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**FINAL WORK PLAN**

for the

**OFF-SHORE INVESTIGATION  
NAVAL EDUCATION AND TRAINING CENTER (NETC)  
NEWPORT, RHODE ISLAND**

August 16, 1993

Prepared for

**TRC Environmental Corporation  
5 Waterside Crossing  
Windsor Connecticut 06095**

Prepared by

**Battelle Ocean Sciences  
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Duxbury, Massachusetts 02332  
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## **1.0 INTRODUCTION**

This Work Plan presents Battelle Ocean Science's (BOS) approach to the field and analytical component of TRC Environmental Corporation's (TRC) study associated with the Offshore Investigation at the Naval Education and Training Center (NETC) in Newport, Rhode Island. This Work Plan presents the field and laboratory technical approach to perform the subject work, applicable quality assurance/quality control (QA/QC) activities, data reduction and reporting procedures, a management plan, and the project schedule.

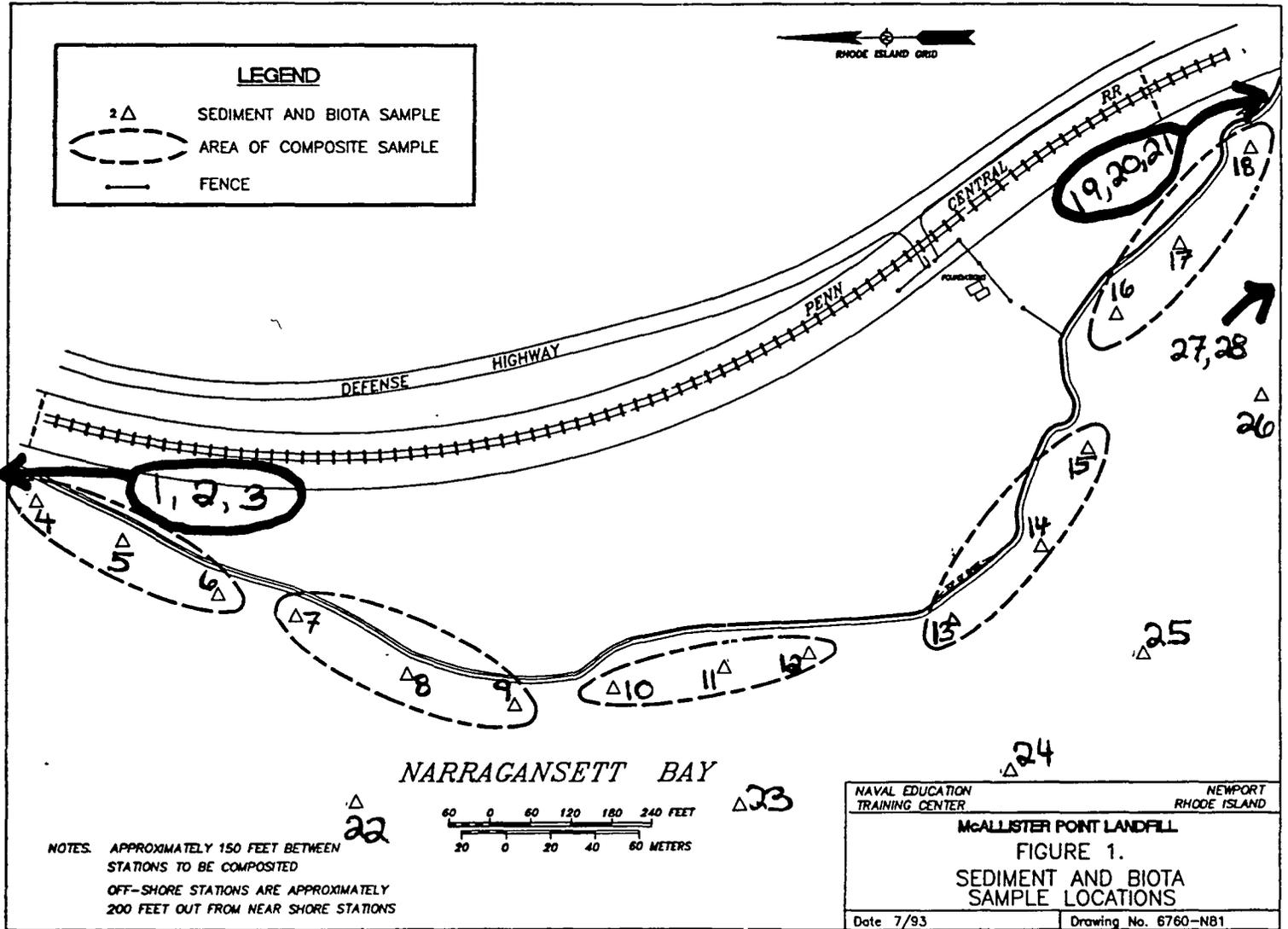
## **2.0 TECHNICAL APPROACH**

The technical work for this study is comprised of (1) collection of sediments and bivalve samples, (2) analysis of these samples for determination of concentrations of a series of environmentally relevant contaminants, and (3) reduction and reporting of the analytical results. The technical approach described in this Work Plan is, where applicable, based on experience gained with procedures used in various national monitoring and site assessment studies [e.g., National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends Mussel Watch Project, the Environmental Protection Agency's (EPA) Environmental Monitoring and Assessment Program (EMAP), and Estuarine Ecological Risk Assessment at Naval Shipyard in Portsmouth, Maine (NOSC, 1992)].

Three sites at the NETC will be sampled

- McAllister Point Landfill (Site 01)
- Melville North Landfill (Site 02)
- Old Fire Fighting Training Area (Site 09)

Approximate NETC sampling locations are presented in Figures 1, 2, and 3. The reference sites and their proximity to the NETC sites are presented in Figure 4. A total of 58 stations will be sampled, 46 NETC field stations and 12 reference stations. There will be 28 stations sampled at Site 01; nine at Site 02; and nine at Site 09. In addition, four reference stations will be sampled at each of three reference sites, and four 2-ft cores (two at Site 01, and one each at Sites 02 and 09) will be collected for archival.



Stations 1, 2, and 3 are nearshore stations located north of what is depicted on the map. Stations 19, 20, and 21 are nearshore stations located south of what is depicted on the map. Stations 27 and 28 are offshore stations located in a depositional area south of what is depicted on the map.

Figure 1. Approximate Locations of Sampling Stations — Site 01, McAllister Point Landfill.

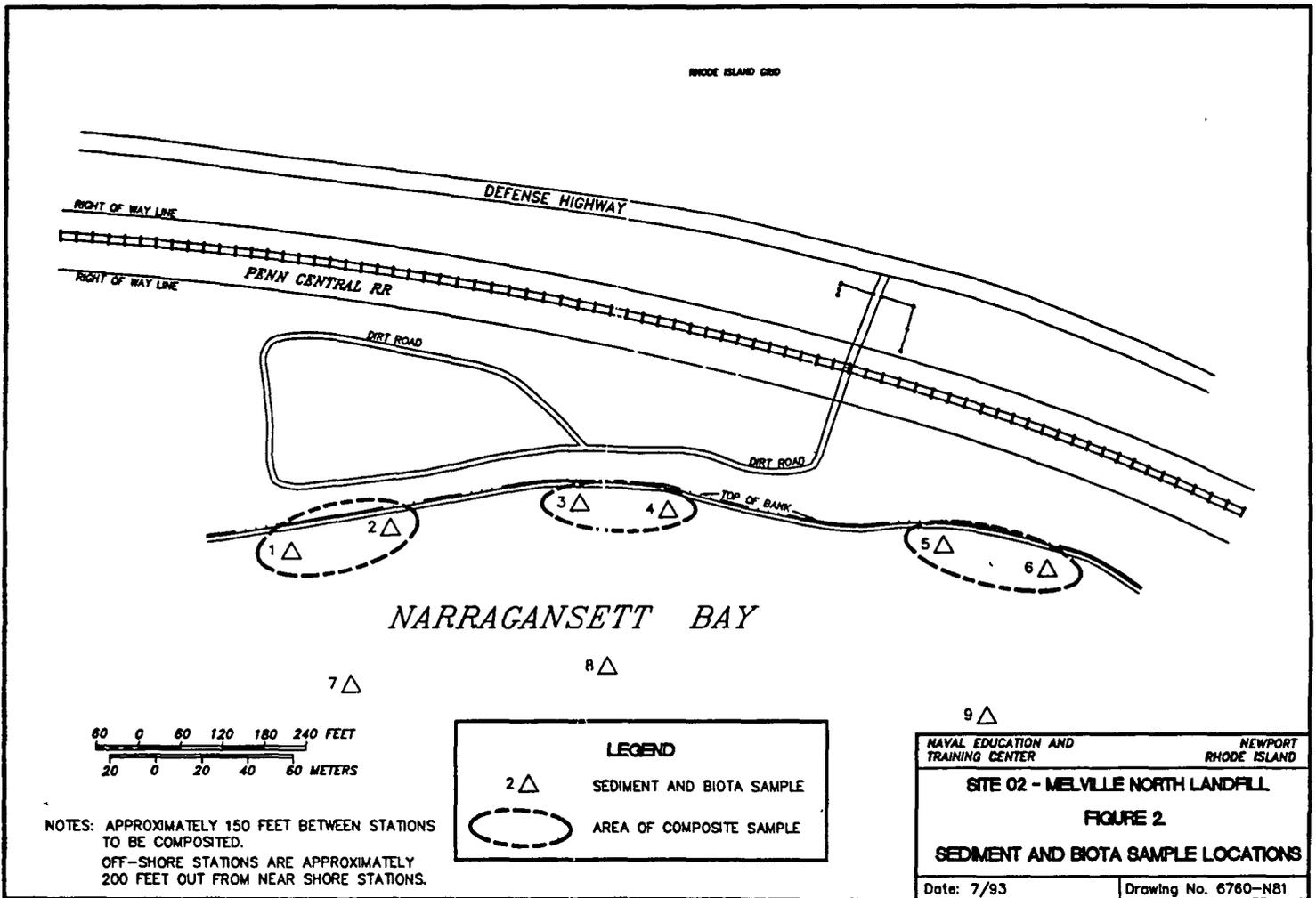
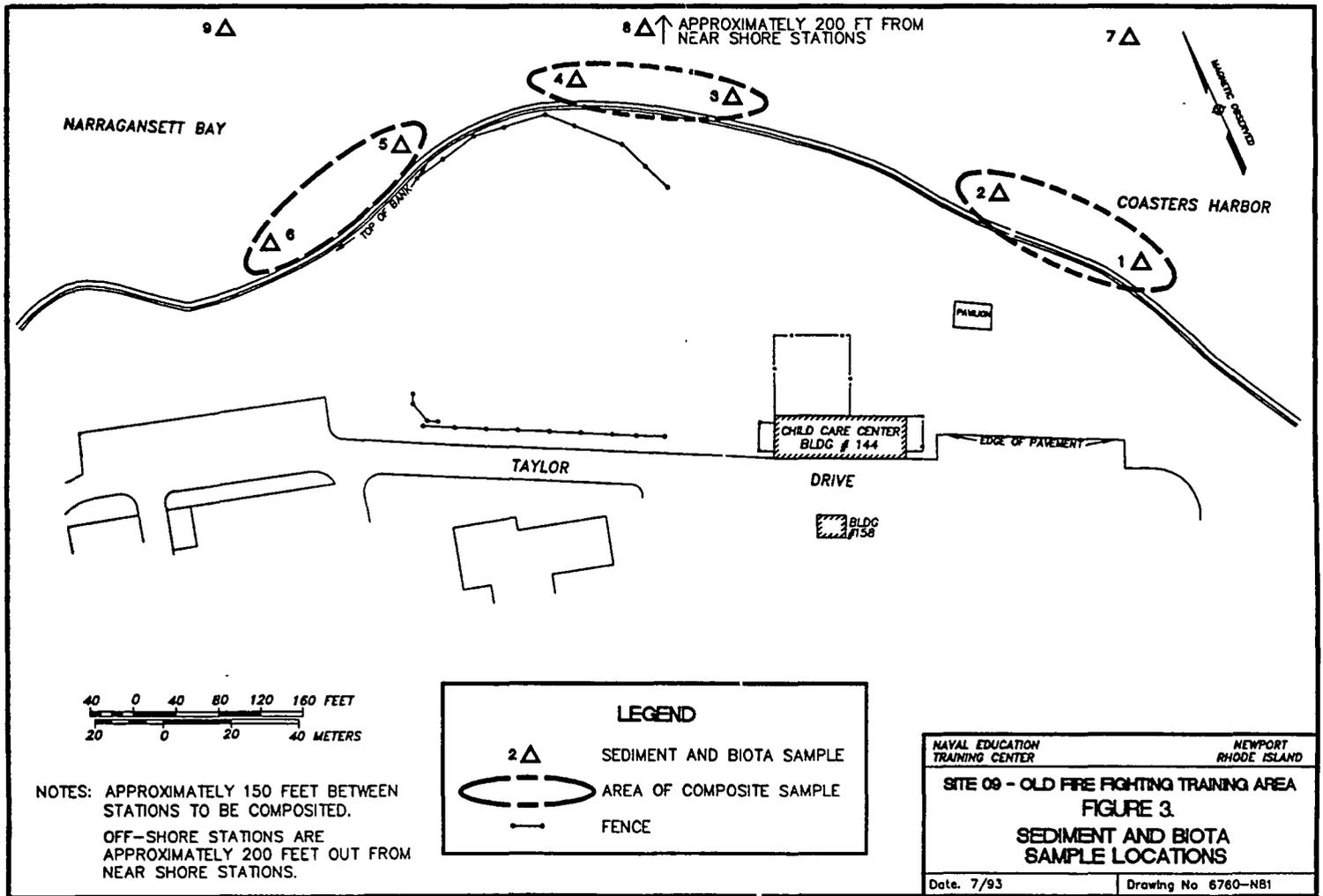


