# Characterization of Selected Bed-Sediment-Bound Organic and Inorganic Contaminants and Toxicity, Barnegat Bay and Major Tributaries, New Jersey, 2012

## Appendix 1. Quality Assurance Project Plan

Prepared in cooperation with the
New Jersey Department of Environmental Protection

Data Series 867

**U.S. Department of the Interior**
**U.S. Geological Survey**

**U.S. Department of the Interior**
SALLY JEWELL, Secretary

**U.S. Geological Survey**
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U.S. Geological Survey, Reston, Virginia: 2014

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# Characterization of Selected Contaminants and Determination of Toxicity of Bed Sediments – Barnegat Bay and Tributaries

**New Jersey Department of Environmental Protection**

**Water Monitoring and Standards**

**2013**

# QUALITY ASSURANCE SAMPLING PLAN
Barnegat Bay Watershed, WMA 13

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3·19 2013

Signature Date
Tim Reilly, Research Hydrologist
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NJDEP Quality Assurance Officer:

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Signature Date
Debra Waller, Quality Assurance Officer
Office of Quality Assurance

1. **Project Name**: Characterization of Selected Contaminants and Determination of Toxicity of Bed Sediments – Barnegat Bay and Tributaries

2. **Requesting Agency**: **NJ Department of Environmental Protection**

3. **Date of Project Requested**: **January 2012**

4. **Date of Project Initiation**: 3/1/2012

5. **Project Officer**: **USGS—Timothy Reilly**

   **NJDEP—Helen Pang**

## 6. Project Description

**Background and Purpose**

Many organic and inorganic compounds have physical and chemical properties which cause them to adsorb to particles and/or the organic materials present within sediments. These contaminated sediments can enter a bay via tributaries (ex. residential/commercial pesticide application) or may have sources proximal to or even within the bay (ex. PAHs from motor boats and metals from anti-fouling paints). Depending upon the specific contaminant, its concentration and the composition of the sediment, these compounds can have negative effects upon the benthic community. Some of these compounds have the potential to become concentrated within these organisms and pose a risk throughout the food web.

Barnegat Bay was evaluated as part of the US Environmental Protection Agency National Estuary Program (NEP) in 2000 and 2001 based in part on concerns regarding the impact of non-point pollution on the Bay's water quality and habitat loss and alteration. Thirty sites within the Bay and its tributaries were evaluated based upon indexes of water quality, sediment quality, benthos, and fish tissue. The overall condition of Barnegat Bay was deemed fair. Sediment quality indexes of the estuarine area indicated that 1% rated poor in sediment toxicity and 12% rated fair or poor in sediment contaminants respectively (EPA 2007a).

The sediment contaminant index used by the NEP considers 91 chemical constituents including metals, PAHs, PCBs and legacy pesticides (Table 1). Results are compared to ERM and ERL guidance values (Long and others, 1995) to assess sediment toxicity. None of the pesticides that are currently applied within the Barnegat Bay watershed (Written Communication, Roy Meyer, 2011) were included in the NEP study.

**Table 1. Compounds with ERLs and ERMs included in the EPA NEP study**

| Compound | Class | Compound | Class |
|---|---|---|---|
| Arsenic | Metal | Anthracene | PAH |
| Cadmium | Metal | Fluorene | PAH |
| Chromium | Metal | 2-Methyl naphthalene | PAH |
| Copper | Metal | Naphthalene | PAH |
| Lead | Metal | Phenanthrene | PAH |
| Mercury | Metal | Benz(a)anthracene | PAH |
| Nickel | Metal | Benzo(a)pyrene | PAH |
| Silver | Metal | Chrysene | PAH |
| Zinc | Metal | Dibenzo(a,h)anthracene | PAH |
| 4,4'-DDE | DDT Degradate | Fluoranthene | PAH |
| Total DDT | Insecticide + degradates | Pyrene | PAH |
| Total PCBs | PCB | Low molecular-weight PAH (total) | PAH |
| Acenaphthene | PAH | High molecular-weight PAH (total) | PAH |
| Acenaphthylene | PAH | Total PAHs | PAH |

Sediment toxicity was determined by the NEP by exposing the marine amphipod *Ampelisca* for 10 days under laboratory conditions to bay sediments and comparing their survival rate to *Ampelisca* exposed to uncontaminated reference sediments (EPA 2007b). The only end point considered in this assessment was survival. As such, non-lethal effects were not quantified. Additionally, the duration of these tests may be too short to observe lethal and non-lethal effects from lower concentrations of sediment-born contaminants. All sampled locations were within the estuarine portion of the bay (Written Communication, Helen Pang, 2011). As such, the potential toxicity of sediments contained within the tributaries (which are certainly mobilized during high flow events and will ultimately make their way into the bay) was not determined.

The purpose of this effort is to determine: 1) the occurrence and distribution of selected contaminants in bed sediments, 2) the toxicity of these bed sediments to amphipods and, where possible, 3) to identify potential sources of toxicity within Barnegat Bay and its tributaries.

This study will provide data to assess if biological changes, such as loss of submerged aquatic vegetation (SAV), decline in hard clams, and increase in invasive species, are caused or exacerbated by sediment toxicity.

# 7. Sediment Monitoring and Design Rationale

## 7.1- Approach

Sediment toxicity may be a cause of changes observed in SAV, hard clam populations and invasive species. To characterize the potential toxicity, the physical and chemical makeup of the sediment must be determined.

In order to determine the occurrence and distribution of selected contaminants in bed sediments and the toxicity of these bed sediments to amphipods, the USGS, in cooperation with the NJDEP and US Army Corps of Engineers (USACE), proposes to collect bed sediments from Barnegat Bay and its tributaries. Samples will be analyzed for contaminants and tested for toxicity as described below.

