluded that ecological habitats and associated receptors were limited to the Carneys Point area of the site (approximately 758 acres) and that no ecological receptors were identified for the manufacturing area. As a result, additional on-site ecological investigations focused on the Carneys Point area of the site and, at the request of NJDEP, limited areas of the manufacturing area (B Basin and two small ponds) were also included. As documented in the *Ecological Investigation Report* (DuPont CRG, 2009), no further evaluations of ecological risk were warranted for exposure areas investigated within the manufacturing or Carneys Point areas, with the exception of elevated concentrations of site-related metals and organic constituents in sediments within ditches draining to Bouttown Creek (DuPont CRG, 2009).

Additional ecological investigations were conducted in the Bouttown Creek ditches to evaluate the bioavailability and toxicity of metals in sediments, as documented in the *Summary of Ecological Investigations in Carneys Point* (URS, 2010b). A weight-of-evidence evaluation of ecological risks based on the findings of the additional investigations supported a recommendation of no further investigation or remedial action on the basis of ecological risk (URS, 2010b). In a letter dated December 6, 2010, NJDEP Bureau of Environmental Evaluation and Risk Assessment, Environmental Toxicology and Risk Assessment (BEERA/ETRA) supported the recommendation for no further investigation, provided environmental conditions in Bouttown Creek do not change dramatically.

Salem Canal

A BEE was conducted for the Dyes Area and White Products Area (AOC 6) of the site in 2007 to support on-going investigations of a groundwater seep along an approximately 100-foot length of the Salem Canal that was identified in 2002 (DuPont CRG, 2007b). The BEE focused on the evaluation of potential ecological exposure to site-related constituents in surface water and sediments in the Salem Canal associated with a groundwater migration pathway from AOC 6 (DuPont CRG, 2007b). The BEE identified elevated concentrations of site-related organic constituents relative to ecological benchmarks in sediments within the canal and recommended further evaluation of ecological exposure in the *Salem Canal Interim Remedial Action Work Plan* (IRAWP), which evaluated remedial options for the canal (DuPont CRG, 2007b). An ecological exposure evaluation was included in the IRAWP to evaluate the protectiveness of a proposed interim remedial measure (IRM) to address groundwater discharge to the Salem Canal.

Delaware River

A BEE was also conducted for the Delaware River adjacent to the site to evaluate existing information and analytical data relevant to the Delaware River to determine whether additional sampling and ecological evaluation were required (URS, 2009). The findings of the BEE indicated that further characterization of site-related constituents in sediment and surface water were warranted. Based on these findings, a remedial investigation work plan (RIWP) was developed to provide a framework for conducting sediment and surface-water investigations in the Delaware River adjacent to the site.

The RIWP developed a multi-phase sampling investigation based on a grid sampling design to enable a systematic characterization of sediment and surface-water quality adjacent to the site (URS, 2011a). Sediment and surface-water sampling within the grid design was conducted based on a phased approach: Phase I (September 2009), Phase II (April 2010), and Phase III (November 2010). The analytical sampling scope for surface water and sediment in Phase I included analyses of target analyte list (TAL) metals plus tin, primary pollutant semi-volatile organic compounds (SVOCs) plus additional site-related SVOCs, and primary pollutant volatile organic compounds (VOCs) plus site-related VOCs. In addition, polychlorinated biphenyl (PCB) congener analyses were conducted on surficial sediment samples from select sampling stations. Consistent with the RIWP, the surface water and sediment analytical scope was refined between sampling phases based on an evaluation of analytical results from the previous phase of data collection. Modifications to the analytical scope were based on consideration of constituent detection frequency, constituent concentrations relative to ecological screening values and representative background concentrations, and the variability in constituent concentrations.

The findings of the multi-phase investigation identified elevated concentrations of site-related organic constituents relative to refined ecological benchmarks in sediments in focused near shore areas of the river adjacent to AOCs 1, 2, and 3. Concentrations in sediments were not elevated relative to benchmarks established in other areas adjacent to the manufacturing or Carneys Point areas. Concentrations of site-related constituents in surface water were nearly all below ecological benchmarks in multiple sampling phases adjacent to AOCs 1, 2, and 3 and were all below ecological benchmarks adjacent to areas north of AOC 1, including the entire Carneys Point shoreline. For areas adjacent to AOCs 1, 2, and 3, no further ecological investigations were recommended until the attainment of hydraulic control at the site perimeter was achieved (URS, 2011a). As requested, once on-site hydraulic control is attained, DuPont will submit an investigation work plan describing additional sampling in the Delaware River. The investigation work plan will address the issues identified by NJDEP regarding the presence of potential site-related constituents in deeper sediment sampling intervals and potential sub-surface migration pathways to the river.

2.4.2 Human Health

In accordance with the NJDEP N.J.A.C. 7:26E, constituents detected in soil or groundwater samples collected during site investigations were compared to risk-based screening criteria for the purpose of assessing the potential for impact to human health and determine recommendations for each SWMU and AOC. Screening criteria used in the evaluations are the soil remediation standards found in N.J.A.C. 7:26D and groundwater quality standards found in N.J.A.C. 7:9C. Soil remediation standards used include New Jersey's Nonresidential Direct Contact Soil Cleanup Criteria (NJNRDCSCC), Impact to Groundwater Soil Cleanup Criteria (IGWSCC), NJNRDCSRS (effective since June 2008) and New Jersey Generic Impact to Groundwater Soil Remediation Standards (NJIGWSRS) (effective since June 2008). Groundwater remediation standards used have been New Jersey Groundwater Quality Class IIA Standards (NJGWIIA). Results of these evaluations are presented within the investigation reports cited within this report.

A site-wide data evaluation was conducted in 2003 to support environmental indicator (EI) determinations for the site. The site has been designated by EPA as one of the Corrective Action (CA) Baseline facilities as part of the agency's efforts to comply with the 1993 Government Performance Results Act (GPRA). Compliance with the GPRA for the RCRA CA Program is measured by achieving a positive determination with two EIs: migration of contaminated groundwater under control (EPA RCRIS Code CA750) and current human exposures under control (EPA RCRIS Code CA725). As a "Baseline" facility, it was desired that compliance with the two relevant EIs be achieved by 2005.

DuPont obtained a positive finding for the EI CA725 in September 2004, indicating that releases, or the potential for releases, identified from RCRA corrective action units at the site do not constitute a significant threat to human health under current land use. Reasonably expected exposures from potentially complete exposure pathways were found to be insignificant. The potential for exposure could be prevented or controlled. DuPont also received a positive determination for EI CA750 in September 2004.

During the EI CA725 evaluation, vapor intrusion (VI) was not deemed a concern for on-site receptors. However, in accordance with N.J.A.C. 7:26E-1.17, a Receptor Evaluation was conducted in February 2011 to further evaluate the VI pathway. The evaluation noted that concentrations of volatile compounds in on-site monitoring wells exceeded the NJDEP generic groundwater screening levels for the VI pathway (GWSLs). Generic GWSLs, which are based on residential land use, are not consistent with current on-site land use and on-site building conditions. Therefore, consistent with Section 2.4.5 of

NJDEP's *Vapor Intrusion Guidance* (NJDEP, 2013), a site-specific evaluation was conducted to further evaluate potential on-site VI pathways.

Results of the evaluation indicate that further evaluation of the potential soil vapor pathway for on-site buildings was recommended. Currently, over 135 occupied structures have been identified in the Chambers Works manufacturing area. A phased approach for the investigation was proposed as detailed in *Vapor Intrusion Remedial Investigation Work Plan* (URS, 2014). The initial phase of investigation was completed in early 2014 and will be used to guide the scope of work for subsequent phases.

2.5 Remedial Actions and Monitoring Activities

This section highlights the remedial actions that have been initiated or completed for specific SWMUs and AOCs as well as for site-wide programs. This section organizes the remedial actions into seven categories: removal, treatment, or cover actions; groundwater recovery programs; engineering controls; institutional controls; DNAPL recovery program; groundwater monitoring programs; and corrective measures. Remedial action related to SWMUs or AOCs are described in the fact sheets (see Appendix A). Groundwater monitoring and recovery programs are included in the semi-annual DGW report. Information provided here was summarized from the fact sheets and the DGW monitoring report completed for the first half of 2013 (URS, 2013d), which documents the on-going remedial actions; the monitoring objectives, activities, and results; and an evaluation of results over time.

2.5.1 Removal, Treatment, or Cover Actions

The following removal, treatment, or cover actions (see Figures 2-2 and 2-3) have been completed at the site as follows:

- SWMUs 5A/5B (Landfill I and Beach Area): A slurry wall was installed in 1994-1995 to prevent the migration of A zone groundwater from seeping into the Delaware River. This slurry wall was later augmented with a groundwater recovery system consisting of 10 well-points to prevent mounding of A Zone groundwater behind the slurry wall. The well-point system was later abandoned and replaced by a more effective groundwater collection trench. Operation of the groundwater collection trench was discontinued in 2001 after installation of the SWMU 5B sheet pile wall, which eliminated the potential for groundwater in the A zone and B aquifer from entering the Delaware River in the SWMU 5 area. Sediment containing site-related constituents was removed and placed in the A Basin vault at Chambers Works. The shoreline was stabilized, and a permanent steel sheet pile cutoff wall (bulkhead) with erosion/scour protection was installed. Vegetation was established by planting in the newly created uplands.
- SWMU 7 (Landfill III): Dinitrotoluene (DNT) impacted soil was removed during the construction of a paved parking lot in this area.
- SWMU 11 (Storage Tank 1): The tank was removed and the area was covered with asphalt.

- SWMU 12 (WWTP Storage Pad): In 1989, approximately 12,000 cubic yards of soil were removed and disposed of in the Secure C Landfill. The area was then backfilled with clean fill.
- SWMU 13 (Cell 1 of Secure C Landfill): Cell 1 was taken out of service in 1979, and a clay cap was installed.
- SWMUs 14 and 15 (A and B Basin Surface Impoundments): Remedial activities were conducted from August 1991 to November 1996. The remedial action included sampling and analysis of subsurface material, addition of Portland cement to A and B Basin material, consolidation of approximately 270,000 cubic yards of treated and bulk-dewatered material, installation of soil cover system, and construction of water management unit in the B Basin. The soil cover system extends over approximately 24 acres within the basin complex.
- SWMU 16 (C Basin Surface Impoundment): Remedial activities were conducted from the first quarter of 1988 to late 1994. C Basin sediment was removed and sent through an on-site batch distillation process to recover tetraethyl lead (TEL). Press cake solids were shipped to an off-site facility for lead reclamation. C Basin surface water was removed and treated at the on-site WWTP. Approximately 3 to 6 inches of tailings were formed during dredging operations by suspended sediments and soil particles mixing and settling. Fifteen feet of clean fill material were placed over the tailings layer. A 4- to 6-inch layer of average #57 stone was placed on top of the clean fill material.
- SWMU 17/17A [Process Water Ditch System (PWDS) and Sidewalls]: From 1993 to 1996, material was removed from the bottom of all ditch sections down to the groundwater table, including 3 inches of saturated soil as required by the NJDEP. Any area of sidewall soil that contained constituent concentrations greater than the soil cleanup criteria was removed to a maximum distance of one foot from the side of the ditch. After excavation and treatment were completed, the PWDS was replaced with a system of pipes and asphalt swales. The replacement system is currently used for collection and conveyance of noncontact cooling water, stormwater runoff, and emergency conveyance of process waste to the wastewater treatment plant in the event of a catastrophic incident (note: The PWDS has never been used for emergency purposes). Stormwater run-off surges that are conveyed by the replacement system are routed to B Basin through a spillway constructed in May 1996. Once the replacement system was installed, the excavated ditch was brought to grade with clean fill and covered with gravel.
- SWMU 19 (Nitrocellulose Waste Disposal Area): In the early 1980s, the nitrocellulose area closure began. The areas were drained, and the waste materials were excavated and ignited with a portable oil burner. In 1986, about 2,600 cubic yards of soil were excavated and treated in a rotary kiln. The treated materials were laboratory-tested for ignitability and then backfilled to the excavated areas. In 2000, a part of SWMU 19 adjacent to Henby Creek was included as part of an approximate 2-acre mitigation site. This mitigation area was selected as part of the SWMU 43 ISM. In general, the ground surface elevations of the mitigation area were lowered to provide the necessary hydrology for the wetlands creation.

Excavated soil from the mitigation area was placed into the on-site vault, which was closed in late 2006.

- SWMU 21 (Thermal Decontamination Furnace and Satellite Storage Area): In 1994 and 1995, SWMU 21 was closed in accordance with the approved closure plan. As required, the constituents present in the furnace system were thermally destroyed to an acceptable level through a normal operating cycle. Surface material (approximately 6 inches) was excavated and stabilized using a proprietary alkaline phosphate reagent. The stabilized material was disposed of in the Secure Landfill C. Geotextile was placed over the excavated area and backfilled with clean fill.
- SWMU 25 (Lead Flue Dust and Lead Furnace Slag Storage Area): In 1992, the asphalt pad was removed, and a geotextile liner with stone was placed on the ground.
- SWMU 26 (Freon Spent Catalyst Storage Area): In 1984, railroad container contents were neutralized and disposed. The container was cleaned, dried, and removed from the area.
- SWMU 39 (USTs): Between 1985 and 1989, 19 underground storage units (USTs) were removed.
- SWMU 39-1 (UST-1): In 2004 and 2005, approximately 99 cubic yards of diesel-impacted soil were excavated at the diesel spill area, and the eastern and western portion of the former pump island.
- SWMU 43 (Former Unified Basin Outfall): In 2001, the basin was dewatered, the area was backfilled and covered with a 6-inch layer of topsoil and upland vegetation was established.
- SWMU 45-7 (Carneys Point Manufacturing Area 7): Tanks were removed in 1977.
- SWMU 45-9 (Carneys Point Manufacturing Area 9 – Former Process Water Drainage System): Between 1992 and 1993, approximately 12,000 linear feet of drainage line consisting of terra cotta and steel pipeline were removed, and approximately 71,000 pounds of nitrocellulose and other waste explosives were removed and burned in accordance with two emergency RCRA permits.
- SWMUs 45-3, 45-4, 45-8, 48-2, 48-4 (Carneys Point Manufacturing and Drum Storage/Cleaning Areas): As discussed above, piping (designated as SWMU 45-9 – former process water drainage system) associated with nitrocellulose manufacturing was cleaned and removed from the areas between 1992 and 1993. Any remaining nitrocellulose was properly disposed of by burning. Piping trenches were backfilled with clean fill. Clean fill was placed on and around the SWMUs for a proposed landfill, which subsequently was not constructed. A minimum of 1 foot of surface soil was removed and replaced with 18 inches of clean fill.
- SWMU 50 (Asbestos Debris Disposal Area): Asbestos debris was removed prior to construction of the Co-Gen Facility. The excavation area was approximately

120 feet by 60 feet, and approximately 800 cubic yards were removed and properly disposed in the A Landfill.

- SWMU 52 (Debris Disposal Area): In 2006, approximately 2.5 acres (~9,000 cubic yards) of non-native fill were stabilized from depths averaging 4 to 10 feet. Approximately 1,325 cubic yards of stabilized material were disposed of in the on-site A Basin soil vault. The area was covered with a 2-foot cap of clean fill and vegetation.
- SWMU 56 [Orthodichlorobenzene (ODCB) in the B Ditch and Aramids Pond]: From October 1999 through March 2000, the ODCB remedial action was completed. The work consisted of in-situ stabilization (mixing Portland cement and carbon in the ditch material), excavation, and placement of excavated material in the A Basin soil vault. Restoration activities included installation of an impermeable pipe, concrete basin stormwater conveyance system, and placement of clean fill and a stone cover. Approximately 5,400 cubic yards of material were stabilized. In late 2003 through 2004, the Aramids Pond area was remediated in the same manner as the ODCB area (i.e., mixing Portland cement and carbon in the ditch material, and then excavation and placement of treated material in the A Basin vault). Clean fill and a stone cover were placed as cover. Approximately 1,100 cubic yards of material was stabilized.
- SWMU 56A [Historic Process Water Ditch System (B Ditch)]: Interim remedial actions were implemented at two sections of SWMU 56A in 1998 and 1999. Remedial actions completed consisted of in situ stabilization (mixing Portland cement and carbon in the ditch material), excavation, and placement of excavated material in the A Basin vault. Restoration activities included installing an impermeable pipe and concrete basin stormwater conveyance system and placing clean fill and stone cover. Approximately 3,846 cubic yards of material were stabilized at ditch section Historical Process Water Ditch System Lead Area and 2,029 cubic yards of material were stabilized at the ditch section 2,4-Dinitrotoluene Area.
- C Ditch Remediation: C Ditch is located within the boundary of SWMU 57 – Antiknocks Area. Remedial action has not been conducted for SWMU 57; however, previous sampling activities for SWMU 57 indicated that the most elevated concentrations of lead were found in the subsoil of the C Ditch. The C Ditch was remediated in 1995 and 1996 under a NJDEP Administrative Consent Order. A remedial action was also completed on a section of the Historical Process Water Ditch System (SWMU 56A) within SWMU 57 in 1997.
- T29 Area – During field activities associated with the groundwater to surface-water interaction at Bouttown Creek, staining was observed on a soil core. Soil and groundwater samples were collected and analyzed. Subsequent delineation of the area resulted in a soil removal action in 2013. Soil containing PCBs was removed from a 15 by 10-foot area to a depth of 15 feet.

2.5.2 Groundwater Recovery Programs

DuPont operates three separate groundwater recovery programs for hydraulic containment of groundwater at the site. All recovered groundwater is diverted to the WWTP for treatment. Figure 2-6 shows the locations of the recovery systems as follows:

- Interceptor Well System: The IWS began operation in 1970 and currently includes seven recovery wells: G08-R01C, G08-R01D, K06-R02CD, M14-R02CD, Q13-R01C, Q13-R01D, and R09-R02C. These wells control groundwater from migrating off-site from the B, C, and D aquifers. The total pumping rate of the IWS system was evaluated in 2009, and results of the study indicated that groundwater in the C and D aquifers could be contained on-site with a decrease in the total pumping rate from 1.5 to 1.0 million gallons per day (URS, 2010c).
- Corrective action program for Area 1 of the Secure C Landfill (SWMU 13): Captured groundwater from wells Q20-M02B and P21-R01B is pumped to Sump 1 of the Secure C Landfill leachate collection system. It is then transported to the WWTP for treatment.
- E aquifer well J05-W01E: Pumping from well J05-W01E began in August 1995 to contain E aquifer groundwater along the southern boundary of the site in response to minor detections of site constituents in that area. The J05-W01E pumping program was designed to augment the containment of E aquifer groundwater at Chambers Works, which was maintained by water supply well R15-W01E.

2.5.3 Engineering Controls

Engineering controls at the site are currently being implemented for individual SWMUs as documented on the fact sheets. In addition to the SWMU-specific engineering controls, the entire site is contained within a perimeter security fence system including perimeter lighting, video surveillance, and motion detection. This perimeter security fence system and a professional security force that is manned 24 hours a day, seven days a week are designed to prevent unauthorized access to the site.

In addition to the IWS, engineering controls for groundwater discharge also include sheet pile barrier installed in areas along the Salem Canal and the Delaware River. Expansion of the sheet pile barrier will be installed in the 2014 to 2015 timeframe. Figure 2-6 shows the existing and proposed sheet pile barrier sections as follows:

- Delaware River SWMU 5A/5B: The remedial action, including the installation of a sheet pile barrier and slurry wall, was completed in 2002.
- SWMU 40: In the 1970s, a new seawall consisting of sheet pile bulkheads was constructed to a depth of approximately -33 feet [National Geodetic Vertical Datum (NGVD)] as part of construction for a new tank along the Delaware River.
- Salem Canal: In 2008, a 900-foot long section was installed on the northern side of the canal to prevent groundwater discharge (along the AOC 6 boundary) from the B aquifer to the Salem Canal sediment and surface water. An approximate 300-foot extension for bank stabilization and erosion control was installed to the

Munson Dam in 2012 (URS, 2013e). An additional extension of approximately 550 feet is scheduled to be installed along the Salem Canal west of the Munson Dam.

- Salem Canal to Delaware River proposed expansion: preliminary design and field investigation activities for a proposed expansion from the Salem Canal sheet pile barriers westward along the property boundary and then northward along the Delaware River to the fuel tank area have been completed. The remedial action will prevent the discharge of groundwater associated with AOCs 2 and 3 from the B aquifer to the Salem Canal and Delaware River as recommended in the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report* (Geosyntec, 2012). The installation will take place in the 2014 to 2015 timeframe.

2.5.4 Institutional Controls

The following institutional controls at the site are being implemented for individual SWMUs as documented on the fact sheets:

- Site-wide security measures as required by the U.S. Department of Homeland Security (DHS) Chemical Facilities Anti-Terrorism Standards (CFATS) regulation.
- A NJDEP Classification Exception Area (CEA) in accordance with N.J.A.C. 7:9-6.6 for groundwater. The CEA was established to provide public notice that the constituent standards for a given aquifer classification (Class II A drinking water) are not being met due to anthropogenic influences. Chambers Works CEA 1 encompasses the entire site and is described in detail in the DuPont Chambers Works Classification Exception Area Biennial Certification Report, which was electronically submitted by DuPont to NJDEP on November 2, 2012. A CEA/Well Restriction Area (WRA) Permit Fact Sheet was also submitted on November 28, 2012.
- The Chambers Works excavation and work permitting procedures, which prevent excavation activities until a site-specific evaluation of safety, health, and environmental data is completed.

2.5.5 DNAPL Recovery Program

Another on-going site-wide corrective action program is the recovery of DNAPL from various wells (see Figure 2-6 for locations). In 1999, a non-aqueous phase liquid (NAPL) survey was initiated across the site to 1) identify specific well locations where either light non-aqueous phase liquid (LNAPL) or DNAPL was present and 2) determine the feasibility of recovering DNAPL from specific wells. During the initial survey, NAPL was detected in 14 out of the approximately 350 on-site wells. Of these 14 wells, three were found to contain recoverable quantities of DNAPL: two on-site monitoring wells (L13-M01B and I12-M01B) and one interceptor well (H11-R01CD). In 2001, a monthly NAPL survey and recovery program was initiated to monitor the 14 original wells for the presence of NAPL, and the accumulated DNAPL was removed if present. Since then, all newly installed monitoring wells were screened for NAPL and added to the program as appropriate.

Accumulated DNAPL is typically removed with a bailer unless the well is able to yield a sufficient volume to justify installation of a permanent pumping system and temporary storage drum. As of July 2014, there were 19 wells in the NAPL survey program, which includes 17 wells that are part of the monthly survey and two wells with dedicated pumping systems. Wells L13-M01B and G05-M03B have produced approximately 3,426 and 1,426 cumulative gallons, respectively as of July 2014. Wells G05-M02B and J12-M02B have produced approximately 52 and 40 cumulative gallons, respectively. The other wells in the program each have produced less than 10 gallons. In 2014, two additional wells, D15-P08B and F09-M03B, were added to the program.

2.5.6 Groundwater Monitoring Programs

Groundwater monitoring is performed under several programs shown in Figure 2-7 and summarized as follows:

- Secure C Landfill Corrective Action Monitoring Program, Detection Monitoring Program, Leachate Collection and Leak Detection Systems (SWMU 13)
- Closure and Post-Closure Groundwater Monitoring Program for the A, B, and C Basins (SWMUs 14, 15, and 16)
- Perimeter Monitoring Program
- Post-Closure RCRA SWMUs Monitoring Program (SWMUs 21, 25, 26, and 28)
- Perfluorooctanoic Acid (PFOA) Monitoring Program

2.5.7 Corrective Measures

As discussed in Section 2.3, four SWMUs (8, 39-1, 40, and 45-2) were recommended for a CMS. A brief summary for each is provided as follows (refer to the SWMU fact sheets for more details).

- SWMU 8 is a 140-acre area that was the primary disposal site for solid and semi-solid wastes generated from the operating areas of the Chambers Works facility from approximately 1930 to 1974. SWMU 8 contains, in whole or in part, SWMUs 1 through 4, 7, 17, 20 through 24, 30, 33, 39-4, 39-7, 55-2, 55-5, 55-6, and 56A (see Figure 2-2). The surface cover includes asphalt, concrete, gravel, foundations, and vegetation. Groundwater beneath SWMU 8 in the B, C, and D aquifers is captured by the IWS. Soil sampling performed during the RCRA RFI phases and RI phases for SWMU 8 as well as soil investigations associated with the manufacturing area interior indicate that the soil investigation for SWMU 8 is complete (see the Fact sheet for a documentation of the specific reports). Soil sampling performed below the water table was completed as CMS activities [SWMU 8 Treatability Study (URS, 2010d)] to characterize sources to groundwater below the water table. In addition to recommendations proposed in that report, it is recommended that groundwater beneath SWMU 8 be addressed as part of the manufacturing area-wide assessment of groundwater.
- SWMU 39-1 consists of three USTs that were installed in 1987. The tanks currently contain gasoline or diesel fuel. These tanks are fiberglass reinforced, non-corrosive plastic tanks, internally lined with epoxy, with double-walled

secondary containment. Overflow protection, automatic level recording, and precision monitoring were also installed. In a letter dated December 2, 1993, the EPA agreed to NFA for this SWMU. On June 16, 2004, approximately 450 gallons of diesel fuel leaked onto the ground during integrity testing of the underground diesel fiberglass transfer line. The integrity testing was the first phase of the repair process for an original June 8, 2004 diesel spill. Subsequent to investigation and remediation of the area, on-going monitoring of groundwater for monitored natural attenuation (MNA) was proposed.

- SWMU 40 is an area where three No. 6 fuel oil aboveground storage tanks are located near the wharf adjacent to the Delaware River (see Figure 2-2). Fuel oil storage tank No.1, No. 2, and No. 3 are surrounded by an asphalt-covered dike containment structure. The tanks are currently idle and are reserved for future service. SWMU 40 was investigated in multiple phases. Soil at SWMU 40 has been characterized, but further investigations may be necessary for remedial action selection and design. Groundwater in the B aquifer is prevented from discharging into the Delaware River by a sheet pile barrier, and groundwater in the C and D aquifers is contained by the IWS. It is recommended that groundwater beneath SWMU 40 be addressed as part of the manufacturing area-wide assessment of groundwater.
- SWMU 45-2 is one of nine areas where nitrocellulose and other explosives were manufactured. SWMU 45-2 consists of two large rectangular concrete foundations connected by a narrow strip of concrete. The surrounding area is mostly covered with high grass, underbrush, and some trees. Due to metals concentrations in the soil and the potential for leaching to groundwater, remedial options will be evaluated for the SWMU 45-2 area.

Additionally, a remedial action to address the on- and off-property groundwater plume along the perimeter of AOC 1 is currently under investigation as described in the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report* (Geosyntec, 2012). Also, a remedial action to address the on-property sediment of the Salem Canal south of the installed sheet-pile barrier is under investigation as described in the *Salem Canal Groundwater Remedial Action Progress and Sediment Investigation Status Report* (URS, 2013e).

2.5.8 On-Going Initiatives

DuPont continues to explore promising technologies that will result in the transformation or destruction of site-related constituents. The following are examples of studies undertaken in the past few years:

DuPont continues to explore promising technologies that will result in the transformation or destruction of contaminant sources. The following are examples of studies undertaken in the past few years:

- A study on the remediation of mixed plumes using ferrate (VI) to remove organic contaminants [Freon-113 and trichloroethene (TCE)] by oxidation and inorganic contaminants (lead and arsenic) by subsequent adsorption.

- A laboratory feasibility study to determine the optimal conditions of surfactant flushing to effectively mobilize and remove targeted DNAPL in the subsurface.
- A laboratory study to identify a suitable surfactant microemulsion system to effectively extract organometallic compounds, specifically TEL through enhanced solubilization (swollen micelles) or mobilization (interfacial tension reduction).
- A bench-scale treatability study to determine if an in-situ chemical treatment is an effective alternative for both oxidizable and non-oxidizable compounds (VOCs and SVOCs) in soil and groundwater.
- A passive aerobic biostimulation field pilot to assess the ability of the Waterloo EmitterTM to deliver oxygen to the shallow aquifer and subsequently enhance aerobic biodegradation of aromatic constituents.
- A study demonstrating the role played by *Dehalobacter* spp in the dehalogenation of dichlorobenzene isomers to monochlorobenzene, and monochlorobenzene to benzene in sediment microcosms derived from site sediment samples.
- A study using compound specific isotope analysis to demonstrate isotopic enrichment as evidence of biodegradation and as an effective means to monitor and potentially quantify anaerobic biodegradation of chlorinated benzenes.

3.0 Environmental Setting

This section summarizes the environmental features including the local topography and surface-water features, and the regional/local climate, geology, and hydrogeology.

3.1 Topography and Surface-Water Features

The site is located along the Delaware River approximately 70 miles upstream of the mouth of the Delaware Bay. The topography of southern New Jersey ranges from approximately 100 feet above mean sea level in the central portion of the state and generally decreases westward to near sea level along the Delaware River. In the area of the site, the surrounding topography is gently rolling with low-lying creeks and wetlands. The manufacturing area has an approximate elevation of 4 to 7 feet NAVD88. Site landfill areas are higher, ranging in elevation from 24 to 70 feet NAVD88.

The western boundary of the site lies along the tidally influenced portion of the Delaware River, which has a tidal range of approximately 6 to 7 feet. The Delaware River is not used for drinking-water purposes in this area because of its brackish water quality. Other surface-water bodies include Bouttown Creek, Henby Creek, and the Salem Canal (see Figure 2-1). Bouttown Creek is dammed near Helms Cove and flows south to Henby Creek. Henby Creek flow is controlled by a sluice gate, and water discharges to the Delaware River during low tide. Bouttown and Henby Creeks are flanked by low-lying wetlands. Neither of these creeks is used for water at the site.

Bouttown Creek originates east of the site near the town of Carneys Point. Stormwater from Carneys Point Township enters the creek off-site and is regulated by a township-operated pump house located near the DuPont property line. Prior to 1974, Bouttown Creek discharged to the north through a sluice gate to the Delaware River. In 1974, the original point of discharge in Bouttown Creek was cut off and filled; flow in Bouttown Creek was then diverted to Henby Creek to the south via a constructed channel.

The Salem Canal is controlled by the Munson Dam, which was constructed to minimize saltwater intrusion from the Delaware River and provide a reservoir of potable water for Chambers Works.

Historically, low-lying areas were reclaimed with fill, sometimes using dredge spoils from the Delaware River. Most of the manufacturing area is covered by paved roads and buildings. Flow from the Whopping John Creek, which formerly crossed the Chambers Works facility south of Henby Creek, is now conveyed via a culvert system under Landfill A (SWMU 8) to the B Settling Basin as part of the site stormwater drainage system. The stormwater drainage system conveys stormwater for most of the operating facility south of Henby Creek. Water in the B Settling Basin is then discharged to the Delaware River via permitted Outfall 001.

Approximately 295 acres of the site are classified as regulated wetlands. Most of the regulated wetlands at the site are located north of Henby Creek and are classified as wetlands of intermediate resource value. These wetlands are largely associated with drainage areas adjacent to Henby Creek and Bouttown Creek. In addition, several small ponds/impoundments are present on-site.

3.2 Climate

Southern New Jersey has a humid subtropical climate. The nearest meteorological station to the site is at the Wilmington/New Castle County Airport, which is located approximately eight miles west-southwest of the site. Precipitation in the area is relatively uniform throughout the year and averages approximately 41 inches per year. Seasonal snowfall may range from as little as 1 to 50 inches; however, most winter precipitation in the area falls as rain. Most of the rain in the summer months comes from thunderstorms, and coastal storms are responsible for most of the rainfall throughout the remainder of the year. Atlantic hurricanes can cause heavy rains during the summer months although winds rarely reach hurricane force in the area. Both heavy rains and high tides can cause flooding of the Delaware River and Delaware Bay. Prevailing winds are from the south from May through September and from the northwest and west-northwest during the remaining months.

3.3 Geology

The site lies in the Atlantic Coastal Plain physiographic province, approximately 3.5 miles southeast of the Fall Line. In general, the site is underlain by unconsolidated sediments of Holocene, Pleistocene, and Cretaceous age. These sedimentary units thicken rapidly as the units dip to the southeast and are of fluvial, estuarine, and marine origin (Stanford and Sugarman, 2006a and 2006b). Beneath the site, the sedimentary units are approximately 500 feet thick. Igneous and metamorphic rocks of the Wilmington Complex (likely of Precambrian era) unconformably underlie the Coastal Plain sedimentary deposits [Barksdale et al., 1958; United States Geological Survey (USGS), 1989].

The Holocene and Pleistocene sedimentary deposits are of fluvial and estuarine origins. These sediments are characterized by deposition and erosion during sea-level fluctuations associated with Quaternary glaciations. Generally, sediments were deposited during periods of higher sea-level and eroded during periods of lower sea-level. The bounding surfaces are erosional and, as a consequence, have variable topographic relief (Stanford, 2003). The Pennsville paleovalley, a larger-scale paleochannel, which is believed to be an abandoned channel of the modern Delaware River has its axis located just east of the site property boundary (Stanford and Sugarmann, 2006a).

The Cretaceous period sedimentary deposits in the site vicinity consist of the Potomac, Raritan and Magothy Formations. Regionally, these non-marine units are grouped together as the Potomac-Raritan-Magothy (PRM) aquifer system. As documented in the *DuPont Chambers Works Geological Framework White Paper* (MWH, 2010), the sedimentary section is undifferentiated, and the hydrogeological units are often interconnected. The strata were deposited in a series of fining-upward alluvial cycles, resulting in alternating deposits of gravel, sand, silt, and clay. Periods of erosion between depositional cycles have resulted in discontinuous units. The Cretaceous period sediment is characterized by irregular channel deposits of sand separated by clay and/or silt aquitards.

3.4 Hydrogeology

Holocene or recent age sedimentary deposits are mostly fine-grained and occur immediately along the Delaware River or its tributaries. Holocene age sediments are not an important source of groundwater production (Weston, 1992). The Pleistocene sand and gravel deposits can produce significant groundwater both locally and regionally with yields of up to 1,500 gallons per minute (gpm) but these deposits are not widely developed as a groundwater resource in Salem County (Rosenau et al., 1969). The Pleistocene deposits are hydraulically connected to the Delaware River and provide recharge to the underlying PRM aquifer system.

The PRM aquifer system is the most productive source of groundwater in Salem County (Rosenau et al., 1969). Although the aquifer is generally considered to be a single unit, it is actually composed of three or four distinct water-bearing zones that are interconnected in some areas. In Salem County, the individual aquifers are 5 to 85 feet thick and are separated by silty clay or clayey silt intervals that act as confining or semi-confining units. The uppermost aquifer, which is approximately 80 to 120 feet below ground surface (bgs), has reportedly yielded up to 800 gpm. The second aquifer, reportedly subjected to the largest withdrawals, is approximately 150 to 250 feet bgs and has yielded from 350 to 700 gpm. The remaining Cretaceous aquifers below 300 feet bgs have reported yields between 250 and 600 gpm.

Recharge to the PRM occurs primarily at the outcrop area in Delaware and from infiltration or leakage of the overlying surficial aquifer (Barksdale et al., 1958). The PRM aquifer system is the most heavily pumped Coastal Plain aquifer, and groundwater flow patterns have been affected by water resource development.

4.0 Recent RFI Field Investigation Activities and Results

This section provides a summary of the field activities and data collected as part of the *RFI Data Gap Sampling Plan* (URS, 2013a). The results presented here and in later sections are combined with historical data to provide a comprehensive evaluation of site conditions. This section also provides a summary of the field activities and data collected as part of the *Vapor Intrusion Remedial Investigation Work Plan* (URS, 2014). The data are evaluated as part of the human health exposure assessment in Section 8. For both field efforts, deviations from the sampling plan are noted in individual sections. Appendix B provides supporting logs, data analysis, and laboratory reports.

4.1 RFI Data Gap Sampling Plan Background

During the summer of 2013, four separate evaluations were performed to identify data gaps to complete the RFI program. These evaluations are documented in the *RFI Data Gap Sampling Plan* (URS, 2013a). The first evaluation was a review of the NJDEP Case Inventory Document (CID), which provides a brief summary and current status for each SWMU, AOC, and study area at the site. This evaluation along with coordinated review of supporting reports and data identified data gaps for SWMUs 55-1 and 55-4 (URS, 2013a).

The second and third evaluations were reviews that focused on complete exposure pathways to both human and ecological receptors, respectively. An assessment of various reports in conjunction with any new data or changes to the CSM since the reports were published provided the basis for evaluating remaining data gaps for receptor exposure assessments. The human health review indicated no data gaps but recommended that the *Vapor Intrusion Remedial Investigation Work Plan* be developed and implemented (URS, 2014). The ecological review indicated no data gaps.

The fourth evaluation was a detailed review of historical documents and data in the manufacturing area AOCs 1 through 10. Because the vadose zone and the B aquifer had undergone the most detailed investigations prior to 2013 (as documented in the *Perimeter Investigation Report* and the *Interior Investigation Technical Memorandum*), this review resulted in data gaps for the C and D aquifers. The *RFI Data Gap Sampling Plan* provides a summary figure and table of the proposed field activities. Figure 4-1 and Table 4-1 show the final locations of the completed field investigation activities. Additionally, the sampling plan proposed to perform approximately 20 slug tests at new C and D aquifer well locations. However, upon subsequent evaluation of historical hydraulic testing that has been performed at the site, it was determined that slug tests should be performed for the B aquifer as well. Figure 4-2 shows the 28 well locations where slug testing was completed in 2014.

A response letter from NJDEP dated December 2, 2013 to the 2013 *RFI Data Gap Sampling Plan* indicated that a review of data gaps should include PFOA and perfluorinated compounds (PFC) sampling. An evaluation of historical PFOA/PFC sampling, results, and data gaps was completed in January 2014. Analyses for PFOA/PFC were added to the proposed 2013 RFI data gap sampling activities. Because the PFOA/PFC evaluation was not described in the sampling plan, a brief summary is provided here.

Prior to 2007, there were several investigations that included PFOA analysis of soil, sediment, and groundwater samples as detailed in the *Site Investigation Report for PFOA* (DuPont CRG, 2006c) and the addendum report (DuPont CRG, 2007c). A PFOA monitoring program was incorporated into the DGW monitoring program in 2007. Since then, PFOA and 12 perfluoroalkyl substances (PFASs) have been analyzed for in semi-annual groundwater samples from monitoring wells. The number and location of wells sampled in the DGW monitoring program have changed somewhat through the years as documented in the *Perflouorooctanoic Acid Groundwater Investigation Report Addendum II* (URS, 2011b). The current number of wells is 36: five in the Carneys Point area and 31 in the manufacturing area. The wells were selected to provide characterization of groundwater quality in the A zone and B through E aquifers along the site perimeter, and in proximity to former PFOA-related operations in the manufacturing area. Results from the latest DGW report (URS, 2013d) were used to evaluate the distribution of the monitoring wells and the groundwater quality with respect to PFCs. Based on this evaluation, potential data gaps in some areas of the manufacturing area could be filled by adding PFAS analyses to 15 monitoring wells. The samples were collected in January 2014. These locations and the associated sampling results are presented in Section 4.6.

The following sections provide a detailed account of the field activities and summaries of the data collected.

4.2 Drilling Activities

From September 2013 to February 2014, Summit Drilling Co, Inc. was on-site to complete the drilling activities associated with the 2013 *RFI Data Gap Sampling Plan*. Drilling activities included the installation of monitoring wells and temporary groundwater sampling devices as well as the advancement of borings for stratigraphic data and soil sampling. A detailed methodology of the installation of the monitoring wells is provided in Section 4.3.

At four locations, stratigraphic borings were advanced using a sonic drill rig with a 3-inch core barrel lined with acetate liners. Cores were obtained from the ground surface to the top of the D/E aquitard. Once the acetate liner was recovered, it was cut with an oscillating multi-tool cutting device. The soil core was split and quickly scanned with a photo-ionization detector (PID) to detect VOCs. The core was then logged per the methodology described in Section 3.1 of the sampling plan (URS, 2013a). Two additional locations proposed in the sampling plan, U12-Strat and S16-Strat, were not completed due to utility clearance and access issues.

At two locations, SWMU-55-1-1 and SWMU-55-1-2, shallow borings were advanced using a direct-push Geoprobe® rig. A 2-inch core barrel lined with an acetate liner was advanced to 10 feet in both locations. The core was split using a purpose-built safety knife and logged by a URS geologist in accordance with the methodology described in the sampling plan. Samples were then collected at the base of the vadose zone, just above the water table. A third location, SWMU-55-4-1, was advanced using a sonic rig. This location was multipurpose in that it was a shallow vadose boring as well as a deep stratigraphic boring to the D/E aquitard. Details of sampling methodology and results are provided in Section 4.5.1.

At three locations, I10B, E14B, and P15B, after a boring was advanced, a temporary well screen was installed to the top of the B/C aquitard. I10B and E14B were advanced using a direct-push Geoprobe rig with a 2–inch core barrel lined with an acetate liner. P15B was advanced using a sonic rig and a 3-inch core barrel lined with an acetate liner. This deviation occurred because the sonic rig was located at P15-M01C to install the C well, and it was a convenient way to complete the tasks required at these locations. In all cases, the soil core was split using a purpose-built safety knife and logged by a URS geologist. From the log, the interval for groundwater sampling was determined. Using a direct-push discrete interval sampling device (Hydropunch™ System) with a 4-foot screen, groundwater grab samples were collected from the B aquifer. Details of sampling methodology and results are provided in Section 4.6.2.

Upon completion, all borings were tremie grouted from the bottom of the boring to ground surface with a cement and bentonite grout mixture. Soil boring logs are provided in Appendix B.1. Boring logs and associated permit forms will also be submitted to the NJDEP as part of the DGW semi-annual reporting requirements for the site.

4.3 Monitoring Well Installation and Development

In accordance with the *RFI Data Gap Sampling Plan* (URS, 2013a), 20 new monitoring wells were installed. One well was installed to the base of the B aquifer (top of the B/C aquitard), 12 wells were installed to the base of the C aquifer (top of C/D aquitard), and eight wells were installed to the base of the D aquifer (top of D/E aquitard). As a deviation from the sampling plan, one additional well was installed in the B aquifer because DNAPL was encountered as the boring was advanced at this location. The following sections contain the installation and development methodologies.

4.3.1 Monitoring Well Installation Methodology

An NJDEP permit was obtained by a NJ licensed driller, Summit Drilling, prior to the installation of the wells. The monitoring wells were installed using a CRS XL Max Roto-Sonic Rig. Prior to installation of each well, a boring was advanced to the top of the C/D or D/E aquitard and logged by a URS geologist. Complete boring logs are provided in Appendix B.1. The well screen interval was determined based on the depth of the appropriate aquifer (C or D) and aquitard (C/D or D/E). In cases where a C aquifer and D aquifer well were installed as a clustered pair, only one deep soil boring was completed, and both well screen depths were determined from one log.

Monitoring wells were constructed using a single cased 2-inch diameter schedule 80 polyvinyl chloride (PVC) riser pipe with a 10-foot, 0.010-inch slotted screen. At four locations, stainless-steel screen and casing were used due to the potential presence of DNAPL and to maintain long-term structural integrity of the well. At two locations (I15-M01C and E14-M01C), the screen length was shortened to 5 feet due to the lack of a significant thickness of hydraulically conductive aquifer. The sand pack (#1 well gravel) in all wells was installed from the bottom of the drilled depth to 2 to 3 feet above the well screen. The wells were then grouted with a cement/bentonite mixture from the top of the sand pack to ground surface and finished with either a flush mount or stick up well casing. Monitoring well construction details can be found in Table 4-2.

While drilling the F09-M01D boring, DNAPL was encountered in the B aquifer interval. This boring was determined to have free flowing DNAPL; therefore, a DNAPL recovery well, F09-M03B, was installed. The original wells specified in the sampling plan (F09-M01C and F09-M01D) were later installed approximately 250 feet to the west of the proposed location to avoid installing deep wells within a DNAPL source area.

4.3.2 Monitoring Well Development Methodology

Following the guidelines of the NJDEP *Field Sampling Procedures Manual* (NJDEP, 2005), the wells were developed using two methods. A submersible Grundfos pump was used to surge the well and clean the screen. A surface centrifugal pump was used to purge the well of larger volumes of silt. Dedicated tubing was used with the centrifugal pump, and disposable tubing was used with the Grundfos pump to prevent cross-contamination between wells. The Grundfos pump was decontaminated between wells by submerging in a bucket of deionized (DI) water and Alconox solution and turned on to cycle the solution through the internal components of the pump. Then the pump was submerged in a bucket of DI water and turned on to rinse the alconox solution from the pump. Notes were recorded on the length of time the well was developed, the gallons that were removed, the water level, color, and odor. Well development logs are provided in Appendix B.2.

4.4 Slug Testing

Slug testing was performed on 28 monitoring wells in January 2014. These included pre-existing and newly installed wells, which were selected based on a data gap analysis of existing slug and pumping test results and an assessment of the hydrogeological characteristics of potential new testing locations. Monitoring wells were slug tested using a conventional solid slug testing method. Both rising and falling head tests were performed as the well conditions allowed. Data were collected and analyzed with the Bouwer and Rice (1976) method as implemented in the USGS spreadsheet tool (USGS, 2004). Occasionally, slug tests of high permeability aquifers can induce an undamped, oscillatory response, in deep monitoring wells. These oscillations can be caused by a combination of inertia, storage, and casing friction in response to the displaced water. In these cases, the slug test response must be analyzed by specific techniques that account for these conditions. The Butler method, as implemented in the AQTESOLV program, was used to analyze the results from wells C10-M01C, H07-M01C, M09-M01C and C06-M01D (Butler, 1998; Hydrosolve, 2014). This method accounts for momentum balance in the water column. A summary of results is provided in Table 4-3, and the analyses are provided in Appendix B.3.

4.5 Soil Sampling and Analyses

Soil samples were collected at nine locations. Three locations were sampled to evaluate soil quality in the vadose zone, three locations were sampled to evaluate soil quality in an aquitard interval, and three locations were sampled to evaluate geotechnical characteristics. The sampling objectives, methodologies of collection, and the findings are detailed in the sections below. Laboratory analysis reports are included in Appendix B.4.

4.5.1 Shallow Vadose Zone Samples

One shallow soil sample was collected from each core obtained at three locations to complete SWMU characterizations. Soil was analyzed for VOCs, SVOCs, moisture, metals, and total organic carbon (TOC). Soil borings were advanced using a direct push Geoprobe rig. The rig pushed a 2-inch core barrel lined with an acetate liner to preserve lithologic integrity. After the section of core was logged for lithologic characteristics, the sample interval was identified. Samples were targeted in the vadose zone, just above the water table. Samples for VOC analysis were collected using a decontaminated En Core® (En Novative Technologies, Inc.) T-handle sampler. The sample was collected directly in the acetate liner to minimize the loss of VOCs. One 125-ml glass jar was filled with the remaining soil from the interval using a disposable plastic scoop. Samples were shipped to Eurofins Lancaster Laboratories following applicable chain-of-custody procedures. Results are provided in Table 4-4a.

4.5.2 Diffusion Sampling Activities

Three locations were targeted for collection of soil samples in fine grained units. The purpose of these samples is to assess vertical concentration gradients, diffusion potential, and mass storage associated with constituents detected in low permeability units (silt and clay). Sample locations and intervals were based on lower permeability units where the overlying aquifer is suspected to contain elevated concentrations of site constituents identified by field observations or existing groundwater quality data. Samples for VOC analysis were collected using a decontaminated En Core (En Novative Technologies, Inc.) T-handle sampler 0 to 3-inch, 3 to 6-inch, and 6 to 9-inch intervals into the unit. One sample was also taken from the overlying aquifer material. Samples were collected in the same intervals for moisture and chloride analyses as well. Results of the diffusion sampling are provided in Table 4-4b.

4.5.3 Geotechnical Samples

Geotechnical soil samples were collected for grain size analysis from cores obtained at three locations. Representative soil samples were collected from each major lithologic strata identified (e.g., silt and clay, gravel, fine- and coarse-grained sand) in the C and D aquifers and the C/D aquitard.

Soil was collected by pushing a 3-inch sonic rig barrel lined with an acetate liner. The core was cut open using an oscillating multi-tool. After logging the soil core, sample intervals were chosen, and glass jars were filled using a clean disposable plastic scoop. Samples were shipped to Eurofins Lancaster Laboratories following applicable chain-of-custody procedures. Samples were analyzed for moisture content, grain size, specific gravity, TOC, and fractional organic carbon (FOC). Results are provided in Table 4-5.

4.6 Groundwater Sampling and Analyses

The newly installed wells were developed after installation and allowed to equilibrate for at least two weeks prior to groundwater sampling and water-level measurements. Groundwater samples were then collected from 20 of the newly installed monitoring wells and three existing wells specified in the *RFI Data Gap Sampling Plan* using the standard procedures described in the NJDEP *Field Sampling Procedures Manual* (NJDEP, 2005). A sample was not collected from monitoring well F09-M03B because of the presence of DNAPL.

4.6.1 Groundwater Sampling Methodology

The 23 wells were sampled using the volume-averaged purging method laid out in Section 6.9.2.4 of the NJDEP *Field Sampling Procedures Manual* (NJDEP, 2005). Dedicated tubing in conjunction with a centrifugal pump was used in all wells to prevent cross-contamination during sampling. Well volumes were calculated based on well depth and diameter. Three well volumes were purged from each well prior to sampling. Field parameters were measured using a YSI 600xl water quality sonde, after each well volume was purged. Parameters measured were pH, dissolved oxygen, turbidity, specific conductivity, oxidation-reduction potential, and temperature. Samples were then collected using a disposable PVC bailer, placed in clean laboratory-supplied containers and shipped to Eurofins Lancaster Laboratories following applicable chain-of-custody procedures. Samples were analyzed for VOCs, SVOCs, PCB aroclors, target analyte list (TAL) metals, chloride, and metabolic gases. In addition, 15 locations were chosen for PFOA and PFAS analysis. These samples were also collected using disposable PVC bailers, placed in clean laboratory-supplied containers, and shipped to AXYS Analytical Services following applicable chain-of-custody procedures. The results are provided in Table 4-6a.

4.6.2 Hydropunch Sampling Methodology

Using a direct-push discrete interval sampling device (Hydropunch System) with a 4-foot screen, groundwater grab samples were collected from three B aquifer locations. At two locations (E14B and I10B), groundwater was sampled from the B aquifer using a Geoprobe SP16 groundwater sampling device. The Geoprobe SP16 is a 4-foot stainless-steel screen inside of a stainless sheath that is driven to the desired sample depth. Then, the outer sheath is retracted to expose the stainless screen and allow for a water sample to be collected. At one location (P15B), a larger device, similar to the SP16, was installed with the sonic rig. Water was collected using disposable plastic bailers, placed in clean laboratory-supplied containers, and shipped to Eurofins Lancaster laboratories following applicable chain-of-custody procedures. The SP16 groundwater sampling device was decontaminated between locations by using a high-pressure power washer. Results can be found in Table 4-6b.

4.7 DNAPL Sample Analytical Findings

If DNAPL was encountered in a groundwater monitoring well, it was to be collected and sent for analysis. One location (F09-M03B) had free flowing NAPL present in the groundwater. The DNAPL was collected using a disposable PVC bailer, placed in clean laboratory-supplied containers, and shipped to Eurofins Lancaster Laboratories following applicable chain-of-custody procedures. Samples were analyzed for VOCs, SVOCs, metals, organochlorine pesticides, PCBs, herbicides, TEL, total and amenable cyanide, TOC, pH, flashpoint, methanol, reactive sulfide, dioxins, furans, and specific gravity. Results are provided in Table 4-7.

4.8 RFI Data Gap Sampling QA/QC Program

The DuPont Analytical Data Quality Management (ADQM) Group conducted data validation on the electronic data deliverable using the DuPont Data Review (DDR) process. This process reviews and evaluates laboratory data, including hold time criteria, blank contamination, matrix spike/matrix spike duplicate (MS/MSD) recoveries, duplicate sample relative percent difference (RPD), and surrogate recoveries. Based on the DDR process, the following qualifiers were assigned to the environmental data as applicable.

Qualifier	Definition
B	Comparable detection in laboratory or field blank.
J	Analyte present. Reported value may not be accurate or precise.
R	Unusable result. Analyte may or may not be present in the sample.
UJ	Not detected. Reporting limit may not be accurate or precise.

As provided in Appendix B.4, the results of the DDR review indicate that the samples were considered useable in consideration of the objectives for the investigation and no significant quality control exceptions were noted. Sample results were qualified due to contamination of the method blank and/or when the sample results were detected between the method detection limit (MDL) and practical quantitation limit (PQL).

4.9 Vapor Intrusion Remedial Investigation Field Activities and Results

The field activities associated with the *Vapor Intrusion Remedial Investigation Work Plan* (URS, 2014) were implemented from April to May 2014. During the investigation, sub-slab soil gas sampling and ambient air sampling were conducted. Of the 135 potentially occupied structures, 15 were targeted for the first phase of investigation. These structures are continuously occupied and located above areas where DNAPL has been identified. Based on the various sizes of the buildings [ranging from 1,500 square feet (ft^2) to 25,000 ft^2] and according to recommendations provided in the NJDEP Vapor Intrusion Guidance (VIG), a minimum of two and maximum of six samples were proposed for each of the 15 buildings to assess the VI pathway under each slab.

Building walk-throughs were conducted to evaluate the quantity and locations for proposed sampling in the work plan. Prior to the collection of the sub-slab samples, a preliminary building inspection/survey was completed in accordance with the NJDEP VIG and site-specific Health and Safety Plan (HASP). The preliminary inspection identified utilities and other structural obstructions, which may affect the locations of the proposed sample locations. Additionally, the inspection assisted in the evaluation of potential background sources within each structure. Figure 4-3 indicates the final sample locations. Sixty samples were collected.

The procedure for sampling was as follows. A hole was drilled through the slab/floor of the building using a 5/8-inch-diameter hammer drill. A stainless-steel soil gas probe, designed by Geoprobe for soil gas sampling, was then inserted through the hole in the sub-slab and into the soil below. Teflon® lined polyethylene tubing was connected to the soil gas probe, and the hole was sealed with a non-volatile emitting and non-shrinking modeling clay, in accordance with the NJDEP VIG. The soil gas probe was connected to a photoionization detector (PID) and a GEM® 2000+ Gas Analyzer and Extraction Monitor to assist in analyzing levels of constituents in the sub-slab.

Additionally, in accordance with Section 3.3.1.4 of the NJDEP VIG, a vacuum leak check was performed on all the canisters and fittings prior to sample collection. To perform this check, a hood for the introduction of a helium tracer gas was placed over the sampling port and tubing connections. An MGD® 2002 Helium/Hydrogen detector was attached to monitor the atmosphere of the hood. The target concentration of helium in the hood was 10 to 20%. Once the proper hood concentration was achieved and verified, the detector was moved to the outlet of the sample probe tubing to measure helium concentrations in the sample stream. If the helium concentration in the sample stream was greater than 10% of the concentration within the hood, then it was considered a leak. If a leak was detected, it was fixed, and the leak check process was repeated.

Upon completion of a successful leak check, the Teflon sample tubing was connected to a one-liter SUMMA canister with a laboratory calibrated regulator to achieve the preferred sample flow rate of 50-100 milliliters per minute (mL/min). Once all connections were in place, the sample was collected as a grab sample in approximately 10 minutes. Sample identification, vacuum readings, flow controller identification numbers, and other relevant information were recorded in a field logbook.

An ambient air sample was also collected for each day of sub-slab soil gas sampling. Each sample was collected over an 8-hour period using batch-certified clean evacuated canisters with inlets positioned at approximately 3 to 5 feet above the ground surface (breathing zone). The sampling rate was maintained by laboratory calibrated flow controllers (approximately 12 mL/min). The ambient air sample was collected in the predicted upwind direction of the building to be sampled for sub-slab sampling.

Sample analysis was conducted by TestAmerica Laboratories in Burlington, Vermont. Soil gas and ambient air samples were analyzed in accordance with procedures detailed in NJDEP's VIG. All samples were submitted for laboratory analysis of VOCs by EPA TO-15 Method. The VOC analyte list was consistent with the full parameter list of Table 1 of the NJDEP Method LLTO-15. Sample results were reported by the laboratory to the MDL. Consistent with current EPA guidance, quality assurance/quality control (QA/QC) samples, including field duplicate samples and trip blanks, were not collected during this event because they are not required for TO-15 analysis (EPA, 2012). Table 4-8 provides a summary of the results and indicates exceedances of criteria. Laboratory reports are provided in Appendix B.4.

The site-wide Quality Assurance Project Plan (QAPP) presented to the NJDEP as part of the First Semester 2010 DGW Report (URS, 2010e) documents the QA/QC program, procedures, and objectives. QA/QC procedures applicable to this investigation include the proper processing and handling of samples. A revised QAPP for this activity is provided as Appendix B in the *Vapor Intrusion Remedial Investigation Work Plan* (URS, 2014).

5.0 Site-Specific Geology and Hydrogeology

This section provides a description of the site-specific geology and hydrogeology. It includes a discussion of both horizontal and vertical flow pathways and a summary of site-specific groundwater sources and sinks.

5.1 Site Geology

The site geology consists of fill material underlain by recent to Cretaceous sedimentary deposits. The site topography is relatively flat as fill material was used to reclaim low-lying creeks, floodplain areas, and wetlands. The fill material is heterogeneous and may consist of sand, gravel, clay, construction rubble and debris. Beneath the fill material, there are recent to Holocene silty sand and organic silt and clay deposits associated with either the upland floodplain deposits of the Delaware River to the west or the low lying former wetlands and stream valleys to the east, respectively. These buried marshy deposits are commonly referred to as meadow mat or marsh mat. Beneath the marsh mat is Holocene and Pleistocene sedimentary deposits of fluvial and estuarine origin, which are associated with Quaternary glaciation (DuPont CRG, 2007a, URS, 2013e).

The Pleistocene units that underlie the site are interpreted to be the Cape May 3 and Cape May 2 Formations (MWH, 2010; Stanford and Sugarman, 2006a and 2006b). The units are fluvial deposits of low sinuosity streams and estuarine deposits, which in combination created intervals of silt, sand, and gravel (fluvial) alternating with semi-continuous intervening intervals of fine-grained silt and clay (estuarine). Interpretation of site data has resulted in the identification of major paleochannels generally oriented northeast-southwest in the eastern portion of the manufacturing area (Weston, 1992; DuPont Environmental Remediation Services, 1993). The paleochannels incised and eroded previously deposited sedimentary units and then deposited channel fill and overbank deposits in their place. The total thickness of the Quaternary sedimentary deposits (Holocene and Pleistocene) varies from 40 to 140 feet beneath the site.

Beneath the Pleistocene section, the Cretaceous sedimentary deposits are classified as the Potomac Formation (MWH, 2010). The Potomac Formation consists of non-marine sediment deposited in a low-gradient, multi-channel fluvial system (MWH, 2010; McKenna et al., 2004). This resulted in a complex stratigraphy of alternating deposits of sand, silt, and clay that is approximately 300 to 400 feet thick beneath the site.

5.2 Site Hydrogeology

The depositional architecture beneath the site is characterized by a vertically stacked sequence of alternating coarser-grained and finer-grained units that generally act as aquifers and aquitards, respectively. Early in the site investigation history, a system was developed to use letters to designate primary hydrogeological units (Weston, 1992; DuPont Environmental Remediation Services, 1993). Since then, site-investigation work has led to the on-going update and refinement of the understanding of the site hydrogeology as documented in *Interim Update: Hydrogeologic Model Refinement* (URS, 2013f). Tables 5-1 and 5-2 provide a summary description of each unit and its hydrogeological characteristics. The nomenclature includes a designation of an A zone, aquifers by letters B through F, and intervening aquitards by the letter designations of the bounding aquifers (e.g., the B/C aquitard lies between the B and C aquifers). In recent years, the B aquifer has been investigated in greater detail and this resulted in a refinement of the B aquifer designation to include three classifications: upper B aquifer, middle B silt, and lower B aquifer (URS, 2013f).

The A zone is primarily fill material. The A/B aquitard varies based on its proximity to the uplands in the western portion of the site where it is a silty to clayey sand as opposed former low-lying areas where it is an organic-rich silt and clay deposit. The vertical interval from the B through D aquifers correspond to the previously described Pleistocene Cape May 3 and Cape May 2 Formations and collectively are part of the Pleistocene aquifer system. The vertical section from the D/E aquitard to the crystalline basement rock corresponds to the previously described Cretaceous Potomac Formation. While the actual Pleistocene-Cretaceous boundary may occur above the D/E aquitard in some areas, the D/E was adopted as a site marker (DuPont CRG, 2007a; URS, 2013f). The D/E aquitard is a relatively, thick, hard clay between the D aquifer and the regional PRM aquifer system (Weston, 1992; DuPont Environmental Remediation Services, 1993).

Figure 5-1 shows the elevation of the top of the D/E aquitard, which ranges from approximately -40 to -140 feet NAVD88 (URS, 2013f). The D/E aquitard dips east-southeast with the shallowest elevations occurring on the western boundary of the site along the Delaware River and the deepest elevations occurring near the southeastern boundary of the manufacturing area. The deeper elevations of the D/E aquitard surface are coincident with the Pennsville paleovalley, a larger-scale paleochannel, which is believed to be an abandoned channel of the modern Delaware River. The paleovalley has its axis located just east of the site property boundary. The change in elevation of the top of the D/E aquitard along the east-southeast dip means that the thickness of the overlying Pleistocene aquifer system changes accordingly, i.e., it is generally thinner in the western-northwestern areas of the site and thicker in the eastern-southeastern areas of the site.

The *Interim Update: Hydrogeologic Model Refinement* report (URS, 2013f) provides 12 cross-sections and the surface structure and thickness of each aquifer and aquitard to a depth of the top of the D/E aquitard. Three cross-sections are presented here to support the discussion of the site-wide hydrogeology. These cross-sections have been modified since publication of the report (URS, 2013f) to include new data collected during the RFI data gap investigation as described in Section 4.

Figures 5-2 through 5-5 show a cross-section location map and three cross-sections. Cross-section A-A’ spans the site from the west at the Delaware River across the manufacturing area to the eastern property boundary. Cross-section B-B’ spans the site south at Salem Canal north across the manufacturing area to Henby Creek. Cross-section C-C’ spans the site from Henby Creek north across Carneys Point toward the northern property boundary. To provide a site-wide characterization, these cross-sections are referenced throughout the following subsections as each unit is described in detail.

5.2.1 A Zone

The A zone generally consists of fill material, which was put in-place to reclaim low-lying areas as the site was developed. The A zone is laterally and vertically heterogeneous and discontinuous, and fill materials may vary from sand, gravel, and clay to construction rubble and debris. Overall, the thickness of the A zone ranges from 0 feet to approximately 10 feet, not including the landfill areas of the site.

Groundwater in the A zone can be perched or associated with the upper portion of the B aquifer. Previous studies documented in the Phase IV RFI (DuPont CRG, 2005b) indicated that A zone groundwater levels in the Carneys Point area directly respond to precipitation events. The predominant groundwater flow path is percolation downward to recharge the B aquifer. Tidal studies indicated that A zone groundwater in the vicinity of the Delaware River has a limited response to tidal fluctuations, likely due to the existing sea-wall structure and the discontinuous nature of the A zone groundwater, i.e., it does not have a well-developed saturated zone across an extensive area along the shoreline that would respond to tidal fluctuations.

5.2.2 A/B Aquitard

The A/B aquitard consists predominantly of silt, clay, peat and organics of recent origin, such as marsh mat, roots and grasses. The A/B aquitard is believed to have been deposited during the Holocene and is associated with the creek related sheet flooding (MWH, 2010) and tidal marshes. While the A/B aquitard is laterally extensive, in some areas the A/B is thin or absent either as a result of non-deposition or erosion by streams. In other areas, the A/B may have been partially or fully removed during construction activities at the site.

The thickness of the A/B aquitard ranges from 0 feet to approximately 11 feet with thicker sections located in the area of Henby Creek and Bouttown Creek. Several smaller discontinuities and thin (less than 1-foot thick) areas of the A/B aquitard are present in the manufacturing area (see Figures 5-3 and 5-4) with a larger discontinuity located beneath the C Landfill area in Carneys Point (see Figure 5-5). The top of the A/B aquitard is typically near 0 feet (NAVD88), especially across Carneys Point (see Figure 5-5). However, in the southern portion of the manufacturing area, the top of the A/B aquitard ranges from -5 to +7 feet (NAVD88).

5.2.3 B Aquifer

The B aquifer is typically a fine to medium-grained sand that is inter-bedded with silt and some clay. The B aquifer is Holocene to Pleistocene (Cape May 3) in age. Recent interpretations indicate the B aquifer has an upper B medium sand layer overlying a lower B coarser sand layer. Also, in some areas of the site, there is a gravel layer at the base of the B aquifer. Between the upper and lower B is a discontinuous layer of silt to clayey-silt, referred to as the middle B silt.

Overall, the B aquifer is approximately 20 feet thick with thicker sections occurring in the central and eastern portions of the manufacturing area. Across Carneys Point, the thickness of the B aquifer is more uniform and on average is approximately 15 feet (see Figure 5-5). In this area, the middle B silt is relatively thin and discontinuous. For the manufacturing area, the thickness of the B aquifer is more variable, ranging from approximately 20 to 40 feet. In the manufacturing area, the middle B silt is generally thicker and more continuous, except in the eastern portion of the site where the middle B silt is absent due to the Pleistocene paleochannel (see Figures 5-3 and 5-4).

The B aquifer is considered to be the shallowest aquifer and is unconfined to semi-confined depending on the presence and quality of the overlying A/B aquitard. In addition, portions of the B aquifer can exist under both unconfined and semi-confined conditions (upper B and lower B, respectively) depending on the thickness and quality of the middle B silt. The geometric means of field slug test estimates of horizontal hydraulic conductivity is 14 feet/day and transmissivity is 190 ft^2/day.

5.2.4 B/C Aquitard

The B/C aquitard consists predominantly of gray to black silt to clayey silt that in some areas is mica rich. The B/C aquitard was likely deposited in an estuarine environment.

Figure 5-6 provides a map of the thickness of the B/C aquitard, which ranges from 0 to approximately 20 feet. In the Carneys Point area, the thickness ranges from 4 to 20 feet and the unit is laterally continuous (see Figure 5-5). Across a large portion of the manufacturing area, the thickness of the B/C aquitard is 8 to 20 feet thick. In the central to eastern portion in the area of the Pleistocene paleochannel, the B/C aquitard is not present (see Figures 5-3 and 5-4).

Where the B/C aquitard is of significant thickness, it may restrict the downward flow of groundwater from the B to the C aquifer. Laboratory hydraulic conductivity analyses indicate that geometric mean of vertical hydraulic conductivity is 1.5E-03 feet/day.

5.2.5 C Aquifer

The C aquifer consists of coarse sand throughout most of the aquifer. However, near its base, the aquifer may contain very coarse sediment ranging from gravel to cobble-sized rocks. The C aquifer was deposited during the Pleistocene and is believed to be part of the Cape May Formation 2.

Overall, the C aquifer is approximately 20 feet thick with an average of approximately 15 feet in the Carneys Point area (see Figure 5-5) and thicker sections greater than 45 feet occurring in the central and eastern portions of the manufacturing area within the Pleistocene paleochannel (see Figures 5-3 and 5-4).

The C aquifer is considered to be a semi-confined to confined aquifer that is relatively permeable. The geometric mean of field slug test estimates of horizontal hydraulic conductivity is 18 feet/day.). The geometric means of field pumping test estimates of transmissivity and storage coefficient are approximately 7,500 ft^2/day and 0.003, respectively. The highest storage coefficient value of the three tests was associated with a test performed in the eastern portion of the manufacturing area in the vicinity of the paleochannel where the B/C aquitard is not present.

5.2.6 C/D Aquitard

The C/D aquitard is described as gray or black, silty clay to clayey silt. This aquitard is interpreted to be part of the Pleistocene Cape May Formation 2.

The thickness of the C/D aquitard ranges from 0 to approximately 20 feet. Although cross-sections A-A’, B-B’, and C-C’ indicate that the C/D aquitard is continuous, there are two primary areas of the site where the unit is either not present or not easily distinguishable. The first is in the Carneys Point area along the Delaware River where there is a large discontinuity in the unit. The second is in the manufacturing area where the underlying D/E aquitard slopes upward to the west such that the C/D aquitard and D aquifer are thin or not distinguishable.

Where the C/D aquitard is of significant thickness, it may restrict the downward flow of groundwater from the C to the D aquifer. One laboratory hydraulic conductivity analysis indicates that vertical hydraulic conductivity is 6.0E-04 feet/day.

5.2.7 D Aquifer

The D aquifer consists of medium sand to poorly sorted, coarse sand with some gravel. The D aquifer was deposited primarily during the Pleistocene and is interpreted as part of the Cape May Formation 2 with some portions interpreted to be the Cretaceous Potomac Formation (MWH, 2010; URS, 2013f).

The thickness of the D aquifer ranges from five to greater than 65 feet with the thicker sections occurring in the eastern and southern portions of the manufacturing area (see Figures 5-3 and 5-4). The D aquifer is thickest where the top of the underlying D/E aquitard dips east-southeast. This structural feature is associated with the Pennsville paleovalley.

The D aquifer is considered to be a semi-confined to confined aquifer. The geometric mean of field slug test estimates of horizontal hydraulic conductivity is 30 feet/day. Field pumping test estimates of transmissivity and storage coefficient are approximately 1,300 ft^2/day and 0.001, respectively.

5.2.8 D/E Aquitard

The D/E aquitard is a dense clay that is red or variegated (red, white, yellow, or gray) in color and easily recognizable at the site. It is the shallowest, continuous Cretaceous unit that has been mapped at the site (Stanford and Sugarman, 2006a and 2006b). This unit consists of a series of stacked paleosols, which originated as floodplain deposits that were part of an anastomosing river system and later consolidated (McKenna et. al., 2004).

The top of the D/E aquitard beneath the site occurs between approximately -40 and -140 feet NAVD88 (see Figures 5-1 and 5-3 through 5-5). The top of the D/E aquitard dips east-southeast with the shallowest elevations occurring on the western boundary of the site along the Delaware River and the deepest elevations occurring near the east-southeastern boundary of the site. The deeper elevations of the D/E aquitard surface are coincident with the Pennsville paleovalley, a larger-scale paleochannel, which is believed to be an abandoned channel of the modern Delaware River with its axis located just east of the site property boundary.

The D/E aquitard ranges in thickness from 20 to 60 feet thick. The D/E aquitard separates the D aquifer from the regional Cretaceous PRM aquifer system. Laboratory hydraulic conductivity analyses indicate that the geometric mean of vertical hydraulic conductivity is 2.2E-05 feet/day, which is one to two orders of magnitude lower than the estimated vertical hydraulic conductivity of the shallower Pleistocene B/C and C/D aquitards at the site.

5.2.9 PRM Aquifer System

The water bearing zones of the Cretaceous PRM aquifer system have been designated as the E and F aquifers beneath the site. The E aquifer is the uppermost interval and consists of fine to medium-grained sand and in some areas, coarse-grained sand. The occurrence of these sands is highly variable (MWH, 2010). In some cases, the section is dominated by clay or poorly developed sand. The elevation of the top of the E aquifer ranges from approximately -70 to -185 feet NAVD88 with a dip to the southeast. Based on borings at the site, the E aquifer is approximately 150 to 200 feet thick.

Beneath the E aquifer is a predominantly silt and clay sequence that may behave as an aquitard between the E and F aquifers. There are limited data at this depth beneath the site, and two distinct hydrologic zones have not been confirmed. Based on limited boring log information, the F aquifer appears to be a well-developed sand interval where present. Bedrock of the Wilmington Complex/Wissahickon Formation was encountered beneath the E and F aquifer interval at an elevation between -415 feet and -505 feet NAVD88.

5.3 Groundwater Flow

Groundwater flow across the site has both horizontal and vertical flow components. As previously discussed, saturated groundwater in the A zone is not considered to be laterally extensive, and A zone groundwater either discharges to surface water or recharges the underlying B aquifer. Groundwater flow in the B aquifer is influenced locally by pumping and containment of the B aquifer (e.g., pumping at the C Landfill and sheet-pile barriers) but more widely by the site-wide IWS pumping in the underlying C and D aquifers. Generally, there are downward gradients from the B to D aquifers; however, near land surface, shallow B aquifer groundwater where less influenced by the IWS has the potential to discharge to local creeks and the Delaware River. The downward gradients are highest near the pumping wells. The intervening aquitards, e.g., B/C and C/D, affect groundwater flow such that the aquifers are less hydraulically connected where an aquitard is thick but potentially behave as a combined aquifer where an aquitard is not present. Even where an aquitard is thick, it is expected that downward leakage through the aquitard can occur.

The D/E aquitard is a relatively thick, continuous, low permeable unit of regional significance. E aquifer groundwater is pumped and contained under a separate program than the IWS pumping in the C and D aquifers. There is a downward gradient from the D to the E aquifer, so leakage through the D/E aquitard can occur; however, the leakage is expected to be very minimal due to the low vertical hydraulic conductivity and significant thickness of the D/E aquitard.

5.3.1 Horizontal Groundwater Flow

Horizontal groundwater flow in the B, C, D, and E aquifers can be approximated by head measurements collected from site monitoring wells. Groundwater maps are prepared semi-annually and published in the DGW report. Water levels were measured in March 2014; this monitoring event included the monitoring wells used in the DGW program and the new monitoring wells installed during the RFI data gap field investigation (see Section 4). There are A zone monitoring wells included in the DGW program associated with a small area of the site (SWMU 5), and a contour map for that area is generated for the DGW report. Site-wide maps are generated for the B through E aquifers and are included here as Figures 5-7 through 5-10 and referenced in the following sub-sections.

B Aquifer

The March 2014 groundwater elevation contour map for the B aquifer is shown in Figure 5-7. The groundwater measurements at wells along the western perimeter are collected during a time as close as possible to mid-tide as predicted from a nearby tidal monitoring station. The surface-water elevation along the Delaware River is estimated as a moving mean average of hourly measurements from a transducer installed adjacent to the manufacturing area. The surface-water elevation for the Salem Canal is estimated from measurements at two staff gauges, one on each side of the Munson Dam. There are other staff gauge measurements at surface-water bodies across the site, which are used for reference when contouring groundwater elevations for the B aquifer.

Along the western site perimeter there are hydraulic gradients toward the Delaware River in three areas: AOC 1 [which is described in more detail in the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report (RASR);* Geosyntec, 2012)], AOCs 2 and 3 (where part of the proposed extension to the sheet pile barrier will be installed; see Figure 2-6), and along the western perimeter of Carneys Point. Inward hydraulic gradients exist along the northern and eastern property boundary. Groundwater elevations within the B aquifer decrease from higher values in the perimeter areas of the site toward the center of the site. In the Carneys Point area, these trends are consistent with groundwater discharge to the Henby and Bouttown Creek wetland areas. In the manufacturing area, this is consistent with the IWS pumping in the underlying C and D aquifers and the thickening of the B aquifer in the central and eastern portions associated with an interpreted paleochannel, which cut into the underlying B/C aquitard and provides a connection from the B aquifer to the C aquifer.

Lower groundwater elevations are regularly observed in the northeast corner of the former basins (near wells H15-M01B and H13-M01A). These groundwater elevations are consistent with the surface-water elevation measured at H16-BM01 and suggest that the controlled water level of the stormwater basin locally influences groundwater elevations in this area. Groundwater elevations are also typically lower near the former A Basin at wells M15-M02B, L15-M01B, and K13-M02B and the southeast corner of Sanitary A Landfill near wells R08-M01B, R09-M01B, and R09-M03B. The depressed water table in these areas is due to the influence of the IWS pumping in the C and D aquifers. Groundwater elevations are also lower within the pumping zone of the P21-R01B and Q20-M02B pumping wells for the Secure C Landfill area.

Finally, in the southern area of the site along the Salem Canal, higher groundwater elevations north of the sheet pile barrier (see Figure 5-7) indicate that the sheet pile barrier is effectively inhibiting groundwater flow from the B aquifer to the Salem Canal. Groundwater modeling performed as part of the sheet pile barrier design indicated that the groundwater diverted to the east would migrate downward through thin zones of the B/C aquitard into the C aquifer where it is captured by the IWS.

C, D, and E Aquifers

The March 2014 groundwater elevation contour maps for the C and D aquifers are shown in Figures 5-8 and 5-9. IWS wells G08-R01C, K06-R02CD, M14-R02CD, and Q13-R01C were actively pumping during the March 2014 groundwater measurement activity. During this time, the total withdrawal from the C and D aquifers was an average of approximately 1 mgd. Hydraulic cones of influence are visible for each pumping well.

Inward gradients for the C and D aquifers (flow onto the site from off-site) are present along the entire manufacturing area perimeter. This indicates that the IWS effectively contains groundwater in the C and D aquifers.

The March 2014 groundwater elevation contour map for the E aquifer is shown in Figures 5-10. Well J05-W01E was actively pumping during the March 2014 groundwater measurement activity. Groundwater in the E aquifer across the site flows toward this pumping well, which has a measured hydraulic head value of approximately -60 feet NAVD88 when the pump is on. In 2009, the J05-W01E pump was off for approximately one year. During that time, hydraulic head in the J05 area was approximately -45 feet NAVD88; the lack of complete recovery of hydraulic head in the E aquifer indicates that the aquifer is influenced by regional pumping of the PRM aquifer system. Also, in March of 2010, the J05-W01E pump was on but the pump for the K06-R02CD, which is an IWS pumping well in the C and D aquifers, was off. During this time, the measured hydraulic head in the C and D aquifer recovered nearly completely, which suggests that pumping in the E aquifer does not significantly affect hydraulic head in the C or D aquifers.

5.3.2 Vertical Leakage and Groundwater Flow

While the groundwater elevation contour maps indicate the general directions of horizontal groundwater flow, there are hydraulic head differences between the aquifers (from pumping) that indicate a potential for downward leakage through the aquitards or a direct groundwater flow connection between the aquifers where the aquitards are not present. For example, Figure 5-11 shows the difference between the hydraulic head in the B and C aquifers for the March 2014 round of measured water levels. The largest head differences between the B and C aquifers occur around the three pumping centers (G08, K06, and M14). This figure demonstrates the site-wide extent that the IWS pumping in the C and D aquifers has the potential to draw water from the B aquifer downward into the C aquifer.

Downward vertical hydraulic gradients are prevalent across the site, especially in the proximity of a pumping well. However, with a relatively thick section of aquitard between two aquifers, the vertical leakage or flow component may be limited. For example, in the central portion of the manufacturing area for the B and C aquifers, there are relatively large differences in hydraulic head near the pumping wells in the C and D aquifers (see Figure 5-11); but, with a relatively thick B/C aquitard in this area (see Figure 5-6), the vertical flow component may not be significant. To assess horizontal and vertical flow components as sources and sinks to aquifers, the site-wide groundwater flow model was used to estimate the water budget for the site. The following section presents that analysis.

5.4 Numerical Groundwater Model and Flow Budget Analysis

A site-wide groundwater flow model was created in 1989 and updated in 1993 and 2006 as documented in the Groundwater Modeling Report (Geotrans, 2006), which was included in Appendix H of the First Semester DGW report (DuPont CRG, 2007d). The site-wide model covers an area of 27,500 feet by 28,000 feet and is discretized into 276 rows and 272 columns with a variable cell size ranging from 50 by 50 feet up to 250 by 250 feet. The model consists of nine layers, one for each of the aquifers B through F and one for each of the intervening aquitards. The model is three-dimensional in that it incorporates the variable surfaces of each layer and then uses a variable layer thickness.

The modeled hydraulic conductivity is relatively simplistic for the site as there are approximately three to four zones of hydraulic conductivity for the aquifers and one to two zones of hydraulic conductivity for the aquitards. This is reasonable for simulation of bulk flow through the site-scale aquifers and aquitards with generalized connections and surface water boundary conditions. The pumping wells at the site were incorporated into the model, and the model simulations were compared to potentiometric surface maps for the site with fairly good agreement for the B and C aquifers. The calibration for the D aquifer was optimized by increasing the vertical hydraulic conductivity of the D/E aquitard in some areas to 10^{-3} and 10^{-4} feet/day, which are one to two orders of magnitude higher than estimated values from laboratory analyzed samples. The impact to the model is that while the predicted hydraulic head in the D aquifer is reasonable as compared to observed hydraulic head, the predicted hydraulic head in the E aquifer is too high as compared to observed hydraulic head. The model allows for an excess of groundwater flux through the D/E aquitard, which is likely to be unrealistic. In summary, the model estimates hydraulic heads for the B through D aquifers that are close to observed values but does not produce reasonable estimates for the E aquifer.

Since the last model re-calibration in 2006, changes to the stratigraphy based on additional field investigation data in the manufacturing area, specifically discontinuities identified in the B/C aquitard, were incorporated into the model. These changes did not affect the quality of the model calibration but allowed the model to provide a more realistic simulation of the flow between the B and C aquifers where the B/C aquitard is not present. Also, since the last model re-calibration in 2006, the IWS system was evaluated and optimized as described in Appendix H of the 2007 First Semester DGW report (DuPont CRG, 2007d) and the *IWS Optimization Project Data Compendium and Review* (URS, 2010c).

To demonstrate the bulk groundwater flow characteristics at the site, the United States Geological Survey modeling algorithm, Zonebudget, was used to assign zones in the existing MODFLOW groundwater flow model and estimate the flow rates from one zone to another. The site was divided into the Carneys Point area and the manufacturing area so that the groundwater flow components for each area could be assessed separately.

Figure 5-12 shows how the zones were assigned and provides a summary of the estimated flow rates predicted by the model between the zones.

5.4.1 B Aquifer

For Carneys Point, groundwater entering the B aquifer includes infiltration from rainfall, surface water from the Delaware River, and aquifer areas off-site to the north and east. Infiltration from precipitation accounts for approximately 94% of the recharge. Groundwater leaving the B aquifer includes discharge to creeks, flow into the manufacturing area, and downward flow into the C aquifer. The groundwater discharge to creeks accounts for 93% of the discharge.

For the manufacturing area, groundwater entering the B aquifer includes infiltration from rainfall and non-contact cooling water discharge into ditches, surface water from the Delaware River, and from aquifer areas off-site to the south and east. Infiltration from precipitation and cooling water accounts for approximately 86% of the recharge. Groundwater leaving the B aquifer includes discharge to areas along the Delaware River (as consistently identified in many site studies, most notably the RASR for AOCs 1, 2, and 3), discharge to creeks, basins, and the Salem Canal, and downward flow into the C aquifer. Approximately 60% of groundwater in the B aquifer in the manufacturing area is moving into the C aquifer.

5.4.2 C Aquifer

For Carneys Point, groundwater entering the C aquifer includes recharge from the B aquifer and aquifer areas off-site to the west, north, and east. Groundwater leaving the C aquifer includes flow into the manufacturing area and downward flow into the D aquifer.

For the manufacturing area, groundwater entering the C aquifer includes recharge from the B aquifer and aquifer areas off-site to the west, south, and east. Groundwater leaving the C aquifer includes groundwater extraction from pumping wells and downward flow into the D aquifer. Approximately 80% of groundwater in the C aquifer is extracted by pumping wells and 20% moves into the D aquifer.

5.4.3 D Aquifer

For Carneys Point, groundwater entering the D aquifer includes recharge from the C aquifer and aquifer areas off-site to the west, north, and east. Groundwater leaving the D aquifer includes flow into the manufacturing area and downward flow into the E aquifer.

For the manufacturing area, groundwater entering the D aquifer includes recharge from the C aquifer and aquifer areas off-site to the west, south, and east. Groundwater leaving the D aquifer includes groundwater extraction from pumping wells and downward flow into the E aquifer. Approximately 70% of groundwater in the D aquifer is extracted by pumping wells and 30% moves into the E aquifer; however, as noted in the groundwater model introduction, the model likely overestimates the amount of groundwater moving from the D to the E aquifer.

5.4.4 E Aquifer

For both Carneys Point and the manufacturing areas, groundwater entering the E aquifer includes recharge from the D aquifer and aquifer areas off-site to the west. Recharge from aquifer areas off-site account for approximately 80% of the recharge. Groundwater leaving the E aquifer includes groundwater extraction from pumping wells and downward flow into the F aquifer.

5.4.5 Summary

Overall, the largest source to groundwater recharge for both the Carneys Point and manufacturing areas is infiltration from precipitation. The largest sink to groundwater in Carneys Point is discharge to creeks while the largest sink to groundwater in the manufacturing area is the IWS pumping wells and the E aquifer groundwater extraction well.

6.0 Carneys Point SWMUs Constituent Characterization and Conceptual Model

There are 28 SWMUs located in the Carneys Point area (see Figure 2-2). A detailed summary of investigation and remedial activities along with other information associated with each SWMU are provided in the fact sheets (see Appendix A). This section provides a high level summary of the data collected as part of separate SWMU investigations in the Carneys Point area as well as additional groundwater data collected as part of one-time sampling or on-going monitoring programs. Additionally, the surface-water, sediment, and interstitial water data collected as part of on-site ecological investigations are presented. Together, these data were used to characterize the nature and extent of impacts, develop a conceptual model for the Carneys Point area, and demonstrate that the RFI for Carneys Point SWMUs is complete. The conceptual model described at the end of this section refers to the characterization of constituents with exceedances in different media and an identification of potential migration pathways. Information from the Carney’s Point conceptual model is incorporated into the site-wide CSM presented in Section 8 to provide a framework for understanding potential receptors, COPCs, and potential sources and pathways.

6.1 Carneys Point Vadose Zone Soil

A list of the Carneys Point SWMUs, a summary of their RFI status, and information on soil data are provided in Table 6-1. The soil datasets consist of data collected as part of historical SWMU investigations. Table 6-1 provides a summary of constituents that exceeded soil criteria as documented in the SWMU fact sheets. Comparison criteria used at the time of each SWMU investigation are cited. In addition to the soil exceedances documented in the fact sheets, the soil datasets were compared to NJNRDCSRS and NJIGWSRS (both effective since 2008). Tables are provided by SWMU in Appendix C.1. A comparison of these tables with the fact sheets confirmed that no significant deviations between the historical screening and the current screening were found. Therefore, the findings and recommendations made for the SWMUs in past RFI phases based on soil sampling are still valid.

Figures were developed to demonstrate the locations where detected constituents exceeded NJNRDCSRS. While there are potentially multiple exceedances at each location, these figures provide a visualization of the spatial distribution of exceedances in Carneys Point soil. Soil data results indicate that the majority of exceedences for the Carneys Point area are associated with SWMU 45-2. Figure 6-1 indicates that the number of locations where SVOC exceedances occurred was 16 out of 82 total locations, and all except one are associated with SWMU 45-2. Figures 6-2 and 6-3 (a close-up view of SWMU 45-2) indicate that the number of locations where metal exceedances occurred was 77 out of 131 total, and all exceedances except four are associated with SWMU 45-2. There were no exceedances for VOCs or pesticides/total PCBs at any locations, so no figures are provided.

The primary constituents with exceedances of NJNRDCSRS related to SWMU 45-2 include: arsenic, lead, five polycyclic aromatic hydrocarbons (PAHs) and 2,4-DNT (see Appendix C.1).

6.2 Carneys Point Groundwater

Groundwater at Chambers Works is evaluated on a site-wide basis but is presented here for the Carneys Point area. The groundwater dataset consists of both one-time sampling at hydropunch locations and the most recent round of sampling at each monitoring well as part of historical SWMU, perimeter and C Landfill investigations or to fulfill the objectives of monitoring programs. A summary of groundwater sampling results are provided in Appendix C.2 by aquifer for VOCs, SVOCs, metals (total and filtered) and inorganics, and pesticides/PCBs across the Carneys Point area as a whole. NJGWIIA were used for comparison, and constituents that exceeded their criterion were identified. In these tables, the maximum detections are shown for data ranging from 1990 to the present. This approach provides a comprehensive summary of the nature and extent of groundwater impacts both past and present, which have supported SWMU investigations and the monitoring required across the Carneys Point area.

Figures were developed to demonstrate the locations where detected constituents exceeded NJGWIIA. The constituent with the maximum exceedance factor (maximum detected concentration divided by the criterion) is shown at each location. Figures 6-4 through 6-11 indicate locations with exceedances for the B and C aquifers for VOCs, SVOCs, metals (total), and pesticides/PCBs. Because exceedances shown in the area south of Henby Creek are more likely related to past practices in the manufacturing area, the area south of Henby Creek is discussed in Section 7 as part of the manufacturing area groundwater discussion. Figures were not developed for the D and E aquifers because there was a limited number of detections and exceedances for these aquifers and these exceedances are primarily related to the manufacturing area (and are considered in Section 7). Otherwise, in general, the primary impacts to B and C aquifer groundwater are metals; specifically, the metals that most frequently exceeded GWIIA to the highest degree are arsenic and lead. The following text provides a summary of exceedances by specific area and aquifer with an emphasis on constituents that are indicated on the figures.

- Perimeter along Delaware River (including SWMU 45-2 area):
    - B aquifer. Limited locations of VOC and SVOC exceedances including tetrachloroethene (PCE) and bis(2-ethylhexyl)phthalate. Metal exceedances include arsenic and lead.
    - C aquifer. Limited locations of VOC and SVOC exceedances including 1,2-dichloroethane (DCA), n-nitrosodimethylamine, and bis(2-ethylhexyl)phthalate. Metal exceedances include iron and manganese.
- Perimeter along north and east property boundary:
    - B aquifer. No VOC or SVOC exceedances. Metal exceedances include aluminum and lead.

  - C aquifer. Limited locations of VOC exceedances including PCE. No SVOC exceedances. Metal exceedances include iron.

- C Landfill area:
  - B aquifer. Limited locations of VOC and SVOC exceedances including benzene and aniline. Metal exceedances include aluminum, iron, and manganese.
  - C aquifer: no sampling or monitoring.
- Other interior areas (related to sampling for SWMUs and monitoring)
  - B aquifer. Limited locations of VOC and SVOC exceedances including TCE, benzo(a)anthracene, and bis(2-ethylhexyl)phthalate. Metal exceedances include aluminum, antimony, cadmium, chromium, iron, and manganese.
  - C aquifer. Limited locations of VOC and SVOC exceedances including methylene chloride. Metal exceedances include iron.