Figure 2. Approximate Locations of Sampling Stations — Site 02, Melville North Landfill.



**Figure 3. Approximate Locations of Sampling Stations — Site 09, Old Fire Fighting Training Area.**

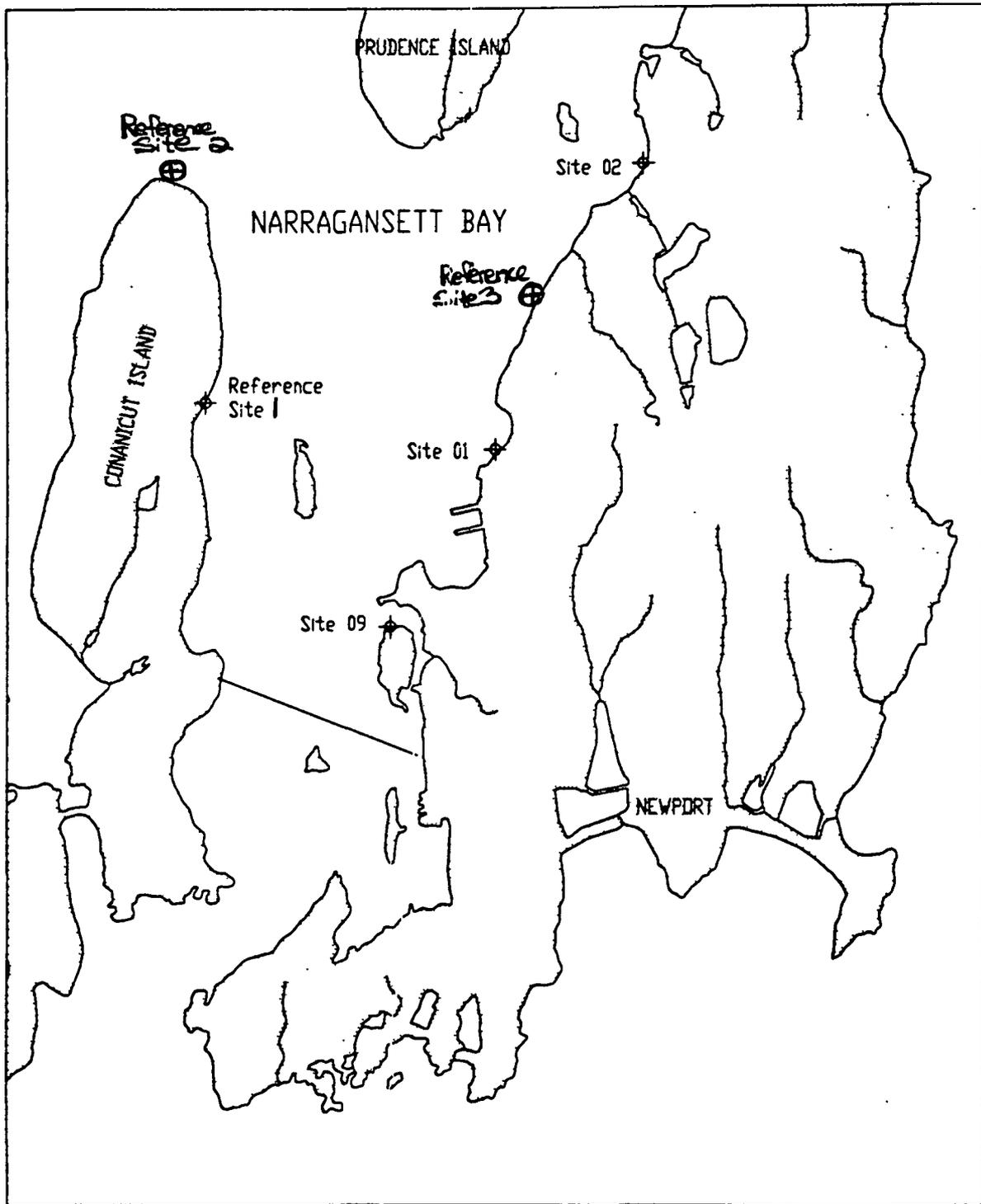


Figure 4. Approximate Locations of Sampling Sites — Reference Sites and NETC Sites.

Two of the reference sites will be located near the shore of Conanicut Island west of the NETC study sites, and the third reference site will be near the shore at an NETC location (Aquidneck Island), as indicated in Figure 4. NOAA navigational charts will be used to locate the sites in the field. These sites are selected to represent the general environment without being impacted by any potential contamination from the NETC study sites or other known point sources. Care will be taken so as to ensure that there are no obvious local point-sources of contamination (e.g., discharge pipes or creek drainage) at the reference site sampling locations. These sites are not tagged for use as reference sites for any particular NETC study site(s), and when the physical and chemical data become available it will be evident what is the most appropriate use of the reference site information.

At each of the stations a sediment core, mussel sample, and clam sample will be collected. Sediment for nearshore stations will be composited in the laboratory in groups of three stations for Site 01 and each of the reference sites, and two stations each for Sites 02 and 09. The bivalve compositing will be accomplished by collecting animals for one sample over the entire area that represents the station composite. Field duplicates will be collected for one set of nearshore stations to be composited at each NETC study site. Discrete sediment cores for the duplicate composite will be collected (i.e., a second sediment core will be collected at each of the stations that make up the composite). The bivalve field duplicates will consist of a second sample collected over the entire area of the two or three stations to be composited.

The additional 2-ft cores will be collected directly next to a standard discrete offshore core and will be archived should analysis of a deeper core be of interest at a later time for comparison to the standard cores. In all, attempts will be made to collect a total of 69 sediment cores (65 "standard" length and four 2-ft), 35 mussel samples, and 35 clam samples. From the sediment cores 35 laboratory sediment samples will be generated for analysis, after appropriate compositing — the 2-ft cores will be archived and are currently not scheduled for laboratory analysis. Each of the 35 mussel and 35 clam samples collected in the field will be analyzed in the laboratory. The sampling scheme, including the field duplicate sampling and laboratory sample compositing, is further summarized in Tables 1 and 2.

**Table 1. Numbers and Types of Samples to be Collected in the Field<sup>a</sup>**

Site/Sample Type	Number of Samples Collected by Matrix and Sample Type						2-Ft Sediment Core
	<u>Mussel</u>		<u>Clam</u>		<u>Sediment</u>		
	Field	FD <sup>b</sup>	Field	FD <sup>b</sup>	Field	FD <sup>b</sup>	
<b><u>Site 01 - McAllister Point Landfill</u></b>							
7 Near-shore (composites) <sup>c</sup>	7	1	7	1	7	1	
7 Off-shore (discrete)	7		7		7		2
<b><u>Site 02 - McEvilla North Landfill</u></b>							
3 Near-shore (composites) <sup>c</sup>	3	1	3	1	3	1	
3 Off-shore (discrete)	3		3		3		1
<b><u>Site 09 - Old Fire Fighting Training Area</u></b>							
3 Near-shore (composites) <sup>c</sup>	3	1	3	1	3	1	
3 Off-shore (discrete)	3		3		3		1
<b><u>Reference Sites<sup>d</sup></u></b>							
2 Conanicut Island (composite & discrete)	2		2		2		
2 North Jamestown (composite & discrete)	2		2		2		
2 NETC (composite & discrete)	2		2		2		

<sup>a</sup> Preliminary sampling plan. Actual number of mussel and clam samples collected may be less depending on animal populations.

<sup>b</sup> Field Duplicate

<sup>c</sup> The nearshore sediment samples at Site 01 will be composited into 7 field (and 1 FD) samples, each consisting of 3 sediment cores from a general area, as indicated in Figure 1. At each of Sites 02 and 09 the near-shore sediment samples will be composited into 3 field (and 1 FD) samples, each consisting of 2 sediment cores from a general area, as indicated in Figures 2 and 3.

<sup>d</sup> There will be one nearshore and one offshore sample at each reference site.

**Table 2. Preliminary Scheme for Handling/Compositing of Field Samples**

<b>Site/Station/ID</b>	<b>Individual (I)/ Composite (C)</b>	<b>Composited with Sample #</b>	<b>Field Duplicate</b>	<b># of Samples of each Type<sup>a</sup></b>
<b>Site 01 - McAllister Point</b>				
<b>Near-shore</b>				
S1-NS-01	C	-02/-03		1
S1-NS-02				
S1-NS-03				
S1-NS-04	C	-05/-06		1
S1-NS-05				
S1-NS-06				
S1-NS-07	C	-08/-09		1
S1-NS-08				
S1-NS-09				
S1-NS-10	C	-11/-12		1
S1-NS-11				
S1-NS-12				
S1-NS-13	C	-14/-15	-14/-15 Dup	2
S1-NS-14				
S1-NS-15				
S1-NS-16	C	-17/-18		1
S1-NS-17				
S1-NS-18				
S1-NS-19	C	-20/-21		1
S1-NS-20				
S1-NS-21				
<b>Off-shore</b>				
S1-OS-22	I			1
S1-OS-23	I			1
S1-OS-24	I			1
S1-OS-25	I			1
S1-OS-26	I			1
S1-OS-27	I			1
S1-OS-28	I			1

<sup>a</sup>Number of field samples to be analyzed for each type of sample (sediment, mussel, and clam).

Table 2 (continued). Preliminary Scheme for Handling/Compositing of Field Samples

Site/Station/ID	Individual (I)/ Composite (C)	Composited with Sample #	Field Duplicate	# of Samples of each Type <sup>a</sup>
<b>Site 02 - Melville North Landfill</b>				
Near-shore				
S2-NS-01	C	-02		1
S2-NS-02				
S2-NS-03	C	-04	-04 Dup	2
S2-NS-04				
S2-NS-05	C	-06		1
S2-NS-06				
Off-shore				
S2-OS-07	I			1
S2-OS-08	I			1
S2-OS-09	I			1
<b>Site 09 - Old Fire Fighting Training Area</b>				
Near-shore				
S9-NS-01	C	-02		1
S9-NS-02				
S9-NS-03	C	-04	-04 Dup	2
S9-NS-04				
S9-NS-05	C	-06		1
S9-NS-06				
Off-shore				
S9-OS-07	I			1
S9-OS-08	I			1
S9-OS-09	I			1
<b>Reference Sites</b>				
Reference #1 (Conanicut Island)				
R1-NS-01	C			1
R1-OS-02	I			1
Reference #2 (North Jamestown)				
R2-NS-01	C			1
R2-OS-02	I			1
Reference #3 (NETC)				
R3-NS-01	C			1
R3-OS-02	I			1

<sup>a</sup>Number of field samples to be analyzed for each type of sample (sediment, mussel, and clam).