## 7.2- Sampling

Twenty-two (11 within tributaries and 11 within the bay) sampling locations were selected to coincide with selected water sampling locations used for the ongoing water quality monitoring project in the Barnegat Bay watershed (Figure 1; Tables 2 and 3). Two non- or minimally impacted reference sites were selected and will be sampled; one fresh water and one estuarine. All locations will be sampled one time during this study in a synoptic fashion between August and September of 2012. The upper 2 cm of bed sediment at tributary sites and the upper 10 cm of bottom material at in-bay sites will be collected by USGS staff using standard USGS and EPA methods and equipment (Hladik and others, 2009; Radtke, 2005; USEPA, 2001). As a large amount of sample (roughly 5 gallons) is needed for the sediment chemistry and toxicological assays, potential sampling locations will be visited prior to sampling to ensure that sufficient depositional locations and sediment are present. Sampling will be coordinated with others researchers (especially those evaluating benthic invertebrate community structure) to ensure that sampling for this project does not adversely affect their results. Detailed notes (including GPS locations and photographs) regarding collection locations will be taken during sampling to document the size of the area sampled. Samples will be thoroughly homogenized prior to sub-sampling. Sub-samples will be transferred to the appropriate dedicated containers for grain size analysis and oven dried at 100°C at the NJWSC prior to shipment to the analyzing laboratory. Sub-samples for chemical analysis will be sieved to remove plant debris and gravel (<2mm) and transferred to the appropriate dedicated containers, preserved as appropriate and shipped to laboratories for the analyses and testing described below (Table 4).

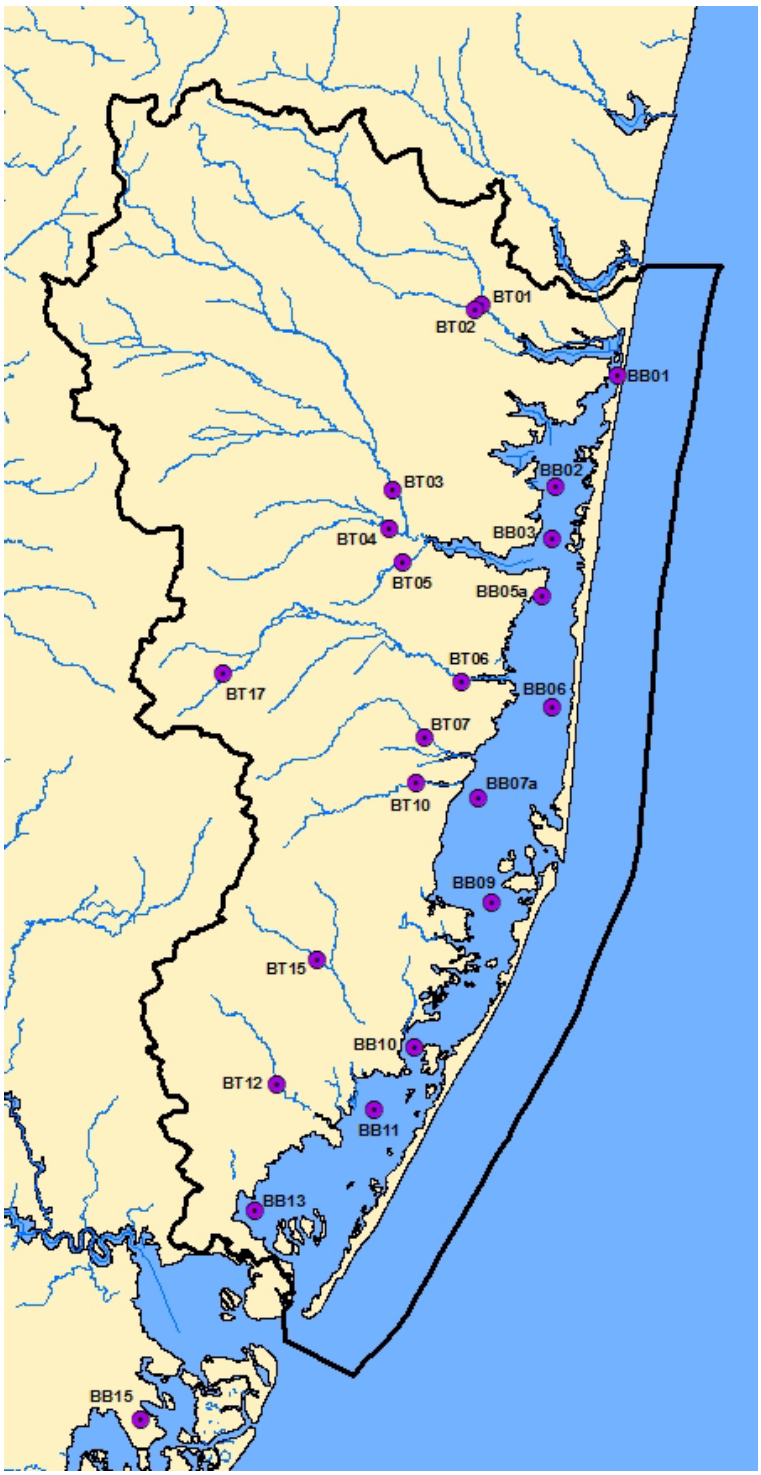


**Figure 1. Map showing the location of monitoring sites within the Barnegat Bay and selected tributaries**

**Table 2. List of sampling locations within Barnegat Bay**

| Project_ID | Site_Description | Type | Longitude | Latitude | Site_Reference_ID |
|---|---|---|---|---|---|
| BB01 | Barnegat Bay at Mantoloking | In-bay grab sample | -74.052222 | 40.04000 | USGS-01408168 |
| BB02 | Barnegat Bay between Silver Bay and Goose Creek | In-bay grab sample | -74.09847 | 39.97762 | USGS-395839074055401 |
| BB04 | Barnegat Bay near the Mouth of Toms River | In-bay grab sample | -74.11014 | 39.93762 | USGS-395653074060501 |
| BB05A | Barnegat Bay between Ocean Gate and South Seaside Park | In-bay grab sample | -74.11291 | 39.88456 | USGS-395458074063401 |
| BB06 | Barnegat Bay below Cedar Creek and above Forked River | In-bay grab sample | -74.10208 | 39.85262 | USGS-395109074060701 |
| BB07A | Barnegat Bay between Forked River and Sedge Island | In-bay grab sample | -74.15319 | 39.79262 | USGS-394805074092601 |
| BB09 | Barnegat Bay below Barnegat Inlet and close to Long Beach | In-bay grab sample | -74.14792 | 39.74262 | USGS-394433074085201 |
| BB10 | Barnegat Bay by Route 72 Bridge | In-bay grab sample | -74.20653 | 39.66095 | USGS-393939074122301 |
| BB11 | Barnegat Bay above Westecunk Creek | In-bay grab sample | -74.2357 | 39.6254 | USGS-393731074140801 |
| BB13 | Barnegat Bay near Tuckerton Creek | In-bay grab sample | -74.32459 | 39.56901 | USGS-393408074192801 |
| BB15 | Edwin B. Forsythe National Wildlife Refuge located off Wildlife Drive, Galloway Twp, NJ | Reference location<br><br>In-bay grab sample | -74.408813 | 39.451571 | USGS-392706074243201 |