Further consideration of exceedances in groundwater will be presented in Section 6.4 in conjunction with the identification of potential migration pathways, the surface water, sediment/hydric soil and sediment interstitial water investigation results, and corrective actions/monitoring activities performed for site-wide groundwater.

6.3 Carneys Point Surface-Water, Sediment/Hydric Soil, and Sediment Interstitial Water

Surface-water, sediment/hydric soil, and sediment interstitial water sampling were performed as part of the RFI program and follow-on investigations that specifically evaluated constituents of potential ecological concern (COPECs). The reports, *Summary of Ecological Investigations in Carneys Point* (URS, 2010b) and *Ecological Investigation Report* (DuPont CRG, 2009), provide a comprehensive account of the historical and more recent investigations of on-site surface water, sediment/hydric soil, and sediment interstitial water, as well as the ecological risk evaluations and conclusions. This section presents a summary of the results and identifies COPECs. Follow-on ecological risk evaluations are presented in Section 8. Off-site surface-water and sediment investigations related to potential migration pathways between impacted media on-site and the Delaware River and Salem Canal were conducted separately (refer to Section 2.4 for reference documents).

Surface-water and/or sediment/hydric soil samples were collected from the following features in Carneys Point: Bouttown Creek, Henby Creek (SWMU 42), Helms Basin, Bouttown Creek Wetlands, Henby Creek Wetlands, A Pond, E Pond, Historical B Pond, and Historical E Pond at specific locations shown in Figure 6-12 (DuPont CRG, 2006a; DuPont CRG, 2009; URS, 2010b). In addition, sediment interstitial water sampling was conducted in Bouttown Creek, Henby Creek, and the Bouttown Creek Wetlands (see Figure 6-12). Sampling areas and locations were based on an evaluation in the site-wide BEE (DuPont CRG, 2006b) of the co-occurrence of COPECs, environmentally sensitive natural resources (ESNRs) and potential migration pathways from the site to ESNRs. Potential migration pathways included historical process discharges, stormwater runoff, and a potential groundwater to surface-water connection from the B aquifer to surface-water bodies.

For the Ecological Investigation conducted during 2007 through 2008, historical sediment, surface-water, soil, and groundwater data were compared to ecological screening criteria (DuPont CRG, 2009). Constituents with concentrations in historical datasets exceeding ecological screening criteria in any medium were identified as preliminary COPECs and included the following:

Semi-Volatile Organic Compounds:

2,4-dinitrotoluene	bis(2-ethylhexyl)phthalate	N-nitrosodiphenylamine

Nitroaromatics/Nitroamines: Nitrocellulose

Polycyclic Aromatic Hydrocarbons (PAHs):

Acenaphthene	Acenaphthylene	Anthracene
Chrysene	Fluoranthene	Fluorene
Naphthalene	Phenanthrene	Pyrene
Benzo(k)fluoranthene	Benzo(b)fluoranthene	Benzo(a)pyrene
Benzo(a)anthracene	Benzo(g,h,i)perylene	Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene		

Metals:

Antimony	Arsenic	Cadmium
Chromium	Copper	Lead
Mercury	Nickel	Selenium
Silver	Vanadium	Zinc

Additionally, one sediment sample (BC-2) was analyzed for VOCs, SVOCs, TAL metals, PCBs, and TPH. For the T29 sediment investigation conducted in 2008, analysis included PCBs, SVOCs, and TAL metals. For the Bouttown Creek ditch sediment investigation conducted later in 2009, selected analytes included metals and SVOCs. Surface-water samples were collected from the mid-water column at co-located sediment sampling stations. Sediment samples analyzed for non-volatile constituents were collected from 0 to 6 inches; samples analyzed for volatile constituents were collected from 6 to 12 inches, as prescribed by NJDEP sediment guidance (NJDEP, 1998; NJDEP, 2012). Sediment interstitial water samples were analyzed for metals identified as COPECs in the 2007-2008 Ecological Investigation (DuPont CRG, 2009).

Surface-water data from the various phases of investigation were used to identify COPECs for surface water. The following screening criteria (current during each respective phase of the investigation) were used as the primary ecological benchmark concentrations to identify COPECs for surface water:

- New Jersey Surface Water Quality Standards (NJSWQS) – freshwater chronic aquatic life protection criteria (NJDEP, 2008)
- National Recommended Water Quality Criteria (NRWQC) – freshwater chronic criteria for protection of aquatic life (EPA, 2006)

- For constituents lacking NJSWQS or NRWQC, alternative sources of screening criteria were identified. These alternative sources of surface-water screening criteria included the following:
  - EPA Tier II freshwater secondary chronic values (SCV) (Suter and Tsao, 1996)
  - Minimum Lowest Chronic Values (LCV) for fish, daphnids, non-daphnid invertebrates, and aquatic plants (Suter and Tsao, 1996)
  - Literature-derived No Observed Effect Concentrations (NOECs) for constituents lacking established criteria from the above sources

Sediment data from the various phases of investigation were used to identify COPECs for sediment. Ecological benchmark concentrations for metals were based on the greater value of the ecological screening value and the 95th percent upper tolerance limit (UTL_{95}) background concentration established for the Ecological Investigation (DuPont CRG, 2009). For metals lacking an ecological screening value, the ecological benchmark concentration was represented by the background UTL_{95} concentration. For organic constituents, ecological benchmark concentrations were selected from available ecological screening values.

Ecological screening values for sediments were identified primarily from sources recommended by NJDEP in its Ecological Screening Criteria (ESC) Table (NJDEP, 2009):

- Ontario Ministry of the Environment Lowest Effects Levels (LEL) for freshwater sediment-dwelling organisms
- Effects Range-Low (ER-L) concentrations for marine/estuarine organisms

For organic constituents without LELs or ER-Ls, alternative sediment screening concentrations were used. These included benchmarks developed using the equilibrium partitioning (EqP) approach, which assumes that the partitioning of the chemical between sediment organic carbon and interstitial water is stable at equilibrium. In addition, Apparent Effects Threshold (AET) values [National Oceanographic and Atmospheric Administration (NOAA), 2006] were used for some organic compounds. For EqP and AET concentrations, organic-carbon normalized screening values were adjusted based on the minimum TOC measurement for each aquatic exposure area to conservatively account for site-specific bioavailability.

COPECs were identified in sediment interstitial water if maximum concentrations (filtered) exceeded ecological screening values for the general protection of aquatic life:

- NJSWQS – freshwater chronic aquatic life protection criteria (NJDEP, 2008)
- NRWQC – freshwater chronic criteria for protection of aquatic life (EPA, 2006)

Given that the NJSWQS and NRWQC are developed for the protection of aquatic life and not specifically for exposure to benthic invertebrates, these criteria represent conservative benchmarks for comparison with sediment interstitial water.

The following sections summarize the results of surface-water, sediment/hydric soil, and sediment interstitial water sampling in ecological exposure areas identified in Carneys Point. Only constituents detected in at least one sample within a given exposure area are presented in summary tables and evaluated. Summary data tables are provided in Appendix C.3.

6.3.1 Helms Basin Surface Water and Sediment

Helms Basin is located adjacent to the Delaware River at the northern most part of Carneys Point (see Figure 6-12). Prior to the diversion of Bouttown Creek to Henby Creek in 1974, Bouttown Creek discharged to the Delaware River via Helms Basin.

The results of surface-water sampling conducted in 2007 as part of the Ecological Investigation did not indicate any surface-water COPECs in Helms Basin (DuPont CRG, 2009). Five metals were detected in surface water; however, maximum concentrations of the metals in filtered samples were below NJSWQS or Tier II SCVs (see Table C.3-1 in Appendix C).

Nickel was the only constituent identified as a COPEC in Helms Basin sediment (see Table C.3-2 in Appendix C). The maximum concentration of nickel [38.6 milligrams per kilogram (mg/kg)] slightly exceeded the background UTL_{95} concentration (36.8 mg/kg). The maximum concentration of benzo(ghi)perylene exceeded its ecological screening value; however, the maximum concentration of total polycyclic aromatic hydrocarbons (tPAHs) was lower than the LEL. tPAHs were not identified as sediment COPECs.

6.3.2 Bouttown Creek Surface Water, Sediment, and Interstitial Water

Bouttown Creek originates east of the site near the town of Carneys Point. Stormwater from Carneys Point Township enters the creek off-site and is regulated by a township-operated pump house located near the DuPont property line (see Figure 6-12). Prior to 1974, Bouttown Creek discharged to the north through a sluice gate to the Delaware River via Helms Basin. In 1974, the original point of discharge in Bouttown Creek was cut off and filled; flow in Bouttown Creek was then diverted to Henby Creek to the south via a constructed channel.

Based on the evaluation of surface-water, sediment, and sediment interstitial water data collected through the completion of the Ecological Investigation in 2007, the following COPECs were identified in Bouttown Creek:

- Surface Water: No COPECs were identified in surface-water samples collected from Bouttown Creek. Lead and mercury were detected in unfiltered surface-water samples; however, only mercury was detected in filtered samples. Concentrations of mercury in filtered samples were below the NJSWQS (see Table C.3-3 in Appendix C).
- Sediment: Thirteen metals, tPAHs, tPCBs, n-nitrosodiphenylamine, 2,4-DNT, and nitrocellulose were identified as sediment COPECs in Bouttown Creek (see Table C.3-4 in Appendix C).
- Sediment interstitial water: No COPECs were identified in sediment interstitial water samples collected within Bouttown Creek (see Table C.3-5 in Appendix C).

Arsenic and chromium were detected in one of three samples at concentrations below NJSWQS.

The findings of the Ecological Investigation indicated that maximum concentrations of 11 of 12 metals and multiple organic COPECs in the Bouttown Creek exposure area were associated with the ditches draining upland areas of Carneys Point to Bouttown Creek (DuPont CRG, 2009). Further investigations were conducted in October 2009 to evaluate the bioavailability and toxicity of metal and organic COPECs in the ditches. A summary of the sediment and sediment interstitial water results for the additional sampling in the Bouttown Creek ditches are presented in Tables C.3-6 and C.3-7 in Appendix C, respectively. The findings of the investigation support the following conclusions regarding metal and organic constituent bioavailability and toxicity in the ditches (URS, 2010):

- Based on simultaneously extractable metals (SEM) and acid volatile sulfide (AVS) measurements in sediment and analyses of metals in sediment interstitial water, the bioavailability and toxicity of metal COPECs in ditch sediment are limited by binding to TOC and AVS.
- Based on EqP models, the site-specific bioavailability and toxicity of organic COPECs are limited by the high binding capacity of TOC in sediment.

6.3.3 Henby Creek Surface Water, Sediment, and Interstitial Water

Henby Creek originates off-site and traverses southeast to northwest, south of the former Carneys Point Works (see Figure 6-12). Henby Creek, which has received discharge from Bouttown Creek since 1974, represents the primary surface-water drainage pathway from Carneys Point. Henby Creek discharges to the Delaware River via a sluice gate.

Based on the evaluation of surface-water and sediment data collected through the completion of the Ecological Investigation in 2007, the following COPECs were identified in Henby Creek:

- Surface Water: No COPECs were identified in surface-water samples collected from Henby Creek. Lead and mercury were not detected in unfiltered or filtered surface-water samples.
- Sediment: Six metals, n-nitrosodiphenylamine, and 2,4-DNT were identified as sediment COPECs in Henby Creek (see Table C.3-8 in Appendix C).
- Sediment Interstitial Water: Cadmium was identified as a COPEC in sediment interstitial water in Henby Creek (see Table C.3-9 in Appendix C). Arsenic, chromium, and nickel were detected in interstitial water at concentrations below NJSWQS.

6.3.4 Carneys Point Ponds Surface Water and Sediment

The Carneys Point ponds were associated with the former operations of the former Carneys Point Works. The following sections summarize analytical sampling results from A Pond and the Domestic Water Pond (E Pond) to evaluate potential constituent pathways from former manufacturing processes in Carneys Point to surface water and sediment in the ponds.

A Pond

A Pond was historically used to sequester acid fumes produced during the manufacture of nitrocellulose in adjacent SWMU 45-2. Based on the evaluation of surface-water and sediment data collected during the Ecological Investigation, the following COPECs were identified for A Pond (DuPont CRG, 2009):

- Surface Water: Six metal COPECs were identified in surface-water samples collected from A Pond: cadmium, copper, lead, nickel, selenium, and zinc (see Table C.3-10 in Appendix C).
- Sediment: Arsenic, copper, selenium, silver, and tPAHs were identified as sediment COPECs in A Pond (see Table C.3-11 in Appendix C).

E Pond (Domestic Water Pond)

E Ponds were historically used as part of the water supply process for the former Carneys Point Works. The Domestic Water Pond (E Pond) was divided into two sections by a wooden bulkhead. Water from supply wells in Carneys Point was pumped into the eastern section to allow iron to precipitate. After settling had occurred, water was pumped to the western section of the pond for future use (DuPont CRG, 2006a).

Based on the evaluation of surface-water and sediment data collected during the Ecological Investigation, the following COPECs were identified for the Domestic Water Pond:

- Surface Water: No COPECs were identified in surface-water samples collected from the Domestic Water Pond. Copper was the only constituent detected in filtered samples; however, the maximum concentration of copper in filtered samples was lower than the NJSWQS protective of aquatic life (see Table C.3-12 in Appendix C).
- Sediment: Cadmium, copper, mercury, nickel, n-nitrosodiphenylamine, and tPAHs were identified as sediment COPECs in the Domestic Water Pond (see Table C.3-13 in Appendix C).

6.3.5 Carneys Point Wetlands Sediment/Hydric Soil and Interstitial Water

Potential wetland habitats are abundant along Henby Creek and Bouttown Creek in the Carneys Point area. In addition, historical ponds (B Pond and E Pond) in Carneys Point are currently vegetated through the accretion of sediments and surrounding wetland vegetation. Concentrations of site-related constituents were characterized in sediment/hydric soils in potential wetland areas adjoining Bouttown and Henby Creeks and historical ponds in Carneys Point as part of the 2007 Ecological Investigation (DuPont CRG, 2009).

Bouttown Creek Wetlands

Sediment/hydric soil and interstitial water samples were collected from six sampling locations in the wetland areas surrounding Bouttown Creek. Based on the evaluation of sediment/hydric soil and interstitial water data, the following COPECs were identified for the Bouttown Creek Wetlands:

- Sediment/hydric Soil: Eight metals, n-nitrosodiphenylamine, 2,4-DNT, and nitrocellulose were identified as sediment COPECs based on maximum detected concentrations exceeding ecological benchmark concentrations (see Table C.3-14 in Appendix C); antimony and vanadium were also identified as COPECs because ecological benchmark concentrations were not available for these metals.
- Sediment/hydric soil Interstitial Water: Cadmium, copper, lead, vanadium, and zinc were identified as COPECs in sediment/hydric soil interstitial water; arsenic, chromium, mercury, and nickel were detected in interstitial water from at least one sample at concentrations below NJSWQS or NRWQC (see Table C.3-15 in Appendix C).

Henby Creek Wetlands

Sediment/hydric soil data were collected from four samples locations in the wetland area surrounding Henby Creek. Nine metals were identified as COPECs based on maximum detected concentrations exceeding ecological benchmark concentrations (see Table C.3-16 in Appendix C); antimony and vanadium were also identified as COPECs because ecological benchmark concentrations were not available for these metals. Nitrocellulose was the only organic constituent detected in sediments/hydric soils in the Henby Creek Wetlands; however, the maximum concentration was lower than the conservative NOEC screening value identified for nitrocellulose.

Historical B Pond

Historical B Pond was used to sequester acid fumes produced during the manufacture of nitrocellulose in adjacent SWMU 45-2. Based on the evaluation of sediment/hydric soil data obtained from Historical B Pond during the 2007 Ecological Investigation, arsenic, mercury, tPAHs, and nitrocellulose were identified as COPECs (see Table C.3-17 in Appendix C); exposure to antimony was also identified as a COPEC because an ecological benchmark concentration was not available for exposure to sediment/hydric soils.

Historical E Pond (Fire Water Pond/Settling Basin)

Based on the evaluation of sediment/hydric soil data from the historical Fire Water Pond and Settling Basin, nitrocellulose was the only COPEC identified based on maximum detected concentrations exceeding the conservative ecological benchmark concentration (see Tables C.3-18 and C.3-19, respectively, in Appendix C).

6.4 Carneys Point Summary and Conceptual Model

The following text provides an integrated summary of the RFI results for Carneys Point. This conceptual model provides the characterization of constituents with exceedances in different media and identifies potential migration pathways. Section 8 will present the CSM, which defines complete pathways to potential human and ecological receptors on a site-wide basis.

6.4.1 Soil

The Carneys Point SWMU investigations focused on characterizing the nature and extent of impacts to soil. Table 6-1 summarized the RFI status of SWMUs, description of vadose zone soil tables, and exceedances of soil standards. In cases where a SWMU recommendation was based on the identification of exceedances as compared to older criteria, the data were re-screened against the most recent criteria, i.e., NJNRDCSRS and NJIGWSRS. Minor deviations were identified for some SWMUs, but those deviations do not change the RFI recommendations made during the SWMU investigations. Impacted soil at SWMUs 13 (Cell 1), 19, 45-3, 45-4, 45-8, 48-2, 48-4, and 52 was remediated or otherwise addressed to prevent further impacts to groundwater and exposure to potential receptors (see Section 2.5.1 and the fact sheets). An exposure assessment is provided in each SWMU fact sheet. Remaining exceedances of criteria for soil were mainly metals (arsenic and lead) and limited SVOCs associated with the SWMU 45-2 area (see Table 6-1). SWMU 45-2 has been fully characterized and was recommended for a CMS in the *Interior Investigation Technical Memorandum* (URS, 2013b).

6.4.2 Groundwater

The Carneys Point groundwater dataset consists of both one-time sampling at hydropunch locations and the most recent round of sampling at each monitoring well as part of historical SWMU, perimeter and C Landfill investigations or to fulfill the objectives of monitoring programs. This approach provides a comprehensive summary of the nature and extent of groundwater impacts both past and present, which have supported SWMU investigations and the monitoring required across the Carneys Point area. Exceedances of NJGWIIA were identified and were holistically summarized for four areas across Carneys Point. There are no groundwater plumes, and exceedances are sporadic and localized. In general, the primary impacts to B aquifer groundwater are metals; specifically, the metals that most frequently exceeded NJGWIIA are arsenic and lead.

6.4.3 Potential Migration Pathways

Along the site perimeter with the Delaware River, groundwater potentiometric monitoring of the B aquifer indicates that generally there are inward hydraulic gradients except in the area of SWMU 45-2; however, B aquifer groundwater locally may have the potential to migrate off-site to the Delaware River. There are inward gradients along the northern and eastern perimeters of Carneys Point. Across Carneys Point, B aquifer groundwater has the potential to discharge to on-site surface-water bodies.

A comprehensive on-site ecological evaluation was completed by reviewing the existing data from the various phases of the RFI including the identification of potential migration pathways. Surface-water and sediment sampling areas and locations were based on an evaluation in the site-wide BEE (DuPont CRG, 2006b) of the co-occurrence of COPECs, ESNRs and potential migration pathways from the site to ESNRs. Potential migration pathways included historical process discharges, stormwater runoff, and a potential groundwater to surface-water connection from the B aquifer to surface-water bodies. Based on the on-site ecological investigation, the COPECs that were identified for surface water, sediment/hydric soil, and sediment interstitial water in this section were carried forward for ecological risk evaluations, which are presented in Section 8.

A comprehensive off-site ecological evaluation was completed to address the potential groundwater to surface-water connection along the Delaware River (in addition to other potential migration pathways to the Delaware River and its shoreline) (URS, 2009). This investigation included the areas adjacent to Carneys Point. The findings of the multi-phase investigation concluded that concentrations in sediment and surface water were not elevated relative to refined sediment and surface-water quality benchmarks established for areas adjacent to Carneys Point.

6.4.4 Additional Potential Groundwater Migration Pathways

B aquifer groundwater also has the potential to migrate downward into the C aquifer. Groundwater exceedances of NJGWIIA in the C aquifer were identified at a small number of locations across Carneys Point. Likewise, there are downward hydraulic gradients from the C and D aquifers to the D and E aquifers, respectively. However, D and E aquifer exceedances are very limited in number of constituents and locations of exceedances. Groundwater in the C, D, and E aquifers moves generally from the Carneys Point area toward the manufacturing area. Groundwater exceedances of NJGWIIA located along the boundary area between the manufacturing area and Carneys Point are incorporated in the analysis of the manufacturing area presented in Section 7.

6.4.5 Carneys Point RFI Complete

Based on the information provided in this RFI report text, tables, and figures and supported by more detailed information in the fact sheets and referenced documents, the RFI for Carneys Point is complete. All of the Carneys Point SWMUs have been fully investigated, the nature and extent of their impacts have been characterized, remediation has been performed as recommended, and RFI recommendations have been substantiated. Groundwater is evaluated on a site-wide basis. For the Carneys Point area, the impacts to groundwater have been characterized. Groundwater at the site is part of the site-wide CEA and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place. The containment and monitoring programs will continue to be documented in the semi-annual DGW reports.

7.0 Manufacturing Area SWMUs/AOCs Constituent Characterization, DNAPL Evaluation, and Conceptual Model

There are 68 SWMUs and 11 AOCs located in the manufacturing area as shown in Figures 2-3 and 2-4. As mentioned in Section 2, six SWMUs are not considered in this report (SWMUs 18, 23, 24, 27, and 29 are RCRA Part B operating units and SWMU 33 is being investigated by the USACE due to historical Manhattan Project activities). A detailed summary of investigation and remedial activities along with other information associated with each SWMU and AOC is provided in the fact sheets (see Appendix A).

This section provides a high level summary of the data collected as part of the SWMU and AOC investigations in the manufacturing area as well as additional groundwater data collected as part of on-going monitoring programs. The surface-water and sediment data collected as part of on-site ecological investigations are presented, and site-wide PFOA/PFCs sampling and monitoring results are provided. Additionally, evidence of DNAPL is evaluated and conceptual models for the manufacturing area are presented. Together, these data and evaluations were used to characterize the nature and extent of impacts, provide a summary conceptual model for the manufacturing area of Chambers Works, and demonstrate that the RFI for the manufacturing area SWMUs and AOCs is complete. The conceptual model described at the end of this section refers to the characterization of constituents with exceedances in different media, identification of significant sources to groundwater, and identification of potential migration pathways. Information from the manufacturing area conceptual model is incorporated into the site-wide CSM presented in Section 8 to provide a framework for understanding potential receptors, COPCs, and potential sources and pathways.

7.1 Manufacturing Area Vadose Zone Soil

A list of the manufacturing area SWMUs and AOCs, a summary of their RFI status, and information on soil data are provided in Tables 7-1 and 7-2. The soil datasets consist of data collected as part of separate SWMU investigations as well as the AOC investigations after the PAR. Table 7-1 provides a summary of constituents that exceeded soil criteria as documented in the SWMU fact sheets. The soil data in the manufacturing area were compiled by AOC such that all SWMU data within the boundary of an AOC (or within SWMU 8) are included as appropriate. Soil data associated with a SWMU that is outside of an AOC boundary were compiled by SWMU. Summary tables of soil data compared to the current NJNRDCSRS and NJIGWSRS (both effective since 2008) are provided in Appendix C.1. A comparison of these tables with the SWMU fact sheets confirmed that no significant deviations between the historical screening and the current screening were found. Therefore, the findings and recommendations made for the SWMUs in past RFI phases based on soil sampling are still valid. Table 7-2 provides a summary of the AOCs, the SWMUs located within their boundaries, and the constituents that exceeded NJNRDCSRS as documented in the AOC fact sheets.

Figures were developed to demonstrate the locations where detected constituents exceeded NJNRDCSRS. While there are potentially multiple exceedances at each location, these figures provide a visualization of the spatial distribution of exceedances in the manufacturing area soil.

Figure 7-1 indicates that the number of locations where VOC exceedances occurred was 54 out of 432 total locations. The largest number of exceedances is located in the SWMU 8 areas, with other exceedances located sporadically across the manufacturing area.

Figure 7-2 indicates that the number of locations where SVOC exceedances occurred was 173 out of 389 total locations. Exceedances of SVOCs occurred throughout the manufacturing area with less frequency in AOCs 3, 8, 9, and 10.

Figure 7-3 indicates that the number of locations where metal exceedances occurred was 129 out of 400 total locations. Exceedances for metals occurred throughout the manufacturing area with less frequency in AOCs 8, 9, and 10.

Figure 7-4 indicates that the number of locations where pesticide/PCB exceedances occurred was 19 out of 188 total locations. Exceedances for pesticides/PCBs were predominantly in AOCs 1 and 6.

In general, there are a wide variety of VOC and SVOC exceedances of NJNRDCSRS including benzene, chlorobenzene, PCE, TCE, 2,4-DNT, 2,6-DNT, and PAHs. Metal exceedances include antimony, arsenic, cadmium, lead and mercury. There were a limited number of exceedances of total PCBs.

7.2 Manufacturing Area Groundwater

Groundwater at Chambers Works is evaluated on a site-wide basis but is presented here for the manufacturing area. The groundwater dataset consists of both one-time sampling at hydropunch locations and the most recent round of sampling at each monitoring well as part of historical SWMU, perimeter, interior, RFI Data Gap investigations or to fulfill the objectives of monitoring programs. A summary of groundwater sampling results are provided in Appendix C.2 by aquifer for VOCs, SVOCs, metals (total and filtered) and inorganics, and pesticides/PCBs across the manufacturing area as a whole. NJGWIIA were used for comparison, and constituents that exceeded their criterion were identified. In these tables, the maximum detections are shown for data ranging from 1990 to the present. This approach provides a comprehensive summary of the nature and extent of groundwater impacts both past and present, which have supported SWMU and AOC investigations and the monitoring required across the manufacturing area.

Figures were developed to demonstrate the locations where detected constituents exceeded NJGWIIA. The constituent with the maximum exceedance factor (maximum detected concentration divided by the criterion) is shown at each location. Figures 7-5 through 7-19 indicate locations with exceedances for the B through E aquifers for VOCs, SVOCs, metals (total), and pesticides/PCBs. Figures were not developed for pesticides/PCBs for the D and E aquifers because there were no exceedances.

The following table provides a higher level summary of constituent exceedances. For each aquifer and constituent category, the number of constituents that had exceedances and the number of locations where exceedances occurred are listed. Beneath that information, the constituents that most frequently exceeded NJGWIIA criteria and by the highest degree for the manufacturing area overall are listed. Many of these constituents appear on the referenced figures, but some additional constituents with a high frequency of exceedance (but not necessarily the highest exceedance factors) were added to the list. For the B aquifer VOCs and SVOCs: 1,2-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, tetrachloroethene, trichloroethene, 4-chloroaniline, and aniline had greater than 150 exceedances across the manufacturing area (see Tables in Appendix C.2). For the B aquifer metals: arsenic, iron, sodium, lead, and manganese had greater than 400 exceedances. For the B aquifer pesticides/total PCBs, exceedances were far less frequent, and the maximum number of exceedances for any constituent was 19. The fact sheets provide more details on the constituents that exceeded NJGWIIA specific to each SWMU or AOC.

B Aquifer			
VOCs Exceedances for 49 VOCs 349 out of 437 locations see Figure 7-5	**SVOCs** Exceedances for 48 SVOCs 267 out of 377 locations see Figure 7-9	**Metals** Exceedances for 19 Metals 405 out of 411 locations see Figures 7-13/7-14	**Pesticides/Total PCBs** Exceedances for 11 Pesticides and Total PCBs 50 out of 132 locations see Figure 7-18
1,2-Dibromoethane (EDB) 1,2-Dichloroethane 1,2-Dichlorobenzene 1,4-Dichlorobenzene Benzene Carbon Tetrachloride Chlorobenzene Tetrachloroethene Toluene Trichloroethene Vinyl Chloride Trichlorofluoromethane[1] 1,1,2-Trichlorotrifluoroethane[1]	1,2,4-Trichlorobenzene 2-Naphthylamine 2,4-Dinitrotoluene 4-Chloroaniline Aniline Benzo(a)Anthracene Hexachlorobenzene Nitrobenzene	Aluminum Antimony Arsenic Beryllium Chromium Iron Lead Manganese Mercury	4,4'-DDD 4,4'-DDE Aldrin Alpha-BHC Heptachlor Total PCBs
C Aquifer			
VOCs Exceedances for 21 VOCs 36 out of 53 locations see Figure 7-6	**SVOCs** Exceedances for 23 SVOCs 27 out of 53 locations see Figure 7-10	**Metals** Exceedances for 11 Metals 48 out of 48 locations see Figure 7-15	**Pesticides/ Total PCBs** Exceedances for 11 Pesticides and Total PCBs 3 out of 22 locations see Figure 7-19
Benzene Chlorobenzene Tetrachloroethene Trichloroethene	1,2,4-Trichlorobenzene 2-Naphthylamine 2,4-Dinitrotoluene 4-Chloroaniline Aniline Hexachlorobenzene Nitrobenzene	Aluminum Antimony Arsenic Iron Lead Manganese	Total PCBs

D Aquifer			
VOCs Exceedances for 19 VOCs 18 out of 27 locations see Figure 7-7	**SVOCs** Exceedances for 11 SVOCs 13 out of 26 locations see Figure 7-11	**Metals** Exceedances for 11 Metals 21 out of 21 locations see Figure 7-16	**Pesticides/ Total PCBs** No Exceedances
Benzene Chlorobenzene Tetrachlorethene Trichloroethene	1,2,4-Trichlorobenzene 4-Chloroaniline Aniline	Aluminum Lead Iron Manganese	None
E Aquifer			
VOCs Exceedances for 11 VOCs 4 out of 15 locations see Figure 7-8	**SVOCs** Exceedances for 4 SVOCs 4 out of 15 locations see Figure 7-12	**Metals** Exceedances for 9 Metals 16 out of 17 locations see Figure 7-17	**Pesticides/ Total PCBs** No Exceedances
Benzene Chlorobenzene	4-Chloroaniline Aniline	Aluminum Arsenic Iron	None

[1] The two Freon compounds listed in the table above had high maximum concentrations but also have high NJGWIIA and do not stand out when exceedance factors are considered. However, these constituents are known to impact groundwater in AOC 1.

A brief evaluation of the exceedances from the B aquifer through the E aquifer is as follows:

- VOCs and SVOCs: The B aquifer has the most sampling locations and the largest number of VOCs and SVOCs with exceedances. The VOCs and SVOCs with exceedances in the C and D aquifers are a subset of those from the B aquifer. Detected concentrations in the C and D aquifers are typically the same order of magnitude but are one to two orders of magnitude lower than detected concentrations in the B aquifer. Spatially, specific constituents with relatively high concentrations identified in the C aquifer appear to be correlated to those identified in the B aquifer, and the fact sheets provide that comparison on a SWMU and AOC basis. But, given the large disparity in the number of sampling locations between the B and C aquifers and the widespread exceedances of nearly 100 VOCs and SVOCs combined in the B aquifer, tracking of individual constituents is not tenable. The detected concentrations in the E aquifer are typically of the same order of magnitude as the D aquifer; however, exceedances in the E aquifer are considered to be localized and specific to failing well casings.
- Metals: The B aquifer has the most sampling locations and the largest number of metals with exceedances. The metals with exceedances in the C and D aquifers are a subset of those from the B aquifer. Detected concentrations in the C and D aquifers are typically the same order of magnitude but are one to two orders of magnitude lower than detected concentrations in the B aquifer (except for iron, manganese, and sodium, which have only slightly higher concentrations in the B aquifer than the underlying C and D aquifers). The detected concentrations in the E aquifer are typically of the same order of magnitude as the D aquifer; however, exceedances in the E aquifer are considered to be localized and specific to failing well casings.

- Pesticides/PCBs: The B aquifer has the most sampling locations and the largest number of pesticides/total PCBs with exceedances. However, detected concentrations in the C aquifer are the same order of magnitude as the B aquifer and there were no exceedances for the D and E aquifers.

Further consideration of exceedances in groundwater will be presented in Sections 7.7 in conjunction with the identification of potential migration pathways, the surface water, sediment/hydric soil and sediment interstitial water investigation results, characterization of significant sources, and remedial actions/monitoring activities performed for site-wide groundwater.

7.3 Manufacturing Area Surface-Water and Sediment Results

The reports, *Summary of Ecological Investigations in Carneys Point* (URS, 2010b) and *Ecological Investigation Report* (DuPont CRG, 2009), provide a comprehensive account of the historical and more recent investigations of on-site surface water, sediment/hydric soil, and sediment interstitial water, as well as the ecological risk evaluations and conclusions. The surface-water and sediment investigation areas for the manufacturing area included two small impoundments (< 0.7 acres) located in the eastern portion of SWMU 8 (Landfill IV Area). For the purposes of the Ecological Investigation, these impoundments were identified as C Pond and D Pond (see Figure 7-20). SWMU 8 was historically a landfill area used to dispose of most of the solid wastes produced at the Chambers Works manufacturing area. Current and historical operations in the manufacturing area represent potential sources of constituents to C Pond and D Pond. Surface-water runoff and shallow groundwater discharge were identified as potential migration pathways from source areas to the ponds (DuPont CRG, 2009).

The following sections summarize the results of the analytical sampling conducted during the 2007 Ecological Investigation to characterize concentrations of site-related constituents in surface water and sediment in C Pond and D Pond (DuPont CRG, 2009). Sampling locations are shown in Figure 7-20. Summary data tables are provided in Appendix C.3. Surface-water and sediment samples were analyzed for VOCs, SVOCs, and TAL metals. Surface-water and sediment data were evaluated relative to ecological benchmark concentrations identified for Carneys Point as described in Section 6.3. This section presents a summary of the results and identifies COPECs for the manufacturing area. Follow-on ecological risk evaluations are presented in Section 8. Off-site surface-water and sediment investigations related to potential migration pathways between impacted media on-site and the Delaware River and Salem Canal were conducted separately (refer to Section 2.4 for reference documents).

7.3.1 C Pond

Based on the evaluation of surface-water and sediment data from two samples collected in C Pond, the following COPECs were identified:

- Surface Water**:** No COPECs were identified in surface water. Arsenic, barium, copper, manganese, mercury, vanadium, and zinc were detected in filtered surface-water samples at concentrations below conservative screening values (e.g., NJSWQS, NRWQC, SCVs, etc.); bromodichloromethane and chloroform were detected in surface water at concentrations below available ecological benchmark concentrations (see Table C.3-19 in Appendix C).

- Sediment**:** Chromium, lead, mercury, and silver were identified as sediment COPECs in C Pond based on maximum detected concentrations exceeding ecological benchmark concentrations; antimony was also identified as a COPEC because an ecological benchmark concentration was not available for this metal (see Table C.3-20 in Appendix C).

7.3.2 D Pond

Based on the evaluation of surface-water and sediment results from two samples in D Pond, the following COPECs were identified:

- Surface Water**:** No COPECs were identified in surface water. Barium, manganese, and vanadium were detected in filtered surface-water samples at concentrations below conservative screening values (e.g., NJSWQS, SCVs, etc.) (see Table C.3-21 in Appendix C).
- Sediment: Antimony, chromium, lead, mercury, and silver were identified as sediment COPECs in D Pond (see Table C.3-22 in Appendix C).

7.4 Site-Wide PFOA/PFCs Soil and Groundwater Results

As described in Section 4.1, a response letter from NJDEP dated December 2, 2013 to the 2013 *RFI Data Gap Sampling Plan* indicated that a review of data gaps should include PFOA and PFC sampling. Based on the letter, historical PFOA/PFC soil and groundwater investigations were reviewed and the current DGW groundwater monitoring program for PFOA/PFC compounds was evaluated. Based on this evaluation, it was determined that there were potential data gaps in some areas of the manufacturing area that could be filled by adding PFOA/PFC analyses to 15 monitoring wells. The samples were collected and analyzed in January 2014. These locations and the associated sampling results are presented in Section 4.6.

Historical PFOA soil data were compiled, and a summary table is provided in Table C.4-1 in Appendix C. Historical soil sampling was performed in the manufacturing area adjacent to specific buildings identified in early stages of the PFOA soil investigations. For the 25 samples analyzed, there were 24 detections, which were compared to the EPA Region 4 (2009) residential soil screening value. There were no exceedances of criteria. Figure 7-21 shows the locations that were sampled and an indication of no exceedances at all locations.

Historical groundwater sampling and the ongoing DGW groundwater monitoring program for PFOA/PFCs includes locations in both the manufacturing area and Carneys Point. Because the PFOA/PFC program has always been approached from a site-wide basis, the groundwater data are presented here on a site-wide basis. Historical and newly collected groundwater samples were compiled, and summary statistics considering all of the historical rounds of sampling are shown in Table C.4-2 in Appendix C. Data from the

A zone and the B through E aquifers were combined. There were detections of all 14 compounds. Groundwater detections for PFOA and perfluorooctanesulfonate (PFOS) were compared to the EPA 2009 Provisional Health Advisory for PFOA. There were no criteria for comparison of other PFC detections. There are exceedances for PFOA and PFOS.

Figures 7-22 through 7-24 show the maximum exceedances for the last sampling event at each location for the A zone, B aquifer, and combined C through E aquifers, respectively. For A zone groundwater (see Figure 7-22), the largest exceedance factors are associated with PFOA located in AOC 6 and the western portion of SWMU 8. For the B aquifer (see Figure 7-23), exceedances were observed throughout the manufacturing area with the largest exceedance factors are associated with PFOA located in AOC 6 and the western portion of SWMU 8. Also there were PFOA exceedances in the C Landfill area. For the C through E aquifers (see Figures 7-24a and 7-24b), the largest exceedance factors are associated with PFOA at three IWS pumping wells, which are screened across both the C and D aquifers: H11-R01CD, K06-R02CD, and M14-M02CD (as of 2014, H11-RO1CD is no longer an IWS pumping well but is still used for monitoring).

7.5 Manufacturing Area DNAPL Characterization

This section summarizes DNAPL characterization in the manufacturing area. Constituents identified in the manufacturing area groundwater may be present as a result of releases that migrated downward to and below the water table. Due to the long site production history, wide variety of production processes, historical waste management practices, extent of the process waste ditches, and complex geology, the characterization of DNAPL at the site is technically challenging. The following sections provide background on the DNAPL investigations and remediation history at the site as well as a lines-of-evidence approach used for characterizing probable and potential DNAPL source zones.

7.5.1 History of DNAPL Investigations at Chambers Works Manufacturing Area

Previous investigations in the manufacturing area have provided evidence that soil and groundwater are impacted by DNAPL. The Phase I and II RFI reports (DuPont Environmental Remediation Services, 1995 and 1998) documented initial surveys of on-site wells and the collection and analysis of DNAPL from six wells. Subsequent to those investigations, a more comprehensive NAPL (both LNAPL and DNAPL) survey program was initiated in 1999 to identify specific well locations where either LNAPL or DNAPL was present and to determine the feasibility of recovering DNAPL from specific wells (documented in the Phase III RFI, DuPont CRG, 2002). From the survey, NAPL was detected in 14 out of the approximately 350 on-site wells. Of these 14 wells, three were found to contain recoverable quantities of DNAPL: two on-site monitoring wells (L13-M01B and I12-M01B) and one interceptor well (H11-R01CD). In 2001, a monthly NAPL survey and recovery program was initiated to monitor the 14 original wells for the presence of NAPL and to remove DNAPL, if present. Since then, all newly installed monitoring wells have been screened for NAPL and added to the program as appropriate.

Accumulated DNAPL is typically removed with a bailer unless the well is able to yield a sufficient volume to justify installation of a permanent pumping and recovery system.

The DNAPL recovery program is documented in the semi-annual DGW reports. As of July 2014, there were 19 wells in the NAPL survey program, which includes two wells with dedicated pumping systems (see Figure 2-6). Wells L13-M01B and G05-M03B, which have the pumping systems, have produced approximately 3,426 and 1,426 cumulative gallons. Wells G05-M02B and J12-M02B have produced approximately 52 and 40 cumulative gallons, respectively. The other wells in the program each have produced less than 10 gallons. Two wells, D15-P08B and F09-M03B, were recently added in 2014.

In addition to the manufacturing area-wide DNAPL survey and recovery program, DNAPL compounds have been investigated as part of SWMU and AOC soil and groundwater investigations. Specifically, DNAPL investigations were incorporated into the SWMU 8 and SWMU 63 investigations because of the magnitude and extent of groundwater impacts related to these SWMUs and the high volume of recovery of DNAPL from the L13-M01B and G05-M03B wells, which lie beneath the SWMU footprints. In addition, DNAPL investigation has been part of the perimeter and interior investigations of the AOCs based on recommendations from the *Preliminary Assessment Report* (DuPont CRG, 2006a) and were documented in the *Perimeter Investigation Report* (URS, 2010) and the *Interior Investigation Technical Memorandum* (URS, 2013b). Finally, investigation was included as part of the RFI Data Gap Investigation (URS, 2013a) with data included in Section 4 of this report.

Earlier DNAPL investigations at the site indicated that DNAPL had passed through the vadose zone and migrated below the water table. The vadose zone investigation (documented in the *Interior Investigation Technical Memorandum)* evaluated the nature and extent of DNAPL-related constituents in soil and the presence of DNAPL. From 153 locations and 1,500 lineal feet of core, 461 soil samples were collected across the manufacturing area and analyzed for VOCs, SVOCs, and metals. Results indicated that DNAPL has a limited distribution in the vadose zone as it was observed visually in only 10 of the 153 cores with most of the locations in the Triangle and Dyes areas (AOC 6) and the TEL area (AOC 2). In general, the laboratory analytical results indicated that constituent concentrations were found at higher concentrations with depth and were associated with the underlying A/B (clayey silt) aquitard.

As documented in the *Interior Investigation Technical Memorandum*, a seven-acre portion of AOC 6, known as the Triangle Intermediates Area, was selected for a focused field study to test various technologies for subsurface investigation of DNAPL (URS, 2013b). Specific sections of the waste ditch system (SWMU 17) were concluded to be the historical entry point of DNAPL to the subsurface in this area. From the study (and consistent with previous RFI investigations), it was concluded that the most reliable DNAPL investigation methodology for the site consists of completion of soil borings, visual logging, and sampling and laboratory analysis of both soil and groundwater. Alternative methodologies such as dye testing, vapor monitoring, camera testing, and other downhole profiling methods did not yield consistent results.

As a result of the focused field investigation of this area, a DNAPL conceptual model was developed, which integrated process history information; soil and groundwater sampling and analytical results; geological and hydrogeological characteristics; and DNAPL properties, migration potential, architecture, and recoverability potential (URS, 2013c). Three potential DNAPL source areas were identified in the Triangle Intermediates Area, and a specific conceptual model was developed for each. Finally, the volume and mass of the impacted soil and the mass of sorbed, dissolved, and free-phase DNAPL were estimated for this area. The conceptual model was intended to provide a preliminary framework for remedial technology screening, and lessons learned from this study were applied to the DNAPL conceptual model developed here for the larger manufacturing area.

A key finding of the Triangle study was that DNAPL is present mostly (80 to 90%) as residual DNAPL trapped in pore spaces of aquifer material, and while there is a potential for pooled DNAPL within depressions on finer-grained or aquitard surfaces, there has been limited success in identifying pools of recoverable DNAPL both in the Triangle Intermediates Area and in the manufacturing area overall. The complex history of releases coupled with the complexity of the geological framework, e.g., the interweaving of coarser and finer-grained sedimentary deposits, means that characterization of DNAPL source zones at a larger scale requires some generalization.

Finally, after 2013-14 RFI Data Gap field investigation activities were completed, groundwater data across the manufacturing area were compiled and presented in the previous Section 7.2. From the tables and figures of results of the complete dataset, the VOCs and SVOCs that had the highest concentrations most frequently in the B aquifer across the manufacturing area were:

1,1,1,2-Tetrachloroethane	1,1,2-Trichlorotrifluoroethane	1,2-Dibromoethane (EDB)
1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene
Benzene	Carbon tetrachloride	Chlorobenzene
Tetrachloroethene	Toluene	Trichloroethene
Trichlorofluoromethane	Vinyl chloride	1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene	1-Naphthalymine	2,4-Dinitrotoluene
2,6-Dinitrotoluene	2-Naphthylamine	4-Chloroaniline
Aniline	Naphthalene	Nitrobenzene
O-Toluidine		

Note: this list includes constituents without NJGWIIA criteria and it is slightly longer than the list provided in Section 7.2, which is based on exceedances of NJGWIIA.

The high concentrations of these compounds in addition to many others indicate that DNAPL is potentially wide-spread across the manufacturing area. Therefore, an evaluation of the presence of DNAPL source zones across the manufacturing area was conducted to complete the RFI characterization in the manufacturing area. The following section provides the background and methodology for DNAPL characterization across the manufacturing area with references cited that are specifically relevant to site-specific conditions at Chambers Works.

7.5.2 DNAPL Characterization Background

Determining the presence or absence of DNAPLs is an important component of a conceptual model and is critical to the proper selection of the remedial approach (Kueper and Davies, 2009). Once it is determined that DNAPL is present beneath a site, characterization is conducted to further define the DNAPL source zone. A DNAPL source zone is defined as the overall volume of the subsurface containing residual and/or pooled DNAPL (Kueper and Davies, 2009). DNAPL source zones will also contain dissolved and sorbed phases [Interstate Technology & Regulatory Council (ITRC), 2011]. DNAPLs have the potential to migrate to significant depths below the water table in a tortuous, dendritic manner such that encountering DNAPL in subsurface investigations is problematic (UK Environment Agency, 2003; Kueper and Davies, 2009).

Subsurface DNAPL acts as a long-term source for dissolved-phase constituents and affects the spatial distribution and persistence of constituent concentrations. Additionally, DNAPL may have diffused into low permeability zones and back-diffusion may sustain dissolved-phase plumes for significant periods of time even when DNAPL has been removed from the aquifer. There has been very limited success in the complete removal of DNAPL from below the water table at sites; therefore, remediation strategies often consider source zone containment or stabilization, partial mass removal, or plume management within the framework of appropriate risk-management objectives (UK Environment Agency, 2003).

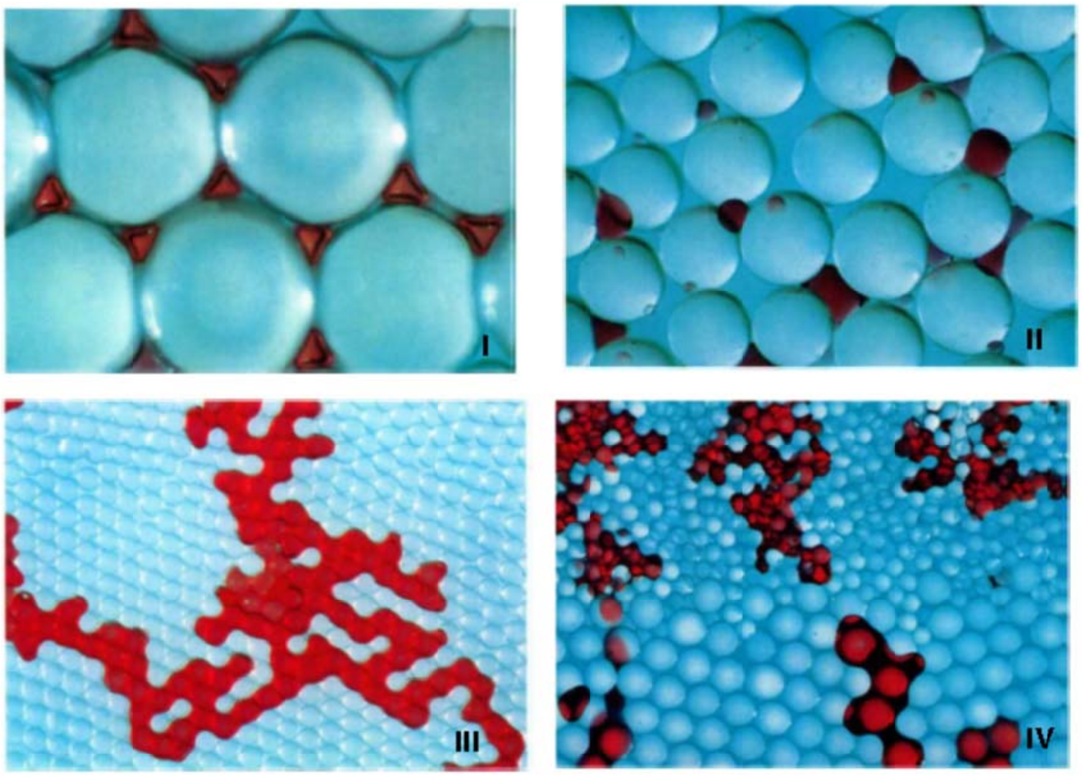
Approaches to determine the presence and distribution of DNAPL in the subsurface have evolved over the last 25 years (Cherry and Feenstra, 1991; Cohen and Mercer, 1993; EPA, 1994; UK Environment Agency, 2003; ITRC, 2003; and Kueper and Davies, 2009). The spatial distribution of residual and pooled DNAPL is influenced by the release history, DNAPL properties and geology. Residual DNAPL, in the form of disconnected blebs and ganglia of organic liquid typically between 1 and 10 sand or matrix grain diameters in length, is formed at the trailing end of a migrating DNAPL body (UK Environment Agency, 2003). Residual DNAPL is trapped by capillary forces, and it may occupy between five and 20 percent of the pore space (Kueper and Davies, 2009 cites up to 30 percent). However, residual DNAPL typically will not enter an adjacent monitoring well even under the influence of aggressive pumping (Pankow and Cherry, 1996).

Pooling can occur in the subsurface above capillary barriers, which are created by changing grain-size characteristics. Examples of capillary barriers are clays and silts, but pooling may also occur above fine sands. Pools represent a continuous distribution of DNAPL and typically correspond to saturations of between 30 and 80 percent of the pore space (Kueper and Davies, 2009). By definition, pools are contiguous through the pore structure and therefore are potentially mobile. Pooling may occur at any scale and in any quantity and is highly dependent on the DNAPL properties and the geological conditions. Although pooled DNAPL is potentially mobile, its recoverability is not assured and is highly dependent on localized conditions.

The following are two common themes in the literature:

- The very nature of residual DNAPL, that it is basically immiscible in water and held in capillary tension at relatively low pore saturation, makes it a long-term source to groundwater and not amenable to recovery.
- The migration pathway of a release both downward and laterally in a complex three-dimensional manner is complicated by heterogeneous geological changes at small scales and makes pooling of DNAPL in significant quantities that are recoverable less likely.

Schwille (Pankow, 1988) was a pioneer in demonstrating these concepts for halogenated DNAPL, specifically PCE, with his publication of a variety of laboratory experiments. Plates I and II below are photographs from experiments that investigated the nature of residual DNAPL, and Plates III and IV are photographs of experiments that investigated the nature of tortuous migration pathways. These experiments demonstrate that even under controlled laboratory conditions with a relatively uniform DNAPL compound, bead size, shape, and distribution and dry/moist/wet conditions (depending on the experiment), tortuous migration pathways and residual DNAPL present difficult challenges for the characterization and remediation of DNAPL.



I. Beads initially moist and PCE dripped in from above. Most of the PCE flowed out leaving isolated drops in the internal portions of the pore spaces (shortened from Pankow, 1988).
II. Beads initially dry and PCE dripped in from above. Beads then saturated from below with water; PCE thereby forced into the smaller pore spaces (shortened from Pankow, 1988).
III. Beads initially saturated with water. PCE infiltrated in a random manner (shortened from Pankow, 1988).
IV. Two-layer bead medium initially saturated with water. PCE then applied from above. Infiltration is broader in the finer bead layer (shortened from Pankow, 1988).

Bead diameter = 0.8 to 1.23 mm

Because mobile DNAPL will migrate along multiple, complex pathways, it is not practicable to define all of the specific DNAPL migration pathways at a typical industrial site (UK Environment Agency, 2003). A more attainable goal is to define the lateral extent of the DNAPL source zone without specific delineation of residual and pooled DNAPL within the source zone. Given the complex nature of DNAPL migration, it follows that the majority of porous media within a DNAPL source zone will not contain either residual or pooled DNAPL. The probability of directly encountering residual or pooled DNAPL with a conventional drilling program is therefore relatively small. Instead, the presence of DNAPL is inferred using a converging lines-of-evidence approach (UK Environment Agency, 2003).

7.5.3 Chambers Works DNAPL Lines of Evidence

The EPA guidance document, *Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites* (Kueper and Davies, 2009) acknowledges the need for a converging lines-of-evidence approach for the characterization of the lateral extent of

DNAPL source zones. The guidance document recommends the use of the following lines of evidence to define DNAPL source zones:

- Site use/history
- Visual observation, including in a soil core/sample or groundwater sample
- Chemical concentrations in soil above threshold DNAPL saturation
- Chemical concentrations in soil above partitioning threshhold
- Vapor concentrations
- Hydrophobic dye testing
- Groundwater analytical evidence, such as persistent plumes of dissolved constituents; presence of constituents in groundwater at concentrations greater than 1 to 5% of their solubility; and large fluctuations in constituent concentrations over time.

As mentioned in Section 7.6.1, the effectiveness of several tools and techniques for determining the presence of DNAPL was evaluated during the Triangle Intermediates Area DNAPL study. These included hydrophobic dye testing, vapor monitoring, camera testing, and other downhole direct push tools. None of these tools yielded consistent results. It was concluded that the most reliable DNAPL investigation methodology for the site consists of completion of soil borings, visual logging, and sampling and laboratory analysis of both soil and groundwater. These data along with information related to the site use/history provide the basis for developing lines of evidence identified in the guidance document. This section provides a review of the relevant data and evaluations that were performed to assemble these lines of evidence for the purpose of identifying probable and potential DNAPL source zones in the manufacturing area.

Site Use/History

The PAR (DuPont CRG, 2006a) provided the most comprehensive assessment of historical process and waste management history for the manufacturing area. Site production history, infrastructure, historical process waste ditches, landfills, outfalls, and site investigation data, including the incorporation of all previously investigated SWMUs, were evaluated and a source prioritization tool was developed. This tool provided a map-based ranking of the relative severity of site buildings and other features to the potential release of constituents to the environment. Since the PAR was approved, the source prioritization tool was used in conjunction with existing site data to develop follow-on field investigation plans for the 11 AOCs in the manufacturing area. Figure 7-25 shows the source prioritization tool layer that indicates features with a historically high potential for a release along with the SWMU 17/56A ditches.

Visual Observations

Visual observations include a note on a boring log e.g., oily stain, identification of DNAPL in a groundwater sample, or collection of DNAPL from a well. All boring logs for the site were reviewed, and a master list of locations was compiled along with the depth of observation and associated aquifer or aquitard. These data were entered into a GIS database so that the information could be sorted by vertical intervals. Locations where no DNAPL was indicated on the log were also entered into the database but these are not considered to be a definitive indicator of the lack of DNAPL. Rather, these locations represent the vast number and spatial distribution of the borings at the site. All of these boring locations are shown in Figure 7-25. During groundwater sampling or monitoring well surveys, there have been instances when DNAPL was observed in the groundwater sample or well, and these locations are also shown in Figure 7-25.

Concentrations in Soil

Chemical concentrations in soil can be used to provide evidence of DNAPL presence. Soil samples from both the unsaturated (vadose zone) and saturated zones (B aquifer) were considered. Three types of evaluations were performed throughout the duration of the RFI process and were based upon project goals at the time, available data, and data quality. The first evaluation was to compare the estimated volume of detected constituents in soil samples to estimated pore space to determine pore saturation. The second evaluation was to analyze analytical results from soil samples via phase partitioning analysis to apportion the constituent mass into various phases (DNAPL, dissolved, sorbed, vapor). The third evaluation used the results from the previous two evaluations. Total constituent concentrations in soil samples were compared to the results of the previous two evaluations to qualitatively estimate the presence of DNAPL. The three evaluations were performed separately and are discussed in more detail in the following subsections. Results are presented collectively in Figure 7-26.

Estimation of Pore Saturation

During the vadose zone investigation of the manufacturing area interior (URS, 2013b), pore saturation was estimated with a comparison of detected constituent volume to available pore volume as suggested by Kueper and Davies (2009). However, instead of specifying a pore saturation and calculating a corresponding soil concentration, the soil concentrations are used to directly estimate the resultant pore saturation. Based on measured constituent concentrations, the top approximately 10 VOCs and 20 SVOCs were selected, and their concentrations were converted to volumes assuming their individual pure component density and a homogenous distribution through a 1-foot soil core. In addition, tentatively identified compounds were also included using an average density. The volumes were summed, and the total volume was divided by an assumed pore volume to estimate the pore saturation.

This method is conservative in that it does not apportion mass to other phases (sorbed, dissolved, vapor) and simply assumes that all mass is present as DNAPL. As such, the results of this method must be correlated with those of the more precise Phase Partitioning that was used during the subsequent B Aquifer Investigation (URS, 2013b). To do this, the pore saturation versus total constituent concentration calculated by this approach were plotted to predict the pore saturation at the concentration ranges predicted by phase partitioning for no DNAPL, Potential DNAPL, and Probable DNAPL (< 200 mg/kg, 200 to 400 mg/kg, and > 400 mg/kg, respectively). The corresponding pore saturation values for the ranges listed were estimated to be <0.1%, 0.1 to 0.15%, and >0.15%.

Phase Equilibrium Calculations

Phase-equilibrium partitioning calculations were performed following B Aquifer Investigation (URS, 2013b) using the NAPLANAL v.2.0 software tool (Jin and Jackson, 2005). NAPLANAL is a program that uses analytical data from a soil sample to estimate the partitioning between dissolved, free (i.e., DNAPL), sorbed, and vapor phases in a saturated or unsaturated soil sample and to estimate pore saturation of DNAPL. Most detected constituents from soil sample results, their thermodynamic properties, and assumed soil density, porosity, and organic carbon content were used to calculate the distribution of mass phases. The resulting estimated pore saturations expressed as a percent of pore space were grouped into three ranges: < 0.001%, 0.001 to 1 %, and > 1% for no DNAPL, Potential DNAPL, and Probable DNAPL, respectively. Greater than one percent was selected as indicating probable DNAPL presence to address uncertainties in the method and to avoid false positives. The other ranges were selected based on a review of the resultant data. Total constituent concentration versus pore saturation calculated by this method yields corresponding concentration ranges of < 200 mg/kg, 200 to 400 mg/kg, and > 400 mg/kg for no DNAPL, Potential DNAPL, and Probable DNAPL, respectively.

Qualitative Evaluation

Results from remaining soil data collected at the site as part of other investigations (e.g., building foundation studies, soil management purposes) were queried from the database. This created a large volume of data that would be problematic to evaluate efficiently using the previous two approaches. Therefore, it was decided to sum the total constituent concentrations for these samples and to compare those results to the ranges predicted by the previously described NAPLANAL analysis. Therefore, the three concentration ranges: < 200 mg/kg, 200 to 400 mg/kg, and > 400 mg/kg were used to assign if no DNAPL is present or potential DNAPL or Probable DNAPL are present at each location.

Groundwater Quality

Sampled groundwater concentrations as related to constituent solubility can provide an indication that the sampled groundwater may have come into contact with DNAPL. EPA suggests that for a single component DNAPL, exceeding one percent of its own total aqueous solubility (TAS) can be used as a screen to flag a particular site for the presence of DNAPL (Kueper and Davies, 2009). For a multi-component DNAPL, there is competition for dissolution, which theoretically reduces the TAS of individual components. Although there are examples of multi-component DNAPLs in which solubility is enhanced, particularly when elevated alcohol concentrations are present [Indiana Department of Transportation (INDOT), 2007], but this would not be the case at Chambers Works because the DNAPL does not contain many alcohols. To assess the presence of DNAPL with multi-component conditions, it is recommended that a summed threshold of all constituents' relation to their TAS be compared to a threshold value as follows:

$$\sum \frac{C_{Obs}}{S_{Obs}} = \alpha$$

such that α is a general rule of thumb value of one percent or a site-specific value that may be determined in conjunction with other lines of evidence and deemed more realistic to site-specific conditions (Kueper and Davies, 2009; UK Environment Agency, 2003).

As previously reported in Section 7.3, there were approximately 50 VOCs and 50 SVOCs that exceeded regulatory criteria in the manufacturing area B aquifer. Of these, the constituents were screened against their solubility limit to develop a shorter list of constituents to assess potential DNAPL presence. Other factors considered in the screening were spatial distribution across the site, known DNAPL constituents identified in laboratory analysis of samples, and results of estimated soil saturations. After reviewing the comprehensive dataset, a list of 25 constituents that are pervasive and occur at high concentrations in groundwater (relative to their solubility limit) was developed. For the manufacturing area, the group of constituents evaluated in the summed concentration-TAS calculation is as follows:

1,1,1,2-Tetrachloroethane	1,1,2-Trichlorotrifluoroethane	1,2-Dibromoethane (EDB)
1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene
Benzene	Carbon tetrachloride	Chlorobenzene
Tetrachloroethene	Toluene	Trichloroethene
Trichlorofluoromethane	Vinyl chloride	1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene	1-Naphthalymine	2,4-Dinitrotoluene
2,6-Dinitrotoluene	2-Naphthylamine	4-Chloroaniline
Aniline	Naphthalene	Nitrobenzene
O-Toluidine		

For each groundwater sample, the summed concentration-TAS ratio expressed as a percent was calculated and posted on a site map along with the other lines of evidence (source prioritization tool/ditches, visual, and soil saturation). Samples collected as grab samples (e.g., hydropunch) are representative of groundwater over a shorter aquifer interval of 1 to 2 feet, whereas samples collected from monitoring wells are representative of groundwater over a longer aquifer interval (5- to 10-foot screens). In a DNAPL source zone, a sample collected from a longer-screened interval is expected to be more diluted and therefore will yield a relatively, lower groundwater concentration and estimated summed concentration-TAS ratio. When the groundwater line of evidence was evaluated spatially across the manufacturing area in conjunction with the other lines of evidence, it was apparent that when the summed concentration-TAS ratio for the longer screened samples was greater than ten percent and for the shorter screened samples was greater than 60 percent, the lines of evidence converged. Figure 7-27 shows the summed-concentration-TAS ratio at each location for the B aquifer organized by sample type and three ranges, simply stated here as low, medium, and high. One percent was considered as the breakpoint between the low and medium ranges per the rule-of-thumb suggested in the literature (Kueper and Davies, 2009; UK Environment Agency, 2003). Ten and 50 percent summed TAS ratios were considered the breakpoints between the medium and high ranges for the long and short-screened samples, respectively.

7.5.4 Converging Lines of Evidence for DNAPL Source Zones

The individual lines of evidence were evaluated for convergence to identify probable and potential DNAPL source zones across the site. These source zones define the lateral extent of DNAPL presence without specific delineation of residual and pooled DNAPL within the source zone. These DNAPL source zones show conservative plan-view boundaries where DNAPL may be present within the interval evaluated but do not imply that residual or pooled DNAPL is contiguous within the source zones. The majority of porous media within a DNAPL source zone will not contain either residual or pooled DNAPL (refer to cross-sections presented later in Section 7.7).

The source prioritization tool, visual, soil saturation, and groundwater summed concentration-TAS ratios were evaluated concurrently and assessed for convergence of multiple lines of evidence. While the previous sections described the lines of evidence separately, the final ranges shown in their figures were developed with all lines of evidence considered. Figure 7-28 shows the extent of probable and potential DNAPL source zones as well as the extent of groundwater plumes for the B aquifer, which is defined as the extent of VOC and SVOC exceedances of NJGWIIA. The zones are defined by the following.

Area Defined on Map	Criteria for Defining Boundaries
Probable DNAPL source zone	Visual evidence and soil saturation estimates greater than 0.15% were considered to be the strongest indicators. DNAPL pore saturation estimates based on partitioning greater than 1% and summed groundwater concentration-TAS ratios greater than 10% for long-screened wells and 60% for short-screened wells were considered to be secondary indicators. Areas where all of these lines of evidence converged and were consistent with the source prioritization tool were included as a source zone. The source prioritization tool was used to guide spatial interpolation between individual data points.
Potential DNAPL source zone	The outer boundary shown as a potential DNAPL source zone was defined by the summed concentration-TAS ratios greater than 1%. It was found that other lines of evidence in these areas were weak or inconsistent and therefore, there was not substantial evidence to define these areas as probable.
Extent of groundwater plumes	The outer boundary shown as the extent of groundwater plumes was defined by exceedances of drinking-water criteria as defined by NJGWIIA.

Both visual and soil saturation evidence for the vadose zone were included in the DNAPL source zone evaluation for the B aquifer; hence, the probable DNAPL source zones for the vadose zone are conservatively identified within the boundaries of the probable DNAPL source zones for the B aquifer. Figures 7-29 and 7-30 show the lines of evidence and potential/probable DNAPL source zones for the C and D aquifers. For the C aquifer, both visual and summed concentration-TAS ratio lines of evidence were used. For the D aquifer, only summed concentration-TAS ratios were available for evaluation. IWS well data were also used if the well had a single screen (e.g., G08-R01C, G08-R01D). IWS wells with multiple screens (e.g., K06-R01CD) were not used. The exception to this was M14-R01CD, which was used in the D aquifer. All of the groundwater samples were collected from long-screened wells; therefore, the three ranges of < 1%, 1-10%, and > 10% were used to be consistent with the B aquifer. For the C aquifer, when the visual and summed concentration-TAS ratio converged in conjunction with the probable DNAPL source zone areas in the overlying B aquifer, three probable DNAPL source zones were identified. Some of the potential source zones were defined where the summed concentration-TAS ratio was greater than one percent, but there was an overlying DNAPL source zone in the B aquifer. For the D aquifer, no probable source zones were identified. Two potential zones were identified where the summed concentration-TAS ratio was greater than 10 percent.

7.5.5 DNAPL Composition and Migration Potential

DNAPL composition and site-specific geological and hydrogeological conditions affect the potential for DNAPL migration. This section provides a description of the composition of DNAPL found in analytical samples collected from the site as well as some discussion on DNAPL migration potential. Throughout the site investigation history, DNAPL-related constituents identified in soil, groundwater, and recovered DNAPL samples have been consistent with the wide variety of known chemical production processes and historical waste discharges. As summarized in Sections 7.2, there were approximately 50 VOCs and 50 SVOCs that exceeded NJGWIIA in the manufacturing area B aquifer. There are approximately 25 constituents that frequently have high concentrations in the B aquifer groundwater across large areas. Most of these constituents are the same as those identified with high pore saturations in soil and identified in analytical samples of recovered DNAPL. While it is known that these DNAPL constituents found in soil and groundwater are co-mingled, DNAPL analytical samples provide evidence of the heterogeneity of the DNAPL mixtures present at the site. These mixtures, or multi-component DNAPLs, are spatially variable at the site.

Sixteen DNAPL samples were collected and analyzed for chemical composition and physical characteristics. These samples contained a large percentage of unknown components, which may be degraded or emulsified chemical compounds, may be unknown compounds, or may consist of natural organic matter that has been dissolved into the NAPL. The identified components were organized into nine groups, and the fractional make-up of each group contributing to the sample was estimated. The nine groups and the components that make up each group are as follows.

Group Number	Group Name	Constituents
1	Chlorinated Benzenes	1,2,4,5-Tetrachlorobenzene, 1,2,3-Trichlorobenzene, 1,2,4-Trichlorobenzene, 1,2-DCB, 1,3-DCB, 1,4-DCB, Chlorobenzene
2	BTEX	Benzene, Toluene, Ethylbenzene, Xylenes (Total)
3	Chlorinated Fluorocarbons	Carbon Tetrachloride, Dichlorodifluoromethane, Freon 113, Trichlorofluoromethane
4	Chlorinated Ethylenes	1,1-Dichloroethene, cis-1,2-Dichloroethene, Tetrachloroethene, Trichloroethene, Vinyl Chloride
5	Chlorinated Ethanes	1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,2-Dibromoethane, 1,2-Dichloroethane

Group Number	Group Name	Constituents
6	Nitroaromatics	1,3-Dinitrobenzene, 1,4-Dinitrobenzene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, Nitrobenzene
7	Amines	1-Naphthylamine, 2-Nitroaniline, 3-Nitroaniline, 4-Nitroaniline, 4-Chloroaniline, Aniline, O-Toluidine, 5-Nitro-O-Toluidine, N-Nitrosodiphenylamine
8	PAHs	2-Methylnaphthalene, Naphthalene, Acenaphthene, Acenaphthylene, Anthracene, Benzo(A)Anthracene, Benzo(A)Pyrene, Benzo(B)Fluoranthene Benzo(G,H,I)Perylene, Benzo(K)Fluoranthene, Dibenz(A,H)Anthracene, Chrysene, Fluoranthene. Fluorene, Phenanthrene, Indeno(1,2,3-Cd)Pyrene, Pyrene
9	Organo Lead	Organo Lead

The fractional make-up of each group is shown at each sample location in Figure 7-31. The estimated probable DNAPL source zones for the B aquifer are shown for reference. There are a large number of samples that were composed predominantly of chlorinated benzenes. Nitroaromatics are predominant in three samples from the SWMU 8, AOC 5, and AOC 6 areas. Chlorinated ethanes and organo lead composed a large fraction of the samples in the AOC 2 area. Chlorinated fluorocarbons composed a large fraction of four samples: two in the AOC 1 area, one in the AOC 2 area, and one in the western portion of AOC 6.

The migration potential of pooled DNAPL was previously evaluated in the Phase II RFI (DuPont Environmental Remediation Services, 1998) and in more detail in the DNAPL conceptual model report for the Triangle Intermediates Area (URS, 2013c). Guidance from Cohen and Mercer (Cohen and Mercer, 1993) was used to evaluate the potential for DNAPL migration based on physical characteristics such as density, viscosity, and interfacial tension. The Triangle report provided a more detailed evaluation that included aquifer characteristics such as grain size and the distribution of aquifer and aquitard media. The findings were that DNAPL at Chambers Works has relatively high density [1.2 to 1.5 grams per cubic centimeters (g/cm^3)] and relatively low absolute viscosity (0.7 to 2.5 centipoise), which are consistent with historical migration of DNAPL to and below the water table.

Additionally, the Triangle Intermediates Area study concluded that the B/C aquitard is an effective impediment to downward migration of DNAPL. However, emplaced DNAPL (pool or globule) can be mobilized if a critical hydraulic gradient is exceeded (Cohen and Mercer 1993). This gradient is most dependent on the distribution of grain sizes for each aquifer, but also is dependent on DNAPL properties and the size of the DNAPL pool. Generally speaking, the critical hydraulic gradient necessary to mobilize a pool or globule of DNAPL increases as the contiguous body size of the DNAPL decreases. Applying site-specific hydraulic gradients for the upper B, lower B, and C aquifers, the following minimum size of DNAPL body (length) that may presently be mobilized are 55, 16, and 3.3 feet, respectively (URS, 2013c). Although horizontal mobilization of emplaced DNAPL is a possibility, no contiguous pools of the identified minimum sizes have been delineated.

7.6 Manufacturing Area Conceptual Model

Conceptual models describe the key mechanisms that control constituent transport behavior within an area of interest (EPA Region 6, 2008). The development of a conceptual model involves the consolidation of a number of data, hypotheses, assumptions, uncertainties, and processes that together describe the system in a consistent manner. In short, these models should be able to provide an explanation and basis for the occurrence of elevated constituent detections in the subsurface. These models can then be used to define potential pathways from sources to receptors and to evaluate the efficacy of potential remedial alternatives. Conceptual models also provide a means of documenting and periodically updating general facility information and data regarding the nature and extent of site related constituents in the environment.

This section presents a DNAPL conceptual model that includes discussion of associated dissolved plumes and constituent mass stored in the subsurface. Significant sources across the manufacturing area both in terms of spatial extent and mass are related to historical DNAPL releases at the site. DNAPL source zones were defined primarily by organic constituents (VOCs and SVOCs), but metals are prevalent in groundwater as well. However, the spatial extent of the dissolved plumes defined by VOCs and SVOCs is consistent with the spatial extent of metals found in groundwater

Due to the size and complexity of the manufacturing area, a general conceptual model is presented, followed by more general sections on DNAPL mass in the aquifers and aquitards. Then, three detailed area-specific conceptual models provide a more robust characterization for the site. The key distinctions between each area-specific model are based upon the presence, thickness, and contiguousness of the B/C aquitard and the groundwater quality in the shallow and deeper aquifers separated by the B/C aquitard. The conceptual models provide the characterization of sources and potential migration pathways. Section 8 will present the CSM, which defines complete pathways to potential human and ecological receptors on a site-wide basis.

7.6.1 General DNAPL Conceptual Model Description

Using the site history and results of the RFI program, a general conceptual model is presented for the manufacturing area as follows. Raw materials used in the manufacturing area included aromatic and other organic compounds, as well as some metals (i.e., catalysts) and other inorganic materials (DuPont CRG, 2006a). Organic raw materials were typically high density, low viscosity, low solubility solvents and oils that form immiscible fluids (DNAPL) if released to subsurface aquifers. Many of the chemical manufacturing businesses located within AOCs were stand-alone operations; therefore, the chemical composition of waste material was spatially variable (see DNAPL sample analyses in Figure 7-31). Waste materials were discharged to ditches which flowed to the basins and combined with other area wastes. This process continued from about the 1920s until the 1980s. After attaining sufficient thickness to overcome fluid resistance, these multi-component wastes entered the subsurface and ultimately, the aquifer to form a complex multiple component DNAPL that migrated downward through an extensive network of non-point continual discharges occurring over many decades.

Vertical downward migration continued until encountering lithologic units of increased capillary resistance (silts and/or clays). Mobile DNAPL then moved laterally and entered thin, possibly dead-end sandy partings and seams within the sandy and silty clay units creating local zones of potentially high saturation. Remaining mobile DNAPL migrated below discontinuous silty clay units, such as the A/B aquitard and middle B silt. In some cases, the release volume was sufficient for DNAPL to reach and form thin pools on the B/C aquitard, preferentially moving toward topographic depressions at a few locations (e.g., L13-M01B DNAPL recovery well). DNAPL migration continued until the DNAPL release ceased, became depleted, or was removed (e.g., ditch remediations and DNAPL recovery program). The migrating DNAPL likely left a trail of residual blebs or ganglia. DNAPL that has been migrating ceases to move once gravitational forces cannot overcome the pore entry pressures. As noted in Section 7.6, visual evidence of DNAPL presence has been recorded in 112 of 2,466 (5%) subsurface boring locations as shown in Figure 7-25. Also, only 17 wells (two to three percent of total wells installed within the manufacturing area) currently pump or have had DNAPL removed in recordable amounts. Based on DNAPL recovery at a few wells, pooled DNAPL is known to occur but is not common.

Since release of DNAPLs into the subsurface, mass redistribution has occurred as a result of one or all of the following processes: dissolution, advection, dispersion, sorption, diffusion, volatilization, and biogeochemical alteration. Detections of dissolved site-related constituents have been measured in groundwater and soil throughout the manufacturing area and in each of the underlying aquifers. Multiple entry points and non-point source discharges, which have created multiple DNAPL source zones, make discerning unique downgradient plumes difficult. Blebs and ganglia of residual DNAPL that at one time may have been connected in vertically stacked residual DNAPL source zones likely have been reduced by groundwater dissolution. However, the observed conditions do not rule out the occasional presence of these features.

Constituents most representative of DNAPL sources to groundwater in the manufacturing area were identified in Section 7.6. The highest groundwater constituent concentrations are in the B aquifer.. Constituent concentrations and spatial extent decrease with depth below the B aquifer. The distribution of dissolved constituents within the manufacturing area spatially constitutes a very large groundwater plume of moderate concentrations along the fringes of the DNAPL source zones, which emanates from much smaller areas of DNAPL sources at various locations around the central portion of the manufacturing area. The DNAPL to a large extent has impacted the groundwater in the B aquifer down to the B/C aquitard, and to a lesser extent the deeper C and D aquifers and the C/D aquitard. Throughout the central portion of the manufacturing area, the DNAPL source zones continue to impact groundwater that enters as recharge and off-site to on-site groundwater flow due to inward gradients caused by the continuous pumping of the IWS in the lower C and D aquifers. Groundwater constituent concentrations change in response to the location of the DNAPL source zones, textural changes in the aquifers, and the IWS pumping regime, which can affect concentrations of constituents along both horizontal and vertical flow paths.

7.6.2 DNAPL Mass Estimate Based on Generalized Conceptual Model

One indicator of mass within the subsurface is the mass removed via the IWS. Groundwater samples are collected from IWS wells to monitor performance and groundwater characteristics that are being sent to the site WWTP. Estimates of total mass removed via the IWS have been prepared using these concentrations, estimates of flow rates, and estimates of time operated for each IWS well. Combining these inputs, it is estimated that the site IWS system has removed approximately five million pounds of constituents since its initial operation in the early 1970s (SAB, 2012). Approximately 52,000 pounds (4,971 total gallons) of mobile DNAPL have been removed from DNAPL recovery wells.

Using the generalized conceptual model and data previously presented in Section 7, an estimate of residual DNAPL mass within the manufacturing area can be calculated. As described in the conceptual model, DNAPL entered the subsurface and partitioned into DNAPL (residual or mobile), dissolved, absorbed, diffused, and volatile phases. A detailed analysis of mass for the Triangle Intermediates Area Study (URS, 2013c) concluded that the majority of constituent mass (80 to 90%) occurs as residual DNAPL. Observations of DNAPL in other areas of the site are consistent with the findings of the Triangle area study. Therefore, the results of the Triangle study were applied to the larger site. These mass estimates are for residual DNAPL and do not include the other phases.

The DNAPL source zone map for the B aquifer (see Figure 7-28) shows probable DNAPL source areas. The summed area of these source zones is approximately 3.9 million square feet. The average thickness of the B aquifer is 20 feet thick. Therefore, the total volume of the confirmed probable DNAPL source zones is approximately 78 million cubic feet.

Bulk average DNAPL saturation (percentage of available pore space occupied by DNAPL) is quite low, even in probable source zones in the manufacturing area (URS, 2013c). Based on two values of bulk saturation of 0.5% and 1%, the estimated remaining residual DNAPL mass are 9 and 18 million pounds, respectively. Assuming that this represents 80 to 90% of the total remaining mass (with 10 to 20% as dissolved, sorbed, diffused, or mobile), then the estimates from these same values for the total remaining mass overall are 10 and 20 million pounds. The following table summarizes the calculations.

Volume (ft^3)	Matrix Porosity (unitless)	Bulk Saturation (unitless)	DNAPL Density (lbs/ft^3)[1]	Residual Mass (lbs)	Total Mass (lbs)
7.8E6	0.3	0.005	78	9E6	10E6
7.8E6	0.3	0.01	78	18E6	20E6

[1] Note: 78 pounds per cubic feet (lbs/ft^3) is equivalent to 1.25 gm/cm^3

These estimates are sensitive to the assumed bulk saturation, which is considered to be highly variable. In large areas of the probable DNAPL source zones, there is no residual or pooled DNAPL, whereas in others there are saturations that are likely higher than the assumed values in the calculations presented. While the calculations are less sensitive to the assumed values of the matrix porosity and the DNAPL density (i.e., are not likely to vary over an order of magnitude), these calculations do not consider the spatial variability of those parameters either. There is additional mass within the potential DNAPL source zone across wide-spread areas but due to lower pore saturations, the mass is likely to be significantly less than the mass in the probable DNAPL source zones. In spite of the simplicity of the calculations and the uncertainties identified, it is still meaningful to provide some estimate of DNAPL mass fully recognizing that it is larger than what has been estimated to have already been removed by the IWS. However, it is also important to note that mass removal by the IWS is not likely to continue at the same rate and residual DNAPL at relatively low pore saturation will persist.

7.6.3 Mass Diffused Into Aquitards

The interior investigation included a focused study to evaluate the potential for diffusion of constituents into low permeability units. Samples collected within the manufacturing area confirm the presence of DNAPL and elevated dissolved concentrations of site constituents within the aquifers at the site. Aquitards and disconnected silt and clay lenses in the subsurface have high porosity and also store water. A concentration gradient is formed when a solute in aquifers comes into contact with cleaner water within the aquitards. This gradient will drive the molecular diffusion of the constituents into the porewater of the aquitard; additionally the constituents can sorb onto organic matter contained within the aquitard. These mechanisms will create a reservoir of constituents that can “back-diffuse” and create a persistent source to groundwater even after aquifer source areas have been restored (Sale et al., 2008).

Closely spaced soil samples beneath the manufacturing area were collected from low permeability units to evaluate the presence of constituent mass. Units evaluated included the middle B silt, and the B/C and C/D aquitards (URS, 2013b; URS, 2013c). Each of these studies confirmed the presence of site-related constituents within the aquitards. One soil sample was collected from the aquifer media directly above the aquitard and three samples collected at 0.25 feet or less intervals into the aquitards.

Figure 7-32a shows the sample locations, and Figure 7-32b shows four representative charts of soil sample results for 1,2-DCB, 1,3-DCB, 1,4-DCB, chlorobenzene, and benzene. Results shown on the graphs are given for total soil results in micrograms per kilogram (µg/kg), Mass dissolved into porewater as well as sorbed mass are not differentiated. Graphs of the sample results shown in Figure 7-32 are for the middle B silt (B-010, 9 feet bgs), B/C aquitard (B-035, 20 feet bgs and F09-M03B, 30 feet bgs) and C/D aquitard (K06-M02C at 54 feet bgs). Each graph shows elevated constituents, most with elevated concentration above one mg/kg (ppm), and demonstrates the potential for back diffusion. Extrapolating the sample result curves, it is reasonable to assume that mass has diffused at least 1 foot into the aquitards. Based on the detailed mass estimates done during the Triangle Intermediates Area Study, it is possible that over 0.0023 pounds per cubic feet (approximately 1 gram per cubic foot) is dissolved and sorbed within this range. If only one aquitard is impacted in this manner (e.g., the B/C aquitard) on its upper surface, then the potential mass stored within the upper foot through the mapped DNAPL source zones (3.9 million square feet) is approximately 8,800 pounds. This number is potentially four times (or more) higher due to the presence of the middle B silt as well as other discontinuous low permeability units in the B and C aquifers. As indicated from an assessment in the Triangle Area study, the portion of total mass that is diffused into aquitards is relatively low when compared to residual DNAPL mass. However, the critical importance of diffused mass is not the quantity of mass stored, but the very slow release mechanism of back diffusion that can maintain groundwater concentrations above NJGWIIA for a considerable period of time after aquifer restoration.

7.6.4 Conceptual Models of Specific Areas

The following section presents area-specific conceptual models for three distinct areas of the manufacturing area. These conceptual models are presented by means of four representative renderings that illustrate the inter-relationship of the various components that control the movement and behavior of constituents in the subsurface. These renderings are orientated roughly parallel to groundwater flow. However, the SWMU 8 area includes two renderings, which are oriented both parallel and perpendicular to groundwater flow. Development of these conceptual models was supported by extensive geological, hydrogeological, and environmental data collected around the manufacturing area as part of the RFI program.

Figure 7-33 shows the locations of the renderings with respect to the probable DNAPL source zones for the B and C aquifers. Figures 7-34 through 7-37 present the renderings in the northwestern area, southwestern area, and central portion (SWMU 8 area) of the manufacturing area, respectively. The conceptual model begins by building a geological model that is based upon data recorded in boring logs collected from the area. Within these renderings hydrogeological characteristics, groundwater flow, probable DNAPL source areas, and mass phases are shown. A description of common model elements is provided in the cross section key (see Figure 7-38). The following text introduces the main components of the conceptual model [geology, hydrogeology, constituents (chemistry), and DNAPL] and provides details observed along these renderings. These show the subsurface as generally layered but it should also be noted that there are large variations both at the site-wide horizontal and smaller-resolution vertical scales caused by heterogeneities such as lateral extent, textural changes, and unit thicknesses.

Northwestern Area Conceptual Model

Figure 7-34 shows a conceptual rendering of the subsurface through the northwestern area. The rendering has a west to east orientation originating in AOC 1 and continuing east to the southern area of the basin complex (SWMUs 14, 15, and 16) and to the main stem of the A ditch (SWMU 17). The rendering intersects probable DNAPL source zones to illustrate the distribution of various phases of constituent mass in the area. Groundwater flow is depicted with blue arrows. The following points provide further explanation of the area.

Process History	• The northwestern portion of the manufacturing area has been historically used for the production of fluoroproducts (e.g., Freon) in AOC 1. • AOC 4 has been used for the production of monomers and other intermediate products used in aramid fiber production. • AOC 5 is the southern extent of the old basins (SWMUs 14, 15, and 16) and ditches (SWMU 17). These were used to transfer and treat wastewater prior to the construction of the wastewater treatment plant. • Elastomers were created at AOC 7, the Elastomers Area. • Waste ditches crisscrossed the area moving liquid wastes to the former basins.
Geological Observations	• The D/E aquitard is structurally shallow (-40 feet NAVD88) within AOC 1. The D/E surface dips to the east-southeast toward the Pennsville Paleovalley. • Shallow aquifer sequences (Pleistocene/Holocene) are thinnest in this area; sandy and silty zones are less continuous with more inter-fingering along the Delaware River at AOC 1. • The B/C aquitard is more continuous toward the south, beneath AOCs 5 and 7.
Hydrogeological Observations	• Shallow groundwater in the B aquifer is tidally influenced from the Delaware River to approximately 600 feet inland. • Shallow groundwater discharges to the Delaware River in the perimeter area of AOC 1. Groundwater in the B aquifer beneath AOCs 4, 5, and 7 flows eastward then downward to be captured by the site IWS (recovery wells M14-R01CD, G08-R01C, and G08-R01D). • Groundwater in the C and D aquifers is under the control of the site IWS and hydraulic gradients are from the manufacturing area boundaries inward. • The B/C aquitard is discontinuous in AOC 1, which allows for the vertical movement of groundwater and constituents into the C aquifer and then inward toward the IWS wells (see Figure 7-29 for C aquifer TAS ratio estimates). • The B/C aquitard is thicker beneath AOCs 5 and 7, which limits the downward movement of groundwater in those areas.
Constituents/ DNAPL Observations	• DNAPL was detected in the shallow aquifer during the Perimeter Investigation (URS, 2010) and Interior Investigation (URS, 2013b). DNAPL was also evaluated at the northwestern corner of SWMU 8 at L13-M01C (SWMU 8 Treatability Study Report, URS, 2010d). • DNAPL source zones have been identified in AOCs 1, 4, 5, and 7 (refer to Figure 7-28 DNAPL source zone map) • DNAPL samples were collected at PIS-077, D15-P08B, INT-B037, L13-M01B, and L12-M03B, and their chemical compositions are shown in Figure 7-31. • DNAPL is collected from two wells (D15-P08B and L13-M01B). • Shallow waste materials were discovered in old waste ditches southeast of building K37 during the vadose zone study (VZH-071S, 2/14/11, 4 to 5 feet bgs) as well as at the Elastomers Area. • Elevated groundwater concentrations of site-related constituents were detected in area monitor wells constructed in the B, C, and D aquifers. • Constituents have diffused into low permeability units (E14-M01D diffusion samples and Figure 7-32 graphs).

Southwestern Area Conceptual Model

Figure 7-35 shows a conceptual rendering of the subsurface through the southwestern portion of the manufacturing area. The rendering was constructed perpendicular to the Delaware River to more easily show the flow of shallow groundwater to the Delaware River and on-site flow in the deeper aquifers in AOCs 2 and 3. This orientation also shows more clearly the influence of the B/C aquitard, which inhibits downward mass transport and groundwater movement due to the IWS. The rendering intersects DNAPL source zones in AOCs 3 and 6 to illustrate the distribution of various phases of mass in the area. The following points provide further explanation of the area.

Process History	• AOC 3 (Jackson Labs) was an area of research and development where bench-scale manufacturing processes were scaled up to the pilot scale. • AOC 6 was an area of finished dye production as well as intermediate compounds used in dye production. Notable sub-areas include the Triangle Intermediates area, Naphthalene Intermediates area, and sulfuric acid production plant. • A diverse mixture of raw materials and waste products were used and created as a result of the batch style operation that was used to create dyes and develop industrial processes. • Ditches carried wastes eastward toward the Dyes Area then north toward the Triangle Intermediate Area and then to the basins.
Geological Observations	• Cretaceous D/E aquitard dips south (between -90 and -100 feet NAVD88) toward the Pennsville Paleovalley. • Sequence of Pleistocene/Holocene sediment is thick in this area; sandy and silty zones are more continuous. • The B/C aquitard becomes thick (10 to 40 feet) and is continuous throughout this area. • The C aquifer is typically more gravelly than the overlying B and underlying D aquifers. • From the C aquifer upward, there is a generally fining upward sequence in the coarse textured units. The D aquifer tends to be a very uniform, well sorted, fine-to-medium white sand.
Hydrogeological Observations	• Shallow groundwater in the B aquifer along the Delaware River is tidally influenced. • A groundwater divide exists in the B aquifer approximately 800 feet inland from the Delaware River. • Shallow groundwater in the B aquifer west of the drainage divide discharges to the Delaware River. East of the divide groundwater flows eastward and downward further east where the B/C aquitard is absent, thin, or of sufficient permeability to transmit groundwater flow. • The B/C aquitard is thick and continuous beneath AOC 3 and inhibits vertical movement of groundwater and constituents to the C aquifer. • Groundwater in the C and D aquifers is under the control of the site IWS; hydraulic gradients are inward and downward. • IWS Wells G08-R01C and G08-R01D typically pump a total of 200 gallons per minute when in operation.
Constituents/ DNAPL Observations	• Converging lines of evidence indicate the probable presence of DNAPL source zones beneath AOCs 3 and 6. The probable DNAPL source zones coincide with the location of waste ditches in the AOCs. • DNAPL has been detected in the B aquifer and soil samples collected at AOCs 3 and 6 at multiple locations (see Figure 7-28). No wells contain recoverable DNAPL. • Soil samples indicate that DNAPL has accumulated in thin layers on multiple low permeability units, e.g., the middle B silt and the B/C aquitard. • Elevated groundwater detections of site-related constituents have been detected in monitoring wells completed in the B, C and D aquifers. • DNAPL is believed to be a continuing source of impact to groundwater. • Based on F09-M03B diffusion samples, constituents have diffused into low permeability units (see Figure 7-32).