## 2.1 FIELD METHODS

Battelle will provide a boat, a boat captain, two field scientists, and all the necessary sampling equipment. The Battelle field scientists will be responsible for the custody and integrity of all the samples. One TRC staff member will be present during the sample collection effort to guide the field team to the proper sampling locations. The TRC field representative will be responsible for determining and indicating where the sampling stations are to be located.

The nearshore stations will be located as close to the low tide water/beach interface as logistically possible, which will be approximately 50 ft from the top of the beach. The stations that are to be composited are spaced approximately 150 ft apart, perpendicular to the shore. The offshore stations will be approximately 200 ft out from the nearshore stations. However, the water depth will be considered to keep the depth relatively similar for the offshore stations at a site, and the distance from the shore may therefore vary somewhat from station to station. The exact sampling locations of the NETC study stations and the reference stations may be modified in the field, should the Battelle/TRC field team determine this to be necessary to collect representative samples.

The three nearshore and one offshore stations at each of the Conanicut Island, N. Jamestown, and NETC (Aquidneck Island) reference sites will be located similarly to the other NETC study site stations; one nearshore composite of three stations approximately 150 ft apart near the low tide water/beach interface, and one offshore station approximately 200 ft out from the nearshore stations. The offshore station at the N. Jamestown reference site is placed further out than 250 ft from the shore to sample at a station for which additional data already exists. If there are no mussels or clams present near the offshore reference station centers, bivalves will be collected closer to the shore but as close to the offshore station as possible.

The exact sampling locations will be determined using a shipboard and/or handheld global positioning system (GPS), and will be recorded on sample collection forms at the time of sample collection. If insufficient satellite signals are available for GPS navigation, the boats Loran-C system will be used during offshore operations; compass bearings and dead reckoning will be used for nearshore operations. In order to tie in the station positions obtained by GPS in this project to other work previously performed by TRC, up to a total of six selected nearshore stations (two per site) will be marked with surveyor posts,

as indicated and requested by the TRC field representative. The rest of the stations will be temporarily marked with flags or stakes which can be removed once all of the samples have been collected for that station. Shoreline landmarks and their approximate relationship to sampling stations will also be documented. The water depth for each station will be recorded at the time of collection. The depth of the offshore stations will be measured with a marked weighted line, while the nearshore water depth will be determined by using a ruler, if applicable.

Table 3 presents the preliminary sampling schedule. Field sampling will take place between August 16 and August 27, 1993. The sample collection will be site-by-site, with the majority of the NETC stations being sampled before the reference stations so as to obtain an understanding of the sedimentary conditions (e.g., grain-size and organic matter content of sediment) at the NETC study sites to then enable the field team to select representative samples from the reference stations. The currents may be quite strong in this area, and the offshore sampling will therefore be scheduled around the slack tide (within approximately 1 hr of high tide). See Table 4 for tidal schedule.

#### **Sediment Sample Collection**

Sediment cores will be collected at each of the stations within each site. Sediment samples will be collected with 16 in. (approximately 40 cm) long, 3-in (approximately 7.6 cm) diameter pre-cleaned polybutyrate cores. Core liners will be pre-cleaned at the laboratory with Contrad 70 and de-ionized water, rinsed with 10% HCl, Milli-Q water, and methanol, and allowed to dry and ends covered with aluminum foil. To minimize contamination and to protect hands from sediment contaminants, the field team will wear polyethylene or other non-contaminating gloves when obtaining sediment cores.

Two techniques will be employed to obtain the sediment cores depending on the station location. The intertidal sampling stations, which comprise most of the nearshore stations, will be sampled during low tide. First any rocks and gravel will be removed from the surface area. The pre-cleaned core liner will then be driven into the sediment by hand or with the aid of a weight to a depth of approximately 25 cm (the exact depth will be recorded). The top and bottom of the core will be capped and the core withdrawn from the sediment. Any overlying water will be siphoned off the top of the sediment using pre-cleaned Tygon tubing with a Teflon tip, taking care not to come in contact with or disturb the sediment. The core will be recapped, sealed with electrical tape, identified with a label, and placed in a cooler where it will be kept upright until frozen and on dry ice until delivered to the laboratory.

**Table 3. Preliminary Field Sampling Schedule.**

---

<b>Date/Time</b>	<b>Activity</b>
<b>August 16 (Monday)</b>	
0700:	Depart Battelle.
0930:	Meet with Brad Wheeler, NETC.
1240:	Low tide. Sample 4 nearshore stations and 2 duplicate stations at Site 09.
1928:	High tide. Sample 2 offshore stations at Site 09.
<b>August 17 (Tuesday)</b>	
0754:	High tide. Sample 1 offshore station at Site 09, including a 2-ft core.
1336:	Low tide. Sample 2 nearshore stations at Site 09 and sample 2 nearshore stations at Site 02.
<b>August 18 (Wednesday)</b>	
0842:	High tide. Sample 2 offshore stations at Site 02.
1425:	Low tide. Sample 4 nearshore stations and 2 duplicate stations at Site 02.
<b>August 19 (Thursday)</b>	
0931:	High tide. Sample 1 offshore station at Site 02, including a 2-ft core, and sample offshore at Reference Site #3, NETC.
1517:	Low tide. Sample nearshore at Reference Site #3, NETC.
1700:	Transport samples to laboratory and swap vehicles.
<b>August 20 (Friday)</b>	
1019:	High tide. Sample 1 offshore station at Site 01.
1606:	Low tide. Sample 6 nearshore stations at Site 01.
<b>August 21 (Saturday)</b>	
1111:	High tide. Sample 2 off shore stations at Site 01.
1700:	Low tide. Sample 6 nearshore stations at Site 01.

---

**Table 3. (continued) Preliminary Field Sampling Schedule.**

---

<b>Date/Time</b>	<b>Activity</b>
<b>August 22 (Sunday)</b>	
1205:	High tide. Sample offshore Reference Site #1, Conanicut Island, and Reference Site #2, North Jamestown.
1756:	Low tide. Sample nearshore Reference Site #1 Conanicut Island, and Reference Site #2, North Jamestown.
<b>August 23 (Monday)</b>	
1303:	High tide. Sample 1 offshore station at Site 01, including a 2-ft core.
1600:	Swap vehicles at NETC and transport samples to laboratory.
1900:	Low tide. Sample 3 nearshore stations and 3 duplicate stations at Site 01.
<b>August 24 (Tuesday)</b>	
0700:	Low tide. Sample 6 nearshore stations at Site 01.
1404:	High tide. Sample 1 offshore station at Site 01, including a 2-ft core.
<b>August 25 (Wednesday)</b>	
1508:	High tide. Sample 2 offshore station at Site 01.
1700:	Return to Duxbury. Transport samples to laboratory.
<b>August 26 (Thursday)</b>	Weather day.
<b>August 27 (Friday)</b>	Weather day.

---

**Table 4. Tidal Schedule for Newport, RI<sup>a</sup>.**

<b>Date</b>	<b>Day</b>	<b>High Tide<sup>b</sup> (time)</b>	<b>Low Tide<sup>b</sup> (time)</b>	<b>High Tide<sup>b</sup> (time)</b>	<b>Low Tide<sup>c</sup> (time)</b>
August					
16	Monday	1826	1140	0607	—
17	Tuesday	0654	1236	1917	0021
18	Wednesday	0742	1325	2004	0107
19	Thursday	0831	1417	2052	0151
20	Friday	0919	1506	2142	0236
21	Saturday	1011	1600	2233	0323
22	Sunday	1105	1656	2330	0409
23	Monday	1203	1800	—	0502
24	Tuesday	1304	0600	0029	1917
25	Wednesday	1408	0707	0133	2053
26	Thursday	1512	0832	0237	2208
27	Friday	1608	0954	0338	2303

<sup>a</sup>Tidal information from NOAA 1983 Tide Tables for East Coast of North and South America. Times are in Eastern Standard Time; the field team will add one hour for Daylight Savings Time.

<sup>b</sup>Primary tidal times for sampling.

<sup>c</sup>Secondary tidal times for sampling.

If it is not possible to collect nearshore sediment cores from the lower part of the beach (e.g., too rocky), then these cores may be sampled by divers (as described for offshore sediment below) in the water as close to the beach as possible. If the bottom is such that nearshore sediment cores cannot be sampled by divers, then the sediment sampling will be performed by digging a pit on the beach at the original station location, and collecting sediment from the side of the pit to a depth of 15 cm and placing it in a pre-cleaned 2-L glass jar (no more than two-thirds full) with a Teflon lined cap. If the pit sampling method is used, the larger rocks will be removed from the sample and the characteristics of this beach sediment will be noted. Sediment from each of the nearshore station replicates to be composited can be collected in the same jar (i.e., composited in the field as opposed to in the laboratory), and attempts will be made to collect approximately the same amount of sediment from each of the station replicates that are composited. The TRC field representative will, following consultation with the Battelle field team members, decide which sediment sampling method is most appropriate for each nearshore station. The sediment sampling method used will be documented.

The subtidal sampling stations, comprising most of the offshore stations, will be sampled using techniques similar to the intertidal stations except that divers, operating out of the 23-ft boat the *Limnora*, will be used to collect the samples. The divers will drive the core into the sediment by hand or with the aid of a weight to a depth of approximately 25 cm (the exact depth will be recorded). A cap will be placed on the top of the core, the core tilted slightly and then partially removed from the sediment. The bottom of the core will then be capped and the core fully removed. The core will be transported upright to the boat where the overlying water will be siphoned off the top of the sediment using pre-cleaned Tygon tubing with a Teflon tip, taking care not to disturb the sediment. Both end caps on the core liner will be sealed with electrical tape, identified with a label, and placed in a cooler where it will be kept upright until frozen and on dry ice until delivered to the laboratory. If the core cannot be driven into the sediment to a depth of 25 cm, this will be documented and a new location will be identified by the TRC and Battelle field team. Attempts will be made to stay within a 25 m radius of the original station location.

### **Bivalve Sample Collection**

The primary objective in sampling for bivalves is to obtain a pool of animals representative of the area from which they were collected. The target species will be blue mussels (*Mytilus edulis*) and the hard-shell clam (*Mercenaria mercenaria*). If blue mussels cannot be collected, attempts will be made to collect another indigenous species of mussel (most likely the ribbed mussel). If hardshell clams are not present in sufficient numbers, the most abundant other clam species will be collected (most likely the softshell clam *Mya arenaria*). Attempts will be made to stay with one mussel and one clam species at as many stations as possible, and ideally for all sample collections. However, this may not be possible. Blue mussels are expected to be present at most nearshore stations, but mussels may not be present offshore. The clam species population will likely vary with location and sediment characteristics (e.g., energy of the environment, water depth, and sediment composition). For instance, hardshell clams may not be present at the nearshore, intertidal, stations, and softshell clams may not be present offshore. Only animals of the same species will be used to generate a sample, including the station composites and field duplicates. Battelle will identify the animal species collected prior to laboratory processing.

