

Site Assessment Screening Evaluation Report

30

Volume I
Text, Tables, and Figures

Former Robert E. Derecktor Shipyard
Naval Education and Training Center
Newport, Rhode Island



Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0268

January 1997



Brown & Root Environmental

A Division of Halliburton NUS Corporation

**SITE ASSESSMENT SCREENING
EVALUATION REPORT**

**VOLUME I
TEXT, TABLES, AND FIGURES**

**FORMER ROBERT E. DERECKTOR SHIPYARD
NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
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E.0 EXECUTIVE SUMMARY

This Site Assessment Screening Evaluation was prepared for the former Robert E. Derecktor Shipyard to identify chemical contaminants present in site soils and groundwater as a result of past activities. This information was used to determine if there is an elevated risk of harmful effects from the contaminants to receptors (humans or ecological components) potentially present at or near the site.

Background

The subject property was leased by the Navy to the Rhode Island Port Authority. The port authority in turn leased the property to Robert E. Derecktor of Rhode Island Inc. The Derecktor Shipyard operated at the site between 1979 and 1992, when the company filed for bankruptcy.

During the lease period, one large building was constructed (Building 234) in which ships were constructed. Two other buildings were dismantled (Buildings 40 and 41) and portions were erected on footings at other locations at the site and renamed Huts 1 & 2. During bankruptcy proceedings, many of the mechanical systems were dismantled, and auctioned. Building 234 was dismantled.

In 1993, a Preliminary Assessment (PA) was performed at the site by ENSR of Acton, Massachusetts. The PA was a site reconnaissance that was performed to identify potential contaminant discharge areas. The PA concluded that poor housekeeping practices and haphazard handling of chemicals and other materials resulted in a number of areas of potential concern. These areas were recommended for further investigations.

Investigations Performed

In July of 1996, Brown and Root Environmental (B&R Environmental) commenced investigations to determine the presence of contaminants in the soils and groundwater in the areas of concern identified by the PA.

Investigations were conducted through sample collection, chemical analysis, and contaminant transport mechanism evaluations. Soil samples were collected by installing test pits and borings. Twenty-eight test pits were excavated on the site, and 25 soil borings were advanced, 8 of which were completed as groundwater monitoring wells. Soils were evaluated using screening instruments and visual observations, and samples of suspect soils were delivered to an analytical laboratory for contaminant

analysis. Two borings were advanced in areas upgradient of the site, which were sampled to provide a basis for comparing analytical results.

Groundwater samples were collected from eight groundwater monitoring wells installed on the site, one well installed in an upgradient location, and one well installed on site during an earlier investigation. All groundwater samples were delivered to the analytical laboratory for contaminant analysis.

In addition to sample analysis, drainage systems for storm water, waste water, and mechanical systems at the site were investigated to identify discharge areas and outfalls. This portion of the investigation was designed to augment the findings of the Marine Ecological Risk Assessment study performed by SAIC and the University of Rhode Island Graduate School of Oceanography.

Finally, the ecological and cultural setting was evaluated to identify the land uses and habitats on site and nearby. This information was used to determine the types of potential receptors (humans and ecological components) at and near the site.

Findings of the Investigations

Soil samples collected from mechanical sumps and utility trenches indicated that some contaminant discharges occurred into the soils from several of these locations.

Investigations of drainage systems revealed that there are two primary storm water collection systems that discharge to Narragansett Bay. These systems drain the storm water runoff from around Buildings 6, 42, and 234. The area in the northern portions of the shipyard contains numerous smaller collection systems and discharge points. Catch basins located between Building 42 and Building A18 were damaged and do not function. A central sump collected discharges from the floor drains in Building 234. The discharge of this sump could not be located because of the presence of the building foundation.

Soil sample analysis confirmed the indications of the PA that surficial discharge of various contaminants had occurred at several locations across the site. Much of the contamination in the soils was localized and apparently related to surficial discharges. Low concentrations of contaminants were also detected in groundwater samples collected at the site.

Risk Assessment

A human health risk analysis was performed to preliminarily identify risks to potential receptors. Current potential receptors are limited to persons working at the site on a full-time basis, as well as persons trespassing on the site. The risk analysis indicates that under the current land use (industrial), there is a risk of contaminants at the site that is similar to the risk that is posed by the contaminants detected in the upgradient (off-site) area. The primary contributor to the risk evaluated in the analysis is arsenic, a naturally occurring element in the soil and groundwater in the Rhode Island geologic formations.

An ecological risk evaluation was also performed to determine if the contaminants on site could interact with ecological receptors (animal and plant species). This evaluation concluded that due to the current condition of the site, which is mostly paved and offers minimal natural habitat for ecological receptors, it is unlikely that any significant risk could be presented to these receptors.

Recommendations

Recommendations include performing limited soil excavations at several areas found to have elevated concentrations of chemical contaminants. These areas are to the immediate south of Building 234, to the northeast of Building 6, and to the north and south of Huts 1 & 2. In addition, the soils under Building 42 are contaminated; therefore it is recommended that they be removed either now or after building demolition. Finally, some of the drainage systems under the Building 234 foundation and south of Building 42 should be dismantled or repaired, depending on the plans for future use of these areas. Further full-scale investigations at the site are not warranted.

1.0 INTRODUCTION

This report has been prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Task Order (CTO) 0268, dated April 26, 1996. The statement of work requires Brown & Root Environmental (B&R Environmental) to perform a Site Assessment Screening Evaluation (SASE) at the former Robert E. Derecktor of Rhode Island Inc. (Derecktor) Shipyard, which is a part of the Naval Education & Training Center (NETC) in Newport, Rhode Island.

The Derecktor Shipyard was a privately operated ship maintenance and construction yard from 1979 to 1992. The property was leased to Robert E. Derecktor but owned by the U. S. Navy. The Navy had also used the site for shipbuilding activities from 1962 to 1978. The site location is shown on Figure 1-1.

1.1 PROJECT OBJECTIVES

The objective of the SASE for Derecktor Shipyard is to identify and evaluate contaminants that may exist on shore in the buildings, fill, soil, and groundwater due to past operations at the site.

The SASE targeted known areas of contaminant discharge for sample collection and analysis. These target areas were identified in a Preliminary Assessment (PA) Report that was performed by Halliburton NUS Corporation and ENSR Consultants and Engineers of Acton, Massachusetts, in May 1993. The PA identified several areas of concern where additional investigations were merited. These areas were identified by visual observations and review of historical records for the shipyard.

The PA Report also recommended conducting investigations in Coddington Cove's marine environment to determine if the ecosystem had been impacted by the on-shore activities. An off-shore investigation and ecological risk assessment were performed for this area; draft report was submitted in July 1996 (URI/SAIC).

Intrusive investigations performed as a part of this SASE concentrated on identifying chemical contaminants in the subsurface materials and the transport mechanisms that are available to them. The contaminants found were evaluated with respect to their opportunity to affect people and other receptors on and around the site.

This information was used to produce a preliminary human health risk assessment, which provides an abbreviated evaluation of the potential effects of exposure to those contaminants. In addition, this information was used to prepare a conceptual model for an "on shore" ecological risk assessment. This model supports the conceptual model and risk assessment that was prepared for the marine environment adjacent to the site. These evaluations and models will be used to determine whether a Remedial Investigation should be conducted.

These on-shore areas of the shipyard were first inspected for this CTO in April 1994 by B&R Environmental personnel, facility representatives, and the NAVFAC Remedial Project Manager (RPM). At that time, the shipyard was divided into four sub-areas for the completion of the SASE:

- North Waterfront: bounded on the north by the existing fence south of Pier 2, on the east by the Penn Central right of way, on the south by the area surrounding Buildings 6 and 42, and on the west by Narragansett Bay.
- Central Shipyard: bounded on the north by unmarked points approximately 100 feet north of Buildings 42 and 6, on the east by the Penn Central right of way, on the south by the southern edge of Simonpietri Drive, and on the west by Narragansett Bay.
- Building 234 Area: bounded on the north by the southern edge of Simonpietri Drive, on the east by the Penn Central right of way, on the south by unmarked points approximately 25 feet south of the foundation for the former Building 234, and on the west by Narragansett Bay.
- South Waterfront: bounded on the north by unmarked points approximately 25 feet south of the foundation for the former Building 234, on the east by the approximate location of the above-ground steam line on the west side of Defense Highway, on the south by the Autoport gas station, and on the west by Narragansett Bay.

1.2 REPORT ORGANIZATION

Section 2 of this report describes the history of the site and some of the findings of previous investigations on and around the site. Section 2 presents the areas of concern identified in the PA, describes actions NETC took to address these areas, and summarizes the approach taken by the SASE to investigate these areas.

Section 3 describes the investigations performed as a part of the SASE. Tasks are listed in the order in which they were executed. Sample collection procedures and analytical parameters are also described in Section 3.

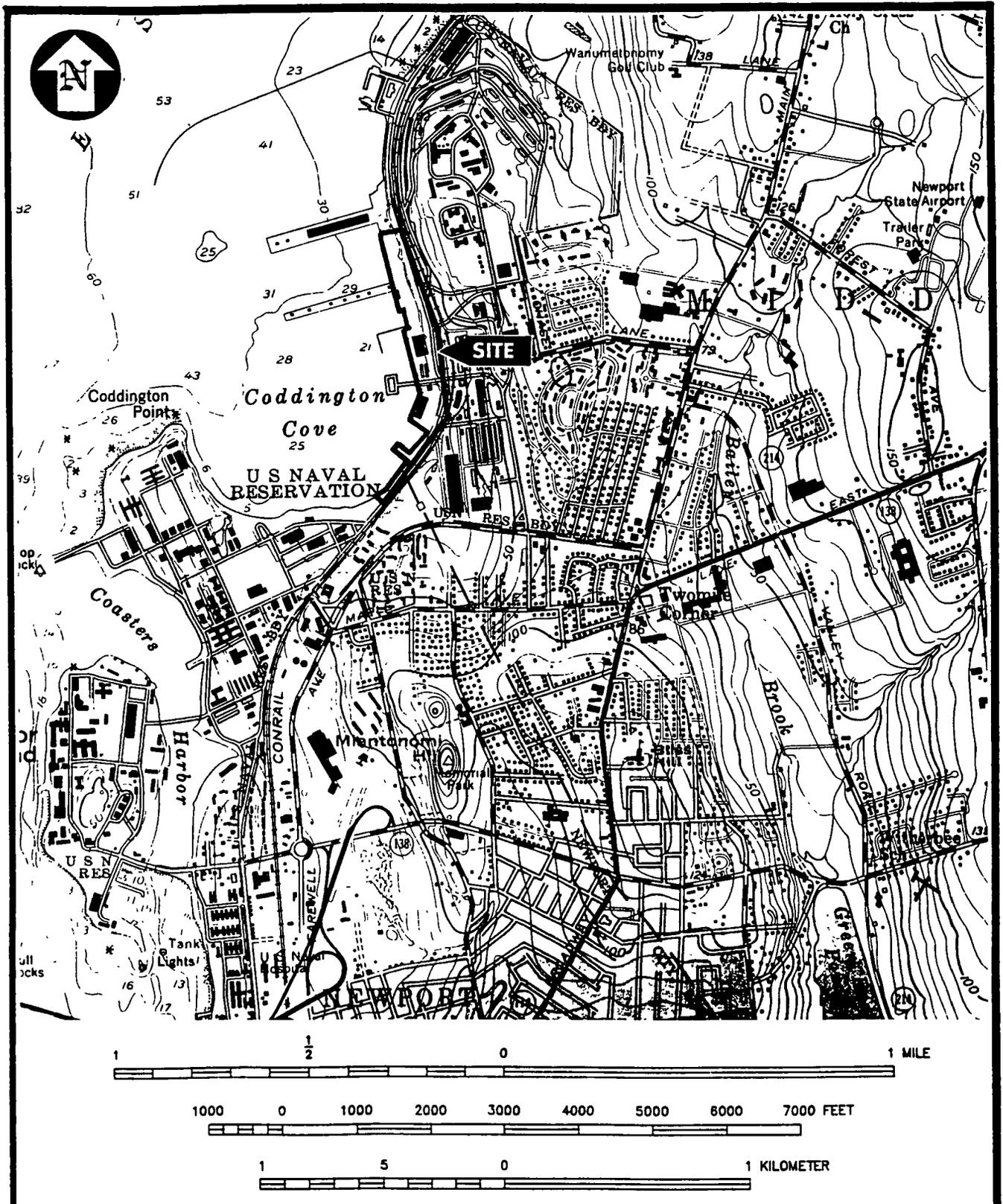
Section 4 presents the findings of the investigation. This section is formatted to follow Section 3; data presented in Section 4.2 was collected during investigations described in Section 3.2.

Section 5 presents a general description of the fate and transport avenues that are available to contaminants detected, based on the concentrations detected, and their persistence and behavior, as well as the physical properties of the contaminated media. Section 5 also presents the current land uses surrounding the shipyard.

Section 6 of this report presents a human health assessment, including a risk-based selection of contaminants of concern, a brief toxicity assessment for contaminants of concern, a description of potential exposure pathways, and a summary of risk to current and possible future human receptors.

Section 7 of this report presents a conceptual model for the ecological receptors identified or expected at the site. This conceptual model is limited to the terrestrial ecosystem, and provides links for the off-shore conceptual model presented in the draft Derecktor Shipyard Marine Ecological Risk Assessment Report (SAIC/URI July 1996).

Appendices present raw data and other pertinent information. This information is referenced in the text of the report, as appropriate.



SITE LOCATION MAP
 DEREKTOR SHIPYARD
 NEWPORT, RHODE ISLAND

 Halliburton NUS
 CORPORATION

FIGURE 1-1

2.0 BACKGROUND

The information provided in this section has been adapted from the PA report for Derecktor Shipyard (ENSR, May 1993), and was re-published in the Work Plan for Site Assessment Screening Evaluation (B&R Environmental, April 1996).

The Derecktor Shipyard consists of 41.35 acres of land and improvements that was leased by the Rhode Island Port Authority and Economic Development Corporation (RIPAEDC) to Derecktor. RIPAEDC, in turn, leased this parcel from the U.S. Navy. The RIPAEDC lease commenced on January 1, 1979; Derecktor's sublease ran concurrently.

The area leased by Derecktor is surrounded on the northern, eastern, and southern property boundaries by Naval Education & Training Center (NETC). The western boundary of the parcel opens onto Coddington Cove, an inlet of Narragansett Bay.

2.1 ACTIVITY HISTORY

The history of government involvement with lands in the Newport, Rhode Island, area dates to the mid-1600s when property was first purchased from the Aquidneck Indians. Throughout the 1700s and 1800s, the presence of the U.S. Navy grew in the Newport area with the development of naval training facilities and the establishment of the Naval War College. Military activities increased sharply at the outbreak of World War I and again at the start of World War II.

Coddington Cove was acquired in 1940 for use as a supply station. Prior to this time, the Coddington Cove area was farm land with few buildings. During World War II, the Coddington Cove area experienced major development, including construction of barracks, warehouse space, and hundreds of Quonset huts. Although naval activity diminished following the end of World War II, some construction at Coddington Cove continued. In 1955, Pier 1 was completed to replace pier space lost in 1954 to Hurricane Carol. The adjacent Pier 2 was added in 1957.

In 1962, Newport became headquarters to the Commander Cruiser-Destroyer Force Atlantic. Dozens of naval warships and auxiliary support ships were home-ported at Newport. A 1962 aerial photograph of the Coddington Cove area shows 18 naval warships moored at Pier 1.

This use of the Coddington Cove area continued until the April 17, 1973, announcement of the Navy's Shore Establishment Realignment (SER) Program. The SER resulted in a reorganization of naval forces at Newport and the transfer of ships and activities to other naval stations. The SER also directed transferring or excessing non-essential land and facilities. The 41 acres of land leased to RIPAEDC and subleased to Derecktor Shipyard was included in the excessing package. The Derecktor Shipyard operated from 1979 until January 1992, when Derecktor filed for Chapter 11 bankruptcy.

The site was used by Derecktor to repair, maintain, and construct private and military ships. Repair and maintenance operations were concentrated around Pier 1. These operations consisted of sand blasting and painting, hull inspections, and other on-board ship repairs. Floating dry docks were moored at Pier 1. A large ferry known as the Greenport Ferry was moored between Buildings A18 and 234 and used as work space.

Derecktor also constructed new ships under contract to the U.S. Coast Guard and the U.S. Army. These ships were steel-structured, such as cutters and tugboats, built from the keel up, and outfitted for initial sea trials. Construction included cutting and welding steel, sand blasting, priming and painting the structure, and assembling the ship. Ship assembly was primarily conducted in Building 234. Supporting the ship maintenance and construction operations was an engineering department, a machine shop, an electrical shop, a pipe shop, and a vehicle maintenance shop.

2.2 SURROUNDING LAND USE

The former Derecktor Shipyard area is surrounded entirely by U.S. naval facilities. NETC facilities are generally situated at a higher elevation than those at Derecktor Shipyard. The majority of the NETC buildings surrounding the site are used for administration, training, or naval research.

Abutting the site to the south is a NETC public works garage and vehicle maintenance building, and an oil-fired heating plant. The public works transportation shop and heating plant directly abut the Derecktor property and are immediately south of Buildings 3 and 5, respectively.

Further south of the site (approximately 500 yards) is a military housing development (Range Road). Additional housing (Simonpietri Drive) is present 150 yards east of the site (upgradient). Commercial fishermen use Coddington Cove for lobster and crab fishing. There are no restrictions on access to the shipyard by water.

No natural fresh water bodies were observed within the Derecktor Shipyard. Approximately 80 percent of the shipyard is covered by buildings or pavement. Because precipitation cannot readily percolate through paved surfaces, water will tend to accumulate on the ground surface, which, in this case, consists of depressions in the pavement.

2.3 GEOLOGY/HYDROGEOLOGY

The regional geology/hydrogeology for the site is presented below. Much of this information was extracted from a March 1993 draft Remedial Investigation/Feasibility Study (RI/FS) report conducted by TRC Environmental Corporation (TRC) for the NETC.

NETC is located at the southeastern end of the Narragansett Basin. This basin is a complex synclinal mass of Pennsylvanian aged sedimentary rocks that is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. Narragansett Basin is an ancient north to south trending structural basin originating near Hanover, Massachusetts. The basin is approximately 55 miles long and varies from 15 to 25 miles wide. The western margin of the basin is in the western portion of Providence, Rhode Island; the eastern margin runs through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin is near the mouth of Narragansett Bay.

The bedrock of the Narragansett Basin has been divided into the following five units: the Rhode Island Formation, Dighton Conglomerate, Wansulta Formation, Pondville Conglomerate, and Felsite at Diamond Hill. At NETC and most of the surrounding area, the bedrock is composed entirely of the Rhode Island Formation. The Rhode Island Formation is the most extensive and thickest of the Pennsylvania formations in Rhode Island.

Included within the Rhode Island Formation are fine to coarse conglomerate, sandstone, lithic graywacke, arkose, shale, and a small amount of meta-anthracite and anthracite. Most of the rock is gray, dark gray, and greenish, but the shale and anthracite are often black. Crossbedding and irregular, discontinuous bedding is characteristic of the formation. Rock in the southern portion of the basin, where the NETC is located, is metamorphosed, and contains quartz-mica schist, feldspathic quartzite, garnet-staurolite schist, and some quartz-mica-sillimanite schist. The beds of meta-anthracite and anthracite are mostly thin, but many areas within basin have been mined. Vein quartz, fibrous quartz, and pyrite are commonly associated with these coal layers, and the ash content is high.

Many areas on Aquidneck Island, on which NETC is located, obtain their water supply from wells. Areas relying on groundwater are mostly north of the Middletown area, but wells exist throughout the island. Most groundwater is used for domestic needs, although some is used by small industries and businesses.

Groundwater on Aquidneck Island is obtained from the unconsolidated glacial deposits of till and outwash and from the underlying Pennsylvanian bedrock. Throughout the area, depth to groundwater ranges from less than 1 foot to about 30 feet, depending upon the topographic location, time of year, and character of subsurface deposits. The average depth to the groundwater is approximately 14 feet on Aquidneck Island and moves from areas of high elevations to Narragansett Bay or the Sakonnet River.

Seasonal water level fluctuations are common in the area. These fluctuations range from less than 5 feet to as much as 20 feet on the hills. In the valleys and lowland areas, the fluctuations are generally less than 5 feet. During the late spring and summer, the water table usually declines as a result of evaporation and the uptake of water by the plants, and rises during autumn and following winter thaws.

The chemical characteristics of the groundwater are similar throughout the area; water is generally satisfactory for most ordinary uses. Most groundwater in the area is soft or only moderately hard; groundwater from till generally contains less mineral material and is softer than groundwater from bedrock. Locations where groundwater has a high iron content are scattered, but are most numerous around Newport and Middletown and the northern part of Portsmouth. Wells that have a high iron content usually penetrate only rocks of Pennsylvanian age.

The groundwater at NETC is shallow (less than 10 feet below the surface in most areas). This shallow depth makes groundwater contamination at NETC highly probable. Pollutants that do migrate into groundwater would flow to the west and discharge into Narragansett Bay. NETC extends along the western shoreline at Aquidneck Island, so the groundwater only has to migrate a short distance before discharging into Narragansett Bay.

The soils occurring at NETC have permeabilities that are moderate to moderately rapid, so they do not restrict the vertical movement of water. The glacial till, from which these soils were derived, is generally less permeable than the overlying soils but does not represent a barrier to the vertical migration of water. Therefore, it is possible that any contaminant transported in this water could contaminate the groundwater. Isolated areas also exist where the bedrock occurs at the surface.

Contamination is possible at these outcrops through the cracks and fissures that commonly occur in the bedrock.

The Rhode Island Department of Environmental Management (RIDEM) has established a state and groundwater classification system to protect its groundwater resources. The groundwater at Derecktor Shipyard is classified as GB. Groundwater classified as GB may not be suitable for drinking water without treatment due to known or presumed degradation. Groundwater classified as GB is typically located at highly urbanized areas or is located in the vicinity of disposal sites for solid waste, hazardous waste, or sewerage sludge.

2.4 FINDINGS OF THE PRELIMINARY SITE ASSESSMENT

Based the information reviewed and the observations made during the PA, a number of conclusions regarding the Derecktor Shipyard were made. The following conclusions are those that apply to the study area, as described in Section 1.0 of this report.

- Derecktor operations generated large quantities of hazardous wastes. These wastes included waste oil, paints, solvents, thinner, sodium hydroxide, and other waste solids and liquids.
- Housekeeping and hazardous material handling practices at the facility were poor. General debris and scrap materials were widely scattered around the facility.
- Waste materials were known to be disposed of on the property, including spent sand blast grit, oily liquids, and bilgewater from the dry dock. These liquids were reportedly placed in a small pit on the northern side of Building 42 which has since been filed.
- Releases of hazardous material to the ground in the hazardous waste storage area (North Waterfront) and the pipe shop (Building 6) are suspected but have not been confirmed.
- Interior areas of some buildings, most notably Buildings 42, 234, and 6, have been significantly impacted by Derecktor operations. Depending on the intended reuse of these buildings, significant cleaning or floor and wall restoration may be necessary.

- The presence of asbestos-containing materials (ACM) is suspected in most of the buildings. If renovation or demolition of the buildings is intended, the presence of ACM would need to be confirmed.
- The primary pathways for contaminants to migrate from the site would be through the storm drain system and groundwater flow. Coddington Cove would be the primary receptor of contaminants through these pathways.

2.5 RECENT ACTIVITY

Since the PA was issued, the site has undergone several major changes. Derecktor's oversized Building 234 was removed, leaving the original Building 234 damaged, but in place, with the north and south walls demolished. All the material, machinery, and equipment in this building has been removed. Buildings 40 and 41 and Huts 3 and 4 were removed. The dry docks were removed, and the Greenport Ferry, once tied at the base of the pier to Building A18, was removed.

After bankruptcy proceedings, and during the shutdown and auction of the saleable materials, debris from building demolition and unwanted material was scattered throughout the site. NETC Newport has performed a surface cleaning at the site that consisted of removing remaining debris, surface cleaning grossly contaminated concrete, and closing and removing underground storage tanks (USTs).

In August 1995, NETC contracted with OHM Corp to perform a removal action to excavate and dispose of sandblast grit that was known to be present on the ground to the north and east of Building 42. OHM removed this material, and covered the exposed ground with a sand and crushed stone mix. As a part of this effort, the embankment to the east of Building 42 was excavated and repaired.

The PA did not include the area designated as the South Waterfront as a part of the study area. NETC representatives have indicated that this area has had fill materials placed on it by Robert E. Derecktor Inc. so it was evaluated as a part of the SASE and is described in this report.

2.6 RECOMMENDATIONS OF THE PRELIMINARY ASSESSMENT REPORT

To confirm observations and conclusions made regarding environmental impacts at the Derecktor Shipyard, the PA recommended a limited investigative program with two objectives. The first was to collect data to confirm presence or absence of the suspected contamination. The second was to resolve issues such as the presence of USTs at Buildings 62 and 234 and the outlets of storm drains

that could not be determined in the PA. The complete nature and extent of contamination at the site need not be defined.

The PA report recommendations are restated below, followed by the Navy's approach to address each recommendation. Since the issuance of the PA report, some of the recommended actions have been instituted; others are addressed by the SASE, as stated below.

Recommendation 1: Soil Sampling - Soil samples should be collected and analyzed for target analyte list metals plus cyanide (TAL inorganics) volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and total petroleum hydrocarbons (TPHs). Samples should be collected at both the surface and at depth. Samples should be collected from the following areas where stained soil was observed or disposal activities were reported:

- Hazardous waste storage area (Waterfront Area)
- 20,000-gallon fuel tank to the northeast of Huts 1 & 2
- Building 234 southeast corner
- Building 234 north side
- Building 42 north and east sides
- Building 6 northeast of loading dock area and pipe shop

Action: These six activities were performed as a part of the SASE. These efforts are detailed in Section 3 of this report.

Recommendation 2. Groundwater Monitoring - Installation of shallow water table groundwater monitoring wells is recommended for areas where liquids are suspected or known to have been released to the ground surface. The wells should be 2-inch PVC installed with a hollow-stem auger drill rig. Following development of the wells, samples should be collected for laboratory analysis of VOC, SVOC and TAL inorganics. Wells should be located as follows:

- Hazardous waste storage area (North Waterfront)
- Building 6 loading dock by pipe shop
- Building 42 northeast corner
- West and northeast of Huts 1 & 2

Action: Installation of these shallow wells, and their development and sampling, was performed as a part of the SASE. These efforts are described in detail in Section 3 of this report.

Recommendation 3. Marine Sediment Sampling - Sampling of marine sediments is recommended to confirm previous results and to determine if other areas of Coddington Cove have been impacted by the shipyard. Samples of marine sediments should be collected with both a dredge for surface samples and with a corer to determine concentrations with depth. Samples should be collected in the following areas:

- North and south sides of Pier 1
- Along the waterfront at storm drain outfalls
- On the east and west sides of the Greenport Ferry, including the storm drain outfall at the northwest corner of Building 234
- At the storm drain outfall west of Building 42
- South of Building 234 at the storm drain outfall
- A background location within Coddington Cove away from shipyard or Navy activities

Action: Sediment sampling of these six areas has been performed as a part of the Marine Ecological Risk Assessment, Derecktor Shipyard (draft report SAIC and URI GSO, July 1996).

Recommendation 4. Other Investigations

4A: Hazard Categorization - Categorization of abandoned drums and containers is recommended to properly classify hazardous wastes for disposal.

Action: Drum and container categorization has been performed by NETC. All chemical containers have been removed from the site.

4B: Blasting Grit - The used sand blast grit (black beauty) and rotoblast should be analyzed for total metal content and by the toxicity characteristic leaching procedure (TCLP).

Action: This effort was partially undertaken by NETC and the U.S. Navy Northern Division. Preliminary sampling and analysis performed by NETC personnel with XRF screening devices indicates that the sandblast material on the ground surface contains low concentrations of metals. Additional sampling was performed by TRC Environmental Corporation (TRC) and presented in an Environmental Assessment Report, dated December 1994. The report indicates that this material has elevated levels of chromium, copper, lead, nickel, and zinc but that these metals do not appear to leach based on previous extraction procedure leaching tests performed by NETC.

The Navy removed the sandblast material in August 1995, as described in Section 2.3 of this report.

4C: Asbestos Survey - Representative samples of suspected ACM should be collected from the buildings and analyzed to determine if asbestos is present in pipe insulation and floor or ceiling tiles.

Action: This effort has been performed by NETC. Asbestos-containing building materials have been identified in the forms of pipe insulation, floor tile, and other insulation materials in several buildings at the site, including Building 42 and Building A-18. A copy of the report is available through NETC.

4D: Underground Storage Tanks - The one UST at Building 5 and reportedly two USTs at Building 234 should be leak tested if the Navy desires to continue using these tanks. If the tanks fail a tightness test, soil borings around the tanks are recommended to determine if petroleum products have been released. The 2,500-gallon UST at Building 234 should be located either through additional record search or a metal detection survey. A metal detection survey is recommended for Building 62 to confirm that all USTs in this area were removed. Soil borings with collection and analysis of samples with depth should be conducted to determine if petroleum products were released by the tanks that were removed.

Action: The UST issues have been resolved by removal of the present USTs. NETC performed this effort and copies of the tank closure reports are on file with the RIDEM UST Section and NETC.

The Navy has eliminated the area around Building 62 from the study area because its only association with the shipyard was as parking. Petroleum contaminants were recently found downgradient of this area during storm drain repair work. This contamination is currently under investigation as part of a separate project.

One UST was located and removed from the southern end of Building 5 under RIDEM UST closure regulations. Follow-up excavations have been performed under remedial actions that are separate from this SASE study.

One UST was located and removed from the northeastern corner of the Building 234 area. Excavations were performed in this area to attempt to locate a second suspected UST but none was found. Corrective action plans were prepared and executed for the USTs removed from Buildings 5 and 234. Reports for these actions are on file with the RIDEM UST Section, and the NETC.

- 4E Above-Ground Storage Tanks - An inventory of above-ground storage tanks should be conducted to determine their condition and contents, if any. This inventory will enable proper disposal of tank contents and proper management of the tanks themselves.

Action: All above-ground storage tanks have been removed by Derecktor as a part of the bankruptcy proceedings and subsequent auctions.

- 4F Storm Drain System Evaluation - The storm drain system should be evaluated to determine the condition of catch basins and the degree of siltation or clogging. Many catch basins were observed to be blocked with debris or silted in with sand blast grit. Cleaning the storm drain system may be necessary to remove continuing sources of pollutants and to restore proper flow.

Action: NETC has performed a basewide investigation to describe the known locations of the storm drain systems, which included Derecktor Shipyard. This effort was performed by Sigmund and Associates, Inc. for the Department of the Navy. These findings were supplemented by the SASE investigation, as described in Sections 3 and 4 of this report.

4G: Building Interior Sampling - Buildings where heavy staining on the concrete floor was observed should be sampled prior to reuse to determine the extent of contamination. This sampling would consist of wipe samples or, if deep staining is present, concrete chip or core samples. The floors should also be visibly inspected for cracks or holes where liquids may have seeped. If buildings will be occupied by personnel, then interior air sampling is recommended. The areas where sampling is recommended are Rooms A, B, and C and the hallways in Building 42, the burning room in Building 234, the tool crib in Building 4, and the pipe shop in Building 6.

Action: The areas of the buildings described have undergone industrial cleaning to ensure safe working conditions, and wipe samples are no longer appropriate. Building 234 has been removed, and others were investigated as a part of the SASE, as described in Section 3 of this report.

3.0 FIELD INVESTIGATION AND SAMPLING PLAN

This section provides a detailed description of field work performed as part of the SASE. The efforts described in this section were scoped in Section 3 of the Work Plan. This section summarizes the field investigations performed for this study. Some procedures were modified in the field. Any field modifications that were made are described in this section.

The objective of the field investigation was to obtain adequate data to draw findings for the SASE report and prepare a preliminary risk evaluation. The data acquired may also be used in a baseline risk assessment if a remedial investigation is warranted.

These efforts are described in the following subsections. The Work Plan described the performance of eight separate tasks. Those tasks have been consolidated in this report into five primary efforts, described in the sequence in which they were performed:

- Inspection of sumps and potential discharge areas
- Investigation of underground drainage systems
- Excavation and sample collection of test pits
- Investigation of Geologic/Hydrogeologic characteristics
- Evaluation of cultural and ecological settings

These efforts are described in the following subsections. The findings from these investigations are detailed in Section 4 of this report.

Figure 3-1 is a base map for the site. This map shows the buildings, roadways, catch basins, and other permanent features in the study area. This map also shows the four study area sub-areas. These sub-areas are the North Waterfront, the Central Shipyard, the Building 234 Area, and the South Waterfront. These areas were segregated based on former uses of the property as reported in the PA report, and geographical location. The Work Plan provides further descriptions of the four sub-areas and their former uses.

Table 3-1 presents a summary of samples collected as a part of these investigations. Additional details of the sample preservation, and handling and holding times (to which these samples were subject) are described in the Work Plan.

3.1 INSPECTION OF SUMPS

Five sumps were found in Building 42. Eight sumps remained in the existing floor foundation of Building 234. Two utility trenches and fifteen sub-floor equipment boxes were also found in the foundation of Building 234. Water and floating debris in these sumps were not visually apparent and created a hazard for personnel working in these areas. Many of these sumps were theorized to be former mechanical vaults for sub-floor equipment that was used during shipyard operations.

Sumps that were found to have unconsolidated bottoms were assumed to have the potential to discharge contaminants to the ground subsurface. These potential discharge points can be interpreted by RIDEM regulations as injection wells (sometimes referred to as UICs). Any hole, sump, or pit can be defined as an injection well if the depth is greater than the largest dimension of the opening. Therefore, sumps or pits that had unconsolidated bottoms were considered potential injection wells. This report refers to these sumps and pits as potential discharge points.

In addition to the sumps described above, other miscellaneous discharge points were found during the initial phases of the field investigations, including pits, dry wells, and other possible discharge areas. This subsection describes the investigative approach taken to evaluate each of these discharge points.

3.1.1 Sump Inspection

The fluids in the sumps were pumped out and containerized for waste characterization and off-site disposal. The solid debris, consisting of soil, bricks, gravel, sludge, wood, and metal was all removed and containerized for waste characterization. The interiors of the sumps were cleaned with high pressure water spray, and inspected for staining, cracks, holes, fractures, and connecting piping; if piping was found, discharge points were determined using smoke tests.

After inspections, each sump was given a specific identifier, and photo documented to clearly show the condition of the interior.

Concrete core samples were to be collected from sumps if it was determined that these pits or sumps were a part of a contaminant source or release flow path. This determination was to be made based on the findings of the inspections, and results from any follow-up soil sample collections performed.

Of all the building sumps identified, five were found to have unconsolidated bottoms, and thus determined to be potential discharge points (S42-1, S42-2, S42-4, S234-1, and S234-4). The fifteen sub-floor equipment boxes in the Building 234 foundation were also found to have unconsolidated bottoms, and thus also may be potential discharge points. One "dry well" was also found to have an unconsolidated bottom. These locations were all identified as potential discharge points and are described in Table 3-1.

3.1.2 Collection of Samples from Discharge Points

An attempt was made to collect three samples from the bottom of each sump using a hand auger. Samples were collected from 0.5 foot intervals to a maximum depth of 1.5 feet below the surface of the bottom materials. Each interval was containerized separately for on-site screening analysis and laboratory analysis for a full analytical set. At some locations, all three intervals were not collected. This was due to the presence of rocky substrate and limitations of the sampling equipment.

The crawl space under Building 42 was inspected by personnel in level B respiratory protection in order to inspect it and collect samples of soils from under the sumps. During this inspection, the soils under two of the sumps (42-1 and 42-2) were collected for chemical analysis. Samples from under S42-4 could not be collected due to unavailable access in the area of the sump.

Samples were acquired by turning decontaminated hand augers into the subsurface materials at 0.5-foot intervals. Each interval was treated as a separate sample, and placed into a decontaminated stainless steel bowl. An aliquot of the material was first removed and containerized for VOCs analysis; the remaining material was homogenized with a decontaminated stainless steel "Scoopula" or similar device. After mixing to homogenize the sample, aliquots were removed for each analyte described in Table 3-2.

Samples collected from sumps were given the designated sump identifier (S#). Samples were labeled as soils (S) and depth intervals were expressed in tenths of feet: Sample DSY-S-S42-2-1015 indicates a surface soil sample from Building 42, Sump No. 2, 1.0 feet to 1.5 feet below ground surface.

Because the borings were shallow, they were not back-filled after sample collection, except that excess sample material was replaced in the borehole within the catch basin, sump, or pit.

While the equipment boxes inspected were found to have unconsolidated bottoms, utility lines and other structures impeded use of hand augers in these areas. Therefore, a drilling rig was used to advance shallow borings through several of these utility boxes and then split barrel samplers were driven into the subsurface material. This process of sample collection is detailed in Section 3.4 of this report. These samples were collected at 2-foot intervals.

At locations where underground discharges were suspected, but point sources could not be precisely sampled, a drilling apparatus was used to install shallow borings. This process of sample collection is detailed in Section 3.4 of this report. Shallow borings were advanced to a target depth (immediately above the probable discharge point), then continuous samples were collected in these areas at 2-foot intervals to a total depth of 6 feet below the expected point of discharge. A minimum of three such borings were advanced at each expected discharge area to allow for error in locating the discharge.

Soil samples collected from shallow borings were collected with a split barrel sampling device, driven into the ground at 2-foot intervals. Aliquots of the material were first removed and containerized for VOCs analysis; the remaining material was homogenized in a decontaminated stainless steel bowl using a contaminant free "Scoopula" or similar device. After mixing to homogenize the sample, aliquots were removed for each analyte described in Table 3-1.

These sample locations were designated as Shallow Borings (SB)#, and depth intervals were expressed in feet: Sample DSY-SB-23-0204 indicates a sample from Shallow Boring No. 23, 2 to 4 feet below ground surface. Details in sample designations are presented in Section 4.3 of the Work Plan.

The shallow borings were back-filled with bentonite and sand mix, as described in the Work Plan.

A total of eight potential discharge points were identified and investigated in this manner, as summarized in Table 3-2. Section 4 of this report describes the findings of the inspections of the pits and sumps, and the results from analysis of the samples collected.

3.2 DRAINAGE SYSTEMS AND OUTFALLS

Storm drains and building floor drains were described in the PA report as a potential contaminant migration route to Coddington Cove. Storm drains were described as clogged with sandblast grit and other material. Photographs previously published in the PA report showed evidence of oil and other chemical disposal in many of these drains.

The Stormwater Pollution Prevention Plan prepared by Sigmund and Associates, Inc. (September 1994) was reviewed and used as a baseline for collecting additional information. A comprehensive records search was performed to attempt to identify existing drain lines and underground utilities.

Culverts and storm drains not identified by the records search were tracked, and cleared for inspection to determine discharge areas. Floor drains in the buildings that were not identified by the records search were also tracked, cleared, and inspected to identify potential discharge areas.

Selected floor drains and sanitary drain lines were cleared with "Jet Rodder" equipment, which uses a low-pressure water spray to clean the pipe and advance the cutting head. Outlets and connections were determined by driving smoke through the drains under air pressure, and noting where smoke emissions occurred. Blocked catch basins were cleared by removing or excavating any blockage with high-powered suction equipment (vactors). Inflow and outflow pipes identified were tracked with smoke tests and robotic video cameras.

The information collected during this task was used to prepare a comprehensive map of underground drainage systems. This map and back-up information is presented in Section 4 of this report.

3.3 TEST PIT EXCAVATION

A large volume of spent sandblast material was used as fill in the study area. Large mounds of soil and possibly other debris was suspected to exist in the South Waterfront area. Therefore, test pits were excavated in the South Waterfront soil piles and other areas of the site to determine presence of spent sand blast grit and other debris.

Because some of the test pit activities were proximal to the shoreline in the South Waterfront, these activities fall under the Rhode Island Coastal Resources Management Council (CRMC) jurisdiction. The CRMC was notified of the work to be performed and a permit was granted for execution.

Test pits were excavated and the soil lithology was examined for staining, odors, presence of sandblast grit, and other foreign debris. Soil samples were collected and screened on site with a field gas chromatograph (Photovac 10S50). Some samples were selected for analysis by an off-site laboratory. Analytical Parameters are described in Table 3-2.

3.3.1 Test Pit Excavation

Twenty-eight test pits were excavated. Target areas and purposes of these test pits are presented on Table 3-3. Excavated material was all returned to the pits as back-fill. While no drums, sludges, tanks etc. were discovered during test pit excavations, signs of petroleum impact, such as staining and a light sheen were noted in several test pits. Possible sandblast grit was noted in two test pits and elevated readings from health and safety screening instruments were noted in five test pits. Detailed findings are presented in Section 4.3 of this report.

Six test pits were excavated in the South Waterfront area (SW). Prior to excavation, this area was inspected to identify areas of stressed vegetation. Test pits were spaced evenly across the South Waterfront as described in the Work Plan but as stressed vegetation areas were found. Access to the southern area was restricted by a fence and heavy vegetative growth. Rather than destroy the vegetation, access to the beach area occurred at low tide, and the test excavations were made into the embankment from the western side.

Five test pits were excavated in the Building 234 area. Two were excavated to the south of the building, and two were located to the northeast. One test pit was added to the north, near the building foundation to locate a suspected floor drain discharge to the north of Building 234, and a possible UST. Abandoned UST piping was discovered, but no tank was found.

Seven test pits were excavated in the Central Shipyard area. One test pit was excavated on the eastern side of Building 42, two test pits were excavated on the southern side of Building 42, and one test pit was excavated on the northern side of Building 42. (Two were planned for this area, however during Work Plan preparation, OHM Corp. excavated this area, precluding the need for multiple test pits.) Two test pits were excavated at Building 6 in suspected areas of chemical discharge. One test pit was excavated on the southern side of Huts 1 & 2, in the reported vicinity of an underground vault (this vault turned out to be a dry well and was sampled as described in Section 3.2).

Ten test pits were excavated in the North Waterfront area. One test pit was excavated to the north of Huts 1 & 2, near a small depression, and a groundwater outbreak near the embankment for Defense Highway. One test pit was excavated at the request of the RIDEM, to the east (upgradient) of Huts 1 & 2. This test pit was excavated to assist delineation of petroleum contaminants associated with an upgradient source. The eight other test pits were excavated on the North Waterfront area located near suspected or possible areas of chemical discharge (Table 3-3).

All test pits were photo documented, back-filled, and marked with stakes following completion. These stakes were surveyed in order to map the sample collection points.

3.3.2 Soil Samples Collected from Test Pits

A minimum of three samples were to be collected from each test pit. Samples were collected from the ground surface (0-1 feet below ground surface or below bottom of the asphalt or concrete surface), middle of the pit, and bottom of the pit. The bottom soils were to be collected from the material located directly above natural soils, if it was identified by visual observation. The samples were collected after the excavation was completed.

Soil samples from test pit operations were collected such that each sample was a composite from each wall of the pit. The samples from the bottom of the pit were a composite from each wall at the bottom of the pit.

Soils were typically collected from the test pits using a "pond sampler" which consists of a contaminant-free jar attached to a pole. Soils were obtained by gouging the walls of the pit with the jar and allowing the soils to fall inside. When this approach was not possible, soils were collected from the center of the backhoe bucket using a contaminant-free scoop, and placed in a stainless steel bowl. Except for VOC samples, which were collected directly from the collection device into the soil jar, all soil samples were homogenized in the bowl prior to splitting for analyses. Analytes are described in the Work Plan.

At locations where concrete or asphalt cover was present on the ground surface, the 0- to 1-foot interval was begun at the bottom of this cover material. If asphalt was found to be in contact with the surface soils, the upper four inches of the soil excluded from the sample to minimize interference of PAH compounds from the asphalt in the soil sample. As a result, the test pit logs describe the ground surface as the bottom of the asphalt. The field geologist/engineer evaluating the samples determined the presence and thickness of asphalt in the sample, and proceeded with the sample collection accordingly.

All samples were to be screened for metals on site with an X-ray fluorescence (XRF) detector, as described in Section 4.5 of the Work Plan. However, due to field XRF costs, it was determined that all the samples collected from the test pits were to be sent for laboratory TAL metals analysis.

In addition, all samples collected were screened using a Photovac 10S50 Gas Chromatograph. This device was calibrated to identify typical organic compounds associated with chemical discharges. Target analytes included: trichloroethene; tetrachloroethene; 1,2 dichloroethene; 1,1,1 trichloroethane; benzene; toluene; ethylbenzene; and xylenes. The selection of target analytes for screening is described in Section 4.5.2 of the Work Plan.

All surface soil samples were collected for laboratory analysis, except surface soils from TP13 and TP25. Clean fill up to 2 feet had been placed at these locations, so it was determined that analysis of these soils would not reflect past discharges to the surficial materials. Based on screening results, one in five subsurface soil samples collected from the test pits was shipped to a CLEAN Master Agreement Laboratory for full chemical analyses. Laboratory samples were analyzed for TCLP metals, total TAL metals, butyltin compounds, and volatile and semivolatile organic compounds (including BNA extractable compounds, pesticides, and PCB compounds) and total petroleum hydrocarbons.

3.4 GEOLOGIC/HYDROGEOLOGIC INVESTIGATION

The objective of this task was to evaluate the presence of soil and groundwater contamination resulting from historical activities at the site. Chemical data was collected to assist in making preliminary determinations on the presence of contaminants in different media. These data were used to prepare the preliminary risk analyses presented in Sections 6 and 7 of this report and to develop the scope of the RI/FS, if required.

The scope of work for the geologic/hydrogeologic investigation included the following specific components: *characterization of the water table aquifer; determination of the leachability of inorganic and organic site contaminants in soils; initial characterization of bedrock; collection and evaluation of groundwater quality data at upgradient locations; assessment of the nature and distribution of groundwater contamination on the site; and additional clarification of contaminant pathways including stormwater culverts, surface water runoff features, and permeable soils.*

As part of this task, 13 target areas were identified for investigation. These areas consist of six areas of concern identified by the PA as potential discharge areas, four secondary areas of the site where extensive activity had occurred but which were not identified by the PA as areas of concern, and three upgradient areas. These areas are summarized in Table 3-4.

One additional target area was identified by the Technical Review Committee (TRC) reviewing the draft versions of the Work Plan. The concern focused on the fill placed at the South Waterfront. Since this

material is piled fill placed on the beach, it was initially determined that the most cost-effective approach to determine the nature of the fill and presence of contaminants within it was to perform test pits (refer to Section 3.3.1).

The TRC requested that if the findings of the test pit excavations indicated the presence of high concentrations of contaminants that may be leaching into the groundwater at the South Waterfront, or if drums or other evidence of gross contamination was discovered, an additional well or wells should be placed in the South Waterfront area to determine the impact on the shallow overburden aquifer. The findings of the test pit excavations indicated that no such obvious contamination was present, and therefore no wells were installed in this location.

3.4.1 Installation of Borings

One boring was installed in each target area. This boring was advanced through the overburden to the top of bedrock. Continuous samples were collected and analyzed by on-site GC screening instruments for target volatile organic compounds during the boring advancement, as described in the Work Plan. The boring was then back-filled to an appropriate depth for the well installation. Depth of well installations was determined after review of the volatile organic compounds detected in the soil samples. In general, the saturated zone that exhibited the highest concentrations of contaminants based on screening analysis was targeted for the well screen interval.

Borings were advanced with hydraulic drilling equipment using drive and wash drilling methods. Soils were described according to the Unified Soil Classification System, and logged to provide a complete lithologic record of the subsurface materials. As each split-spoon was opened, the soils were monitored for organic vapors using a FID. The borehole itself was periodically monitored for organic vapors, in accordance with the Health and Safety Plan (Appendix A of the Work Plan).

Borings were continued to bedrock as determined by the field geologist. A log of each borehole was maintained by the field geologist to describe lithologies encountered, geologic contacts depth, water levels, sample depths, blow counts, bedrock characteristics, and any other pertinent observations made during drilling. Boring logs also include information on sample number, type, and depth and sample interval and recovery.

Two borings were continued into bedrock by coring (MW05 and MW09). One boring (MW05) was cored into bedrock 10 feet and was finished as a bedrock monitoring well to provide bedrock aquifer water quality information. MW09 was cored into rock more than 5 feet to further characterize upper

bedrock. Rock coring was performed with standard NX double-wall core barrels, providing a nominal 2-inch core and a 3-inch-diameter borehole. Additional rock coring details are described in the Work Plan.

The well screen for MW10 was installed across the overburden/bedrock contact. However, this contact is only identifiable by close inspection of the split barrel samples collected. The bedrock in this area is not competent, and does not serve as a confining layer. In addition, this well did not accumulate water during the study period.

Drill cuttings were containerized and sampled for waste characterization, as described in Section 3.6 of this report. Decontamination of sampling equipment and drilling apparatus was performed after completion of each borehole as described in Section 3.6 of the Work Plan.

Drilling fluids were changed after reaching bedrock to eliminate the potential for cross contamination of aquifers. Drilling fluids were also changed if periodic GC screening of the wash water from the overburden resulted in detection of target COCs.

3.4.2 Soil Samples Collected From Borings

Soil samples were collected from the interval 0 to 1 foot at all boring locations, and all of these samples were sent for off-site laboratory analyses.

At locations where concrete or asphalt cover was present on the ground surface, the 0- to 1-foot interval began at the bottom of this cover material. If asphalt was in contact with the surface soils, the upper four inches of the soil cover was extruded from the sample to minimize interference of PAH compounds from the asphalt in the soil sample. As a result, the boring logs describe the ground surface as the bottom of the asphalt layer.

Samples collected from below the 1-foot interval were screened with an on-site Photovac 10S50 portable gas chromatograph, calibrated to identify typical chlorinated volatile organic compounds and fuel oil components. Aliquots from 20 percent of these samples were shipped to laboratories for analysis of TCL volatile organic compounds, total petroleum hydrocarbons, TCLP metals, total TAL metals, butyltin compounds, and TCL semivolatile organic compounds (including BNA extractable compounds, pesticides, and PCB compounds). Samples were selected for laboratory analysis based on highest concentrations of organic compounds detected by the field GC. A 20 percent sample frequency allowed between one and four samples per borehole to be shipped for laboratory analysis.

An analytical hierarchy was established in the Work Plan, based on the type of disposal area. However, sample volume was not a problem at any location, due to use of 3-inch outside diameter split-barrel samplers and favorable subsurface materials.

Each sample for each interval was treated separately, and placed into a decontaminated stainless steel bowl. Aliquots of the material were first removed and containerized for VOCs analysis; the remaining material was homogenized with a contaminant free scoop. After mixing to homogenize the sample, aliquots were removed for each analyte described above.

Samples were identified with the well designation (MW##), and depth intervals were expressed in feet: Sample DSY-A-MW05-0204 indicates a sample from the boring for MW05, 2 feet to 4 feet below ground surface.

3.4.3 Groundwater Monitoring Well Installation

As part of the assessment of the nature and distribution of contaminants in groundwater, a monitoring well installation and sampling program was conducted. This program included installing groundwater monitoring wells in borings advanced as described above. Each well was screened at an elevation selected after review of field GC results. Two wells were installed on NETC property in locations hydraulically upgradient of the shipyard to establish background groundwater quality conditions in the overburden aquifer. One existing well, located upgradient of the Building 234 Area, was evaluated and sampled as a part of this task (MW104).

As described in the Work Plan, well screens and sandpicks used for overburden well installations were sized in accordance with the geologic formation at each boring location. Well screens with slot sizes of 0.010 (0.25 mm) and 0.020 (0.5mm) were available. Filter pack sizes of 20-40 (0.85 mm - 0.425 mm) and 10-20 (2.0mm - 0.85 mm) sieve size sand were available for installation with each respective screen aperture.

Screen aperture size and filter pack were selected based on a visual inspection of the split-barrel soil samples collected from the screened interval. The field geologist classified the soil sample, and visually estimated the quantity of the coarse sand fraction present in the interval to be screened. In all borings, where wells were to be installed, coarse sand represented less than 70% of the screened interval, so 0.010 slot screens and 20-40 sieve size filter packs were installed.

The well screens were installed in the saturated zones, if possible, across the interval that showed the highest level of contamination by field GC. An allowance was present in the Work Plan (if contaminants detected by screening indicated the presence of a light non-aqueous phase liquid [LNAPL]), screens could have been placed across the water table to sample the LNAPL). Such a modification was not necessary; no LNAPL was identified in the borings/monitoring wells in any of the visual observations or analytical results.

Wells were constructed as described in the Work Plan. During the well installation process, the depths of all backfill materials were continually monitored by the rig geologist. Wells were completed at the ground surface using flush-mounted road boxes or protective guard pipes. Wells located within paved areas were finished with concrete grout to match the existing grade of the surrounding paved surfaces.

The horizontal and vertical locations of the wells were surveyed following the completion of well construction. A notch was cut into the tops of the PVC well riser that will be used as a permanent reference point. The survey operations are described in detail in Section 3.5 of the Work Plan.

Wells were developed by surging and pumping. Fine-grained material around the well screen was drawn into the well and removed by agitating the well water with a surge block and simultaneously pumping water from the well at a low discharge rate. A pump outfitted with ASTM drinking water grade polyethylene tubing was used for removing the water from the well. The surge block was decontaminated between use in each well and the polyethylene tubing was replaced after each use.

The volume of ground water extracted from each monitoring well during development was monitored and every 15 minutes water quality parameters were measured for pH, temperature, dissolved oxygen, specific conductance, and turbidity. Development continued until pH, temperature, and specific conductance all stabilized and turbidity was equal to or less than 10 nephelometric turbidity units (NTUs). In some cases the 10 NTU turbidity level was not achieved, and the other parameters were used to determine when to stop development. Partial development data is presented in Table 3-5.

3.4.4 Groundwater Elevation Survey

Groundwater levels in all wells were measured to a reference point, consisting of a notch cut at the top of the PVC well riser. Continuous recording pressure transducers were installed in the 10 wells, and water levels were recorded over a four-day period. This tidal study was performed to determine the influence of the tidal fluctuation on the groundwater heads in each well. Salinity was then measured to determine if seawater was interacting with the soils at these locations.

3.4.5 Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing was conducted by performing variable-head slug tests in the nine on-site overburden monitoring wells. This information was collected to characterize the aquifer system and evaluate potential velocity of groundwater flow through the subsurface materials.

3.4.6 Groundwater Sample Collection

One round of groundwater sampling and analysis was conducted. Due to concern noted by the TRC regarding turbidity of groundwater samples collected during a 1994 study at Building 42, a low-flow sample collection operation was used for this task.

Samples were collected from each of the newly installed monitoring wells, except MW10 (upgradient), which was found to be dry. In addition, one sample was collected from one of the existing wells (MW104) west of the steam plant (Building 7), offsite and upgradient of Building 234.

Groundwater samples were analyzed for TCL volatile organic compounds, total TAL metals, butyltin compounds, and TCL semivolatiles organic compounds (including BNA extractable compounds, pesticides, and PCB compounds). Table 3-1 presents a summary of analytical parameters.

The U.S. EPA Region I SOP for low-flow sample collection (SOP GW-001, 8/3/95) was adhered to strictly during the collection of groundwater samples. RIDEM provided a recommended approach for low-flow sample collection differing slightly from the approach described in the Work Plan. The conflict was resolved by deciding that if the EPA method was unsuccessful in collecting a sample, the RIDEM method would be used. This did not prove to be a problem, and the wells were successfully sampled using submersible pumps and the EPA procedure. Table 3-6 describes measured parameters that were used to determine well stabilization.

Following purging procedures, samples were collected directly through the tubing into appropriate sample bottles. Samples were preserved according to requirements described in Section 4.0 of the Work Plan.

Purge water from the wells was containerized for waste characterization and off-site disposal.

3.5 EVALUATION OF CULTURAL AND ECOLOGICAL SETTINGS

One of the goals of the SASE is to provide a preliminary determination of the presence of risk to area receptors from the contaminants on site. As a part of that preliminary determination, the potential receptors to contaminants at the site were identified.

The surrounding area was evaluated briefly as a part of the PA. This evaluation was expanded with an evaluation of the cultural setting and an evaluation of the terrestrial ecological setting.

3.5.1 Cultural Setting

The cultural setting of the site was evaluated to determine the presence of contamination of environmental media with regard to the potential exposure of human receptors. Receptors may include persons living, working, or recreating within a one-half mile radius of the study area. The current land uses were evaluated to determine the possibility of off-site residential, recreational, and water receptors within this area.

3.5.2 Off-Shore Ecological Setting

The ecology of the marine environment adjacent to the site is being evaluated as a part of the Marine Ecological Risk Assessment for Derecktor Shipyard; a draft report was delivered to the Navy in July 1996.

3.5.3 On-Shore Ecological Setting

An on-shore ecological screening characterization of the site was performed, in part, through the performance of a site walkover by a qualified ecologist. This walkover was performed to

- Identify the types and spatial extent of habitats that are present on and around the site.
- Identify the species and biological communities on and adjacent to the site that may use these habitats and that may be potential receptors with regard to contaminants present in soils, sediments, and surface waters at the site.

- Determine the presence of contamination of environmental media with regard to potential exposure of receptor species.
- Identify on-site and adjacent wetlands, if appropriate, and their approximate boundaries; provide sketch maps of the wetland boundaries relative to the site.
- If feasible, determine the habitat(s) present at the site prior to shipyard operations (1979).

The habitats of the area were characterized to identify the nature and composition of non-marine animal and plant communities in the vicinity of the site to provide a basis for identifying potential receptors. The marine ecosystems near the site are characterized in a separate study.

A literature review was performed to provide background information on the habitats and species of plants and animals expected to occur on the site and in proximate areas, and the use of the general area by migrating or over-wintering species. The review included RIDEM, US Fish and Wildlife Service (USFWS), and B&R Environmental data sources.

RIDEM and USFWS, Office of Endangered Species, lists were reviewed by B&R Environmental to identify endangered, protected, or threatened species that may inhabit or use the Newport area and the environments associated with the site. This information was checked with RIDEM and the USFWS.

Field verification of the types of habitat and wildlife on and near the site was performed in August 1996. This assessment was performed to provide site-specific observations concerning the diversity (type) of species rather than data for assessment of population structure or community analyses. Since the objective is to provide an inventory of terrestrial fauna on site, the survey will be qualitative rather than quantitative.

During the survey, observations were made on major flora in habitat areas, bird, amphibian, reptile, and mammal sightings or physical evidence of these, e.g., nesting sites, tracks.

Observations were recorded in several ways:

- A base map was used to mark the locations of major habitat types.
- Observations and notes were recorded by the biologist in a field log book.

Lists of flora and fauna were produced for inclusion in the report. These lists are species-specific where possible. The method for species identification, i.e., visual sighting, identification by tracks or other physical evidence, and audible identification, is included on the fauna list.

This information was used to develop a conceptual model for the site, presented in Section 7 of this report.

3.6 INVESTIGATION-DERIVED WASTE (IDW)

Waste materials that were generated during the field investigation include drill cuttings and fluids, well purge and development water, decontamination fluids, steam cleaning and pit and sump cleaning wash water, disposable sampling equipment, and used personal protective equipment (PPE).

B&R Environmental identified the nature of all investigative waste materials (well purge water, soil cuttings, and PPE) following completion of the field investigation program. Wastes were disposed of by the Navy through DRMO or the BRAC Contractor.

Containers of IDW were labeled as to their point of origin, and collection date. Samples of these materials were labeled with the information on the containers.

Personal protective equipment (gloves, tyvek, and disposable boots) were decontaminated, double bagged, and disposed of in an on-site industrial dumpster.

Excess drill cuttings, discarded sample material, and other soil wastes were containerized. Soils from different target areas were not mixed.

Laboratory analysis of samples collected during the investigation program was used to characterize the materials, as required by state and federal disposal requirements.

Decontamination fluids, well purge and development water, and drilling fluids were initially contained in 55-gallon drums and storage tanks.

3.7 LOCATION SURVEY

Following the investigative work, a land survey was performed to identify horizontal locations of sample points, and other significant features identified during the investigation.

The survey was conducted to establish relative locations of sample points. Survey control was maintained by tying into the State of Rhode Island grid systems. Horizontal and vertical measurements were made relative to existing wells or on-site control points.

All surveyed features were horizontally located to within ± 0.1 foot. Tops of PVC well risers were located to plus or minus 0.01 foot vertically.

**TABLE 3-1
SUMMARY OF UICs AND SAMPLES COLLECTED
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

UIC Identifier	Source Area ²	Sampling Approach	Sample Stations	Summary of Samples Collected
S42-1	CS: Bldg 42, Paint Room	Access through the building crawl space, hand auger	S42-1-XXXX	One sample, 0-0.5 feet below ground surface. ³
S42-2	CS: Bldg 42, West Hall	Access through the building crawl space, hand auger	S42-2-XXXX	Two samples, 0.5-foot intervals to a total depth of 1.0 foot below ground surface. ³
S42-5	CS: Bldg 42, septic tank	Hand auger from above entry port	S42-5-XXXX	Three samples, 0.5-foot intervals to a total depth of 1.5 feet. ³
		Three shallow borings surrounding the perimeter of the tank.	SB08, SB09, SB10	Three samples from each of the shallow borings, collected from two-foot intervals, to a total depth of 6 feet below the bottom of the tank. ⁴
S234-1	234: Bldg 234, under canopy	Hand auger	S234-1-XXXX	Three samples, 0.5-foot intervals to a total depth of 1.5 feet. ³
S234-4	234: Bldg 234, under canopy	Hand auger	S234-4-XXXX	Three samples, 0.5-foot intervals to a total depth of 1.5 feet. ³
Equipment boxes ¹	234: Bldg 234, south side	One shallow boring in each of the four representative boxes. ¹	SB04, SB05, SB06, SB07	Three samples, two-foot intervals, to a total depth of 6 feet below the bottom of the box. ⁴

**TABLE 3-1
SUMMARY OF UICs AND SAMPLES COLLECTED
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
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UIC Identifier	Source Area ²	Sampling Approach	Sample Stations	Summary of Samples Collected
Dry Well	CS: South of Huts 1 & 2	Three shallow borings surrounding the perimeter of the dry well.	SB01, SB02, SB03	Three samples from each of the shallow borings, collected from 2-foot intervals, to a total depth of 6 feet below the bottom of the dry well. ⁴
S234-7	234: Building 234, near floor drain	Three shallow borings.	SB14, SB15, SB16	Three samples from each of the shallow borings, collected from 2-foot intervals, to a total depth of 6 feet below the ground surface. ³

Notes:

- ¹ Fifteen equipment boxes present on southern portion of the slab for Building 234. Four were selected randomly for shallow borings.
- ² Site identifiers are as follows: NW - North Waterfront, CS - Central Shipyard, 234 - Building 234 Area, SW - South Waterfront
- ³ All samples collected were analyzed by an off-site laboratory for parameters described on Table 3-2.
- ⁴ All samples were analyzed on site for volatile organics. Based on this screening, one sample in five was analyzed by an off-site laboratory for parameters described on Table 3-1

**TABLE 3-2
SAMPLE MEDIUM AND ANALYTICAL METHODS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

SAMPLE MEDIUM	ANALYSIS (METHOD)	PRESERVATIVE	HOLDING TIME
Soils	Target VOCs Screening (Field GC) TCL VOCs (CLP SOW OLM03.0) TCL SVOCs (CLP SOW OLM03.0) ¹ TCL PCBs/Pesticides (CLP SOW OLM03.0) TPH by IR (EPA 418.1) TAL Metals (CLP SOW ILM03.0) TCLP Metals (SW/1311 40 CFR Part 261) Butyltin Compounds (Wade 1990)	None Cool to 4° c. Cool to 4° c.	7 Days (Analysis) 14 Days (Analysis) 7 Days (Extraction) 7 Days (Extraction) 28 Days (Analysis) 6 Months (Analysis) ³ 6 Months (Analysis) ³ 7 Days (Analysis)
Groundwater	TCL VOCs (CLP SOW OLM03.0) TCL SVOCs (CLP SOW OLM03.0) ¹ TCL PCBs/Pesticides (CLP SOW OLM03.0) TPH by IR (EPA 418.1) TAL Metals (CLP SOW ILM02.1) Butyltin Compounds (Wade 1990) Specific Conductance (EPA 120.1) ² pH (EPA 150.1) ² Temperature (EPA 170.1) ² Dissolved Oxygen (EPA 360.1) ² Turbidity (EPA 180.1) ² Salinity (Standard Methods) ²	HCl to pH <2, Cool to 4° c. Cool to 4° c. Cool to 4° c. HCl to pH <2 HNO ₃ to pH <2 Cool to 4° c. Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable	14 Days (Analysis) 7 Days (Extraction) 7 Days (Extraction) 28 Days (Analysis) 6 Months (Analysis) ³ Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable

Notes:

¹ Analysis included decachlorobiphenyl (tradename: Deka), found by URI in the marine sediments proximal to the shipyard.

² Field measurement, direct read instrumentation.

³ Extraction for mercury is performed within 28 days. For other metals, holding time is 6 months.

**TABLE 3-3
SUMMARY OF TEST PITS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

TEST PIT NUMBER	LOCATION ⁽¹⁾	TARGET AREA	PURPOSE OF TEST PIT
TPs 01 - 06	SW	In soil piles, South Waterfront.	Determine nature of fill piles, determine presence of waste or chemical constituents.
TPs 07, 08	234	South side of Building 234 slab, in area of suspected chemical discharge.	Determine nature of soils, and identify chemical constituents suspected in this area.
TPs 09, 10	234	Upgradient of Building 234, near off-site UST locations.	Identify chemical constituents in soils upgradient of one large suspected source area (Building 234)
TPs 11 - 13	CS	South and east of Building 42, in area of former material storage and used sandblast disposal.	Assess impacts of these former activities to the soils around Building 42.
TPs 14, 15	CS	North and west of Building 6 - in chemical storage and suspected discharge areas.	Assess impacts of storage and disposal on the soils in this area.
TP17	CS	South of Huts 1 & 2 near former dry well.	Assess impacts of possible discharge in this area to the soils.
TPs 16, 18-20	NW	Between Huts 1 & 2, and Pier 1: former bulk storage area and fuel storage area.	Assess impacts of former storage on soil.

