DuPont

DuPont Corporate Remediation Group
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June 18, 2010

Mr. Sin-Kie Tjho
U.S. EPA Region II
RCRA Programs Branch
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Mr. Frank Faranca
Remedial Project Manager
NJDEP/Bureau of Case Management
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Summary of Ecological Investigations in Carneys Point
Rt. 130, Pennsville Twp, New Jersey, 08023
SRP PI# 008221
EA ID #: NOD070002 - 008221

Dear Mr. Tjho and Mr. Faranca:

The enclosed report summarizes the findings of ecological investigations conducted to date in the Carneys Point Area of the DuPont Chambers Works site in Deepwater, New Jersey. The findings summarized in this report were reviewed during the March 17, 2010 site status meeting with the New Jersey Department of Environmental Protection (NJDEP) and the U.S. Environmental Protection Agency (EPA). During the March status meeting, NJDEP requested that DuPont prepare this report to provide a concise summary of Carneys Point ecological investigations that have been reported in multiple submittals to the agencies.

In addition, DuPont is providing responses to comments received from the NJDEP on the *Ecological Investigation Report* (EI Report) submitted in March 2009. NJDEP comments on the EI Report were provided to DuPont via email on January 14, 2010. The text of the comments provided in the NJDEP letter is below followed by the DuPont responses.

NJDEP Comment: After careful review of the extremely detailed qualitative ecological evaluations and quantitative modeling calculations, BEERA/ETRA doesn't disagree with DuPont's conclusions but also doesn't necessarily agree with all of their methodology. Examples are provided below:

NJDEP Example 1: Total PAHs were identified and evaluated as COPECs. Individual PAHs should have also been considered and evaluated, but a close review of data tables didn't reveal any major concerns given the lack of quality habitat in the Carney's Point Area.

DuPont Response 1: Ecological exposure to PAHs was evaluated in the EI as an exposure to PAH mixtures due to the additive toxicity of multiple PAH compounds and because PAHs occur in the environment as mixtures rather than individual chemicals (EPA, 2003). In the Tier II exposure evaluation of sediments, PAH exposures to benthic invertebrate receptors were evaluated consistent with EPA *Equilibrium Partitioning Sediment Guidelines* (ESGs) *for the Protection of Benthic Organisms: PAH Mixtures*

(EPA, 2003). This guidance document takes into account the additive toxicity of multiple PAH compounds with differing relative toxicities to benthic organisms.

In addition to the PAH mixtures model for sediments, PAH concentrations in hydric soils/sediment samples in wetland exposure areas were evaluated relative to EPA Ecological Soil Screening Levels (Eco-SSLs) for total PAHs (EPA 2007). Eco-SSLs were developed for two PAH classes based on additive toxicity of individual compounds within each class: low molecular weight PAH compounds (less than four aromatic ring structures) and high molecular weight PAH compounds (four or greater aromatic ring structures).

Based on the guidance provided in the above documents, the EI evaluated ecological exposure to PAHs based on the additive toxicity of PAH mixtures.

NJDEP Example 2: Area use factors (AUFs) used in the Tier II analyses of ecological impacts (0.1) were frequently an order of magnitude less than the 100 % used in the more conservative Tier I analyses of ecological impacts. BEERA/ETRA considers 0.1 unrealistically low; however, given the lack of substantial quality habitat in the Carneys Point Area and the Manufacturing Areas of the site, these low AUFs were considered in this instance.

DuPont Response 2: Exposure evaluations for wildlife included area use factors (AUFs) to represent the proportion of time that a receptor may forage in a given exposure area as a function of the typical foraging range of the receptor. Tier I exposure evaluations conservatively assumed that receptors would forage 100 percent of the time in the exposure area, regardless of the relative size of the exposure area to the typical foraging range. Tier II exposure evaluations calculated AUFs as the ratio of the area of the exposure to the area of the foraging range. A default AUF of 1.0 was assumed for receptors with home ranges smaller than the exposure area; the minimum AUF applied to exposure models was 0.01 (1 percent area use). The low AUFs calculated for some receptors (e.g., great blue heron, mallard, osprey) reflect the low proportion of time that receptors with large foraging ranges will be exposed to contaminants in the smaller exposure area.

NJDEP Example 3: Filtered water sample results (e.g., surface water, interstitial water) were utilized in the EI. It isn't known if this was per the approved workplan, but DEP prefers to have unfiltered results reported as well.

DuPont Response 3: Filtered and unfiltered surface-water samples were collected and analyzed for metals in the EI as part of the characterization of aquatic exposure areas; organic constituents in surface water were analyzed in unfiltered samples only. While both fractions were reported for metals in surface water, the selection of COPECs was based on the filtered fraction. The filtered fraction represents the bioavailable fraction most relevant to evaluating ecological effects of metals and the relevant fraction for the comparison of many metals concentrations to New Jersey Surface Water Quality Standards and National Recommended Water Quality Criteria. Sediment interstitial water samples were collected to evaluate the bioavailability of metals in sediment; these samples were filtered to remove particulate-bound or colloidal metals in sediment interstitial water that are not considered to be bioavailable to benthic or wetland invertebrates.

NJDEP Example 4: Additional investigations of ecological exposures in former ditches draining the uplands portions of Carneys Point into Bouttown Creek include an assessment of the bioavailability of COPECs in sediments to reduce uncertainty regarding potential risks to benthic communities associated with the ditches. Given that the EIR already applied liberal or "more realistic" exposure assumptions in the Tier II evaluation which determined sediments in these former ditches may pose unacceptable risks to benthic receptors, it is recommended remedial alternatives be evaluated for this area.

DuPont Response 4: Complete Tier II exposure evaluations were not conducted on sediments in the ditches draining the upland portions of Carneys Point to Bouttown Creek. The data available for these ditches at the time of the EI consisted only of bulk sediment chemistry; no information was available to evaluate the bioavailability of metal and organic COPECs in ditch sediment. As a result, Tier II evaluations were limited to comparison of bulk sediment chemistry with severe effect levels (SELs). As discussed in the EI, SELs do not take into account the site-specific factors, such as sediment sulfide and organic carbon content, which can mitigate the bioavailability and toxicity of metals.

As presented in Section 4.0 of the enclosed report, a supplemental investigation was conducted in October 2009 to evaluate uncertainty regarding benthic invertebrate exposure in the ditches. The investigation included the collection of Tier II exposure data, including surficial sediment, sediment interstitial water, and simultaneously extractable metal/acid volatile sulfide data. The findings of the investigation do not indicate unacceptable risks to benthic invertebrate communities and support the recommendation of no further investigation in the Bouttown Creek ditches on the basis of ecological risk.

If you have any questions, please email me at Albert.J.Boettler@usa.dupont.com or call me at 302-999-3891.

Very truly yours,

Albert J. Boettler DuPont
Sr. Environmental Consultant
DuPont Corporate Remediation – NJ

cc: Barry Tornick, EPA Region II (cover letter only)
Gary Long, URS Corporation
CRG Central File Projects Database (507611)

Summary of Ecological Investigations in Carneys Point

CERTIFICATION I

"I certify under penalty of law that the information provided is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

Albert J. Boettler ______ 6/18/10
Albert J. Boettler — Date
DuPont Corporate Remediation Group
Senior Consultant

WITNESSED THIS 18 DAY OF June, 2010

Donna L Bolender

Summary of Ecological Investigations in Carneys Point

CERTIFICATION II

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attached documents, and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

______________________ 6/18/10

Isidoros J. Zarikos — Date

DuPont Corporate Remediation Group

Remediation Team Manager

WITNESSED THIS 18 DAY OF June, 2010

Donna L Balender

Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Date: June 2010 Project No.: 18984386.09001

URS Corporation

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Acronym List

Acronym	Explanation
AOC	Area of Concern
ADD	Average Daily Dose
ASV	Acid Volatile Sulfides
BEE	Baseline Ecological Evaluation
bgs	below ground surface
COPEC	Constituents of Potential Ecological Concern
CRG	DuPont Corporate Remediation Group
DuPont	E.I. du Pont de Nemours and Company
EBC	Ecological Benchmark Concentration
Eco-SSL	Ecological Soil Screening Level
ECSM	Ecological Conceptual Site Model
EI	Ecological Investigation
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ESB	Equilibrium Partitioning Sediment Benchmark
ESNR	Environmentally Sensitive Natural Resource
FCV	Final Chronic Value
HQ	Hazard Quotient
LEL	Lowest Effects Level
LOAEL	Lowest Observed Adverse Effect Level
LOEC	Lowest Observed Effects Concentration
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NJDEP	New Jersey Department of Environmental Protection
NJSWQS	New Jersey Surface Water Quality Standard
NOAEL	No Observed Adverse Effects Levels
NOEC	No Observed Effect Concentrations
NRWQC	National Recommended Water Quality Criterion
ORP	Oxidation-Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Perchlorethylene
RCRA	Resource Conservation and Recovery Act
REIWP	Revised Ecological Investigation Work Plan
RI	Remedial Investigation
ROC	Receptors of Concern
SCV	Secondary Chronic Value
SEM	Simultaneously Extracted Metals
SQG	Sediment Quality Guidelines
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
tPAH	Total Polycyclic Aromatic Hydrocarbon
TRV	Toxicity Reference Value
URS	URS Corporation
UTL	Upper Tolerance
VOC	Volatile Organic Compound

Executive Summary

URS Corporation (URS) has prepared this report on behalf of E.I. du Pont de Nemours and Company (DuPont) to summarize the findings of ecological investigations conducted to date in the Carneys Point Area of the DuPont Chambers Works site in Deepwater, New Jersey (see Figure 1). The findings summarized in this report were reviewed during the March 17, 2010 site status meeting with the New Jersey Department of Environmental Protection (NJDEP). During the March status meeting, NJDEP requested that DuPont prepare this report to provide a concise summary of Carneys Point ecological investigations that have been reported in multiple submittals to the agency.

Ecological investigations in the Carneys Point portion of Chambers Works have been conducted in accordance with NJDEP *Technical Requirements for Site Remediation* N.J.A.C. 7:26E and under the oversight of NJDEP and the United States Environmental Protection Agency (EPA). Consistent with the process prescribed in N.J.A.C. 7:26E for conducting ecological investigations, the ecological evaluation of Carneys Point has included multiple phases of investigations. The findings of two of these phases of investigation have been submitted to NJDEP in previous documents; the third phase is presented in this summary report:

- *Baseline Ecological Evaluation* (BEE) [DuPont Corporate Remediation Group (CRG), 2006b)]
- *Ecological Investigation* (EI) *Report* (DuPont CRG, 2009)
- *Bouttown Creek Ditch Investigation* (summarized in this report)

The findings of the BEE provided the basis for the comprehensive EI field investigations conducted between March 2007 and July 2008. In addition to the recommendations of the BEE, the scope of the EI was developed based on EPA and NJDEP review and subsequent comments on the BEE and *Revised Ecological Investigation Work Plan* (REIWP) (DuPont CRG, 2008).

Overall, the comprehensive EI did not identify unacceptable risks resulting from exposure to site-related constituents in Carneys Point exposure areas, with the possible exception of the ditches draining upland areas of Carneys Point to Bouttown Creek. The greatest potential for risk to benthic invertebrate communities in Bouttown Creek was associated with sediment constituents of potential ecological concern (COPEC) concentrations in the ditches; the EI did not identify unacceptable risks to wildlife in the Bouttown Creek exposure area. The evaluation of potential benthic community impacts associated with these ditches was limited in the EI to bulk sediment chemistry analyses, resulting in uncertainty that required further investigation. Based on the recommendation of the EI, further investigations were conducted in October 2009 to address the uncertainty associated with benthic invertebrate exposure in the ditches.

The Bouttown Creek ditch investigation was conducted in October 2009 with the objective of reducing uncertainty identified in the EI regarding benthic invertebrate exposure to sediment COPECs. The findings of the investigation indicated limited bioavailability and toxicity of sediment COPECs to benthic invertebrates. When considering the limited bioavailability and toxicity of sediment COPECs in the context of the benthic habitat characteristics, including benthic habitat quality and sediment stability, it is unlikely that COPEC concentrations in sediment are adversely affecting benthic invertebrate communities. The findings of the ditch investigations adequately address the uncertainty in the EI and provide multiple lines of evidence indicating the absence of unacceptable risk to benthic invertebrates. As a result, the findings support the recommendation of no further ecological investigation in the Bouttown Creek ditches.

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

- 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 these comprehensive 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 Historic 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, which is the primary constituent group of concern

The integrated findings of the multiple ecological investigations described in this document support the recommendation of no further ecological investigation or remedial action in Carneys Point on the basis of ecological risk.

1.0 Introduction

URS Corporation (URS) has prepared this report on behalf of E.I. du Pont de Nemours and Company (DuPont) to summarize the findings of ecological investigations conducted to date in the Carneys Point Area of the DuPont Chambers Works site in Deepwater, New Jersey (see Figure 1). The findings summarized in this report were reviewed during the March 17, 2010 site status meeting with the New Jersey Department of Environmental Protection (NJDEP). During the March status meeting, NJDEP requested that DuPont prepare this report to provide a concise summary of Carneys Point ecological investigations that have been reported in multiple submittals to the agency.

Ecological investigations in the Carneys Point portion of Chambers Works have been conducted in accordance with NJDEP *Technical Requirements for Site Remediation* N.J.A.C. 7:26E and under the oversight of NJDEP and the United States Environmental Protection Agency (EPA). Consistent with the process prescribed in N.J.A.C. 7:26E for conducting ecological investigations, the ecological evaluation of Carneys Point has included multiple phases of investigations. The findings of two of these phases of investigation have been submitted to NJDEP in previous documents; the third phase is presented in this summary report:

- *Baseline Ecological Evaluation* (BEE) [DuPont Corporate Remediation Group (CRG), 2006b)]
- *Ecological Investigation* (EI) *Report* (DuPont CRG, 2009)
- *Bouttown Creek Ditch Investigation* (summarized in this report)

The primary objectives of this report are as follows:

- Summarize the findings of the BEE and EI that are relevant to Carneys Point ecological exposure areas.
- Present the findings of a recent evaluation of ecological exposure in the ditches draining upland areas of Carneys Point to Bouttown Creek, which was conducted as a continuation of the EI.

The scope of this summary report is limited to ecological investigations in the Carneys Point portion of the site. Additional areas of the site evaluated during the ecological investigation process at the site are not included. Areas not addressed in this summary report include the Chambers Works Manufacturing Area, Salem Canal, and Delaware River.

This report is organized into the following sections:

- Section 2.0: Chambers Works Background
- Section 3.0: Summary of Previous Carneys Point Investigations
- Section 4.0: Bouttown Creek Ditch Investigation
- Section 5.0: Summary of Carneys Point Ecological Investigations
- Section 6.0: References

2.0 Chambers Works Background

The following sections provide background information regarding the Carneys Point Area of the site (see Figure 1). A brief description of the operational history of the site is provided along with a description of the environmental setting of the area; further detail regarding the site is provided in the *Preliminary Assessment Report* (PAR) (DuPont CRG, 2006a).

2.1 Historic Information

The DuPont Chambers Works site consists of the former Carneys Point Works and the Chambers Works Manufacturing Area. The Carneys Point Works operated from 1892 to 1978 and produced smokeless gunpowder, nitrocellulose, and related products (DuPont CRG, 2006a). In the early 1900s, production lines in the Carneys Point Works were increased. In 1914, new plants were constructed to supply gunpowder during World War I. Plant 1 in Carneys Point Works operated continuously, making nitrocellulose and smokeless gunpowder from 1914 until 1977, with increased production from 1938 to 1945 during World War II. Spin-offs of nitrocellulose production included nitrate film (celluloid), carboxymethyl cellulose, lacquer, cellulose acetate, and rayon. Cellulose (cotton or wood fibers), alcohols, and acids were primarily used as part of the manufacturing process. Production at the Carneys Point Works ceased in 1978, and decommissioning of the plant was completed around 1979.

2.2 Environmental Setting

The Carneys Point Area consists of approximately 758 acres located in the northernmost section of the Chambers Works complex. Since operations at the Carneys Point Works ceased in 1978, the area has become increasingly naturalized through the successional development of vegetative communities on areas previously disturbed by plant operations. Carneys Point also contains undeveloped areas and water bodies capable of supporting aquatic and semi-aquatic wildlife.

Bouttown Creek and Henby Creek are the principal aquatic systems within the Carneys Point Area, representing the primary ecological feature in this portion of the site. Additional aquatic resources in Carneys Point include the former Bouttown Creek discharge, known as Helms Basin, and small ponds (Pond A and Pond E) associated with former operations (see Figure 2).

Potential wetland habitats are abundant along Henby Creek and Bouttown Creek in the Carneys Point Area. Overall, potential wetland areas occupy greater than 300 acres or greater than 20 percent of the area in Carneys Point. The hydrology of the potential wetland areas varies both seasonally and spatially by proximity to the creeks.

The upland portions of the former Carneys Point Works, including areas in the vicinity of the Solid Waste Management Units (SWMUs) and/or Areas of Concern (AOCs), are 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, typify the majority of vegetation that grows in the upland portion of this area.

3.0 Previous Carneys Point Ecological Investigations

Ecological investigations in the Carneys Point portion of Chambers Works have been conducted in accordance with NJDEP *Technical Requirements for Site Remediation* (Tech Regs) N.J.A.C. 7:26E and at the direction and oversight of NJDEP and EPA. Consistent with the process prescribed in N.J.A.C. 7:26E for conducting ecological investigations, the results of previous investigations in Carneys Point have been reported in the BEE and EI Report submitted to NJDEP.

The following sections summarize the key findings of these previous ecological investigations and the recommendations for additional investigations based on NJDEP and EPA review.

3.1 Site-Wide Baseline Ecological Evaluation

The BEE evaluated both the Chambers Works facility and the former Carneys Point site and was completed according to N.J.A.C. 7:26E-3.11. For the purposes of this summary document, only results from the former Carneys Point will be presented.

The BEE followed the completion of the Phase IV Resource Conservation and Recovery Act (RCRA) Facility Investigation for the site. The BEE was conducted to characterize potentially complete ecological exposure pathways between site-related constituents and ecological habitats. The objective of the BEE was to identify the co-occurrence of constituents of potential ecological concern (COPECs), environmentally sensitive natural resources (ESNRs) (formerly referred to in the Tech Regs and previously submitted documents as Environmentally Sensitive Areas or ESAs), and contaminant migration pathways to ESNRs. The BEE identified areas of the site where no further ecological evaluation could be supported without additional investigation and areas where further ecological evaluation would be appropriate. The following sections summarize the key findings of the BEE that supported recommendations for further ecological investigations in Carneys Point.

3.1.1 BEE COPEC Identification

Analytical data from the four Phases of the Remedial Investigation (RI) (DuPont CRG, 1995, 1998, 2002a, 2004) were evaluated to identify site-related constituents that may represent COPECs.

Data sets used in the BEE consisted of soil, sediment, and surface water from the undeveloped Carneys Point portion of the site. Specifically, data evaluated in the BEE included the following:

- Surficial [0 to1 foot below ground surface (bgs)] soil samples from SWMUs and adjacent areas from the Carneys Point portion of the site
- Surficial sediment samples from the Bouttown Creek and Henby Creek drainages
- Surface-water samples from the Bouttown Creek and Henby Creek drainages

Groundwater data were not specifically evaluated in the BEE; however, potential groundwater-to-surface interactions were addressed as potential contaminant migration pathways (see Section 3.1.3). Potential groundwater-to-surface water pathways from the site to the Delaware River are currently being investigated as part of the Delaware River RI (URS, 2009).