Several different collection techniques may be employed to obtain bivalves, depending upon the water depth, bivalve species, and environmental conditions at the site. At intertidal sites, the mussel populations will be collected from the natural substrate by hand. At intertidal sites and in water less than 1 m deep, clams can be collected using a stainless steel clam rake. The field team will wear polyethylene or other non-contaminating gloves when removing the bivalves from the substrate. In deeper water, divers may collect the bivalve samples by hand or using a clam rake, or a bivalve dredge may be used. The dredge is a toothed skip dredge of stainless steel. The dredge bag is constructed of polypropylene mesh to minimize trace-metal contamination. The dredge will be used in conjunction with the A-frame and winch on board the boat.

After the bivalves are collected, they will be separated from one another, if possible, and washed with site water to remove mud and debris. All the samples from each station will be double wrapped in aluminum foil, affixed with a label, placed in a Ziploc® bag, and stored on dry ice until transported to the laboratory.

The target size range for the mussels is 5 to 8 cm; the size range of the clams may be different depending on species and the age of the local population. Approximately 20 to 50 mussels and clams will be collected at each station (more or less depending on size). The ability to collect sufficient numbers and optimum size of biota samples will depend highly on the population of individuals near the designated stations. For discrete, individual, station samples (Table 2) bivalves should, ideally, be collected within 50 m of the pre-determined station location. For each of the nearshore composite bivalve samples, one sample will be collected directly in the field (i.e., two or three discrete bivalve samples need not be collected). The bivalves will be collected with an even distribution over the "composited" area (three stations for Site 01; two stations each for Sites 02 and 09). If bivalves cannot be found within approximately 50 m of the station center, the TRC field representative will be consulted for guidance on if a different location should be sampled, or if no sample should be collected for that station and the situation merely documented.

It is anticipated that mussels will be found at most nearshore stations. However, it will probably be more difficult to locate mussels at the offshore stations and clams may be difficult to find at several near- and off-shore stations, depending on the habitat. If the number of bivalve samples collected are fewer than originally planned, the Battelle and TRC Project Managers will be informed of this during the last week of the field work, and alternative sampling (e.g., additional stations at McAllister Point) may be authorized.

#### **Field Quality Control Samples**

Field duplicate samples will be collected as indicated in Tables 1 and 2. The sediment field duplicate will consist of a core of similar sediment texture as the original core (e.g., grain size, organic material, color) and should be collected within 2 m of the original core. The bivalve field duplicate will consist of separate animals collected in the same location as the original sample. Trip or field blanks will not be collected as they are not appropriate for a sediment and bivalve collection effort such as this. However, the field procedures will minimize the potential for contamination.

#### **General Sampling Precautions**

- Sampling equipment will not be deployed or retrieved through a visible surface slick.
- The bilge will be secured during sampling.
- Samples will be processed and transferred to dry ice storage as quickly as possible
- Smoking will not be allowed during any phase of the field effort.

- The boat will be positioned so that the engine exhaust remains downwind of sampling activities.
- All bivalves will be inspected to ensure that shells are intact and unbroken, and that specimens are alive.
- Bivalves will not be stored in water.
- Only site water will be used to wash bivalves.
- Hard sole boots will be worn while sampling at McAllister Point Landfill, due to the metal debris around the area.

### **Field Sample Documentation, Storage, and Shipping**

The exact locations of the sampling stations will be determined in the field using a global positioning system (GPS) and the latitude and longitude information will be recorded on Sample Collection forms. A TRC staff member will direct the field team to the appropriate sampling locations during the field work, and Battelle will determine and document the station location using the GPS. The GPS will be calibrated regularly using a point with known positions. If the Loran-C has to be used it will also be calibrated at a point with known positions. The calibration position and procedures will be documented (Figure 5).

Sample Collection forms (Figure 6) will be completed for each station as it is being sampled. It will include information such as

- sample identification code (sample label)
- site and station identification
- latitude and longitude
- description of station locations relative to shoreline landmarks
- date and time
- person(s) collecting the bivalve and sediment samples
- bivalve sample collection method
- water depth at time of collection
- types of samples collected
- any noteworthy observations

Every sample collected at a specific station will be assigned a unique alphanumeric sample-identification number (Table 2) using preprinted labels (Figure 7). Self-adhesive labels will be affixed and taped in place. Ms. Ann Spellacy, a Battelle field scientist, will maintain custody of all samples until they are delivered to the laboratory. A chain-of-custody form will be completed at the end of each sampling day (Figure 8).

**Navigation Calibration Form**

Chart Number: _____	Chart Date: _____
<u>Chart Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
<u>GPS/Loran C Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
GPS Re-initialized: Yes / No	Loran C offset: ____ N ____ W
Recorded by: _____	Date: _____ Time: _____

Chart Number: _____	Chart Date: _____
<u>Chart Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
<u>GPS/Loran C Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
GPS Re-initialized: Yes / No	Loran C offset: ____ N ____ W
Recorded by: _____	Date: _____ Time: _____

Chart Number: _____	Chart Date: _____
<u>Chart Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
<u>GPS/Loran C Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
GPS Re-initialized: Yes / No	Loran C offset: ____ N ____ W
Recorded by: _____	Date: _____ Time: _____

Chart Number: _____	Chart Date: _____
<u>Chart Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
<u>GPS/Loran C Coordinates</u>	
Latitude: _____ N	Longitude: _____ W
GPS Re-initialized: Yes / No	Loran C offset: ____ N ____ W
Recorded by: _____	Date: _____ Time: _____

**Figure 5. Example Navigation System Calibration Documentation Form.**



Sample Collection Form  
TRC August 1993  
G283301-0001

Place label here

Site: \_\_\_\_\_

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Time: \_\_\_\_\_

Latitude: \_\_\_\_\_ N

Longitude: \_\_\_\_\_ W

Water Depth: \_\_\_\_\_

Bivalve collection method: Hand Rake Dredge

Samples Collected (check appropriate box)

Individual

Sediment Core

Tissue—Mussels

Tissue—Clams

Composite with stations \_\_\_\_\_

Tissue—Mussels

Tissue—Clams

Location relative to shoreline landmarks: \_\_\_\_\_

Comments: \_\_\_\_\_

Entered/Collected by: \_\_\_\_\_

Figure 6. Example Sample Collection Form.

Sample ID:  
**S9-NS-01/02**  
Sample Type:

Project #: G283301-0002  
Jar/Packet \_\_\_\_\_ of \_\_\_\_\_  
Initials: \_\_\_\_\_ Date: \_\_\_\_\_

**Figure 7. Example Sample Label.**



Sediment cores will be capped and labelled immediately after sample collection. Bivalve samples from each station will be wrapped in aluminum foil. The aluminum foil sample package will be labeled, and placed in a Ziploc bag. The bivalve samples will be placed in coolers with dry ice and will be kept frozen at all times. The sediment cores will be placed upright until frozen in coolers with dry ice and kept frozen at all times. Samples will be delivered to Battelle approximately every four days, and at the end of the sampling effort. Chain-of-custody forms will accompany each shipment. The samples will either be driven to Battelle by Battelle field staff, picked up in the field by other Battelle staff, or shipped by next-day delivery service. The coolers will contain enough dry ice to ensure that the samples remain frozen during transit. The storage condition on arrival at Battelle will be documented by the sample custodian. Battelle will store all samples at approximately  $-20^{\circ}\text{C}$  in laboratory freezers until sample processing can begin in the laboratory.

#### **Contacts and Field Sources**

The following personnel who should be informed of any schedule changes or problems if they arise during field sampling.

##### Battelle Contact Person

The Battelle Ocean Sciences contact person is Mr. Gregory Durell, (617) 934-0571. He is the Battelle Project Manager and is to be kept informed of the status of the sampling effort and any problems that arise. He will notify the TRC Project Manager of any changes in schedule.

##### TRC Contact Person

The TRC contact person is Mr. Jim Peronto, (203) 289-8631. He is the TRC Project Manager and the Battelle Project Manager will keep him informed of the status of the sampling effort and any problems that arise.

##### NETC Contact Person

The NETC contact person is Mr. Brad Wheeler, (401) 841-3735. He will be kept informed of any schedule changes in field sample collection and is also available to answer questions from the field scientists. Lt. Jeff Borowy is the Navy's Program Manager and may also be reached at the above number if Mr. Wheeler is not available.

##### US Navy Contact Person

The US Navy contact person is Mr. Franco LaGreca, (215) 595-0567. He is the US Navy Northern Division Remedial Project Manager and the TRC Project Manager will keep him informed of the status of the sampling and other project tasks. The Battelle Project Manager may, if appropriate, contact the Navy Remedial Project Manager to discuss project issues.

The following are sources of expendable supplies needed during sample collection.

Dry Ice

Corp. Brothers Ice Co  
1 Brook St.  
(India St. other side of highway)  
East Providence, RI  
(401) 331-8020  
Hours: 8-5 (M-F); 8-12 (Sat)

Dive Shop

Viking Dive Shop  
Rt. 138 (East Main Rd.)  
Middletown, RI  
(401) 847-4179  
Hours: 10-6 (M-F); 9-5 (Sat); 9-1 (Sun)

The following is additional information that may be needed during the field sampling effort.

Boat Launch Site and Docking Facilities

The NETC will provide a boat launch site at the Officers Club near Gate 1 on the base for use by Battelle personnel. NETC has arranged for dock space to be available for use by Battelle next to Pier 2 at the YP yard from August 13 to 27, 1993.

Scientific Collector's Permit

A copy of the Scientific Collector's Permit No. 93-02 issued by the Rhode Island Department of Environmental Management Division of Fish and Wildlife to Battelle will be carried by the field scientists while collecting mussels and clams. Although the permit was initially acquired for the NOAA "Mussel Watch" Program the permit is valid for this project per communication with Richard Sisson of the Rhode Island Department of Fish and Wildlife, (401) 789-3094.

**Post-Fieldwork Preliminary Sample Processing**

Preliminary sample processing at Battelle will be conducted in a clean laboratory environment to minimize contamination. The sediment cores will be partially thawed, carefully extruded onto pre-cleaned aluminum foil (new solvent-cleaned foil will be used for each sample), and the 0- to 15-cm section isolated for laboratory analysis. The compaction of the sediment will be accounted for when isolating the sediment that represents the 0 to 15 cm depth in the field, by using the data of how deep into the sediment the core was driven and the length of the core once it has been extruded. These data will be documented. General physical observations of the sediment (e.g., color, rough grain size, presence of plant and other debris) will be made and recorded prior to slicing the core. Sediment cores that are to be composited into single samples (Table 2) will be extruded, sliced, and processed together. Pre-cleaned stainless steel, Teflon, and Kynar coated knives and spatulas will be used for handling the samples during the processing.

Representative sub-samples will be removed from approximately 10 evenly spaced depths of the undisturbed 1- to 15-cm segment of the sediment sample for acid volatile sulfide (AVS) and simultaneously extracted metal (SEM) analysis and placed in a pre-labelled, pre-cleaned 2-oz Qorpak jar to approximately two-thirds full. No sediment from the top cm (0- to 1-cm) will be used for the AVS/SEM sample. Subsampling for AVS/SEM analysis should be completed in as short a time period as possible, and the jar with the AVS/SEM sample sealed securely and placed in a freezer at approximately  $-20^{\circ}\text{C}$  immediately after completing the subsampling.

The remaining sediment to be used for analysis will then be placed in a pre-labelled, pre-cleaned 1,000-mL (individual/discrete samples) or 2,000-mL (composite samples) glass jars and thoroughly homogenized by stirring. Approximately 25 g of sediment will then be removed for trace-metal analysis and placed in a pre-labelled, pre-cleaned 125-mL polystyrene Spex jar. Approximately 100 g will be removed and placed in a Whirl-Pak bag for grain-size analysis, and approximately 5 g will be placed in a 25-mL glass vial with a Teflon lined cap for total organic carbon (TOC) analysis. For two of the composite samples, the amount of sediment will be approximately tripled for the grain-size and doubled for TOC analyses to provide enough sample for replicate analyses. The remaining sample will be used for polycyclic aromatic hydrocarbon (PAH) and polychlorinated biphenyl (PCB) analyses and will remain in the 1,000- or 2,000-mL glass jar which will be sealed with a Teflon lined cap. Sediment samples for PAH, PCB, AVS/SEM and TOC analysis will be stored frozen at approximately  $-20^{\circ}\text{C}$  until laboratory sample processing can begin or they can be shipped for offsite analyses (AVS/SEM and TOC samples). The trace-metal and grain-size samples will be stored at  $4^{\circ}\text{C}$  in a refrigerator until they can be sent for analysis. The remaining sediment, representing the 15- to 25-cm depth from each core will be stored frozen in a 500-mL glass jar with a Teflon lined cap until the analytical results have been reviewed by TRC.