**TABLE 3-3
SUMMARY OF TEST PITS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND
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TEST PIT NUMBER	LOCATION	TARGET AREA	PURPOSE OF TEST PIT
TPs 21 - 24	NW	North of Pier 1: In area of fuel oil pipeline, hazardous waste storage area, and bulk material staging area	Assess impacts of fuel oil pipeline, and storage areas to soils.
TP25	CS	North of Building 42, in area of former bilge water discharge pit.	Assess impacts of disposal activities on soil.
TP26	234	North side of Building 234 slab, near storm drains, former USTs, and floor drains for building 234.	Determine possible impacts of possible discharges to the soils in this area.
TP27	NW	Between Huts 1 & 2, and Pier 1.	Request of RIDEM: Equidistant between TP 19 and TP 18 - should help identify TPH in soils possibly migrating from upgradient of the site to Narragansett Bay.
TP28	NW	Upgradient of Huts 1 & 2 (former parking area)	Request of RIDEM: determine presence of TPH in soils downgradient of a former fuel station, and upgradient of the shipyard site.

Note:

⁽¹⁾ NW - North Waterfront; CS - Central Shipyard Area; SW - South Waterfront; 234 - Building 234 Area

**TABLE 3-4
SUMMARY OF WELL INSTALLATIONS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

BORING/ WELL NUMBER	LOCATION ⁽¹⁾	FORMER USE	WELL SCREEN INTERVAL	PURPOSE OF WELL	GEOLOGIC UNIT
MW01	UPGRADIENT	Southeast of site in grassy area north of Gate 10	6.5-11.5	Establish background soil and groundwater quality.	silty gravelly sand; weathered phyllite
MW02	NW	West of former oil discharge area	16-26	Assess impacts of former oil discharges to soil and groundwater.	silty sand; silty gravelly sand; trace silt, trace shell fragments
MW03	NW	Hazardous Waste Storage Area	7-17	Assess impacts of hazardous waste storage area on deep portions of soil and groundwater.	clayey silt; sand; silty gravelly sand
MW04	NW	Northwest of Huts 1 and 2 in vicinity of vehicle maintenance facility and truck parking area	13-23	Assess impacts of vehicle maintenance activities on soil and groundwater.	silty sand; clayey silt; silty sand; clayey silty gravelly sand
MW05	CS	North of Building 42 within historical disposal area	49-58	Assess impacts of bilge water disposal in former pit on soil and shallow bedrock aquifer.	phyllite/schist with calcite and quartz veins. fissile
MW06	CS	East of Building 6 in area of potential chemical disposal	Well not installed, shallow bedrock	Assess impacts of reported disposal on soil and overburden aquifer.	silty sandy gravel; weathered phyllite
MW07	CS	South of Building 42 in former location of Building 40, former drummed hazardous waste storage area, and former fuel storage area	8-18	Assess impacts of former waste and fuel storage on soil and overburden aquifer.	silty sand; silty gravelly sand; clayey silt

**TABLE 3-4
SUMMARY OF MONITORING WELLS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND
PAGE TWO**

BORING/ WELL NUMBER	LOCATION	FORMER USE	WELL SCREEN INTERVAL	PURPOSE OF WELL	GEOLOGIC UNIT
MW08	234	Northeast of Building 234 in area of former USTs and former machine shop	6.5-11.5	Assess impacts of USTs and former machine shop to soil and overburden aquifer.	gravelly silty sand; silty gravelly sand; weathered phyllite
MW09	234	Southeast of Building 234 in area of suspected liquid/solid waste disposal	7-17	Assess impacts of disposal activities on soil and overburden aquifer, characterize upper bedrock.	silty gravelly sand; gravelly sand; gravelly silty sand
MW10	UPGRADIENT	Immediately east of Gate 11 and Building 1	6-11	Establish background soil and groundwater quality.	silty gravelly sand; weathered phyllite; silty sandy gravel
MW11	NW	Between Pier 2 and the Former Hazardous Waste Storage area (former bulk storage area)	19-29	Assess impacts of former storage areas and other disposal on deep portions of overburden aquifer.	sand; silty gravelly sand
MW12	NW	Between Pier 1 and the Former Hazardous Waste Storage area (former bulk storage area)	15-25	Assess impacts of former storage areas and other disposal on deep portions of overburden aquifer.	silty gravelly sand
MW104 ⁽²⁾	234	West of Building 7, steam plant	5-25	Evaluate groundwater quality immediately upgradient of the site.	Coarse-fine sand; light gray shale; dark gray shale

Notes:

⁽¹⁾ NW - North Waterfront; CS - Central Shipyard area; SW - South Waterfront; 234 - Building 234 area.

⁽²⁾ This well was installed by GZA in October 1993.

**TABLE 3-5
SUMMARY OF WELL DEVELOPMENT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

WELL NUMBER	ONE WELL VOLUME	TOTAL DEVELOPMENT TIME (HRS)	GALLONS REMOVED (PURGED)	FLOW RATE (L/MIN)	ENDING TURBIDITY (NTUs)
MW01	1	3	22	6 to 1	10
MW02	1.2	1	45	3	9
MW03	1.3	4	100	4	147
MW04	2.3	1.5	70	4	1
MW05	8	2.25	150	3	3
MW07	1	2.5	4	6 to 1	.5
MW08	0.5	4	9	0.24	75
MW09	1.3	2.5	15	4	168
MW11	4	2	135	4	3
MW12	2.6	4	175	4	1

Note: MW06, MW10, and MW104 were not developed. MW06 was not installed, MW10 was dry, and MW104 was installed by GZA.

TABLE 3-6
 STABILIZED GROUNDWATER FIELD PARAMETERS
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Well No.	Sample Date	Well Screen Interval (ft bgs)	Initial Water Level (ft bgs)	Purge Time (hr:min)	Purge Rate (ml/min)	Drawdown (ft)	Temp. (Celsius)	Turb. (NTU)	pH (standard units)	Specific Conductance (mmhos/cm)	Dissolved Oxygen (mg/L)	Salinity (parts per thousand, ppt)
MW01	09/11/96	6-11	3.69	0:45	350	1.16	19.7	0.55	6.41	0.012	2.0	0
MW02	09/11/96	16-26	9.00	0:45	700	0.33	18.1	0.57	7.84	nm	0.3	1
MW03	09/10/96	6-16	8.07	1:30	600	0.47	20.0	0.81	5.62	0.659	2.4	0.5
MW04	09/11/96	12-22	9.78	1:05	600	0.85	20.4	0.52	7.62	0.584	0.2	0
MW05	09/11/96	50-60	8.26	1:20	700	0.08	14.6	1.28	7.38	1.290	0.2	1.0
MW07	09/11/96	10-20	13.22	1:00	340	2.73	18.3	42.3	6.67	0.844	1.2	0.5
MW08	09/12/96	6-11	8.02	0:45	500	0.82	22.1	4.83	6.27	nm	1.6	0.5
MW09	09/11/96	9-19	8.82	1:05	500	1.20	20.5	9.90	6.17	0.705	7.4	0.5
MW10	NS											
MW11	09/10/96	19-29	6.36	1:05	500	0.64	20.4	0.82	7.68	0.706	0.3	0.5
MW12	09/10/96	6-16	9.13	1:05	440	0.24	20.9	2.09	8.03	0.423	0.4	0.5
MW104	09/11/96	5-25	11.69*	1:35	600	3.14	18.9	2.61	7.00	0.912	6.4	1.0

NOTES:

NM – Not Measured

NS – Not Sampled

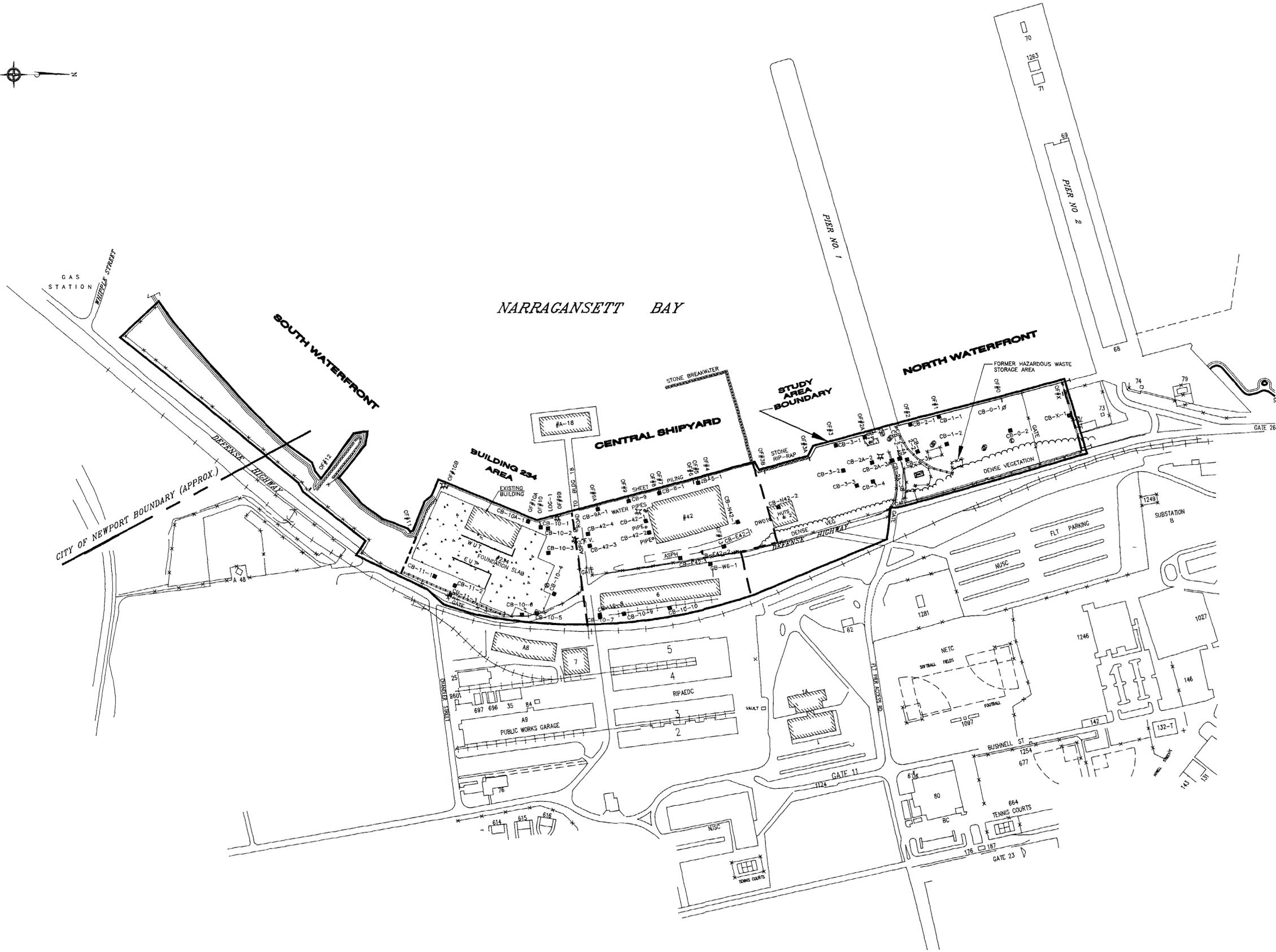
ft bgs – feet below ground surface

* – ft below pvc



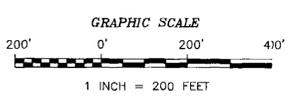
LEGEND

	FENCE
	OUTFALL NUMBER
	CATCH BASIN WITH IDENTIFIER
	BUILDING OF INTEREST
	BUILDING



NOTES

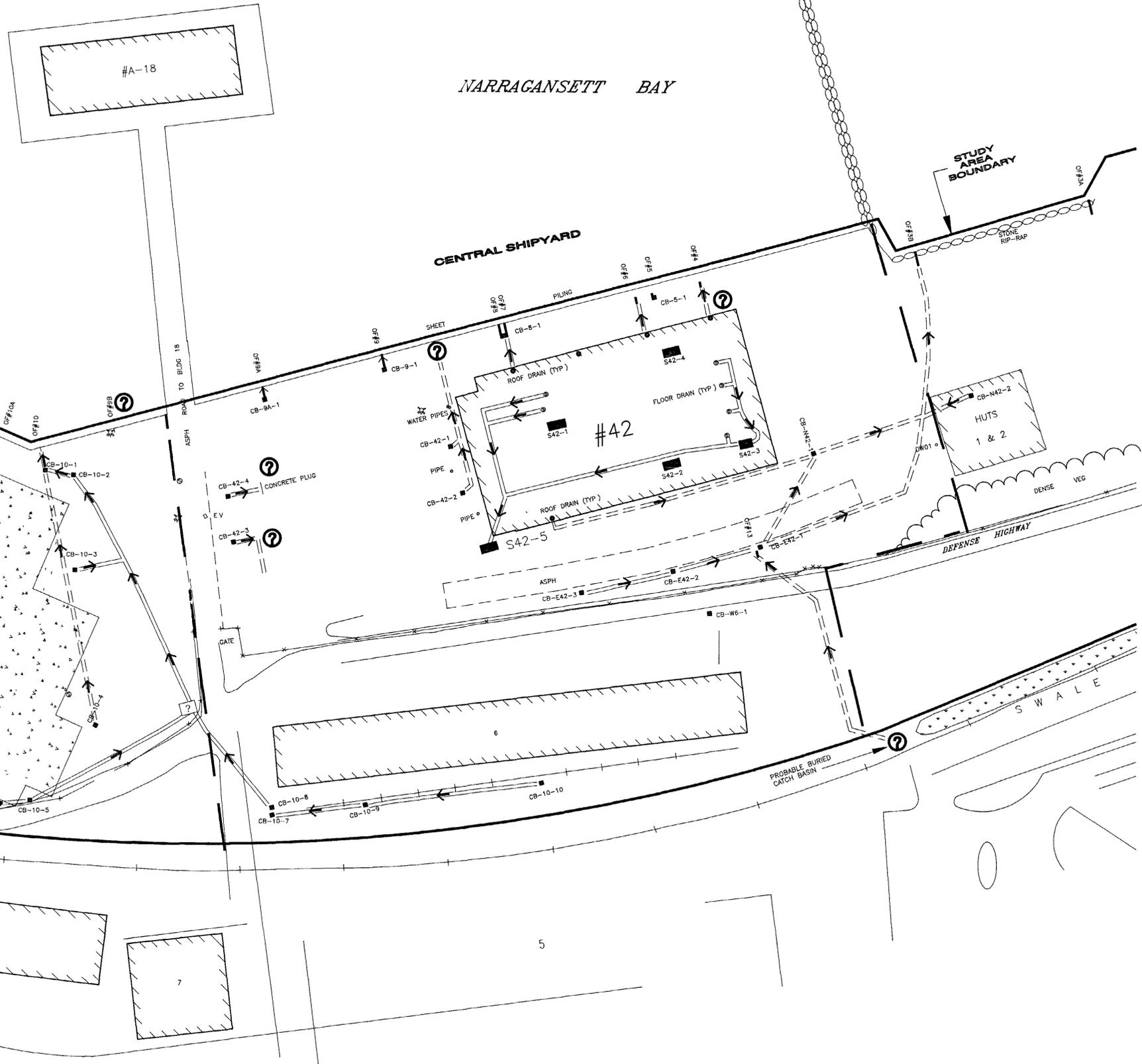
- 1 ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
- 2 PLAN NOT TO BE USED FOR DESIGN



DRAWN BY R.G. DEWSNAP		TITLE	
PREPARED BY K. O'NEILL		BASE MAP	
CHECKED BY S. PARKER		SITE ASSESSMENT SCREENING EVALUATION REPORT	
		FORMER ROBERT E. DERECKTOR SHIPYARD	
		NEWPORT, RHODE ISLAND	
SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS			
SCALE	DATE	PROJ NO	
1" = 200'	JAN. 24, 1997	7368 CTO 2682	
PROJECT MANAGER: S. PARKER	DRAWING NO:	ACFILE NAME:	REV
PROGRAM MANAGER: J. TREPANOWSKI	FIGURE 3-1	D:\DOW\NAVY\DEREKTOR\SASER\BASE_MAP.DWG	0

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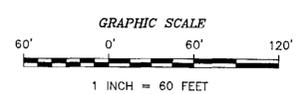
LEGEND

- FENCE
- OF#
- CATCH BASIN WITH IDENTIFIER
- BUILDING OF INTEREST
- BUILDING
- CONFIRMED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)
- SUSPECTED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)
- FLOOR DRAIN

Discharge Point (Outfall No.)	Collection Points/Input Area	Remarks
3B	CB-N42-1, CB-N42-2, CB-E42-1, CB-E42-2, CB-E42-3, OF#13, Roof drains (1), CB-W6-1, SWALE (2)	OF#3B outlet is not visible, buried in riprap wall, tracer and smoke tested
4 8" ID	Building 42 roof drain (west)*	assumed, see text
5 12" ID	CB-5-1, surface drainage west of Building 42	visual observation
6 8" ID	Building 42 west roof drain	tracer study
7 8" ID	Building 42 west roof drain	tracer study
8 12" ID	CB-8-1, Surface drainage west of Building 42	visual observation
9 12" ID	CB-9-1, Surface drainage west of Building 42	visual observation
9A 12" ID	CB-9A-1, Surface drainage west of Building 42	visual observation
Unknown	CB-42-1, CB-42-2, surface drainage south of Building 42	not determined, historically discharged to bay, probable decommissioned or damaged outfall
Unknown	CB-42-3, surface drainage south of Building 42	not determined, video traced 16' north then 90° turns east
Unknown	CB-42-4, surface drainage south of Building 42	not determined, video tracked 30' north to concrete wall (?)
-----	CB-10-7, CB-10-8, CB-10-9, CB-10-10	see Table 4-6

(1) Roof drains on the eastern edge of Building 42 drain to CB-N42-1
 (2) The off-site swale parallels the Penn Central right-of-way, north of Building 6
 * presumed, not determined due to roof damage

NOTES
 1 ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
 2 PLAN NOT TO BE USED FOR DESIGN



DRAWN BY: R.G. DEWSNAP	TITLE: UNDERGROUND DRAINAGE SYSTEMS - CENTRAL SHIPYARD AREA SITE ASSESSMENT SCREENING EVALUATION REPORT
PREPARED BY: K. O'NEILL	FORMER ROBERT E. DERECKTOR SHIPYARD NEWPORT, RHODE ISLAND
CHECKED BY: S. PARKER	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS
	SCALE: 1" = 60' DATE: JAN 24, 1997 PROJ NO: 7368 CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4-3
PROGRAM MANAGER: J. TREPANOWSKI	ACFILE NAME: G:\DWA\NAVY\DEREKTOR\SASR\CEN_SHYD.DWG REV: 0

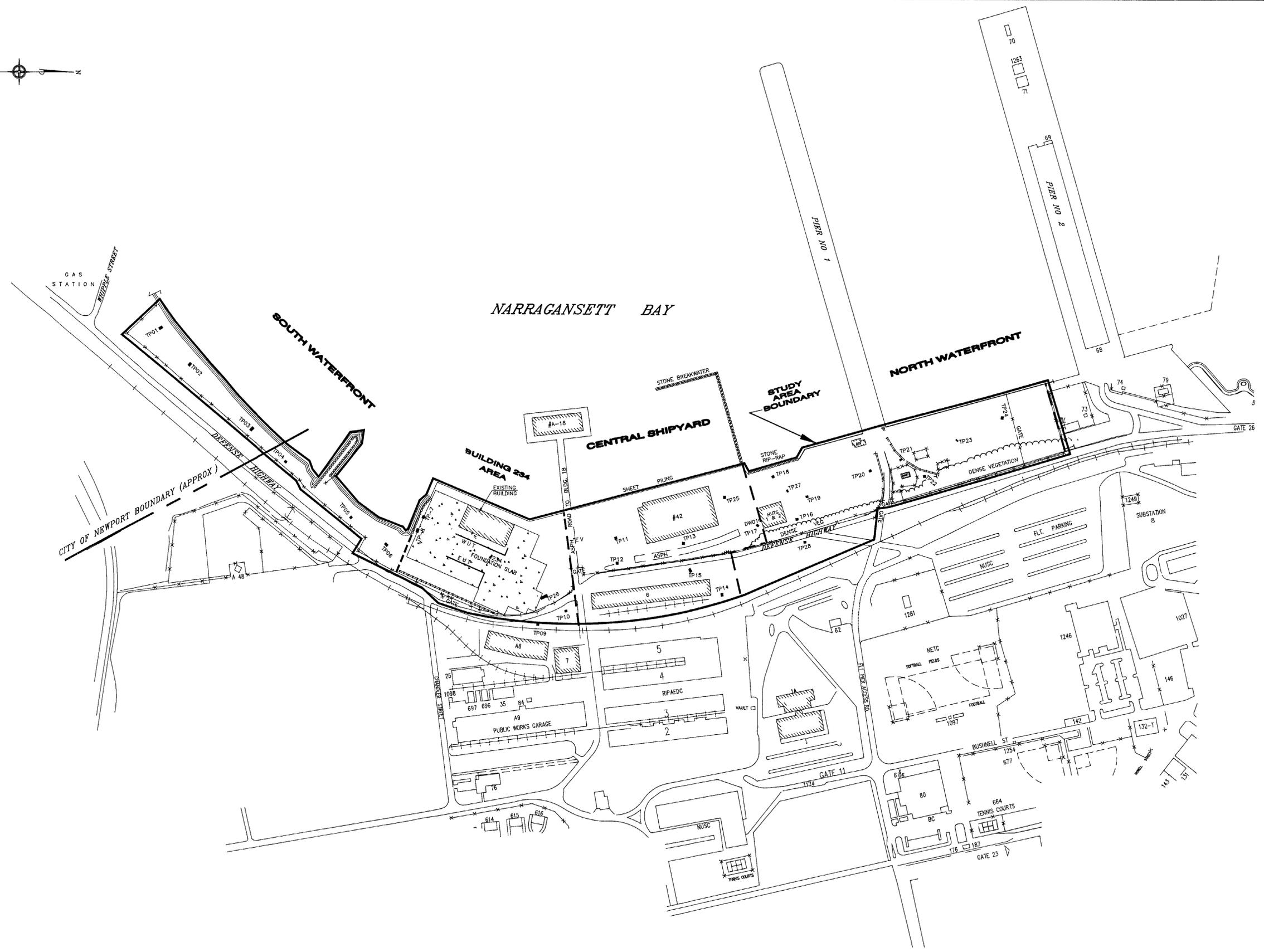
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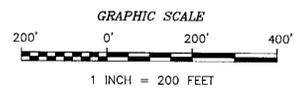


LEGEND

	FENCE
	TEST PIT LOCATION WITH IDENTIFIER
	BUILDING OF INTEREST
	BUILDING



- NOTES**
- 1 ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
 - 2 PLAN NOI TO BE USED FOR DESIGN



DRAWN BY: R.G. DEWSNAP	TITLE: TEST PIT LOCATIONS		
PREPARED BY: K. O'NEILL	SITE ASSESSMENT SCREENING EVALUATION REPORT		
CHECKED BY: S. PARKER	FORMER ROBERT E. DEREKTOR SHIPYARD		
	NEWPORT, RHODE ISLAND		
	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS		
	FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS		
SCALE: 1" = 200'	DATE: JAN 24, 1997	PROJ NO: 7368	CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4-5	ACFILE NAME: D:\DWG\NAVY\DEREKTOR\SASER\TESTPITS.DWG	REV: 0
PROGRAM MANAGER: J. TREPANOWSKI			

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4.0 FINDINGS OF THE INVESTIGATIONS

This section describes the data collected and other findings from the SASE field investigation, as described in Section 3.0. Screening analytical data is presented in Appendix A. Laboratory analytical data is presented in Appendix B1 through B4. Boring logs are presented in Appendix C, and monitoring well construction logs are presented in Appendix D.

4.1 FINDINGS FROM SUMP INVESTIGATIONS

This section describes the findings from the investigations of the sumps, and suspected subsurface discharge areas. The investigative methods used are described in the work plan and summarized in Section 3.1 of this report.

Thirty-one sumps were investigated as a part of this SASE and are depicted on Figure 4-1. The term "sumps" as used in this report, identifies existing vaults, sumps, utility trenches, or other voids in the subsurface of either the buildings or the ground that were not connected to the storm water drainage systems. The term is not intended to describe floor drains or stormwater catch basins.

After inspections, each sump was evaluated for its potential to discharge contaminants into the subsurface materials, and if applicable, identified as a potential discharge point. Sumps were located in the Central Shipyard area and the Building 234 area.

Six sumps (one of which was a dry well) were found in the Central Shipyard area. Locations of these sumps are depicted on Figure 4-1. Results of the inspections of these sumps are presented in Table 4-1.

Twenty-five sumps (15 of which were equipment boxes), and two large utility trenches (E.U.T. and W.U.T.) were found in the Building 234 area. Locations of these sumps are also depicted on Figure 4-1. Results of the inspections of these sumps and trenches are presented on Table 4-2. The locations of equipment boxes are not depicted on Figure 4-1.

Sumps that were determined to be potential discharge points were tracked to identify discharge areas, and if possible, soil samples were collected at or near these discharge areas.

Tables 4-1 and 4-2 identify which of the sumps were identified as potential subsurface discharge areas. Only the potential discharge areas and the results of samples collected from them are presented in the following subsections.

Analytical results from soil samples collected from the bottoms of sumps and potential injection wells or subsurface discharge areas discussed in this section are summarized in Tables 4-3A through 4-3D. These tables describe detected constituents reported by the analytical laboratory in October and November of 1996. These results have not been validated. A complete set of data from laboratory analysis of the samples discussed in this section is presented in Appendix B1.

4.1.1 S42-1

Sump S42-1 was found in what was referred to in the PA Report as the Paint Room of Building 42. After removal of water and sludge, this sump was found to be lined with welded steel. A discharge piping hole was found near the bottom, which had been sealed with cement.

The crawl space under Building 42 was entered to inspect piping under the building. No piping was found remaining underneath this sump. However, the soils under the sump were heavily stained with unidentifiable material. One soil sample was collected in this area, as described in Section 3.0 of this report.

A summary of laboratory analysis of the soils from this sample is presented in Table 4-3A. This analysis indicated the presence of high concentrations of PAH compounds, phthalate compounds, and butyltin compounds. In addition, PCBs were detected (Aroclor 1260, detected at 260 ug/kg), and two pesticide compounds were detected. Metals concentrations in this sample were also elevated, in particular, zinc (11,900 mg/kg), copper (2,120 mg/kg), lead (1,290 mg/kg), nickel (160 mg/kg), and barium (1,620 mg/kg). In addition, a trace of mercury was detected (0.6 mg/kg). Several volatile organic compounds were detected, which are typically found as laboratory artifacts and qualified as undetected during validation. The analysis for total petroleum hydrocarbons indicated a presence of oil in the sample.

Building 42 is supported on pilings and the crawl space is approximately 3 to 4 feet high. The floor is loose dirt and gravel. The gravel inhibited collection of soil samples more than 6 inches in depth.

4.1.2 S42-2

A second sump (S42-2) found within Building 42 was found to have a drain hole at its center, apparently installed to allow material caught in it to drain into the crawl space below. The crawl space was entered to inspect piping from S42-2. No piping was found underneath this sump. Soil samples were collected under the sump using hand augers, as described in Section 3.0 of this report. Due to the presence of gravel in the crawl space, only two soil samples could be collected, to a total depth of 1.0 foot below ground surface.

Laboratory analyses of the soils from these samples are presented in Table 4-3A. These results indicate the presence of moderate to high concentrations of PAH compounds and phthalate compounds. Butyltin compounds were detected at low concentrations. PCBs (Aroclor 1260, detected at 140 ug/kg), and three pesticide compounds were detected. Metals concentrations in this sample were somewhat elevated. In particular, zinc (727 mg/kg), copper (89.8 mg/kg), and lead (82.8 mg/kg) were above concentrations detected in upgradient samples soil samples. Upgradient soil samples are discussed in Section 4.3.2 of this report. In addition, mercury was detected at trace concentrations (0.2 mg/kg). Several volatile organic compounds were detected, which are typically found as laboratory artifacts and qualified as undetected during validation.

4.1.3 S42-5

Sump S42-5 was found outside the southeast corner of the building. The cover of this sump was exposed during the 1995 removal of sandblast grit on the eastern side of Building 42. After the cover was removed, the sump was found to be a large vault. The style of construction and odors inside indicated it may have been constructed as a domestic wastewater holding tank.

The vault was pumped out and a video camera was lowered to inspect its interior. The walls and ceilings were poured concrete with two pipes leading into the upper northeast corner. These appeared to be inlet pipes because they enter the vault from above. No outlet piping was noted during the inspection. The floor also seemed to be poured concrete, however, it could not be thoroughly inspected due to the presence of water and soil. The type of soil on the floor of the vault under the opening indicated that it likely fell into the vault from above when the cover was removed.

Three soil samples from the vault floor were collected using a hand auger operated through the cover opening. Laboratory analysis of these soil samples is presented on Table 4-3A. These samples indicate elevated concentrations of metals, particularly arsenic (279 mg/kg), copper (273 mg/kg), nickel (54 mg/kg), and zinc (593 mg/kg). Also detected were low concentrations of PAH compounds, one PCB compound (Aroclor 1254, detected at 23 ug/kg), and low concentrations of butyltin compounds.

In addition to the samples collected inside the vault, shallow borings were drilled adjacent to the west and south walls of the vault to collect subsurface soil samples. Shallow borings were installed at locations depicted on Figure 4-1. Sample collection procedures are described in Section 3.1 of this report. Boring logs are presented in Appendix C of this report.

Laboratory analysis of the two samples collected from borings installed outside the vault is presented in Table 4-3B. These results indicate the presence of traces of PAH compounds and metals. Several volatile organic compounds were detected, which are typically found as laboratory artifacts and qualified as undetected during validation. Concentrations of metals were within the same order of magnitude or lower than concentrations detected in subsurface soil samples collected upgradient of the site. Upgradient soil samples are discussed in Section 4.3.2 of this report.

Because piping was connected to this vault, smoke tests were performed to identify the piping origins. Results from the smoke testing operations are presented in Section 4.2 of this report.

4.1.4 Dry Well, Huts 1 & 2

A septic pit or "dry well" was found on the southern side of Huts 1 & 2. This location (DW01) is depicted on Figure 4-1. One inflow pipe was present, which appeared to be connected to the toilet room in the alcove between Huts 1 & 2 (this was later confirmed by smoke testing). Huts 1 & 2 roof drains also discharged to the surface at the dry well.

The dry well was lined with stacked brick, which was not cemented. This arrangement allows for solids to settle and liquid to seep into the surrounding soils. The bottom was brick or compacted gravel, which did not allow sample collection with hand augers.

Therefore, shallow borings were drilled adjacent to and downgradient of the dry well to collect subsurface soil samples from below the expected discharge point. Shallow borings were installed at

locations depicted on Figure 4-1. Sample collection procedures are described in Section 3.1 of this report. Boring logs are presented in Appendix C of this report.

Laboratory analysis of these samples is presented in Table 4-3B. These results indicated the presence of traces of three PAH compounds, one phthalate compound and metals. Several volatile organic compounds were detected, which are typically found as laboratory artifacts and qualified as undetected during validation. Concentrations of metals were within the same order of magnitude or lower than concentrations detected in subsurface soil samples collected upgradient of the site. Upgradient soil samples are discussed in Section 4.3.2 of this report.

4.1.5 S234-1

This sump is actually a utility trench, installed after the building was constructed. The concrete floor was cut and conduit was laid in the bottom of this trench. The bottom of the trench consisted of the soils underlying the building, and as a result, it was identified as a potential discharge area.

Three soil samples on the bottom of the trench from the surface to 1.5 feet deep were collected using a hand auger. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analysis of these samples is presented in Table 4-3C. These results indicate the presence of traces of a phthalate compound and one PCB compound (Aroclor 1242, detected at 9 ug/kg). In addition, a butyltin compound was also detected at trace concentrations between 0.5 and 1.0 feet below the bottom of the trench (monobutyltin, detected at 4.3 ug/kg).

Several volatile organic compounds were detected, which are typically found as laboratory artifacts and qualified as undetected during validation. Concentrations of metals were within the same order of magnitude or lower than concentrations detected in subsurface soil samples collected upgradient of the site. Upgradient soil samples are discussed in Section 4.3.2 of this report.

4.1.6 S234-4

This sump is a trench, which appears to have housed sub-floor lifting equipment. The sides are concrete, but the bottom was not completely covered with concrete, probably due to the depth of the installation (6 feet). As a result of this construction, it was identified as a potential discharge area.

Three soil samples from the bottom of the trench from the surface to 1.5 feet deep were collected using a hand auger. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analysis of these samples is presented in Table 4-3C. These results indicated the presence several volatile organic compounds, which are typically found as laboratory artifacts and qualified as undetected during validation. Concentrations of metals were within the same order of magnitude or lower than concentrations detected in subsurface soil samples collected upgradient of the site. Upgradient soil samples are discussed in Section 4.3.2 of this report.

4.1.7 S234-7

This sump is a trench, at the northeast corner of Building 234, that appears to have functioned as a fluid collection trench. A floor drain was found in the western corner of this trench, and another floor drain was found outside the trench, approximately 5 feet to the west. The sides and bottom were found to be constructed of poured concrete in good condition. Due to the presence of the floor drains in this area, the sump was identified as a potential discharge area.

Therefore, shallow borings were drilled into the subsurface materials in the vicinity of this sump to collect soil samples below. Continuous samples were collected to 6 feet below the bottom of the pavement or concrete slab. After screening, three representative samples were shipped to the laboratory for analysis. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analyses of the samples are summarized in Table 4-3D. These results indicate the presence of several volatile organic compounds, which are typically found as laboratory artifacts and qualified as undetected during validation. PAH compounds were present at low concentrations, indicating the presence of heavier fuel oils or other oil-based material. Concentrations of most metals were within the same order of magnitude as concentrations in subsurface soil samples collected upgradient of the site. Upgradient soil samples are discussed in Section 4.3.2 of this report.

The floor drains in this area were found to be connected to the central building sump, S234-8, as discussed in Section 4.2 of this report.

4.1.8 Equipment Boxes, Building 234

Fifteen equipment boxes are set into the floor of the southern section of Building 234. This area was used as a set-up area for ship construction. Each equipment box was a utility access point for the workers. Each box appears to have had an electrical hookup, a compressed air hookup, and possibly a water supply. All were damaged during the building demolition.

During the investigation, two boxes were dismantled and inspected to determine their construction. It appeared that while there was a lot of piping and conduit in the bottoms, no physical barrier existed to prevent liquid from discharging to the subsurface.

Therefore, shallow borings were drilled directly through the center of four of these equipment boxes to collect samples of soil underneath them. Continuous samples were collected to 6 feet below the bottom of each box. After screening, two representative samples were shipped to the laboratory for analysis. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analyses of the samples are summarized in Table 4-3D. These results indicate the presence of several volatile organic compounds, which are typically found as laboratory artifacts and qualified as undetected during validation. In addition, benzene and toluene were detected at trace concentrations, indicating possible minor releases of fuel oils. Concentrations of most metals were within the same order of magnitude or lower than concentrations detected in subsurface soil samples collected upgradient of the site. However, copper and chromium were detected at higher concentrations than those present in upgradient soils. Upgradient soil samples are discussed in Section 4.3.2 of this report.

4.2 DRAINAGE SYSTEMS AND OUTFALLS

This section describes the findings from the investigations of the drainage systems and outfalls within the study area. The investigative methods used are presented in Section 3.2 of this report.

4.2.1 Drainage System Inspections

Forty-one catch basins (CB) and 22 outfalls (OF) were investigated as part of study area drainage system inspection. Building 42, Huts 1 & 2, and Building 234 exterior (roof) and interior (floor drains, sumps, etc.) drainage systems were also investigated.

During the preliminary inspection, blocked catch basins or drainage pipes were flagged for clearing, as described in Section 3.2. The orientation of inflow and outflow pipes within the catch basins and sumps was recorded and was used to determine where smoke testing, video recording, or tracer studies would be required.

Figures 4-2, 4-3, and 4-4 respectively, identify potential contaminant discharge points (outfalls), and indicate known and suspected drainage routes for each sub-area of the site. Points of collection are typically represented by catch basins, sump drains, and building floor drains in the Northern Waterfront, Central Waterfront, and Building 234 Area.

4.2.1.1 Northern Waterfront

Most of the area of the North Waterfront is paved with asphalt. The stormwater drainage system within the North Waterfront is comprised of a surface drainage system of catch basins that drain the pavement areas that discharge from six outfalls to Narragansett Bay. A seventh outfall (OF#3B) is present in the North Waterfront that discharges water collected from the Central Shipyard. The drainage system for the Northern Waterfront is presented in Figure 4-2.

Outfalls #X and #0 are located at the old shoreline pilings and are approximately 40 feet east of the newer concrete dock at the northern end of the area.

Outfall #3A may no longer function as a discharge location, because no catch basins were found to be connected to this outfall. In addition, no discharge was observed at OF#3A during several heavy rain events in 1996.

4.2.1.2 Central Shipyard

The drainage system within the Central Shipyard consists of a stormwater catch basin system that drains the area east and north of Building 42 to outfall #3B. A separate system collects water from the floor drain and west roof drain system of Building 42. Four catch basins are present that appear to drain the former location of Quonset huts located to the south of Building 42. A detailed presentation of the flow pattern of the Central Shipyard drainage system is presented on Figure 4-3.

Building 42 Exterior Drainage System

Catch Basins 5-1, 8-1, 9-1, and 9A-1 collect surface drainage on the western perimeter of Building 42 and discharge directly through their respective outfalls (OF#5, OF#8, OF#9, and OF#9A) to Narragansett Bay. Roof drains on the western side of Building 42 were observed to discharge from OF#6 and OF#7. Outfall #4 (OF#4) is also considered a roof drain outlet, but was not tested because of roof damage at the northwest corner of Building 42. Outfall #4 is similar in appearance and construction to OF#6 and OF#7.

Catch basins E42-1, E42-2 and E42-3 collect surface drainage on the eastern perimeter of Building 42. Catch basin CB-N42-1 receives the discharge from OF#13, a discharge pipe protruding from the retaining wall east of Building 42. The main source of the OF#13 flow comes from an off-site drainage swales along the Penn Central right-of-way, north of Building 6. Surface water in the swale enters the storm drainage system at the northeast corner of the asphalt surface of Building 6 and is discharged at OF#13. This swale receives surface drainage from upgradient parking areas in the vicinity of Building 62.

During smoke testing of CB-N42-1, it was observed that several different drainage points are conveyed to catch basin CB-N42-1. These include:

- Surface drainage at the northeast area of Building 42.
- Roof drains on the eastern perimeter of Building 42.
- Surface drainage from catch basin N42-2 (within Huts 1 & 2).
- Surface drainage from catch basin E42-1 (and OF#13), E42-2 and E42-3.

Drainage from these areas discharge to Narragansett Bay at OF#3B. Outfall #3B is buried beneath rip-rap boulders, so the outfall construction details (diameter and material) were not determined.

Surface drainage east of Building 6 is collected at Catch Basins 10-7, 10-8, 10-9, and 10-10, which discharge at OF#10 in the Building 234 Area. The complete drainage pattern is presented on Figure 4-4.

Building 42 Interior Floor Drainage System

A diagram of the Building 42 interior drainage system is presented in Figure 4-3. The crawl space beneath Building 42 was entered to visually inspect and track the building interior floor drain system. Two sumps (S42-3 and S42-5) are connected to this system. Information on the remaining sumps of Building 42 is addressed in Section 4-1. The existing Building 42 interior drainage discharges to sump S42-5, which is outside the southeastern corner of Building 42. Sump S42-5 is a concrete-lined holding tank with no identified discharge location.

Engineering records for the Building 42 area were researched at different times. Available information regarding the sanitary disposal system from this building was not found. S42-5 appears to be a holding tank or vault for the Building 42 sanitary system. No discharge piping was found, but interior pumps may have been removed for auction during bankruptcy proceedings. Smoke tests applied to this vault indicated that inflow pipes were connected to the floor drains, S42-3, S42-5, and the lavatories in Building 42 (floor drains and toilets). This led the investigators to believe that S42-5 is a collection tank. However, as mentioned previously, no discharge equipment was found.

Historic Huts 1 & 2 Drainage System

Aerial photographs indicate that Huts 1 & 2 were previously located in the field south of Building 42 prior to Derektor Shipyard operations. Catch Basins 42-1, 42-2, 42-3 and 42-4 apparently drained the area surrounding these huts. The inverts within the four catch basins were blocked prior to the site investigation. The four catch basins were cleared to the best extent possible using "jet rod" equipment. After cleaning, Catch Basins 42-1 and 42-2 retained water and no longer appeared to function properly as part of the drainage system. Historic naval site drawings created prior to Derektor Shipyard operations indicate that Catch Basins 42-1 and 42-2 discharge pipes were connected to Building 42 roof drains but also indicate that the discharge lines end abruptly before the sheet piling near the southwestern corner of Building 42. In addition, no outfall was indicated in the drawing or presently appears at this location. The outfall drainage is presumed to have been damaged or decommissioned and, as a result, no longer functions as a drainage system.

Video tracking of CB-42-3 traced the invert pipe 16 feet north and then makes a 90 degree turn to the east. The drainage pipe could not be tracked beyond this point. No points of discharge were noted during smoke testing of CB-42-3.

Video tracking of CB-42-4 traced the invert pipe 30 feet north where it ended abruptly at a concrete plug. Smoke testing at CB-42-4 also indicated no points of discharge.

Dry Well (DW01) Location

The dry well (DW01) located to the south of the current location of Huts 1 & 2 received sewage disposal and roof drain discharge from Huts 1 and 2. The dry well has brick sides and a compacted gravel bottom. The dry well is discussed in more detail in Section 4.1.

4.2.1.3 Building 234 Area

The drainage system in the Building 234 area consists of catch basin stormwater systems, a mechanical sumps and trenches drainage system on the old Building 234 foundation, and a roof drain system. The drainage system for the Building 234 area is presented in Figure 4-4.

Surface Drainage and Roof Drains

Surface drainage from the paved area north of Building 234 and the paved area to the east of Building 6 flows through a series of catch basins and eventually discharges to Narragansett Bay at OF#10. Catch basins 11-1, 11-2, and 11-3 collect surface drainage on the east perimeter of Building 234 and discharge to Narragansett Bay at OF#11. Outfall #11 also appears to receive flowage from upgradient off-site areas.

Catch Basin 10A-1 collects area surface drainage and discharge from the roof drains of the existing building on the Building 234 foundation slab.

Building 234 Foundation

Smoke tests performed at Sump S234-8 indicate that this vault receives drainage from floor drains in the East Utility Trench, West Utility Trench, sump S234-7, at least one unidentified pipe, assumed to be a roof drain (at the eastern foundation slab wall) and several capped floor drains. Smoke discharge was noted at these areas during the smoke test of S234-8, however, no outlet to Narragansett Bay was found. This sump contains two large suction pumps that connect to one 4-inch ID discharge pipe. To locate the outfall, the discharge pipe was dismantled and cleaned to the extent possible using "jet

rod" equipment. However, because of multiple turns in the piping route, the jet rod equipment jammed and was removed after traveling approximately 80 feet.

Video tracking of sump S234-8 discharge was not conclusive. Video tracking followed the apparent discharge pipe 27 feet west but was stopped by a series of 45 degree turns in the piping.

The laboratory analysis of marine sediment sampling performed by the University of Rhode Island found a rare PCB compound, decachlorobiphenyl (trade name: Dekal). In the sediment offshore of Outfall 10B. Tests were performed to find this compound in all soil and water samples collected during this on-shore SASE investigation, but none was detected at any location by the analytical laboratory. In order to be certain, a sediment sample was taken from the bottom of S234-8 and delivered to the same URI laboratory that found Dekal in the marine sediments. As of the date of this draft report, this analysis has not been completed.

Information on points of collection and/or input areas for Outfalls #9B and #10B are presently unknown. However, it is believed that S234-8 ultimately discharges to one of these outfalls.

As was the case for the Building 42 sanitary sewer system, no as-built or design drawings for Building 234 were found during the PA or as part of this SASE. NETC's engineering department was not able to locate drawings for this building. The floor plan drawings were found, but did not provide any information regarding drainage or sanitary systems.

4.3 SUBSURFACE CONDITIONS

Regional and site-specific geologic conditions are discussed in the sections that follow. The site geologic conditions are presented for each area investigated (upgradient areas, North Waterfront, Central Shipyard, Building 234 area, and South Waterfront), and are based on subsurface investigations that were conducted in each of these five areas.

Soil samples were collected from test pits and borings, as described in Section 3.0 of this report. Figure 4-5 (map pocket) presents locations of excavated test pits. Figure 4-6 (map pocket) presents locations of borings completed as monitoring wells.

At each boring or test pit location, a surface soil sample was collected for laboratory analysis. All subsurface soil samples were first screened using a portable gas chromatograph in the field office.

Based on the results of the screening analysis, 20 percent of the subsurface soil samples collected were selected from each boring or test pit for laboratory analysis of organic and inorganic compounds, and TPH, as described in Section 3.0. Screening results are presented in Appendix A. All subsurface soil samples collected from test pits were analyzed for total metals, as described in Section 3.3. Laboratory results from soil samples collected are presented in Appendix B2 (samples collected from test pits) and Appendix B3 (samples collected from borings installed at MW locations).

The geologic conditions were evaluated during the installation of borings and test pits. Boring logs and test pit logs are presented in Appendix C. Most borings were completed as groundwater monitoring wells, as described in Section 3.0. Well construction logs are presented in Appendix D.

Tables 4-4A, B, C, D, and E present summaries of contaminants detected by laboratory analysis in the surface soils of the upgradient areas, North Waterfront, Central Shipyard, Building 234 area, and South Waterfront, respectively. Tables 4-5A, B, C, D, and E present summaries of contaminants detected by laboratory analysis in the subsurface soils of the upgradient areas, North Waterfront, Central Shipyard, Building 234 area, and South Waterfront, respectively. Surface and subsurface soil analyses are presented separately because risk summaries must be developed separately based on these different media.

These laboratory analytical results are discussed briefly in the following subsections.

4.3.1 Regional Geology

The regional geology for the site is presented below. Much of this information was extracted from a March 1993 Remedial Investigation/Feasibility Study (RI/FS) Work Plan conducted by TRC Environmental Corporation (TRC) for NETC.

NETC is located at the southeastern end of the Narragansett Basin. This basin is a complex synclinal mass of Pennsylvanian aged sedimentary rocks that is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. Narragansett Basin is an ancient north to south trending structural basin originating near Hanover, Massachusetts. The basin is approximately 55 miles long and varies from 15 to 25 miles wide. The western margin of the basin is in the western portion of Providence, Rhode Island, and the eastern margin runs through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin is near the mouth of Narragansett Bay.

The bedrock of the Narragansett Basin has been divided into the following five units: the Rhode Island Formation, Dighton Conglomerate, Wansulta Formation, Pondville Conglomerate, and Felsite at Diamond Hill. At NETC and most of the surrounding area, the bedrock is composed entirely of the Rhode Island Formation. The Rhode Island Formation is the most extensive and thickest of the Pennsylvania formations in Rhode Island.

Included within the Rhode Island Formation are fine to coarse conglomerate, sandstone, lithic graywacke, arkose, shale, and a small amount of meta-anthracite and anthracite. Most of the rock is gray, dark gray, and greenish, but the shale and anthracite are often black. Crossbedding and irregular, discontinuous bedding is characteristic of the formation. Rock in the southern portion of the basin, where NETC is located, is metamorphosed, and contains quartz-mica schist, feldspathic quartzite, garnet-stauroilite schist, and some quartz-mica-sillimanite schist. The beds of meta-anthracite and anthracite are mostly thin, but many areas within the basin have been mined. Vein quartz, fibrous quartz, and pyrite are commonly associated with these coal layers, and the ash content is high.

Overburden materials consist of unconsolidated glacial sediments ranging from gravel to silt, as well as glacial till. The till is characteristically poorly sorted, dense, and variable in texture. More detailed descriptions of on-site unconsolidated deposits are presented in the subsections below.

It should be noted that portions of the study area are known to have been extensively altered by construction activities and emplacement of fill materials, based on historical information including aerial photographs; however, it was frequently not possible to discriminate between natural soils and fill materials, since much of the fill material was apparently not significantly different from the natural glacial materials that exist at the site. Where obvious artificial fill materials (asphalt, brick, concrete, etc.) were observed in boring logs, approximate depths of fill were estimated, as discussed in the sections that follow.

4.3.2 Upgradient Off-Site Area

This section summarizes the geologic and analytical data collected from two soil borings that are located in the upgradient direction between 800 and 1000 feet to the east of the site boundary (Fig.4-6). Both borings MW01 and MW10 were completed as groundwater monitoring wells, as described in Section 3.4.1 (refer to Appendix C for boring logs and Appendix D for well construction logs). Analytical results from soils from these locations are discussed in Section 4.3.6.2, and complete analytical results are presented in Appendix B.

4.3.2.1 Geology

The uppermost surficial materials at both of the upgradient locations consists of between 1 to 4 feet of poorly graded fine and fine to medium sands, with little silt, and traces of gravel and clay. At MW01, from approximately 4 to 8 feet below ground surface (bgs), probable till was encountered, described as grey to brown compact and dense silty, gravelly, poorly graded sands with trace clay. This unit was observed directly overlying weathered bedrock, encountered near 8 feet bgs. At MW10, roughly 7 feet of a similar silty, gravelly, poorly graded fine sand with trace clay (till) is overlying weathered bedrock, which was encountered between approximately 10 to 11 feet bgs. At both locations, bedrock was identified in split-barrel samples as highly altered and weathered, grey phyllite which is fissile and easily broken in hand, with trace clay filling in fractures.

4.3.2.2 Chemistry

Analytical results from laboratory analyses of samples collected are presented in Appendix B of this report. Table 4-4A presents a summary of contaminants detected in surface soil samples in the upgradient borings. Table 4-5A presents a summary of contaminants detected in subsurface soil samples in these borings. These results are unvalidated data reported by the analytical laboratory. Several volatile organic compounds (2-butanone, acetone, and methylene chloride) were detected. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation.

These results indicate the presence of one phthalate compound, and several PAH compounds in the surface soils. These types of contaminants are typically found in surface soils near roadways and buildings. In addition, trace concentrations of two pesticides were detected in the surface soils at MW10, which is also typical in professionally maintained lawns such as those present in this area. However, tributyltin was detected in the surface soil at MW10, which was unexpected.

Metals concentrations detected in the surface soils at MW1 and MW10 were comparable. Notably, arsenic was detected at 19.5 and 20.3 mg/kg, respectively. Lead was detected at 18.3 and 16.2 mg/kg respectively. A trace of mercury (0.08 mg/kg) was detected at MW1, and a trace of cadmium (0.61 mg/kg) was detected at MW10. Concentrations of metals detected in the subsurface soils were within the same order of magnitude as the concentrations of those metals in the surface soils, with one exception: lead was found at lower concentrations in the subsurface soil at MW10. This is not

unexpected, as one source of lead in surface soils could be past use of leaded gasoline, particularly since this is an area that is subject to moderately high vehicular traffic.

4.3.3 North Waterfront Area

This section summarizes the geologic and analytical data collected from ten test pits and eight soil borings that are located throughout the North Waterfront area (Figures 4-5 and 4-6). Three of the soil borings were advanced near the Former Hazardous Waste Storage Area to investigate potential releases (SB11, SB12, and SB13). Five of the eight soil borings: MW02, MW03, MW04, MW11, and MW12 were completed as overburden groundwater monitoring wells, as described in Section 3.4.1 (refer to Appendices C and D for boring, test pit and well construction logs). Boring depths ranged from 6 feet to 36 feet below ground surface (bgs).

Ten test pits: TP16, TP18 through TP24, TP27, and TP28 were excavated in this area (Figure 4-5). Test pit depths ranged from 10 to 14 feet bgs. Each test pit was logged, sampled, video-taped, and back-filled under the direction of the B&R site geologist. Analytical results from soils from these borings and test pits are discussed in Section 4.3.2.2, and complete analytical results are presented in Appendix B.

4.3.3.1 Geology

The uppermost surficial materials in the Central Shipyard area are described primarily as gravelly sands, silty sands, and fine to medium poorly graded sands with varying proportions of silt, gravel, and traces of shell fragments in some soils. These sands continue at the deepest borings to approximate depths of between 10 feet bgs (at MW03) to 24 feet bgs (at MW02), and are underlain by a tight and dense, silty, gravelly, sand with trace clay (probable till). The probable till, encountered above weathered bedrock, varied between approximately 8 feet thick at MW03 to approximately 12 feet thick at MW04.

As noted in the test pit log for TP16, a light sheen was noted on groundwater (encountered at approximately 11 feet bgs) and elevated FID readings were reported from soils in this area. Petroleum-stained soils and odor were also reported near the ground surface at this test pit location.

As observed in the borings advanced during this investigation, depths to bedrock vary from approximately 18 feet bgs at MW03 to approximately 34 feet bgs at MW02. Bedrock, as described in the boring logs, is highly weathered, fissile, phyllite and schist. Some samples of bedrock were degraded to clay and silt (saprolite).

4.3.3.2 Chemistry

Analytical results from laboratory analyses are presented in Appendix B of this report. Table 4-4B presents a summary of contaminants detected in surface soil samples in the borings and test pits installed in the North Waterfront. Table 4-5B presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results are unvalidated data reported by the analytical laboratory.

Several volatile organic compounds (2-butanone, acetone, and methylene chloride) were detected. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation.

However, traces of two other volatile organic compounds (toluene and xylene) were detected in the surface soils at TP18 through 21, 23, 24, and MW11, indicating the possibility of minor fuel releases in these areas. In the subsurface soil samples, trichloroethene (TCE) was detected in TP23 (9 to 11 feet bgs), MW03 (8 to 10 feet bgs), and MW11 (27 to 31 feet bgs). TCE concentrations detected were all below 5 ug/kg.

Semivolatile organic compounds detected in this area include Bis(2-ethylhexyl)phthalate (which was detected in almost every surface soil sample at concentrations less than 300 ug/kg), and various PAH compounds. One phenol compound was detected at 1,100 ug/kg at the bottom of TP16 (11 to 12 feet bgs).

PAH concentrations were elevated in surface soils at TP-28, a location that is upgradient of the active areas of the site, in a former parking lot. This test pit was excavated at the request of RIDEM to acquire screening samples to locate a contaminant plume that was expected to be migrating onto the site. TPH was also detected in this sample, at a concentration of 130 mg/kg. Subsurface soil samples were not collected for laboratory analysis. Subsurface soil samples were analyzed using the on-site GC, and these results are presented in Appendix A.

Butyltin compounds were detected in surface soils at TP16, 18, 22, 23 and 24. Concentrations were highest in samples collected at TP16 (total of 149.3 ug/kg); other locations were below 36 ug/kg (total). Traces of butyltins were also found in subsurface soil samples, collected from TP16, MW02 MW11, and MW12.

One PCB compound was detected in the surface soil (Aroclor 1260, detected at 24 ug/kg from TP16). No PCBs were detected in the subsurface soils in the North Waterfront. Several pesticide compounds were detected in the surface and subsurface soils, but these compounds did not exhibit any particular pattern, indicating surficial discharge or an overall contamination situation.

Metals concentrations detected in the surface soils in this area were comparable with those metal concentrations detected in upgradient samples collected. However, at TP 16, almost all the metals were elevated slightly. In addition, TCLP analysis of this sample showed leaching of arsenic, cadmium, chromium, and particularly lead (71.8 mg/l detected in the leachate). Concentrations of metals detected in the subsurface soils were generally within the same order of magnitude as the concentrations of those metals in the upgradient samples. TCLP analysis of subsurface soils detected slightly elevated concentrations of lead, silver, selenium, and chromium at MW04, at a depth of 32 to 34 feet bgs.

4.3.4 Central Shipyard Area

This section summarizes the geologic and analytical data collected from nine soil borings and seven test pits that are located throughout the Central Shipyard area (Figures 4-5 and 4-6). Three of the soil borings, SB01, SB02, and SB03, were advanced in the area surrounding a "dry well" south of Huts 1 & 2. Three other shallow soil borings were installed proximate to S42-5, near the southeast corner of Building 42 to investigate potential releases (refer to Section 4.1 of this report).

Boring MW05, located near the northern end of Building 42, was completed as a bedrock monitoring well, as described in Section 3.4.1. Boring MW06 was advanced to 6 feet bgs and back-filled due to the shallow depth to bedrock encountered at this location. Boring MW07 was completed as an overburden groundwater monitoring well. Boring depths ranged from 6 to 59 feet bgs. Bedrock coring was also performed at MW05 to identify and investigate the upper bedrock in the area. Refer to Appendices C and D for boring, test pit, and well construction logs.

Seven test pits, TP11 through TP15, TP17, and TP25, were excavated throughout this area (Figure 4-5). Test pit depths ranged from 6 to 13 feet bgs. Each test pit was logged, sampled, video-taped, and back-filled under the direction of the B&R site geologist. Analytical results from soils from these borings and test pits are discussed in Section 4.3.3.2, and complete analytical results are presented in Appendix B.

4.3.4.1 Geology

Based on the subsurface investigations advanced in the Central Shipyard area, the uppermost surficial materials in this area are comprised primarily of gravelly sands and sandy gravels with varying proportions of silt, and silty sands.

As detailed in the boring and test pit logs, artificial fill materials (asphalt pieces, brick) and an "asphalt odor" were noted in soils sampled at MW05 and at adjacent TP25 at depths of up to 14 feet bgs. A visible sheen was noted on groundwater in TP25 and elevated FID readings were reported from soils in this area. Artificial fill materials (brick, concrete, wood) were also observed in soils in the area of borings SB08, SB09, and SB10 at depths up to approximately 18 feet. Elevated FID readings were also detected in soils from TP11 (11 to 13 feet bgs) and TP13 (5 to 6 feet bgs). Miscellaneous piping/cable was observed in TP14 and TP17 (at 5.5 feet bgs).

As observed at the two deepest borings in the Central Shipyard area, MW05 and MW07, a dense clayey, silty, gravelly sand (probable till) was observed underlying the upper sands and gravels, from approximately 28 to 42 feet bgs at MW05, and from approximately 24 to 33 feet bgs at MW07.

Dense silt or interlayered sands and silts were observed immediately above weathered bedrock at MW05 and MW07 from approximately 42.0 to 46.5 feet bgs and from 33.0 to 37.5 feet bgs, respectively.

The depth to bedrock in the Central Shipyard area increases significantly from east to west, ranging from approximately 4.3 feet bgs at MW06 to 46.5 feet bgs at MW05, and 37.5 feet bgs at MW07. Bedrock in this area is described in the logs as weathered, fissile, gray phyllite. The RQD of bedrock cored at MW05 was 43 percent (poor rock quality).

4.3.4.2 Chemistry

Analytical results from laboratory analyses are presented in Appendix B of this report. Table 4-4C presents a summary of contaminants detected in surface soil samples in the borings and test pits installed at the Central Shipyard area. Table 4-5C presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results are unvalidated data reported by the analytical laboratory.

Several volatile organic compounds (2-butanone, acetone, carbon disulfide and methylene chloride) were detected in surface and subsurface soils. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation. No other volatile organic compounds were detected in these soil samples.

Semivolatile organic compounds detected in this area include bis(2-ethylhexyl)phthalate, and various PAH compounds. PAH concentrations were elevated in surface soils at TP15 (inside an enclosure for a set of above-ground storage tanks), TP17 (to the south of Huts 1 & 2, which were historically used as a vehicle maintenance shop), and MW06 (located downgradient of the former pipe shop in the northeast corner of Building 6 and also downgradient of a railway drainage ditch). PAH compounds were detected in subsurface soils from MW05 and MW07. The highest concentrations were found in the subsurface soil samples collected from MW05, installed near a reported area of an oily water discharge pit (refer to Table 3-4).

In addition, moderate concentrations of phenolic compounds were detected in TP17, installed to the south of the huts. These compounds were detected in the surface soils, and because there were no elevated concentrations of volatile organic compounds in the screening samples evaluated in the field, subsurface soil samples were not analyzed by the laboratory from this location. However, this test pit was excavated because of its proximity to the "dry well" described in Section 4.1 of this report, and three borings were installed near and down-gradient of the dry well (Figure 4-1). Laboratory analysis of subsurface soil samples from these borings did not detect any of these phenol compounds.

Total petroleum hydrocarbons were detected in surface soils at TP12 (2000 mg/kg); TP14 (1700 mg/kg); TP15 (68 mg/kg); and TP17 (170 mg/kg). TPH was detected in subsurface soils at TP25 (150 mg/kg, 10 to 11 feet bgs); MW05 (4100 mg/kg, 10 to 12 feet bgs and 76 mg/kg at 20 to 22 feet bgs); MW06 (83 mg/kg, 4 to 6 feet bgs); and MW07 (160 mg/kg, 8 to 10 feet bgs).

Butyltin compounds were detected in surface soils at TP15 (less than 20 ug/kg). Butyltin compounds were also found in subsurface soil samples, collected from TP13 (42 ug/kg) and MW05 (11 ug/kg).

One PCB compound was detected in the surface soil in the Central Shipyard. Aroclor 1260 was detected at a high concentration of 71,000 ug/kg in the surface soil collected at TP14. One of four sources may have caused this PCB detection. The test pit was installed in an area downgradient of a railway drainage ditch, the former pipe shop located in the northeast corner of Building 6, and the former transformer station (to the northwest). In addition, a PCB-filled electrical cable was encountered in the excavation of this test pit, but was not disrupted. This source seems unlikely, however, because the cable was found 4 feet bgs and the PCB contamination was detected in the surface soil. Finally, the PA report for this site states that PCB transformers were temporarily stored on the loading dock on the eastern side of Building 6; they may have leaked during their period at this location.

Pesticides were detected at several locations. Most notable were high concentrations of pesticides in the surface soils at TP14. In addition, numerous detections were found in the subsurface soils in MW05, at a depth of 22 to 24 feet. Finally, high concentrations of DDD, DDE, and DDT were detected in subsurface soils at MW07 (16 to 18 feet bgs).

Metals concentrations detected in the surface soils in this area were comparable with those metal concentrations detected in upgradient samples collected. However, TCLP analysis of the surface soil sample collected from TP14 indicated leaching of lead (37.2 mg/l detected in the leachate). Concentrations of metals detected in the subsurface soils were generally within the same order of magnitude as the concentrations of those metals in the upgradient samples, however, lead was elevated at MW05 (109 mg/kg, at 22 to 24 feet bgs). TCLP analysis of this sample also revealed an elevated concentration of lead (68.6 mg/l in leachate collected). TCLP analysis of subsurface soils collected from TP11 (12 to 13 feet bgs) indicated high leachability of metals, although total metals concentrations were not particularly elevated.

4.3.5 Building 234 Area

This section summarizes the geologic and analytical data collected from nine soil borings and five test pits that are located throughout the Building 234 area (Figures 4-5 and 4-6).

Four shallow soil borings, SB04 through SB07, were advanced inside four of the 15 equipment boxes to depths of 2 to 6 feet bgs. Three additional shallow soil borings, SB14 through SB16, were advanced to depths of 7 feet bgs and were located in and around S234-7 and TP26 at the northeast corner of the Building 234 slab to investigate potential releases from a former UST in this area. Two of the nine soil borings, MW08 and MW09, advanced to depths of 12.5 feet and 51.0 feet, respectively, were completed as overburden groundwater monitoring wells, as described in Section 3.4.1. Bedrock coring was also performed at MW09 to identify and investigate the upper bedrock in the area. Refer to Appendices C and D for boring, test pit, and well construction logs.

Five test pits, TP07 through TP10 and TP26, were excavated in the Building 234 area (Figure 4-5). Test pit depths ranged from 3 feet to 13 feet bgs. (TP07 met refusal on rip-rap material at 3 feet bgs.) Each test pit was logged, sampled, video-taped, and back-filled under the direction of the B&R site geologist. Analytical results from soils from these borings and test pits are discussed in Section 4.3.5.2, and complete analytical results are presented in Appendix B.

4.3.5.1 Geology

Based on subsurface investigations as detailed above, the uppermost surficial materials at the Building 234 area primarily consist of gravelly, silty, sand, silty sand, and sand. As recorded on the boring logs, the majority of the sands are poorly graded, and include varying proportions of silt and subrounded to angular gravel, where present. In one location, TP08, shells were also observed within the gravelly sand identified from 5 to 9 feet bgs.

A silty, sandy, gravel (probable fill) was identified in the area of borings SB14 through SB16 at depths ranging between 1 to 7 feet bgs. A sandy gravel (probable fill) was also identified at TP10 from 0 to 1.5 feet bgs.

Also at SB14 through SB15, advanced in the area of S234-7 and TP26 (area of a former UST), petroleum odors were detected in the sand and gravel soils (probable fill), which were sampled from approximately 1 to 5 feet bgs, directly below the concrete slab that was cored in this area to approximately 1 foot to access the underlying soils. Several localized zones of petroleum-impacted soils were also observed at TP26 between approximately 3 to 5 feet bgs. Miscellaneous piping related to a former UST in this area was encountered during excavation; artificial fill materials (metal, brick) were noted from approximately 4.5 to 10.0 feet bgs.

At the deepest boring (MW-09), advanced to 51 feet bgs, dense gravelly, silty, sand (till) was observed from approximately 10.5 to 18.0 feet bgs. From approximately 18 to 46 feet bgs in this boring, a dense sandy silt (till) with varying amounts of gravel was identified overlying weathered bedrock, which was encountered at approximately 46 feet.

As described in the logs, bedrock in this area is identified as fissile, grey to black phyllite, which is generally weathered and broken (at the depths observed in these subsurface investigations). Based on the subsurface investigations described above, the depth to bedrock in the area of Building 234 increases significantly toward the south, varying from approximately 8.5 feet bgs at TP09 to approximately 46.0 feet bgs at MW-09. At MW08, 4 inches of rock was recovered in a split-spoon sample from approximately 12.0 to 12.5 feet bgs, although coring was not conducted at this location for confirmation of bedrock. At MW-104 (installed by GZA Inc. in 1993) bedrock was reported at approximately 14 feet bgs. The RQD of bedrock cored at MW09 was 0 percent (very poor rock quality).