The maximum detected concentration of constituents in each medium (soil, sediment, and surface water) was compared to its respective ecological benchmark concentration. A constituent exceeding its benchmark concentration was further evaluated based on background concentrations, frequency of detection, and site-relatedness to determine its designation as a COPEC. Background soil concentrations were compiled from a study by the NJDEP Division of Science Research & Technology of ambient metals levels in 91 urban Coastal Plain soil samples (Sanders, 2003). Any constituents not detected in a single sample from a given medium were eliminated from further consideration in the BEE. The following sections summarize the COPECs identified in the BEE for each medium.

Soil

Surficial soil samples collected were analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs), nitroaromatics/nitroamines, pesticides, and polychlorinated biphenyls (PCBs). Table 1 lists SWMUs where surficial soil samples were collected; Figures 3 and 4 illustrate the location of SWMUs in the Bouttown Creek and Henby Creek drainages, respectively.

In addition to SWMU soil samples, 12 soil borings were taken in an area east of SWMU 48-6 and 48-7, known as the 40-Acre Parcel. This area was sampled as part of a Phase II Environmental Site Assessment for a potential land transaction (DuPont CRG, 2002b).

Soil collected in 11 SWMUs and the 40-Acre Parcel located within Carneys Point were evaluated relative to ecological benchmarks and representative background concentrations. Eleven metals were identified as soil COPECs based on maximum concentrations exceeding ecological benchmark concentrations and representative background concentrations (Sanders, 2003; see Table 1). In addition, four organic constituents were identified in surficial soil from SWMU 52. Soil COPECs were not identified for the 40-Acre Parcel, as maximum concentrations of constituents were below background concentrations. A list of COPECs identified for each SWMU/area of investigation is presented in Table 1.

Sediment

Surficial sediment data were collected from Henby Creek (SWMU 42) and Bouttown Creek (in SWMU 45-9) in 1997 and 2004. A total of 13 sediment samples were obtained from 10 stations in drainage ditches along the western border of Bouttown Creek during the Phase II and Phase IV RI investigations (see Figure 3). Analyses of surficial sediment included metals, SVOCs (including PAHs), and nitroaromatics/nitroamines.

The evaluation of sediment data in the BEE supported the following conclusions regarding ecological exposure to sediment in Bouttown Creek and Henby Creek:

- Maximum detected concentrations of eight SVOCs exceeded ecological benchmark concentrations and were identified as COPECs (see Table 2).
- Eight metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) were detected at concentrations exceeding their respective sediment benchmarks and were retained as COPECs (see Table 2).

Sediment data from the intertidal zone of the Delaware River are not discussed in this summary report. Remedial actions designed to be protective of ecological receptors in SWMU 52 were implemented in 2006 and 2007. Based on these remedial actions, no further investigation was conducted for SWMU 52 in subsequent ecological investigations. In addition, sediments in the Delaware River adjacent to SWMU 52 and the Chambers Works facility are being investigated in a separate, multi-phase study initiated in September 2009 (URS, 2009).

Surface Water

The surface-water dataset for the BEE consists of eight samples taken in Henby Creek and Bouttown Creek drainage channels from 1994 to 2004 (see Figures 3 and 4). Additional surface-water samples were collected for the DuPont semi-annual surface-water monitoring program (implemented in March 2000) for the earthen ditch system and pipelines (SWMU 45-9) that conveyed wastes from Carneys Point to the Trade Waste Pit (SWMU 37) or Bouttown Creek. Surface-water samples were analyzed for VOCs, SVOCs, and total and dissolved metals.

The evaluation of surface-water data in the BEE supported the following conclusions regarding ecological exposure to surface water in Bouttown Creek and Henby Creek:

- Maximum dissolved concentrations of lead and mercury were greater than the ecological benchmarks; however, lead was detected only once in 10 samples at a concentration marginally higher than the screening level. Dissolved mercury concentrations exceeded the New Jersey Surface Water Quality Standard (NJSWQS) in six samples, but all detections were below the chronic National Recommended Water Quality Criterion (NRWQC) established by EPA (EPA, 2002). Surface water concentrations of mercury and lead concentrations in Henby and Bouttown Creeks were further evaluated in the EI as discussed in Section 3.2.
- The single detected concentration of bis(2-ethylhexyl)phthalate, a common laboratory contaminant, slightly exceeded the surface-water benchmark concentration for this compound but was below the secondary chronic value (SCV) of 32.2 ug/L (Suter, 1996). As such, bis(2-ethylhexyl)phthalate was not identified as a COPEC for surface water.

Surface-water data from SWMU 52 in the Delaware River are not discussed in this summary report. In 2006 and 2007, remedial actions designed to be protective of ecological receptors were implemented in SWMU 52. COPEC concentrations in surface water from the Delaware River adjacent to SWMU 52 and the Chambers Works facility are being investigated in a separate, multi-phase study initiated in September 2009 (URS, 2009).

3.1.2 Environmentally Sensitive Natural Resources

The BEE identified the presence of the following ESNRs in and adjacent to the Carneys Point Area of the site:

- Carneys Point Upland Areas: Upland portions of the former Carneys Point Works, including the vicinities of the SWMUs and/or AOCs, are not considered sensitive ecological habitats. These areas are dominated by early successional herbaceous or grass species and shrubs with relatively few trees. However, uplands portions of Carneys Point were identified as ESNRs in the BEE because they may represent potential exposure areas for mobile animals.
- Wetland and wetland transitional areas: Extensive wetland corridors border Henby Creek and Bouttown Creek.
- Surface-water bodies: Surface-water ESNRs in Carneys Point include jurisdictional water bodies including Henby Creek, Bouttown Creek, site ponds, and the Delaware River.

Consistent with the revised Tech Regs dated May 3, 2010, groundwater underlying Carneys Point is also identified as an ESNR.

3.1.3 Contaminant Migration Pathways

As identified in the BEE, potentially complete COPEC migration pathways between SWMUs and ESNRs in Carneys Point include the following:

- Historic discharge into the former process drainage system: Historic discharges from manufacturing areas to Bouttown Creek were via earthen ditches and pipelines. Given that Bouttown Creek discharges to Henby Creek, the former process drainage structure represents a potential contaminant migration pathways to Henby Creek as well.
- Stormwater runoff: Potential stormwater runoff migration pathways to Henby and Bouttown Creeks and associated wetland and transitional wetland areas were identified for select SWMUs.
- Groundwater: Groundwater from the B Aquifer underlying SWMUs 48-1, 48-5, 48-6, and 48-7 may be hydraulically connected to Henby Creek and Bouttown Creek (DuPont CRG, 2002a). Potential groundwater-to-surface water interactions between the site and the Delaware River are currently being investigated in the Delaware River RI (URS, 2009).

3.1.4 BEE Conclusions and Recommendations

The BEE identified the co-occurrence of ESNRs, COPECs, and potential contaminant migration pathways to environmentally sensitive natural resources in the Carneys Point

Area. The findings of the BEE supported the following conclusions regarding further ecological investigations in Carneys Point:

- Additional ecological evaluation was warranted for select areas of Bouttown and Henby Creeks and the adjoining wetlands.
- Further ecological evaluations would be performed using SWMU surface soil data to evaluate potential risk to mobile animals in Carneys Point Upland Areas.
- The selected remedial actions for SWMU 52 were protective of ecological receptors; no further ecological investigation was warranted for this area.

The BEE recommended that further ecological data collection in Carneys Point target on-site ESNRs where contaminant migration pathways were identified. Specifically, the BEE recommended additional investigation to address the following:

- Stormwater runoff and/or erosion and groundwater discharges to surface water in Bouttown Creek and Henby Creek and the two small ponds located adjacent to SWMU 45-2
- Potential exposure to mobile animals in select upland SWMUs
- Additional characterization of surface water and surficial sediment (0 to 6 inches) in Henby and Bouttown Creeks based on COPECs identified in the BEE
- Collection of regional data from Bouttown and Henby Creeks where they enter the site to determine non–site-related (background) contributions of COPECs to the creeks

3.2 Ecological Investigation

Consistent with N.J.A.C. 7:26E-4.7, an EI was conducted based on the recommendations of the BEE to evaluate potential risk to ecological receptors at the Chambers Works site. The scope of investigation for the EI was developed based on comments provided by the NJDEP on July 13, 2007 and EPA on August 14, 2007, as well as subsequent discussions between DuPont, NJDEP, and EPA during a teleconference on September 13, 2007.

The scope of the EI focused on the evaluation of potential ecological risks in the Carneys Point Area and limited portions of the Chambers Works Manufacturing Area of the site. For the purposes of this summary document, only investigations of ecological exposure in the Carneys Point Area will be presented. Specific objectives of investigations relevant to the Carneys Point Area include the following:

- Further characterization of migration pathways of COPECs to ESNRs
- Evaluation of potential risk to sediment-dwelling invertebrate communities in Henby Creek and Bouttown Creek
- Evaluation of potential risk to fish, amphibian, and reptilian communities in Henby Creek and Bouttown Creek
- Evaluation of potential risk to wildlife in the Carneys Point area, including mobile wildlife that may occasionally forage in upland SWMUs

3.2.1 EI Activities

Comprehensive analytical and ecological resource data were available to evaluate potential risk to receptors associated with the ecological exposure areas identified in Carneys Point.

Field investigations to support the EI were conducted between March 2007 and July 2008. The scope of the field investigations to support EI objectives was outlined in the *Revised Ecological Investigation Work Plan* (REIWP) submitted to NJDEP on February 8, 2008 (DuPont CRG, 2008). The REIWP was developed based on the recommendations of the BEE and correspondence with NJDEP and EPA, including comments on the draft EI Work Plan submitted on February 13, 2007. The following data were collected specifically to meet EI data objectives for Carneys Point:

- **Surface water:** Surface-water samples were collected from mid-water column at co-located sediment sampling stations in the following surface-water features in Carneys Point: Bouttown Creek, Henby Creek, Helms Basin, A Pond, and E Pond (see Figures 3 and 4). Surface-water samples collected from Bouttown Creek and Henby Creek were analyzed for lead and mercury, the two constituents identified as COPECs for the creeks in the BEE. For Helms Basin, A Pond and E Pond, surface-water samples were analyzed for COPECs identified in the BEE from historic soil, sediment, surface-water, or groundwater samples collected from the Carneys Point Area (see Table 2). Surface-water analyses for metals were conducted on filtered and unfiltered samples.
- **Sediment:** Further characterization of COPEC concentrations in sediments was conducted in the following surface-water features in Carneys Point: Bouttown Creek, Henby Creek, Helms Basin, Pond A, and Pond E (see Table 3). Samples analyzed for non-volatile constituents were collected from 0-6 inches; samples analyzed for volatile constituents were collected from 6-12 inches, as prescribed by NJDEP sediment guidance (NJDEP, 1998). Sediment samples were analyzed for COPECs identified in historic soil, sediment, surface-water, or groundwater samples from the Carneys Point Area as identified in the BEE, as well as Total Organic Carbon (TOC), grain size, and simultaneously extracted metals (SEM) and acid volatile sulfides (ASV) (see Table 2).
- **Background surface water and sediment:** Sediment and surface-water metals data from off-site background locations were characterized to evaluate the potential contribution of off-site sources of COPECs to the creeks and the regional distribution of COPECs in surface water and sediment. Background datasets were developed from two areas to characterize the two types of surface-water features on-site: 1) Off-site Bouttown and Henby Creek samples to characterize background for on-site water bodies not influenced by the tidal Delaware River (Henby Creek, Bouttown Creek, and on-site ponds) and 2) Cedar Swamp samples to characterize background for water bodies influenced by the tidal Delaware River (Helms Basin). Representative background concentrations for metals were calculated as the 95 percent upper tolerance limit (UTL_{95}) (with 90 percent coverage) using EPA ProUCL 4.0.

- **Hydric soils:** Sediment/hydric soils were characterized in potential wetland areas adjoining Bouttown and Henby Creeks and historic ponds in Carneys Point (B Pond and E Pond). Sediment/hydric soil samples were collected from the 0-6-inch interval and analyses for COPECs identified in historic soil, sediment, surface-water, or groundwater samples from the Carneys Point Area, as well as TOC, grain size, and SEM:AVS (see Table 2).
- **Sediment/hydric soil interstitial water:** Sediment/hydric soil interstitial water samples were collected from five co-located sediment/surface-water locations in Bouttown and Henby Creek and four sediment/hydric soil locations in wetlands adjacent to the creeks. Sediment interstitial water samples were collected from approximately 2 to 6 inches using a PushPoint sampler. At each location, an unfiltered sample of interstitial water was collected and analyzed for hardness and a 0.2-µm filtered sample was analyzed for select metals identified as COPECs in the BEE for the Carneys Point Area (see Table 2).
- **Benthic community:** Benthic invertebrate community surveys were conducted in Henby Creek and Bouttown Creek at co-located sediment, surface-water, and sediment interstitial water sampling locations to provide spatially and temporally integrated information regarding surface-water and sediment quality. Benthic invertebrate community analyses were collected from four on-site sampling stations in Bouttown Creek and four on-site stations in Henby Creek (see Figures 3 and 4). Samples of reference benthic invertebrate communities were collected from two co-located surface-water and sediment background stations located on each creek approximately 300 feet within the site property boundary.

Data collected as part of EI field investigations supplemented analytical data previously collected in the four phases of the RI (DuPont CRG, 1995, 1998, 2002a, 2004). In addition to data collected for the EI, historic data for COPECs identified in the BEE were carried forward for additional evaluation in the EI. Table 3 summarizes the data used in the EI to evaluate potential ecological risk from the various exposure media identified in Carneys Point.

3.2.2 EI Assessment Approach

Based on the detailed ecological site characterization provided in Section 3.0 of the EI Report, ecological conceptual site models (ECSMs) were developed to describe contaminant sources, migration pathways, and exposure pathways warranting evaluation in the EI. ECSMs were developed for the following systems in Carneys Point having similar contaminant sources, migration pathways, and exposure pathways (see Figure 2):

- Henby-Bouttown Creek System
- Henby-Bouttown Wetland System
- Carneys Point Ponds and Historic Ponds
- Carneys Point Uplands

Based on the ECSMs developed for each system, receptors of concern (ROCs) and corresponding assessment endpoints and measurement endpoints were identified for evaluation in the EI. Table 4 summarizes the assessment endpoints and associated measurement endpoints evaluated for each system identified above for Carneys Point. Detailed descriptions of the measurement endpoints used to evaluate the identified assessment endpoints is provided in Section 5.4.1 of the EI Report.

Potential ecological exposures to COPECs were evaluated in the EI 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. Assumptions for the tiered exposure evaluations are summarized for each receptor category in Table 5.

Potential risks associated with ecological exposure to COPECs were expressed as a hazard quotient (HQ), which represents the ratio of the measured exposure point concentration (EPC) to the ecological benchmark concentration (EBC) for direct contact pathways or the calculated average daily dose (ADD) to the toxicity reference value (TRV) for wildlife ingestion pathways:

$$HQ = \frac{EPC}{EBC} \text{ or } \frac{ADD}{TRV}$$

Potential risk may be characterized based on HQs as follows:

- HQs greater than 1.0 indicate that exposure exceeds a known threshold of effects, which could represent no observed effect concentrations (NOECs), no observed adverse effects levels (NOAELs), lowest observed effects concentration (LOECs), or lowest observed adverse effect levels (LOAELs).
- HQs less than 1.0 based on a NOEC or NOAEL indicate that adverse effects are extremely unlikely because COPEC concentrations result in an exposure that has been demonstrated not to cause adverse ecological effects.
- HQs less than 1.0 based on a LOEC or LOAEL indicate that COPEC concentrations do not result in an exposure associated with adverse ecological effects.

3.2.3 EI Risk Characterization

Potential ecological risk is characterized below for each ecological exposure area evaluated in Carneys Point. Table 6 summarizes the findings of the tiered exposure evaluations.

Henby-Bouttown Creek System

Bouttown Creek and Henby Creek are the principal aquatic systems within the Carneys Point Area, representing the primary ecological feature in this portion of the site. The Henby-Bouttown Creek system includes the potential aquatic exposure areas of Helms Basin, Bouttown Creek, and Henby Creek. The findings of the EI exposure evaluations support the following conclusions for these three areas:

- **Helms Basin:** No unacceptable risks were identified in the Tier I Exposure Evaluation for ecological receptors exposed to surface water and sediment in Helms Basin. Given that no unacceptable risks to ecological receptors were identified based on worst-case exposure assumptions, potential risks associated with Helms Basin were considered negligible. No further evaluations on the basis of ecological risk are warranted for this exposure area.

- **Bouttown Creek:** Potential ecological risks associated with exposure to site-related media in Bouttown Creek were limited to potential benthic community exposures to elevated COPEC concentrations in the ditches draining upland areas of Carneys Point; no unacceptable risks to fish/reptile or wildlife communities were identified in Bouttown Creek.

  Multiple lines of evidence indicate that COPEC concentrations in sediments are not adversely impacting benthic communities within the Bouttown Creek channel. On-site benthic invertebrate communities are generally depauparate and similar to communities observed outside of the influence of the site. The similarity of benthic community metrics at locations BC01 and BC02 with other benthic community metric values in other areas of Bouttown Creek is particularly important due to the elevated concentrations of mercury in sediments at BC01 and BC02 relative to other portions of the creek. This finding indicates that the fundamental benthic community structure is not impacted by elevated concentrations of mercury in sediment at these locations.

  Sediment interstitial water results indicate that sediment metals concentrations exceeding SQBs are not present in interstitial water at concentrations likely to result in adverse effects. Because interstitial water is a better predictor of the bioavailability and toxicity of metals in sediments rather than bulk sediment measurements (EPA, 2007; EPA 2005; Di Toro et al., 2005; Ankley et al., 2006; Hansen et al., 1996; Ankley et al., 1991; Di Toro et al., 1992; Luoma, 1989), additional weight was afforded to this line of evidence in the risk characterization.

  The greatest potential for risk to benthic invertebrate communities is associated with sediment metals in the ditches draining Carneys Point. Maximum concentrations of 11 of 12 metals and multiple organic COPECs were associated with the ditches. Evaluation of exposure in the ditches was limited to the analysis of bulk sediment chemistry; therefore, there is some uncertainty regarding potential ecological impacts associated with ditch sediment.

  Additional investigations of ecological exposure in the Bouttown Creek ditches were recommended, including an assessment of potential COPEC bioavailability in sediments. An understanding of potential COPEC bioavailability would reduce uncertainty regarding potential risks to benthic communities associated with the ditches.

  Based on the Tier II Exposure Evaluation, no unacceptable risks were identified for wildlife receptors potentially foraging within Bouttown Creek. Only limited exceedances of NOAEL doses for methylmercury were identified for piscivorous mink; estimated doses were lower than LOAEL doses for all receptors evaluated. The estimated dose of methylmercury to mink was based on the conservative assumption that mink forage exclusively in Bouttown Creek 100 percent of the time. Given this conservative assumption and the inherent conservatism built into the dose rate models, adverse ecological effects are not likely for wildlife exposed to COPECs in sediments and prey items in Bouttown Creek.

- **Henby Creek:** No unacceptable risks were identified for benthic invertebrates, fish/reptiles, and wildlife receptors based on the tiered exposure evaluation conducted in the EI. No further evaluations on the basis of ecological risk are warranted for the Henby Creek exposure area.