Preliminary bivalve sample processing will begin as soon as a sufficient amount of samples have arrived at the laboratory and the species has been determined and documented. Bivalves (mussels and clams) will be shucked using stainless steel utensils, and all the tissue from the animals and associated fluids that constitute one sample [i.e., collected from one station if an individual sample, or several stations if a composite sample (Table 2)] will be placed in a 500-mL pre-labelled, pre-cleaned glass jar. The number and size of each bivalve will be determined and recorded for each sample. The bivalve tissue will be thoroughly homogenized in the glass jars using a tissue homogenizer. A subsample of approximately

15 g will be removed for trace-metal analysis and placed in a pre-cleaned, pre-labelled 125-mL polystyrene Spex jar. The remaining homogenate will remain in the 500-mL tall glass jar, sealed with a Teflon lined cap, and used for PAH, PCB, and butyltin analysis. Tissue samples will be stored frozen at approximately  $-20^{\circ}\text{C}$  until laboratory sample processing can begin.

The samples to be analyzed at other laboratories will be shipped by overnight delivery service within approximately five days of completing the preliminary sample processing. Grain-size and trace-metal samples will be shipped in coolers on ice. AVS/SEM and TOC samples will be sent in coolers with dry ice to ensure that they remain frozen in transit. Chain-of-custody documentation will accompany the samples shipped and will be completed by the receiving laboratory and returned to Battelle.

## 2.2 LABORATORY ANALYTICAL METHODS

Table 5 lists the numbers and types of samples to be analyzed in the laboratory. The laboratory quality control (QC) sample program is discussed in more detail in Section 3.2. The analytical parameters and approximate detection limits are listed in Table 6. The actual MDLs that are applicable at the time of the analyses will be reported with the data.

The NOAA National Status and Trends Mussel Watch Project analytical methods will be used in this study (NOAA, 1992). These methods have been developed specifically for the analysis of trace contaminants in marine tissue and sediment, generally offering greater sensitivity, accuracy, and precision than do the comparable standard EPA methodologies. In addition, the use of these methods will insure that the data will be comparable to other data generated in national monitoring programs such as Mussel Watch data from sites in the Rhode Island coastal environment where the same methods were used.

The PCB, PAH, and butyltin analyses will be performed by Battelle Ocean Sciences, Duxbury, Massachusetts. The trace-metal, AVS, and SEM analyses will be performed by Battelle Marine Science Laboratory, Sequim, Washington. The TOC and grain-size analyses will be performed by Battelle's subcontractors Global Geochemistry and Geo/Plan Associates, respectively.

**Table 5. Numbers and Types of Samples to be Analyzed in the Laboratory<sup>a,b</sup>**

<b>Analysis Type</b>	<b># of Field Samples</b>	<b># of Lab Batches<sup>a</sup></b>	<b># of Lab QC Samples<sup>b</sup></b>	<b>Total # of Samples for Analysis</b>
<b><u>Sediment</u></b>				
PAH/PCB	35	2	10	45
TAL Metals	35	2	10	45
AVS	35	NA	4	39
SEM	35	NA	4	39
TOC	35	NA	4	39
Grain size	35	NA	4	39
<b><u>Tissue</u></b>				
PAH/PCB	70	4	20	90
TCL Metals	70	4	20	90
Butyltins	35 <sup>c</sup>	2	6	41

<sup>a</sup> Number of analytical batches for PAH/PCB, TAL metals, and butyltin analysis is designed so that no batches include more than 20 field samples.

<sup>b</sup> The quality control sample program is described in the Quality Control section of the Work Plan. Each tissue and sediment analytical batch will contain the following laboratory QC samples:

PAH/PCB: 1 procedural blank (PB), 1 blank spike (BS), 1 matrix spike (MS), 1 matrix spike duplicate (MSD), and one standard reference material (SRM).

TAL metals: 1 PB, 1 BS, 1 MS, 1 SRM, and 1 duplicate (DUP).

Butyltins: 1 PB, 1 MS, and 1 MSD.

The quality control program for the AVS, SEM, TOC, and grain-size is as follows:

AVS: 2 PB and 2 DUP.

SEM: 2 PB and 2 DUP.

TOC: 2 PB and 2 DUP.

Grain-size: 2 sets of triplicate analyses.

<sup>c</sup> The butyltin analysis will be performed on fewer tissue samples than the other analyses because only mussel samples (not clam) will be analyzed for butyltins.

Table 6. List of Analytes and Approximate Detection Limits

Polycyclic Aromatic Hydrocarbons (PAH)	Approximate Detection Limit (mg/kg, dry weight)	
	Tissue	Sediment
naphthalene	0.01	0.002
C <sub>1</sub> -naphthalenes	0.01	0.002
C <sub>2</sub> -naphthalenes	0.01	0.002
C <sub>3</sub> -naphthalenes	0.01	0.002
C <sub>4</sub> -naphthalenes	0.01	0.002
biphenyl	0.01	0.002
acenaphthylene	0.01	0.002
acenaphthene	0.01	0.002
dibenzofuran	0.01	0.002
fluorene	0.01	0.002
C <sub>1</sub> -fluorenes	0.01	0.002
C <sub>2</sub> -fluorenes	0.01	0.002
C <sub>3</sub> -fluorenes	0.01	0.002
phenanthrene	0.01	0.002
anthracene	0.01	0.002
C <sub>1</sub> -phenanthrenes/anthracenes	0.01	0.002
C <sub>2</sub> -phenanthrenes/anthracenes	0.01	0.002
C <sub>3</sub> -phenanthrenes/anthracenes	0.01	0.002
C <sub>4</sub> -phenanthrenes/anthracenes	0.01	0.002
dibenzothiophene	0.01	0.002
C <sub>1</sub> -dibenzothiophenes	0.01	0.002
C <sub>2</sub> -dibenzothiophenes	0.01	0.002
C <sub>3</sub> -dibenzothiophenes	0.01	0.002
fluoranthene	0.01	0.002
pyrene	0.01	0.002
C <sub>1</sub> -fluoranthenes/pyrenes	0.01	0.002
benz(a)anthracene	0.01	0.002
chrysene	0.01	0.002
C <sub>1</sub> -chrysene	0.01	0.002
C <sub>2</sub> -chrysene	0.01	0.002
C <sub>3</sub> -chrysene	0.01	0.002
C <sub>4</sub> -chrysene	0.01	0.002
benzo[b]fluoranthene	0.01	0.002
benzo[k]fluoranthene	0.01	0.002
benzo[e]pyrene	0.01	0.002
benzo[a]pyrene	0.01	0.002
perylene	0.01	0.002
indeno[1,2,3-cd]pyrene	0.01	0.002
dibenz[a,h]anthracene	0.01	0.002
benzo[g,h,i]perylene	0.01	0.002

The highlighted PAH compounds represent the 16 priority pollutant PAHs.

Table 6 (continued). List of Analytes and Approximate Detection Limits

Polychlorinated Biphenyl (PCB)	Approximate Detection Limit (mg/kg, dry weight)	
	<u>Tissue</u>	<u>Sediment</u>
Cl <sub>2</sub> (8)	0.002	0.001
Cl <sub>3</sub> (18)	0.002	0.001
Cl <sub>3</sub> (28)	0.001	0.0005
Cl <sub>4</sub> (52)	0.001	0.0005
Cl <sub>4</sub> (44)	0.001	0.0005
Cl <sub>4</sub> (66)	0.001	0.0005
Cl <sub>5</sub> (101)	0.001	0.0005
Cl <sub>4</sub> (77)	0.001	0.0005
Cl <sub>5</sub> (118)	0.001	0.0005
Cl <sub>6</sub> (153)	0.001	0.0005
Cl <sub>5</sub> (105)	0.001	0.0005
Cl <sub>6</sub> (138)	0.001	0.0005
Cl <sub>5</sub> (126)	0.001	0.0005
Cl <sub>7</sub> (187)	0.001	0.0005
Cl <sub>6</sub> (128)	0.001	0.0005
Cl <sub>7</sub> (180)	0.001	0.0005
Cl <sub>7</sub> (170)	0.001	0.0005
Cl <sub>8</sub> (195)	0.001	0.0005
Cl <sub>9</sub> (206)	0.002	0.001
Cl <sub>10</sub> (209)	0.002	0.001
<b>Aroclor 1016/1242</b>	0.02	0.01
<b>Aroclor 1221</b>	0.02	0.01
<b>Aroclor 1232</b>	0.02	0.01
<b>Aroclor 1248</b>	0.02	0.01
<b>Aroclor 1254</b>	0.02	0.01
<b>Aroclor 1260</b>	0.02	0.01
<b>Butyltins</b>		
Monobutyltin (MBT)	0.01	NA
Dibutyltin (DBT)	0.01	NA
Tributyltin (TBT)	0.01	NA
Tetrabutyltin (TTBT)	0.01	NA

The highlighted PCBs represent Aroclor formulations. The other analytes are individual PCB congeners.

Table 6 (continued). List of Analytes and Approximate Detection Limits

TAL Metals	Approximate Detection Limit (mg/kg, dry weight)	
	Tissue	Sediment
Aluminum	10	10
Antimony	0.05	0.05
Arsenic	0.2	0.2
Barium	0.2	0.2
Beryllium	0.1	0.1
Boron	50	50
Cadmium	0.05	0.05
Calcium	50	50
Chromium	0.2	0.2
Cobalt	0.2	0.2
Copper	0.2	0.2
Iron	50	50
Lead	0.1	0.1
Magnesium	50	50
Manganese	0.2	0.2
Mercury	0.005	0.005
Nickel	0.2	0.2
Potassium	50	50
Selenium	0.5	0.5
Silver	0.05	0.05
Sodium	50	50
Thallium	0.1	0.1
Vanadium	0.3	0.3
Zinc	0.3	0.3
<b>Acid Volatile Sulfide (AVS)</b>	NA	0.1 $\mu$ mol/g
<b>Simultaneously Extracted Metal (SEM)</b>	NA	same as TAL metals
<b>Ancillary Measurements</b>		
Total Organic Carbon (TOC)	NA	0.01 %
Grain-size	NA	0.1 %

### 2.2.1 PAH and PCB Analysis

The analytes to be determined in the organic analyses are listed in Table 6, along with their respective approximate detection limits. The list includes the 16 priority pollutant PAH, a series of alkylated PAH, and additional environmentally relevant parent PAH. The PCB analysis in this study will be for the determination of total PCB as the most predominant Aroclor, as well as determination of concentrations of the 20 individual PCB congener analytes, as determined in the Mussel Watch Project (NOAA, 1992) and described in the work plan for the Estuarine Ecological Risk Assessment at Naval Shipyard, Portsmouth, Maine (NOSC, 1992). Sample processing and analysis methods will be comparable to the procedures used in the Mussel Watch Project.

#### 2.2.1.1 Sample Preparation

Table 7 lists the pertinent standard operating procedures that will be used in this study. Sample extraction for the PCB and PAH analysis of tissue and sediment will be performed according to Battelle SOPs 5-190 *Tissue Extraction for Trace Level Semivolatile Organic Contaminants Including Lipid Weight Determination* and 5-192 *Sediment Extraction for Trace Level Semivolatile Organic Contaminants*, respectively. The sample extracts will be cleaned up prior to instrumental analysis following the procedures described in SOP 5-191 *HPLC Cleanup of Sediment and Tissue Extracts for Semivolatile Organic Pollutants*. The sample preparation procedures are summarized below.