**Table 3. List of sampling locations within selected Barnegat Bay tributaries**

| Project_ID | Site_Description | Type | Longitude | Latitude | Site_Reference_ID |
|---|---|---|---|---|---|
| BT01 | North Branch Metedeconk R near Laurelton | Tributary grab sample | -74.152222 | 40.081389 | USGS-01408123 |
| BT02 | SB Metedeconk River near Laurelton (Chambers Bridge Rd) | Tributary grab sample | -74.156667 | 40.078333 | USGS-01408152 |
| BT03 | Toms River near Toms River | Tributary grab sample | -74.218333 | 39.976389 | USGS-01408505 |
| BT04 | Wrangle Brook near South Toms River | Tributary grab sample | -74.221389 | 39.954722 | USGS-01408640 |
| BT05 | Jakes Branch at South Toms River (Route 619) | Tributary grab sample | -74.211667 | 39.935278 | USGS-01408710 |
| BT06 | Cedar Creek at Lanoka Harbor | Tributary grab sample | -74.169167 | 39.8675 | USGS-01409000 |
| BT07 | NB Forked River at Forked River | Tributary grab sample | -74.196389 | 39.836111 | USGS-01409055 |
| BT10 | Oyster Creek (upstream Route 9 at JCPL) | Tributary grab sample | -74.202657 | 39.811011 | USGS-01409103 |
| BT12 | Westecunk Creek at Railroad Ave at West Creek | Tributary grab sample | -74.308056 | 39.640278 | USGS-01409281 |
| BT15 | Upstream from Manahawkin Lake near access road to Garden State Parkway in Stafford Twp, NJ | Tributary grab sample | -74.277389 | 39.710833 | USGS-01409103 |
| BT17 | Chamberlin Branch of Cedar Creek on Jone Road in the Greenwood Forest/Pasadena WMA , Lacey Twp, NJ | Reference location<br><br>Tributary grab sample | -74.34423 | 39.873076 | USGS-01408790 |

**Table 4. Summary of sediment analysis type, participating laboratories, sampling containers and preservation needs**

| Analysis | Laboratory | Minimum Sample Volume or Mass | Container type | Preservative | Storage needs |
|---|---|---|---|---|---|
| Current-use pesticides; Carbon and Nitrogen content | USGS-PFRG | 125 ml | 250 ml clear baked glass | None | Chill to 4°C in field, store at -20 °C until analysis |
| Legacy pesticides | USACE-ERDC | 125 ml | 250 ml Amber baked glass | None | Chill to 4°C in field, store at 4°C in dark until analysis |
| Metals | USACE-ERDC | 125 ml | 250 ml HDPE | None | Store cool and dark |
| Priority and alkalyted PAHs | USACE-ERDC | 125 ml | 250 ml Amber baked glass | None | Chill to 4°C in field, store at 4°C in dark until analysis |
| PCB arocholors and congeners | USACE-ERDC | 125 ml | 250 ml Amber baked glass | None | Chill to 4°C in field, store at 4°C in dark until analysis |
| Sediment Toxicity and Phase 1 TIE | USACE-ERDC | 18 L | 18 L plastic bucket | None | Chill to 4 °C in dark |
| pH and conductivity | ANSP | 50g | 250 ml plastic bag (Whirlpack) | None | None |
| Grain size | RUSTL | 40g | 250 ml plastic bag (Whirlpack) | None | None |

## 7.3- Sediment Chemistry and Grain Size

Bed sediment will be analyzed by the USGS-Pesticide Fate Research Group (USGS-PFRG), US Army Corps of Engineers Engineer Research and Development Center (USACE-ERDC), the Academy of Natural Sciences of Drexel University (ANSP) and the Rutgers Soil Testing Laboratory (RUSTL). Samples for organic chemicals analysis by USACE-ERDC will be prepared using EPA method 3545. Samples for currently-used pesticide analysis will be prepared as described in Smalling and Kuivia (2008). Instruments will be calibrated in accordance with the acceptance criteria for the methods used. The wavelength used for testing in EPA 6010B is not predetermined; it will be selected based upon analysis of QA data from each individual run in accordance with EPA method 6010B. The wavelengths chosen for the analysis will be included in the analytical report for the data generated. Quality assurance samples (replicates, standard reference materials (as appropriate), blanks and laboratory matrix spikes) will be analyzed on 10% of the samples (Table 5).

Dried sediments will be analyzed for pH and electrical conductivity using standard soil analytical techniques; instruments will be calibrated and quality assurances practices employed as described within primary references for the methods used (SW846 Method 9045D and EPA Method 120.1). After calibration at pH 10 and 4, a check measurement will be made in a buffer solution with a pH of 7. The check measurement must be +/- 0.1 pH units of 7.0 (6.9-7.1). After electrical conductivity calibration a check measurement will be made using a standard solution. The check measurement must be within 1% of the standard value.

Grain size (USDA sand/silt/clay percentages) will be determined on oven dried sediments using standard soil measurement techniques with quality control practices described in the primary reference for the method used (Gee and Bauder, 1986). The procedure is being modified to allow for a reading at 6 hours and 52 minutes in addition to the reading at 40 seconds. Quality assurance is maintained by the RUSTL's participation in the North American Proficiency Testing program of the Soil Science Society of America and by the analysis of duplicate sample testing. A relative percent difference between the duplicate results of <20% is required for the data to be considered acceptable. The average of the results of the duplicate testing will be reported.