  The weight-of-evidence approach used to evaluate benthic invertebrate exposure in Henby Creek indicates that sediment COPECs are not adversely impacting benthic communities. Benthic community data indicate that the generally depauparate benthic communities that inhabit on-site areas of Henby Creek are found in samples collected outside of the influence of site activities. Multiple lines of evidence indicate that metal COPECs in sediments are not bioavailable at concentrations likely to adversely affect benthic organisms:

  - Concentrations of metals in sediment interstitial water were lower than either NJSWQS or the NOEC benchmarks.
  - SEM:AVS ratios were less than 1.0 at three of four stations, indicating that sufficient AVS is present at most stations to form insoluble metal-sulfide complexes that are not bioavailable.
  - Concentrations of organic COPECs in sediment are lower than EqP benchmarks considered to be protective of benthic organisms.

  No surface-water COPECs were identified in Henby Creek; therefore, potential risks to fish and reptile communities associated with surface-water exposure are considered negligible.

  Wildlife exposure evaluations did not identify unacceptable risk to receptors potentially foraging within Henby Creek. Based on the more realistic assumptions of the Tier II Exposure Evaluation, the estimated dose of methylmercury to mink was the only exceedance of a NOAEL dose; the estimated dose of methylmercury to mink was lower than the LOAEL dose. As with Bouttown Creek, the estimated dose to mink was based on the conservative assumption that mink forage exclusively in Henby Creek 100 percent of the time. Given these conservative assumptions and the inherit conservatism built into the dose rate models, adverse ecological effects are not likely for wildlife exposed to COPECs in sediments and prey items in Henby Creek.

Henby-Bouttown Wetland System

Potential wetlands are abundant in areas adjacent to Henby Creek and Bouttown Creek. These potential wetlands represent ecological exposure areas along the conceptual contaminant migration pathway from SWMUs associated with the Carneys Point Works and the Henby-Bouttown Creek system. The results of the tiered exposure evaluations conducted in the EI support the following conclusions for the Henby-Bouttown Wetland System:

- **Bouttown Creek Wetlands:** The tiered exposure evaluation for the Bouttown Creek Wetlands did not identify unacceptable risks to wetland vegetation, wetland invertebrate communities, or wildlife potentially foraging throughout the exposure area. Based on these findings, no further evaluations of the Bouttown Creek Wetlands are warranted on the basis of ecological risk.

  Evaluation of the various measurement endpoints used to assess potential risks to wetland invertebrates in the Bouttown Wetlands indicate that adverse effects from exposure to sediment/hydric soils is unlikely. Concentrations of metals in sediment/hydric soil interstitial water were lower than either NJSWQS or NOEC benchmarks identified for sediment-dwelling organisms at all locations except zinc at BCW03, which resulted in a relatively low HQ_{NOEC} of 1.7. These results indicated that concentrations of metals in wetland substrates, although elevated above sediment quality guidelines (SQGs), are not bioavailable at concentrations likely to result in adverse ecological effects. As previously stated, interstitial water is a better predictor of the bioavailability and toxicity of metals in sediments when compared to bulk sediment measurements; therefore, additional weight was afforded to this measurement endpoint when evaluating potential invertebrate community impacts associated with metal concentrations.

  Wildlife exposure evaluations did not identify unacceptable risk to receptors potentially foraging within the Bouttown Wetlands. With the exception of red-winged blackbird exposure to methylmercury, exceedances of NOAEL doses in the conservative Tier I exposure models generally resulted in HQs of three or less. In the Tier II exposure models, which retained the conservative assumption of 100 percent area use by receptors, exceedances of NOAEL doses were relatively minor and only red-winged blackbird exposure to methylmercury and vanadium resulted in doses slightly exceeding LOAEL doses. Red-winged blackbird exposure is likely overestimated in the Tier II model by the assumption that birds would forage at the EPC 100 percent of the time. Based on these results, and considering the conservative assumptions of the Tier II models, adverse effects are not likely for wildlife exposed to COPECs in sediment and prey items in the Bouttown Wetlands.

- **Henby Creek Wetlands:** No unacceptable risks to ecological receptors were identified in exposure evaluations conducted for the Henby Creek Wetlands; therefore, no further evaluations of ecological exposures are warranted.

  Exposures to COPEC concentrations in wetland substrates are not likely to result in adverse ecological effects to wetland invertebrate communities. Based on the Tier II exposure evaluation, wetland substrates are not likely sufficiently inundated to support a fully aquatic (benthic) invertebrate community. Drier substrates are likely more conducive to use by terrestrial invertebrates. Comparisons of metal COPEC concentrations to Eco-SSLs indicate that zinc only slightly exceeds screening values for soil invertebrates (HQ = 1.8). Given that the Eco-SSLs are derived as conservative screening values, it is not likely that metals concentrations are sufficiently elevated to result in adverse effects to the invertebrate communities that may inhabit Henby Wetland substrates.

The wildlife exposure evaluations did not identify unacceptable risk to receptors potentially foraging within the Henby Creek Wetlands. With the exception of red-winged blackbird exposure to methylmercury, estimated doses of COPECs were lower than LOAELs based on the conservative Tier I model, which assumes that receptors forage at maximum concentrations 100 percent of the time. Based on the Tier II models, only slight exceedances of NOAEL doses were observed (HQs generally less than 2.0), and no estimated dose exceeded a LOAEL. Based on these results, and considering the conservative assumptions of the Tier II models, they are not likely to adversely affect wildlife exposed to COPECs in sediment and prey items in the Henby Wetlands.

Carneys Point Ponds and Historic Ponds

Potential ecological exposures were evaluated in Carneys Point for two ponds that currently contain surface water (A Pond and E Pond) and three historic ponds that are vegetated and no longer contain surface water (Historic B Pond and Historic E Ponds – Domestic and Fire Water). The findings of the tiered exposure evaluations support the following conclusions for the ponds and historic pond exposure areas:

- **A Pond:** No unacceptable risks were identified in the tiered exposure evaluation of A Pond. The value of aquatic habitat is limited in A Pond by shallow water depths and highly organic sediments, which result in reduced, low-oxygen conditions that are limiting to benthic invertebrate communities. Due to its shallow water depths and low oxygen conditions, A Pond is not likely to support a fish community; vertebrate use of the aquatic habitat in A Pond is likely limited to reptile communities. Potential wildlife use of A Pond is likely limited by its small size (0.007 acres).

  Considering the results of the exposure evaluation in the context of the limited habitat value associated with A Pond, no unacceptable risks were identified. Potential risks to benthic invertebrate communities are primarily limited to elevated metal concentrations that may be mitigated by high AVS concentrations. Potential risks associated with reptile exposure to surface water are considered negligible based on NOEC benchmarks for sensitive life stages of amphibians. Negligible risks to wildlife were identified based on the most conservative exposure assumptions including maximum exposure concentrations and 100 percent area use. Based on these findings, no further evaluation of A Pond is warranted.

- **Historic B Pond:** The Tier II exposure evaluation of sediment/hydric soils in Historic B pond did not identify unacceptable risks to wetland invertebrate or wildlife receptors. No evidence of stressed or dead vegetation was observed, indicating that COPEC impacts to the vegetative community are unlikely. Wetland invertebrate exposures did not exceed effects-based SQGs for arsenic or mercury or the Ecological Soil Screening Level (Eco-SSL) value for total (tPAHs). Equilibrium partitioning sediment benchmark (ESB) models for tPAHs also indicated that substantial impacts to invertebrate communities are unlikely. Potential wildlife use of Historic B Pond is likely limited due to its inaccessibility from thick stands of *Phragmites*, which dominate the vegetative community, and its relatively small size of 0.2 acres. No unacceptable risks to wildlife receptors were identified from Tier II wildlife exposure models. Based on these findings, no unacceptable risks to ecological receptors are identified for Historic B Pond; no further evaluations are warranted for this exposure area.

- **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 Tier II exposure evaluation did not identify unacceptable risks to ecological receptors. The Domestic Water Pond provides limited habitat to support permanent aquatic communities due to shallow water depths and highly organic sediments, which limits the available oxygen in sediments and surface water necessary to support aquatic communities. Elevated AVS concentrations in the sediment are indicative of low-oxygen, reducing conditions. Oxygen-limiting conditions in highly organic sediments limit the establishment of a diverse and abundant benthic invertebrate community.

  Considering the limiting habitat conditions identified in the Domestic Water Pond, the results of 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 (EPOND02); however, given the habitat limiting conditions in the sediments, a diverse and abundant benthic invertebrate community is not expected to occur in the Domestic Water Pond. Potential risks associated with reptile exposure to surface water are considered negligible based on concentrations not exceeding NJSWQS, which are generally protective of aquatic organisms. Unacceptable risks to wildlife were not identified in Tier II wildlife exposure evaluations. Based on these findings, no unacceptable risks to ecological receptors are identified, and no further evaluations are warranted for this exposure area.

  - **Historic 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 Historic E Ponds. Maximum concentrations of nitrocellulose exceeded a conservative NOEC concentration for chironomid exposure; however, concentrations of nitrocellulose were not present in soil at concentrations related to a physical barrier to colonization from nitrocellulose coating of substrates. Conservative wildlife exposure models indicate 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 is warranted in the Historic E Ponds.

Carneys Point Uplands

The evaluation of mobile wildlife exposure to COPECs concentrations in upland soil did not identify unacceptable risk. 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 Tier I exposure assumptions. Based on these results, and considering the conservative assumptions of the overall exposure models, adverse ecological effects are not likely for wildlife exposed to COPECs in soil from upland SWMUs in the Carneys Point Area. No further evaluation of these exposure areas are warranted based on ecological risk.

3.2.4 EI Conclusions and Recommendations

Overall, unacceptable risks resulting from exposure to site-related constituents were not identified in any of the Carneys Point exposure areas evaluated in the EI, with the possible exception of the ditches draining upland areas of Carneys Point to Bouttown Creek. The evaluation of potential ecological impacts associated with these ditches was limited to bulk sediment chemistry analyses, resulting in uncertainty that required further investigation.

The EI recommended additional investigations to address the uncertainty regarding ecological exposure in the Bouttown Creek ditches. Additional investigations were warranted to assess the bioavailability of sediment COPECs, particularly metals, to benthic invertebrate communities. The greatest potential for risk to benthic invertebrate communities in Bouttown Creek was associated with exposure to sediments in the ditches; maximum concentrations of 11 of 12 metals and multiple organic COPECs evaluated in Bouttown Creek were reported in the ditches. Because available data for the ditches was limited to bulk sediment chemistry analyses, there was uncertainty regarding potential COPEC bioavailability. An understanding of COPEC bioavailability was necessary to reduce the uncertainty regarding potential risks to benthic communities associated with the ditches.

4.0 Bouttown Creek Ditch Investigation

As discussed in the previous section, the EI conducted for the Chambers Works site recommended additional evaluation of ecological exposures in the ditches draining upland areas of Carneys Point to Bouttown Creek. The greatest potential for risk to benthic invertebrate communities in Bouttown Creek was associated with sediment COPEC concentrations in the ditches. Further investigations were recommended to reduce uncertainty regarding potential risks to benthic invertebrate communities associated with the ditches. The EI did not identify unacceptable risks to wildlife in the Bouttown Creek exposure area; therefore, no additional evaluation of wildlife exposure was included for the ditches.

The investigation of the Bouttown Creek ditches was conducted in October 2009. The overall objective of the investigation was to collect additional data to address uncertainty regarding benthic invertebrate exposure in the ditches. Based on the risk characterization presented in the EI, maximum concentrations of 11 of 12 metals and multiple organic COPECs in the Bouttown Creek exposure area were associated with the ditches; however, only bulk sediment chemistry data were available to evaluate potential risks to benthic receptors. Based on the framework established in the EI for Tier II exposure evaluations, additional data were collected to evaluate the following lines of evidence:

- The bioavailability and toxicity of metal COPECs in sediment based on measured concentrations of metals in filtered sediment interstitial water
- The bioavailability and toxicity of divalent metal COPECs (cadmium, copper, lead, nickel, and zinc) based on sediment TOC concentrations and relative molar concentrations of SEM and ASV (EPA, 2005)
- The potential bioavailability and toxicity of PAHs and n-nitrosodiphenylamine based on equilibrium partitioning to sediment TOC (EPA, 2003)

The following sections describe the investigation approach and present the findings of the additional ecological exposure evaluation conducted in the Bouttown Creek ditches.

4.1 Investigation Approach

The following sections detail the field sampling activities and data evaluation conducted to support the Bouttown Creek ditch investigation.

4.1.1 Field Sampling Activities

Sampling to support the Bouttown Creek investigation was conducted during October 20-22, 2009. Surficial sediment (0-6 inches) and sediment interstitial water samples were collected from 11 stations within the ditches draining the upland areas of Carneys Point to Bouttown Creek. Nine sampling stations were approximately co-located with historic sediment sampling stations; two additional stations were located at intersections within the ditch system to increase the spatial coverage of the dataset (see Figure 5).

Surficial sediment samples were collected from 0-6 inches using a petite ponar, consistent with sampling procedures detailed in Appendix B of the EI Work Plan (DuPont CRG, 2008). Analyses of sediment samples focused on COPECs identified in sediment samples from the Carneys Point area as identified in the EI Report (see Table 7); additional sediment analyses included TOC, grain size, and SEM-AVS analyses.

Sediment interstitial water samples were collected using a Push Point sampler, consistent with the sampling procedures used in the EI (DuPont CRG, 2008). The PushPoint sampler is a small bore, stainless-steel tube fashioned with a screened zone at the bottom end and a sampling port at the top. At each sampling location, the sampler was inserted into the sediments, and interstitial water was extracted using a low-flow peristaltic pump via dedicated tubing attached to the sampling port. At most stations, fine-grained, clay sediments adhered to the screened zone of the PushPoint sampler, eventually preventing the flow of interstitial water through the sampling port before an adequate sample volume could be collected. In these instances, the sampler was removed, the adhered sediment was cleared from the screened zone, and the sampler was re-inserted into the sediments to collect additional aliquots of interstitial water. This process was repeated multiple times to obtain the requisite sample volume for analysis.

At each location, an unfiltered sample of interstitial water was collected and analyzed for hardness and a filtered sample (0.2-µm filter) was collected and analyzed for metal COPECs. In addition to the collection of analytical samples, pH, conductivity, and oxidation-reduction potential (ORP) of unfiltered interstitial water and surface-water samples were measured *in situ* with a Myron 6P meter. Comparable conductivity measurements in interstitial water and surface water suggest that overlying surface water may have been drawn into the interstitial water sample.

Quality control samples for sediment and sediment interstitial water sampling included equipment blanks, field duplicates, and matrix spike/matrix spike duplicates samples (MS/MSD). All quality control samples were collected at the frequency detailed in the REIWP (DuPont CRG, 2008).

4.1.2 Data Evaluation

The evaluation of data collected in the Bouttown Creek ditch investigation was consistent with the weight-of-evidence framework established in the Tier II exposure evaluations conducted in the EI. Tier II exposure evaluations used EqP guidance and methodologies to assess the potential bioavailability and toxicity of sediment COPECs to benthic invertebrates based on site-specific mitigating factors (e.g., TOC, sulfides). The following sections summarize the primary elements included in the weight-of-evidence data evaluation:

- **Sediment Chemistry:** Bulk sediment chemistry results were compared to the greater value of the lowest effects level (LEL) sediment screening values or the background UTL_{95}. LELs are generally developed from and applied to a broad range of sediment conditions and, therefore, may have less relevance to site conditions. LELs provide little information on the bioavailability or toxicity of a particular constituent and assume a direct causal relationship between constituent concentrations and observed effects. Therefore, additional site-specific lines of evidence, including sediment interstitial water and EqP models were used to further evaluate the bioavailability and toxicity of sediment COPECs.

- **Sediment Interstitial Water Chemistry:** Metal concentrations measured in filtered interstitial water samples represent the bioavailable fraction of metals in sediment. It is generally accepted that the bioavailability and toxicity of metals in sediments is correlated with the bioavailable fraction of metals in sediment interstitial water rather than the total metal concentration measured in bulk sediment (EPA, 2007; Di Toro et al., 2005; Ankley et al., 2006; Hansen et al., 1996; Ankley et al., 1991; Di Toro et al., 1992; Luoma, 1989). Therefore, the direct measurement of metal concentrations in sediment interstitial water is a better indicator of potential metal toxicity in sediments than comparisons of bulk sediment concentrations to LELs. Concentrations of metals measured in sediment interstitial water results were compared to NJSWQS and/or NRWQC to evaluate potential adverse effects to benthic invertebrate receptors.
- **ESB Model for Metals Mixtures:** The bioavailability, and thus the potential toxicity, of divalent metal COPECs can be estimated based on AVS concentrations in sediment. The combination of AVS and SEM forms insoluble metal-sulfides that are not biologically available for uptake by benthic organisms (Di Toro et al., 1992; Ankley et al., 1996; Berry et al., 1996). If the ratio of the molar concentration of AVS is greater than the molar concentration of SEM (SEM:AVS < 1), divalent metal COPECs are not expected to be bioavailable or toxic (EPA, 2005).

  Normalizing SEM:AVS results by sediment TOC concentrations provides further indication of the bioavailability and toxicity of divalent metals in ditch sediments. Normalization by TOC considers the capacity of sediment organic carbon to bind divalent metals, in addition to the metal-binding of capacity to sulfides. EPA (2005) reported that TOC-normalization improved the ability of the SEM:AVS ratios to predict toxicity in paired sediment and toxicity testing datasets. Consistent with EPA (2005), the combined binding capacity of TOC and AVS was considered based on the following relationship: SEM-AVS/f_{oc}. Based on survival data from sediment toxicity testing, EPA (2005) reported that SEM-AVS/f_{oc} values less than 130 µmol/g_{oc} were unlikely to result in toxicity, while toxicity was likely to occur at values SEM-AVS/f_{oc} > 3,000 µmol/g_{oc}; toxicity at values in between these thresholds was uncertain (EPA, 2005).
- **ESB Model for PAH Mixtures:** Concentrations of tPAHs in sediment samples were evaluated based on the additive toxicity of tPAHs to benthic organisms consistent with EPA guidance (EPA, 2003). The toxicity of 13 individual PAH compounds was expressed as the sum of equilibrium sediment benchmark toxic units ($\Sigma ESBTU_{FCV}$), which represents the sum of the organic-carbon normalized sediment concentration divided by the organic-carbon normalized final chronic value (FCV) developed for each compound (EPA, 2003). For the purposes of $ESBTU_{FCV}$ calculations, 50 percent of the detection limit was used to estimate the concentration of PAH compounds below the detection limit. To account for other PAH compounds that were not measured in the sample, the sum of the toxicity

units for the 13 PAH compounds is multiplied by an uncertainty factor of 6.78, which estimates the toxicity units of t PAHs with 80 percent confidence. If the $ESBTU_{FCV}$ calculated for a sample is greater than 1.0, it is concluded that PAH mixtures exceed levels that are protective of benthic organisms (EPA, 2003).

- **EqP Sediment Quality Guidelines:** As described in detail in Appendix G of the EI, site-specific sediment quality benchmarks representing NOECs (EqP_{NOECs})were calculated for n-nitrosodiphenylamine using EqP based on the following relationship (Jones et al., 1997):

$$SQG = f_{oc} \; x \; K_{oc} \; x \; WQB,$$

where:

f_{oc} = the fraction of organic carbon in the site sediment (SQGs were calculated based on exposure area-specific organic carbon concentrations)

K_{oc} = the organic carbon partition coefficient

WQB = water quality benchmarks based on measured or estimated NOECs; when available, toxicity data for benthic organisms likely to occur at the site were selected as WQBs

4.2 Investigation Findings

The results of sediment and interstitial sediment sampling are presented in Figure 5. A summary of sediment results is provided in Table 8; sediment interstitial water analytical results are provided in Table 9.