An aliquot of approximately 30 g (wet weight) is taken from the tissue homogenate for PAH/PCB analysis; 50 g (wet weight) for sediment extraction; and 5- to 10-g (wet weight) for dry-weight determination. The appropriate surrogate internal standards (SIS) are added to the subsample to be extracted to allow accurate measurement of target organic compounds. The surrogate compounds will be naphthalene-d<sub>8</sub>, acenaphthene-d<sub>10</sub>, and benzo[a]pyrene-d<sub>12</sub> for the PAH analysis and dibromooctafluorobiphenyl (DBOBF) and the PCB congener Cl<sub>5</sub>(112) for the PCB analysis. Internal standard spiking amounts are listed in Table 8. Sodium sulfate is added to absorb water from the sample and facilitate extraction with organic solvent. The sodium sulfate also improves efficiency of the tissue maceration process. Additionally, activated copper is added to sediment samples to remove any sulfur that may be present in the sample.

**Table 7. Pertinent Battelle Standard Operating Procedures (SOPs)**

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<b>SOP Number</b>	<b>Title</b>
3-004	Use of the Cahn Model 25 and Cahn Model 28 Electrobalances
3-011	Use of Mettler and Ohaus Top-Loading Balances
3-092	Operation and Maintenance of Hewlett-Packard 5970B Gas Chromatograph/Mass Selective Detector (GC/MSD)
3-116	Operation and Maintenance of Gas Chromatographs
3-132	Analytical Instrument Data Acquisition Using the Hewlett-Packard LAS System
4-015	Quality Assurance Audits of Reported Data
5-128	Identification and Quantification of Polychlorinated Biphenyls (by Congener and Aroclor) and Chlorinated Pesticides by Gas Chromatography/Electron Capture Detection
5-157	Identification and Quantification of Polynuclear Aromatic Hydrocarbons by Gas Chromatography/Mass Spectrometry
5-190	Tissue Extraction for Trace Level Semivolatile Organic Contaminants, Including Lipid Weight Determination
5-191	HPLC Cleanup of Samples for Semivolatile Organic Pollutants
5-192	Sediment Extraction for Trace Level Semivolatile Organic Contaminants
5-196	Measurement of Butyltin Species in Tissues
6-007	Chemistry Laboratory Sample Identification
6-010	Chemistry Laboratory Sample Control
6-017	Data Recording
6-025	Documentation Procedures in the Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) Facilities
7-014	Data Transfer from GC/MS Data System and GC/HP/LAS Data System to the Chemistry Department Database

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**Table 7 (continued). Pertinent Battelle Standard Operating Procedures (SOPs)**

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<b>SOP Number</b>	<b>Title</b>
MSL-A-1	Log-in Procedure
MSL-M-1	Determination of Acid Volatile Sulfides/SEM metals in Sediment
MSL-M-7	TAMU Sediment Digestion
MSL-M-18	TAMU Tissue Digestion
MSL-M-25	Metals in Solid Samples by ICP-MS
MSL-M-33	Metals in Tissues and Sediments by GFAA
MSL-M-31	Total Hg in Tissues and Sediments

---

**Table 8. Standard Spiking Levels for the Organic Contaminant Analyses**

<b>SURROGATE INTERNAL STANDARDS (SIS)</b>	<b>Approximate Amount (ng)</b>	
	<b><u>Tissue</u></b>	<b><u>Sediment</u></b>
<b>PAH Analysis</b>		
naphthalene-d <sub>8</sub>	750	1,500
acenaphthene-d <sub>10</sub>	750	1,500
benzo[a]pyrene-d <sub>12</sub>	750	1,500
<b>PCB Analysis</b>		
dibromooctachlorobiphenyl (DBOFB)	50	100
Cl <sub>5</sub> (112)	50	100
<b>Butyltin Analysis</b>		
tripropyltin chloride (TPT)	1,000	NA <sup>a</sup>
tripentyltin chloride (TPET)	1,000	NA
<b>MATRIX SPIKE SOLUTIONS (BS, MS, and MSD Samples Only)</b>		
PAH analysis (NIST Mussel Watch target analytes)	600	1,200
PCB analysis (NIST Mussel Watch target congeners)	40	80
Butyltin analysis (target analytes)	1,000	NA
<b>RECOVERY INTERNAL STANDARDS (RIS)</b>		
<b>PAH Analysis</b>		
biphenyl-d <sub>10</sub>	500	1,000
phenanthrene-d <sub>10</sub>	500	1,000
<b>PCB Analysis</b>		
tetrachloro- <i>m</i> -xylene (TCMX)	30	60
Cl <sub>6</sub> (166)	30	60
<b>Butyltin Analysis</b>		
dipropyldipentyltin (DPT)	1,000	NA

\*NA: Not applicable.

The tissue homogenate is macerated/extracted twice for 2 min each with a Tisumizer<sup>®</sup>, using dichloromethane (DCM) as the extraction solvent. The sample is centrifuged between the extractions, and the solvent decanted into a precleaned, labeled Erlenmeyer flask. After the two maceration steps, DCM is added to the sample and the jar is shaken for approximately 60 min. Once again, the sample is centrifuged and the solvent decanted into the Erlenmeyer flask. An aliquot from the combined tissue sample extract is removed and dried for lipid-weight determination.

The sediment homogenate is shaken/tumbled once for a minimum of 12 hrs, and then twice for at least 1 hr, using a 50:50 mix of acetone:dichloromethane (DCM) as the extraction solvent. The sample is centrifuged between the extractions, and the solvent decanted into a precleaned, labeled Erlenmeyer flask.

The combined tissue or sediment extract is passed through a 20-g alumina cleanup column and concentrated, using Kuderna-Danish (KD) techniques followed by gentle evaporation with nitrogen gas to a final volume of approximately 900  $\mu\text{L}$ . The volume of the concentrated extract is measured exactly with a syringe, and 600  $\mu\text{L}$  are processed by size-exclusion/gel-permeation high-performance liquid chromatography (HPLC). The remaining 300  $\mu\text{L}$  are archived. The HPLC cleanup step is calibrated daily.

After HPLC fractionation, the tissue and sediment extracts are concentrated to approximately 500 and 1000  $\mu\text{L}$ , respectively, using nitrogen gas evaporation methods, spiked with recovery internal standards (RIS), and split approximately 50:50 for PAH and PCB analysis. The PCB fraction is solvent exchanged with isooctane, the two splits concentrated to a final volume of approximately 250 (tissue) or 500  $\mu\text{L}$  (sediment), and submitted for PAH and PCB instrumental analysis.

#### **2.2.1.2 PAH Instrumental Analysis**

Tissue and sediment concentrations of the 16 priority pollutant PAH and 24 additional PAH parameters listed in Table 6 will be determined using gas chromatography with mass spectrometric detection (GC/MS) following Battelle SOP 5-157 *Identification and Quantification of Polynuclear Aromatic Hydrocarbons by Gas Chromatography/Mass Spectrometry*. Total PAH will be determined as the sum of the 40 PAH parameters. The homologous series of alkylated PAH will be quantified using the response factor of the parent PAH.

Instrumental methods, maintenance, and QC procedures for the GC/MS analysis of samples for PAH will be performed according to Battelle SOP No. 5-157, a modification of EPA Method 8270. The instrument will be calibrated using a 3-point calibration curve which brackets the expected concentration range of the samples. Samples which exceed the highest calibration standard will be diluted and rerun. The Battelle modifications include the use of selected ion monitoring (SIM) to improve method sensitivity and use of surrogates as internal standards to improve method accuracy. Analytes will be quantified by the method of internal standards using the surrogate compounds naphthalene-d<sub>8</sub> (for the quantification of naphthalene through acenaphthylene), acenaphthene-d<sub>10</sub> (for acenaphthene through the fluoranthenes/pyrenes homologous series), and benzo[*a*]pyrene-d<sub>12</sub> (for benz[*a*]anthracene through benzo[*g,h,i*]perylene) as the SIS. Just prior to instrumental analysis, the recovery internal standards (RIS), biphenyl-d<sub>10</sub> and phenanthrene-d<sub>10</sub> will be added to the samples to measure recovery of the SISs. Gas chromatographic separation will be carried out using a 30-m DB-5MS high resolution fused silica capillary column (J&W Scientific, Inc.). Dry weight will be determined on all samples and analyte concentrations will be reported in mg/kg (dry weight).

#### **2.2.1.3 PCB Instrumental Analysis**

Tissue and sediment PCB concentrations will be determined using gas chromatography with electron capture detection (GC/ECD) in accordance with Battelle SOP 5-128 *Identification and Quantification of Polychlorinated Biphenyls (by Congener and Aroclor) and Chlorinated Pesticides by Gas Chromatography/Electron Capture Detection*. Total PCB concentrations will be determined as the most abundant of the 6 target Aroclors, and individual concentrations will be determined for the 20 PCB congeners listed in Table 6.

Instrument methods, maintenance, and QC applicable to GC/ECD analysis of samples for PCB will conform to guidance presented in Battelle SOP No. 5-128. The Battelle method uses a 3-point calibration curve for 20 individual PCB congeners, and is a modification of EPA Method 8080. Additionally, single-point Aroclor standards of each of the 6 target Aroclors will be analyzed at the beginning of each analytical sequence. A set of approximately 8 to 10 congeners will be chosen to represent each Aroclor for the Aroclor quantification. The Battelle method modification includes the use of high resolution capillary column chromatography for improved analyte resolution and determination of discrete PCB congeners, and use of SISs as internal standards for improved accuracy. Individual congener

quantification will be performed by the method of internal standards using the SIS dibromo-octafluorobiphenyl [(DBOFB) for congeners Cl<sub>2</sub>(8) through Cl<sub>5</sub>(101)] and Cl<sub>5</sub>(112) [for congeners Cl<sub>4</sub>(77) through Cl<sub>10</sub>(209)]. Just prior to instrumental analysis, the RISs tetrachloro-*m*-xylene (TCMX) and Cl<sub>6</sub>(166) will be added to the samples to measure recovery of the SISs. Primary, quantitative, analysis will be carried out on a 30-m DB-5 high resolution fused silica capillary column (J&W Scientific, Inc.). Secondary qualitative confirmation of the PCB Aroclor will be performed on the using a 30-m DB-1701 capillary column (J&W Scientific, Inc.). Analyte concentrations will be reported in mg/kg (dry weight).

### 2.2.2 Butyltin Analysis

Concentrations of tributyltin (TBT) and its degradation products monobutyltin (MBT) and dibutyltin (DBT), and the TBT manufacturing impurity tetrabutyltin (TTBT) will be determined in all mussel tissue samples. Butyltins will not be determined in clam tissue or sediment samples. The butyltin analysis will be performed in accordance with Battelle SOP 5-196 *Measurement of Butyltin Species in Tissues*.

Butyltin sample preparation consists of solvent extraction of approximately 30 g of the tissue homogenate using hexane, HBr, and Tropolone, followed by derivation using *n*-hexylmagnesium bromide. The sample is fortified with the SISs tripropyltin chloride (TPT) and tripropyltin chloride (TPET) prior to extraction. The extract is dried using sodium sulfate, concentrated, purified using a combination of Florisil and silica gel, spiked with the RIS dipropyltin (DPT), and adjusted to a final volume of approximately 500 to 1,000  $\mu$ L.

Concentrations of butyltin analytes will be determined using gas chromatography with flame photometric detection (GC/FPD). The butyltin instrumental analysis method uses a 3-point calibration curve. All analytes will be quantified by the method of internal standards using the SIS. Just prior to instrumental analysis, the RIS dipropyltin (DPT) will be added to samples to measure recovery of the SIS. Analysis will be carried out on a 30-m DB-5 high resolution fused silica capillary column (J&W Scientific, Inc.), using a 610-nm bandpass filter with the detector. Dry weight will be determined on all samples and analyte concentrations will be reported in mg/kg (dry weight).