4.3.5.2 Chemistry

Analytical results from laboratory analyses are presented in Appendix B of this report. Table 4-4D presents a summary of contaminants detected in surface soil samples in the borings and test pits installed at the Building 234 area. Table 4-5D presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results are unvalidated data reported by the analytical laboratory.

Several volatile organic compounds (2-butanone, acetone and methylene chloride) were detected in surface and subsurface soils. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation.

However, traces of two other volatile organic compounds (toluene and xylene) were detected in the surface soils at TP07 and 08, and MW08, indicating the possibility of minor fuel releases in these areas. In the subsurface soil samples, trichloroethene was detected in TP23 (9 to 11 feet bgs), MW03 (8 to 10 feet bgs), and MW11 (27 to 31 feet bgs). Concentrations detected were all below 5 ug/kg.

In addition, xylene and ethylbenzene were detected in soils 3 to 5 feet bgs at TP26, excavated at the northeast corner of former Building 234, in an area of a former UST noted in the PA report. Finally, traces of chlorinated solvents (1,2-dichloroethene, and trichloroethene, both detected at a maximum concentration of 3 ug/kg) were detected in subsurface soils collected from MW08 and MW09.

Semivolatile organic compounds detected in this area include bis(2-ethylhexyl)phthalate (which was detected in almost every soil sample), and various PAH compounds. The phthalate compound was detected at high concentrations in the surface soils at TP07 (8,700 ug/kg); TP08 (1,600 ug/kg); TP09 (2,700 ug/kg); and MW08 (1,200 ug/kg). Concentrations of bis(2-ethylhexyl)phthalate in the subsurface soils were lower, with one exception: in TP08 this compound was detected at 22,000 ug/kg at a depth of 9 to 10 feet bgs.

PAH compounds were detected in most of the surface soil samples collected. Concentrations were slightly elevated at TP10 (northeast and upgradient of former Building 234), and MW09 (in an area of suspected discharge, to the south of the former building). PAH compounds were detected in subsurface soils from TP08 (near MW09 and the former suspected discharge area), TP26 (in the area of the former UST to the north of the former building), and MW09 (in the former suspected discharge area). The highest concentrations detected were in the former location of the UST. Furthermore, during excavation of this test pit, old piping was found, which had probably not been removed with the UST due to its proximity to the building foundation.

Total petroleum hydrocarbons were detected in surface soils at TP10 (61 mg/kg); TP26 (320 mg/kg); MW08 (270 mg/kg); and MW09 (77 mg/kg). TPH was detected in subsurface soils at TP26 (2200 mg/kg, 3 to 5 feet bgs); MW08 (490 mg/kg, 8 to 10 feet bgs); and MW09 (72 mg/kg, 10 to 12 feet bgs).

Butyltin compounds were detected in surface soils at TP09 (total of 22.5 ug/kg) and MW08 (11 ug/kg). Butyltin compounds were also found in one subsurface soil sample, collected from TP08 (4.6 ug/kg, at 9 to 10 feet bgs).

PCB compounds were detected in two surface soil samples at the Building 234 area. Aroclor 1260 was detected at 24 ug/kg in the surface soil collected at TP10. Aroclor 1254 was detected at 38 ug/kg in the surface soil collected from MW08. Several pesticide compounds were detected in the surface and subsurface soils, but these compounds did not exhibit any particular pattern indicating surficial discharge or an overall contamination situation.

Metals concentrations detected in the surface soils in this area were generally comparable to upgradient samples collected, with two exceptions: lead and zinc were slightly elevated in soils collected from TP08 and TP10. Secondly, copper, lead, nickel, and zinc were all elevated in the surface sample collected from MW08. TCLP analysis of these surface soil samples indicated leaching of lead (lead concentrations were close to, or in excess of, 100 mg/l in leachate collected). Concentrations of metals detected in the subsurface soils were also mostly within the same order of magnitude as the concentrations of those metals in the upgradient samples, however, lead was slightly elevated at TP26 (75 mg/kg, at 4 to 6 feet bgs) and zinc was slightly elevated in that test pit also (117 mg/kg at 9 to 10 feet bgs).

4.3.6 South Waterfront Area

This section summarizes the geologic and analytical data collected from six test pits that are located along the shoreline throughout the South Waterfront area (Figure 4-5). Test pits TP01 through TP04 were excavated in the soil piles in the southernmost area of the site, south of the stone pier in the South Waterfront area (Figure 4-5). Test pits TP05 and TP06 were located in the soil piles north of the stone pier, and south of Building 234. Test pit depths ranged from 7 to 16 feet bgs. Each test pit was logged, sampled, video-taped, and back-filled under the direction of the B&R site geologist. Analytical results from soils from these borings and test pits are discussed in Section 4.3.5.2, and complete analytical results are presented in Appendix B. Refer to Appendix C for test pit logs.

4.3.6.1 Geology

Surficial materials in the soil piles in the South Waterfront area are primarily described as gravelly sands, consisting of mostly fine or fine to medium sands, with some fine to coarse subrounded to subangular gravel. These materials are believed to be primarily fill. The gravelly sands continued throughout the depths of most test pits, (excavated from 7 to 16 feet bgs) with the following exceptions: a layer of sand (mostly fine to medium), identified as possible beach sand, was described at TP01 from 11 to 12 feet bgs (the bottom of test pit). In TP03, a sand layer (mostly fine sand) was identified from 3 to 9 feet bgs (the bottom of test pit), however, pieces of asphalt also identified in TP03 from 6 to 9 feet indicate this to be probable fill material.

Within the sands, artificial fill materials such as asphalt, concrete, metal debris, and/or possible sand blast grit were also identified at each test pit location, at depths up to 9 feet bgs, as follows: at TP01, from 0 to 1 foot bgs (concrete, asphalt); at TP02, from 7 to 9 feet bgs (asphalt, metal); at TP03, from

0 to 3 feet and 6 to 9 feet bgs (concrete, asphalt); and at TP04, at 6 feet (concrete, metal). At the two northernmost test pits excavated in the South Waterfront area (TP05 and TP06), possible sand blast grit was identified, from 3 to 4 inches thick, as follows: at TP05, at approximately 2.0 feet bgs and at TP06, at approximately 1.5 feet bgs.

Bedrock was not encountered in any of the test pits.

4.3.6.2 Chemistry

Analytical results from laboratory analyses are presented in Appendix B of this report. Table 4-4E presents a summary of contaminants detected in surface soil samples in the test pits installed at the South Waterfront. Table 4-5E presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results are unvalidated data reported by the analytical laboratory.

Several volatile organic compounds (acetone and methylene chloride) were detected in surface and subsurface soils. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation.

Semivolatile organic compounds detected in this area include Bis(2-ethylhexyl)phthalate (which was detected in almost every soil sample), and various PAH compounds. The phthalate compound was detected at a maximum concentration in the surface soils at TP05 (1,100 ug/kg); the remaining detections were below 250 ug/kg. Concentrations of the phthalate compound in the subsurface soils were less than 100 ug/kg.

PAH compounds were detected in most of the surface soil samples collected. Concentrations were slightly elevated in the surface soils at TP06 (north end of the South Waterfront). PAH compounds were detected in subsurface soils from TP01 (traces detected only) and TP05 (concentrations similar to those found in other parts of the site).

Total petroleum hydrocarbons were detected in surface soils at TP03 (94 mg/kg), TP04 (110 mg/kg), and TP06 (110 mg/kg). TPH was detected in subsurface soils at TP01 (72 mg/kg, 11 to 12 feet bgs), and TP03 (540 mg/kg, 6 to 8 feet bgs). These low concentrations of TPH could be attributed to particles of asphalt debris, which were observed in some of these test pits.

Trace concentrations of butyltin compounds were detected in surface soils at TP05 (3.1 ug/kg) and TP06 (total of 8.8 ug/kg). A trace of tetrabutyltin was also found in one subsurface soil sample, collected from TP05 (8.5 ug/kg, at 5 to 7 feet bgs).

One PCB compound was detected in two surface soil samples: Aroclor 1260 was detected at 25 ug/kg in the surface soil collected at TP04, and at 15 ug/kg in the surface soil collected at TP06. Several pesticide compounds were detected in soils from TP05 and TP06, but these compounds did not exhibit any particular pattern indicating surficial discharge or an overall contamination situation. No pesticides were detected in the soils south of Outfall #12 at the midsection of the South Waterfront.

Metals concentrations detected in subsurface soils in this area were generally comparable to upgradient samples collected. However, surface soils showed zinc concentrations to be elevated at TP02 (225 mg/kg); TP03 (172 mg/kg); TP04 (501 mg/kg); TP05 (896 mg/kg); and TP06 (284 mg/kg). Lead was slightly elevated, but within the same order of magnitude as upgradient samples at all locations except one: lead was detected at TP04 at 119 mg/kg. TCLP analysis did not indicate a particularly high potential for leachability of these metals from the soils.

4.4 GROUNDWATER CONDITIONS

This section describes hydrogeologic conditions at the site. This section is limited by the scope of the study and the nature of the data collected. It is intended to provide initial information on the potential for contaminants present in the groundwater to be carried off site.

4.4.1 Groundwater Sample Analysis

Analytical results from laboratory analyses are presented in Appendix B of this report. Table 4-6 presents a summary of contaminants detected in groundwater samples collected from all the areas at the former Derecktor Shipyard. These results are unvalidated data reported by the analytical laboratory.

Samples were collected using low-flow, low-stress, groundwater sample collection methods, using submersible pumps, as described in Section 3.0 of this report. MW10 (upgradient) was found to be dry at the time of sample collection.

Several volatile organic compounds (acetone and methylene chloride) were detected in the samples collected. These compounds are typically found in analytical results as laboratory artifacts and qualified as undetected during validation.

However, two chlorinated solvents were also detected in the groundwater at the site. These compounds (1,2 dichloroethene and trichloroethene) were detected in the groundwater in the North Waterfront (maximum concentration of 33 ug/l) and Central Shipyard areas (maximum concentration of 13 ug/kg). In addition, 1,2 dichloroethene was detected at 180 ug/kg in the sample collected from MW104, upgradient of the site, but downgradient of the steam plant (Building 7) (south of Building 6). Vinyl chloride was also detected in this sample at a concentration of 100 ug/kg. This distribution of contaminants is indicative of decay of chlorinated solvents, as discussed in Section 5.0 of this report.

Two semivolatile organic compounds were detected: Bis(2-ethylhexyl)phthalate was detected at a concentration of 13 ug/kg in water from MW11, and butyl-benzyl-phthalate was detected in the same sample at a concentration of 2 ug/l. A trace concentration of monobutyltin was detected in water collected from MW01, upgradient of the site. No PCBs or pesticides were detected in groundwater samples collected.

Metals concentrations detected in groundwater were generally comparable to upgradient samples collected, with several exceptions. Manganese was elevated in MW02 (230 mg/l). Aluminum and arsenic were slightly elevated in MW03 and in the field duplicate collected at that station. Iron and manganese were elevated in the groundwater collected from MW05, the only bedrock well sampled as a part of this study. Aluminum, arsenic, iron, and manganese were all elevated in samples collected from MW07, MW08, and MW09. Numerous metals in MW104 were elevated somewhat, which could be attributed to impacts to the soils and groundwater from remedial actions in progress at this area.

4.4.2 Regional Hydrogeology

The regional hydrogeology for the site is presented below. Much of this information was extracted from a March 1993 Remedial Investigation/Feasibility Study (RI/FS) Work Plan conducted by TRC Environmental Corporation (TRC) for NETC.

Many areas on Aquidneck Island, on which NETC is located, obtain their water supply from wells. Areas relying on groundwater are mostly north of the Middletown area, but wells exist throughout the island. Most groundwater is used for domestic needs, although some is used by small industries and businesses.

Groundwater on Aquidneck Island is obtained from the unconsolidated glacial deposits of till and outwash and from the underlying Pennsylvanian bedrock. Throughout the area, depth to groundwater ranges from less than one foot to approximately 30 feet, depending upon the topographic location, time of year, and character of subsurface deposits. The average depth to the groundwater is approximately 14 feet on Aquidneck Island and moves from areas of high elevations to Narragansett Bay or the Sakonnet River.

Seasonal water level fluctuations are common in the area. These fluctuations range from less than 5 feet to as much as 20 feet on the hills. In the valleys and lowland areas, the fluctuations are generally less than 5 feet. During the late spring and summer, the water table usually declines as a result of evaporation and the uptake of water by the plants, and rises during autumn and following winter thaws.

The chemical characteristics of the groundwater are similar throughout the area; water is generally satisfactory for most ordinary uses. Most groundwater in the area is soft or only moderately hard; groundwater from till generally contains less mineral material and is softer than groundwater from bedrock. Locations where groundwater has a high iron content are scattered, but are most numerous around Newport and Middletown and the northern part of Portsmouth. Wells that have a high iron content usually penetrate only rocks of Pennsylvanian age.

The groundwater at NETC is shallow (less than 10 feet below the surface in most areas). This shallow depth makes groundwater contamination at NETC highly probable. Pollutants that do migrate into groundwater would flow to the west and discharge into Narragansett Bay. NETC extends along the western shoreline of Aquidneck Island, so the groundwater only has to migrate a short distance before discharging into Narragansett Bay.

The soils occurring at NETC have permeabilities that are moderate to moderately rapid, so they do not restrict the vertical movement of water. The glacial till, from which these soils were derived, is generally less permeable than the overlying soils but does not represent a barrier to the vertical migration of water. Therefore, it is possible that any contaminant transported in this water could

contaminate the groundwater. Isolated areas also exist where the bedrock occurs at the surface. Contamination is possible at these outcrops through the cracks and fissures that commonly occur in the bedrock.

The RIDEM has established a state and groundwater classification system to protect its groundwater resources. The groundwater at Derecktor Shipyard is classified as GB. Groundwater classified as GB may not be suitable for drinking water without treatment due to known or presumed degradation. Groundwater classified as GB is typically located at highly urbanized areas or is located in the vicinity of disposal sites for solid waste, hazardous waste, or sewerage sludge.

4.4.3 Site-Specific Hydrogeology

Hydrogeologic conditions of the former Derecktor Shipyard were evaluated by performing two tasks: measuring hydraulic conductivity of the soils in which the wells are screened and determining the nature of the influence of the tide on the groundwater at the site. The results of the respective investigations are presented in the following subsections.

4.4.3.1 Hydraulic Conductivity

The hydraulic conductivity of the geologic materials at the site was estimated by conducting slug tests. A description of the test procedure is presented in the work plan and briefly summarized in Section 3.3.5 of this report. Data gathered during the slug tests was evaluated to provide an estimate of the hydraulic conductivity of the geologic material adjacent to the monitoring well being tested.

A review of Appendix E, which presents a summary of the test results, indicates that the hydraulic conductivity ranges from a low of 0.48 feet per day (MW03) to a high of 1.71 feet per day (MW12). These values are comparable to values reported in the literature for similar geologic materials. Graphic descriptions of the rising and falling heads in wells tested are presented in Appendix E.

The time required for groundwater to flow between two points can be estimated by first calculating the specific discharge of groundwater. The specific discharge is the product of the hydraulic conductivity and the groundwater gradient. The resulting value is not the groundwater velocity although it has the units of velocity. The groundwater velocity is calculated by dividing the specific discharge by the porosity of the geologic materials. The resulting value is the estimated groundwater velocity.

Groundwater flows along a sinuous path, caused by aquifer particles such as sand and silt, as groundwater moves from one pore to the next. This results in a groundwater flow path that is larger than the straight-line flow path between two points of interest. The actual flow path of groundwater between two points of interest cannot be determined. Therefore, the calculated groundwater velocity can only be used to estimate the time for groundwater to flow between two points of interest. The calculated travel times should be used as estimates and the actual time for groundwater flow will be different, and probably longer.

4.4.3.2 Tidal Fluctuation

Water levels were monitored over five days from September 19 to September 23, 1996. During this period, pressure transducers were suspended below the water surface in selected wells and from the sheet piling near Building 234 (point used is identified as LOG-1 on Figure 4-6). The data was normalized to elevation and vapor pressure, and the changes over time were depicted on graphs. Graphs from selected wells are presented as Figures 4-7 through 4-12.

These figures show tide changes (in feet) occurring in wells installed near the sheet piling wall and at areas more than 100 feet in land. These figures show that tide changes do influence both the shallow bedrock groundwater and the overburden groundwater. From this information, it would appear that a close hydraulic connection exists between the seawater and MW04 and MW05.

Another notable finding is that the elevation of water in the bedrock well (MW05) was continually below the elevation of the seawater. Since this was not expected, the measurements were checked and it was confirmed that although the bedrock groundwater fluctuates with tide, the elevation of the bedrock groundwater is below the elevation of the ocean.

Salinity, measured in the groundwater during groundwater sample collection, is presented in Table 3-6. This table describes salinity as a percent, between 0.5 parts per thousand (ppt) and 1.0 ppt. After the tidal study data was collected, salinity was again measured in all wells. This data, collected in October 1996, confirmed concentrations of salinity of 1 ppt or less in on-site wells. Salinity of the seawater adjacent to the sheet piling wall was measured as 22 ppt.

4.5 ON-SHORE ECOLOGICAL SCREENING CHARACTERIZATION

This section presents a general description of the environmental setting of the on-shore study area of the Derecktor Shipyard. The off-shore (marine) environment adjacent to the site (Narragansett Bay) is being evaluated in a separate study, the Off-Shore Ecological Risk Assessment for Derecktor Shipyard.

4.5.1 Environmental Setting

The study area has been divided into four sub-areas. Figure 4-13 presents the boundaries of the study area and its four sub-areas. These include the North Waterfront (North), Central Shipyard (Central), Building 234 area, and the South Waterfront (South).

Topographic relief of the Derecktor Shipyard is slight, except for a steep rise in elevation along the eastern perimeter of the site up to Defense Highway. This rise is typically between 10 to 20 feet. The western perimeter of the North, Central, and Building 234 areas consists mostly of sheet piling shoreline, with the exception of short stone rip-rap areas west of Huts 1 & 2 and along the southern edge of the Building 234 shoreline. The South Waterfront is a narrow parcel of disturbed, undeveloped, vegetated land that has a steep slope down to a more natural shoreline on Narragansett Bay.

Habitats dispersed throughout and adjacent to the site are characteristic of fragmented, developed landscapes of a lightly industrialized/residential area in the New England region. Most of the on-site precipitation is collected by a storm drain system and is discharged to Narragansett Bay. Approximately 80 percent of the shipyard is covered by buildings or pavement, with the remaining area providing minimal habitat value. Most of Derecktor Shipyard is encircled by chain-link fence that separates it from off-site upland areas, except the unfenced western perimeter (Narragansett Bay).

4.5.2 On-site Vegetation Areas

This section provides a description of the terrestrial and wetland vegetation within the four sub-areas of the site.

4.5.2.1 North Waterfront Vegetation

This area is bounded on the north by the existing fence south of Pier 2, on the east by the Penn Central right-of-way, on the south by the area surrounding Buildings 6 and 42, and on the west by Narragansett Bay (Figure 4-13).

Vegetation associated with the North Waterfront includes an upland shrub/vine area, an upland tree/shrub area, and a small early successional grassland/invasive weed plot. A small wetland area is present in a drainage swale within the Penn Central railroad right-of-way in this area. The wetland swale is technically offsite but was included in the vegetation description of this area due to its proximity to the study area border.

Present vegetation areas were historically maintained in an orderly fashion during naval operations before to Derektor Shipyard involvement at the site. The plant species present over much of the study area includes vegetational cover that typically colonizes areas that have been disturbed by human activity (ruderal vegetation).

Area 1

Area 1 consists of a narrow 2-acre corridor of shrub vegetation that parallels the western side of Defense Highway. The area is fenced on the north, east, and west sides and is further fragmented by the entrance roadways to Piers 1 and 2. Vegetation consists of a mixture of Asiatic and climbing bittersweet (*Celastrus orbiculatus* and *C. scandens*), respectively), Wisteria (*Wisteria* spp.), Japanese knotweed (*Polygonum cuspidatum*), Staghorn sumac (*Rhus typhina*), black cherry (*Prunus serotina*), northern bayberry (*Myrica pennsylvanica*), and poison-ivy (*Toxicodendron radicans*).

Area 2

A second narrow 0.4 acre corridor of shrub vegetation area (Area 2, Figure 4-13) is located between Fleet Pier Access Road to the north, the Penn Central right-of-way to the east, the pavement at the north end of Building 6, and a parking lot to the west. The upland vegetation is dominated by shrub/scrub/sapling species with a sparse tree canopy. An offsite drainage swale within the Penn Central right-of-way line provides habitat for wetland plant species.

The moderate to dense upland shrub/scrub/sapling vegetation consists of northern bayberry, American silverberry (*Elaeagnus communtata*), northern arrowwood (*Viburnum recognitum*), crabapples (*Pyrus* spp.), Norway maple (*Acer plantanoides*), black cherry, bittersweet, poison ivy, Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), common blackberry (*Rubus allegheniensis*), black raspberry *R. occidentalis*, goldenrod (*Solidago* spp.), Japanese knotweed, and unidentified grasses. The tree canopy is comprised of black cherry, crabapple, and white oak (*Quercus alba*).

The off-site swale located near Area 2 supports shrub and emergent wetland vegetation. The swale is approximately 400 feet long with an area of approximately 1200 square feet. The swale receives stormwater runoff from upgradient parking lots and roadways to the east. The swale drains to the south and enters the stormwater drainage system at the northern end of Building 6, eventually discharging to Narragansett Bay at OF#3B.

The shrub layer of the wetland swale consists of pussy willow (*Salix discolor*), northern arrowwood, bittersweet, multiflora rose, blackberry, and black raspberry. The emergent vegetation consists of sensitive fern (*Onoclea sensibilis*), spotted Joe-Pye weed (*Eupatorium maculatum*), cattail, (*Typha latifolia*), marsh fern (*Thelypteris thelypteris*), cinnamon fern (*Osmunda cinnamomea*), blueflag (*Iris versicolor*), bedstraw (*Galium* spp.), and bittersweet nightshade (*Solanum dulcamera*).

Area 3

A small plot (approximately 6100 square feet) designated as Area 3 is located at the northern end of the North Waterfront (Figure 4-13). The Navy historically maintained this area as a formal lawn. The vegetation is primarily grass mixed with invasive weed species. The vegetation consists of grasses, common ragweed (*Ambrosia artimisiifolia*), white sweet clover (*Melilotus alba*), and black knapweed (*Centaurea nigra*). A single, living 25-foot specimen and two windthrows of blue spruce (*Picea pungens*) are also present in this area.

4.5.2.2 Central Shipyard

This area is bordered on the north by unmarked points approximately 100 feet north of Buildings 42 and 6, on the east by the Penn Central right-of-way, on the south by the south end of Simonpietri Drive, and on the west by Narragansett Bay.

Area 4

Most of the area in the Central Shipyard was devoid of vegetation at the time of the ecological investigation due to past removal actions around Building 42. The terrestrial vegetation present is an early successional grassland/invasive weed area (Area 4, Figure 4-13) with an area of approximately 1 acre at the southern end of Building 42. This area historically had been the location of Quonset huts that were utilized as maintenance and storage facilities by the Navy. The vegetation in this field consists of grasses, sweet white clover, common ragweed, Queen Anne's lace (*Daucus carota*), black fleabane, goldenrod, red clover (*Trifolium pratense*), chicory (*Cichorium intibus*), and birdsfoot trefoil (*Lotus corniculatus*).

The vegetated area at the northern end of Building 6 was included in the vegetation description presented for Area 2 in the North Waterfront.

4.5.2.3 Building 234 Area

The Building 234 area is bounded on the north by Simonpietri Drive, on the east by the Penn Central right-of-way, on the south by unmarked points approximately 25 feet south of the foundation for the former Building 234, and on the west by Narragansett Bay.

Most of the area is covered by the Building 234 foundation or pavement. Terrestrial vegetations include two small early successional grassland/invasive weed areas. Area 5 (Figure 4-13) is a small isolated vegetated island (approximately 4,000 square feet) surrounded by roadway and railroad. Area 6 (Figure 4-13) is a 0.6 acre field southeast of the Building 234 foundation. The area is fenced along its eastern edge but is not isolated from the South Waterfront vegetation described below. It is likely that these areas were historically maintained in a more cleared condition during earlier Naval operations and during more frequent railway activity.

The vegetation in Areas 5 and 6 is similar to the vegetation presented for the field south of Building 42 (Area 4, Central Shipyard), described in Section 4.5.2.2.

4.5.2.4 South Waterfront

The South Waterfront is bounded on the north by unmarked points approximately 25 feet south of the foundation for the former Building 234, on the east and south by the chain-link fenceline, and on the west by Narragansett Bay.

The vegetation in the South Waterfront include a narrow 3-acre corridor of upland shrub/scrub species and dune/beach vegetation along Narragansett Bay (Area 7, Figure 4-13).

The upland vegetation exists primarily on a soil berm with a relatively steep embankment down to Narragansett Bay. The upland and beach areas between OF#11 and 12 (Figure 4-13) have been significantly disturbed. Large sections of concrete debris have been dumped along the western edge of some of the South Waterfront area. The concrete debris was placed during Derecktor Shipyard operation. The concrete debris is also present, although to a lesser extent, approximately 300 feet south of OF#12. The off-site areas south and west of the fence line are primarily maintained as lawn.

The majority of the upland scrub/shrub vegetation is comprised of a dense cover of American silverberry, multiflora rose, black cherry, crabapple, northern bayberry, Japanese knotweed, bittersweet, and poison-ivy. A few areas of sparse shrub vegetation also include rugosa rose (*Rosa rugosa*), and grasses, cowvetch (*Vicia cracca*), black mustard (*Brassica nigra*), yellow birdsfoot, rough-stemmed goldenrod (*Solidago rugosa*), curley dock (*Rumex crispus*), bull thistle (*Cirsium vulgare*), pokeweed (*Phytolacca*), common evening primrose (*Oenothera biennis*), sweet white clover, and timothy (*Phleum pratense*).

The dune/beach vegetation consists of rugosa rose, marsh elder (*Iva frutescens*), grasses, saltwater cordgrass (*Spartina alterniflora*), salt hay grass (*S. patens*), beach pea (*Lathyrus* spp.), saltmarsh fleabane (*Pluchea purpurascens*), jewelweed (*Impatiens capensis*), saltwort (*Salsola kali*), marsh mallow (*Althaea officinalis*), salt marsh aster (*Aster* spp.), and hedge bindweed (*Calystegia sepium*), including a mixture of the species listed in the preceding paragraph.

4.5.3 Off-Site Areas

This section describes two adjacent wetland areas and an off-site area, one of the least disturbed, which is north of the site and which appears to be representative of the shoreline vegetation in the area. Most of the area surrounding the site consists of NETC property with minimal habitat value.

Wetland vegetation is located to the east of the South Waterfront on the eastern side of the Penn Central right-of-way (Figure 4-13). An unnamed, tidally influence creek, is culverted under Defense Highway and the railroad line, and discharges at Outfall 12. The vegetation is dominated by a monoculture of common reed (*Phragmites communis*).

A small off-site area of wetland vegetation of approximately 900 square feet (Area 8, Figure 4-13) is present to the south of the South Waterfront fence line. The wetland vegetation is located in a stone rip-rapped swale and appears to receive stormwater runoff from Defense Highway. The vegetation consists of cattail, sedge (*Carex* spp.), pickerelweed (*Pontederia cordata*), water purslane (*Ludwigia* spp.), and bulrush (*Scirpus* spp.).

The nearest off-site area with similar topography and setting, but with relatively less disturbance, is located approximately three miles north of the site. This tree/shrub/beach vegetation complex is north of the Navy Morale, Welfare, and Recreation (MWR) area and south of the Weaver Cove public boat ramp on Defense Highway. The narrow corridor vegetation is bounded on the east by Defense Highway and on the west by Narragansett Bay. The Penn Central railroad line also runs through the area.

The upland vegetation has a sparse, broken canopy of red maple (*Acer rubrum*), black cherry, and quaking aspen (*Populus tremuloides*). The dense shrub/scrub layer consists of bayberry, silverberry, smooth sumac (*Rhus glabra*), staghorn sumac (*R. typhina*), red cedar (*Juniperus virginiana*), northern arrowwood, bittersweet, grape (*Vitis* spp.), and poison ivy. The dune/beach vegetation that parallels the upland vegetation and is setback from the Narragansett Bay high water line, consists of Japanese knotweed, rugosa rose, goldenrod, tansy (*Tanacetum vulgare*), black fleabane, Queen Ann's lace, and salt hay grass.

4.5.4 Wildlife

The highly fragmented habitat, ruderal vegetation, large open paved areas, chain-link fence around most of the site, and the minimal habitat surrounding the site (NETC facility) are expected to limit the assemblage of terrestrial, wetland, and avian species that utilize the site. The limited on-site vegetations may provide cover, foraging, and nesting/breeding areas for birds, mammals, reptiles and amphibians that have small home ranges. Additionally, migratory birds may utilize these areas for resting and foraging during migration. The small off-site wetland vegetation Areas 2 and 8 offers the nearest fresh water sources for the small mammals that have limited home ranges.

Species lists are provided for birds, mammals, and reptiles and amphibians that were observed on-site or may potentially utilize the site habitats are presented in Tables 4-7, 4-8 and 4-9. The quantity and quality of the on-site habitats is not sufficiently large or complex to support all species mentioned in the lists. In addition, the list should not be considered a conclusive list of wildlife that may utilize the on-site habitats. The majority of the species listed in Tables 4-8 (mammals) and Table 4-9 (reptiles and amphibians) were qualified as "potential presence" based mostly on their geographical distribution ranges and not on the availability of habitat at the site.

4.5.4.1 Birds

During the 1996 field investigation, the most observed avian species were seabirds (gulls (*Larus* spp.) that use the hard asphalt and concrete surfaces for dropping and cracking open shellfish for food. An inhabited gull nest was observed in OF#9A. A pair of barn swallows (*Tachycineta bicolor*) were observed nesting in Building 42 and foraging on insects over the field south of the building. Birds observed offshore include the great egret (*Casmerodius albus*), double-crested cormorant (*Phalacrocorax auritus*), mallard duck (*Anas platyrhynchos*), and black-crowned night heron (*Nycticorax nycticorax*). A list of upland and seabirds observed onsite is presented in Table 4-7.

4.5.4.2 Mammals

The following mammals were observed on site during the 1996 fieldwork: white-footed mouse (*Peromyscus leucopus*), eastern cottontail (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus*), and a domestic cat (*Felis Domestica*). In addition, racoon (*Procyon lotor*) tracks were observed on the beach of the South Waterfront. Red fox (*Vulpes Vulpes*) has been reported on site and sign has been observed less than one mile north of the site and at the Melville North Landfill, approximately 3 miles north of the site. The Penn Central right-of-way may provide an access corridor between off-site and on-site areas. A list of observed and expected mammals that may find suitable habitat on-site is presented in Table 4-8.

4.5.4.3 Reptiles and Amphibians

The eastern garter snake (*Thamnophis s. sirtalis*) was the only reptile or amphibian observed on site during the 1996 fieldwork. Table 4-9 presents the observed species and also lists reptile and amphibian species that may be expected to utilize the on-site habitats.

4.5.4.4 Endangered Species

According to the U.S. Fish and Wildlife Service (U.S. DOI, 1996) and Rhode Island Natural Heritage Program (RIDEM, 1996), there are no species of special concern of ecologically significant natural communities at or near the Former Robert E. Derecktor Shipyard. However, a possible exception is occasional transient bald eagles (*Haliaeetus leucocephalus*) or peregrine falcons (*Falo peregrinus*).

4.6 EVALUATION OF CULTURAL SETTING

The cultural setting was evaluated in more general terms than the ecological setting. The cultural setting of the surrounding area was evaluated for the presence of recreational, residential commercial, and industrial land uses in the area in order to identify potential receptors for the preliminary human health risk assessment, presented in Section 6.0. This generalized approach for evaluating the cultural setting is appropriate because of industrialized nature of the site itself and the locations and types of potential receptors. Because the future land use is always uncertain, the preliminary risk assessment compensates for the general description of the current land uses by evaluating numerous types of receptors in both present and future use exposure scenarios.

The former Derecktor Shipyard was developed on land and pier space previously utilized by the U.S. Navy. These spaces have been under Navy control since the development of the Coddington Cove shoreline. Prior to this time, it is assumed that this property was used as farmland. Much of the property in the Central Shipyard was beach area and filled in with the installation of the present sheet piling wall and piers.

No groundwater supply wells exist on site. As described elsewhere in this report, overburden groundwater gradient is toward Narragansett Bay, implying that overburden groundwater flows in that direction.

Because of the industrial nature of the site and the physical structures that are present, it is highly unlikely that the future land use will change from the primary use as a port, and thus potential for exposure would exist for site workers or passers-by (adult). However, should this port be used by the general public, these potential exposures could exist for children as well. In addition, all sites should have an evaluation of exposure potential for trespassers, both for young adult (teen) and adult. Future use of the property for residential purposes is highly unlikely.

The land abutting the site is all property owned and maintained by the U.S. Navy, the Naval Education and Training Center (NETC) and the Naval Undersea Warfare Center (NUWC). The use of the surrounding properties is commercial and industrial in nature, in that the personnel in these areas (both civilian Navy employees and Navy military personnel) are working at assigned duties, rather than using the property for recreational or residential use.

Recreational facilities are present 400 feet to the east of the North Waterfront (NETC Softball Fields) as shown on Figure 4-5 and 4-6. These areas are upgradient, but sometimes downwind of the North Waterfront. In addition, there is a recreational exercise path approximately 800 feet to the south west of the south waterfront property (not shown). Both these recreational facilities are maintained by the Navy and can be used by both adults and children.

Residential property is present 800 feet south east and upgradient of the Building 234 Area (Navy Housing) and 900 feet east and upgradient of the Central Shipyard area (private ownership). These areas are reportedly supplied with town water for domestic use.

**TABLE 4-1
RESULTS FROM INSPECTIONS OF SUMPS, CENTRAL SHIPYARD AREA
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

Identifier	Dimensions ¹	Construction	Outlet Piping Present	Potential Discharge Point	Former Use
S42-1	5.5'x 5'x 4.5'	Steel walls and bottom	2-inch ID ⁶ drain pipe in outlet sealed with cement	Yes - former	Paint mixing and thinning
S42-2	6'x 5.4 'x 2'	Concrete sides and bottom	2-inch ID drain at center of bottom, no connecting piping	Yes	Unknown
S42-3	4.4'x 2.1'x 4.5'	Steel sides and bottom	Piping present, connecting to floor drain system and S42-5 ³	No	Dip tank, unknown use
S42-4	6'x 5.4'x 2.1'	Concrete sides and bottom	2-inch ID drain at center of bottom, no connecting piping	Yes ²	Unknown
S42-5 (Vault)	Approx. 15'x 15'x 7'	Concrete walls, bottom, and ceiling	Piping entrance from top from floor drain system and other points	Possibly ⁴	Holding tank or pumping station for septic system, Bldg 42 and Huts 1 & 2
Dry Well	Varies with depth depth = 8.0	Brick sides, compacted gravel bottom	3-inch ID PVC pipe 3 ft from top	Yes	Sewage disposal from current location of Huts 1 & 2

Notes:

- ¹ Length x width x height in feet
- ² No access available to soils under building in this area through crawl space, so no soil samples collected
- ³ Refer to figures describing piping routes under Building 42 (Section 4.2 of this report)
- ⁴ Because the floor of the vault could not be thoroughly inspected, this vault was initially assumed to be a potential discharge area.
- ⁶ ID - Inside Diameter

TABLE 4-2
RESULTS FROM THE INSPECTION OF SUMPS, BUILDING 234 AREA
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Identifier	Dimensions ¹	Construction	Outlet Piping Present	Potential Discharge Point	Former Use
S234-1	20'x 0.6'x 0.8'	Concrete sides, soil bottom	None	Yes	Utility trench
S234-2	14.5'x 1.9'x 0.8'	Concrete sides and bottom	None	No	Unknown
S234-3	22'x 5.7'x 1.9'	Steel sides and bottom	None	No	Mounting brackets present indicate a holding pit for equipment
S234-4	Various, 6' depth	Concrete sides, soil bottom	None	Yes	Shape indicates former housing for lifting equipment
S234-5	12.6'x 1.6'x 1.5'	Steel walls and bottom, welded seams	None	No	Unknown
S234-6	7'x 30'x 12'	Concrete walls and bottom	None	No	Unknown
S234-7	Various, shallow trench less than 1' depth	Concrete walls and bottom	Floor drain present, confirmed to lead to S234-8	Possibly	Unknown
S234-8	Approx. 5'x 5' x 8'	Concrete walls and bottom	Pumps present, various inlet piping present	Possibly ²	Collection sump for building drains (roof, floor, etc)
Equipment Boxes (15)	5'x 2.5'x 2.5'	Concrete walls, unconsolidated bottom	Many utility supply lines present, no drains present	Yes	Utility hookups for power and air tools.
East Utility Trench	241'x 2.6'x 2.5'	Concrete walls and bottom	Floor drains present, confirmed to lead to S234-8	No	Sub-floor utility corridor in work areas
West Utility Trench	261'x 2.6'x 2.5'	Concrete walls and bottom	Floor drains present, confirmed to lead to S234-8	No	Sub-floor utility corridor in work areas

Notes:

¹ Length x width x depth in feet

² Sump had sealed bottoms, so no samples were collected. However, outlet required identification, as described in Section 4.2.

TABLE 4-3A
CONSTITUENTS DETECTED IN SOILS
POTENTIAL DISCHARGE POINTS, CENTRAL SHIPYARD
FORMER ROBERT E. DEREKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

SUMP IDENTIFIER: SAMPLE NUMBER: DSY-S	SAMPLE LOCATION/TYPE					
	S42-1	S42-2	S42-2	S42-5	S42-5	S42-5
	S42-1-0005	S42-2-0005	S42-2-0510	S42-5-0005	S42-5-0510	S42-5-1015
ANALYTE	Soil, 0.0-0.5 ft	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 1.0-1.5
Volatile Organic Compounds (µg/Kg)						
2-Butanone	ND	ND	2 J	3 J	ND	ND
Acetone	31	57	16	180	69	ND
Chlorobenzene	ND	ND	ND	ND	ND	120
Methylene Chloride	9 J	18	17	5 J	8 J	6
Semivolatile Organic Compounds (µg/Kg)						
2,2'-Oxybis(1-chloropropane)	ND	ND	ND	ND	ND	190 J
Acenaphthylene	ND	ND	370 J	ND	ND	ND
Anthracene	ND	ND	610 J	ND	35 J	ND
Benzo(a)anthracene	460 J	110 J	4300	85 J	150 J	82 J
Benzo(a)pyrene	380 J	110 J	3900	110 J	150 J	130 J
Benzo(b)fluoranthene	860 J	190 J	4900	210 J	320 J	190 J
Benzo(g,h,i)perylene	450 J	150 J	2600	ND	ND	ND
Benzo(k)fluoranthene	230 J	71 J	3200	60 J	95 J	81 J
Bis(2-ethylhexyl)phthalate	5500	410 J	230 J	100 J	120 J	100 J
Chrysene	560 J	130 J	4700	91 J	170 J	96 J
Di-n-butylphthalate	2800	100 J	ND	ND	ND	ND
Di-n-octylphthalate	990 J	ND	ND	ND	ND	ND
Fluoranthene	1000 J	170 J	6200	170 J	320 J	180 J
Indeno(1,2,3-cd)pyrene	330 J	96 J	ND	ND	ND	ND
Phenanthrene	1000 J	130 J	1200 J	100 J	220 J	83 J
Pyrene	1500 J	220 J	6400	160 J	380	160 J
Butyltins (µg/Kg)						
Dibutyltin	1000	15 J	88 J	ND	61	39 J
Monobutyltin	360	46 J	3 J	ND	26 J	95 J
Tetrabutyltin	15 J	ND	ND	ND	ND	ND
Tributyltin	2300 J	16	18 J	ND	50 J	ND
Pesticides/PCBs (µg/Kg)						
4,4'-DDD	86	ND	ND	39	ND	ND
4,4'-DDE	24	ND	ND	ND	ND	ND
4,4'-DDT	27	14	ND	10	98	16
Alpha-chlordane	41	ND	ND	ND	ND	46
Aroclor-1254	ND	ND	ND	33	23 J	36 J
Aroclor-1260	260	140	57	ND	ND	ND
Dieldrin	22	16	63	ND	ND	ND
Endrin Aldehyde	ND	64	ND	ND	ND	ND
Gamma-chlordane	68	ND	ND	ND	ND	64
Heptachlor	ND	ND	ND	ND	ND	64
Heptachlor epoxide	ND	47	ND	ND	ND	ND

TABLE 4-3A
 CONSTITUENTS DETECTED IN SOILS
 POTENTIAL DISCHARGE POINTS, CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

SUMP IDENTIFIER: SAMPLE NUMBER: DSY-S	SAMPLE LOCATION/TYPE					
	S42-1	S42-2	S42-2	S42-5	S42-5	S42-5
ANALYTE	S42-1-0005	S42-2-0005	S42-2-0510	S42-5-0005	S42-5-0510	S42-5-1015
	Soil, 0.0-0.5 ft	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 1.0-1.5
TOTAL Metals (mg/Kg)						
Aluminum	10900	8440	5500	18600	18200	15800
Antimony	ND	ND	ND	ND	ND	
Arsenic	13.9	10	9	11.4	9.2	8.3
Barium	1620	62.4	44	279	211	
Beryllium	1.5	0.39	0.30	2	1.5	
Cadmium	28.9	1	1	ND	ND	ND
Chromium	278	21.5	15.6	53.7	47.6	38.6
Cobalt	31.7	7.2	5.8	16.1	12.1	
Copper	2120	89.8	69.8	273	193	195
Iron	122000	21400	23900	39300	39300	30900
Lead	1290	82.8	63	240	65.1	105
Manganese	1260	248	182	279	301	
Mercury	0.6	0.18	0.1	ND	ND	ND
Nickel	150	17.3	13.7	54.4	47.1	61.9
Selenium	3.4	ND	ND	2	1.7	
Silver	ND	ND	ND	ND	ND	
Thallium	ND	ND	ND	ND	ND	
Tin	67.4	ND	ND	20	15.3	ND
Vanadium	23.5	13.8	12.3	29.1	28.5	
Zinc	11900	727	593	658	593	534
TCLP Metals (µg/L)						
Arsenic	10.2	7.7	ND	ND	ND	ND
Barium	400	151	238	303	455	204
Cadmium	114	4.8	6.1	ND	ND	ND
Chromium	12.8	ND	ND	7.9	ND	ND
Lead	12.6	ND	ND	2.6	ND	60
Mercury	ND	0.19	ND	ND	ND	ND
Selenium	5.8	ND	5.4	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)						
TPH	1600					

NOTES
 NA - Not Analyzed
 ND - Not Detected
 J - Estimated quantitation
 * - Dilution results.

TABLE 4-3B
CHEMICAL CONSTITUENTS DETECTED IN SHALLOW BORINGS INSTALLED NEAR POTENTIAL DISCHARGE POINTS
CENTRAL SHIPYARD
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

SUMP IDENTIFIER: DSY-S	SAMPLE LOCATION / TYPE			
	S42-5	S42-5	Dry Well	Dry Well
	SB09-1416	SB10-1416	SB01-0911	SB03-0911
ANALYTE	Boring, 14-16 ft	Boring, 14-16 ft	Boring, 9-11 ft	Boring, 9-11 ft
Volatile Organic Compounds (µg/Kg)				
2-Butanone	11 J	17	3 J	ND
Acetone	50	65	16	14
Methylene Chloride	22	23	22	19
Toluene	1 J	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)				
Benzo(a)anthracene	84 J	ND	ND	ND
Benzo(a)pyrene	73 J	ND	74 J	ND
Benzo(b)fluoranthene	130 J	ND	81 J	ND
Benzo(g,h,i)perylene	ND	ND	61 J	ND
Benzo(k)fluoranthene	65 J	ND	ND	ND
Bis(2-ethylhexyl)phthalate	210 J	120 J	140 J	150 J
Di-n-butylphthalate	48 J	ND	ND	ND
Carbazole		ND	ND	ND
Chrysene	88 J	ND	ND	ND
Fluoranthene	130 J	ND	ND	ND
Phenanthrene	120 J	ND	ND	ND
Pyrene	170 J	ND	ND	ND
Butyltins (µg/Kg)				
Tetrabutyltin	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND
Tributyltin	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)				
4,4'-DDD	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND
Aldrin	ND	ND	ND	ND
Alpha-chlordane	ND	ND	ND	ND
Endrin	ND	ND	ND	ND
Gamma-chlordane	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND

TABLE 4-3B
 CHEMICAL CONSTITUENTS DETECTED IN SHALLOW BORINGS INSTALLED NEAR POTENTIAL DISCHARGE POINTS
 CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION / TYPE				
	SUMP IDENTIFIER: DSY-S	S42-5	S42-5	Dry Well	Dry Well
		SB09-1416	SB10-1416	SB01-0911	SB03-0911
	Boring, 14-16 ft	Boring, 14-16 ft	Boring, 9-11 ft	Boring, 9-11 ft	
TOTAL Metals (mg/Kg)					
Aluminum		9530	13000	11100	10400
Antimony		ND	ND	ND	ND
Arsenic		15.7	17.8	24	17
Barium		19.4	20.2	8.3	6.3
Beryllium		0.45	0.52	0.25	ND
Cadmium		ND	1.1	1	0.72
Chromium		13.1	18.4	15.9	13.6
Cobalt		12	12.1	14.7	11.8
Copper		18.5	12.4	16.2	16.1
Iron		25700	31100	36000	32300
Lead		16.1	8.2	12.5	15.5
Manganese		366	311	551	451
Mercury		ND	ND	ND	ND
Nickel		18	24.7	21.2	21.2
Selenium		ND	ND	ND	ND
Silver		ND	ND	ND	ND
Thallium		ND	ND	ND	ND
Tin		ND	ND	8.9	ND
Vanadium		17.5	22.8	19.4	17.6
Zinc		50.9	50.1	64	82.5
TCLP Metals (µg/L)					
Arsenic		13.5	24.6	ND	ND
Barium		186	158	75	103
Cadmium		13.4	6.6	ND	ND
Chromium		7.8	29.5	ND	18.2
Lead		1.3	4.2	9.6	14.1
Mercury		ND	ND	ND	ND
Selenium		ND	ND	ND	ND
Silver		11.5	20.4	13.7	7.5
Total Petroleum Hydrocarbons (mg/Kg)					
TPH		17000	ND	ND	ND

NOTES.

NA - Not Analyzed

ND - Not Detected

J - Estimated quantitation

* - Dilution Results

TABLE 4-3C
 CHEMICAL CONSTITUENTS DETECTED IN SOILS
 POTENTIAL DISCHARGE POINTS, BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

SUMP IDENTIFIER: SAMPLE NUMBER: DSY-S	SAMPLE LOCATION/TYPE					
	S234-1	S234-1	S234-1	S234-4	S234-4	S234-4
ANALYTE	S234-1-0005	S234-1-0510	S234-1-1015	S234-4-0005	S234-4-0510	S234-4-1015
	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 1.0-1.5 ft.	Soil, 0.0-0.5 ft.	Soil, 0.5-1.0 ft.	Soil, 1.0-1.5 ft.
Volatile Organic Compounds (µg/Kg)						
2-Butanone	ND	9 J	8 J	ND	ND	3 J
Acetone	7 J	14	14	7 J	6 J	7 J
Methylene Chloride	8 J	7 J	7 J	31	23	26
Semivolatile Organic Compounds (µg/Kg)						
Bis(2-ethylhexyl)phthalate	54 J	130 J	ND	ND	ND	ND
Butyltins (µg/Kg)						
Monobutyltin	ND	43 J	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)						
Aroclor-1242	ND	9 J	ND	ND	ND	ND
TOTAL Metals (mg/Kg)						
Aluminum	5390	5000	4220	3000	3900	2940
Arsenic	4	39	34	27	35	34
Barium	92	95	53	129	4	34
Beryllium	0.20	0.19	ND	ND	ND	ND
Cadmium	ND	ND	ND	0.85	ND	ND
Chromium	79	58	58	91	59	54
Cobalt	69	66	34	45	43	29
Copper	157	162	7	178	67	39
Iron	15100	14900	12100	10100	11500	9360
Lead	92	48	26	437	25	14
Manganese	279	251	126	119	922	862
Mercury	ND	ND	ND	ND	ND	ND
Nickel	119	94	78	71	89	58
Selenium	ND	1.1	ND	ND	0.89	ND
Tin	NA	NA	NA	NA	NA	NA
Vanadium	7	66	68	6	66	59
Zinc	367	283	224	177	252	17
TCLP Metals (µg/L)						
Arsenic	ND	ND	ND	ND	ND	ND
Barium	503	373	331	453	639	554
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	67	ND	ND	ND	ND	ND
Lead	ND	ND	ND	18	166	ND
Total Petroleum Hydrocarbons (mg/Kg)						
TPH	ND	ND	ND	19000	11000	9200

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation

TABLE 4-3D
 CHEMICAL CONSTITUENTS DETECTED IN BORINGS INSTALLED NEAR POTENTIAL DISCHARGE AREAS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SUMP IDENTIFIER: DSY-S	SAMPLE LOCATION/TYPE				
		EQUIPMENT BOXES		S234-7		
		SB04-0406 Boring, 4-6 ft	SB06-0204 Boring, 2-4 ft	SB14-0103 Field Dup 11 Boring 1-3 ft	DUPL-11 Field Dup 11 Boring, 1-3 ft	SB15-0103 Boring, 1-3 ft
Volatile Organic Compounds (µg/Kg)						
1,2-Dichloroethene (total)		ND	ND	ND	ND	ND
2-Butanone		ND	9 J	ND	ND	5 J
Acetone		19	27	15	14	18
Benzene		ND	1 J	ND	ND	ND
Chlorobenzene		ND	ND	ND	ND	ND
Carbon disulfide		ND	ND	ND	ND	ND
Ethylbenzene		ND	ND	ND	ND	ND
Methylene Chloride		16	20	10	8	8 J
Toluene		ND	1 J	ND	ND	ND
Trichloroethene		ND	ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)						
2-Methylnaphthalene		ND	ND	50 J	ND	66 J
Benzo(a)anthracene		ND	ND	67 J	ND	ND
Benzo(a)pyrene		ND	ND	58 J	ND	ND
Benzo(b)fluoranthene		ND	ND	100 J	ND	ND
Bis(2-ethylhexyl)phthalate		800	200 J	160 J	260 J	130 J
Di-n-butylphthalate		50 J	28 J	ND	ND	ND
Chrysene		ND	ND	62 J	ND	110 J
Fluoranthene		ND	ND	130 J	56 J	110 J
Phenanthrene		ND	ND	110 J	ND	160 J
Pyrene		ND	ND	150 J	43 J	100 J
Butyltins (µg/Kg)						
Tetrabutyltin		ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	8.8 J	ND
Tributyltin		ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)						
		ND	ND	ND	ND	ND

TABLE 4-3D
 CHEMICAL CONSTITUENTS DETECTED IN BORINGS INSTALLED NEAR POTENTIAL DISCHARGE AREAS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SUMP IDENTIFIER: DSY-S-	SAMPLE LOCATION/TYPE				
		EQUIPMENT BOXES		S234-7		
		SB04-0406 Boring, 4-6 ft	SB06-0204 Boring, 2-4 ft	SB14-0103 Field Dup 11 Boring 1-3 ft	DUPL-11 Field Dup 11 Boring, 1-3 ft	SB15-0103 Boring, 1-3 ft
TOTAL Metals (mg/Kg)						
Aluminum		3270	3990	10500	10400	10700
Antimony		ND	ND	ND	ND	ND
Arsenic		3.5	7.7	17.7	17.9	16.1
Barium		4	6.6	20.7	21.1	10.1
Beryllium		ND	ND	0.44	0.46	0.32
Cadmium		ND	ND	ND	1	0.97
Chromium		8.1	60.2	14.3	13.2	14.5
Cobalt		3.9	6.3	10.8	9.6	12.8
Copper		4.1	38.8	20.7	14.3	19.9
Iron		9520	29200	24200	24400	28400
Lead		1.5	1.3	12.5	29.5	5.3
Manganese		93.2	236	352	302	289
Mercury		ND	ND	ND	ND	ND
Nickel		7.2	30.1	16.6	16.9	21.9
Selenium		ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND
Vanadium		7	10.7	15.8	15.8	14
Zinc		18	49.9	54.7	48.2	43.6
TCLP Metals (µg/L)						
Arsenic		4 U	4 U	4 U	4.3	6.2
Barium		78.5	123	113	115	149
Cadmium		3 U	21.5	3.5	7.8	8.5
Chromium		7.4	129	6 U	7.6	6 U
Lead		1.3	1 U	3.1	5.3	6.1
Mercury		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Selenium		4 U	4 U	4 U	4 U	4 U
Silver		9	10.6	10.2	7.2	11.9
Total Petroleum Hydrocarbons (mg/Kg)						
TPH		ND	ND	ND	ND	ND

NA - Not Analyzed
 ND - Not Detected
 J - Estimated quantitation

TABLE 4-4A
 CONSTITUENTS DETECTED IN SURFACE SOILS
 UPGRADIENT AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE	
		MW01-0002	MW10-0002
		Boring, 0-1 ft	Boring, 0-1 ft
Volatile Organic Compounds (µg/Kg)			
2-Butanone		ND	ND
Acetone		13	5 J
Methylene Chloride		19	14
Toluene		ND	ND
Xylenes, Total		ND	ND
Semivolatile Organic Compounds (µg/Kg)			
2,2'-Oxybis(1-chloropropane)		ND	ND
2,4-Dimethylphenol		ND	ND
2-Chlorophenol		ND	ND
2-Methylphenol		ND	ND
4-Methylphenol		ND	ND
Acenaphthene		ND	ND
Anthracene		ND	ND
Benzo(a)anthracene		ND	ND
Benzo(a)pyrene		ND	ND
Benzo(b)fluoranthene		ND	55 J
Benzo(g,h,i)perylene		ND	ND
Benzo(k)fluoranthene		ND	ND
Bis(2-ethylhexyl)phthalate		90 J	210 J
Carbazole		ND	ND
Chrysene		ND	ND
Di-n-butylphthalate		ND	ND
Di-n-octylphthalate		ND	120 J
Dibenzo(a,h)anthracene		ND	ND
Fluoranthene		53 J	63 J
Fluorene		ND	ND
Hexachloroethane		ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND
Phenanthrene		ND	ND
Phenol		ND	ND
Pyrene		54 J	59 J
Butyltins (µg/Kg)			
Tetrabutyltin		ND	ND
Tributyltin		ND	11 J
Di-butyltin		ND	ND
Monobutyltin		ND	ND
Pesticides/PCBs (µg/Kg)			
4,4'-DDD		ND	ND
4,4'-DDE		ND	27
4,4'-DDT		ND	32
Alpha-chlordane		ND	ND
Aroclor-1254		ND	ND
Aroclor-1260		ND	ND

TABLE 4-4A
 CONSTITUENTS DETECTED IN SURFACE SOILS
 UPGRADIENT AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE	
		MW01-0002	MW10-0002
		Boring, 0-1 ft	Boring, 0-1 ft
Pesticides/PCBs (µg/Kg) - con't			
Dieldrin		ND	ND
Endrin		ND	ND
Endrin ketone		ND	ND
Gamma-chlordane		ND	ND
Heptachlor		ND	ND
Heptachlor epoxide		ND	ND
Methoxychlor		ND	ND
TOTAL Metals (mg/Kg)			
Aluminum		13100	13200
Antimony		ND	ND
Arsenic		19.5	20.3
Barium		36.3	20.1
Beryllium		0.76	0.43
Cadmium		ND	0.61
Chromium		16.4	15
Cobalt		18.4	10.5
Copper		11.2	15
Iron		28200	26900
Lead		18.3	16.2
Manganese		1580	338
Mercury		0.08	ND
Nickel		21.4	19.2
Selenium		ND	ND
Silver		ND	ND
Thallium		ND	ND
Tin		ND	13.4
Vanadium		21.7	22.2
Zinc		49.7	54
TCLP Metals (µg/L)			
Arsenic		ND	ND
Barium		194	141
Cadmium		ND	ND
Chromium		ND	17.8
Lead		1.1	5.6
Mercury		0.13	ND
Selenium		ND	4.6
Silver		13.5	8.2
Total Petroleum Hydrocarbons (mg/Kg)			
TPH		260	ND

ND - Not Detected
 J - Estimated quantitation

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE						
	DSY-S	TP16-0001	TP18-0001	DUPL-02	TP19-0001	TP20-0001	TP21-0001
		Field Dup 02	Field Dup 02	Field Dup 02	Field Dup 02	Field Dup 02	Field Dup 02
	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0.3-1.3 ft			
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	14	110	120	100	77	110	
Methylene Chloride	3 J	5 J	4 J	4 J	5 J	5 J	
Toluene	ND	ND	1 J	1 J	2 J	1 J	
Xylenes, Total	ND	ND	ND	ND	ND	ND	
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)	ND	ND	39 J	ND	ND	ND	
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	
2-Chlorophenol	ND	ND	ND	ND	ND	ND	
2-Methylphenol	ND	ND	ND	ND	ND	ND	
4-Methylphenol	ND	ND	ND	ND	ND	ND	
Acenaphthene	ND	ND	ND	ND	ND	ND	
Anthracene	ND	ND	ND	ND	ND	ND	
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	
Bis(2-ethylhexyl)phthalate	ND	150 J	65 J	66 J	44 J	68 J	
Carbazole	ND	ND	ND	ND	ND	ND	
Chrysene	ND	ND	ND	ND	ND	ND	
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	
Fluoranthene	ND	ND	ND	ND	ND	ND	
Fluorene	ND	ND	ND	ND	ND	ND	
Hexachloroethane	ND	ND	ND	ND	55 J	ND	
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	
Phenanthrene	ND	ND	ND	ND	ND	ND	
Phenol	ND	170 J	ND	ND	ND	ND	
Pyrene	1400 J	ND	ND	ND	ND	ND	
Butyltins (µg/Kg)							
Tetrabutyltin	ND	ND	ND	ND	76 J	91 J	
Tributyltin	463 J	14 J	ND	ND	ND	ND	
Dibutyltin	511	21 J	12 J	ND	ND	ND	
Monobutyltin	519	ND	ND	ND	ND	ND	
Pesticides/PCBs (µg/Kg)							
4,4'-DDD	ND	ND	ND	ND	ND	ND	
4,4'-DDE	ND	ND	ND	ND	ND	ND	
4,4'-DDT	ND	ND	ND	ND	ND	ND	
Alpha-chlordane	ND	ND	ND	ND	ND	ND	
Aroclor-1254	ND	ND	ND	ND	ND	ND	
Aroclor-1260	24 J	ND	ND	ND	ND	ND	

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFR NT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP16-0001	TP18-0001	DUPL-02	TP19-0001	TP20-0001	TP21-0001
		Test Pit, 0-1 ft	Field Dup 02 Test Pit, 0-1 ft	Field Dup 02 Test Pit, 0-1 ft	Test Pit, 0.3-1.3 ft	Test Pit, 0.3-1.3 ft	Test Pit, 0.3-1.3 ft
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		16	ND	ND	ND	ND	ND
Endrin		26	ND	ND	ND	ND	ND
Endrin ketone		ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		8290	5280	5250	4920	5980	3950
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		4.7	4.2	5	2.6	4.5	5.1
Barium		49.4	28.6	11.1	5.1	13.5	8.3
Beryllium		1.1	0.18	0.23	ND	0.23	0.21
Cadmium		0.85	ND	ND	ND	ND	ND
Chromium		24.1	6.6	7	7.9	7.7	5.2
Cobalt		14.7	8	8	3.4	8.6	9.1
Copper		111	22.9	26.9	4.3	20.8	19.3
Iron		19600	15400	17400	11200	18100	15900
Lead		85.5	20.6	14.8	3.7	14.2	9.5
Manganese		187	284	299	84.1	306	322
Mercury		0.1	ND	0.05	ND	ND	ND
Nickel		68.5	13	14	9.3	14.4	14.3
Selenium		0.99	0.64	ND	ND	ND	0.66
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		12.2	ND	ND	ND	ND	ND
Vanadium		22.4	9.9	9.2	8.6	10.2	7.6
Zinc		883	76.4	77.8	48	41	40.6
TCLP Metals (µg/L)							
Arsenic		6.2	ND	ND	ND	ND	ND
Barium		193	184	111	41.3	203	167
Cadmium		3.1	5.1	ND	ND	ND	4.2
Chromium		6.5	10.2	6.1	ND	9.8	12
Lead		71.8	12.4	12.1	1.9	9.7	4.4
Mercury		ND	ND	ND	ND	ND	ND
Selenium		ND	5.1	5.3	6.1	4.3	5.7
Silver		ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		4900	170	ND	310	200	ND

ND - Not Detected
 J - Estimated quantitation

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP22-0001	TP23-0001	TP24-0102	DUPL-01	TP27-0001	TP28-0001
		Test Pit, 0.3-1.3 ft	Test Pit, 0.3-1.3 ft	Field Dup 01 Test Pit, 1-2 ft	Field Dup 01 Test Pit, 1-2 ft	Test Pit, 0.3-1.3 ft	Test Pit, 0-1 ft
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	
Volatile Organic Compounds (µg/Kg)							
2-Butanone		ND	ND	14	ND	ND	ND
Acetone		75	92	99	33	ND	8 J
Methylene Chloride		5 J	6 J	6 J	6 J	11	21
Toluene		ND	4 J	2 J	ND	ND	ND
Xylenes, Total		ND	2 J	2 J	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)		ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol		ND	ND	ND	ND	ND	ND
2-Chlorophenol		ND	ND	ND	ND	ND	ND
2-Methylphenol		ND	ND	ND	ND	ND	ND
4-Methylphenol		ND	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	ND	ND	ND	ND
Anthracene		ND	ND	ND	ND	ND	ND
Benzo(a)anthracene		ND	ND	ND	53 J	ND	710 J
Benzo(a)pyrene		ND	ND	ND	44 J	ND	680 J
Benzo(b)fluoranthene		ND	ND	ND	71 J	ND	1000 J
Benzo(g,h,i)perylene		ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		65 J	110 J	97 J	43 J	ND	1500 J
Carbazole		ND	ND	ND	ND	ND	ND
Chrysene		ND	ND	ND	44 J	ND	690 J
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND
Di-n-octylphthalate		ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND	ND	ND	ND	ND
Fluoranthene		ND	ND	ND	81 J	ND	1400 J
Fluorene		ND	ND	ND	ND	ND	ND
Hexachloroethane		ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND	ND	ND	520 J
Phenanthrene		ND	ND	ND	54 J	ND	730 J
Phenol		ND	ND	ND	ND	ND	ND
Pyrene		ND	ND	ND	ND	ND	1300 J
Butyltins (µg/Kg)							
Tetrabutyltin		17 J	10 J	7.6 J	25 J	ND	ND
Tributyltin		ND	26 J	ND	ND	ND	ND
Dibutyltin		ND	ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		ND	ND	ND	ND	ND	ND
4,4'-DDE		ND	ND	ND	ND	ND	22
4,4'-DDT		ND	ND	ND	ND	ND	56*
Alpha-chlordane		ND	ND	ND	ND	ND	7.3
Aroclor-1254		ND	ND	ND	ND	ND	ND
Aroclor-1260		ND	ND	ND	ND	ND	ND

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP22-0001	TP23-0001	TP24-0102	DUPL-01	TP27-0001	TP28-0001
		Test Pit, 0.3-1.3 ft	Test Pit, 0.3-1.3 ft	Field Dup 01 Test Pit, 1-2 ft	Field Dup 01 Test Pit, 1-2 ft	Test Pit, 0.3-1.3 ft	Test Pit, 0-1 ft
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND
Endrin ketone		ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	4.2
Methoxychlor		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		4810	7830	4940	4960	3840	9100
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		5.3	8.8	5.7	5.5	3.3	10.9
Barium		9.5	15.1	1.3	12.9	7.1	26.6
Beryllium		ND	0.31	0.25	0.19	ND	0.38
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		5.8	9.2	6.3	6.1	5.3	12.0
Cobalt		7.9	9.8	9	9	6.4	7.3
Copper		18.8	19.3	20.7	18.7	16.4	20.4
Iron		15900	19400	17700	17400	13200	19100
Lead		9.8	10.8	7.5	7.3	13.8	11.5
Manganese		259	340	400	329	218	314
Mercury		ND	0.05	ND	ND	ND	0.17
Nickel		12.4	17	15.7	14.9	8.9	14.5
Selenium		ND	0.63	0.69	0.63	ND	ND
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND
Vanadium		8.4	12.2	9	8.9	6.5	39
Zinc		44.4	42.4	40.1	39.1	30.3	59.6
TCPL Metals (µg/L)							
Arsenic		ND	ND	5.8	ND	ND	ND
Barium		110	140	109	225	719	556
Cadmium		ND	ND	ND	4	ND	ND
Chromium		ND	6.3	ND	ND	16.6	ND
Lead		3.3	5.2	3.6	1.2	5.7	71.9
Mercury		ND	ND	ND	ND	ND	0.2
Selenium		6.2	7	8.3	5.1	ND	4.3
Silver		ND	ND	ND	ND	ND	8.1
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		ND	290	ND	ND	61	130