Sediments in the Bouttown Creek ditches were characterized by loosely consolidated, highly organic, fine-grained (silt/clay) material. The distribution of fine-grained sediments in ditch sediment ranged from 34 to 95 percent silt/clay (passing 64 µm), with 10 of 11 stations containing greater than 50 percent fine-grained sediments (see Figure 6). TOC content of sediments ranged from 2.5 to 15 percent (see Figure 7), with sediments at 10 of 11 stations containing TOC concentrations greater than 5 percent. Reducing conditions were observed in sediments at most locations, as indicated by hydrogen sulfide odor and dark brown-black color. *In situ* sediment ORP measurements also indicate reducing conditions, ranging from -126.8 to -211.6 millivolts (mV).

4.2.1 Metals

The evaluation of benthic invertebrate exposure to metal COPECs in Bouttown Creek ditch sediments indicates that the limited benthic invertebrate communities present in the ditches are not likely adversely affected by sediment metals concentrations. Multiple lines of evidence indicate that metals in sediment are likely bound and, therefore, not bioavailable or toxic to benthic invertebrates. When the limited bioavailability and toxicity of sediment metals are considered in the context of benthic habitat quality, adverse effect associated with metal COPECs in sediment are not likely.

Concentrations of nine metals (arsenic, beryllium, cadmium, chromium, lead, mercury, selenium, vanadium, and zinc) were detected in sediment at concentrations that exceeded

LELs and background UTL_{95} concentrations presented in the EI. In general, the northern two ditches contained greater mercury and PAH concentrations in sediment, while the southern two ditches contained greater concentrations of lead and zinc in sediment (see Figure 5).

An evaluation of SEM-AVS data indicates that divalent metals in the ditches are not bioavailable or toxic to benthic receptors. SEM:AVS ratios were less than 1.0 for all but two stations (BCD-08 and BCD-09), indicating that a sufficient concentration of AVS is present in the sediment to bind divalent metals into metal-sulfide complexes (see Figure 8). These metal-sulfide complexes are insoluble and, therefore, are not generally bioavailable to sediment-dwelling organisms (Di Toro et al., 1992; Ankley et al., 1996; Berry et al., 1996). SEM:AVS ratios at BCD-08 and BCD-09 were 1.2 and 4.7, respectively (see Figure 5).

Normalizing the SEM:AVS results by TOC concentrations provides further support for the limited bioavailability of divalent metals in ditch sediments. As previously discussed, TOC normalization considers the capacity of sediment organic carbon to bind divalent metals and improves the ability of the SEM-AVS relationship to predict toxicity (EPA, 2005). As illustrated in Figure 9, SEM-AVS/f_{oc} values were less than 130 µmol/g_{oc} at all 11 stations evaluated in the ditch system. As previously discussed in Section 4.1.2, 130 µmol/g_{oc} is the threshold below which toxicity to benthic invertebrates is unlikely (EPA, 2005). Based on the relative concentrations of SEM, AVS, and TOC in ditch sediments, it is unlikely that divalent metals are bioavailable or toxic to benthic invertebrate receptors.

Sediment interstitial water results provide additional support for the limited bioavailability of sediment metals. Of the 10 metals evaluated, only nickel, vanadium, and zinc were detected in filtered interstitial water samples; concentrations of all three metals were below NJSWQS (see Figure 5). These results indicate that metals in sediments are bound to sediment particulates and are not present in sediment interstitial water in the free ion form considered to be most bioavailable.

In situ measurements indicate that sediment interstitial water conductivity was generally greater relative to surface water conductivity (see Figure 10). In cases where comparable conductivities were measured in interstitial water and surface water, multiple aliquots of interstitial water samples were collected due to sediment adhering to the PushPoint screen. The adherence of sediment to the sampler confirms that the PushPoint was inserted into the sediment matrix and that the interstitial water was collected from within that matrix. The similarity of interstitial water to surface water at these stations may be related to the loosely consolidated sediments, ranging from approximately 50 to 85 percent moisture, which may contain a higher proportion of overlying water within the sediment slurry (see Table 8).

When the SEM-AVS and sediment interstitial water results are considered in the context of the benthic habitat characteristics, it is unlikely that COPEC concentrations in sediment are adversely affecting benthic invertebrate communities in the ditches. As demonstrated in the benthic community surveys conducted as part of the EI, benthic invertebrate communities within the Bouttown Creek channel are generally depauperate and similar to communities observed outside of the influence of the site. The ditches provide lower quality benthic habitat relative to the benthic habitat within the creek channel because the ditches are more susceptible to changes in seasonal hydrology (e.g., drying) and low-oxygen conditions that are consistent with stagnant, shallow surface water and highly organic, fine-grained sediments. As a result, it is not expected that the ditches would support a more abundant or diverse benthic community than the generally depauperate communities characterized at on-site and reference locations in the EI. Furthermore, due to the quiescent, backwater character, Bouttown Creek represents a stable depositional environment. Sediments in the ditches are not regularly disturbed by high flows, indicating a stability of the reducing conditions that mitigate the bioavailability and toxicity of metals in sediment.

4.2.2 Organics

The evaluation of benthic invertebrate exposure to organic COPECs at select ditch locations indicates that adverse effects to invertebrates are not likely. The evaluation of $ESBTU_{FCV}$ for PAH mixtures in sediment at two ditch stations (BCD-01 and BCD-05) resulted in values ranging from 0.98 to 2.0 (see Table 10). As discussed in Section 4.1.2, $ESBTU_{FCV}$ values less than 1.0 are considered to be protective of benthic invertebrates; concentrations greater than 1.0 do not indicate adverse effects but indicate that the potential for adverse effects cannot be eliminated. Given the limited benthic habitat quality in the ditches described in the preceding section and the relatively low exceedance of the conservative $ESBTU_{FCV,}$ it is not likely that tPAHs in sediments at these locations are adversely affecting benthic invertebrate communities.

The evaluation of n-nitrosodiphenylamine concentrations in sediment at BCD-05 indicates minimal potential for adverse effects to benthic invertebrate communities. Measured concentrations of n-nitrosodiphenylamine were approximately two orders of magnitude lower than TOC-specific EqP sediment quality guidelines calculated based on methods utilized in the EI (see Table 11; see Figure 5). In the context of the limited habitat quality in the ditches, it is unlikely that n-nitrosodiphenylamine concentrations in sediment are adversely affecting benthic invertebrate communities.

4.3 Investigation Conclusions

The findings of the Bouttown Creek ditch investigations described in the previous sections reduce the uncertainty identified in the EI regarding benthic invertebrate exposure to sediment COPECs. The findings of the investigation support the following conclusions regarding benthic invertebrate exposure in the ditches:

- Based on SEM-AVS measurements and sediment interstitial water results, 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.
- Sediments in the ditches are not regularly disturbed by high flows, indicating a stability of the reducing conditions in sediments that mitigate the bioavailability and toxicity of metals.

- Benthic habitat quality is limited in the ditches relative to on-site and reference locations in Bouttown Creek that were characterized in the EI by generally depauperate benthic invertebrate communities.

In total, the findings of the investigations described in the preceding sections adequately address the uncertainty in the EI regarding potential benthic invertebrate exposure in the Bouttown Creek ditches. These findings do not indicate unacceptable risks and support the recommendation of no further investigation in the Bouttown Creek ditches on the basis of ecological risk.

5.0 Carneys Point Ecological Investigation Conclusions

Ecological investigations in the Carneys Point portion of Chambers Works have been conducted in accordance with NJDEP *Technical Requirements for Site Remediation* and under the oversight of NJDEP and EPA. Consistent with the process prescribed in N.J.A.C. 7:26E for conducting ecological investigations, three phases of ecological investigations in Carneys Point have been conducted. The findings of each phase of investigation have been reported in the BEE, EI Report, and this report.

The findings of the BEE provided the basis for the comprehensive EI field investigations conducted between March 2007 and July 2008. In addition to the recommendations of the BEE, the scope of the EI was developed based on EPA and NJDEP review and subsequent comments on the BEE and REIWP.

Overall, the comprehensive EI did not identify unacceptable risks resulting from exposure to site-related constituents in the Carneys Point exposure areas, with the possible exception of the ditches draining upland areas of Carneys Point to Bouttown Creek. The greatest potential for risk to benthic invertebrate communities in Bouttown Creek was associated with sediment COPEC concentrations in the ditches; the EI did not identify unacceptable risks to wildlife in the Bouttown Creek exposure area. The evaluation of potential benthic community impacts associated with these ditches was limited in the EI to bulk sediment chemistry analyses, resulting in uncertainty that required further investigation. Based on the EI recommendations, further investigations were conducted in October 2009 to address the uncertainty associated with benthic invertebrate exposure in the ditches.

The Bouttown Creek ditch investigation was conducted in October 2009, with the objective of reducing uncertainty identified in the EI regarding benthic invertebrate exposure to sediment COPECs. The findings of the investigation indicated limited bioavailability and toxicity of sediment COPECs to benthic invertebrates. When considering the limited bioavailability and toxicity of sediment COPECs in the context of the benthic habitat characteristics, including benthic habitat quality and sediment stability, it is unlikely that COPEC concentrations in sediment are adversely affecting benthic invertebrate communities. The findings of the ditch investigations adequately address the uncertainty in the EI and provide multiple lines of evidence indicating the absence of unacceptable risk to benthic invertebrates. As a result, the findings support the recommendation of no further ecological investigation in the Bouttown Creek ditches.

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

- 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 these comprehensive 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 Historic 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, which is the primary constituent group of concern

The integrated findings of the multiple ecological investigations described in this document support the recommendation of no further ecological investigation or remedial action in Carneys Point on the basis of ecological risk.

6.0 References

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Tables

Table 1
List of COPECs Identified in Surface Soil
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

SWMU/ Investigation Area	SWMU Description / Analyte:	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc	2,4-Dinitrotoluene	Bis (2-ethylhexyl)phthalate	N-nitrosodiphenylamine	Nitrocellulose
45-2	Manufacturing Area 2		I			I	I	I			I	I				
45-9	Manufacturing Area 9		I		I	I	I	I	I	I		I				
47	Area of Fill Deposition				I			I		I						
48-1	Carneys Point Storage/Cleaning Area 1															
48-3	Carneys Point Storage/Cleaning Area 3															
48-5	Carneys Point Storage/Cleaning Area 5															
48-6	Carneys Point Storage/Cleaning Area 6															
48-7	Carneys Point Storage/Cleaning Area 7															
52	Debris Disposal Area	I	I	I	I	I	I	I	I			I	I	I	I	I
54	Solvent Recovery Units															
60	Drum Disposal Area	I				I										
61	Disposal Area II					I	I	I				I				
40-Acre Parcel	Potential Land Transaction East of 48-6 and 48-7															

Table 2
Analytes Selected for Investigation in the Carneys Point Area
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Analyte	COPECs Identified in the Baseline Ecological Evaluation				EI Analyte List Carneys Point
	Sediment	Surface Water	Ground Water	Surface Soils	
	Henby and Bouttown Creeks	Henby and Bouttown Creeks	Carney's Point Area	Carney's Point Area SWMUs	
Volatile Organic Compounds					
Chloroform			l		
Semi-Volatile Organic Compounds					
2,4-dinitrotoluene	l			l	l
bis(2-ethylhexyl)phthalate				l	l
N-nitrosodiphenylamine	l			l	l
Polycyclic Aromatic Hydrocarbons[1]					l
Acenapthene	l				
Benzo(b)fluoranthene	l				
Chrysene	l				
Naphthalene	l				
Phenanthrene	l				
Pyrene	l				
Nitroaromatics/Nitroamines					
Nitrocellulose				l	l
Metals[2]					
Antimony				l	l
Arsenic	l			l	l
Cadmium	l			l	l
Chromium	l			l	l
Copper	l		l	l	l
Lead	l	l	l	l	l
Mercury	l	l		l	l
Nickel	l			l	l
Selenium				l	l
Silver				l	l
Vanadium			l		l
Zinc	l		l	l	l

Notes:

[1], Analyses of PAHs included the following PAH compounds:

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

[2], Analyses for metals in surface water were conducted on filtered and unfiltered samples; sediment interstitial water was analyzed from filtered samples only.

Table 3
Number of Samples Available for Evaluation in the Ecological Investigation
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Area of Investigation	Surface Water	Sediment	Hydric Soils	Sediment/Hydric Soil Interstitial Water	Benthic Community
Henby-Bouttown Creek System					
Helms Basin	4	4			
Henby Creek	4	**6**		2	4
Bouttown Creek	**11 (7)**	**30 (7)**[1]		2	4
Henby-Bouttown Wetland System					
Henby Wetlands			4		
Bouttown Wetlands			6	5	
Carneys Point Ponds and Historic Ponds					
A Pond (east of SWMU-45-2)	2	2			
B Pond (east of SWMU-45-2)			2		
E Ponds (SWMU 44)	2	2	4		
Manufacturing Area Ponds and B Basin					
C Pond (east of SWMU 8)	2	2			
D Pond (east of SWMU 8)	2	2			
B Basin					
Background Datasets:					
Off-Site Bouttown and Henby Creeks	8	8			4
Cedar Swamp	**10 (8)**	**12 (8)**			

Notes:
Bold values indicate total number of combined samples collected during the EI and previous phases of the RI; values in parentheses indicate number of samples collected during the EI field investigations in October 2007.
[1], Total number of samples includes 10 samples collected as part of the T29 investigation in March/June 2008 (DuPont CRG, 2008).

Table 4
Assessment and Measurement Endpoint Evaluated for Complete Exposure Pathways
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Assessment Endpoint	**Henby-Bouttown Creek System**			**Henby-Bouttown Wetland System**		**Carneys Point Ponds and Historic Ponds**					**Carneys Point Uplands**
Measurement Endpoint	**Helms Basin**	**Henby Creek**	**Bouttown Creek**	**Henby Wetlands**	**Bouttown Wetlands**	**A Pond**	**Historic B Pond**	**E Pond Domestic Water**	**Historic E Pond Fire Water**	**Historic E Pond Settling Basin**	
Benthic Macroinvertebrate Community:											
Sediment Concentration vs. Sediment Benchmark (NOEC/LOEC)[1]	I	I	I			I		I			
SEM:AVS	I	I	I			I		I			
Community Assessment		I	I								
Sediment Interstitial Water Concentration v. NOEC/LOEC		I	I								
Fish/Herptile Community:											
Surface Water Concentration v. NOEC/LOEC	I	I	I			I		I			
Avian Wildlife Community: Dose-rate modeling of average daily dose (ADD) v. NOAEL/LOAEL											
Mallard	I	I	I			I		I			
Great blue heron	I	I	I			I		I			
Osprey	I	I	I								
Red-winged blackbird				I	I		I		I	I	
American woodcock				I	I		I		I	I	I
American robin											I
Barred owl											I
Mourning dove											I
Red-tailed hawk											I
Mammalian Wildlife Community: Dose-rate modeling of average daily dose (ADD) v. NOAEL/LOAEL											
Mink	I	I	I	I	I	I	I	I			
Raccoon	I	I	I	I	I	I	I	I	I	I	
Meadow vole											I
Short-tailed shrew											I
Long-tailed weasel											I
Red fox											I
Wetland Vegetative Community:											
Qualitative evaluation based on field observations of the vitality of the communities				I	I		I		I		
Wetland Invertebrate Community:											
Sediment/Hydric Soil Concentration vs. NOEC/LOEC				I	I		I		I	I	
SEM:AVS				I	I		I		I	I	
Sediment/Hydric Soil Interstitial Water Concentration v. NOEC/LOEC					I						

Notes:
[1], Sediment exposure to polycyclic aromatic hydrocarbons (PAHs) were evaluated based on the *Equilbrium Partitioning Sediment Benchmark (ESB) Model for PAH Mixtures* (EPA, 2003);
equilibrium partitioning (EqP) sediment quality guidelines were also calculated for select organic constituents.

Table 5
Assumptions for Tiered Exposure Evaluations
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Receptor Category	Tier I Exposure Evaluation		Tier II Exposure Evaluation	
Direct Contact Exposure Pathways				
Benthic Invertebrate Community	**Sediment Chemistry:** **Interstitial Chemistry:** **Community Analysis:**	[Max] vs. LEL SEM:AVS ratios [Max] vs. NJSWQS/NRWQC Comparison with off-site (creeks only)	**Sediment Chemistry:** **Interstitial Chemistry:** **Community Analysis:**	[Max] vs. SEL SEM:AVS ratios ESB Model for PAH Mixtures EqP Sediment Benchmarks [Max] vs. benthic NOECs Comparison with off-site (creeks only)
Wetland Invertebrate Community	**Sediment Chemistry:** **Interstitial Chemistry:**	[Max] vs. LEL SEM:AVS ratios [Max] vs. NJSWQS/NRWQC	**Sediment Chemistry:** **Interstitial Chemistry:**	[Max] vs. SEL (aquatic) [Max] vs. SSL (terrestrial) SEM:AVS ratios [Max] vs. benthic NOECs
Fish/Herptile Community	**Surface Water Chemistry:**	Analytical: [Max] vs. NJSWQS/NRWQC	**Surface Water Chemistry:**	[Max] vs. NOEC for amphibians
Wildlife Ingestion Exposure Pathways				
Wildlife Community	**Dose Rate Modeling:**	EPCs: [Max] AUFs: 1.0	**Dose Rate Modeling:**	EPCs: UCL_{95} (n ≥ 8) or mean (n < 8) AUFs: Expsoure Area/Home Range

Notes:
[Max], Maximum concentration
AUF, Area use factor
EPC, Exposure point concentration
EqP, Equilibrium partitioning
ESB, Equilibrium sediment benchmarks for PAH mixtures
LEL. Lowest effects level
NJSWQS, New Jersey Surface Water Quality Standards
NOEC, No observed effect concentration
NRWQC, National Recommended Water Qualtiy Criteria
SEL, Severe effects level
SEM:AVS, Ratio of the molar concentrations of simultaneously extractable metals to acid volatile sulfides
SSL, Ecological soil screeing level (Eco-SSL)
UCL_{95}, 95 percent upper confidence limit of the mean

Table 6
Summary of Tiered Exposure Evaluations and EI Conclusions
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
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 are not indicative of impacts to benthos in the creek	Ditches: Further evaluate COPEC bioavailability in the biologically active zone of ditch sediments to reduce uncertainty regarding potential impacts to benthic invertebrates 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 are 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 are 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
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 is fully vegetated	No further evaluation conducted	No further evaluation warranted

Table 6
Summary of Tiered Exposure Evaluations and EI Conclusions
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Exposure Area Receptor Category	Tier I Exposure Summary	Tier II Exposure Summary	Ecological Investigation Conclusions and Recommendations
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 are 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 is 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 are 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
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 Historic 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

Table 6
Summary of Tiered Exposure Evaluations and EI Conclusions
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
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 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
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

Table 7
List of Target COPECs for Bouttown Creek Ditches
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Target COPECs	
Metals	**Select Organics**
Arsenic	Total PAHs (tPAH)
Beryllium	N-Nitrosodiphenylamine (NDPA)
Cadmium	
Chromium	
Copper	
Lead	
Mercury	
Nickel	
Selenium	
Zinc	