Testing for pH, conductivity, and sediment analysis for sand/silt/clay shall be performed by a New Jersey laboratory certified under the requirements of N.J.A.C. 7:18 or laboratories which have formal approval from the NJDEP-Office of Quality Assurance. Certificates of formal approval were approved for the Academy of Natural Sciences (pH and conductivity) and Rutgers University Soil Testing Laboratory (RUSTL for sediment analysis) and are effective through June 30, 2014.

**Table 5. Environmental and QA/QC sample count**

| Media | Environmental | Replicates | Blanks | Spikes |
|---|---|---|---|---|
| Tributary Bed Sediment | 10 | 1 | 1 | 1 |
| In-Bay Bed Sediment | 10 | 1 | 1 | 1 |
| Reference Site Bed Sediment | 2 | 0 | 0 | 0 |
| Standard Reference Material (NIST SRM 1941b Organics in Marine Sediment – organics, carbon and nitrogen) | 2 | 0 | 0 | 0 |

## *List of Analyses and analytical methods*

- **Sediment Contaminants**
  o Current-use pesticides (Smalling and Kuivila, 2008) (Table 6) – USGS- PFRG
  o Legacy pesticides (USEPA method 8081A) (Table 7) – USACE- ERDC
  o Metals (USEPA methods 7471A and 6010) via digestion block (Table 8) – USACE-ERDC
  o Priority and alkalyted PAHs (USEPA methods 8270 and 8270C) (Table 9) – USACE-ERDC
  o PCB arocholors and congeners (USEPA Method 8082) (Table 10) – USACE-ERDC

- **Other Sediment Properties**
  o Carbon and Nitrogen content (EPA 440.0)-USGS-PFRG
  o pH (SW846 Method 9045D) and conductivity (EPA Method 120.1) – ANSP (replicate only, no blanks or spikes)
  o USDA clay/silt/sand percentage (Gee and Bauder, 1986) – RUSTL (replicate only, no blanks or spikes)

## Table 6. Current-use pesticides analyzed by the USGS-PFRG and their method detection limits

| Compound | MDL(µg/kg) | Compound | MDL(µg/kg) |
|---|---|---|---|
| **Anilide** | | **Pyrazole** | |
| Fenhexamide | 3.2 | Fipronil | 1.9 |
| **Anilines** | | Fipronil desulfinyl | 2.8 |
| 3,4-DCA | 2.5 | Fipronil sulfide | 2.2 |
| 3,5-DCA | 3 | Fipronil sulfone | 1.1 |
| Ethalfluralin | 1.3 | **Pyrethroids** | |
| Pendimethalin | 1.0 | Allethrin | 1.5 |
| Propanil | 3.2 | Bifenthrin | 2.2 |
| Trifluralin | 1.7 | Cyfluthrin | 2.0 |
| **Aromatic** | | Cypermethrin | 2.6 |
| Chlorothalonil | 1.2 | Deltamethrin | 2.5 |
| **Azoles/Triazoles** | | Esfenvalerate | 2.1 |
| Cyproconazole | 1.5 | Etofenprox | 2.5 |
| Difenoconazole | 0.6 | Fenpropathrin | 2.1 |
| Fenbuconazole | 2.2 | Lambda-Cyhalothrin | 2.4 |
| Flusilazole | 3.0 | Permethrin | 1.0 |
| Flutriafol | 1.3 | Phenothrin | 1.3 |
| Imazalil | 2.5 | Remethrin | 1.9 |
| Metconazole | 0.7 | Tau-Fluvalinate | 2.6 |
| Myclobutanil | 2.9 | Tefluthrin | 1.1 |
| Propiconazole | 1.6 | Tetramethrin | 1.4 |
| Tebuconazole | 1.6 | **Pyrimidine/Anilinopyrimidine** | |
| Tetraconazole | 1.3 | Cyprodinil | 2.4 |
| Triadimefon | 3.8 | Fenarimol | 1.5 |
| Triadimenol | 1.6 | Pyrimethanil | 1.2 |
| Triflumizole | 0.6 | **Pyridine** | |
| Triticonazole | 2.4 | Fluazinam | NA |
| **Benzamide** | | **Pyrrole** | |
| Zoxamide | 1.1 | Fludioxinil | 3.7 |
| **Carbamates** | | **Strobilurins** | |
| Carbaryl | 1.8 | Azoxystrobin | 1.1 |
| Carbofuran | 1.5 | Fluoxastrobin | 1.8 |
| **Carboxamide** | | Kresoxim-methyl | 0.6 |
| Boscalid | 1.7 | Pyraclostrobin | 1.6 |
| **Chloroacetanilides** | | Trifloxystrobin | 1.4 |
| Alachlor | 1.0 | **Thiocarbamates** | |
| Metolachlor | 1.3 | Butylate | 1.6 |
| **Imidazole\Oxazole** | | Cycloate | 1.0 |
| Famoxadone | 2.4 | EPTC | 0.9 |
| Iprodione | 0.9 | Molinate | 1.1 |
| Vinclozolin | 1.8 | Pebulate | 1.4 |
| **Morpholine** | | Thiobencarb | 0.6 |
| Dimethomorph | 2.0 | **Triazines/Triazones** | |
| **Organochlorines** | | Atrazine | 1.7 |
| Pentachloroanisole (PCA) | 1.4 | Clomazome | 2.5 |
| Pentachloronitrobenzene (PCNB) | 1.2 | Hexazinone | 1.2 |
| p,p'-DDD | 1.4 | Prometryn | 2.8 |
| p,p'-DDE | 1.4 | Prometon | 3.4 |
| p,p'-DDT | 1.3 | Propyzamide | 1.5 |
| **Organophosphates** | | Simazine | 1.5 |
| Chlorpyrifos | 2.0 | Terbuthylazine | 1.7 |
| Diazinon | 2.0 | **Miscellaneous** | |
| Malathion | 1.1 | DCPA | 2.5 |
| Methidathion | 2.9 | Methoprene | 2.4 |
| Methyl parathion | 1.2 | Napropamide | 1.3 |
| Phosmet | 1.4 | Oxyfluorfen | 3.6 |
| | | Piperonyl butoxide | 1.6 |