ND - Not Detected
 J - Estimated quantitation

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		MW02-0002	MW03-0002	MW04-0002	MW11-0002	MW12-0002	SB11-0002
		Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.3-1.3 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)							
2-Butanone		ND	ND	ND	ND	ND	2 J
Acetone		6 J	10 J	8 J	41	5 J	6 J
Methylene Chloride		10 J	12	17	18	7 J	18
Toluene		ND	ND	ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	1 J	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)		ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol		ND	ND	ND	ND	ND	ND
2-Chlorophenol		ND	ND	ND	ND	ND	ND
2-Methylphenol		ND	ND	ND	ND	ND	ND
4-Methylphenol		ND	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	ND	ND	ND	ND
Anthracene		ND	ND	ND	ND	ND	ND
Benzo(a)anthracene		ND	ND	ND	ND	ND	ND
Benzo(a)pyrene		ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene		ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene		ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		46 J	34 J	43 J	160 J	80 J	230 J
Carbazole		ND	ND	ND	ND	ND	ND
Chrysene		ND	ND	ND	ND	ND	ND
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND
Di-n-octylphthalate		ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND	ND	ND	ND	ND
Fluoranthene		ND	ND	ND	ND	ND	ND
Fluorene		ND	ND	ND	ND	ND	ND
Hexachloroethane		ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND	ND	ND	ND
Phenanthrene		ND	ND	ND	ND	ND	ND
Phenol		ND	ND	ND	ND	ND	ND
Pyrene		ND	ND	ND	ND	ND	ND
Butyltins (µg/Kg)							
Tetrabutyltin		ND	ND	ND	ND	ND	ND
Tributyltin		ND	ND	ND	ND	ND	ND
Dibutyltin		ND	ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		ND	ND	ND	ND	ND	ND
4,4'-DDE		ND	ND	ND	ND	ND	ND
4,4'-DDT		ND	ND	ND	ND	ND	ND
Alpha-chlordane		ND	2	ND	ND	ND	ND
Aroclor-1254		ND	ND	ND	ND	ND	ND
Aroclor-1260		ND	ND	ND	ND	ND	ND

TABLE 4-4B
 CONSTITUENTS DETECTED IN SURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		MW02-0002	MW03-0002	MW04-0002	MW11-0002	MW12-0002	SB11-0002
		Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.3-1.3 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	5.7
Endrin ketone		ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	2.4	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		4620	4460	3440	4220	4690	4300
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		3	3.3	4.9	3.8	2.8	2.9
Barium		5.4	5.9	6.4	9.3	4.1	7.2
Beryllium		ND	ND	ND	ND	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		7.8	8.8	6.9	6.5	7.4	6.7
Cobalt		4.4	3.5	4.6	8	2.6	4.6
Copper		8.9	13.6	9.2	15.7	3.1	8
Iron		12800	13100	12100	11900	11500	12900
Lead		3.7	20.1	7	4.8	2.3	8
Manganese		137	111	149	268	81.4	135
Mercury		ND	0.06	ND	ND	ND	ND
Nickel		13.1	9.7	8.2	9.4	9.8	11
Selenium		0.78	ND	ND	ND	1	ND
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND
Vanadium		7.4	7.7	6.6	6.4	7.4	8.4
Zinc		28.8	49.2	22.8	22.8	22.8	26.4
TCLP Metals (µg/L)							
Arsenic		ND	ND	ND	ND	ND	4.4
Barium		609	125	278	112	592	150
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		ND	ND	ND	ND	ND	40.5
Lead		ND	ND	5.7	ND	1.1	4.5
Mercury		ND	ND	ND	ND	ND	ND
Selenium		ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	6.2	ND	18.6
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		ND	ND	ND	ND	ND	

ND - Not Detected
 J - Estimated quantitation

TABLE 4-4C
 CONSTITUENTS DETECTED IN SURFACE SOILS
 CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					MW05-0002 Field Dup 8 Boring, 0-1 ft
		TP11-0001	TP12-0001	TP14-0001	TP15-0001	TP17-0001	
		Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	
Volatile Organic Compounds (µg/Kg)							
2-Butanone		ND	ND	ND	ND	ND	ND
Acetone		ND	ND	ND	ND	ND	11
Methylene Chloride		7 J	6 J	7 J	6 J	6 J	23
Toluene		ND	ND	ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)		ND	ND	ND	180 J	410	ND
2,4-Dimethylphenol		ND	ND	ND	ND	320 J	ND
2-Chlorophenol		ND	ND	ND	ND	40 J	ND
2-Methylphenol		ND	ND	ND	ND	560	ND
4-Methylphenol		ND	ND	ND	ND	2400	ND
Acenaphthene		ND	ND	ND	92 J	ND	ND
Anthracene		ND	ND	ND	130 J	ND	ND
Benzo(a)anthracene		ND	ND	ND	410	140 J	ND
Benzo(a)pyrene		ND	ND	ND	86 J	ND	ND
Benzo(b)fluoranthene		ND	ND	ND	410	280 J	ND
Benzo(g,h,i)perylene		ND	ND	ND	110 J	56 J	ND
Benzo(k)fluoranthene		ND	ND	ND	360 J	ND	ND
Bis(2-ethylhexyl)phthalate		37 J	ND	ND	44 J	ND	ND
Carbazole		ND	ND	ND	97 J	ND	ND
Chrysene		ND	ND	ND	420	130 J	ND
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND
Di-n-octylphthalate		ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND	ND	ND	ND	ND
Fluoranthene		ND	ND	ND	870	270 J	ND
Fluorene		ND	ND	ND	65 J	ND	ND
Hexachloroethane		ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND	150 J	73 J	ND
Phenanthrene		ND	ND	ND	580	140 J	ND
Phenol		ND	ND	ND	ND	1200	ND
Pyrene		ND	ND	ND	740	240 J	ND
Butyltins (µg/Kg)							
Tetrabutyltin		ND	ND	ND	142 J	ND	ND
Tributyltin		ND	ND	ND	767 J	ND	ND
Dibutyltin		ND	ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		ND	ND	ND	43	ND	ND
4,4'-DDE		ND	ND	ND	ND	ND	ND
4,4'-DDT		ND	ND	ND	62	ND	ND
Alpha-chlordane		ND	ND	ND	ND	ND	ND
Aroclor-1254		ND	ND	ND	ND	ND	ND
Aroclor-1260		ND	ND	71000 *	32 J	ND	ND

TABLE 4-4C
 CONSTITUENTS DETECTED IN SURFACE SOILS
 CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE						
	DSY-S	TP11-0001	TP12-0001	TP14-0001	TP15-0001	TP17-0001	MW05-0002
		Test Pit, 0-1 ft	Field Dup 8 Boring, 0-1 ft				
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		ND	ND	470	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND
Endrin ketone		ND	ND	1100	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	2300	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		12100	13200	14400	12700	5820	8060
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		24.4	20.1	9.5	19.3	3.9	5.8
Barium		17.1	21.4	19.8	24	14.5	12.5
Beryllium		0.41	0.42	0.31	0.47	0.23	0.26
Cadmium		0.97	0.88	1.2	1.0	0.75	ND
Chromium		15.6	18.2	19	16.8	11.0	10
Cobalt		14.4	14.4	12	12.2	7.6	9.3
Copper		25.6	31.8	33	29.6	23.1	15.2
Iron		31800	32500	32900	31200	23200	18000
Lead		10.3	14.7	24.8	27.4	26.2	5.8
Manganese		445	421	318	349	325	323
Mercury		0.09	0.11	0.11	0.13	0.08	ND
Nickel		23.7	27.1	27.4	24.4	15.6	14.5
Selenium		0.87	0.74	ND	1.2	ND	ND
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND
Vanadium		17.8	18.9	21.2	21.8	13.7	8.6
Zinc		51.2	70.2	123	71.0	60.0	32.7
TCPL Metals (µg/L)							
Arsenic		ND	ND	ND	5.3	ND	ND
Barium		87.1	306	154	186	114	683
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		ND	ND	ND	ND	7.1	ND
Lead		ND	12.8	37.2	21.1	13.1	ND
Mercury		ND	ND	ND	ND	ND	ND
Selenium		ND	7.7	ND	ND	4.0	ND
Silver		ND	ND	ND	ND	ND	6.1
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		ND	2000	1700	68	170	ND

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-4C
 CONSTITUENTS DETECTED IN SURFACE SOILS
 CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE		
		DUPL-08	MW06-0002	MW07-0002
		Field Dup 8 Boring, 0-1 ft	Boring, 0.8-1.8 ft	Boring, 0-1 ft
Volatile Organic Compounds (µg/Kg)				
2-Butanone		2 J	ND	ND
Acetone		12	12	6 J
Methylene Chloride		18	30	15
Toluene		ND	ND	ND
Xylenes, Total		ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)				
2,2'-Oxybis(1-chloropropane)		ND	ND	ND
2,4-Dimethylphenol		ND	ND	ND
2-Chlorophenol		ND	ND	ND
2-Methylphenol		ND	ND	ND
4-Methylphenol		ND	ND	ND
Acenaphthene		ND	ND	ND
Anthracene		ND	ND	ND
Benzo(a)anthracene		ND	130 J	ND
Benzo(a)pyrene		ND	120 J	ND
Benzo(b)fluoranthene		ND	180 J	ND
Benzo(g,h,i)perylene		ND	72 J	ND
Benzo(k)fluoranthene		ND	86 J	ND
Bis(2-ethylhexyl)phthalate		ND	57 J	ND
Carbazole		ND	ND	ND
Chrysene		ND	140 J	ND
Di-n-butylphthalate		ND	ND	ND
Di-n-octylphthalate		ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND	ND
Fluoranthene		ND	300 J	ND
Fluorene		ND	ND	ND
Hexachloroethane		ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	71 J	ND
Phenanthrene		ND	120 J	ND
Phenol		ND	ND	ND
Pyrene		ND	230 J	ND
Butyltins (µg/Kg)				
Tetrabutyltin		ND	ND	ND
Tributyltin		ND	ND	ND
Di-butyltin		ND	ND	ND
Monobutyltin		ND	ND	ND
Pesticides/PCBs (µg/Kg)				
4,4'-DDD		ND	ND	ND
4,4'-DDE		ND	ND	ND
4,4'-DDT		ND	ND	ND
Alpha-chlordane		ND	ND	ND
Aroclor-1254		ND	ND	ND
Aroclor-1260		ND	ND	ND

TABLE 4-4C
 CONSTITUENTS DETECTED IN SURFACE SOILS
 CENTRAL SHIPYARD
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE		
		DUPL-08	MW06-0002	MW07-0002
		Field Dup 8 Boring, 0-1 ft	Boring, 0.8-1.8 ft	Boring, 0-1 ft
Pesticides/PCBs (µg/Kg) - con't				
Dieldrin		ND	ND	ND
Endrin		ND	ND	ND
Endrin ketone		ND	ND	ND
Gamma-chlordane		ND	ND	ND
Heptachlor		ND	ND	ND
Heptachlor epoxide		ND	ND	ND
Methoxychlor		ND	ND	ND
TOTAL Metals (mg/Kg)				
Aluminum		8300	12300	13100
Antimony		ND	ND	ND
Arsenic		4.9	10.4	23.9
Barium		12.4	14.8	12.1
Beryllium		0.26	0.45	0.38
Cadmium		ND	ND	ND
Chromium		9.6	15.8	15.8
Cobalt		8.6	22.7	14.7
Copper		15.1	30.2	19.5
Iron		19000	30600	31000
Lead		21.2	18.1	9.2
Manganese		272	619	448
Mercury		ND	ND	0.12
Nickel		15.3	24.9	24.9
Selenium		ND	ND	ND
Silver		ND	ND	ND
Thallium		ND	ND	ND
Tin		ND	ND	ND
Vanadium		8.9	14.5	14.5
Zinc		34	88.5	54.8
TCLP Metals (µg/L)				
Arsenic		4.6	ND	5.7
Barium		634	121	724
Cadmium		ND	ND	ND
Chromium		ND	13.6	ND
Lead		ND	6.2	1.8
Mercury		ND	ND	ND
Selenium		ND	ND	ND
Silver		7.5	7.6	ND
Total Petroleum Hydrocarbons (mg/Kg)				
TPH		ND	72	ND

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-4D
 CONSTITUENTS DETECTED IN SURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE						
	DSY-S	TP07-0001	TP08-0001	DUPL-04	TP09-0001	TP10-0001	TP26-0001
		Test Pit, 0-1 ft	Field Dup 04 Test Pit, 0-1 ft	Field Dup 04 Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0.5-1.5 ft
Volatile Organic Compounds (µg/Kg)							
2-Butanone		6 J	ND		3 J	ND	ND
Acetone		26	19		20	7 J	5 J
Methylene Chloride		10 J	11		11	9 J	6 J
Toluene		1 J	2 J		1 J	ND	ND
Xylenes, Total		ND	ND		ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)		ND	ND		ND	ND	ND
2,4-Dimethylphenol		ND	ND		ND	ND	ND
2-Chlorophenol		ND	ND		ND	ND	ND
2-Methylphenol		ND	ND		ND	ND	ND
4-Methylphenol		ND	ND		ND	ND	ND
Acenaphthene		ND	ND		ND	ND	46 J
Anthracene		ND	ND		ND	ND	65 J
Benzo(a)anthracene		170 J	ND		ND	ND	250 J
Benzo(a)pyrene		200 J	ND		ND	ND	210 J
Benzo(b)fluoranthene		410 J	38 J		77 J	ND	340 J
Benzo(g,h,i)perylene		ND	ND		ND	ND	160 J
Benzo(k)fluoranthene		ND	ND		ND	ND	140 J
Bis(2-ethylhexyl)phthalate		8700	1600		380	2700	930
Carbazole		ND	ND		ND	ND	56 J
Chrysene		310 J	ND		41 J	ND	290 J
Di-n-butylphthalate		ND	ND		ND	ND	ND
Di-n-octylphthalate		ND	ND		ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND		ND	ND	ND
Fluoranthene		ND	50 J		100 J	ND	470
Fluorene		ND	ND		ND	ND	ND
Hexachloroethane		ND	ND		ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND		ND	ND	150 J
Phenanthrene		ND	36 J		47 J	ND	350 J
Phenol		ND	ND		ND	ND	ND
Pyrene		320 J	72 J		72 J	ND	560
120 J							
Butyltins (µg/Kg)							
Tetrabutyltin		ND	ND		ND	19 J	ND
Tributyltin		ND	ND		ND	35 J	ND
Di-butyltin		ND	ND		ND	ND	ND
Monobutyltin		ND	ND		ND	ND	ND
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		ND	ND		ND	ND	ND
4,4'-DDE		ND	ND		4.5	ND	ND
4,4'-DDT		ND	8.9		8.3	ND	5
Alpha-chlordane		ND	ND		ND	ND	ND
Aroclor-1254		ND	ND		ND	ND	ND
Aroclor-1260		ND	ND		ND	ND	24 J

TABLE 4-4D
 CONSTITUENTS DETECTED IN SURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP07-0001	TP08-0001	DUPL-04	TP09-0001	TP10-0001	TP26-0001
		Test Pit, 0-1 ft	Field Dup 04 Test Pit, 0-1 ft	Field Dup 04 Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0.5-1.5 ft
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND
Endrin ketone		ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	3.9	ND
Heptachlor		ND	ND	ND	ND	4.5	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		4930	5910	6340	11300	10000	3810
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		3.9	4.9	7.4	23.6	15.8	2.6
Barium		8.9	46.8	42	18	28.1	13.5
Beryllium		0.18	0.21	0.24	0.44	0.54	0.29
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		12.3	15	16	16	18.4	6.4
Cobalt		5.4	7.9	8.6	21.4	13.5	3.3
Copper		16.8	26.7	26.9	26.4	35	12.9
Iron		14500	19500	21100	37200	26700	7770
Lead		17.2	52.8	50.2	12.8	62.5	9.7
Manganese		195	291	310	597	448	157
Mercury		ND	ND	ND	ND	ND	0.09
Nickel		12.6	16.3	18.2	28.2	26.7	7.8
Selenium		ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND
Vanadium		10.1	12.2	13.9	20	23.2	6.8
Zinc		63.6	131	126	75.3	139	44.3
TCLP Metals (µg/L)							
Arsenic		ND	ND	ND	ND	ND	ND
Barium		90.7	350	456	128	152	411
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		ND	39.5	52.4	ND	ND	ND
Lead		9.6	90.5	114	2.5	41.6	29.0
Mercury		0.53	0.55	0.56	0.55	0.59	ND
Selenium		5.5	5.9	5.8	4.9	5	8.1
Silver		ND	ND	ND	ND	14.4	ND
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		ND	ND	ND	ND	61	320

NA - Not Analyzed
 ND - Not Detected
 J - Estimated quantitation
 * - Dilution results

TABLE 4-4D
 CONSTITUENTS DETECTED IN SURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE	
	DSY-S-	
	MW08-0002	MW09-0002
	Boring, 1-2 ft	Boring, 0-1 ft
Volatile Organic Compounds (µg/Kg)		
2-Butanone	10 J	ND
Acetone	28	10 J
Methylene Chloride	31	31
Toluene	ND	ND
Xylenes, Total	3 J	ND
Semivolatile Organic Compounds (µg/Kg)		
2,2'-Oxybis(1-chloropropane)	ND	ND
2,4-Dimethylphenol	ND	ND
2-Chlorophenol	ND	ND
2-Methylphenol	ND	ND
4-Methylphenol	ND	ND
Acenaphthene	52 J	ND
Anthracene	110 J	51 J
Benzo(a)anthracene	200 J	470
Benzo(a)pyrene	170 J	410
Benzo(b)fluoranthene	230 J	660
Benzo(g,h,i)perylene	88 J	190 J
Benzo(k)fluoranthene	87 J	270 J
Bis(2-ethylhexyl)phthalate	1200	250 J
Carbazole	37 J	ND
Chrysene	220 J	580
Di-n-butylphthalate	51 J	64 J
Di-n-octylphthalate	62 J	ND
Dibenzo(a,h)anthracene	ND	62 J
Fluoranthene	460	770
Fluorene	50 J	ND
Hexachloroethane	ND	ND
Indeno(1,2,3-cd)pyrene	80 J	190 J
Phenanthrene	420	180 J
Phenol	ND	ND
Pyrene	460	750
Butyltins (µg/Kg)		
Tetrabutyltin	ND	ND
Tributyltin	11 J	ND
Dimethyltin	ND	ND
Monobutyltin	ND	ND
Pesticides/PCBs (µg/Kg)		
4,4'-DDD	ND	ND
4,4'-DDE	ND	ND
4,4'-DDT	ND	5.2
Alpha-chlordane	ND	ND
Aroclor-1254	38	ND
Aroclor-1260	ND	ND

TABLE 4-4D
 CONSTITUENTS DETECTED IN SURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE	
	DSY-S-	
	MW08-0002	MW09-0002
	Boring, 1-2 ft	Boring, 0-1 ft
Pesticides/PCBs (µg/Kg) - con't		
Dieldrin	ND	ND
Endrin	ND	ND
Endrin ketone	ND	ND
Gamma-chlordane	ND	ND
Heptachlor	ND	ND
Heptachlor epoxide	ND	ND
Methoxychlor	ND	ND
TOTAL Metals (mg/Kg)		
Aluminum	10100	5260
Antimony	ND	ND
Arsenic	19.2	5.3
Barium	67	12.9
Beryllium	3.5	ND
Cadmium	ND	ND
Chromium	40.2	13.7
Cobalt	23.9	7
Copper	262	25.5
Iron	32900	16900
Lead	189	23.4
Manganese	489	307
Mercury	0.07	ND
Nickel	113	17.8
Selenium	ND	ND
Silver	ND	ND
Thallium	ND	ND
Tin	40.6	ND
Vanadium	13.1	16.7
Zinc	831	175
TCLP Metals (µg/L)		
Arsenic	6.3	ND
Barium	272	129
Cadmium	4	ND
Chromium	8.7	ND
Lead	81.3	16.4
Mercury	ND	ND
Selenium	ND	ND
Silver	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)		
TPH	270	77

NA - Not Analyzed
 ND - Not Detected
 J - Estimated quantitation
 * - Dilution results

TABLE 4-4E
 CONSTITUENTS DETECTED IN SURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP01-0001	TP02-0001	TP03-0001	TP04-0001	TP05-0001	TP06-0001
		Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft
Volatile Organic Compounds (µg/Kg)							
2-Butanone		ND	ND	ND	ND	ND	ND
Acetone		12	ND	25	6 J	12	11
Methylene Chloride		13	11	43	13	11	10
Toluene		ND	ND	ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
2,2'-Oxybis(1-chloropropane)		ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol		ND	ND	ND	ND	ND	ND
2-Chlorophenol		ND	ND	ND	ND	ND	ND
2-Methylphenol		ND	ND	ND	ND	ND	ND
4-Methylphenol		ND	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	ND	ND	ND	ND
Anthracene		ND	ND	ND	150 J	ND	ND
Benzo(a)anthracene		58 J	71 J	ND	120 J	93 J	210 J
Benzo(a)pyrene		55 J	46 J	ND	84 J	81 J	160 J
Benzo(b)fluoranthene		88 J	81 J	ND	120 J	120 J	270 J
Benzo(g,h,i)perylene		42 J	ND	ND	55 J	54 J	ND
Benzo(k)fluoranthene		38 J	41 J	ND	86 J	66 J	150 J
Bis(2-ethylhexyl)phthalate		75 J	170 J	ND	55 J	1100	240 J
Carbazole		ND	ND	ND	ND	ND	ND
Chrysene		53 J	61 J	ND	130 J	94 J	230 J
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND
Di-n-octylphthalate		ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene		ND	ND	ND	ND	ND	ND
Fluoranthene		71 J	150 J	ND	320 J	220 J	460 J
Fluorene		ND	ND	ND	ND	ND	ND
Hexachloroethane		ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		42 J	ND	ND	55 J	49 J	110 J
Phenanthrene		ND	120 J	ND	160 J	94 J	280 J
Phenol		ND	ND	ND	ND	ND	ND
Pyrene		73 J	130 J	ND	190 J	140 J	380 J
Butyltins (µg/Kg)							
Tetrabutyltin		ND	ND	ND	ND	ND	ND
Tributyltin		ND	ND	ND	ND	31 J	45 J
Di-butyltin		ND	ND	ND	ND	ND	43 J
Monobutyltin		ND	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		ND	ND	ND	ND	ND	ND
4,4'-DDE		ND	ND	ND	ND	ND	61
4,4'-DDT		ND	ND	ND	ND	ND	14
Alpha-chlordane		ND	ND	ND	ND	ND	ND
Aroclor-1254		ND	ND	ND	ND	ND	ND
Aroclor-1260		ND	ND	ND	25 J	ND	15 J

TABLE 4-4E
 CONSTITUENTS DETECTED IN SURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP01-0001	TP02-0001	TP03-0001	TP04-0001	TP05-0001	TP06-0001
		Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft	Test Pit, 0-1 ft
Pesticides/PCBs (µg/Kg) - con't							
Dieldrin		ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND
Endrin ketone		ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Methoxychlor		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		8090	7770	9120	6870	33300	11100
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		14 6	15 3	11 2	9 7	13 1	13 3
Barium		12 3	18 7	22 8	35 6	420	52 1
Beryllium		0 3	1 1	0 71	2 5	2	0 45
Cadmium		ND	ND	ND	ND	ND	0 48
Chromium		10 5	14 9	16 2	24 7	53 5	21 6
Cobalt		8 9	11 8	11 7	16 8	18 3	11 1
Copper		13	59 6	49 7	145	76 4	45 2
Iron		21300	23600	23500	22200	58100	26200
Lead		13 5	48 7	35 5	119	51	41 3
Manganese		286	423	343	296	299	350
Mercury		0 05	ND	0 17	0 05	ND	ND
Nickel		17 2	32 8	30 3	70 8	60 1	24 3
Selenium		ND	ND	0 85	ND	1 2	1 4
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	9 3	27 4	ND	ND
Vanadium		12 3	11 3	13 8	9 7	52 7	21 7
Zinc		40 8	225	172	501	896	284
TCLP Metals (µg/L)							
Arsenic		ND	ND	ND	ND	ND	ND
Barium		631	1140	601	424	184	190
Cadmium		ND	ND	ND	ND	3 5	ND
Chromium		ND	11 8	ND	18 4	ND	ND
Lead		16 1	8 9	3	16 1	6 6	8 9
Mercury		ND	ND	ND	ND	0 53	0 55
Selenium		ND	ND	ND	ND	6 4	ND
Silver		16 9	9	ND	16 7	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)							
TPH		ND	ND	94	110	ND	110

ND - Not Detected J - Estimated quantitation

TABLE 4-5A
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 UPGRADIENT AREAS
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY - S	LOCATION/TYPE MW10-0810 Boring, 8-10 ft
Volatile Organic Compounds (µg/Kg)		
1,2-Dichloroethene (total)		ND
2-Butanone		3 J
Acetone		4 J
Benzene		ND
Chlorobenzene		ND
Carbon disulfide		ND
Ethylbenzene		ND
Methylene Chloride		14
Toluene		ND
Trichloroethene		ND
Xylenes, Total		ND
Semivolatile Organic Compounds (µg/Kg)		
2-Methylnaphthalene		ND
4-Chloro-3-Methylphenol		ND
Acenaphthene		ND
Anthracene		ND
Benzo(a)anthracene		ND
Benzo(a)pyrene		ND
Benzo(b)fluoranthene		ND
Benzo(g,h,i)perylene		ND
Benzo(k)fluoranthene		ND
Bis(2-ethylhexyl)phthalate		200 J
Di-n-butylphthalate		ND
Carbazole		ND
Chrysene		ND
Fluoranthene		ND
Fluorene		ND
Indeno(1,2,3-cd)pyrene		ND
Naphthalene		ND
Phenanthrene		ND
Pyrene		ND
Butyltins (µg/Kg)		
Tetrabutyltin		ND
Monobutyltin		ND
Tributyltin		ND
Pesticides/PCBs (µg/Kg)		
4,4'-DDD		ND
4,4'-DDE		ND
4,4'-DDT		ND
Aldrin		ND
Alpha-chlordane		ND
Endrin		ND
Gamma-chlordane		ND
Heptachlor		ND
Heptachlor epoxide		ND

TABLE 4-5A
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 UPGRADIENT AREAS
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	LOCATION/TYPE
		MW10-0810 Boring, 8-10 ft
TOTAL Metals (mg/Kg)		
Aluminum		11700
Antimony		ND
Arsenic		38.5
Barium		13.9
Beryllium		0.36
Cadmium		1.5
Chromium		15.2
Cobalt		16.6
Copper		19.4
Iron		37100
Lead		6.6
Manganese		746
Mercury		ND
Nickel		28.9
Selenium		ND
Silver		ND
Thallium		ND
Tin		9.4
Vanadium		20.6
Zinc		68.6
TCLP Metals (µg/L)		
Arsenic		ND
Barium		105
Cadmium		5.4
Chromium		ND
Lead		1.6
Mercury		ND
Selenium		ND
Silver		6.9
Total Petroleum Hydrocarbons (mg/Kg)		
TPH		ND

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- - Dilution Results

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP16-0506	TP16-1112	TP18-0507	TP18-1011	TP19-0507	TP19-1011	TP20-0507
		Test Pit, 5-6 ft	Test Pit, 11-12 ft	Test Pit, 5-7 ft	Test Pit, 10-11 ft	Test Pit, 5-7 ft	Test Pit, 10-11 ft	Test Pit, 5-7 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	ND	NA	NA	NA	NA	NA
2-Butanone		NA	ND	NA	NA	NA	NA	NA
Acetone		NA	ND	NA	NA	NA	NA	NA
Benzene		NA	ND	NA	NA	NA	NA	NA
Chlorobenzene		NA	ND	NA	NA	NA	NA	NA
Carbon disulfide		NA	ND	NA	NA	NA	NA	NA
Ethylbenzene		NA	ND	NA	NA	NA	NA	NA
Methylene Chloride		NA	24 J	NA	NA	NA	NA	NA
Toluene		NA	ND	NA	NA	NA	NA	NA
Trichloroethene		NA	ND	NA	NA	NA	NA	NA
Xylenes, Total		NA	ND	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	ND	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol		NA	1100 J	NA	NA	NA	NA	NA
Acenaphthene		NA	ND	NA	NA	NA	NA	NA
Anthracene		NA	ND	NA	NA	NA	NA	NA
Benzo(a)anthracene		NA	ND	NA	NA	NA	NA	NA
Benzo(a)pyrene		NA	ND	NA	NA	NA	NA	NA
Benzo(b)fluoranthene		NA	ND	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene		NA	ND	NA	NA	NA	NA	NA
Benzo(k)fluoranthene		NA	ND	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate		NA	ND	NA	NA	NA	NA	NA
Di-n-butylphthalate		NA	ND	NA	NA	NA	NA	NA
Carbazole		NA	ND	NA	NA	NA	NA	NA
Chrysene		NA	ND	NA	NA	NA	NA	NA
Fluoranthene		NA	ND	NA	NA	NA	NA	NA
Fluorene		NA	ND	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene		NA	ND	NA	NA	NA	NA	NA
Napthalene		NA	ND	NA	NA	NA	NA	NA
Phenanthrene		NA	ND	NA	NA	NA	NA	NA
Pyrene		NA	1600 J	NA	NA	NA	NA	NA
Butyltins (µg/Kg)								
Tetrabutyltin		NA	84 J	NA	NA	NA	NA	NA
Monobutyltin		NA	ND	NA	NA	NA	NA	NA
Tributyltin		NA	ND	NA	NA	NA	NA	NA
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	ND	NA	NA	NA	NA	NA
4,4'-DDE		NA	ND	NA	NA	NA	NA	NA
4,4'-DDT		NA	ND	NA	NA	NA	NA	NA
Aldrin		NA	44	NA	NA	NA	NA	NA
Alpha-chlordane		NA	ND	NA	NA	NA	NA	NA
Endrin		NA	15	NA	NA	NA	NA	NA
Gamma-chlordane		NA	ND	NA	NA	NA	NA	NA
Heptachlor		NA	31	NA	NA	NA	NA	NA
Heptachlor epoxide		NA	ND	NA	NA	NA	NA	NA

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP16-0506	TP16-1112	TP18-0507	TP18-1011	TP19-0507	TP19-1011	TP20-05 7
		Test Pit, 5-6 ft	Test Pit, 11-12 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
TOTAL Metals (mg/Kg)								
Aluminum		2470	7820	3300	3860	2620	2950	4070
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		31	166	44	38	27	3	39
Barium		26	63	34	57	3	48	43
Beryllium		ND	0.27	ND	ND	ND	ND	ND
Cadmium		1.1	ND	ND	ND	0.6	ND	0.65
Chromium		22	123	34	43	36	34	4
Cobalt		26	94	31	6	31	57	3
Copper		41	152	73	104	62	48	62
Iron		8170	23600	10900	11100	8340	8020	11200
Lead		16	161	27	46	21	19	32
Manganese		102	262	75	421	554	836	704
Mercury		0.15	0.11	0.06	0.06	0.07	0.12	0.08
Nickel		51	183	69	68	52	92	75
Selenium		ND	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		56	142	71	65	62	62	81
Zinc		146	505	182	206	164	236	219
TCLP Metals (µg/L)								
Arsenic		NA		NA	NA	NA	NA	NA
Barium		NA	ND	NA	NA	NA	NA	NA
Cadmium		NA	70	NA	NA	NA	NA	NA
Chromium		NA	ND	NA	NA	NA	NA	NA
Lead		NA	ND	NA	NA	NA	NA	NA
Mercury		NA	61	NA	NA	NA	NA	NA
Selenium		NA	ND	NA	NA	NA	NA	NA
Silver		NA	ND	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA		NA	NA	NA	NA	NA

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP20-1011	TP21-0507	TP21-1011	TP22-0506	TP22-1112	TP23-0507	TP23-0910
		Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-6 ft	Test Pit, 11-12 f	Test Pit, 5-7 ft	Test Pit, 9-10 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	NA	NA	NA	NA	NA	ND
2-Butanone		NA	NA	NA	NA	NA	NA	ND
Acetone		NA	NA	NA	NA	NA	NA	16
Benzene		NA	NA	NA	NA	NA	NA	ND
Chlorobenzene		NA	NA	NA	NA	NA	NA	ND
Carbon disulfide		NA	NA	NA	NA	NA	NA	ND
Ethylbenzene		NA	NA	NA	NA	NA	NA	ND
Methylene Chloride		NA	NA	NA	NA	NA	NA	7 J
Toluene		NA	NA	NA	NA	NA	NA	ND
Trichloroethene		NA	NA	NA	NA	NA	NA	1 J
Xylenes, Total		NA	NA	NA	NA	NA	NA	ND
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	NA	NA	NA	NA	NA	ND
4-Chloro-3-Methylphenol		NA	NA	NA	NA	NA	NA	ND
Acenaphthene		NA	NA	NA	NA	NA	NA	ND
Anthracene		NA	NA	NA	NA	NA	NA	ND
Benzo(a)anthracene		NA	NA	NA	NA	NA	NA	ND
Benzo(a)pyrene		NA	NA	NA	NA	NA	NA	ND
Benzo(b)fluoranthene		NA	NA	NA	NA	NA	NA	ND
Benzo(g,h,i)perylene		NA	NA	NA	NA	NA	NA	ND
Benzo(k)fluoranthene		NA	NA	NA	NA	NA	NA	ND
Bis(2-ethylhexyl)phthalate		NA	NA	NA	NA	NA	NA	65 J
Di-n-butylphthalate		NA	NA	NA	NA	NA	NA	ND
Carbazole		NA	NA	NA	NA	NA	NA	ND
Chrysene		NA	NA	NA	NA	NA	NA	ND
Fluoranthene		NA	NA	NA	NA	NA	NA	ND
Fluorene		NA	NA	NA	NA	NA	NA	ND
Indeno(1,2,3-cd)pyrene		NA	NA	NA	NA	NA	NA	ND
Naphthalene		NA	NA	NA	NA	NA	NA	ND
Phenanthrene		NA	NA	NA	NA	NA	NA	ND
Pyrene		NA	NA	NA	NA	NA	NA	ND
Butyltins (µg/Kg)								
Tetrabutyltin		NA	NA	NA	NA	NA	NA	ND
Monobutyltin		NA	NA	NA	NA	NA	NA	ND
Tributyltin		NA	NA	NA	NA	NA	NA	ND
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	NA	NA	NA	NA	NA	ND
4,4'-DDE		NA	NA	NA	NA	NA	NA	ND
4,4'-DDT		NA	NA	NA	NA	NA	NA	ND
Aldrin		NA	NA	NA	NA	NA	NA	ND
Alpha-chlordane		NA	NA	NA	NA	NA	NA	ND
Endrin		NA	NA	NA	NA	NA	NA	ND
Gamma-chlordane		NA	NA	NA	NA	NA	NA	ND
Heptachlor		NA	NA	NA	NA	NA	NA	ND
Heptachlor epoxide		NA	NA	NA	NA	NA	NA	ND

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP20-1011	TP21-0507	TP21-1011	TP22-0506	TP22-1112	TP23-0507	TP23-0910
		Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-6 ft	Test Pit, 11-12 f	Test Pit, 5-7 ft	Test Pit, 9-10 ft
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	NW	
TOTAL Metals (mg/Kg)								
Aluminum		3350	3010	3740	7700	10000	6060	5810
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		43	3.1	27	8.1	70	55	46
Barium		5	6	4.3	17.6	249	101	101
Beryllium		ND	ND	ND	03	035	022	024
Cadmium		ND	ND	ND	081	065	ND	ND
Chromium		44	28	48	76	146	84	7
Cobalt		58	32	5	99	138	89	83
Copper		67	54	58	177	168	182	199
Iron		12000	9380	10600	18400	25600	18900	16200
Lead		4	34	36	63	86	73	62
Manganese		173	932	125	322	549	308	218
Mercury		012	006	009	018	008	01	ND
Nickel		78	68	114	166	25	141	141
Selenium		ND	ND	ND	ND	ND	11	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		76	62	79	128	161	93	76
Zinc		245	177	248	343	522	351	332
TCLP Metals (µg/L)								
Arsenic		NA	NA	NA	NA	NA	NA	ND
Barium		NA	NA	NA	NA	NA	NA	151
Cadmium		NA	NA	NA	NA	NA	NA	ND
Chromium		NA	NA	NA	NA	NA	NA	78
Lead		NA	NA	NA	NA	NA	NA	16
Mercury		NA	NA	NA	NA	NA	NA	ND
Selenium		NA	NA	NA	NA	NA	NA	ND
Silver		NA	NA	NA	NA	NA	NA	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA	NA	NA	NA	NA	NA	ND

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE					
		TP24-0507	TP24-1011	TP27-0507	TP27-1011	TP28-0507	TP28-1314
		Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 13-14 f
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)							
1,2-Dichloroethene (total)		NA	NA	NA	NA	NA	NA
2-Butanone		NA	NA	NA	NA	NA	NA
Acetone		NA	NA	NA	NA	NA	NA
Benzene		NA	NA	NA	NA	NA	ND
Chlorobenzene		NA	NA	NA	NA	NA	NA
Carbon disulfide		NA	NA	NA	NA	NA	NA
Ethylbenzene		NA	NA	NA	NA	NA	NA
Methylene Chloride		NA	NA	NA	NA	NA	NA
Toluene		NA	NA	NA	NA	NA	NA
Trichloroethene		NA	NA	NA	NA	NA	NA
Xylenes, Total		NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (µg/Kg)							
2-Methylnaphthalene		NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol		NA	NA	NA	NA	NA	NA
Acenaphthene		NA	NA	NA	NA	NA	NA
Anthracene		NA	NA	NA	NA	NA	NA
Benzo(a)anthracene		NA	NA	NA	NA	NA	NA
Benzo(a)pyrene		NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene		NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene		NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene		NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate		NA	NA	NA	NA	NA	NA
Di-n-butylphthalate		NA	NA	NA	NA	NA	NA
Carbazole		NA	NA	NA	NA	NA	NA
Chrysene		NA	NA	NA	NA	NA	NA
Fluoranthene		NA	NA	NA	NA	NA	NA
Fluorene		NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene		NA	NA	NA	NA	NA	NA
Naphthalene		NA	NA	NA	NA	NA	NA
Phenanthrene		NA	NA	NA	NA	NA	NA
Pyrene		NA	NA	NA	NA	NA	NA
Butyltins (µg/Kg)							
Tetrabutyltin		NA	NA	NA	NA	NA	NA
Monobutyltin		NA	NA	NA	NA	NA	NA
Tributyltin		NA	NA	NA	NA	NA	NA
Pesticides/PCBs (µg/Kg)							
4,4'-DDD		NA	NA	NA	NA	NA	NA
4,4'-DDE		NA	NA	NA	NA	NA	NA
4,4'-DDT		NA	NA	NA	NA	NA	NA
Aldrin		NA	NA	NA	NA	NA	NA
Alpha-chlordane		NA	NA	NA	NA	NA	NA
Endrin		NA	NA	NA	NA	NA	NA
Gamma-chlordane		NA	NA	NA	NA	NA	NA
Heptachlor		NA	NA	NA	NA	NA	NA
Heptachlor epoxide		NA	NA	NA	NA	NA	NA

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	SAMPLE LOCATION/TYPE						
	DSY-S	TP24-0507	TP24-1011	TP27-0507	TP27-1011	TP28-0507	TP28-1314
		Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 10-11 f	Test Pit, 5-7 ft	Test Pit, 13-14 f
SITE AREA DESIGNATION:	NW	NW	NW	NW	NW	NW	
TOTAL Metals (mg/Kg)							
Aluminum		5920	6600	3480	2570	12800	9240
Antimony	ND	ND	ND	ND	ND	ND	ND
Arsenic		51	34	41	47	137	77
Barium		109	127	21	24	137	262
Beryllium		023	027	ND	ND	035	035
Cadmium	ND	ND	ND	ND	ND	ND	ND
Chromium		95	90	57	37	142	119
Cobalt		7	7.2	4	3	143	108
Copper		134	196	5	41	221	186
Iron		18200	17100	10400	6970	27100	20800
Lead		63	79	25	16	154	8
Manganese		210	213	106	554	302	320
Mercury		008	009	ND	ND	006	ND
Nickel		144	143	62	52	191	179
Selenium		06	ND	ND	083	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	ND	ND	ND	ND	ND
Tin	ND	ND	ND	ND	ND	ND	ND
Vanadium		109	9.5	64	43	164	137
Zinc		368	354	186	136	444	42.5
TCLP Metals (µg/L)							
Arsenic	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/Kg)							
TPH	NA	NA	NA	NA	NA	NA	NA

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE							
		MW02-1820	MW02-2426	MW02-3436	MW03-0810	MW03-1618	MW04-0810	MW04-1618	
		Boring, 18-20 ft	Boring, 24-26 ft	Boring, 34-36 ft	Boring, 8-10 ft	Boring, 16-18 ft	Boring, 8-10 ft	Boring, 12-18 ft	
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW	
Volatile Organic Compounds (µg/Kg)									
1,2-Dichloroethene (total)		ND	ND	ND	ND	ND	ND	ND	
2-Butanone		4 J	ND	ND	ND	ND	ND	ND	
Acetone		12 J	6 J	4 J	29	10 J	9 J	13 J	
Benzene		ND	ND	ND	ND	ND	ND	ND	
Chlorobenzene		ND	ND	ND	ND	ND	ND	ND	
Carbon disulfide		2 J	ND	ND	ND	ND	ND	ND	
Ethylbenzene		ND	ND	ND	ND	ND	ND	ND	
Methylene Chloride		7 J	17	18	13 J	11 J	18	22	
Toluene		ND	ND	ND	ND	ND	ND	ND	
Trichloroethene		ND	ND	ND	1 J	ND	ND	ND	
Xylenes, Total		ND	ND	ND	ND	ND	ND	ND	
Semivolatile Organic Compounds (µg/Kg)									
2-Methylnaphthalene		ND	ND	ND	ND	ND	ND	ND	
4-Chloro-3-Methylphenol		ND	ND	ND	ND	ND	ND	ND	
Acenaphthene		ND	ND	ND	ND	ND	ND	ND	
Anthracene		ND	ND	ND	ND	ND	ND	ND	
Benzo(a)anthracene		ND	ND	ND	ND	ND	ND	ND	
Benzo(a)pyrene		ND	ND	ND	ND	ND	ND	ND	
Benzo(b)fluoranthene		ND	ND	ND	ND	ND	ND	ND	
Benzo(g,h,i)perylene		ND	ND	ND	ND	ND	ND	ND	
Benzo(k)fluoranthene		ND	ND	ND	ND	ND	ND	ND	
Bis(2-ethylhexyl)phthalate		90 J	84 J	91 J	ND	110 J	66 J	63 J	
Di-n-butylphthalate		45 J	ND	42 J	ND	ND	ND	270 J	
Carbazole		ND	ND	ND	ND	ND	ND	ND	
Chrysene		ND	ND	ND	ND	ND	ND	ND	
Fluoranthene		ND	ND	ND	42 J	ND	ND	ND	
Fluorene		ND	ND	ND	ND	ND	ND	ND	
Indeno(1,2,3-cd)pyrene		ND	ND	ND	ND	ND	ND	ND	
Napthalene		ND	ND	ND	ND	ND	ND	ND	
Phenanthrene		ND	ND	ND	ND	ND	ND	ND	
Pyrene		ND	ND	ND	41 J	ND	ND	ND	
Butyltins (µg/Kg)									
Tetrabutyltin		ND	ND	ND	ND	ND	ND	ND	
Monobutyltin		ND	ND	ND	ND	ND	ND	ND	
Tributyltin		35 J	ND	23 J	ND	ND	ND	ND	
Pesticides/PCBs (µg/Kg)									
4,4'-DDD		ND	ND	ND	ND	ND	ND	ND	
4,4'-DDE		ND	ND	ND	ND	ND	ND	ND	
4,4'-DDT		ND	ND	ND	ND	ND	ND	ND	
Aldrin		ND	ND	ND	ND	ND	ND	ND	
Alpha-chlordane		ND	ND	ND	2 1	ND	ND	ND	
Endrin		ND	ND	ND	ND	ND	ND	ND	
Gamma-chlordane		ND	ND	ND	2 1	ND	ND	ND	
Heptachlor		ND	3.8	ND	ND	3 3	ND	ND	
Heptachlor epoxide		ND	ND	ND	ND	ND	ND	ND	

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		MW02-1820	MW02-2426	MW02-3436	MW03-0810	MW03-1618	MW04-0810	MW04-1618
		Boring, 18-20 ft	Boring, 24-26 ft	Boring, 34-36 ft	Boring, 8-10 ft	Boring, 16-18 ft	Boring, 8-10 ft	Boring, 12-18 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
T TAL Metals (mg/Kg)								
Aluminum		4890	7320	18200	4400	11100	2430	6000
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		4.3	4	6.6	7	9.9	3	7.3
Barium		3.2	7.6	7.1	7.5	9	2.6	3.9
Beryllium		ND	ND	0.33	ND	0.23	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		10.9	12.3	27.1	10.3	18.1	6	10.7
Cobalt		5.2	7.1	19.8	6.7	15.4	2.6	5.9
Copper		8.6	11.4	30.9	11.5	23.5	5	10.6
Iron		13500	18600	40600	15500	26800	7440	17000
Lead		6	3.1	10	2.7	29.2	2.1	8.3
Manganese		97.9	159	385	113	370	89.2	149
Mercury		ND	ND	ND	0.07	ND	ND	ND
Nickel		8.9	15.8	39.5	12	22.7	5.5	11.9
Selenium		ND	1.2	1	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		11	12.9	17.2	11	19.3	5.5	11.5
Zinc		37	35.4	71.3	30.8	52.8	13.7	37.9
TCPL Metals (µg/L)								
Arsenic		ND	ND	ND	ND	ND	ND	ND
Banum		53.8	373	352	78.3	114	307	250
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		ND	ND	ND	ND	ND	ND	ND
Lead		24.7	ND	ND	ND	ND	ND	45.4
Mercury		ND	ND	ND	ND	ND	ND	ND
Selenium		ND	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	7.5	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		ND	ND	ND	ND	ND	ND	89

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5B
CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
NORTH WATERFRONT
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

ANALYTE	DSY - S	SAMPLE LOCATION/TYPE						
		MW04-3234	MW11-0103	MW11-1113 Duplicate 5	DUPL-05 Duplicate 5	MW11-2729	MW11-2931 Duplicate 6	DUPL-06 Duplicate 6
		Boring, 32-34 ft	Boring, 1-3 ft	Boring, 11-13 ft	Boring, 11-13 ft	Boring, 27-29 ft	Boring, 29-31 ft	Boring, 29-31 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		ND	ND	ND	ND	ND	1 J	5 J
2-Butanone		ND	10 J	10 J	ND	ND	ND	ND
Acetone		10 J	75	150	110	77	240	270
Benzene		ND	ND	ND	ND	ND	ND	ND
Chlorobenzene		ND	ND	ND	ND	ND	ND	ND
Carbon disulfide		ND	ND	ND	ND	ND	ND	ND
Ethylbenzene		ND	ND	ND	ND	ND	ND	ND
Methylene Chloride		19	18	16	22	21	23	36
Toluene		ND	ND	ND	ND	ND	ND	ND
Trichloroethene		ND	ND	ND	ND	2 J	4 J	4 J
Xylenes, Total		ND	2 J	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-Methylphenol		ND	ND	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	ND	ND	ND	ND	ND
Anthracene		ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene		ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene		ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene		ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene		ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		51 J	67 J	120 J	75 J	83 J	ND	ND
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND	ND
Carbazole		ND	ND	ND	ND	ND	ND	ND
Chrysene		ND	ND	ND	ND	ND	ND	ND
Fluoranthene		ND	ND	ND	ND	ND	ND	ND
Fluorene		ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND	ND	ND	ND	ND
Napthalene		ND	ND	ND	ND	ND	ND	ND
Phenanthrene		ND	ND	ND	ND	ND	ND	ND
Pyrene		ND	ND	ND	ND	ND	ND	ND
Butyltins (µg/Kg)								
Tetrabutyltin		ND	ND	ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND	ND	ND	ND
Tributyltin		ND	ND	57 J	ND	ND	18 J	ND
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		ND	ND	ND	ND	ND	ND	ND
4,4'-DDE		ND	ND	ND	ND	ND	ND	ND
4,4'-DDT		ND	ND	ND	ND	ND	ND	ND
Aldrin		ND	ND	ND	ND	ND	ND	ND
Alpha-chlordane		ND	ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND	ND	ND	ND
Heptachlor		ND	ND	24	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND	ND

**TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND**

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		MW04-3234 Boring, 32-34 ft	MW11-0103 Boring, 1-3 ft	MW11-1113 Duplicate 5 Boring, 11-13 ft	DUPL-05 Duplicate 5 Boring, 11-13 ft	MW11-2729 Boring, 27-29 ft	MW11-2931 Duplicate 6 Boring, 29-31 ft	DUPL-06 Duplicate 6 Boring, 29- 1 ft
SITE AREA DESIGNATION:		NW	NW	NW	NW	NW	NW	NW
TOTAL Metals (mg/Kg)								
Aluminum		10100	6570	6260	5950	7540	17900	15100
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		49	37	33	31	146	147	133
Barium		66	247	151	136	86	37	37
Beryllium		ND	0.32	0.23	0.27	0.24	0.27	0.26
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		182	10	78	98	183	246	23
Cobalt		96	85	54	49	102	117	106
Copper		241	155	14	166	193	236	287
Iron		24100	14200	12800	14900	32000	44400	38200
Lead		234	7.4	66	62	36	118	96
Manganese		155	376	180	181	203	334	280
Mercury		ND	ND	0.05	ND	ND	0.31	0.15
Nickel		249	126	11	103	186	339	295
Selenium		11	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		109	97	84	85	149	239	188
Zinc		501	327	255	29	496	749	597
TCLP Metals (µg/L)								
Arsenic		ND	ND	ND	ND	ND	ND	ND
Barium		415	733	337	460	788	729	87
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		74	ND	ND	ND	ND	ND	ND
Lead		122	ND	23	1.8	ND	15	ND
Mercury		ND	ND	ND	ND	ND	ND	ND
Selenium		69	ND	ND	ND	ND	ND	ND
Silver		78	11	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		ND	ND	ND	ND	ND	ND	ND

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE		
		MW12-0709	MW12-2123	MW12-2931
		Boring, 7-9 ft	Boring, 21-23 ft	Boring, 29-31 ft
SITE AREA DESIGNATION:		NW	NW	NW
Volatile Organic Compounds (µg/Kg)				
1,2-Dichloroethene (total)		ND	ND	ND
2-Butanone		ND	ND	ND
Acetone		8 J	7 J	11 J
Benzene		ND	ND	ND
Chlorobenzene		ND	ND	ND
Carbon disulfide		ND	ND	ND
Ethylbenzene		ND	ND	ND
Methylene Chloride		14	16	13
Toluene		ND	ND	ND
Trichloroethene		ND	ND	ND
Xylenes, Total		ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)				
2-Methylnaphthalene		ND	ND	ND
4-Chloro-3-Methylphenol		ND	ND	ND
Acenaphthene		ND	ND	ND
Anthracene		ND	ND	ND
Benzo(a)anthracene		ND	ND	ND
Benzo(a)pyrene		ND	ND	ND
Benzo(b)fluoranthene		ND	ND	ND
Benzo(g,h,i)perylene		ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND
Bis(2-ethylhexyl)phthalate		44 J	ND	57 J
Di-n-butylphthalate		ND	ND	ND
Carbazole		ND	ND	ND
Chrysene		ND	ND	ND
Fluoranthene		ND	ND	ND
Fluorene		ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND
Napthalene		ND	ND	ND
Phenanthrene		ND	ND	ND
Pyrene		ND	ND	ND
Butyltins (µg/Kg)				
Tetrabutyltin		10 J	ND	ND
Monobutyltin		ND	ND	ND
Tributyltin		ND	ND	ND
Pesticides/PCBs (µg/Kg)				
4,4'-DDD		ND	ND	ND
4,4'-DDE		ND	ND	ND
4,4'-DDT		ND	ND	ND
Aldrin		ND	ND	ND
Alpha-chlordane		ND	ND	ND
Endrin		ND	ND	ND
Gamma-chlordane		ND	ND	ND
Heptachlor		ND	ND	ND
Heptachlor epoxide		ND	ND	ND

TABLE 4-5B
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 NORTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE		
		MW12-0709	MW12-2123	MW12-2931
		Boring, 7-9 ft	Boring, 21-23 ft	Boring, 29-31 ft
SITE AREA DESIGNATION:		NW	NW	NW
TOTAL Metals (mg/Kg)				
Aluminum		3840	7770	17200
Antimony		ND	ND	ND
Arsenic		43	56	76
Barium		35	13	55
Beryllium		ND	0.28	0.23
Cadmium		ND	ND	ND
Chromium		65	142	23
Cobalt		45	97	12.7
Copper		79	172	25.1
Iron		12000	18600	43100
Lead		17	4	5.7
Manganese		97.5	274	382
Mercury		ND	ND	0.16
Nickel		94	18.3	31.2
Selenium		ND	0.79	1.3
Silver		ND	ND	ND
Thallium		ND	ND	ND
Tin		ND	ND	ND
Vanadium		64	13	17.4
Zinc		22	37.3	73.4
TCLP Metals (µg/L)				
Arsenic		ND	ND	ND
Barium		330	605	421
Cadmium		ND	ND	ND
Chromium		ND	ND	ND
Lead		ND	ND	ND
Mercury		ND	ND	ND
Selenium		ND	ND	ND
Silver		ND	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)				
TPH		ND	ND	ND

NA - Not Analyzed ND - Not Detected
 J - Estimated quantitation * - Dilution Results

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP11-0507	TP11-1213	TP12-0507	TP12-1213	TP13-0506	DUPL-03	TP13-1011
		Test Pit, 5-7 ft	Test Pit, 12-13 ft	Test Pit, 5-7 ft	Test Pit, 12-13 ft	Field Dup 03 Test Pit, 5-6 ft	Field Dup 03 Test Pit, 5-6 ft	Test Pit, 10-11 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS	CS	CS	CS
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	ND	NA	NA	ND	ND	NA
2-Butanone		NA	ND	NA	NA	22	22	NA
Acetone		NA	23	NA	NA	110	87	NA
Benzene		NA	ND	NA	NA	ND	ND	NA
Chlorobenzene		NA	ND	NA	NA	ND	ND	NA
Carbon disulfide		NA	ND	NA	NA	ND	ND	NA
Ethylbenzene		NA	ND	NA	NA	ND	ND	NA
Methylene Chloride		NA	11 J	NA	NA	11 J	7 J	NA
Toluene		NA	ND	NA	NA	ND	ND	NA
Trichloroethene		NA	ND	NA	NA	ND	ND	NA
Xylenes, Total		NA	ND	NA	NA	ND	ND	NA
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	ND	NA	NA	ND	ND	NA
4-Chloro-3-Methylphenol		NA	ND	NA	NA	ND	ND	NA
Acenaphthene		NA	ND	NA	NA	ND	ND	NA
Anthracene		NA	ND	NA	NA	ND	ND	NA
Benzo(a)anthracene		NA	ND	NA	NA	ND	ND	NA
Benzo(a)pyrene		NA	ND	NA	NA	ND	ND	NA
Benzo(b)fluoranthene		NA	ND	NA	NA	ND	ND	NA
Benzo(g,h,i)perylene		NA	ND	NA	NA	ND	ND	NA
Benzo(k)fluoranthene		NA	ND	NA	NA	ND	ND	NA
Bis(2-ethylhexyl)phthalate		NA	ND	NA	NA	ND	ND	NA
Di-n-butylphthalate		NA	ND	NA	NA	ND	ND	NA
Carbazole		NA	ND	NA	NA	ND	ND	NA
Chrysene		NA	ND	NA	NA	ND	ND	NA
Fluoranthene		NA	ND	NA	NA	ND	ND	NA
Fluorene		NA	ND	NA	NA	ND	ND	NA
Indeno(1,2,3-cd)pyrene		NA	ND	NA	NA	ND	ND	NA
Napthalene		NA	ND	NA	NA	ND	ND	NA
Phenanthrene		NA	ND	NA	NA	ND	ND	NA
Pyrene		NA	ND	NA	NA	ND	ND	NA
Butyltins (µg/Kg)								
Tetrabutyltin		NA	ND	NA	NA	42.5 J	7.3 J	NA
Monobutyltin		NA	ND	NA	NA	ND	ND	NA
Tributyltin		NA	ND	NA	NA	ND	ND	NA
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	ND	NA	NA	ND	ND	NA
4,4'-DDE		NA	ND	NA	NA	ND	ND	NA
4,4'-DDT		NA	ND	NA	NA	ND	ND	NA
Aldrin		NA	ND	NA	NA	ND	ND	NA
Alpha-chlordane		NA	ND	NA	NA	ND	ND	NA
Endrin		NA	5.5	NA	NA	ND	ND	NA
Gamma-chlordane		NA	ND	NA	NA	ND	ND	NA
Heptachlor		NA	ND	NA	NA	ND	ND	NA
Heptachlor epoxide		NA	ND	NA	NA	ND	ND	NA

TABLE 4-5C
CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
CENTRAL SHIPYARD AREA
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP11-0507 Test Pit, 5-7 ft	TP11-1213 Test Pit, 12-13 ft	TP12-0507 Test Pit, 5-7 ft	TP12-1213 Test Pit, 12-13 ft	TP13-0506 Field Dup 03 Test Pit, 5-6 ft	DUPL-03 Field Dup 03 Test Pit, 5-6 ft	TP13-1011 Test Pit, 10-11 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS	CS	CS	CS
TOTAL Metals (mg/Kg)								
Aluminum		9950	12600	11700	14300	11000	11200	9310
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		22	36.9	24.1	37.3	16.1	18	15.7
Barium		15.9	17.5	13.8	11.3	23.4	25.7	14.5
Beryllium		0.53	0.48	0.52	0.44	0.4	0.42	0.54
Cadmium		1.1	1.2	1.1	1.3	0.7	ND	0.97
Chromium		8.9	17.8	10.4	12.6	13.3	14.3	9.6
Cobalt		11.4	20.2	12.7	18.5	10	11	9
Copper		18.1	27.4	18.6	26	11	11	15.8
Iron		25800	40100	30200	35000	25400	24700	26000
Lead		8.5	11.3	12.1	21.2	11.8	11.3	24.1
Manganese		323	612	315	514	529	584	373
Mercury		ND	0.08	ND	ND	0.11	0.13	0.07
Nickel		20.1	33.1	23.2	30.4	15	16.5	14.4
Selenium		ND	0.83	ND	ND	1.4	ND	ND
Silver		ND	ND	ND	1.6	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		16.8	18.5	17.1	18.8	17.8	18	16.2
Zinc		41.9	65.1	50.9	66.1	38.9	40.2	47.9
TCLP Metals (µg/L)								
Arsenic		NA	67.2	NA	NA	22.6	24.3	NA
Barium		NA	366	NA	NA	143	283	NA
Cadmium		NA	ND	NA	NA	ND	ND	NA
Chromium		NA	13.3	NA	NA	6.3	ND	NA
Lead		NA	56.2	NA	NA	5.5	5	NA
Mercury		NA	0.13	NA	NA	ND	ND	NA
Selenium		NA	18	NA	NA	ND	ND	NA
Silver		NA	36.4	NA	NA	ND	ND	NA
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA	ND	NA	NA	ND	ND	NA

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- * - Dilution Results

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP14-0506	TP15-0506	TP15-1112	TP17-0507	TP17-1112	TP25-0507	TP25-1011
		Test Pit, 5-6 ft	Test Pit, 5-6 ft	Test Pit, 11-12 ft	Test Pit, 5-7 ft	Test Pit, 11-12 ft	Test Pit, 5-7 ft	Test Pit, 10-11 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS	CS	CS	
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	NA	NA	NA	NA	ND	
2-Butanone		NA	NA	NA	NA	NA	ND	
Acetone		NA	NA	NA	NA	NA	18	
Benzene		NA	NA	NA	NA	NA	ND	
Chlorobenzene		NA	NA	NA	NA	NA	ND	
Carbon disulfide		NA	NA	NA	NA	NA	ND	
Ethylbenzene		NA	NA	NA	NA	NA	ND	
Methylene Chloride		NA	NA	NA	NA	NA	6 J	
Toluene		NA	NA	NA	NA	NA	ND	
Trichloroethene		NA	NA	NA	NA	NA	ND	
Xylenes, Total		NA	NA	NA	NA	NA	ND	
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	NA	NA	NA	NA	ND	
4-Chloro-3-Methylphenol		NA	NA	NA	NA	NA	ND	
Acenaphthene		NA	NA	NA	NA	NA	ND	
Anthracene		NA	NA	NA	NA	NA	ND	
Benzo(a)anthracene		NA	NA	NA	NA	NA	48 J	
Benzo(a)pyrene		NA	NA	NA	NA	NA	47 J	
Benzo(b)fluoranthene		NA	NA	NA	NA	NA	65 J	
Benzo(g,h,i)perylene		NA	NA	NA	NA	NA	ND	
Benzo(k)fluoranthene		NA	NA	NA	NA	NA	ND	
Bis(2-ethylhexyl)phthalate		NA	NA	NA	NA	NA	77 J	
Di-n-butylphthalate		NA	NA	NA	NA	NA	ND	
Carbazole		NA	NA	NA	NA	NA	ND	
Chrysene		NA	NA	NA	NA	NA	58 J	
Fluoranthene		NA	NA	NA	NA	NA	110 J	
Fluorene		NA	NA	NA	NA	NA	ND	
Indeno(1,2,3-cd)pyrene		NA	NA	NA	NA	NA	ND	
Napthalene		NA	NA	NA	NA	NA	ND	
Phenanthrene		NA	NA	NA	NA	NA	78 J	
Pyrene		NA	NA	NA	NA	NA	110 J	
Butyltins (µg/Kg)								
Tetrabutyltin		NA	NA	NA	NA	NA	ND	
Monobutyltin		NA	NA	NA	NA	NA	ND	
Tributyltin		NA	NA	NA	NA	NA	ND	
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	NA	NA	NA	NA	ND	
4,4'-DDE		NA	NA	NA	NA	NA	ND	
4,4'-DDT		NA	NA	NA	NA	NA	ND	
Aldrin		NA	NA	NA	NA	NA	ND	
Alpha-chlordane		NA	NA	NA	NA	NA	13 J	
Endrin		NA	NA	NA	NA	NA	ND	
Gamma-chlordane		NA	NA	NA	NA	NA	ND	
Heptachlor		NA	NA	NA	NA	NA	ND	
Heptachlor epoxide		NA	NA	NA	NA	NA	ND	

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						TP25-1011
		TP14-0506	TP15-0506	TP15-1112	TP17-0507	TP17-1112	TP25-0507	
SITE AREA DESIGNATION:		Test Pit, 5-6 ft	Test Pit, 5-6 ft	Test Pit, 11-12 ft	Test Pit, 5-7 ft	Test Pit, 11-12 ft	Test Pit, 5-7 ft	Test Pit, 10-11 ft
		CS	CS	CS	CS	CS	CS	CS
TOTAL Metals (mg/Kg)								
Aluminum		18800	10200	7360	6420	8330	11100	10800
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		4.8	11.4	6.1	13.6	8.7	15.6	13
Barium		61	15	9.4	8.5	16.1	18.5	18.4
Beryllium		0.38	0.49	0.39	0.4	0.24	0.44	0.38
Cadmium		1.5	1	1.1	0.99	ND	1.2	ND
Chromium		19	10.1	6.8	6.3	7.2	10.1	13
Cobalt		24.7	13.6	8.5	16.2	10.6	13.1	10.1
Copper		31.1	23.7	14.3	25.7	16	27.9	25.1
Iron		43800	25200	17300	17700	20400	27400	24800
Lead		49.4	11.2	5.7	13	10.5	26.4	18.6
Manganese		72.7	32.6	22.5	34.0	52.4	37.7	37.8
Mercury		ND	ND	ND	ND	ND	ND	0.11
Nickel		36.3	22.8	13.8	14.6	18	22.7	20
Selenium		ND	ND	ND	ND	ND	ND	0.86
Silver		1.7	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		20.9	15.9	11.4	9.7	11.9	17.6	15.2
Zinc		77.4	50.6	35.4	41.5	38.8	62.1	56.7
TCLP Metals (µg/L)								
Arsenic		NA	NA	NA	NA	NA	NA	16.7
Barium		NA	NA	NA	NA	NA	NA	129
Cadmium		NA	NA	NA	NA	NA	NA	ND
Chromium		NA	NA	NA	NA	NA	NA	ND
Lead		NA	NA	NA	NA	NA	NA	21.9
Mercury		NA	NA	NA	NA	NA	NA	ND
Selenium		NA	NA	NA	NA	NA	NA	ND
Silver		NA	NA	NA	NA	NA	NA	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA	NA	NA	NA	NA	NA	150

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- * - Dilution Results

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		MW05-1012	MW05-2224	DUPL-09	MW05-3234	MW05-4446	MW06-0406	MW07-0810
		Boring, 10-12 ft	Field Dup 9 Boring, 22-24 ft	Field Dup 9 Boring, 22-24 ft	Boring, 32-34 ft	Boring, 44-46 ft	Boring, 4-6 ft	Boring, 8-10 ft
SITE AREA DESIGNATION:	CS	CS	CS	CS	CS	CS	CS	
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		ND	ND	ND	ND	ND	ND	ND
2-Butanone		ND	ND	ND	ND	ND	2 J	ND
Acetone		33	18	ND	14	13	10 J	25
Benzene		ND	ND	ND	ND	ND	ND	ND
Chlorobenzene		ND	ND	ND	ND	ND	ND	ND
Carbon disulfide		ND	ND	ND	ND	ND	ND	ND
Ethylbenzene		ND	ND	ND	ND	ND	ND	ND
Methylene Chloride		12	17	14	17	34	22	18
Toluene		ND	ND	ND	ND	ND	ND	ND
Trichloroethene		ND	ND	ND	ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		ND	ND	ND	ND	ND	ND	280 J
4-Chloro-3-Methylphenol		ND	ND	ND	ND	ND	ND	ND
Acenaphthene		ND	ND	37 J	ND	ND	ND	ND
Anthracene		ND	ND	92 J	ND	ND	ND	ND
Benzo(a)anthracene		ND	ND	500	ND	ND	ND	ND
Benzo(a)pyrene		ND	ND	380	ND	ND	ND	ND
Benzo(b)fluoranthene		ND	ND	610	ND	ND	ND	ND
Benzo(g,h,i)perylene		ND	ND	210 J	ND	ND	ND	ND
Benzo(k)fluoranthene		ND	ND	210 J	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		ND	110 J	38 J	140 J	ND	ND	ND
Di-n-butylphthalate		ND	ND	ND	ND	ND	ND	ND
Carbazole		ND	ND	52 J	ND	ND	ND	ND
Chrysene		ND	ND	470	ND	ND	ND	ND
Fluoranthene		ND	ND	920	ND	ND	ND	ND
Fluorene		ND	ND	52 J	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	240 J	ND	ND	ND	ND
Napthalene		ND	ND	ND	ND	ND	ND	49 J
Phenanthrene		ND	ND	550	ND	ND	ND	48 J
Pyrene		ND	ND	880	ND	ND	ND	ND
Butyltins (µg/Kg)								
Tetrabutyltin		ND	ND	ND	ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND	ND	ND	ND
Tributyltin		11.02 J	ND	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		ND	ND	ND	ND	ND	ND	ND
4,4'-DDE		ND	ND	17	ND	ND	ND	ND
4,4'-DDT		ND	ND	45	ND	ND	ND	ND
Aldrin		ND	ND	ND	ND	ND	ND	ND
Alpha-chlordane		ND	ND	89	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND	ND
Gamma-chlordane		ND	ND	63	ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	26	ND	ND	ND	ND