Table 8
Summary of Sediment Results
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Analyte	Units	Number of Samples	Number of Detections	Minimum Detected Concentration	Maximum Detected Concentration	Ecological Benchmark Concentration	Benchmark Type	Benchmark Source	Background UTL Concentration	COPEC Decision
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)										
ACENAPHTHENE	UG/KG	2	1	250	250	16	ERL	NJDEP 1998	NA	Y
ACENAPHTHYLENE	UG/KG	2	0	0	0	44	ERL	NJDEP 1998	NA	N
ANTHRACENE	UG/KG	2	2	270	350	220	LEL	NJDEP 1998	NA	Y
BENZO(A)ANTHRACENE	UG/KG	2	2	810	1400	320	LEL	NJDEP 1998	NA	Y
BENZO(B)FLUORANTHENE	UG/KG	2	2	1500	4100	1800	AET	NOAA 2006	NA	Y
BENZO(G,H,I)PERYLENE	UG/KG	2	2	500	740	170	LEL	NJDEP 1998	NA	Y
BENZO(K)FLUORANTHENE	UG/KG	2	2	630	1300	240	LEL	NJDEP 1998	NA	Y
BENZO(A)PYRENE	UG/KG	2	2	760	1100	370	LEL	NJDEP 1998	NA	Y
CHRYSENE	UG/KG	2	2	1100	2000	340	LEL	NJDEP 1998	NA	Y
DIBENZ(A,H)ANTHRACENE	UG/KG	2	1	210	210	60	LEL	NJDEP 1998	NA	Y
FLUORANTHENE	UG/KG	2	2	1100	2500	750	LEL	NJDEP 1998	NA	Y
FLUORENE	UG/KG	2	1	580	580	190	LEL	NJDEP 1998	NA	Y
INDENO(1,2,3-CD)PYRENE	UG/KG	2	2	480	780	200	LEL	NJDEP 1998	NA	Y
NAPHTHALENE	UG/KG	2	0	0	0	160	ERL	NJDEP 1998	NA	N
PHENANTHRENE	UG/KG	2	2	170	690	560	LEL	NJDEP 1998	NA	Y
PYRENE	UG/KG	2	2	840	2000	490	LEL	NJDEP 1998	NA	Y
Total PAHs (non-detects 50% detection limit)	UG/KG	2	2	12465	14290	4000	LEL	NJDEP 1998	NA	Y
Total PAHs (non-detects as zeros)	UG/KG	2	2	12150	14010	4000	LEL	NJDEP 1998	NA	Y
SEMI-VOLATILE ORGANIC COMPOUNDS										
N-NITROSODIPHENYLAMINE	UG/KG	1	1	310	310	28343	EqP	DuPont CRG 2008	NA	N
METALS										
ARSENIC	MG/KG	11	11	7.91	34.4	6	LEL	NJDEP 1998	16.5	Y
BERYLLIUM	MG/KG	11	5	0.449	3.47	NS	--	--	2.641	Y
CADMIUM	MG/KG	11	11	0.667	16.1	0.6	LEL	NJDEP 1998	2.28	Y
CHROMIUM	MG/KG	11	11	42.8	71	26	LEL	NJDEP 1998	79.12	N
COPPER	MG/KG	11	11	37.3	911	16	LEL	NJDEP 1998	170.2	Y
LEAD	MG/KG	11	11	75	1020	31	LEL	NJDEP 1998	296.8	Y
MERCURY	MG/KG	11	11	0.784	12.2	0.2	LEL	NJDEP 1998	0.712	Y
NICKEL	MG/KG	11	11	20.8	52.3	16	LEL	NJDEP 1998	58.64	N
SELENIUM	MG/KG	11	2	5.79	18.3	5	--	BC	ND	Y
VANADIUM	MG/KG	11	11	40.1	231	NS	--	--	115.5	Y
ZINC	MG/KG	11	11	194	4100	120	LEL	NJDEP 1998	1101	Y
SEM-AVS ANALYSES										
CADMIUM	UMOL/G	11	11	0.00152	0.00991	--	--	--	NA	--
COPPER	UMOL/G	11	11	0.0367	0.361	--	--	--	NA	--
LEAD	UMOL/G	11	11	0.0474	0.449	--	--	--	NA	--
NICKEL	UMOL/G	11	11	0.0178	0.0628	--	--	--	NA	--
ZINC	UMOL/G	11	11	0.372	6.3	--	--	--	NA	--
Sum SEM	UMOL/G	11	11	0.49412	7.09371	--	--	--	NA	--
ACID VOLATILE SULFIDE (AVS)	UMOL/G	11	10	0.92	18.4	--	--	--	NA	--
SEM:AVS	UMOL/G	11	11	0.033966848	4.72914	1	ESB	USEPA 2005	NA	Y
SEM-AVS/foc	$UMOL/G_{OC}$	11	11	-161.591	101.1520796	130	ESB	USEPA 2005	NA	N
OTHER PARAMETERS										
PERCENT MOISTURE	%	11	11	49.6	84.5	--	--	--	NA	--
PERCENT FINE-GRAIN (<0.064 MM)	% PASSING	11	11	34	95	--	--	--	NA	--
TOTAL ORGANIC CARBON	MG/KG	11	11	24500	150000	--	--	--	NA	--

Table 9
Summary of Sediment Interstitial Water Results
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Analyte	Units	Dissolved/Total	ECOBCD-01				ECOBCD-02				ECOBCD-03				ECOBCD-04			
			10/20/09				10/20/09				10/22/09				10/20/09			
			Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision
Metals																		
ARSENIC	µg/L	D	ND(7.2)	--	--	--	ND(7.2)	--	--	--	ND(7.2)	--	--	--	ND(7.2)	--	--	--
BERYLLIUM	µg/L	D	ND(1.4)	--	--	--	ND(1.4)	--	--	--	ND(1.4)	--	--	--	ND(1.4)	--	--	--
CADMIUM	µg/L	D	ND(2)	--	--	--	ND(2)	--	--	--	ND(2)	--	--	--	ND(2)	--	--	--
CHROMIUM	µg/L	D	ND(3.4)	--	--	--	ND(3.4)	--	--	--	ND(3.4)	--	--	--	ND(3.4)	--	--	--
COPPER	µg/L	D	ND(2.7)	--	--	--	ND(2.7)	--	--	--	ND(2.7)	--	--	--	ND(2.7)	--	--	--
LEAD	µg/L	D	ND(6.9)	--	--	--	ND(6.9)	--	--	--	ND(6.9)	--	--	--	ND(6.9)	--	--	--
MERCURY	µg/L	D	ND(0.056)	--	--	--	ND(0.056)	--	--	--	ND(0.056)	--	--	--	ND(0.056)	--	--	--
NICKEL	µg/L	D	8.8	92.9	0.09	N	3.3	95.2	0.03	N	ND(1.8)	--	--	--	ND(1.8)	--	--	--
SELENIUM	µg/L	D	ND(8.9)	--	--	--	ND(8.9)	--	--	--	ND(8.9)	--	--	--	ND(8.9)	--	--	--
VANADIUM	µg/L	D	ND(2.5)	--	--	--	ND(2.5)	--	--	--	ND(2.5)	--	--	--	ND(2.5)	--	--	--
ZINC	µg/L	D	35.5	239.8	0.15	N	ND(8.1)	--	--	--	ND(8.1)	--	--	--	ND(8.1)	--	--	--
Water Quality Parameters																		
TOTAL HARDNESS AS CACO3	MG/L	T	241	--	--	--	248	--	--	--	156	--	--	--	171	--	--	--

Analyte	Units	Dissolved/Total	ECOBCD-05				ECOBCD-06				ECOBCD-07				ECOBCD-08			
			10/20/09				10/21/09				10/21/09				10/21/09			
			Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision	Result	Ecological Benchmark Concentration[1,2]	HQ	COPEC Decision
Metals																		
ARSENIC	µg/L	D	ND(7.2)	--	--	--	ND(7.2)	--	--	--	ND(7.2)	--	--	--	ND(7.2)	--	--	--
BERYLLIUM	µg/L	D	ND(1.4)	--	--	--	ND(1.4)	--	--	--	ND(1.4)	--	--	--	ND(1.4)	--	--	--
CADMIUM	µg/L	D	ND(2)	--	--	--	ND(2)	--	--	--	ND(2)	--	--	--	ND(2)	--	--	--
CHROMIUM	µg/L	D	ND(3.4)	--	--	--	ND(3.4)	--	--	--	ND(3.4)	--	--	--	ND(3.4)	--	--	--
COPPER	µg/L	D	ND(2.7)	--	--	--	ND(2.7)	--	--	--	ND(2.7)	--	--	--	ND(2.7)	--	--	--
LEAD	µg/L	D	ND(6.9)	--	--	--	ND(6.9)	--	--	--	ND(6.9)	--	--	--	ND(6.9)	--	--	--
MERCURY	µg/L	D	ND(0.056)	--	--	--	ND(0.056)	--	--	--	ND(0.056)	--	--	--	ND(0.056)	--	--	--
NICKEL	µg/L	D	ND(1.8)	--	--	--	ND(1.8)	--	--	--	ND(1.8)	--	--	--	ND(1.8)	--	--	--
SELENIUM	µg/L	D	ND(8.9)	--	--	--	ND(8.9)	--	--	--	ND(8.9)	--	--	--	ND(8.9)	--	--	--
VANADIUM	µg/L	D	ND(2.5)	--	--	--	ND(2.5)	--	--	--	ND(2.5)	--	--	--	ND(2.5)	--	--	--
ZINC	µg/L	D	ND(8.1)	--	--	--	ND(8.1)	--	--	--	ND(8.1)	--	--	--	ND(8.1)	--	--	--
Water Quality Parameters																		
TOTAL HARDNESS AS CACO3	MG/L	T	102	--	--	--	262	--	--	--	153	--	--	--	109	--	--	--

Analyte	Units	Dissolved/Total	ECOBCD-09				ECOBCD-10				ECOBCD-11			
			10/22/09				10/22/09				10/21/09			
			Result	Ecological Benchmark Concentration	HQ	COPEC Decision	Result	Ecological Benchmark Concentration	HQ	COPEC Decision	Result	Ecological Benchmark Concentration	HQ	COPEC Decision
Metals														
ARSENIC	µg/L	D	ND(7.2)	--	--	--	ND(7.2)	--	--	--	ND(7.2)	--	--	--
BERYLLIUM	µg/L	D	ND(1.4)	--	--	--	ND(1.4)	--	--	--	ND(1.4)	--	--	--
CADMIUM	µg/L	D	ND(2)	--	--	--	ND(2)	--	--	--	ND(2)	--	--	--
CHROMIUM	µg/L	D	ND(3.4)	--	--	--	ND(3.4)	--	--	--	ND(3.4)	--	--	--
COPPER	µg/L	D	ND(2.7)	--	--	--	ND(2.7)	--	--	--	ND(2.7)	--	--	--
LEAD	µg/L	D	ND(6.9)	--	--	--	ND(6.9)	--	--	--	ND(6.9)	--	--	--
MERCURY	µg/L	D	ND(0.056)	--	--	--	ND(0.056)	--	--	--	ND(0.056)	--	--	--
NICKEL	µg/L	D	5.7	62.9	0.09	N	ND(1.8)	--	--	--	ND(1.8)	--	--	--
SELENIUM	µg/L	D	ND(8.9)	--	--	--	ND(8.9)	--	--	--	ND(8.9)	--	--	--
VANADIUM	µg/L	D	4.1	12	0.3417	N	ND(2.5)	--	--	--	ND(2.5)	--	--	--
ZINC	µg/L	D	13.3	162.30	0.08	N	ND(8.1)	--	--	--	ND(8.1)	--	--	--
Water Quality Parameters														
TOTAL HARDNESS AS CACO3	MG/L	T	152	--	--	--	64.5	--	--	--	157	--	--	--

Notes:

1. NJ DEP Ecological Screening Criteria (2009) Freshwater (FW2) Chronic Criteria
2. Ecological benchmark concentrations for nickel and zinc were adjusted for hardness based on the following formulas referenced in NJDEP Surface Water Quality Guidelines (2006): Ni - WER[$e^{(0.846(\ln [hardness])+0.0584)}$]0.846 and Zn - WER[$e^{(0.8473(\ln) [hardness])+0.884)}$]0.95.

ND - Not detected; method detection limit in parenthesis

Table 10
Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for PAH Mixtures
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

PAH Compound	$C_{oc,PAHi,FCVi}$/ $C_{oc,PAHi,Maxi}$ [a]	CWK-E-ECOBCD01(0-0.5)			CWK-E-ECOBCD05(0-0.5)			CWK-E-ECOBCD05(0-0.5)-DUP		
		f_{oc} =	0.1100		f_{oc} =	0.0636		f_{oc} =	0.0512	
		C_{sed} (ug/g)	C_{oc} (ug/g$_{oc}$)	$ESBTU_{FCVi}$	C_{sed} (ug/g)	C_{oc} (ug/g$_{oc}$)	$ESBTU_{FCVi}$	C_{sed} (ug/g)	C_{oc} (ug/g$_{oc}$)	$ESBTU_{FCVi}$
Acenaphthene	491	0.25	2.2727	0.0046	*0.15*	*2.3585*	*0.0048*	*0.14*	*2.7344*	*0.0056*
Acenaphthylene	452	*0.21*	*1.9091*	*0.0042*	*0.15*	*2.3585*	*0.0052*	*0.14*	*2.7344*	*0.0060*
Anthracene	594	0.35	3.1818	0.0054	*0.15*	*2.3585*	*0.0040*	0.27	5.2734	0.0089
Benzo(a)anthracene	841	0.81	7.3636	0.0088	0.16	2.5157	0.0030	1.4	27.3438	0.0325
Benzo(a)pyrene	965	0.76	6.9091	0.0072	0.18	2.8302	0.0029	1.1	21.4844	0.0223
Benzo(b)fluoranthene	979	1.5	13.6364	0.0139	0.28	4.4025	0.0045	4.1	80.0781	0.0818
Benzo(k)fluoranthene	981	0.63	5.7273	0.0058	*0.15*	*2.3585*	*0.0024*	1.3	25.3906	0.0259
Chrysene	826	1.1	10.0000	0.0121	0.24	3.7736	0.0046	2	39.0625	0.0473
Fluoranthene	707	2.5	22.7273	0.0321	0.29	4.5597	0.0064	1.1	21.4844	0.0304
Fluorene	538	0.58	5.2727	0.0098	*0.15*	*2.3585*	*0.0044*	*0.14*	*2.7344*	*0.0051*
Naphthalene	385	*0.21*	*1.9091*	*0.0050*	*0.15*	*2.3585*	*0.0061*	*0.14*	*2.7344*	*0.0071*
Phenanthrene	596	0.69	6.2727	0.0105	0.17	2.6730	0.0045	0.17	3.3203	0.0056
Pyrene	697	2	18.1818	0.0261	0.27	4.2453	0.0061	0.84	16.4063	0.0235
			S $ESBTU_{FCV,13}$ =	0.1455		**S $ESBTU_{FCV,13}$ =**	0.0589		**S $ESBTU_{FCV,13}$ =**	0.3019
			S $ESBTU_{FCV}$ [b] =	0.9866		**S $ESBTU_{FCV}$ [b] =**	0.3995		**S $ESBTU_{FCV}$ [b] =**	2.0471

Notes:

Shaded cells indicate samples with PAH mixtures that exceed concentrations protective of benthic organisms. (S $ESBTU_{FCV}$ > 1.0)

Equilibrium Partitioning Sediment Benchmarks for PAH mixtures calculated as:

$$\sum ESGTU_{FCV} = \sum_i \frac{C_{OC,\,PAHi}}{C_{OC,\,PAHi,\,FCVi}}$$

where:

$ESBTU_{FCV}$ = Equilibrium Partitioning Sediment Benchmark Toxic Unit based on the Final Chronic Value (FCV)

$C_{OCiPAHi}$ = Organic-carbon-normalized sediment concentration of PAH_i

$C_{OCiPAHiFCVi}$ = Critical concentration of PAH_i in sediment from USEPA (2000)

f_{oc} = Fraction of organic carbon

a, The lower value of $C_{oc,PAHi,FCVi}$ and $C_{oc,PAHi,Maxi}$ was used in the calculation

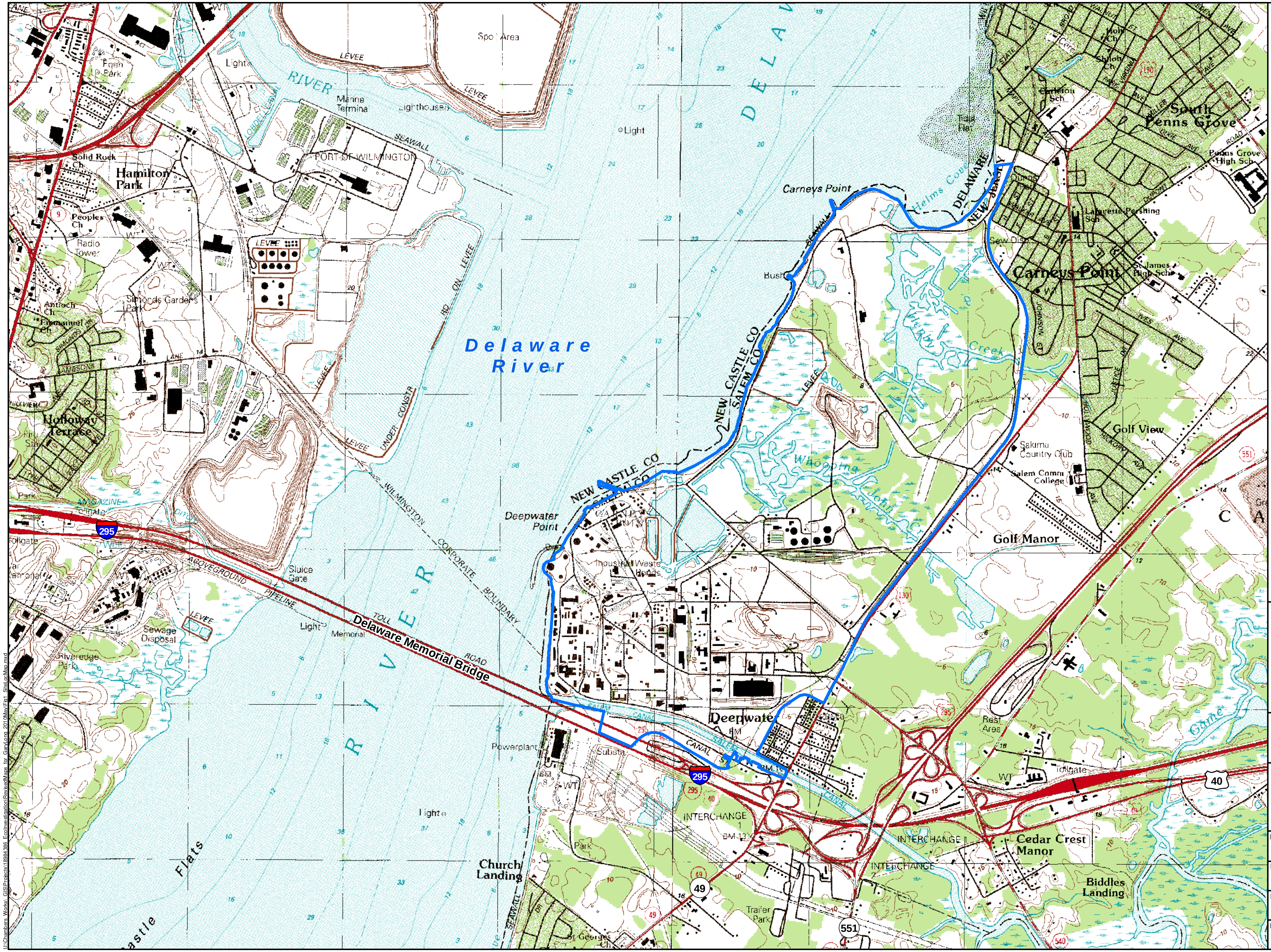
b, An uncertainty factor of 6.78 was multiplied to S $ESBTU_{FCV,13}$ to estimate S $ESBTU_{FCV}$ for 34 PAHs with 80% confidence (USEPA 2003).