**Table 7. Analytical method information for legacy pesticides analyzed using EPA method 8081A by the USACE-ERDC**

| Analyte | MDL | Reporting Limit | Surrogate % recovery | RPD | Matrix spike % recovery | RPD | Blank % recovery | RPD |
|---|---|---|---|---|---|---|---|---|
| surr: 2,4,5,6 Tetrachloro-m-xylene | 0.0400 | | 40 - 125 | 30 | | | | |
| surr: 2,4,5,6 Tetrachloro-m-xylene [2C] | 0.0400 | | 40 - 125 | 30 | | | | |
| 2,4´-DDD | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 2,4'-DDD (2C) | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 2,4´-DDE | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 2,4'-DDE (2C) | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 2,4´-DDT | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 2,4'-DDT (2C) | 0.0400 | 0.420 ug/kg | | 30 | 40 - 110 | 30 | 50 - 110 | 30 |
| 4,4´-DDD | 0.0900 | 0.420 ug/kg | | 30 | 30 - 135 | 30 | 30 - 135 | 30 |
| 4,4'-DDD [2C] | 0.0900 | 0.420 ug/kg | | 30 | 30 - 135 | 30 | 30 - 135 | 30 |
| 4,4´-DDE | 0.126 | 0.420 ug/kg | | 30 | 70 - 125 | 30 | 70 - 125 | 30 |
| 4,4'-DDE [2C] | 0.126 | 0.420 ug/kg | | 30 | 70 - 125 | 30 | 70 - 125 | 30 |
| 4,4´-DDT | 0.114 | 0.420 ug/kg | | 30 | 45 - 140 | 30 | 45 - 140 | 30 |
| 4,4'-DDT [2C] | 0.114 | 0.420 ug/kg | | 30 | 45 - 140 | 30 | 45 - 140 | 30 |
| Aldrin | 0.0760 | 0.420 ug/kg | | 30 | 45 - 140 | 30 | 45 - 140 | 30 |
| Aldrin [2C] | 0.0760 | 0.420 ug/kg | | 30 | 45 - 140 | 30 | 45 - 140 | 30 |
| alpha-BHC | 0.113 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| alpha-BHC [2C] | 0.113 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| alpha-Chlordane | 0.118 | 0.420 ug/kg | | 30 | 65 - 120 | 30 | 65 - 120 | 30 |
| alpha-Chlordane [2C] | 0.118 | 0.420 ug/kg | | 30 | 35 - 120 | 30 | 65 - 120 | 30 |
| beta-BHC | 0.126 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| beta-BHC [2C] | 0.126 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| surr: Decachlorobiphenyl | 0.0400 | | 55 - 130 | 30 | | | | |
| surr: Decachorobiphenyl [2C] | 0.0400 | | 55 - 130 | 30 | | | | |
| delta-BHC | 0.108 | 0.420 ug/kg | | 30 | 55 - 130 | 30 | 55 - 130 | 30 |
| delta-BHC [2C] | 0.108 | 0.420 ug/kg | | 30 | 55 - 130 | 30 | 55 - 130 | 30 |
| Dieldrin | 0.0930 | 0.420 ug/kg | | 30 | 65 - 125 | 30 | 65 - 125 | 30 |
| Dieldrin [2C] | 0.0930 | 0.420 ug/kg | | 30 | 65 - 125 | 30 | 65 - 125 | 30 |
| Endosulfan I | 0.256 | 0.420 ug/kg | | 30 | 15 - 135 | 30 | 15 - 135 | 30 |
| EndoSulfan I [2C] | 0.256 | 0.420 ug/kg | | 30 | 15 - 135 | 30 | 15 - 135 | 30 |
| Endosulfan II | 0.296 | 0.420 ug/kg | | 30 | 35 - 140 | 30 | 35 - 140 | 30 |
| Endosulfan II [2C] | 0.296 | 0.420 ug/kg | | 30 | 35 - 140 | 30 | 35 - 140 | 30 |
| Endosulfan sulfate | 0.117 | 0.420 ug/kg | | 30 | 60 - 135 | 30 | 60 - 135 | 30 |
| Endosulfan sulfate [2C] | 0.117 | 0.420 ug/kg | | 30 | 60 - 135 | 30 | 60 - 135 | 30 |
| Endrin | 0.105 | 0.420 ug/kg | | 30 | 60 - 135 | 30 | 60 - 135 | 30 |
| Endrin [2C] | 0.105 | 0.420 ug/kg | | 30 | 60 - 135 | 30 | 60 - 135 | 30 |
| Endrin aldehyde | 0.205 | 0.420 ug/kg | | 30 | 35 - 145 | 30 | 35 - 145 | 30 |
| Endrin aldehyde [2C] | 0.205 | 0.420 ug/kg | | 30 | 35 - 145 | 30 | 35 - 145 | 30 |
| Endrin ketone | 0.0480 | 0.420 ug/kg | | 30 | 65 - 135 | 30 | 65 - 135 | 30 |
| Endrin ketone [2C] | 0.0480 | 0.420 ug/kg | | 30 | 65 - 135 | 30 | 65 - 135 | 30 |
| gamma-BHC (Lindane) | 0.129 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| gamma-BHC [Lindane] [2C] | 0.129 | 0.420 ug/kg | | 30 | 60 - 125 | 30 | 60 - 125 | 30 |
| gamma-Chlordane | 0.127 | 0.420 ug/kg | | 30 | 65 - 125 | 30 | 65 - 125 | 30 |
| gamma-Chlorodane [2C] | 0.127 | 0.420 ug/kg | | 30 | 65 - 125 | 30 | 65 - 125 | 30 |
| Heptachlor | 0.131 | 0.420 ug/kg | | 30 | 50 - 140 | 30 | 50 - 140 | 30 |
| Heptachlor [2C] | 0.131 | 0.420 ug/kg | | 30 | 50 - 140 | 30 | 50 - 140 | 30 |