### **2.2.3 Trace Metal Analysis**

The analytes to be determined in the trace-metal analyses, the Target Analyte List for metals (TAL), are listed in Table 6, along with their respective approximate detection limits. Wherever appropriate, sample processing and analysis methods will be comparable to the procedures used in the Mussel Watch Project. However, several of the target analytes for this study are not analyzed in the Mussel Watch program.

#### **2.2.3.1 Sample Preparation**

Tissue and sediment samples will be prepared and analyzed using methods that have been developed for optimum performance with marine samples. The National Status and Trends Mussel Watch Project tissue and sediment sample preparation methods that will be used are modifications of EPA Methods 200.3 and 200.4, respectively, and provide a total digestion sample digestate (as compared with the alternative partial digestion procedure). The modifications and improvements that have been made for marine tissue and sediment applications include the use of Teflon instead of glassware in the sample processing (to minimize laboratory contamination) and microwave digestion.

Samples are freeze-dried to a constant weight and the dry sample ground/homogenized in a Spex mixer-mill. The sample is then digested with nitric acid (nitric acid/hydrofluoric acid for sediment samples) in a Teflon digestion vessels using a microwave oven. The digestion bombs are then cooled, the content diluted with the appropriate amount of deionized water, and transferred for instrumental analysis.

#### **2.2.3.2 Trace Metal Instrumental Analysis**

The analysis for mercury will be performed by cold vapor atomic absorption (CVAA) using a LDC Mercury Monitor with methods that are modifications of EPA methods 245.5 (for sediment) and 245.6 (for tissue). The analysis of selenium will be by x-ray fluorescence (XRF) or graphite furnace atomic absorption spectroscopy (GFAAS), calcium and iron will be analyzed by XRF or inductively coupled plasma/mass spectrometry (ICP/MS), and chromium will be analyzed by GFAAS or ICP/MS, as deemed necessary for proper analyte detection. The analysis for all other metals will be by ICP/MS, using a Perkin-Elmer Sciex 5000 with a modification of EPA method 200.8. Aqueous standards, traceable to certified National Institute of Standards and Testing (NIST) materials, are used to produce calibration curves for the elements of interest. Concentrations will be reported in mg/kg (dry weight).

#### 2.2.4 AVS and SEM Analysis

Battelle's MSL (Sequim, WA) will initiate the AVS and SEM analysis within 7 days of receipt of the samples. To obtain a representative subsample, the top few mm of sediment in the sample jar will be discarded at the laboratory prior to subsampling for analysis. Experience has shown that the sampling and storage methods described for AVS and SEM will provide accurate and precise results.

The analytical method used for AVS analysis employs selective generation of hydrogen sulfide, cryogenic trapping, gas chromatographic separation, and photoionization detection. This analytical method employs the principles of Cutter and Oatts (1987). This method gives high sensitivity and very limited chemical interference with minimal sample handling. A 100 to 500 mg aliquot of sediment will be reacted for 25 minutes with 24 mL 1N HCl and the generated H<sub>2</sub>S will be purged with a helium gas stream onto a cryogenically cooled GC column. The trapped H<sub>2</sub>S will then be eluted through a photoionization detector for quantification. Following the AVS analysis, the HCl-sediment leachate will be filtered and analyzed for SEM using the appropriate instrumental analysis as described for the TAL metals (Table 6) in Section 2.2.3. SEM data will be generated for all 24 TAL metals. Sediment AVS and SEM concentrations will be reported in  $\mu\text{mol/g}$  and  $\text{mg/kg}$  (dry weight), respectively.

#### 2.2.5 TOC and Grain Size Analysis

Total organic carbon (TOC) analysis will be performed by Battelle's subcontractor, Global Geochemistry, Inc., using a LECO carbon analyzer. This method relies on the high-temperature conversion of carbon to CO<sub>2</sub>, which is subsequently measured. Grain-size analysis will be performed by Battelle's subcontractor, Geo/Plan Associates, by the standard sieve-pipette method to determine the percent gravel/sand/silt/clay distribution by weight of the sample. These laboratories also perform these analyses for the Mussel Watch program using the same procedures that will be used in this study. TOC data will be reported in percent, dry weight, and grain-size will be reported as percent of total for each of the four grain-size fractions.

### 3.0 QUALITY CONTROL AND QUALITY ASSURANCE

#### 3.1 QUALITY CONTROL

##### 3.1.1 Sample Quality Control

Battelle will adhere to a rigorous quality control (QC) program to ensure that the data meet the high quality standards that are essential for an investigation such as this. Other rigorous field and laboratory quality control programs were consulted, reviewed, and incorporated as appropriate to compose the most suitable QC program for this work (NOAA, 1992; NOSC, 1992; NEESA, 1988). For instance, the quality control program for this study is designed to meet the requirements of NEESA Level E quality control, which is the level of quality control the NEESA program applies to investigations that include tissue analyses.

Each batch of no more than 20 field samples processed for PAH, PCB, and trace-metal analysis will also include five laboratory QC samples. Each batch of butyltin samples will include three QC samples. These QC samples will be as follows.

**PAH and PCB Analysis** — One procedural blank, one blank spike, one matrix spike, one matrix spike duplicate, and one standard reference material (SRM) sample will be processed with each of batch of samples. Additionally, surrogate recoveries will be tracked in all samples.

**Trace-metal Analysis** — One procedural blank, one blank spike, one matrix spike, one SRM, and one laboratory duplicate will be processed with each batch of samples.

**Butyltin Analysis** — One procedural blank, one matrix spike, and one matrix spike duplicate will be processed with each of batch of samples. Additionally, surrogate recoveries will be tracked in all samples.

The procedural blanks (containing all reagents used in the sample processing, carried through all steps, and treated as samples) will ensure that there are no significant levels of laboratory contamination. The blank spike (similar to the procedural blank except it is also fortified with the target analytes), matrix spike (field sample spiked with the target analytes), sample duplicates, and SRM analyses will be used to demonstrate laboratory accuracy and precision. Internal standard recoveries will be monitored for

every PAH, PCB, and butyltin sample to provide data on the efficiency of the sample extraction and other sample processing manipulations. The QC sample data quality objectives that will apply to this study are listed in Table 9. No data quality objectives have been established for QC samples associated with AVS, SEM, TOC, and grain-size because these analyses have not been requested by the client and are used only as interpretive aid.

All data that do not meet the listed data quality objectives will be submitted to the Project Manager for review and assessment of the potential impact of the results. Affected samples may be reanalyzed at the Project Manager's discretion. Data that are accepted outside these criteria will be flagged with the appropriate data qualifier (Table 10), and the rationale for accepting the analysis will be thoroughly documented.

### **3.1.2 Instrument Quality Control**

The gas chromatography calibration criteria goal will be  $\pm 25\%$  relative standard deviation (RSD) in the average response factor (RF) for the individual analytes in the 3-point initial calibration for the PAH, PCB, and butyltin analyses. The average %RSD for all target analytes must be below 15%. A mid-level calibration check standard will be analyzed no less frequently than every ten samples and the RF of the individual analytes must be within 25% of the average RF from the initial calibration, and within 15% of the RF from the initial calibration on average for all analytes.

The trace-metal analysis will be calibrated using a minimum of a 3-point initial calibration curve and the linear regression correlation coefficient must be 0.99, or better. A mid-level calibration check standard will be analyzed no less frequently than every twenty samples with a response factor within 10% of the original response.

### **3.1.3 Validation**

The Project Manager, Analytical Task Managers, and quality assurance unit will monitor the activities described in this Work Plan which describes the field and laboratory procedures as well as a quality control plan. Project documentation and data will be reviewed by the appropriate Analytical Task Manager, Quality Assurance Unit, and Project Manager, and deviations from the Work Plan will be

Table 9. Quality Control Sample Data Quality Objectives

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<b>Organic Analysis</b>	
Surrogate recovery	40%-120%
Blank spike analyte <i>absolute</i> recovery <sup>a</sup>	40%-120%
Blank spike analyte <i>relative</i> recovery <sup>b</sup>	70%-130%
Matrix spike analyte <i>absolute</i> recovery	40%-120%
Matrix spike analyte <i>relative</i> recovery	50%-150%
Matrix spike/spike duplicate quantification precision	30% RPD <sup>c</sup>
SRM quantification accuracy	70-130% of certified value <sup>d</sup>
Procedural blank	< 3 × detection limit
 <b>Trace Metal Analysis</b>	
Blank spike analyte recovery	85%-115%
Matrix spike analyte recovery	50%-150%
Sample duplicate quantification precision	30% RPD
SRM quantification accuracy	85-115% of certified value
Procedural blank	< 3 × detection limit

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<sup>a</sup> Absolute recovery is determined relative to the internal standard.

<sup>b</sup> Relative recovery is determined relative to the surrogate compound.

<sup>c</sup> Relative percent difference in the duplicate determinations.

<sup>d</sup> Accuracy of determinations of target analytes for which certified values exist.

Table 10. Data Reporting Qualifiers

Data Qualifier	Purpose
J	Detected, but below the MDL <sup>a</sup> .
E	Estimate; significant matrix interference.
B	Analyte detected at $> 3 \times$ the MDL <sup>b</sup> .
ND	Not detected; a value of 0 will be reported in the concentration/value column.
NC	Not confirmed; PCB Aroclor identified and quantified using primary column analysis but was not qualitatively confirmed in the second-column analysis. Non-confirmed value from primary analysis will be reported.
&	QC value outside the accuracy criteria goal (SRM, surrogate, matrix spike, and blank spike recovery data).
*	QC value outside the precision criteria goal (%RPD in matrix spike/matrix spike duplicate and sample duplicate quantifications).

<sup>a</sup> Analyte signal sufficient to confidently identify and quantify analyte (signal-to-noise ration of approximately 5:1), but concentration is below the reported MDL. Recently determined, appropriate, analyte specific MDLs will be identified and reported separately and used as the reference.

<sup>b</sup> This qualifier will be used to qualify the Procedural Blank data (reported on a dry weight basis using the approximate average sample dry weight of the analytical batch) and all affected field sample data. Data will not be blank corrected.

recorded and approved by the Project Manager. The Project Manager and the analytical Task Managers will be responsible for identifying and implementing appropriate corrective action to any identified problems.

Battelle will follow approved standard operating procedures (SOP) in all relevant aspects of this work. Selected pertinent Battelle SOPs are listed in Table 7. This is not a complete listing of all SOPs that will be used in the conduct of this work, but a listing of the major technical SOPs that will be employed.

### **3.2 QUALITY ASSURANCE**

The Quality Assurance Unit (QAU) at Battelle Ocean Sciences will remain independent of all work activities pertaining to this study. The QAU will monitor the project according to existing Battelle SOPs and the study Work Plan to ensure accuracy, integrity, and completeness of the data. The QAU scope includes system inspections, data audits, and document review.

### **3.3 SAMPLE AND DATA TRACKING**

Sample labeling, chain-of-custody, and log-in procedures will adhere to Battelle Ocean Sciences standard procedures (SOP No. 6-010). During sample collection, Sample Collection Forms will be completed and will include information such as location, sample ID, date, collection method, time, person(s) collecting, and other relevant field observations as described in Section 2.1. Sample storage conditions will also be recorded on the Chain-of-Custody Form. In the field, all samples will be placed in containers that are affixed with a sample identification label that directly links it to the Sample Collection Form. The samples will remain in the custody of a Battelle field scientist while in the field. Chain-of-Custody Forms will accompany the samples when shipped from the field to the laboratory. When the samples arrive at the laboratory, custody will be relinquished to the Laboratory Sample Custodian. Upon receipt of the samples at Battelle, the Sample Custodian will examine the samples, verify that sample-specific information recorded on the Chain-of-Custody Form is accurate, and log the samples into the laboratory tracking system. Samples released to other laboratory personnel for analysis will be accompanied by sample-transfer documentation. Remaining unused sediment and tissue sample, and sample extracts from the organic contaminant analyses, are archived.