Table 11
Derivation of Equilibrium Partitioning (EqP) Sediment Quality Guidelines for N-Nitrosodiphenylamine
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

Unit	Sample ID	Diphenylamine Concentration in Sediment[6] (mg/kg)	Sediment TOC (mg/kg)	log K_{ow}	log K_{oc}	MW[1]	Acute LC_{50}[2] (µg/L)	ACR[3]	Chronic NOEC[4] (µg/L)	*f* TOC	SQB[5]		
											SEL (mg/kg)	LEL (mg/kg)	NEC (mg/kg)
Default 1% Sediment TOC Concentration:			10000	3.16	3.11	198.23	3506	8.10	433	0.010	45	16	6
CWK BCD	ECOBCD-05	0.21	63600	3.16	3.11	198.23	3506	8.10	433	0.0636	285	100	35.184
CWK BCD	ECOBCD-05-DUP	0.31	51200	3.16	3.11	198.23	3506	8.10	433	0.0512	229	81	28.324

Notes:
1, Molecular weight
2, Lethal concentration for 50% of organisms tested based on QSAR in Hermens et al. (1984)
3, Acute-to-chronic ratio based on daphnid LC50:NOEC ratio reported in USEPA 2006 and Gersich and Milazzo (1990), respectively.
4, Chronic no observed effect concentration calculated as the acute LC50 / ACR
5, Sediment Quality Benchmark:
SEL - Severe effect level
LEL - Lowest effect level
NEC - No effect concentration
6, Shaded cells indicate that concentration exceeds calculated NEC benchmark

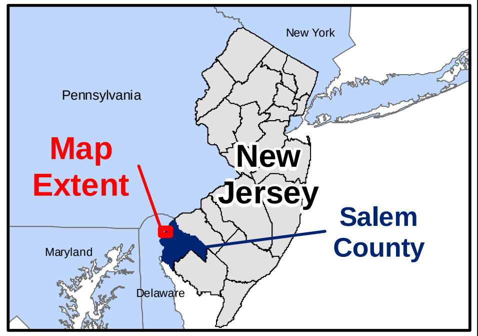
Figures



Legend

DuPont Site Property Line

Source: DRG 1:24K Topographic maps (quads Wilmington South and Pennsgrove) created by USGS.
Map Scale: 1:24,000
Map Projection: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet



N
W E
S

0 1,000 2,000 4,000
Feet
1 inch = 2,000 feet

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

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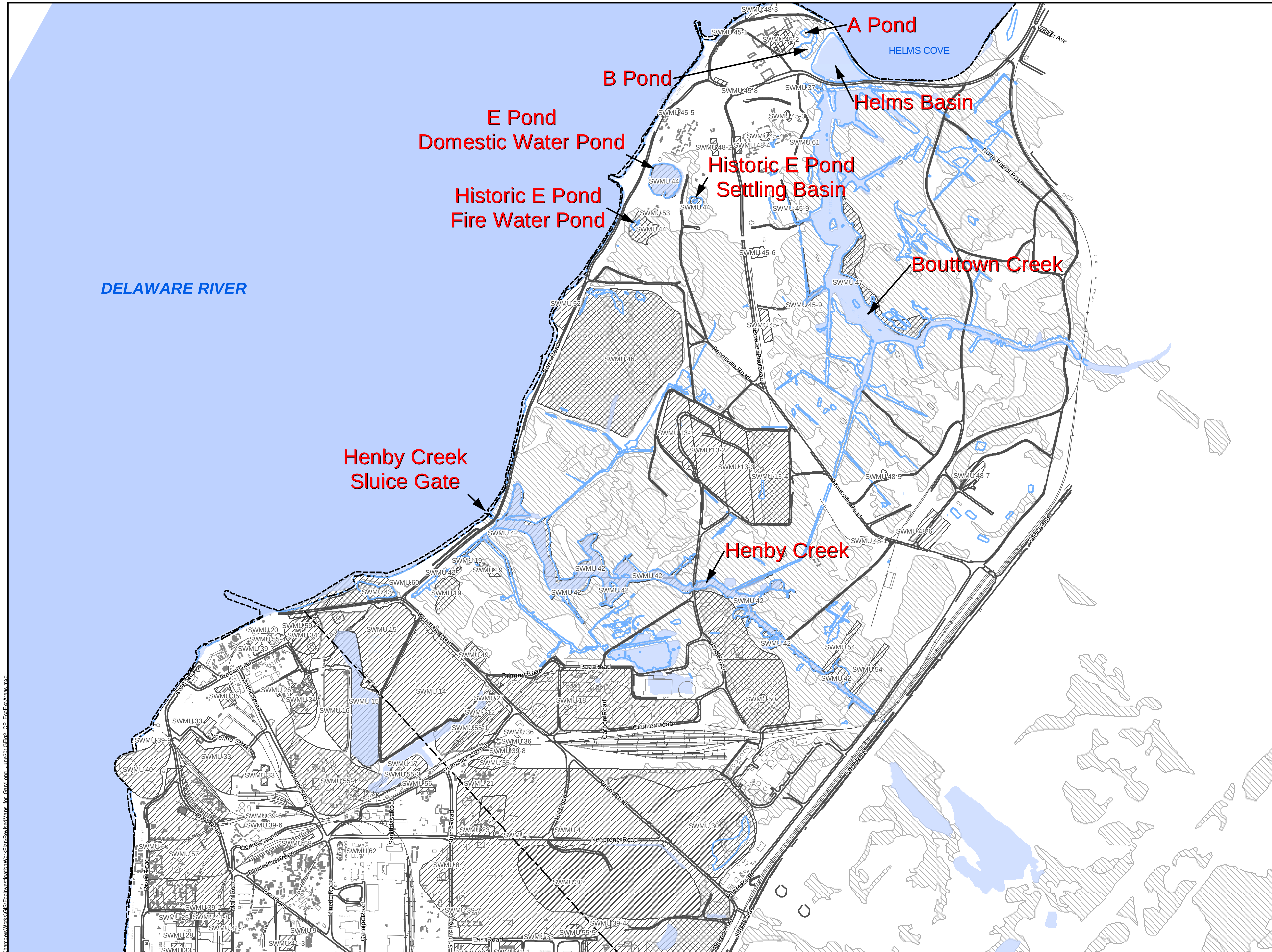
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

SITE LOCATION MAP

Ecological Investigation

DuPont Chambers Works Site
Deepwater, New Jersey

FILE NUMBER:	PROJECT NUMBER: 18984386
DESIGNED BY: CAA	DATE: 05/27/2010
DRAWN BY: CAA	FIGURE NUMBER: 1
DATA QUALITY CHECK BY: GRL	



Legend

- 2002 Shoreline*
- Road
- Railroad
- Boundary of Waterbody
- Structure
- Dismantled Structure
- Waterbody Area**
- Wetland Area**
- SWMU

*Shoreline digitized in GIS from 2002 ortho image.
**Data obtained from NJDEP. Some data adjusted to 2002 aerial.

Map Scale: 1:12,000
Map Projection: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet

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

MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
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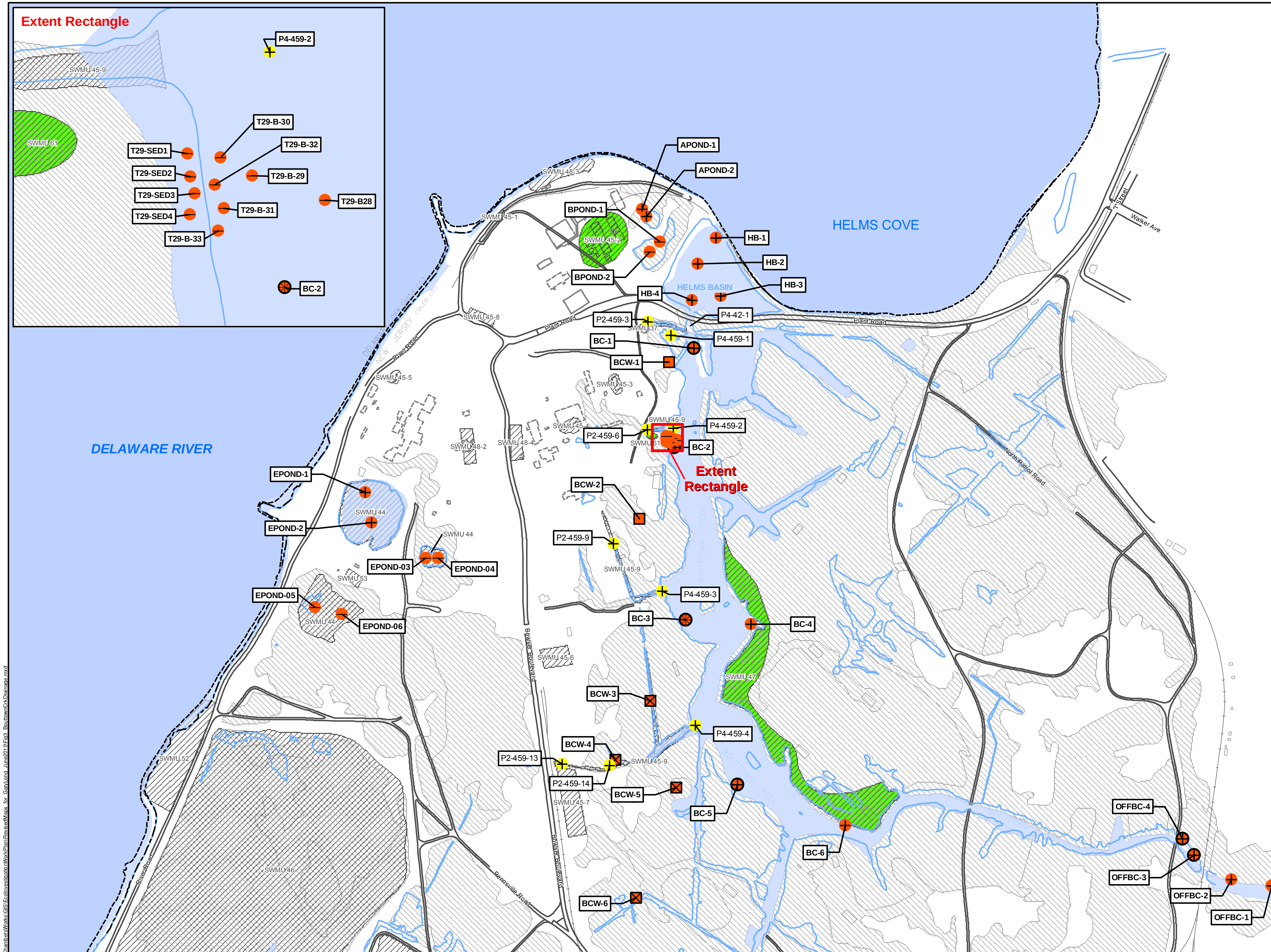
CARNEYS POINT ECOLOGICAL EXPOSURE AREAS

Ecological Investigation
DuPont Chambers Works Site
Deepwater, New Jersey

FILE NUMBER:	PROJECT NUMBER: 18984386
DESIGNED BY: CAA	DATE: 06/03/2010
DRAWN BY: CAA	FIGURE NUMBER: 2
DATA QUALITY CHECK BY: GRL	



Legend

- 2002 Shoreline*
- Road
- Railroad
- Boundary of Waterbody
- Structure
- Dismantled Structure
- Waterbody Area**
- Wetland Area**
- SWMU
- SWMU Evaluated for Exposure to Mobile Wildlife
- Sediment Sampling Location
- Surface Water and Sediment Sampling Location
- Surface Water, Sediment, and Benthic Community Sampling Location
- Surface Water, Sediment, Benthic Community, and PushPoint Sampling Location
- Wetland Sediment/Hydric Soil Sampling Location
- Wetland Sediment/Hydric Soil and PushPoint Sampling Location
- Historic Sediment and/or Surface Water Sampling Location

*Shoreline digitized in GIS from 2002 ortho image.
**Data obtained from NJDEP. Some data adjusted to 2002 aerial.

Map Scale: 1:6,000
Map Projection: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet

N / S / E / W

0 250 500 1,000
Feet
1 inch = 500 feet

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

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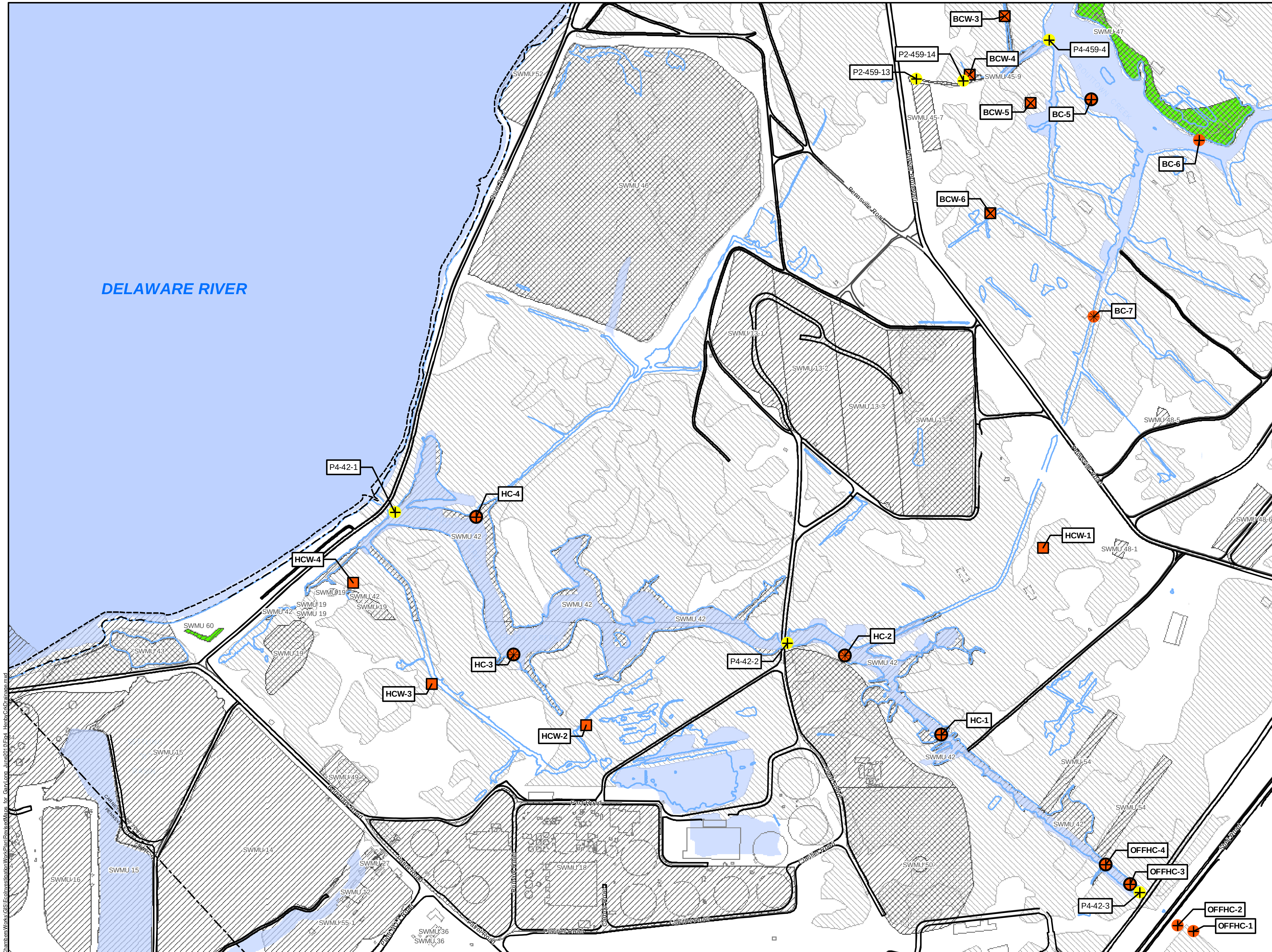
BOUTTOWN CREEK DRAINAGE

Ecological Investigation
DuPont Chambers Works Site
Deepwater, New Jersey

FILE NUMBER:	PROJECT NUMBER: 18984386
DESIGNED BY: CAA	DATE: 06/03/2010
DRAWN BY: CAA	FIGURE NUMBER: 3
DATA QUALITY CHECK BY: GRL	



Legend

- 2002 Shoreline*
- Road
- Railroad
- Township Boundary
- Boundary of Waterbody
- Structure
- Dismantled Structure
- Waterbody Area**
- Wetland Area**
- SWMU
- SWMUs Evaluated for Exposure to Mobile Wildlife
- Surface Water and Sediment Sampling Location
- Surface Water, Sediment, and Benthic Community Sampling Location
- Surface Water, Sediment, and PushPoint Sampling Location
- Surface Water, Sediment, Benthic Community, and PushPoint Sampling Location
- Wetland Sediment/Hydric Soil Sampling Location
- Wetland Sediment/Hydric Soil and PushPoint Sampling Location
- Historic Sediment and/or Surface Water Sampling Location

*Shoreline digitized in GIS from 2002 ortho image.
**Data obtained from NJDEP. Some data adjusted to 2002 aerial.