**Table 7. Analytical method information for legacy pesticides analyzed using EPA method 8081A by the USACE-ERDC (Cont.)**

| Analyte | MDL | Reporting Limit | Surrogate % recovery | RPD | Matrix spike % recovery | RPD | Blank % recovery | RPD |
|---|---|---|---|---|---|---|---|---|
| Heptachlor epoxide | 0.142 | 0.420 ug/kg | | 30 | 65 - 130 | 30 | 65 - 130 | 30 |
| Heptachlor epoxide [2C] | 0.142 | 0.420 ug/kg | | 30 | 65 - 130 | 30 | 65 - 130 | 30 |
| Hexachlorocyclopentadiene | 0.0400 | 0.420 ug/kg | | 30 | 75 - 125 | 30 | 75 - 125 | 30 |
| Hexachlorocyclopentadiene (2C | 0.0400 | 0.420 ug/kg | | 30 | 50 - 110 | 30 | 60 - 120 | 30 |
| Methoxychlor | 0.199 | 0.420 ug/kg | | 30 | 55 - 145 | 30 | 55 - 145 | 30 |
| Methoxychlor [2C] | 0.199 | 0.420 ug/kg | | 30 | 55 - 145 | 30 | 55 - 145 | 30 |
| Toxaphene | 0.00300 | 16.7 ug/kg | | 30 | 75 - 125 | 30 | 75 - 125 | 30 |
| Toxaphene [2C] | 0.00300 | 16.7 ug/kg | | 30 | 75 - 125 | 30 | 75 - 125 | 30 |

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**Table 8. Analytical method information for metals analyzed using EPA methods 7471A and 6010 by the USACE-ERDC**

| | | Reporting | Surrogate | Duplicate | Matrix Spike | | Blank Spike / LCS | |
|---|---|---|---|---|---|---|---|---|
| Analyte | MDL | Limit | %R | RPD | %R | RPD | %R | RPD |
| Aluminum | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Antimony | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Arsenic | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Barium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Beryllium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Cadmium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Calcium | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Chromium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Cobalt | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Copper | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Iron | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Lead | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Magnesium | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Manganese | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Mercury | 0.00400 | 0.00400 mg/kg | | 25 | 75 - 125 | 25 | 75 - 125 | 25 |
| Nickel | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Potassium | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Selenium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Silver | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Sodium | 1.00 | 5.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Sulfur | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Thallium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Vanadium | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Zinc | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |
| Phosphorus | 0.400 | 2.00 mg/kg | 20 | | 80 - 120 | 20 | 80 - 120 | |

**Table 9. Analytical method information for priority and alkylated PAHS analyzed using EPA method 8270 by the USACE-ERDC**

| | | Reporting | Surrogate | Duplicate | Matrix Spike | | Blank Spike / LCS | |
|---|---|---|---|---|---|---|---|---|
| Analyte | MDL | Limit | %R | RPD | %R | RPD | %R | RPD |
| 2-Methylnaphthalene | 1.00 | 4.00 ug/kg | 30 | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-Methylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-ethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-ethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2,6/2,7-dimethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1,3-dimethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1,6-dimethylnaphthtalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1,4/2,3-dimethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-isopropylnaphthalene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 1,8-dimethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2,3,5-Trimethylnaphthalene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-methylfluoene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-ethylfluorene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1,8-dimethylfluorene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| Dibenzothiophene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 1-Methylphenanthrene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-methylphenanthrene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-methylanthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 9-methylanthracene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2,3-dimethylanthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 9,10-dimethylanthracene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-tetrabutylanthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 9-ethyl-10-methylphenanthrene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-methylpyrene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1,4,5,8-tetramethylanthracene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-methylfluoranthene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-methylfluoranthene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 1-methylbenz(a)anthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 1-methylchrysene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 2-methylchrysene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 3-methylchrysene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| 6-ethylchrysene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |

**Table 9. Analytical method information for priority and alkylated PAHS analyzed using EPA method 8270 by the USACE-ERDC (cont.)**

| | | Reporting | Surrogate | Duplicate | Matrix Spike | | Blank Spike / LCS | |
|---|---|---|---|---|---|---|---|---|
| Analyte | MDL | Limit | %R | RPD | %R | RPD | %R | RPD |
| 6,8-dimethylbenz(a)anthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 3,9-dimethylbenz(a)anthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 8,9,11-trimethylbenz(a)anthracene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 8-methylbenzo(a)pyrene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| 7,10-dimethylbenzo(a)pyrene | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| Acenaphthene-d10 | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| C1-Benz(a)anthracene/Chrysene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C1-Fluoranthenes/Pyrenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C1-Fluorenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C1-Naphthalenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C1-Phenanthrenes/Anthracenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C2-Benz(a)anthracene/Chrysene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C2-Fluoranthene/Pyrene | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C2-Fluorenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C2-Naphthalenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C2-Phenanthrenes/Anthracenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C3-Fluorenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C3-Naphthalenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C3-Phenanthrenes/Anthracenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C4-Naphthalenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| C4-Phenanthrenes/Anthracenes | 1.00 | 4.00 ug/kg | | | | 40 | | 40 |
| Chrysene-d12 | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| Naphthalene-d8 | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |
| Phenanthrene-d10 | 1.00 | 4.00 ug/kg | | | 45 - 105 | 40 | 50 - 110 | 40 |