Eastern Area Specific Conceptual Model

Figures 7-36 and 7-37 show conceptual renderings of the subsurface in the eastern portion of the manufacturing area. These renderings include AOCs 8 and 9 and SWMU 8. This eastern area extends from the eastern property line at Route 130 westward to near the interior of the site and the center of the former and current manufacturing area. A second rendering extends from the south near Salem Canal north to the WWTP. The renderings intersect DNAPL source zones to illustrate the distribution of various phases of mass in the area. The following points provide further explanation of the area.

Process History	• Before SWMU 8 disposal activities began, the area was occupied by a low lying marsh and Whopping John Creek. The low lying area was progressively filled in with solid and semi-solid waste materials over time, including dredge spoils from the former basins complex. • Two permitted landfills (Landfill A and Landfill B) are located above SWMU 8. The landfills contain solid waste, construction debris, and debris containing asbestos and form prominent topographic features. • Dye manufacturing (Monastral and Ponsol colors) was located in AOC 9 at the southern end of this eastern area. • A main section of the former A process waste ditch (SWMU 17), runs south to north along the western edge of AOC9 and SWMU 8.
Geological Observations	• Paleovalleys created by the ancient Delaware River have been mapped just to the east of AOC 9 and through SWMU 8. Additional fluvial channels have also been interpreted in the eastern area of SWMU 8 based on very coarse cobbles and boulders encountered during drilling in this area. • Low permeability layers can be thick (20 feet) but also discontinuous. • The B/C and C/D aquitards are discontinuous beneath the SWMU 8 area.
Hydrogeological Observations	• Groundwater flows onto the site from the south and east. • Pathways for the downward movement of dissolved constituents occur where the B/C and C/D aquitards are absent. The absence of aquitards and the strong influence of the IWS tend to create downward vertical groundwater flow components especially in the vicinity of pumping wells. • Thick gravels may be zones of preferred groundwater flow paths.
Constituents/ DNAPL Observations	• Converging lines of evidence indicate the probable presence of DNAPL source zones beneath AOCs 8, 9, and SWMU 8. These areas are coincident with the larger waste ditches. Probable DNAPL areas are more scattered in SWMU 8 where ditches and process operations were not present. • DNAPL has been detected in the B aquifer and samples collected at AOC 9 and SWMU 8 (see Figure 7-31). Well L13-M01B produces pumpable DNAPL. • A polyvinyl chloride (PVC) D aquifer well (L13-M01D) collapsed due to reacting with constituents at 29 feet bgs. A DNAPL sample from this area was mostly nitrated benzene compounds (refer to Figure 7-31). • DNAPL caused a B aquifer PVC well to collapse (J10-M01B). A DNAPL sample from this area indicated it composed primarily of chlorobenzene. • High groundwater TAS results (>10%) have been recorded in the C and D aquifers. • DNAPL at L13-M01B is believed to be pooled in a depression on the surface of the B/C aquitard (Appendix K of the SWMU 8 Treatability Study Report, URS, 2010d). • Diffusion samples at K06-M01C indicate mass has diffused into the B/C and C/D aquitards (see Figure 7-32).

7.7 Summary of Manufacturing Area Characterization

The following text provides an integrated summary of the RFI investigation for the manufacturing area.

7.7.1 Soil

The manufacturing area SWMU and AOC investigations characterized the nature and extent of impacts to vadose zone soil. Tables 7-1 and 7-2 summarized the RFI status of SWMUs and AOCs, description of vadose zone soil tables, and exceedances of soil standards. In cases where a SWMU recommendation was based on the identification of exceedances as compared to older criteria, data were re-screened and compared to the most recent criteria, i.e., NJNRDCSRS and NJIGWSRS. Minor deviations were identified for some SWMUs, but those deviations do not change the RFI recommendations made during the SWMU investigations. When a SWMU was located within SWMU 8 or an AOC, the soil data was included in a summary table for the larger unit. Summary soil tables are provided in Appendix C.1. Impacted soil at numerous SWMUs as identified in Table 7-1 was remediated or otherwise addressed to prevent further impacts to groundwater and exposure to potential receptors (see Section 2.5.1 and the fact sheets for details on the specific remedial actions). An exposure assessment is provided in each SWMU and AOC fact sheet.

All of the manufacturing area SWMUs and AOCs were approved or recommended for NFA prior to this 2014 Comprehensive RFI report except SWMUs 8, 39-1, 40, 55-1 and 55-4 and AOCs 1 through 10. Soil sampling performed during RCRA RFI phases for SWMUs 8, 39-1, and 40 fully characterized soil, and a CMS for groundwater was recommended in a previous report. Soil sampling for SWMUs 55-1, 55-4 and AOCs 1 through 10 was completed during the 2013-14 RFI Data Gap investigation. Soil sampling for SWMUs 55-1 and 55-4 was limited in the 2013-14 investigation based on data gaps identified. Results were presented in Section 4, and evaluation of the data is summarized in the fact sheets (see Appendix A). Based on these results, SWMUs 55-1 and 55-4 were recommended for NFA.

AOCs 1 through 10 were defined in the PAR (DuPont CRG, 2006a) as the result of a detailed site-wide evaluation of site production history, infrastructure, historical process waste ditches, landfills, outfalls, and site investigation data, including the incorporation of all previously investigated SWMUs. Follow-on investigations of vadose zone soil were included in the perimeter, interior, and 2013-14 RFI Data Gap investigations of the manufacturing area. Vadose zone soil sampling within AOC boundaries presented in this RFI report indicate that the vadose zone soil investigation for AOCs 1 through 10 are complete. Figures 7-1 through 7-4 indicate locations where there are vadose zone soil exceedances as compared to NJNRDCSRS. Exposure assessments and the justification for NFA or a CMS are summarized in each fact sheet. In general, there are a wide variety of VOC and SVOC exceedances of NJNRDCSRS including benzene, chlorobenzene, PCE, TCE, 2,4-DNT, 2,6-DNT, and PAHs. Metal exceedances include antimony, arsenic, cadmium, lead and mercury. There were a limited number of exceedances of total PCBs.

Historical PFOA soil data were compiled from sampling performed in the manufacturing area adjacent to specific buildings identified in early stages of the PFOA soil investigations. For the 25 samples analyzed, there were 24 detections, which were compared to the EPA Region 4 (2009) residential soil screening value. There were no exceedances of criteria.

7.7.2 Groundwater and Significant Sources to Groundwater

Throughout the RFI process, groundwater has been evaluated on a site-wide basis. Groundwater sampling performed as part of SWMU investigations, the follow-on AOC investigations that were completed after the PAR was approved, and on-going groundwater monitoring were compiled and presented for the entire manufacturing area. Summary groundwater tables are provided in Appendix C.2. Figures 7-5 through 7-19 indicate locations where there are groundwater exceedances as compared to NJGWIIA for VOCs, SVOCs, metals, and pesticide/PCBs and identify the constituent that had the maximum exceedance factor at each of those locations. Comparable tables and figures are presented on a site-wide basis for PFOA/PFCs compounds in soil and groundwater in Appendix C.4 and Figures 7-21 through 7-24, respectively.

Overall, there are nearly 100 VOCs and SVOCs combined with exceedances of NJGWIIA for the B aquifer. These exceedances are widespread across the manufacturing area. The VOCs and SVOCs that had the highest exceedances most frequently in the B aquifer across the manufacturing area were:

1,2-Dibromoethane (EDB)	1,2-Dichloroethane	1,2-Dichlorobenzene
1,4-Dichlorobenzene	Benzene	Carbon Tetrachloride
Chlorobenzene	Tetrachloroethene	Toluene
Trichloroethene	Vinyl Chloride	Trichlorofluoromethane
1,1,2-Trichlorotrifluoroethane	1,2,4-Trichlorobenzene	2-Naphthylamine
2,4-Dinitrotoluene	4-Chloroaniline	Aniline
Benzo(a)Anthracene	Hexachlorobenzene	Nitrobenzene

Metal exceedances of NJGWIIA included aluminum, antimony, arsenic, beryllium, chromium, iron, lead, manganese, and mercury and exceedances were wide-spread across the manufacturing area in the B aquifer. There were also some pesticide/total PCB exceedances in the B aquifer, but these exceedances are less frequent and spatially sporadic.

The VOCs and SVOCs with exceedances in the C and D aquifers are a subset of those from the B aquifer. Detected concentrations in the C and D aquifers are typically the same order of magnitude but are one to two orders of magnitude lower than detected concentrations in the B aquifer. Spatially, specific constituents with relatively high concentrations identified in the C aquifer appear to be correlated to those identified in the B aquifer, and the fact sheets provide that comparison on a SWMU and AOC basis. The detected concentrations in the E aquifer are typically of the same order of magnitude as the D aquifer; however, exceedances in the E aquifer are considered to be localized and specific to failing well casings. Concentrations of detected metals have similar trends as the VOCs/SVOCs with the B aquifer having the highest number of metals with exceedances and highest detected concentrations with decreases in these numbers in the C and D aquifers. Exceedances of pesticides/total PCBs are minimal in the C aquifer and there are no exceedances in the D and E aquifers.

Historical groundwater sampling and the ongoing DGW groundwater monitoring program for PFOA/PFCs includes locations in both the manufacturing area and Carneys Point. Additional data was collected as part of the 2013-14 RFI Data Gap investigation. Groundwater detections for PFOA and PFOS were compared to the EPA 2009

Provisional Health Advisory for PFOA. There were no criteria for comparison of other PFC detections. There are a relatively large number of exceedances for PFOA and a relatively small number of exceedances for PFOS.

A manufacturing area-wide characterization of DNAPL was presented. Historical releases were wide-spread primarily along process waste ditches. DNAPL is characterized as multi-component and heterogeneous across the manufacturing area. Figures 7-25 through 7-38 provide summaries of data used as lines of evidence, probable and potential DNAPL source zones identified by assessing converging lines of evidence, and area-specific renderings that integrate DNAPL characteristics with geological and hydrogeological conditions in cross-section view. The DNAPL source zones depicted represent significant sources to groundwater but are only a generalized representation of their lateral extent based on converging lines of evidence. The site-specific conditions within these DNAPL source zones are likely to be highly variable over both lateral and vertical distances, with conditions potentially changing over the inch-to-foot range. The spatial variability is more easily depicted on the renderings in cross-section view and yet, given the complexity of DNAPL releases, the heterogeneous conditions in the subsurface, and the fundamental nature of DNAPL migration and fate in the subsurface, it is necessary to generalize the conditions even in cross-section view.

Figure 7-39 shows the areal extent of impacted groundwater for the B, C, and D aquifers with respect to AOCs 1 through 11 and SWMUs 8 and 40. It is recommended that all of the area within the extent of impacted groundwater be recommended for a manufacturing area-wide CMS for groundwater, including the identified DNAPL source zones below the water table. Extensive investigation of the vadose zone indicated that there was a minimal number of locations where evidence indicated the presence of DNAPL. These data were included in the visual and soil saturation lines of evidence for the B aquifer and therefore are included within the boundary of the probable DNAPL source zones for the B aquifer.

7.7.3 Potential Migration Pathways

Figure 7-40 shows the areal extent of impacted groundwater for the B, C, and D aquifers with respect to on-going remedial actions. These activities are described in more detail in Section 2.5 and are shown in Figure 2-6. Groundwater in the B aquifer is currently contained or will be contained by either a sheet pile barrier and/or IWS pumping along the manufacturing area boundary of impacted groundwater, except in the perimeter area of AOC 1. A remedial action for B aquifer groundwater in the AOC 1 perimeter is currently being considered as part of the RASR (Geosyntec, 2012). Portions of the B aquifer beneath AOC 11 are captured by the IWS preventing off-site groundwater migration; see Figure 5-7 and documentation in the Perimeter Report (URS, 2010a) and fact sheet for AOC 11. B aquifer groundwater to the east of the sheet pile barrier along the Salem Canal is contained by the IWS; see Figure 5-7 and documentation in the Salem Canal Report (URS, 2013e).

B aquifer groundwater has the potential to migrate downward into the C aquifer. Likewise, there are downward hydraulic gradients from the C and D aquifers to the D and E aquifers, respectively. Groundwater in the C and D aquifers is contained by the IWS across the entire manufacturing area. The low vertical hydraulic conductivity of the D/E aquitard as well as its significant thickness across most of the manufacturing area (e.g., greater than 20 feet thick) impedes that movement of groundwater from the D to E aquifer beneath the manufacturing area. Groundwater in the E aquifer (to the depth of site-related impacts) is contained by the E aquifer recovery well system.

Figure 7-41 shows the areal extent of impacted groundwater for the B, C, and D aquifers with respect to on-going monitoring activities. These activities are described in more detail in Section 2.5 and are shown in Figure 2-7. Groundwater containment and monitoring programs will continue and be documented in semi-annual DGW reports. In addition to groundwater containment and monitoring, additional engineering and institutional controls are described in all SWMU and AOC fact sheets.

Investigation of the E aquifer was documented in the Phase IV RFI (DuPont CRG, 2005b) and the Phase IV Supplemental Report (DuPont CRG, 2005a). Based on these investigations, it was concluded that the E aquifer is impacted only where leaky well casings allowed downward migration of site-related constituents from the overlying aquifers. To address this issue, several suspect or known leaky wells were abandoned. However, wells L09-M01D (an E aquifer well) and L09-M01E, which were identified for abandonment could not be abandoned due to safety issues related to a regional power line. Pumping from well J05-W01E began in August 1995 to contain E aquifer groundwater along the southern boundary of the site in response to minor detections of site constituents in that area. The J05-W01E pumping program was designed to augment the containment of E aquifer groundwater at Chambers Works, which was maintained by water supply well R15-W01E. Monitoring of the E aquifer will continue and be documented in semi-annual DGW reports.

Although B aquifer groundwater in the manufacturing area will be contained except in AOC 1 (as described above), B aquifer groundwater has the potential to discharge to on-site surface-water bodies. A comprehensive on-site ecological evaluation was completed by reviewing the existing data from the various phases of the RFI including the identification of potential migration pathways. Surface water and sediment sampling areas and locations were based on an evaluation in the site-wide BEE (DuPont CRG, 2006b) of ESNRs and potential migration pathways from historical process discharges, stormwater runoff, and a potential groundwater to surface-water connection from the B aquifer to surface-water bodies. Two small impoundments (< 0.7 acres) located in the eastern portion of SWMU 8 (Landfill IV Area) in the manufacturing area were evaluated during the 2007 Ecological Investigation (DuPont CRG, 2009). For the purposes of the Ecological Investigation, these impoundments were identified as C Pond and D Pond (see Figure 7-20). Surface-water and sediment samples were analyzed for VOCs, SVOCs, and TAL metals. Surface-water and sediment data were evaluated relative to ecological benchmark concentrations. No COPECs were identified for surface water, and the COPECs that were identified for sediment/hydric soil are carried forward for ecological risk evaluations, which are presented in Section 8.

A comprehensive off-site ecological evaluation was completed to address the potential groundwater to surface-water connection along the Delaware River (in addition to other potential migration pathways to the Delaware River and the shoreline sediment) (URS, 2009). This investigation involved systematic sampling along the entire shoreline of the site, including areas adjacent to AOCs 1, 2, 3, 11 and SWMUs 5 and 40. The findings of the multi-phase investigation identified elevated concentrations of site-related organic constituents relative to refined ecological benchmarks in sediments in focused near shore areas of the river adjacent to AOCs 1, 2, and 3. Concentrations in sediments were not elevated relative to benchmarks established in other areas adjacent to the manufacturing or Carneys Point areas. Concentrations of site-related constituents in surface water were nearly all below ecological benchmarks in multiple sampling phases adjacent to AOCs 1, 2, and 3 and were all below ecological benchmarks adjacent to areas north of AOC 1 including the entire Carneys Point shoreline. For areas adjacent to AOCs 1, 2, and 3, no further ecological investigations were recommended until the attainment of hydraulic control at the site perimeter was achieved (URS, 2011a).

7.7.4 Manufacturing Area RFI Complete

Based on the information provided in this RFI report text, tables, and figures and supported by more detailed information in the fact sheets and referenced documents, the RFI for the manufacturing area is complete. All of the manufacturing area SWMUs and AOCs have been fully investigated, the nature and extent of their impacts have been characterized, remediation has been performed as recommended, and RFI recommendations have been substantiated. Groundwater is evaluated on a site-wide basis. For the manufacturing area, the impacts to groundwater have been characterized. Groundwater at the site is part of the site-wide CEA and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place. The containment and monitoring programs will continue to be documented in the semi-annual DGW reports.

7.7.5 Future Considerations for the CMS

The next phase of work should focus on corrective measures and restoration of the aquifers. While the IWS and the DNAPL recovery programs will continue to remove mass from the site, it is expected that DNAPL source zones will present the largest challenge to aquifer restoration.

Some key site-specific issues are as follows:

- The Chambers Works manufacturing area had a long and complex site production history with a wide variety of production processes and spatially extensive process waste ditches that led to the release of a large volume of heterogeneous compounds. DNAPLs have migrated to and below the water table to a depth of up to 30 feet bgs.
- The manufacturing area is underlain by a complex hydrogeological environment. A relatively thick sequence of inter-bedded aquifers and aquitards of alluvial, fluvial, and estuarine origin form a complex groundwater flow system as well as a heterogeneous, environment where constituent mass is likely to be present in

multiple phases, i.e., residual DNAPL, pooled DNAPL, sorbed, dissolved, and diffused into low permeability zones.

- While DNAPL source zones have been identified after extensive site investigation phases that progressively contributed new information over time, these source zones are only a generalized representation of their lateral extent based on converging lines of evidence. The site-specific conditions within these DNAPL source zones are likely to be highly variable over both lateral and vertical distances, with conditions potentially changing over the inch-to-foot range.
- The IWS is effective at containing groundwater in the manufacturing area (except for the B aquifer along the site perimeter areas previously identified) and creating downward gradients from the B aquifer to the underlying C and D aquifers, but groundwater flow can be short circuited by gravelly zones, which can create avenues of enhanced flushing to the detriment of less permeable zones. This results in inefficient pore-water turnover and limits the overall dissolution of mass. Likewise, absences of aquitards can create zones of enhanced groundwater flow such that different rates of pore flushing occur.
- Pumping multiple extraction wells creates areas of enhanced flushing near pumping centers with less groundwater flushing occurring further away from the pumping wells.
- The composition of DNAPL varies at Chambers Works, i.e., there is no one typical makeup; therefore, potential chemical or biological transformation may be highly variable.
- Dissolution of individual DNAPL components will be limited by competition with other components, which may increase the total time of complete dissolution.
- Even as aquifers concentrations decrease, back diffusion of DNAPL from low permeability zones will persist as on-going sources to groundwater.

These issues present significant challenges to enhancing the restoration of the aquifers by implementing additional technologies but will be explored in more detail in the corrective measures phase.

8.0 Overall Conceptual Site Model

The use of a CSM provides a means of documenting and periodically updating general facility information and data regarding potential releases to the environment. The CSM also provides a framework for problem definition, aids in the identification of data gaps that can then be addressed in the site investigations, and assists in the identification of appropriate remedial technologies, if necessary.

The CSM includes four primary elements:

- Identification and characterization of potential source areas
- Identification of constituents of potential concern (COPCs)
- Definition of primary transport mechanisms
- Identification of potential receptors and exposure points

The first three elements, including the spatial distribution of COPCs, were presented in the conceptual models detailed in Sections 6 and 7 for Carneys Point and the manufacturing area, respectively. The purpose of this section is to further evaluate the fourth element for both human and ecological receptors.

In support of the CSM, an understanding of the geology, hydrology, and hydrogeology at and in the vicinity of the site must also be known. A description of the regional/local and site geology and hydrogeology was previously presented in Sections 3 and 5. Additionally, the site-specific geological and hydrogeological characteristics at the site were integrated into conceptual models of the nature and extent of constituents and their primary transport mechanisms in Sections 6 and 7.

The CSM is a dynamic tool that is refined as additional data are collected. The CSM has been updated and refined from the CSM previously presented in the *Perimeter Investigation Report* (URS, 2010a) and represents the current understanding of site conditions.

8.1 Human Health Exposure Assessment

The purpose of the human health exposure assessment presented herein is to identify potentially complete exposure pathways by which human receptors may be exposed to site-related constituents in environmental media under both current and reasonably anticipated future land- and water use conditions at the site.

An exposure pathway consists of the following:

- Source of constituents
- Mechanism of constituent release to the environment
- Transport or exposure medium containing the constituents
- Exposure point where human receptors can contact the exposure medium
- Exposure route (e.g., inhalation, ingestion, or dermal contact)

All of these elements must be present for an exposure to occur. Figure 8-1 depicts exposure pathways by which human receptors may be exposed to constituents in environmental media under both current and future land- and water-use conditions. The purpose of the figure is to identify chemical sources and exposure pathways that can result in human exposure; to aid in identifying data needs to address significant chemical release and migration pathways; and to aid in identifying effective remedial alternatives that are targeted at significant contaminant sources and exposure pathways.

SWMUs and AOCs present in Carneys Point and the manufacturing area include site landfills, basins, ponds, disposal areas or pits, waste storage areas, former manufacturing area, process ditches and incinerators. Physical descriptions, dates of operation, and descriptions of the waste managed at each of the corrective action units are detailed in the fact sheets provided in Appendix A. These potential source areas were investigated during the RFI. As concluded in Sections 6 and 7 of this report, all of the Carneys Point and manufacturing area SWMUs and AOCs have been fully investigated, the nature and extent of their impacts have been characterized, and remediation was performed as recommended.

Sections 6 and 7 identified constituents that exceeded applicable criteria and will be discussed in this section as COPCs based on a comparison to the screening levels detailed in Section 2.4.2. Exceedances of screening levels do not in themselves indicate that an unacceptable exposure exists. Rather, the screening levels serve to indicate the potential for some degree of human exposure to occur.

COPCs were identified in soil, groundwater and sub-slab soil gas and include the following[1]:

- Soil:
  - VOCs (benzene, chlorobenzene, 1,2 dichlorobenzene)
  - SVOCs (PAHs, aniline, hexachlorobenzene, 2,4-DNT, 2,6 DNT)
  - Metals (antimony, arsenic, copper, lead, and zinc)
- Groundwater
  - VOCs [1,1- dichloroethene (DCE), 1,2-DCA, 1,2-DCB, 1,4-DCB, benzene, carbon tetrachloride, chlorobenzene, chloroform, cis-1,2-DCE, EDB, Freon 113, methylene chloride, TCE, PCE, and vinyl chloride]
  - SVOCs [1,2,4-trichlorobenzene, 1,3- dinitrobenzene (DNB), 2-naphthylamine, 2 nitrotoluene, 2,4-DNT, 2,6-DNT, 4-chloroaniline, 4-nitrotoluene, aniline, hexachlorobenzene, and nitrobenzene]
  - Pesticides [4,4’-dichlorodiphenyldichloroethane (DDD), 4,4’-dichlorodiphenyldichloroethylene (DDE), 4,4’ dichlorodiphenyltrichlroethane (DDT), aldrin, alpha-BHC, beta-BHC, dieldrin, endrin, heptachlor, heptachlor epoxide, and lindane]

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[1] This list presented within this section is not comprehensive of all constituents detected above screening criteria. A complete listing is provided in the tables in Appendix C.

  - Metals (total and dissolved aluminum, arsenic, antimony, beryllium, cadmium, chromium, iron, lead, manganese, and mercury)
- Sub-Slab Soil Gas
  - 1,2-DCA, 1,4-DCB, benzene, bromodichloromethane, carbon tetrachloride, chlorobenzene, chloroform, ethylbenzene, PCE, TCE, and vinyl chloride

Potential human receptors may come into contact with these constituents in soil (surface and subsurface), groundwater and sub-slab soil gas; and, potentially complete and incomplete exposure pathways for these receptors are detailed in the following sections.

On-site surface water and sediment are not considered exposure media of concern for human health. Portions of Henby Creek and Bouttown Creek, which have been impacted by site operations, are contained within the Chambers Works property. Therefore, fencing around the property eliminates recreational activities (i.e., fishing) in these areas. In addition, neither of these areas is used for drinking-water purposes. Similarly, the B Basin cannot be used for recreational activities or drinking-water purposes. However, off-site surface water is evaluated further in this human health exposure assessment, since a portion of impacted groundwater may discharge to the Delaware River.

8.1.1 Potential Receptors

Potential receptors are defined as human populations or individuals that are susceptible to contaminant exposure from Chambers Works. Only current land- and water-use conditions were considered in determining exposure scenarios. However, future land use is anticipated to be no different than current, in that manufacturing operations will continue and use of the property will remain non-residential.

Approximately 650 acres of the Chambers Works Complex is currently developed, primarily in the southern portion of the site. Chambers Works currently employs 895 people and produces more than 500 finished products used to make clothing, textiles, computer chips, personal care products, agricultural chemicals, and paint.

The Chambers Works Complex is located in a moderately populated area consisting of light to heavy industry, recreational areas, community service areas, and residential neighborhoods. Situated south of Chambers Works is the Calpine (formerly Atlantic Electric) Power Plant. East of Chambers Works are light industrial, residential, and recreational areas. North of the complex lies community service and residential areas. West of the complex is the Delaware River, which may receive a portion of impacted B aquifer groundwater.

Therefore, the following potential receptors were identified, given the site setting and land uses at and adjacent to the site:

- On-site industrial worker
- On-site construction/excavation worker
- Recreational user of the Delaware River

The entire site is contained within a perimeter security fence system including perimeter lighting, video surveillance, and motion detection. This perimeter security fence system and a professional security force that is manned 24 hours a day, seven days a week are designed to prevent unauthorized access to the site. Routine security patrols are also conducted throughout the site. Therefore, trespassers were not considered potential receptors. Exposure to SWMUs, which are located outside of the fence (SWMUs 5, 52, 55-7, and 60), will be addressed under the recreational-use scenario.

Groundwater contamination in the C, D, and E aquifers is contained on-site by the IWS and other containment measures (i.e., SWMU 5 slurry and sheet pile walls and E aquifer recovery well J05-W01E). As a result, no off-site migration of impacted groundwater is occurring in these aquifers. The public drinking-water supply is supplied by two water companies, the municipality of Pennsville and Penns Grove Water Company. The area surrounding Chambers Works also uses well water for all public drinking water. However, the public water supply well head protection areas do not extend onto the site and do not intersect the established CEA for the Chambers Works Complex[2]. Therefore, off-site residents exposed to groundwater were not considered potential receptors.

8.1.2 Potentially Complete Exposure Pathways

The model in Figure 8-1 shows both potentially complete and incomplete pathways. A description of each of the potentially complete exposure pathways is provided below. Incomplete exposure pathways are discussed in Section 8.1.3.

Groundwater

The potential for exposure is low since groundwater is contained on-site by the IWS, with exception; and, where groundwater is impacted at specific SWMUs and AOCs, groundwater is not used for any purpose. However, due to the shallow depth of groundwater in some portions of the site, exposure may occur during construction/excavation activities. In addition, portions of B aquifer groundwater may discharge to the Delaware River. Therefore, complete exposure pathways may include the following:

- <u>On-site construction/excavation worker</u>: Incidental ingestion of and dermal contact with groundwater, and inhalation of vapor phase chemicals released from groundwater to a confined space (trench)
- <u>Recreational User of Delaware River</u>: Incidental ingestion of and dermal contact with groundwater discharged to surface water while swimming, boating or fishing

Soil

COPCs were identified in soil (surface soil and subsurface soil) at several SWMUs and AOCs at the site (see Tables 6-1, 7-1 and 7-2 and Appendix C). The potential for exposure to contaminants in soil is limited to on-site receptors since impacted soils are contained within the facility boundaries. Even on-site, the potential for exposure to surface soil is low for most receptors, because the principal areas of surface soil contamination have limited access, are located in remote/inactive portions of the site, or

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[2] As detailed in the Receptor Evaluation Form provided to NJDEP on February 25, 2011.

are gravel-covered, paved, or covered by old foundations/existing buildings. The receptor with the greatest potential for exposure is the on-site construction/excavation worker, where a greater likelihood of direct contact with impacted soil is associated with intrusive activities.

Complete exposure pathways, therefore, may include the following:

- On-site industrial worker: Incidental ingestion of and dermal contact with surface soil and inhalation of soil-derived particulates and vapors
- On-site construction/excavation worker - Incidental ingestion of and dermal contact with soil (surface and subsurface) and inhalation of soil-derived particulates and vapors

Sub-Slab Soil Gas

Vapor intrusion of volatile constituents in groundwater (and soil) to the indoor air of overlying structures may occur at the site. Currently, over 135 potentially occupied structures have been identified in the manufacturing area. These include both continuously and intermittently occupied structures. DuPont intends to evaluate both types of structures. However, DuPont has addressed structures with continuous occupancy first. As a result, a phased approach for vapor intrusion investigations has been implemented. Fifteen structures were sampled during the initial phase of the investigation conducted in April/May 2014. Buildings sampled were located in AOCs 1 through 6 and 9. These 15 structures primarily represent confirmed, continuously occupied structures located within the extent of DNAPL source zones identified at the site or are located where occupational-based groundwater VI screening levels have been exceeded. However, Building 1420 located in AOC 9 was also included to evaluate VI potential under a range of conditions.

COPCs in sub-slab soil gas were identified in five buildings at AOC 1, four buildings at AOC 3, one building at AOC 5, and two buildings at AOC 6. Vapor intrusion of volatile constituents in sub-slab soil gas to the indoor air of these overlying structures may occur. Therefore, potentially complete exposure pathways may include for the on-site industrial worker: inhalation of vapor-phase chemicals released from the subsurface to indoor air.

8.1.3 Incomplete Exposure Pathways

Mitigating factors were used in the evaluation of the completeness of an exposure pathway for this human health exposure assessment. The evaluation of mitigating factors uses logical and scientifically defensible reasoning based on a broader, more site-specific understanding of the CSM to predict more accurately the potential effects of evaluated releases.

Mitigating factors may include caps and covers that minimize the potential for direct contact, groundwater-use restrictions, or institutional controls established to minimize worker exposure. Current human exposures are considered to be controlled if there is not a complete exposure pathway.

Groundwater

The Chambers Works Complex has one CEA that covers the entire site. A CEA has the effect of suspending the designated uses (potable for the Class IIA Quaternary Aquifer and PRM Aquifer System beneath the site) and constituent standards in the indicated area for the duration of the operation of the recovery systems. In addition, groundwater is not used for potable water at Chambers Works. Potable water is obtained from an intake on the Munson Dam, in Salem Canal. Constituents are non-detect at the potable water intake. Therefore, direct contact (ingestion or dermal contact) with potable groundwater for on-site industrial workers is incomplete.

Soil

Because the day-to-day operations of the on-site industrial worker do not include intrusive activities, direct contact (ingestion or dermal contact) with subsurface soil is not anticipated and is incomplete. Likewise, if surface soil contamination exists in an area of the site, which is not routinely accessible to on-site industrial workers due to institutional or physical controls (e.g., locked areas or asphalt caps), then exposure pathways in those areas are incomplete as well. For instance, plant security controls access to impacted SWMUs, and routine security checks are completed daily.

Surface Water

Potential exposure to COPCs via ingestion of fish is expected to be negligible to nonexistent. Remedial actions have been completed in the Salem Canal. Surface water samples collected outside of the boom area did not contain concentrations of site-related constituents exceeding ecological benchmarks (DuPont CRG, 2007b). In addition, fishing occurs primarily upstream in Salem Canal away from the Chambers Works Complex.

8.1.4 Significance of Potentially Complete Exposure Pathways

The potentially complete exposure pathways identified in Section 8.1.2 were further analyzed to determine which exposure pathways may require further evaluation or investigation. This section considers the site-specific activity patterns and physical conditions that exist at the site and focuses on whether potentially complete exposure pathways can be reasonably expected to be significant (i.e., potentially “unacceptable”).

A quantitative risk assessment was not completed as part of the RFI. However, the human health conceptual exposure model, described within this section, will be used to support risk management decisions in the CMS.

On-Site Industrial Worker Exposure Pathways

Direct Contact Exposure Pathways

Institutional controls are in place to prevent disturbance of soil (both surface and subsurface) such that on-site receptors will not become exposed to contaminants in excess of screening criteria. These controls include permits, security patrols, and deed restrictions. Permits are required for various activities at the site. Specifically, excavation permits are required for an intrusive activity (Section 7.1). The permit process is a defined process where work locations are checked against site-wide maps. All available site environmental data, soil characterization and utility information are also reviewed to ensure appropriate personal protective equipment (PPE) is used to prevent exposure. The site is fenced and security controls access on-site 24 hours a day. Routine security patrols are also conducted throughout the site. In addition, site and area orientations are required for all workers prior to commencing work on-site.

Areas where surface soil exceeds screening criteria are located in remote or inactive portions of the plant; are paved or covered by old foundation and existing buildings; either heavily vegetated or a gravel cover is present; or access is restricted due to security fencing.

Due to the strict adherence to the intrusive activity permitting process that is required at the Chambers Works Complex and the location of surface soil exceedances, potential on-site industrial worker exposure to impacted surface soil is not significant.

Vapor Intrusion Exposure Pathways

During the VI investigation, sub-slab soil gas samples were collected at 15 continuously occupied structures. Constituents detected above generic New Jersey Non-Residential Soil Gas Screening Levels (NJNRSGSLs) in these samples include 1,2-DCA, 1,4-DCB, benzene, bromodichloromethane, carbon tetrachloride, chlorobenzene, chloroform, ethylbenzene, PCE, TCE and vinyl chloride (see Table 4-8). The following observations were noted:

- Exceedances were observed in 11 buildings investigated in AOCs 1, 3, 5, and 6: 857, K-21, K-24, K-29, K-37, 603, 667, J-27, J-30, 85, and 604.
- Overall, the magnitude and type of constituents detected in sub-slab soil gas correlated well with the magnitude and type of constituents detected in on-site groundwater.

  For example, the presence of Freon 113 at higher concentrations in sub-slab soil gas correlated with the presence of Freon 113 in DNAPL zones in AOC 1. The presence of higher Freon 113 concentrations did result in higher detection limits in one sample collected at Building K-29 in AOC 1. However, other target analytes were detected above the higher detection limits (such as chloroform) in the sample. Freon 113 was not detected above screening criteria in any sample.
- For some constituents (1,2-DCA, 1,4-DCB, benzene, bromodichloromethane chlorobenzene, ethyl benzene, and vinyl chloride) exceeds were limited to one building. Vinyl chloride exceeded generic NJNRSGSLs beneath Building J-30 in AOC 3. The other constituents were observed beneath Building 604 in AOC 6. Both buildings are within the extent of DNAPL zones.
- Carbon tetrachloride, chloroform, PCE, and TCE exceeded screening criteria in more than one building location. Of these, chloroform most frequently exceeded generic NJNRSGSLs (in 28 out of 60 samples). Chloroform concentrations above the NJNRSGSL [27 micrograms per cubic meters ($\mu g/m^3$)] ranged between 43 μg /m^3 to 72, 000 μg /m^3.
- The highest concentrations of carbon tetrachloride, chloroform, PCE, and TCE were observed in samples collected at AOC 1 (Buildings K-29 and K-37) and in

samples collected at AOC 3 (Buildings J-30 and J-27). Buildings K-29, K-37, and J-30 are within the extent of DNAPL zones.

- Occupied structures evaluated in AOCs 2 and 4 (Buildings 63 and 1247) are also located within the extent of DNAPL zones. However, no exceedances were observed. Also, no exceedances were observed in samples collected at AOC 9.

With the exception of bromodichloromethane, each of the constituents listed above is used on-site. Therefore, concentrations in sub-slab soil gas were also compared directly to occupational screening levels [Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs)]. This comparison is a very conservative screening step because it does not account for dispersion and dilution in ambient air. As detailed in Table 8-1, maximum detected concentrations of these constituents in sub-slab soil gas were less than the occupational screening level.

This comparison correlates with indoor air industrial hygiene (IH) sampling conducted by the plant in March/April 2012 prior to the VI investigation. Six buildings (K-21, K-24, K-29, K-37, 603, and 85) were included in the sampling. Samples were analyzed for a portion of the constituents identified above using SKC 575-001 Passive Samplers, with analysis using OSHA method 7 to evaluate benzene, carbon tetrachloride, PCE, and TCE; and, NIOSH method 1003 to evaluate Freon 113.

Eight-hour samples were collected over a four-week period from each sample location (for a total of four sampling events). None of the constituents were detected above reporting limits, which were less than occupational exposure limits (e.g., OSHA PELs).

As a result, based on the lines of evidence presented, vapor intrusion from groundwater to indoor air is not expected to be a concern. However, to confirm the results and further evaluate the vapor intrusion pathway, additional investigation is recommended.

On-Site Construction/Excavation Worker Exposure Pathways

Since impacted groundwater underlies much of the Chambers Works Complex, there are potentially complete exposure pathways for on-site construction/excavation workers engaged in excavation activities where the water table might be encountered. With regard to the on-site construction worker, the exposure pathway is not significant due to a rigorous system of policies and procedures employed at the facility to protect against unacceptable human exposures. As noted above, the Chambers Works Complex has used a permitting process, which requires Chambers Works Environmental Affairs' authorization for any intrusive activities (boring, drilling, excavation, etc.) into the soils or building foundations at the facility. The purpose of the permitting process is to confirm the following:

- Appropriate measures are taken for personnel protection should such subsurface activity encounter impacted soils or groundwater (i.e., PPE).
- Construction methods are conducive to protection of the groundwater from contamination or transfer of contaminants laterally or vertically.
- Construction practices are carried out so as to minimize the generation of potentially impacted media and to ensure that such media are properly characterized and disposed of in accordance with regulatory requirements.

Due to the strict adherence to the intrusive activity permitting process that is required at the Chambers Works Complex, the potential exposure of on-site construction/excavation workers to impacted groundwater and soil is not significant.

Recreational Users of Delaware River Exposure Pathways

As noted previously, portions of B aquifer groundwater may discharge to the Delaware River. As a result, an evaluation of groundwater release to surface water was performed to determine whether or not concentrations of constituents detected in perimeter groundwater monitoring wells are likely to result in exceedances of relevant surface-water quality criteria in the river.

This evaluation was completed as part of the Perimeter Investigation using information collected between November 2009 and December 2009. The following section presents a summary of the evaluation. The detailed evaluation is provided in the *Perimeter Investigation Report* (URS, 2010a).

A multi-tiered risk-based screening approach was used for this evaluation in which constituents, media, or receptors were screened at successive levels of detail, with low concern issues screened out at each step. For the first step or tier, maximum detected concentrations in perimeter monitoring well locations for each area were compared to appropriate groundwater to surface-water screening criteria identified for the site. Screening criteria used in the evaluation was chosen consistent with the designated use of the Delaware River, which is classified as Zone 5 by the Delaware River Basin Commission (DRBC). Water uses to be protected in Zone 5 include industrial water supply, maintenance and propagation of aquatic life, wildlife, recreational use (including swimming, boating, and fishing), and navigation. Zone 5 is not classified as a drinking water supply.

A generic dilution factor of 100 (based on professional judgment) was applied to the screening criteria used in the first tier of evaluation to account for groundwater to surface-water interaction. The use of a conservative dilution factor is consistent with current ecological investigation guidance and the 1996 Advanced Notice of Proposed Rule Making (ANPRM) regarding establishing point of compliance for surface-water discharges (EPA, 1996). Constituents, whose maximum detected concentration exceeded 100 times the screening criteria, were retained for evaluation in the second tier of the evaluation to determine if their discharge would be acceptable. Groundwater discharge of constituents with concentrations less than 100 times the screening criteria was considered insignificant.

For the second tier of the evaluation, an evaluation of groundwater release to the Delaware River was performed using a groundwater flux model to determine whether concentrations of COPCs in perimeter groundwater are likely to result in exceedances of relevant surface-water quality criteria in the river. The groundwater flux was calculated using conservative assumptions and site-specific hydraulic information presented in the *Perimeter Investigation Report* (URS, 2010a).

Finally, modifying factors were considered to refine the list of constituents which remained following the first two tiers of the evaluation. These modifying factors included the environmental fate and transport characteristics of the COPCs, tidal effects, Delaware

River use and habitat characteristics, and empirical data collected within the river during ecological investigations.

Consistent with previous evaluations of groundwater to surface-water discharge completed for the site, the findings of the evaluation presented in the *Perimeter Investigation Report* continue to support that the exposure of potential human receptors to groundwater discharged to surface water in the Delaware River is not considered significant. This conclusion is supported by the following findings.

- Based on the multi-tiered risk-based screening, COPCs identified in perimeter groundwater include Freon 113, 1,2-DCB, 1,4-DCB, 2-chloroaniline, 4-chloroaniline, benzidine, carbon tetrachloride, chlorobenzene and PCE.
- The tidal attenuation model indicates that groundwater concentrations would decrease to below applicable surface-water screening levels prior to discharge. Empirical surface-water data collected in 2009 generally support the model findings (URS, 2011a).
- The Delaware River in the vicinity of Chambers Works continues to be highly industrialized and subject to a number of point and non-point discharges, as well as heavy shipping traffic. The river is tidal, and the intertidal sediments along the shoreline are exposed only periodically. Access to this area by recreational users is limited to watercraft access. Seasonal fishing and crab harvesting in the vicinity of the site has been observed. It is highly unlikely, but possible, that an individual in a watercraft might choose to wade or swim in the shallows near the site (DuPont, 2003b). Based on the low frequency of exceedances of surface water quality criteria in the river protective of human health, exposure of potential recreational users in the river to constituents discharged from perimeter groundwater is considered low.

As additional data are collected, this evaluation will continue to be refined.

8.1.5 Summary and Conclusions

Results of the RFI were used to conduct a human health exposure assessment for the Chambers Works Complex. Potentially complete exposure pathways were evaluated for potential receptors identified based on current and reasonably anticipated future land use. Based on an evaluation of site-specific exposure conditions, no significant potentially complete exposure pathways for human health were identified at this time, including vapor intrusion and groundwater discharge to the Delaware River. However, additional investigation of the vapor intrusion pathway is recommended. As additional data are collected, this evaluation will continue to be refined.

8.2 Ecological Evaluation

Ecological investigations in the on-site portion of Chambers Works were conducted in accordance with N.J.A.C. 7:26E and under the oversight of NJDEP and EPA. Consistent with the process prescribed in N.J.A.C. 7:26E for conducting ecological investigations, the ecological evaluation of on-site areas included multiple phases of investigations:

- BEE: Submitted September 2006 (DuPont CRG, 2006b)

- Ecological Investigation Report (EIR): Submitted March 2009 (DuPont CRG, 2009)
- *Bouttown Creek Ditch Investigation*: Submitted May 2010 (URS, 2010b)

The findings of the BEE provided the basis for the comprehensive EIR field investigations conducted between March 2007 and July 2008. Potential ecological exposures to COPECs were evaluated in the EIR using a tiered approach. The Tier I Exposure Evaluation quantified potential exposure based on the most conservative exposure scenario; the Tier II Exposure Evaluation quantified potential ecological exposures based on more realistic, site-specific scenarios. A summary of the findings of each tier of evaluation is presented in Table 8-2. Based on the findings of the EIR and subsequent NJDEP and EPA review comments, a focused investigation was conducted in the ditches draining Carneys Point to Bouttown Creek to address uncertainty regarding benthic invertebrate exposure to site-related constituents in sediments (URS, 2010b).

The following sections present the ecological CSM developed for potential ecological exposure areas identified in on-site areas based on evaluations conducted through multiple phases of ecological investigations. A summary of the conclusions and recommendations of the EIR that were used to develop the CSM is provided in Table 8-2.

8.2.1 Henby-Bouttown Creek System

Henby Creek and Bouttown Creek are the principal aquatic systems within the Carneys Point area and represent the primary ecological feature in this portion of the site. The Henby-Bouttown Creek system includes the potential aquatic exposure areas of Henby Creek, Bouttown Creek, and Helms Basin. The following sections summarize the conceptual site models for ecological exposure in the Henby-Bouttown Creek system.

Henby Creek and Bouttown Creek

The EIR evaluated potential exposure pathways between site-related constituents in environmental media and ecological receptors within Henby Creek and Bouttown Creek (DuPont CRG, 2009). Site-related constituents may have been transported from SWMUs associated with the former Carneys Point Works to the creek system through the historical discharge of waste, stormwater runoff, groundwater to surface-water discharge, and downstream transport from Bouttown Creek to Henby Creek.

Aquatic habitats in Henby Creek and Bouttown Creek support limited ecological communities of generally tolerant species (DuPont CRG, 2009). The creeks are characterized by shallow water depths, highly-organic depositional substrates, and limited flow due to the sluice gate on Henby Creek and a township-operated pump house on Bouttown Creek upstream of the site. In addition, surface-water quality parameters measured during the October 2007 field investigations indicate that Henby Creek and Bouttown Creek were oligosaline (i.e., slightly brackish) environments, potentially influenced by tidal fluctuations in the Delaware River through the Henby Creek sluice gate. Consistent with these physio-chemical conditions, benthic invertebrate communities observed in on-site and off-site areas in Henby Creek and Bouttown Creek were generally depauparate (i.e., lacking in abundance and diversity), consisting of only two to four taxa; fish communities in the creeks were dominated by tolerant common carp (*Cyprinus carpio*).

Exposure evaluations for benthic invertebrate, fish/herptile, and wildlife (i.e., semi-aquatic birds and mammals) receptor categories identified for Henby Creek and Bouttown Creek were conducted based on analyses of the bulk sediment, sediment interstitial water, and/or surface-water data summarized in Section 6. In addition, benthic community data collected as part of the EIR were used to evaluate potential impacts to benthic macroinvertebrate communities in the creeks (DuPont CRG, 2009). The exposure evaluations conducted in the EIR support the following findings for Henby Creek and Bouttown Creek (see Table 8-2; DuPont CRG, 2009; URS, 2010b):

- The weight-of-evidence approach used to evaluate benthic invertebrate exposure indicated that sediment COPECs were not adversely impacting benthic communities.
    - Benthic community data indicated that the generally depauparate benthic communities that inhabit on-site areas of Henby Creek and Bouttown Creek were found in samples collected outside of the influence of site activities.
    - Concentrations of metals in sediment interstitial water were lower than either chronic NJSWQS or NOEC benchmarks, indicating that COPEC concentrations in sediments were not bioavailable at concentrations likely to adversely affect benthic organisms.
    - Ratios of simultaneously extractable metals to acid volatile sulfides (SEM:AVS) were generally less than 1.0, indicating that sufficient AVS was present at most stations to form insoluble metal-sulfide complexes that are not bioavailable.
    - Concentrations of organic COPECs in sediment were lower than EqP-based benchmarks considered to be protective of benthic organisms.
- No surface water COPECs were identified; therefore, potential risks to fish and herptile communities associated with surface water exposure were considered to be negligible.
- Dietary exposure modeling did not identify unacceptable risk to wildlife receptors potentially foraging within Henby Creek or Bouttown Creek. Given the conservative assumptions built into the dietary exposure models used to evaluate exposure, adverse ecological effects were not likely for wildlife exposed to COPECs in sediments and prey items.

Based on the EIR findings, no unacceptable risks were identified for benthic invertebrate, fish/herptile, and wildlife receptors in Henby Creek based the tiered exposure evaluation; therefore, no further evaluations were recommended for the Henby Creek exposure area on the basis of ecological risk (see Table 8-2; DuPont CRG, 2009). For Bouttown Creek, no unacceptable risks to fish/herptile or wildlife communities were identified in the EIR. Potential ecological risks associated with Bouttown Creek were limited to potential benthic community exposures to elevated sediment COPEC concentrations in the ditches draining upland areas of Carneys Point. The EIR recommended further investigations of the Bouttown Creek ditch sediments to assess potential COPEC bioavailability (see Table 8.2; DuPont, 2009).

Consistent with the recommendation of the EIR, the Bouttown Creek ditch investigation was conducted in October 2009, with the objective of reducing uncertainty identified in the EIR regarding benthic invertebrate exposure to sediment COPECs. The findings of the investigation indicated limited bioavailability and toxicity of sediment COPECs to benthic invertebrates (URS, 2010b). The investigation concluded that concentrations of sediment COPECs were not likely affecting benthic invertebrate communities when considering the limited bioavailability and toxicity of sediment COPECs in the context of benthic habitat characteristics, including degraded benthic habitat quality (i.e., shallow water, limited flow, highly organic substrates) and high sediment stability.

The findings of the ecological investigations conducted in Henby Creek and Bouttown Creek were presented to NJDEP in the *Ecological Investigation Report* (DuPont CRG, 2009) and the *Summary of Ecological Investigations in Carneys Point* (URS, 2010b). The conclusions of these investigations supported a recommendation of no further investigation or remedial action on the basis of ecological risk in Henby Creek or Bouttown Creek. In a letter dated December 6, 2010, the BEERA/ETRA supported the recommendation for no further investigation, provided environmental conditions in Bouttown Creek do not change dramatically.

Helms Basin

Prior to the diversion of Bouttown Creek to Henby Creek in 1974, Bouttown Creek discharged to the Delaware River via Helms Basin. As a result, Bouttown Creek may have transported site-related constituents from SWMUs associated with the former Carneys Point Works to Helms Basin. The basin is tidally influenced and shallow, with water depths typically less than 2.5 feet during high tide. Substrates in Helms Basin varied from coarse sediments (approximately 39 percent fine-grained sediments) near the mouth of Helms Basin to fine-grained sediment (approximately 96 percent) in depositional areas adjacent to the tidal channel. Due to its connectivity with the Delaware River, Helms Basin likely supports similar aquatic species observed in shallow water habitats of the river.

The ecological exposure evaluation conducted for Helms Basin as part of the EIR did not identity unacceptable risks to benthic invertebrate, fish/herptile, and wildlife receptor categories based on worst-case exposure assumptions (DuPont CRG, 2009). No surface-water COPECs were identified, and only nickel was identified as a COPEC in sediment. Sediment nickel concentrations were not considered likely to result in adverse effects to benthic invertebrate communities because the maximum concentration measured in Helms Basin only slightly exceeded the background upper tolerance limit (UTL) concentration. In addition, SEM:AVS ratios in sediment were less than 1.0 for all samples analyzed, indicating that there was sufficient AVS available to bind nickel and other divalent metals into insoluble metal-sulfide complexes. Based on these findings, no further evaluations on the basis of ecological risk were recommended for the Helms Basin exposure area (see Table 8-2; DuPont CRG, 2009).

8.2.2 Henby-Bouttown Wetland System

The potential wetlands that are adjacent to Henby Creek and Bouttown Creek represent ecological exposure areas along the conceptual migration pathway for site-related constituents from SWMUs associated with the former Carneys Point Works and the Henby-Bouttown Creek system. The results of the tiered exposure evaluations conducted in the EIR are summarized below.

The tiered exposure evaluation for the Bouttown Creek Wetlands and Henby Creek Wetlands did not identify unacceptable risks to wetland vegetation, wetland invertebrate communities, or wildlife based on the following lines of evidence (DuPont CRG, 2009):

- Qualitative observations of vegetation in the wetland areas during the August 2007 EIR field investigation indicated a robust vegetative community. The exposure area was fully vegetated, and no signs of stressed vegetation were observed.
- Concentrations of metals in sediment interstitial water within the Bouttown Creek Wetlands were less than or only slightly exceeded conservative chronic NJSWQS or NOEC benchmarks in all samples, indicating that metals were generally not bioavailable in wetland substrates at concentrations likely to result in adverse effects to wetland invertebrates.
- Maximum concentrations of 2,4-DNT and n-nitrosodiphenylamine in the Bouttown Creek Wetlands were below the EqP-based NOEC benchmarks for wetland invertebrates.
- Exposures to metal COPEC concentrations in Henby Creek Wetland substrates were not likely to result in adverse ecological effects to wetland invertebrates. Temporally limited inundation in the Henby Creek Wetlands suggests that substrates are more conducive to terrestrial invertebrates rather than fully aquatic (benthic) invertebrates. An evaluation of metal COPEC concentrations indicated limited potential for adverse effects to soil invertebrates as only zinc slightly exceeded conservative ecological soil screening levels (Eco-SSLs) for soil invertebrates.
- Wildlife dietary exposure modeling did not indicate unacceptable risks to birds and mammals based on Tier II dietary exposure models, which included conservative assumptions of 100 percent area use by receptors.

Based on these findings, no further evaluations of the Bouttown Creek Wetlands or Henby Creek Wetlands were recommended on the basis of ecological risk (see Table 8-2; DuPont CRG, 2009).

8.2.3 Carneys Point Ponds and Historical Ponds

Potential ecological exposures were evaluated in Carneys Point for two ponds that contained surface water (A Pond and E Pond – Domestic Water Pond) at the time of the 2007 EIR field investigations and three historical ponds that were vegetated and no longer contained surface water (Historical B Pond and Historical E Ponds - Domestic and Fire Water). The Carneys Point ponds were associated with the operations from the former Carneys Point Works. As such, the former processes associated with these ponds represent the primary sources of site-related constituents to surface water and/or sediments/hydric soils contained within the ponds.

The conditions of the ponds and historical ponds at the time of the EIR indicated limited ecological habitat value. A Pond and E Pond were small, shallow ponds with highly organic sediments that were not likely to support robust aquatic communities due to high biological oxygen demand (BOD) and low dissolved oxygen conditions during warm summer months. As a result of these conditions, the ponds were not likely to support a fish community or an abundant and diverse community of benthic invertebrates. Vegetation in the historical ponds was dominated by common reed (*Phragmites sp.*), which provides limited habitat for wetland invertebrates and little forage value for birds and other wildlife species.

Exposure evaluations for wetland vegetation, wetland/benthic invertebrate, herptile, and wildlife (i.e., semi-aquatic birds and mammals) receptor categories identified for the Carneys Point ponds and historical ponds were conducted based on analyses of the sediment/hydric soil and/or surface-water data summarized in Section 6. The findings of the tiered exposure evaluations support the following conclusions for the ponds and historical pond exposure areas (see Table 8-2; DuPont CRG, 2009):

- A Pond: No unacceptable risks were identified in the EIR considering the results of the exposure evaluation in the context of the limited habitat value associated with A Pond. Potential risks to benthic invertebrates were limited to elevated metal concentrations that may be mitigated by high AVS concentrations. Potential risks associated with herptile exposure to surface water were considered negligible based on filtered surface-water concentrations that were below NOEC benchmarks for sensitive life stages of amphibians. Negligible risks to wildlife were identified based on the most conservative assumptions in dietary exposure modeling, including maximum exposure concentrations and 100 percent area use. Based on these findings, no further evaluation of A Pond was recommended.
- E Pond – Domestic Water Pond: In the context of the limited habitat value identified for the Domestic Water Pond, including low-oxygen conditions resulting from shallow water and highly organic sediments, the exposure evaluation did not identify unacceptable risks to ecological receptors. The evaluation of benthic invertebrate exposure indicated potential risk related to metal and tPAH concentrations at one location; however, given the habitat-limiting conditions in the sediments, a diverse and abundant benthic invertebrate community was not expected to occur in the Domestic Water Pond. Potential risks associated with herptile exposure to surface water were considered negligible based on filtered surface-water concentrations that were below NJSWQS. Tier II wildlife exposure evaluations did not identify unacceptable risks to wildlife that potentially forage in the Domestic Water Pond. Based on these findings, no unacceptable risks were identified, and no further evaluations were recommended for E Pond.
- Historical B Pond: The Tier II exposure evaluation of sediment/hydric soils in Historical B Pond did not identify unacceptable risks to wetland vegetation, wetland invertebrate, or wildlife receptors. No evidence of stressed or dead

vegetation was observed, indicating that COPEC impacts to the vegetative community were unlikely. Wetland invertebrate exposure concentrations did not exceed effects-based sediment quality guidelines for arsenic or mercury or Eco-SSL values for tPAHs. EqP-based models for tPAHs also indicated that substantial impacts to invertebrate communities were unlikely. No unacceptable risks to wildlife receptors were identified from Tier II wildlife exposure models, particularly in the context of the limited foraging quality and relatively small size of 0.2 acres. Based on these findings, no unacceptable risks to ecological receptors were identified, and no further evaluations were recommended for Historical B Pond.

- Historical E Ponds – Fire Water Pond/Settling Basin: The results of the Tier I exposure evaluation indicate negligible risk to wetland invertebrate and wildlife receptors based on the most conservative exposure scenario for the Historical E Ponds. Nitrocellulose, the only COPEC identified in hydric soils, was not present in soil at concentrations that have been shown to inhibit wetland invertebrate colonization. Conservative wildlife exposure models indicated negligible risk associated with exposure to nitrocellulose. No evidence of stressed or dead vegetation was observed to indicate potential COPEC impacts to the vegetative community. These findings indicate that no further evaluation of ecological exposure was warranted in the Historical E Pond.

8.2.4 Carneys Point Uplands

The upland portions of the former Carneys Point Works, including areas in the vicinity of the SWMUs and/or AOCs, are mostly developed, contain roadways and concrete pads of former buildings, or have been re-graded or otherwise disturbed. Early successional herbaceous or grass species, shrubs, and relatively few trees, typified the majority of vegetation growing in the upland portion of this area.

The ecological investigation evaluated potential exposure to mobile wildlife that may forage in four Carneys Point SWMUs identified as having soil COPECs in the BEE (DuPont CRG, 2006b):

- SWMU 45-2 (Carneys Point Manufacturing Area 2)
- SWMU 47 (Carneys Point Area of Fill Deposition)
- SWMU 60 (Drum Disposal Area)
- SWMU 61 (Disposal Area II)

Former operations associated with these SWMUs represent potential sources of site-related constituents to soils. Site-related constituents may have been released and transported from SWMUs through surface-water runoff during storm events. Potential risks to mobile wildlife exposed to site related constituents in surface soil (0 to 1 foot bgs) were evaluated based on dietary exposure models (DuPont CRG, 2009).

The evaluation of mobile wildlife exposure to COPECs concentrations in upland soil did not identify unacceptable risk to representative birds and mammals (DuPont CRG, 2009). Tier II evaluations of exposure to soil COPECs in SWMU 45-2 did not identify unacceptable risk to any wildlife receptors. Unacceptable risks associated with soil

COPECs were not identified for wildlife in SWMUs 47, 60, and 61 based on highly conservative Tier I exposure assumptions. Based on these results and considering the conservative assumptions of the overall exposure models, adverse effects were not considered likely for wildlife exposed to COPECs in soil from these upland SWMUs in the Carneys Point area. No further evaluation of these exposure areas was recommended in the EIR based on ecological risk (see Table 8-2).

8.2.5 Manufacturing Area Ponds and B Basin

Overall, the Chambers Works manufacturing area is an active manufacturing site with limited habitat to support ecological communities. The manufacturing area is generally paved or otherwise disturbed by plant buildings and infrastructure. The vegetative community is limited to sparsely distributed, herbaceous species (grasses) and small, relatively fragmented patches of woody vegetation. As a result of the sparse and fragmented habitat in the manufacturing area, complete ecological exposure pathways are limited. Only two small ponds (C Pond and D Pond) and B Basin were evaluated as potential ecological exposure areas within the manufacturing area.

At the request of NJDEP, potential ecological exposures were evaluated in the EIR for C Pond and D Pond. C Pond and D Pond are small (0.26 and 0.7 acres, respectively) and shallow ponds characterized by fine-grained, highly organic sediments with low dissolved oxygen concentrations. As a result of these conditions, the ponds support limited fish and invertebrate communities. Current and historical operations in the manufacturing area represent the likely source of constituents to C Pond and D Pond; surface-water runoff and shallow groundwater discharge are potential migration pathways from source areas to the ponds.

An additional evaluation of potential exposure pathways for piscivorous (i.e., fish-eating) waterfowl in the B Basis was conducted at the request of NJDEP. B Basin is an approximately 7.3-acre constructed basin used to manage stormwater and noncontact cooling water for the plant. The basin is located within active process areas of the site. B Basin provides limited habitat value for wildlife due to the frequent disturbance of the area by plant operations, a lack of shelter and foraging opportunities, inaccessibility for terrestrial wildlife, and a lack of contiguous naturalized areas to support wildlife. The EIR included waterfowl use and fish community surveys to evaluate whether complete dietary exposure pathways existed for piscivorous waterfowl in the B Basin.

The findings of ecological exposure evaluations for the C Pond and D Pond and the piscivorous wildlife exposure pathway evaluation in the B Basin support the following conclusions regarding potential risks to ecological receptors for each potential exposure area (see Table 8-2; DuPont CRG, 2009):

- C Pond and D Pond: No unacceptable risks were identified in the evaluation of potential ecological exposure associated with the C Pond or D Pond. Potential risks in both ponds were limited to benthic invertebrate community exposure to elevated metals concentrations in sediment; however, the reduced, low-oxygen environment identified in the C Pond and D Pond likely limits their overall value as benthic habitats. Potential risks to fish and herptile communities were negligible and no unacceptable risks to wildlife receptors were identified based on

Tier II exposure assumptions. These findings did not indicate unacceptable risks to potential ecological receptors; therefore, no further evaluations were recommended in the EIR on the basis of ecological exposure.

- B Basin: The results of the waterfowl and fish community surveys conducted in the B Basin indicated insignificant or incomplete exposure pathways to piscivorous waterfowl. The results of the waterfowl survey indicated minimal use by piscivorous wildlife and the limited number of fish collected during the fish community survey indicated that there was an insufficient forage base in the B Basin to support piscivorous communities. Based on these findings, it was concluded that the exposure pathway for piscivorous waterfowl was negligible in the B Basin. No further evaluations of this potential exposure pathway were recommended in the EIR.

8.2.6 Ecological Conceptual Site Model Summary

In summary, the findings of the combined investigations do not indicate unacceptable risks to ecological receptors in any exposure area evaluated in the Carneys Point area or the manufacturing area. These conclusions are supported by the following findings:

- Comprehensive chemical, physical, and biological data collected over multiple phases of ecological investigations in Carneys Point exposure areas.
- Multiple lines of evidence provided through analysis of multi-phase chemical, physical, and biological datasets indicating the absence of unacceptable risk to ecological receptors in the Henby-Bouttown Creek System, the Henby-Bouttown Wetland System, Carneys Point ponds and historical ponds, and Carneys Point Uplands.
- Limited benthic habitat quality in the Henby-Bouttown Creek System resulting in depauperate benthic communities on-site and off-site beyond the influence of the site.
- A stable sediment environment in the Henby-Bouttown Creek System that maintains reducing conditions in sediments that mitigate the bioavailability and toxicity of metals, the primary constituent group of concern.
- Limited ecological exposure pathways in the manufacturing area due to absent or low quality habitats to support ecological receptor communities.

The integrated findings of the multiple ecological investigations used to develop the ecological conceptual site model presented in the previous sections support the recommendation of no further ecological investigation or remedial action in the Carneys Point area or the manufacturing area on the basis of ecological risk.

9.0 RFI Conclusions and Recommendations

This RFI report presents a comprehensive summary of data collected from prior RFI phases and associated investigations and integrates the data and information collected during the most recent 2013-14 RFI data gap investigation. This comprehensive dataset is used to support recommendations of NFA or CMS for SWMUs and AOCs. The overall goal of this RFI report is to demonstrate that the RFI phase has been completed for the site. In addition, this report presents a robust CSM that integrates site-specific physical features, nature and extent of site-related chemical constituents released to media, potential migration pathways, and potential receptor information.

9.1 Carneys Point Conclusions and Recommendations

The following bullets provide a summary of conclusions and recommendations for the Carneys Point area of the site:

- There are 28 SWMUs located in the Carneys Point area. Soil was stabilized or removed at many of these SWMUs. All of the Carneys Point SWMUs are recommended for an NFA, except SWMU 45-2, which is recommended for a CMS. The primary constituents with exceedances of NJNRDCSRS related to SWMU 45-2 are arsenic, lead, five PAHs, and 2,4-DNT. A CMS for SWMU 45-2 will evaluate remedial options to address potential soil exposure pathways in a manner consistent with future property use.
- Four areas within Carneys Point had constituents in groundwater that exceeded NJGWIIA. There are no groundwater plumes, and exceedances are sporadic and localized. In general, the primary impacts to B aquifer groundwater are metals; specifically, the metals that most frequently exceeded NJGWIIA are arsenic and lead.
- B aquifer groundwater has the potential to discharge to on-site surface-water bodies and the Delaware River. Potentially complete exposure pathways for human and ecological receptors were evaluated. Conclusions and recommendations are summarized in Section 9.3.
- B aquifer groundwater also has the potential to migrate downward into the C aquifer. Groundwater exceedances of NJGWIIA in the C aquifer were identified at a small number of locations across Carneys Point. Likewise, there are downward hydraulic gradients from the C and D aquifers to the D and E aquifers, respectively. However, D and E aquifer exceedances are very limited in number of constituents and locations of exceedances. Groundwater in the C, D, and E aquifers moves generally from the Carneys Point area toward the manufacturing area where C and D aquifer groundwater is captured by the IWS and E aquifer groundwater is contained (to the depth of site-related impacts) by the E aquifer recovery well system. Groundwater at the site is part of the site-wide CEA and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place.

9.2 Manufacturing Area Conclusions and Recommendations

The following bullets provide a summary of conclusions and recommendations for the manufacturing area of the site:

- There are 68 SWMUs and 11 AOCs located in the manufacturing area. Six SWMUs are not considered in this report (RCRA Part B Operating Units or USACE led); therefore, 62 is the total number considered in the manufacturing area. Soil was stabilized or removed at many of these SWMUs. All of the manufacturing area SWMUs are recommended for an NFA, except SWMUs 8, 39-1, and 40, which are recommended for a CMS for groundwater. AOCs 1 through 11 are recommended for an NFA for soil but collectively are recommended to be carried forward to a CMS for manufacturing area-wide groundwater. The extent of impacted groundwater across the manufacturing area encompasses areas beneath AOCs 1 through 11 (except for a small area of AOC 9) as well as most of SWMUs 8 and 40. For all SWMUs and AOCs, investigation of soil has been completed, and no further soil investigation is recommended.
- The CMS for manufacturing area-wide groundwater will address impacted groundwater as well as evaluate the feasibility of remediating significant sources to groundwater identified in this report. Initial CMS activities for SWMU 8 were completed with specific objectives to remediate sources to groundwater (URS, 2010d), but it is recommended that the SWMU 8 CMS be incorporated into the manufacturing area-wide CMS activities. It is also recommended that the CMS for SWMU 40 be incorporated into the manufacturing area-wide CMS activities. The CMS for SWMU 39-1 will be implemented separately according to recommendations in the *Garage Diesel Spill Groundwater Remedial Investigation and Remedial Action Selection Report* (URS, 2009). Additionally, B aquifer groundwater along the perimeter areas of AOCs 1, 2, and 3 will continue to be considered separately in conjunction with the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report* (Geosyntec, 2012). Also, a remedial action to address the on-property sediment of the Salem Canal south of the installed sheet-pile barrier will continue as described in the *Salem Canal Groundwater Remedial Action Progress and Sediment Investigation Status Report* (URS, 2013e).
- In soil, there are a wide variety of VOC and SVOC exceedances of NJNRDCSRS remaining, including benzene, chlorobenzene, PCE, TCE, 2,4-DNT, 2,6-DNT, and PAHs. Metal exceedances include antimony, arsenic, cadmium, lead and mercury. There was a limited number of exceedances of total PCBs. There were no exceedances of EPA Region 4 (2009) criteria for PFOA.

- In groundwater, there are approximately 100 VOCs and SVOCs detected at concentrations that exceeded of NJGWIIA in the B aquifer. These exceedances are widespread across the manufacturing area. The VOCs and SVOCs that had the highest exceedances most frequently in the B aquifer were:

1,2-Dibromoethane (EDB)	1,2-Dichloroethane	1,2-Dichlorobenzene
1,4-Dichlorobenzene	Benzene	Carbon Tetrachloride
Chlorobenzene	Tetrachloroethene	Toluene
Trichloroethene	Vinyl Chloride	Trichlorofluoromethane
1,1,2-Trichlorotrifluoroethane	1,2,4-Trichlorobenzene	2-Naphthylamine
2,4-Dinitrotoluene	4-Chloroaniline	Aniline
Benzo(a)Anthracene	Hexachlorobenzene	Nitrobenzene

  Metal exceedances of NJGWIIA included aluminum, antimony, arsenic, beryllium, chromium, iron, lead, manganese, and mercury and exceedances were wide-spread across the manufacturing area in the B aquifer. There were also some pesticide/total PCB exceedances in the B aquifer, but these exceedances are less frequent and spatially sporadic.

- DNAPL source zones are pervasive in the B aquifer across the manufacturing area and represent significant sources to groundwater. DNAPL is characterized as multi-component and heterogeneous. The majority of constituent mass (80 to 90%) occurs as residual DNAPL with 10 to 20% occurring as dissolved, sorbed, diffused, or mobile.

- B aquifer groundwater has the potential to discharge to on-site surface-water bodies and the Delaware River. Potentially complete exposure pathways to human and ecological receptors were evaluated. Conclusions and recommendations are summarized in Section 9.3.

- B aquifer groundwater has the potential to migrate downward into the C aquifer. Likewise, there are downward hydraulic gradients from the C and D aquifers to the D and E aquifers, respectively. Groundwater in the C and D aquifers is contained by the IWS across the entire manufacturing area. The low vertical hydraulic conductivity of the D/E aquitard as well as its significant thickness across most of the manufacturing area (e.g., greater than 20 feet thick) impedes that movement of groundwater from the D to E aquifer. Groundwater in the E aquifer is contained (to the depth of site-related impacts) by the E aquifer recovery well system. Groundwater at the site is part of the site-wide CEA and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place.

- The VOCs and SVOCs with exceedances in the C and D aquifers are a subset of those from the B aquifer. Detected concentrations in the C and D aquifers are typically the same order of magnitude but are one to two orders of magnitude lower than detected concentrations in the B aquifer. The detected concentrations in the E aquifer are typically of the same order of magnitude as the D aquifer; however, exceedances in the E aquifer are considered to be localized and specific to failing well casings. Concentrations of detected metals have similar trends as the VOCs/SVOCs with the B aquifer having the highest number of metals with exceedances and highest detected concentrations with decreases in these numbers in the C and D aquifers. Exceedances of pesticides/total PCBs are minimal in the C aquifer, and there are no exceedances in the D and E aquifers.

- Groundwater sampling for PFOA/PFCs includes locations in both the manufacturing area and Carneys Point. Groundwater detections for PFOA and PFOS were compared to the EPA 2009 Provisional Health Advisory for PFOA. There were no criteria for comparison of other PFC detections. There are exceedances for PFOA and PFOS.
- Constituents consistent with B aquifer groundwater were observed in sub-slab soil gas samples above generic NJNRSGSLs. However, industrial hygiene indoor air sampling conducted by the plant did not indicate any detections in indoor air. Therefore, vapor intrusion from groundwater to indoor air is not expected to be a concern. Regardless, to confirm the results and further evaluate the vapor intrusion pathway, additional indoor air sampling along with confirmatory sub-slab soil gas sampling is recommended during the CMS phase.

9.3 Site-Wide Human Health and Ecological Conclusions and Recommendations

Potential receptors and exposure points were evaluated for both human and ecological receptors as summarized in Section 8 (which references previous deliverables and approvals). The following bullets provide a summary of conclusions and recommendations from those evaluations.

- Given the site setting and land uses at and adjacent to the site, potential human receptors included on-site industrial workers, on-site construction/excavation workers, and recreational users of the Delaware River.
- Site-specific activity patterns and physical conditions that exist at the site and along the Delaware River were evaluated to determine whether potentially complete exposure pathways for these receptors can be reasonably expected to be significant (i.e., potentially “unacceptable”). Based on these evaluations, no significant potentially complete exposure pathways for human health were identified at this time, including vapor intrusion and groundwater discharge to the Delaware River. However, additional investigation of the vapor intrusion pathway is recommended. As additional data are collected during the corrective measure phase, this evaluation will continue to be refined.
- Comprehensive on-site and off-site ecological evaluations were completed. Potential migration pathways included historical process discharges, stormwater runoff, and a potential groundwater to surface-water connection from the B aquifer to surface-water bodies. Based on the on-site ecological investigation, the surface water, sediment/hydric soil, and sediment interstitial water exceedances of ecological benchmarks were carried forward for ecological risk evaluations. The integrated findings do not indicate unacceptable risks to ecological receptors in any exposure area evaluated in Carneys Point or the manufacturing area and support the recommendation of no further ecological investigation or remedial action at the site on the basis of ecological risk.

- The Salem Canal ecological evaluation identified exceedances of ecological benchmarks in sediment in a localized area within the canal. A remedial action to address the on-property sediment of the Salem Canal south of the installed sheet-pile barrier is under investigation as described in the *Salem Canal Groundwater Remedial Action Progress and Sediment Investigation Status Report* (URS, 2013e).
- The Delaware River ecological evaluation identified exceedances of ecological benchmarks in sediments and surface water in near-shore areas adjacent to AOCs 1, 2, and 3. There were no exceedances of ecological benchmarks in sediment and surface water in other areas adjacent to the Delaware River shoreline. As part of the *Delaware River Remedial Investigation Report*, no further ecological investigation was recommended in areas adjacent to AOCs 1,2, and 3 until the attainment of hydraulic control at the site perimeter is achieved (URS, 2011a).

9.4 Site-Wide RFI Complete

This report demonstrates that the RFI phase has been completed for the site. The Chambers Works SWMUs and AOCs have been fully investigated, the nature and extent of their impacts have been characterized, remediation has been performed as recommended, and RFI recommendations have been substantiated. Institutional controls are in place to prevent disturbance of soil (both surface and subsurface) such that on-site workers will not become exposed to contaminants in excess of screening criteria. Groundwater at the site is part of the site-wide CEA and not used for any purpose. Containment systems will continue to operate, and groundwater will continue to be monitored per the site-wide monitoring programs that are in-place. The containment and monitoring programs will continue to be documented in the semi-annual DGW reports.

It is expected that following the RFI phase, corrective measures will be evaluated as the next phase under the RCRA program. A summary of the recommended CMS work is as follows.

CMS	Description
SWMU 39-1	The proposed remedy of MNA for groundwater will be implemented according to the recommendations provided in the *Garage Diesel Spill Groundwater Remedial Investigation and Remedial Action Selection Report*.
SWMU 45-2	There were several metals in soil at concentrations exceeding the impact to groundwater and direct contact soil remediation standards. Remedial options will be evaluated to address potential receptor pathways in a manner consistent with future property use.
Manufacturing Area-Wide	Impacted groundwater exceeding NJGWIIA extends across the manufacturing area, encompassing areas beneath AOCs 1 through 10 (except for a small area of AOC 9) as well as most of SWMUs 8, 40, and AOC 11. The IWS will be a major component of the final corrective measure as well as continued groundwater monitoring and DNAPL recovery as part of the DNAPL recovery program. Additionally, the feasibility of remediating significant sources to groundwater will be evaluated, and further investigation of the vapor intrusion pathway will be conducted.

10.0 References

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Tables

Table 4-1
Summary of Field Investigation Activities and Objectives
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Map ID	Description	Stratigraphy	Soil Quality	B Aquifer GW Quality	C Aquifer GW Quality	D Aquifer GW Quality	DNAPL B	DNAPL C	DNAPL D	B Aquifer GW Head	C Aquifer GW Head	D Aquifer GW Head	Diffusion	Geotechnical Soil Analysis	Data Objective
C06-M01D	Well	--	--	--	--	Y	--	--	--	--	--	Y	--	--	Require D groundwater quality and head between AOC source area and IWS well; this needs to be coordinated with existing C06-M01C and its boring log.
D13-Strat	Boring	Y	--	--	--	--	--	--	--	--	--	--	--	--	B/C is potentially thin – lack of data; data will substantiate B/C thickness.
D15-M01D	Well	Y	--	--	--	Y	--	--	--	--	--	Y	--	Y	Existing C well along perimeter; determine stratigraphy, D groundwater quality and head along perimeter.
E11-Strat	Boring	Y	--	--	--	--	--	--	--	--	--	--	--	--	Strat to D/E.
E14B	Boring/HP	Y	--	Y	--	--	--	--	--	--	--	--	--	--	DNAPL in Upper B; determine if Middle B is present – strat to B/C and groundwater quality in Lower B.
E14-M01C/D	Well	Y	--	--	Y	Y	--	--	--	--	Y	Y	Y	--	Determine groundwater quality and head to improve data density per variogram analysis. Also, diffusion samples.
F06-Strat	Boring	Y	--	--	--	--	--	--	--	--	--	--	--	--	Strat to D/E.
F09-M03B	Well	--	--	Y	--	--	--	--	--	--	--	--	--	--	This well was added during the field investigation due to DNAPL encountered during the drilling process.
F09-M01C/D	Well	--	--	--	Y	Y	--	Y	Y	--	Y	Y	Y	--	B/C is thick; DNAPL is indicated in Lower B; no groundwater quality data in C. Also, this location is between AOC source area and IWS. Determine groundwater quality and head in C and D. Also, diffusion samples.
G08-M01C	Well	--	--	--	--	--	--	--	--	--	Y	--	--	--	Install monitoring well within 50-100 feet of IWS pumping well; data will improve drawdown cones around the pumping well. Data will provide a better means to evaluate vertical/horizontal flow components toward the pumping well.
G12-M01C/D	Well	Y	--	--	Y	Y	--	--	--	--	Y	Y	--	Y	Groundwater quality and head between AOC source area and IWS well.
H07-M01C/D	Well	Y	--	--	Y	Y	--	--	--	--	Y	Y	--	--	Groundwater quality and head between AOC source area and IWS well.
H13-M01C	Well	Y	--	--	Y	--	--	--	--	--	Y	--	--	--	B/C is thin; DNAPL is indicated in Lower B; no groundwater quality data in C. Determine groundwater quality in C.
I10B	Boring/HP	Y	--	Y	--	--	Y	--	--	--	--	--	--	--	DNAPL indication in Upper B does not have good groundwater data control; middle B is thick. Groundwater quality in Upper B.
I12-Strat	Boring	Y	--	--	--	--	--	--	--	--	--	--	--	--	D/E clay not well defined in the area of I13.
I15-M01C/D	Well	Y	--	--	Y	Y	--	--	--	--	Y	Y	--	--	Groundwater quality and head between AOC source area and IWS well.
K06-M01C	Well	--	--	--	--	--	--	--	--	--	Y	--	Y	Y	Install monitoring well within 50-100 feet of IWS pumping well; data will improve drawdown cones around the pumping well. Data will provide a better means to evaluate vertical/horizontal flow components toward the pumping well. Also, diffusion samples.
K11-M01C	Well	--	--	--	Y	--	--	Y	--	--	Y	--	--	--	B/C is thick; DNAPL is indicated in Lower B; no groundwater quality data in C. Determine groundwater quality in C.
K17-M01C	GW Sample	--	--	--	Y	--	--	--	--	--	--	--	--	--	Groundwater quality – along with other wells in the area.
L15-Strat	Boring	Y	--	--	--	--	--	--	--	--	--	--	--	--	Strat to D/E.
M09-M01C/D	Well	--	--	--	Y	Y	--	Y	Y	--	Y	Y	--	--	At L09 cluster, groundwater concentration in D is greater than C; may be attributable to source in C at N08. Groundwater quality and head relative to L09/N08.
M14-M01C	Well	--	--	--	--	--	--	--	--	--	Y	--	--	--	Install monitoring well within 50-100 feet of IWS pumping well; data will improve drawdown cones around the pumping well. Data will provide a better means to evaluate vertical/ horizontal flow components toward the pumping well.
O08-M01B	GW Sample	--	--	Y	--	--	--	--	--	--	--	--	--	--	Visual DNAPL in the area – no groundwater quality data; determine groundwater quality.
O16-P01B	GW Sample	--	--	Y	--	--	--	--	--	--	--	--	--	--	Groundwater quality to determine the edge of the groundwater plume.
P15B	HP	--	--	Y	--	--	--	--	--	--	--	--	--	--	Determine groundwater quality to define plume boundary in B.
P15-M01C	Well	--	--	--	Y	--	--	--	--	--	Y	--	--	--	Determine groundwater quality in C to improve data density per variogram analysis.
SWMU 55-1-1	Soil Sample	--	Y	--	--	--	--	--	--	--	--	--	--	--	Data gap review – SWMU 55-1. Determine impact of A ditch to bottom of A zone (vadose zone).
SWMU 55-1-2	Soil Sample	--	Y	--	--	--	--	--	--	--	--	--	--	--	Data gap review – SWMU 55-1. Determine impact of A ditch to bottom of A zone (vadose zone).
SWMU 55-4-1/Strat	Boring/Soil Sample	Y	Y	--	--	--	--	--	--	--	--	--	--	--	D/E Clay not well defined in the area of D15/E14. CID Review data gap; collect shallow soil sample for SWMU 55-4 near P2-554-8.