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S-	SAMPLE LOCATION/TYPE						
		MW05-1012 Boring, 10-12 ft	MW05-2224 Field Dup 9 Boring, 22-24 ft	DUPL-09 Field Dup 9 Boring, 22-24 ft	MW05-3234 Boring, 32-34 ft	MW05-4446 Boring, 44-46 ft	MW06-0406 Boring, 4-6 ft	MW07-0810 Boring, 8-10 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS	CS	CS	
TOTAL Metals (mg/Kg)								
Aluminum		6490	4820	10200	6840	6990	19900	8890
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		7.1	6.3	10.8	8	4.1	11.1	20.3
Barium		12.6	2.6	29.4	14.7	14.3	5.5	17.2
Beryllium		0.3	ND	0.39	0.22	0.23	ND	0.41
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		8.7	7.7	13	11.7	10.4	25.6	10.5
Cobalt		7.3	3.9	8.1	10.2	6.7	24	10.2
Copper		13.9	5.1	20.7	15	10	21.2	17.3
Iron		16100	14300	20300	20500	14500	43600	25200
Lead		12.8	2.1	10.9	4.3	3.9	13.3	7.6
Manganese		310	86.2	34.9	22.7	15.6	4.95	3.96
Mercury		0.06	ND	0.17	ND	ND	ND	0.07
Nickel		13.4	10.4	17.8	16.9	13.9	39.7	16.8
Selenium		ND	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		8.9	10.5	40	10.9	10.9	17.7	13
Zinc		31.9	31.3	63.4	37.9	31.1	72	40.6
TCLP Metals (µg/L)								
Arsenic		8.8	ND	ND	ND	ND	ND	18.6
Barium		806	693	648	184	122	55	710
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		21.5	8.5	10.6	ND	ND	ND	7.3
Lead		23.5	2.4	68.6	3	ND	5.1	1.8
Mercury		0.2	ND	ND	ND	ND	ND	ND
Selenium		ND	ND	ND	ND	6.7	ND	ND
Silver		ND	ND	ND	ND	ND	8.6	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		4100	ND	76	ND	ND	83	160

NOTES:

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- * - Dilution Results

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE			
		MW07-1618 Duplicate 7 Boring, 16-18 ft	DUPL-07 Duplicate 7 Boring, 16-18 ft	MW07-2224 Boring, 22-24 ft	MW07-3436 Boring, 34-36 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS
Volatile Organic Compounds (µg/Kg)					
1,2-Dichloroethene (total)		ND	ND	ND	ND
2-Butanone		ND	18	ND	ND
Acetone		39	45	23	7 J
Benzene		ND	ND	ND	ND
Chlorobenzene		ND	ND	ND	ND
Carbon disulfide		ND	ND	4 J	ND
Ethylbenzene		ND	ND	ND	ND
Methylene Chloride		13	11 J	15	13
Toluene		ND	ND	ND	ND
Trichloroethene		ND	ND	ND	ND
Xylenes, Total		ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)					
2-Methylnaphthalene		ND	ND	ND	ND
4-Chloro-3-Methylphenol		ND	ND	ND	ND
Acenaphthene		ND	ND	ND	ND
Anthracene		ND	ND	ND	ND
Benzo(a)anthracene		ND	ND	ND	ND
Benzo(a)pyrene		ND	ND	ND	ND
Benzo(b)fluoranthene		ND	ND	ND	ND
Benzo(g,h,i)perylene		ND	ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		42 J	63 J	ND	84 J
Di-n-butylphthalate		ND	ND	ND	ND
Carbazole		ND	ND	ND	ND
Chrysene		51 J	ND	ND	ND
Fluoranthene		49 J	49 J	ND	ND
Fluorene		ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		ND	ND	ND	ND
Naphthalene		ND	ND	ND	ND
Phenanthrene		ND	ND	ND	ND
Pyrene		42 J	45 J	ND	ND
Butyltins (µg/Kg)					
Tetrabutyltin		ND	ND	ND	ND
Monobutyltin		ND	ND	ND	ND
Tributyltin		ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)					
4,4'-DDD		ND	220*	28	7 4
4,4'-DDE		ND	11	ND	ND
4,4'-DDT		ND	100*	ND	ND
Aldrin		ND	ND	ND	ND
Alpha-chlordane		ND	ND	ND	ND
Endrin		ND	ND	ND	ND
Gamma-chlordane		ND	ND	ND	ND
Heptachlor		ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND

TABLE 4-5C
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 CENTRAL SHIPYARD AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE			
		MW07-1618 Duplicate 7 Boring, 16-18 ft	DUPL-07 Duplicate 7 Boring, 16-18 ft	MW07-2224 Boring, 22-24 ft	MW07-3436 Boring, 34-36 ft
SITE AREA DESIGNATION:		CS	CS	CS	CS
TOTAL Metals (mg/Kg)					
Aluminum		10100	8820	5800	7350
Antimony		ND	ND	ND	ND
Arsenic		20.9	18.4	5	3.9
Barium		15.7	13.2	4.1	13.2
Beryllium		0.38	0.38	ND	0.26
Cadmium		ND	ND	ND	ND
Chromium		12.3	11	8.2	10.3
Cobalt		11.4	11.4	4.6	6.4
Copper		17.4	17.5	5.9	11.4
Iron		28400	26200	15100	15100
Lead		37.1	35.1	2.6	4.5
Manganese		364	336	92.5	147
Mercury		ND	0.15	ND	ND
Nickel		20.7	20.1	11.5	13.9
Selenium		ND	ND	ND	ND
Silver		ND	ND	ND	ND
Thallium		ND	ND	ND	ND
Tin		ND	ND	ND	ND
Vanadium		13.7	11.7	12.3	11.5
Zinc		60.1	58.6	28	32.2
TCLP Metals (µg/L)					
Arsenic		24.6	26.8	4.2	ND
Barium		514	681	340	613
Cadmium		ND	ND	ND	ND
Chromium		ND	ND	ND	14.6
Lead		37.1	38.1	38.1	ND
Mercury		ND	ND	ND	ND
Selenium		ND	ND	ND	ND
Silver		ND	ND	ND	8.1
Total Petroleum Hydrocarbons (mg/Kg)					
TPH		ND	ND	ND	ND

NOTES:

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- - Dilution Results

TABLE 4-5D
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DEREKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						TP26-0305
		TP08-0408	TP08-0910	TP09-0406	TP09-0910	TP10-0507	TP10-1213	
		Test Pit, 4-6 ft	Test Pit, 9-10 ft	Test Pit, 4-6 ft	Test Pit, 9-10 ft	Test Pit, 5-7 ft	Test Pit, 12-13 ft	
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		ND	ND	NA	NA	NA	NA	ND
2-Butanone		ND	ND	NA	NA	NA	NA	12 J
Acetone		2 J	15	NA	NA	NA	NA	66 J
Benzene		ND	ND	NA	NA	NA	NA	ND
Chlorobenzene		ND	ND	NA	NA	NA	NA	ND
Carbon disulfide		ND	ND	NA	NA	NA	NA	ND
Ethylbenzene		ND	ND	NA	NA	NA	NA	66 J
Methylene Chloride		7 J	8 J	NA	NA	NA	NA	63 J
Toluene		ND	ND	NA	NA	NA	NA	ND
Trichloroethene		ND	ND	NA	NA	NA	NA	ND
Xylenes, Total		ND	ND	NA	NA	NA	NA	150
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		ND	ND	NA	NA	NA	NA	14000
4-Chloro-3-Methylphenol		ND	ND	NA	NA	NA	NA	ND
Acenaphthene		ND	ND	NA	NA	NA	NA	ND
Anthracene		ND	ND	NA	NA	NA	NA	900 J
Benzo(a)anthracene		48 J	ND	NA	NA	NA	NA	ND
Benzo(a)pyrene		55 J	ND	NA	NA	NA	NA	ND
Benzo(b)fluoranthene		80 J	ND	NA	NA	NA	NA	ND
Benzo(g,h,i)perylene		45 J	ND	NA	NA	NA	NA	ND
Benzo(k)fluoranthene		68 J	ND	NA	NA	NA	NA	ND
Bis(2-ethylhexyl)phthalate		54 J	22000	NA	NA	NA	NA	560 J
Di-n-butylphthalate		ND	ND	NA	NA	NA	NA	ND
Carbazole		ND	ND	NA	NA	NA	NA	ND
Chrysene		54 J	ND	NA	NA	NA	NA	ND
Fluoranthene		120 J	ND	NA	NA	NA	NA	ND
Fluorene		ND	ND	NA	NA	NA	NA	2100 J
Indeno(1,2,3-cd)pyrene		41 J	ND	NA	NA	NA	NA	ND
Naphthalene		ND	ND	NA	NA	NA	NA	2200 J
Phenanthrene		57 J	ND	NA	NA	NA	NA	4800
Pyrene		87 J	ND	NA	NA	NA	NA	460 J
Butyltins (µg/Kg)								
Tetrabutyltin		ND	46 J	NA	NA	NA	NA	ND
Monobutyltin		ND	ND	NA	NA	NA	NA	ND
Tributyltin		ND	ND	NA	NA	NA	NA	ND
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		ND	ND	NA	NA	NA	NA	ND
4,4'-DDE		ND	ND	NA	NA	NA	NA	ND
4,4'-DDT		ND	ND	NA	NA	NA	NA	ND
Aldrin		ND	ND	NA	NA	NA	NA	ND
Alpha-chlordane		ND	ND	NA	NA	NA	NA	ND
Endrin		ND	ND	NA	NA	NA	NA	ND
Gamma-chlordane		ND	ND	NA	NA	NA	NA	ND
Heptachlor		ND	ND	NA	NA	NA	NA	4
Heptachlor epoxide		ND	ND	NA	NA	NA	NA	ND

TABLE 4-5D
CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
BUILDING 234 AREA
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP08-0406	TP08-0910	TP09-0406	TP09-0910	TP10-0507	TP10-1213	TP26-0305
		Test Pit, 4-6 ft	Test Pit, 9-10 ft	Test Pit, 4-6 ft	Test Pit, 9-10 ft	Test Pit, 5-7 ft	Test Pit, 12-13 ft	Test Pit, 3-5 ft
TOTAL Metals (mg/Kg)								
Aluminum		7660	4900	17100	23300	3610	10000	1690
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		8.7	3.2	11.7	15.9	3	17.3	1.2
Barium		18.4	7.2	13.2	16	5.4	17.3	9.7
Beryllium		0.67	0.2	0.37	0.46	ND	0.27	ND
Cadmium		ND	ND	ND	ND	ND	0.66	ND
Chromium		18.2	9.3	22.5	32.5	6.2	13	2.2
Cobalt		9.9	4.1	14	25	3.1	11.3	1.1
Copper		46.1	9.5	22.1	39	6	18	34.9
Iron		22300	13000	36200	50000	10600	25100	4060
Lead		67.2	7.1	12.9	34.6	4.1	7.7	3.2
Manganese		305	150	398	2450	78.6	344	108
Mercury		ND	ND	ND	ND	ND	ND	ND
Nickel		31.6	10.2	27.7	48.1	8.9	19.7	2.3
Selenium		ND	ND	1.4	ND	ND	ND	ND
Silver		ND	ND	ND	1.6	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		13.5	8.4	19.6	19.5	7.5	15.9	4.4
Zinc		158	31.4	58.3	84.6	21.2	44	10
TCLP Metals (µg/L)								
Arsenic		ND	ND	NA	NA	NA	NA	ND
Barium		128	69.9	NA	NA	NA	NA	133
Cadmium		ND	ND	NA	NA	NA	NA	ND
Chromium		ND	ND	NA	NA	NA	NA	ND
Lead		4.8	3.4	NA	NA	NA	NA	1.7
Mercury		0.42	0.54	NA	NA	NA	NA	0.53
Selenium		6.3	6.3	NA	NA	NA	NA	4.2
Silver		ND	ND	NA	NA	NA	NA	27.5
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		ND	ND	NA	NA	NA	NA	2200

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- * - Dilution Results

TABLE 4-5D
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP26-0406	TP26-0910	MW08-0810	MW09-1012 Duplicate 10	DUPL-10 Duplicate 10	MW09-2022	MW09-3032
		Test Pit, 4-6 ft	Test Pit, 9-10 ft	Boring, 8-10 ft	Boring, 10-12 ft	Boring, 10-12 ft	Boring, 20-22 ft	Boring, 30-32 ft
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	NA	3 J	ND	1 J	ND	ND
2-Butanone		NA	NA	ND	15	6 J	15	ND
Acetone		NA	NA	11	7 J	9 J	20	13
Benzene		NA	NA	ND	ND	ND	ND	ND
Chlorobenzene		NA	NA	ND	ND	ND	ND	ND
Carbon disulfide		NA	NA	ND	ND	ND	ND	ND
Ethylbenzene		NA	NA	ND	ND	ND	ND	ND
Methylene Chloride		NA	NA	34	17	14	33	37
Toluene		NA	NA	ND	ND	ND	ND	ND
Trichloroethene		NA	NA	3 J	ND	ND	ND	ND
Xylenes, Total		NA	NA	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	NA	ND	ND	ND	ND	ND
4-Chloro-3-Methylphenol		NA	NA	ND	ND	ND	ND	ND
Acenaphthene		NA	NA	ND	ND	ND	ND	ND
Anthracene		NA	NA	ND	ND	ND	ND	ND
Benzo(a)anthracene		NA	NA	ND	53 J	70 J	ND	ND
Benzo(a)pyrene		NA	NA	ND	41 J	42 J	ND	ND
Benzo(b)fluoranthene		NA	NA	ND	63 J	ND	ND	ND
Benzo(g,h,i)perylene		NA	NA	ND	ND	ND	ND	ND
Benzo(k)fluoranthene		NA	NA	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate		NA	NA	ND	75 J	42 J	400	41 J
Di-n-butylphthalate		NA	NA	ND	ND	ND	ND	ND
Carbazole		NA	NA	ND	ND	ND	ND	ND
Chrysene		NA	NA	ND	54 J	41 J	ND	ND
Fluoranthene		NA	NA	100 J	130 J	130 J	ND	ND
Fluorene		NA	NA	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene		NA	NA	ND	ND	ND	ND	ND
Napthalene		NA	NA	ND	ND	ND	ND	ND
Phenanthrene		NA	NA	51 J	61 J	74 J	ND	ND
Pyrene		NA	NA	100 J	98 J	ND	ND	ND
Butyltins (µg/Kg)								
Tetrabutyltin		NA	NA	ND	ND	ND	ND	ND
Monobutyltin		NA	NA	ND	ND	ND	ND	ND
Tributyltin		NA	NA	ND	ND	ND	ND	ND
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	NA	ND	ND	ND	ND	ND
4,4'-DDE		NA	NA	ND	ND	ND	ND	ND
4,4'-DDT		NA	NA	ND	ND	ND	ND	ND
Aldrin		NA	NA	ND	ND	ND	ND	ND
Alpha-chlordane		NA	NA	ND	ND	ND	ND	ND
Endrin		NA	NA	ND	ND	ND	ND	ND
Gamma-chlordane		NA	NA	ND	ND	ND	ND	ND
Heptachlor		NA	NA	ND	ND	ND	ND	ND
Heptachlor epoxide		NA	NA	ND	ND	ND	ND	ND

TABLE 4-5D
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DEREKKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP26-0406	TP26-0910	MW08-0810	MW09-1012 Duplicate 10	DUPL-10 Duplicate 10	MW09-2022	MW09-3032
		Test Pit, 4-6 ft	Test Pit, 9-10 ft	Boring, 8-10 ft	Boring, 10-12 ft	Boring, 10-12 ft	Boring, 20-22 ft	Boring, 30-32 ft
TOTAL Metals (mg/Kg)								
Aluminum		10100	10200	11200	10400	6960	11100	16300
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		42	17.8	20.7	17.8	19	9.8	9.7
Barium		28.7	33.6	9.3	10.5	9.3	17.7	3.1
Beryllium		0.44	0.51	0.3	0.32	0.31	0.3	ND
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		14.8	20.1	16.1	16.3	10.6	16.5	21.6
Cobalt		11.5	11.5	13.7	11.2	8.8	13	15.9
Copper		21.9	34.7	23.9	23.2	18.6	16.2	30.9
Iron		25500	24700	30200	31000	28200	31800	36800
Lead		75	28.4	17.3	24.2	23.8	6.8	17.8
Manganese		342	363	502	251	246	462	391
Mercury		0.06	ND	ND	ND	ND	ND	ND
Nickel		18.8	25.5	24.5	20.9	17.2	25.3	32.5
Selenium		0.81	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		18.2	16.2	13.1	17.5	11.7	15.2	13.4
Zinc		80.1	117	59	73	67.3	63.2	66.3
TCCLP Metals (µg/L)								
Arsenic		NA	NA	ND	ND	ND	ND	ND
Barium		NA	NA	61.5	92.1	77.5	83.8	69.6
Cadmium		NA	NA	ND	ND	ND	ND	ND
Chromium		NA	NA	ND	ND	ND	ND	ND
Lead		NA	NA	2.6	15.8	21.8	1.9	5.4
Mercury		NA	NA	ND	ND	ND	ND	ND
Selenium		NA	NA	ND	ND	ND	ND	ND
Silver		NA	NA	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA	NA	490	ND	72	ND	ND

NOTES:

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- ~ - Dilution Results

TABLE 4-5D
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	LOCATION/TYPE
		MW09-3638 Boring, 36-38 ft
Volatile Organic Compounds (µg/Kg)		
1,2-Dichloroethene (total)		ND
2-Butanone		ND
Acetone		10 J
Benzene		ND
Chlorobenzene		ND
Carbon disulfide		ND
Ethylbenzene		ND
Methylene Chloride		16
Toluene		ND
Trichloroethene		ND
Xylenes, Total		ND
Semivolatile Organic Compounds (µg/Kg)		
2-Methylnaphthalene		ND
4-Chloro-3-Methylphenol		ND
Acenaphthene		ND
Anthracene		ND
Benzo(a)anthracene		ND
Benzo(a)pyrene		ND
Benzo(b)fluoranthene		ND
Benzo(g,h,i)perylene		ND
Benzo(k)fluoranthene		ND
Bis(2-ethylhexyl)phthalate		51 J
Di-n-butylphthalate		ND
Carbazole		ND
Chrysene		ND
Fluoranthene		ND
Fluorene		ND
Indeno(1,2,3-cd)pyrene		ND
Naphthalene		ND
Phenanthrene		ND
Pyrene		ND
Butyltins (µg/Kg)		
Tetrabutyltin		ND
Monobutyltin		ND
Tributyltin		ND
Pesticides/PCBs (µg/Kg)		
4,4'-DDD		ND
4,4'-DDE		ND
4,4'-DDT		ND
Aldrin		ND
Alpha-chlordane		ND
Endrin		ND
Gamma-chlordane		ND
Heptachlor		ND
Heptachlor epoxide		ND

TABLE 4-5D
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 BUILDING 234 AREA
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	LOCATION/TYPE
		MW09-3638 Boring, 36-38 ft
T TAL Metals (mg/Kg)		
Aluminum		16700
Antimony		ND
Arsenic		4.4
Barium		4.7
Beryllium		0.21
Cadmium		ND
Chromium		20.8
Cobalt		16.1
Copper		41.5
Iron		40400
Lead		3.1
Manganese		728
Mercury		ND
Nickel		33.2
Selenium		ND
Silver		ND
Thallium		ND
Tin		ND
Vanadium		12.3
Zinc		53.8
TCLP Metals (µg/L)		
Arsenic		ND
Barium		91.6
Cadmium		ND
Chromium		ND
Lead		2.8
Mercury		ND
Selenium		ND
Silver		ND
Total Petroleum Hydrocarbons (mg/Kg)		
TPH		ND

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- - Dilution Results

TABLE 4-5E
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP01-0507	TP01-1112	TP02-0709	TP02-1516	TP03-0305	TP03-0608	TP04-0607
		Test Pit, 5-7 ft	Test Pit, 11-12 f	Test Pit, 7-9 ft	Test Pit, 15-16 f	Test Pit, 3-5 ft	Test Pit, 6-8 ft	Test Pit, 6-7 ft
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (total)		NA	ND	NA	NA	NA	ND	NA
2-Butanone		NA	ND	NA	NA	NA	ND	NA
Acetone		NA	15	NA	NA	NA	10 J	NA
Benzene		NA	ND	NA	NA	NA	ND	NA
Chlorobenzene		NA	ND	NA	NA	NA	ND	NA
Carbon disulfide		NA	ND	NA	NA	NA	ND	NA
Ethylbenzene		NA	ND	NA	NA	NA	ND	NA
Methylene Chloride		NA	13	NA	NA	NA	28	NA
Toluene		NA	ND	NA	NA	NA	ND	NA
Trichloroethene		NA	ND	NA	NA	NA	ND	NA
Xylenes, Total		NA	ND	NA	NA	NA	ND	NA
Semivolatile Organic Compounds (µg/Kg)								
2-Methylnaphthalene		NA	ND	NA	NA	NA	ND	NA
4-Chloro-3-Methylphenol		NA	ND	NA	NA	NA	ND	NA
Acenaphthene		NA	ND	NA	NA	NA	ND	NA
Anthracene		NA	ND	NA	NA	NA	ND	NA
Benzo(a)anthracene		NA	ND	NA	NA	NA	ND	NA
Benzo(a)pyrene		NA	ND	NA	NA	NA	ND	NA
Benzo(b)fluoranthene		NA	43 J	NA	NA	NA	ND	NA
Benzo(g,h,i)perylene		NA	ND	NA	NA	NA	ND	NA
Benzo(k)fluoranthene		NA	ND	NA	NA	NA	ND	NA
Bis(2-ethylhexyl)phthalate		NA	160 J	NA	NA	NA	ND	NA
Di-n-butylphthalate		NA	ND	NA	NA	NA	ND	NA
Carbazole		NA	ND	NA	NA	NA	ND	NA
Chrysene		NA	ND	NA	NA	NA	ND	NA
Fluoranthene		NA	59 J	NA	NA	NA	ND	NA
Fluorene		NA	ND	NA	NA	NA	ND	NA
Indeno(1,2,3-cd)pyrene		NA	ND	NA	NA	NA	ND	NA
Napthalene		NA	ND	NA	NA	NA	ND	NA
Phenanthrene		NA	ND	NA	NA	NA	ND	NA
Pyrene		NA	67 J	NA	NA	NA	ND	NA
Butyltins (µg/Kg)								
Tetrabutyltin		NA	ND	NA	NA	NA	ND	NA
Monobutyltin		NA	ND	NA	NA	NA	ND	NA
Tributyltin		NA	ND	NA	NA	NA	ND	NA
Pesticides/PCBs (µg/Kg)								
4,4'-DDD		NA	ND	NA	NA	NA	ND	NA
4,4'-DDE		NA	ND	NA	NA	NA	ND	NA
4,4'-DDT		NA	ND	NA	NA	NA	ND	NA
Aldrin		NA	ND	NA	NA	NA	ND	NA
Alpha-chlordane		NA	ND	NA	NA	NA	ND	NA
Endrin		NA	ND	NA	NA	NA	ND	NA
Gamma-chlordane		NA	ND	NA	NA	NA	ND	NA
Heptachlor		NA	ND	NA	NA	NA	ND	NA
Heptachlor epoxide		NA	ND	NA	NA	NA	ND	NA

TABLE 4-5E
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE						
		TP01-0507	TP01-1112	TP02-0709	TP02-1516	TP03-0305	TP03-0608	TP04-0607
		Test Pit, 5-7 ft	Test Pit, 11-12 f	Test Pit, 7-9 ft	Test Pit, 15-16 f	Test Pit, 3-5 ft	Test Pit, 6-8 ft	Test Pit, 6-7 ft
TOTAL Metals (mg/Kg)								
Aluminum		7040	5860	10500	7450	7940	5730	8380
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		7.2	7.7	16.0	7.8	ND	6.8	12.3
Barium		16.6	2.9	14.6	18	14.6	9.2	14.6
Beryllium		0.36	ND	0.37	0.34	0.39	0.33	0.28
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		9.4	6.6	12.0	10.9	11.0	9.3	10.2
Cobalt		8	4.4	11.6	9.1	8.5	6.6	9.2
Copper		17.8	7.0	21.5	21.2	18.0	52.5	19.6
Iron		18100	16800	25500	19700	18600	16100	21300
Lead		30.0	7.6	21.2	34.2	5.5	21.8	52.3
Manganese		257	104	299	353	283	226	366
Mercury		0.07	ND	0.06	0.06	0.11	0.12	0.02
Nickel		13.5	10.7	24.4	18.9	17.7	17.4	17.0
Selenium		ND	ND	ND	ND	2.6	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	9.2
Vanadium		12	9	15.2	13.9	15	10.6	13.1
Zinc		67.3	52.5	66.2	74.8	57.7	67.8	67.7
TCLP Metals (µg/L)								
Arsenic		NA	ND	NA	NA	NA	ND	NA
Barium		NA	508	NA	NA	NA	448	NA
Cadmium		NA	ND	NA	NA	NA	ND	NA
Chromium		NA	ND	NA	NA	NA	ND	NA
Lead		NA	2.9	NA	NA	NA	11.2	NA
Mercury		NA	ND	NA	NA	NA	ND	NA
Selenium		NA	4.3	NA	NA	NA	ND	NA
Silver		NA	15.4	NA	NA	NA	ND	NA
Total Petroleum Hydrocarbons (mg/Kg)								
TPH		NA	72	NA	NA	NA	540	NA

NOTES
 NA - Not Analyzed
 ND - Not Detected
 J - Estimated quantitation
 * - Dilution Results

TABLE 4-5E
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE			
		TP05-0507	TP05-1213	TP06-0507	TP06-1213
		Test Pit, 5-7 ft	Test Pit, 12-13 ft	Test Pit, 5-7 ft	Test Pit, 12-13 ft
Volatile Organic Compounds (µg/Kg)					
1,2-Dichloroethene (total)		ND	NA	NA	NA
2-Butanone		7 J	NA	NA	NA
Acetone		44	NA	NA	NA
Benzene		ND	NA	NA	NA
Chlorobenzene		ND	NA	NA	NA
Carbon disulfide		ND	NA	NA	NA
Ethylbenzene		ND	NA	NA	NA
Methylene Chloride		11	NA	NA	NA
Toluene		ND	NA	NA	NA
Trichloroethene		ND	NA	NA	NA
Xylenes, Total		ND	NA	NA	NA
Semivolatile Organic Compounds (µg/Kg)					
2-Methylnaphthalene		50 J	NA	NA	NA
4-Chloro-3-Methylphenol		ND	NA	NA	NA
Acenaphthene		ND	NA	NA	NA
Anthracene		ND	NA	NA	NA
Benzo(a)anthracene		91 J	NA	NA	NA
Benzo(a)pyrene		79 J	NA	NA	NA
Benzo(b)fluoranthene		110 J	NA	NA	NA
Benzo(g,h,i)perylene		46 J	NA	NA	NA
Benzo(k)fluoranthene		78 J	NA	NA	NA
Bis(2-ethylhexyl)phthalate		72 J	NA	NA	NA
Di-n-butylphthalate		ND	NA	NA	NA
Carbazole		ND	NA	NA	NA
Chrysene		100 J	NA	NA	NA
Fluoranthene		320 J	NA	NA	NA
Fluorene		ND	NA	NA	NA
Indeno(1,2,3-cd)pyrene		53 J	NA	NA	NA
Naphthalene		ND	NA	NA	NA
Phenanthrene		100 J	NA	NA	NA
Pyrene		180 J	NA	NA	NA
Butyltins (µg/Kg)					
Tetrabutyltin		8.5 J	NA	NA	NA
Monobutyltin		ND	NA	NA	NA
Tributyltin		ND	NA	NA	NA
Pesticides/PCBs (µg/Kg)					
4,4'-DDD		ND	NA	NA	NA
4,4'-DDE		6.5	NA	NA	NA
4,4'-DDT		7	NA	NA	NA
Aldrin		ND	NA	NA	NA
Alpha-chlordane		ND	NA	NA	NA
Endrin		ND	NA	NA	NA
Gamma-chlordane		ND	NA	NA	NA
Heptachlor		2.1	NA	NA	NA
Heptachlor epoxide		ND	NA	NA	NA

TABLE 4-5E
 CHEMICAL CONSTITUENTS: SUBSURFACE SOILS
 SOUTH WATERFRONT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-S	SAMPLE LOCATION/TYPE			
		TP05-0507	TP05-1213	TP06-0507	TP06-1213
		Test Pit, 5-7 ft	Test Pit, 12-13 ft	Test Pit, 5-7 ft	Test Pit, 12-13 ft
TOTAL Metals (mg/Kg)					
Aluminum		10800	12100	14900	13400
Antimony		ND	ND	ND	ND
Arsenic		22	23.2	16.8	21.6
Barium		16.2	13.9	8.2	14.3
Beryllium		0.5	0.38	0.21	0.39
Cadmium		ND	ND	ND	0.56
Chromium		14.8	15	19.3	16.5
Cobalt		12.7	29.9	13.5	16.3
Copper		26	18.9	20.2	23.6
Iron		29500	30800	37000	34100
Lead		31.2	10.6	10	15.8
Manganese		385	800	436	512
Mercury		0.06	ND	ND	ND
Nickel		22.6	30.9	28	24.1
Selenium		0.89	ND	0.85	ND
Silver		ND	ND	1.2	ND
Thallium		ND	ND	ND	ND
Tin		ND	ND	ND	ND
Vanadium		23.8	17	16.2	18.3
Zinc		61.4	59.3	59.5	57
TCLP Metals (µg/L)					
Arsenic		ND	NA	NA	NA
Barium		156	NA	NA	NA
Cadmium		ND	NA	NA	NA
Chromium		6.5	NA	NA	NA
Lead		8.2	NA	NA	NA
Mercury		0.57	NA	NA	NA
Selenium		5.8	NA	NA	NA
Silver		ND	NA	NA	NA
Total Petroleum Hydrocarbons (mg/Kg)					
TPH		ND	NA	NA	NA

NOTES

- NA - Not Analyzed
- ND - Not Detected
- J - Estimated quantitation
- - Dilution Results

TABLE 4-6
 CHEMICAL CONSTITUENTS DETECTED IN GROUNDWATER
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-A	SAMPLE LOCATION/TYPE						
		MW01-01	DUPL-13	MW104-01	MW11-01	MW12-01	MW02-01	MW03-01
		FIELD DUP 13 Overburden	FIELD DUP 13 Overburden	Overburden	Overburden	Overburden	Overburden	FIELD DUP 12 Overburden
SITE AREA DESIGNATION:	UP	UP	UP **	NW	NW	NW	NW	
Volatile Organic Compounds (µg/Kg)								
1,2-Dichloroethene (Total)		ND	ND	180	18	16	5 J	ND
Acetone		ND	ND	ND	ND	40	ND	10
Methylene Chloride		12	3	4 J	3 J	10	12	10
Trichloroethene		ND	ND	ND	ND	16	ND	32
Vinyl Chloride		ND	ND	100	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)								
Bis(2-ethylhexyl)phthalate		ND	ND	ND	13	ND	ND	ND
Butyl Benzyl Phthalate		ND	ND	ND	2 J	ND	ND	ND
Butyltins (µg/Kg)								
Monobutyltin		ND	0.81 J	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)								
Aluminum		64.6	33.7	88.9	100	66.5	48.8	227
Antimony		ND	ND	ND	ND	ND	ND	ND
Arsenic		ND	ND	19.8	13.2	ND	ND	6.3
Barium		10.8	11.5	44.6	15.8	11.2	44.4	11.8
Beryllium		ND	ND	ND	ND	ND	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND	ND
Chromium		19.5	7.5	7.2	7.3	ND	ND	ND
Cobalt		15.1	3.4	12.3	4.5	ND	ND	5.4
Copper		ND	ND	12.7	ND	ND	ND	5.4
Iron		328	140	1880	414	216	205	540
Lead		ND	ND	14.6	ND	ND	ND	ND
Manganese		25.3	20.5	4300	373	125	230	30
Mercury		ND	ND	ND	ND	ND	ND	ND
Nickel		11.4	ND	20.6	9.6	ND	ND	ND
Selenium		ND	ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND	ND
Vanadium		ND	ND	ND	ND	ND	ND	ND
Zinc		23.2	52.1	14.2	21.3	15.2	68.3	23.7

NOTES.

- ND - Not Detected
- J - Estimated quantitation
- CS - Central Shipyard
- UP - Upgradient, MW104 Between Building 234 and Steam Plant
- NW - North Waterfront
- SW - South Waterfront
- 234 - Building 234 Area

TABLE 4-6
 CHEMICAL CONSTITUENTS DETECTED IN GROUNDWATER
 FORMER ROBERT E. DERECKTOR SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 NETC NEWPORT RHODE ISLAND

ANALYTE	DSY-A	SAMPLE LOCATION/TYPE					
		DUPL-12	MW04-01	MW05-01	MW07-01	MW08-01	MW09-01
		FIELD DUP 12 Overburden	Overburden	Bedrock	Overburden	Overburden	Overburden
SITE AREA DESIGNATION:	NW	NW	CS	CS	234	234	
Volatile Organic Compounds (µg/Kg)							
1,2-Dichloroethene (Total)		ND	ND	ND	ND	13	ND
Acetone		ND	ND	ND	ND	ND	ND
Methylene Chloride		10	11	8 J	10	11	11
Trichloroethene		33	ND	ND	ND	4 J	3 J
Vinyl Chloride		ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds (µg/Kg)							
Bis(2-ethylhexyl)phthalate		ND	ND	ND	ND	ND	1 J
Butyl Benzyl Phthalate		ND	ND	ND	ND	ND	ND
Butyltins (µg/Kg)							
Monobutyltin		ND	ND	ND	ND	ND	ND
TOTAL Metals (mg/Kg)							
Aluminum		59	43.9	ND	1240	102	1010
Antimony		ND	ND	ND	ND	ND	ND
Arsenic		4.3	5.1	ND	57.6	15.6	ND
Barium		10.4	33.5	49.1	51.7	33.9	99.3
Beryllium		ND	ND	ND	ND	ND	ND
Cadmium		ND	ND	ND	ND	ND	ND
Chromium		ND	ND	ND	12.8	30.3	57.6
Cobalt		3.6	ND	3.9	4.5	18.5	7.8
Copper		5.8	ND	ND	ND	ND	5.9
Iron		78.3	134	1260	18400	5660	2600
Lead		5.9	ND	ND	1.8	ND	ND
Manganese		19.9	371	1360	753	3410	830
Mercury		ND	ND	ND	ND	ND	ND
Nickel		11.4	ND	10.3	11.3	18.4	34.6
Selenium		ND	ND	ND	ND	ND	ND
Silver		ND	ND	ND	ND	ND	ND
Thallium		ND	ND	ND	ND	ND	ND
Tin		ND	ND	ND	ND	ND	ND
Vanadium		ND	ND	ND	ND	ND	ND
Zinc		19.9	17.3	3.9	26.4	33.6	22.4

NOTES:

ND - Not Detected

J - Estimated quantitation

CS - Central Shipyard

UP - Upgradient, MW104 Between Building 234 and Steam Plant

NW - North Waterfront

SW - South Waterfront

234 - Building 234 Area

**TABLE 4-7
BIRD SPECIES AND STATUS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

Common Name	Scientific Name	Status
Herring gull	<i>Larus argentatus</i>	o
Ring-billed gull	<i>Larus delawarensis</i>	o
Black-capped chickadee	<i>Parus atricapillus</i>	o
American crow	<i>Corvus brachyrhynchos</i>	o
Barn swallow	<i>Hirundo rustica</i>	o
Tree swallow	<i>Tachycineta bicolor</i>	o
Chimney swift	<i>Chaetura pelagica</i>	o
American goldfinch	<i>Carduelis tristis</i>	o
American Robin	<i>Turdus migratorius</i>	o
Brown-headed cowbird	<i>Molothrus ater</i>	o
Purple finch	<i>Carpodacus purpureus</i>	o
Mockingbird	<i>Mimus polyglottos</i>	o
Gray catbird	<i>Dumetella carolinensis</i>	o
Cedar waxwing	<i>Bombycilla cedrorum</i>	o
Common Grackle	<i>Quiscalus quiscula</i>	o
Northern Cardinal	<i>Cardinalis cardinalis</i>	o
Great Egret	<i>Casmerodius albus</i>	os
Double Crested Corarant	<i>Phalacrocorax auritus</i>	os
Mallard Duck	<i>Anas platyrhynchos</i>	os
Black-capped night heron	<i>Nycticorax nycticoray</i>	os

o = observed

os = observed off-shore

**TABLE 4-8
MAMMAL SPECIES AND STATUS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

Common Name	Scientific Name	North Water-front	Central Shipyard	Building 234 Area	South Water-front	Off-site
White-footed mouse	<i>Peromyscus leucopus</i>	p	o	p	p	p
Eastern Cottontail	<i>Sylvilagus floridanus</i>	p	p	p	o	p
Eastern Chipmunk	<i>Tamias striatus</i>	o	p	p	p	p
Raccoon	<i>Procyon lotor</i>	p	p	p	s	p
Red Fox	<i>Vulpes vulpes</i>	r	p	p	p	s
Domestic cat	<i>Felis domestica</i>	p	p	p	o	p
Star-nosed mole	<i>Condylura cristata</i>	p	p	p	p	p
Northern short-tailed shrew	<i>Blarina brevicauda</i>	p	p	p	p	p
Eastern mole	<i>Scalopus aquaticus</i>	p	p	p	p	p
Woodchuck	<i>Marmota monax</i>	p	p	p	p	p
Meadow vole	<i>Microtus pennsylvanicus</i>	p	p	p	p	p
House mouse	<i>Mus musculus</i>	e	e	e	e	e

o = observed, s = sign, p = potential,
r = reported, but not confirmed

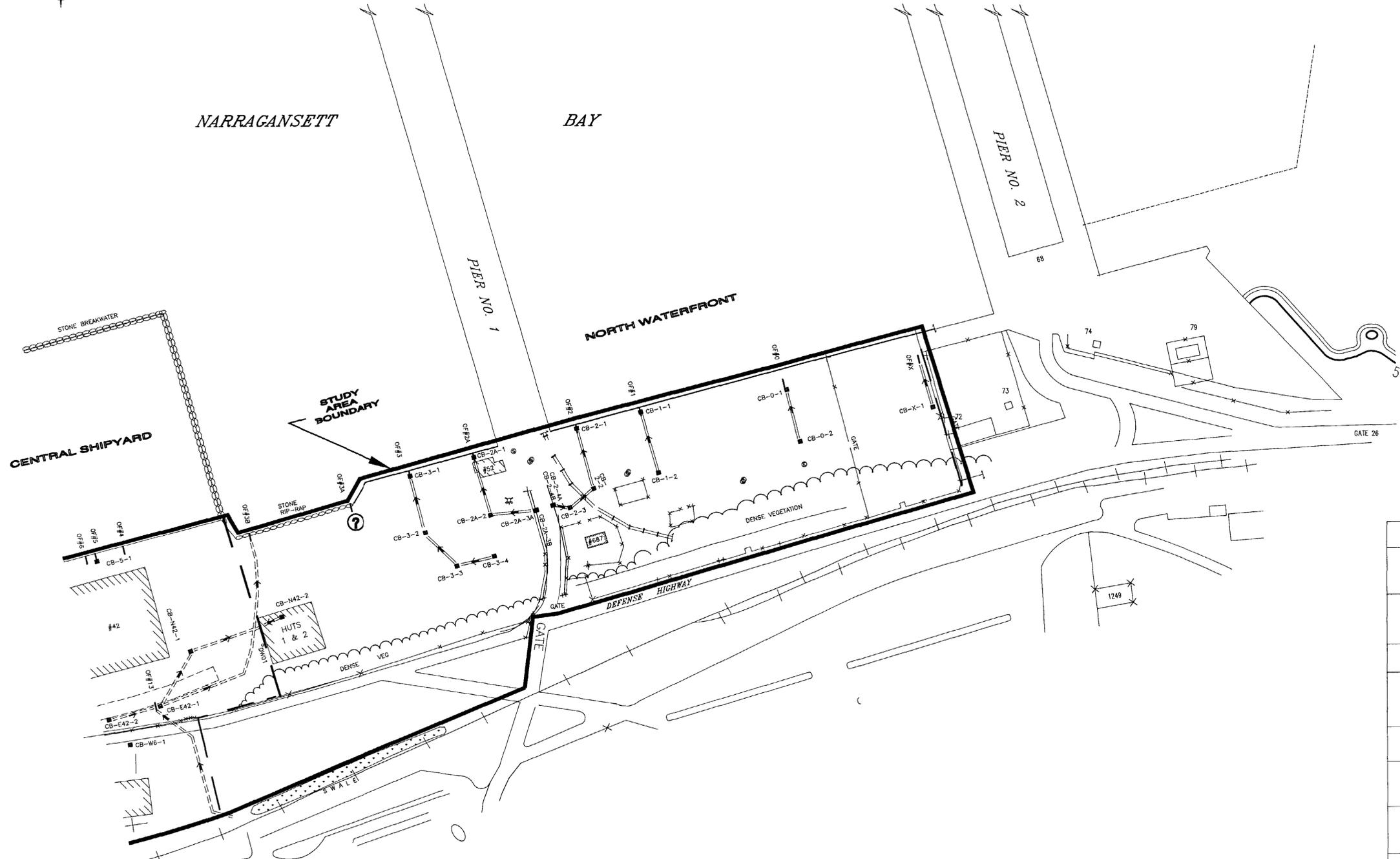
**TABLE 4-9
REPTILES AND AMPHIBIANS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

Common Name	Scientific Name	Status
Eastern garter snake	<i>Thamnophis s. sirtalis</i>	o
Eastern Hognose	<i>Heterodon platyrhinos</i>	p
Northern brown snake	<i>Storeria d. dekayi</i>	p
Eastern smooth greensnake	<i>Opheodrys v. vernalis</i>	p
Eastern milk snake	<i>Lampropeltist. triangulum</i>	p
Eastern American toad	<i>Bufo a. americanus</i>	p
Green frog	<i>Rana clamitans melanota</i>	p

o = observed
p = potential

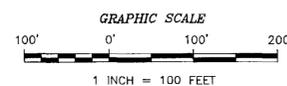
LEGEND

- x-x- FENCE
- OF# OUTFALL NUMBER
- CB-1-2 CATCH BASIN WITH IDENTIFIER
- [Hatched Box] BUILDING OF INTEREST
- [Empty Box] BUILDING
- CONFIRMED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)
- ⇌ SUSPECTED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)



Point of Discharge (Outfall No.)	Collection Point (Catch Basin)	Remarks
X 12" ID	CB-X-1	outfall is under concrete dock, approx. 40' east of edge, smoke tested
0 12" I.D.	CB-0-1 CB-0-2	outfall is under dock, approx 40' east of edge, smoke tested
1 24" ID	CB-1-1 CB-1-2	smoke tested
2 24" ID	CB-2-1 CB-2-2 CB-2-3 CB-2-4A CB-2-4B	smoke tested
2A 24" ID	CB-2A-1 CB-2A-2 CB-2A-3A	visual observation
3 36" I.D.	CB-3-1 CB-3-2 CB-3-3 CB-3-4	visual observation
3A 12" ID	Unknown	no input areas were located, no discharge was observed at outfall
3B	see remarks	see Figure 4-3, part of Central Shipyard drainage system

- NOTES:
- 1 ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
 - 2 PLAN NOT TO BE USED FOR DESIGN



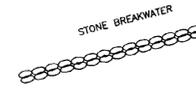
DRAWN BY R.G DEWSNAP		TITLE: UNDERGROUND DRAINAGE SYSTEM - NORTH WATERFRONT AREA	
PREPARED BY K O'NEILL		SITE ASSESSMENT SCREENING EVALUATION REPORT	
CHECKED BY: S. PARKER		FORMER ROBERT E. DERECKTOR SHIPYARD	
		NEWPORT, RHODE ISLAND	
SOURCE COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS			
SCALE 1" = 100'	DATE JAN. 24, 1997	PROJ. NO. 7368	CTO. 2682
PROJECT MANAGER S. PARKER	DRAWING NO. FIGURE 4-2	ACFILE NAME D:\DWS\NAVY\DEREKTOR\SASER_NO_SHIPYD.DWG	REV 0
PROGRAM MANAGER: J. TREPANOWSKI			

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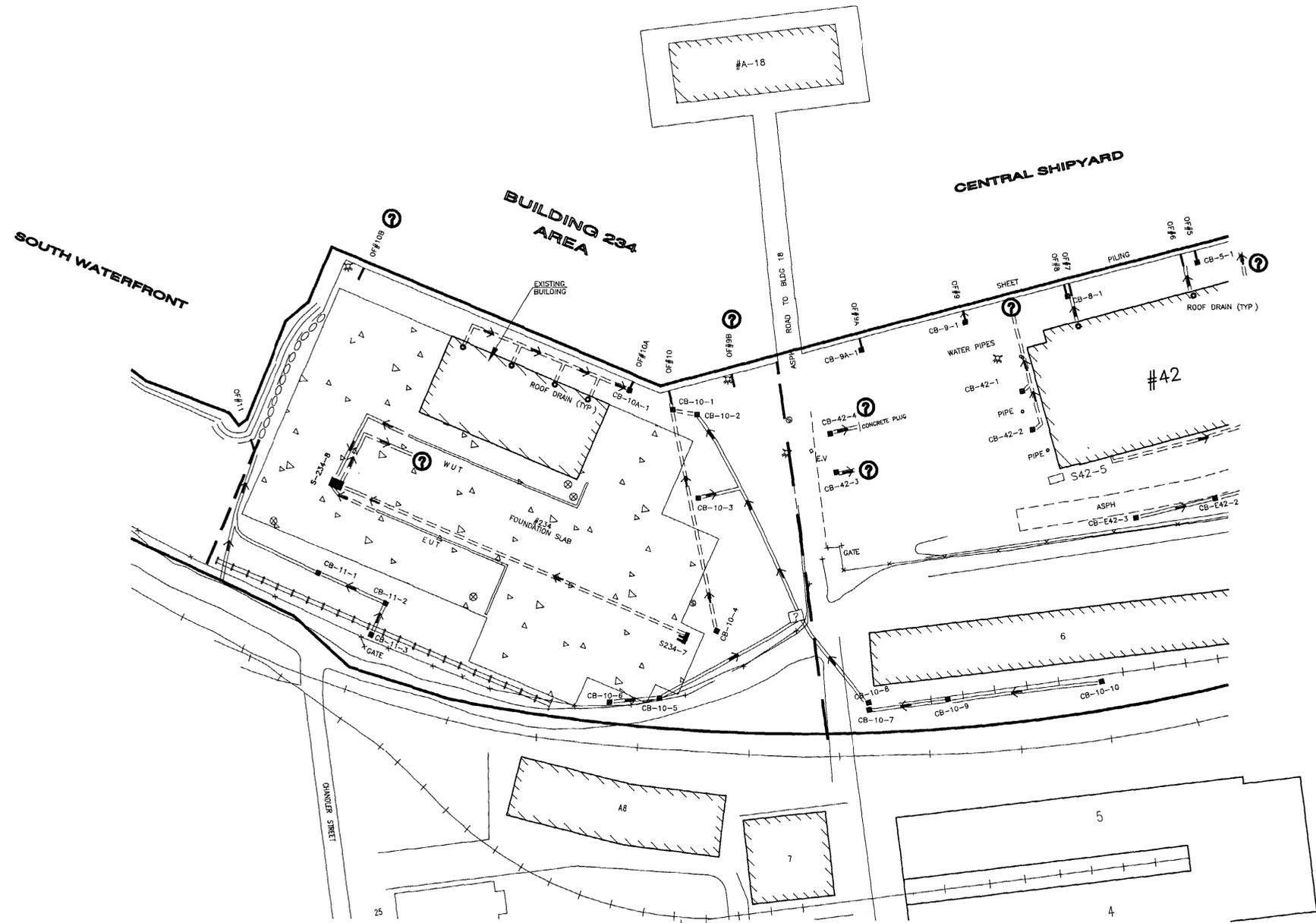


NARRAGANSETT BAY



LEGEND

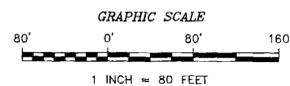
- x—x— FENCE
- OF# OUTFALL NUMBER
- CB-1-2 CATCH BASIN WITH IDENTIFIER
- #A-18 BUILDING OF INTEREST
- BUILDING
- >— CONFIRMED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)
- ==> SUSPECTED DRAINAGE PATH (ARROW INDICATES FLOW DIRECTION)
- ⊗ COVERED FLOOR DRAIN / CLEANOUT (SUSPECTED DRAINAGE PATHS NOT SHOWN FOR CLARITY)



Point of Discharge (Outfall No)	Collection Point/Input Area (Catch Basins, Sumps, Trenches)	Remarks
9B 18" I.D. steel	Unknown	has 24" I.D. steel sleeve
10 36" I.D. concrete	CB-10-1, CB-10-2, CB-10-3, CB-10-4, CB-10-5, CB-10-6, CB-10-7, CB-10-8, CB-10-9, CB-10-10	surface drainage, smoke test, video
10A 24" I.D. steel	CB-10A-1	roof drains of existing building, surface drainage
10B 18" I.D. steel	Unknown	has 24" I.D. steel sleeve steel
11 30" I.D. concrete	CB-11-1, CB-11-3, CB-11-3, unknown off-site area	outfall in south water front
Unknown Point of Discharge from S234-B	E.U.T., W.U.T., S234-7, covered floor drains or cleanouts connected to S234-B	drains at bottom of sumps/trenches connected to S234-B, discharge from S234-8 not determined

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
2. PLAN NOT TO BE USED FOR DESIGN
3. SOUTHEASTERN COVERED FLOOR DRAIN / CLEANOUT DRAINAGE LINE CONNECTED TO S234-8.



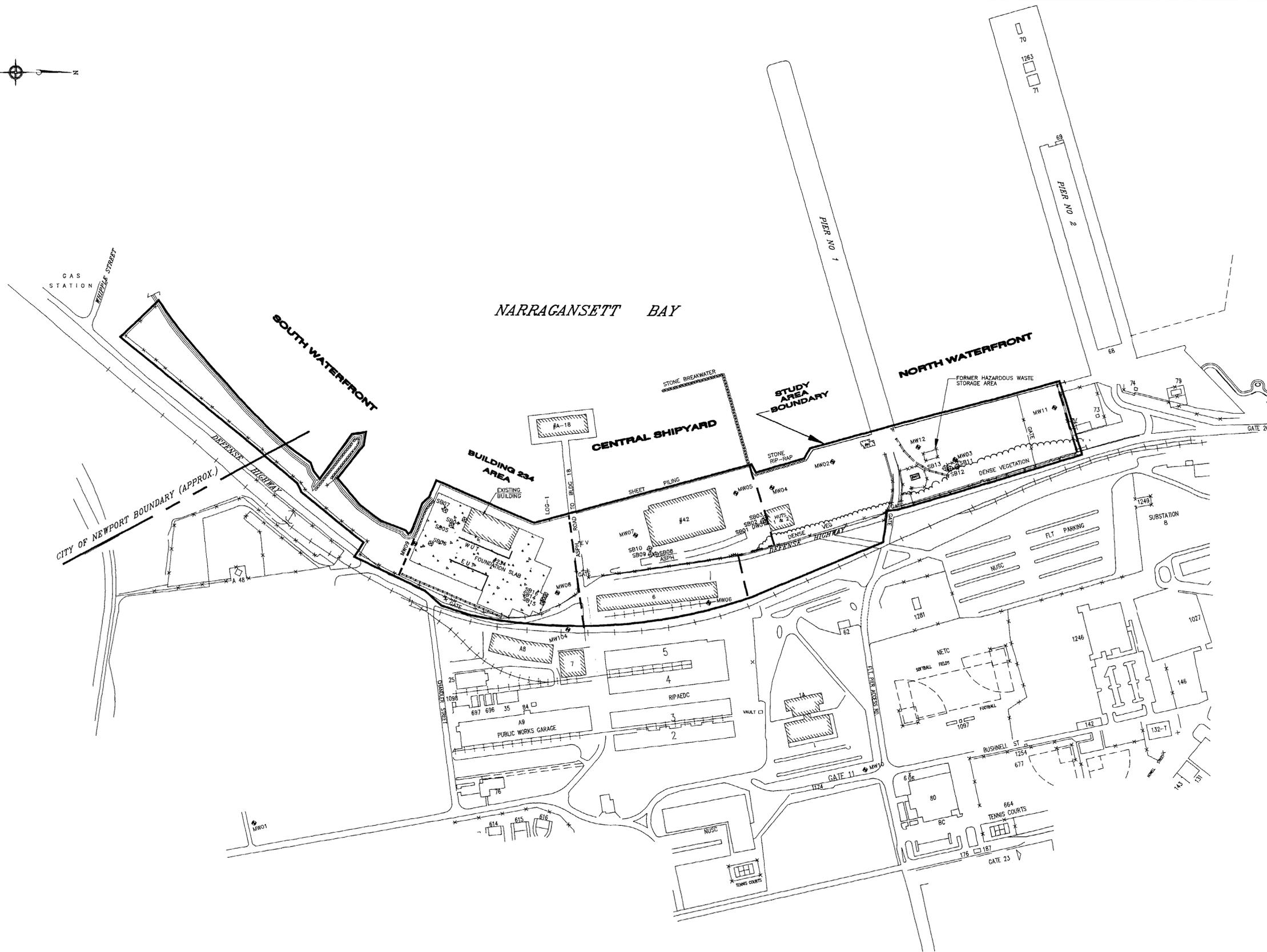
DRAWN BY: R.G. DEWSNAP	TITLE: UNDERGROUND DRAINAGE SYSTEM - BUILDING 234
PREPARED BY: K. O'NEILL	SITE ASSESSMENT SCREENING EVALUATION REPORT
CHECKED BY: S. PARKER	FORMER ROBERT E. DERECKTOR SHIPYARD
	NEWPORT, RHODE ISLAND
	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS
PROJECT MANAGER: S. PARKER	SCALE: 1" = 80'
PROGRAM MANAGER: J. TREPANOWSKI	DATE: JAN. 24, 1997
	PROJ. NO.: 7368 CTO: 2682
	DRAWING NO.: FIGURE 4-4
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	REV: 0

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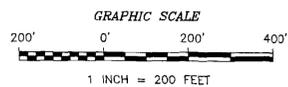


LEGEND	
	FENCE
	MONITORING WELL WITH IDENTIFIER
	SOIL BORING WITH IDENTIFIER
	BUILDING OF INTEREST
	BUILDING



NOTES

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN



DRAWN BY: R.G. DEWSNAP	TITLE: BORINGS AND MONITORING WELL LOCATIONS		
PREPARED BY: K. O'NEILL	SITE ASSESSMENT SCREENING EVALUATION REPORT		
CHECKED BY: S. PARKER	FORMER ROBERT E. DEREKTOR SHIPYARD		
	NEWPORT, RHODE ISLAND		
SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS			
SCALE: 1" = 200'	DATE: JAN 24, 1997	PROJ. NO: 7368	CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4-6	ACFILE NAME: D:\LOWE\NAVY\DEREKTOR\SASEP\MW_LOC.DWG	REV: 0
PROGRAM MANAGER: J. TREPANOWSKI			


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FIGURE 4-7
Tidal Fluctuation of MW03 (North Waterfront)
Site Assessment Screening Evaluation
Former Robert E. Derektor Shipyard
NETC Newport Rhode Island

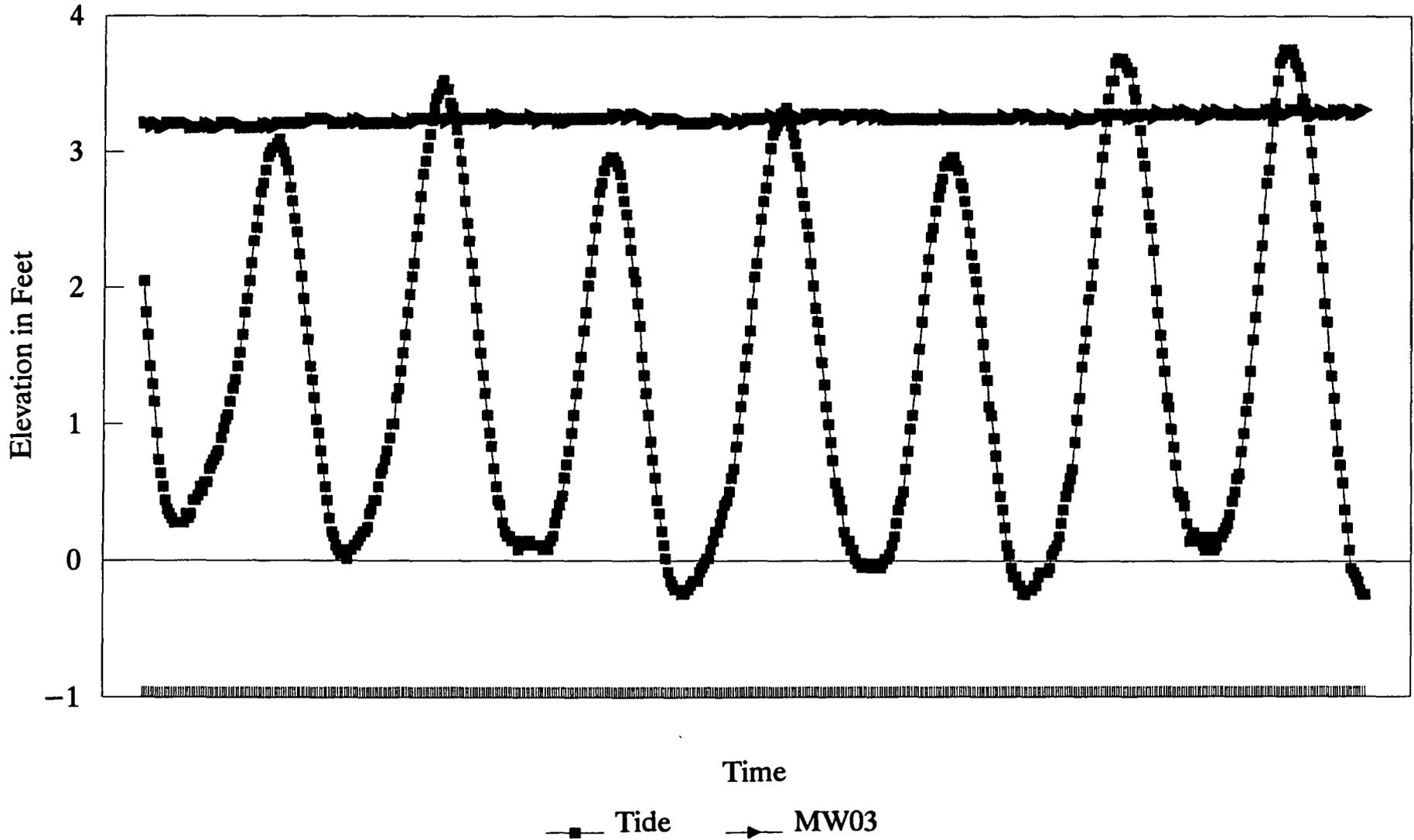


FIGURE 4-8
Tidal Fluctuation of MW04 (North Waterfront
Site Assessment Screening Evaluation
Former Robert E. Dericktor Shipyard
NETC Newport Rhode Island

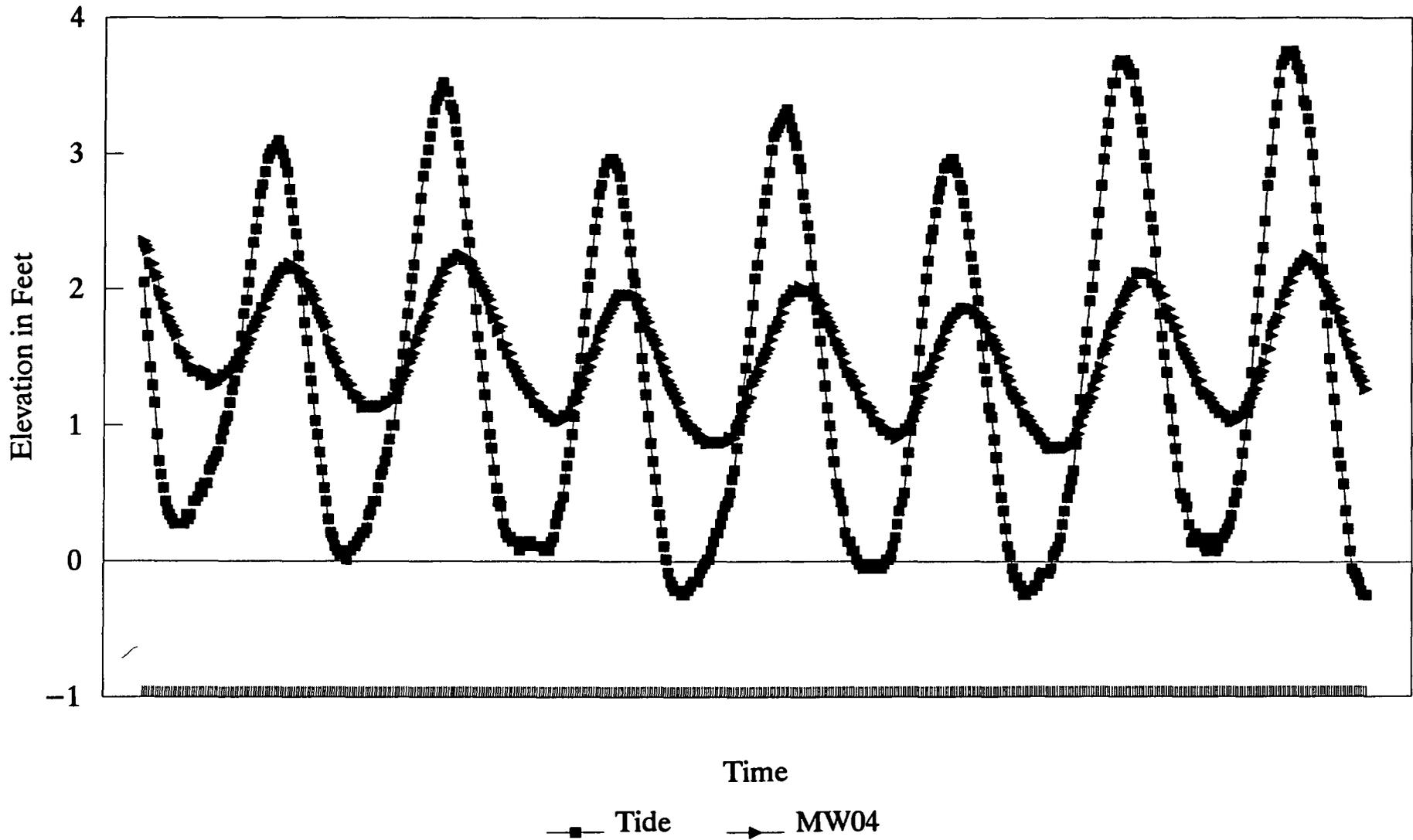


FIGURE 4-9
Tidal Fluctuation of MW11 (North Waterfront)
Site Assessment Screening Evaluation
Former Robert E. Derektor Shipyard
NETC Newport Rhode Island

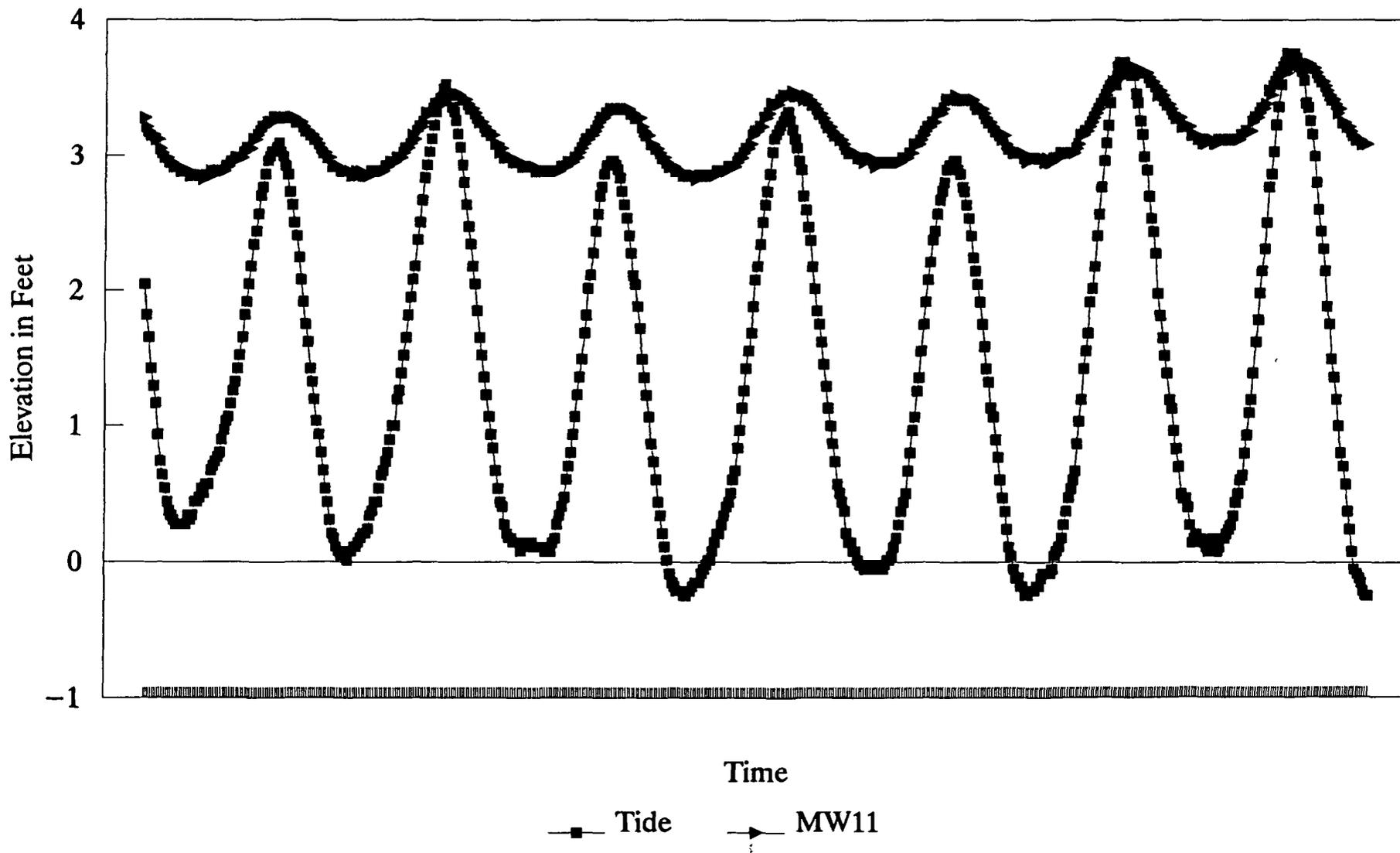


FIGURE 4-10
Tidal Fluctuation of MW05 (Central Shipyard - Bedrock)
Site Assessment Screening Evaluation
Former Robert E. Dericktor Shipyard
NETC Newport Rhode Island