**Table 9. Analytical method information for priority and alkylated PAHS analyzed using EPA method 8270 by the USACE-ERDC (cont.)**

| | | Reporting | Surrogate | Duplicate | Matrix Spike | | Blank Spike / LCS | |
|---|---|---|---|---|---|---|---|---|
| Analyte | MDL | Limit | %R | RPD | %R | RPD | %R | RPD |
| Acenaphthene | 0.400 | 1.70 ug/kg | | 30 | 45 - 110 | 30 | 45 - 110 | 30 |
| Acenaphthylene | 0.400 | 1.70 ug/kg | | 30 | 45 - 105 | 30 | 45 - 105 | 30 |
| Anthracene | 0.400 | 1.70 ug/kg | | 30 | 55 - 105 | 30 | 55 - 105 | 30 |
| Benzo (a) anthracene | 0.400 | 1.70 ug/kg | | 30 | 50 - 110 | 30 | 50 - 110 | 30 |
| Benzo (a) pyrene | 0.400 | 1.70 ug/kg | | 30 | 50 - 110 | 30 | 50 - 110 | 30 |
| Benzo (b) fluoranthene | 0.400 | 1.70 ug/kg | | 30 | 45 - 115 | 30 | 45 - 115 | 30 |
| Benzo (g,h,i) perylene | 0.400 | 1.70 ug/kg | | 30 | 40 - 125 | 30 | 40 - 125 | 30 |
| Benzo (k) fluoranthene | 0.400 | 1.70 ug/kg | | 30 | 45 - 125 | 30 | 45 - 125 | 30 |
| Chrysene | 0.400 | 1.70 ug/kg | | 30 | 55 - 110 | 30 | 55 - 110 | 30 |
| Dibenz (a,h) anthracene | 0.400 | 1.70 ug/kg | | 30 | 40 - 125 | 30 | 40 - 125 | 30 |
| Fluoranthene | 0.400 | 1.70 ug/kg | | 30 | 55 - 115 | 30 | 55 - 115 | 30 |
| Fluorene | 0.400 | 1.70 ug/kg | | 30 | 50 - 110 | 30 | 50 - 110 | 30 |
| Indeno (1,2,3-cd) pyrene | 0.400 | 1.70 ug/kg | | 30 | 40 - 120 | 30 | 40 - 120 | 30 |
| Naphthalene | 0.400 | 1.70 ug/kg | | 30 | 40 - 105 | 30 | 40 - 105 | 30 |
| Phenanthrene | 0.400 | 1.70 ug/kg | | 30 | 50 - 110 | 30 | 50 - 110 | 30 |
| Pyrene | 0.400 | 1.70 ug/kg | | 30 | 45 - 125 | 30 | 45 - 125 | 30 |
| surr: 2-Fluorobiphenyl | 0.400 | | 45 - 105 | | | | | |
| surr: Terphenyl-dl4 | 0.400 | | 30 - 125 | | | | | |

**Table 10. Analytical method information for PCB aroclors and congeners analyzed using EPA method 8082**

| Analyte | MDL | Reporting Limit | Surrogate %R | Duplicate RPD | Matrix Spike %R | Matrix Spike RPD | Blank Spike / LCS %R | Blank Spike / LCS RPD |
|---|---|---|---|---|---|---|---|---|
| PCB-1016 | 2.07 | 3.30 ug/kg | | | 40 - 140 | 30 | 60 - 130 | 30 |
| PCB 1016 [2C] | 2.19 | 3.30 ug/kg | | | 40 - 140 | 30 | 60 - 130 | 30 |
| PCB-1221 | 2.16 | 3.30 ug/kg | | 30 | | | | |
| PCB 1221 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB-1232 | 2.16 | 3.30 ug/kg | | 30 | | | | |
| PCB 1232 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB-1242 | 2.16 | 3.30 ug/kg | | 30 | | | | |
| PCB 1242 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB-1248 | 2.16 | 3.30 ug/kg | | 30 | | | | |
| PCB 1248 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB-1254 | 2.16 | 3.30 ug/kg | | 30 | | | | |
| PCB 1254 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB-1260 | 2.14 | 3.30 ug/kg | | 30 | 40 - 140 | 30 | 65 - 140 | 30 |
| PCB 1260 [2C] | 2.22 | 3.30 ug/kg | | | 40 - 140 | 30 | 65 - 140 | 30 |
| PCB 1262 | 2.16 | 3.30 ug/kg | | | | | | |
| PCB 1262 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| PCB 1268 | 2.16 | 3.30 ug/kg | | | | | | |
| PCB 1268 [2C] | 2.16 | 3.30 ug/kg | | | | | | |
| surr: 2,4,5,6 Tetrachloro-m-xylene | | | 40 - 125 | | | | | |
| surr: 2,4,5,6 Tetrachloro-m-xylene [2C] | | | 40 - 125 | | | | | |
| surr: Decachlorobiphenyl | | | 50 - 125 | | | | | |
| surr: Decachorobiphenyl [2C] | | | 50 - 125 | | | | | |

## 7.4- Sediment Toxicity Determination

Estuarine/Marine sediments from the Barnegat Bay area will be tested utilizing the estuarine amphipod *Leptocheirus plumulosus* 28-d toxicity method in basic accordance with methods outlined in US EPA/USACE 2001. Freshwater sediments from the Barnegat Bay area will be tested utilizing the freshwater amphipod *Hyalella azteca* chronic 28-d toxicity test method. This test method will be conducted in basic accordance with the procedures outlined in US EPA 2000 and ASTM 2010. Endpoints to be assessed will be survival and growth (weight and total biomass).

Of the freshwater and estuarine/marine sediments assessed for 28-d toxicity, a subset will be chosen to undergo a Phase I Sediment Toxicity Identification Evaluation (TIE) in basic accordance with procedures outlined in US EPA (2007c). This TIE will consist of the sediment amendments activated carbon (removes organics), SIR-300 (removes metals), SIR-600 (removes ammonia), and sand (tests for dilution effects of other treatments) as well as a treatment utilizing reduced temperature (to test for effects due

to pyrethroid pesticides). The effects of these sediment treatments will be compared against chronic 28-d *Hyalella azteca* toxicity bioassays (performed in basic accordance with ASTM (2010) and USEPA (2000)) for freshwater sites and chronic 28-d *Leptocheirus plumulosus* toxicity bioassays (performed in basic accordance with EPA/USACE (2001) for the estuarine/marine sites.

# 8. Data Usage

Sediment chemistry and toxicity data sampled under this project will be used to determine whether or not sediment is a contributing factor with regards to biological changes observed within the Barnegat Bay. All sampling procedures must be in conformance with NJDEP or USGS (Hladik and others, 2009; Radtke, 2005; USEPA, 2001) field sampling procedures as well as other applicable guidance. If a method or procedure requires change and is not contained in Tables 6 through 10, this information should be brought to the attention of the signatories of this QAPP through writing and will require approval prior to being used.