Map Scale: 1:6,000
Map Projection: NAD_1983_StatePlane_New_Jersey_FIPS_2900_Feet

0 250 500 1,000
Feet
1 inch = 500 feet

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

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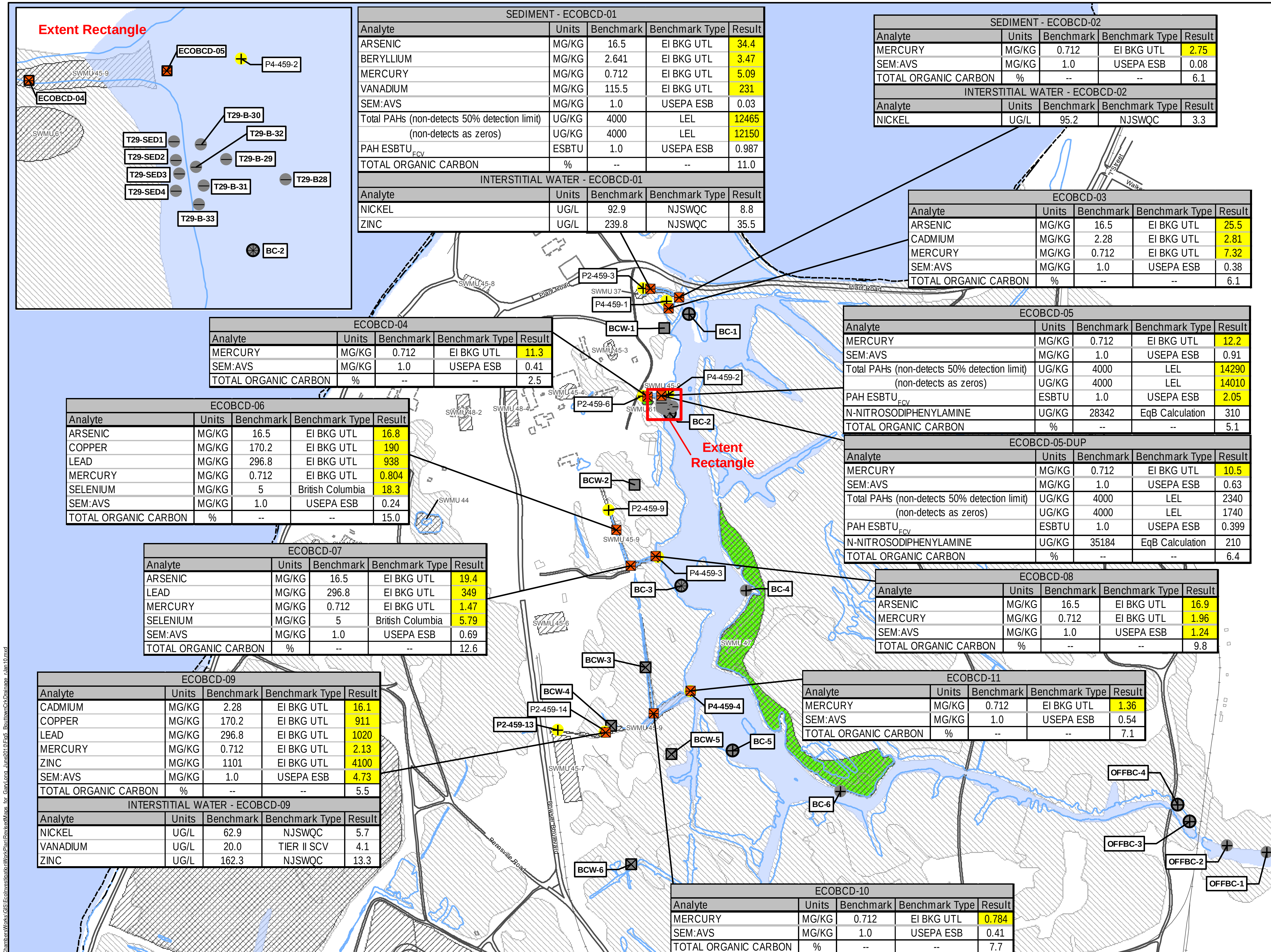
4051 Ogletown Road, Suite 300
Newark, DE 19713

HENBY CREEK DRAINAGE

Ecological Investigation
DuPont Chambers Works Site
Deepwater, New Jersey

FILE NUMBER:	PROJECT NUMBER: 18984386
DESIGNED BY: CAA	DATE: 06/03/2010
DRAWN BY: CAA	FIGURE NUMBER: 4
DATA QUALITY CHECK BY: GRL	



SEDIMENT - ECOBCD-01				
Analyte	Units	Benchmark	Benchmark Type	Result
ARSENIC	MG/KG	16.5	EI BKG UTL	34.4
BERYLLIUM	MG/KG	2.641	EI BKG UTL	3.47
MERCURY	MG/KG	0.712	EI BKG UTL	5.09
VANADIUM	MG/KG	115.5	EI BKG UTL	231
SEM:AVS	MG/KG	1.0	USEPA ESB	0.03
Total PAHs (non-detects 50% detection limit)	UG/KG	4000	LEL	12465
(non-detects as zeros)	UG/KG	4000	LEL	12150
PAH ESBTU$_{FCV}$	ESBTU	1.0	USEPA ESB	0.987
TOTAL ORGANIC CARBON	%	--	--	11.0

INTERSTITIAL WATER - ECOBCD-01				
Analyte	Units	Benchmark	Benchmark Type	Result
NICKEL	UG/L	92.9	NJSWQC	8.8
ZINC	UG/L	239.8	NJSWQC	35.5

SEDIMENT - ECOBCD-02				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	2.75
SEM:AVS	MG/KG	1.0	USEPA ESB	0.08
TOTAL ORGANIC CARBON	%	--	--	6.1

INTERSTITIAL WATER - ECOBCD-02				
Analyte	Units	Benchmark	Benchmark Type	Result
NICKEL	UG/L	95.2	NJSWQC	3.3

ECOBCD-03				
Analyte	Units	Benchmark	Benchmark Type	Result
ARSENIC	MG/KG	16.5	EI BKG UTL	25.5
CADMIUM	MG/KG	2.28	EI BKG UTL	2.81
MERCURY	MG/KG	0.712	EI BKG UTL	7.32
SEM:AVS	MG/KG	1.0	USEPA ESB	0.38
TOTAL ORGANIC CARBON	%	--	--	6.1

ECOBCD-04				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	11.3
SEM:AVS	MG/KG	1.0	USEPA ESB	0.41
TOTAL ORGANIC CARBON	%	--	--	2.5

ECOBCD-05				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	12.2
SEM:AVS	MG/KG	1.0	USEPA ESB	0.91
Total PAHs (non-detects 50% detection limit)	UG/KG	4000	LEL	14290
(non-detects as zeros)	UG/KG	4000	LEL	14010
PAH ESBTU$_{FCV}$	ESBTU	1.0	USEPA ESB	2.05
N-NITROSODIPHENYLAMINE	UG/KG	28342	EqB Calculation	310
TOTAL ORGANIC CARBON	%	--	--	5.1

ECOBCD-05-DUP				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	10.5
SEM:AVS	MG/KG	1.0	USEPA ESB	0.63
Total PAHs (non-detects 50% detection limit)	UG/KG	4000	LEL	2340
(non-detects as zeros)	UG/KG	4000	LEL	1740
PAH ESBTU$_{FCV}$	ESBTU	1.0	USEPA ESB	0.399
N-NITROSODIPHENYLAMINE	UG/KG	35184	EqB Calculation	210
TOTAL ORGANIC CARBON	%	--	--	6.4

ECOBCD-06				
Analyte	Units	Benchmark	Benchmark Type	Result
ARSENIC	MG/KG	16.5	EI BKG UTL	16.8
COPPER	MG/KG	170.2	EI BKG UTL	190
LEAD	MG/KG	296.8	EI BKG UTL	938
MERCURY	MG/KG	0.712	EI BKG UTL	0.804
SELENIUM	MG/KG	5	British Columbia	18.3
SEM:AVS	MG/KG	1.0	USEPA ESB	0.24
TOTAL ORGANIC CARBON	%	--	--	15.0

ECOBCD-07				
Analyte	Units	Benchmark	Benchmark Type	Result
ARSENIC	MG/KG	16.5	EI BKG UTL	19.4
LEAD	MG/KG	296.8	EI BKG UTL	349
MERCURY	MG/KG	0.712	EI BKG UTL	1.47
SELENIUM	MG/KG	5	British Columbia	5.79
SEM:AVS	MG/KG	1.0	USEPA ESB	0.69
TOTAL ORGANIC CARBON	%	--	--	12.6

ECOBCD-08				
Analyte	Units	Benchmark	Benchmark Type	Result
ARSENIC	MG/KG	16.5	EI BKG UTL	16.9
MERCURY	MG/KG	0.712	EI BKG UTL	1.96
SEM:AVS	MG/KG	1.0	USEPA ESB	1.24
TOTAL ORGANIC CARBON	%	--	--	9.8

ECOBCD-09				
Analyte	Units	Benchmark	Benchmark Type	Result
CADMIUM	MG/KG	2.28	EI BKG UTL	16.1
COPPER	MG/KG	170.2	EI BKG UTL	911
LEAD	MG/KG	296.8	EI BKG UTL	1020
MERCURY	MG/KG	0.712	EI BKG UTL	2.13
ZINC	MG/KG	1101	EI BKG UTL	4100
SEM:AVS	MG/KG	1.0	USEPA ESB	4.73
TOTAL ORGANIC CARBON	%	--	--	5.5

INTERSTITIAL WATER - ECOBCD-09				
Analyte	Units	Benchmark	Benchmark Type	Result
NICKEL	UG/L	62.9	NJSWQC	5.7
VANADIUM	UG/L	20.0	TIER II SCV	4.1
ZINC	UG/L	162.3	NJSWQC	13.3

ECOBCD-10				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	0.784
SEM:AVS	MG/KG	1.0	USEPA ESB	0.41
TOTAL ORGANIC CARBON	%	--	--	7.7

ECOBCD-11				
Analyte	Units	Benchmark	Benchmark Type	Result
MERCURY	MG/KG	0.712	EI BKG UTL	1.36
SEM:AVS	MG/KG	1.0	USEPA ESB	0.54
TOTAL ORGANIC CARBON	%	--	--	7.1

Legend

- 2002 Shoreline*
- Road
- Railroad
- Boundary of Waterbody
- Structure
- Dismantled Structure
- Waterbody Area**
- Wetland Area**
- SWMU
- SWMU Evaluated for Exposure to Mobile Wildlife
- October 2009 Sediment and Interstitial Water Sampling Location

Ecological Investigation and Historic RI Sampling Locations

- Sediment Sampling Location
- Surface Water and Sediment Sampling Location
- Surface Water, Sediment, and Benthic Community Sampling Location
- Surface Water, Sediment, Benthic Community, and PushPoint Sampling Location
- Wetland Sediment/Hydric Soil Sampling Location
- Wetland Sediment/Hydric Soil and PushPoint Sampling Location
- Historic Sediment and/or Surface Water Sampling Location

NOTES:
*Shoreline digitized in GIS from 2002 ortho image.
**Data obtained from NJDEP. Some data adjusted to 2002 aerial.
Map Scale: 1:6,000
Map Projection: NAD 1983 State Plane New Jersey FIPS 2900 Feet

0 250 500 1,000
Feet
1 inch = 500 feet
MAP FORMATTED FOR "B" (11" X 17") SIZE SHEET.
TEXT SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

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Bouttown Creek Drainage

Ecological Investigation
DuPont Chambers Works Site
Deepwater, New Jersey

FILE NUMBER:	PROJECT NUMBER: 18984386
DESIGNED BY: GRL	DATE: 06/03/2010
DRAWN BY: CAA	FIGURE NUMBER: 5
DATA QUALITY CHECK BY: GRL	

FIGURE 6
DISTRIBUTION OF FINE-GRAINED SEDIMENT
BOUTTOWN CREEK DITCH INVESTIGATION
DUPONT CHAMBERS WORKS
DEEPWATER, NEW JERSEY

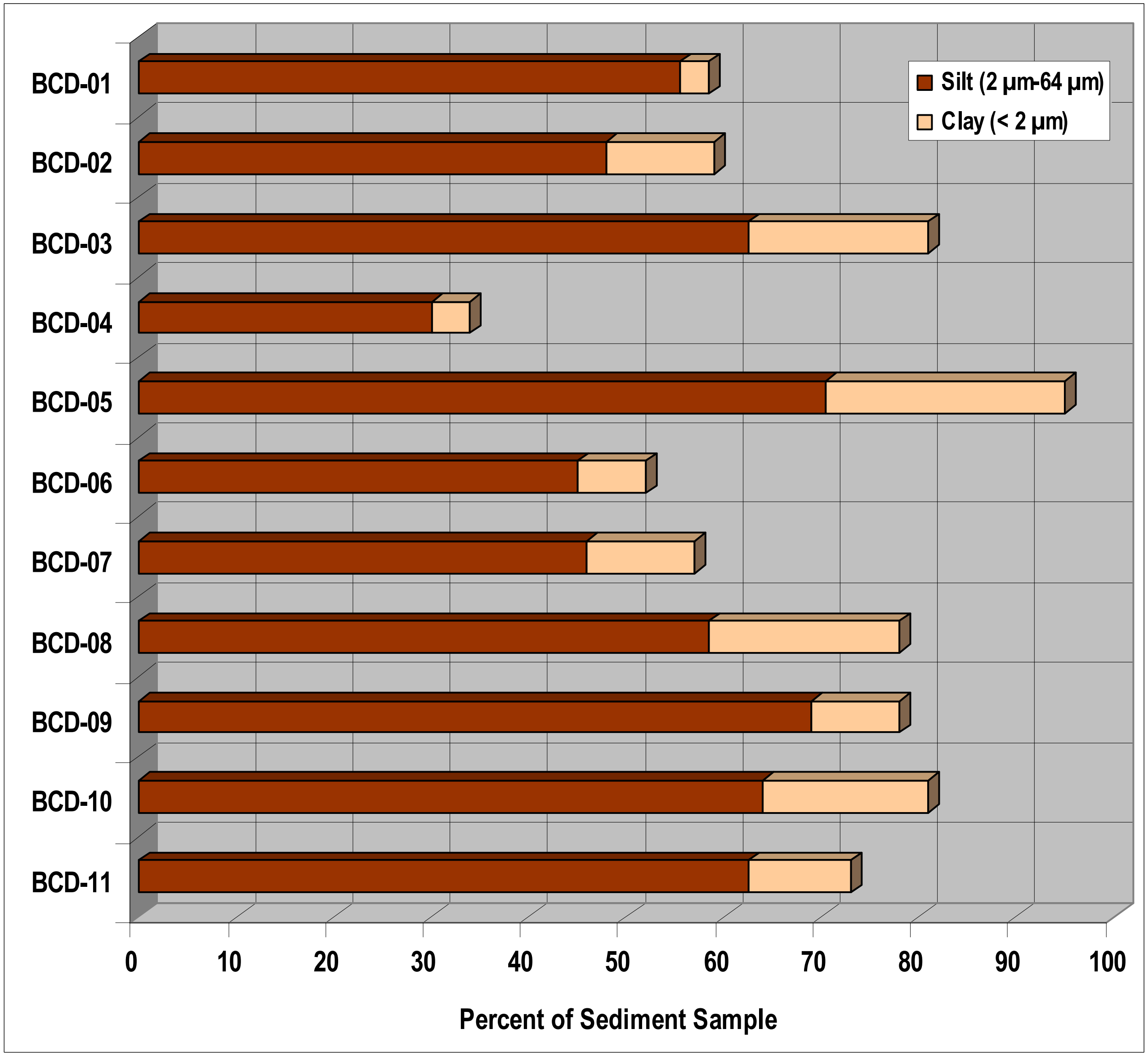


FIGURE 7
TOTAL SEDIMENT ORGANIC CARBON CONTENT
BOUTTOWN CREEK DITCH INVESTIGATION
DUPONT CHAMBERS WORKS
DEEPWATER, NEW JERSEY