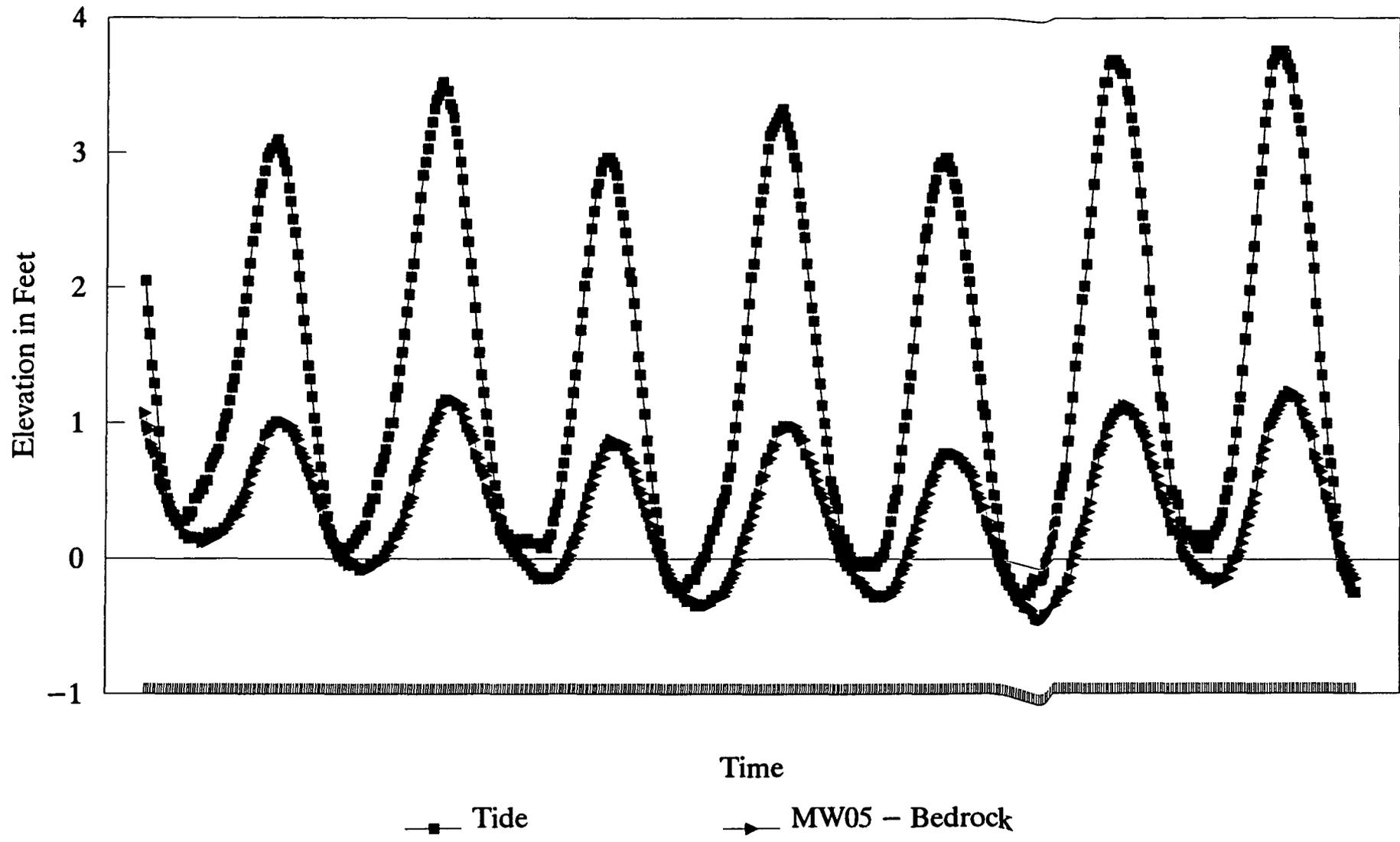


FIGURE 4-11
Tidal Fluctuation of MW07 (Central Shipyard)
Site Assessment Screening Evaluation
Former Robert E. Derektor Shipyard
NETC Newport Rhode Island

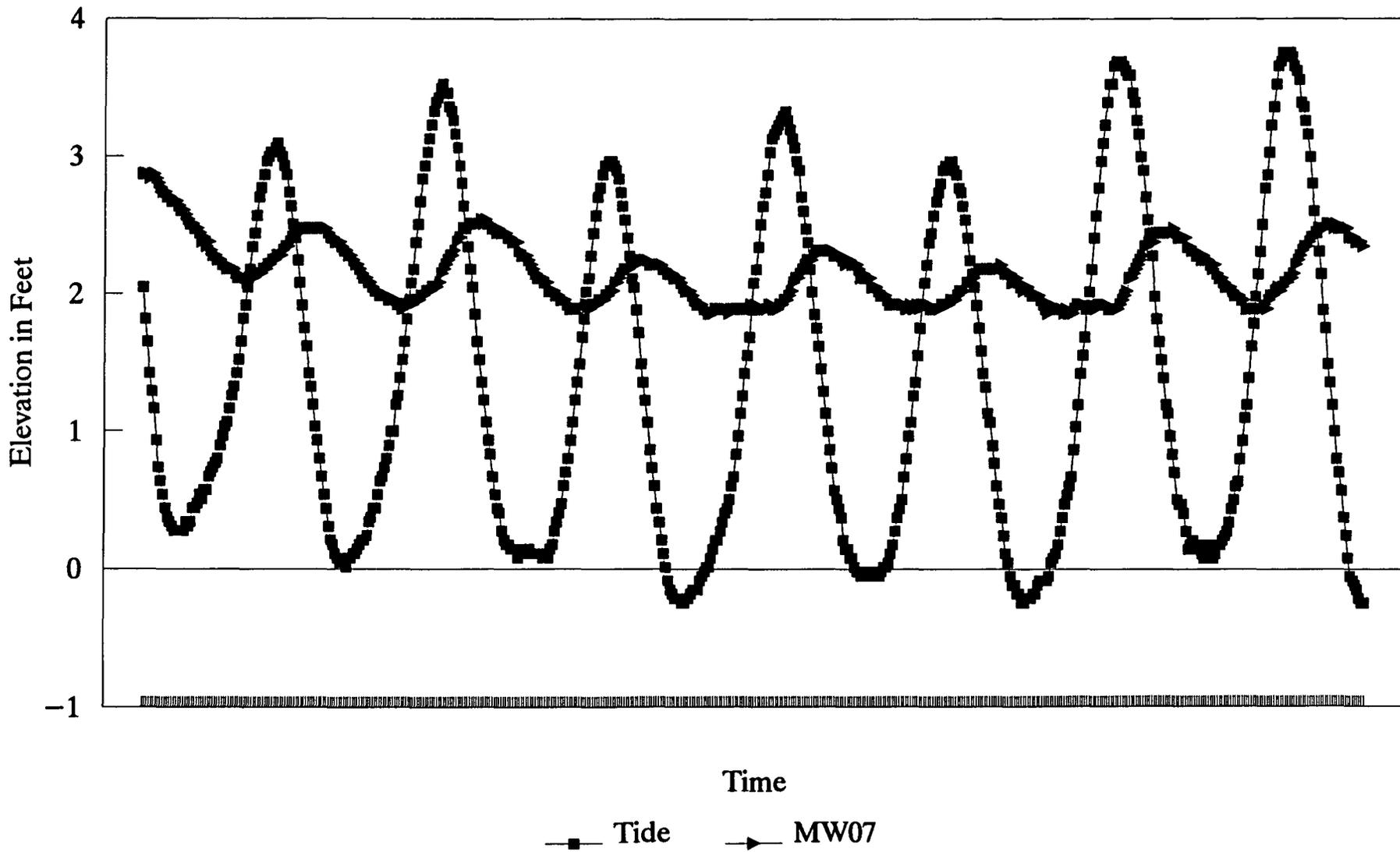
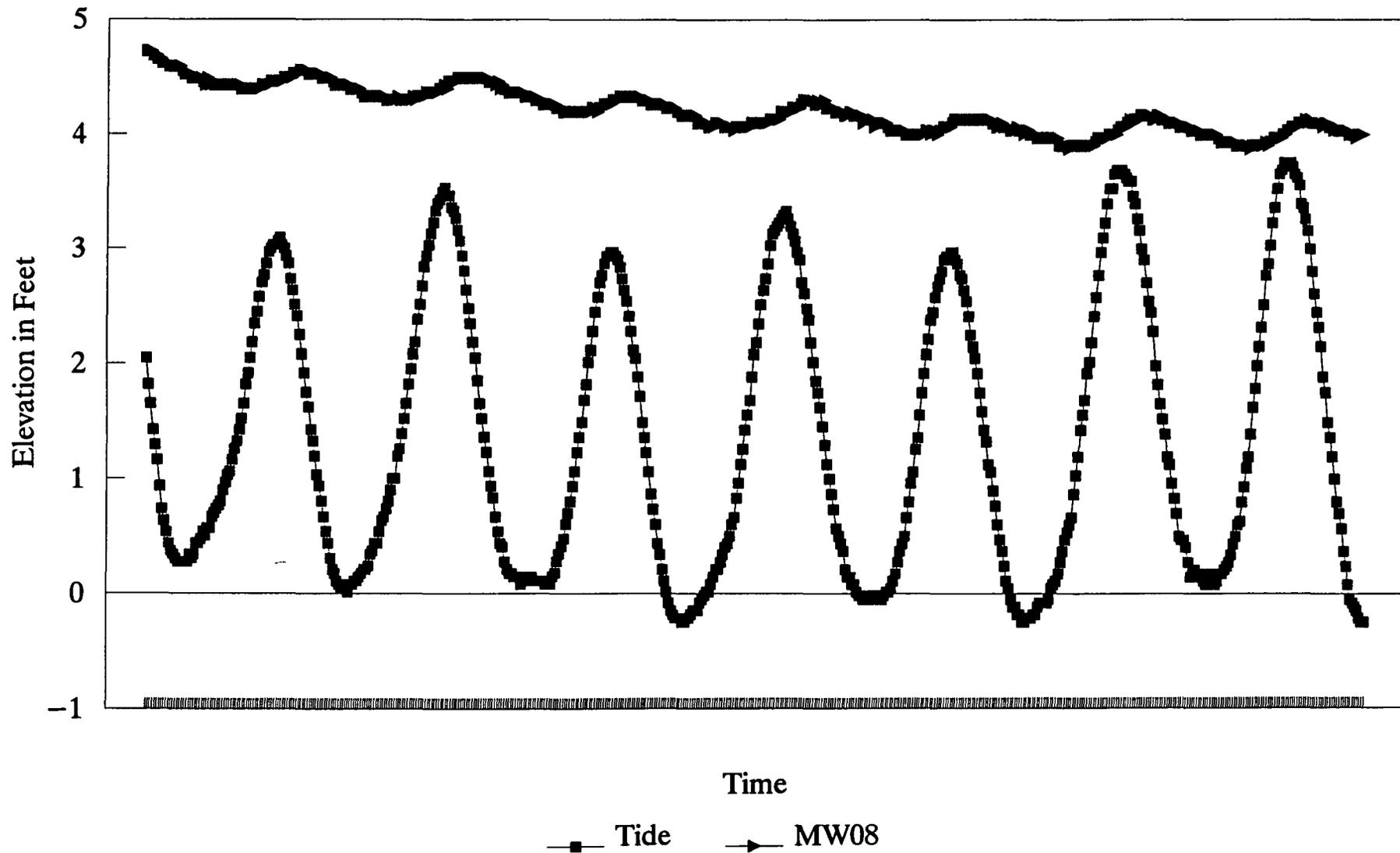
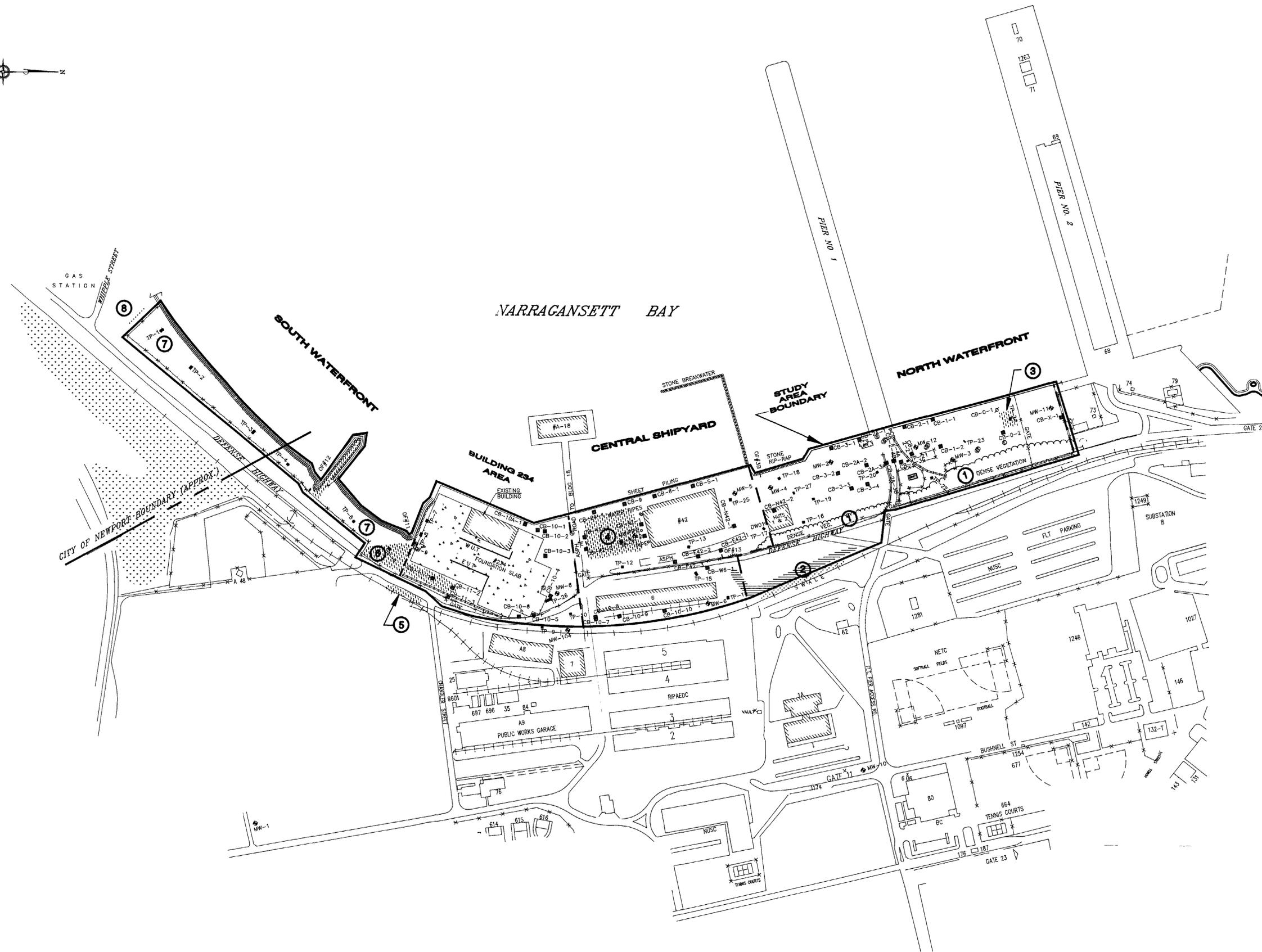


FIGURE 4-12
Tidal Fluctuation of MW08 (Building 234 Ar a)
Site Assessment Screening Evaluation
Former Robert E. Derektor Shipyard
NETC Newport Rhode Island



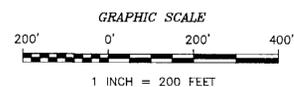


- LEGEND**
- VEGETATION AREA NUMBER
 - GRASSLAND / WEED VEGETATION
 - TREE / SHRUB VEGETATION
 - SHRUB / SCRUB / VINE VEGETATION
 - WETLAND VEGETATION
 - DUNE / BEACH HABITAT
 - FENCE
 - OFF#
 - CATCH BASIN WITH IDENTIFIER
 - BUILDING OF INTEREST
 - BUILDING



NOTES

- 1 ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
- 2 PLAN NOT TO BE USED FOR DESIGN
- 3 ALL HABITAT AREAS ARE BASED ON FIELD OBSERVATIONS AND ARE TO BE CONSIDERED APPROXIMATE
- 4 TEST PIT (TP) AND MONITORING WELL (MW) INDICATE SURFACE SOIL SAMPLE LOCATIONS FOR THE ECOLOGICAL RISK ASSESSMENT



DRAWN BY: R.G. DEWSNAP
 PREPARED BY: K. O'NEILL
 CHECKED BY: S. PARKER
 PROJECT MANAGER: S. PARKER
 PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
 ONSITE ECOLOGICAL CHARACTERIZATION - VEGETATION AREAS
 SITE ASSESSMENT SCREENING EVALUATION REPORT
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NEWPORT, RHODE ISLAND

SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS

SCALE: 1" = 200'
DATE: JAN 23, 1997
PROJ. NO: 7368
CTO: 2682

DRAWING NO: FIGURE 4-13
ACFILE NAME: D:\DWG\NAVY\DEREKTOR\CASER\HAB_TYP1.DWG
REV: 0

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5.0 FATE AND TRANSPORT OF SITE CONTAMINANTS

This section presents an overview of transport mechanisms that may be available to the contaminants present in the soil and groundwater at the site. This section describes physical flowpaths of contaminants present at the site, as well as the potential for leachability of contaminants from the soils.

5.1 CONTAMINANT LEACHING

The Work Plan for the SASE states that this section would focus on the leachability of metals from the sandblast grit that was used as fill in different locations around the site. As described in Section 2.0 of this report, the recoverable sandblast grit that was disposed of in the Building 234 area and east of Building 42 was removed in 1995 by OHM corporation, and transported to the McAllister Point Landfill.

Metals tend to be less mobile in the subsurface than many organics. Under natural conditions, dissolution of metals in the presence of groundwater or precipitation (rainfall or snowmelt) occurs and some metal ions migration is likely. TCLP analysis of samples collected at the site exhibit a worst possible case scenario of dissolving the metals out of the soils into the groundwater. Results from these analyses are described in Section 4.0. Conversely, metals migrating through soils can readily precipitate out of solution and adsorb to soils if water pH is high.

As described in Section 4.0 of this report, analytical results from samples of soils and groundwater in these areas showed slightly elevated concentrations of metals present. Leached metals were expected to be present in TP13 (from sand blast grit disposal around Building 42), MW05 (downgradient of TP13), and in MW08 and TP26 (from disposal at Building 234).

Section 4.3.5.2 of this report describes contaminants detected near Building 234. This section states that copper, lead, nickel, and zinc are all elevated in the surface soils collected at MW08. In addition, TCLP analysis indicated elevated levels of lead in the leachate. However, MW08 was drilled through asphalt cover, which indicates that the contaminants were present before the pavement was installed. Aluminum, arsenic, iron, and manganese concentrations in groundwater at MW08 were all elevated. These parameters may be influenced from upgradient sources (MW104) or from local, past discharges.

Section 4.3.4.2 of this report describes contaminants detected near Building 42 (Central Shipyard). This section states that lead was elevated in the subsurface soils collected at MW05. In addition, TCLP analysis indicated elevated levels of lead in the leachate extracted from this sample. However, this boring was installed in an area that is downgradient of the sandblast grit disposal area, near a former bilge water disposal pit (Section 2.0 of this report). Therefore, the elevated lead concentrations at this site may be more likely to be attributed to the local disposal of oily fluids in this area. There were no elevated concentrations of metals present in the subsurface soils from TP13, excavated at the center of the former sandblast grit disposal area east of Building 42.

Higher concentrations of metals and other contaminants were restricted to specific disposal areas, such as under sumps, near former USTs, and in the surface soils at discharge areas. Section 4.0 describes results from metals TCLP analysis' which indicate the potential for metals leaching from surface soils in these areas. However, results from groundwater analysis do not indicate high concentrations of metals present.

Arsenic is also present in the groundwater and soils at concentrations that can be considered slightly elevated, but arsenic is abundant in the Rhode Island formations, and the levels detected in the upgradient soils collected at MW10 and MW01 are expected to be naturally occurring.

5.2 CONTAMINANT MIGRATION

Contaminants have the potential to migrate if they become exposed to a transport mechanism. Transport mechanisms are typically mechanical. Transport of contaminants in groundwater can occur through processes of advection or mechanical dispersion. If contaminants were to leach or dissolve into the groundwater either in particulate or in a dissolved state, these contaminants would migrate with groundwater to the west, and eventually into Narragansett Bay (Section 4.0).

Contaminants in groundwater can also undergo molecular diffusion. This is a process in which dissolved contaminants migrate in response to a concentration gradient from higher to lower concentrations of the aquifer. Because this transport process occurs on the molecular scale, its affect is small in comparison to the forces driving the more rapid groundwater advection processes; diffusion is significant only in aquifers that have clayey sands and silts with low groundwater velocities.

Contaminants in surface soils have the potential to become airborne and migrate off site. While no wind studies were performed at the site, it was observed that the site is protected from the east by land mass, but is exposed to the north and west. Strong west and north winds that have been

observed at the site have the potential to allow surficial contaminants that are present in exposed soils to migrate in a down-wind direction. Surficial contaminants were evaluated in Section 4.0 of this report.

5.3 PERSISTENCE OR DECAY

Decay of contaminants in groundwater occurs by biological and non-biological means. Biological decay is caused by microorganisms oxidizing the contaminants. Non-biological decay can occur through hydrolysis, photolysis, oxidation, and reduction.

Through decay, chemicals that were not originally present at the site may be produced. In some cases, these daughter products may be more toxic than the original compounds released at the site. For example, chlorinated ethylenes (PCE, TCE, and DCE) can be transformed into vinyl chloride by sequential dehalogenation. A similar reductive dehalogenation process occurs within the chlorinated ethane family (1,1,1-TCA→1,1-DCA→chloroethane). This scenario is represented by contaminants detected in soil and groundwater collected at MW104 (Sections 4.3.5.2 and 4.4.1).

PCB and PAH compounds tend to be more stable and less likely to undergo these decay processes. Because of their low water solubilities and high organic carbon partition coefficients, PCBs would tend to adsorb to the organic constituents of the soil matrix and be relatively immobile in the subsurface, unless there is mobilization of soil particles themselves.

6.0 PRELIMINARY HUMAN HEALTH RISK ASSESSMENT

This section provides a description of the limited human health risk assessment methods used to evaluate the data collected in surface soil, subsurface soil, and groundwater at four designated areas at the former Robert E. Derecktor Shipyard (the Site). The four designated areas are the North Waterfront, Central Shipyard, South Waterfront, and the Building 234 area. The objectives of this preliminary risk assessment were to estimate the actual or potential risks to human health resulting from the presence of contamination in applicable media and to provide the basis for determining the need for an in-depth RI/FS and potential further investigation of the media at the site.

Three major aspects of chemical contamination must be considered when assessing public health risks: contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; potential exposure points must exist either at the source or via migration pathways if exposure occurs at a remote location other than the source; and human or environmental receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without any one of the three factors listed above, there is no risk.

The risk assessment processes used for the site were in accordance with current EPA risk assessment guidance (EPA, 1989a), including other applicable general EPA guidance and specific EPA Region I Guidance (EPA, 1989b and 1992a).

The human health risk assessment consists of five subsections: Data Evaluation and Chemicals of Potential Concern (COPC) Selection, Toxicity Assessment, Exposure Assessment, Risk Characterization, and Uncertainty Analysis.

6.1 DATA EVALUATION AND COPC SELECTION

This subsection presents the approaches for identifying Chemicals of Potential Concern (COPCs), distributional analysis of the data and representative concentrations. The section also presents the COPCs and representative concentrations at the four site designated areas.

6.1.1 Occurrence and Distribution of the Data and Identification of COPCS

COPC selection was based on various aspects of chemical concentration, occurrence, distribution, and toxicity. Chemicals were selected to represent the site contamination and provided the framework for

the quantitative risk assessment at the North Waterfront, Central Shipyard, South Waterfront, and Building 234 area (B234).

The data were collected by B&R Environmental during the summer and fall, 1996, as described in Section 3.0. Surface soil (exposed soil as well as soil under pavement) and subsurface soil samples were collected at all four designated areas. Data used for this assessment were previously described in Section 4.0 of this report and are presented in Tables 4-4A through 4-4E (surface soil) and Tables 4-5A through 4-5E (subsurface soil). Groundwater samples were collected at the NW, Central Shipyard, and Building 234 designated areas only. Surface soil samples were collected at a depth of generally 0 to 1 foot, whereas subsurface soil samples were collected at various depths greater than 2 feet (Section 3.0 of this report).

The positively detected organic chemicals and all inorganic chemicals for surface soils are presented in Tables 6-1 through 6-4 for North Waterfront, Central Shipyard, South Waterfront, and B234, respectively. The positively detected organic chemicals and all inorganic chemicals for subsurface soils are presented in Tables 6-5 through 6-8 for North Waterfront, Central Shipyard, South Waterfront, and B234, respectively. The positively detected organic chemicals and all inorganic chemicals for groundwater are presented in Tables 6-9 through 6-11 for North Waterfront, Central Shipyard, and B234, respectively. Occurrence and distribution statistics for contaminants detected are also presented on these tables.

The samples chosen to represent upgradient conditions are described in Section 4.0. COPC selection was based on the information provided in Tables 6-1 through 6-11 and the following criteria:

- Comparison to risk-based criteria (RBC) for surface and subsurface soil (EPA, 1996a). A chemical was eliminated as a COPC if the maximum concentration was less than EPA Region III residential RBCs determined at a risk level of 1E-06 or a hazard quotient (HQ) of 1.0.
- Comparison to risk-based criteria (RBC) for groundwater (EPA, 1996a). A chemical was eliminated as a COPC if the maximum concentration was less than EPA Region III tap water RBCs determined at a risk level of 1E-06 or a hazard quotient (HQ) of 1.0.
- The essential nutrients, including calcium, magnesium, potassium, and sodium, were eliminated as COPCs if they were not present at high concentrations in surface soils, subsurface soils, or groundwater (EPA, 1989a).

The COPCs selected for each designated area are presented later in this subsection. An explanation of the derivation of representative concentration is presented as Section 6.1.2.

6.1.2 Distributional Analysis of the Data and Representative Concentrations

Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989a) suggests the use of statistics in data evaluation, especially concerning distributional analysis of the data. Statistical analyses discussed in this subsection adhere to the guidance referenced in several EPA and related publications (EPA, 1989a, 1989c, 1989d, 1992b, and Gilbert, 1987). Before representative concentrations were estimated for North Waterfront, Central Shipyard, South Waterfront, and Building 234 designated areas, the underlying statistical distribution of data (using the Shapiro-Wilk W test) was determined for each chemical in each medium.

This risk assessment was performed using a representative concentration for each COPC identified at applicable media in North Waterfront, Central Shipyard, South Waterfront, and B234. The representative concentration was calculated using the latest risk assessment guidance from EPA (EPA, 1989a). The validated data were used to calculate representative concentrations. For chemicals with at least one positive detection, the corresponding non-detects were assumed to be one-half the detection limit (sample quantitation limit). Rejected values and blank contaminated (R and B) values were eliminated from further consideration. Estimated and biased values (J, K, L) were used as the reported value.

Duplicate samples were averaged together and considered as one result. For duplicates, where one result was positive and the other result was a non-detect, the problem of calculating an average result arose whenever half the detection limit exceeded the positive result. In these situations, the positive result was used to represent the non-detect.

The calculation of the representative concentration is a two-step process. First, the distribution of the data is determined. The representative concentration is then selected as the lesser value of the one-sided 95 percent UCL on the appropriate distribution and the maximum positive value in the data set. The maximum positive value is frequently the default choice when the number of samples in the data set is small or when a lognormal distribution (having a higher upper confidence limit from the distributional shape) is used.

6.1.3 Special Note Concerning Chromium Concentrations

A conservative approach to the treatment of chromium was applied to this limited risk assessment. Chromium data were considered to be the hexavalent chromium (VI) form as opposed to the trivalent form (chromium III) because no speciation data were available. Hexavalent chromium is considered the more toxic form, and this is considered a conservative approach.

6.1.4 Presentation of COPCS and Representative Concentrations

The results of the COPC selection process at the designated areas are presented in tables as described below. The representative concentrations for selected COPCs are also shown on these tables.

6.1.4.1 North Waterfront

The COPC results and representative concentrations for surface soil, subsurface soil, and groundwater for North Waterfront are presented in Table 6-12 through 6-14, respectively. The COPCs selected are as follows:

- Surface Soils - arsenic, beryllium, benzo(a)pyrene, benzo(b)fluoranthene (Table 6-12)
- Subsurface Soils - arsenic, beryllium (Table 6-13)
- Groundwater - arsenic, bis(2-ethylhexyl)phthalate, methylene chloride, TCE (Table 6-14)

6.1.4.2 Central Shipyard

The COPC results and representative concentrations for surface soil, subsurface soil, and groundwater for Central Shipyard are presented in Table 6-15 through 6-17, respectively. The COPCs selected are as follows:

- Surface Soils - arsenic, beryllium, iron, Aroclor-1260, dieldrin, benzo(a)pyrene (Table 6-15)
- Subsurface Soils - arsenic, beryllium, iron, benzo(a)pyrene (Table 6-16)
- Groundwater - arsenic, iron, manganese, methylene chloride (Table 6-17)

6.1.4.3 South Waterfront

The COPC results and representative concentrations for surface soil and subsurface soil for South Waterfront are presented in Table 6-18 and 6-19, respectively. The COPCs selected are as follows:

- Surface Soils - arsenic, beryllium, iron, benzo(a)pyrene (Table 6-18)
- Subsurface Soils - arsenic, beryllium, iron (Table 6-19)

6.1.4.4 Building 234 Area

The COPC results and representative concentrations for surface soil, subsurface soil, and groundwater for Building 234 are presented in Table 6-20 through 6-22, respectively. The COPCs selected are as follows:

- Surface Soils - arsenic, beryllium, iron, benzo(a)pyrene (Table 6-20)
- Subsurface Soils - arsenic, beryllium, iron (Table 6-21)
- Groundwater - arsenic, manganese, methylene chloride, TCE (Table 6-22)

6.2 TOXICITY ASSESSMENT

The purpose of this subsection is to identify the potential health hazards associated with exposure to each of the COPCs. A toxicological evaluation characterizes the inherent toxicity of a compound. The literature indicates that the COPCs have the potential to cause carcinogenic and/or noncarcinogenic health effects in humans. Although the COPCs may cause adverse health effects, dose-response relationships and the potential for exposure must be evaluated before the risks to receptors can be determined. Dose-response relationships correlate the magnitude of the intake with the probability of toxic effects, as discussed below. Toxicity information for the COPCs at the designated areas are presented in Table 6-23 and in the form of brief toxicological profiles, which are presented later in this section.

An important component of the risk assessment process is the relationship between the intake of a compound (the amount of a chemical that is absorbed by a receptor) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts can be quantified. The published information of doses and responses is used in conjunction with information on the nature and magnitude of human exposure to develop an estimate of potential health risks.

Reference doses (RfDs) and slope factors (SFs) have been developed by EPA (1996b, 1995) and other sources for many organics and inorganics. This subsection provides a brief description of these parameters.

6.2.1 Reference Doses (RfDs)

The RfD is developed by EPA for chronic and/or subchronic human exposure to hazardous chemicals and is based solely on the noncarcinogenic effects of chemical substances. The RfD is usually expressed as a dose (mg) per unit body weight (kg) per unit time (day). It is generally derived by dividing a No-Observed-Adverse-Effect-Level (NOAEL) or a Lowest-Observed-Adverse-Effect-Level (LOAEL) by an appropriate uncertainty factor. NOAELs, etc. are determined from laboratory animal or epidemiological toxicity studies. The uncertainty factor is based on the extent and applicability of toxicity data to human exposure.

Uncertainty factors are generally applied as multiples of 10 to represent specific areas of uncertainty in the available data. A factor of 10 is used to account for variations in the general population (to protect sensitive subpopulations), extrapolation of test results from animals to humans (to account for interspecies variability), derivation of a NOAEL from a subchronic study (instead of a chronic study) for developing the RfD, and use of a LOAEL instead of a NOAEL. In addition, EPA reserves the use of a modifying factor of up to 10 for professional judgment of uncertainties in the database not already accounted for. The default value of the modifying factor is 1. The RfD incorporates the reliability of the evidence for chronic human health effects. Even if applicable human data exist, the RfD (as reduced by the uncertainty factor) still maintains a margin of safety so that chronic human health effects are not underestimated. Thus, the RfD is an acceptable guideline for evaluation of noncarcinogenic risk, although the associated uncertainties preclude its use for precise risk quantitation. RfDs for the designated area contaminants are provided in Table 6-23.

6.2.2 Cancer Slope Factors (SFs)

SFs are applicable for estimating the lifetime probability (assumed 70-year lifespan) of human receptors developing cancer as a result of exposure to known or potential carcinogens. This factor is generally reported in units of $1/(\text{mg}/\text{kg}/\text{day})$ and is derived through an assumed low-dosage linear relationship of extrapolation from high to low dose responses determined from animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit. SFs for the designated area contaminants are provided in Table 6-23.

6.2.3 EPA Weight-of-Evidence

The weight-of-evidence designations indicate the preponderance of evidence regarding carcinogenic effects in humans and animals. The categories are defined in Table 6-24 (EPA, 1992c).

6.2.4 Adjustment of Dose-Response Parameters

Risks associated with dermal exposures are evaluated using toxicity values that are specific to dermally absorbed doses. Most oral toxicity values are based on administered doses rather than absorbed doses. Therefore, in accordance with EPA guidance (1989a, Appendix A), the toxicity values based on administered doses were adjusted before they were used for evaluation of absorbed doses. Dermal RfDs and SFs are obtained from oral RfDs and SFs via the following relationships:

$$RfD_{Adjusted} = RfD_{Oral} * ABSEFF_{Oral}$$

and

$$SF_{Adjusted} = SF_{Oral} / ABSEFF_{Oral}$$

where:

$ABSEFF_{Oral}$ = Absorption Efficiency in the study that is the basis of the oral toxicity value.

The default ABSEFFs are assumed as follows:

80 percent for volatile organic compounds (VOCs)

50 percent for semivolatile organic compounds (SVOCs) and pesticides

20 percent for inorganic chemicals

6.2.5 Carcinogenicity of PAHS

Carcinogenic PAHs are related by chemical structure. Only benzo(a)pyrene [B(a)P] has an EPA published SF (EPA, 1996b). All other carcinogenic PAHs have SFs based on their potency relative to B(a)P's, and these factors are published by EPA (1996a). Benzo(a)pyrene and benzo(b)fluoranthene were the only carcinogenic PAHs selected as COPCs at the designated areas. Benzo(b)fluoranthene's relative potency factor (which is also commonly known as toxicity equivalence factor (TEFs)) is one-tenth (0.1) of benzo(a)pyrene's.

6.3 EXPOSURE ASSESSMENT

The purpose of this subsection is to evaluate the potential for human exposure to the chemicals detected in the environmental media at the designated areas. This subsection characterizes the exposure setting, characterizes the potentially exposed populations, identifies actual or potential exposure routes, and summarizes the methods used to generate exposure estimates. To determine whether there is an actual or potential exposure, the most likely pathways of contaminant release and transport, as well as the human and environmental activity patterns, must be considered. A complete exposure pathway has three components: a source, a route of transport, and an exposure point for receptors.

6.3.1 Characterization of the Exposure Setting

A description of the facility, its setting, and its surroundings are provided in Section 5.0 of this report.

6.3.2 Potential Receptors

The receptors chosen for the designated areas are presented in this subsection. All of the receptors listed below are applicable to every designated area because the same exposures to media are anticipated at each designated area.

Current Exposure Scenarios:

- Industrial Worker - The full-time on-site worker is an adult assumed to work at the site all year (250 days/year). This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in currently exposed (not covered by asphalt, gravel, etc.) surface soil.
- Adolescent and Adult Trespasser - A trespasser is an adult or adolescent assumed to trespass at the site for 45 days/year. These receptors are potentially exposed via ingestion of, dermal contact with, and inhalation of (COPCs) in currently exposed (not covered by asphalt, gravel, etc.) surface soil.

Future Exposure Scenarios:

- Industrial Worker - The full-time on-site worker is an adult who works at the site all year (250 days/year). This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil (includes all surface soil, including those areas sampled that are currently covered with asphalt, gravel, etc.) and ingestion of and dermal contact with COPCs in groundwater.
- Adolescent and Adult Trespasser - A trespasser is an adult or adolescent who trespasses at the site for 45 days/year. These receptors are potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil (includes all surface soil, including those areas sampled that are currently covered with asphalt, gravel, etc.).
- Excavation Worker - A future excavation worker is an adult who is assumed to work at the site in the future during any type of excavation activity (30 days/year). This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in subsurface soil.
- Resident - A future resident is a person who will live in a residence at or near the site in a hypothetical future scenario. This receptor resides at the residence for 30 years, 0 through 6 years as a child and the remaining 24 years as an adult. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil (includes all surface soil, including those areas sampled that are currently covered with asphalt, gravel, etc.). This receptor is also potentially exposed via ingestion of, dermal contact with, and inhalation of vapors during showering (estimated for adult resident only) in groundwater.

6.3.3 Exposure Routes by Medium

There are three environmental media at the site through which potential receptors (see previous subsection) can be either directly or indirectly exposed to site-related COPCs: surface soil, subsurface soil, or groundwater. Surface and subsurface soil samples were collected at all four designated areas. Groundwater was sampled at only three of the designated areas (North Waterfront, Central Shipyard, and B234). Potential exposure routes include ingestion, dermal contact, and inhalation.

6.3.3.1 Surface Soil

Surface soil exposure routes include incidental ingestion, dermal contact, and inhalation of fugitive dust. All scenarios are based on COPC representative concentrations in surface soils. All three exposure routes were evaluated using industrial workers and trespassers (current and future scenarios) and residential receptors (future scenario). These receptors were chosen because it is unknown whether the site will remain industrial only or whether all of the site (or a portion of it) might become a commercial or residential area in the future. For fugitive dust emissions under both scenarios, the assumption of surface cover would resemble the type of vegetation, paving, and buildings that are currently in place. For surface soil, low levels of VOCs did not warrant full-scale modeling and an estimation of the exposure. VOCs were generally not detected in surface soil except for the common laboratory contaminants, methylene chloride and acetone. Therefore, exposure to volatilized chemicals is expected to be negligible at the site, and ingestion and dermal contact would contribute to the bulk of the risk.

6.3.3.2 Subsurface Soil

Because there is currently no direct contact with subsurface soil, only potential future incidental ingestion, dermal contact, or inhalation of fugitive dusts could be evaluated. All three exposure routes were evaluated using excavation workers (future scenario). The exposure scenarios for subsurface soil are based on the assumption that subsurface soil could eventually become surface soil if uncontrolled excavations, erosion, construction, or landscaping activities occurred. Exposure scenarios related to concentrations in subsurface soil are conservative, based on this assumption. For fugitive dust emissions from subsurface soil under the future industrial scenario, the assumption of surface cover would be based on the type of vegetation, paving, and buildings that are currently in place.

Subsurface soil contamination may also have an impact on future groundwater quality, especially for relatively mobile contaminants such as VOCs. This risk assessment does not take into account future loading of COPCs from subsurface soils to groundwater, however, VOCs were detected infrequently in subsurface soils.

6.3.3.3 Groundwater

Groundwater exposure routes include incidental ingestion, dermal contact, and inhalation of volatile vapors during showering (estimated for an adult resident only because residential children and industrial

worker exposure is expected to be significantly lower based on frequency of contact and exposure time). These exposure routes were evaluated using future industrial and future residential receptors.

6.3.4 Exposure Estimates

The estimation methods and models used in this subsection are consistent with current EPA risk assessment guidance (EPA, 1989a; 1989b, 1991, 1992a, and 1992d). Exposure estimates (in the form of chemical intake) associated with each exposure route are presented below. All exposure scenarios incorporate the representative concentrations in the estimation of intakes.

Noncarcinogenic risks are estimated using the concept of an average annual exposure. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. This is used with the "averaging time," which converts the daily exposure frequency and duration to an annual exposure by dividing by 365 days per year of exposure. Noncarcinogenic risks for some exposure routes (e.g., soil) are generally greater for children than for adults because of the much lower body weights of children and their similar or higher ingestion rates. Carcinogenic risks, on the other hand, are calculated as an incremental lifetime risk and, therefore, incorporate terms to represent the exposure duration (years) over the course of a lifetime (70 years).

6.3.4.1 Surface Soil

Incidental soil ingestion, dermal contact, and inhalation of fugitive dust exposure is estimated from the following equations (EPA, 1989a):

$$INTAKE_{INGESTION}(mg/kg)/day = \frac{CS * IR_{SOIL} * FI * CF * EF * ED}{BW * AT * 365 \text{ days/year}}$$

$$INTAKE_{DERMAL}(mg/kg)/day = \frac{DA_{EVENT} * SA * EF * ED}{BW * AT * 365 \text{ days/year}}$$

$$DA_{event} = CS * AF * ABS_{dermal} * CF$$

$$INTAKE_{INHALATION}(mg/kg)/day = \frac{CA * IR_{air} * ET * EF * ED}{BW * AT * 365 \text{ days/year}}$$

where:

CA	=	Chemical concentration in air (mg/m ³)
CS	=	Chemical concentration in soil (mg/kg or μ g/kg soil)
IR _{soil}	=	Soil ingestion rate (mg soil/day)
IR _{air}	=	Inhalation rate (m ³ /hr)
FI	=	Fraction ingested from contaminated source (unitless)
ET	=	Exposure time (hr/day)
EF	=	Exposure frequency (days/yr)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (years)
CF	=	Conversion factor (1 x 10 ⁻⁶ kg/mg for inorganics; 1 x 10 ⁻⁹ kg/mg for organics)
SA	=	Skin surface area available for contact (cm ²)
AF	=	Soil-to-skin adherence factor (mg/cm ²)
ABS _{dermal}	=	Absorption fraction (unitless)

The input parameters for these exposure routes, along with the rationale for the selection of each value, are presented in Tables 6-25 through 6-27. As discussed in Subsection 6.3.2, the potential receptors for this scenario were current and future industrial workers, current and future trespassers, and future residents. EPA or conventional values were selected for all input parameters.

Exposure to fugitive dust emissions can be calculated by first estimating the rate of distribution and COPC emission from each designated area and then translating this to the exposure rate for the receptors. The derivation of the CA term in the inhalation equation is rather lengthy and complicated and beyond the scope of this limited risk assessment. An explanation of the derivation of this term and input parameters are provided in Cowherd (Cowherd et al. 1985) and Pasquill (1975).

6.3.4.2 Subsurface Soil Exposure

The methods used to assess subsurface soil exposure are the same as the equations for surface soil presented in the previous subsection. The potential receptor for this pathway is a future excavation worker and the assumptions for subsurface soil exposure are presented in Table 6-28. EPA or conventional values were selected for all input parameters.

6.3.4.3 Groundwater Exposure

Incidental ingestion and dermal contact exposure are estimated from the following equations (EPA, 1989a):

$$INTAKE_{INGESTION}(\text{mg/kg})/\text{day} = \frac{CW * IR_{\text{groundwater}} * CF_1 * EF * ED}{BW * AT * 365 \text{ days/year}}$$

$$INTAKE_{DERMAL}(\text{mg/kg})/\text{day} = \frac{DA_{EVENT} * SA * EF * ED * EV}{BW * AT * 365 \text{ days/year}}$$

$$DA_{event} = PC_{event} * CW * CF_1 * CF_2$$

$$INTAKE_{INHALATION}(\text{mg/kg})/\text{day} = \frac{CA * ET * EF * ED}{CF_2 * AT * 365 \text{ days/year}}$$

where:

CW	=	Concentration of contaminant in groundwater ($\mu\text{g/L}$)
CA	=	Concentration of contaminant in shower ($\mu\text{g}/\text{m}^3$)
$IR_{\text{groundwater}}$	=	Groundwater ingestion rate (l/day)
CF_1	=	Conversion factor ($\text{mg}/10^3 \mu\text{g}$)
CF_2	=	Conversion Factor ($\text{l}/10^3 \text{cm}^3$)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
ET	=	Exposure Time (hr/day)
AT	=	Averaging time (years)
SA	=	Surface area (cm^2)
BW	=	Body weight (kg)
PC_{event}	=	Diffusion depth per event (cm/event)

The input parameters for these exposure routes, along with the rationale for the selection of each value, are presented in Tables 6-29 and 6-30. As discussed in Subsection 6.3.2, the potential receptors for this scenario were future industrial workers and future residents. EPA or conventional values were selected for all input parameters.

Exposure to vapors during showering can be calculated by first estimating the concentration of a COPC in shower air. The derivation of the CA term in the inhalation equation is rather lengthy and complicated and beyond the scope of this limited risk assessment. An explanation of the derivation of this term and input parameters are provided in Andelman (1985) and Foster and Chrostowski (1987).

6.3.5 COPC Toxicity Profiles

This section presents abbreviated toxicity profiles for the COPCs selected for the site. The information has been gathered from published literature and other available sources.

6.3.5.1 Arsenic

Noncarcinogenic Toxicity

A lethal dose of arsenic trioxide in humans is 70 to 180 mg (approximately 50 to 140 mg arsenic; Ishinishi et al. 1986). Acute oral exposure of humans to high doses of arsenic produce liver swelling, skin lesions, disturbed heart function, and neurological effects. The only non-carcinogenic effects in humans clearly attributable to chronic oral exposure to arsenic are dermal hyperpigmentation and keratosis, as revealed by studies of several hundred Chinese exposed to naturally occurring arsenic in well water (Tseng 1977; Tseng et al. 1968; EPA 1996b). Similar effects were observed in persons exposed to high levels of arsenic in water in Utah and the northern part of Mexico (Cebrian et al. 1983; Southwick et al. 1983). Occupational (predominantly inhalation) exposure is also associated with neurological deficits, anemia, and cardiovascular effects (Ishinishi et al. 1986), but concomitant exposure to other chemicals cannot be ruled out. The EPA (1996b) derived an RfD of 0.3 $\mu\text{g}/\text{kg}/\text{day}$ for chronic oral exposure, based on an NOAEL of 0.8 $\mu\text{g}/\text{kg}/\text{day}$ for skin lesions from the Chinese data. The principal target organ for arsenic appears to be the skin. The nervous system and cardiovascular systems appear to be less significant target organs. Inorganic arsenic may be an essential nutrient, exerting beneficial effects on growth, health, and feed conversion efficiency (Underwood 1977).

Carcinogenicity

Inorganic arsenic is clearly a carcinogen in humans. Inhalation exposure is associated with increased risk of lung cancer in persons employed as smelter workers, in arsenical pesticide applicators, and in a population residing near a pesticide manufacturing plant (EPA 1996b). Oral exposure to high levels in well water is associated with increased risk of skin cancer (Tseng 1977; EPA 1996b). Extensive

animal testing with various forms of arsenic given by many routes of exposure to several species, however, has not demonstrated the carcinogenicity of arsenic (International Agency for Research on Cancer [IARC] 1980). The EPA (1996b) classifies inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen), and recommends an oral unit risk of 0.00005 $\mu\text{g}/\text{L}$ in drinking water, based on the incidence of skin cancer in the Tseng (1977) study. The EPA (1996b) notes that the uncertainties associated with the oral unit risk are considerably less than those for most carcinogens, so that the unit risk might be reduced an order of magnitude. An inhalation unit risk of 0.0043 per $\mu\text{g}/\text{m}^3$ was derived for inorganic arsenic from the incidence of lung cancer in occupationally exposed men (EPA 1996b).

6.3.5.2 Beryllium

Noncarcinogenic Toxicity

Beryllium has a low order of toxicity when ingested because it is poorly absorbed from the GI tract (Reeves 1986b). Occupational exposure was associated with dermatitis, acute pneumonitis, and chronic pulmonary granulomatosis (berylliosis). Berylliosis was also observed in humans living in the vicinity of a beryllium plant. Similar pulmonary effects were observed in laboratory animals subjected to inhalation exposure. A verified chronic oral RfD value of 0.005 mg/kg/day (EPA 1996b) was based on an NOAEL in a lifetime drinking water study in rats and an uncertainty factor of 100 (EPA 1996b). The EPA (1995) presented the same value as a provisional subchronic oral RfD. The target organ for inhalation exposure appears to be the lung; a target organ is not identified for oral exposure.

Carcinogenicity

The EPA (1996b) classifies beryllium in cancer weight-of-evidence Group B2 (probable human carcinogen) based on inadequate human (occupational) cancer data and sufficient animal data. A significant increase in lung tumors occurred in rats and in rhesus monkeys subjected to inhalation exposure or intratracheal instillation of a variety of beryllium compounds. Osteogenic sarcomas were induced in rabbits and mice, but not in rats or guinea pigs, injected intravenously with various beryllium compounds. Oral studies in animals yielded inconclusive results. The EPA (1996b) derived an oral slope factor of 4.3 per mg/kg/day (EPA 1996b) from a statistically nonsignificant increase in total tumors in a lifetime drinking water study in rats. An inhalation unit risk of 0.0024 per $\mu\text{g}/\text{m}^3$, equivalent to 8.4 per mg/kg/day (EPA 1996b) (assuming an inhalation rate of 20 m^3/day and body weight of 70 kg for humans), was derived from an occupational study.

6.3.5.3 Bis(2-ethylhexyl)phthalate (di[2-ethylhexyl]phthalate)

Noncarcinogenic Toxicity

The acute oral toxicity of bis(2-ethylhexyl)phthalate is very low; oral LD_{50/30} (lethal dose to 50 percent of population within 30 days without medical treatment) values in rats and mice were 33,800 and 26,300 mg/kg, respectively (ACGIH 1991). Repeated high-dose oral exposures were associated with decreased growth, altered organ weights, testicular degeneration, and developmental effects. The EPA (1996b) presented a verified chronic oral RfD of 0.02 mg/kg/day based on an LOAEL for increased relative liver weight in guinea pigs and an uncertainty factor of 1,000. The EPA (1995) adopted the chronic oral RfD as the provisional subchronic oral RfD. The principal target organs for the toxicity of bis(2-ethylhexyl)phthalate are the liver and testis.

Carcinogenicity

The EPA (1996b) classifies bis(2-ethylhexyl)phthalate in cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate human cancer data (one limited occupational study) and sufficient cancer data in laboratory animals. An oral slope factor of 0.014 per mg/kg/day (EPA 1996b) was based on the increased incidence of liver tumors in a dietary study in male mice.

6.3.5.4 Dieldrin

Noncarcinogenic Toxicity

Dieldrin has an established EPA (1996b) oral RfD of 5E-05 (mg/kg/day). This is based on a NOAEL of 0.1 ppm (0.005 mg/kg/day) in female rats with liver lesions characterized as the critical effect (Walker et al., 1969). An uncertainty factor of 100 was applied to the NOAEL value to establish an oral RfD. Dieldrin is toxic to the reproductive system and may cause teratogenic effects. Reproductive effects include decreased fertility, increased fetal death, and effects on gestation; while teratogenic effects include cleft palate, webbed foot, and skeletal anomalies. Chronic effects attributed to aldrin and dieldrin include liver toxicity and central nervous system abnormalities. Dieldrin is acutely toxic; the oral LD50 is around 50 mg/kg, and the dermal LD50 is about 100 mg/kg.

Carcinogenicity

Dieldrin has been shown to be a carcinogen, causing increases in a variety of tumors in rats at low but not at high doses and producing a higher incidence of liver tumors in mice. The reason for this reversed dose-response relationship is unclear. Dieldrin does not appear to be mutagenic when tested in a number of systems. An EPA established oral SF of $1.6E+01$ 1/(mg/kg/day) based on carcinogenicity in seven strains of mice when administered orally (EPA, 1996b). Dieldrin is structurally similar to compounds that produce tumors in rodents including aldrin, chlordane, heptachlor, heptachlor epoxide, and chlorendic acid.

6.3.5.5 Iron

Noncarcinogenic Toxicity

Iron is potentially toxic in all forms and by all routes of exposure. Inorganic iron is a poison by the intraperitoneal route. The inhalation of large amounts of iron dust may result in iron pneumoconiosis or arc welders lung. Chronic exposure to excess levels of iron (>50-100 mg iron/day) can result in pathological deposition of iron in tissues. The target organs are the pancreas and liver (Sax and Lewis 1989).

Iron compounds are of varying toxicity. Iron oxides are a potential risk in all industrial settings. In general, ferrous compounds are more toxic than ferric compounds. Acute exposure to excessive levels of ferrous compounds can cause liver and kidney damage, altered respiratory rates, and convulsions (Sax and Lewis 1989). An oral RfD of 0.3 mg/kg/day has recently been published for iron by EPA (1995b). No inhalation RfD has been found for iron.

Carcinogenicity

Some iron compounds are suspected human carcinogens. Iron dust is an experimental neoplastigen and an increased incidence of lung cancer has been associated with exposure to iron dust. Iron oxide is an experimental tumorigen and a suspected human carcinogen. (Sax and Lewis 1989). EPA has not published oral or inhalation slope factors for iron.

6.3.5.6 Manganese

Noncarcinogenic Toxicity

Manganese is nutritionally required in humans for normal growth and health (EPA 1996b). Humans exposed to approximately 0.8 mg manganese/kg/day in drinking water exhibited lethargy, mental disturbances (1/16 committed suicide), and other neurologic effects. The elderly appeared to be more sensitive than children. Oral treatment of laboratory rodents induced biochemical changes in the brain, but rodents did not exhibit the neurological signs exhibited by humans. Occupational exposure to high concentrations in air induced a generally typical spectrum of neurological effects, and increased incidence of pneumonia (ACGIH 1986).

Very recently, a chronic oral RfD of 2.3E-02 mg/kg/day has been established in EPA (1996a) from the oral RfD via intake of food of 1.4E-01 mg/kg/day (EPA 1996b). The EPA (1996b) presented a verified chronic inhalation RfC of 0.00005 mg/m³ based on an LOAEL for respiratory symptoms and psychomotor disturbances in occupationally exposed humans and an uncertainty factor of 1,000. The EPA (1996b) presented the same value as a subchronic inhalation RfC. The inhalation RfC is equivalent to 0.000014 mg/kg/day (EPA 1996b), assuming humans inhale 20 m³ of air/day and weigh 70 kg. The CNS and respiratory tract are target organs of inhalation exposure to manganese.

Carcinogenicity

The EPA (1996b) classifies manganese in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans). Quantitative cancer risk estimates are not derived for Group D chemicals.

6.3.5.7 Methylene Chloride

Noncarcinogenic Toxicity

Occupational exposure to high concentrations of methylene chloride may induce liver damage (ACGIH 1986). Liver effects were induced in animals by inhalation or oral exposure (EPA 1996b). The EPA (1996b) presented a verified chronic oral RfD for methylene chloride of 0.06 mg/kg/day based on an NOAEL for liver toxicity in male and female rats in chronic drinking water studies and an uncertainty factor of 100. The EPA (1995) presented the same value as a provisional subchronic oral RfD. The EPA (1995) also presented a provisional subchronic and chronic inhalation RfC of 3 mg/m³, derived from an NOAEL for liver toxicity in a two-year intermittent exposure inhalation study in rats and an

uncertainty factor of 100. The inhalation RfC is equivalent to 0.9 mg/kg/day (EPA 1995), assuming humans inhale 20 m³ of air/day and weigh 70 kg. The principal target organ for methylene chloride is the liver.

Carcinogenicity

Methylene chloride is classified in EPA cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate human data and sufficient evidence of carcinogenicity in animals (EPA 1996b). Animal inhalation studies showed increased incidence of hepatocellular neoplasms and alveolar/bronchiolar neoplasms in male and female mice, mammary tumors in rats of either sex, salivary gland sarcomas in male rats, and leukemia in female rats. Oral studies were inconclusive. An oral slope factor of 0.0075 per mg/kg/day (EPA 1996b) was based on the incidence of liver tumors in two inhalation studies in mice. An inhalation unit risk of 4.7 E-07 per $\mu\text{g}/\text{m}^3$ was based on the incidence of liver and lung tumors in one inhalation study. The inhalation unit risk is equivalent to 0.0016 per mg/kg/day (EPA 1996b), based on inhaled dose, assuming humans inhale 20 m³ of air/day and weigh 70 kg.

6.3.5.8 PAHs - Benzo(a)pyrene

Noncarcinogenic Toxicity

Oral non-carcinogenic toxicity data are not available for benzo(a)pyrene.

Carcinogenicity

The PAHs are ubiquitous, being released to the environment from anthropogenic as well as from natural sources (ATSDR 1987). Benzo(a)pyrene is the most extensively studied member of the class, inducing tumors in multiple tissues of virtually all laboratory species tested by all routes of exposure. Although epidemiology studies suggested that complex mixtures that contain PAHs (coal tar, soots, coke oven emissions, cigarette smoke) are carcinogenic to humans (EPA 1996b), the carcinogenicity cannot be attributed to PAHs alone because of the presence of other potentially carcinogenic substances in these mixtures (ATSDR 1987). In addition, recent investigations showed that the PAH fraction of roofing tar, cigarette smoke, and coke oven emissions accounted for only 0.1 to 8.0 percent of the total mutagenic activity of the unfractionated complex mixture in Salmonella (Lewtas 1988). Aromatic amines, nitrogen heterocyclic compounds, highly oxygenated quinones, diones, and nitrooxygenated compounds, none of which would be expected to arise from in vivo metabolism of PAHs, probably

accounted for the majority of the mutagenicity of coke oven emissions and cigarette smoke. Furthermore, coal tar, which contains a mixture of many PAHs, has a long history of use in the clinical treatment of a variety of skin disorders in humans (ATSDR 1987).

Because of the lack of human cancer data, assignment of individual PAHs to EPA cancer weight-of-evidence groups was based largely on the results of animal studies with large doses of purified compound (EPA 1996b). Frequently, unnatural routes of exposure, including implants of the test chemical in beeswax and trioctanoin in the lungs of female Osborne-Mendel rats, intratracheal instillation, and subcutaneous or intraperitoneal injection, were used. Of the PAHs of concern, no EPA cancer weight-of-evidence group classification was provided for acenaphthene (EPA 1996b). Anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, and naphthalene were classified in Group D (not classifiable as to carcinogenicity to humans), and benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were classified in Group B2 (probable human carcinogens).

The EPA (1996b) verified a slope factor for oral exposure to benzo(a)pyrene of 7.3 per mg/kg/day, based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates were available for the other PAHs in Group B2. The EPA (1980) promulgated an ambient water quality criterion for "total carcinogenic PAHs," based on an oral slope factor derived from a study with benzo(a)pyrene, as being sufficiently protective for the class. Largely because of this precedent, the quantitative risk estimates for benzo(a)pyrene were adopted for the other carcinogenic PAHs when quantitative estimates were needed.

Recent reevaluations of the carcinogenicity and mutagenicity of the Group B2 PAHs suggest that there are large differences between individual PAHs in cancer potency (Krewski et al., 1989). Based on the available cancer and mutagenicity data, and assuming that there is a constant relative potency between different carcinogens across different bioassay systems and that the PAHs under consideration have similar dose-response curves, Thorslund and Charnley (1988) derived relative potency values for several PAHs. A more recent Relative Potency Factor (RPF) scheme for the Group B2 PAHs was based only on the induction of lung epidermoid carcinomas in female Osborne-Mendel rats in the lung-implantation experiments (Clement International 1990). EPA (1996b) presented slope factors for several PAHs: benzo(k)fluoranthene has an oral CSF of 0.073 and an inhalation CSF of 0.061, chrysene has an oral CSF of 0.0073 and an inhalation CSF of 0.0061, carbazole has an oral slope factor of 0.02 per mg/kg/day and an inhalation CSF was not found. EPA presented oral slope factors of 7.30 per mg/kg/day for benzo(a)pyrene and dibenz(a,h)anthracene, and 0.73 per mg/kg/day for benzo(a)anthracene and benzo(b)fluoranthene. Inhalation slope factors presented by EPA were

6.10 per mg/kg/day for dibenz(a,h)anthracene, and 0.61 for benzo(a)anthracene and benzo(b)fluoranthene.

6.3.5.9 Benzo(B)fluoranthene

Noncarcinogenic Toxicity

Little information is available on benzo(b)fluoranthene. However based on the similarities of chemical structures, most properties should be similar to benzo(a)pyrene.

Carcinogenicity

A Clement's relative potency factor (RFP) has been developed (Clement International, 1990) for benzo(b)fluoranthene that allows the estimation of CSFs of 0.73 (EPA 1995b) and 0.61 per mg/kg/day (EPA 1995b) for the oral and inhalation routes, respectively. The EPA (1996b) has classified benzo(b)fluoranthene in cancer weight-of-evidence Group B2 (Probable Human Carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans), based on lung tumors in mice.

6.3.5.10 Polychlorinated Biphenyls (PCBs)

Noncarcinogenic Toxicity

Epidemiologic studies of women in the United States associated oral PCB exposure with low birth weight or retarded musculoskeletal or neurobehavioral development of their infants (ATSDR 1991a). Oral studies in animals established the liver as the target organ in all species, and the thyroid as an additional target organ in the rat. Effects observed in monkeys included gastritis, anemia, chloracne-like dermatitis, and immunosuppression. Oral treatment of animals induced developmental effects, including retarded neurobehavioral and learning development in monkeys. The EPA (1996b) presented a chronic oral RfD of 0.02 ug/kg/day for Aroclor 1254.

Occupational exposure to PCBs was associated with upper respiratory tract and ocular irritation, loss of appetite, liver enlargement, increased serum concentrations of liver enzymes, skin irritation, rashes and chloracne, and, in heavily exposed female workers, decreased birth weight of their infants (ATSDR 1991a). Concurrent exposure to other chemicals confounded the interpretation of the occupational exposure studies. Laboratory animals exposed by inhalation to Aroclor-1254 vapors exhibited

moderate liver degeneration, decreased body weight gain and slight renal tubular degeneration. Neither subchronic nor chronic inhalation RfC values were available.

Specific information was not available for Aroclor 1248 and 1260 but would be assumed to be similar to that of Aroclor 1254.

Carcinogenicity

The EPA (1996b) classifies the PCBs as EPA cancer weight-of-evidence Group B2 substances (probable human carcinogens), based on inadequate data in humans and sufficient data in animals. The human data consist of several epidemiologic occupational and accidental oral exposure studies with serious limitations, including poorly quantified concentrations of PCBs and durations of exposure, and probable exposures to other potential carcinogens.

The animal data consist of several oral studies in rats and mice with various Aroclors, Kanechlors, or Clophens (commercial PCB mixtures manufactured in the United States, Japan, and Germany, respectively) that reported increased incidence of liver tumors in both species (EPA 1996b). The EPA (1996b) presents a verified oral slope factor of 7.7 per mg/kg/day for all PCBs based on liver tumors in rats treated with Aroclor 1260.

6.3.5.11 Trichloroethene (TCE)

Noncarcinogenic Toxicity

Little is known about the toxicity of prolonged oral exposure to trichloroethene. Acute inhalation exposure to high levels induced anesthesia, tachypnea, and ventricular arrhythmias (ACGIH 1986). Occupational exposure was associated with headache, dizziness, lassitude, and other CNS effects. Prolonged inhalation exposure of animals affected the liver and kidneys. The EPA has published an oral RfD of 0.006 mg/kg/day (1995b) for trichloroethene. An RfC value was not located. The principal target organs for trichloroethene are the CNS and heart, and, to a lesser extent, the liver and kidney.

Carcinogenicity

Carcinogenicity studies in laboratory animals showed increased incidence of hepatocellular carcinomas (gavage exposure) and malignant lymphomas (inhalation exposure) in mice and increased incidence of renal adenocarcinomas in male rats (gavage) (EPA 1988d). Cancer studies in humans were inadequate.

Interpretation of the data regarding the carcinogenicity of trichloroethene is controversial, and the EPA (1992c) has not adopted a final position on a cancer weight-of-evidence classification or quantitative risk estimates for trichloroethene. For this reason, trichloroethene was removed from the IRIS and the 1992 HEAST (EPA 1992). Currently, EPA believes the weight-of-evidence to be on the C-B2 continuum (possible-probable human carcinogen), and offers slope factors of 0.011 per mg/kg/day for oral exposure and 0.006 per mg/kg/day (EPA 1995b) for inhalation exposure as being useful.

6.4 RISK CHARACTERIZATION

Potential human health risks resulting from the exposures outlined in the preceding subsections are characterized on a quantitative and qualitative basis in this subsection. Quantitative risk estimates are generated based on risk assessment methods outlined in current EPA guidance (EPA, 1989a; 1989b, and 1992a).