Note:
Y = Denotes main objectives of RFI investigation for each location
-- = Objective not performed for each location

Table 4-2
Summary of Well Construction Details
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Well	Drilling Method	Start Date	Finish Date	Total Depth Drilled (ft bgs)	Finished Well Depth (ft bgs)	Screen Length (ft)	Well Diameter (inches)	Well Material	Slot Size (inches)	Sand Pack Interval (ft bgs)	Grouted Interval (ft bgs)	Grouting Method	Well Surface
C06-M01D	Sonic	10/2/2013	10/3/2013	104	98	10	2	PVC	0.01	85-104	0-85	Tremie	Stick-up
D15-M01D	Sonic	10/23/2013	10/23/2013	54	49	10	2	PVC	0.01	36-54	0.5-36	Tremie	Flush mount
E14-M01C	Sonic	1/14/2014	1/15/2014	35	35	5	2	SS	0.01	27-35	0-27	Tremie	Stick-up
E14-M01D	Sonic	1/13/2014	1/14/2014	54	46	10	2	SS	0.01	33-54	0-33	Tremie	Stick-up
F09-M01C	Sonic	12/20/2013	12/20/2013	59	59	10	2	PVC	0.01	46-59	0-46	Tremie	Stick-up
F09-M01D	Sonic	12/18/2013	12/19/2013	104	93	10	2	PVC	0.01	80-104	0-80	Tremie	Stick-up
F09-M03B	Sonic	10/15/2013	10/15/2013	34	31	10	2	SS	0.01	18-34	0-18	Tremie	Stick-up
G08-M01C	Sonic	10/11/2013	10/11/2013	54	54	10	2	PVC	0.01	41-54	0-41	Tremie	Stick-up
G12-M01C	Sonic	10/21/2013	10/21/2013	54	54	10	2	PVC	0.01	40-54	0.5-40	Tremie	Flush mount
G12-M01D	Sonic	10/16/2013	10/17/2013	94	88	10	2	PVC	0.01	76-94	0.5-76	Tremie	Flush mount
H07-M01C	Sonic	10/22/2013	10/22/2013	76	76	10	2	PVC	0.01	63-76	0-63	Tremie	Stick-up
H07-M01D	Sonic	10/9/2013	10/10/2013	104	102	10	2	PVC	0.01	89-104	0-89	Tremie	Stick-up
H13-M01D	Sonic	1/9/2014	1/10/2014	64	58	10	2	PVC	0.01	45-64	0-45	Tremie	Stick-up
I15-M01C	Sonic	10/31/2013	10/31/2013	34	34	5	2	SS	0.01	26-34	0-26	Tremie	Stick-up
I15-M01D	Sonic	10/30/2013	10/30/2013	69	67	10	2	SS	0.01	54-69	0-54	Tremie	Stick-up
K06-M01C	Sonic	10/7/2013	10/7/2013	94	90	10	2	SS	0.01	77-94	0-77	Tremie	Stick-up
K11-M01C	Sonic	10/28/2013	10/28/2013	69	62	10	2	PVC	0.01	50-69	0-50	Tremie	Stick-up
M09-M01C	Sonic	10/28/2013	10/28/2013	79	80	10	2	PVC	0.01	67-79	0-67	Tremie	Stick-up
M09-M01D	Sonic	10/24/2013	10/25/2013	124	119	10	2	PVC	0.01	107-124	0-107	Tremie	Stick-up
M14-M01C	Sonic	12/16/2013	12/17/2013	74	69	10	2	PVC	0.01	56-74	0-56	Tremie	Stick-up
P15-M01C	Sonic	12/11/2013	12/13/2013	74	66	10	2	PVC	0.01	53-74	0.5-53	Tremie	Flush mount

Table 4-3
Summary of Slug Test Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Well ID	Soil Description	Aquifer	Screen Diameter (inches)	Well Diameter (inches)	Screen Length (ft)	Depth to Top of Screen (ft bgs)	Bore Hole Radius (inches)	Depth to Water (ft bgs)	Hydraulic Conductivity (ft/day)
C10-M03B	medium to very coarse sand and fine gravel	B	2	2	5	15	6	8.74	13
F06-M02B	coarse sand and gravels	B	2	2	10	17	6	6.41	11
F16-M01B	fine to coarse sand and gravel, little silt	B	4	4	5	15	8	9.57	40
G15-M01B	fine to coarse sand, some fine to coarse gravel, little silt	B	4	4	5	17	8	6.78	35
P07-M01B	fine to medium sand, clayey sand	B	2	2	10	27	6	8.70	26
M09-M01B	fine to medium sand, gravelly sand, silt	B	2	2	10	36	6	16.07	34
M10-M04B	fine to medium sand	B	2	2	10	20	6	20.90	17
Q13-M02B	fine sand	B	6	6	10	16	10	9.80	31
Geometric Mean									24
C10-M01C	fine to coarse sand and gravel	C	2	2	10	30	6	12.27	149
D15-M01C	silty f sand to c gravel, clay	C	2	2	5	25	6	5.66	3
E14-M01C	fine to medium sand	C	2	2	5	30	6	8.85	8
H07-M01C	medium to very coarse sand, some gravel and cobbles	C	2	2	10	66	6	16.08	82
Q13-M01C	coarse sand to gravels	C	6	6	10	60	10	11.88	2
P06-M02C	medium to coarse sand	C	4	4	10	52	8	7.29	84
M09-M01C	coarse to very coarse sands and gravels	C	2	2	10	70	6	22.65	212
K12-M01C	gravels	C	6	6	5	54	10	3.26	22
I15-M01C	medium to coarse sands and clays	C	2	2	10	56	6	10.66	9
Geometric Mean									23
C06-M01D	coarse sand	D	2	2	10	88	6	13.82	80
C11-M02D	poor quality boring log, no description indicated	D	4	4	10	46	8	9.86	38
D15-M01D	medium to coarse sand	D	2	2	10	38	6	5.63	13
E14-M01D	fine to coarse sands, clay and sand layers	D	2	2	10	38	6	9.03	1
P06-M01D	coarse sand and gravels	D	6	6	5	103	10	9.15	41
Q13-M01D	coarse sand	D	6	6	10	80	10	12.91	27
M09-M01D	fine to medium sands	D	2	2	10	109	6	23.18	34
K12-M01D	sand and stones	D	6	6	5	80	10	9.79	20
I15-M01D	fine to medium sand and silty sands	D	2	2	10	56	6	13.00	5
H07-M01D	medium to very coarse sands	D	2	2	10	36	6	16.12	34
Geometric Mean									19

Table 4-4a
Summary of Vadose Zone Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	NJ IGWSRS	Field Sample ID Sample Depth Sample Date NJ NRDCSRS	INTCD-SWMU55-1-1 6.0'-7.0' 12/05/2013	INTCD-SWMU55-1-2 5.7'-6.7' 12/05/2013	INTCD-SWMU55-4-1 1.8'-2.8' 01/16/2014
Volatile Organic Compounds						
1,1,1-Trichloroethane	UG/KG	200	4,200,000	<1U	<1U	<1U
1,1,2,2-Tetrachloroethane	UG/KG	5	3,000	<1U	<1U	<1U
1,1,2-Trichloroethane	UG/KG	10	6,000	<1U	<1U	<1U
1,1-Dichloroethane	UG/KG	200	24,000	<1U	<1U	<1U
1,1-Dichloroethene	UG/KG	5	150,000	<1U	<1U	<1U
1,2-Dibromo-3-Chloropropane	UG/KG	5	200	<2U	<2U	<2U
1,2-Dibromoethane (EDB)	UG/KG	5	40	<1U	<1U	<1U
1,2-Dichlorobenzene	UG/KG	11,000	59,000,000	<1U	4J	<1U
1,2-Dichloroethane	UG/KG	5	3,000	<1U	<1U	<1U
1,2-Dichloropropane	UG/KG	5	5,000	<1U	<1U	<1U
1,3-Dichlorobenzene	UG/KG	12,000	59,000,000	<1U	3J	<1U
1,4-Dichlorobenzene	UG/KG	1,000	13,000	<1U	7	<1U
Acetone	UG/KG	12,000		10J	31	22
Benzene	UG/KG	5	5,000	<0.5U	<0.5U	<0.5U
Bromodichloromethane	UG/KG	5	3,000	<1U	<1U	<1U
Bromoform	UG/KG	20	280,000	<1U	<1U	<1U
Carbon Disulfide	UG/KG	4,000	110,000,000	<1U	3J	<1U
Carbon Tetrachloride	UG/KG	5	2,000	<1U	<1U	<1U
Chlorobenzene	UG/KG	400	7,400,000	<1U	6	<1U
Chlorodibromomethane	UG/KG	5	8,000	<1U	<1U	<1U
Chloroform	UG/KG	200	2,000	<1U	<1U	<1U
cis-1,2 Dichloroethene	UG/KG	200	560,000	<1U	<1U	<1U
Ethyl Chloride	UG/KG		1,100,000	<2U	<2U	<2U
Ethylbenzene	UG/KG	8,000	110,000,000	<1U	<1U	<1U
Methyl Bromide	UG/KG	30	59,000	<2U	<2U	<2U
Methyl Chloride	UG/KG		12,000	<2U	<2U	<2U
Methyl Ethyl Ketone	UG/KG	600	44,000,000	<4U	<4U	<4U
Methylene Chloride	UG/KG	7	97,000	<2U	<2U	<2U
Styrene	UG/KG	2,000	260,000	<1U	<1U	<1U
Tetrachloroethene	UG/KG	5	5,000	<1U	<1U	<1U
Toluene	UG/KG	4,000	91,000,000	<1U	<1U	<1U
trans-1,2-Dichloroethene	UG/KG	400	720,000	<1U	<1U	<1U
Trichloroethene	UG/KG	7	20,000	<1U	<1U	<1U
Vinyl Chloride	UG/KG	5	2,000	<1U	<1U	<1U
Xylenes	UG/KG	12,000	170,000,000	<1U	<1U	<1U

Table 4-4a
Summary of Vadose Zone Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	NJ IGWSRS	Field Sample ID Sample Depth Sample Date NJ NRDCSRS	INTCD-SWMU55-1-1 6.0'-7.0' 12/05/2013	INTCD-SWMU55-1-2 5.7'-6.7' 12/05/2013	INTCD-SWMU55-4-1 1.8'-2.8' 01/16/2014
Semi-Volatile Organic Compounds						
1,2,4-Trichlorobenzene	UG/KG	400	820,000	480	<18U	53
2,4,5-Trichlorophenol	UG/KG	44,000	68,000,000	<190U	<18U	<19U
2,4,6-Trichlorophenol	UG/KG	200	74,000	<190U	<18U	<19U
2,4-Dichlorophenol	UG/KG	200	2,100,000	<190U	<18U	<19U
2,4-Dimethylphenol	UG/KG	700	14,000,000	<190U	<18U	<19U
2,4-Dinitrophenol	UG/KG	300	1,400,000	<3,300U	<330U	<340U
2,4-Dinitrotoluene	UG/KG	200	3,000	<740U	<73U	<77U
2,6-Dinitrotoluene	UG/KG	200	3,000	<190U	<18U	<19U
2-Chlorophenol	UG/KG	500	2,200,000	<190U	<18U	<19U
2-Methylnaphthalene	UG/KG	5,000	2,400,000	72J	<4U	7J
2-Methylphenol (O-Cresol)	UG/KG		3,400,000	<190U	<18U	<19U
2-Nitroaniline	UG/KG		23,000,000	<190U	<18U	<19U
3,3'-Dichlorobenzidine	UG/KG	200	4,000	<1,100U	<110U	<110U
4,6-Dinitro-2-Methylphenol	UG/KG	300	68,000	<1,900U	<180U	<190U
4-Chloroaniline	UG/KG	200		<190U	<18U	<19U
4-Methylphenol (P-Cresol)	UG/KG		340,000	<190U	<18U	<19U
Acenaphthene	UG/KG	74,000	37,000,000	<37U	<4U	<4U
Acenaphthylene	UG/KG		300,000,000	<37U	<4U	4J
Anthracene	UG/KG	1,500,000	30,000,000	<37U	<4U	9J
Benzo(A)Anthracene	UG/KG	500	2,000	<37U	<4U	25
Benzo(B)Fluoranthene	UG/KG	2,000	2,000	62J	<4U	37
Benzo(G,H,I)Perylene	UG/KG		30,000,000	<37U	<4U	17J
Benzo(K)Fluoranthene	UG/KG	16,000	23,000	<37U	<4U	16J
Benzo[A]Pyrene	UG/KG	200	200	<37U	<4U	20J
Bis(2-Chloro-1-Methylethyl) Ether	UG/KG	3,000	67,000	<190U	<18U	<19U
Bis(2-Chloroethyl)Ether	UG/KG	200	2,000	<190U	<18U	<19U
Bis(2-Ethylhexyl)Phthalate	UG/KG	790,000	140,000	<740U	<73U	<77U
Butyl Benzyl Phthalate	UG/KG	150,000	14,000,000	<740U	<73U	<77U
Chrysene	UG/KG	52,000	230,000	<37U	<4U	49
Di-N-Butyl Phthalate	UG/KG	620,000	68,000,000	<740U	<73U	<77U
Dibenz(A,H)Anthracene	UG/KG	500	200	<37U	<4U	<4U
Diethyl Phthalate	UG/KG	57,000	550,000,000	<740U	<73U	<77U
Fluoranthene	UG/KG	840,000	24,000,000	54J	<4U	47
Fluorene	UG/KG	110,000	24,000,000	<37U	<4U	7J
Hexachlorobenzene	UG/KG	200	1,000	<37U	<4U	<4U
Hexachlorobutadiene	UG/KG	600	25,000	<190U	<18U	<19U
Hexachlorocyclopentadiene	UG/KG	210,000	110,000	<1,900U	<180U	<190U

Table 4-4a
Summary of Vadose Zone Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
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			Field Sample ID	**INTCD-SWMU55-1-1**	**INTCD-SWMU55-1-2**	**INTCD-SWMU55-4-1**
			Sample Depth	**6.0'-7.0'**	**5.7'-6.7'**	**1.8'-2.8'**
			Sample Date	**12/05/2013**	**12/05/2013**	**01/16/2014**
Analyte	**Units**	**NJ IGWSRS**	**NJ NRDCSRS**			
Hexachloroethane	UG/KG	200	140,000	<370U	<37U	<38U
Indeno (1,2,3-CD) Pyrene	UG/KG	5,000	2,000	<37U	<4U	12J
Isophorone	UG/KG	200	2,000,000	<190U	<18U	<19U
N-Dioctyl Phthalate	UG/KG	3,300,000	27,000,000	<740U	<73U	<77U
N-Nitrosodi-N-Propylamine	UG/KG	200	300	<190U	<18U	<19U
N-Nitrosodiphenylamine	UG/KG	200	390,000	<190U	<18U	<19U
Naphthalene	UG/KG	16,000	17,000	60J	<4U	12J
Nitrobenzene	UG/KG	200	340,000	<190U	<18U	<19U
Pentachlorophenol	UG/KG	300	10,000	<370U	<37U	<38U
Phenanthrene	UG/KG		300,000,000	<37U	<4U	25
Phenol	UG/KG	5,000	210,000,000	<190U	22J	<19U
Pyrene	UG/KG	550,000	18,000,000	55J	<4U	52
Metals						
Aluminum	MG/KG	3,900		9,850	6,650	8,540
Antimony	MG/KG	6	450	3.09	<0.811U	<0.845U
Arsenic	MG/KG	19	19	7.64	10.5	3.01
Barium	MG/KG	1,300	59,000	127J	13.8J	43.1
Beryllium	MG/KG	1	140	0.321J	0.791	0.282J
Cadmium	MG/KG	1	78	<0.0825U	<0.0833U	<0.0868U
Cobalt	MG/KG	59	590	3.83	2.69	2.71J
Copper	MG/KG	7,300	45,000	26.8J	4.54J	6.12
Lead	MG/KG	59	800	404J	9.41J	69.0J
Manganese	MG/KG	42	5,900	87.4J	26.8J	45.8
Mercury	MG/KG	0	65	2.55	<0.0110U	<0.0114U
Nickel	MG/KG	31	23,000	24.5J	8.34J	6.24
Selenium	MG/KG	7	5,700	<0.869U	<0.876U	0.918J
Silver	MG/KG	1	5,700	<0.185U	<0.186U	<0.194U
Thallium	MG/KG	3	79	<0.565U	0.767J	<0.594U
Vanadium	MG/KG		1,100	39.5J	31.8J	16.5
Zinc	MG/KG	600	110,000	47.3	30	48.7J

Notes:
NJ IGWSRS = Impact to Groundwater Soil Remediation Standards
NJ NRDCSRS = Non-Residential Direct Contact Soil Remediation Standards
J = Estimated Value
U = Not detected
< = Not detected at stated reporting limit
🟨 = Exceedance of Remediation Standards

Table 4-4b
Summary of Diffusion Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	Sample ID Sample Date Sample Depth NJ NRDCSRS	INTCD-E14-M01D 01/14/2014 12.75'-13'	INTCD-E14-M01D 01/14/2014 13'-13.25'	INTCD-E14-M01D 01/14/2014 13.25'-13.5'	INTCD-E14-M01D 01/14/2014 13.5'-13.75'	INTCD-E14-M01D 01/14/2014 24.75'-25'	INTCD-E14-M01D 01/14/2014 25'-25.25'	INTCD-E14-M01D 01/14/2014 25.25'-25.5'	INTCD-E14-M01D 01/14/2014 25.5'-25.75'	INTCD-E14-M01D 01/14/2014 45.5'-45.75'	INTCD-E14-M01D 01/14/2014 45.75'-46'
Semi Volatile Organic Compounds												
1,1,1-Trichloroethane	UG/KG	4,200,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,1,2,2-Tetrachloroethane	UG/KG	3,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,1,2-Trichloroethane	UG/KG	6,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,1-Dichloroethane	UG/KG	24,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,1-Dichloroethene	UG/KG	150,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,2-Dibromo-3-Chloropropane	UG/KG	200	<2U	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
1,2-Dibromoethane (EDB)	UG/KG	40	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,2-Dichlorobenzene	UG/KG	59,000,000	40	160J	110J	140J	550	110J	64J	82J	<1U	<1U
1,2-Dichloroethane	UG/KG	3,000	13	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,2-Dichloropropane	UG/KG	5,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,3-Dichlorobenzene	UG/KG	59,000,000	2J	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
1,4-Dichlorobenzene	UG/KG	13,000	43	210J	140J	170J	1,600	340	190J	230J	<1U	<1U
Acrolein	UG/KG	1,000	<20U	<1,100U	<1,000U	<980U	<1,100U	<990U	<970U	<1,000U	<20U	<20U
Acrylonitrile	UG/KG	3,000	<4U	<210U	<200U	<200U	<210U	<200U	<190U	<200U	<4U	<4U
Benzene	UG/KG	5,000	480	2,800	1,700	2,300	<27U	<25U	<24U	<25U	<0.5U	<0.5U
Bromodichloromethane	UG/KG	3,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Bromoform	UG/KG	280,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Carbon Disulfide	UG/KG	110,000,000	5J	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Carbon Tetrachloride	UG/KG	2,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Chlorobenzene	UG/KG	7,400,000	740	3,100	1,800	2500	11,000	3,400	2,700	3400	12	<1U
Chlorodibromomethane	UG/KG	8,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Chloroform	UG/KG	2,000	48	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
cis-1,2 Dichloroethene	UG/KG	560,000	8	71J	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Dichlorodifluoromethane	UG/KG	230,000,000	71	<110U	<100U	<98U	<110U	<99U	<97U	<100U	3J	<2U
Ethyl Chloride	UG/KG	1,100,000	<2U	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
Ethylbenzene	UG/KG	110,000,000	88	420	240J	380	<53U	<49U	<48U	<50U	<1U	<1U
Methyl Bromide	UG/KG	59,000	<2U	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
Methyl Chloride	UG/KG	12,000	<2U	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
Methyl Ethyl Ketone	UG/KG	44,000,000	<4U	<210U	<200U	<200U	<210U	<200U	<190U	<200U	<4U	<4U
Methylene Chloride	UG/KG	97,000	9	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
Naphthalene	UG/KG	17,000	54J	--	--	--	--	--	--	--	--	--
Nitrobenzene	UG/KG	340,000	--	--	--	--	--	--	--	--	--	--
Styrene	UG/KG	260,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Tetrachloroethene	UG/KG	5,000	16	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Toluene	UG/KG	91,000,000	310	530	230J	380	<53U	<49U	<48U	<50U	<1U	<1U
trans-1,2-Dichloroethene	UG/KG	720,000	<1U	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Trichloroethene	UG/KG	20,000	1J	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Trichlorofluoromethane	UG/KG	340,000,000	<2U	<110U	<100U	<98U	<110U	<99U	<97U	<100U	<2U	<2U
Vinyl Chloride	UG/KG	2,000	2J	<54U	<51U	<49U	<53U	<49U	<48U	<50U	<1U	<1U
Xylenes	UG/KG	170,000,000	580	2,600	1,600	2,500	<53U	<49U	<48U	<50U	<1U	<1U

Notes:
NJ NRDCSRS = Non Residential Direct Contact Soil
J = Estimated Value
U = Not detected
< = Not detected at stated reporting limit
🟨 = Exceedance of Remediation Standards

Table 4-4b
Summary of Diffusion Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	Sample ID Sample Date Sample Depth NJ NRDCSRS	INTCD-E14-M01D 01/14/2014 46'-46.25'	INTCD-E14-M01D 01/14/2014 46.25'-46.5'	INTCD-F09-M03B 10/15/2013 29.5'-30'	INTCD-F09-M03B 10/15/2013 30'-30.25'	INTCD-F09-M03B 10/15/2013 30.25'-30.5'	INTCD-F09-M03B 10/15/2013 30.5'-30.75'	INTCD-K06-M01C 10/07/2013 14.25'-14.75'	INTCD-K06-M01C 10/07/2013 14.75'-15'	INTCD-K06-M01C 10/07/2013 15'-15.25'	INTCD-K06-M01C 10/07/2013 15.25'-15.5'
Semi Volatile Organic Compounds												
1,1,1-Trichloroethane	UG/KG	4,200,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5300U	<5100U	<540U	<300U
1,1,2,2-Tetrachloroethane	UG/KG	3,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5300U	<5100U	<540U	<300U
1,1,2-Trichloroethane	UG/KG	6,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5300U	<5100U	<540U	<300U
1,1-Dichloroethane	UG/KG	24,000	<1U	<0.9U	<89U	<84U	2J	<79U	<5,300U	<5,100U	<540U	<300U
1,1-Dichloroethene	UG/KG	150,000	<1U	<0.9U	<89U	<84U	7J	<79U	<5,300U	<5,100U	<540U	<300U
1,2-Dibromo-3-Chloropropane	UG/KG	200	<2U	<2U	<180U	<170U	<3U	<160U	<11,000U	<10,000U	<1,100U	<590U
1,2-Dibromoethane (EDB)	UG/KG	40	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
1,2-Dichlorobenzene	UG/KG	59,000,000	<1U	<0.9U	1,800,000	110,000	5,300	77,000	2,600,000	5,500,000	290,000	250,000
1,2-Dichloroethane	UG/KG	3,000	<1U	<0.9U	260J	<84U	17	<79U	<5,300U	<5,100U	<540U	<300U
1,2-Dichloropropane	UG/KG	5,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
1,3-Dichlorobenzene	UG/KG	59,000,000	<1U	<0.9U	1,200	<84U	20	<79U	91,000	180,000	11,000	9,400
1,4-Dichlorobenzene	UG/KG	13,000	<1U	<0.9U	200,000	10,000	640	7,900	420,000	840,000	54,000	47,000
Acrolein	UG/KG	1,000	<20U	<18U	<1,800U	<1,700U	<32U	<1,600U	<110,000U	<100,000U	<11000U	<5,900U
Acrylonitrile	UG/KG	3,000	<4U	<4U	<360U	<340U	<6U	<320U	<21,000U	<2,1000U	<2,200U	<1,200U
Benzene	UG/KG	5,000	<0.5U	<0.5U	33,000	3,300	1,100	2,600	<2,600U	<2,600U	<270U	<150U
Bromodichloromethane	UG/KG	3,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Bromoform	UG/KG	280,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Carbon Disulfide	UG/KG	110,000,000	<1U	<0.9U	410J	<84U	19	<79U	<5,300U	<5,100U	<540U	<300U
Carbon Tetrachloride	UG/KG	2,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Chlorobenzene	UG/KG	7,400,000	<1U	<0.9U	510,000	31,000	2,000	22,000	54,000	67,000	5,300	4,500
Chlorodibromomethane	UG/KG	8,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Chloroform	UG/KG	2,000	<1U	<0.9U	18,000	1,600	140J	1,300	<5,300U	<5,100U	<540U	<300U
cis-1,2 Dichloroethene	UG/KG	560,000	<1U	<0.9U	290J	<84U	14	<79U	<5,300U	<5,100U	<540U	<300U
Dichlorodifluoromethane	UG/KG	230,000,000	<2U	<2U	<180U	<170U	4J	<160U	<11,000U	<10,000U	<1,100U	<590U
Ethyl Chloride	UG/KG	1,100,000	<2U	<2U	<180U	<170U	<3U	<160U	<11,000U	<10,000U	<1,100U	<590U
Ethylbenzene	UG/KG	110,000,000	<1U	<0.9U	310J	<84U	10	<79U	<5,300U	<5,100U	<540U	<300U
Methyl Bromide	UG/KG	59,000	<2U	<2U	<180U	<170U	<3U	<160U	<11,000U	<10,000U	<1,100U	<590U
Methyl Chloride	UG/KG	12,000	<2U	<2U	<180U	<170U	<3U	<160U	<11,000U	<10,000U	<1,100U	<590U
Methyl Ethyl Ketone	UG/KG	44,000,000	<4U	<4U	<360U	<340U	<6U	<320U	<21,000U	<21,000U	<2,200U	<1,200U
Methylene Chloride	UG/KG	97,000	<2U	<2U	530	220J	190	180J	<11,000U	<10,000U	<1,100U	<590U
Naphthalene	UG/KG	17,000	--	--	33,000J	--	11J	1,800J	--	--	--	--
Nitrobenzene	UG/KG	340,000	--	--	53,000J	--	1,100J	2,200J	--	--	--	--
Styrene	UG/KG	260,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Tetrachloroethene	UG/KG	5,000	<1U	<0.9U	4,600	320J	180	240J	<5,300U	<5,100U	<540U	<300U
Toluene	UG/KG	91,000,000	<1U	<0.9U	4,200	280J	150	220J	<5,300U	<5,100U	<540U	<300U
trans-1,2-Dichloroethene	UG/KG	720,000	<1U	<0.9U	<89U	<84U	2J	<79U	<5,300U	<5,100U	<540U	<300U
Trichloroethene	UG/KG	20,000	<1U	<0.9U	7,900	590	400	460	<5,300U	<5,100U	<540U	<300U
Trichlorofluoromethane	UG/KG	340,000,000	<2U	<2U	<180U	<170U	<3U	<160U	<11,000U	<10,000U	<1,100U	<590U
Vinyl Chloride	UG/KG	2,000	<1U	<0.9U	<89U	<84U	<2U	<79U	<5,300U	<5,100U	<540U	<300U
Xylenes	UG/KG	170,000,000	<1U	<0.9U	1,800	87J	53	<79U	<5,300U	<5,100U	<540U	<300U

Notes:
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Table 4-4b
Summary of Diffusion Soil Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	Sample ID Sample Date Sample Depth NJ NRDCSRS	INTCD-K06-M01C 10/07/2013 24.1'-24.6'	INTCD-K06-M01C 10/07/2013 24.6'-24.85'	INTCD-K06-M01C 10/07/2013 24.85'-25.1'	INTCD-K06-M01C 10/07/2013 25.1'-25.35'	INTCD-K06-M01C 10/07/2013 53.5'-54'	INTCD-K06-M01C 10/07/2013 54'-54.25'	INTCD-K06-M01C 10/07/2013 54.25'-54.5'	INTCD-K06-M01C 10/07/2013 54.5'-54.75'
Semi Volatile Organic Compounds										
1,1,1-Trichloroethane	UG/KG	4,200,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,1,2,2-Tetrachloroethane	UG/KG	3,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,1,2-Trichloroethane	UG/KG	6,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,1-Dichloroethane	UG/KG	24,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,1-Dichloroethene	UG/KG	150,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,2-Dibromo-3-Chloropropane	UG/KG	200	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
1,2-Dibromoethane (EDB)	UG/KG	40	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,2-Dichlorobenzene	UG/KG	59,000,000	13	19	<1U	6	70J	62,000	100,000	170,000
1,2-Dichloroethane	UG/KG	3,000	<1U	<1U	<1U	<1U	3J	<150U	<170U	<360U
1,2-Dichloropropane	UG/KG	5,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
1,3-Dichlorobenzene	UG/KG	59,000,000	<1U	<1U	<1U	<1U	3J	1,200	1,800	4,500
1,4-Dichlorobenzene	UG/KG	13,000	2J	3J	<1U	<1U	18J	9,400	13,000	28,000
Acrolein	UG/KG	1,000	<22U	<23U	<21U	<22U	<22U	<2,900U	<3,400U	<7,200U
Acrylonitrile	UG/KG	3,000	<4U	<5U	<4U	<4U	<4U	<590U	<670U	<1,400U
Benzene	UG/KG	5,000	<0.5U	<0.6U	<0.5U	<0.5U	<0.5U	170J	170J	<180U
Bromodichloromethane	UG/KG	3,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Bromoform	UG/KG	280,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Carbon Disulfide	UG/KG	110,000,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Carbon Tetrachloride	UG/KG	2,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Chlorobenzene	UG/KG	7,400,000	3J	4J	4J	2J	50J	35,000	41,000	32,000
Chlorodibromomethane	UG/KG	8,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Chloroform	UG/KG	2,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
cis-1,2 Dichloroethene	UG/KG	560,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Dichlorodifluoromethane	UG/KG	230,000,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Ethyl Chloride	UG/KG	1,100,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Ethylbenzene	UG/KG	110,000,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Methyl Bromide	UG/KG	59,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Methyl Chloride	UG/KG	12,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Methyl Ethyl Ketone	UG/KG	44,000,000	<4U	<5U	<4U	<4U	<4U	<590U	<670U	<1,400U
Methylene Chloride	UG/KG	97,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Naphthalene	UG/KG	17,000	--	--	--	--	--	--	--	--
Nitrobenzene	UG/KG	340,000	--	--	--	--	--	--	--	--
Styrene	UG/KG	260,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Tetrachloroethene	UG/KG	5,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Toluene	UG/KG	91,000,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
trans-1,2-Dichloroethene	UG/KG	720,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Trichloroethene	UG/KG	20,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Trichlorofluoromethane	UG/KG	340,000,000	<2U	<2U	<2U	<2U	<2U	<290U	<340U	<720U
Vinyl Chloride	UG/KG	2,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U
Xylenes	UG/KG	170,000,000	<1U	<1U	<1U	<1U	<1U	<150U	<170U	<360U

Notes:
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Table 4-5
Summary of Soil Geotechnical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

	Location	**D15-M01D**	**D15-M01D**	**D15-M01D**	**G12-M01D**	**G12-M01D**	**G12-M01D**	**M09-M01D**	**M09-M01D**	**M09-M01D**
	Sample Date	**10/23/2013**	**10/23/2013**	**10/23/2013**	**10/16/2013**	**10/16/2013**	**10/16/2013**	**10/25/2013**	**10/25/2013**	**10/25/2013**
	Depth	**25.7' - 26.7'**	**39.0' - 39.6'**	**40.2' - 40.7'**	**40.6' - 41.6'**	**49.0' - 50.0'**	**57.0' - 58.0'**	**77.0' - 77.8'**	**89.4' - 90.0'**	**92.0' - 93.0'**
Parameter Name	**Units**									
37.5 MM	% FINER	--	--	--	--	--	--	100	--	--
25 MM	% FINER	--	--	--	--	--	--	77	--	--
19 MM	% FINER	100	100	--	100	100	--	72	--	--
12.50 MM	% FINER	96	96	--	86	86	--	59	--	--
9.5 MM	% FINER	86	86	100	75	75	100	54	100	--
4.75 MM	% FINER	75	75	100	70	99	99	44	99	100
2 MM	% FINER	63	99	99	66	99	99	36	98	100
0.85 MM	% FINER	44	97	97	59	99	99	28	97	100
0.42 MM	% FINER	28	96	96	48	99	99	18	95	100
0.25 MM	% FINER	20	95	95	32	94	85	10	93	97
0.15 MM	% FINER	15	93	93	17	71	22	5	81	63
0.075 MM	% FINER	12	86	86	8	8	10	4	54	27
Fraction Organic Carbon	% BY WT.	<0.027	0.041	0.037	0.044	0.15	0.036	<0.028	<0.03	0.032
Percent Gravel	%	25.3	25.3	0.4	30.3	30.3	0.9	56	1.2	ND
Percent Moisture	%	8.5	9.3	20.1	15.8	23.7	23.7	12.3	21.2	20.7
Percent Sand	%	62.7	86.2	13.5	61.8	89.6	89.6	40	44.9	73.1
Silt and Clay	%	12	86.1	86.1	7.9	9.5	9.5	4	53.9	26.9
Specific Gravity	NA	2.67	2.69	2.69	2.72	2.72	2.64	2.7	2.68	2.69
Total Organic Carbon	MG/KG	<110	<119	<119	183J	6,120	<127	<112	<123	<120

< = Not detected
-- = No Results

Table 4-6a
Summary of Monitoring Well Groundwater Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analytes	Units	NJ_CLASSIIA 11/09	Location Sample Date Filtered	C06-M01D 01/29/2014	D15-M01D 01/30/2014	E14-M01C 02/11/2014	E14-M01D 02/11/2014	F09-M01C 02/11/2014	F09-M01D 02/11/2014	G08-M01C 01/29/2014	G12-M01C 01/30/2014	G12-M01D 01/30/2014	H07-M01C 01/31/2014	H07-M01D 01/31/2014	H13-M01C 02/11/2014	I15-M01C 01/28/2014	I15-M01D 01/28/2014	K06-M01C 01/29/2014	K11-M01C 01/28/2014	K17-M01C 02/12/2014	M09-M01C 01/27/2014	M09-M01D 01/27/2014	M14-M01C 02/11/2014	O08-M01B 02/12/2014	O16-P01B 02/12/2014	P15-M01C 02/12/2014
Volatile Organic Compounds																										
1,1,1-Trichloroethane	UG/L	30	N	<0.8	<2	<4	<4	<0.8	<0.8	<0.8	<4	<4	<40	<40	<0.8	<8	<2	<2	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
1,1,2,2-Tetrachloroethane	UG/L	1	N	<1	<2	<5	<5	<1	4 J	<1	380	21 J	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	UG/L	3	N	<0.8	<2	<4	<4	<0.8	<0.8	<0.8	5 J	<4	<40	<40	<0.8	<8	<2	<2	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
1,1-Dichloroethane	UG/L	50	N	<1	<2	<5	<5	1 J	4 J	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	UG/L	1	N	<0.8	3 J	100	63	<0.8	3 J	<0.8	26	37	<40	<40	<0.8	<8	<2	<2	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
1,2-Dibromo-3-Chloropropane	UG/L	0.02	N	<2	<4	<10	<10	<2	<2	<2	<10	<10	<100	<100	<2	<20	<4	<4	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane (EDB)	UG/L	0.03	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichlorobenzene	UG/L	600	N	<1	420	380	370	8	70	180	1,900	1,200	41,000	5,500	2 J	1,200	1,100	320	33 J	<1	18	170	40	23	<1	<1
1,2-Dichloroethane	UG/L	2	N	<1	<2	14 J	<5	13	170	640	35	9,300	<50	<50	2 J	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	UG/L	1	N	<1	<2	<5	<5	1 J	13	3 J	<5	21 J	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
1,3-Dichlorobenzene	UG/L	600	N	<1	29	13 J	14 J	<1	1 J	7	23 J	47	280	1,800	<1	<10	4 J	420	25 J	<1	18	99	<1	12	<1	<1
1,4-Dichlorobenzene	UG/L	75	N	<1	720	770	780	<1	42	10	140	1,900	1,600	3,000	<1	87	33	620	45 J	<1	22	350	1 J	35	<1	<1
2-Hexanone	UG/L	300	N	<3	<6	<15	<15	<3	<3	<3	<15	<15	<150	<150	<3	<30	<6	<6	4 J	<3	<3	<3	<3	<3	<3	<3
Acetone	UG/L	6000	N	<6	<12	140	90 J	<6	9 J	<6	110	96 J	<300	<300	<6	<60	44	<12	9 J	<6	<6	6 J	<6	<6	<6	<6
Benzene	UG/L	1	N	<0.5	49	890	1,100	24	290	330	83	1,000	500	1,300	2 J	150	24	31	170 J	<0.5	6	47	14	3 J	<0.5	<0.5
Bromochloromethane	UG/L	NA	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	UG/L	1	N	2 J	<2	<5	<5	3 J	2 J	<1	<5	<5	<50	<50	4 J	<10	<2	<2	<1	<1	3 J	7	7	<1	<1	2 J
Bromoform	UG/L	4	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	1 J	<1	<1	<1	<1
Carbon Disulfide	UG/L	700	N	<1	4 J	<5	<5	2 J	<1	<1	<5	<5	<50	<50	3 J	<10	<2	<2	3 J	<1	2 J	1 J	<1	<1	<1	1 J
Carbon Tetrachloride	UG/L	1	N	<1	<2	<5	<5	<1	<1	<1	270	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	UG/L	50	N	<0.8	2,600	6,800	7,000	14	460	340	1,100	9,900	32,000	45,000	14	11,000	1,200	1,900	450 J	<0.8	79	610	32	630	<0.8	<0.8
Chlorodibromomethane	UG/L	1	N	2 J	<2	<5	<5	<1	<1	2 J	<5	<5	<50	<50	2 J	<10	<2	<2	<1	<1	1 J	5	1 J	<1	<1	<1
Chloroform	UG/L	70	N	8	33	1,100	570	27	110	4 J	3,300	330	<40	<40	25	<8	2 J	4 J	1 J	<0.8	8	15	30	<0.8	<0.8	11
cis-1,2 Dichloroethene	UG/L	70	N	<0.8	<2	8 J	<4	4 J	4 J	13	79	9 J	<40	<40	4 J	230	8 J	4 J	<0.8	<0.8	11	11	2 J	<0.8	<0.8	<0.8
cis-1,3-Dichloropropene	UG/L	NA	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl Chloride	UG/L	5	N	<1	<2	<5	<5	<1	2 J	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	UG/L	700	N	<0.8	21	100	590	<0.8	1 J	<0.8	5 J	20 J	<40	<40	<0.8	15 J	6 J	2 J	2 J	<0.8	<0.8	2 J	<0.8	<0.8	<0.8	<0.8
Methyl Bromide	UG/L	10	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Chloride	UG/L	NA	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Methyl Ethyl Ketone	UG/L	300	N	<3	<6	<15	<15	<3	<3	<3	<15	<15	<150	<150	<3	<30	9 J	<6	<3	<3	<3	<3	<3	<3	<3	<3
Methyl Isobutyl Ketone	UG/L	NA	N	<3	<6	<15	<15	<3	<3	<3	<15	<15	<150	<150	<3	<30	<6	<6	<3	<3	<3	5 J	<3	<3	<3	<3
Methylene Chloride	UG/L	3	N	<2	<4	65	25	<2	8	5	200	35	<100	<100	<2	<20	12	<4	3 J	<2	<2	<2	<2	<2	<2	<2
Styrene	UG/L	100	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	UG/L	1	N	<0.8	56	1,700	1,200	<0.8	43	7	4,300	820	150 J	<40	<0.8	110	10	<2	<0.8	<0.8	1 J	4 J	2 J	<0.8	<0.8	<0.8
Toluene	UG/L	600	N	<0.7	98	540	5,400	<0.7	13	3 J	20 J	56	500	<35	<0.7	36 J	180	<1	<0.7	<0.7	<0.7	0.7 J	0.9 J	<0.7	<0.7	<0.7
trans-1,2-Dichloroethene	UG/L	100	N	<0.8	<2	<4	<4	<0.8	<0.8	<0.8	7 J	<4	<40	<40	<0.8	<8	<2	<2	2 J	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
trans-1,3-Dichloropropene	UG/L	NA	N	<1	<2	<5	<5	<1	<1	<1	<5	<5	<50	<50	<1	<10	<2	<2	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	UG/L	1	N	<1	4 J	230	180	1 J	5	6	130	63	<50	<50	1 J	44 J	4 J	<2	<1	<1	<1	2 J	3 J	<1	<1	<1
Vinyl Chloride	UG/L	1	N	<1	<2	<5	<5	3 J	8	4 J	11 J	<5	<50	<50	<1	26 J	<2	3 J	<1	<1	<1	1 J	<1	<1	<1	<1
Xylenes	UG/L	1000	N	<0.8	150	670	4,900	<0.8	4 J	<0.8	5 J	45	<40	<40	<0.8	15 J	20	<2	<0.8	<0.8	<0.8	2 J	<0.8	<0.8	<0.8	<0.8
Semi-Volatile Organic Compounds																										
1,2,4-Trichlorobenzene	UG/L	9	N	<0.5	<0.5	10	8	<0.5	<0.5	20	4	16 J	2,500	92	<0.5	69 J	53	34	<0.5	<0.5	2	33	0.6 J	6	<0.5	1
2,4,5-Trichlorophenol	UG/L	700	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol	UG/L	20	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dichlorophenol	UG/L	20	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	3	<0.5	6	<0.5	<0.5	0.6 J	0.7 J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol	UG/L	100	N	<0.5	<0.5 R	5 J	3 J	<0.5	<0.5	<0.5	<0.5 R	1	0.6 J	0.7 J	<0.5	2	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dinitrophenol	UG/L	40	N	<11	<10 R	<11 R	<11 R	<11	<11	<10	<10 R	<11	<10	<10	<10	<11	<11	<10	<11	<11	<10	<10	<11	<10	<11	<11
2,4-Dinitrotoluene	UG/L	10	N	<1	<1	<1	<1	<1	<1	<1	<1	<1 R	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,6-Dinitrotoluene	UG/L	10	N	1	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chloronaphthalene	UG/L	600	N	<0.4	<0.4	<0.4	<0.4	<0.4	0.6 J	<0.4	<0.4	<0.4 R	16	48	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
2-Chlorophenol	UG/L	40	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	1	<0.5	1 J	9	17	56	<0.5	24	<0.5	3	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5
2-Methylnaphthalene	UG/L	30	N	<0.1	0.4 J	1	4	1	7	<0.1	4	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.8	<0.1	<0.1	<0.1
2-Methylphenol (O-Cresol)	UG/L	NA	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	2 J	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitroaniline	UG/L	NA	N	<0.5	<0.5	15	2	<0.5	<0.5	<0.5	<0.5	<0.5 R	150	<0.5	<0.5	25 J	23	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitrophenol	UG/L	NA	N	<0.5	<0.5 R	3 J	2 J	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3,3'-Dichlorobenzidine	UG/L	30	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2 UJ	<2 UJ	<2	<2	<2	<2
3-Nitroaniline	UG/L	NA	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	2	<0.5	<0.5	3 J	19	<0.5	<0.5	<0.5	<0.5 UJ	<0.5 UJ	<0.5	<0.5	<0.5	<0.5
4,6-Dinitro-2-Methylphenol	UG/L	1	N	<5	<5 R	<5 R	<6 R	<5	<5	<5	<5 R	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
4-Bromophenyl Phenyl Ether	UG/L	NA	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-Methylphenol	UG/L	100	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloroaniline	UG/L	30	N	0.6 J	1	59	19	220	1,300	28	2,500	59 J	2,300 B	3,500	1	1,800	1,400	3,500	1,200	<0.5	6	53	60	<0.5	2	<0.5
4-Chlorophenyl Phenyl Ether	UG/L	NA	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Methylphenol (P-Cresol)	UG/L	NA	N	<0.5	<0.5 R	18 J	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	0.6 J	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Nitroaniline	UG/L	NA	N	<0.5	<0.5	11	1	<0.5	<0.5	<0.5	<0.5	<0.5 R	22	<0.5	<0.5	12 J	17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Nitrophenol	UG/L	NA	N	<11	<10 R	<11 R	<11 R	<11	<11	<10	<10 R	<11	12 J	<10	<10	<11	<11	<10	<11	<11	<10	<10	<11	<10	<11	<11
Acenaphthene	UG/L	400	N	<0.1	<0.1	0.5	0.3 J	<0.1	0.9	<0.1	2	1 J	<0.1	0.8	<0.1	0.3 J	0.9	0.4 J	3	<0.1	<0.1	<0.1	<0.1	2	<0.1	<0.1
Acenaphthylene	UG/L	100	N	<0.1	<0.1	<0.1	0.1 J	0.1 J	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	UG/L	2000	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	0.2 J	<0.1	0.7	<0.1	0.3 J	0.2 J	<0.1	<0.1	<0.1	<0.1	0.2 J	<0.1	<0.1
Benzo(A)Anthracene	UG/L	0.1	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(B)Fluoranthene	UG/L	0.2	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(G,H,I)Perylene	UG/L	100	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(K)Fluoranthene	UG/L	0.5	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BenzoAPyrene	UG/L	0.1	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bis(2-Chloro-1-Methylethyl) Ether	UG/L	300	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 4-6a
Summary of Monitoring Well Groundwater Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

			Location	C06-M01D	D15-M01D	E14-M01C	E14-M01D	F09-M01C	F09-M01D	G08-M01C	G12-M01C	G12-M01D	H07-M01C	H07-M01D	H13-M01C	I15-M01C	I15-M01D	K06-M01C	K11-M01C	K17-M01C	M09-M01C	M09-M01D	M14-M01C	O08-M01B	O16-P01B	P15-M01C
		NJ_CLASSIIA	Sample Date	01/29/2014	01/30/2014	02/11/2014	02/11/2014	02/11/2014	02/11/2014	01/29/2014	01/30/2014	01/30/2014	01/31/2014	01/31/2014	02/11/2014	01/28/2014	01/28/2014	01/29/2014	01/28/2014	02/12/2014	01/27/2014	01/27/2014	02/11/2014	02/12/2014	02/12/2014	02/12/2014
Analytes	**Units**	11/09	Filtered																							
Bis(2-Chloroethoxy)Methane	UG/L	NA	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-Chloroethyl)Ether	UG/L	7	N	<0.5	<0.5	<0.5	<0.6	0.6 J	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bis(2-Ethylhexyl)Phthalate	UG/L	3	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	2 J	<2	<2	<2	<2	<2	<2	<2	<2	<2
Butyl Benzyl Phthalate	UG/L	100	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chrysene	UG/L	5	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Di-N-Butyl Phthalate	UG/L	700	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibenz(A,H)Anthracene	UG/L	0.3	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzofuran	UG/L	NA	N	<0.5	<0.5	0.6 J	<0.6	<0.5	<0.5	<0.5	1	0.6 J	<0.5	0.6 J	<0.5	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5
Diethyl Phthalate	UG/L	6000	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dimethyl Phthalate	UG/L	100	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Fluoranthene	UG/L	300	N	<0.1	<0.1	<0.1	<0.1	<0.1	0.1 J	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	UG/L	300	N	<0.1	0.1 J	0.4 J	0.8	<0.1	0.4 J	<0.1	0.6	1 J	<0.1	1	<0.1	<0.1	<0.1	0.7	3	<0.1	<0.1	<0.1	<0.1	1	<0.1	<0.1
Hexachlorobenzene	UG/L	0.02	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorobutadiene	UG/L	1	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	1	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene	UG/L	40	N	<5	<5	<5	<6	<5	<5	<5	<5	<5 R	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Hexachloroethane	UG/L	7	N	<1	<1	<1	<1	<1	<1	<1	<1	<1 R	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Indeno (1,2,3-CD) Pyrene	UG/L	0.2	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Isophorone	UG/L	40	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Dioctyl Phthalate	UG/L	100	N	<2	<2	<2	<2	<2	<2	<2	<2	<2 R	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
N-Nitrosodi-N-Propylamine	UG/L	10	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5 UJ	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Nitrosodiphenylamine	UG/L	10	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	6	<0.5	1 J	<0.5	0.7 J	<0.5	16 J	5	0.5 J	<0.5	<0.5	<0.5	<0.5	<0.5	0.7 J	<0.5	<0.5
Naphthalene	UG/L	300	N	<0.1	11	36	190	0.4 J	3	0.5	35	38 J	390	380	0.2 J	35 J	<0.1	2	0.8	<0.1	<0.1	11	0.4 J	1	<0.1	<0.1
Nitrobenzene	UG/L	6	N	<0.5	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5 R	5,200	13	<0.5	<0.5	11	5	<0.5	<0.5	<0.5	<0.5	20	<0.5	<0.5	<0.5
Pentachlorophenol	UG/L	0.3	N	<1	<1 R	<1 R	<1 R	<1	<1	<1	<1 R	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenanthrene	UG/L	100	N	<0.1	<0.1	0.7	0.5 J	<0.1	0.3 J	<0.1	0.8	0.3 J	0.2 J	0.5	<0.1	2 J	<0.1	0.1 J	4	<0.1	<0.1	<0.1	<0.1	0.3 J	<0.1	<0.1
Phenol	UG/L	2000	N	<0.5	<0.5 R	<0.5 R	<0.6 R	<0.5	<0.5	<0.5	<0.5 R	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	28	<0.5	<0.5
Pyrene	UG/L	200	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1 R	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Metals																										
Aluminum	MG/L	0.2	N	0.385	3.23 J	18.6 J	0.364 J	1.09 J	6.16 J	1.87	21.2 J	5.29 J	7.28 J	0.428 J	0.820 J	0.66	17.6	0.535	0.307	0.104 J	0.231	0.118 J	0.659 J	1.88 J	31.9 J	0.779 J
Antimony	MG/L	0.006	N	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	0.0084 J	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053
Barium	MG/L	6	N	0.085	0.199	0.316 J	0.156 J	0.0594 J	0.0726 J	0.0589	0.194	0.0696	0.0737	0.0781	0.0220 J	0.556	3.14	0.169	0.0699	0.100 J	0.0526	0.0449	0.0262 J	0.276 J	0.294 J	0.0992 J
Calcium	MG/L	NA	N	45.8	37.8	49.4	65.3	53.3	73.3	114	79.1	131	21.8	78.3	29	153	1,250	66.2	51.2	60.2	30.4	30.8	23.2	36.4	99.6	30
Chromium	MG/L	0.07	N	0.0070 J	0.0291	0.125	0.0112 J	0.0082 J	0.0212	0.0067 J	0.0626	0.0425	0.101	0.0061 J	0.0034 J	0.0452	2.84	0.0269	0.0042 J	0.359	0.0038 J	0.0033 J	0.0047 J	0.0066 J	0.0691	0.0074 J
Cobalt	MG/L	0.1	N	<0.0013	0.0118	0.0262	0.0084	<0.0013	0.0039 J	0.0020 J	0.0478	0.0191	0.0243	<0.0013	<0.0013	<0.0013	0.0708	<0.0013	<0.0013	0.0021 J	<0.0013	<0.0013	<0.0013	<0.0013	0.0196	<0.0013
Copper	MG/L	1.3	N	0.0065 J	0.0219	0.0226	<0.0027	0.0178	0.0166	0.0044 J	0.0342	0.0033 J	0.0253	<0.0027	0.0070 J	0.0036 J	0.2	0.0038 J	<0.0027	0.0084 J	0.0042 J	0.0040 J	0.0063 J	<0.0027	0.038	0.0057 J
Iron	MG/L	0.3	N	9.7	72.6	73.4	33.2	59.8	198	329	271	484	33	76.3	27.2	97.5	455	18.6	5.01	3.51	5.84	2.65	2.69	11	86.7	33
Magnesium	MG/L	NA	N	8	37.6	23	17.6	27.3	46.8	58.9	68.5	101	14.4	31.7	11.3	36	120	16	15.9	25.6	8.27	9.48	7.3	29.3	27.8	11.5
Manganese	MG/L	0.05	N	0.178	3.48	4.63	2.960	1.86	3.930	9.72	14.2	16.5	2.52	3.32	0.876	2.2	9.73	2.18	0.585	0.409	0.251	0.096	0.164	0.586	0.637	0.867
Nickel	MG/L	0.1	N	0.0055 J	0.0144	0.114	0.0369	0.0057 J	0.0135	<0.0015	0.02	<0.0015	0.0145	<0.0015	0.0049 J	0.0363	1.88	0.0181	0.0056 J	0.424	0.0043 J	0.0035 J	0.0057 J	0.0029 J	0.0493	0.0037 J
Potassium	MG/L	NA	N	16.8 J	9.34	31.3	15.9	22.8	15.6	8.09 J	14.1	18.9	6.9	8.07	8.87	15.1 J	25.6 J	15.5 J	20.4 J	18.9	11.9 J	10.6 J	9.14	10.8	12.4	7.61
Silver	MG/L	0.04	N	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	0.0067	0.0153	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021	<0.0021
Sodium	MG/L	50	N	88.3	325	240	208	281	647	370	405	1,060	132	142	125	465	215	93.8	126	168	66.5	91.4	68.8	360	119	87
Vanadium	MG/L	NA	N	<0.0020	0.16	0.0616	<0.0020	0.0040 J	0.0319	0.0098	0.0666	0.0467	0.145	0.0029 J	0.0028 J	0.0029 J	0.0997	0.0029 J	0.0023 J	<0.0020	<0.0020	<0.0020	<0.0020	0.0034 J	0.0795	0.0033 J
Zinc	MG/L	2	N	0.0533	0.0177 J	0.0533	0.0113 J	0.0313	0.139	0.0284	0.0807	0.0441	0.046	0.0174 J	0.0422	0.0167 B	0.338	0.0132 B	0.0351	<0.0020	0.071	0.088	0.0548	0.0262	0.208	0.032
Arsenic	MG/L	0.003	N	0.00056 J	0.006	0.0036	0.0019 J	0.0028	0.0056	0.0012 J	0.0108	0.0118	0.0064	0.0010 J	0.0016 J	0.0038	0.0422	0.00076 J	0.0032	<0.00078	0.0018 J	0.0011 J	0.00080 J	0.0014 J	0.0142	0.0013 J
Beryllium	MG/L	0.001	N	<0.000043	0.00029 J	0.00073	0.000071 J	0.000044 J	0.00045 J	0.00030 J	0.0042	0.00049 J	0.0013	0.00011 J	0.00025 J	<0.00022	0.0023	0.0037	0.000097 J	<0.000043	0.00035 J	0.00015 J	0.000063 J	0.00027 J	0.0019	0.000089 J
Cadmium	MG/L	0.004	N	<0.00023	0.00024 J	<0.00023	<0.00023	0.00062	0.00045 J	0.0028	<0.00023	<0.00023	<0.00023	<0.00023	<0.00023	0.00025 J	0.0012	<0.00023	<0.00023	<0.00023	<0.00023	<0.00023	<0.00023	<0.00023	0.00089	<0.00023
Lead	MG/L	0.005	N	0.0048 J	0.0084	0.0111	0.0012	0.0439	0.469	0.0021 J	0.0086	0.0156	0.0121	0.0014	0.0084	0.0326 J	0.170 J	0.0022 J	0.0015 J	0.00078 J	0.0066 J	0.0076 J	0.0084	0.0018	0.0561	0.0038
Selenium	MG/L	0.04	N	<0.00050	<0.00050	0.0011 J	0.0011 J	0.00077 J	0.00091 J	0.00067 J	<0.00050	0.0013 J	<0.00050	<0.00050	<0.00050	0.0022	0.0017 J	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00079 J	<0.00050
Thallium	MG/L	0.002	N	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.00028 J	<0.00015
Mercury	MG/L	0.002	N	<0.000060	<0.00030	<0.00060 UJ	<0.000060 UJ	<0.00060 UJ	<0.00060 UJ	<0.000060	<0.00030	<0.00030	<0.00030	<0.000060	<0.00060 UJ	<0.00030	<0.00030	<0.000060	<0.000060	<0.000060 UJ	<0.000060	<0.000060	<0.000060 UJ	<0.000060 UJ	<0.00060 UJ	<0.00060 UJ
Miscellaneous Parameters																										
Chloride	MG/L	250	N	176	603	542	417	530	1,350	502	681	1,710	138	270	200	1,110	441	138	185	355	67.9	98.3	72.6	654	211	139
Total Organic Carbon	MG/L	NA	N	10.5	3	32.9	51.8	26.9	20.2	16.8	19.3	7.1	24.6	28.0	60.0	38.5 J	39.7 J	7.4	40.5 J	3.4	20.0 J	24.1 J	11.9	9.5	15.9	8.1
Gases																										
Carbon Dioxide	UG/L	NA	N	<4,000	61,000	58,000	21,000	75,000	90,000	200,000	170,000	180,000	110,000	130,000	47,000	180,000	50,000	57,000	38,000	5,300 J	63,000	36,000	13,000	100,000	200,000	59,000
Ethane	UG/L	NA	N	<1.0	<1.0	3.8 J	2.1 J	120	270	6.7	130	110	12	45	14	950	47	5.8	14	<1.0	1.8 J	13	5.5	16	<1.0	<1.0
Ethene	UG/L	NA	N	<1.0	<1.0	5.4	1.7 J	72	460	77	3.5 J	520	14	54	<1.0	18 J	<1.0	<1.0	27	<1.0	2.6 J	8.6	2.8 J	<1.0	<1.0	<1.0
Methane	UG/L	NA	N	35	57	450	170	150	300	800	700	970	1,000	480	18	7,200	460	170	950	<3.0	46	71	25	2,800	3,700	72
PCB Aroclors																										
PCB 1016	UG/L	NA	N	<0.082 UJ	<0.084 UJ	<0.085	<0.085	<0.086	<0.085	<0.083 UJ	<0.083 UJ	<0.082 UJ	<0.083 R	<0.086 UJ	<0.084 UJ	<0.085 UJ	<0.082 UJ	<0.082 UJ	<0.084 UJ	<0.084	<0.083 UJ	<0.084 R	<0.088	<0.84	<0.090	<0.085
PCB 1221	UG/L	NA	N	<0.082 UJ	<0.084 UJ	0.38 J	<0.22	<0.086	<0.085	<0.083 UJ	<0.083 UJ	<0.082 UJ	<0.083 R	<0.086 UJ	<0.084 UJ	<0.085 UJ	<0.082 UJ	<0.082 UJ	<0.084 UJ	<0.084	<0.083 UJ	<0.084 R	<0.088	<0.84	<0.090	<0.085
PCB 1232	UG/L	NA	N	<0.16 UJ	<0.17 UJ	<0.17	<0.17	<0.17	<0.17	<0.17 UJ	<0.17 UJ	<0.16 UJ	<0.17 R	<0.17 UJ	<0.17 UJ	<0.17 UJ	<0.16 UJ	<0.16 UJ	<0.17 UJ	<0.17	<0.17 UJ	<0.17 R	<0.18	<1.7	<0.18	<0.17
PCB 1242	UG/L	NA	N	<0.082 UJ	<0.084 UJ	<0.085	<0.085	<0.086	<0.085	<0.083 UJ	<0.083 UJ	<0.082 UJ	<0.083 R	<0.086 UJ	<0.084 UJ	<0.085 UJ	<0.082 UJ	<0.082 UJ	<0.084 UJ	<0.084	<0.083 UJ	<0.084 R	<0.088	<0.84	<0.090	<0.085
PCB 1248	UG/L	NA	N	<0.082 UJ	<0.084 UJ	<0.085	<0.085	<0.086	<0.085	<0.083 UJ	<0.083 UJ	<0.082 UJ	<0.083 R	<0.086 UJ	<0.084 UJ	<0.085 UJ	<0.082 UJ	<0.082 UJ	<0.084 UJ	<0.084	<0.083 UJ	<0.084 R	<0.088	39	<0.090	<0.085
PCB 1254	UG/L	NA	N	<0.082 UJ	<0.084 UJ	<0.085	<0.085	<0.086	<0.085	<0.083 UJ	<0.083 UJ	<0.082 UJ	<0.083 R	<0.086 UJ	<0.084 UJ	<0.085 UJ	<0.082 UJ	<0.082 UJ	<0.084 UJ	<0.084	<0.083 UJ	<0.084 R	<0.088	22	<0.090	<0.085
PCB 1260	UG/L	NA	N	<0.12 UJ	<0.13 UJ	<0.13	<0.13	<0.13	<0.13	<0.12 UJ	<0.12 UJ	<0.12 UJ	<0.13 R	<0.13 UJ	<0.13 UJ	<0.13 UJ	<0.12 UJ	<0.12 UJ	<0.13 UJ	<0.13	<0.13 UJ	<0.13 R	<0.13	<1.3	<0.14	<0.13
Perfluorooctanoic Acids (PFOAs)																										
Perfluorobutane Sulfonic Acid	UG/L	NA	Y	0.017	--	0.015	0.011	0.0041	0.021	--	0.019	0.051	<0.21	0.28	--	0.36	<0.050	--	0.081	0.024	--	--	--	--	0.025	<0.017
Perfluorobutanoic Acid	UG/L	NA	Y	0.24	--	0.12	0.08	0.39	0.13	--	0.12	0.14	1.2	0.54	--	21	3.1	--	0.83	0.21	--	--	--	--	0.98	1.2
Perfluorodecanoic Acid	UG/L	NA	Y	0.011	--	0.04	0.03	0.022	0.042	--	0.025 J	0.012	0.42	0.11	--	0.23	0.061	--	0.08	0.12	--	--	--	--	0.34	0.037
Perfluorododecanoic Acid	UG/L	NA	Y	0.0016	--	0.0081	0.0064	0.0099	0.0098	--	0.0033	0.0031	<0.10	0.014	--	<0.14	<0.025	--	<0.010	0.007	--	--	--	--	<0.010	<0.0084
Perfluoroheptanoic Acid	UG/L	NA	Y	0.028	--	0.12	0.093	0.049	0.11	--	0.14	0.077	2	0.8	--	12	2.2	--	1.4	0.32	--	--	--	--	1.4	2.2
Perfluorohexane Sulfonic Acid	UG/L	NA	Y	0.0027	--	0.005	0.0029	<0.0030	0.0026	--	0.0054	<0.0019	<0.21	<0.026	--	<0.28	<0.050	--	<0.020	0.0073	--	--	--	--	<0.020	<0.017
Perfluorohexanoic Acid	UG/L	NA	Y	0.091	--	0.4	0.25	0.39	0.26	--	0.31	0.16	7.3	1.7	--	110	17	--	4.4	0.58	--	--	--	--	2.8	4.1

Table 4-6a
Summary of Monitoring Well Groundwater Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analytes	Units	NJ_CLASSIIA 11/09	Location Sample Date Filtered	C06-M01D 01/29/2014	D15-M01D 01/30/2014	E14-M01C 02/11/2014	E14-M01D 02/11/2014	F09-M01C 02/11/2014	F09-M01D 02/11/2014	G08-M01C 01/29/2014	G12-M01C 01/30/2014	G12-M01D 01/30/2014	H07-M01C 01/31/2014	H07-M01D 01/31/2014	H13-M01C 02/11/2014	I15-M01C 01/28/2014	I15-M01D 01/28/2014	K06-M01C 01/29/2014	K11-M01C 01/28/2014	K17-M01C 02/12/2014	M09-M01C 01/27/2014	M09-M01D 01/27/2014	M14-M01C 02/11/2014	O08-M01B 02/12/2014	O16-P01B 02/12/2014	P15-M01C 02/12/2014
Perfluorononanoic Acid	UG/L	NA	Y	0.017	--	0.24	0.21	0.037	0.074	--	0.15	0.02	0.5	0.17	--	0.63 J	0.4	--	0.15	0.26	--	--	--	--	0.57	0.17
Perfluorooctane Sulfonamide	UG/L	NA	Y	<0.0010	--	0.0012	0.0013	<0.0012	<0.00096	--	<0.00091	<0.00095	<0.10	<0.013	--	<0.14	<0.025	--	<0.010	0.0022	--	--	--	--	<0.010	<0.0084
Perfluoropentanoic Acid	UG/L	NA	Y	0.21	--	0.096	0.061	0.057	0.084	--	0.091	0.073	2	0.85	--	29	3.3	--	1.4	0.3	--	--	--	--	1.8	2.7
Perfluoroundecanoic Acid	UG/L	NA	Y	0.0024	--	0.012	0.011	0.0065	0.012	--	0.0049 J	0.0024	<0.10	<0.013	--	<0.14	<0.025	--	<0.010	0.011	--	--	--	--	0.019	<0.0084
PFOA*	UG/L	0.4	Y	0.094	--	1.4	1	0.28	0.69	--	1.8	0.24	36	4.3	--	17	5.1	--	2.7	1	--	--	--	--	4.9	3.3
PFOS*	UG/L	0.2	Y	0.0044 B	--	0.011	0.012	<0.0023	<0.0019	--	0.0084	<0.0019	<0.21	<0.026	--	<0.28	<0.050	--	<0.020	0.043	--	--	--	--	<0.020	<0.017
Tentativley Identified Compounds																										
1,1,2-Trichlorotrifluoroethane	UG/L	NA	N	--	430 J	5,400 J	3,400 J	15 J	200 J	17 J	5,300 J	3,500 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloro-2,2-Difluoroethene	UG/L	NA	N	--	--	--	--	--	--	--	180 J	--	--	--	--	--	--	--	--	--	--	--	10 J	--	--	--
1,2,4-Trimethylbenzene	UG/L	NA	N	--	--	--	84 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloro-1,1,2-Trifluoroethane	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	92 J	--	--	--	--	--	--	--	--	--	--
1,2-Dichloro-1,1-Difluoroethane	UG/L	NA	N	--	--	--	--	--	--	--	--	170 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorotetrafluoroethane	UG/L	NA	N	--	--	44 J	--	--	--	--	1,500 J	310 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Difluorotetrachloroethane	UG/L	NA	N	--	--	47 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	UG/L	NA	N	--	--	--	36 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Ethyl-2-Methylbenzene	UG/L	NA	N	--	--	--	270 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloro-1,1,1-Trifluoroethane	UG/L	NA	N	--	--	140 J	120 J	6 J	130 J	--	1,000 J	3,500 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Difluorotetrachloroethane	UG/L	NA	N	--	--	--	--	--	--	--	250 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylbutane	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25 J	--	--	--	--	--	--	--	--
2-Nitrotoluene	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	22 J	--	--	--	--	--	--	--	--	--
2-Vinylnaphthalene	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	75 J	28 J	--
Bromoethene	UG/L	NA	N	--	--	--	--	20 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CFC-1113	UG/L	NA	N	--	10 J	180 J	82 J	22 J	17 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlorofluoromethane	UG/L	NA	N	--	--	--	--	--	120 J	62 J	--	990 J	--	--	--	61 J	--	--	--	--	--	--	--	--	--	--
Diethyl Ether	UG/L	1000	N	--	--	--	--	32 J	190 J	340 J	--	--	--	--	14 J	--	120 J	--	7 J	--	--	--	--	--	--	--
Diphenyl Ether	UG/L	100	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	390 J	240 J	--
Ethyl Sulfide	UG/L	NA	N	--	--	--	--	28 J	100 J	--	--	--	--	--	--	870 J	40 J	--	8 J	--	--	--	--	--	--	--
Methyl Tertiary Butyl Ether	UG/L	70	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8 J	--	--	--	--	--
Methylcyclopentane	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11 J	--	--	--	--	--	--	--	--
Naphthalene	UG/L	300	N	--	--	--	300 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tentativley Identified Compound	UG/L	NA	N	9 J	--	130 J	53 J	8 J	27 J	--	590 J	90 J	--	--	8 J	110 J	31 J	43 J	8 J	--	6 J	8 J	9 J	--	--	--
Trichlorofluoromethane	UG/L	2000	N	--	35 J	4,000 J	3,500 J	--	47 J	--	1,300 J	820 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1'-Biphenyl-2,2'-Diamine	UG/L	NA	N	--	--	--	--	--	--	9 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trimethylbenzene	UG/L	NA	N	--	--	--	19 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	UG/L	NA	N	--	--	--	7 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	UG/L	75	N	--	--	--	--	--	--	--	--	--	--	--	--	160 J	--	--	--	--	--	--	--	--	--	--
1-Ethyl-2-Methylbenzene	UG/L	NA	N	--	--	--	9 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Methyl-4-Nitrobenzene	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	57 J	--	--	--	--	--	--	--	--	--
1-Naphthylamine	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	250 J	42 J	140 J	--	--	--	--	--	--	--	--
2,3-Dichloroaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31 J	--	--	--
2,5-Dimethylaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	120 J	--	--	--	--	--	5 J	--	--	--
2,6-Dichloro-3-Methylaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6 J	--	--	--	--	--	--	--	--
2,6-Xylidine	UG/L	NA	N	--	--	--	--	--	--	5 J	--	--	--	--	--	--	--	5 J	--	--	--	--	--	--	--	--
2-Chloro-5-Methylbenzenamine	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	93 J	--	--	--	--	--	--	--
2-Chloroaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	170 J	280 J	--	--
2-Naphthylamine	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	15 J	--	--	--	--	--	--	--	440 J	--	--
2-Nitrotoluene	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	68 J	--	--	--	--	--	--	--	--	--
3,4-Dichloroaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9 J	--	--	--
3,4-Dimethylaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Chloroaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	72 J	--	--	--
3-Ethyltoluene	UG/L	NA	N	--	--	--	5 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methylaniline	UG/L	NA	N	--	--	--	--	--	--	8 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4-Diaminobenzophenone	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	30 J	8 J	35 J	--	--	--	--	--	--	--
4-Chloro-2-Methylaniline	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	63 J	--	--	--	--	--	--	--	--
Benzenamine, 2-Ethoxy-	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14 J	--	--	--	--	--	--	--	--
Benzoic Acid	UG/L	30000	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8 J	--	--
Biphenyl	UG/L	400	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	87 J	--	--
Camphor	UG/L	1000	N	--	--	28 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diphenyl Ether	UG/L	100	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26 J	--	--	--	--	--	820 J	--	--
Ethyl Sulfide	UG/L	NA	N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
O-Toluidine	UG/L	NA	N	--	--	--	9 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tentativley Identified Compound	UG/L	NA	N	91 J	54 J	7 J	7 J	61 J	8 J	9 J	95 J	9 J	87 J	87 J	9 J	98 J	68 J	6 J	93 J	--	97 J	87 J	73 J	8 J	5 J	9 J

Notes:
B = Comparable detection in lab or field blank
J = Estimated Value
R = Unusable result
U = Not detected
UJ = Not detected. Reporting limit may not be accurate or precise.
< = Not detected at stated reporting limit
🟨 = Exceedance of Remediation Standards
* Provisional Health Advisory for PFOA, EPA 2009

Table 4-6b
Summary of Hydropunch Groundwater Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

		Sample ID	**INTCD-E14B**	**INTCD-I10B**	**INTCD-P15B**
		Sample Depth	**27' - 31'**	**10' - 15'**	**28' - 32'**
	NJ CLASS IIA	**Sample Date**	**12/05/2013**	**12/06/2013**	**12/16/2013**
Analyte	**11/09**	**Units**			
Volatile Organics Compounds					
1,1,2,2-Tetrachloroethane	1	UG/L	130	<1U	<1U
1,2-Dibromoethane (EDB)	0.03	UG/L	29J	<1U	<1U
1,2-Dichloro-1,1-Difluoroethane		UG/L	260J	--	--
1,2-Dichlorobenzene	600	UG/L	2,200	89	<1U
1,2-Dichloroethane	2	UG/L	150	<1U	<1U
1,2-Dichlorotetrafluoroethane		UG/L	1,400J	--	--
1,3-Dichlorobenzene	600	UG/L	50J	17	<1U
1,4-Dichlorobenzene	75	UG/L	1,300	74	<1U
2,2-Dichloro-1,1,1-Trifluoroethane		UG/L	22,000J	--	--
Acetone	6,000	UG/L	1,600	<6U	900
Benzene	1	UG/L	710	2J	<0.5U
Bromodichloromethane	1	UG/L	<20U	5	7
Carbon Disulfide	700	UG/L	590	1J	<1U
Carbon Tetrachloride	1	UG/L	59,000	<1U	<1U
Chlorobenzene	50	UG/L	24,000	350	<0.8U
Chlorodibromomethane	1	UG/L	<20U	<1U	2J
Chloroform	70	UG/L	18,000	18	19
cis-1,2 Dichloroethene	70	UG/L	29J	<0.8U	<0.8U
Ethylbenzene	700	UG/L	110	1J	<0.8U
Methylene Chloride	3	UG/L	860	<2U	<2U
Naphthalene,1,2,3,4-Tetrahydro		UG/L	--	120J	--
Sulfur Dioxide		UG/L	--	15J	--
Tentativley Identified Compound		UG/L	150J	93J	--
Tetrachloroethene	1	UG/L	3,900	<0.8U	<0.8U
Toluene	600	UG/L	470	<0.7U	<0.7U
Trichloroethene	1	UG/L	100	<1U	<1U
Trichlorofluoromethane	2,000	UG/L	2,700J	--	--
Xylenes	1,000	UG/L	1,000	9	<0.8U
Semi-Volatile Organics Compounds					
1,2,4-Trichlorobenzene	9	UG/L	9	0.9J	<0.5U
1,3-Dichlorobenzene	600	UG/L	--	16J	--
1,4-Dichlorobenzene	75	UG/L	22J	--	--
1-Nitronaphthalene		UG/L	16J	--	--
2,4-Dichlorophenol	20	UG/L	1J	<0.5U	<0.5U
2,4-Dimethylphenol	100	UG/L	6J	<0.5U	<0.5U
2,4-Dinitrotoluene	10	UG/L	<1U	<1U	2J
2-Chloronaphthalene	600	UG/L	<0.5U	0.8J	<0.4U
2-Chlorophenol	40	UG/L	12J	0.7J	<0.5U
2-Methylnaphthalene	30	UG/L	10	0.7	0.6
2-Methylphenol (O-Cresol)		UG/L	3J	<0.5U	<0.5U
2-Naphthylamine		UG/L	130J	24J	--
2-Nitroaniline		UG/L	2	<0.5U	<0.5U
2-Nitrotoluene		UG/L	8J	--	--
3-Methylaniline		UG/L	5J	--	--
3-Nitroaniline		UG/L	0.6J	<0.5U	<0.5U
4,4-Diaminobenzophenone		UG/L	--	1,200J	--
4-Chloroaniline	30	UG/L	18	3	<0.5U
4-Hydroxy-4-Methyl-2-Pentanone		UG/L	--	--	10J
Acenaphthene	400	UG/L	0.8	0.3J	<0.1U
Anthracene	2,000	UG/L	0.2J	0.1J	<0.1U
Chlorobenzene	50	UG/L	140J	69J	--
Dibenzofuran		UG/L	6	<0.5U	<0.5U
Dodecanoic Acid		UG/L	150J	--	--
Fluorene	300	UG/L	2	0.2J	<0.1U
Heptanal		UG/L	--	--	11J
Hexachlorobutadiene	1	UG/L	6	<0.5U	<0.5U

Table 4-6b
Summary of Hydropunch Groundwater Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

		Sample ID	**INTCD-E14B**	**INTCD-I10B**	**INTCD-P15B**
		Sample Depth	**27' - 31'**	**10' - 15'**	**28' - 32'**
		Sample Date	**12/05/2013**	**12/06/2013**	**12/16/2013**
Analyte	**NJ CLASS IIA 11/09**	**Units**			
Hexachloroethane	7	UG/L	86	<1U	<1U
Hexatriacontane		UG/L	--	--	6J
M-Xylene		UG/L	7J	--	--
Naphthalene	300	UG/L	98	2	1
PCN-6		UG/L	--	4J	--
Phenanthrene	100	UG/L	5	0.1J	<0.1U
Phenol	2,000	UG/L	2J	<0.5U	<0.5U
Propylene Glycol		UG/L	--	--	11J
Tentativley Identified Compound		UG/L	5J	8J	8J
Tetrachloroethene	1	UG/L	33J	--	--
Toluene	600	UG/L	13J	--	--
Metals					
Aluminum	0.2	MG/L	1,640J	393J	317J
Antimony	0.006	MG/L	<0.0053U	0.0319J	<0.0053U
Arsenic	0.003	MG/L	0.419J	0.367J	0.0254
Barium	6	MG/L	9.39	0.97	1.18J
Beryllium	0.001	MG/L	0.0806	0.0186	0.0238J
Cadmium	0.004	MG/L	<0.0038U	0.0081J	<0.00076U
Calcium		MG/L	436	122	27.1J
Chromium	0.07	MG/L	3.78	1.26	0.801J
Cobalt	0.1	MG/L	0.794	0.21	0.140J
Copper	1.3	MG/L	2.71	33.5	0.303J
Iron	0.3	MG/L	1,630J	549J	351J
Lead	0.005	MG/L	0.755	12.8	0.207J
Magnesium		MG/L	150	53.7	69.1J
Manganese	0.05	MG/L	21.3	2.19	2.54J
Mercury	0.002	MG/L	0.0012	0.418	0.00034J
Nickel	0.1	MG/L	1.6	0.652	0.436J
Potassium		MG/L	69.8	35.1	35.3J
Sodium	50	MG/L	312	77.7	81.3
Vanadium		MG/L	4.72	0.866	0.720J
Zinc	2	MG/L	5.03	7.12	2.45J
Miscellaneous Parameters					
Carbon Dioxide		UG/L	55,000	<4,000U	13,000J
Chloride	250	MG/L	1,220	203	160J
Ethane		UG/L	28	3.1J	<1.0U
Ethene		UG/L	17	1.1J	<1.0U
Methane		UG/L	1,200	200	18
Total Organic Carbon		MG/L	16.6	26.1	9.2J

Notes:
J = Estimated Value
U = Not detected
-- = Not Analyzed
< = Not detected at indicated reporting limit
🟨 = Exceedance of Remediation Standards

Table 4-7
Summary of DNAPL Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

	Field Sample ID	F09-M03BDNAPL-111913
	Location	F09-M03B
	Sample Date	11/18/2013
Analytes	**Units**	
Volatile Organic Compounds		
1,1,1,2-TETRACHLOROETHANE	UG/KG	<2,000 UJ
1,1,1-TRICHLOROETHANE	UG/KG	<2,000 UJ
1,1,2,2-TETRACHLOROETHANE	UG/KG	<2,000 UJ
1,1,2-TRICHLOROETHANE	UG/KG	<2,000 UJ
1,1,2-TRICHLOROTRIFLUOROETHANE	UG/KG	930,000 J
1,1-DICHLOROETHANE	UG/KG	<2,000 UJ
1,1-DICHLOROETHENE	UG/KG	2,500 J
1,2,3-TRICHLOROBENZENE	UG/KG	7,100 J
1,2,3-TRICHLOROPROPANE	UG/KG	<2,000 UJ
1,2-DIBROMO-3-CHLOROPROPANE	UG/KG	<4,000 UJ
1,2-DIBROMOETHANE (EDB)	UG/KG	<2,000 UJ
1,2-DICHLORO-1,1,2-TRIFLUOROETHANE	UG/KG	14,000 J
1,2-DICHLOROBENZENE	UG/KG	140,000 J
1,2-DICHLOROETHANE	UG/KG	8,200 J
1,2-DICHLOROPROPANE	UG/KG	<2,000 UJ
1,3,5-TRICHLOROBENZENE	UG/KG	<2,000 UJ
1,4-DICHLOROBENZENE	UG/KG	54,000 J
1-METHYL-4-NITROBENZENE	UG/KG	22,000 J
2-CHLORO-1,1,1-TRIFLUOROETHANE	UG/KG	<4,000 UJ
2-HEXANONE	UG/KG	<6,000 UJ
ACETONE	UG/KG	<14,000 UJ
ACETONITRILE	UG/KG	<50,000 UJ
ACROLEIN	UG/KG	<40,000 UJ
ACRYLONITRILE	UG/KG	<8,000 UJ
ALLYL CHLORIDE	UG/KG	<2,000 UJ
BENZENE	UG/KG	130,0000 J
BROMODICHLOROMETHANE	UG/KG	<2,000 UJ
BROMOFORM	UG/KG	<2,000 UJ
CARBON DISULFIDE	UG/KG	22,000 J
CARBON TETRACHLORIDE	UG/KG	<2,000 UJ
CFC-1113	UG/KG	<4,000 UJ
CHLOROBENZENE	UG/KG	14,000,000
CHLORODIBROMOMETHANE	UG/KG	<2,000 UJ
CHLOROFORM	UG/KG	800,000 J
CHLOROPRENE	UG/KG	<2,000 UJ
CIS-1,2 DICHLOROETHENE	UG/KG	12,000 J
CIS-1,3-DICHLOROPROPENE	UG/KG	<2,000 UJ
DICHLORODIFLUOROMETHANE	UG/KG	<4,000 UJ
DICHLOROFLUOROMETHANE	UG/KG	<4,000 UJ
ETHYL CHLORIDE	UG/KG	<4,000 UJ
ETHYL METHACRYLATE	UG/KG	<2,000 UJ
ETHYLBENZENE	UG/KG	8,400 J
IODOMETHANE	UG/KG	<6,000 UJ
ISOBUTYL ALCOHOL	UG/KG	<200,000 UJ
METHACRYLONITRILE	UG/KG	<10,000 UJ
METHYL BROMIDE	UG/KG	<4,000 UJ
METHYL CHLORIDE	UG/KG	<4,000 UJ
METHYL ETHYL KETONE	UG/KG	<8,000 UJ
METHYL ISOBUTYL KETONE	UG/KG	<6,000 UJ
METHYL METHACRYLATE	UG/KG	<2,000 UJ
METHYLENE BROMIDE	UG/KG	<2,000 UJ
METHYLENE CHLORIDE	UG/KG	29,000 J
NAPHTHALENE	UG/KG	15,000 J
NITROBENZENE	UG/KG	32,000 J
P-CHLORONITROBENZENE	UG/KG	11,000 J
PENTACHLOROETHANE	UG/KG	<2,000 UJ

Table 4-7
Summary of DNAPL Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analytes	Field Sample ID Location Sample Date Units	F09-M03BDNAPL-111913 F09-M03B 11/18/2013
PROPIONITRILE	UG/KG	<60,000 UJ
STYRENE	UG/KG	<2,000 UJ
TENTATIVELY IDENTIFIED COMPOUND	UG/KG	79,000 J
TETRACHLOROETHENE	UG/KG	130,000 J
TOLUENE	UG/KG	130,000 J
TRANS-1,2-DICHLOROETHENE	UG/KG	2,100 J
TRANS-1,3-DICHLOROPROPENE	UG/KG	<2,000 UJ
TRANS-1,4-DICHLOROBUTENE-2	UG/KG	<20,000 UJ
TRICHLOROETHENE	UG/KG	300,000 J
TRICHLOROFLUOROMETHANE	UG/KG	<4,000 UJ
VINYL ACETATE	UG/KG	<4,000 UJ
VINYL CHLORIDE	UG/KG	<2,000 UJ
XYLENES	UG/KG	48,000 J
SemiVolatile Organic Compounds		
1,2,4,5-TETRACHLOROBENZENE	UG/KG	21,000
1,2,4-TRICHLOROBENZENE	UG/KG	92,000
1,2-DICHLOROBENZENE	UG/KG	35,000,000
1,3,5-TRINITROBENZENE	UG/KG	<100,000
1,3-DICHLOROBENZENE	UG/KG	26,000
1,3-DINITROBENZENE	UG/KG	14,000,000
1,4-DICHLOROBENZENE	UG/KG	4,600,000
1,4-DIOXANE	UG/KG	<60,000
1,4-NAPHTHOQUINONE	UG/KG	<500,000
1-NAPHTHYLAMINE	UG/KG	<100,000
2,3,4,6-TETRACHLOROPHENOL	UG/KG	<40,000
2,4,5-TRICHLOROPHENOL	UG/KG	<10,000
2,4,6-TRICHLOROPHENOL	UG/KG	<10,000
2,4-DICHLOROPHENOL	UG/KG	<10,000
2,4-DIMETHYLPHENOL	UG/KG	<10,000
2,4-DINITROPHENOL	UG/KG	<180,000
2,4-DINITROTOLUENE	UG/KG	160,000,000
2,6-DICHLOROPHENOL	UG/KG	<10,000
2,6-DINITROTOLUENE	UG/KG	50,000,000
2-ACETYLAMINOFLUORENE	UG/KG	<40,000
2-CHLORONAPHTHALENE	UG/KG	<4,200
2-CHLOROPHENOL	UG/KG	<10,000
2-METHYLNAPHTHALENE	UG/KG	60,000
2-METHYLPHENOL (O-CRESOL)	UG/KG	<10,000
2-NAPHTHYLAMINE	UG/KG	<100,000
2-NITROANILINE	UG/KG	<10,000
2-NITROPHENOL	UG/KG	<10,000
2-PICOLINE	UG/KG	<60,000
3,3'-DICHLOROBENZIDINE	UG/KG	<60,000
3,3'-DIMETHYLBENZIDINE	UG/KG	<300,000
3-CHLOROANILINE	UG/KG	<20,000
3-METHYLCHOLANTHRENE	UG/KG	<10,000
3-NITROANILINE	UG/KG	<40,000
4,6-DINITRO-2-METHYLPHENOL	UG/KG	<100,000
4-AMINOBIPHENYL	UG/KG	<100,000
4-BROMOPHENYL PHENYL ETHER	UG/KG	<10,000
4-CHLORO-3-METHYLPHENOL	UG/KG	<10,000
4-CHLOROANILINE	UG/KG	<10,000
4-CHLOROPHENYL PHENYL ETHER	UG/KG	<10,000
4-DIMETHYLAMINOAZOBENZENE	UG/KG	<40,000
4-METHYLPHENOL (P-CRESOL)	UG/KG	<10,000
4-NITROANILINE	UG/KG	<40,000
4-NITROPHENOL	UG/KG	<100,000

Table 4-7
Summary of DNAPL Analytical Results
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	Field Sample ID	F09-M03BDNAPL-111913
	Location	F09-M03B
	Sample Date	11/18/2013
Analytes	**Units**	
4-NITROQUINOLINE-N-OXIDE	UG/KG	<200,000
5-NITRO-ORTHO-TOLUIDINE	UG/KG	<100,000
7,12-DIMETHYLBENZ[A]ANTHRACENE	UG/KG	<10,000
ACENAPHTHENE	UG/KG	48,000
ACENAPHTHYLENE	UG/KG	<2,000
ACETOPHENONE	UG/KG	<10,000
ALPHA,ALPHA-DIMETHYLPHENETHYLAMINE	UG/KG	<60,000
ANILINE	UG/KG	<100,000
ANTHRACENE	UG/KG	27,000
ARAMITE	UG/KG	<40,000
BENZO(A)ANTHRACENE	UG/KG	11,000
BENZO(B)FLUORANTHENE	UG/KG	8,800 J
BENZO(G,H,I)PERYLENE	UG/KG	2,500 J
BENZO(K)FLUORANTHENE	UG/KG	4,200 J
BENZO[A]PYRENE	UG/KG	5,400 J
BENZYL ALCOHOL	UG/KG	<100,000
BIS(2-CHLOROETHOXY)METHANE	UG/KG	<10,000
BIS(2-CHLOROETHYL)ETHER	UG/KG	<10,000
BIS(2-CHLOROISOPROPYL)ETHER	UG/KG	<10,000
BIS(2-ETHYLHEXYL)PHTHALATE	UG/KG	<40,000
BUTYL BENZYL PHTHALATE	UG/KG	<40,000
CHLOROBENZILATE	UG/KG	<20,000
CHRYSENE	UG/KG	13,000
DIALLATE	UG/KG	<20,000
DIBENZ(A,H)ANTHRACENE	UG/KG	<2,000
DIBENZOFURAN	UG/KG	41,000
DIETHYL PHTHALATE	UG/KG	<40,000
DIMETHOATE	UG/KG	<100,000
DIMETHYL PHTHALATE	UG/KG	<40,000
DI-N-BUTYL PHTHALATE	UG/KG	<40,000
ETHYL METHANESULFONATE	UG/KG	<40,000
FLUORANTHENE	UG/KG	61,000
FLUORENE	UG/KG	<2,000
HEXACHLOROBENZENE	UG/KG	500,000
HEXACHLOROBUTADIENE	UG/KG	<10,000
HEXACHLOROCYCLOPENTADIENE	UG/KG	<100,000
HEXACHLOROETHANE	UG/KG	<20,000
HEXACHLOROPROPYLENE	UG/KG	<60,000
INDENO (1,2,3-CD) PYRENE	UG/KG	2,800 J
ISODRIN	UG/KG	<10,000
ISOPHORONE	UG/KG	<10,000
ISOSAFROLE	UG/KG	<40,000
METHAPYRILENE	UG/KG	<1,000,000
METHYL METHANESULFONATE	UG/KG	<20,000
NAPHTHALENE	UG/KG	950,000
N-DIOCTYL PHTHALATE	UG/KG	<40,000
NITROBENZENE	UG/KG	26,000,000
N-NITROSO(METHYL)ETHYLAMINE	UG/KG	<40,000
N-NITROSODIETHYLAMINE	UG/KG	<10,000
N-NITROSODIMETHYLAMINE	UG/KG	<40,000
N-NITROSO-DI-N-BUTYLAMINE	UG/KG	<40,000
N-NITROSODI-N-PROPYLAMINE	UG/KG	<10,000
N-NITROSODIPHENYLAMINE	UG/KG	<10,000
N-NITROSOMORPHOLINE	UG/KG	<40,000 UJ
N-NITROSOPIPERIDINE	UG/KG	<10,000
N-NITROSOPYRROLIDINE	UG/KG	<10,000
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/KG	<40,000

Table 4-7
Summary of DNAPL Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analytes	Field Sample ID Location Sample Date Units	F09-M03BDNAPL-111913 F09-M03B 11/18/2013
O-TOLUIDINE	UG/KG	<120,000
PARA-PHENYLENEDIAMINE	UG/KG	<7,000,000
PENTACHLOROBENZENE	UG/KG	<10,000
PENTACHLORONITROBENZENE	UG/KG	<40,000
PENTACHLOROPHENOL	UG/KG	<20,000 UJ
PHENACETIN	UG/KG	<40,000
PHENANTHRENE	UG/KG	130,000
PHENOL	UG/KG	<10,000
PRONAMIDE	UG/KG	<20,000
PYRENE	UG/KG	37,000
PYRIDINE	UG/KG	<40,000
SAFROLE	UG/KG	<40,000
TENTATIVELY IDENTIFIED COMPOUND	UG/KG	93,000 J
TETRAETHYL DITHIOPYROPHOSPHATE	UG/KG	<40,000
THIONAZIN	UG/KG	<40,000
MNA Parameter		
METHANOL	UG/KG	<200 UJ
Herbicides/Pesticides		
4,4'-DDD	UG/KG	1,500 J
4,4'-DDE	UG/KG	<990
4,4'-DDT	UG/KG	<1,100
ALDRIN	UG/KG	<570
ALPHA-BHC	UG/KG	<510
BETA-BHC	UG/KG	<900
CHLORDANE	UG/KG	<12,000
DELTA-BHC	UG/KG	150,000
DIELDRIN	UG/KG	<990
ENDOSULFAN I	UG/KG	<660
ENDOSULFAN II	UG/KG	4,600 J
ENDOSULFAN SULFATE	UG/KG	<990
ENDRIN	UG/KG	<1,500
ENDRIN ALDEHYDE	UG/KG	2,000 J
HEPTACHLOR	UG/KG	<510
HEPTACHLOR EPOXIDE	UG/KG	<510
KEPONE	UG/KG	<6,900
LINDANE	UG/KG	<650
METHOXYCHLOR	UG/KG	<5,100
TOXAPHENE	UG/KG	<42,000
2,4,5-T	UG/KG	<24,000
2,4-DICHLOROPHENOXYACETIC ACID	UG/KG	<380,000
DINOSEB	UG/KG	<27,000
HEXACHLOROPHENE	UG/KG	<24,000
SILVEX	UG/KG	<2,300
Dioxins and Furans		
1,2,3,4,6,7,8-HPCDD	PG/G	1,200
1,2,3,4,6,7,8-HPCDF	PG/G	1,220
1,2,3,4,7,8,9-HPCDF	PG/G	145
1,2,3,4,7,8-HXCDD	PG/G	19.6 J
1,2,3,4,7,8-HXCDF	PG/G	57
1,2,3,6,7,8-HXCDD	PG/G	79
1,2,3,6,7,8-HXCDF	PG/G	42.8 J
1,2,3,7,8,9-HXCDD	PG/G	53
1,2,3,7,8,9-HXCDF	PG/G	14.7 J
1,2,3,7,8-PECDD	PG/G	7.42 J
1,2,3,7,8-PECDF	PG/G	14.2 J
2,3,4,6,7,8-HXCDF	PG/G	29.3 J
2,3,4,7,8-PECDF	PG/G	17.2 J

Table 4-7
Summary of DNAPL Analytical Results
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Analytes	Field Sample ID Location Sample Date Units	F09-M03BDNAPL-111913 F09-M03B 11/18/2013
2,3,7,8-TCDD	PG/G	2.06 J
2,3,7,8-TCDF	PG/G	252
HPCDDS	PG/G	3,270
HPCDFS	PG/G	2,710
HXCDDS	PG/G	1,680
HXCDFS	PG/G	716
OCDD	PG/G	17,900
OCDF	PG/G	11,600
TCDDS	PG/G	159
TCDFS	PG/G	4,680
TOTAL PECDDS	PG/G	455
TOTAL PECDFS	PG/G	766
Metals		
ANTIMONY	MG/KG	<0.725
ARSENIC	MG/KG	<0.686
BARIUM	MG/KG	0.195 B
BERYLLIUM	MG/KG	<0.0657
CADMIUM	MG/KG	<0.0745
CHROMIUM	MG/KG	2
COBALT	MG/KG	4
COPPER	MG/KG	22
LEAD	MG/KG	0.655 J
NICKEL	MG/KG	30
SELENIUM	MG/KG	1.18 J
SILVER	MG/KG	<0.167
TETRAETHYL LEAD	MG/KG	<100
THALLIUM	MG/KG	<0.510
TIN	MG/KG	1.44 J
VANADIUM	MG/KG	6
ZINC	MG/KG	0.532 B
MERCURY	MG/KG	6
Miscellaneous		
AMENABLE CYANIDE	MG/KG	0.74 J
CYANIDE	UG/KG	880
PH	STD UNITS	7.22 J
TOTAL ORGANIC CARBON	MG/KG	259,000
KINEMATIC VISCOSITY	CST	4
FLASHPOINT	deg F	188
PCB 1016	UG/KG	<5,000
PCB 1221	UG/KG	<5,000
PCB 1232	UG/KG	<5,000
PCB 1242	UG/KG	<5,000
PCB 1248	UG/KG	<5,000
PCB 1254	UG/KG	<25,000
PCB 1260	UG/KG	<5,000
REACTIVE SULFIDE	MG/KG	<53.6
SPECIFIC GRAVITY	NONE	1

Notes:
J = Estimated Value
UJ = Not detected. Reporting limit may not be accurate or precise.
B = Analyte is present in the associated method blank at a reportable level
< = Non detect at stated reporting limit