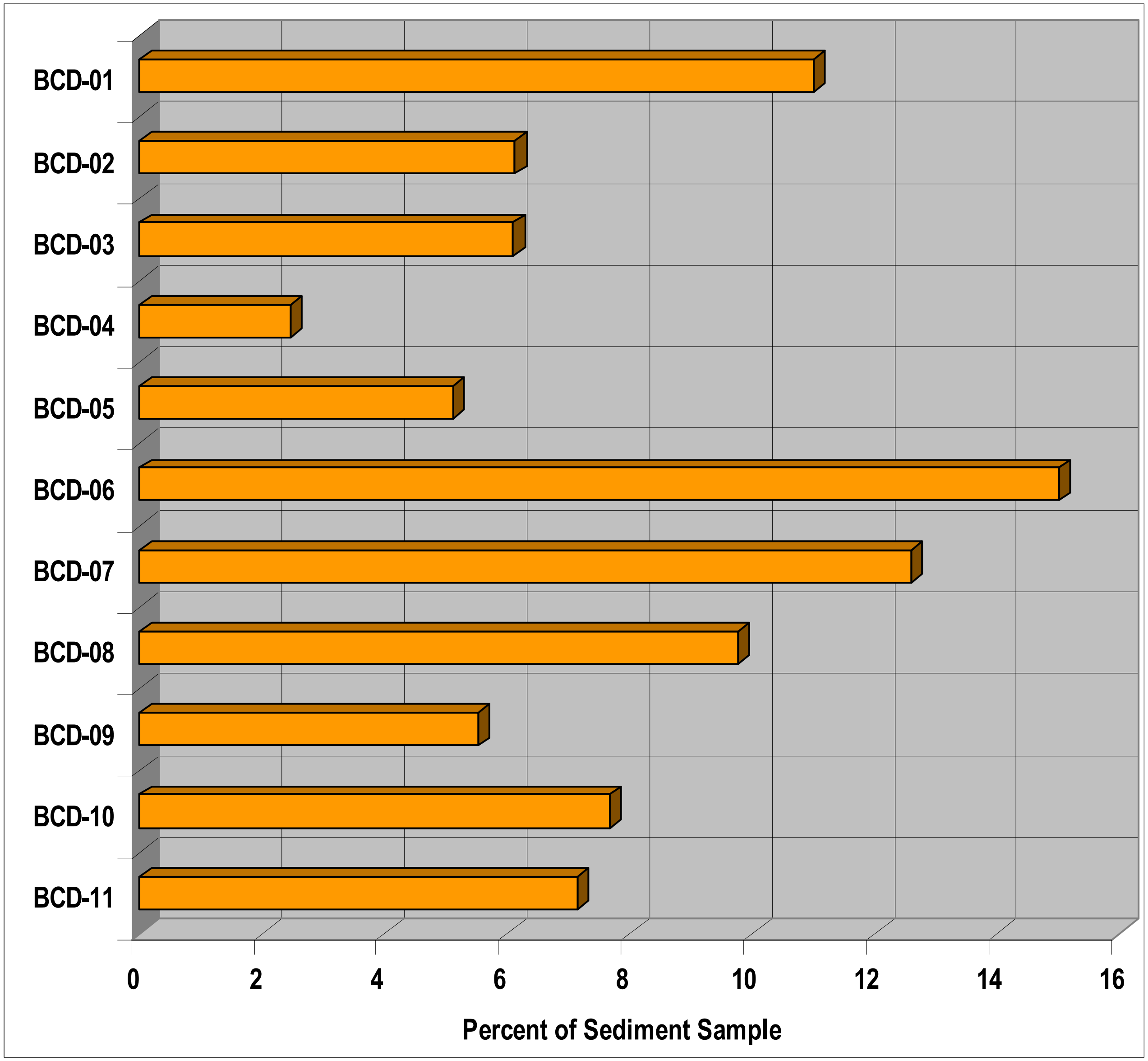


FIGURE 8
SEM:AVS RATIOS
BOUTTOWN CREEK DITCH INVESTIGATION
DUPONT CHAMBERS WORKS
DEEPWATER, NEW JERSEY

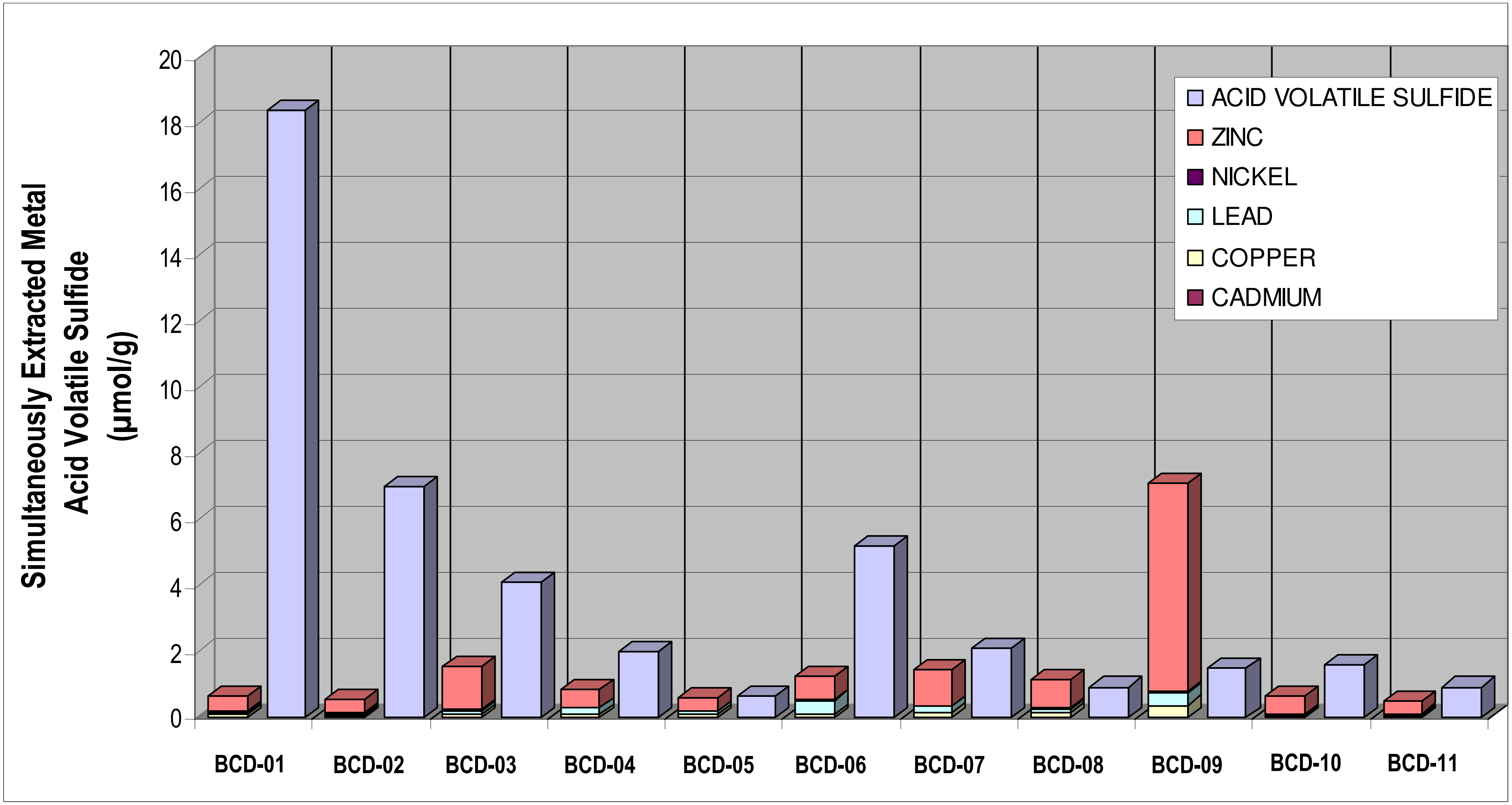


FIGURE 9

TOC NORMALIZED SEM-AVS RESULTS

BOUTTOWN CREEK DITCH INVESTIGATION

DUPONT CHAMBERS WORKS

DEEPWATER, NEW JERSEY

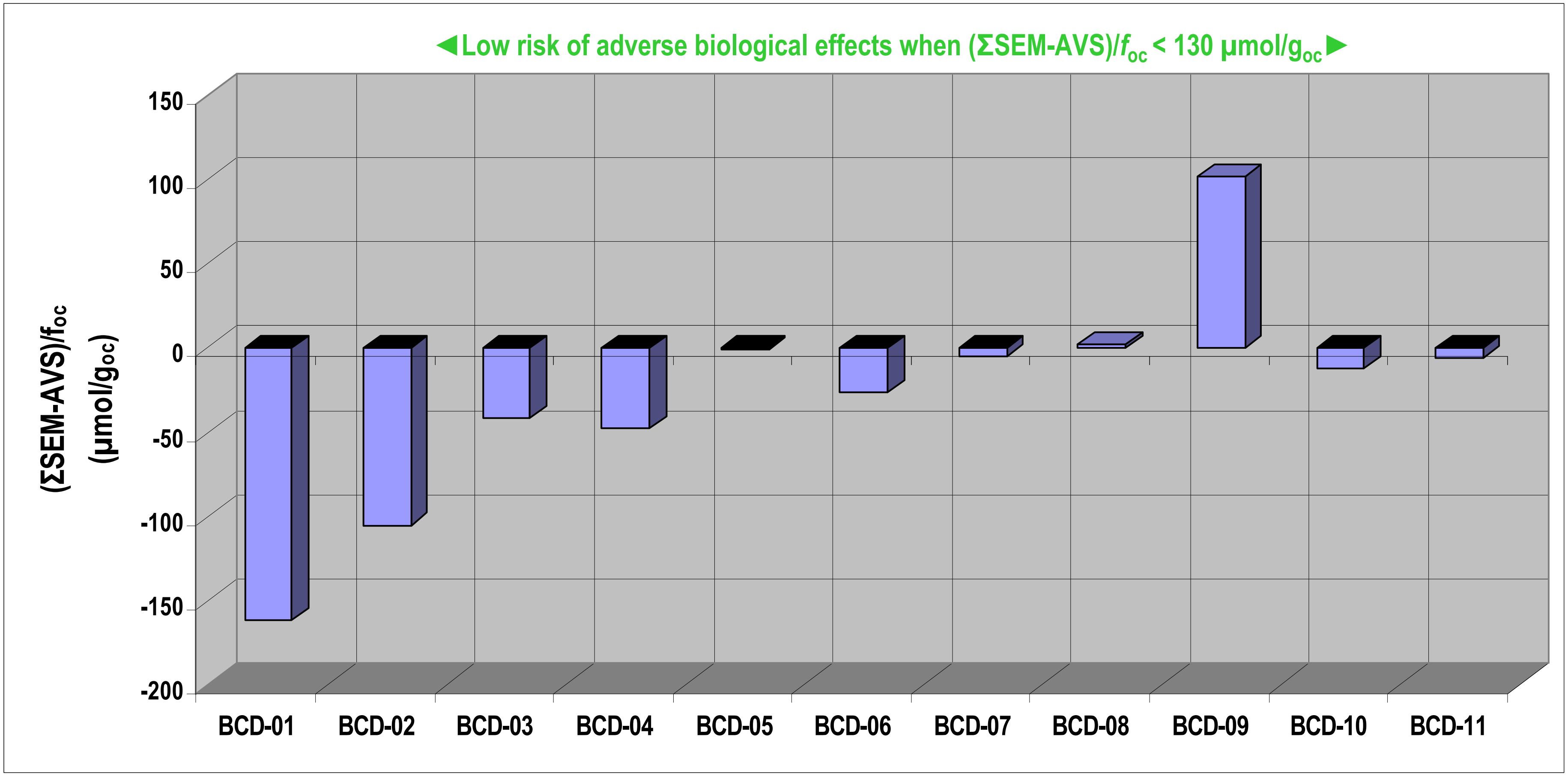
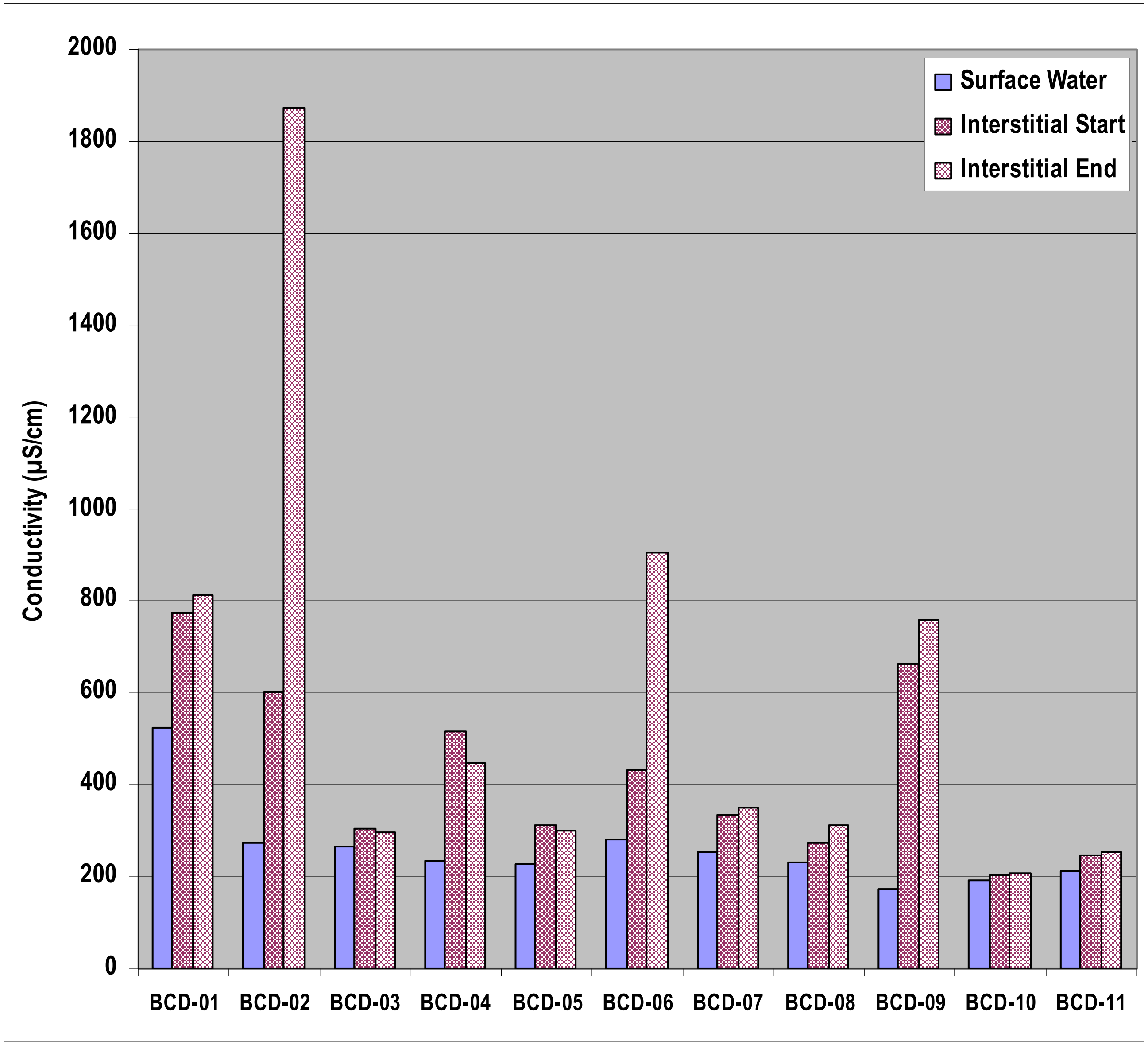


FIGURE 10
IN SITU SURFACE WATER AND SEDIMENT INTERSTITIAL WATER CONDUCTIVITY MEASUREMENTS
BOUTTOWN CREEK DITCH INVESTIGATION
DUPONT CHAMBERS WORKS
DEEPWATER, NEW JERSEY



Appendices

Appendix A

Sediment Analytical Data – Bouttown Creek Ditch Investigation

Appendix A
Sediment Analytical Data – Bouttown Creek Ditch Investigation
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

			Location	ECOBCD-01	ECOBCD-02	ECOBCD-03	ECOBCD-04	ECOBCD-05	ECOBCD-05	ECOBCD-06	ECOBCD-07	ECOBCD-08	ECOBCD-09	ECOBCD-10	ECOBCD-11
			Date	10/20/09	10/20/09	10/20/09	10/20/09	10/20/09	10/20/09	10/21/09	10/21/09	10/21/09	10/22/09	10/22/09	10/21/09
			Top (ft)	0	0	0	0	0	0	0	0	0	0	0	0
		Total (T)/	Bottom (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Analyte	Units	Diss. (D)	Duplicate	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS
Semi-Volatile Organic Compounds															
ACENAPHTHENE	UG/KG	T		250 J				ND (150)	ND (140) UJ						
ACENAPHTHYLENE	UG/KG	T		ND (210)				ND (150)	ND (140) UJ						
ANTHRACENE	UG/KG	T		350 J				ND (150)	270 J						
BENZO(A)ANTHRACENE	UG/KG	T		810 J				160 J	1400						
BENZO(B)FLUORANTHENE	UG/KG	T		1500				280 J	4100						
BENZO(G,H,I)PERYLENE	UG/KG	T		500 J				150 J	740						
BENZO(K)FLUORANTHENE	UG/KG	T		630 J				ND (150)	1300						
BENZO[A]PYRENE	UG/KG	T		760 J				180 J	1100						
CHRYSENE	UG/KG	T		1100				240 J	2000						
DIBENZ(A,H)ANTHRACENE	UG/KG	T		ND (210)				ND (150)	210 J						
DIPHENYL AMINE	UG/KG	T							310 J						
FLUORANTHENE	UG/KG	T		2500				290 J	1100						
FLUORENE	UG/KG	T		580 J				ND (150)	ND (140)						
INDENO (1,2,3-CD) PYRENE	UG/KG	T		480 J				ND (150)	780						
NAPHTHALENE	UG/KG	T		ND (210)				ND (150)	ND (140)						
PHENANTHRENE	UG/KG	T		690 J				170 J	170 J						
PYRENE	UG/KG	T		2000				270 J	840						
N-NITROSODIPHENYLAMINE	UG/KG	T						210 J							
Metals															
ARSENIC	MG/KG	T		34.4	13.6	25.5	8.05	13.8	14.3	16.8	19.4	16.9	9.74	7.91	14.1
BERYLLIUM	MG/KG	T		3.47	0.523 J	1.45 J	ND (0.186)	ND (0.297)	ND (0.288)	0.449 J	ND (0.351)	ND (0.273)	0.493 J	ND (0.244)	ND (0.267)
CADMIUM	MG/KG	T		2.26 J	0.667 J	2.81	0.888 J	0.895 J	0.877 J	1.64 J	1.65 J	1.16 J	16.1	0.828 J	0.786 J
CHROMIUM	MG/KG	T		60.3	42.8	63.7	55.3	71	69.3	46.1	64.4	53.1	56.2	47.7	52.5
COPPER	MG/KG	T		159	51	148	95.3	90.6	97.1	190	157	85.6	911	56.7	37.3
LEAD	MG/KG	T		130	93.6	192	223	163	159	938	349	182	1020	75	89.8
MERCURY	MG/KG	T		5.09	2.75	7.32	11.3	10.5	12.2	0.804	1.47	1.96	2.13	0.784	1.36
NICKEL	MG/KG	T		52.3	30.8	51.2	20.8	31.9	31.3	33.1	38.5	32.4	39.3	25.9	32.2
SELENIUM	MG/KG	T		ND (6.13)	ND (3.61)	ND (4.67)	ND (2.68)	ND (4.28)	ND (4.15)	18.3	5.79 J	ND (4.01)	ND (1.89)	ND (3.51)	ND (3.97)
VANADIUM	MG/KG	T		231	81	77.1	40.1	73.7	72.7	54.8	73.2	61.2	56.8	57	57.6
ZINC	MG/KG	T		399	207	968	232	255	242	616	727	404	4100	244	194
SEM-AVS															
ACID VOLATILE SULFIDE	UMOL/G	T		18.4	7	4.1	2	1 J	ND (0.63)	5.2	2.1	0.92 J	1.5 J	1.6 J	0.92 J
CADMIUM	UMOL/G	T		0.00459	0.00209	0.00318	0.00188	0.00182	0.00171	0.00247	0.00295	0.00238	0.00991	0.00179	0.00152
COPPER	UMOL/G	T		0.0966	0.0489	0.108	0.103	0.0682	0.0757	0.0707 J	0.126 J	0.124 J	0.361 J	0.0367 J	0.0427 J
LEAD	UMOL/G	T		0.0474	0.0563	0.089	0.172	0.108	0.103	0.449	0.199	0.131	0.36	0.0544	0.0575
NICKEL	UMOL/G	T		0.0444	0.0436	0.0355	0.0264	0.0225	0.0178	0.0222	0.0274	0.0284	0.0628	0.0193	0.0204
ZINC	UMOL/G	T		0.432	0.389	1.32	0.524	0.425	0.375	0.72	1.1	0.854	6.3	0.551	0.372
Grain Size Distribution															
0.001 MM	% PASSING	T		ND (0.5)	5	7	2	7	7	1	3	1.5	7	12	5
0.002 MM	% PASSING	T		3	11	18.5	4	23	24.5	7	11	19.5	9	17	10.5
0.005 MM	% PASSING	T		9.5	20	33.5	6	42.5	46	15	21	41	16	30	21
0.02 MM	% PASSING	T		33	46.5	64.5	21	79	82	36	47	69.5	53.5	72	59.5
0.05 MM	% PASSING	T		49.5	56.5	77	31	86	92.5	49	56	78.5	72	79.5	70
0.064 MM	% PASSING	T		58.5	59	81	34	87.5	95	52	57	78	78	81	73
0.075 MM	% PASSING	T		61.9	59.8	82.6	35.1	87.9	95.7	54.5	57.5	78	81	81.3	75.6
0.15 MM	% PASSING	T		70.1	66.1	85.3	43.2	89.2	97.2	63.7	60.3	84.6	86.3	84.2	80.4
0.3 MM	% PASSING	T		78.5	76.5	88.1	61.9	90.2	98.4	72.2	63.6	89.7	91.8	87.4	85.7
0.6 MM	% PASSING	T		87.1	87.3	90.7	82.3	90.7	99	79.8	68.5	92.3	95.2	90.5	90.2
1.18 MM	% PASSING	T		96.7	92.6	93.8	92.8	91.1	99.1	87.6	88.1	93.9	97.1	93.7	95.1
19 MM	% PASSING	T		100	100	100	100	100	100	99.9	100	100	99.9	100	100
2.36 MM	% PASSING	T		98.5	93.8	95	97.3	91.3	99.2	97.4	99.3	94.7	97.7	97.1	98.9
3.35 MM	% PASSING	T		99.1	94.3	97.5	98.7	96.7	99.6	98.9	99.6	96.8	98.8	97.8	99.6
37.5 MM	% PASSING	T		100	100	100	100	100	100	100	100	100	100	100	100
4.75 MM	% PASSING	T		99.6	94.7	98.7	99.5	99	99.8	99.5	99.9	98	99.3	98.3	100
75 MM	% PASSING	T		100	100	100	100	100	100	100	100	100	100	100	100
Other Parameters															
PERCENT MOISTURE	%	T		84	73.4	79	63.4	77.1	76.4	84.5	80.6	75.8	49.6	72.1	75.3
TOTAL ORGANIC CARBON	MG/KG	T		110000	61300	61000	24500	63600	51200	150000	126000	97700	55300	76800	71400

Appendix B

Sediment Interstitial Water Data – Bouttown Creek Ditch Investigation

Appendix B
Sediment Interstitial Water Data – Bouttown Creek Ditch Investigation
Summary of Ecological Investigations in Carneys Point
DuPont Chambers Works Site
Deepwater, New Jersey

			Location	ECOBCD-01	ECOBCD-02	ECOBCD-03	ECOBCD-04	ECOBCD-04	ECOBCD-05	ECOBCD-06	ECOBCD-07	ECOBCD-08	ECOBCD-09	ECOBCD-10	ECOBCD-11
			Date	10/20/09	10/20/09	10/22/09	10/20/09	10/20/09	10/20/09	10/21/09	10/21/09	10/21/09	10/22/09	10/22/09	10/21/09
			Top (ft)	0	0	0	0	0	0	0	0	0	0	0	0
		Total (T)/	**Bottom (ft)**	0	0	0	0	0	0	0	0	0	0	0	0
Analyte	**Units**	**Diss. (D)**	**Duplicate**	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
Metals															
ARSENIC	UG/L	D		ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)	ND (7.2)
BERYLLIUM	UG/L	D		ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)	ND (1.4)
CADMIUM	UG/L	D		ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
CHROMIUM	UG/L	D		ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)	ND (3.4)
COPPER	UG/L	D		ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)	ND (2.7)
LEAD	UG/L	D		ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)	ND (6.9)
MERCURY	UG/L	D		ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)	ND (0.056)
NICKEL	UG/L	D		8.8 J	3.3 J	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	5.7 J	ND (1.8)	ND (1.8)
SELENIUM	UG/L	D		ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)	ND (8.9)
VANADIUM	UG/L	D		ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	4.1 J	ND (2.5)	ND (2.5)
ZINC	UG/L	D		35.5	ND (8.1)	ND (8.1)	ND (8.1)	ND (8.1)	ND (8.1)	ND (8.1)	ND (8.1)	ND (8.1)	13.3 B	ND (8.1)	ND (8.1)
Total Hardness															
TOTAL HARDNESS AS CACO3	MG/L	T		241	248	156	162	171	102	262	153	109	152	64.5	157