All risks were calculated as reasonable maximum exposure (RME) estimates. This method of risk estimation generates a conservative risk value that is at the upper end of the range of risks that could occur for a group of human receptors. Risks are generated under the assumption that exposure intakes resulting from individual receptor behavior patterns (exposure frequency, duration, quantities of contaminated media ingested per day, etc.) are in the upper 90 to 95 percentile of the range encountered in the general population. In addition, the representative concentration is also calculated as a value that is the upper 95 percentile of the exposure point concentration, or the maximum detected concentration, in the case of small data sets.

Noncarcinogenic risk estimates are presented in the form of Hazard Quotients (HQs) and Hazard Indices (HIs) that are determined through integration of estimated intakes with published RfDs. Incremental cancer risk estimates are provided in the form of dimensionless probabilities based on SFs.

Estimated human intakes were developed for each of the specific exposure routes discussed in the preceding subsections. Both carcinogenic and noncarcinogenic risks are summarized for each exposure route on a series of tables in this subsection.

6.4.1 Carcinogenic Risks

Incremental cancer risk estimates are generated for each of the exposure pathways using the estimated intakes and published SFs, as follows:

$$Risk = Intake * SF$$

If the above equation results in a risk greater than 0.01, the following equation is used:

$$Risk = 1 - e^{-(Intake * SF)}$$

The risk determined using these equations is a unitless expression of an individual's increased likelihood of developing cancer as a result of exposure to carcinogenic chemicals. An incremental cancer risk of 1E-06 indicates that the exposed receptor has a one in a million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons. The calculated cancer risks should be recognized as upper-limit estimates. SFs are the upper 95 percent confidence limit of a dose-response curve generally derived from animal studies. Actual human risk, while not identifiable, is not expected to exceed the upper limit based on the SFs and may, in fact, be lower.

EPA has generally defined risks in the range of 1E-04 to 1E-06 or less as being acceptable for most hazardous waste facilities addressed under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). For CERCLA activities, residual risks on the order of 1E-06 are the primary goal but are often modified by such regulatory requirements as MCLs or chemical-specific clean-up goals.

6.4.2 Noncarcinogenic Risks

Noncarcinogenic risks are estimated using the concept of HQs and HIs. The HQ is the ratio of the estimated intake and the RfD for a selected chemical of concern, as follows:

$$HQ = \frac{Intake}{RfD}$$

HIs are the sums of the individual HQs for the COPCs. If the value of the HQ or the HI exceeds unity (1.0), the potential for noncarcinogenic health risks associated with exposure to that particular chemical or particular chemical mixture, respectively, cannot be ruled out (EPA, 1989a). If the individual HQs are less than 1.0 and the HI is greater than 1.0, particular attention should be paid to the target organ(s) affected by each chemical because these are generally the organ(s) associated with RfD-derived effects, and toxicity for different organs is not truly additive. The HI is not a mathematical

prediction of the severity of toxic effects; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.4.3 Receptor Risks

Receptor risks are presented for each site in the form of tables and summary text. Each of these subsections includes summaries of risks estimated by the exposure scenarios. It should be noted that, in each risk summary table where HQs are reported as "N/A," the HQs were not calculable because no RfD has been established. Usually in such cases, carcinogenicity is considered to be more important, since carcinogenicity will generally be seen at lower doses than noncarcinogenic effects. Cancer risks of zero or "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed.

Cumulative risk for current exposure scenarios at each area of the site are presented on Tables 6-31 through 6-34. Cumulative risk for future exposure scenarios at each area of the site are presented on Tables 6-35 through 6-38. Cumulative risks for current and future exposure scenarios for the upgradient area are presented for comparison purposes on Table 6-39.

6.4.3.1 North Waterfront

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 3E-05. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 2E-05. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current industrial worker. The estimated carcinogenic risks for the current adult trespasser and the adolescent trespasser are 5E-06 and 4E-06, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 4E-06 and 4E-06, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{derl}$) presented in Subsection 6.2. The principal COPC

contributing to this cancer risk is arsenic; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.1), current adult trespasser (0.03), and adolescent trespasser (0.05) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is $8E-04$. For this receptor exposure scenario, the exposure pathway associated with inhalation of volatiles during showering with contaminated groundwater has an incremental cancer risk of $4E-04$, with TCE contributing the significant portion of inhalation risk. The exposure pathway associated with consumption of contaminated groundwater has a cancer risk of $3E-04$, with arsenic contributing the significant portion of ingestion risk. These two groundwater exposure routes contribute the majority of the cumulative carcinogenic risk for the future resident.

The estimated carcinogenic risk for the future industrial worker exposure scenario is $6E-05$. For this receptor exposure scenario, the exposure pathway associated with consumption of contaminated groundwater has a cancer risk of $4E-05$, with arsenic contributing the significant portion of ingestion risk. The dermal contact with surface soil exposure pathway has an incremental cancer risk of $2E-05$. The groundwater ingestion and surface soil exposure routes contribute the most significant portion of the cumulative carcinogenic risk for the future industrial worker.

The estimated carcinogenic risks for the future adult trespasser and the adolescent trespasser are the same as the risks for these receptors presented earlier under the current exposures section. The estimated carcinogenic risk for the future excavation worker exposure scenario is $3E-07$, which is below $1E-06$.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. The principal COPC

contributing to this cancer risk is arsenic; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future industrial worker (0.3), future excavation worker (0.04), future adult trespasser (0.02), and future adolescent trespasser (0.03) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The cumulative HI for the future residential receptor is 3.5, which is greater than a value of 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic, via groundwater ingestion, is the principal contributor to noncarcinogenic risk for this receptor.

6.4.3.2 Central Shipyard

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 3E-04. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 2E-04. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current industrial worker. The estimated carcinogenic risks for the current adult trespasser and the adolescent trespasser are 5E-05 and 5E-05, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 4E-05 and 4E-05, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. The principal COPCs contributing to this cancer risk are Aroclor-1260 and arsenic in surface soil. Arsenic is a major contributor to risk in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.3), current adult trespasser (0.08), and adolescent trespasser (0.1) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 3E-03. For this receptor exposure scenario, the exposure pathway associated with consumption of contaminated groundwater has a cancer risk of 1E-03, with arsenic contributing the significant portion of ingestion risk. The exposure pathway associated with dermal contact with surface soil has a cancer risk of 1E-03, with arsenic and Aroclor 1260 contributing the significant portion of dermal carcinogenic risk. The groundwater ingestion and surface soil dermal contact exposure routes contribute the majority of the cumulative carcinogenic risk for the future resident.

The estimated carcinogenic risk for the future industrial worker exposure scenario is 4E-04. For this receptor exposure scenario, the exposure pathway associated with consumption of contaminated groundwater has a cancer risk of 2E-04, with arsenic contributing the significant portion of ingestion risk. The dermal contact with surface soil exposure pathway has an incremental cancer risk of 2E-04. The groundwater ingestion and surface soil exposure routes contribute the major portion of the cumulative carcinogenic risk for the future industrial worker.

The estimated carcinogenic risks for the future adult trespasser and the adolescent trespasser are the same as the risks for these receptors presented earlier under the current exposures section. The estimated carcinogenic risk for the future excavation worker exposure scenario is 3E-07, which is below a benchmark value of 1E-06.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. The principal COPCs contributing to this cancer risk are Aroclor-1260 and arsenic in surface soil. Arsenic is a major contributor to risk in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future excavation worker (0.2), future adult trespasser (0.08), and future adolescent trespasser (0.1) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The values of the cumulative HI for the future residential receptor (3.5) and the future industrial worker (1.9) are greater than 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic, iron, and manganese, via groundwater ingestion, exhibited hazard quotients (HQs) greater than 1.0 or were principal contributors to the noncarcinogenic risk for these receptors.

6.4.3.3 South Waterfront

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 4E-05. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 3E-05. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current industrial worker. The estimated carcinogenic risks for the current adult trespasser and the adolescent trespasser are 7E-06 and 6E-06, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 6E-06 and 5E-06, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. Arsenic is a major contributor to risk in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.2), current adult trespasser (0.05), and adolescent trespasser (0.08) are all less than 1.0, a benchmark below

which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is $2E-04$. For this receptor exposure scenario, the exposure pathway associated with dermal contact with surface soil has a cancer risk of $1E-04$, with arsenic contributing the significant portion of dermal carcinogenic risk. The exposure pathway associated with incidental ingestion of surface soil has a cancer risk of $5E-05$, with arsenic contributing the significant portion of ingestion carcinogenic risk. The surface soil ingestion and dermal contact exposure routes contribute the majority of the cumulative carcinogenic risk for the future resident.

The estimated carcinogenic risks for the future industrial worker, the future adult trespasser, and the adolescent trespasser are the same as the risks for these receptors presented earlier under the current exposures section.

The estimated carcinogenic risk for the future excavation worker exposure scenario is $8E-07$, which is below a benchmark value of $1E-06$.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. Arsenic is a major contributor to risk in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future industrial worker (0.2), future excavation worker (0.2), future adult trespasser (0.05), and future adolescent trespasser (0.08) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The cumulative HI for the future residential receptor (1.1) is greater than 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic, via dermal contact with surface soil, was the principal contributor to the noncarcinogenic risk for this receptor.

6.4.3.3 Building 234

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 6E-05. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 5E-05. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current industrial worker. The estimated carcinogenic risks for the current adult trespasser and the adolescent trespasser are 1E-05 and 9E-06, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 9E-06 and 8E-06, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers. The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. The principal COPC contributing to this cancer risk is arsenic in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.3), current adult trespasser (0.07), and adolescent trespasser (0.1) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 7E-04. For this receptor exposure scenario, the exposure pathway associated with consumption of contaminated groundwater

has a cancer risk of 4E-04, with arsenic contributing the significant portion of ingestion risk. The exposure pathway associated with dermal contact with surface soil has a cancer risk of 2E-04, with arsenic contributing the significant portion of dermal carcinogenic risk. The groundwater ingestion and surface soil dermal contact exposure routes contribute the majority of the cumulative carcinogenic risk for the future resident.

The estimated carcinogenic risk for the future industrial worker exposure scenario is 1E-04. For this receptor exposure scenario, the exposure pathway associated with consumption of contaminated groundwater has a cancer risk of 4E-05, with arsenic contributing the significant portion of ingestion risk. The dermal contact with surface soil exposure pathway has an incremental cancer risk of 5E-05. The groundwater ingestion and surface soil exposure routes contribute the major portion of the cumulative carcinogenic risk for the future industrial worker.

The estimated carcinogenic risks for the future adult trespasser and the adolescent trespasser are the same as the risks for these receptors presented earlier under the current exposures section. The estimated carcinogenic risk for the future excavation worker exposure scenario is 6E-07, which is below a benchmark value of 1E-06.

The dermal contact with COPCs in soil exposure route is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{derm}$) presented in Subsection 6.2. The principal COPC contributing to this cancer risk is arsenic in surface soil; however, it was detected at levels that were only slightly above background.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future excavation worker (0.2), future adult trespasser (0.07), and future adolescent trespasser (0.1) are all less than 1.0, a benchmark below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

The values of the cumulative HI for the future residential receptor (1.5) and the future industrial worker (1.3) are greater than 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic and manganese, via groundwater ingestion, exhibited hazard quotients (HQs) greater than 1.0 or were principal contributors to the noncarcinogenic risk for these receptors.

6.4.3.4 Background

Risks for the upgradient area were only estimated for COPCs found in the on-site media. Therefore, the presence of vinyl chloride and SVOCs in MW104 were not calculated as contributors to the risk in this area.

Background risks were estimated for all COPCs selected (at the designated areas) in each particular medium at the site. Background risks are presented to give an indication of the risks associated with chemicals found in areas not affected by site contaminants and to use as a comparison tool that can give an indication of the risk based solely on site contamination.

Comparison of Risks at Background Locations to On-site Areas: Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk at background locations for the current industrial worker exposure scenario is 1E-04. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 4E-05. Arsenic in this background exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current industrial worker, as is the case for the risks estimated at most areas of concern. At the Central Shipyard, Aroclor 1260 also contributed a significant portion of surface soil carcinogenic risk, but was not associated with background risks.

The estimated carcinogenic risks at background locations for the current adult trespasser and the adolescent trespasser are 8E-06 and 7E-06, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 7E-06 and 7E-06, respectively. Arsenic in this background exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers, as is the case for the risks estimated at most areas of concern. At the Central Shipyard, Aroclor 1260 also contributed a significant portion of surface soil carcinogenic risk, but was not associated with background risks.

For all current receptors, the estimated carcinogenic risks associated with arsenic at background locations are greater than or within 20 percent of the carcinogenic risks from arsenic at the North Waterfront area, the South Waterfront area, and the Building 234 area. The carcinogenic risks from arsenic at the Central Shipyard area are slightly greater than (but within an order of magnitude of) the

risks from arsenic at background locations. At all areas of concern except the Central Shipyard area, it can be concluded that carcinogenic risks estimated for current receptors are not significantly elevated over carcinogenic risks associated with non-site related (i.e., background) exposures. In the latter case, carcinogenic risks are within an order of magnitude of background risks.

Dermal contact with COPCs in background soil exposure is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. Arsenic is the major contributor to background risk, and is a naturally occurring element in soil. Benzo(a)pyrene is a minor contributor to the background risk in surface soil; PAHs detected in soil samples may be associated with runoff from asphalt parking lots or roads.

Noncarcinogenic Risks

At background locations, the estimated values of the cumulative hazard index (HI) for the current industrial worker (0.3), current adult trespasser (0.06), and adolescent trespasser (0.1) are below 1.0, which is similar to or greater than the estimated HI for current receptors at each area of concern.

Comparison of Risks at Background Locations to On-site Areas: Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk at background locations for the future resident exposure scenario is $7E-04$. Arsenic contributes the most significant portion of the cumulative carcinogenic risk for the future resident (groundwater ingestion, $4E-04$; and surface soil dermal contact, $2E-04$). This is similar to the case for the residential carcinogenic risks estimated at most areas of concern. At the Central Shipyard, Aroclor 1260 also contributed a significant portion of surface soil carcinogenic risk, but was not associated with background risks. At the North Waterfront area, TCE also contributed a significant portion of groundwater carcinogenic risk, but was not associated with background risks.

The estimated carcinogenic risk at background locations for the future industrial worker exposure scenario is $1E-04$. Arsenic contributes the most significant portion of the cumulative carcinogenic risk for the future industrial worker (groundwater ingestion, $5E-05$; and surface soil dermal contact, $4E-05$). This is similar to the case for the industrial worker carcinogenic risks estimated at most areas of concern. As discussed above, Aroclor 1260 and TCE also contributed a significant portion of carcinogenic risks at two areas of concern, but were not associated with background risks.

At background locations, the estimated carcinogenic risks for the future adult trespasser and the adolescent trespasser are the same as the risks for these receptors presented earlier under the current exposures section.

The estimated carcinogenic risk for the future excavation worker exposure scenario is 1E-06. This background receptor risk was greater than the excavation worker risks estimated for each area. The exposure scenario at background locations was the only instance where the excavation worker carcinogenic risk exceeded the benchmark value of 1E-06 (none of the areas of concern were above this value).

For all current receptors, the estimated carcinogenic risks associated with arsenic at background locations are greater than or within 20 percent of the carcinogenic risks from arsenic at the North Waterfront area, the South Waterfront area, and the Building 234 area. The carcinogenic risks from arsenic at the Central Shipyard area are slightly greater than (but within an order of magnitude of) the risks from arsenic at background locations. At all areas of concern except the Central Shipyard area, it can be concluded that carcinogenic risks estimated for current receptors are not significantly elevated over carcinogenic risks associated with non-site related (i.e., background) exposures. In the later case, carcinogenic risks are within an order of magnitude of background risks.

Dermal contact with COPCs in background soil exposure is associated with high uncertainty based on the dermal absorption efficiency ($ABSEFF_{oral}$) presented in Subsection 6.2. Arsenic is the major contributor to background risk, and is a naturally occurring element in soil. Benzo(a)pyrene is a minor contributor to the background risk in surface soil; PAHs detected in soil samples may be associated with runoff from asphalt parking lots or roads.

Noncarcinogenic Risks

At background locations, the estimated values of the cumulative hazard index (HI) for the future excavation worker (0.3), future adult trespasser (0.06), and future adolescent trespasser (0.1) are below 1.0, similar to or greater than the HIs for current receptors at each area of concern. At background locations, the estimated HIs for the future resident (61) and the future industrial worker (4.8) are greater than 1.0. These background HI values exceeded those of residential and industrial receptors at each area of concern. Manganese (via ingestion of groundwater) was the principal contributor to the HI for the background exposure scenarios, with arsenic also exceeding an HQ of 1.0. However, at the Central Shipyard area, iron also contributed significantly to the groundwater noncarcinogenic HI, which did not occur at background locations. An HI of 1.0 is the benchmark

below which adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment. Overall, a greater potential for noncarcinogenic risks was estimated for each future receptor at background locations than at each area of concern.

6.5 UNCERTAINTY ANALYSIS

There are uncertainties associated with each aspect of risk assessment, from data evaluation through risk characterization. Significant uncertainties for the limited risk assessment at the site are noted in the following subsections.

6.5.1 Data Evaluation

The chemical-analytical database has some limitations that add to the uncertainty of the risk assessment. Established data validation procedures were not applied to define uncertainties in terms of qualifying data as inaccurate or imprecise. Because of the lack of validated data, uncertainties are present regarding accuracy, precision, and data gaps. For simplicity, data qualified with an "R" or "B" were considered unusable and eliminated from the quantitative risk assessment. Areal extent of the samples (including the number collected and location of the sampling points) in a particular medium at each designated area also represents data evaluation uncertainty. Every effort was made to collect samples that reflect actual designated area conditions. However, biased sampling may have occurred if an unknown area of contamination at a particular designated area was under- or over-sampled.

After the data have been selected for use in the risk assessment, uncertainties exist regarding selection of a concentration for input into the quantitative risk assessment. The use of the representative concentration to estimate risk is generally regarded as a conservative estimate since this entails using either the upper 95 percent confidence limit on the arithmetic mean (based on the data distribution) or the maximum concentration. The choice of the representative concentration as the value for input into the risk assessment generally lowers the chances of under estimation of the actual risk present in a pathway to a potential receptor. However, the use of the representative concentration may overestimate the actual risk present in an exposure pathway at a particular designated area.

The use of current subsurface soil concentrations to represent future subsurface excavation exposure concentrations assumes two things that add to the uncertainty of this risk assessment. First, this exposure scenario assumes that soil would be excavated to the sampling depth. Second, this exposure scenario assumes that once the soil is excavated to the subsurface soil sampling depth, no degradation

of the chemicals in the subsurface soil would have taken place and/or no additional contamination would be transported to the soils. These uncertainties may cause either an under- or over-estimation of the exposure at a particular designated area.

Uncertainties associated with the lack of groundwater modeling and soil to groundwater loading at each designated area include the assumption that current conditions are indicative of future concentrations of contaminants. Contaminants may increase (due to migration, loading, or chemical transformation) or decrease (due to migration or transformation) over time and vary at the site or from designated area to designated area and within the mixing zone. This does not add uncertainty to the quantitative risk; rather, it adds uncertainty to media concentrations that are inputs to the risk assessment.

The chemical-specific parameters such as permeability constants were literature-derived values that are measured under conditions that may or may not be representative of on-site conditions. Parameters such as vapor pressure and solubility were not always obtainable at the desired temperature.

The use of unfiltered monitoring well data for the evaluation of groundwater inorganics in all probability provides an overestimation of exposure and risk.

6.5.2 Toxicity Assessment

There is uncertainty associated with the RfDs and SFs. The uncertainty results from the extrapolation of animal data to humans, the extrapolation of carcinogenic effects from the laboratory high-dose to the environmental low-dose scenarios, and interspecies and intraspecies variations in toxicological endpoints caused by chemical exposure. The use of EPA SF values is generally considered to be conservative because the doses are based on no-effect or lowest-observed-effect levels and then further reduced with uncertainty factors to increase the margin of safety. The RfDs and SFs of some chemicals have not been established, and therefore toxicity could not be quantitatively assessed. In most cases, where RfDs were unavailable for carcinogens, the carcinogenic risk is considered to be much more significant since carcinogenic effects usually occur at much lower doses.

6.5.3 Exposure Assessment

Exposure assumptions can add uncertainty into the risk assessment process based on input values selected for each exposure route. For example, not all people weigh 70 kilograms, drink 2 liters of water per day, and live at the same residence for 30 years. The rationale for each assumption was provided in each table of input parameters. Receptor characteristics, such as age and body weight, were based on published values. Conservative values (based on reasonable maximum exposure or professional judgment) were used in most exposure equations.

In addition to activity patterns and receptor characteristics, uncertainties are also associated with chemical-specific properties and chemical transport modeling assumptions. For example, dermal exposure to soil assumes constant factors for absorption from soil for each class of compounds under all conditions. As estimated by EPA (1992d), the absorbed dermal dose could vary by as much as a factor of 50 from the model estimates, even presuming that activity patterns lead to the exposure duration applied in the model. Exposure to fugitive dust emissions conservatively assumes that residents and workers will be exposed to the same concentration indoors as outdoors, that soils within an area have unlimited erosion potential, that emissions can be estimated from mean annual windspeed and vegetative cover, and that dispersion concentrations can be estimated from source area, downwind distance to receptors, and region-wide meteorological factors. Uncertainties exist in the exposure model for the inhalation of volatiles during showering such as chemical-specific rates of volatilization, droplet size, and droplet residence time in the shower. Most of the inputs into the models were considered conservative; therefore, the output may overestimate the exposure for these routes.

6.5.4 Risk Characterization

From a toxicological standpoint, it is not strictly correct to add HQs for a total HI, because RfDs are based on effects to various target organs. However, if the HI is less than or equal to 1.0, this demonstrates that, even when this conservative calculation is performed, the noncarcinogenic HI does not indicate a hazard for a particular exposure pathway. This is a conservative approach that will generally overestimate the HI for a particular pathway. The target organs affected by those chemicals that significantly contribute to the pathway-specific HI are listed in Table 6-23. This information will give an indication of whether two or more chemicals that significantly contribute to the HI can affect the same target organs.

These models also assumed that chemicals did not interact synergistically (a possible underestimate of the actual risk) or antagonistically (a possible overestimate of the actual risk). Finally, degradation was not taken into account; this is generally a conservative approach.

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TABLE 8-1
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SURFACE SOIL - NORTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				LOCATION OF MAXIMUM
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	
ALUMINUM	M	SS	2/2	13100 00	13200 00	16/16	3440 00	9100 00	5482 97	DSY-S-TP28-0001
ARSENIC	M	SS	2/2	19 50	20 30	16/16	2 60	10 90	4 65	DSY-S-TP28-0001
BARIUM	M	SS	0/0	0 00	0 00	16/16	4 10	49 40	13 78	DSY-S-TP16-0001
BERYLLIUM	M	SS	0/0	0 00	0 00	9/16	0 16	1 10	0 24	DSY-S-TP16-0001
CADMIUM	M	SS	0/1	0 00	0 00	1/16	0 85	0 85	0 32	DSY-S-TP16-0001
CALCIUM	M	SS	1/1	1310 00	1310 00	16/16	112 55	1780 00	506 44	DSY-S-TP16-0001
CHROMIUM	M	SS	2/2	15 00	16 40	16/16	5 20	24 10	8 79	DSY-S-TP16-0001
COBALT	M	SS	2/2	10 50	18 40	16/16	2 60	14 70	7 04	DSY-S-TP16-0001
COPPER	M	SS	2/2	11 20	15 00	16/16	3 10	111 00	20 71	DSY-S-TP16-0001
IRON	M	SS	2/2	26900 00	28200 00	16/16	11200 00	19600 00	15080 34	DSY-S-TP16-0001
LEAD	M	SS	2/2	16 20	18 30	16/16	2 30	115 00	20 90	DSY-S-TP28-0001
MAGNESIUM	M	SS	2/2	2510 00	2580 00	16/16	1350 00	2570 00	1920 72	DSY-S-TP23-0001
MANGANESE	M	SS	2/2	338 00	1580 00	16/16	81 40	376 00	226 75	DSY-S-MW11-0103
MERCURY	M	SS	0/1	0 00	0 00	6/16	0 04	0 17	0 04	DSY-S-TP28-0001
NICKEL	M	SS	2/2	19 20	21 40	16/16	8 20	68 50	15 59	DSY-S-TP16-0001
POTASSIUM	M	SS	0/0	0 00	0 00	16/16	198 00	711 00	324 19	DSY-S-MW11-0103
SELENIUM	M	SS	0/2	0 00	0 00	6/16	0 50	1 00	0 53	DSY-S-MW12-0002
SODIUM	M	SS	0/0	0 00	0 00	16/16	11 70	172 00	38 13	DSY-S-TP16-0001
VANADIUM	M	SS	2/2	21 70	22 20	16/16	6 50	39 00	11 28	DSY-S-TP28-0001
ZINC	M	SS	2/2	49 70	54 00	16/16	22 80	883 00	92 37	DSY-S-TP16-0001
4,4'-DDE	P	SS	1/2	27 00	27 00	1/16	22 00	22 00	3 01	DSY-S-TP28-0001
4,4'-DDT	P	SS	1/2	32 00	32 00	1/16	63 00	63 00	5 58	DSY-S-TP28-0001
ALPHA-CHLORDANE	P	SS	0/2	0 00	0 00	2/16	2 00	7 30	1 37	DSY-S-TP28-0001
AROCLOR-1260	P	SS	0/2	0 00	0 00	1/16	24 00	24 00	17 80	DSY-S-TP16-0001
DIELDRIN	P	SS	0/2	0 00	0 00	1/16	16 00	16 00	2 63	DSY-S-TP16-0001
ENDRIN	P	SS	0/2	0 00	0 00	2/16	5 70	26 00	3 48	DSY-S-TP16-0001
GAMMA-CHLORDANE	P	SS	0/2	0 00	0 00	1/16	2 40	2 40	1 00	DSY-S-MW03-0002
HEPTACHLOR EPOXIDE	P	SS	0/2	0 00	0 00	1/16	4 20	4 20	1 11	DSY-S-TP28-0001
2,2-OXYBIS(1-CHLOROPROPANE)	S	SS	0/2	0 00	0 00	1/16	39 00	39 00	639 31	DSY-S-TP18-0001
BENZ(A)ANTHRACENE	S	SS	0/2	0 00	0 00	1/16	710 00	710 00	577 50	DSY-S-TP28-0001
BENZO(A)PYRENE	S	SS	0/2	0 00	0 00	1/16	680 00	680 00	575 63	DSY-S-TP28-0001
BENZO(B)FLUORANTHENE	S	SS	1/2	55 00	55 00	1/16	1000 00	1000 00	595 63	DSY-S-TP28-0001
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	2/2	90 00	210 00	14/16	34 00	1500 00	549 72	DSY-S-TP28-0001
CHRYSENE	S	SS	0/2	0 00	0 00	1/16	690 00	690 00	576 25	DSY-S-TP28-0001
DIBUTYLTIN	S	SS	0/2	0 00	0 00	2/16	16 50	51 00	22 97	DSY-S-TP16-0001
FLUORANTHENE	S	SS	2/2	53 00	63 00	1/16	1400 00	1400 00	620 63	DSY-S-TP28-0001
HEXACHLOROETHANE	S	SS	0/2	0 00	0 00	1/16	55 00	55 00	640 31	DSY-S-TP20-0001
INDENO(1,2,3-CD)PYRENE	S	SS	0/2	0 00	0 00	1/16	520 00	520 00	565 63	DSY-S-TP28-0001
MONOBUTYLTIN	S	SS	0/2	0 00	0 00	1/16	52 00	52 00	23 55	DSY-S-TP16-0001
PHENANTHRENE	S	SS	0/2	0 00	0 00	1/16	730 00	730 00	578 75	DSY-S-TP28-0001
PHENOL	S	SS	0/2	0 00	0 00	1/16	170 00	170 00	647 50	DSY-S-TP18-0001
PYRENE	S	SS	2/2	54 00	59 00	2/16	1300 00	1400 00	326 88	DSY-S-TP16-0001
TETRABUTYLTIN	S	SS	0/2	0 00	0 00	4/16	7 60	17 00	18 40	DSY-S-TP22-0001
TIN	S	SS	0/1	0 00	0 00	1/16	12 20	12 20	4 29	DSY-S-TP16-0001
TPH	S	SS	1/2	260 00	260 00	7/16	61 00	4900 00	402 00	DSY-S-TP16-0001
TRIBUTYLTIN	S	SS	1/2	11 00	11 00	3/16	14 00	46 00	22 59	DSY-S-TP16-0001
2-BUTANONE	V	SS	0/2	0 00	0 00	2/16	2 00	10 00	5 56	DSY-S-MW11-0103
ACETONE	V	SS	1/1	5 00	5 00	15/16	5 00	115 00	46 72	DSY-S-TP18-0001
METHYLENE CHLORIDE	V	SS	0/0	0 00	0 00	16/16	3 00	21 00	10 28	DSY-S-TP28-0001
TOLUENE	V	SS	0/2	0 00	0 00	5/16	1 00	4 00	4 34	DSY-S-TP23-0001
XYLENE (TOTAL)	V	SS	0/2	0 00	0 00	3/16	1 00	2 00	4 78	DSY-S-MW11-0103

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-2
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SURFACE SOIL - CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES		SITE SAMPLES			LOCATION OF MAXIMUM		
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN			
ALUMINUM	M	SS	2/2	13100 00	13200 00	8/8	5820 00	14400 00	11518 88	DSY-S-TP14-0001
ARSENIC	M	SS	2/2	19 50	20 30	8/8	3 90	24 40	14 86	DSY-S-TP11-0001
BARIUM	M	SS	0/0	0 00	0 00	8/8	12 10	24 00	16 82	DSY-S-TP15-0001
BERYLLIUM	M	SS	0/0	0 00	0 00	8/8	0 23	0 47	0 37	DSY-S-TP15-0001
CADMIUM	M	SS	0/1	0 00	0 00	5/8	0 75	1 20	0 70	DSY-S-TP14-0001
CALCIUM	M	SS	1/1	1310 00	1310 00	8/8	426 00	1230 00	929 06	DSY-S-TP14-0001
CHROMIUM	M	SS	2/2	15 00	16 40	8/8	9 80	19 00	15 30	DSY-S-TP14-0001
COBALT	M	SS	2/2	10 50	18 40	8/8	7 60	22 70	13 36	DSY-S-MW06-0002
COPPER	M	SS	2/2	11 20	15 00	8/8	15 15	33 00	25 73	DSY-S-TP14-0001
IRON	M	SS	2/2	26900 00	28200 00	8/8	18500 00	33662 00	29107 75	DSY-S-TP12-0001
LEAD	M	SS	2/2	16 20	18 30	8/8	9 20	27 40	17 95	DSY-S-TP15-0001
MAGNESIUM	M	SS	2/2	2510 00	2580 00	8/8	2310 00	4740 00	3603 25	DSY-S-TP14-0001
MANGANESE	M	SS	2/2	338 00	1580 00	8/8	297 50	619 00	403 69	DSY-S-MW06-0002
MERCURY	M	SS	0/1	0 00	0 00	6/8	0 08	0 16	0 09	DSY-S-TP12-0001
NICKEL	M	SS	2/2	19 20	21 40	8/8	14 90	27 70	22 94	DSY-S-TP12-0001
POTASSIUM	M	SS	0/0	0 00	0 00	8/8	241 00	606 00	348 00	DSY-S-TP17-0001
SELENIUM	M	SS	0/2	0 00	0 00	3/8	0 75	1 20	0 58	DSY-S-TP15-0001
SODIUM	M	SS	0/0	0 00	0 00	8/8	22 60	87 90	53 31	DSY-S-TP17-0001
VANADIUM	M	SS	2/2	21 70	22 20	8/8	8 75	21 80	16 42	DSY-S-TP15-0001
ZINC	M	SS	2/2	49 70	54 00	8/8	33 35	123 00	69 56	DSY-S-TP14-0001
4,4'-DDD	P	SS	0/2	0 00	0 00	1/8	4 30	4 30	24 37	DSY-S-TP15-0001
4,4'-DDT	P	SS	1/2	32 00	32 00	1/8	6 20	6 20	24 61	DSY-S-TP15-0001
AROCLOR-1260	P	SS	0/2	0 00	0 00	2/8	32 00	59000 00	7392 31	DSY-S-TP14-0001
DECACHLOROBIPHENYL	P	SS	0/2	0 00	0 00	1/15	3 60	3 60	265 42	DSY-S-MW06-0002
DIELDRIN	P	SS	0/2	0 00	0 00	1/8	470 00	470 00	60 31	DSY-S-TP14-0001
ENDRIN KETONE	P	SS	0/2	0 00	0 00	1/8	1100 00	1100 00	139 06	DSY-S-TP14-0001
METHOXYCHLOR	P	SS	0/2	0 00	0 00	1/8	2300 00	2300 00	295 56	DSY-S-TP14-0001
2,2-OXYBIS(1-CHLOROPROPAN	S	SS	0/2	0 00	0 00	2/8	180 00	410 00	873 13	DSY-S-TP17-0001
2,4-DIMETHYLPHENOL	S	SS	0/2	0 00	0 00	1/8	320 00	320 00	862 50	DSY-S-TP17-0001
2-CHLOROPHENOL	S	SS	0/2	0 00	0 00	1/8	40 00	40 00	827 50	DSY-S-TP17-0001
2-METHYLPHENOL	S	SS	0/2	0 00	0 00	1/8	560 00	560 00	892 50	DSY-S-TP17-0001
4-METHYLPHENOL	S	SS	0/2	0 00	0 00	1/8	2400 00	2400 00	1122 50	DSY-S-TP17-0001
ACENAPHTHENE	S	SS	0/2	0 00	0 00	1/8	92 00	92 00	832 75	DSY-S-TP15-0001
ANTHRACENE	S	SS	0/2	0 00	0 00	1/8	130 00	130 00	837 50	DSY-S-TP15-0001
BENZ(A)ANTHRACENE	S	SS	0/2	0 00	0 00	3/8	130 00	410 00	861 88	DSY-S-TP15-0001
BENZO(A)PYRENE	S	SS	0/2	0 00	0 00	2/8	86 00	120 00	824 50	DSY-S-MW06-0002
BENZO(B)FLUORANTHENE	S	SS	1/2	55 00	55 00	3/8	180 00	410 00	885 63	DSY-S-TP15-0001
BENZO(G,H,I)PERYLENE	S	SS	0/2	0 00	0 00	3/8	56 00	110 00	806 63	DSY-S-TP15-0001
BENZO(K)FLUORANTHENE	S	SS	0/2	0 00	0 00	2/8	86 00	360 00	854 50	DSY-S-TP15-0001
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	2/2	90 00	210 00	3/8	37 00	57 00	794 13	DSY-S-MW06-0002
CARBAZOLE	S	SS	0/2	0 00	0 00	1/8	97 00	97 00	833 38	DSY-S-TP15-0001
CHRYSENE	S	SS	0/2	0 00	0 00	3/8	130 00	420 00	863 13	DSY-S-TP15-0001
FLUORANTHENE	S	SS	2/2	53 00	63 00	3/8	270 00	870 00	956 88	DSY-S-TP15-0001
FLUORENE	S	SS	0/2	0 00	0 00	1/8	65 00	65 00	829 38	DSY-S-TP15-0001
INDENO(1,2,3-CD)PYRENE	S	SS	0/2	0 00	0 00	3/8	71 00	150 00	813 63	DSY-S-TP15-0001
PHENANTHRENE	S	SS	0/2	0 00	0 00	3/8	120 00	580 00	881 88	DSY-S-TP15-0001
PHENOL	S	SS	0/2	0 00	0 00	1/8	5500 00	5500 00	1510 00	DSY-S-TP17-0001
PYRENE	S	SS	2/2	54 00	59 00	3/8	230 00	740 00	928 13	DSY-S-TP15-0001
TETRABUTYL TIN	S	SS	0/2	0 00	0 00	1/8	14 00	14 00	23 47	DSY-S-TP15-0001
TPH	S	SS	1/2	260 00	260 00	5/8	68 00	2000 00	512 53	DSY-S-TP12-0001
TRIBUTYL TIN	S	SS	1/2	11 00	11 00	1/8	7 70	7 70	22 68	DSY-S-TP15-0001
2-BUTANONE	V	SS	0/2	0 00	0 00	1/8	2 00	2 00	5 06	DSY-S-MW05-0002
ACETONE	V	SS	1/1	5 00	5 00	3/8	6 00	12 00	7 13	DSY-S-MW06-0002
METHYLENE CHLORIDE	V	SS	0/0	0 00	0 00	8/8	6 00	30 00	12 19	DSY-S-MW06-0002

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-3
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SURFACE SOIL - SOUTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	LOCATION OF MAXIMUM
ALUMINUM	M	SS	2/2	13100 00	13200 00	6/6	6448 50	33300 00	12638 08	DSY-S-TP05-0001
ARSENIC	M	SS	2/2	19 50	20 30	6/6	8 70	15 30	12 70	DSY-S-TP02-0001
BARIUM	M	SS	0/0	0 00	0 00	6/6	12 30	420 00	92 49	DSY-S-TP05-0001
BERYLLIUM	M	SS	0/0	0 00	0 00	6/6	0 30	2 05	1 10	DSY-S-TP04-0001
CADMIUM	M	SS	0/1	0 00	0 00	1/6	0 48	0 48	0 33	DSY-S-TP06-0001
CALCIUM	M	SS	1/1	1310 00	1310 00	6/6	504 00	8780 00	2427 42	DSY-S-TP05-0001
CHROMIUM	M	SS	2/2	15 00	16 40	6/6	10 50	53 50	23 65	DSY-S-TP05-0001
COBALT	M	SS	2/2	10 50	18 40	6/6	8 90	18 30	12 63	DSY-S-TP05-0001
COPPER	M	SS	2/2	11 20	15 00	6/6	13 00	116 80	60 12	DSY-S-TP04-0001
IRON	M	SS	2/2	26900 00	28200 00	6/6	19931 00	58100 00	28771 83	DSY-S-TP05-0001
LEAD	M	SS	2/2	16 20	18 30	6/6	13 50	101 15	48 53	DSY-S-TP04-0001
MAGNESIUM	M	SS	2/2	2510 00	2580 00	6/6	2103 00	2730 00	2515 50	DSY-S-TP05-0001
MANGANESE	M	SS	2/2	338 00	1580 00	6/6	274 00	423 00	329 17	DSY-S-TP02-0001
MERCURY	M	SS	0/1	0 00	0 00	3/6	0 05	0 17	0 06	DSY-S-TP03-0001
NICKEL	M	SS	2/2	19 20	21 40	6/6	17 20	60 10	37 01	DSY-S-TP05-0001
POTASSIUM	M	SS	0/0	0 00	0 00	6/6	291 00	4050 00	982 75	DSY-S-TP05-0001
SELENIUM	M	SS	0/2	0 00	0 00	3/6	0 85	1 40	0 78	DSY-S-TP06-0001
SODIUM	M	SS	0/0	0 00	0 00	6/6	56 50	965 00	260 64	DSY-S-TP05-0001
VANADIUM	M	SS	2/2	21 70	22 20	6/6	9 00	52 70	20 13	DSY-S-TP05-0001
ZINC	M	SS	2/2	49 70	54 00	6/6	40 80	896 00	335 72	DSY-S-TP05-0001
4,4'-DDE	P	SS	1/2	27 00	27 00	1/6	6 10	6 10	2 44	DSY-S-TP06-0001
4,4'-DDT	P	SS	1/2	32 00	32 00	1/6	14 00	14 00	3 76	DSY-S-TP06-0001
AROCLOR-1260	P	SS	0/2	0 00	0 00	2/6	15 00	25 00	18 00	DSY-S-TP04-0001
ANTHRACENE	S	SS	0/2	0 00	0 00	1/6	150 00	150 00	308 33	DSY-S-TP04-0001
BENZ(A)ANTHRACENE	S	SS	0/2	0 00	0 00	5/6	58 00	210 00	233 67	DSY-S-TP06-0001
BENZO(A)PYRENE	S	SS	0/2	0 00	0 00	5/6	46 00	180 00	216 00	DSY-S-TP06-0001
BENZO(B)FLUORANTHENE	S	SS	1/2	55 00	55 00	5/6	81 00	270 00	254 83	DSY-S-TP06-0001
BENZO(G,H,I)PERYLENE	S	SS	0/2	0 00	0 00	3/6	42 00	55 00	250 17	DSY-S-TP04-0001
BENZO(K)FLUORANTHENE	S	SS	0/2	0 00	0 00	5/6	38 00	150 00	205 17	DSY-S-TP06-0001
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	2/2	90 00	210 00	5/6	55 00	1100 00	415 00	DSY-S-TP05-0001
CHRYSENE	S	SS	0/2	0 00	0 00	5/6	53 00	230 00	236 33	DSY-S-TP06-0001
DIBUTYL TIN	S	SS	0/2	0 00	0 00	1/6	4 30	4 30	21 38	DSY-S-TP06-0001
FLUORANTHENE	S	SS	2/2	53 00	63 00	5/6	71 00	460 00	345 17	DSY-S-TP06-0001
INDENO(1,2,3-CD)PYRENE	S	SS	0/2	0 00	0 00	4/6	42 00	110 00	212 67	DSY-S-TP06-0001
PHENANTHRENE	S	SS	0/2	0 00	0 00	4/6	94 00	280 00	279 83	DSY-S-TP06-0001
PYRENE	S	SS	2/2	54 00	59 00	5/6	73 00	380 00	293 83	DSY-S-TP06-0001
TIN	S	SS	0/1	0 00	0 00	2/6	9 30	27 85	8 71	DSY-S-TP04-0001
TPH	S	SS	1/2	260 00	260 00	3/6	94 00	110 00	67 42	DSY-S-TP04-0001
TRIBUTYL TIN	S	SS	1/2	11 00	11 00	2/6	3 10	4 50	17 85	DSY-S-TP06-0001
ACETONE	V	SS	1/1	5 00	5 00	5/6	6 00	25 00	11 92	DSY-S-TP03-0001
METHYLENE CHLORIDE	V	SS	0/0	0 00	0 00	6/6	10 00	43 00	16 83	DSY-S-TP03-0001

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-4
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SURFACE SOIL - BUILDING 234
 SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				LOCATION OF MAXIMUM
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	
ALUMINUM	M	SS	2/2	13100 00	13200 00	9/9	3810 00	11307 50	8086 61	DSY-S-TP09-0001
ARSENIC	M	SS	2/2	19 50	20 30	9/9	2 60	22 65	12 31	DSY-S-TP09-0001
BARIUM	M	SS	0/0	0 00	0 00	9/9	8 90	67 00	25 23	DSY-S-MW08-0002
BERYLLIUM	M	SS	0/0	0 00	0 00	8/9	0 18	3 50	0 67	DSY-S-MW08-0002
CADMIUM	M	SS	0/1	0 00	0 00	3/9	0 43	0 97	0 41	DSY-SB-15-0103
CALCIUM	M	SS	1/1	1310 00	1310 00	9/9	521 00	2790 00	1019 89	DSY-S-MW08-0002
CHROMIUM	M	SS	2/2	15 00	16 40	9/9	6 40	40 20	17 53	DSY-S-MW08-0002
COBALT	M	SS	2/2	10 50	18 40	9/9	3 30	23 90	11 66	DSY-S-MW08-0002
COPPER	M	SS	2/2	11 20	15 00	9/9	12 90	262 00	49 99	DSY-S-MW08-0002
IRON	M	SS	2/2	26900 00	28200 00	9/9	7770 00	35708 50	23309 56	DSY-S-TP09-0001
LEAD	M	SS	2/2	16 20	18 30	9/9	5 30	189 00	44 69	DSY-S-MW08-0002
MAGNESIUM	M	SS	2/2	2510 00	2580 00	9/9	1170 00	3450 00	2494 72	DSY-SB-15-0103
MANGANESE	M	SS	2/2	338 00	1580 00	9/9	157 00	580 00	343 33	DSY-S-TP09-0001
MERCURY	M	SS	0/1	0 00	0 00	2/9	0 07	0 09	0 04	DSY-S-TP26-0001
NICKEL	M	SS	2/2	19 20	21 40	9/9	7 80	113 00	29 47	DSY-S-MW08-0002
POTASSIUM	M	SS	0/0	0 00	0 00	9/9	227 00	585 50	361 28	DSY-SB-14-0103
SODIUM	M	SS	0/0	0 00	0 00	9/9	23 80	163 00	53 77	DSY-S-MW08-0002
VANADIUM	M	SS	2/2	21 70	22 20	9/9	6 80	23 20	14 87	DSY-S-TP10-0001
ZINC	M	SS	2/2	49 70	54 00	9/9	43 60	831 00	177 49	DSY-S-MW08-0002
4,4'-DDE	P	SS	1/2	27 00	27 00	1/9	3 10	3 10	1 98	DSY-S-TP08-0001
4,4'-DDT	P	SS	1/2	32 00	32 00	3/9	5 00	8 60	3 33	DSY-S-TP08-0001
AROCLOR-1254	P	SS	0/2	0 00	0 00	1/9	38 00	38 00	20 47	DSY-S-MW08-0002
AROCLOR-1260	P	SS	0/2	0 00	0 00	1/9	24 00	24 00	18 97	DSY-S-TP10-0001
DECACHLOROBIPHENYL	P	SS	0/2	0 00	0 00	3/17	3 60	3 60	2 10	DSY-S-MW08-0002
GAMMA-CHLORDANE	P	SS	0/2	0 00	0 00	1/9	3 90	3 90	1 27	DSY-S-TP10-0001
HEPTACHLOR	P	SS	0/2	0 00	0 00	1/9	4 50	4 50	1 34	DSY-S-TP10-0001
2-METHYLNAPHTHALENE	S	SS	0/2	0 00	0 00	2/9	50 00	66 00	245 39	DSY-SB-15-0103
ACENAPHTHENE	S	SS	0/2	0 00	0 00	2/9	46 00	52 00	249 22	DSY-S-MW08-0002
ANTHRACENE	S	SS	0/2	0 00	0 00	3/9	51 00	110 00	243 44	DSY-S-MW08-0002
BENZ(A)ANTHRACENE	S	SS	0/2	0 00	0 00	6/9	50 00	470 00	214 94	DSY-S-MW09-0002
BENZO(A)PYRENE	S	SS	0/2	0 00	0 00	5/9	58 00	410 00	216 72	DSY-S-MW09-0002
BENZO(B)FLUORANTHENE	S	SS	1/2	55 00	55 00	7/9	41 00	660 00	265 83	DSY-S-MW09-0002
BENZO(G,H,I)PERYLENE	S	SS	0/2	0 00	0 00	3/9	88 00	190 00	267 00	DSY-S-MW09-0002
BENZO(K)FLUORANTHENE	S	SS	0/2	0 00	0 00	3/9	87 00	270 00	273 56	DSY-S-MW09-0002
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	2/2	90 00	210 00	9/9	130 00	8700 00	1701 11	DSY-S-TP07-0001
CARBAZOLE	S	SS	0/2	0 00	0 00	2/9	37 00	56 00	248 67	DSY-S-TP10-0001
CHRYSENE	S	SS	0/2	0 00	0 00	8/9	41 00	580 00	224 44	DSY-S-MW09-0002
DI-N-BUTYLPHTHALATE	S	SS	0/2	0 00	0 00	2/9	51 00	64 00	251 11	DSY-S-MW09-0002
DI-N-OCTYLPHTHALATE	S	SS	1/2	120 00	120 00	1/9	62 00	62 00	265 22	DSY-S-MW08-0002
DIBENZO(A,H)ANTHRACENE	S	SS	0/2	0 00	0 00	1/9	62 00	62 00	265 22	DSY-S-MW09-0002
FLUORANTHENE	S	SS	2/2	53 00	63 00	7/9	75 00	770 00	363 89	DSY-S-MW09-0002
FLUORENE	S	SS	0/2	0 00	0 00	1/9	50 00	50 00	263 89	DSY-S-MW08-0002
INDENO(1,2,3-CD)PYRENE	S	SS	0/2	0 00	0 00	3/9	80 00	190 00	265 00	DSY-S-MW09-0002
MONOBUTYL TIN	S	SS	0/2	0 00	0 00	1/9	8 80	8 80	23 01	DSY-SB-14-0103
PHENANTHRENE	S	SS	0/2	0 00	0 00	7/9	41 50	420 00	282 06	DSY-S-MW08-0002
PYRENE	S	SS	2/2	54 00	59 00	8/9	72 00	750 00	314 83	DSY-S-MW09-0002
TETRABUTYL TIN	S	SS	0/2	0 00	0 00	1/9	19 00	19 00	24 14	DSY-S-TP09-0001
TIN	S	SS	0/1	0 00	0 00	1/9	40 60	40 60	7 88	DSY-S-MW08-0002
TPH	S	SS	1/2	260 00	260 00	4/9	61 00	320 00	98 44	DSY-S-TP26-0001
TRIBUTYL TIN	S	SS	1/2	11 00	11 00	2/9	3 50	11 00	20 86	DSY-S-MW08-0002
2-BUTANONE	V	SS	0/2	0 00	0 00	4/9	3 00	10 00	5 67	DSY-S-MW08-0002
ACETONE	V	SS	1/1	5 00	5 00	8/9	5 00	28 00	14 61	DSY-S-MW08-0002
METHYLENE CHLORIDE	V	SS	0/0	0 00	0 00	9/9	6 00	31 00	13 78	DSY-S-MW08-0002
TOLUENE	V	SS	0/2	0 00	0 00	2/9	1 00	1 50	4 50	DSY-S-TP08-0001
XYLENE (TOTAL)	V	SS	0/2	0 00	0 00	1/9	3 00	3 00	5 14	DSY-S-MW08-0002

* UNITS FOR METALS (M) ARE IN MG/KG
 * UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-5
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SUBSURFACE SOIL - NORTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION - FORMER R. BERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES		SITE SAMPLES			LOCATION OF MAXIMUM		
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN			
ALUMINUM	M	SB	1/1	11700 00	11700 00	35/35	2430 00	18200 00	6733 89	DSY-S-MW02-3438
ARSENIC	M	SB	1/1	38 50	38 50	35/35	2 70	18 80	6 12	DSY-S-TP18-1112
BARIUM	M	SB	0/0	0 00	0 00	35/35	2 10	28 20	8 15	DSY-S-TP28-1314
BERYLLIUM	M	SB	0/0	0 00	0 00	18/35	0 18	0 35	0 19	DSY-S-TP22-1112
CADMIUM	M	SB	1/1	1 50	1 50	6/35	0 60	1 10	0 38	DSY-S-TP18-0508
CALCIUM	M	SB	0/0	0 00	0 00	35/35	309 00	3480 00	847 53	DSY-S-MW02-1820
CHROMIUM	M	SB	1/1	15 20	15 20	35/35	2 20	27 10	10 00	DSY-S-MW02-3438
COBALT	M	SB	1/1	18 60	18 60	35/35	2 60	19 80	7 68	DSY-S-MW02-3438
COPPER	M	SB	1/1	19 40	19 40	35/35	4 10	30 80	13 74	DSY-S-MW02-3438
IRON	M	SB	1/1	37100 00	37100 00	35/35	6970 00	43100 00	18175 30	DSY-S-MW12-2931
LEAD	M	SB	1/1	6 60	6 60	35/35	1 80	29 20	6 60	DSY-S-MW03-1818
MAGNESIUM	M	SB	1/1	3980 00	3980 00	35/35	921 00	7680 00	2480 51	DSY-S-MW02-3438
MANGANESE	M	SB	1/1	748 00	748 00	35/35	55 40	549 00	211 48	DSY-S-TP22-1112
MERCURY	M	SB	0/1	0 00	0 00	20/35	0 04	0 23	0 07	DSY-S-MW11-2931
NICKEL	M	SB	1/1	28 80	28 80	35/35	5 10	39 50	14 54	DSY-S-MW02-3438
POTASSIUM	M	SB	0/0	0 00	0 00	35/35	132 00	1180 00	304 31	DSY-S-MW12-2123
SELENIUM	M	SB	0/1	0 00	0 00	9/35	0 80	1 30	0 55	DSY-S-MW12-2931
SODIUM	M	SB	0/0	0 00	0 00	35/35	18 80	147 00	48 08	DSY-S-MW02-2428
VANADIUM	M	SB	1/1	20 80	20 80	35/35	4 30	21 35	10 63	DSY-S-MW11-2931
ZINC	M	SB	1/1	88 60	88 60	35/35	13 60	73 40	34 98	DSY-S-MW12-2931
ALDRIN	P	SB	0/1	0 00	0 00	1/17	4 40	4 40	1 18	DSY-S-TP18-1112
ALPHA-CHLORDANE	P	SB	0/1	0 00	0 00	1/17	2 10	2 10	1 02	DSY-S-MW03-0810
ENDRIN	P	SB	0/1	0 00	0 00	1/17	15 00	15 00	2 85	DSY-S-TP18-1112
GAMMA-CHLORDANE	P	SB	0/1	0 00	0 00	1/17	2 10	2 10	1 02	DSY-S-MW03-0810
HEPTACHLOR	P	SB	0/1	0 00	0 00	4/17	1 85	3 80	1 43	DSY-S-MW02-2428
4-CHLORO-3-METHYLPHENOL	S	SB	0/1	0 00	0 00	1/17	1100 00	1100 00	242 79	DSY-S-TP18-1112
BENZ(A)ANTHRACENE	S	SB	0/1	0 00	0 00	1/17	53 00	53 00	493 71	DSY-S-TP24-0102
BENZO(A)PYRENE	S	SB	0/1	0 00	0 00	1/17	44 00	44 00	493 18	DSY-S-TP24-0102
BENZO(B)FLUORANTHENE	S	SB	0/1	0 00	0 00	1/17	71 00	71 00	494 78	DSY-S-TP24-0102
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	1/1	200 00	200 00	13/17	44 00	110 00	413 03	DSY-S-MW03-1818
CHRYSENE	S	SB	0/1	0 00	0 00	1/17	44 00	44 00	493 18	DSY-S-TP24-0102
DI-N-BUTYLPHTHALATE	S	SB	0/1	0 00	0 00	3/17	42 00	270 00	486 74	DSY-S-MW04-1818
FLUORANTHENE	S	SB	0/1	0 00	0 00	2/17	42 00	81 00	486 06	DSY-S-TP24-0102
PHENANTHRENE	S	SB	0/1	0 00	0 00	1/17	54 00	54 00	493 78	DSY-S-TP24-0102
PYRENE	S	SB	0/1	0 00	0 00	2/17	41 00	1600 00	262 85	DSY-S-TP18-1112
TETRABUTYL TIN	S	SB	0/1	0 00	0 00	3/17	8 40	18 30	18 09	DSY-S-TP24-0102
TPH	S	SB	0/1	0 00	0 00	1/18	89 00	89 00	50 98	DSY-S-MW04-1818
TRIBUTYL TIN	S	SB	0/1	0 00	0 00	4/17	2 30	18 00	14 93	DSY-S-MW11-2931
1,2-DICHLOROETHENE (TOTAL)	V	SB	0/1	0 00	0 00	1/17	3 00	3 00	8 62	DSY-S-MW11-2931
2-BUTANONE	V	SB	1/1	3 00	3 00	3/17	4 00	9 75	9 22	DSY-S-TP24-0102
ACETONE	V	SB	1/1	4 00	4 00	18/17	4 00	255 00	42 24	DSY-S-MW11-2931
CARBON DISULFIDE	V	SB	0/1	0 00	0 00	1/17	2 00	2 00	8 74	DSY-S-MW02-1820
METHYLENE CHLORIDE	V	SB	0/0	0 00	0 00	17/17	6 00	29 50	18 15	DSY-S-MW11-2931
TOLUENE	V	SB	0/1	0 00	0 00	1/17	2 00	2 00	8 76	DSY-S-TP24-0102
TRICHLOROETHENE	V	SB	0/1	0 00	0 00	4/17	1 00	4 00	7 79	DSY-S-MW11-2931
XYLENE (TOTAL)	V	SB	0/1	0 00	0 00	1/17	2 00	2 00	8 76	DSY-S-TP24-0102

* UNITS FOR METALS (M) ARE IN MG/KG

† UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

**TABLE 6-6
OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SUBSURFACE SOIL - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES			LOCATION OF MAXIMUM	
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION			MEAN
ALUMINUM	M	SB	1/1	11700 00	11700 00	26/26	5800 00	19900 00	10208 37	DSY-S-MW06-0406
ARSENIC	M	SB	1/1	38 50	38 50	26/26	3 90	37 30	14 93	DSY-S-TP12-1213
BARIUM	M	SB	0/0	0 00	0 00	26/26	4 10	24 55	13 68	DSY-S-TP13-0506
BERYLLIUM	M	SB	0/0	0 00	0 00	23/26	0 22	0 54	0 36	DSY-S-TP13-1011
CADMILM	M	SB	1/1	1 50	1 50	14/26	0 49	1 50	0 71	DSY-S-TP14-0506
CALCIUM	M	SB	0/0	0 00	0 00	26/26	363 00	3630 00	1050 21	DSY-SB-09-1416
CHROMIUM	M	SB	1/1	15 20	15 20	26/26	6 30	25 90	12 06	DSY-S-MW06-0406
COBALT	M	SB	1/1	16 60	16 60	26/26	4 60	24 70	12 18	DSY-S-TP14-0506
COPPER	M	SB	1/1	19 40	19 40	26/26	5 90	31 10	18 03	DSY-S-TP14-0506
IRON	M	SB	1/1	37100 00	37100 00	26/26	14500 00	43800 00	26081 06	DSY-S-TP14-0506
LEAD	M	SB	1/1	6 60	6 60	26/26	2 60	55 55	16 02	DSY-S-MW05-2224
MAGNESIUM	M	SB	1/1	3980 00	3980 00	26/26	2105 00	7130 00	3279 04	DSY-S-MW06-0406
MANGANESE	M	SB	1/1	748 00	748 00	26/26	92 50	727 00	371 04	DSY-S-TP14-0506
MERCURY	M	SB	0/1	0 00	0 00	6/26	0 06	0 12	0 05	DSY-S-TP13-0506
NICKEL	M	SB	1/1	28 90	28 90	26/26	11 50	39 70	20 49	DSY-S-MW06-0406
POTASSIUM	M	SB	0/0	0 00	0 00	26/26	118 00	568 00	314 04	DSY-S-MW07-3436
SELENIUM	M	SB	0/1	0 00	0 00	3/26	0 63	0 89	0 47	DSY-S-TP13-0506
SILVER	M	SB	0/1	0 00	0 00	2/26	1 60	1 70	0 72	DSY-S-TP14-0506
SODIUM	M	SB	0/0	0 00	0 00	26/26	18 25	228 00	81 67	DSY-S-MW07-3436
VANADIUM	M	SB	1/1	20 60	20 60	26/26	8 90	25 25	15 68	DSY-S-MW05-2224
ZINC	M	SB	1/1	66 60	66 60	26/26	28 00	82 50	50 00	DSY-SB-03-0911
4,4'-DDD	P	SB	0/1	0 00	0 00	3/16	7 40	115 90	11 12	DSY-S-MW07-1618
4,4'-DDE	P	SB	0/1	0 00	0 00	2/16	6 40	9 40	2 78	DSY-S-MW05-2224
4,4'-DDT	P	SB	0/1	0 00	0 00	2/16	23 40	55 90	6 75	DSY-S-MW07-1618
ALPHA-CHLORDANE	P	SB	0/1	0 00	0 00	1/16	4 93	4 93	1 29	DSY-S-MW05-2224
AROCLOR-1260	P	SB	0/1	0 00	0 00	1/16	13 00	13 00	19 69	DSY-S-TP25-1011
DECACHLOROBIPHENYL	P	SB	0/1	0 00	0 00	4/22	3 40	3 80	2 33	DSY-S-MW07-3436
ENDRIN	P	SB	0/1	0 00	0 00	1/16	5 50	5 50	2 23	DSY-S-TP11-1213
GAMMA-CHLORDANE	P	SB	0/1	0 00	0 00	1/16	3 63	3 63	1 21	DSY-S-MW05-2224
HEPTACHLOR EPOXIDE	P	SB	0/1	0 00	0 00	1/16	1 78	1 78	1 09	DSY-S-MW05-2224
2-METHYLNAPHTHALENE	S	SB	0/1	0 00	0 00	1/16	280 00	280 00	319 84	DSY-S-MW07-0810
ACENAPHTHENE	S	SB	0/1	0 00	0 00	1/16	37 00	37 00	305 44	DSY-S-MW05-2224
ANTHRACENE	S	SB	0/1	0 00	0 00	1/16	92 00	92 00	306 66	DSY-S-MW05-2224
BENZ(A)ANTHRACENE	S	SB	0/1	0 00	0 00	3/16	48 00	340 00	306 69	DSY-S-MW05-2224
BENZ(A)PYRENE	S	SB	0/1	0 00	0 00	4/16	47 00	280 00	290 25	DSY-S-MW05-2224
BENZ(O,B)FLUORANTHENE	S	SB	0/1	0 00	0 00	4/16	65 00	395 00	302 56	DSY-S-MW05-2224
BENZO(G,H,I)PERYLENE	S	SB	0/1	0 00	0 00	2/16	61 00	195 00	302 56	DSY-S-MW05-2224
BENZO(K)FLUORANTHENE	S	SB	0/1	0 00	0 00	2/16	65 00	195 00	305 94	DSY-S-MW05-2224
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	1/1	200 00	200 00	9/16	52 50	210 00	260 94	DSY-SB-09-1416
BUTYLBENZYLPHTHALATE	S	SB	0/1	0 00	0 00	1/16	48 00	48 00	303 47	DSY-SB-09-1416
CARBAZOLE	S	SB	0/1	0 00	0 00	1/16	52 00	52 00	306 38	DSY-S-MW05-2224
CHRYSENE	S	SB	0/1	0 00	0 00	4/16	51 00	325 00	298 09	DSY-S-MW05-2224
FLUORANTHENE	S	SB	0/1	0 00	0 00	4/16	49 00	550 00	317 91	DSY-S-MW05-2224
FLUORENE	S	SB	0/1	0 00	0 00	1/16	52 00	52 00	306 38	DSY-S-MW05-2224
INDENO(1,2,3-CD)PYRENE	S	SB	0/1	0 00	0 00	1/16	210 00	210 00	318 25	DSY-S-MW05-2224
NAPHTHALENE	S	SB	0/1	0 00	0 00	1/16	49 00	49 00	305 41	DSY-S-MW07-0810
PHENANTHRENE	S	SB	0/1	0 00	0 00	4/16	48 00	365 00	303 81	DSY-S-MW05-2224
PYRENE	S	SB	0/1	0 00	0 00	4/16	43 50	530 00	318 81	DSY-S-MW05-2224
TETRABUTYL TIN	S	SB	0/1	0 00	0 00	1/16	25 15	25 15	24 81	DSY-S-TP13-0506
TIN	S	SB	0/0	0 00	0 00	1/26	8 90	8 90	4 36	DSY-SB-01-0911
TPH	S	SB	0/1	0 00	0 00	6/16	56 00	17000 00	1370 50	DSY-SB-09-1416
TRIBUTYL TIN	S	SB	0/1	0 00	0 00	1/16	11 02	11 02	23 91	DSY-S-MW05-1012
2-BUTANONE	V	SB	1/1	3 00	3 00	6/16	2 00	22 00	7 78	DSY-S-TP13-0506
ACETONE	V	SB	1/1	4 00	4 00	16/16	7 00	98 50	28 95	DSY-S-TP13-0506
CARBON DISULFIDE	V	SB	0/1	0 00	0 00	1/16	4 00	4 00	5 66	DSY-S-MW07-2224
METHYLENE CHLORIDE	V	SB	0/0	0 00	0 00	16/16	6 00	34 00	16 91	DSY-S-MW05-4446
TOLUENE	V	SB	0/1	0 00	0 00	1/16	1 00	1 00	5 47	DSY-SB-09-1416