Table 4-8
Comparison of Sub-Slab Soil Gas Analytical Results to New Jersey Non-Residential Soil Gas Screening Levels
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte	Units	NJVI SOILGAS NONRES 2013	AOC1-FP-857 04/21/2014	AOC1-FP-857-1 04/21/2014	AOC1-FP-857-2 04/21/2014	AOC1-FP-857-3 04/21/2014	AOC1-FP-857-4 04/21/2014	AOC1-FP-K21 04/22/2014	AOC1-FP-K21-1 04/22/2014	AOC1-FP-K21-2 04/22/2014	AOC1-FP-K21-3 04/22/2014	AOC1-FP-K21-4 04/24/2014	AOC1-FP-K24 04/23/2014	AOC1-FP-K24-1 04/23/2014	AOC1-FP-K24-2 04/23/2014	AOC1-FP-K24-3 04/23/2014	AOC1-FP-K29-1 04/22/2014	AOC1-FP-K29-2 04/22/2014
Volatile Organic Compounds																		
1,1,1-Trichloroethane	UG/M^3	1,100,000	<1U	<11U	<77U	<140U	<11U	<1U	<11U	<60U	<11U	<11U	<2U	810	<360U	<110U	<43U	<44U
1,1,2,2-Tetrachloroethane	UG/M^3	34	<2U	<14U	^<97U	^<180U	<14U	<1U	<14U	^<75U	<14U	<14U	<2U	^<700U	^<460U	^<140U	^<55U	^<55U
1,1,2-Trichloroethane	UG/M^3	38	<1U	<11U	^<77U	^<140U	<11U	<1U	<11U	^<60U	<11U	<11U	<2U	^<550U	^<360U	^<110U	^<43U	^<44U
1,1,2-Trichlorotrifluoroethane	UG/M^3	6,600,000	<2U	750	17,000	28,000	21	5	170	<84U	290	280	<2U	150,000	92,000	27,000	8,200	8,400
1,1-Dichloroethane	UG/M^3	380	<0.9U	8	<57U	<100U	<8U	<0.8U	<8U	<44U	8	<8U	<1U	^<410U	<270U	<81U	<32U	<33U
1,1-Dichloroethene	UG/M^3	44,000	<0.9U	<8U	<56U	<100U	<8U	<0.8U	<8U	<43U	<8U	<8U	<1U	<400U	<260U	<79U	<32U	<32U
1,2,4-Trichlorobenzene	UG/M^3	440	<4U	<37U	<260U	^<470U	<37U	<4U	<37U	<200U	<37U	<37U	<6U	^<1,900U	^<1,200U	<370U	<150U	<150U
1,2-Dibromoethane (EDB)	UG/M^3	38	<2U	<15U	^<110U	^<200U	<15U	<2U	<15U	^<84U	<15U	<15U	<2U	^<780U	^<510U	^<150U	^<61U	^<62U
1,2-Dichlorobenzene	UG/M^3	44,000	<1U	<12U	<85U	<150U	<12U	<1U	<12U	<66U	<12U	<12U	<2U	<610U	<400U	<120U	<48U	<49U
1,2-Dichloroethane	UG/M^3	24	<0.9U	<8U	^<57U	^<100U	<8U	<0.8U	<8U	^<44U	<8U	<8U	<1U	^<410U	^<270U	^<81U	^<32U	^<33U
1,2-Dichloropropane	UG/M^3	61	<1U	<9U	^<65U	^<120U	<9U	<0.9U	<9U	<50U	<9U	<9U	<1U	^<470U	^<310U	^<92U	<37U	<37U
1,3-Butadiene	UG/M^3	20	<0.5U	<4U	^<31U	^<57U	<4U	<0.4U	<4U	^<24U	<4U	<4U	<0.7U	^<220U	^<150U	^<44U	<18U	<18U
1,4-Dichlorobenzene	UG/M^3	56	<1U	<12U	^<85U	^<150U	<12U	<1U	<12U	^<66U	<12U	<12U	<2U	^<610U	^<400U	^<120U	<48U	<49U
Acetone	UG/M^3	6,800,000	17	<120U	<830U	<1,500U	<120U	<12U	<120U	<650U	<120U	<120U	23	<6,000U	<4,000U	<1,200U	950	<480U
Allyl Chloride	UG/M^3	100	<2U	<16U	^<110U	^<200U	<16U	<2U	<16U	<85U	<16U	<16U	<2U	^<800U	^<520U	^<160U	<62U	<63U
Benzene	UG/M^3	79	<0.7U	<6U	<45U	^<82U	<6U	<0.6U	<6U	<35U	<6U	<6U	<1U	^<320U	^<210U	<64U	<25U	<26U
Bromodichloromethane	UG/M^3	34	<2U	<13U	^<94U	^<170U	<13U	<1U	<13U	^<73U	<13U	<13U	<2U	^<680U	^<450U	^<130U	^<53U	^<54U
Bromoethene	UG/M^3	22	<1U	<9U	^<62U	^<110U	<9U	<0.9U	<9U	^<48U	<9U	<9U	<1U	^<440U	^<290U	^<87U	^<35U	^<35U
Bromoform	UG/M^3	560	<2U	<21U	<150U	<260U	<21U	<2U	<21U	<110U	<21U	<21U	<3U	^<1,100U	^<690U	<210U	<82U	<84U
Carbon Disulfide	UG/M^3	150,000	<2U	<16U	<110U	<200U	<16U	<2U	<16U	<85U	<16U	<16U	<2U	<790U	<520U	<160U	<62U	<63U
Carbon Tetrachloride	UG/M^3	100	<1U	91	^110	^<160U	<13U	<1U	50	<69U	<13U	<13U	<2U	^5,900	^2,200	^580	<50U	^150
Chlorobenzene	UG/M^3	11,000	110	<9U	<65U	<120U	<9U	18	<9U	<50U	<9U	<9U	4	<470U	<310U	<92U	<37U	<37U
Chlorodibromomethane	UG/M^3	43	<2U	<17U	^<120U	^<220U	<17U	<2U	<17U	^<93U	<17U	<17U	<3U	^<870U	^<570U	^<170U	^<68U	^<69U
Chloroform	UG/M^3	27	<1U	^120	^4,600	^430	^43	<1U	^150	^<53U	20	<10U	<2U	^6,500	^9,100	^1,800	^97	^1,300
cis-1,3-Dichloropropene	UG/M^3	150	<1U	<9U	<64U	<120U	<9U	<0.9U	<9U	<50U	<9U	<9U	<1U	^<460U	^<300U	<91U	<36U	<37U
Cyclohexane	UG/M^3	1,300,000	<0.8U	<7U	<48U	<88U	<7U	<0.7U	<7U	64	9	<7U	<1U	<350U	<230U	<69U	<27U	<28U
Dichlorodifluoromethane	UG/M^3	22,000	<3U	<25U	1,100	3,000	<25U	<2U	<25U	<140U	<25U	<25U	6	<1,300U	<830U	<250U	140	100
Ethyl Chloride	UG/M^3	2,200,000	<1U	<13U	<93U	<170U	<13U	<1U	<13U	<72U	<13U	<13U	<2U	<670U	<440U	<130U	<53U	<53U
Ethylbenzene	UG/M^3	250	4	<9U	<61U	<110U	<9U	1	<9U	<47U	<9U	<9U	<1U	^<440U	^<290U	<87U	<35U	<35U
Hexachlorobutadiene	UG/M^3	53	<2U	<21U	^<150U	^<270U	<21U	<2U	<21U	^<120U	<21U	<21U	<3U	^<1,100U	^<710U	^<210U	^<85U	^<86U
Hexane	UG/M^3	150,000	<0.8U	<7U	<50U	<90U	<7U	<0.7U	<7U	<38U	<7U	<7U	2	<360U	<240U	<70U	<28U	<28U
Meta- And Para-Xylene	UG/M^3	22,000	14	<22U	<150U	<280U	<22U	3	<22U	<120U	<22U	<22U	<3U	<1,100U	<730U	<220U	<86U	<88U
Methyl Bromide	UG/M^3	1,100	<0.9U	<8U	<55U	<99U	<8U	<0.8U	<8U	<42U	<8U	<8U	<1U	<390U	<260U	<78U	<31U	<31U
Methyl Chloride	UG/M^3	20,000	1	<10U	<73U	<130U	<10U	1	<10U	<56U	<10U	<10U	3	<520U	<340U	<100U	<41U	<42U
Methyl Ethyl Ketone	UG/M^3	1,100,000	14	<15U	<100U	<190U	<15U	7	<15U	760	160	<15U	<2U	<750U	<490U	<150U	<59U	<60U
Methyl Isobutyl Ketone	UG/M^3	660,000	<2U	<20U	<140U	<260U	<20U	<2U	<20U	<110U	<20U	<20U	<3U	<1,000U	<680U	<200U	<82U	<83U
Methyl Tertiary Butyl Ether	UG/M^3	2,400	<0.8U	<7U	<51U	<92U	<7U	<0.7U	<7U	<39U	<7U	<7U	<1U	<370U	<240U	<72U	<29U	<29U
Methylene Chloride	UG/M^3	61,000	<2U	<17U	<120U	<220U	<17U	<2U	<17U	<95U	<17U	<17U	17	<880U	<580U	<170U	<69U	<70U
Naphthalene	UG/M^3	26	<3U	^<26U	^<180U	^<340U	^<26U	<3U	^<26U	^<140U	^<26U	^<26U	<4U	^<1,300U	^<880U	^<260U	^<100U	^<110U
Ortho-Xylene	UG/M^3	22,000	5	<9U	<61U	<110U	<9U	<0.9U	<9U	<47U	<9U	<9U	<1U	<440U	<290U	<87U	<35U	<35U
Styrene	UG/M^3	220,000	<1U	<9U	<60U	<110U	<9U	<0.9U	<9U	<47U	<9U	<9U	<1U	<430U	<280U	<85U	<34U	<34U
Tetrachloroethene	UG/M^3	2,400	<2U	220	340	1,100	<14U	<1U	360	<74U	<14U	60	<2U	^11,000	^14,000	^5,900	1,400	^11,000
Toluene	UG/M^3	1,100,000	15	72	310	900	<8U	4	<8U	7,300	200	<8U	1	<380U	<250U	<75U	<30U	<30U
trans-1,2-Dichloroethene	UG/M^3	13,000	<0.9U	<8U	<56U	<100U	<8U	<0.8U	<8U	<43U	<8U	<8U	<1U	<400U	<260U	<79U	<32U	<32U
trans-1,3-Dichloropropene	UG/M^3	150	<1U	<9U	<64U	<120U	<9U	<0.9U	<9U	<50U	<9U	<9U	<1U	^<460U	^<300U	<91U	<36U	<37U
Trichloroethene	UG/M^3	150	<1U	44	^160	<140U	<11U	<1U	<11U	<59U	<11U	<11U	<2U	^1,100	^<360U	130	52	^450
Trichlorofluoromethane	UG/M^3	150,000	2	160	3,200	10,000	<11U	1	1,800	<61U	220	16	3	6,400	35,000	7,600	1,300	2,100
Vinyl Chloride	UG/M^3	140	<0.6U	<5U	<36U	<65U	<5U	<0.5U	<5U	<28U	<5U	<5U	<0.8U	^<260U	^<170U	<51U	<20U	<21U
Xylenes	UG/M^3	22,000	18	<9U	<61U	<110U	<9U	3	<9U	<47U	<9U	<9U	<1U	<440U	<290U	<87U	<35U	<35U

Notes:
NJVI_SOILGAS_NORES_2013 = Vapor Intrusion Soil Gas Non-Residential Criteria
U = Not detected
< = Not detected at stated reporting limit
🟨 = ^ and yellow shading indicates an Exceedance of Remediation Standards
🟧 = ^ and orange shading indicates that the detection limit is above the screening criteria

Table 4-8
Comparison of Sub-Slab Soil Gas Analytical Results to New Jersey Non-Residential Soil Gas Screening Levels
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte	Units	NJVI SOILGAS NONRES 2013	AOC1-FP-K29-3 04/22/2014	AOC1-FP-K29-4 04/22/2014	AOC1-FP-K29-5 04/22/2014	AOC1-FP-K37 04/24/2014	AOC1-FP-K37-1 04/24/2014	AOC1-FP-K37-2 04/24/2014	AOC1-FP-K37-3 04/24/2014	AOC1-FP-K37-4 04/24/2014	AOC1-FP-K37-5 04/24/2014	AOC1-FP-K37-6 04/24/2014	AOC2-TEL-63 05/06/2014	AOC2-TEL-63-1 05/06/2014	AOC2-TEL-63-2 05/06/2014	AOC2-TEL-63-3 05/06/2014	AOC2-TEL-63-4 05/06/2014	AOC2-TEL-63-5 05/06/2014
Volatile Organic Compounds																		
1,1,1-Trichloroethane	UG/M^3	1,100,000	<3,100U	<21,000U	<580U	<1U	<150U	<180U	<19U	<110U	<11U	<11U	<1U	<15U	39	<5U	<1U	<1U
1,1,2,2-Tetrachloroethane	UG/M^3	34	^<3,900U	^<26,000U	^<730U	<1U	^<190U	^<220U	<23U	^<140U	<14U	<14U	<1U	<19U	<11U	<7U	<1U	<1U
1,1,2-Trichloroethane	UG/M^3	38	^<3,100U	^<21,000U	^<580U	<1U	^<150U	^<180U	<19U	^<110U	<11U	<11U	<1U	<15U	<9U	<5U	<1U	<1U
1,1,2-Trichlorotrifluoroethane	UG/M^3	6,600,000	690,000	3,600,000	140,000	9	7,200	5,300	4,600	14,000	60	25	<2U	2,100	1,100	<8U	<2U	120
1,1-Dichloroethane	UG/M^3	380	^<2,300U	^<15,000U	^<430U	<0.8U	<110U	<130U	<14U	<81U	<8U	<8U	<0.8U	<11U	<6U	<4U	<0.8U	<0.8U
1,1-Dichloroethene	UG/M^3	44,000	<2,300U	<15,000U	<420U	<0.8U	<110U	<130U	<13U	<79U	<8U	<8U	<0.8U	140	69	79	23	110
1,2,4-Trichlorobenzene	UG/M^3	440	^<11,000U	^<71,000U	^<2,000U	<4U	^<500U	^<600U	<63U	<370U	<37U	<37U	<4U	<52U	<30U	<19U	<4U	<4U
1,2-Dibromoethane (EDB)	UG/M^3	38	^<4,400U	^<29,000U	^<820U	<2U	^<210U	^<250U	<26U	^<150U	<15U	<15U	<2U	<22U	<12U	<8U	<2U	<2U
1,2-Dichlorobenzene	UG/M^3	44,000	<3,500U	<23,000U	<640U	2	<160U	<190U	<20U	<120U	<12U	<12U	<1U	<17U	<10U	<6U	<1U	<1U
1,2-Dichloroethane	UG/M^3	24	^<2,300U	^<15,000U	^<430U	<0.8U	^<110U	^<130U	<14U	^<81U	<8U	<8U	<0.8U	<11U	<6U	<4U	<0.8U	<0.8U
1,2-Dichloropropane	UG/M^3	61	^<2,700U	^<18,000U	^<490U	<0.9U	^<120U	^<150U	<16U	^<92U	<9U	<9U	<0.9U	<13U	<7U	<5U	<0.9U	<0.9U
1,3-Butadiene	UG/M^3	20	^<1,300U	^<8,400U	^<230U	<0.4U	^<60U	^<71U	<8U	^<44U	<4U	<4U	<0.4U	<6U	<4U	8	<0.4U	5
1,4-Dichlorobenzene	UG/M^3	56	^<3,500U	^<23,000U	^<640U	3	^<160U	^<190U	<20U	^<120U	<12U	<12U	<1U	<17U	<10U	<6U	<1U	<1U
Acetone	UG/M^3	6,800,000	<34,000U	<230,000U	<6,300U	<12U	<1,600U	<1,900U	<200U	<1,200U	<120U	120	<12U	<170U	<95U	270	20	51
Allyl Chloride	UG/M^3	100	^<4,500U	^<30,000U	^<830U	<2U	^<210U	^<250U	<27U	^<160U	<16U	<16U	<2U	<22U	<13U	<8U	<2U	<2U
Benzene	UG/M^3	79	^<1,800U	^<12,000U	^<340U	2	^<86U	^<100U	<11U	<64U	12	9	<0.6U	9	<5U	6	1	5
Bromodichloromethane	UG/M^3	34	^<3,800U	^<25,000U	^<710U	<1U	^<180U	^<220U	<23U	^<130U	<13U	<13U	<1U	<19U	<11U	<7U	<1U	<1U
Bromoethene	UG/M^3	22	^<2,500U	^<17,000U	^<460U	<0.9U	^<120U	^<140U	<15U	^<87U	<9U	<9U	<0.9U	<12U	<7U	<4U	<0.9U	<0.9U
Bromoform	UG/M^3	560	^<5,900U	^<39,000U	^<1,100U	<2U	<280U	<330U	<35U	<210U	<21U	<21U	<2U	<29U	<17U	<10U	<2U	<2U
Carbon Disulfide	UG/M^3	150,000	<4,500U	<30,000U	<830U	<2U	<210U	<250U	<26U	<160U	<16U	<16U	<2U	<22U	27	<8U	3	16
Carbon Tetrachloride	UG/M^3	100	^<3,600U	^<24,000U	^<670U	8	^620	^430	28	^180	<13U	<13U	<1U	<18U	<10U	<6U	<1U	4
Chlorobenzene	UG/M^3	11,000	<2,600U	^<17,000U	<490U	11	<120U	<150U	<16U	<92U	<9U	<9U	<0.9U	<13U	<7U	<5U	<0.9U	1
Chlorodibromomethane	UG/M^3	43	^<4,900U	^<32,000U	^<900U	<2U	^<230U	^<270U	<29U	^<170U	<17U	<17U	<2U	<24U	<14U	<9U	<2U	<2U
Chloroform	UG/M^3	27	^8,000	^72,000	^1,400	2	^3,400	^4,700	19	^950	<10U	<10U	<1U	<14U	<8U	10	20	6
cis-1,3-Dichloropropene	UG/M^3	150	^<2,600U	^<17,000U	^<480U	<0.9U	<120U	^<150U	<15U	<91U	<9U	<9U	<0.9U	<13U	<7U	<5U	<0.9U	<0.9U
Cyclohexane	UG/M^3	1,300,000	<2,000U	<13,000U	<370U	<0.7U	<93U	<110U	<12U	<69U	<7U	<7U	<0.7U	26	8	<3U	<0.7U	1
Dichlorodifluoromethane	UG/M^3	22,000	<7,100U	^<47,000U	<1,300U	<2U	<330U	<400U	<42U	<250U	<25U	<25U	<2U	<35U	<20U	<12U	<2U	<2U
Ethyl Chloride	UG/M^3	2,200,000	<3,800U	<25,000U	<700U	<1U	<180U	<210U	<22U	<130U	<13U	<13U	<1U	<19U	<11U	<7U	<1U	<1U
Ethylbenzene	UG/M^3	250	^<2,500U	^<17,000U	^<460U	<0.9U	<120U	<140U	<15U	<87U	<9U	<9U	<0.9U	28	<7U	<4U	<0.9U	<0.9U
Hexachlorobutadiene	UG/M^3	53	^<6,100U	^<41,000U	^<1,100U	<2U	^<290U	^<340U	<36U	^<210U	<21U	<21U	<2U	<30U	<17U	<11U	<2U	<2U
Hexane	UG/M^3	150,000	<2,000U	<13,000U	<370U	<0.7U	<95U	<110U	<12U	<70U	<7U	41	1	23	8	<4U	1	1
Meta- And Para-Xylene	UG/M^3	22,000	<6,200U	^<41,000U	<1,200U	<2U	<290U	<350U	<37U	<220U	<22U	<22U	<2U	33	<17U	<11U	<2U	<2U
Methyl Bromide	UG/M^3	1,100	^<2,200U	^<15,000U	<410U	<0.8U	<100U	<130U	<13U	<78U	<8U	<8U	<0.8U	<11U	<6U	<4U	<0.8U	<0.8U
Methyl Chloride	UG/M^3	20,000	<3,000U	^<20,000U	<550U	1	<140U	<170U	<18U	<100U	<10U	<10U	1	<15U	<8U	<5U	<1U	<1U
Methyl Ethyl Ketone	UG/M^3	1,100,000	<4,200U	<28,000U	<780U	2	<200U	<240U	<25U	<150U	54	88	<1U	<21U	<12U	14	3	9
Methyl Isobutyl Ketone	UG/M^3	660,000	<5,900U	<39,000U	<1,100U	<2U	<280U	<330U	<35U	<200U	<20U	<20U	<2U	<29U	<16U	<10U	<2U	<2U
Methyl Tertiary Butyl Ether	UG/M^3	2,400	<2,100U	^<14,000U	<380U	<0.7U	<97U	<120U	<12U	<72U	<7U	<7U	<0.7U	<10U	<6U	<4U	<0.7U	<0.7U
Methylene Chloride	UG/M^3	61,000	<5,000U	<33,000U	<920U	<2U	<230U	<280U	<30U	<170U	<17U	<17U	2	<24U	<14U	<9U	7	<2U
Naphthalene	UG/M^3	26	^<7,500U	^<50,000U	^<1,400U	<3U	^<350U	^<420U	^<45U	^<260U	^<26U	^<26U	<3U	^<37U	<21U	<13U	<3U	<3U
Ortho-Xylene	UG/M^3	22,000	<2,500U	<17,000U	<460U	<0.9U	<120U	<140U	<15U	<87U	<9U	<9U	<0.9U	31	<7U	<4U	<0.9U	<0.9U
Styrene	UG/M^3	220,000	<2,400U	<16,000U	<450U	<0.9U	<120U	<140U	<14U	<85U	<9U	<9U	<0.9U	<12U	<7U	<4U	<0.9U	<0.9U
Tetrachloroethene	UG/M^3	2,400	^100,000	^<26,000U	^27,000	<1U	^23,000	^29,000	330	910	<14U	<14U	<1U	680	<11U	<7U	8	7
Toluene	UG/M^3	1,100,000	<2,200U	<14,000U	<400U	2	<100U	<120U	<13U	<75U	160	84	1	16	8	<4U	1	6
trans-1,2-Dichloroethene	UG/M^3	13,000	<2,300U	^<15,000U	<420U	<0.8U	<110U	<130U	<13U	<79U	<8U	<8U	<0.8U	<11U	<6U	<4U	<0.8U	<0.8U
trans-1,3-Dichloropropene	UG/M^3	150	^<2,600U	^<17,000U	^<480U	<0.9U	<120U	^<150U	<15U	<91U	<9U	<9U	<0.9U	<13U	<7U	<5U	<0.9U	<0.9U
Trichloroethene	UG/M^3	150	^<3,100U	^<20,000U	^630	<1U	^2,200	^4,400	<18U	<110U	<11U	<11U	<1U	<15U	<9U	<5U	13	3
Trichlorofluoromethane	UG/M^3	150,000	37,000	130,000	7,500	3	4,600	4,400	1,100	11,000	<11U	<11U	1	<16U	<9U	10	2	<1U
Vinyl Chloride	UG/M^3	140	^<1,500U	^<9,700U	^<270U	<0.5U	<69U	<82U	<9U	<51U	<5U	<5U	<0.5U	<7U	<4U	<3U	<0.5U	<0.5U
Xylenes	UG/M^3	22,000	<2,500U	<17,000U	<460U	<0.9U	<120U	<140U	<15U	<87U	<9U	<9U	<0.9U	63	<7U	<4U	<0.9U	<0.9U

Notes:
NJVI_SOILGAS_NORES_2013 = Vapor Intrusion Soil Gas Non-Residential Criteria
U = Not detected
< = Not detected at stated reporting limit
🟨 = ^ and yellow shading indicates an Exceedance of Remediation Standards
🟧 = ^ and orange shading indicates that the detection limit is above the screening criteria

Table 4-8
Comparison of Sub-Slab Soil Gas Analytical Results to New Jersey Non-Residential Soil Gas Screening Levels
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte	Units	NJVI SOILGAS NONRES 2013	AOC3-JL-1059 04/28/2014	AOC3-JL-603-1 04/29/2014	AOC3-JL-603-2 04/29/2014	AOC3-JL-603-3 04/29/2014	AOC3-JL-603-4 04/29/2014	AOC3-JL-603-5 04/29/2014	AOC3-JL-667-1 04/30/2014	AOC3-JL-667-2 04/30/2014	AOC3-JL-667-3 04/30/2014	AOC3-JL-J27-1 04/28/2014	AOC3-JL-J27-2 04/28/2014	AOC3-JL-J27-3 04/28/2014	AOC3-JL-J30-1 04/28/2014	AOC3-JL-J30-2 04/28/2014	AOC3-JL-J30-3 04/28/2014	AOC3-JL-J30-4 04/28/2014
Volatile Organic Compounds																		
1,1,1-Trichloroethane	UG/M^3	1,100,000	<1U	23	<17U	<27U	<17U	<11U	<11U	<34U	<11U	<220U	<110U	<1,500U	<33U	<4,200U	<1,400U	<16U
1,1,2,2-Tetrachloroethane	UG/M^3	34	<1U	<14U	<22U	<33U	<22U	<14U	<14U	^<43U	<14U	^<280U	^<140U	^<1,800U	^<41U	^<5,300U	^<1,700U	<20U
1,1,2-Trichloroethane	UG/M^3	38	<1U	<11U	<17U	<27U	<17U	<11U	<11U	<34U	<11U	^<220U	^<110U	^<1,500U	<33U	^<4,200U	^<1,400U	<16U
1,1,2-Trichlorotrifluoroethane	UG/M^3	6,600,000	<2U	49	39	3,600	130	76	<16U	<48U	<15U	5,000	3,300	49,000	2,700	1,000,000	52,000	890
1,1-Dichloroethane	UG/M^3	380	<0.8U	<8U	<13U	<20U	<13U	<8U	<8U	<26U	<8U	<160U	<81U	^<1,100U	<24U	^<3,100U	^<1,000U	<12U
1,1-Dichloroethene	UG/M^3	44,000	<0.8U	130	<13U	280	280	<8U	45	180	140	<160U	<79U	<1,100U	<24U	<3,100U	1,400	<12U
1,2,4-Trichlorobenzene	UG/M^3	440	<4U	<37U	<59U	<90U	<59U	<37U	<39U	<120U	<37U	^<750U	<370U	^<5,000U	<110U	^<14,000U	^<4,700U	<55U
1,2-Dibromoethane (EDB)	UG/M^3	38	<2U	<15U	<24U	<37U	<25U	<15U	<16U	^<49U	<15U	^<310U	^<150U	^<2,100U	^<46U	^<5,900U	^<1,900U	<23U
1,2-Dichlorobenzene	UG/M^3	44,000	<1U	<12U	<19U	<29U	<19U	<12U	<13U	<38U	<12U	<240U	<120U	<1,600U	<36U	<4,600U	<1,500U	<18U
1,2-Dichloroethane	UG/M^3	24	<0.8U	<8U	<13U	<20U	<13U	<8U	<8U	^<26U	<8U	^<160U	^<81U	^<1,100U	^<24U	^<3,100U	^<1,000U	<12U
1,2-Dichloropropane	UG/M^3	61	<0.9U	<9U	<15U	<22U	<15U	<9U	<10U	<29U	<9U	^<190U	^<92U	^<1,200U	<28U	^<3,600U	^<1,200U	<14U
1,3-Butadiene	UG/M^3	20	<0.4U	<4U	<7U	<11U	<7U	<4U	<5U	<14U	<4U	^<89U	^<44U	^<590U	<13U	^<1,700U	^<560U	<7U
1,4-Dichlorobenzene	UG/M^3	56	<1U	<12U	<19U	<29U	<19U	<12U	<13U	<38U	<12U	^<240U	^<120U	^<1,600U	<36U	^<4,600U	^<1,500U	<18U
Acetone	UG/M^3	6,800,000	<12U	<120U	<190U	380	760	<120U	<120U	<380U	<120U	<2,400U	<1,200U	<16,000U	<360U	<46,000U	<15,000U	<180U
Allyl Chloride	UG/M^3	100	<2U	<16U	<25U	<38U	<25U	<16U	<16U	<49U	<16U	^<320U	^<160U	^<2,100U	<47U	^<6,000U	^<2,000U	<23U
Benzene	UG/M^3	79	<0.6U	<6U	<10U	<16U	<10U	<6U	<7U	<20U	<6U	^<130U	<64U	^<860U	<19U	^<2,500U	^<810U	<9U
Bromodichloromethane	UG/M^3	34	<1U	<13U	<21U	<33U	<21U	<13U	<14U	^<42U	<13U	^<270U	^<130U	^<1,800U	^<40U	^<5,200U	^<1,700U	<20U
Bromoethene	UG/M^3	22	<0.9U	<9U	<14U	<21U	<14U	<9U	<9U	^<28U	<9U	^<180U	^<87U	^<1,200U	^<26U	^<3,400U	^<1,100U	<13U
Bromoform	UG/M^3	560	<2U	<21U	<33U	<50U	<33U	<21U	<22U	<65U	<21U	<420U	<210U	^<2,800U	<62U	^<8,000U	^<2,600U	<31U
Carbon Disulfide	UG/M^3	150,000	<2U	<16U	<25U	<38U	<25U	<16U	<16U	<49U	<16U	<310U	<160U	<2,100U	<47U	<6,000U	<2,000U	<23U
Carbon Tetrachloride	UG/M^3	100	<1U	<13U	<20U	<31U	<20U	<13U	43	92	<13U	^2,400	^570	^39,000	<38U	^<4,900U	^<1,600U	<19U
Chlorobenzene	UG/M^3	11,000	<0.9U	<9U	<15U	23	<15U	<9U	<10U	<29U	<9U	<190U	<92U	<1,200U	<28U	<3,600U	<1,200U	<14U
Chlorodibromomethane	UG/M^3	43	<2U	<17U	<27U	<41U	<27U	<17U	<18U	^<54U	<17U	^<340U	^<170U	^<2,300U	^<51U	^<6,600U	^<2,100U	<25U
Chloroform	UG/M^3	27	<1U	<10U	^120	<24U	<16U	^61	^250	^2,700	<10U	^5,200	^2,400	^40,000	^88	^<3,800U	^4,100	26
cis-1,3-Dichloropropene	UG/M^3	150	<0.9U	<9U	<14U	<22U	<15U	<9U	<10U	<29U	<9U	^<180U	<90U	^<1,200U	<27U	^<3,500U	^<1,100U	<13U
Cyclohexane	UG/M^3	1,300,000	<0.7U	<7U	<11U	<17U	<11U	<7U	<7U	<22U	<7U	<140U	<69U	<920U	<21U	<2,700U	<870U	<10U
Dichlorodifluoromethane	UG/M^3	22,000	<2U	<25U	<39U	<60U	<40U	<25U	<26U	<78U	<25U	<500U	<250U	<3,300U	<74U	<9,500U	<3,100U	<37U
Ethyl Chloride	UG/M^3	2,200,000	<1U	<13U	<21U	<32U	<21U	<13U	<14U	<42U	<13U	<270U	<130U	<1,800U	<40U	<5,100U	<1,700U	<20U
Ethylbenzene	UG/M^3	250	<0.9U	<9U	<14U	<21U	<14U	<9U	<9U	<27U	<9U	<180U	<86U	^<1,200U	<26U	^<3,400U	^<1,100U	<13U
Hexachlorobutadiene	UG/M^3	53	<2U	<21U	<34U	<52U	<34U	<21U	<22U	^<67U	<21U	^<430U	^<210U	^<2,900U	^<64U	^<8,200U	^<2,700U	<32U
Hexane	UG/M^3	150,000	1	<7U	<11U	<17U	<11U	<7U	<7U	<22U	<7U	<140U	<70U	<940U	<21U	<2,700U	<890U	<10U
Meta- And Para-Xylene	UG/M^3	22,000	<2U	<22U	<35U	<53U	<35U	<22U	<23U	<69U	<22U	<440U	<220U	<2,900U	<65U	<8,400U	<2,700U	<32U
Methyl Bromide	UG/M^3	1,100	<0.8U	<8U	<12U	<19U	<12U	<8U	<8U	<25U	<8U	<160U	<77U	<1,000U	<23U	^<3,000U	<980U	<11U
Methyl Chloride	UG/M^3	20,000	1	<10U	<16U	<25U	<17U	<10U	<11U	<33U	<10U	<210U	<100U	<1,400U	<31U	<4,000U	<1,300U	<15U
Methyl Ethyl Ketone	UG/M^3	1,100,000	<1U	<15U	<23U	<36U	54	<15U	<15U	<47U	19	<300U	<150U	<2,000U	<44U	<5,700U	<1,900U	43
Methyl Isobutyl Ketone	UG/M^3	660,000	<2U	<20U	<33U	<50U	<33U	<20U	<22U	<65U	<20U	<410U	<200U	<2,700U	<62U	<7,900U	<2,600U	<30U
Methyl Tertiary Butyl Ether	UG/M^3	2,400	<0.7U	<7U	<11U	<18U	<12U	<7U	<8U	<23U	<7U	<150U	<72U	<970U	<22U	^<2,800U	<910U	<11U
Methylene Chloride	UG/M^3	61,000	<2U	<17U	<28U	<42U	<28U	<17U	<18U	<55U	<17U	<350U	<170U	<2,300U	<52U	<6,700U	<2,200U	<26U
Naphthalene	UG/M^3	26	<3U	^<26U	^<42U	^<64U	^<42U	^<26U	^<28U	^<83U	^<26U	^<530U	^<260U	^<3,500U	^<79U	^<10,000U	^<3,300U	^<39U
Ortho-Xylene	UG/M^3	22,000	<0.9U	<9U	<14U	<21U	<14U	<9U	<9U	<27U	<9U	<180U	<86U	<1,200U	<26U	<3,400U	<1,100U	<13U
Styrene	UG/M^3	220,000	<0.9U	<9U	<14U	<21U	<14U	<9U	<9U	<27U	<9U	<170U	<85U	<1,100U	<26U	<3,300U	<1,100U	<13U
Tetrachloroethene	UG/M^3	2,400	<1U	250	^2,500	<33U	52	19	26	51	42	^23,000	^12,000	^300,000	330	^54,000	^220,000	2,100
Toluene	UG/M^3	1,100,000	<0.8U	9	<12U	37	<12U	<8U	21	32	30	<150U	<75U	<1,000U	39	<2,900U	<950U	130
trans-1,2-Dichloroethene	UG/M^3	13,000	<0.8U	<8U	<13U	<19U	84	<8U	<8U	<25U	<8U	<160U	<79U	<1,100U	<24U	<3,100U	<1,000U	13
trans-1,3-Dichloropropene	UG/M^3	150	<0.9U	<9U	<14U	<22U	<15U	<9U	<10U	<29U	<9U	^<180U	<90U	^<1,200U	<27U	^<3,500U	^<1,100U	<13U
Trichloroethene	UG/M^3	150	<1U	<11U	100	<26U	120	<11U	^570	^1,600	<11U	^3,800	^1,700	^100,000	^2,800	^19,000	^110,000	^600
Trichlorofluoromethane	UG/M^3	150,000	1	<11U	<18U	180	<18U	<11U	<12U	<36U	<11U	400	110	2,700	3,300	<4,300U	2,700	<17U
Vinyl Chloride	UG/M^3	140	<0.5U	<5U	<8U	<12U	11	<5U	<5U	<16U	<5U	<100U	<51U	^<690U	<15U	^<2,000U	^790	23
Xylenes	UG/M^3	22,000	<0.9U	<9U	<14U	<21U	<14U	<9U	<9U	<27U	<9U	<180U	<86U	<1,200U	<26U	<3,400U	<1,100U	<13U

Notes:
NJVI_SOILGAS_NORES_2013 = Vapor Intrusion Soil Gas Non-Residential Criteria
U = Not detected
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Table 4-8
Comparison of Sub-Slab Soil Gas Analytical Results to New Jersey Non-Residential Soil Gas Screening Levels
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte	Units	NJVI SOILGAS NONRES 2013	AOC4-INT-1247 04/30/2014	AOC4-INT-1247-1 04/30/2014	AOC4-INT-1247-2 04/30/2014	AOC4-INT-1247-3 04/30/2014	AOC4-INT-1247-4 04/30/2014	AOC5-INT-84-1 04/24/2014	AOC5-INT-84-2 04/24/2014	AOC5-INT-84-3 04/24/2014	AOC6-INT-604 04/29/2014	AOC6-INT-604-1 04/29/2014	AOC6-INT-604-2 04/29/2014	AOC6-INT-604-3 04/29/2014	AOC6-TEL-85 04/25/2014	AOC6-TEL-85-1 04/25/2014	AOC6-TEL-85-2 04/25/2014
Volatile Organic Compounds																	
1,1,1-Trichloroethane	UG/M^3	1,100,000	<1U	<22U	<11U	<11U	<22U	17	14	<11U	<1U	<11U	<110U	<11U	<1U	<11U	<11U
1,1,2,2-Tetrachloroethane	UG/M^3	34	<2U	<27U	<14U	<14U	<27U	<14U	<14U	<14U	<1U	<14U	^<140U	<14U	<1U	<14U	<14U
1,1,2-Trichloroethane	UG/M^3	38	<1U	<22U	<11U	<11U	<22U	<11U	<11U	<11U	<1U	<11U	^<110U	<11U	<1U	<11U	<11U
1,1,2-Trichlorotrifluoroethane	UG/M^3	6,600,000	<2U	<31U	75	110	<31U	920	550	<15U	<2U	<15U	<160U	<15U	<2U	1,300	24
1,1-Dichloroethane	UG/M^3	380	<1U	<16U	<8U	<8U	<16U	<8U	<8U	<8U	<0.8U	<8U	<83U	<8U	<0.8U	<8U	<8U
1,1-Dichloroethene	UG/M^3	44,000	<0.9U	250	370	200	130	<8U	<8U	<8U	<0.8U	<8U	<81U	<8U	<0.8U	<8U	<8U
1,2,4-Trichlorobenzene	UG/M^3	440	<4U	<74U	<37U	<37U	<74U	<37U	<37U	<37U	<4U	<37U	<380U	<37U	<4U	<37U	<37U
1,2-Dibromoethane (EDB)	UG/M^3	38	<2U	<31U	<15U	<15U	<31U	<15U	<15U	<15U	<2U	<15U	^<160U	<15U	<2U	<15U	<15U
1,2-Dichlorobenzene	UG/M^3	44,000	<1U	<24U	<12U	<12U	<24U	<12U	<12U	<12U	<1U	90	4,500	<12U	<1U	<12U	<12U
1,2-Dichloroethane	UG/M^3	24	<1U	<16U	<8U	<8U	<16U	<8U	<8U	<8U	<0.8U	^130	^160	<8U	<0.8U	<8U	<8U
1,2-Dichloropropane	UG/M^3	61	<1U	<18U	<9U	<9U	<18U	<9U	<9U	<9U	<0.9U	<9U	^<94U	<9U	<0.9U	<9U	<9U
1,3-Butadiene	UG/M^3	20	<0.5U	<9U	<4U	<4U	<9U	<4U	<4U	<4U	<0.4U	<4U	^<45U	6	<0.4U	<4U	<4U
1,4-Dichlorobenzene	UG/M^3	56	<1U	<24U	<12U	<12U	<24U	<12U	<12U	<12U	<1U	^56	^670	<12U	<1U	<12U	<12U
Acetone	UG/M^3	6,800,000	24	<240U	160	<120U	<240U	170	<120U	<120U	<12U	<120U	<1,200U	<120U	<12U	<120U	<120U
Allyl Chloride	UG/M^3	100	<2U	<31U	<16U	<16U	<31U	<16U	<16U	<16U	<2U	<16U	^<160U	<16U	<2U	<16U	<16U
Benzene	UG/M^3	79	<0.8U	<13U	<6U	<6U	<13U	<6U	<6U	<6U	<0.6U	^320	^1,100	14	<0.6U	<6U	<6U
Bromodichloromethane	UG/M^3	34	<2U	<27U	<13U	<13U	<27U	<13U	<13U	<13U	<1U	<13U	^<140U	^150	<1U	<13U	<13U
Bromoethene	UG/M^3	22	<1U	<17U	<9U	<9U	<17U	<9U	<9U	<9U	<0.9U	<9U	^<89U	<9U	<0.9U	<9U	<9U
Bromoform	UG/M^3	560	<2U	<41U	<21U	<21U	<41U	<21U	<21U	<21U	<2U	<21U	<210U	<21U	<2U	<21U	<21U
Carbon Disulfide	UG/M^3	150,000	<2U	<31U	<16U	<16U	<31U	22	<16U	<16U	<2U	45	<160U	<16U	<2U	79	<16U
Carbon Tetrachloride	UG/M^3	100	<1U	<25U	<13U	<13U	<25U	<13U	<13U	<13U	<1U	<13U	^<130U	<13U	<1U	<13U	<13U
Chlorobenzene	UG/M^3	11,000	9	<18U	<9U	<9U	<18U	<9U	<9U	<9U	<0.9U	430	^12,000	<9U	12	<9U	<9U
Chlorodibromomethane	UG/M^3	43	<2U	<34U	<17U	<17U	<34U	<17U	<17U	<17U	<2U	<17U	^<170U	23	<2U	<17U	<17U
Chloroform	UG/M^3	27	<1U	<20U	<10U	12	<20U	25	<10U	<10U	<1U	^27	^<100U	^700	<1U	17	<10U
cis-1,3-Dichloropropene	UG/M^3	150	<1U	<18U	<9U	<9U	<18U	<9U	<9U	<9U	<0.9U	<9U	<93U	<9U	<0.9U	<9U	<9U
Cyclohexane	UG/M^3	1,300,000	<0.8U	<14U	<7U	<7U	<14U	<7U	<7U	<7U	<0.7U	<7U	<70U	<7U	1	<7U	<7U
Dichlorodifluoromethane	UG/M^3	22,000	4	1,800	<25U	<25U	1,800	<25U	<25U	<25U	<2U	<25U	<250U	<25U	<2U	<25U	<25U
Ethyl Chloride	UG/M^3	2,200,000	<2U	<26U	<13U	<13U	<26U	<13U	<13U	<13U	<1U	<13U	<130U	<13U	<1U	<13U	<13U
Ethylbenzene	UG/M^3	250	<1U	<17U	<9U	<9U	<17U	<9U	<9U	<9U	<0.9U	10	^470	<9U	<0.9U	<9U	<9U
Hexachlorobutadiene	UG/M^3	53	<3U	<43U	<21U	<21U	<43U	<21U	<21U	<21U	<2U	<21U	^<220U	<21U	<2U	<21U	<21U
Hexane	UG/M^3	150,000	<0.8U	<14U	<7U	<7U	<14U	<7U	<7U	<7U	<0.7U	<7U	<72U	<7U	2	<7U	<7U
Meta- And Para-Xylene	UG/M^3	22,000	<3U	<43U	<22U	<22U	<43U	<22U	<22U	<22U	<2U	150	2,500	27	<2U	<22U	<22U
Methyl Bromide	UG/M^3	1,100	<0.9U	<16U	<8U	<8U	<16U	<8U	<8U	<8U	<0.8U	<8U	<79U	<8U	<0.8U	<8U	<8U
Methyl Chloride	UG/M^3	20,000	2	<21U	<10U	<10U	<21U	<10U	<10U	<10U	<1U	<10U	<110U	<10U	1	<10U	<10U
Methyl Ethyl Ketone	UG/M^3	1,100,000	7	<29U	19	27	<29U	25	<15U	<15U	<1U	<15U	<150U	<15U	8	38	28
Methyl Isobutyl Ketone	UG/M^3	660,000	<2U	<41U	<20U	<20U	<41U	<20U	<20U	<20U	<2U	<20U	<210U	<20U	<2U	<20U	<20U
Methyl Tertiary Butyl Ether	UG/M^3	2,400	<0.9U	<14U	<7U	<7U	<14U	<7U	<7U	<7U	<0.7U	<7U	<74U	<7U	<0.7U	<7U	<7U
Methylene Chloride	UG/M^3	61,000	<2U	<35U	<17U	<17U	<35U	<17U	<17U	<17U	<2U	<17U	<180U	<17U	<2U	<17U	<17U
Naphthalene	UG/M^3	26	<3U	^<52U	^<26U	^<26U	^<52U	^<26U	^<26U	^<26U	<3U	^<26U	^<270U	^<26U	<3U	^<26U	^<26U
Ortho-Xylene	UG/M^3	22,000	<1U	<17U	<9U	<9U	<17U	<9U	<9U	<9U	<0.9U	39	410	10	<0.9U	<9U	<9U
Styrene	UG/M^3	220,000	<1U	<17U	<9U	<9U	<17U	<9U	<9U	<9U	<0.9U	<9U	<87U	<9U	<0.9U	<9U	<9U
Tetrachloroethene	UG/M^3	2,400	<2U	<27U	<14U	31	36	74	350	<14U	<1U	620	190	<14U	<1U	<14U	25
Toluene	UG/M^3	1,100,000	2	<15U	12	21	41	44	<8U	<8U	<0.8U	540	1,800	12	2	120	34
trans-1,2-Dichloroethene	UG/M^3	13,000	<0.9U	<16U	<8U	<8U	<16U	<8U	<8U	<8U	<0.8U	<8U	<81U	<8U	<0.8U	<8U	<8U
trans-1,3-Dichloropropene	UG/M^3	150	<1U	<18U	<9U	<9U	<18U	<9U	<9U	<9U	<0.9U	<9U	<93U	<9U	<0.9U	<9U	<9U
Trichloroethene	UG/M^3	150	<1U	<21U	<11U	<11U	<21U	^210	17	<11U	<1U	<11U	<110U	<11U	<1U	20	<11U
Trichlorofluoromethane	UG/M^3	150,000	1	<22U	<11U	15	49	170	<11U	<11U	1	<11U	<110U	<11U	1	100	<11U
Vinyl Chloride	UG/M^3	140	<0.6U	<10U	<5U	<5U	<10U	<5U	<5U	<5U	<0.5U	<5U	<52U	<5U	<0.5U	<5U	<5U
Xylenes	UG/M^3	22,000	<1U	<17U	<9U	<9U	<17U	<9U	<9U	<9U	<0.9U	190	2,900	37	<0.9U	<9U	<9U

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Table 4-8
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Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte	Units	NJVI SOILGAS NONRES 2013	AOC6-TEL-85-3 04/25/2014	AOC6-TEL-85-4 04/25/2014	AOC6-TEL-85-5 04/25/2014	AOC9-INT-1420 05/01/2014	AOC9-INT-1420-1 05/01/2014	AOC9-INT-1420-2 05/01/2014	AOC9-INT-1420-3 05/01/2014
Volatile Organic Compounds									
1,1,1-Trichloroethane	UG/M^3	1,100,000	13	51	<11U	<3U	<11U	<11U	<11U
1,1,2,2-Tetrachloroethane	UG/M^3	34	<14U	<14U	<14U	<3U	<14U	<14U	<14U
1,1,2-Trichloroethane	UG/M^3	38	<11U	<11U	<11U	<3U	<11U	<11U	<11U
1,1,2-Trichlorotrifluoroethane	UG/M^3	6,600,000	41	92	51	<4U	<15U	<15U	<15U
1,1-Dichloroethane	UG/M^3	380	<8U	<8U	<8U	<2U	<8U	<8U	<8U
1,1-Dichloroethene	UG/M^3	44,000	<8U	<8U	<8U	<2U	<8U	<8U	<8U
1,2,4-Trichlorobenzene	UG/M^3	440	<37U	<37U	<37U	<9U	<37U	<37U	<37U
1,2-Dibromoethane (EDB)	UG/M^3	38	<15U	<15U	<15U	<4U	<15U	<15U	<15U
1,2-Dichlorobenzene	UG/M^3	44,000	<12U	<12U	<12U	<3U	<12U	<12U	<12U
1,2-Dichloroethane	UG/M^3	24	<8U	<8U	<8U	<2U	<8U	<8U	<8U
1,2-Dichloropropane	UG/M^3	61	<9U	<9U	<9U	<2U	<9U	<9U	<9U
1,3-Butadiene	UG/M^3	20	<4U	<4U	<4U	<1U	<4U	<4U	<4U
1,4-Dichlorobenzene	UG/M^3	56	<12U	<12U	<12U	<3U	<12U	<12U	<12U
Acetone	UG/M^3	6,800,000	<120U	<120U	<120U	27	<120U	<120U	<120U
Allyl Chloride	UG/M^3	100	<16U	<16U	<16U	<4U	<16U	<16U	<16U
Benzene	UG/M^3	79	<6U	<6U	<6U	<2U	<6U	<6U	<6U
Bromodichloromethane	UG/M^3	34	<13U	<13U	<13U	<3U	<13U	<13U	<13U
Bromoethene	UG/M^3	22	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Bromoform	UG/M^3	560	<21U	<21U	<21U	<5U	<21U	<21U	<21U
Carbon Disulfide	UG/M^3	150,000	<16U	35	84	<4U	<16U	<16U	<16U
Carbon Tetrachloride	UG/M^3	100	<13U	32	<13U	<3U	<13U	<13U	<13U
Chlorobenzene	UG/M^3	11,000	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Chlorodibromomethane	UG/M^3	43	<17U	<17U	<17U	<4U	<17U	<17U	<17U
Chloroform	UG/M^3	27	<10U	<10U	^100	<2U	<10U	<10U	<10U
cis-1,3-Dichloropropene	UG/M^3	150	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Cyclohexane	UG/M^3	1,300,000	<7U	11	11	2	<7U	<7U	<7U
Dichlorodifluoromethane	UG/M^3	22,000	<25U	<25U	<25U	<6U	<25U	<25U	<25U
Ethyl Chloride	UG/M^3	2,200,000	<13U	<13U	<13U	<3U	<13U	<13U	<13U
Ethylbenzene	UG/M^3	250	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Hexachlorobutadiene	UG/M^3	53	<21U	<21U	<21U	<5U	<21U	<21U	<21U
Hexane	UG/M^3	150,000	<7U	<7U	21	5	<7U	<7U	<7U
Meta- And Para-Xylene	UG/M^3	22,000	<22U	<22U	<22U	<5U	<22U	<22U	<22U
Methyl Bromide	UG/M^3	1,100	<8U	<8U	<8U	<2U	<8U	<8U	<8U
Methyl Chloride	UG/M^3	20,000	<10U	<10U	<10U	<2U	<10U	<10U	<10U
Methyl Ethyl Ketone	UG/M^3	1,100,000	89	<15U	15	6	<15U	<15U	<15U
Methyl Isobutyl Ketone	UG/M^3	660,000	<20U	<20U	<20U	<5U	<20U	<20U	<20U
Methyl Tertiary Butyl Ether	UG/M^3	2,400	<7U	<7U	<7U	<2U	<7U	<7U	<7U
Methylene Chloride	UG/M^3	61,000	<17U	<17U	<17U	<4U	<17U	<17U	<17U
Naphthalene	UG/M^3	26	^<26U	^<26U	^<26U	<6U	^<26U	^<26U	^<26U
Ortho-Xylene	UG/M^3	22,000	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Styrene	UG/M^3	220,000	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Tetrachloroethene	UG/M^3	2,400	53	78	34	<3U	<14U	<14U	<14U
Toluene	UG/M^3	1,100,000	270	<8U	14	2	<8U	<8U	<8U
trans-1,2-Dichloroethene	UG/M^3	13,000	<8U	<8U	<8U	<2U	<8U	<8U	<8U
trans-1,3-Dichloropropene	UG/M^3	150	<9U	<9U	<9U	<2U	<9U	<9U	<9U
Trichloroethene	UG/M^3	150	<11U	<11U	99	17	<11U	<11U	<11U
Trichlorofluoromethane	UG/M^3	150,000	<11U	46	75	<3U	<11U	<11U	<11U
Vinyl Chloride	UG/M^3	140	<5U	<5U	<5U	<1U	<5U	<5U	<5U
Xylenes	UG/M^3	22,000	<9U	<9U	<9U	<2U	<9U	<9U	<9U

Notes:
NJVI_SOILGAS_NORES_2013 = Vapor Intrusion Soil Gas Non-Residential Criteria
U = Not detected
< = Not detected at stated reporting limit
🟨 = ^ and yellow shading indicates an Exceedance of Remediation Standards
🟧 = ^ and orange shading indicates that the detection limit is above the screening criteria

Table 5-1
Description of Hydrogeologic Units
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Hydrogeologic Unit	Geologic Age	Interpreted Depositional Environment	Geologic Description	Thickness (feet)	Hydrogeologic Description
A	Recent	Fill	Sand and gravel to clay and rubble	0-10 not including landfill areas.	Generally, saturated groundwater has limited lateral extent. Saturated groundwater may be perched above A/B or part of Upper B where A/B not present.
A/B	Recent to Holocene	Marsh, Floodplain/Overbank	Organic silt, clay and peat	0-11	Aquitard. Not laterally continuous due to breaching by recent streams and on-site excavations.
Upper B	Pleistocene Cape May Formation 3 (potential Holocene component near western boundary of site)	Fluvial	Interbedded clays, silts and sands, typically with a basal sand and gravel	0-15+ in area of Salem Canal and eastern half of site	Unconfined to semi-confined aquifer
Middle B Silt	Pleistocene Cape May Formation 3	Marsh, Estuarine	Silt to clayey silt	≤5; multiple discontinuities; two larger discontinuities associated with the Pleistocene paleochannel and in the area of Bouttown Creek	
Lower B	Pleistocene Cape May Formation 3	Fluvial	Fine to medium-grained sand that often contains a gravel component near the base.	<5 to 35+; thicker in area of the Pleistocene paleochannel	
B/C	Pleistocene - potentially associated with Sangamonian interglacial highstand	Marsh, Estuarine	Gray to black silt or clayey silt	0-20+ with large discontinuity present near eastern boundary just south of Henby Creek.	Aquitard. Thin to absent or sandy in the eastern portion of the site and in the vicinity of the basins, but well developed along Delaware River.
C	Pleistocene Cape May Formation 2	Fluvial	Coarse sand with areas of gravel/cobbles near base.	Approximately 20 or less except in the area of the Pleistocene paleochannel where thickness is 20-40.	Semi-confined to confined aquifer
C/D	Pleistocene Cape May Formation 2	Marsh, Estuarine	Gray, grayish green, or black silty clay to clayey silt	5-20+ in southern half of site; 5-13 in northern half of site	Aquitard
D	Predominantly Pleistocene Cape May Formation 2 with portions consistent with Cretaceous Potomac Formation.	Fluvial	Medium sand to poorly sorted coarse-grained sand with some gravel	5-65; thicker in areas coinciding with the Pennsville paleovalley	Semi-confined to confined aquifer
D/E	Cretaceous Potomac Formation	Floodplain Paleosol	Dense red clay or variegated (red, white to tan, yellow and gray clay)	10-60	Aquitard (regional)
E through F	Cretaceous Potomac Formation	Fluvial	Several fining upward sequences of sand, silt and clay	300-400	PRM Aquifer System

Table 5-2
Hydrogeologic Unit Characteristics
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

Hydrogeologic Unit	Geometric Mean of Horizontal Hydraulic Conductivity Slug Testing Results (ft/day)	Geometric Mean of Transmissivity (ft^2/day)	Storage Coefficient	Geometric Mean of D60 (mm)	Geometric Mean of Vertical Hydraulic Conductivity Lab Testing Results (ft/day)
A	Not available	Not available	Not available	0.57 (n = 3)	Not available
A/B	Not available	Not available	Not available	0.14 (n = 5)	1.5E-03 (n = 3)
Upper B	14 (n = 56)	190 (n = 9)	None reported	0.76 (n = 9)	Not available
Middle B Silt				0.15 (n = 5)	3.6E-04 (n = 1)
Lower B				1.19 (n = 11)	Not available
B/C	Not available	Not available	Not available	0.05 (n = 23)	1.5E-03 (n = 11)
C	18 (n = 14)	7500 (n = 3)	0.003 (n = 3)	1.00 (n = 7)	7.3E-01 (n = 1)
C/D	Not available	Not available	Not available	0.08 (n = 5)	6.0E-04 (n = 1)
D	30 (n = 12)	1300 (n = 1)	0.001 (n = 1)	0.18 (n = 2)	7.1E-01 (n = 1)
D/E	Not available	Not available	Not available	0.014 (n = 5)	2.2E-05 (n = 4)
E through F	Not available	Not available	Not available	Not available	Not available

References for field testing estimates of transmissivity, storativity, and horizontal hydraulic conductivity:
Carneys Point Hydrogeological Assessment, Blickedel and DuPont Engineering, 1991.
Salem Canal Inerim Remedial Action Work Plan, DuPont CRG, 2007; Appendix A Salem Canal Pre-Design Investigation Report.
IWS Optimization Project Data Compendium and Review, DuPont ChambersWorks, Deepwater, New Jersey, URS, 2010.
Comprehensive RFI Report, URS, 2014. Data collected as part of the RFI Data Gap Field Investigation with results presented in this report.

References for lab testing estimates of D60 and vertical hydraulic conductivity:
Salem Canal Inerim Remedial Action Work Plan, DuPont CRG, 2007; Appendix A Salem Canal Pre-Design Investigation Report.
Phase IV Supplemental RFI Report, DuPont Chambers Works Complex, Deepwater New Jersey, DuPont, 2007.
G08 and K37 recovery well studies, 2008
Salem Canal Sheet Pile Barrier Design Data, 2012
Interior Investigation Technical Memorandum, DuPont Chambers Works, Deepwater New Jersey, URS, 2013.
Perimeter Investigation Sheet Pile Barrier Design Data, 2013.
Comprehensive RFI Report, URS, 2014. Data collected as part of the RFI Data Gap Field Investigation with results presented in this report.

Table 6-1
Summary of Carneys Point SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes/No/Not Applicable)[2]
13	Cell 1 of the Secure "C" Landfill	NFA Approved EPA Letter 2002	No soil data collected. Groundwater data collected.	Not applicable	Not applicable
19	Nitrocellulose Waste Disposal Area	NFA Approved EPA Letter 1993	Soil stabilized or removed; data not included in summary tables.	Not applicable	Not applicable
37	Carneys Point Manufacturing Disposal Area	NFA Approved EPA Letter 2002	Soil data included in SWMU 37 summary tables.	NJRDCSCC - None	No.
42	Henby Creek	NFA Recommended PAR 2006 and Summary of Carneys Point Ecological Investigations 2010	No soil data collected.	Not applicable	Not applicable
44	Carneys Point Surface Impoundments	NFA Recommended PAR 2006	Determined not to be SWMU; no soil data collected.	Not applicable	Not applicable
45-1	Carneys Point Manufacturing Area 1	NFA Recommended PAR 2006	Soil data not included in summary tables. Sample locations include B-45-1.1, B-45-1.2, B-45-1.3	NJNRDCSCC - Slight exceedance of benzo(a)pyrene and arsenic NJIGWSCC - None	No.[3]
45-2	Carneys Point Manufacturing Area 2	CMS Recommended 2013	Soil data included in SWMU 45-2 summary tables.	Pre-2011 Investigations NJNRDCSCC - Arsenic, copper, lead, zinc, 5 PAHs and 2,4-DNT GWIIA - SPLP arsenic and lead Interior Investigation NJNRDCSRS - arsenic and lead	No.
45-3	Carneys Point Manufacturing Area 3	NFA Recommended PAR 2006	Soil stabilized or removed; data not included in summary tables.	Not applicable	Not applicable
45-4	Carneys Point Manufacturing Area 4	NFA Recommended PAR 2006	Soil stabilized or removed; data not included in summary tables.	Not applicable	Not applicable
45-5	Carneys Point Manufacturing Area 5	NFA Recommended PAR 2006	Soil data not included in summary tables. Sample locations include B-45-5.1, B-45-5.2, B-45-5.	NJNRDCSCC - Slight exceedance of arsenic NJIGWSCC-None	No.[3]

Table 6-1
Summary of Carneys Point SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes/No/Not Applicable)[2]
45-6	Carneys Point Manufacturing Area 6	NFA Recommended P3RFI 2002 and PAR 2006	Soil data included in SWMU 45-6 summary tables.	NJRDCSCC – None NJNRDCSCC - None NJIGWSCC - None	No.
45-7	Carneys Point Manufacturing Area 7	NFA Recommended P3RFI 2002 and PAR 2006	Soil data included in SWMU 45-7 summary tables.	NJRDCSCC –None NJNRDCSCC – None NJIGWSCC - None	No.
45-8	Carneys Point Manufacturing Area 8	NFA Recommended PAR 2006	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable
45-9	Carneys Point Manufacturing Area 9	NFA Recommended PAR 2006	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable
46	Dredge Spoils Area	NFA Approved EPA Letter 2002	Soil not included in summary tables. Sample locations include B-1, B-2, B-3, B-4, B-5	NJNRDCSCC - None	No.
47	Carneys Point Area of Fill Deposition	NFA Approved EPA Letter 2002	Soil data included in SWMU 47 summary tables.	NJNRDCSCC - Slight exceedance of arsenic	No.
48-1	Carneys Point Drum Storage/Cleaning Area 1	NFA Recommended P3RFI 2002	Soil data included in SWMU 48-1 summary tables.	NJNRDCSCC - Slight exceedance of arsenic	No
48-2	Carneys Point Drum Storage/Cleaning Area 2	NFA Recommended P4RFI 2006	Soil was stabilized or removed; data not included in summary tables; samples outside of remediated area included in SWMU 48-2 summary tables.	NJNRDCSCC – None NJIGWSCC – None	No.
48-3	Carneys Point Drum Storage/Cleaning Area 3	NFA Recommended P3RFI 2002 and BEE 2006	Soil data included in SWMU 48-3 summary tables.	NJRDCSCC – None NJNRDCSCC - None NJIGWSCC - None	No.[4]
48-4	Carneys Point Drum Storage/Cleaning Area 4	NFA Approved EPA Letter 1993	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable
48-5	Carneys Point Drum Storage/Cleaning Area 5	NFA Recommended P3RFI 2002 and BEE 2006	Soil data included in SWMU 48-5 summary tables.	NJRDCSCC – None NJNRDCSCC - None NJIGWSCC - None	No.[4]
48-6	Carneys Point Drum Storage/Cleaning Area 6	NFA Recommended P3RFI 2002 and BEE 2006	Soil data included in SWMU 48-6 summary tables.	NJRDCSCC – None NJNRDCSCC - None NJIGWSCC - None	No.[4]

Table 6-1
Summary of Carneys Point SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes/No/Not Applicable)[2]
48-7	Carneys Point Drum Storage/Cleaning Area 7	NFA Recommended P3RFI 2002 and BEE 2006	Soil data included in SWMU 48-7 summary tables.	NJRDCSCC – None NJNRDCSCC - None NJIGWSCC - None	No.[4]
49	Dewatering Pad	NFA Approved EPA Letter1993	Soil data not included in summary tables. Sample locations include B49-1, B49-A, B49-B, B49-5	NJNRDCSCC - Slight exceedance of benzo(k)fluoranthene and dibenzo(a,h)anthracene NJIGWSCC - None	No.
52	Debris Disposal Area	NFA Recommended SWMU 52 ISM RAR 2007	Soil was stabilized or removed; data not included in summary tables; samples outside of remediated area included in SWMU 52 summary tables.	NJNRDCSCC - Slight exceedance of lead	No.
53	Carneys Point Water Treatment Facility	NFA Recommended PAR 2006	Determined not to be SWMU; no soil data collected.	Not applicable	Not applicable
54	Solvent Recovery Units	NFA Approved EPA Letter 2002	Soil data included in SWMU 54 summary tables.	NJRDCSCC- None	No.
61	Carneys Point Disposal Area 2	NFA Approved EPA Letter 2002	Soil data included in SWMU 61 summary tables.	NJNRDCSCC - Arsenic and lead	No.

Notes:

[1] Criteria standards cited are those used for screening during the SWMU investigation.

[2] Current SRS criteria were used to re-screen soil data, and summary results are provided in Appendix C.1. Constituents that exceeded criteria were compared to those previously identified during the SWMU investigations, which mostly used SCC criteria. Significant deviations between the screenings were identified by a Yes or No in conjunction with the NFA or CMS recommendation for the SWMU. Not applicable means that either there were no soil data or the SRS criteria were used during the SWMU investigation and comparison between SCC and SRS screening of soil data is not applicable.

[3] Some additional exceedances of NJIGWSRS for metals (lead, cadmium, and mercury) were identified but are not significantly greater than the criteria. Exceedances of NJNRDSRS and NJIGWSRS for methylene chloride do not alter the recommendation for the SWMU.

[4] There were no IGWSCC criteria for metals developed at the time of the SWMU investigations. Some additional exceedances of NJIGWSRS for metals (aluminum, manganese, and mercury) were identified but are not significantly greater than the criteria.

NJRDCSCC = New Jersey Residential Direct Contact Soil Clean-up Criteria
NJNRDCSCC = New Jersey Non-Residential Direct Contact Soil Clean-up Criteria
NJIGWSCC = New Jersey Impact to Groundwater Soil Clean-up Criteria

Constituents that do not have a NJ soil criterion are not presented. Refer to SWMU Fact Sheets for more detailed information.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
1-2	Incinerators I and II	NFA Recommended Interior Investigation Technical Memorandum 2013	Soil data included in SWMU 8 summary tables.	NJNRDCSRS - 1,4-Dichlorobenzene, Benzene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Naphthalene, and Lead NJIGWSRS - VOCs, SVOCs, and metals	Not Applicable.
3	Incinerator III	NFA Recommended Interior Investigation Technical Memorandum 2013	Soil data included in SWMU 8 summary tables.	NJNRDCSRS - None NJIGWSRS - Aluminum	Not Applicable.
4	Incinerators IV	NFA Recommended Interior Investigation Technical Memorandum 2013	Soil data included in SWMU 8 summary tables.	NJNRDCSRS - Lead NJIGWSRS - VOCs, SVOCs, and metals	Not Applicable.
5A	Landfill I	NFA Recommended SWMU 5 ISM-RAR 2002	Soil data included in SWMU 5A summary tables.	NJNRDCSCC - PAHs and Lead NJIGWSCC – Chlorobenzene NJGWIIA - SPLP VOCs, SVOCs, antimony, arsenic, and lead.	No.
5B	Landfill I Beach Area	NFA Recommended SWMU 5 ISM-RAR 2002	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not Applicable.
6	Landfill II	NFA Recommended Phase II RFI 1998	Soil data included in AOC 2 summary tables.	NJNRDCSCC - Lead	No.
7	Landfill III	NFA Recommended Interior Investigation Technical Memorandum 2013	Area was remediated prior to SWMU investigation. Soil data included in SWMU 8 summary tables.	NJNRDCSRS - Benzo(a)pyrene and lead NJIGWSRS - Benzene, Chlorobenzene, 1,2,4-Trichlorobenzene, 4-Chloroaniline, Benzo(a)anthracene, Benzo(a)pyrene and metals	Not Applicable.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
8	Landifll IV	CMS Recommended SWMU 8 CMS-RASR 2007	SWMUs 1-4, 7, 21, 22, 24, 30, 39-4, 39-7, 55-5, 55-6 and portions of 17/17A, 55-2 and 56A are within the SWMU 8 boundary. Data from SWMU 8/interior investigations as well as from SWMUs (as appropriate) included in SWMU 8 summary tables.	NJNRDSRS – VOCs, SVOCs,dieldrin, total PCBs and Metals NJIGWSRS - VOCs, SVOCs and Metals	No.
9	Solvent Recovery Unit I	NFA Approved EPA Letter 2002	Soil data included in AOC 6 summary tables.	NJRDCSCC - None	No.
10	Solvent Recovery Unit II	NFA Approved EPA Letter 2002	Soil data included in AOC 6 summary tables.	NJRDCSCC – None	No.
11	Storage Tank	NFA Approved EPA Letter 2002	Soil data included in AOC 8 summary tables.	Detections of sulfate and sodium had no criteria for comparison.	No.
12	WWTP Storage Pad	NFA Recommended SWMU 12 IRM Report 1999	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.
14-16	A, B, C Basin Surface Impoundments	NFA Approved EPA Letter 2002	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.
17/17A	Process Water Ditch System/Sidewalls	NFA Recommended Phase II RFI 1998	Soil data included in summary tables for AOCs 1-10, SWMU 8 as appropriate. Remediated soil not included in summary tables.	NJNRDCSCC – 2,4-DNT, 2,6-DNT, PAHs, Lead and Copper NJIGWSCC – VOCs and SVOCs NJGWIIA – SPLP VOCs, SVOCs Antimony, Arsenic and Lead	No.
18	WWTP	RCRA Part B Operating Unit	Soil data not collected.	Not applicable.	Not applicable.
18A	WWTP Pump Pit	NFA Recommended Phase II RFI 1998	Soil samples collected below the water table. Soil data is not included in summary tables.	Not applicable.	Not applicable.
20	Ethyl Chloride Incinerator	NFA Recommended Interior Investigation Technical Memorandum 2013	Soil data included in AOC 1 summary tables.	NJNRDCSRS – None NJIGWSRS – Aluminum, cadmium, lead, and manganese	Not applicable.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
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Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
21	Thermal Decon Furnace (FR-65) and Satellite Storage Area	NFA Recommended Phase III RFI 2002	Area was remediated prior to SWMU investigation. Soil data included in SWMU 8 summary tables.	NJNRDCSCC - Lead	No.
22	Multipurpose Incinerator (FR-01)	NFA Recommended RCRA Clean Closed 1989	No soil data collected.	Not applicable.	Not applicable.
23	Chemical Waste Tank Storage Area	RCRA Part B Operating Unit	No soil data collected.	Not applicable.	Not applicable.
24	Chemical Waste Container Storage Area	RCRA Part B Operating Unit	No soil data collected.	Not applicable.	Not applicable.
25	Lead Flue Dust and Lead Furnace Slag Storage Area	NFA Recommended Phase III RFI 2002	Soil data included in AOC 2 summary tables.	NJNRDCSCC - Lead	No.
26	Freon Spent Catalyst Storage Area	NFA Recommended Phase III RFI 2002	Soil data included in AOC 1 summary tables.	NJRDCSCC - Antimony NJNRDCSCC – None	
27	Oil/Water Separator	RCRA Part B Operating Unit	No soil data collected.	Not applicable.	Not applicable.
28	Telomer “A” Waste Container Storage Area	NFA Recommended Phase III RFI 2002	Soil data included in AOC 3 summary tables.	NJRDCSCC – None NJNRDCSCC – None NJIGWSCC - None	No.
29	Telomer “A” Waste Treatment (RCRA Part B Operating Unit)	RCRA Part B Operating Unit	No soil data collected.	Not applicable.	Not applicable.
30	Sanitary Landfills A and B	NFA Recommended SWMU 8 CMS-RASR 2007	No soil data collected.	Not applicable.	Not applicable.
31	Fly Ash Disposal Area	NFA Recommended Phase III RFI 2002	Soil data included in SWMU 31 summary tables.	NJRDCSCC – None NJNRDCSCC – None NJIGWSCC - None	No.
32A	Co-Gen Area A	NFA Recommended EPA Letter 1993	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
32B	Co-Gen Area B	NFA Approved EPA Letter 2002	Soil data not available in database; not included in summary tables. Sample locations include B32-5A, B32-5B, B32-6A, B32-6B, B32-7A, B32-7B, B32-8S, B32-8D, B32-9S and B32-9D.	NJNRDCSCC - Arsenic	No.
33	Manhattan Project	USACE Lead	Soil data not included in summary tables.	Not applicable.	Not applicable.
34	Gypsum Disposal Area	NFA Recommended Phase II RFI 1998	Soil data included in AOC 1 summary table.	NJNRDCSCC – None NJGWIIA – SPLP Antimony, Arsenic, Lead and Thallium	No.
35	Freon Disposal Area	NFA Recommended PAR 2006	Determined not to be SWMU; no soil data collected.	Not applicable.	Not applicable.
36	Building 1082	NFA Recommended PAR 2006	Determined not to be SWMU; no soil data collected.	Not applicable.	Not applicable.
38	Clean Water Injection Wells	NFA Approved EPA Letter 1993	Determined not to be SWMU; no soil data collected.	Not applicable.	Not applicable.
39-1	UST-1	CMS Recommended RI-RASR 2009	Soil data included in AOC 9 summary tables.	NJNRDCSCC – None NJIGWSCC - Benzene	No.
39-2 through 39-9	Underground Storage Tanks	NFA Approved EPA Letter 1993	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.
40	Fuel Oil Storage Tanks	CMS Recommended Phase II RFI 1998	Soil data included in SWMU 40 summary tables.	NJNRDCSCC – Benzo(a)pyrene TPH ranges from 20-4,400 mg/kg	No.
41-1	Drum Storage Area 1	NFA Recommended Phase III RFI 2002	Soil data included in AOC 9 summary tables.	NJNRDCSCC – None NJIGWSCC – None	No.
41-2	Drum Storage Area 2	NFA Recommended Phase III RFI 2002	Soil data included in AOC 9 summary tables.	NJRDCSCC – None NJNRDCSCC – None NJIGWSCC - None	No.
41-3	Drum Storage Area 3	NFA Recommended Phase III RFI 2002	Soil data included in AOC 6 summary tables.	NJRDCSCC – None NJNRDCSCC – None NJIGWSCC - None	No.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
41-4	Drum Storage Area 4	NFA Approved EPA Letter 2002	Soil data included in AOC 9 summary tables.	NJRDCSCC – None	No.
41-5	Drum Storage Area 5	NFA Approved EPA Letter 2002	Soil data included in SWMU 41-5 summary tables.	NJRDCSCC – None	No.
41-6	Drum Storage Area 6	NFA Approved EPA Letter 2002	Soil data included in AOC 6 summary tables.	NJNRDCSCC – None	No.
41-7	Drum Storage Area 7	NFA Approved EPA Letter 2002	Soil data included in AOC 6 summary tables.	NJRDCSCC – None	No.
41-8	Drum Storage Area 8	NFA Recommended Phase II RFI 1998	Soil data included in AOC 6 summary tables.	NJNRDCSCC – Benzo(a)pyrene	No.
43	Former Unified Basin Outfall	NFA Recommended SWMU ISM-RAR 2002	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.
50	Asbestos Disposal Area	NFA Approved EPA Letter 1993	Soil stabilized or removed; data not included in summary tables.	Not applicable.	Not applicable.
51	Well DW-8	NFA Approved EPA Letter 1993	No soil data collected. Groundwater data only collected.	Not applicable.	Not applicable.
55-1	Area of Fill Deposition 1	NFA Recommended in Comprehensive RFI 2014	Soil data included in AOC 5 summary tables.	Phase II RFI NJNRDCSCC – None NJIGWSCC – None NJGWIIA – SPLP Antimony, Arsenic and Lead Data Gap Investigation NJNRDCSRS – None NJIGWSRS – 1,2,4-TCB, aluminum, beryllium, lead, manganese and mercury	No.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
55-2	Area of Fill Deposition 2	NFA Recommended Phase II RFI 1998	Soil data included in SWMU 8 summary tables.	NJRDCSCC - None NJNRDCSCC – None NJIGWSCC – None NJGWIIA – SPLP None	No.
55-3	Area of Fill Deposition 3	NFA Recommended PAR 2006	Soil data included in AOC 5 summary tables.	NJNRDCSCC – Antimony, Arsenic, Copper, Benzene, Chlorobenzene, Naphthalene, Benzo(a)anthracene NJIGWSCC – Benzene, Chlorobenzene, Tetrachloroethene, Naphthalene, N-nitrosodiphenylamine, 1,2,4-TCB, 1,2-DCB. 1,3-DCB and 1,4-DCB NJGWIIA – SPLP Antimony, Arsenic, Lead, Benzene, Chlorobenzene, Tetrachloroethene, 1,2,4-TCB, 1,2-DCB, 1,4-DCB, benzidine, naphthalene, N-nitrosodiphenylamine	No.
55-4	Area of Fill Deposition 4	NFA Recommended in Comprehensive RFI 2014	Soil data included in AOC 1, AOC 4, and AOC 5 summary tables.	Phase II RFI NJNRDCSCC – Antimony, Arsenic, Copper, Lead, Hexachlorobenzene, and PAHs NJIGWSCC – VOCs and SVOCs NJGWIIA – SPLP Antimony, Arsenic, Lead, Thallium, Benzene, Chlorobenzene, Tetrachloroethene and benzidine Data Gap Investigation NJNRDCSRS – None NJIGWSRS – Aluminum, Lead and Manganese	No.
55-5	Area of Fill Deposition 5	NFA Recommended SWMU 8 CMS-RASR 2007	Soil data included in SWMU 8summary table.	NJNRDCSCC – Lead, Hexachlorobenzene and PAHs NJIGWSCC – Chlorobenzene, PAHs NJGWIIA – SPLP Antimony, Arsenic, Beryllium, Lead, Methylene Chloride and 1,2,4-TCB	No.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
55-6	Area of Fill Deposition 6	NFA Recommended Interior Investigation Tech Memo 2013	Soil data included in SWMU 8 summary tables.	NJNRDCSRS – None NJIGWSRS – Aluminum, Lead, Manganese and Mercury	Not Applicable.
55-7	Area of Fill Deposition 7	NFA Recommended Phase II RFI 1998	Soil data included in SWMU 55-7 summary tables.	NJRDCSCC - None NJNRDCSCC – None NJIGWSCC – None NJGWIIA – SPLP None	No.
56	ODCB in B-Ditch	NFA Recommended SWMU 56 RAR – OCDB Area 2000 and SWMU 56 RAR – Aramids Pond 2004	Remediated soil not included in summary tables; otherwise, soil data included in AOC 5 summary tables as appropriate.	NJNRDCSCC - ODCB	No.
56A	Historic PWDS	NFA Recommended Remedial Action Report HWPDS Lead Area 1998	Remediated soil not included in summary tables; otherwise, soil data included in summary tables for AOCs1, 2, 4-7, 9, SWMU 8 as appropriate.	NJNRDCSCC – Antimony, Arsenic, Hexachlorobenzene and Lead	No.
57	Anti-knocks Area	NFA Recommended Phase II RFI 1998	Soil data included in AOC 2 summary tables.	NJNRDCSCC – Lead NJGWIIA – SPLP Lead TEL detected in soil and SPLP but no criteria available	No.
58	Former Sludge Pit	NFA Recommended Phase II RFI 1998	Soil data included in AOC 5 summary tables.	NJNRDSCC – None. NJIGWSCC – None.	No.
59	Disposal Area V	NFA Recommended Phase II RFI 1998	Soil data included in AOC 1 summary tables.	NJNRDCSCC – Lead NJIGWSCC – None NJGWIIA - SPLP Arsenic, Lead and Thallium	No.
60	Drum Disposal Area	NFA Recommended Ecological Investigation Report 2009	Soil data included in AOC 11 summary tables,	NJNRDCSCC – 2,4-DNT and PAHs NJIGW – None NJGWIIA – SPLP Antimony, Arsenic, Cadmium, Lead, bis(2-ethylhexyl)phthalate, and nitrobenzene	No.

Table 7-1
Summary of Manufacturing Area SWMUs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

SWMU	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (criteria specified by SWMU)[1]	Significant Deviation of Exceedances (Yes, No, Not Applicable)[2]
62	Aramids/Nitrators Sump	NFA Recommended Phase II RFI 1998	Soil data included in SWMU 62 summary tables.	NJRDCSCC – 2,4-DNT NJNRDCSCC – None NJIGWSCC - Benzene.	No.
63	Azo-Dye Area	NFA Recommended Phase IV Supplemental RFI 2007	Soil data included in AOC 6 summary tables.	NJNRDCSCC – SVOCs NJIGWSCC – Chlorobenzene and SVOCs	No.

Notes:

[1] Criteria standards cited are those used for screening during the SWMU investigation.

[2] Current SRS criteria were used to re-screen soil data, and summary results are provided in Appendix C.1. Constituents that exceeded criteria were compared to those previously identified during the SWMU investigations, which mostly used SCC criteria. Significant deviations between the screenings were identified by a Yes or No in conjunction with the NFA or CMS recommendation for the SWMU. Not applicable means that either there were no soil data or the SRS criteria were used during the SWMU investigation and comparison between SCC and SRS screening of soil data is not applicable. In some cases, soil data collected below the water table was included in the comparison of criteria in the Fact Sheets but the data is not included in the summary tables in Appendix C.1.

NJRDCSCC = New Jersey Residential Direct Contact Soil Clean-up Criteria
NJNRDCSCC = New Jersey Non-Residential Direct Contact Soil Clean-up Criteria
NJIGWSCC = New Jersey Impact to Groundwater Soil Clean-up Criteria
Constituents that do not have a NJ soil criterion are not presented. Refer to SWMU Fact Sheets for more detailed information.

Table 7-2
Summary of Manufacturing Area AOCs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

AOC	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (NJNRDSRS)[1]
AOC 1	Fluoroproducts	Recommendation in 2014 RFI required	SWMU 20, 26, 35, 39-3, 59 and portions of 17/17A, 34, 55-4 and 56A are within AOC 1 boundary. Data from perimeter/interior investigation/RFI data gap as well as from SWMUs (as appropriate) included in AOC 1 summary tables.	1,4-Dichlorobenzene Chloroform Tetrachloroethene 6 PAHs Hexachlorobenzene Total PCBs Antimony Arsenic Lead Mercury
AOC 2	TEL	Recommendation in 2014 RFI required	SWMU 6, 25, 39-2, and portions of 17/17A, 56A, and 57 are within AOC 2 boundary. Soil data from perimeter/interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 2 summary tables.	1,2-Dibromoethan (EDB) 1,2-Dichloroethane 1,2-Diphenylhydrazine 6 PAHs Lead TEL
AOC 3	Jackson Lab	Recommendation in 2014 RFI required	SWMUs 28, 29, and portions of 17/17A, and 57 are within AOC 3 boundary. Soil data from perimeter/interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 3 summary tables.	4 PAHs Hexachlorobenzene Total PCBs Lead Mercury
AOC 4	Aramids	Recommendation in 2014 RFI required	SWMUs 39-6 and portions of 17/17A, 55-4, and 56A are within AOC 4 boundary. Soil data from interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 4 summary tables.	7 PAHs Arsenic Lead
AOC 5	Historical Basin Footprint and Ditches	Recommendation in 2014 RFI required	SWMUs 12, 27, 55-1, 55-3, 58 and portions of 17/17A, 18, 56, and 56A are within AOC 5 boundary. Data from interior/RFI data gap investigations as well as from SWMUs (as appropriate) included AOC 5 in summary tables.	1,4-Dichlorobenzene Benzene 2,4-Dinitrotoluene 2,6-Dinitrotoluene 8 PAHs Total PCBs Antimony Arsenic Lead

Table 7-2
Summary of Manufacturing Area AOCs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

AOC	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (NJNRDSRS)[1]
AOC 6	Dyes	Recommendation in 2014 RFI required	SWMUs 9, 10, 38, 41-3, 41-6 through 41-8, 63 and portions of 17/17A and 56A are within AOC 6 boundary. Data from perimeter/interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 6 summary tables.	1,2-Dichlorobezene 1,4-Dichlorobenzene Benzene Chlorobenzene Chloroform Tetrachloroethene Trichloroethene 1,2-diphenylhydrazine 2,4-Dinitrotoluene 2,6-Dintirotoluene Benzidine 7 PAHs Hexachlorobenzene Total PCBs Arsenic Cadmium Lead
AOC 7	Elastomers	Recommendation in 2014 RFI required	Portions of SWMUs 17/17A and 56A are within AOC 7 boundary. Data from interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 7 summary tables.	1,2-Dichlorobenzene 1,4-Dichlorobenzene Benzene Chlorobenzene Trichloroethene 1,2-Diphenylhydrazine 2,4-Dinitrotoluene 2,6-Dinitrotoluene 5 PAHs Total PCBs Arsenic Lead
AOC 8	Warehouse, Transport and Construction	Recommendation in 2014 RFI required	SWMU 11 and portions of SWMU 17/17A are within AOC 8 boundary. Data from interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 8 summary tables.	1,4-Dichlorobenzene Benzo[a]pyrene Lead
AOC 9	Monastral	Recommendation in 2014 RFI required	SWMUs 39-1, 41-1, 41-2, 41-4 and portions of 17/17A, 55-5, and 56A are within AOC 9 boundary. Data from interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 9 summary tables.	4 PAHs

Table 7-2
Summary of Manufacturing Area AOCs and Soil Data Status
Comprehensive RFI Report
DuPont Chambers Works Complex
Deepwater, New Jersey

AOC	Description	RFI Status	Soil Data Set Status	Fact Sheet Soil Exceedances (NJNRDSRS)[1]
AOC 10	White Products	Recommendation in 2014 RFI required	Portions of SWMU 17/17A are within AOC 10 boundary. Data from perimeter/interior/RFI data gap investigations as well as from SWMUs (as appropriate) included in AOC 10 summary tables.	Benzo[a]pyrene
AOC 11	Former Drainage Ditch	NFA Recommended Perimeter Investigation 2011.	SWMU 60 is mostly within AOC 11 boundary. Data from perimeter investigations as well as from SWMU 60 included in AOC 11 summary tables.	2,4-Dinitrotoluene 5 PAHs

Note:

[1] All soil data included within the boundary of each AOC was compared to NJNRDSRS and NJIGWSRS and is provided in Appendix C.1 by AOC. Constituents listed above are those that exceeded NJNRDCSRS at one more locations within the AOC. Constituents that do not have a NJ soil criterion are not included here. Refer to the AOC soil tables in Appendix C.1 and the Fact Sheets in Appendix A for more detailed information.
NJNRDCSRS = New Jersey Non-Residential Direct Contact Soil Remediation Standards
NJIGWSRS = New Jersey Impact to Groundwater Soil Remediation Standards.

Table 8-1
Comparison of Sub-Slab Soil Gas Analytical Results to Occupational Screening Levels
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Analyte[1]	Units	No. of Samples	No. of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Location/ Building Max Detect	OSHA PEL
1,2-Dichloroethane	ug/m^3	60	2	130	160	AOC6-INT-604-2 / 604	202,500
1,4-Dichlorobenzene	ug/m^3	60	3	56	670	AOC6-INT-604-2 / 604	450,000
Benzene	ug/m^3	60	9	0.7	1,100	AOC6-INT-604-2 / 604	3,190
Carbon tetrachloride	ug/m^3	60	18	4	39,000	AOC3-JL-J27-3 / J-27	62,900
Chlorobenzene	ug/m^3	60	4	1	12,000	AOC6-INT-604-2 / 604	350,000
Chloroform	ug/m^3	60	37	2	72,000	AOC1-FP-K29-4 / K-29	240,000
Ethylbenzene	ug/m^3	60	3	10	470	AOC6-INT-604-2 / 604	435,000
Tetrachloroethylene	ug/m^3	60	43	7	300,000	AOC3-JL-J27-3 / J-27	678,000
Trichloroethylene	ug/m^3	60	26	3	110,000	AOC3-JL-J30-3 / J-30	537,000
Vinyl chloride	ug/m^3	60	3	11	790	AOC3-JL-J30-3 / J-30	2,560

Notes:

1 - Constituents detected in sub-slab soil gas above New Jersey Soil Gas Screening Levels (March 2013) and used on-site.