# 9. Data Reporting and Retention

Results will be reported to the USGS from analyzing laboratories as Excel spreadsheets via email. Results will be reported to NJDEP and the public in a USGS open-file report and made available to the public on an associated web site. All data will be permanently archived in appropriate data bases (NWIS and a project database) by the USGS NJ Water Science Center (USGS NJWSC). Request for data will be managed by USGS NJWSC staff. All QAPP related data and all associated raw data records (including chain of custody records, records of calibrations and calibration checks) shall reside indefinitely at the facility producing the data or the academic or research institution performing the review and compilation of data. If the facility cannot provide the required storage, the data shall be transferred for archival storage to the Department.

# 10. Project area

The watershed project area covered under this project is the Barnegat Bay Watershed in WMA 13 (see Figure 1 for the spatial extent of the study). The GIS map provided identifies proposed monitoring locations and approximate head of tide.

# 11. Data Representativeness

The same methods and techniques will be used by all field collection staff.

# 12. Data Validation

Quality assurance samples (blanks, spikes and replicates) will be analyzed on 10 percent of the samples collected. Standard reference samples will be analyzed at the rate where appropriate standards exist. The data is verified using the replicate data percent difference discussed above. The data is validated using the QC data.
No standard reference material exists for current-use pesticides in sediment as suchSRM 1941b (Organic in Marine Sediment) from the National Institute of Standards and Technology (Gaithursburg, MD) as the certified reference material to measure the accuracy and precision of organic contaminants, carbon and nitrogen. SRM's

will be measured in 10 % of the samples. Measured value should be 70-130% of the 95% confidence intervals.

The QC sample must fall between two standard deviations at the 95th percentile confidence level to be valid. All laboratory and field spikes must be between 70-130 % unless otherwise noted on Tables 7-10. Results will be assessed against available, historical data from the locations monitored. All data collected will be provided to NJDEP and WM&S staff will perform the data validation process. Data that can not be confirmed by these reviews or explained by circumstances (i.e. heavy rain, drought) or project QA data will be classified as questionable by NJDEP. In addition, quality assurance protocols will be used by USGS, USACE, ANS and RUSTL for the data validations under the supervision of a quality assurance officer. All project data including any data rejected as outliers, laboratory results flagged for not meeting quality control acceptance criteria or any other scientifically-based reason, even if the data is not used in the final research analysis will be submitted to the Department.

# 13. Data Quality Requirements

**Field Quality Assurance and Quality Control**

The Laboratories participating in this project will follow the laboratory methods specified in the primary references for each method and as outlined in this plan (summarized in Table 11). Any changes to the methods used must be pre-approved by the DEP before sample testing continues.

**Table 11. Summary of preservation methods, method detection limits, reporting limits, methodologies and holding times for sediment chemical analyses**

| Laboratory | Analytes | Preservation | Method Detection Limit | Lab Reporting Limit | Method(s) | Holding Time |
|---|---|---|---|---|---|---|
| USGS-PFRG | Current-Use Pesticides | -20°C | 0.6–3.8 (µg/kg) | 0.6–3.8 (µg/kg) | Smalling and Kuivila, 2008 | 12 months |
| USGS-PFRG | Total Organic Carbon and Nitrogen | -20 ºC | 0.01 % | 0.01 % | USEPA 440.0 | 12 months |
| USACE-ERDC | Legacy Pesticides | 4°C | 0.04–0.296 (µg/kg) | 0.42 (µg/kg) | USEPA 8081A | 14 days |
| USACE-ERDC | Metals | 4°C | 0.400–1.00 (mg/kg) | 2.00–5.00 (mg/kg) | USEPA 6010 | 180 days |
| USACE-ERDC | Mercury | 4°C | 0.004 (mg/kg) | 0.004 (mg/kg) | USEPA 7471 | 28 days |
| USACE-ERDC | Priority and alkalyted PAHs | 4°C | 0.400 – 1.00 (µg/kg) | 1.70–4.00 (µg/kg) | USEPA 8270 & 8270C | 14 days |
| USACE-ERDC | PCB arocholors and congeners | 4°C | 2.07 – 2.22 (µg/kg) | 3.30 (µg/kg) | USEPA 8082 | 14 days |
| ANSP | pH | None | 0-14 | 0-14 | SW846 Method | 12 |

| Laboratory | Analytes | Preservation | Method Detection Limit | Lab Reporting Limit | Method(s) | Holding Time |
|---|---|---|---|---|---|---|
| | | | standard units | standard units | 9045D | months |
| ANSP | Electrical conductivity | None | 0-100,000 µS/cm | 0-100,000 µS/cm | EPA Method 120.1 | 12 months |
| RUSTL | Sediment as silt/clay/sand | None | 0-100% | 0% | Gee and Bauder 1986 as modified for this project | N/A |

## 14.Chain Of Custody

Chain of custody procedures will be instituted for this project. Chain of custody procedures will be employed until samples reach the appropriate laboratories. Once samples reach the laboratories, internal sample tracking procedures will be utilized. (See Appendix A)

## 15. Corrective Action

The laboratories involved in this project are required to maintain standard operating procedures which outline specific action to pursue should corrective action be necessary. If acceptable results cannot be obtained due to: either field or laboratory errors (calibration standards, proficiency testing samples, blanks, spikes, or duplicates falling out of range) the affected samples will be re-analyzed and steps will be taken to ensure that the data produced is accurate. Standards and reagents will be replaced, equipment will be checked, or other action, will be taken to remedy the situation. NJDEP designated project officers will be notified in writing anytime a deviation from the approved work plan has occurred.

# Appendix A: Sample Chain of Custody Form

**US Geological Survey**

**Chain of Custody**

810 Bear Tavern Rd
Suite 206
West Trenton, NJ
08628

Contact: Tim Reilly

Phone: (609) 947-1147

Final Destination:

Contact:

Phone:

| Sample Name | Sample ID Number | Date | Analysis | Quantity | | | |
|---|---|---|---|---|---|---|---|
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| | Date | Time | Signature | Print |
|---|---|---|---|---|
| Relinquished by: | | | | |
| Received by: | | | | |
| Relinquished by: | | | | |
| Received by: | | | | |

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