### **3.4 HOLDING TIMES**

Samples will be stored at approximately -20°C until sample processing can begin. Holding times for sediment and tissue for organic contaminant analysis will be 7 days from verified time of sample receipt to solvent extraction, and 40 days to instrumental analysis. Holding times will be 26 days for mercury analysis from verified time of sample receipt to instrumental analysis, and 6 months for the other metals. However, the trace metal analyses, as all other analyses, are expected to be completed within approximately 60 days of sample receipt.

## **4.0 DOCUMENTATION, DATA REDUCTION AND ASSESSMENT, AND REPORTING**

### **4.1 DOCUMENTATION**

All laboratory records will be maintained on standard forms in three-ring binders or in Battelle Laboratory Record Books. Project-specific forms will be used to record critical sample processing steps. Sample storage, data, and type of manipulation/analysis will also be recorded as the samples progress through the laboratory. All data will be recorded in black ink, entries signed and dated on the date of entry, and any changes initialed, dated, and explained. All field and laboratory project documentation, and raw and reduced analytical data, will be archived with the study record using Battelle's access controlled archival system. The quality assurance unit manages all archived project files. All remaining samples and sample extracts will be stored at Battelle for 6 months after delivery of the Final Data Report. After 6 months TRC and the Navy will be contacted for permission to disposed of any remaining unused sample material and the sample extracts.

### **4.2 DATA REDUCTION AND ASSESSMENT**

#### **Data Reduction**

All instrumental analytical data will be transferred electronically to a personal computer so that the data can be incorporated into the chemistry department database. The analytical data will be merged with other relevant information (e.g., sample dry weights, tissue lipid weight) and will receive the appropriate data qualifiers (Table 10). The data will subsequently be transferred to spreadsheets for final calculations and tabular results presentation.

## **Data Assessment**

The contaminant concentration data will be assessed to determine qualitative and quantitative significance of levels measured at the NETC sites. Data normalized, to TOC for selected trace-organic parameters and grain-size and/or aluminum for selected trace-metal parameters, and non-normalized will be reviewed. Statistical testing using analysis of variance (ANOVA), or other appropriate techniques, will be investigated and considered to assess the magnitude, likelihood, and significance of contaminant concentrations at the NETC sites being elevated over reference sites. Other statistical and/or graphical methods of interpreting the data will be assessed and employed as appropriate. The station data will be reviewed for suitable grouping for contaminant assessment purposes. However, the lack of field replicate analyses in this study may make rigorous, defensible, traditional statistical assessment inappropriate.

Other data assessment techniques that will be investigated and applied, as appropriate, to quantitatively and qualitatively determine similarities and dissimilarities in the magnitude and composition of the contaminants at the NETC sites versus the reference sites include (1) cluster analysis, (2) discriminate analysis, (3) principal component analysis, and (4) contaminant fingerprinting. For instance, the PAH data for a set of samples will be subjected to fingerprinting analysis through a ratio analysis/reduction technique to determine whether these hydrocarbon contaminants are primarily of pyrogenic or petrogenic origin, and an attempt will be made to identify the type of product if the hydrocarbon appears to be primarily of petrogenic origin. This exercise will be performed on approximately 12 samples; Battelle and TRC will jointly decide which 12 samples after the PAH data are available.

Historical sediment and bivalve data from nearby Mussel Watch Sites will also be compiled, presented, and compared to the data generated in this study, and discussed as part of the data assessment process, as well as other Narragansett Bay data made available to Battelle by TRC, the U.S. Navy/NOSC, and the University of Rhode Island. A thorough literature review is beyond the scope of this work.

## **4.3 REPORTING**

A complete copy of each of the data-packages and the field documentation will be delivered to TRC approximately 60 days after the samples arrived at the laboratory. A progress report will be provided to TRC and NEESA each month until the Final Data Report has been delivered, starting with a report for the month of August due mid-September.

A Draft Data Report will be delivered approximately 30 days after the completion of all laboratory analyses, and delivery of the data-packages. The report will contain a summary of the field, laboratory and data reduction and assessment methods used, will present the analytical and data assessment results, and will briefly discuss the field and quality control sample data.

As part of this project the Battelle Project Manager will attend two TRC coordinated meetings for discussion of the work. These will be a Work Plan presentation/discussion meeting (held on 07/28/93 in Newport, Rhode Island) and a Draft Data Report review/discussion meeting. The appropriate Draft Report review comments will be incorporated into the report and a Final Data Report will be delivered within 30 days of receiving all review comments.

Analytical results will be delivered with the Data Report as hard-copy spreadsheet tables and on diskettes formatted for use on an IBM-compatible personal computer in Lotus 1-2-3<sup>®</sup> spreadsheet format, and, if requested, in ASCII format.

## 5.0 MANAGEMENT PLAN

The proposed project organization is presented in Figure 9. The Battelle Project Manager will be Mr. Gregory Durell. He will be the main contact person at Battelle for this study. Mr. Durell will also coordinate the organic analyses on a day-to-day basis. Additional key personnel who will be involved in this project are listed below.

William Steinhauer	Battelle Ocean Sciences Operations Manager
Allen Uhler	Chemistry Department Manager
Brenda Lasorsa	Task Leader — Trace-metal and AVS/SEM Analysis
Deborah West	Field Work Coordinator
Ann Spellacy	Field Team Leader, Butyltin Analysis
Robert Lizotte	PCB Analysis
Frank Querzoli	PAH Analysis, Field Work
George Desreousseau	Organic Sample Preparation
Rich Restucci	Butyltin Sample Preparation

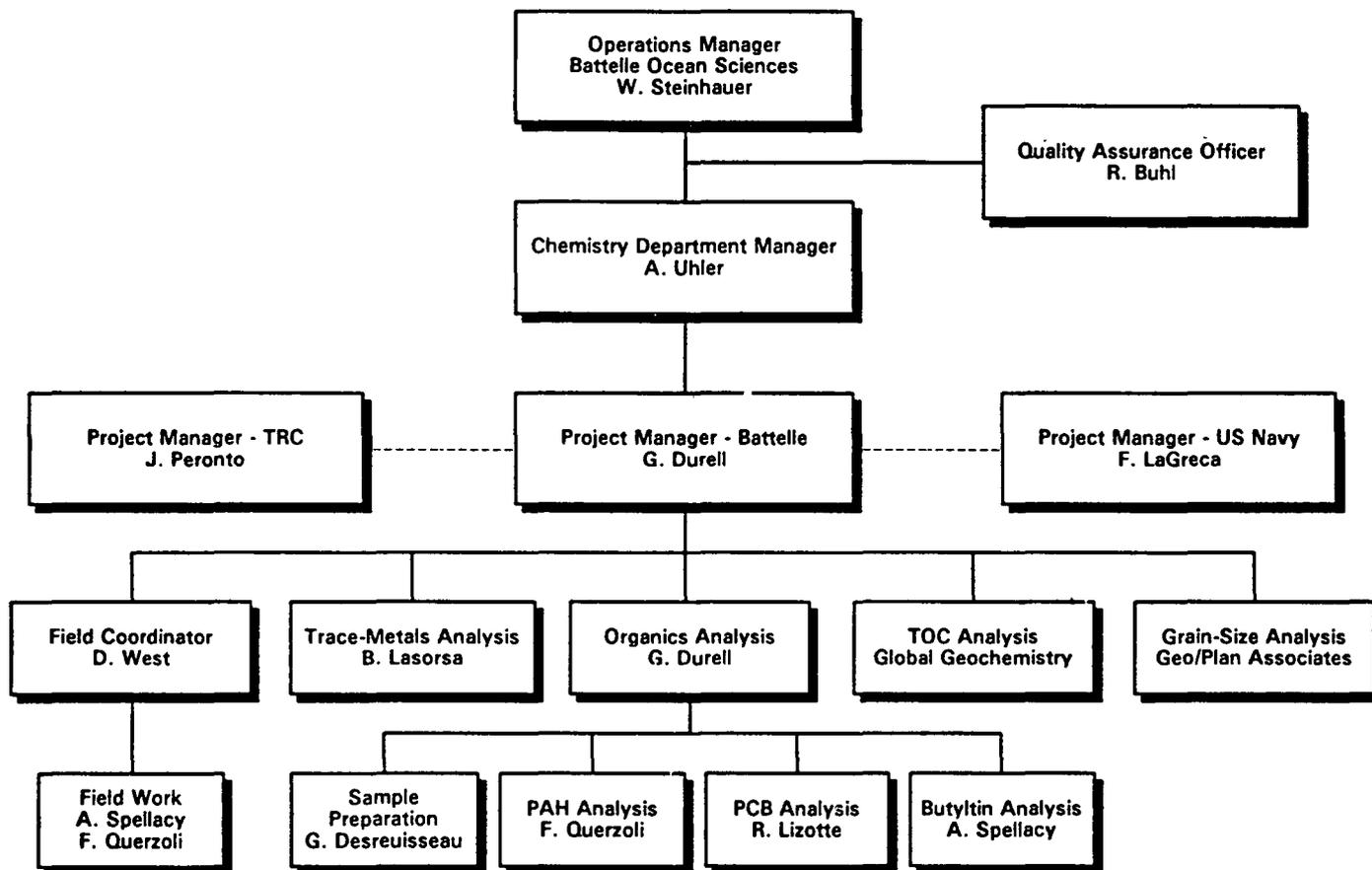


Figure 9. Project Organization.

Ray Siegner

PAH Analysis

Rosanna Buhl

Quality Assurance Officer

## 6.0 SCHEDULE

The field sample collection is expected to take place in mid- to late-August with analysis following directly. The Draft Data Report is expected to be completed by late November and the Final Data Report will be delivered 30 days after receiving all review comments. A preliminary schedule is presented in Table 11.

## 7.0 REFERENCES

- NOAA. 1992. Benthic Surveillance and Mussel Watch Projects Analytical Protocols. 1284-1992. NOAA Technical Memorandum. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division. Rockville, MD.
- Battelle. 1992. Phase 6 Final Report. Collection of Bivalve Molluscs and Surficial Sediments from Coastal U.S. Atlantic and Pacific Locations and Analyses for Organic Chemicals and Trace Metals. Prepared for the Department of Commerce, National Oceanic and Atmospheric Administration, Ocean Assessment Division.
- Cutter, G.A., and T.J. Oatts. 1987. Determination of Dissolved Sulfide and Sedimentary Sulfur Speciation using Gas Chromatography and Photoionization Detection. *Anal. Chem.* 59:717.
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- NOSC. 1992. Analytical Chemistry Quality Assurance and Quality Control Protocols, Criteria, and Corrective Action for the Estuarine Ecological Risk Assessment at Naval Shipyard, Portsmouth, Maine. Prepared by the Naval Ocean Systems Center (NOSC), Marine Environmental Support Office, and the U.S. EPA, Environmental Research Laboratory Narragansett. March 31, 1992.
- Peven, C.S. and A.D. Uhler. 1993. Appendix IV Trace Organic Analysis in Benthic Surveillance and Mussel Watch Projects Analytical Protocols. NOAA, Coastal Monitoring and Bioeffects Division Office of Ocean Resources Conservation and Assessments, National Ocean Service, Rockville, MD.

**Table 11. Preliminary Project Schedule**

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<b>Task</b>	<b>Elapsed Time (days)</b>	<b>Approximate Date</b>
Written Work Authorization	0	July 6, 1993
Work Plan Delivered	13	July 19, 1993
Work Plan Comments Received	24	July 30, 1993
Final Work Plan Completed	41	August 16, 1993
Field Sampling Initiated	41	August 16, 1993
Field Sampling Completed	53	August 27, 1993
Data Package Delivered <sup>a</sup>	115	October 25, 1993
Draft Data Report Delivered	147	November 26, 1993
Final Data Report Delivered	30 days after receiving all review comments	

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<sup>a</sup> Data-packages will be available approximately 60 days from delivery and availability of all samples to the laboratory (August 30, 1993). All samples will be treated as one set because the sampling effort is planned as one continuous event.