OSHA PEL - Occupational Safety and Health Administration Permissible Exposure Levels

Table 8.2
Summary of Tiered Exposure Evaluation and EI Conclusions
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Exposure Area Receptor Category	Tier I Exposure Summary	Tier II Exposure Summary	Ecological Investigation Conclusions and Recommendations
Henby-Bouttown Creek System			
Helms Basin:			
Benthic Invertebrate Community	Negligible risk to benthic invertebrates; Nickel was the only COPEC identified in sediment at a maximum concentration comparable to the background UTL$_{95}$ concentration	No further evaluation conducted	No further evaluation warranted on the basis of ecological risk
Fish/Herptile Community	Negligible risk to fish and herptile communities; no surface water COPECs identified	No further evaluation conducted	
Wildlife Community	Negligible risk to wildlife based on most conservative exposure scenario	No further evaluation conducted	
Bouttown Creek:			
Benthic Invertebrate Community	HQs > 1 based on LELs and maximum sediment concentrations of multiple metals, total PAHs, SVOCs, total PCBs, and nitrocellulose	Greatest sediment concentrations of metals and total PAHs in ditches draining Carneys Point Benthic community and interstitial water results were not indicative of impacts to benthos in the creek	Ditches: 2009 ditch investigation indicated limited COPEC bioavailability in the biologically active zone of sediments; concluded that adverse effects to benthic invertebrates were unlikely due to exposure to COPECs in sediment. Creek: No further evaluation
Fish/Herptile Community	Negligible Risk	No Further Evaluation	No further evaluation
Wildlife Community:	HQs$_{NOAEL}$ > 1 for multiple metals based on maximum exposure point concentrations and maximum area use factors HQs$_{NOAEL}$ > 1 for avian piscivore exposure to total PCBs	HQs$_{NOAEL}$ slightly exceed 1 for avian and mammalian piscivores exposed to Hg and avian piscivores exposed to total PCBs HQs$_{LOAEL}$ < 1 for all COPECs and receptors	No further evaluation based on Tier II dose rate exposure models
Henby Creek:			
Benthic Invertebrate Community	HQs > 1 based on LELs and maximum sediment concentrations of multiple metals, 2,4-DNT, n-nitrosodiphenylamine Maximum Cd concentration in interstitial water exceeds NJSWQS Benthic community and SEM:AVS ratios were not indicative of impacts to benthos in the creek	Max Cr, Se, and Hg concentrations comparable to SEL (HC04) 3 of 4 lines of evidence were not indicative of impacts to benthos in the creek: - benthic community analysis - SEM:AVS ratios - interstitial water results	No further evaluation warranted based on a weight of evidence evaluation of potential risk
Fish/Herptile Community	Negligible risk to fish and herptile communities; no surface water COPECs identified	No further evaluation conducted	No further evaluation warranted on the basis of ecological risk

Table 8.2
Summary of Tiered Exposure Evaluation and EI Conclusions
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Exposure Area Receptor Category	Tier I Exposure Summary	Tier II Exposure Summary	Ecological Investigation Conclusions and Recommendations
Wildlife Community:	HQs_{NOAEL} > 1 for multiple metals (Cr, Se, Hg) based on maximum exposure point concentrations and maximum area use factors	HQs_{NOAEL} slightly exceed 1 for avian and mammalian piscivores exposed to Hg HQs_{LOAEL} < 1 for all COPECs and receptors	No further evaluation based on Tier II dose rate exposure models
Henby-Bouttown Wetland System			
Bouttown Wetlands:			
Wetland Vegetative Community	No observed signs of stressed or dead vegetation; exposure area was fully vegetated	No further evaluation conducted	No further evaluation warranted
Wetland Invertebrate Community	HQs > 1 based on LELs and maximum sediment concentrations of multiple metals, SVOCs, and nitrocellulose Interstitial water screening and SEM:AVS ratios indicate potential metal bioavailability	Interstitial water concentrations were lower than NOECs for benthic invertebrates at all locations except Zn @ BCW-03 (HQ ~2)	No further evaluation warranted based on Tier II exposure evaluation
Wildlife Community:	HQs_{NOAEL} > 1 for multiple metals based on maximum concentrations and maximum area use factors	HQs_{NOAEL} slightly exceed 1 for avian insectivore exposure to Cd, Cr, Cu, Pb, Hg based on UCL_{95} concentrations HQs_{LOAEL} < 1 for all COPECs and receptors	No further evaluation based on Tier II dose rate exposure models
Henby Wetlands:			
Wetland Vegetative Community	No observed signs of stressed or dead vegetation; exposure area was fully vegetated	No further evaluation conducted	No further evaluation warranted
Wetland Invertebrate Community	HQs > 1 based on LELs and maximum sediment concentrations of multiple metals SEM:AVS ratios indicate potential metal bioavailability	HQs < 1 or ~ 1 (Cr, Ag, Pb) based on SELs Metal concentrations were generally below SSLs for terrestrial invertebrates	No further evaluation based on Tier II exposure evaluation
Wildlife Community:	HQs_{NOAEL} > 1 for multiple metals (Cd, Cr, Pb, Hg) based on maximum concentrations and maximum area use factors	HQ_{NOAEL} slightly exceed 1 for red-winged blackbird exposure to Cr based on average concentrations HQs_{LOAEL} < 1 for all COPECs and receptors	No further evaluation based on Tier II dose rate exposure models
Carneys Point Uplands			
Wildlife Community:	Estimated doses for wildlife in SWMU 45-2 exceeds NOAEL doses for multiple metals; minor exceedances of NOAEL doses in other SWMUs	Minor exceedances of NOAEL doses in SWMUs 45-2 and 47 HQs_{LOAEL} < 1 for all COPECs and receptors	No further evaluation warranted on the basis of ecological risk

Table 8.2
Summary of Tiered Exposure Evaluation and EI Conclusions
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

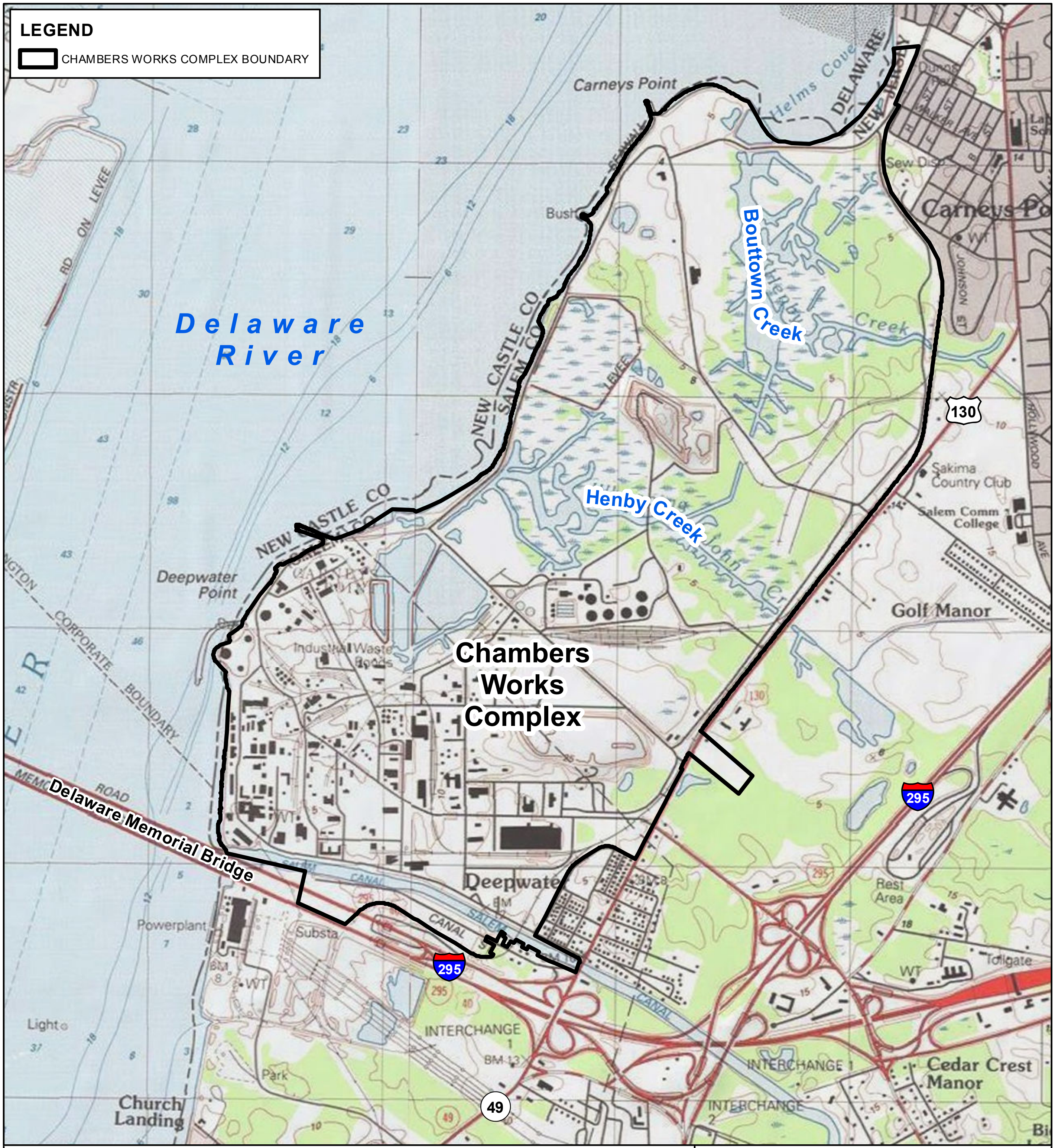
Exposure Area Receptor Category	Tier I Exposure Summary	Tier II Exposure Summary	Ecological Investigation Conclusions and Recommendations
Carneys Point Ponds			
Carneys Point Ponds:			
Benthic Invertebrate Community	HQs > 1 based on LELs and maximum sediment concentrations of multiple metals, total PAHs; constituent concentrations greatest in E Pond	Exceedances of SELs for select metals; SEM:AVS < 1 in A Pond and variable in E Pond; elevated tPAH concentrations at one location in each pond A Pond and E Pond are shallow with highly organic sediments, which limits their capacity to support benthic invertebrate communities Metals in Historical B Pond lower than SELs (aquatic) and Eco-SSLs (terrestrial)	No further evaluation based on Tier II exposure evaluation
Herptile Community	Only A Pond contains surface water metals exceeding NJSWQS/NRWQC	A Pond: $HQs_{NOEC} < 1$ based on amphibian endpoints	No further evaluation warranted
Wildlife Community:	$HQs_{NOAEL} > 1$ for Hg in E Pond and B Pond based on maximum exposure point concentrations and maximum area use factors $HQs_{NOAEL} < 1$ for all other constituents and receptors	$HQs_{NOAEL} < 1$ based on average exposure point concentrations and adjusted area use factors $HQs_{LOAEL} < 1$ for all COPECs and receptors	No further evaluation warranted on the basis of Tier II dose rate exposure models
Manufacturing Area Ponds			
Benthic Invertebrate Community	Greater constituent concentrations and variable SEM:AVS ratios in C Pond sediment	C Pond does not likely provide permanent aquatic habitat to support an abundant and diverse benthic community; Exceedances of SELs for two metals with variable SEM:AVS ratios Sediment metals in D Pond are not likely bioavailable based on SEM:AVS < 1	No further evaluation based on Tier II exposure evaluation
Herptile Community	Negligible Risk	No further evaluation conducted	No further evaluation warranted
Wildlife Community:	$HQs_{NOAEL} > 1$ for Hg and Cr in C Pond and D Pond based on maximum exposure point concentrations and maximum area use factors $HQs_{NOAEL} > 1$ for all other metals and receptors	$HQs_{NOAEL} < 1$ based on average exposure point concentrations and adjusted area use factors $HQs_{LOAEL} < 1$ for all COPECs and receptors	No further evaluation warranted based on Tier II dose rate exposure models

Table 8.2
Summary of Tiered Exposure Evaluation and EI Conclusions
Comprehensive RFI Report
DuPont Chambers Works
Deepwater, New Jersey

Exposure Area Receptor Category	Tier I Exposure Summary	Tier II Exposure Summary	Ecological Investigation Conclusions and Recommendations
B Basin			
Piscivorous Waterfowl Exposure Pathway:	Waterfowl and fish community surveys indicate an incomplete or insignificant exposure pathway for piscivorous waterfowl potentially foraging in B Basin		No further evaluation warranted on the basis of ecological risk

Notes:
HQ, Hazard quotient; expressed as the ratio of the exposure point concentration or modeled dose to an ecological benchmark concentration or dose
NOAEL, No observable adverse effects level dose
LOAEL, Lowest observable adverse effects level dose
UTL, Upper tolerance limit of the background dataset
SEL, Severe effects level
COPECs, Constituents of potential ecological concern
Eco-SSLs, EPA Ecological Soil Screening Levels

Figures



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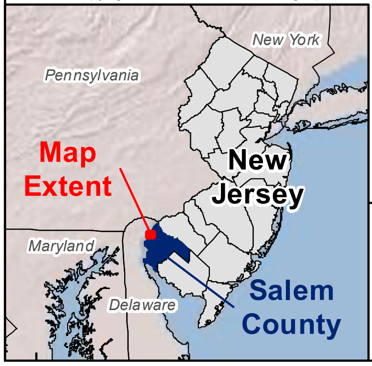

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Feet
1 inch = 2,000 feet
MAP FORMATTED FOR "A" (8.5" X 11") SIZE SHEET.
TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

SITE LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: M.LAYTON	DATE: 3/28/2014
DRAWN BY: MKL	FIGURE NUMBER: 1-1
DATA QUALITY CHECK BY: L.GROSS	

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LEGEND

- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- OCCUPIED SITE STRUCTURE
- ▨ LANDFILL
- CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

Notes:

Map Projection: NAD83 NJ State Plane feet

2012 Aerial imagery provided by Axis Geospatial LLC.

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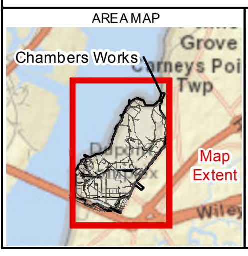
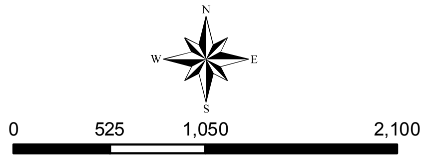
AREA MAP





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1 inch = 1,050 feet

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DESIGNED BY:	L.GROSS
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	S.NORCROSS

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PRIMARY SITE FEATURES

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:	18985881
DATE:	3/7/2014
FIGURE NUMBER:	2-1

LEGEND

PROPERTY BOUNDARY
EDGE OF PAVEMENT
RAILROAD
CARNEYS POINT/
MANUFACTURING AREA BOUNDARY

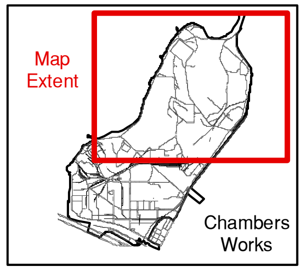
SWMU STATUS

🟩 NFA
🟨 CMS RECOMMENDED

Notes:

Map Projection: NAD83 NJ State Plane feet

2012 Aerial imagery provided by Axis Geospatial LLC.



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CARNEYS POINT - RCRA SWMU LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 2-2
DATA QUALITY CHECK BY: S.NORCROSS	

User: Matt_Layton, Date: 8/27/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-2_CarneysPoint_RCRA_SWMU_Locations.mxd

LEGEND

- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

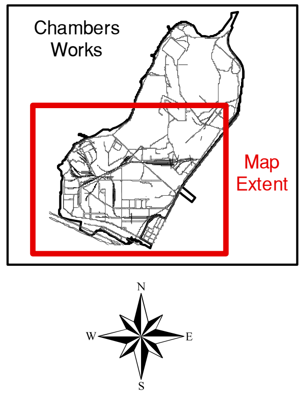
SWMU STATUS

- 🟩 NFA
- 🟦 2013-14 RFI DATA GAP INVESTIGATION
- 🟨 CMS RECOMMENDED
- 🟪 RCRA OPERATING UNIT OR USACE LEAD

Notes:

Map Projection: NAD83 NJ State Plane feet

2012 Aerial imagery provided by Axis Geospatial LLC.



0 400 800 1,600

Feet

1 inch = 800 feet

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

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Newark, DE 19713

MANUFACTURING AREA - RCRA SWMU LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 2-3
DATA QUALITY CHECK BY: S.NORCROSS	

User: Matt_Layton, Date: 8/27/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-3_Manufacturing_RCRA_SWMU_Locations.mxd

LEGEND

- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

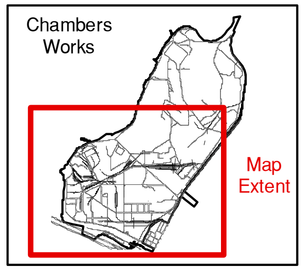
AOC STATUS

- 🟦 2013-14 RFI DATA GAP INVESTIGATION
- 🟩 NFA

Notes:

Map Projection: NAD83 NJ State Plane feet

2012 Aerial imagery provided by Axis Geospatial LLC.



N W E S

0 400 800 1,600

Feet

1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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RCRA
AOC LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 2-4
DATA QUALITY CHECK BY: S.NORCROSS	

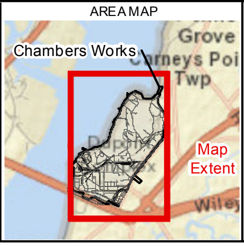
User: Matt_Layton, Date: 8/27/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-4_RCRA_AOC_Locations.mxd

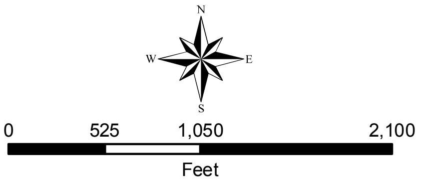
Notes:

Map Projection: NAD83 NJ State Plane feet

2012 Aerial imagery provided by Axis Geospatial LLC.

AREA MAP





1 inch = 1,050 feet

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

FILE NUMBER:	
DESIGNED BY:	L.GROSS
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	S.NORCROSS

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Newark, DE 19713

PERIMETER INVESTIGATION BOUNDARY MAP

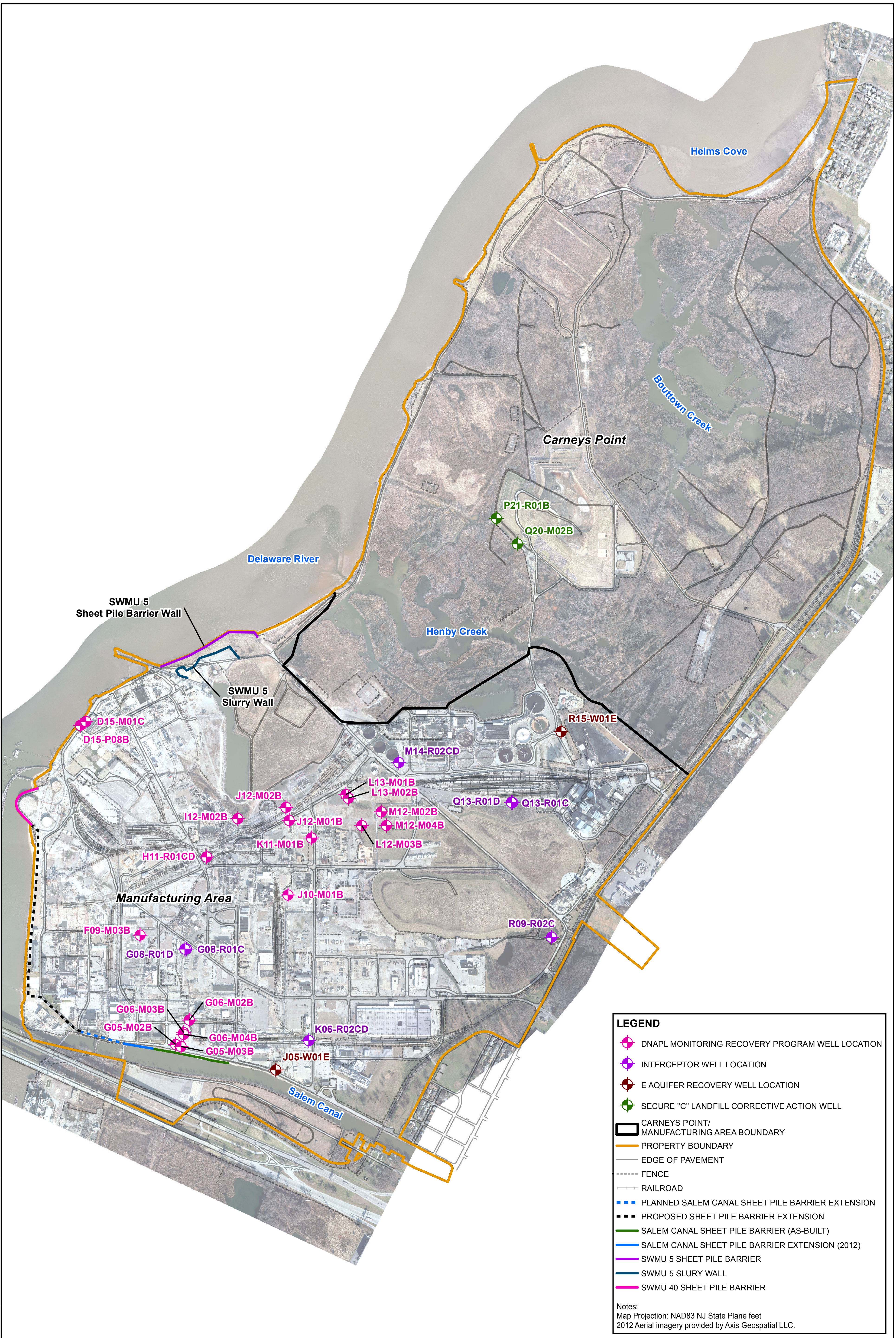
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 3/7/2014

FIGURE NUMBER: 2-5

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-5_Perimeter_Investigation_Boundary.mxd

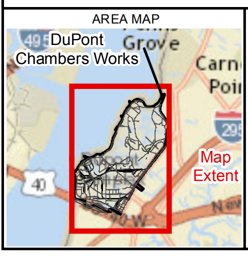


LEGEND

- ● DNAPL MONITORING RECOVERY PROGRAM WELL LOCATION
- ● INTERCEPTOR WELL LOCATION
- ● E AQUIFER RECOVERY WELL LOCATION
- ● SECURE "C" LANDFILL CORRECTIVE ACTION WELL
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- FENCE
- RAILROAD
- PLANNED SALEM CANAL SHEET PILE BARRIER EXTENSION
- PROPOSED SHEET PILE BARRIER EXTENSION
- SALEM CANAL SHEET PILE BARRIER (AS-BUILT)
- SALEM CANAL SHEET PILE BARRIER EXTENSION (2012)
- SWMU 5 SHEET PILE BARRIER
- SWMU 5 SLURY WALL
- SWMU 40 SHEET PILE BARRIER

Notes:
Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

AREA MAP



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Feet
1 inch = 1,050 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:

DESIGNED BY: L.GROSS

DRAWN BY: MKL/CAD

DATA QUALITY CHECK BY: S.NORCROSS

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Newark, DE 19713

ON-GOING REMEDIAL ACTIONS

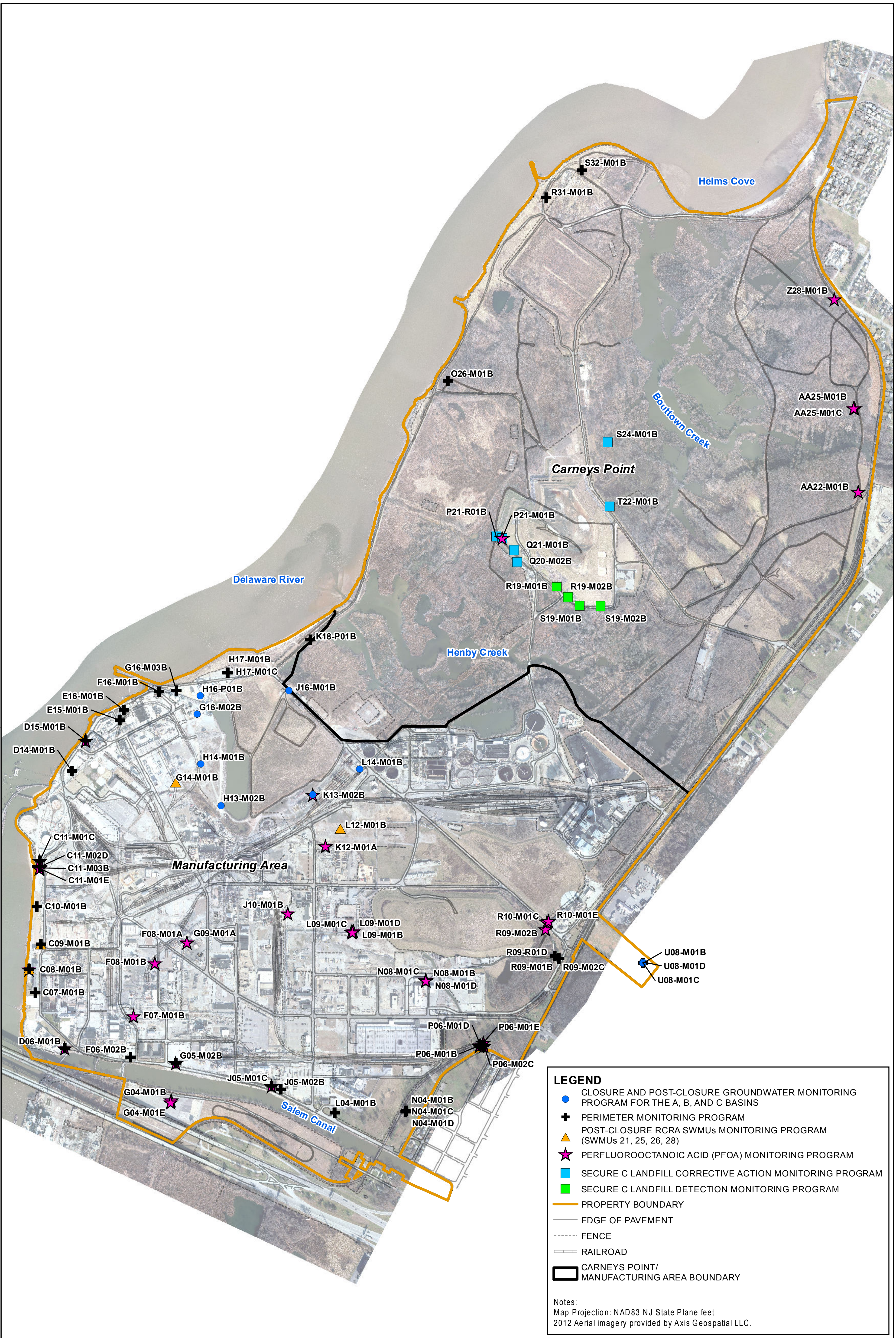
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 8/29/2014

FIGURE NUMBER: 2-6

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-6_On-Going_Remedial_Actions.mxd

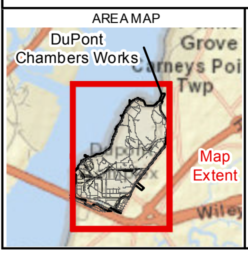


LEGEND

- ● CLOSURE AND POST-CLOSURE GROUNDWATER MONITORING PROGRAM FOR THE A, B, AND C BASINS
- ✚ PERIMETER MONITORING PROGRAM
- ▲ POST-CLOSURE RCRA SWMUs MONITORING PROGRAM (SWMUs 21, 25, 26, 28)
- ★ PERFLUOROOCTANOIC ACID (PFOA) MONITORING PROGRAM
- 🟦 SECURE C LANDFILL CORRECTIVE ACTION MONITORING PROGRAM
- 🟩 SECURE C LANDFILL DETECTION MONITORING PROGRAM
- ━ PROPERTY BOUNDARY
- ─ EDGE OF PAVEMENT
- ┄ FENCE
- ┼┼ RAILROAD
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

Notes:
Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

AREA MAP



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Feet
1 inch = 1,050 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:	
DESIGNED BY:	L.GROSS
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	S.NORCROSS

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ON-GOING MONITORING ACTIVITIES

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:	18985881
DATE:	3/7/2014
FIGURE NUMBER:	2-7

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig2-7_On-Going_Monitoring_Activities.mxd

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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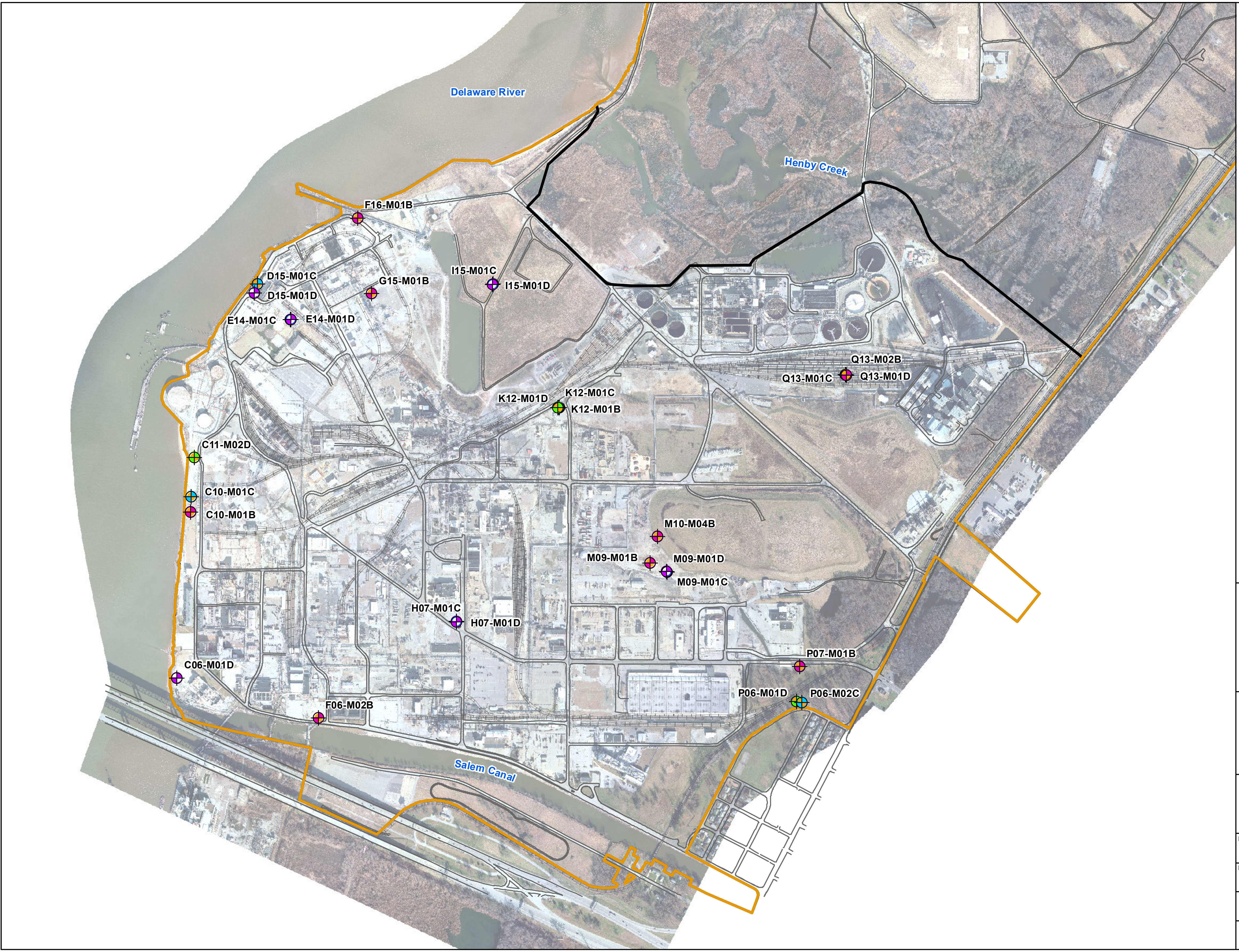
RFI DATA GAP INVESTIGATION FIELD INVESTIGATION LOCATIONS MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: K.DAVIS	DATE: 7/8/2014
DRAWN BY: MKL	FIGURE NUMBER: 4-1
DATA QUALITY CHECK BY: L.GROSS	

User: Matt_Layton, Date: 7/8/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig4-1_Field_Investigation_Locations_Map.mxd

User: Matt_Layton, Date: 7/8/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig4-2_Slug_Testing_Location_Map.mxd

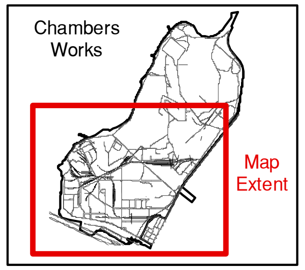


LEGEND

⊕ NEW MONITORING WELL (C AQUIFER)
⊕ NEW MONITORING WELL (D AQUIFER)
⊕ EXISTING MONITORING WELL (B AQUIFER)
⊕ EXISTING MONITORING WELL (C AQUIFER)
⊕ EXISTING MONITORING WELL (D AQUIFER)
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
— RAILROAD
▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.



N
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0 325 650 1,300
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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RFI DATA GAP INVESTIGATION SLUG TESTING LOCATIONS MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: K.DAVIS	DATE: 7/8/2014
DRAWN BY: MKL	FIGURE NUMBER: 4-2
DATA QUALITY CHECK BY: L.GROSS	

LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▭ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD

OCCUPIED SITE STRUCTURE (2013)

- ■ BUILDING PART OF SAMPLING EVENT
- ▨ BUILDING NOT PART OF SAMPLING EVENT

VI SAMPLE LOCATION

- ▲ AMBIENT AIR
- ● SOIL GAS

Notes:

Map Projection: NAD83 NJ State Plane Feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet

1 inch = 700 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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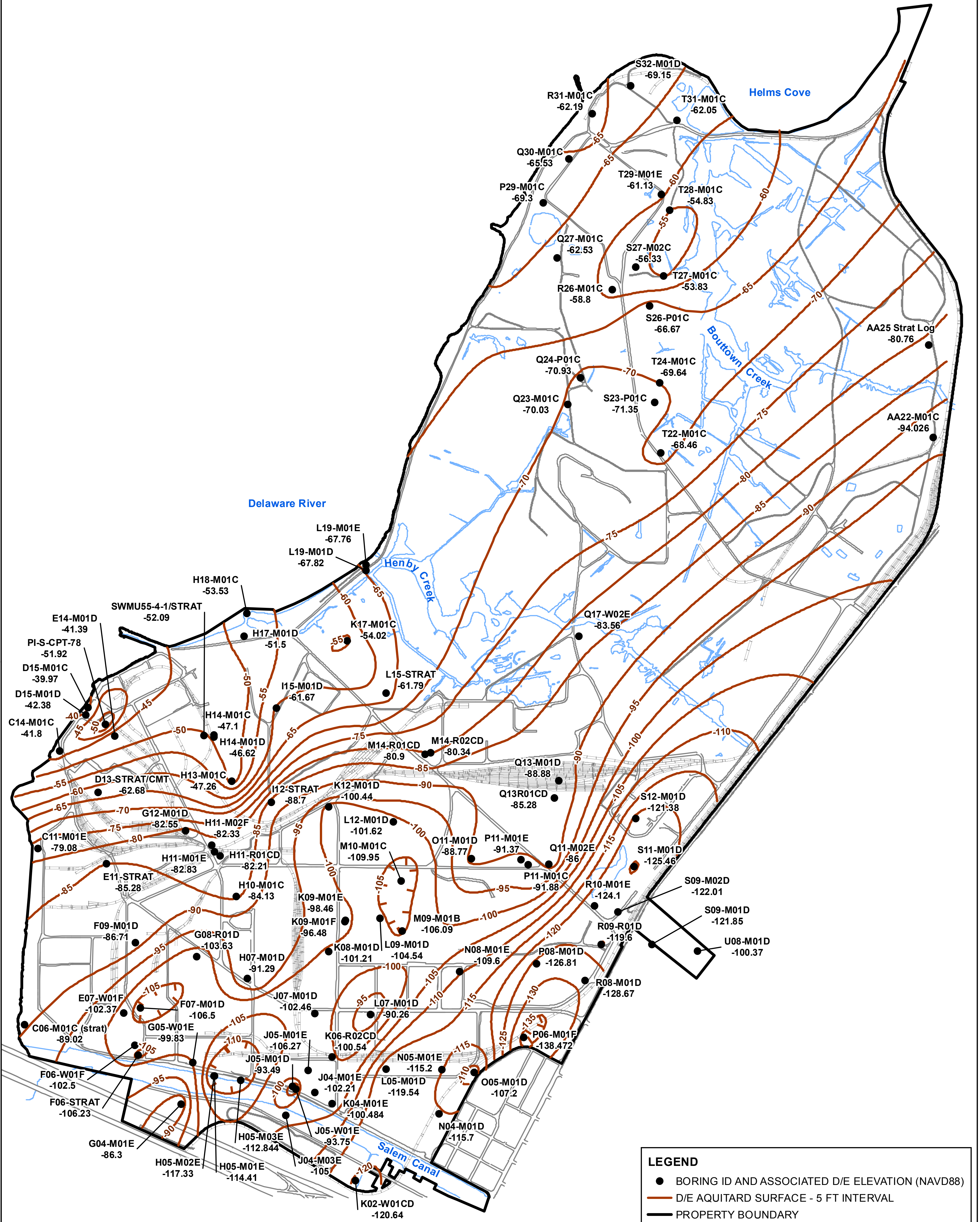
VAPOR INTRUSION INVESTIGATION PHASE I SUB-SOIL GAS SAMPLE LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: T.MCGEE	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 4-3
DATA QUALITY CHECK BY: T.MCGEE	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig4-3_VI_PhaseI_SubSoil_Gas_Location_Map.mxd

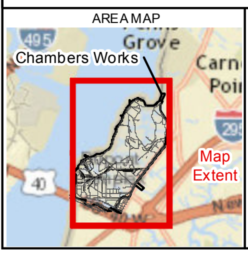


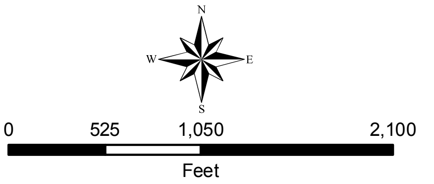
LEGEND

- ● BORING ID AND ASSOCIATED D/E ELEVATION (NAVD88)
- D/E AQUITARD SURFACE - 5 FT INTERVAL
- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE/WATER BODY

Notes:

Map Projection: NAD83 NJ State Plane feet





1 inch = 1,050 feet

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

FILE NUMBER:

DESIGNED BY: P.CHEN

DRAWN BY: MKL

DATA QUALITY CHECK BY: S.MORGAN

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TOP OF D/E AQUITARD ELEVATION MAP

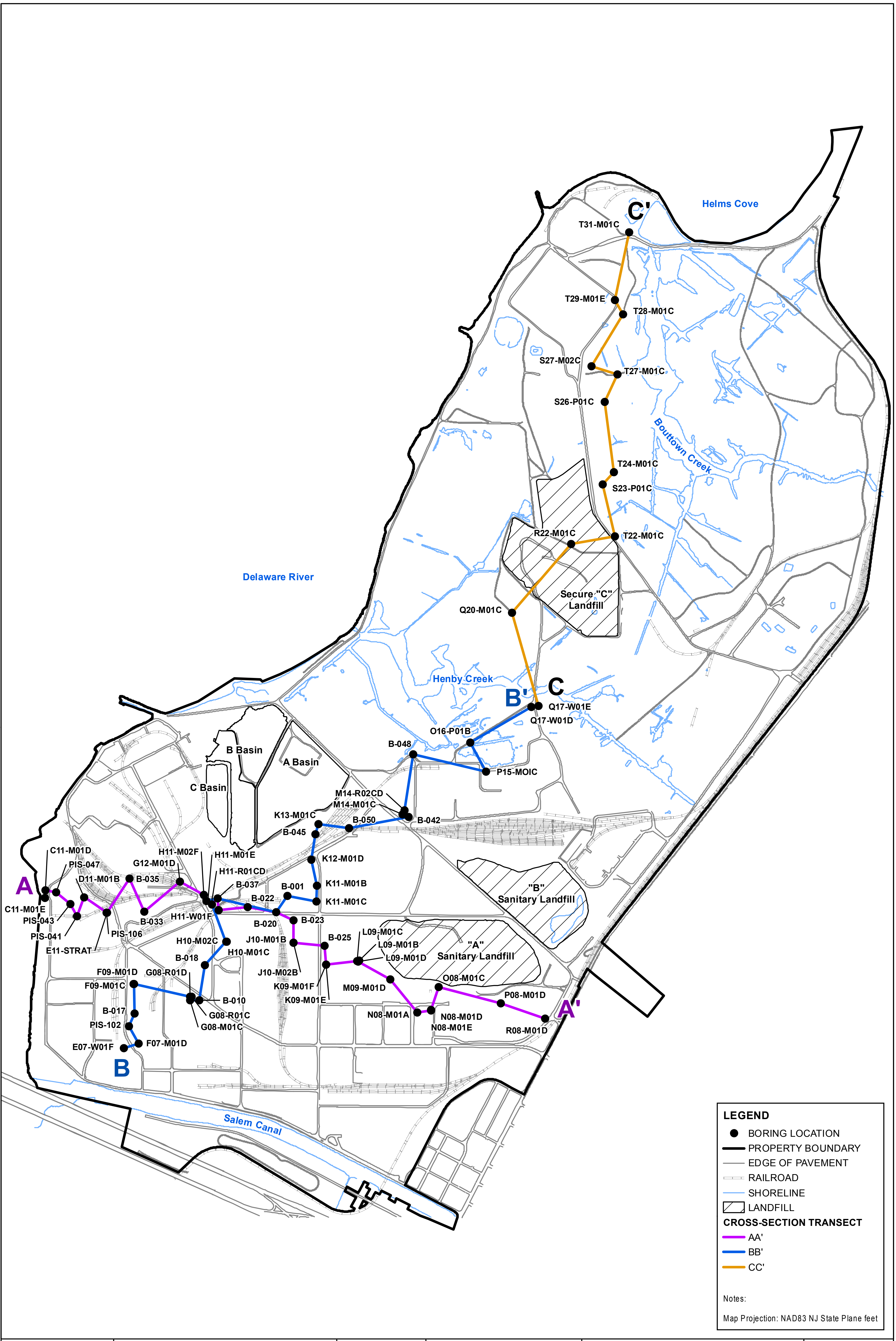
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 8/29/2014

FIGURE NUMBER: 5-1

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-1_Top_DE_Aquitard.mxd



LEGEND

- ● BORING LOCATION
- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE
- ▨ LANDFILL

CROSS-SECTION TRANSECT

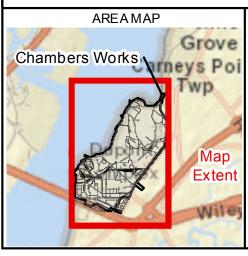
- AA'
- BB'
- CC'

Notes:

Map Projection: NAD83 NJ State Plane feet

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-2_Cross_Section_Location_Map.mxd

AREA MAP



1 inch = 1,050 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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FILE NUMBER:

DESIGNED BY:
P.CHEN

DRAWN BY:
MKL

DATA QUALITY CHECK BY:
S.MORGAN

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4051 Ogletown Road, Suite 300
Newark, DE 19713

CROSS-SECTION LOCATION MAP

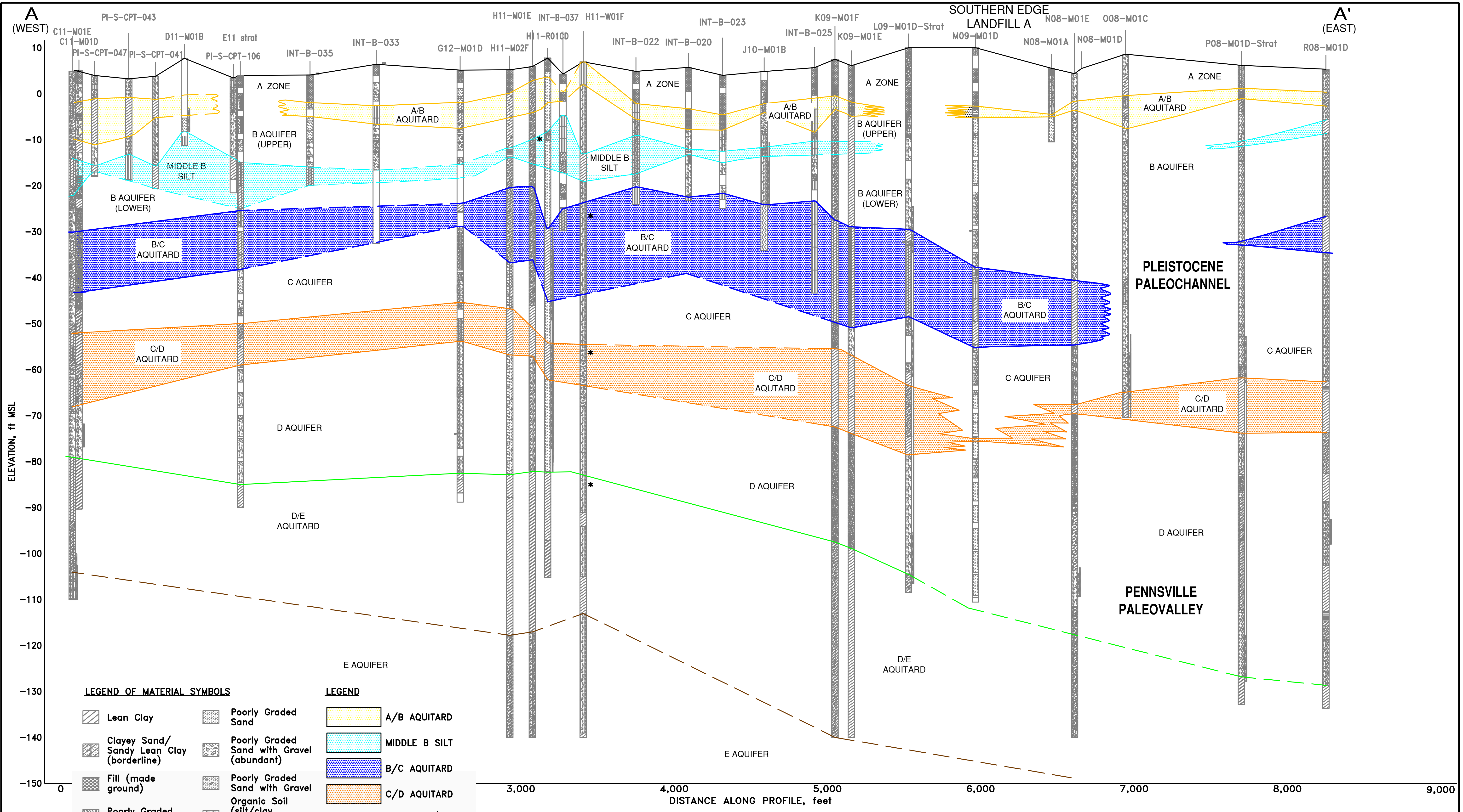
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:
18985881

DATE:
3/7/2014

FIGURE NUMBER:
5-2

V:\Projects\Dupont\Chambers_Works\CAD_1\18985881 (P.J. Chen)\Phils Cross-Sections\Phils A-A' section.dwg, 8/5/2014 11:46 AM, Littel, David E, PDF995.pc3, User32767, 1'-0" = 1'-0"



NOTES

* FINAL CORRELATIONS COMPLETED USING AVAILABLE LITHOLOGIC AND GEOPHYSICAL DATA. ONLY LITHOLOGIC DATA IS PROVIDED FOR REFERENCE.

VERTICAL EXAGGERATION 30X

SCALE

600' 0 600'

DESIGNED BY:	P. CHEN
DRAWN BY:	D. LITTEL
DATA QUALITY CHKD:	CHEN/NORCROSS
APPROVED BY:	S. MORGAN

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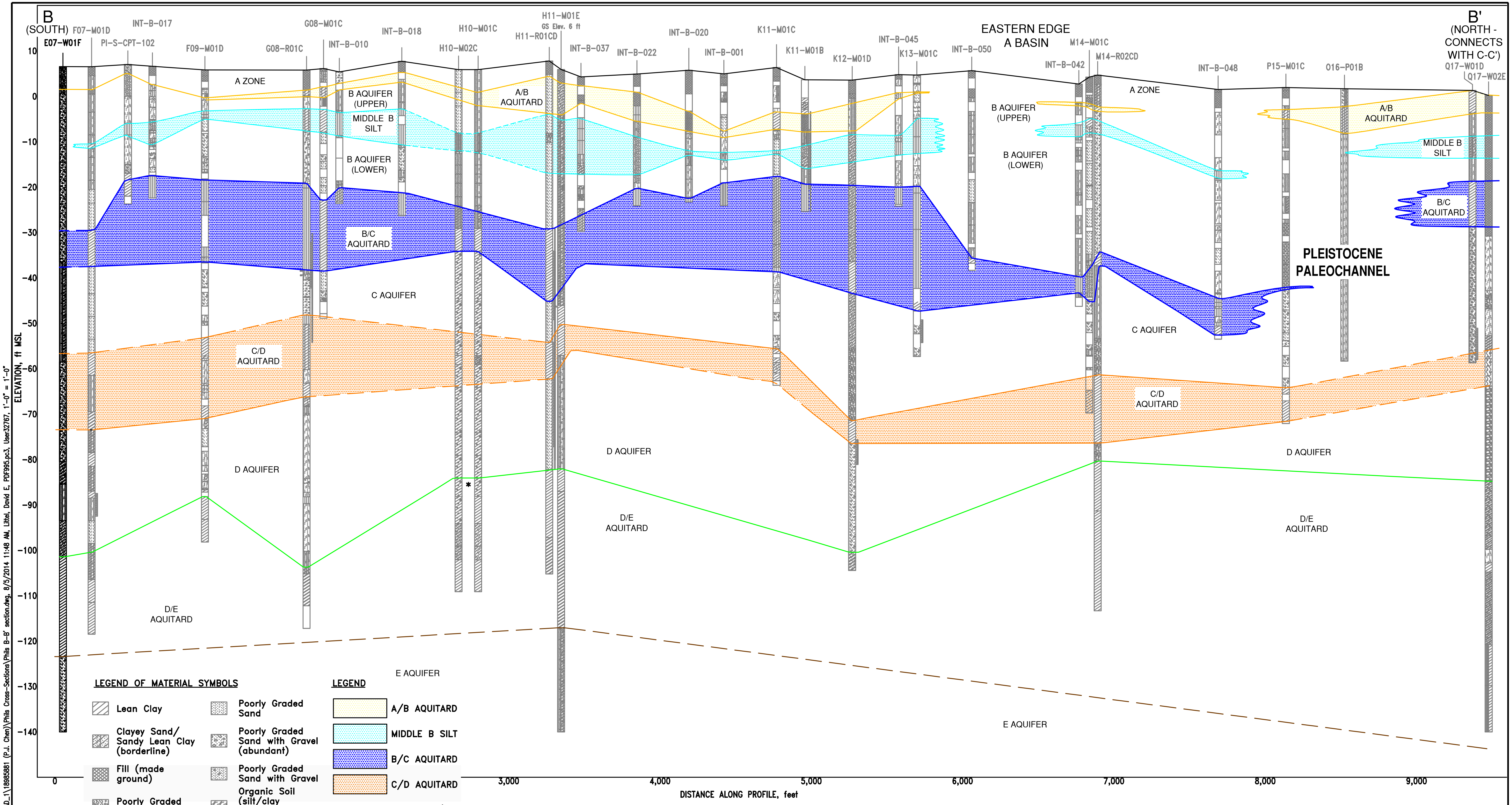
Sabre Building, Suite 300
4051 Ogletown Road
Newark, Delaware 19713
Phone: 302-781-5900

CROSS-SECTION A-A'

DUPONT CHAMBERS WORKS
DEEPWATER, NEW JERSEY

PROJECT NO.	18985881
DATE	2/14/14
FIGURE No:	5-3



LEGEND OF MATERIAL SYMBOLS

▨ Lean Clay	▒ Poorly Graded Sand
▨ Clayey Sand/ Sandy Lean Clay (borderline)	▒ Poorly Graded Sand with Gravel (abundant)
▦ Fill (made ground)	▒ Poorly Graded Sand with Gravel
▒ Poorly Graded Gravel	▨ Organic Soil (silt/clay classification uncertain)
▨ Organic Silt with Gravel	▒ Boulders and cobbles
▨ Silty Lean Clay	▦ Peat
▥ Silt	│ Well Screen

LEGEND

- 🟨 A/B AQUITARD
- ▒ MIDDLE B SILT
- 🟦 B/C AQUITARD
- 🟧 C/D AQUITARD
- — TOP OF D/E AQUITARD
- — TOP OF E AQUIFER

NOTES

* FINAL CORRELATIONS COMPLETED USING AVAILABLE LITHOLOGIC AND GEOPHYSICAL DATA. ONLY LITHOLOGIC DATA IS PROVIDED FOR REFERENCE.

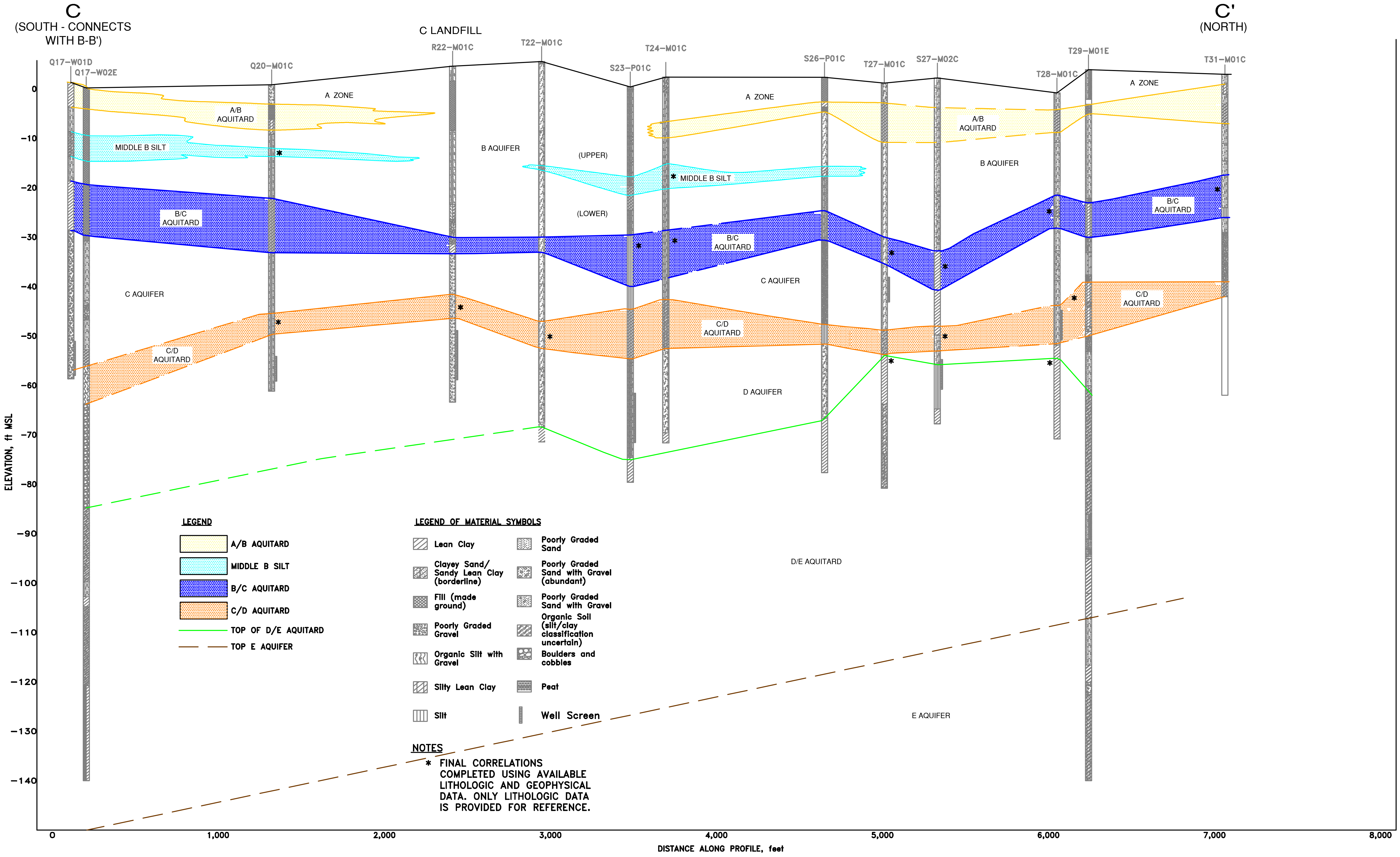
VERTICAL EXAGGERATION 30X

SCALE

600' 0 600'

DESIGNED BY: P. CHEN	URS	CROSS-SECTION B-B'	PROJECT NO. 18985881
DRAWN BY: D. LITTEL			DATE 2/14/14
DATA QUALITY CHKD: CHEN/NORCROSS	URS Corporation Sabre Building, Suite 300 4051 Ogletown Road Newark, Delaware 19713 Phone: 302-781-5900	DUPONT CHAMBERS WORKS DEEPWATER, NEW JERSEY	FIGURE No: 5-4
APPROVED BY: S. MORGAN			

V:\Projects\Dupont\Chambers_Works\CAD_1\18985881 (P.J. Chen)\Phils Cross-Sections\Phils B-B' section.dwg, 8/5/2014 11:48 AM, Littel, David E, PDF995.pc3, User32767, 1'-0" = 1'-0"

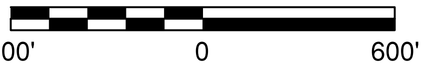


NOTES

* FINAL CORRELATIONS COMPLETED USING AVAILABLE LITHOLOGIC AND GEOPHYSICAL DATA. ONLY LITHOLOGIC DATA IS PROVIDED FOR REFERENCE.

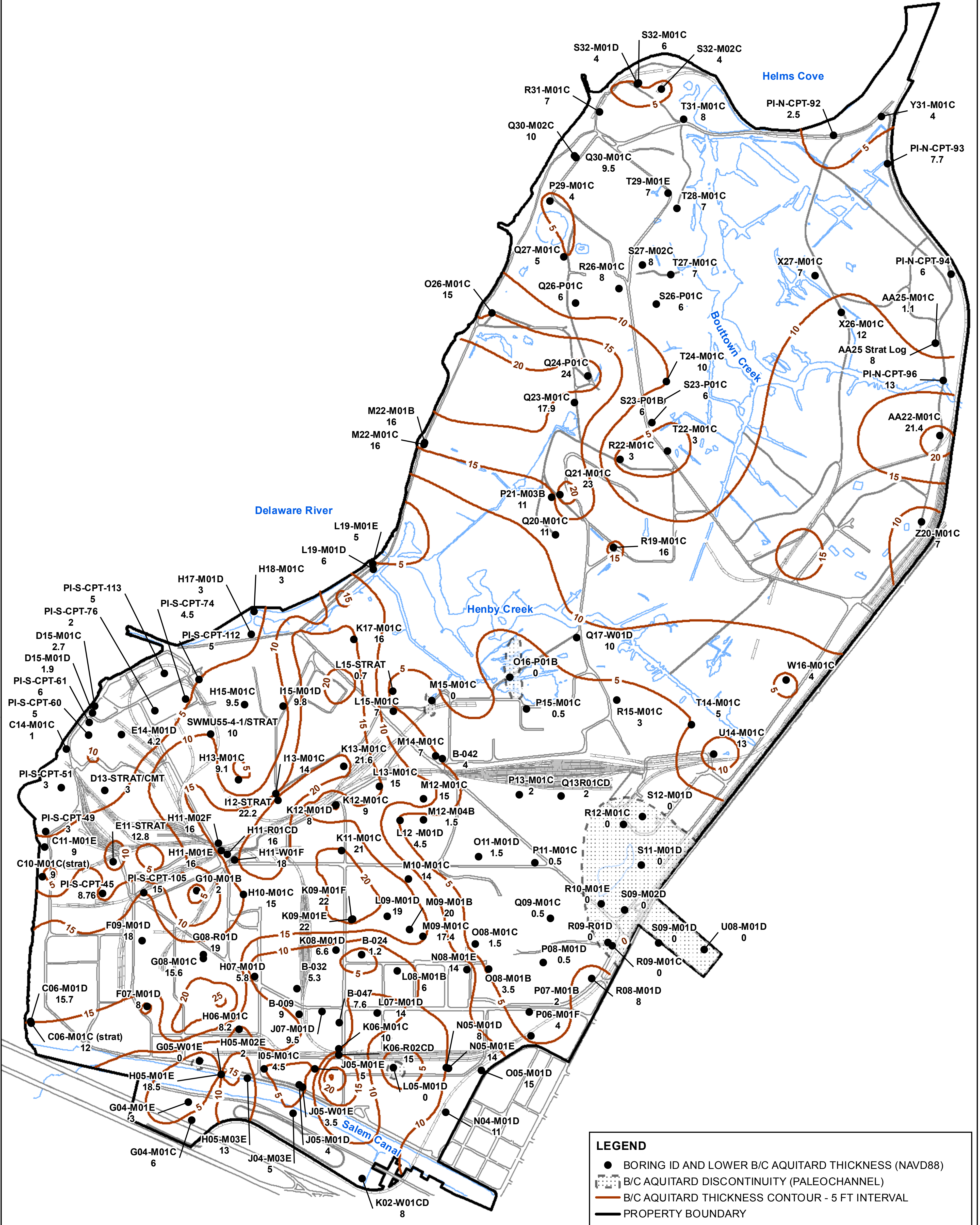
VERTICAL EXAGGERATION 30X

SCALE



DESIGNED BY: P. CHEN	URS URS Corporation Sabre Building, Suite 300 4051 Ogletown Road Newark, Delaware 19713 Phone: 302-781-5900	CROSS-SECTION C-C'	PROJECT NO. 18985881
DRAWN BY: D. LITTEL			DATE 2/14/14
DATA QUALITY CHKD: CHEN/NORCROSS		DUPONT CHAMBERS WORKS DEEPWATER, NEW JERSEY	FIGURE No: 5-5
APPROVED BY: S. MORGAN			

V:\Projects\Dupont\Chambers_Works\CAD_1\18985881 (P.J. Chen)\Phils Cross-Sections\Phils C-C' section.dwg, 8/27/2014 5:03 PM, Littel, David E, PDF995.pc3, User32767, 1'-0" = 1'-0"



LEGEND

● BORING ID AND LOWER B/C AQUITARD THICKNESS (NAVD88)

▨ B/C AQUITARD DISCONTINUITY (PALEOCHANNEL)

B/C AQUITARD THICKNESS CONTOUR - 5 FT INTERVAL

PROPERTY BOUNDARY

SHORELINE/WATER BODY

EDGE OF PAVEMENT

RAILROAD

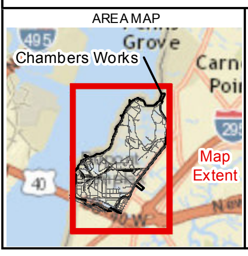
Notes:

The B/C aquitard thickness across the site was determined by subtracting the interpolated grid of the top of the C aquifer from the interpolated grid of the top of the B/C aquitard. Location IDs and values shown on the map are provided for reference. Contours based on historical data were updated with new data from the 2013-14 data gap field investigation.

Map Projection: NAD83 NJ State Plane feet

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-6_BC_Aquitard_Thickness.mxd

AREA MAP



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Feet

1 inch = 1,050 feet

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

FILE NUMBER:	
DESIGNED BY:	P.CHEN
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	S.MORGAN

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Newark, DE 19713

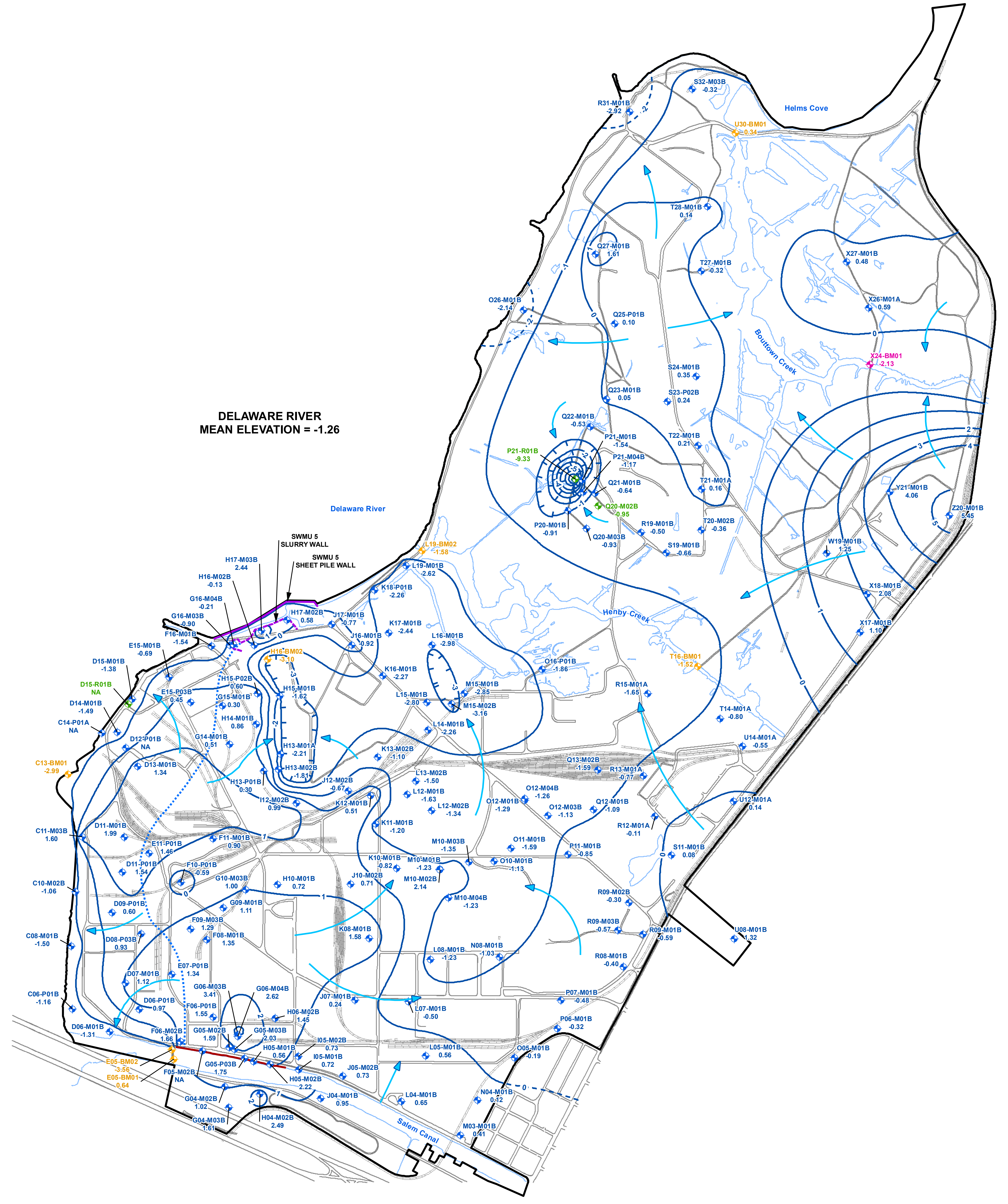
B/C AQUITARD THICKNESS MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 8/29/2014

FIGURE NUMBER: 5-6



RECOVERY WELLS	PUMP STATUS	GPM
D15-P01B	OFF	NA
C LANDFILL:		
P21-R01B	ON	13
Q20-M02B	OFF	0

LEGEND

- ANOMALOUS DATA POINT
- B AQUIFER WELL
- RECOVERY WELL
- BENCH MARK
- B AQUIFER GROUNDWATER ELEVATION CONTOUR - 1 FT INTERVAL (NAVD88)
- GROUNDWATER FLOW DIVIDE
- GROUNDWATER FLOW DIRECTION
- SALEM CANAL SHEET PILE BARRIER
- SWMU 5 SHEET PILE BARRIER
- SWMU 5 SLURRY WALL
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE
- PROPERTY BOUNDARY

N
S
E
W

0 375 750 1,500
Feet
1 inch = 750 feet
MAP FORMATTED FOR "C" (17" x 22") SIZE SHEET.
SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:

DESIGNED BY: L.GROSS

DRAWN BY: MKL

DATA QUALITY CHECK BY: S.MORGAN/K.WEST

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GROUNDWATER ELEVATION CONTOUR MAP - B AQUIFER
MARCH 13, 2014

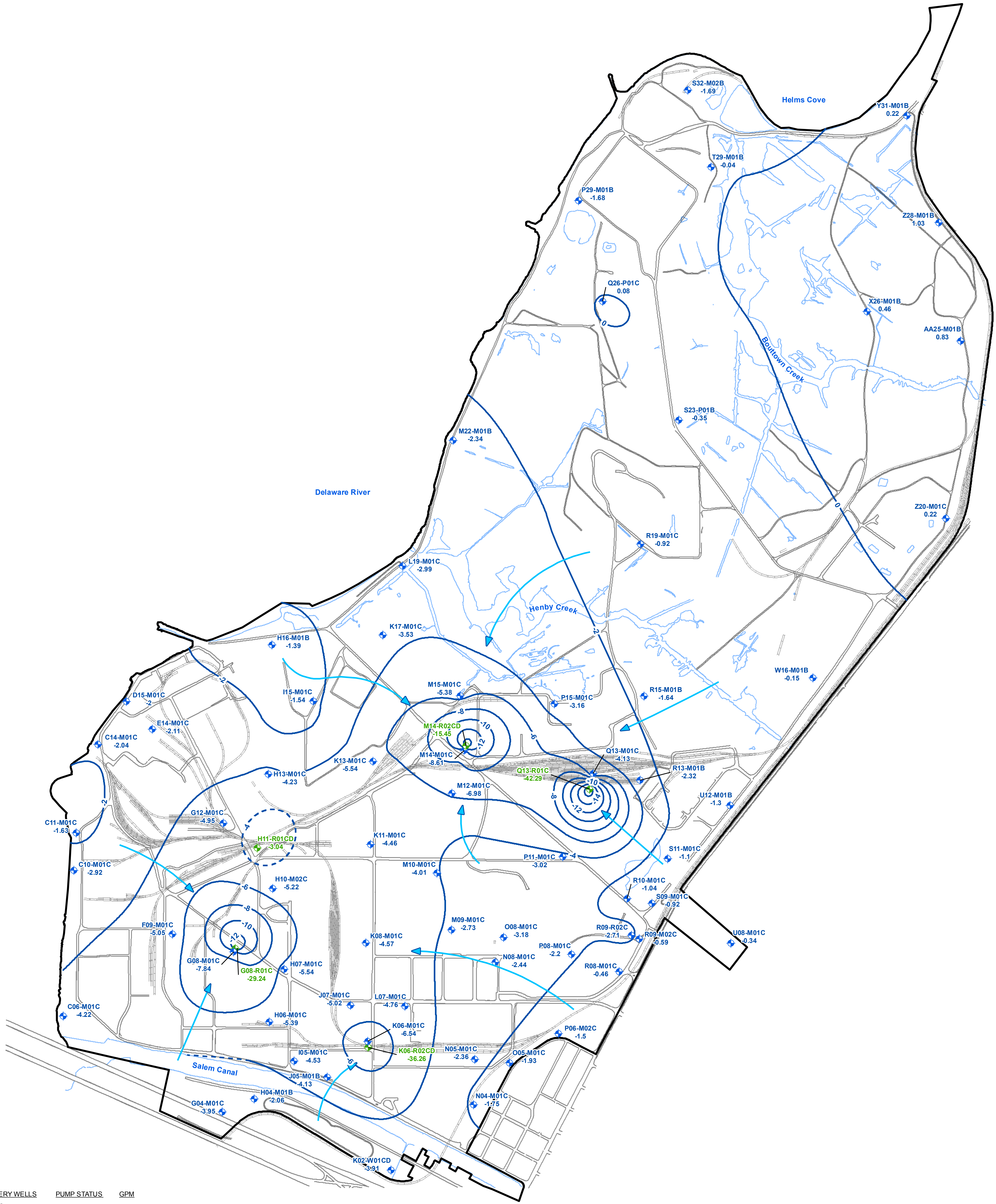
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18986540

DATE: 8/29/2014

FIGURE NUMBER: 5-7

V:\Projects\Dupont\Chambers_Works_GIS\Projects\18986581_Comprehensive_RFI_2014\Fig5-7_GW_Contour_Map_B_Aquifer.mxd



RECOVERY WELLS	PUMP STATUS	GPM
IWS:		
G08-R01C	ON	115
R09-R02C	OFF	0
Q13-R01C	ON	250
H11-R01CD	OFF	0
K06-R02CD	ON	315
M14-R02CD	ON	200
SUPPLY WELL:		
K02-W01CD	OFF	0

NOTE:

ACTUAL MEASURED WATER LEVEL ELEVATIONS FOR PUMPING WELLS SHOW WATER LEVELS USED IN CONTOURING CORRECTED TO ACCOUNT FOR WELL LOSSES AS FOLLOWS:

K06-R02CD -7.5' BASED ON SEMILOG CORRECTION FACTOR.
G08-R01C -14' BASED ON SEMILOG CORRECTION FACTOR.
Q13-R01C -17.8' BASED ON 1/3 MEASURED DTW.
M14-R02CD -15.46 USED ACTUAL FIELD MEASUREMENT.

LEGEND

- ANOMALOUS DATA POINT
- C AQUIFER WELL
- RECOVERY WELL
- C AQUIFER GROUNDWATER ELEVATION CONTOUR - 2 FT INTERVAL (NAVD88)
- GROUNDWATER FLOW DIRECTION
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE
- PROPERTY BOUNDARY

N
W E
S

0 375 750 1,500
Feet
1 inch = 750 feet
MAP FORMATTED FOR "C" (17" X 22") SIZE SHEET.
SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:

DESIGNED BY: L.GROSS

DRAWN BY: MKL

DATA QUALITY CHECK BY: S.MORGAN/K.WEST

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GROUNDWATER ELEVATION CONTOUR MAP - C AQUIFER MARCH 13, 2014

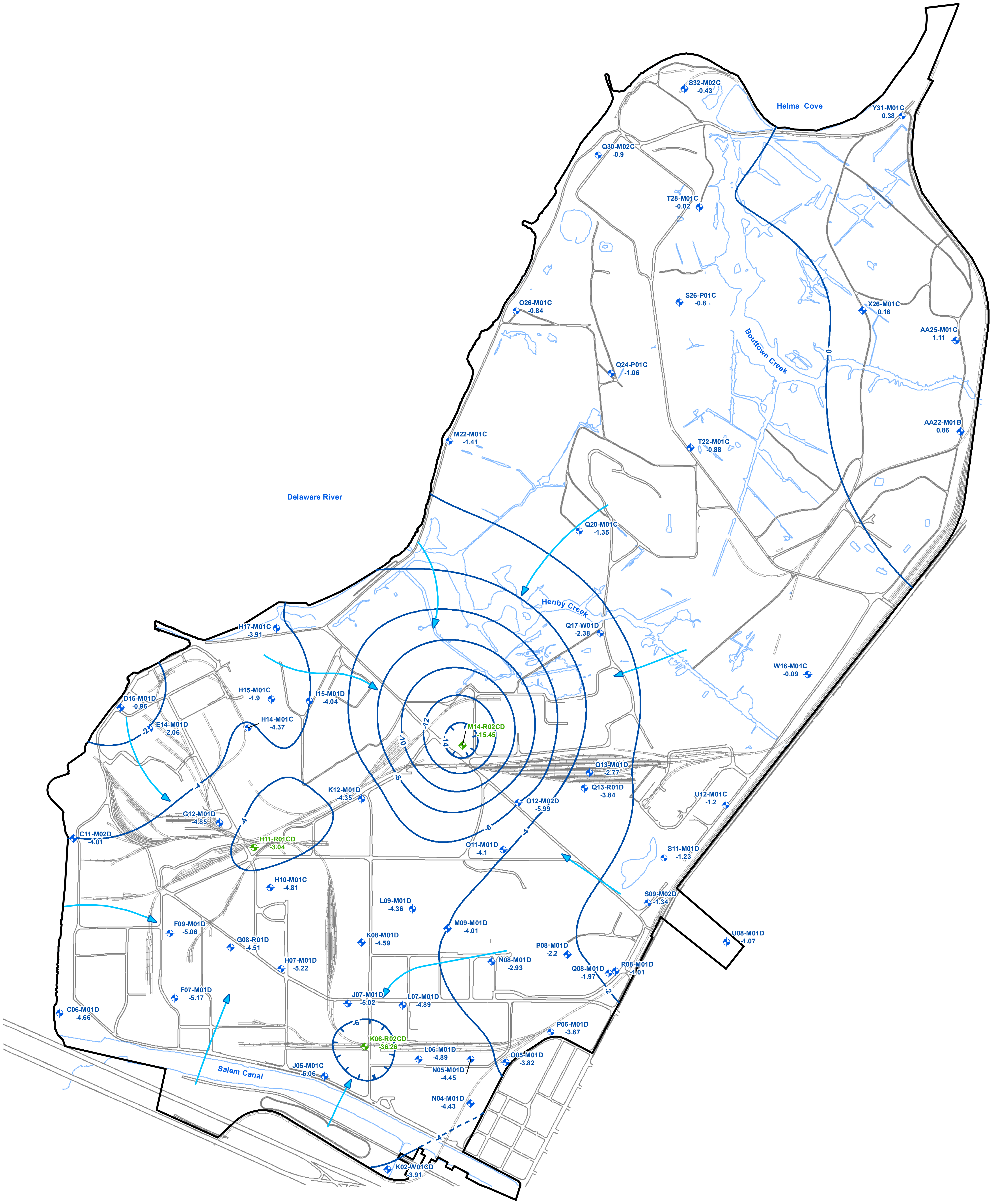
COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 8/29/2014

FIGURE NUMBER: 5-8

V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-8_GW_Contour_Map_C_Aquifer.mxd



RECOVERY WELLS	PUMP STATUS	GPM
IWS:		
G08-R01D	OFF	0
Q13-R01D	OFF	0
H11-R01CD	REMOVED	NA
K06-R02CD	ON	315
M14-R02CD	ON	200
SUPPLY WELL:		
K02-W01CD	OFF	0

NOTE:

ACTUAL MEASURED WATER LEVEL ELEVATIONS FOR PUMPING WELLS SHOW WATER LEVELS USED IN CONTOURING CORRECTED TO ACCOUNT FOR WELL LOSSES AS FOLLOWS:

K06-R02CD -7.5' BASED ON SEMILOG CORRECTION FACTOR.
M14-R02CD -15.46 USED ACTUAL FIELD MEASUREMENT.

LEGEND

- ⊕ ANOMALOUS DATA POINT
- ⊕ D AQUIFER WELL
- ⊕ RECOVERY WELL
- — D AQUIFER GROUNDWATER ELEVATION CONTOUR - 2 FT INTERVAL (NAVD88)
- — EDGE OF PAVEMENT
- ▶ GROUNDWATER FLOW DIRECTION
- ┼┼ RAILROAD
- — SHORELINE
- ☐ PROPERTY BOUNDARY

N
W E
S

0 375 750 1,500
Feet
1 inch = 750 feet
MAP FORMATTED FOR "C" (17" X 22") SIZE SHEET.
SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:	
DESIGNED BY:	L.GROSS
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	S.MORGAN/K.WEST

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GROUNDWATER ELEVATION CONTOUR MAP - D AQUIFER
MARCH 13, 2014

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881
DATE: 8/29/2014
FIGURE NUMBER: 5-9

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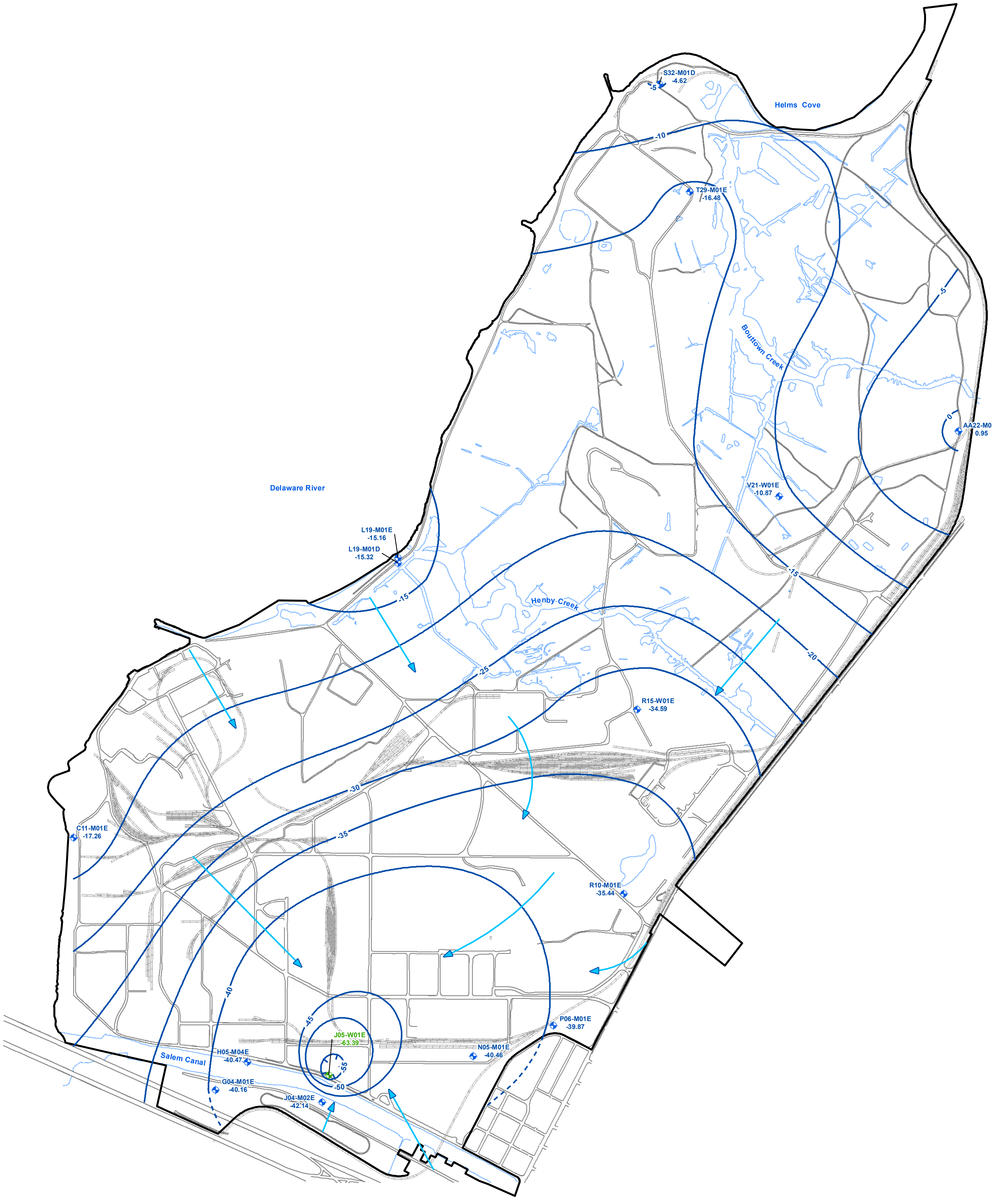

RECOVERY WELLS	PUMP STATUS	GPM
J05-W01E	ON	228
SUPPLY WELL:		
R15-W01E	OFF	0

LEGEND

- ⊕ E AQUIFER WELL
- ⊕ RECOVERY WELL
- — E AQUIFER GROUNDWATER ELEVATION CONTOUR - 5 FT INTERVAL (NAVD88)
- → GROUNDWATER FLOW DIRECTION
- — EDGE OF PAVEMENT
- ┼┼┼ RAILROAD
- — SHORELINE
- ▭ PROPERTY BOUNDARY

N W E S

0 375 750 1,500
Feet
1 inch = 750 feet

MAP FORMATTED FOR "C" (17" X 22") SIZE SHEET.
SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:

DESIGNED BY: L.GROSS

DRAWN BY: MKL

DATA QUALITY CHECK BY: S.MORGAN/K.WEST

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GROUNDWATER ELEVATION CONTOUR MAP - E AQUIFER MARCH 13, 2014

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18986540

DATE: 8/29/2014

FIGURE NUMBER: 5-10

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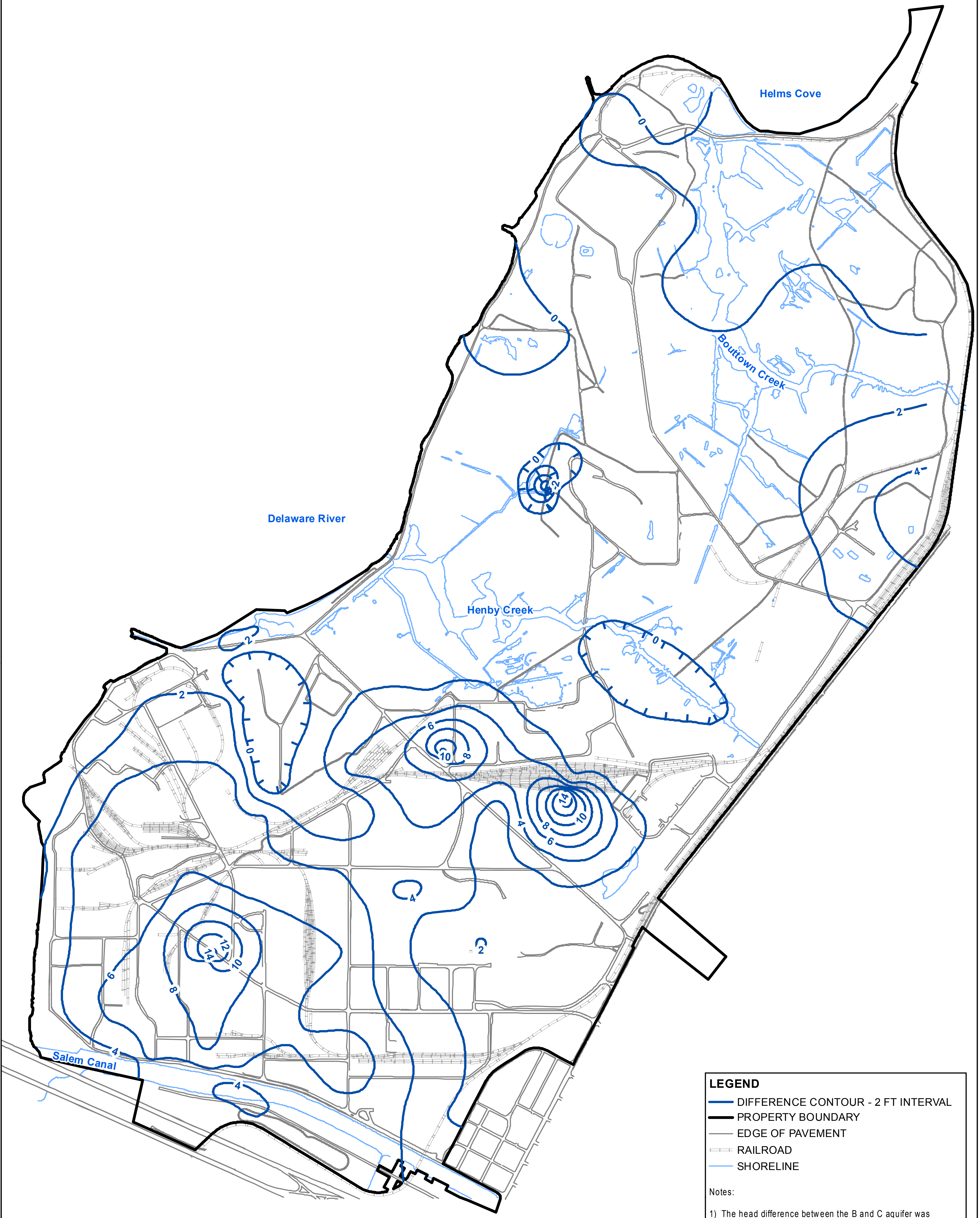


LEGEND

- DIFFERENCE CONTOUR - 2 FT INTERVAL
- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE

Notes:

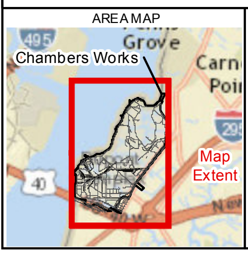
1) The head difference between the B and C aquifer was determined by grid subtraction in GIS where the C aquifer grid was subtracted from the B aquifer grid. The original contours were generated with data collected for the 1H14 DGW report.

2) A positive value indicates that hydraulic head in the B aquifer is greater than in the C aquifer and the vertical hydraulic gradient is downward.

Map Projection: NAD83 NJ State Plane feet

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-11_Hydraulic_Head_Difference.mxd

AREA MAP



N
W E
S

0 525 1,050 2,100

Feet

1 inch = 1,050 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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FILE NUMBER:	
DESIGNED BY:	S.MORGAN
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	L.GROSS

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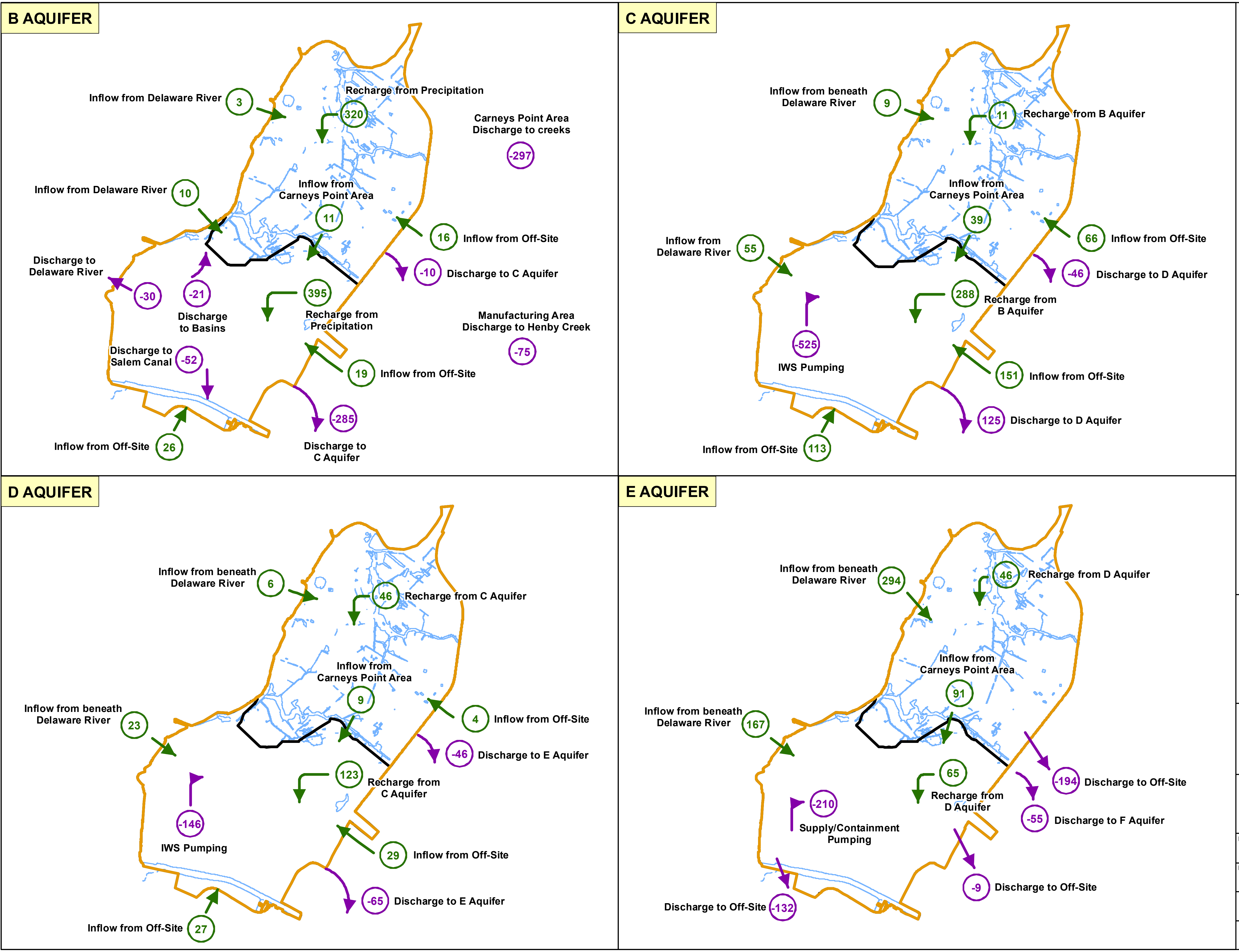
GROUNDWATER HYDRAULIC HEAD DIFFERENCE MAP - B TO C AQUIFER

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:	18985881
DATE:	7/17/2014
FIGURE NUMBER:	5-11



LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- — PROPERTY BOUNDARY
- — SHORELINE
- -75 DISCHARGE
- 151 INFLOW/RECHARGE

Notes:

Flow estimates provided are +/- 5 gpm in precision due to small estimation errors that result when flow is oblique to the orthometric model grid.

Map Projection: NAD83 NJ State Plane feet

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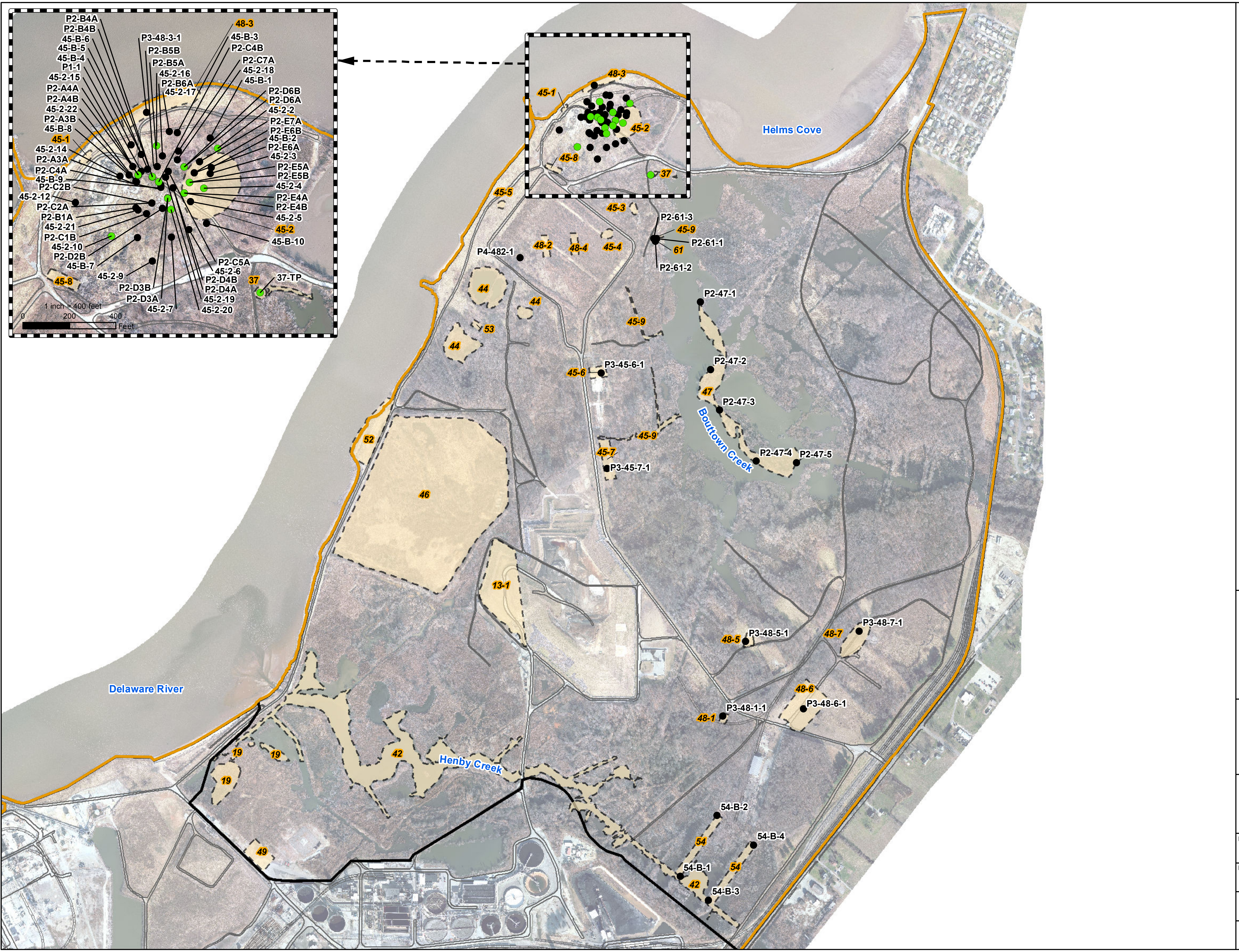
GROUNDWATER FLOW BUDGET ANALYSIS RESULTS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.MORGAN	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 5-12
DATA QUALITY CHECK BY: L.GROSS	

User: Matt_Layton, Date: 9/3/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig5-12_GW_Flow_Analysis.mxd



LEGEND

● EXCEEDANCE

● NO EXCEEDANCE

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.
2. No soil data is shown for the following:
   - -SWMUs 45-1, 45-5, 46, 49 (not available in electronic database)
   - -SWMUs 19, 45-3, 45-4, 45-8, 45-9, 48-2, 48-4, 52 (soil was stabilized or removed)
   - -SWMUs 44, 53 (determined not to be a SWMU - no soil data collected)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W
E
S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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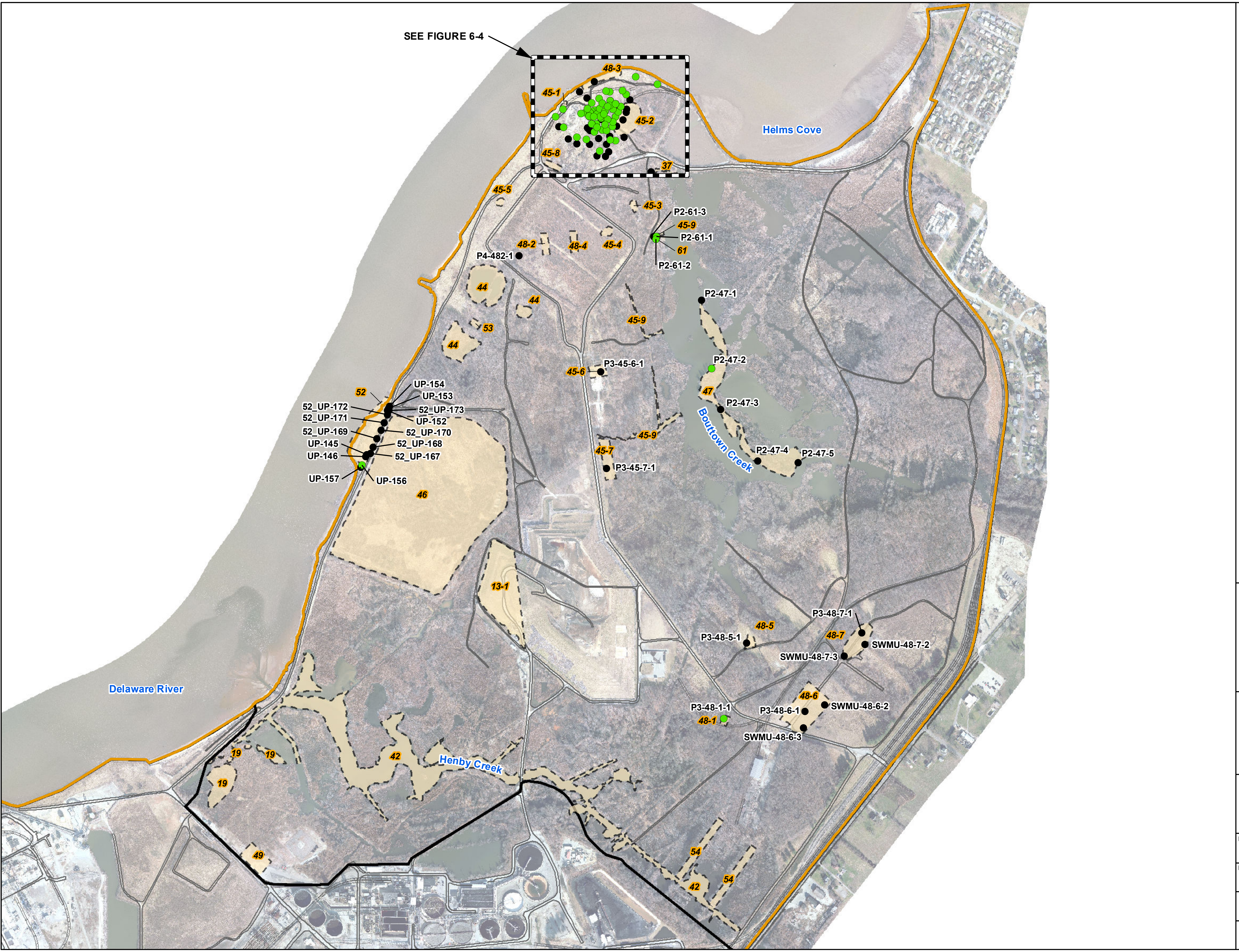
CARNEYS POINT
EXCEEDANCES
VADOSE ZONE SOIL
SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-1
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-1_CarneysPoint_SOIL_SVOC.mxd



LEGEND

- ● EXCEEDANCE
- ● NO EXCEEDANCE
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- — RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - -SWMUs 45-1, 45-5, 46, 49 (not available in electronic database)
   - -SWMUs 19, 45-3, 45-4, 45-8, 45-9, 48-2, 48-4, 52 (soil was stabilized or removed)
   - -SWMUs 44, 53 (determined not to be a SWMU - no soil data collected)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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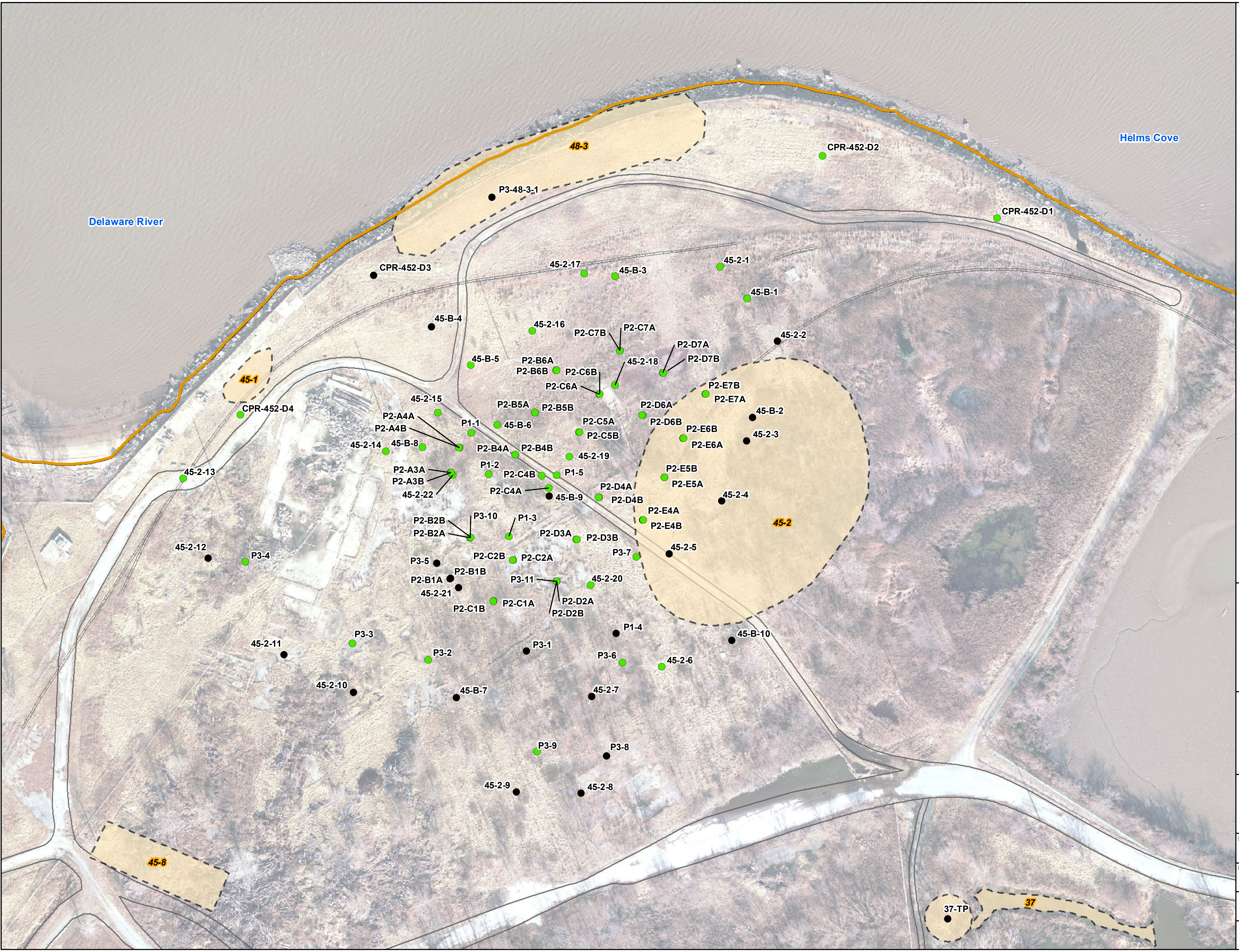
CARNEYS POINT EXCEEDANCES VADOSE ZONE SOIL METALS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-2
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-2_CarneysPoint_SOIL_Metals.mxd



LEGEND

- ● EXCEEDANCE
- ● NO EXCEEDANCE
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- ▬ PROPERTY BOUNDARY
- ─ EDGE OF PAVEMENT
- ┼ RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - SWMUs 45-1, 45-5, 46, 49 (not available in electronic database)
   - SWMUs 19, 45-3, 45-4, 45-8, 45-9, 48-2, 48-4, 52 (soil was stabilized or removed)
   - SWMUs 44, 53 (determined not to be a SWMU - no soil data collected)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 50 100 200
Feet
1 inch = 100 feet

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CARNEYS POINT EXCEEDANCES VADOSE ZONE SOIL SWMU 45 - METALS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-3
DATA QUALITY CHECK BY: K.ROBERTSON	

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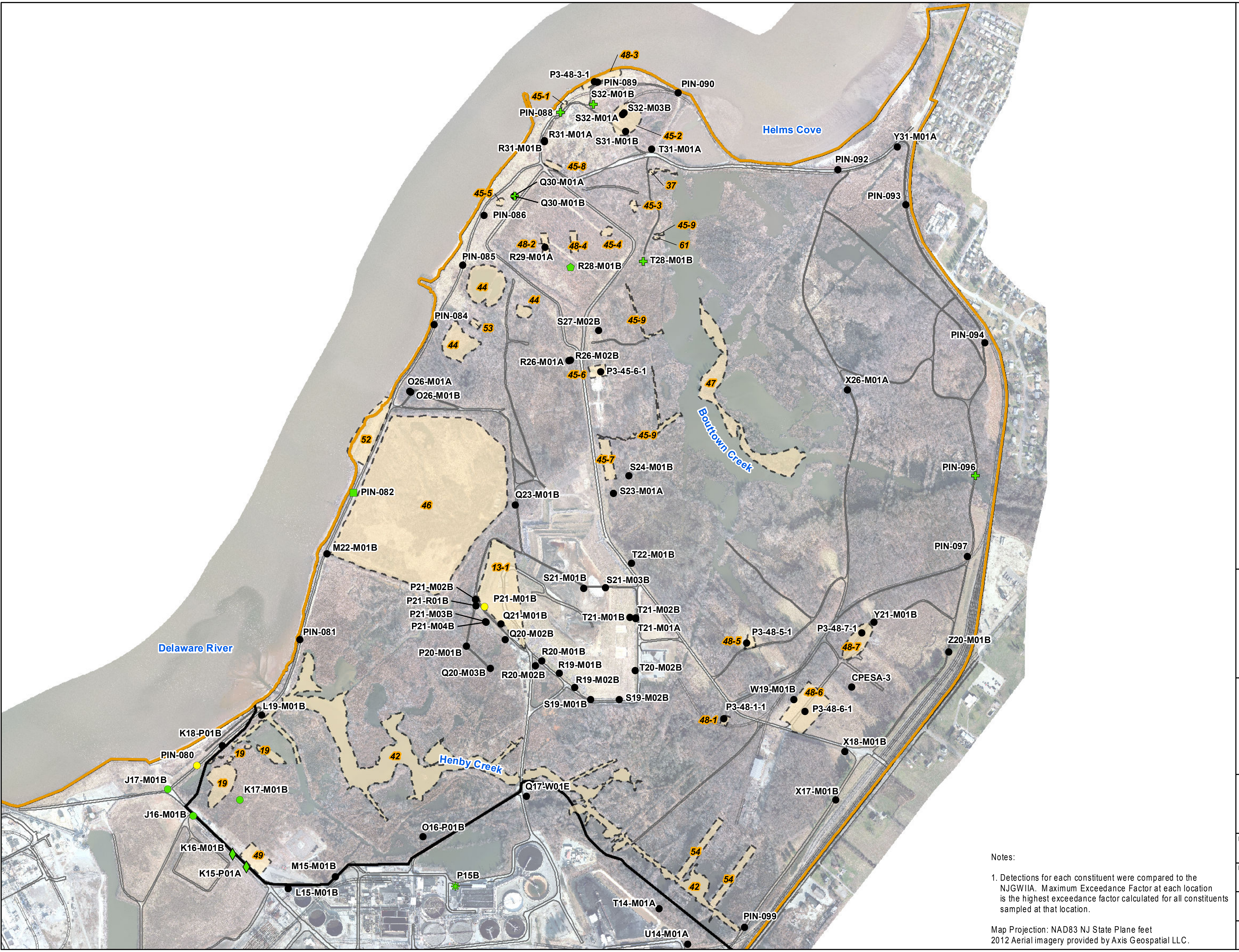

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LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
┼┼ RAILROAD
● NO EXCEEDANCE/DETECTION

COMPOUND

□ 1,2-DIBROMOETHANE (EDB)
○ BENZENE
✲ BROMODICHLOROMETHANE
◇ CHLOROBENZENE
✚ TETRACHLOROETHENE
⬠ TRICHLOROETHENE

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

N
W E
S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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CARNEYS POINT MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-4
DATA QUALITY CHECK BY: K.ROBERTSON	

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

□ 1,2-DICHLOROETHANE

○ BENZENE

✲ BROMODICHLOROMETHANE

⬠ METHYLENE CHLORIDE

✚ TETRACHLOROETHENE

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 400 800 1,600
Feet
1 inch = 800 feet

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

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CARNEYS POINT MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-5
DATA QUALITY CHECK BY: K.ROBERTSON	

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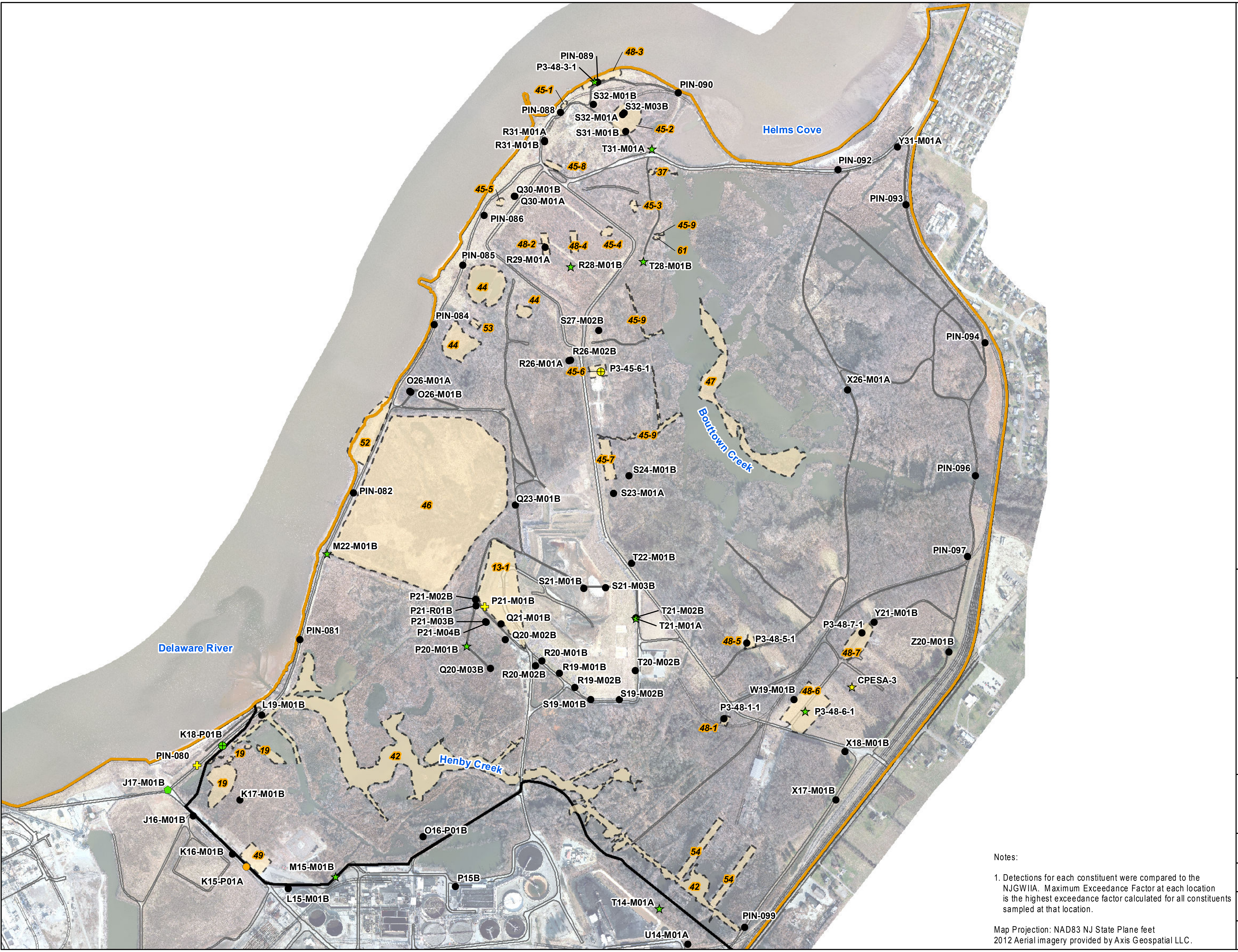

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ SWMU

━ PROPERTY BOUNDARY

─ EDGE OF PAVEMENT

┄ RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

○ 1-NAPHTHYLAMINE

⬠ 4-CHLOROANILINE

✚ ANILINE

⊕ BENZO(A)ANTHRACENE

☆ BIS(2-ETHYLHEXYL)PHTHALATE

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

N W E S

0 400 800 1,600

Feet

1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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CARNEYS POINT MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-6
DATA QUALITY CHECK BY: K.ROBERTSON	

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-6_CarneysPoint_GW_B_Aquifer_SVOC.mxd

LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼ RAILROAD
- ● NO EXCEEDANCE/DETECTION

COMPOUND

- △ 2-NITROTOLUENE
- ☆ BIS(2-ETHYLHEXY)PHTHALATE
- ✳ N-NITROSODIMETHYLAMINE

MAXIMUM EXCEEDANCE FACTOR

- 🟩 < 100
- 🟨 100 - 10,000
- 🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sample at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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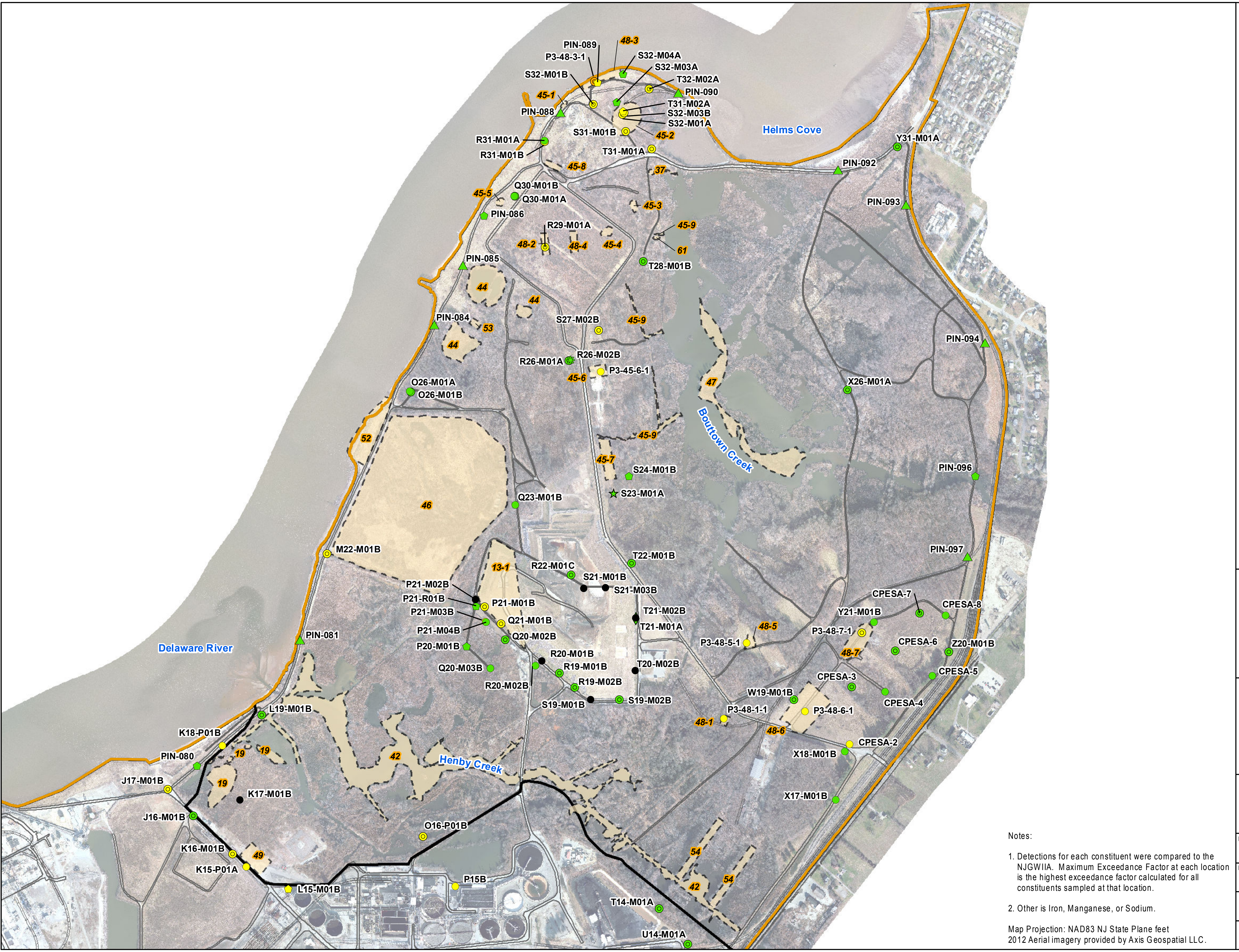
CARNEYS POINT MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-7
DATA QUALITY CHECK BY: K.ROBERTSON	



LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD
- ● NO EXCEEDANCE/DETECTION

COMPOUND

- ○ ALUMINUM
- ☆ ANTIMONY
- ⬠ ARSENIC
- ◇ CADMIUM
- ✲ CHROMIUM
- △ LEAD
- ◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

- 🟩 < 100
- 🟨 100 - 10,000
- 🟧 > 10,000

N W E S

0 400 800 1,600

Feet

1 inch = 800 feet

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

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CARNEYS POINT MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER METALS (TOTAL) AND INORGANICS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-8
DATA QUALITY CHECK BY: K.ROBERTSON	

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.
2. Other is Iron, Manganese, or Sodium.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-8_CarneysPoint_GW_B_Aquifer_Metals_Total.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

— RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

☐ IRON

△ MANGANESE

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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CARNEYS POINT MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER METALS (TOTAL) AND INORGANICS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-9
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-9_CarneysPoint_GW_C_Aquifer_Metals_Total.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

◎ ALDRIN

✚ HEPTACHLOR EPOXIDE

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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CARNEYS POINT MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER PESTICIDES AND PCBs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-10
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-10_CarneysPoint_GW_B_Aquifer_PEST_PCBs.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

✚ DIELDRIN

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 400 800 1,600
Feet
1 inch = 800 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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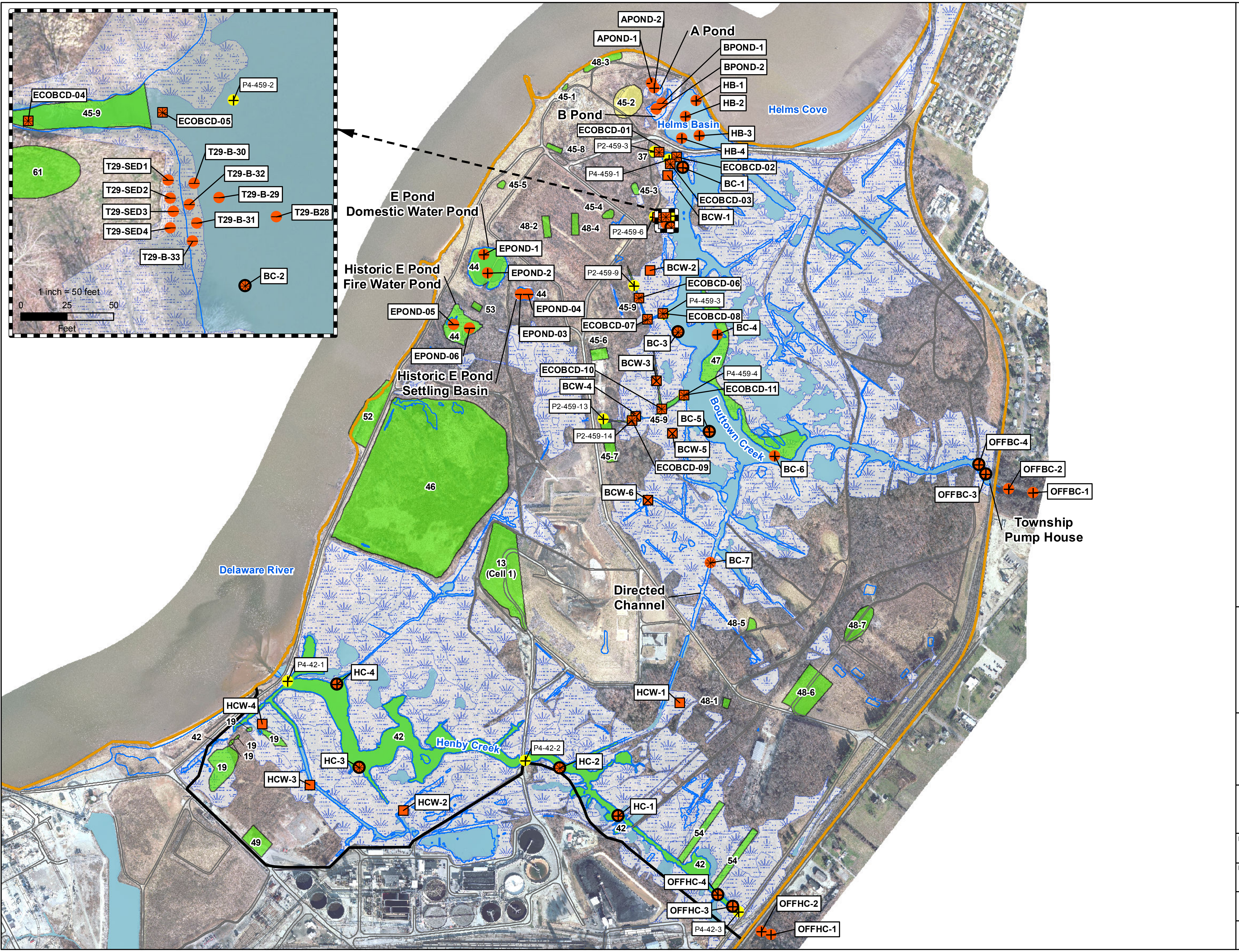
CARNEYS POINT MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER PESTICIDES AND PCBs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-11
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-11_CarneysPoint_GW_C_Aquifer_PEST_PCBs.mxd



LEGEND

- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- SHORELINE
- 🟦 WATER
- ▨ WETLAND AREA
- ☐ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

SWMU STATUS

- 🟩 NFA
- 🟨 CMS

ECOLOGICAL INVESTIGATION SAMPLE LOCATION

- ⊖ SEDIMENT
- ✛ SURFACE WATER AND SEDIMENT
- ⊕ SURFACE WATER, SEDIMENT, BENTHIC COMMUNITY
- ✱ SURFACE WATER, SEDIMENT, AND PUSHPOINT
- ⊛ SURFACE WATER, SEDIMENT, BENTHIC COMMUNITY, AND PUSHPOINT
- ■ WETLAND SEDIMENT/HYDRIC SOIL
- ☒ WETLAND SEDIMENT/HYDRIC SOIL AND PUSHPOINT
- ▩ OCTOBER 2009 SEDIMENT AND INTERSTITIAL WATER SAMPLING LOCATION
- ✛ HISTORIC SEDIMENT AND/OR SURFACE WATER

Notes:
Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 400 800 1,600
Feet

1 inch = 800 feet

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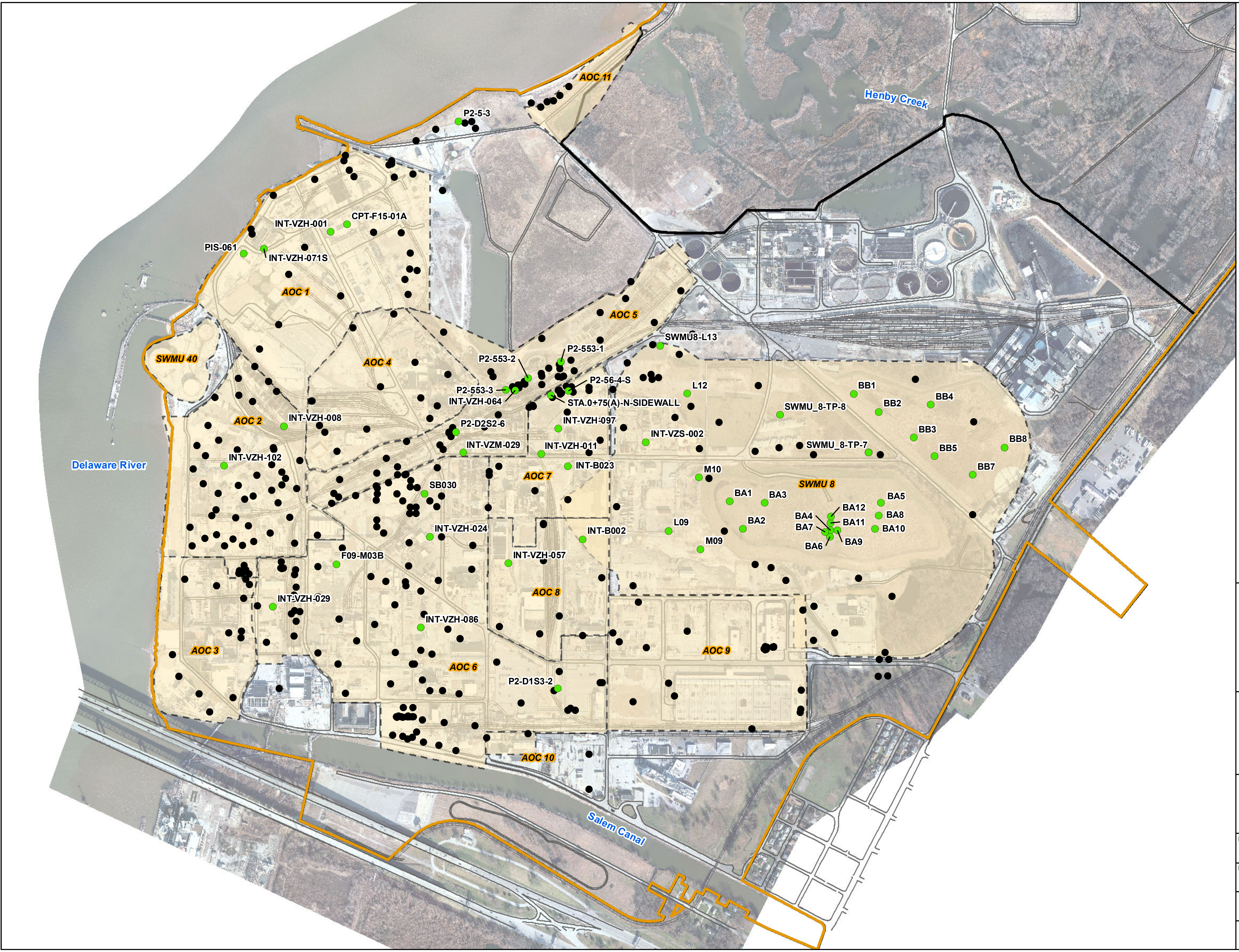
CARNEYS POINT - SURFACE WATER, SEDIMENT, AND WETLAND HYDRIC SOIL SAMPLING LOCATIONS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 6-12
DATA QUALITY CHECK BY: G.LONG	

User: Matt_Layton, Date: 8/27/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig6-12_CarneysPoint_SW_SED_Hydric_Samples.mxd



LEGEND

- ● EXCEEDANCE
- ● NO EXCEEDANCE
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - -SWMUs 12, 14, 15, 16, 32A, 39, 39-1, 50 (soil was stabilized or removed)
   - -SWMU 35, 36, 38 (determined not to be a SWMU – no soil data collected)
   - -SWMUs 18, 23, 24, 27, and 29 (RCRA Part B Operating Unit)
   - -SWMU 32B (soil data not available in electronic database)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA EXCEEDANCES VADOSE ZONE SOIL VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-1
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-1_ManufacturingArea_SOIL_Vadose_Zone_VOC.mxd

LEGEND

● EXCEEDANCE

● NO EXCEEDANCE

CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - -SWMUs 12, 14, 15, 16, 32A, 39, 39-1, 50 (soil was stabilized or removed)
   - -SWMU 35, 36, 38 (determined not to be a SWMU – no soil data collected)
   - -SWMUs 18, 23, 24, 27, and 29 (RCRA Part B Operating Unit)
   - -SWMU 32B (soil data not available in electronic database)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N E S W

0 350 700 1,400
Feet
1 inch = 700 feet

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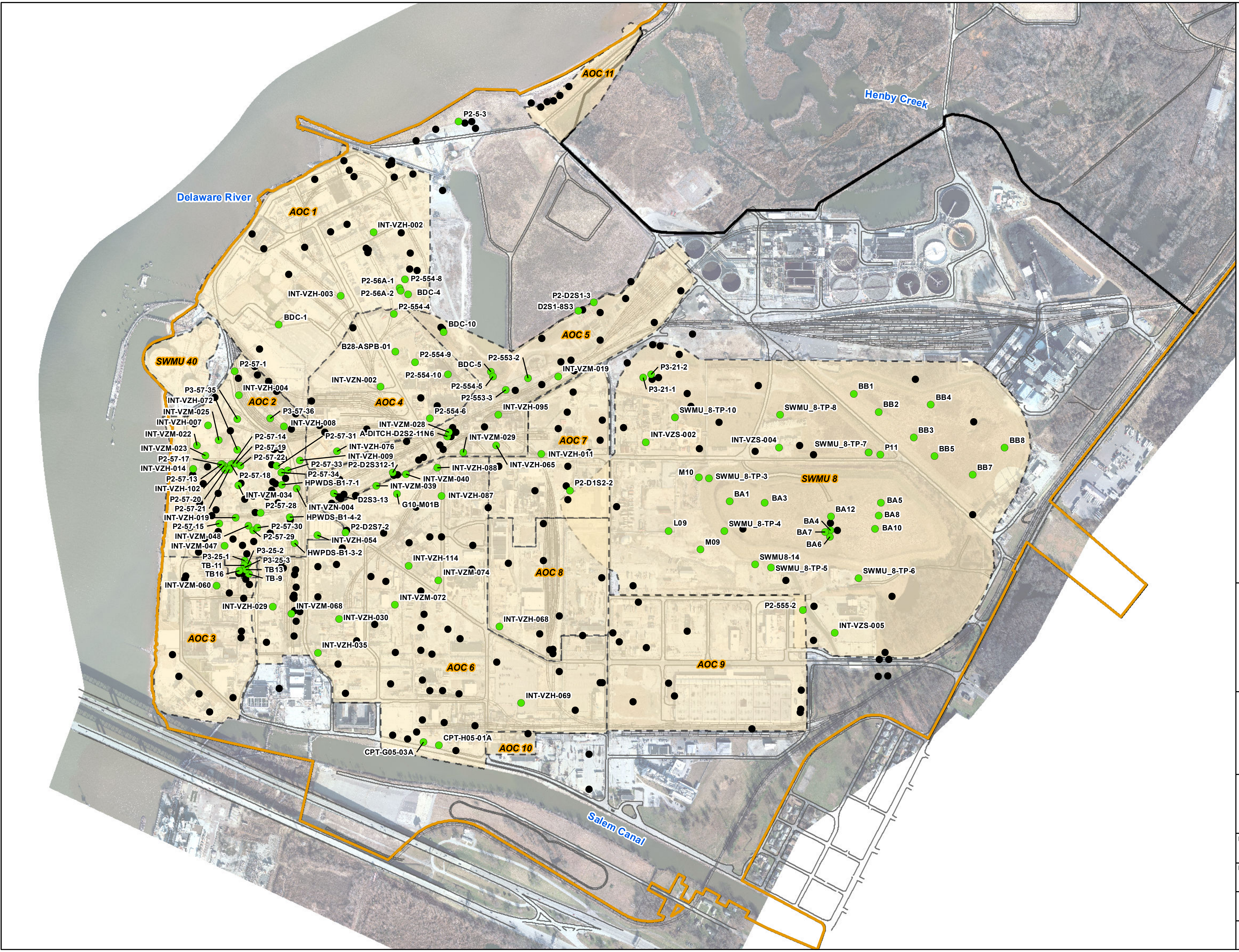
MANUFACTURING AREA EXCEEDANCES VADOSE ZONE SOIL SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-2
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-2_ManufacturingArea_SOIL_Vadose_Zone_SVOC.mxd



LEGEND

● EXCEEDANCE

● NO EXCEEDANCE

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - -SWMUs 12, 14, 15, 16, 32A, 39, 39-1, 50 (soil was stabilized or removed)
   - -SWMU 35, 36, 38 (determined not to be a SWMU – no soil data collected)
   - -SWMUs 18, 23, 24, 27, and 29 (RCRA Part B Operating Unit)
   - -SWMU 32B (soil data not available in electronic database)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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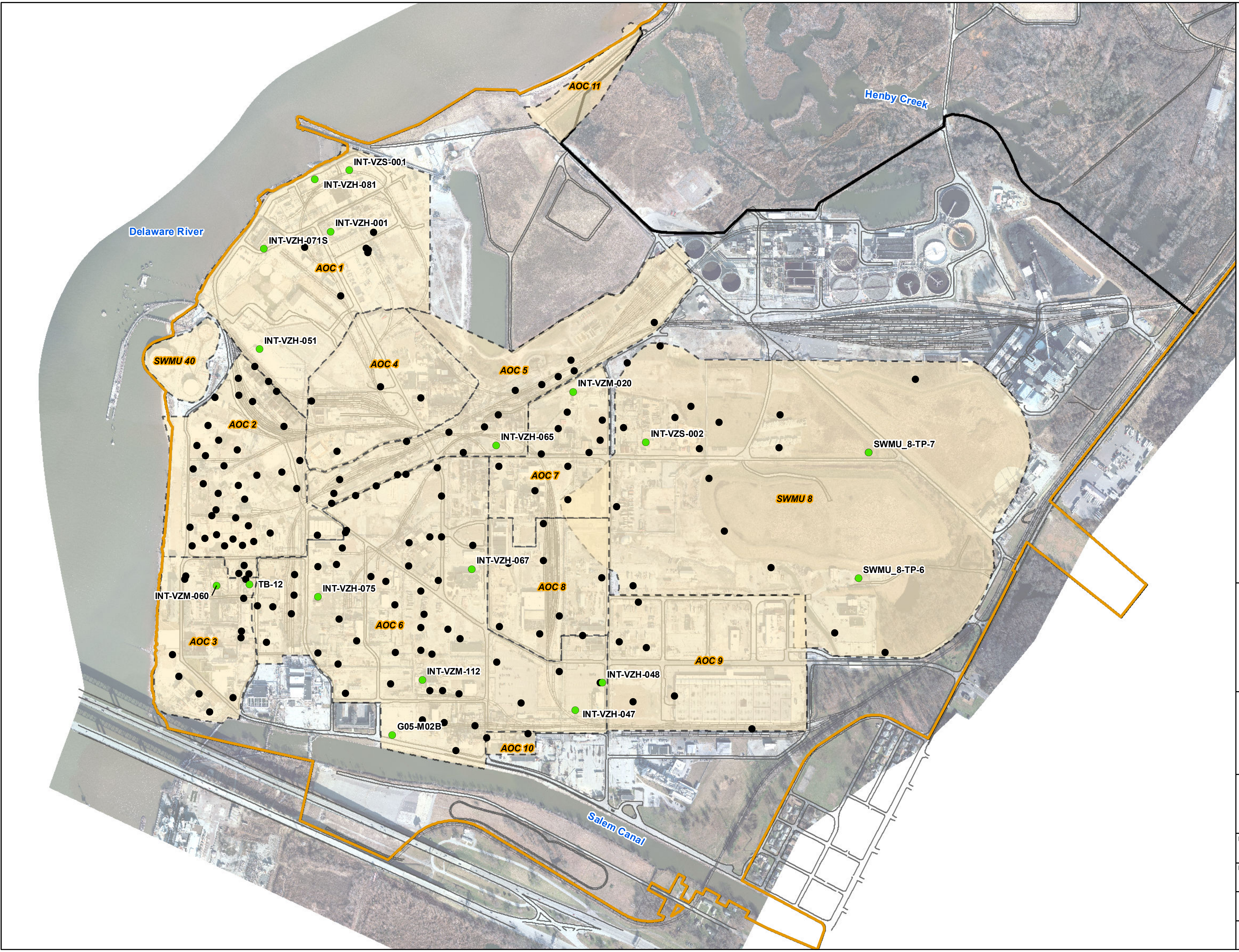
MANUFACTURING AREA EXCEEDANCES VADOSE ZONE SOIL METALS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-3
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-3_ManufacturingArea_SOIL_Vadose_Zone_Metals.mxd



LEGEND

- ● EXCEEDANCE
- ● NO EXCEEDANCE
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┈ RAILROAD

Notes:

1. Detections for each constituent were compared to NJNRDCSRS. One or more constituents may exceed NJNRDCSRS at each green sample location.

2. No soil data is shown for the following:
   - -SWMUs 12, 14, 15, 16, 32A, 39, 39-1, 50 (soil was stabilized or removed)
   - -SWMU 35, 36, 38 (determined not to be a SWMU – no soil data collected)
   - -SWMUs 18, 23, 24, 27, and 29 (RCRA Part B Operating Unit)
   - -SWMU 32B (soil data not available in electronic database)

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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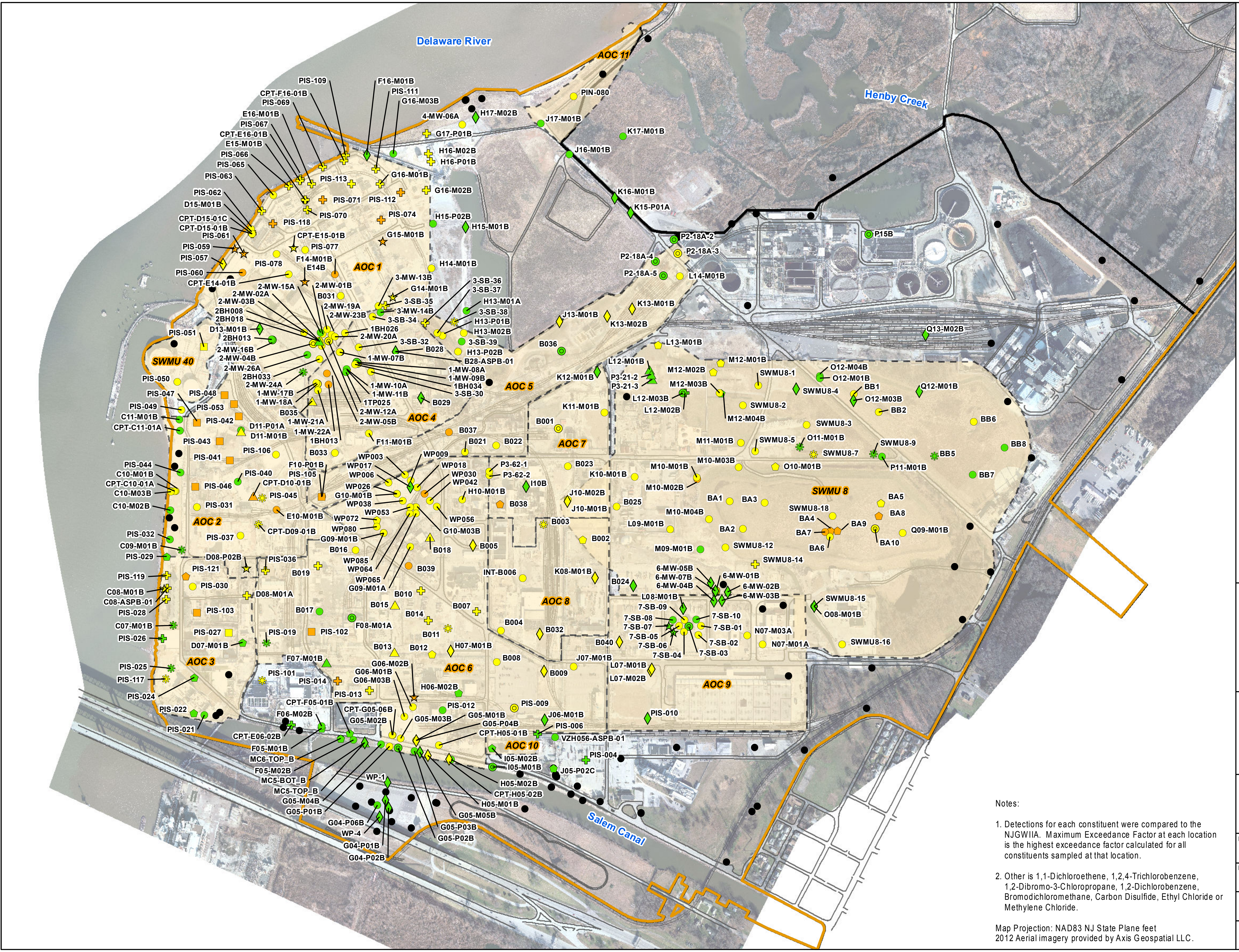
MANUFACTURING AREA EXCEEDANCES VADOSE ZONE SOIL PESTICIDES AND TOTAL PCBs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-4
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-4_ManufacturingArea_SOIL_Vadose_Zone_Pesticides_Total_PCBs.mxd



Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 1,1-Dichloroethene, 1,2,4-Trichlorobenzene, 1,2-Dibromo-3-Chloropropane, 1,2-Dichloroethane, Bromodichloromethane, Carbon Disulfide, Ethyl Chloride or Methylene Chloride.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼ RAILROAD
- ● NO EXCEEDANCE/DETECTION

COMPOUND

- □ 1,2-DIBROMOETHANE (EDB)
- △ 1,2-DICHLOROETHANE
- ○ BENZENE
- ☆ CARBON TETRACHLORIDE
- ◇ CHLOROBENZENE
- ✚ TETRACHLOROETHENE
- ⬠ TRICHLOROETHENE
- ✳ VINYL CHLORIDE
- ◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

- 🟩 < 100
- 🟨 100 - 10,000
- 🟧 > 10,000

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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MANUFACTURING AREA MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-5
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-5_GW_B_Aquifer_VOC.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

○ BENZENE

◇ CHLOROBENZENE

✚ TETRACHLOROETHENE

⬠ TRICHLOROETHENE

◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 1,4-Dichlorobenzene or Bromodichloromethane.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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

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MANUFACTURING AREA MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-6
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-6_GW_C_Aquifer_VOC.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ AOC/SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
— RAILROAD
● NO EXCEEDANCE/DETECTION

COMPOUND

△ 1,2-DICHLOROETHANE
○ BENZENE
✚ TETRACHLOROETHENE
✳ VINYL CHLORIDE
◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Bromodichloromethane.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
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0 350 700 1,400
Feet
1 inch = 700 feet

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

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MANUFACTURING AREA MAXIMUM EXCEEDANCES D AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-7
DATA QUALITY CHECK BY: K.ROBERTSON	

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LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

○ BENZENE

◊ CHLOROBENZENE

◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Bromodichloromethane.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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

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MANUFACTURING AREA MAXIMUM EXCEEDANCES E AQUIFER GROUNDWATER VOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-8
DATA QUALITY CHECK BY: K.ROBERTSON	

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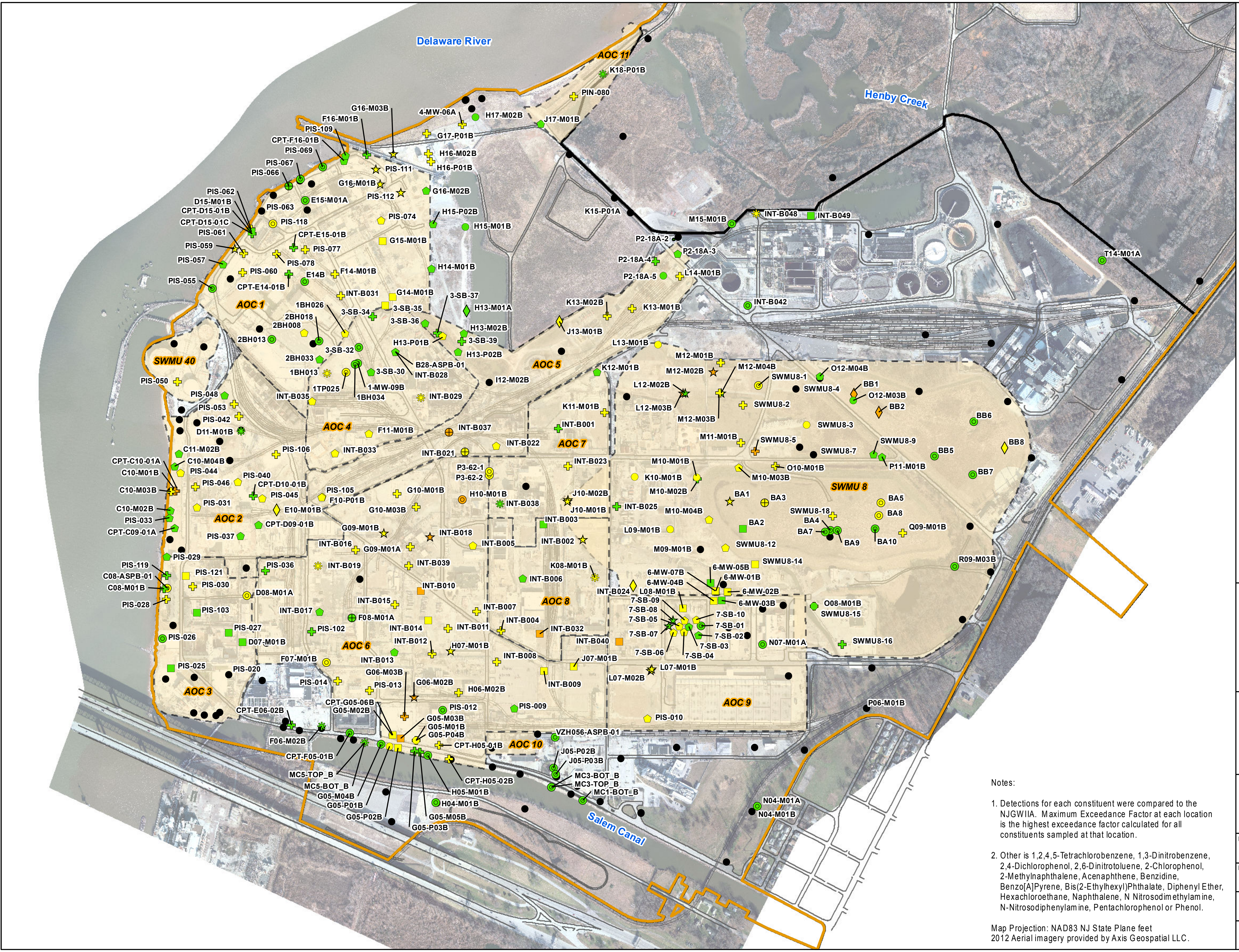

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

□ 1,2,4-TRICHLOROBENZENE

○ 2-NAPHTHYLAMINE

⊕ 2,4-DINITROTOLUENE

⬠ 4-CHLOROANILINE

✚ ANILINE

✺ BENZO(A)ANTHRACENE

◇ HEXACHLOROBENZENE

☆ NITROBENZENE

◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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MANUFACTURING AREA MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-9
DATA QUALITY CHECK BY: K.ROBERTSON	

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 1,2,4,5-Tetrachlorobenzene, 1,3-Dinitrobenzene, 2,4-Dichlorophenol, 2,6-Dinitrotoluene, 2-Chlorophenol, 2-Methylnaphthalene, Acenaphthene, Benzidine, Benzo[A]Pyrene, Bis(2-Ethylhexyl)Phthalate, Diphenyl Ether, Hexachloroethane, Naphthalene, N Nitrosodimethylamine, N-Nitrosodiphenylamine, Pentachlorophenol or Phenol.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-9_GW_B_Aquifer_SVOC.mxd

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 1,2-Diphenylhydrazine, 2,4-Dichlorophenol, 2-Chloronapthene, 4-Nitroaniline, Acenapthene, or Bis(2-EthylHexyl)Phthalate.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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MANUFACTURING AREA MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-10
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-10_GW_C_Aquifer_SVOC.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

□ 1,2,4-TRICHLOROBENZENE

⬠ 4-CHLOROANILINE

✚ ANILINE

◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 2,6-Dinitrotoluene, Diphenyl Ether, or Naphthalene.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
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0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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MANUFACTURING AREA MAXIMUM EXCEEDANCES D AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-11
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-11_GW_D_Aquifer_SVOC.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ AOC/SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
— RAILROAD
● NO EXCEEDANCE/DETECTION

COMPOUND

⬠ 4-CHLOROANILINE
✚ ANILINE
◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.
2. Other is Bis(2-ChloroEthyl)Ether or Bis(2-EthylHexyl)Phthalate.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
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0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES E AQUIFER GROUNDWATER SVOCs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-12
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-12_GW_E_Aquifer_SVOC.mxd

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Iron, Manganese or Sodium.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD
- ● NO EXCEEDANCE/DETECTION

COMPOUND

- ☐ ALUMINUM
- ○ ANTIMONY
- ⬠ ARSENIC
- ✚ BERYLLIUM
- ✲ CHROMIUM
- △ LEAD
- ☆ MERCURY
- ◎ OTHER
- ⊕ THALLIUM

MAXIMUM EXCEEDANCE FACTOR

- 🟩 < 100
- 🟨 100 - 10,000
- 🟧 > 10,000

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER METALS (TOTAL)

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-13
DATA QUALITY CHECK BY: K.ROBERTSON	

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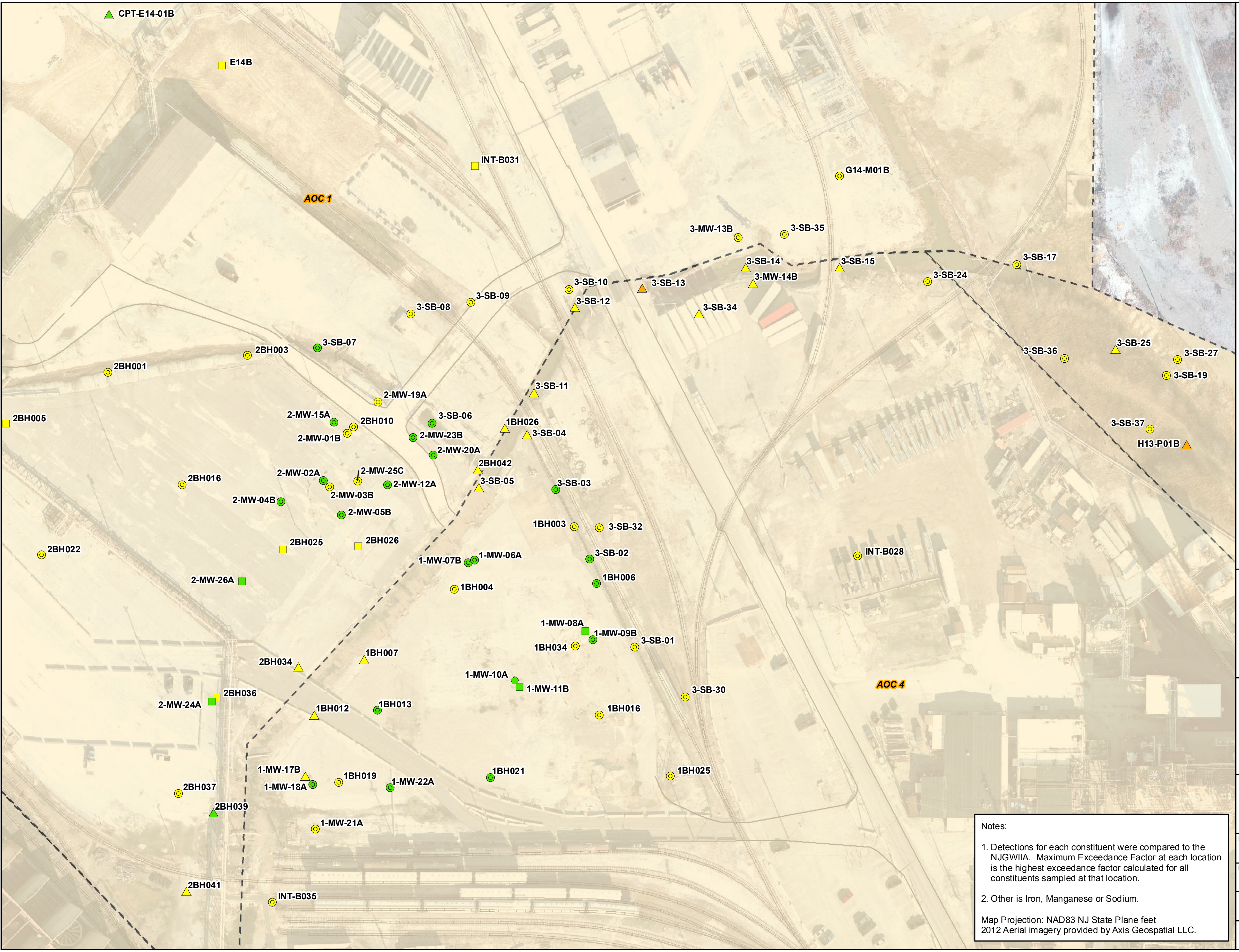

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Iron, Manganese or Sodium.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ AOC/SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
┼ RAILROAD
● NO EXCEEDANCE/DETECTION

COMPOUND

□ ALUMINUM
○ ANTIMONY
⬠ ARSENIC
✚ BERYLLIUM
✳ CHROMIUM
△ LEAD
☆ MERCURY
◎ OTHER
⊕ THALLIUM

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

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MANUFACTURING AREA MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER AOC 1/4 AREA METALS (TOTAL)

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-14
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-14_GW_B_Aquifer_Metals_AOC_1_And_4.mxd

LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD

COMPOUND

- ○ ANTIMONY
- ⬠ ARSENIC
- ◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

- 🟩 < 100
- 🟨 100 - 10,000
- 🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Iron, Manganese or Sodium.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER METALS (TOTAL)

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-15
DATA QUALITY CHECK BY: K.ROBERTSON	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-15_GW_C_Aquifer_Metals.mxd

LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ AOC/SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
— RAILROAD

COMPOUND

△ LEAD
◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Iron or Manganese.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES D AQUIFER GROUNDWATER METALS (TOTAL)

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-16
DATA QUALITY CHECK BY: K.ROBERTSON	

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LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
▨ AOC/SWMU
— PROPERTY BOUNDARY
— EDGE OF PAVEMENT
— RAILROAD
● NO EXCEEDANCE/DETECTION

COMPOUND

□ ALUMINUM
⬠ ARSENIC
◎ OTHER

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100
🟨 100 - 10,000
🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is Iron.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES E AQUIFER GROUNDWATER METALS (TOTAL)

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-17
DATA QUALITY CHECK BY: K.ROBERTSON	

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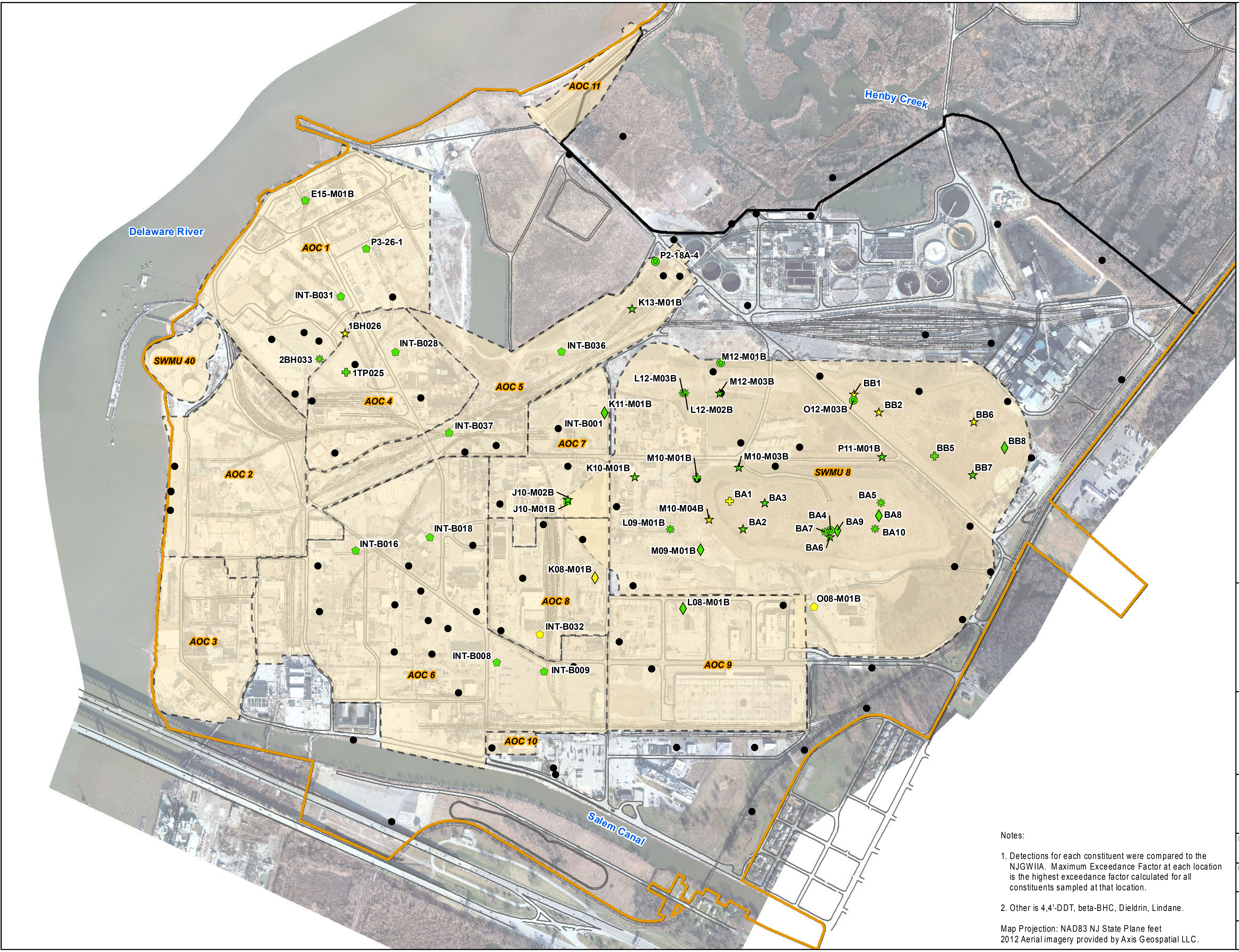

LEGEND

CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

✚ 4,4'-DDD

✺ 4,4'-DDE

◎ ALDRIN

☆ ALPHA-BHC

□ HEPTACHLOR

◊ OTHER

⬠ TOTAL PCBs

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

N

W E

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0 350 700 1,400

Feet

1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES B AQUIFER GROUNDWATER PESTICIDES AND TOTAL PCBs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-18
DATA QUALITY CHECK BY: K.ROBERTSON	

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

2. Other is 4,4'-DDT, beta-BHC, Dieldrin, Lindane.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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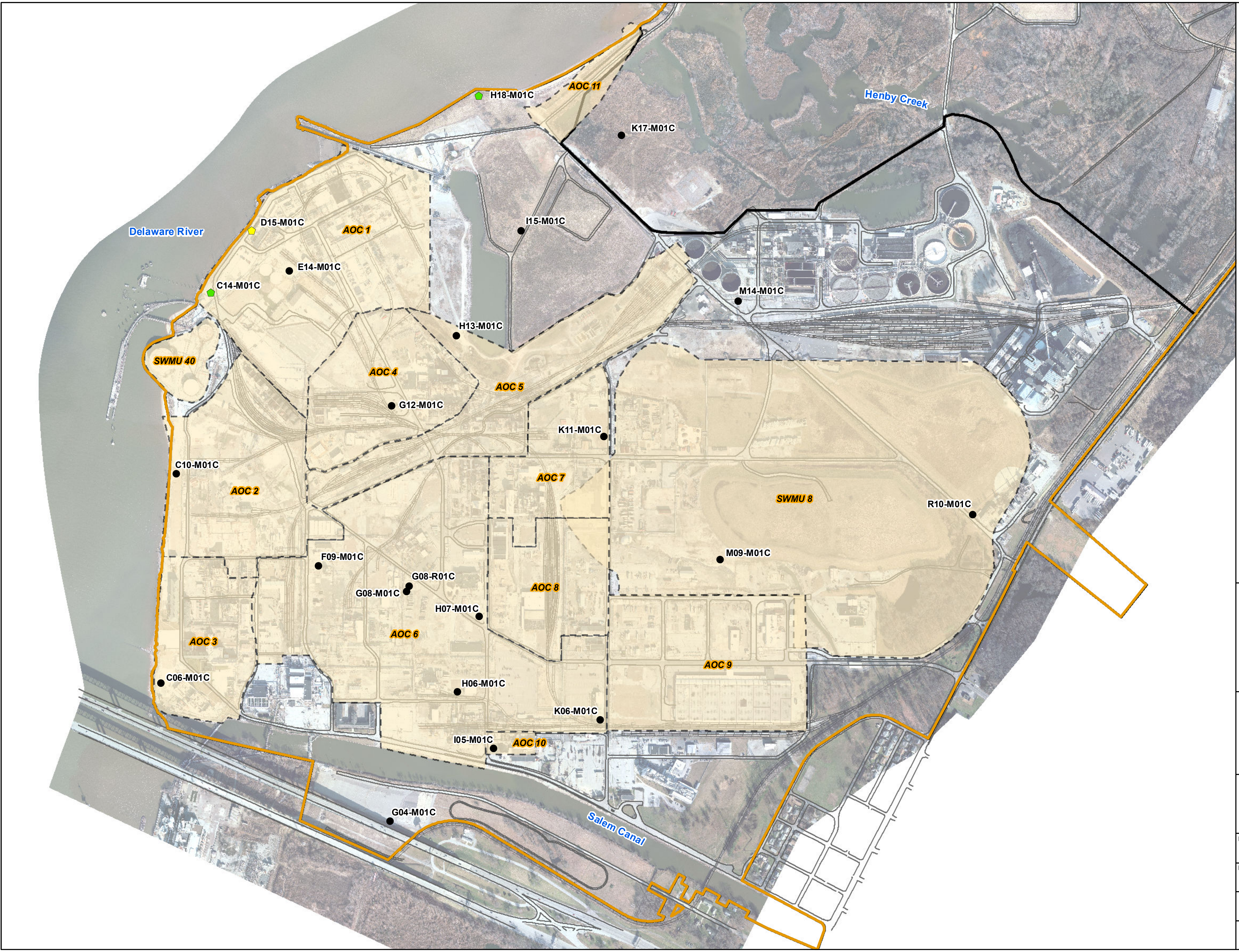

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LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION

COMPOUND

⬠ TOTAL PCBs

MAXIMUM EXCEEDANCE FACTOR

🟩 < 100

🟨 100 - 10,000

🟧 > 10,000

Notes:

1. Detections for each constituent were compared to the NJGWIIA. Maximum Exceedance Factor at each location is the highest exceedance factor calculated for all constituents sampled at that location.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA MAXIMUM EXCEEDANCES C AQUIFER GROUNDWATER PESTICIDES AND TOTAL PCBs

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:

PROJECT NUMBER: 18985881

DESIGNED BY: L.GROSS

DATE: 8/29/2014

DRAWN BY: MKL

FIGURE NUMBER: 7-19

DATA QUALITY CHECK BY: K.ROBERTSON

LEGEND

━ PROPERTY BOUNDARY
— EDGE OF PAVEMENT
┼ RAILROAD
— SHORELINE
🟦 WATER
▨ WETLAND AREA
▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

SWMU STATUS

🟩 NFA
🟦 2013 DATA GAP INVESTIGATION
🟨 CMS
🟪 RCRA OPERATING UNIT OR USACE LEAD

ECOLOGICAL INVESTIGATION SAMPLE LOCATION

⊖ SEDIMENT
⊕ SURFACE WATER AND SEDIMENT
⊕ SURFACE WATER, SEDIMENT, BENTHIC COMMUNITY
✳ SURFACE WATER, SEDIMENT, AND PUSHPOINT
⊛ SURFACE WATER, SEDIMENT, BENTHIC COMMUNITY, AND PUSHPOINT
■ WETLAND SEDIMENT/HYDRIC SOIL
☒ WETLAND SEDIMENT/HYDRIC SOIL AND PUSHPOINT
+ HISTORIC SEDIMENT AND/OR SURFACE WATER

Notes:
Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
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0 400 800 1,600
Feet
1 inch = 800 feet

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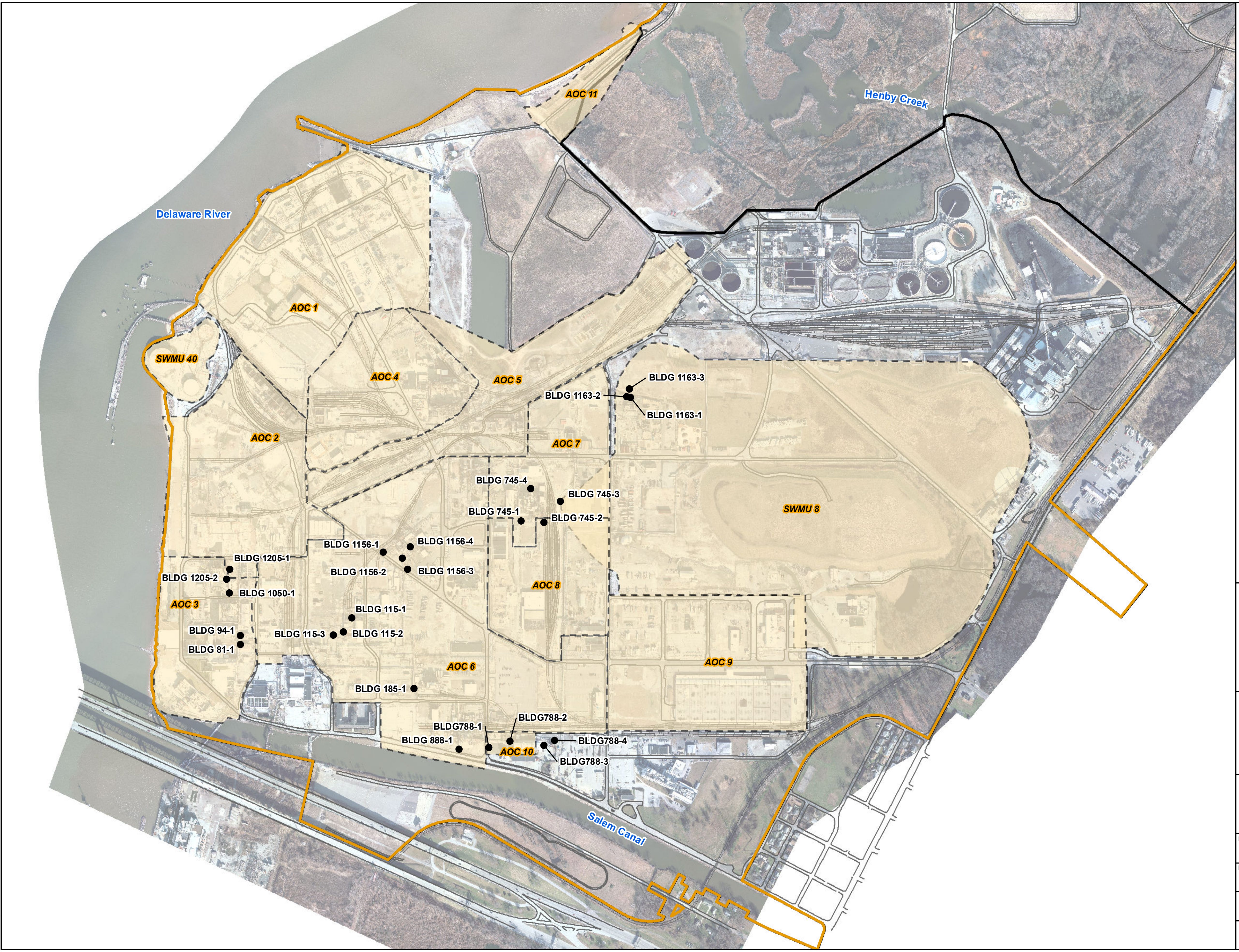
MANUFACTURING AREA - SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 7/15/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-20
DATA QUALITY CHECK BY: G.LONG	

User: Matt_Layton, Date: 7/15/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-20_Manufacturing_Area_SW_SED_Locations.mxd



LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- ― PROPERTY BOUNDARY
- ― EDGE OF PAVEMENT
- ┄ RAILROAD
- ● NO EXCEEDANCE/DETECTION

Notes:

Detections for PFOA was compared to EPA Region 4 (2009) residential soil screening value of 16,000 ug/kg.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

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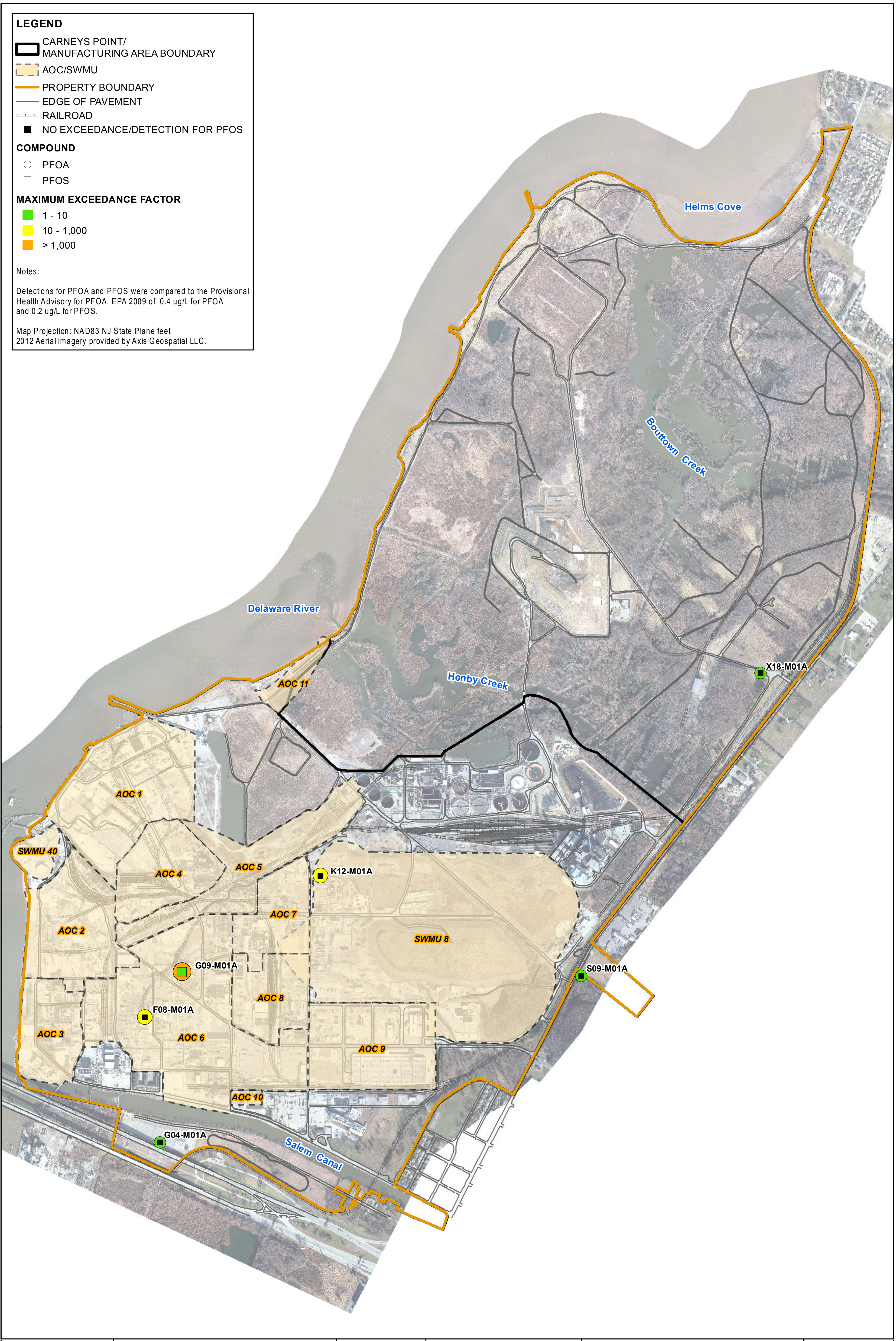
SITE-WIDE MAXIMUM EXCEEDANCES VADOSE ZONE SOIL PFOA

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-21
DATA QUALITY CHECK BY: K.DAVIS	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-21_PFOA_Soil.mxd



LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

▨ AOC/SWMU

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

RAILROAD

■ NO EXCEEDANCE/DETECTION FOR PFOS

COMPOUND

○ PFOA

□ PFOS

MAXIMUM EXCEEDANCE FACTOR

🟩 1 - 10

🟨 10 - 1,000

🟧 > 1,000

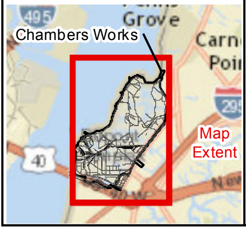
Notes:

Detections for PFOA and PFOS were compared to the Provisional Health Advisory for PFOA, EPA 2009 of 0.4 ug/L for PFOA and 0.2 ug/L for PFOS.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-22_PFOA_PFOS_A_Zone_GW.mxd

AREA MAP



N
W E
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0 525 1,050 2,100
Feet
1 inch = 1,050 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:

DESIGNED BY:
L.GROSS

DRAWN BY:
MKL

DATA QUALITY CHECK BY:
K.DAVIS

URS

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Newark, DE 19713

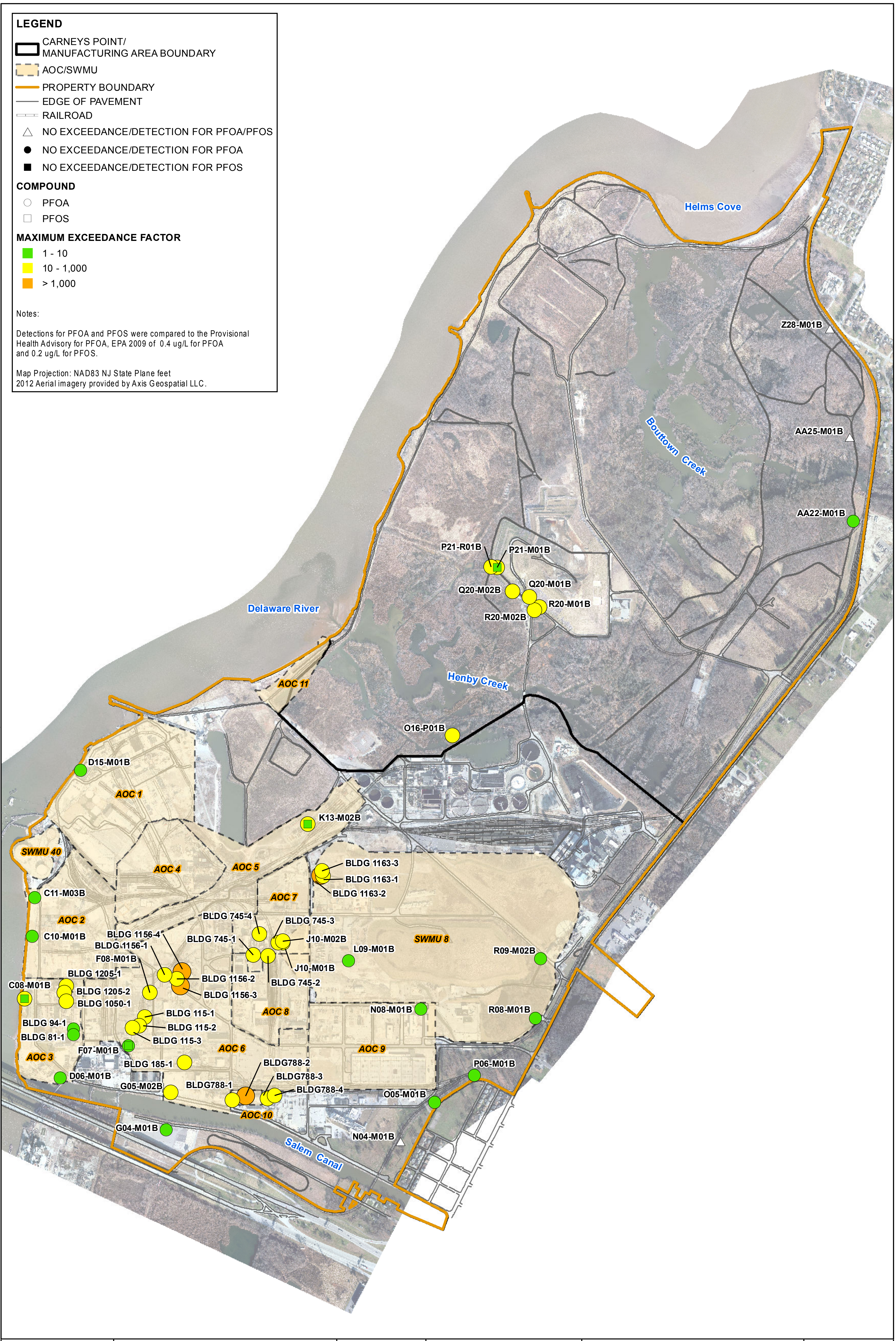
SITE-WIDE
MAXIMUM EXCEEDANCES
A ZONE GROUNDWATER
PFOA/PFOS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:
18985881

DATE:
8/29/2014

FIGURE NUMBER:
7-22



LEGEND

CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

△ NO EXCEEDANCE/DETECTION FOR PFOA/PFOS

● NO EXCEEDANCE/DETECTION FOR PFOA

■ NO EXCEEDANCE/DETECTION FOR PFOS

COMPOUND

○ PFOA

□ PFOS

MAXIMUM EXCEEDANCE FACTOR

🟩 1 - 10

🟨 10 - 1,000

🟧 > 1,000

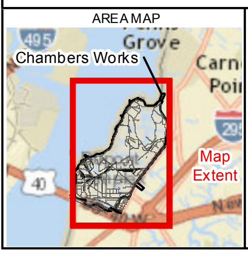
Notes:

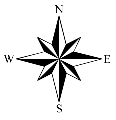
Detections for PFOA and PFOS were compared to the Provisional Health Advisory for PFOA, EPA 2009 of 0.4 ug/L for PFOA and 0.2 ug/L for PFOS.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-23_PFOA_PFOS_B_Aquifer_GW.mxd

AREA MAP





0 525 1,050 2,100
Feet
1 inch = 1,050 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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FILE NUMBER:	
DESIGNED BY:	L.GROSS
DRAWN BY:	MKL
DATA QUALITY CHECK BY:	K.DAVIS

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Newark, DE 19713

SITE-WIDE
MAXIMUM EXCEEDANCES
B AQUIFER GROUNDWATER
PFOA/PFOS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:	18985881
DATE:	8/29/2014
FIGURE NUMBER:	7-23

LEGEND

CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

AOC/SWMU

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

● NO EXCEEDANCE/DETECTION FOR PFOA

MAXIMUM EXCEEDANCE FACTOR

🟩 1 - 10

🟨 10 - 1,000

🟧 > 1,000

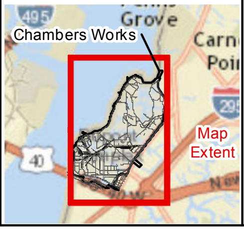
Notes:

Detections for PFOA and PFOS were compared to the Provisional Health Advisory for PFOA, EPA 2009 of 0.4 ug/L for PFOA and 0.2 ug/L for PFOS.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-24A_PFOA_CDE_Aquifer_GW.mxd

AREA MAP



N
W E
S

0 525 1,050 2,100

Feet

1 inch = 1,050 feet

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FILE NUMBER:	
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DRAWN BY:	MKL
DATA QUALITY CHECK BY:	K.DAVIS

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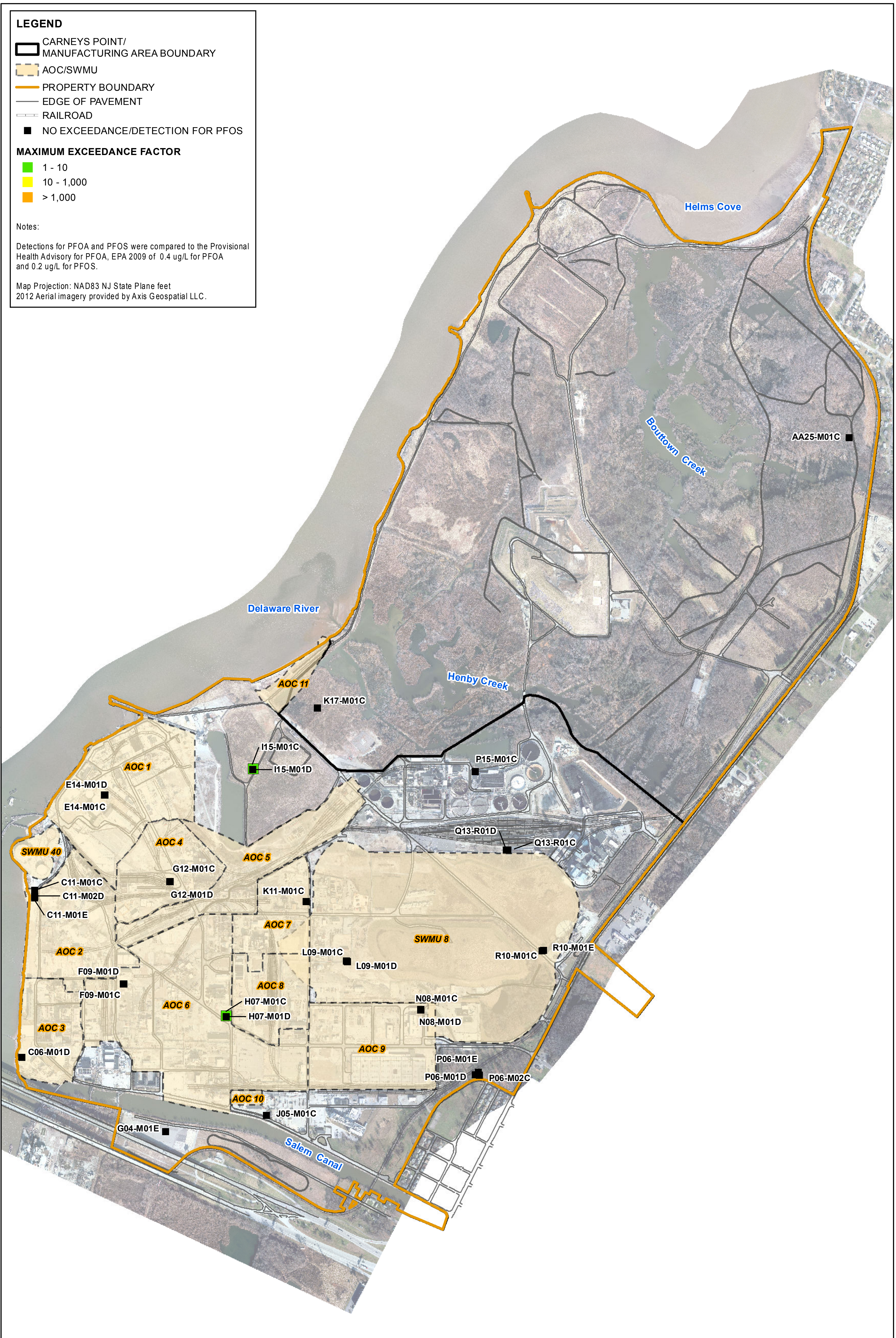
SITE-WIDE MAXIMUM EXCEEDANCES C,D, AND E AQUIFER GROUNDWATER PFOA

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER: 18985881

DATE: 8/29/2014

FIGURE NUMBER: 7-24a



LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ AOC/SWMU
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┄ RAILROAD
- ■ NO EXCEEDANCE/DETECTION FOR PFOS

MAXIMUM EXCEEDANCE FACTOR

- 🟩 1 - 10
- 🟨 10 - 1,000
- 🟧 > 1,000

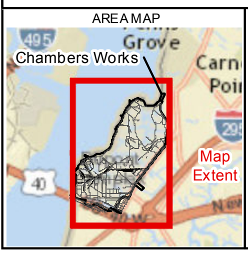
Notes:

Detections for PFOA and PFOS were compared to the Provisional Health Advisory for PFOA, EPA 2009 of 0.4 ug/L for PFOA and 0.2 ug/L for PFOS.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-24B_PFOS_CDE_Aquifer_GW.mxd

AREA MAP



N
W E
S

0 525 1,050 2,100
Feet
1 inch = 1,050 feet
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FILE NUMBER:

DESIGNED BY:
L.GROSS

DRAWN BY:
MKL

DATA QUALITY CHECK BY:
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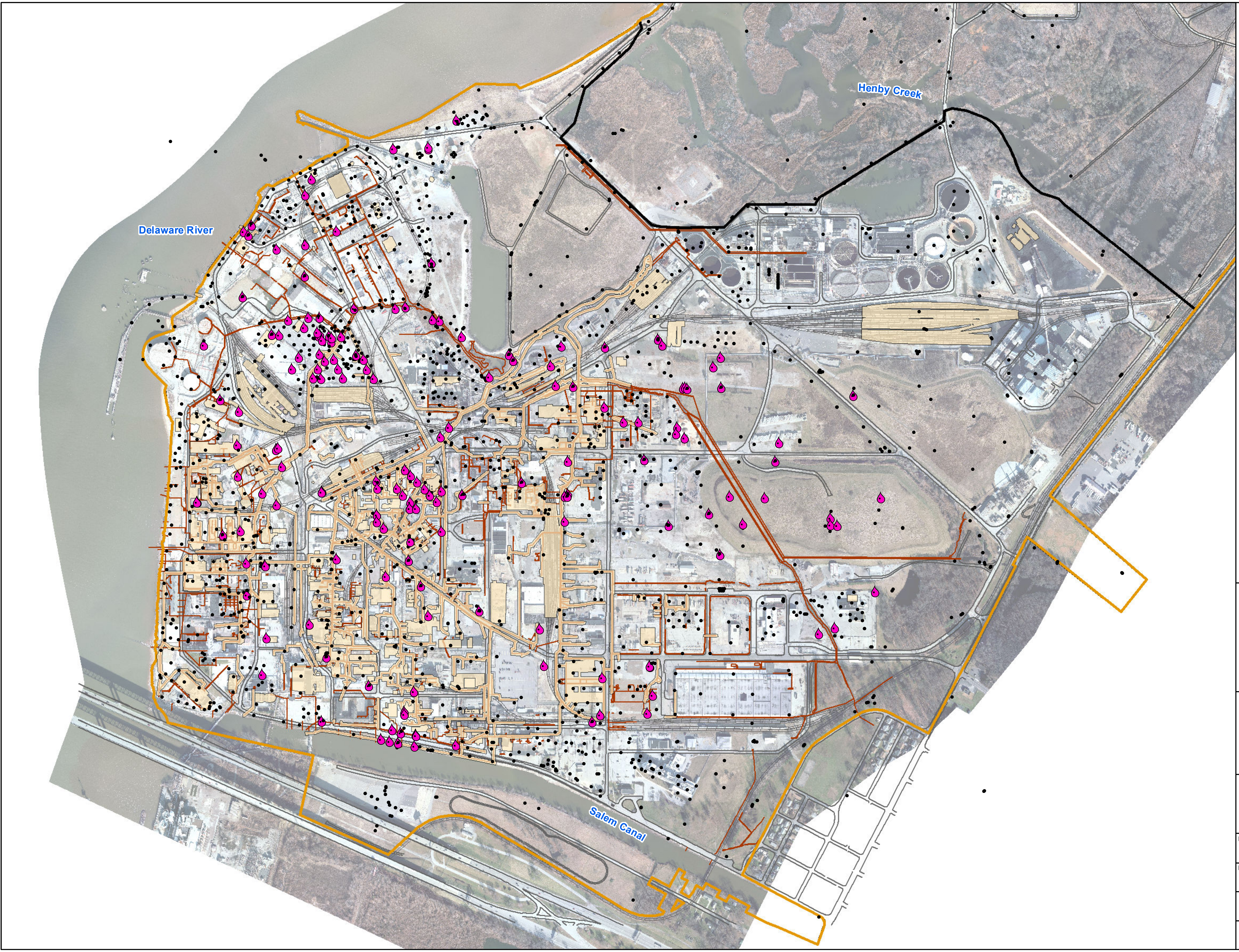
SITE-WIDE
MAXIMUM EXCEEDANCES
C,D, AND E AQUIFER GROUNDWATER
PFOS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NUMBER:
18985881

DATE:
8/29/2014

FIGURE NUMBER:
7-24b



LEGEND

- ● NO NAPL NOTED IN LOG OR OBSERVED IN SAMPLE
- 💧 NAPL VISUALLY OBSERVED IN SOIL CORE, GROUNDWATER SAMPLE, OR WELL
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA VISUAL LINE OF EVIDENCE FOR DNAPL MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS	DATE: 7/14/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-25
DATA QUALITY CHECK BY: L.GROSS	

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LEGEND

- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▭ SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- — RAILROAD

VADOSE ZONE PORE SATURATION

- ● 0.00 - 0.10
- △ 0.10 - 0.15
- ▲ > 0.15

VADOSE ZONE AND B AQUIFER SOIL PARTITIONING ESTIMATED SATURATION

- ● 0.000 - 0.001
- △ 0.001 - 1.0
- ▲ > 1.0

VADOSE ZONE AND B AQUIFER QUALITATIVE SCREENING

- ● < 200 ppm
- △ 200 - 400 ppm
- ▲ > 400 ppm

Notes:
Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

0 350 700 1,400
Feet
1 inch = 700 feet

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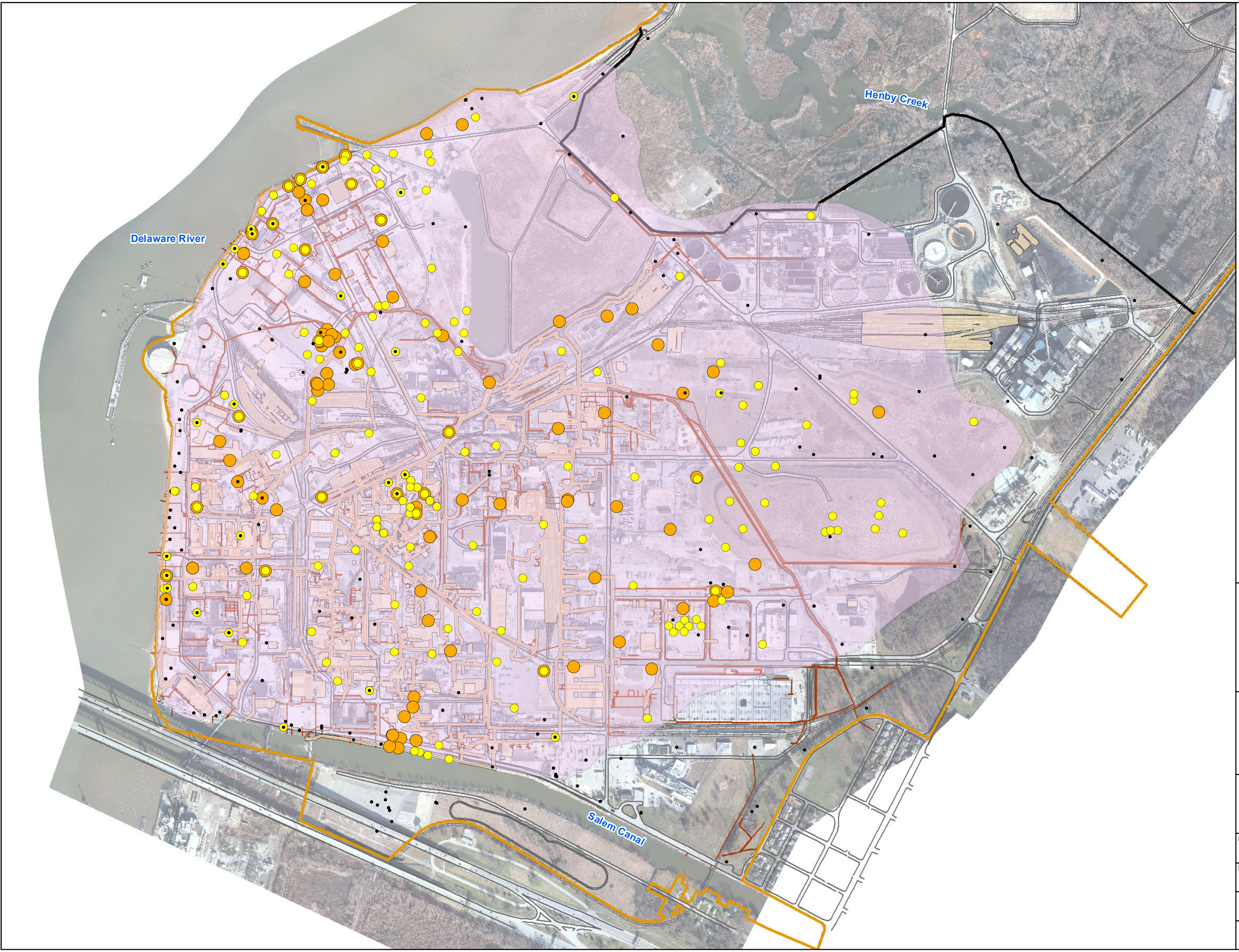
MANUFACTURING AREA SOIL SATURATION LINE OF EVIDENCE FOR DNAPL MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:
PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS
DATE: 6/6/2014
DRAWN BY: MKL
FIGURE NUMBER: 7-26
DATA QUALITY CHECK BY: L.GROSS

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-26_Soil_LOE_DNAPL.mxd



LEGEND

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

🟧 SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE

🟪 B AQUIFER EXTENT OF GROUNDWATER PLUME

— SWMU 17/56A DITCH SECTION

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

SHORT-SCREEN GROUNDWATER SAMPLE - SUMMED CONCENTRATION/TAS PERCENT

- • 0.0 - 1.0
- ● 1.0 - 50.0
- ● > 50.0

LONG-SCREEN GROUNDWATER SAMPLE - SUMMED CONCENTRATION/TAS PERCENT

- • 0.0 - 1.0
- ● 1.0 - 10.0
- ● > 10.0

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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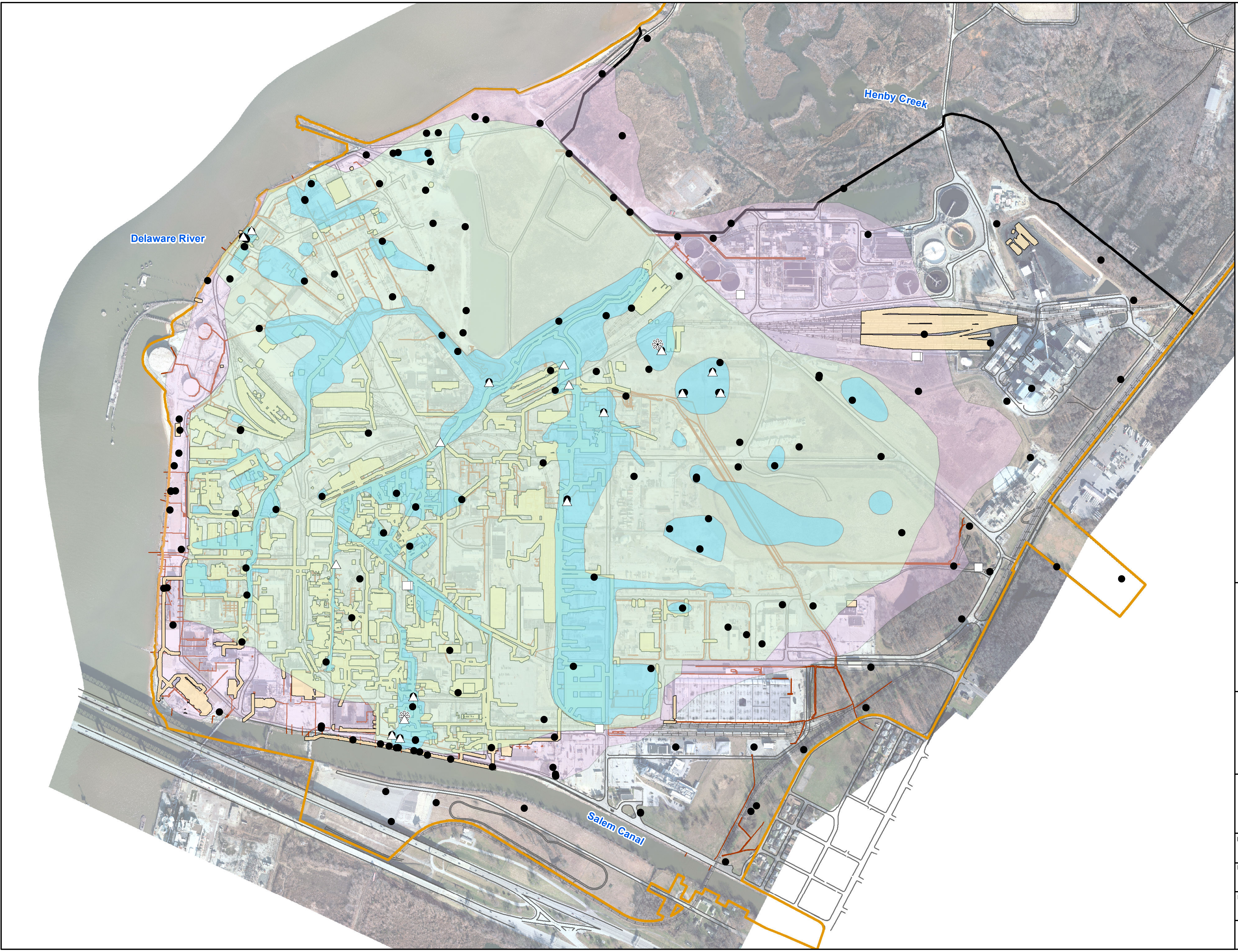
MANUFACTURING AREA B AQUIFER GROUNDWATER TOTAL AQUEOUS SOLUBILITY LINE OF EVIDENCE FOR DNAPL MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS	DATE: 6/6/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-27
DATA QUALITY CHECK BY: L.GROSS	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-27_B_Aquifer_TAS_LOE.mxd



LEGEND

- △ CURRENT DNAPL SURVEY WELL - BAILER
- ✳ CURRENT DNAPL SURVEY WELL - PUMP
- □ IWS WELL LOCATION
- ● CURRENT MONITORING WELL LOCATION
- 🟦 B AQUIFER PROBABLE DNAPL SOURCE ZONE
- 🟩 B AQUIFER POTENTIAL DNAPL SOURCE ZONE
- 🟪 B AQUIFER EXTENT OF GROUNDWATER PLUME
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- 🟨 SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA B AQUIFER DNAPL SOURCE ZONES MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-28
DATA QUALITY CHECK BY: S.NORCROSS	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-28_B_Aquifer_DNAPL_Source_Zones.mxd

LEGEND

- 🟦 C AQUIFER PROBABLE DNAPL SOURCE ZONE
- 🟩 C AQUIFER POTENTIAL DNAPL SOURCE ZONE
- 🟪 C AQUIFER EXTENT OF GROUNDWATER PLUME
- ▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- 🟨 SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼┼ RAILROAD
- 💧 NAPL VISUALLY OBSERVED IN SOIL CORE, GROUNDWATER SAMPLE, OR WELL

C AQUIFER - TAS PERCENT

- ● 0.01 - 1.0
- ● 1.0 - 10.0
- ● > 10.0

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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MANUFACTURING AREA C AQUIFER DNAPL LINE OF EVIDENCE AND DNAPL SOURCE ZONES MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS	DATE: 6/6/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-29
DATA QUALITY CHECK BY: L.GROSS	

Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-29_C_Aquifer_DNAPL_LOE.mxd

LEGEND

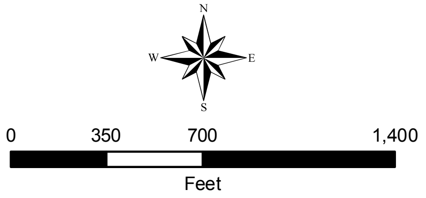
- 🟩 D AQUIFER POTENTIAL DNAPL SOURCE ZONE
- ▨ D AQUIFER EXTENT OF GROUNDWATER PLUME
- ☐ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- ┼ RAILROAD

D AQUIFER - TAS PERCENT

- ● 0.0 - 1.0
- ● 1.0 - 10.0
- ● > 10.0

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.



1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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MANUFACTURING AREA D AQUIFER LINE OF EVIDENCE MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS	DATE: 6/13/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-30
DATA QUALITY CHECK BY: L.GROSS	

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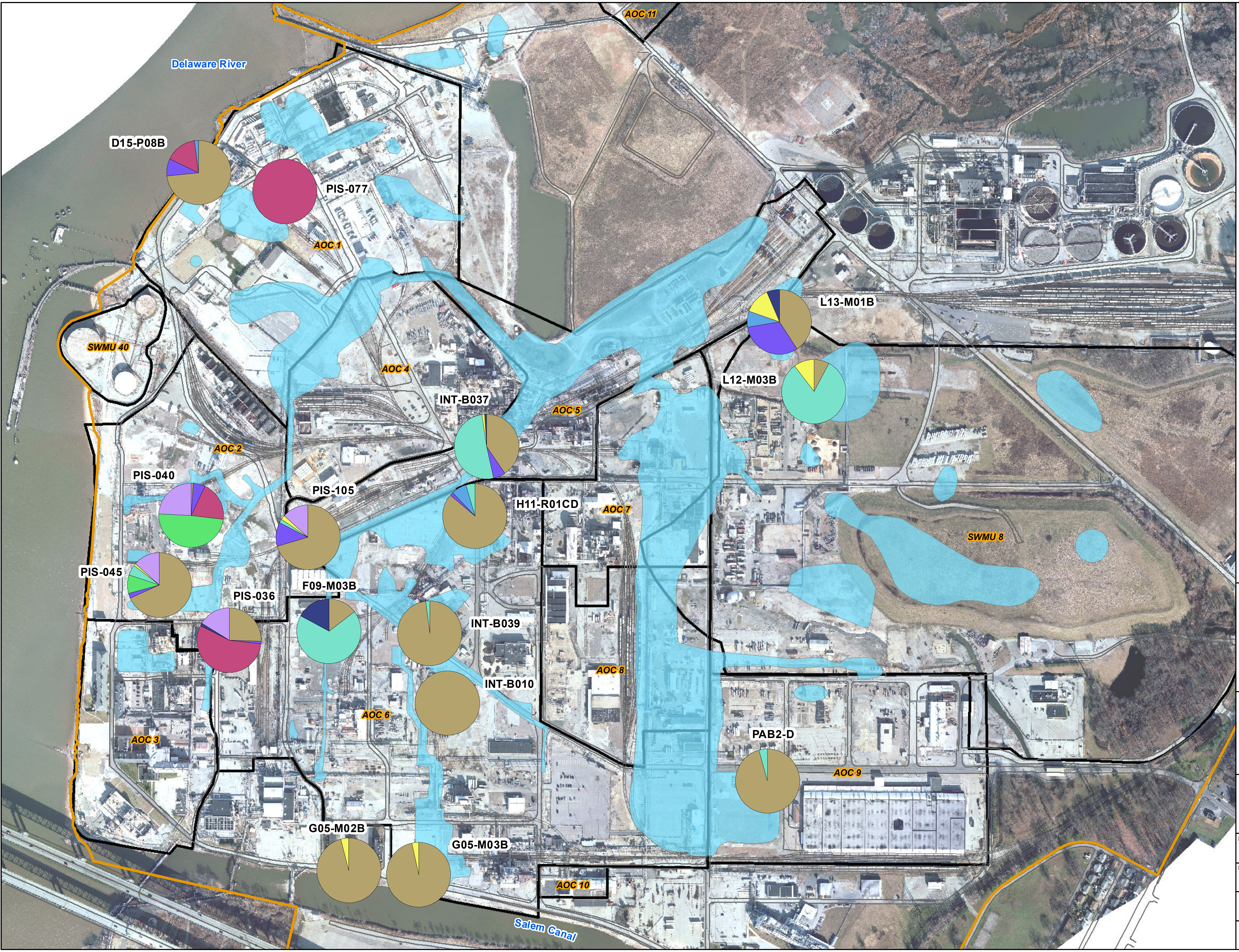

LEGEND

- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD
- B AQUIFER PROBABLE DNAPL SOURCE ZONE
- AOC/SWMU

DNAPL PIE CHART

- GROUP 1 - CHLORINATED BENZENES
- GROUP 2 - BTEX
- GROUP 3 - CHLORINATED FLUOROCARBONS
- GROUP 4 - CHLORINATED ETHYLENES
- GROUP 5 - CHLORINATED ETHANES
- GROUP 6 - NITROAROMATICS
- GROUP 7 - AMINES
- GROUP 8 - PAHs
- GROUP 9 - ORGANO LEAD

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 250 500 1,000
Feet
1 inch = 500 feet

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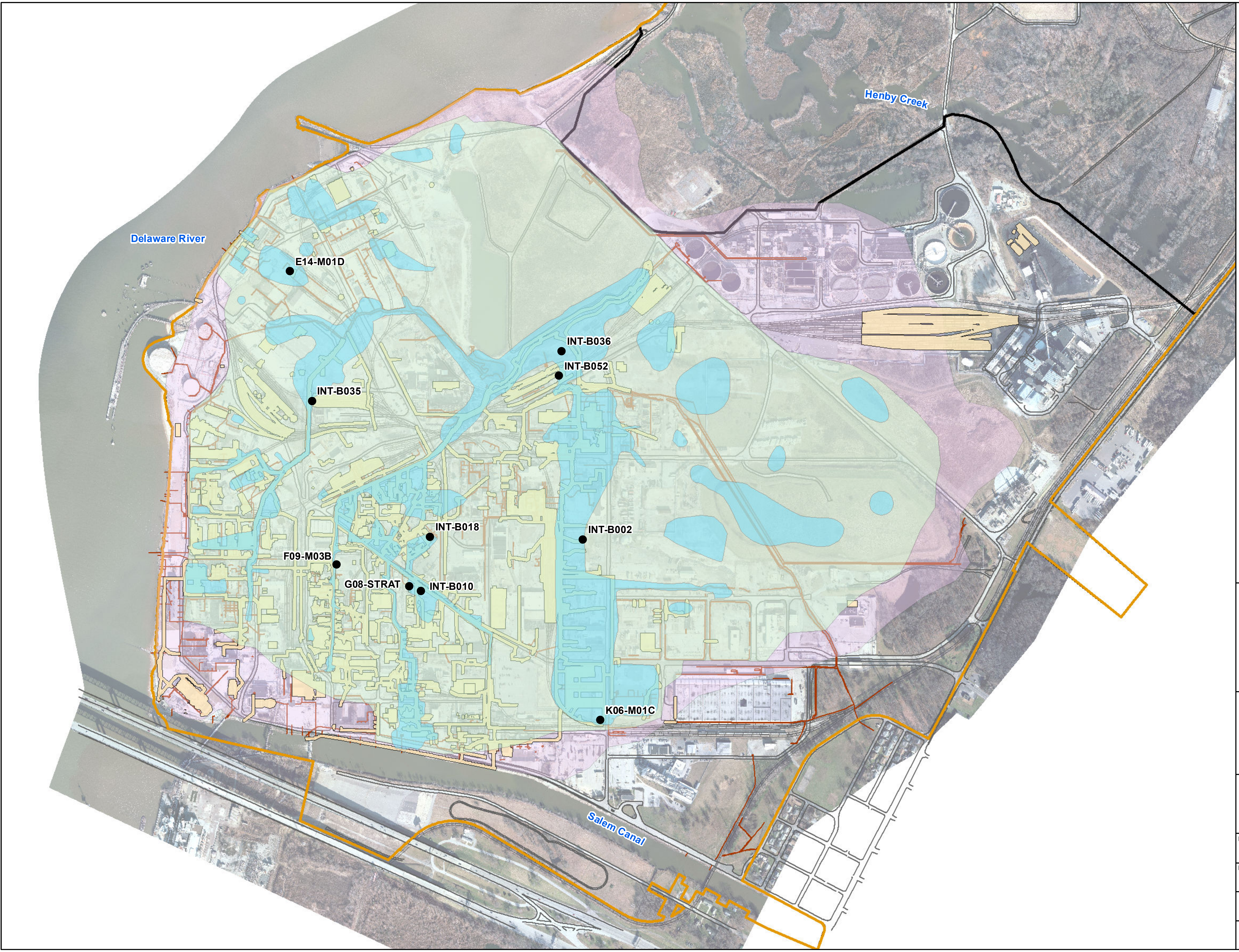
MANUFACTURING AREA B AQUIFER PROBABLE SOURCE ZONES AND DNAPL SAMPLE ANALYSIS MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-31
DATA QUALITY CHECK BY: S.MORGAN	

User: Matt_Layton, Date: 9/3/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-31_DNAPL_Pie_Chart_Map.mxd



LEGEND

- ● DIFFUSION SAMPLE LOCATION
- 🟦 B AQUIFER PROBABLE DNAPL SOURCE ZONE
- 🟩 B AQUIFER POTENTIAL DNAPL SOURCE ZONE
- ▨ B AQUIFER EXTENT OF GROUNDWATER PLUME
- ☐ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- ▨ SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE
- — SWMU 17/56A DITCH SECTION
- — PROPERTY BOUNDARY
- — EDGE OF PAVEMENT
- — RAILROAD

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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SELECTED AQUITARD DIFFUSION SAMPLE LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 7/28/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-32a
DATA QUALITY CHECK BY: K.ROBERTSON	

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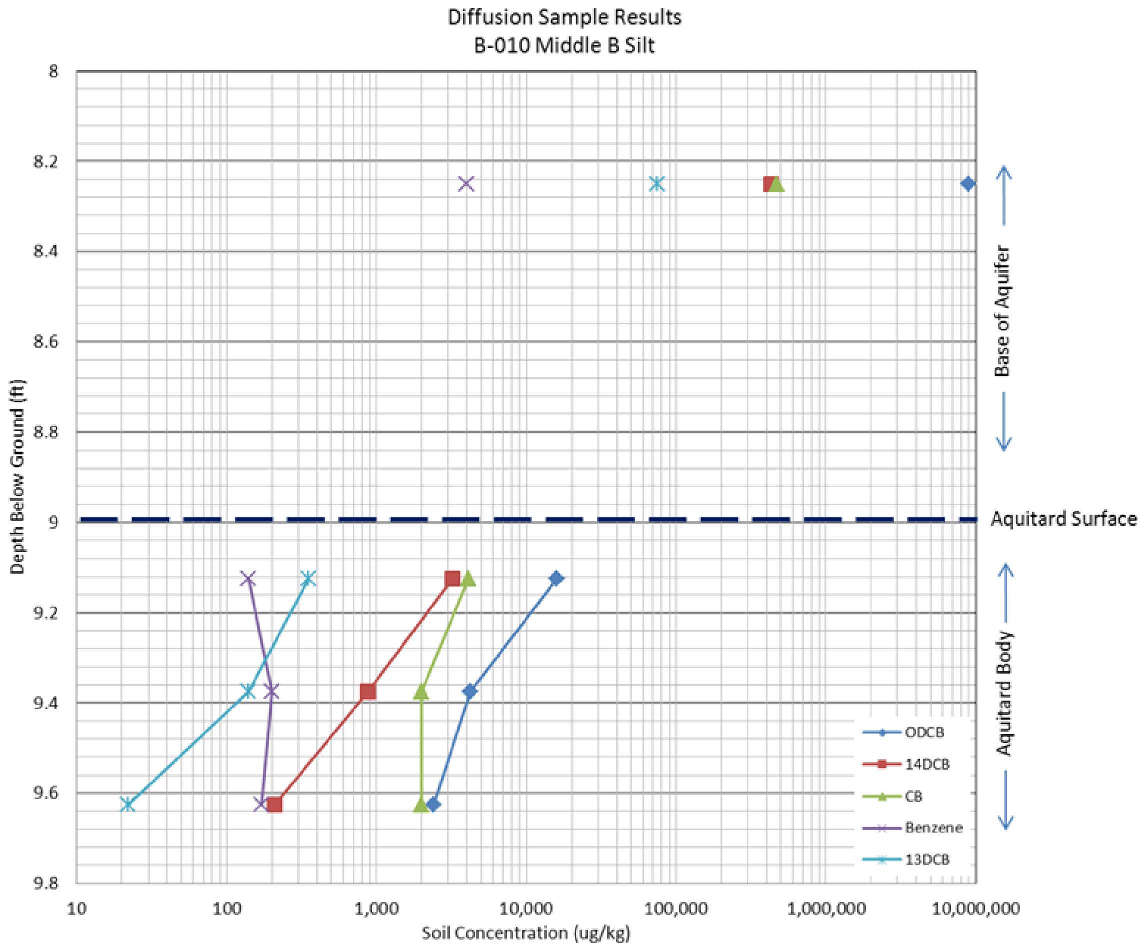
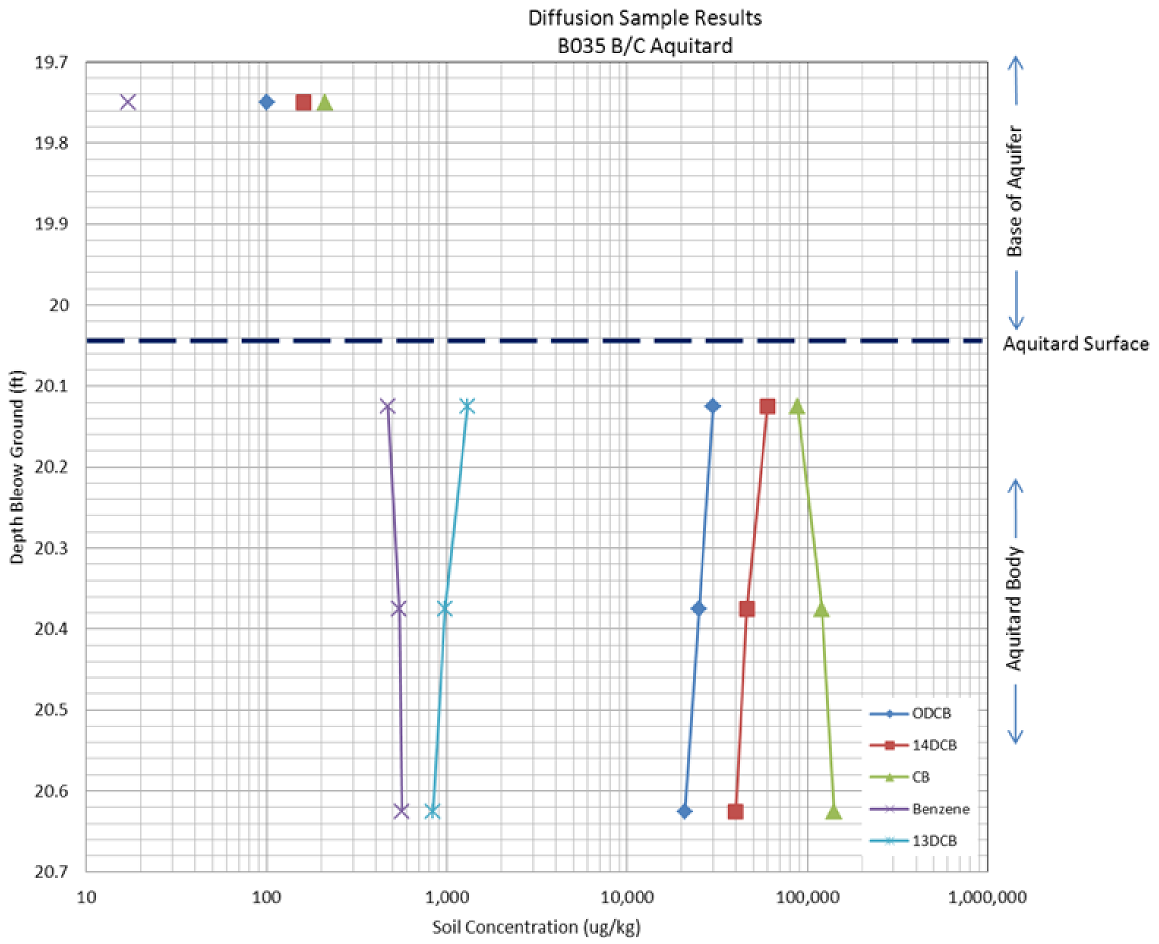
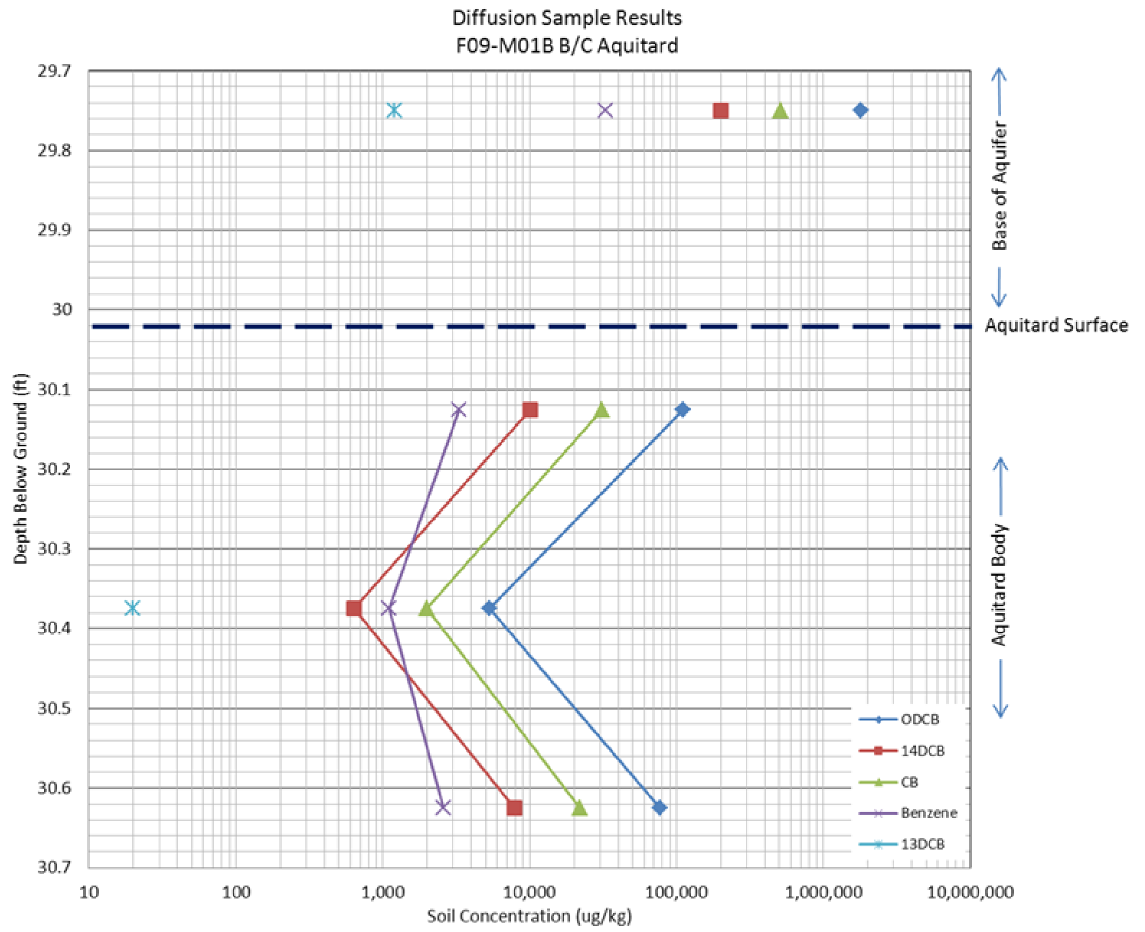


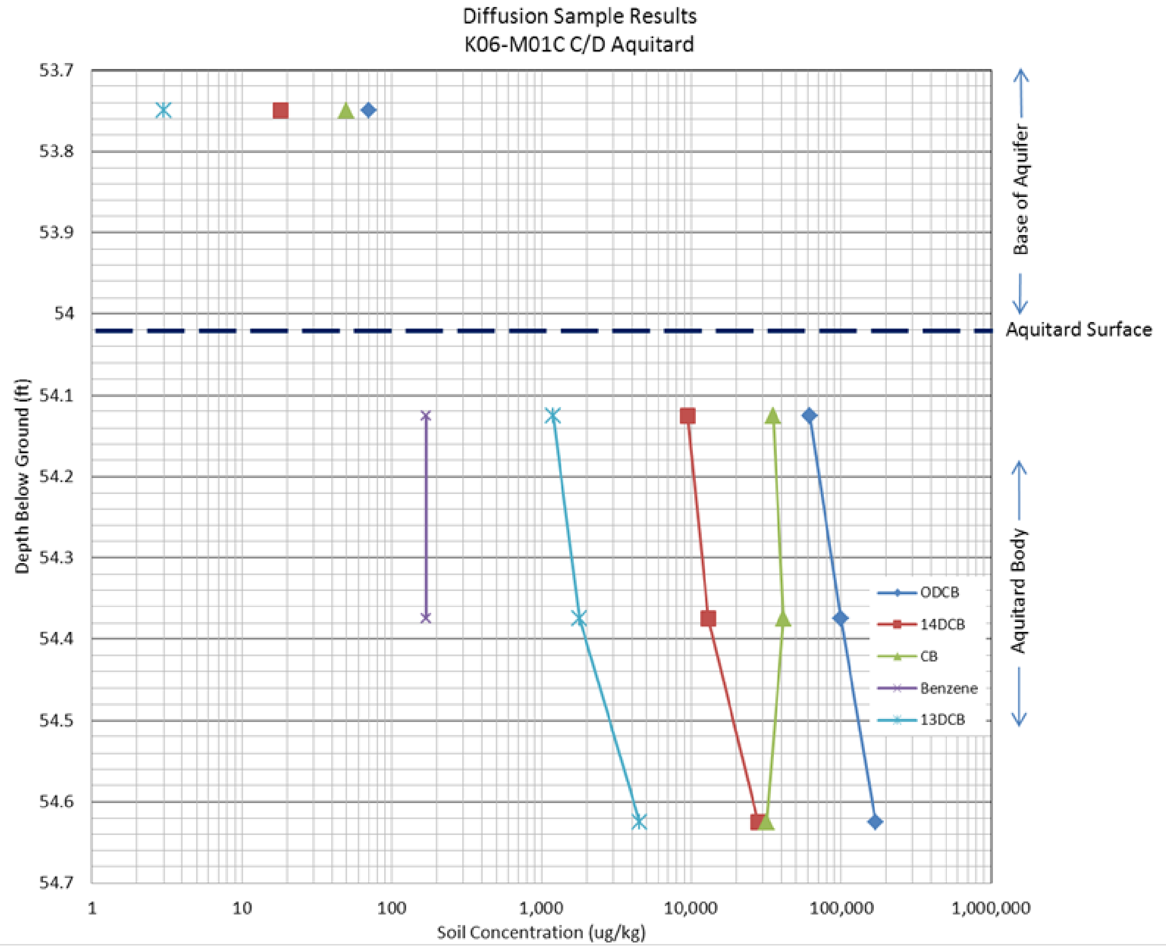
Diffusion Sample Results
B-010 Middle B Silt



Diffusion Sample Results
B035 B/C Aquitard



Diffusion Sample Results
F09-M01B B/C Aquitard



Diffusion Sample Results
K06-M01C C/D Aquitard

User: Matt_Layton, Date: 7/24/2014, Path: V:\Projects\Dupont\Chambers_Works_GIS\Projects\18985881_Comprehensive_RFI_2014\Fig7-32B_Selected_Aquitard_Diffusion.mxd

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SELECTED AQUITARD DIFFUSION SAMPLE RESULTS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.MORGAN	DATE: 7/24/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-32b
DATA QUALITY CHECK BY: L.GROSS	

LEGEND

● BORING OR MONITORING WELL LOCATION

B AQUIFER PROBABLE DNAPL SOURCE ZONE

C AQUIFER PROBABLE DNAPL SOURCE ZONE

CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

SOURCE PRIORITIZATION TOOL HIGH POTENTIAL FOR RELEASE

SWMU 17/56A DITCH SECTION

PROPERTY BOUNDARY

EDGE OF PAVEMENT

RAILROAD

MANUFACTURING AREA CONCEPTUAL MODEL CROSS-SECTION

AA'

BB'

CC'

DD'

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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MANUFACTURING AREA CONCEPTUAL MODEL RENDERING LOCATION MAP

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: S.NORCROSS	DATE: 7/24/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-33
DATA QUALITY CHECK BY: L.GROSS	

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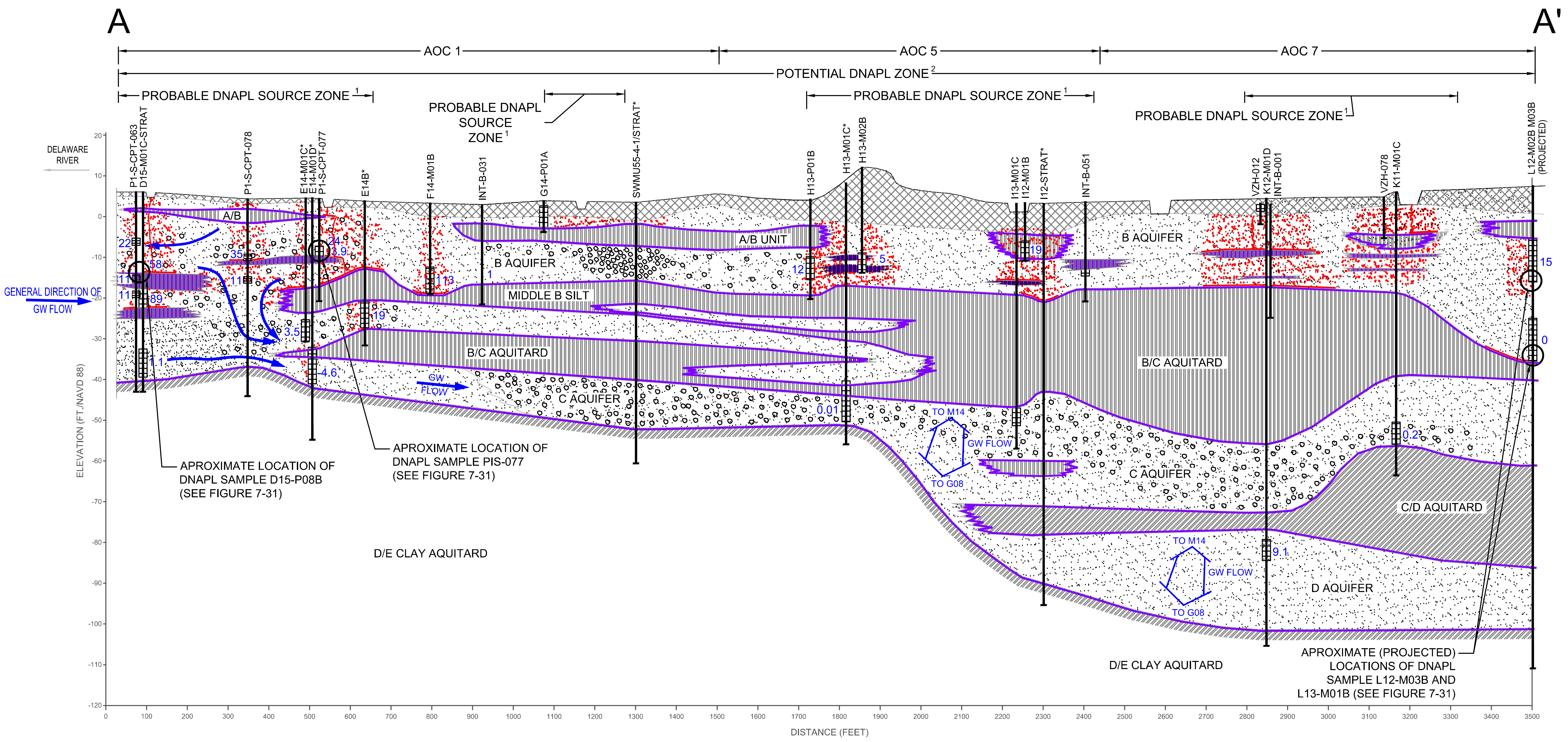

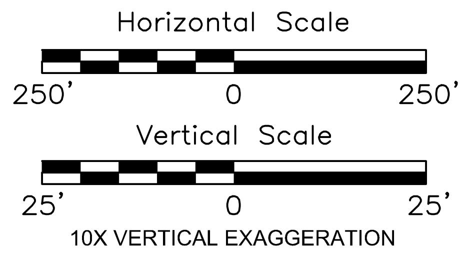

10X VERTICAL EXAGGERATION

Legend:

⁘	SAND
⁘○	SAND AND GRAVEL
▥	SANDY SILT/SILT
▨	SILTY CLAY/CLAY
⁘	SILTY SAND
☒	FILL
➡	GENERAL DIRECTION OF GROUNDWATER FLOW
―	DIFFUSION AREA
⁘	PROBABLE DNAPL (SEE FIGURE 7-38 KEY AND NOTE 3)
┃	BOREHOLE TOTAL DEPTH
▤	WELL SCREEN
	TAS - TOTAL AQUEOUS SOLUBILITY AS %
⩩	DITCH LOCATION

Notes:

* 2013-2014 NEWLY INSTALLED BORINGS.

1) EXTENT OF PROBABLE DNAPL SOURCE ZONE BASED ON CONVERGING LINES OF EVIDENCE FOR THE B AQUIFER (SEE FIGURE 7-28).
2) EXTENT OF POTENTIAL DNAPL SOURCE ZONE PRIMARILY BASED ON PERCENT OF TOTAL AQUEOUS SOLUBILITY FOR B AQUIFER GROUNDWATER (SEE FIGURE 7-28).
3) RED STIPPLING IS USED TO INDICATE INTERVALS WHERE DNAPL LINES OF EVIDENCE CONVERGE AT SPECIFIC LOCATIONS. THE VERTICAL AND LATERAL EXTENT OF STIPPLING IS CONCEPTUAL AND NOT MEANT TO INDICATE AREAS WHERE DNAPL WAS POSITIVELY IDENTIFIED IN A CONTINUOUS MANNER. VISUAL CONFIRMATION OF DNAPL FROM FIELD SAMPLES OR CONTINUOUS CORES IS TYPICALLY LIMITED TO THE SCALE OF INCHES. SCALING OF THE RED STIPPLING IS EXAGGERATED BOTH HORIZONTALLY AND VERTICALLY TO PROVIDE A CONCEPTUALIZATION OF POTENTIAL DNAPL MIGRATION PATHWAYS. SEE FIGURE 7-38 FOR A PHYSICAL DESCRIPTION.

DESIGNED BY:	K. WEST
DRAWN BY:	D. LITTEL
DATA QUALITY CHKD:	S. MORGAN
APPROVED BY:	

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MANUFACTURING AREA
NORTHWESTERN AREA CONCEPTUAL
MODEL RENDERING

DUPONT CHAMBERS WORKS COMPLEX
COMPREHENSIVE RFI REPORT
DEEPWATER, NEW JERSEY

PROJECT NO.	18985881
DATE	9/4/14
FIGURE No:	7-34

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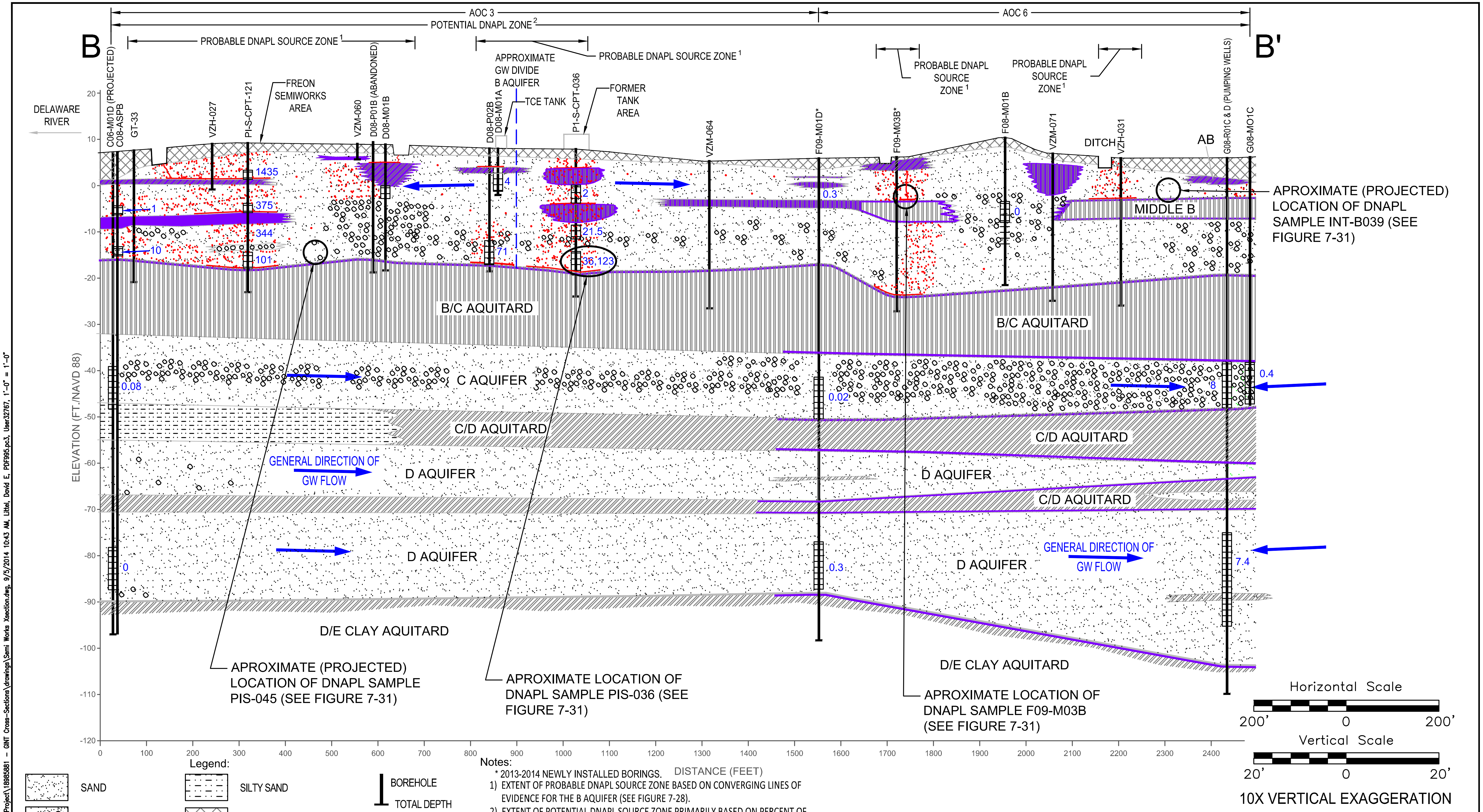

Legend:

⁙	SAND
⁙	SAND AND GRAVEL
▥	SANDY SILT/SILT
▨	SILTY CLAY/CLAY
▤	SILTY SAND
▩	FILL
➡	GENERAL DIRECTION OF GROUNDWATER FLOW
―	DIFFUSION AREA
⁙	PROBABLE DNAPL (SEE FIGURE 7-38 KEY AND NOTE 3)
┃	BOREHOLE
┻	TOTAL DEPTH
▤	WELL SCREEN
	TAS - TOTAL AQUEOUS SOLUBILITY AS %
	DITCH LOCATION

Notes:

* 2013-2014 NEWLY INSTALLED BORINGS.

1) EXTENT OF PROBABLE DNAPL SOURCE ZONE BASED ON CONVERGING LINES OF EVIDENCE FOR THE B AQUIFER (SEE FIGURE 7-28).
2) EXTENT OF POTENTIAL DNAPL SOURCE ZONE PRIMARILY BASED ON PERCENT OF TOTAL AQUEOUS SOLUBILITY FOR B AQUIFER GROUNDWATER (SEE FIGURE 7-28).
3) RED STIPPLING IS USED TO INDICATE INTERVALS WHERE DNAPL LINES OF EVIDENCE CONVERGE AT SPECIFIC LOCATIONS. THE VERTICAL AND LATERAL EXTENT OF STIPPLING IS CONCEPTUAL AND NOT MEANT TO INDICATE AREAS WHERE DNAPL WAS POSITIVELY IDENTIFIED IN A CONTINUOUS MANNER. VISUAL CONFIRMATION OF DNAPL FROM FIELD SAMPLES OR CONTINUOUS CORES IS TYPICALLY LIMITED TO THE SCALE OF INCHES. SCALING OF THE RED STIPPLING IS EXAGGERATED BOTH HORIZONTALLY AND VERTICALLY TO PROVIDE A CONCEPTUALIZATION OF POTENTIAL DNAPL MIGRATION PATHWAYS. SEE FIGURE 7-38 FOR A PHYSICAL DESCRIPTION.

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DATA QUALITY CHKD:	S. MORGAN
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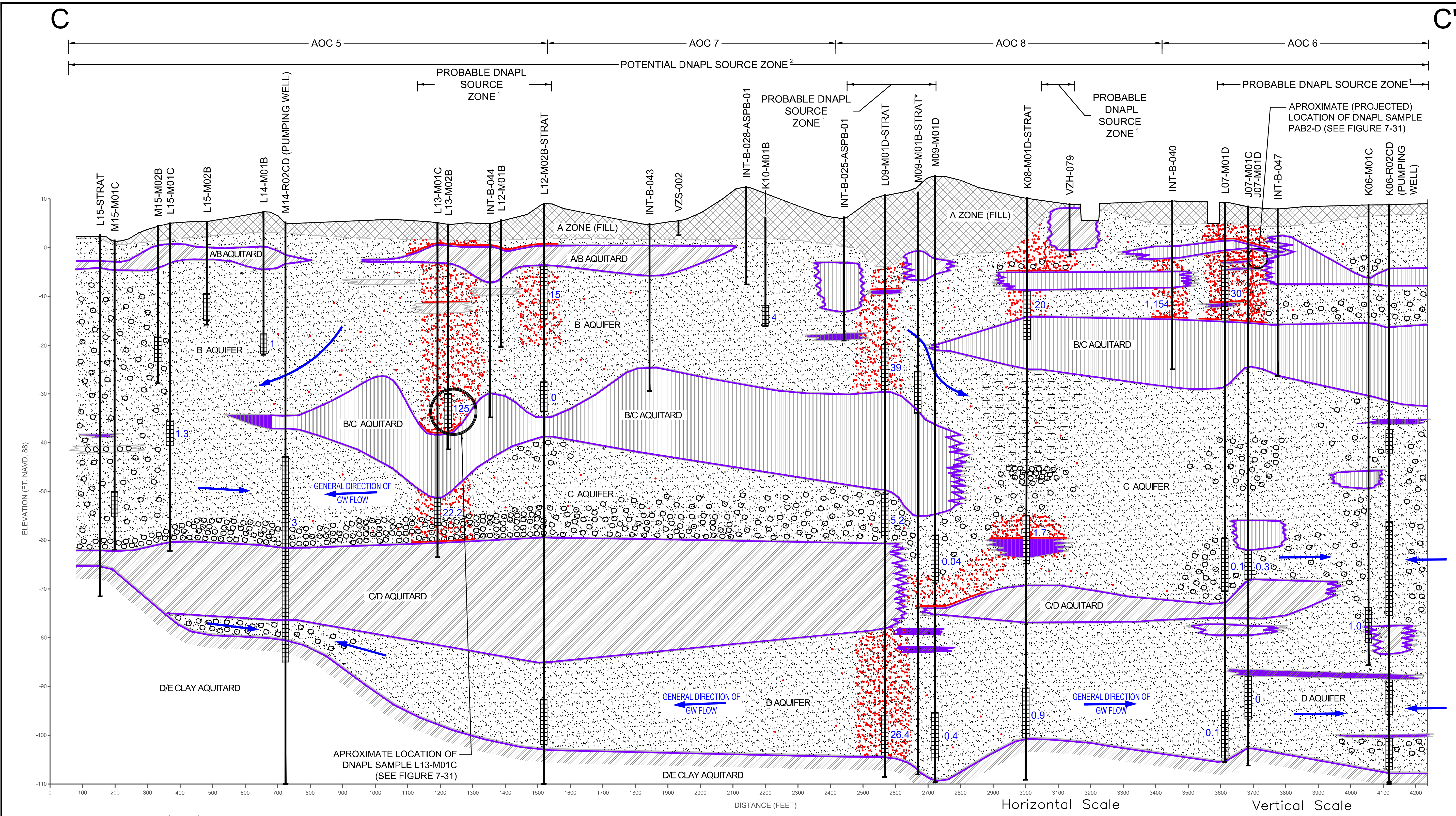
MANUFACTURING AREA SOUTHWESTERN AREA CONCEPTUAL MODEL RENDERING

DUPONT CHAMBERS WORKS COMPLEX
COMPREHENSIVE RFI REPORT
DEEPWATER, NEW JERSEY

PROJECT NO. 18985881
DATE 9/4/14
FIGURE No: 7-35



Horizontal Scale

300' 0 300'

Vertical Scale

20' 0 20'

15X VERTICAL EXAGGERATION

Legend:

⛶	SAND
⛶	SAND AND GRAVEL
▥	SANDY SILT/SILT
▨	SILTY CLAY/CLAY
⛶	SILTY SAND
⊠	FILL
➡	GENERAL DIRECTION OF GROUNDWATER FLOW
—	DIFFUSION AREA
▦	PROBABLE DNAPL (SEE FIGURE 7-38 KEY AND NOTE 3)
┴	BOREHOLE TOTAL DEPTH
▤	WELL SCREEN
	TAS - TOTAL AQUEOUS SOLUBILITY AS %
⌇	DITCH LOCATION

Notes: * 2013-2014 NEWLY INSTALLED BORINGS.

1) EXTENT OF PROBABLE DNAPL SOURCE ZONE BASED ON CONVERGING LINES OF EVIDENCE FOR THE B AQUIFER (SEE FIGURE 7-28).

2) EXTENT OF POTENTIAL DNAPL SOURCE ZONE PRIMARILY BASED ON PERCENT OF TOTAL AQUEOUS SOLUBILITY FOR B AQUIFER GROUNDWATER (SEE FIGURE 7-28).

3) RED STIPPLING IS USED TO INDICATE INTERVALS WHERE DNAPL LINES OF EVIDENCE CONVERGE AT SPECIFIC LOCATIONS. THE VERTICAL AND LATERAL EXTENT OF STIPPLING IS CONCEPTUAL AND NOT MEANT TO INDICATE AREAS WHERE DNAPL WAS POSITIVELY IDENTIFIED IN A CONTINUOUS MANNER. VISUAL CONFIRMATION OF DNAPL FROM FIELD SAMPLES OR CONTINUOUS CORES IS TYPICALLY LIMITED TO THE SCALE OF INCHES. SCALING OF THE RED STIPPLING IS EXAGGERATED BOTH HORIZONTALLY AND VERTICALLY TO PROVIDE A CONCEPTUALIZATION OF POTENTIAL DNAPL MIGRATION PATHWAYS. SEE FIGURE 7-38 FOR A PHYSICAL DESCRIPTION.

DESIGNED BY: K. WEST	URS URS Corporation Sabre Building, Suite 300 4051 Ogletown Road Newark, Delaware 19713 Phone: 302-781-5900	MANUFACTURING AREA EASTERN AREA - NORTH TO SOUTH CONCEPTUAL MODEL RENDERING	PROJECT NO. 18985881
DRAWN BY: D. LITTEL			DATE 9/4/14
DATA QUALITY CHKD: S. MORGAN		DUPONT CHAMBERS WORKS COMPLEX COMPREHENSIVE RFI REPORT DEEPWATER, NEW JERSEY	FIGURE No: 7-36
APPROVED BY:			

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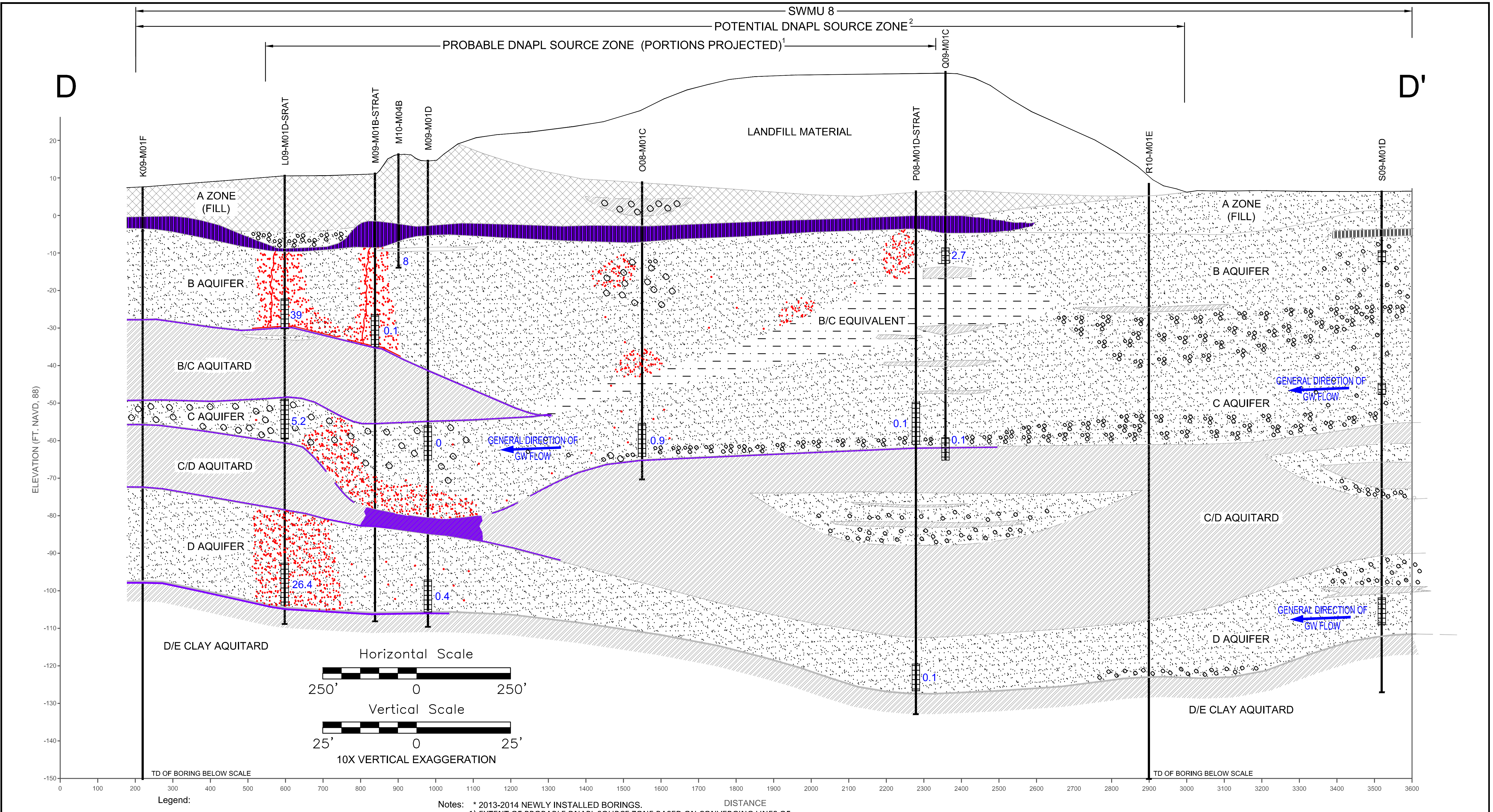

Legend:

⁘	SAND	☷	SILTY SAND
⁘	SAND AND GRAVEL	▨	FILL
▥	SANDY SILT/SILT	→	GENERAL DIRECTION OF GROUNDWATER FLOW
▨	SILTY CLAY/CLAY	—	DIFFUSION AREA
		▩	PROBABLE DNAPL (SEE FIGURE 7-38 KEY AND NOTE 3)

BOREHOLE
TOTAL DEPTH
WELL SCREEN
TAS - TOTAL AQUEOUS SOLUBILITY AS %
DITCH LOCATION

Notes: * 2013-2014 NEWLY INSTALLED BORINGS.

1) EXTENT OF PROBABLE DNAPL SOURCE ZONE BASED ON CONVERGING LINES OF EVIDENCE FOR THE B AQUIFER (SEE FIGURE 7-28).
2) EXTENT OF POTENTIAL DNAPL SOURCE ZONE PRIMARILY BASED ON PERCENT OF TOTAL AQUEOUS SOLUBILITY FOR B AQUIFER GROUNDWATER (SEE FIGURE 7-28).
3) RED STIPPLING IS USED TO INDICATE INTERVALS WHERE DNAPL LINES OF EVIDENCE CONVERGE AT SPECIFIC LOCATIONS. THE VERTICAL AND LATERAL EXTENT OF STIPPLING IS CONCEPTUAL AND NOT MEANT TO INDICATE AREAS WHERE DNAPL WAS POSITIVELY IDENTIFIED IN A CONTINUOUS MANNER. VISUAL CONFIRMATION OF DNAPL FROM FIELD SAMPLES OR CONTINUOUS CORES IS TYPICALLY LIMITED TO THE SCALE OF INCHES. SCALING OF THE RED STIPPLING IS EXAGGERATED BOTH HORIZONTALLY AND VERTICALLY TO PROVIDE A CONCEPTUALIZATION OF POTENTIAL DNAPL MIGRATION PATHWAYS. SEE FIGURE 7-38 FOR A PHYSICAL DESCRIPTION.

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MANUFACTURING AREA EASTERN AREA - WEST TO EAST CONCEPTUAL MODEL RENDERING

DUPONT CHAMBERS WORKS COMPLEX
COMPREHENSIVE RFI REPORT
DEEPWATER, NEW JERSEY

PROJECT NO.
18985881
DATE
9/4/14
FIGURE No:
7-37

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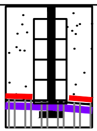
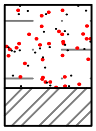
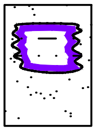
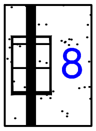
Symbol	Geologic Unit	Hydrogeologic Unit	Description
▩	Fill - Process Waste	Vadose Zone	Sandy gravel, rubble, construction debris and engineered fill, occassional plant waste (particulary in the site's eastern portion). Frequently underlain by sandy silt and and organic clay ("marsh mat"). Largely unsaturated, dominated by vertical infiltration of precipitation. When present, DNAPL occurs as residual at low pore saturation (<1%). Thin zones of DNAPL (pore saturation 20-60%) have been noted on the marsh mat in the eastern side of the site.
⁙	Sand/Sandy Silt	Aquifer	Fine to medium silty quartz sand, thin silt laminae, occassional coarse sand, fine gravel lenses. Typically fining upward sequences. When present, DNAPL predominatly occurs as residual phase (disconnected blebs trapped within pore spaces) at low pore saturations (<1%, on average through vertical section). Except in areas of induced groundwater flow (e.g. near IWS wells or next to aquitard discontinuites) groundwater flux is low due to lower hydraulic conductivity, therefore mass flux is relatively low and mass storage relatively high. Typically a mass storage zone due to retention of residual mass and lower dissolution rates due to lower groundwater flux.
▨	Silt, Clayey Silt, Silty Clay lenses	Local low permeability zone	Discontinuous, thin, silt, clayey silt, silty clay lenses within larger sand units. Possibly deposited in slack water, as marsh deposits or riverine flood deposits. Some low permeability units are not functional aquitards due to their thin and/or discontinuous nature. Although inconsequential to groundwater flow, these units can effectively limit and control the movement of DNAPL. When present, DNAPL can pool in thin layers on top of the silt/clay surface. Concentration gradients between aquifer and silt/clay drive diffusion of related constituents into the lenses. Silty clay lenses within aquifer can therefore increase the amount of mass stored within a hydrogeologic unit. Site constituents will back diffuse from low permeability units for extended periods of time following reduction of constituent concentrations in groundwater.
⬡	Coarse Sand, Gravelly Sand, and Gravel	Aquifer	Medium to coarse quartz sand, lesser amounts of schist, granitic, and quartz gravels and cobbles. If a sufficently large release occurred nearby, DNAPL would have migrated downward until a capillary barrier was encountered (e.g. fine sand, silt, clay) where it may have migrate laterally into depressions and other catchments (e.g., dead end partings) of underlying lower permeability units. Therefore, it is unusual to detect DNAPL in coarse sands and gravels. The presence of residual DNAPL in overlying silty sand and underlying traps in conjunction with elevated groundwater flux due to higher permeability of the gravels and sands can result in higher mass flux to gravel zones.
☰	Sandy Silt/Silt/Clayey Silt/Clay	Aquitard	Sandy silt, silt, clayey silt deposited within marsh and estuarine environments. Low permeability units; functional aquitards that inhibit vertical movement of groundwater and site related constituents. When present, DNAPL may occur as thin layers of DNAPL on the aquitard surface. In a few cases, these layers are thick enough to allow recovery of NAPL from wells. DNAPL may also migrate to depressions or other traps, such as sandy partings, where it will remain immobilized. Concentration gradients between aquifer and the aquitard drive diffusion of site-related constituents into the aquitard. Diffusion "halos" have been measured at the site exceeding 1 foot in thickness, which results in additional mass storage. Site constituents will back diffuse from low permeability units for extended periods of time following reduction of constituent concentrations in groundwater.

Symbol	Expression	Description
	Depressions of aquitard surfaces, atop silty lenses within aquifers	Pooled Multi-Compontent DNAPL, when present occurs as thin (=<0.25 inch) to thicker layers of high pore saturation (20-80%) on top of low permeability lenses and/or as thin seams within aquifer bodies. The thickest pool encountered at the site is 1.15 ft at L13-M01B. Pooled DNAPL can invade roots holes, fractures and other secondary porosity features of aquitards creating trapped mass that is difficult to access. Pooled DNAPL impacts groundwater and drives diffusion gradients into porewater within aquitards.
	Disconnected ganglia and blebs within sandy, silty sand, clayey sand aquifers	Confirmed/Probable zone of elevated (1 to 20%) DNAPL pore saturation. When present, occurs as disconnected DNAPL blebs trapped by tension within intergranular pore spaces. Residual DNAPL accounts for the single greatest contribution (up to 80%) of the total mass estimates for the site. The low pore saturation of residual DNAPL creates extremely high surface area exposure which may result in higher bulk dissolution compared to a pooled DNAPL. However, residual DNAPL that resides in silty sand units often have smaller groundwater flux rates compared to zones with higher hydraulic conductivity, such as gravel zones.
	Sorbed mass within low permeability units.	Diffused constituents in low permeability units. Aqueous constituents plumes create concentration gradients that drive diffusive transport of dissolved constituents which then sorb to organic matter and solids increasing the total mass within these low permeability units. The maximum depth of a diffusion front measured at the site was 1.5 ft. For thin low permeability units within the aquifer, diffusion may occur from above and below, resulting in a significantly elevated constituent mass per unit basis. As groundwater concentrations are reduced within aquifers, mass within these low permeability units will back-diffuse into the aquifer groundwater (See Fig. 7-32).
	Elevated dissolved concentrations and sorbed mass downgradient of source zone.	Plume of aqueous phase site related constituents. Clean groundwater (through precipitation infiltration or groundwater flow from off-site to on-site) may migrate through DNAPL zones. Resultant dissolution creates a plume extending down gradient. Measurement of summed partial effective solubilities above 10% total aqueous solubility in groundwater monitoring wells at the site suggest the presence of DNAPL in close proximity. As the dissolved plume migrates, sorption of dissolved constituents to organic matter and solids within the aquifer moves the mass from DNAPL source zones and re-distributes constituents throughout the aquifer within the dissolved plume. Desorption of constituent mass in the dissolved plume can result in significant time to aquifer restoration even after source areas are addressed.

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CROSS-SECTION KEY

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

PROJECT NO.
18985881
DATE
6/12/14
FIGURE No:
7-38

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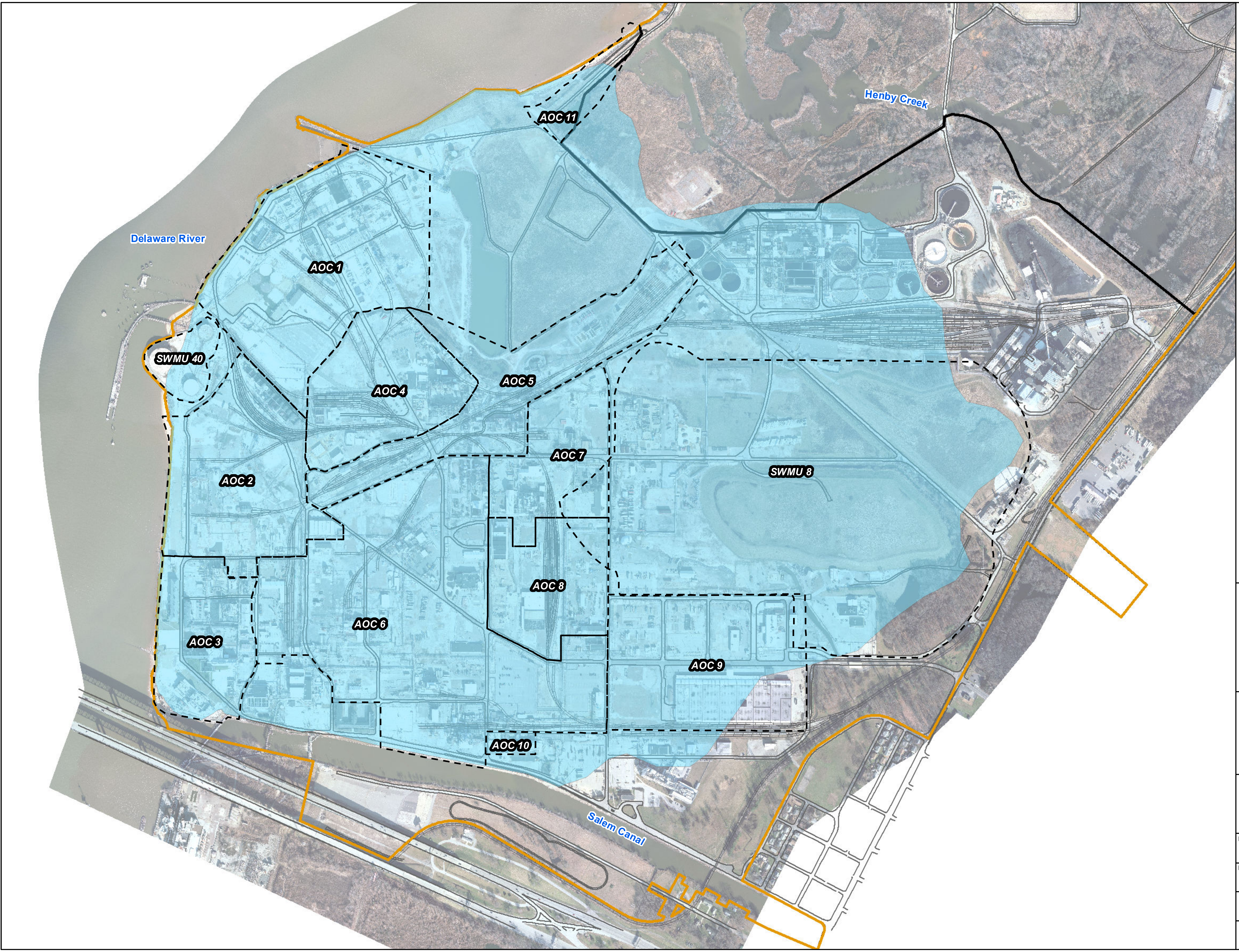

LEGEND

🟦	B, C, AND D AQUIFER GROUNDWATER PLUME COMPOSITE OUTLINE
▭	AOC/SWMU
▭	CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
—	PROPERTY BOUNDARY
—	EDGE OF PAVEMENT
┼┼	RAILROAD

Notes:

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

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

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MANUFACTURING AREA COMPOSITE PLUME EXTENT FOR B, C, AND D AQUIFERS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 7/17/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-39
DATA QUALITY CHECK BY: K.ROBERTSON	

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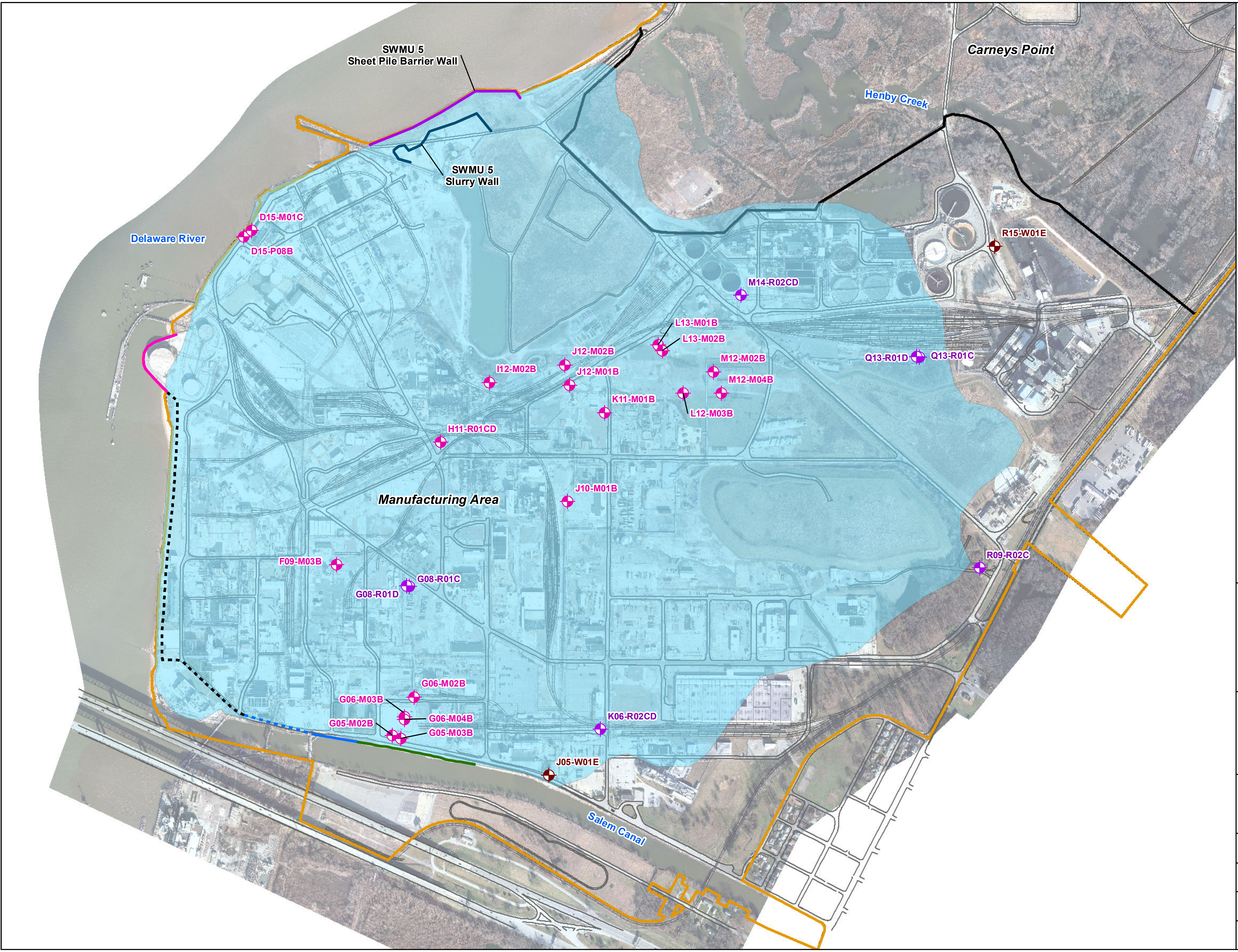

LEGEND

- DNAPL MONITORING RECOVERY PROGRAM WELL LOCATION
- INTERCEPTOR WELL LOCATION
- E AQUIFER WELL LOCATION
- B, C, AND D AQUIFER GROUNDWATER PLUME COMPOSITE OUTLINE
- CARNEYS POINT/ MANUFACTURING AREA BOUNDARY
- PLANNED SALEM CANAL SHEET PILE BARRIER EXTENSION
- PROPOSED SHEET PILE BARRIER EXTENSION
- SALEM CANAL SHEET PILE BARRIER (AS-BUILT)
- SALEM CANAL SHEET PILE BARRIER EXTENSION (2012)
- SWMU 5 SHEET PILE BARRIER
- SWMU 5 SLURY WALL
- SWMU 40 SHEET PILE BARRIER
- PROPERTY BOUNDARY
- EDGE OF PAVEMENT
- RAILROAD

Notes:

Plume extent defined by VOC and SVOC exceedances of NJGWIIA criteria.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N W E S

0 350 700 1,400
Feet
1 inch = 700 feet

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COMPOSITE PLUME EXTENT OF B, C, D AQUIFERS WITH ON-GOING REMEDIAL ACTIONS

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 8/29/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-40
DATA QUALITY CHECK BY: S.NORCROSS	

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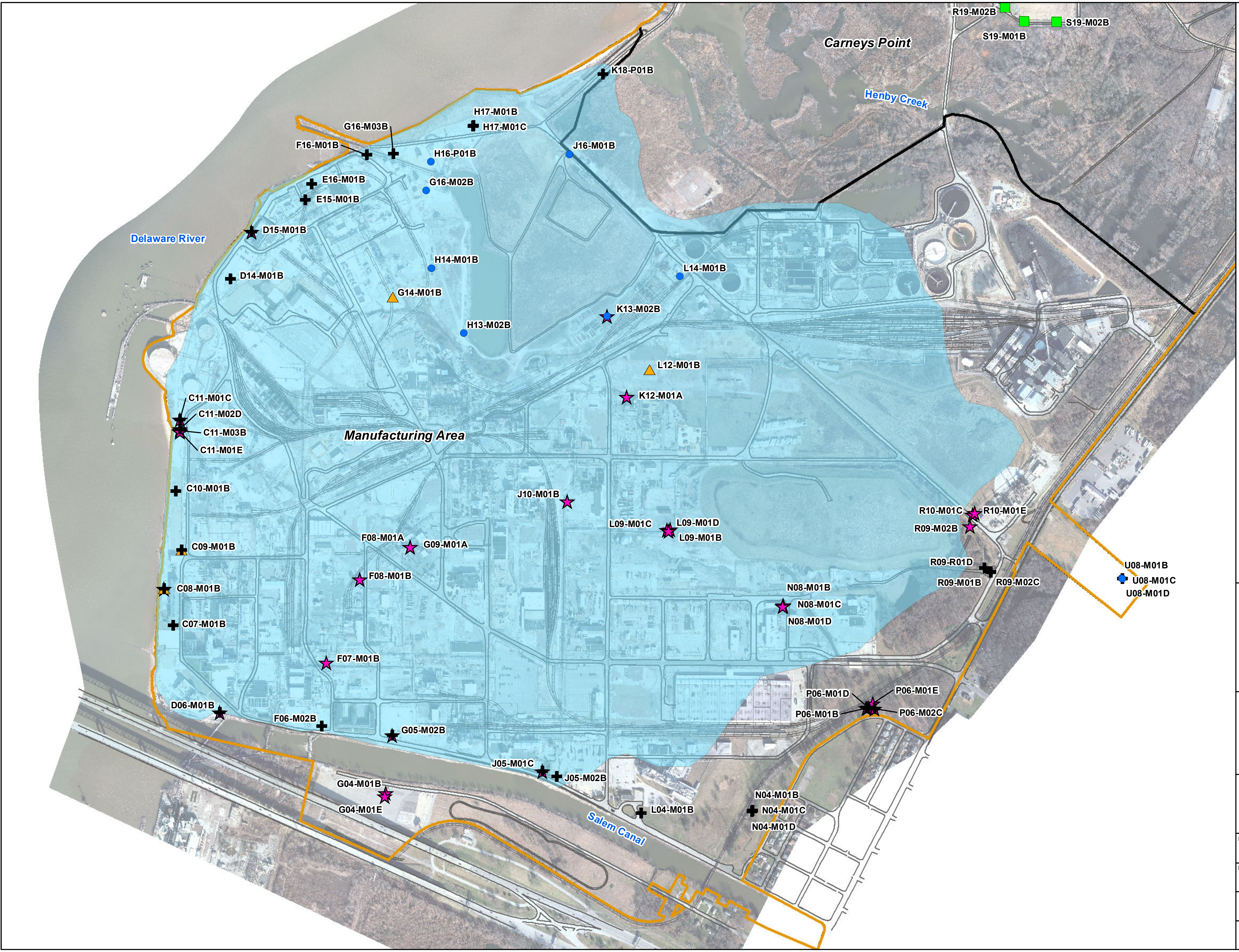

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LEGEND

● CLOSURE AND POST-CLOSURE GROUNDWATER MONITORING PROGRAM FOR THE A, B, AND C BASINS

✚ PERIMETER MONITORING PROGRAM

▲ POST-CLOSURE RCRA SWMUs MONITORING PROGRAM (SWMUs 21, 25, 26, 28)

★ PERFLUOROOCTANOIC ACID (PFOA) MONITORING PROGRAM

■ SECURE C LANDFILL CORRECTIVE ACTION MONITORING PROGRAM

🟩 SECURE C LANDFILL DETECTION MONITORING PROGRAM

▭ B, C, AND D AQUIFER GROUNDWATER PLUME COMPOSITE OUTLINE

▭ CARNEYS POINT/ MANUFACTURING AREA BOUNDARY

— PROPERTY BOUNDARY

— EDGE OF PAVEMENT

┼┼ RAILROAD

Notes:

Plume extent defined by VOC and SVOC exceedances of NJGWIIA criteria.

Map Projection: NAD83 NJ State Plane feet
2012 Aerial imagery provided by Axis Geospatial LLC.

N
W E
S

0 350 700 1,400
Feet
1 inch = 700 feet

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

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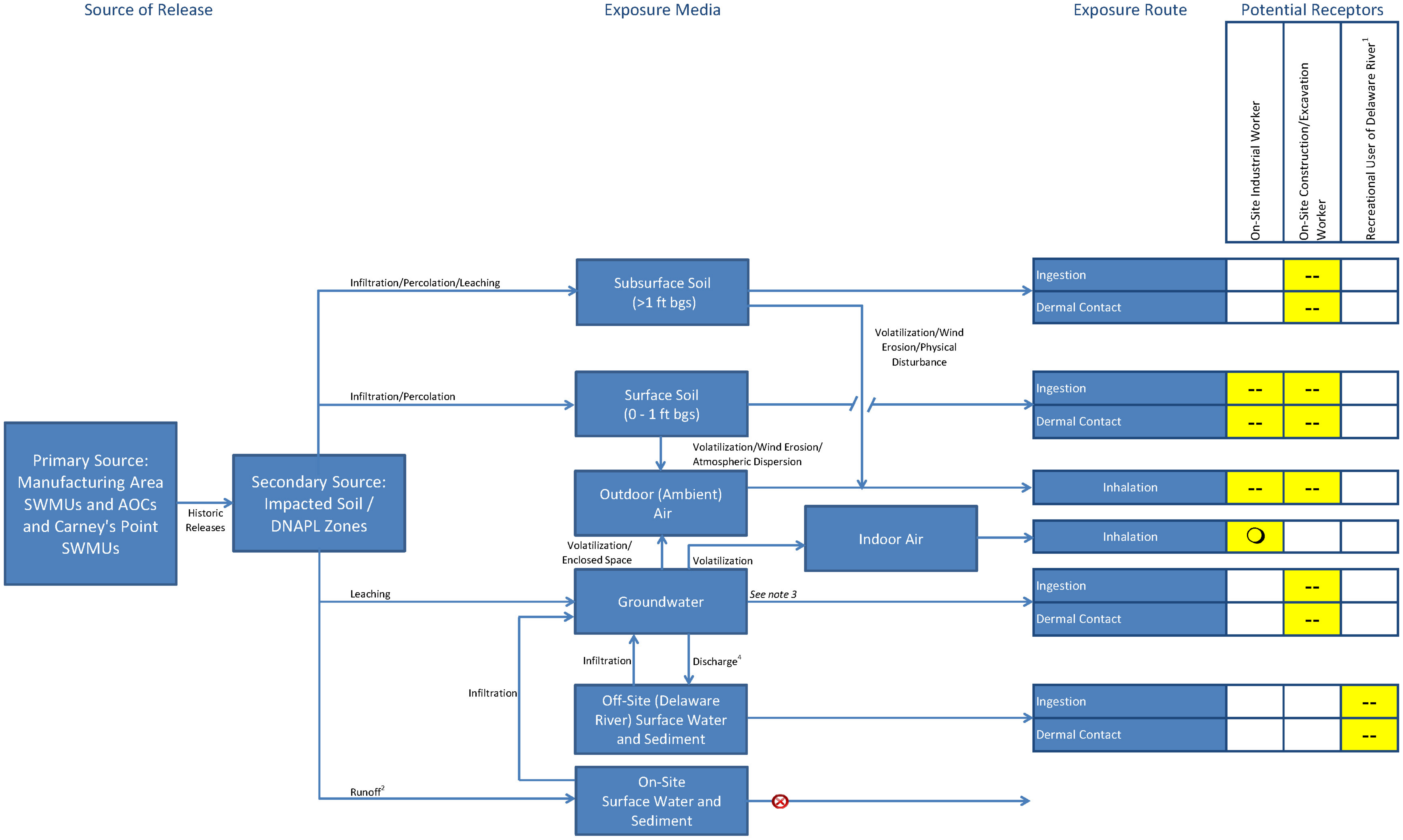
COMPOSITE PLUME EXTENT OF B, C, D AQUIFERS WITH ON-GOING MONITORING ACTIVITIES

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: L.GROSS	DATE: 7/21/2014
DRAWN BY: MKL	FIGURE NUMBER: 7-41
DATA QUALITY CHECK BY: S.NORCROSS	



Exposure Route	On-Site Industrial Worker	On-Site Construction/Excavation Worker	Recreational User of Delaware River[1]
Ingestion		--	
Dermal Contact		--	
Ingestion	--	--	
Dermal Contact	--	--	
Inhalation	--	--	
Inhalation	○		
Ingestion		--	
Dermal Contact		--	
Ingestion			--
Dermal Contact			--

Legend

⊗	Not a media or pathway of concern for human health
☐	Incomplete pathway, receptors would not be in contact with affected media
○	Potentially complete pathway; receptors may be in contact with affected media
--	Potentially complete but not significant exposure pathway (see Section 8.1)

1 - Ingestion of harvested fish not considered an exposure pathway of concern. Potential exposure to COPCs via ingestion of fish is expected to be negligible to nonexistent.
2 - Most runoff is directed to plant ditch system
3 - Groundwater is not used on-site for potable purposes.
Most groundwater is contained on-site by the Interceptor Well System (IWS).
4 - B Aquifer groundwater discharge is limited to the active manufacturing area.
Potential for discharge from Carneys Point is insignificant.

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HUMAN HEALTH CONCEPTUAL EXPOSURE MODEL

COMPREHENSIVE RFI REPORT
DUPONT CHAMBERS WORKS COMPLEX
DEEPWATER, NEW JERSEY

FILE NUMBER:	PROJECT NUMBER: 18985881
DESIGNED BY: D.MCCUE	DATE: 9/3/2014
DRAWN BY: MKL	FIGURE NUMBER: 8-1
DATA QUALITY CHECK BY: L.GROSS	

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