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-7
OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SUBSURFACE SOIL - SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	LOCATION OF MAXIMUM
ALUMINUM	M	SB	1/1	11700 00	11700 00	11/11	5730 00	14900 00	9463 64	DSY-S-TP06-0507
ARSENIC	M	SB	1/1	38 50	38 50	10/11	6 80	23 20	12 89	DSY-S-TP05-1213
BARIUM	M	SB	0/0	0 00	0 00	11/11	2 90	18 00	13 01	DSY-S-TP02-1516
BERYLLIUM	M	SB	0/0	0 00	0 00	10/11	0 21	0 50	0 33	DSY-S-TP05-0507
CADMIUM	M	SB	1/1	1 50	1 50	1/11	0 56	0 56	0 31	DSY-S-TP06-1213
CALCIUM	M	SB	0/0	0 00	0 00	11/11	812 00	3490 00	1414 82	DSY-S-TP02-1516
CHROMIUM	M	SB	1/1	15 20	15 20	11/11	6 60	19 30	12 27	DSY-S-TP06-0507
COBALT	M	SB	1/1	16 60	16 60	11/11	4 40	29 90	11 80	DSY-S-TP05-1213
COPPER	M	SB	1/1	19 40	19 40	11/11	7 00	52 50	22 39	DSY-S-TP03-0608
IRON	M	SB	1/1	37100 00	37100 00	11/11	16100 00	37000 00	24318 18	DSY-S-TP06-0507
LEAD	M	SB	1/1	6 60	6 60	11/11	5 50	52 30	21 84	DSY-S-TP04-0607
MAGNESIUM	M	SB	1/1	3980 00	3980 00	11/11	1950 00	4820 00	2960 91	DSY-S-TP06-0507
MANGANESE	M	SB	1/1	746 00	746 00	11/11	104 00	800 00	365 55	DSY-S-TP05-1213
MERCURY	M	SB	0/1	0 00	0 00	7/11	0 02	0 12	0 06	DSY-S-TP03-0608
NICKEL	M	SB	1/1	28 90	28 90	11/11	10 70	30 90	20 47	DSY-S-TP05-1213
POTASSIUM	M	SB	0/0	0 00	0 00	11/11	121 00	365 00	268 00	DSY-S-TP05-1213
SELENIUM	M	SB	0/1	0 00	0 00	3/11	0 85	2 60	0 67	DSY-S-TP03-0305
SILVER	M	SB	0/1	0 00	0 00	1/11	1 20	1 20	0 62	DSY-S-TP06-0507
SODIUM	M	SB	0/0	0 00	0 00	10/11	9 00	412 00	119 49	DSY-S-TP03-0608
VANADIUM	M	SB	1/1	20 60	20 60	11/11	9 00	23 80	14 92	DSY-S-TP05-0507
ZINC	M	SB	1/1	68 60	68 60	11/11	52 50	74 80	62 84	DSY-S-TP02-1516
4,4'-DDE	P	SB	0/1	0 00	0 00	1/3	6 50	6 50	3 38	DSY-S-TP05-0507
4,4'-DDT	P	SB	0/1	0 00	0 00	2/3	7 00	7 40	5 40	DSY-S-TP03-0608
HEPTACHLOR	P	SB	0/1	0 00	0 00	1/3	2 10	2 10	1 33	DSY-S-TP05-0507
2-METHYLNAPHTHALENE	S	SB	0/1	0 00	0 00	1/3	50 00	50 00	693 33	DSY-S-TP05-0507
BENZ(A)ANTHRACENE	S	SB	0/1	0 00	0 00	1/3	91 00	91 00	707 00	DSY-S-TP05-0507
BENZO(A)PYRENE	S	SB	0/1	0 00	0 00	1/3	79 00	79 00	703 00	DSY-S-TP05-0507
BENZO(B)FLUORANTHENE	S	SB	0/1	0 00	0 00	2/3	43 00	110 00	667 67	DSY-S-TP05-0507
BENZO(G,H,I)PERYLENE	S	SB	0/1	0 00	0 00	1/3	46 00	46 00	692 00	DSY-S-TP05-0507
BENZO(K)FLUORANTHENE	S	SB	0/1	0 00	0 00	1/3	78 00	78 00	702 67	DSY-S-TP05-0507
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	1/1	200 00	200 00	2/3	72 00	160 00	694 00	DSY-S-TP01-1112
CHRYSENE	S	SB	0/1	0 00	0 00	1/3	100 00	100 00	710 00	DSY-S-TP05-0507
FLUORANTHENE	S	SB	0/1	0 00	0 00	2/3	59 00	320 00	743 00	DSY-S-TP05-0507
INDENO(1,2,3-CD)PYRENE	S	SB	0/1	0 00	0 00	1/3	53 00	53 00	694 33	DSY-S-TP05-0507
PHENANTHRENE	S	SB	0/1	0 00	0 00	1/3	100 00	100 00	710 00	DSY-S-TP05-0507
PYRENE	S	SB	0/1	0 00	0 00	2/3	67 00	180 00	699 00	DSY-S-TP05-0507
TETRABUTYL TIN	S	SB	0/1	0 00	0 00	1/3	8 50	8 50	19 50	DSY-S-TP05-0507
TIN	S	SB	0/0	0 00	0 00	1/11	9 20	9 20	4 20	DSY-S-TP04-0607
TPH	S	SB	0/1	0 00	0 00	2/3	72 00	540 00	213 50	DSY-S-TP03-0608
2-BUTANONE	V	SB	1/1	3 00	3 00	1/3	7 00	7 00	6 17	DSY-S-TP05-0507
ACETONE	V	SB	1/1	4 00	4 00	3/3	10 00	44 00	23 00	DSY-S-TP05-0507
METHYLENE CHLORIDE	V	SB	0/0	0 00	0 00	3/3	11 00	28 00	17 33	DSY-S-TP03-0608

* UNITS FOR METALS (M) ARE IN MG/KG
 * UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-8
OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SUBSURFACE SOIL - BUILDING 234
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				LOCATION OF MAXIMUM
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	
ALUMINUM	M	SB	1/1	11700 00	11700 00	16/16	1690 00	23300 00	8987 50	DSY-S-TP09-0910
ARSENIC	M	SB	1/1	38 50	38 50	16/16	1 20	42 00	12 19	DSY-S-TP26-0406
BARIUM	M	SB	0/0	0 00	0 00	16/16	3 10	33 60	12 80	DSY-S-TP26-0910
BERYLLIUM	M	SB	0/0	0 00	0 00	11/16	0 20	0 67	0 28	DSY-S-TP08-0406
CADMIUM	M	SB	1/1	1 50	1 50	1/16	0 66	0 66	0 32	DSY-S-TP10-1213
CALCIUM	M	SB	0/0	0 00	0 00	16/16	322 00	5190 00	1297 25	DSY-S-MW09-3638
CHROMIUM	M	SB	1/1	15 20	15 20	16/16	2 20	60 20	18 47	DSY-SB-06-0204
COBALT	M	SB	1/1	16 60	16 60	16/16	1 10	25 00	10 65	DSY-S-TP09-0910
COPPER	M	SB	1/1	19 40	19 40	16/16	4 10	46 10	25 53	DSY-S-TP08-0406
IRON	M	SB	1/1	37100 00	37100 00	16/16	4060 00	50000 00	26188 25	DSY-S-TP09-0910
LEAD	M	SB	1/1	6 60	6 60	16/16	1 30	75 00	18 50	DSY-S-TP26-0406
MAGNESIUM	M	SB	1/1	3980 00	3980 00	16/16	534 00	8600 00	3596 19	DSY-S-TP09-0910
MANGANESE	M	SB	1/1	746 00	746 00	16/16	78 60	2450 00	449 96	DSY-S-TP09-0910
MERCURY	M	SB	0/1	0 00	0 00	1/16	0 06	0 06	0 03	DSY-S-TP26-0406
NICKEL	M	SB	1/1	28 90	28 90	16/16	2 30	48 10	22 79	DSY-S-TP09-0910
POTASSIUM	M	SB	0/0	0 00	0 00	16/16	108 00	593 00	297 03	DSY-S-MW09-2022
SELENIUM	M	SB	0/1	0 00	0 00	2/16	0 81	1 40	0 48	DSY-S-TP09-0406
SILVER	M	SB	0/1	0 00	0 00	1/16	1 60	1 60	0 68	DSY-S-TP09-0910
SODIUM	M	SB	0/0	0 00	0 00	16/16	14 50	353 00	62 07	DSY-S-TP08-0910
VANADIUM	M	SB	1/1	20 60	20 60	16/16	4 40	19 60	13 09	DSY-S-TP09-0406
ZINC	M	SB	1/1	68 60	68 60	16/16	10 00	158 00	61 56	DSY-S-TP08-0406
DECACHLOROBIPHENYL	P	SB	0/1	0 00	0 00	5/13	3 40	3 85	2 62	DSY-S-MW09-1012
HEPTACHLOR	P	SB	0/1	0 00	0 00	1/10	4 00	4 00	1 30	DSY-S-TP26-0305
2-METHYLNAPHTHALENE	S	SB	0/1	0 00	0 00	1/10	14000 00	14000 00	1735 75	DSY-S-TP26-0305
ANTHRACENE	S	SB	0/1	0 00	0 00	1/10	900 00	900 00	425 75	DSY-S-TP26-0305
BENZO(A)ANTHRACENE	S	SB	0/1	0 00	0 00	2/10	48 00	61 50	504 95	DSY-S-MW09-1012
BENZO(A)PYRENE	S	SB	0/1	0 00	0 00	2/10	41 50	55 00	503 65	DSY-S-TP08-0406
BENZO(B)FLUORANTHENE	S	SB	0/1	0 00	0 00	2/10	63 00	80 00	508 30	DSY-S-TP08-0406
BENZO(G,H,I)PERYLENE	S	SB	0/1	0 00	0 00	1/10	45 00	45 00	517 75	DSY-S-TP08-0406
BENZO(K)FLUORANTHENE	S	SB	0/1	0 00	0 00	1/10	68 00	68 00	520 05	DSY-S-TP08-0406
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	1/1	200 00	200 00	9/10	41 00	22000 00	2433 45	DSY-S-TP08-0910
CHRYSENE	S	SB	0/1	0 00	0 00	2/10	47 50	54 00	504 15	DSY-S-TP08-0406
DI-N-BUTYLPHTHALATE	S	SB	0/1	0 00	0 00	2/10	28 00	50 00	492 05	DSY-SB-04-0406
FLUORANTHENE	S	SB	0/1	0 00	0 00	3/10	100 00	130 00	512 00	DSY-S-MW09-1012
FLUORENE	S	SB	0/1	0 00	0 00	1/10	2100 00	2100 00	545 75	DSY-S-TP26-0305
INDENO(1,2,3-CD)PYRENE	S	SB	0/1	0 00	0 00	1/10	41 00	41 00	517 35	DSY-S-TP08-0406
NAPHTHALENE	S	SB	0/1	0 00	0 00	1/10	2200 00	2200 00	555 75	DSY-S-TP26-0305
PHENANTHRENE	S	SB	0/1	0 00	0 00	4/10	51 00	4800 00	780 55	DSY-S-TP26-0305
PYRENE	S	SB	0/1	0 00	0 00	4/10	87 00	460 00	358 10	DSY-S-TP26-0305
TETRABUTYL TIN	S	SB	0/1	0 00	0 00	1/10	4 60	4 60	22 84	DSY-S-TP08-0910
TPH	S	SB	0/1	0 00	0 00	3/10	54 25	2200 00	299 38	DSY-S-TP26-0305
1,2-DICHLOROETHENE (TOTAL)	V	SB	0/1	0 00	0 00	2/10	1 00	3 00	9 90	DSY-S-MW08-0810
2-BUTANONE	V	SB	1/1	3 00	3 00	4/10	9 00	15 00	8 05	DSY-S-MW09-2022
ACETONE	V	SB	1/1	4 00	4 00	10/10	2 00	66 00	19 10	DSY-S-TP26-0305
BENZENE	V	SB	0/1	0 00	0 00	1/10	1 00	1 00	10 08	DSY-SB-06-0204
ETHYLBENZENE	V	SB	0/1	0 00	0 00	1/10	66 00	66 00	11 68	DSY-S-TP26-0305
METHYLENE CHLORIDE	V	SB	0/0	0 00	0 00	10/10	7 00	63 00	24 95	DSY-S-TP26-0305
TOLUENE	V	SB	0/1	0 00	0 00	1/10	1 00	1 00	10 08	DSY-SB-06-0204
TRICHLOROETHENE	V	SB	0/1	0 00	0 00	1/10	3 00	3 00	10 33	DSY-S-MW08-0810
XYLENE (TOTAL)	V	SB	0/1	0 00	0 00	1/10	150 00	150 00	20 08	DSY-S-TP26-0305

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-9
OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN GROUNDWATER - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	LOCATION OF MAXIMUM
ALUMINUM	M	GW	0/0	0.00	0.00	5/5	43.90	143.00	80.44	DSY-A-MW03-01
ARSENIC	M	GW	1/2	19.80	19.80	3/5	5.10	13.20	5.52	DSY-A-MW11-01
BARIUM	M	GW	0/0	0.00	0.00	5/5	11.10	44.40	23.20	DSY-A-MW02-01
CALCIUM	M	GW	2/2	34350.00	46900.00	5/5	22000.00	80200.00	47930.00	DSY-A-MW04-01
CHROMIUM	M	GW	0/0	0.00	0.00	1/5	7.30	7.30	3.86	DSY-A-MW11-01
COBALT	M	GW	0/0	0.00	0.00	2/5	4.50	4.50	2.70	DSY-A-MW11-01
COPPER	M	GW	0/1	0.00	0.00	1/5	5.60	5.60	3.12	DSY-A-MW03-01
IRON	M	GW	2/2	234.00	1880.00	5/5	134.00	414.00	255.63	DSY-A-MW11-01
LEAD	M	GW	1/2	14.60	14.60	1/5	3.20	3.20	1.04	DSY-A-MW03-01
MAGNESIUM	M	GW	2/2	7470.00	13350.00	5/5	6700.00	31600.00	17430.00	DSY-A-MW02-01
MANGANESE	M	GW	2/2	22.90	4300.00	5/5	24.95	373.00	224.79	DSY-A-MW11-01
NICKEL	M	GW	0/1	0.00	0.00	2/5	7.95	9.60	6.21	DSY-A-MW11-01
POTASSIUM	M	GW	0/0	0.00	0.00	5/5	1900.00	17100.00	8728.00	DSY-A-MW02-01
SODIUM	M	GW	2/2	32300.00	119000.00	5/5	29700.00	200000.00	88300.00	DSY-A-MW02-01
ZINC	M	GW	1/1	37.65	37.65	5/5	15.20	68.30	28.78	DSY-A-MW02-01
BIS(2-ETHYLHEXYL)PHTHALATE	S	GW	0/2	0.00	0.00	1/5	13.00	13.00	6.60	DSY-A-MW11-01
BUTYLBENZYLPHTHALATE	S	GW	0/2	0.00	0.00	1/5	2.00	2.00	4.40	DSY-A-MW11-01
1,2-DICHLOROETHENE (TOTAL)	V	GW	1/2	180.00	180.00	3/5	5.00	18.00	9.80	DSY-A-MW11-01
ACETONE	V	GW	0/2	0.00	0.00	2/5	7.50	40.00	12.50	DSY-A-MW12-01
METHYLENE CHLORIDE	V	GW	2/2	3.00	4.00	5/5	3.00	12.00	9.20	DSY-A-MW02-01
TRICHLOROETHENE	V	GW	0/2	0.00	0.00	2/5	16.00	32.50	12.70	DSY-A-MW03-01

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-10
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN GROUNDWATER - CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATI N - FORMER ROBERT E. DERECKT R SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES			LOCATION OF MAXIMUM	
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION			MEAN
ALUMINUM	M	GW	0/0	0 00	0 00	1/2	1240 00	1240 00	624 00	DSY-A-MW07-01
ARSENIC	M	GW	1/2	19 80	19 80	1/2	57 80	57 80	29 80	DSY-A-MW07-01
BARIUM	M	GW	0/0	0 00	0 00	2/2	49 10	51 70	50 40	DSY-A-MW07-01
CALCIUM	M	GW	2/2	34350 00	46900 00	2/2	14100 00	128000 00	70050 00	DSY-A-MW05-01
CHROMIUM	M	GW	0/0	0 00	0 00	1/2	12 80	12 80	7 80	DSY-A-MW07-01
COBALT	M	GW	0/0	0 00	0 00	2/2	3 90	4 50	4 20	DSY-A-MW07-01
IRON	M	GW	2/2	234 00	1880 00	2/2	1280 00	18400 00	9830 00	DSY-A-MW07-01
LEAD	M	GW	1/2	14 60	14 60	1/2	1 80	1 80	1 15	DSY-A-MW07-01
MAGNESIUM	M	GW	2/2	7470 00	13350 00	2/2	5430 00	40000 00	22715 00	DSY-A-MW05-01
MANGANESE	M	GW	2/2	22 90	4300 00	2/2	753 00	1380 00	1058 50	DSY-A-MW05-01
NICKEL	M	GW	0/1	0 00	0 00	2/2	10 30	11 30	10 80	DSY-A-MW07-01
POTASSIUM	M	GW	0/0	0 00	0 00	2/2	2480 00	3570 00	3030 00	DSY-A-MW07-01
SODIUM	M	GW	2/2	32300 00	119000 00	2/2	142000 00	379000 00	260500 00	DSY-A-MW05-01
ZINC	M	GW	1/1	37 65	37 65	2/2	3 90	28 40	15 15	DSY-A-MW07-01
METHYLENE CHLORIDE	V	GW	2/2	3 00	4 00	2/2	8 00	10 00	9 00	DSY-A-MW07-01

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-11
 OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN ROUNDWATER - BUILDING 234
 SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	BACKGROUND SAMPLES			SITE SAMPLES				
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION		MEAN	LOCATION OF MAXIMUM
ALUMINUM	M	GW	0/0	0.00	0.00	2/2	102.00	1010.00	556.00	DSY-A-MW09-01
ARSENIC	M	GW	1/2	19.80	19.80	1/2	15.60	15.60	8.80	DSY-A-MW08-01
BARIUM	M	GW	0/0	0.00	0.00	2/2	33.90	99.30	66.60	DSY-A-MW09-01
CALCIUM	M	GW	2/2	34350.00	46900.00	2/2	28400.00	42000.00	35200.00	DSY-A-MW09-01
CHROMIUM	M	GW	0/0	0.00	0.00	2/2	30.30	57.60	43.95	DSY-A-MW09-01
COBALT	M	GW	0/0	0.00	0.00	2/2	7.80	18.50	13.15	DSY-A-MW08-01
COPPER	M	GW	0/1	0.00	0.00	1/2	5.90	5.90	4.20	DSY-A-MW09-01
IRON	M	GW	2/2	234.00	1880.00	2/2	2600.00	5660.00	4130.00	DSY-A-MW08-01
MAGNESIUM	M	GW	2/2	7470.00	13350.00	2/2	6530.00	12800.00	9665.00	DSY-A-MW09-01
MANGANESE	M	GW	2/2	22.90	4300.00	2/2	830.00	3410.00	2120.00	DSY-A-MW08-01
NICKEL	M	GW	0/1	0.00	0.00	2/2	18.40	34.60	26.50	DSY-A-MW09-01
POTASSIUM	M	GW	0/0	0.00	0.00	2/2	3990.00	7650.00	5820.00	DSY-A-MW09-01
SODIUM	M	GW	2/2	32300.00	119000.00	2/2	45000.00	103000.00	74000.00	DSY-A-MW09-01
ZINC	M	GW	1/1	37.65	37.65	2/2	22.40	33.60	28.00	DSY-A-MW08-01
BIS(2-ETHYLHEXYL)PHTHALATE	S	GW	0/2	0.00	0.00	1/2	1.00	1.00	3.00	DSY-A-MW09-01
1,2-DICHLOROETHENE (TOTAL)	V	GW	1/2	180.00	180.00	1/2	13.00	13.00	9.00	DSY-A-MW08-01
METHYLENE CHLORIDE	V	GW	2/2	3.00	4.00	2/2	11.00	11.00	11.00	DSY-A-MW09-01
TRICHLOROETHENE	V	GW	0/2	0.00	0.00	2/2	3.00	4.00	3.50	DSY-A-MW08-01

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-12
SELECTION OF COPCS IN SURFACE SOILS - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATI N - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SURFACE SOILS							
ALUMINUM	M	SS	3440 00	9100 00	78000 00	6212 98	NO
ARSENIC	M	SS	2 60	10 90	0 43	5 63	YES
BARIUM	M	SS	4 10	49 40	5500 00	18 94	NO
BERYLLIUM	M	SS	0 16	1 10	0 15	0 35	YES
CADMIUM	M	SS	0 85	0 85	39 00	0 38	NO
CALCIUM	M	SS	112 55	1780 00	0 00	671 23	NO
CHROMIUM	M	SS	5 20	24 10	78000 00	10 73	NO
COBALT	M	SS	2 60	14 70	4700 00	9 13	NO
COPPER	M	SS	3 10	111 00	3100 00	31 62	NO
IRON	M	SS	11200 00	19600 00	23000 00	16480 48	NO
LEAD	M	SS	2 30	115 00	0 00	34 85	NO
MAGNESIUM	M	SS	1350 00	2570 00	0 00	2085 86	NO
MANGANESE	M	SS	81 40	376 00	1800 00	305 16	NO
MERCURY	M	SS	0 04	0 17	23 00	0 06	NO
NICKEL	M	SS	8 20	68 50	1600 00	21 87	NO
POTASSIUM	M	SS	198 00	711 00	0 00	382 63	NO
SELENIUM	M	SS	0 50	1 00	390 00	0 62	NO
SODIUM	M	SS	11 70	172 00	0 00	54 43	NO
VANADIUM	M	SS	6 50	39 00	550 00	14 91	NO
ZINC	M	SS	22 80	883 00	23000 00	184 99	NO
4,4'-DDE	P	SS	22 00	22 00	1900 00	5 23	NO
4,4'-DDT	P	SS	63 00	63 00	1900 00	12 29	NO
ALPHA-CHLORDANE	P	SS	2 00	7 30	490 00	2 08	NO
AROCLOR-1260	P	SS	24 00	24 00	83 00	18 64	NO
DIELDRIN	P	SS	16 00	16 00	40 00	4 19	NO
ENDRIN	P	SS	5 70	26 00	23000 00	6 15	NO
GAMMA-CHLORDANE	P	SS	2 40	2 40	490 00	1 17	NO
HEPTACHLOR EPOXIDE	P	SS	4 20	4 20	70 00	1 47	NO
2,2'-OXYBIS(1-CHLOROPROPANE	S	SS	39 00	39 00	9100 00	39 00	NO
BENZ(A)ANTHRACENE	S	SS	710 00	710 00	880 00	710 00	NO
BENZO(A)PYRENE	S	SS	680 00	680 00	88 00	680 00	YES
BENZO(B)FLUORANTHENE	S	SS	1000 00	1000 00	880 00	1000 00	YES
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	34 00	1500 00	46000 00	1205 44	NO
CHRYSENE	S	SS	690 00	690 00	88000 00	690 00	NO
FLUORANTHENE	S	SS	1400 00	1400 00	3100000 00	1263 30	NO
HEXACHLOROETHANE	S	SS	55 00	55 00	46000 00	55 00	NO
INDENO(1,2,3-CD)PYRENE	S	SS	520 00	520 00	880 00	520 00	NO
PHENANTHRENE	S	SS	730 00	730 00	0 00	730 00	NO
PHENOL	S	SS	170 00	170 00	47000000 00	170 00	NO
PYRENE	S	SS	1300 00	1400 00	2300000 00	502 15	NO
TIN	S	SS	12 20	12 20	47000 00	5 23	NO
2-BUTANONE	V	SS	2 00	10 00	47000000 00	6 50	NO
ACETONE	V	SS	5 00	115 00	7800000 00	65 75	N
METHYLENE CHLORIDE	V	SS	3 00	21 00	85000 00	13 01	N
TOLUENE	V	SS	1 00	4 00	16000000 00	4 00	NO

* UNITS FOR METALS (M) ARE IN MG/KG

COPC DER XLS4 17 PM1/22/97 * UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-13
SELECTION OF COPCS IN SUBSURFACE SOILS - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SUBSURFACE SOILS							
ALUMINUM	M	SB	2430.00	18200.00	78000.00	7941.47	NO
ARSENIC	M	SB	2.70	16.60	0.43	7.15	YES
BARIUM	M	SB	2.10	26.20	5500.00	9.84	NO
BERYLLIUM	M	SB	0.16	0.35	0.15	0.22	YES
CADMIUM	M	SB	0.60	1.10	39.00	0.43	NO
CALCIUM	M	SB	309.00	3480.00	0.00	1042.69	NO
CHROMIUM	M	SB	2.20	27.10	78000.00	11.84	NO
COBALT	M	SB	2.60	19.80	4700.00	8.86	NO
COPPER	M	SB	4.10	30.90	3100.00	17.31	NO
IRON	M	SB	6970.00	43100.00	23000.00	20931.20	NO
LEAD	M	SB	1.60	29.20	0.00	8.21	NO
MAGNESIUM	M	SB	921.00	7680.00	0.00	2942.09	NO
MANGANESE	M	SB	55.40	549.00	1800.00	247.25	NO
MERCURY	M	SB	0.04	0.23	23.00	0.08	NO
NICKEL	M	SB	5.10	39.50	1600.00	16.93	NO
POTASSIUM	M	SB	132.00	1190.00	0.00	364.60	NO
SELENIUM	M	SB	0.60	1.30	390.00	0.62	NO
SODIUM	M	SB	16.80	147.00	0.00	54.57	NO
VANADIUM	M	SB	4.30	21.35	550.00	11.89	NO
ZINC	M	SB	13.60	73.40	23000.00	39.60	NO
ALDRIN	P	SB	4.40	4.40	38.00	1.51	NO
ALPHA-CHLORDANE	P	SB	2.10	2.10	490.00	1.14	NO
ENDRIN	P	SB	15.00	15.00	23000.00	3.99	NO
GAMMA-CHLORDANE	P	SB	2.10	2.10	490.00	1.14	NO
HEPTACHLOR	P	SB	1.65	3.80	140.00	1.84	NO
BENZ(A)ANTHRACENE	S	SB	53.00	53.00	880.00	53.00	NO
BENZO(A)PYRENE	S	SB	44.00	44.00	88.00	44.00	NO
BENZO(B)FLUORANTHENE	S	SB	71.00	71.00	880.00	71.00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	44.00	110.00	46000.00	110.00	NO
CHRYSENE	S	SB	44.00	44.00	88000.00	44.00	NO
FLUORANTHENE	S	SB	42.00	81.00	3100000.00	81.00	NO
PHENANTHRENE	S	SB	54.00	54.00	0.00	54.00	NO
PYRENE	S	SB	41.00	1600.00	2300000.00	409.63	NO
1,2-DICHLOROETHENE (TOTAL)	V	SB	3.00	3.00	700000.00	3.00	NO
2-BUTANONE	V	SB	4.00	9.75	47000000.00	9.75	NO
ACETONE	V	SB	4.00	255.00	7800000.00	69.61	NO
CARBON DISULFIDE	V	SB	2.00	2.00	7800000.00	2.00	NO
METHYLENE CHLORIDE	V	SB	6.00	29.50	85000.00	20.55	NO
TOLUENE	V	SB	2.00	2.00	16000000.00	2.00	NO
TRICHLOROETHENE	V	SB	1.00	4.00	58000.00	4.00	NO

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-14
SELECTION OF COPCS IN GROUNDWATER - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
			(ug/L)	(ug/L)	(ug/L)	(ug/L)	
WATER							
ALUMINUM	M	GW	43.90	143.00	37000.00	119.83	NO
ARSENIC	M	GW	5.10	13.20	0.05	13.20	YES
BARIUM	M	GW	11.10	44.40	2600.00	44.40	NO
CALCIUM	M	GW	22000.00	80200.00	0.00	80200.00	NO
CHROMIUM	M	GW	7.30	7.30	37000.00	6.56	NO
COBALT	M	GW	4.50	4.50	2200.00	4.50	NO
COPPER	M	GW	5.60	5.60	1500.00	4.96	NO
IRON	M	GW	134.00	414.00	11000.00	414.00	NO
LEAD	M	GW	3.20	3.20	0.00	3.20	NO
MAGNESIUM	M	GW	6700.00	31600.00	0.00	31600.00	NO
MANGANESE	M	GW	24.95	373.00	840.00	373.00	NO
NICKEL	M	GW	7.95	9.60	730.00	9.60	NO
POTASSIUM	M	GW	1900.00	17100.00	0.00	17100.00	NO
SODIUM	M	GW	29700.00	200000.00	0.00	200000.00	NO
ZINC	M	GW	15.20	68.30	11000.00	68.30	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	GW	13.00	13.00	4.80	11.88	YES
1,2-DICHLOROETHENE (TOTAL)	V	GW	5.00	18.00	55.00	18.00	NO
ACETONE	V	GW	7.50	40.00	3700.00	40.00	NO
METHYLENE CHLORIDE	V	GW	3.00	12.00	4.10	12.00	YES
TRICHLOROETHENE	V	GW	16.00	32.50	1.60	24.19	YES

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-15
SELECTION OF COPCS IN SURFACE SOILS - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SURFACE SOILS							
ALUMINUM	M	SS	5820 00	14400 00	78000 00	14400 00	NO
ARSENIC	M	SS	3 90	24 40	0 43	24 40	YES
BARIUM	M	SS	12 10	24 00	5500 00	20 46	NO
BERYLLIUM	M	SS	0 23	0 47	0 15	0 45	YES
CADMIUM	M	SS	0 75	1 20	39 00	1 20	NO
CALCIUM	M	SS	426 00	1230 00	0 00	1230 00	NO
CHROMIUM	M	SS	9 80	19 00	78000 00	18 40	NO
COBALT	M	SS	7 60	22 70	4700 00	17 54	NO
COPPER	M	SS	15 15	33 00	3100 00	31 69	NO
IRON	M	SS	18500 00	33662 00	23000 00	33662 00	YES
LEAD	M	SS	9 20	27 40	0 00	26 09	NO
MAGNESIUM	M	SS	2310 00	4740 00	0 00	4273 54	NO
MANGANESE	M	SS	297 50	619 00	1800 00	486 55	NO
MERCURY	M	SS	0 08	0 16	23 00	0 16	NO
NICKEL	M	SS	14 90	27 70	1600 00	27 70	NO
POTASSIUM	M	SS	241 00	606 00	0 00	422 69	NO
SELENIUM	M	SS	0 75	1 20	390 00	0 80	NO
SODIUM	M	SS	22 60	87 90	0 00	81 01	NO
VANADIUM	M	SS	8 75	21 80	550 00	20 89	NO
ZINC	M	SS	33 35	123 00	23000 00	96 97	NO
4,4'-DDD	P	SS	4 30	4 30	2700 00	4 30	NO
4,4'-DDT	P	SS	6 20	6 20	1900 00	6 20	NO
AROCOR-1260	P	SS	32 00	59000 00	83 00	21360 15	YES
DECACHLOROBIPHENYL	P	SS	3 60	3 60	83 00	3 60	NO
DIELDRIN	P	SS	470 00	470 00	40 00	171 20	YES
ENDRIN KETONE	P	SS	1100 00	1100 00	23000 00	399 14	NO
METHOXYCHLOR	P	SS	2300 00	2300 00	390000 00	838 07	NO
2,2'-OXYBIS(1-CHLOROPROPAN	S	SS	180 00	410 00	9100 00	410 00	NO
2,4-DIMETHYLPHENOL	S	SS	320 00	320 00	1600000 00	320 00	NO
2-CHLOROPHENOL	S	SS	40 00	40 00	390000 00	40 00	NO
2-METHYLPHENOL	S	SS	560 00	560 00	3900000 00	560 00	NO
4-METHYLPHENOL	S	SS	2400 00	2400 00	390000 00	2400 00	NO
ACENAPHTHENE	S	SS	92 00	92 00	4700000 00	92 00	NO
ANTHRACENE	S	SS	130 00	130 00	23000000 00	130 00	NO
BENZ(A)ANTHRACENE	S	SS	130 00	410 00	880 00	410 00	NO
BENZO(A)PYRENE	S	SS	86 00	120 00	88 00	120 00	YES
BENZO(B)FLUORANTHENE	S	SS	180 00	410 00	880 00	410 00	NO
BENZO(G,H,I)PERYLENE	S	SS	56 00	110 00	0 00	110 00	NO
BENZO(K)FLUORANTHENE	S	SS	86 00	360 00	8800 00	360 00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	37 00	57 00	46000 00	57 00	NO
CARBAZOLE	S	SS	97 00	97 00	32000 00	97 00	NO
CHRYSENE	S	SS	130 00	420 00	88000 00	420 00	NO
FLUORANTHENE	S	SS	270 00	870 00	3100000 00	870 00	NO
FLUORENE	S	SS	65 00	65 00	3100000 00	65 00	NO
INDENO(1,2,3-CD)PYRENE	S	SS	71 00	150 00	880 00	150 00	NO
PHENANTHRENE	S	SS	120 00	580 00	0 00	580 00	NO
PHENOL	S	SS	5500 00	5500 00	47000000 00	3159 60	NO
PYRENE	S	SS	230 00	740 00	2300000 00	740 00	NO
2-BUTANONE	V	SS	2 00	2 00	47000000 00	2 00	NO
ACETONE	V	SS	6 00	12 00	7800000 00	9 04	NO
METHYLENE CHLORIDE	V	SS	6 00	30 00	85000 00	18 19	NO

* UNITS FOR METALS (M) ARE IN MG/KG

TABLE 6-18
SELECTION OF COPCS IN SUBSURFACE SOILS - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SUBSURFACE SOILS							
ALUMINUM	M	SB	5800 00	19900 00	78000 00	11373 78	NO
ARSENIC	M	SB	3 90	37 30	0 43	17 93	YES
BARIUM	M	SB	4 10	24 55	5500 00	16 50	NO
BERYLLIUM	M	SB	0 22	0 54	0 15	0 43	YES
CADMIUM	M	SB	0 49	1 50	39 00	0 95	NO
CALCIUM	M	SB	363 00	3630 00	0 00	1276 21	NO
CHROMIUM	M	SB	6 30	25 60	78000 00	13 52	NO
COBALT	M	SB	4 60	24 70	4700 00	13 89	NO
COPPER	M	SB	5 90	31 10	3100 00	20 90	NO
IRON	M	SB	14500 00	43800 00	23000 00	29505 41	YES
LEAD	M	SB	2 60	55 55	0 00	20 42	NO
MAGNESIUM	M	SB	2105 00	7130 00	0 00	3696 56	NO
MANGANESE	M	SB	92 50	727 00	1800 00	453 20	NO
MERCURY	M	SB	0 06	0 12	23 00	0 06	NO
NICKEL	M	SB	11 50	39 70	1600 00	22 94	NO
POTASSIUM	M	SB	116 00	566 00	0 00	361 84	NO
SELENIUM	M	SB	0 83	0 89	390 00	0 52	NO
SILVER	M	SB	1 60	1 70	390 00	0 81	NO
SODIUM	M	SB	18 25	228 00	0 00	76 21	NO
VANADIUM	M	SB	8 90	25 25	550 00	17 33	NO
ZINC	M	SB	28 00	82 50	23000 00	55 82	NO
4,4'-DDD	P	SB	7 40	115 90	2700 00	23 69	NO
4,4'-DDE	P	SB	6 40	9 40	1900 00	3 69	NO
4,4'-DDT	P	SB	23 40	55 90	1900 00	12 95	NO
ALPHA-CHLORDANE	P	SB	4 93	4 93	490 00	1 72	NO
AROCLOR-1260	P	SB	13 00	13 00	83 00	13 00	NO
DECACHLOROBIPHENYL	P	SB	3 40	3 80	83 00	2 57	NO
ENDRIN	P	SB	5 50	5 50	23000 00	2 64	NO
GAMMA-CHLORDANE	P	SB	3 63	3 63	490 00	1 50	NO
HEPTACHLOR EPOXIDE	P	SB	1 78	1 78	70 00	1 19	NO
2-METHYLNAPHTHALENE	S	SB	280 00	280 00	0 00	280 00	NO
ACENAPHTHENE	S	SB	37 00	37 00	4700000 00	37 00	NO
ANTHRACENE	S	SB	92 00	92 00	23000000 00	92 00	NO
BENZ(A)ANTHRACENE	S	SB	48 00	340 00	880 00	340 00	NO
BENZO(A)PYRENE	S	SB	47 00	280 00	88 00	280 00	YES
BENZO(B)FLUORANTHENE	S	SB	65 00	395 00	880 00	395 00	NO
BENZO(G,H,I)PERYLENE	S	SB	61 00	195 00	0 00	195 00	NO
BENZO(K)FLUORANTHENE	S	SB	65 00	195 00	8800 00	195 00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	52 50	210 00	46000 00	210 00	NO
CARBAZOLE	S	SB	52 00	52 00	32000 00	52 00	NO
CHRYSENE	S	SB	51 00	325 00	88000 00	325 00	NO
FLUORANTHENE	S	SB	49 00	550 00	3100000 00	519 92	NO
FLUORENE	S	SB	52 00	52 00	3100000 00	52 00	NO
INDENO(1,2,3-CD)PYRENE	S	SB	210 00	210 00	880 00	210 00	NO
NAPHTHALENE	S	SB	49 00	49 00	3100000 00	49 00	NO
PHENANTHRENE	S	SB	48 00	365 00	0 00	365 00	NO
PYRENE	S	SB	43 50	530 00	2300000 00	520 21	NO
TIN	S	SB	8 90	8 90	47000 00	4 70	NO
2-BUTANONE	V	SB	2 00	22 00	47000000 00	10 08	NO
ACETONE	V	SB	7 00	98 50	7800000 00	39 68	NO
CARBON DISULFIDE	V	SB	4 00	4 00	7800000 00	4 00	NO
METHYLENE CHLORIDE	V	SB	6 00	34 00	85000 00	21 20	NO
TOLUENE	V	SB	1 00	1 00	1600000 00	1 00	NO

* UNITS FOR METALS (M) ARE IN MG/KG

TABLE 6-17
SELECTION OF COPCS IN ROUNDWATER - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
WATER			(ug/L)	(ug/L)	(ug/L)	(ug/L)	
ALUMINUM	M	GW	1240.00	1240.00	37000.00	1240.00	NO
ARSENIC	M	GW	57.60	57.60	0.05	57.60	YES
BARIUM	M	GW	49.10	51.70	2600.00	51.70	NO
CALCIUM	M	GW	14100.00	126000.00	0.00	126000.00	NO
CHROMIUM	M	GW	12.80	12.80	37000.00	12.80	NO
COBALT	M	GW	3.90	4.50	2200.00	4.50	NO
IRON	M	GW	1260.00	18400.00	11000.00	18400.00	YES
LEAD	M	GW	1.80	1.80	0.00	1.80	NO
MAGNESIUM	M	GW	5430.00	40000.00	0.00	40000.00	NO
MANGANESE	M	GW	753.00	1360.00	840.00	1360.00	YES
NICKEL	M	GW	10.30	11.30	730.00	11.30	NO
POTASSIUM	M	GW	2490.00	3570.00	0.00	3570.00	NO
SODIUM	M	GW	142000.00	379000.00	0.00	379000.00	NO
ZINC	M	GW	3.90	26.40	11000.00	26.40	NO
METHYLENE CHLORIDE	V	GW	8.00	10.00	4.10	10.00	YES

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-18
SELECTION OF COPCS IN SURFACE SOILS - SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SURFACE SOILS							
ALUMINUM	M	SS	6448.50	33300.00	78000.00	21062.43	NO
ARSENIC	M	SS	8.70	15.30	0.43	15.30	YES
BARIUM	M	SS	12.30	420.00	5500.00	224.96	NO
BERYLLIUM	M	SS	0.30	2.05	0.15	2.05	YES
CADMIUM	M	SS	0.48	0.48	39.00	0.39	NO
CALCIUM	M	SS	504.00	8780.00	0.00	5023.82	NO
CHROMIUM	M	SS	10.50	53.50	78000.00	48.20	NO
COBALT	M	SS	8.90	18.30	4700.00	15.99	NO
COPPER	M	SS	13.00	116.80	3100.00	116.80	NO
IRON	M	SS	19931.00	58100.00	23000.00	40722.98	YES
LEAD	M	SS	13.50	101.15	0.00	101.15	NO
MAGNESIUM	M	SS	2103.00	2730.00	0.00	2730.00	NO
MANGANESE	M	SS	274.00	423.00	1800.00	381.47	NO
MERCURY	M	SS	0.05	0.17	23.00	0.10	NO
NICKEL	M	SS	17.20	60.10	1600.00	60.10	NO
POTASSIUM	M	SS	291.00	4050.00	0.00	2221.71	NO
SELENIUM	M	SS	0.85	1.40	390.00	1.40	NO
SODIUM	M	SS	56.50	965.00	0.00	547.93	NO
VANADIUM	M	SS	9.00	52.70	550.00	33.73	NO
ZINC	M	SS	40.80	896.00	23000.00	896.00	NO
4,4'-DDE	P	SS	6.10	6.10	1900.00	3.92	NO
4,4'-DDT	P	SS	14.00	14.00	1900.00	7.89	NO
AROCLOR-1260	P	SS	15.00	25.00	83.00	20.91	NO
ANTHRACENE	S	SS	150.00	150.00	2300000.00	150.00	NO
BENZ(A)ANTHRACENE	S	SS	58.00	210.00	880.00	210.00	NO
BENZO(A)PYRENE	S	SS	46.00	180.00	88.00	180.00	YES
BENZO(B)FLUORANTHENE	S	SS	81.00	270.00	880.00	270.00	NO
BENZO(G,H,I)PERYLENE	S	SS	42.00	55.00	0.00	55.00	NO
BENZO(K)FLUORANTHENE	S	SS	38.00	150.00	8800.00	150.00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	55.00	1100.00	46000.00	1100.00	NO
CHRYSENE	S	SS	53.00	230.00	88000.00	230.00	NO
FLUORANTHENE	S	SS	71.00	460.00	3100000.00	460.00	NO
INDENO(1,2,3-CD)PYRENE	S	SS	42.00	110.00	880.00	110.00	NO
PHENANTHRENE	S	SS	94.00	280.00	0.00	280.00	NO
PYRENE	S	SS	73.00	380.00	2300000.00	380.00	NO
TIN	S	SS	9.30	27.85	47000.00	16.64	NO
ACETONE	V	SS	6.00	25.00	7800000.00	24.09	NO
METHYLENE CHLORIDE	V	SS	10.00	43.00	85000.00	27.42	NO

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-19
SELECTION OF COPCS IN SUBSURFACE SOILS - SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - F RMER ROBERT E. DERECKT R SHIPYARD
NETC, NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SUBSURFACE SOILS							
ALUMINUM	M	SB	5730 00	14900 00	78000 00	11656 60	NO
ARSENIC	M	SB	6 80	23 20	0 43	23 20	YES
BARIIUM	M	SB	2 90	18 00	5500 00	18 00	NO
BERYLLIUM	M	SB	0 21	0 50	0 15	0 45	YES
CADMIUM	M	SB	0 56	0 56	39 00	0 36	NO
CALCIUM	M	SB	812 00	3490 00	0 00	1858 28	NO
CHROMIUM	M	SB	6 60	19 30	78000 00	14 91	NO
COBALT	M	SB	4 40	29 90	4700 00	15 56	NO
COPPER	M	SB	7 00	52 50	3100 00	28 44	NO
IRON	M	SB	16100 00	37000 00	23000 00	29341 18	YES
LEAD	M	SB	5 50	52 30	0 00	39 42	NO
MAGNESIUM	M	SB	1950 00	4820 00	0 00	3578 53	NO
MANGANESE	M	SB	104 00	800 00	1800 00	534 50	NO
MERCURY	M	SB	0 02	0 12	23 00	0 09	NO
NICKEL	M	SB	10 70	30 90	1600 00	25 07	NO
POTASSIUM	M	SB	121 00	365 00	0 00	330 02	NO
SELENIUM	M	SB	0 85	2 60	390 00	1 03	NO
SILVER	M	SB	1 20	1 20	390 00	0 73	NO
SODIUM	M	SB	9 00	412 00	0 00	199 00	NO
VANADIUM	M	SB	9 00	23 80	550 00	17 60	NO
ZINC	M	SB	52 50	74 80	23000 00	66 61	NO
4,4'-DDE	P	SB	6 50	6 50	1900 00	6 50	NO
4,4'-DDT	P	SB	7 00	7 40	1900 00	7 40	NO
HEPTACHLOR	P	SB	2 10	2 10	140 00	2 10	NO
2-METHYLNAPHTHALENE	S	SB	50 00	50 00	0 00	50 00	NO
BENZ(A)ANTHRACENE	S	SB	91 00	91 00	880 00	91 00	NO
BENZO(A)PYRENE	S	SB	79 00	79 00	88 00	79 00	NO
BENZO(B)FLUORANTHENE	S	SB	43 00	110 00	880 00	110 00	NO
BENZO(G,H,I)PERYLENE	S	SB	46 00	46 00	0 00	46 00	NO
BENZO(K)FLUORANTHENE	S	SB	78 00	78 00	8800 00	78 00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	72 00	160 00	46000 00	160 00	NO
CHRYSENE	S	SB	100 00	100 00	88000 00	100 00	NO
FLUORANTHENE	S	SB	59 00	320 00	3100000 00	320 00	NO
INDENO(1,2,3-CD)PYRENE	S	SB	53 00	53 00	880 00	53 00	NO
PHENANTHRENE	S	SB	100 00	100 00	0 00	100 00	NO
PYRENE	S	SB	67 00	180 00	2300000 00	180 00	NO
TIN	S	SB	9 20	9 20	47000 00	5 12	NO
2-BUTANONE	V	SB	7 00	7 00	47000000 00	7 00	NO
ACETONE	V	SB	10 00	44 00	7800000 00	44 00	NO
METHYLENE CHLORIDE	V	SB	11 00	28 00	85000 00	28 00	NO

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-20
SELECTION F COPCS IN SURFACE SOILS - BUILDING 234
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SURFACE SOILS							
ALUMINUM	M	SS	3810 00	11307 50	78000 00	11241 92	N
ARSENIC	M	SS	2 60	22 65	0 43	22 65	YES
BARIUM	M	SS	8 90	67 00	5500 00	37 07	N
BERYLLIUM	M	SS	0 18	3 50	0 15	1 33	YES
CADMIUM	M	SS	0 43	0 97	39 00	0 60	NO
CALCIUM	M	SS	521 00	2790 00	0 00	1459 17	NO
CHROMIUM	M	SS	6 40	40 20	78000 00	23 34	NO
COBALT	M	SS	3 30	23 90	4700 00	21 00	NO
COPPER	M	SS	12 90	262 00	3100 00	99 48	NO
IRON	M	SS	7770 00	35708 50	23000 00	34791 46	YES
LEAD	M	SS	5 30	189 00	0 00	80 31	NO
MAGNESIUM	M	SS	1170 00	3450 00	0 00	3247 35	NO
MANGANESE	M	SS	157 00	580 00	1800 00	479 84	NO
MERCURY	M	SS	0 07	0 09	23 00	0 05	N
NICKEL	M	SS	7 80	113 00	1600 00	49 32	NO
POTASSIUM	M	SS	227 00	585 50	0 00	442 38	NO
SODIUM	M	SS	23 80	163 00	0 00	81 33	N
VANADIUM	M	SS	6 80	23 20	550 00	19 78	NO
ZINC	M	SS	43 60	831 00	23000 00	333 52	N
4,4'-DDE	P	SS	3 10	3 10	1900 00	2 25	N
4,4'-DDT	P	SS	5 00	8 60	1900 00	4 83	N
AROCLOR-1254	P	SS	38 00	38 00	83 00	24 64	NO
AROCLOR-1260	P	SS	24 00	24 00	83 00	20 43	N
DECACHLOROBIPHENYL	P	SS	3 60	3 60	83 00	2 41	N
GAMMA-CHLORDANE	P	SS	3 90	3 90	490 00	1 88	NO
HEPTACHLOR	P	SS	4 50	4 50	140 00	2 07	NO
2-METHYLNAPHTHALENE	S	SS	50 00	66 00	0 00	66 00	NO
ACENAPHTHENE	S	SS	46 00	52 00	4700000 00	52 00	NO
ANTHRACENE	S	SS	51 00	110 00	23000000 00	110 00	NO
BENZ(A)ANTHRACENE	S	SS	50 00	470 00	880 00	447 65	NO
BENZO(A)PYRENE	S	SS	58 00	410 00	88 00	355 00	YES
BENZO(B)FLUORANTHENE	S	SS	41 00	660 00	880 00	660 00	N
BENZO(G,H,I)PERYLENE	S	SS	88 00	190 00	0 00	190 00	N
BENZO(K)FLUORANTHENE	S	SS	87 00	270 00	8800 00	270 00	N
BIS(2-ETHYLHEXYL)PHTHALATE	S	SS	130 00	8700 00	46000 00	3404 07	N
CARBAZOLE	S	SS	37 00	56 00	32000 00	56 00	N
CHRYSENE	S	SS	41 00	580 00	88000 00	580 00	NO
DIBENZ(A,H)ANTHRACENE	S	SS	62 00	62 00	88 00	62 00	NO
FLUORANTHENE	S	SS	75 00	770 00	3100000 00	770 00	NO
FLUORENE	S	SS	50 00	50 00	3100000 00	50 00	NO
INDENO(1,2,3-CD)PYRENE	S	SS	80 00	190 00	880 00	190 00	N
PHENANTHRENE	S	SS	41 50	420 00	0 00	420 00	N
PYRENE	S	SS	72 00	750 00	2300000 00	750 00	N
TIN	S	SS	40 60	40 60	47000 00	15 49	NO
2-BUTANONE	V	SS	3 00	10 00	47000000 00	6 81	NO
ACETONE	V	SS	5 00	28 00	7800000 00	27 02	N
METHYLENE CHLORIDE	V	SS	6 00	31 00	85000 00	19 89	NO
TOLUENE	V	SS	1 00	1 50	16000000 00	1 50	NO

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-21
SELECTION OF COPCS IN SUBSURFACE SOILS - BUILDIN 234
SITE ASSESSMENT SCREENING EVALUATION - R BERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RH DE ISLAND

CHEMICAL	ANALYTE TYPE*	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
SUBSURFACE SOILS							
ALUMINUM	M	SB	1690 00	23300 00	78000 00	16110 10	NO
ARSENIC	M	SB	1 20	42 00	0 43	16 62	YES
BARIIUM	M	SB	3 10	33 60	5500 00	16 66	NO
BERYLLIUM	M	SB	0 20	0 67	0 15	0 43	YES
CADMIUM	M	SB	0 66	0 66	39 00	0 36	NO
CALCIUM	M	SB	322 00	5190 00	0 00	1801 94	NO
CHROMIUM	M	SB	2 20	60 20	78000 00	24 31	NO
COBALT	M	SB	1 10	25 00	4700 00	19 04	NO
COPPER	M	SB	4 10	46 10	3100 00	41 46	NO
IRON	M	SB	4060 00	50000 00	23000 00	40365 68	YES
LEAD	M	SB	1 30	75 00	0 00	29 38	NO
MAGNESIUM	M	SB	534 00	8600 00	0 00	5925 05	NO
MANGANESE	M	SB	78 60	2450 00	1800 00	695 19	NO
MERCURY	M	SB	0 06	0 06	23 00	0 03	NO
NICKEL	M	SB	2 30	48 10	1600 00	39 72	NO
POTASSIUM	M	SB	108 00	593 00	0 00	377 59	NO
SELENIUM	M	SB	0 81	1 40	390 00	0 60	NO
SILVER	M	SB	1 60	1 60	390 00	0 77	NO
SODIUM	M	SB	14 50	353 00	0 00	98 93	NO
VANADIUM	M	SB	4 40	19 60	550 00	16 44	NO
ZINC	M	SB	10 00	158 00	23000 00	98 16	NO
DECACHLOROBIPHENYL	P	SB	3 40	3 85	83 00	3 06	NO
HEPTACHLOR	P	SB	4 00	4 00	140 00	1 85	NO
2-METHYLNAPHTHALENE	S	SB	14000 00	14000 00	0 00	4250 82	NO
ANTHRACENE	S	SB	900 00	900 00	23000000 00	734 01	NO
BENZ(A)ANTHRACENE	S	SB	48 00	61 50	880 00	61 50	NO
BENZO(A)PYRENE	S	SB	41 50	55 00	88 00	55 00	NO
BENZO(B)FLUORANTHENE	S	SB	63 00	80 00	880 00	80 00	NO
BENZO(G,H,I)PERYLENE	S	SB	45 00	45 00	0 00	45 00	NO
BENZO(K)FLUORANTHENE	S	SB	68 00	68 00	8800 00	68 00	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	SB	41 00	22000 00	46000 00	6421 50	NO
CHRYSENE	S	SB	47 50	54 00	88000 00	54 00	NO
FLUORANTHENE	S	SB	100 00	130 00	3100000 00	130 00	NO
FLUORENE	S	SB	2100 00	2100 00	3100000 00	976 92	NO
INDENO(1,2,3-CD)PYRENE	S	SB	41 00	41 00	880 00	41 00	NO
NAPHTHALENE	S	SB	2200 00	2200 00	3100000 00	1000 56	NO
PHENANTHRENE	S	SB	51 00	4800 00	0 00	1653 51	NO
PYRENE	S	SB	87 00	460 00	2300000 00	460 00	NO
1,2-DICHLOROETHENE (TOTAL)	V	SB	1 00	3 00	700000 00	3 00	NO
2-BUTANONE	V	SB	9 00	15 00	47000000 00	10 04	NO
ACETONE	V	SB	2 00	66 00	7800000 00	29 47	NO
BENZENE	V	SB	1 00	1 00	22000 00	1 00	NO
ETHYLBENZENE	V	SB	66 00	66 00	7800000 00	22 74	NO
METHYLENE CHLORIDE	V	SB	7 00	63 00	85000 00	46 16	NO
TOLUENE	V	SB	1 00	1 00	16000000 00	1 00	N
TRICHLOROETHENE	V	SB	3 00	3 00	58000 00	3 00	NO

* UNITS FOR METALS (M) ARE IN MG/KG

* UNITS FOR ORGANICS (S, V, P) ARE IN UG/KG

TABLE 6-22
SELECTION OF COPCS IN ROUNDWATER - BUILDING 234
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES		SCREENING VALUE	REPRESENTATIVE CONCENTRATION	SELECTED AS COPC
			RANGE OF DETECTED CONCENTRATION				
			(ug/L)	(ug/L)	(ug/L)	(ug/L)	
WATER							
ALUMINUM	M	GW	102.00	1010.00	37000.00	1010.00	NO
ARSENIC	M	GW	15.60	15.60	0.05	15.60	YES
BIARIUM	M	GW	33.90	99.30	2600.00	99.30	NO
CALCIUM	M	GW	28400.00	42000.00	0.00	42000.00	NO
CHROMIUM	M	GW	30.30	57.60	37000.00	57.60	NO
COBALT	M	GW	7.80	18.50	2200.00	18.50	NO
COPPER	M	GW	5.90	5.90	1500.00	5.90	NO
IRON	M	GW	2600.00	5660.00	11000.00	5660.00	NO
MAGNESIUM	M	GW	6530.00	12800.00	0.00	12800.00	NO
MANGANESE	M	GW	830.00	3410.00	840.00	3410.00	YES
NICKEL	M	GW	18.40	34.60	730.00	34.60	NO
POTASSIUM	M	GW	3990.00	7650.00	0.00	7650.00	NO
SODIUM	M	GW	45000.00	103000.00	0.00	103000.00	NO
ZINC	M	GW	22.40	33.60	11000.00	33.60	NO
BIS(2-ETHYLHEXYL)PHTHALATE	S	GW	1.00	1.00	4.80	1.00	NO
1,2-DICHLOROETHENE (TOTAL)	V	GW	13.00	13.00	55.00	13.00	NO
METHYLENE CHLORIDE	V	GW	11.00	11.00	4.10	11.00	YES
TRICHLOROETHENE	V	GW	3.00	4.00	1.60	4.00	YES

* UNITS FOR METALS (M) AND ORGANICS (S, V, P) ARE IN UG/L

TABLE 6-23

**DOSE-RESPONSE PARAMETERS - POTENTIAL CHEMICALS OF CONCERN
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND**

Substance	Fraction of COPC Absorbed in the Gastrointestinal Tract (unitless)**	Toxicity Values											
		Noncarcinogenic					Carcinogenic						
		RfD Oral (mg/kg)/day	Target Organ/Critical Effect***	RfD Dermal (mg/kg)/day	RfD Inhalation (mg/kg)/day	Target Organ/Critical Effect***	SF* Oral 1(mg/kg)/day	Tumor Type	Weight of Evidence	SF Dermal 1(mg/kg)/day	SF Inhalation 1(mg/kg)/day	Tumor Type	Weight of Evidence
INORGANICS													
Arsenic (total)	0.20	3.00E-04	S	6.0E-05	-	-	1.50E+00	Skin - humans	A	7.50E+00	1.51E+01	Lung - Occupational	A
Beryllium	0.20	5.00E-03	-	1.0E-03	-	-	4.30E+00	Various - rats	B2	-	8.40E+00	Lung - Occupational	B2
Iron	0.20	3.00E-01 E	L, P	6.0E-02	-	-	-	-	-	-	-	-	-
Manganese	0.20	2.30E-02	CNS	4.60E-03	1.43E-05	CNS	-	-	-	-	-	-	-
PESTICIDES/PCBs													
Aroclor 1260	0.50	-	S, H, RS	-	-	-	7.70E+00	Liver - rats	B2	1.54E+01	-	-	B2
Dieldrin	0.50	5.00E-05	RS	2.5E-05	-	-	1.6E+01	Liver - mice	B2	3.2E+01	1.6E+01	Various - mice/rats	B2
SEMIVOLATILE ORGANIC COMPOUNDS													
Benzo(a)pyrene	0.50	-	-	-	-	-	7.30E+00 E	Various - mice/rats	B2	1.46E+01	3.10E+00 W	Various - mice/rats	B2
Bis(2ethylhexylphthalate)	0.50	2.00E-02	L	1.00E-02	-	-	1.40E-02	Liver - mice	B2	2.8E-02	-	-	-
Benzo(b)fluoranthene	0.50	-	-	-	-	-	7.30E-01 E	Same as B(A)P	B2	1.46E+00	3.10E-01 E	Same as B(A)P	B2
VOLATILE ORGANIC COMPOUNDS													
Methylene Chloride	0.80	6.00E-02	L	4.80E-02	8.57E-01 H	L	7.5E-03	Liver - mice	B2	9.38E-03	1.64E-03	Liver, Lung	B2
Trichloroethene	0.80	6.00E-03	L, K	7.50E-03	-	-	1.1E-02 W	??	C-B2	1.38E-02	6.00E-03	Liver	C-B2

- = No dose-response value is available for this chemical in this classification

* = All toxicity values are from Integrated Risk Information System (IRIS) unless otherwise noted as

A = HEAST Alternative (EPA, 1995c)

E = EPA-NCEA Regional Support provisional service (EPA, 1995b)

H = Health Effects Assessment Summary Tables (HEAST)(EPA, 1995c)

W = Withdrawn from IRIS or HEAST

** = Modifying factor applied only to the dermal RfDs and SFs, from EPA (1995a)

***Target Organs are abbreviated as follows

B = Blood

C = Heart

CNS = Central Nervous System

K = Kidney

L = Liver

RS = Reproductive System

S = Skin

TABLE 6-24
EPA WEIGHT OF EVIDENCE CARCINOGENIC CLASSIFICATIONS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

EPA Category	Description of Group	Description of Evidence
Group A	Human carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer
Group B1	Probable human carcinogen	Limited evidence of carcinogenicity in humans from epidemiologic studies
Group B2	Probable human carcinogen	Sufficient evidence of carcinogenicity in animals; inadequate evidence of carcinogenicity in humans
Group C	Possible human carcinogen	Limited evidence of carcinogenicity in animals
Group D	Not classified	Inadequate evidence of carcinogenicity in animals
Group E	No evidence of carcinogenicity	No evidence for carcinogenicity in at least two adequate animal tests or in both epidemiological and animal studies

TABLE 6-25
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION,
DERMAL, AND INHALATION EXPOSURE TO SURFACE SOILS, INDUSTRIAL WORKER
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Industrial Worker	Units	Source
CS	Chemical Specific	mg/kg or µg/kg	Analysis
IR _{soil}	100	mg/day	USEPA, 1991a
FI	1.0	unitless	Assumption
CF _{inorganics}	1×10^{-6}	kg/mg	
CF _{organics}	1×10^{-9}	kg/µg	
EF	250	days/year	USEPA, 1991a
ED	25	years	USEPA, 1991a
ET	8	hours/day	Assumption
AT _{cancer}	70	years	USEPA, 1991a
AT _{non-cancer}	25	years	USEPA, 1991a
SA	2300*	cm ²	USEPA, 1992a
IR _{air}	0.833	m ³ /hour	USEPA, 1991a
BW	70	kg	USEPA, 1991a
AF	1	mg/cm ² per event	USEPA, 1995a
ABS _{dermal}	Chemical Specific	unitless	USEPA, 1995
CA	Chemical Specific	mg/m ³	Cowherd

*10% of total body surface

TABLE 6-26
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION, DERMAL, AND
INHALATION EXPOSURE TO SURFACE SOILS, ADOLESCENT AND ADULT TRESPASSERS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Adolescent	Adult	Units	Source
CS	Chemical Specific	Chemical Specific	mg/kg or µg/kg	Analysis
IR _{soil}	100	100	mg/day	USEPA, 1991a
FI	1.0	1.0	unitless	Assumption
CF _{inorganics}	1×10^{-6}	1×10^{-6}	kg/mg	
CF _{organics}	1×10^{-9}	1×10^{-9}	kg/µg	
EF	30	24	days/year	USEPA, 1991a
ED	11	19	years	USEPA, 1991a
ET	4	4	hours/day	Assumption
AT _{cancer}	70	70	years	USEPA, 1991a
AT _{non-cancer}	11	19	years	USEPA, 1991a
SA	Varies with Age	5750*	cm ²	USEPA, 1992a
IR _{air}	0.833	0.833	m ³ /hour	USEPA, 1991a
BW	40	70	kg	USEPA, 1991a
AF	1	1	mg/cm ² per event	USEPA, 1995a
ABS _{dermal}	Chemical Specific	Chemical Specific	unitless	USEPA, 1995
CA	Chemical Specific	Chemical Specific	mg/m ³	Cowherd

*25% of total body surface

TABLE 6-27
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION, DERMAL, AND
INHALATION EXPOSURE TO SURFACE SOILS, RESIDENTIAL CHILDREN AND ADULTS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Child (0-6 yrs)	Adult	Units	Source
CS	Chemical Specific	Chemical Specific	mg/kg or µg/kg	Analysis
IRsoil	200	100	mg/day	USEPA, 1991a
FI	1.0	1.0	unitless	Assumption
CF _{inorganics}	1×10^{-6}	1×10^{-6}	kg/mg	
CF _{organics}	1×10^{-9}	1×10^{-9}	kg/µg	
EF	350	350	days/year	USEPA, 1991a
ED	6	24	years	USEPA, 1991a
ET	16	16	hours/day	Assumption
AT _{cancer}	70	70	years	USEPA, 1991a
AT _{non-cancer}	6	24	years	USEPA, 1991a
SA	Varies with Age	5750*	cm ²	USEPA, 1992a
IR _{air}	0.833	0.833	m ³ /hour	USEPA, 1991a
BW	15	70	kg	USEPA, 1991a
AF	1	1	mg/cm ² per event	USEPA, 1995a
ABS _{dermal}	Chemical Specific	Chemical Specific	unitless	USEPA, 1995
CA	Chemical Specific	Chemical Specific	mg/m ³	Cowherd

*25% of total body surface

TABLE 6-28
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION, DERMAL,
AND INHALATION EXPOSURE TO SUBSURFACE SOIL, EXCAVATION WORKER
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Excavation Worker	Units	Source
CS	Chemical Specific	mg/kg or µg/kg	Analysis
IR _{soil}	480	mg/day	USEPA, 1991a
FI	1.0	unitless	Assumption
CF _{inorganics}	1×10^{-6}	kg/mg	
CF _{organics}	1×10^{-9}	kg/µg	
EF	30	days/year	USEPA, 1991a
ED	1	years	USEPA, 1991a
ET	8	hours/day	Assumption
AT _{cancer}	70	years	USEPA, 1991a
AT _{non-cancer}	1	years	USEPA, 1991a
SA	5750*	cm ²	USEPA, 1992a
IR _{air}	2.5	m ³ /hour	USEPA, 1991a
BW	70	kg	USEPA, 1991a
AF	1	mg/cm ² per event	USEPA, 1995a
ABS _{dermal}	Chemical Specific	unitless	USEPA, 1995a
CA	Chemical Specific	mg/m ³	Cowherd

*25% of total body surface

TABLE 6-29
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION
AND DERMAL EXPOSURE TO GROUNDWATER, INDUSTRIAL WORKER
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Industrial Worker	Units	Source
CW	Chemical Specific	µg/l	Analysis
IR _{groundwater}	0.5	liters/day	USEPA, 1988
CF1	0.001	mg/µg	
CF2	0.001	liters/cm ³	
EF	250	days/year	USEPA, 1991a
ED	25	years	USEPA, 1991a
AT _{cancer}	70	years	USEPA, 1991a
AT _{non-cancer}	25	years	USEPA, 1991a
SA	820*	cm ²	USEPA, 1989a
BW	70	kg	USEPA, 1991a
PC _{event} **	Chemical Specific	cm/event	USEPA, 1992a

*represents the hands of the industrial worker

TABLE 6-30
INPUT PARAMETERS FOR CALCULATING CHEMICAL INTAKE FROM INGESTION
AND DERMAL EXPOSURE TO GROUNDWATER, FUTURE RESIDENTS
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Parameter	Child (0-6 yrs)	Adult	Units	Source
CW	Chemical Specific	Chemical Specific	µg/l	Analysis
CA _{air}	-	Chemical Specific	ug/m ³	Andelman, 1985
IR _{groundwater}	1	2	liters/day	USEPA, 1988
CF1	0.001	0.001	mg/µg	
CF2	0.001	0.001	liters/cm ³	
EF	350	350	days/year	USEPA, 1991a
ET	-	0.2	hr/day	
ED	6	24	years	USEPA, 1991a
AT _{cancer}	70	70	years	USEPA, 1991a
AT _{non-cancer}	6	24	years	USEPA, 1991a
SA	Varies with Age	23000*	cm ²	USEPA, 1992a
BW	15	70	kg	USEPA, 1991a
PC _{event}	Chemical Specific	Chemical Specific	cm/event	USEPA, 1992a

*100% of total body surface

TABLE 6-31
 CUMULATIVE RISKS - CURRENT EXPOSURE - NORTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	NA	6.83E-07	8.65E-07	NA	9.36E-06
Dermal Contact	NA	3.87E-06	3.52E-06	NA	2.12E-05
Inhalation of Fugitive Dust	NA	4.46E-08	5.65E-08	NA	1.22E-06
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	4.60E-06	4.44E-06	NA	3.18E-05
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	NA	3.34E-09	4.55E-09	NA	8.56E-08
Dermal Contact	NA	3.14E-02	4.94E-02	NA	1.31E-01
Inhalation of Fugitive Dust	NA	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	3.14E-02	4.94E-02	NA	1.31E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values
 NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-32
 CUMULATIVE RISKS - CURRENT EXPOSURE - CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	NA	5.95E-06	7.54E-06	NA	8.16E-05
Dermal Contact	NA	4.33E-05	3.94E-05	NA	2.38E-04
Inhalation of Fugitive Dust	NA	6.60E-08	8.36E-08	NA	1.81E-06
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	4.94E-05	4.71E-05	NA	3.21E-04
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	NA	6.33E-08	8.19E-08	NA	1.70E-06
Dermal Contact	NA	7.76E-02	1.22E-01	NA	3.23E-01
Inhalation of Fugitive Dust	NA	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	7.76E-02	1.22E-01	NA	3.23E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-33
 CUMULATIVE RISKS - CURRENT EXPOSURE - SOUTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DEREKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	NA	8.43E-07	1.07E-06	NA	1.16E-05
Dermal Contact	NA	5.83E-06	5.31E-06	NA	3.20E-05
Inhalation of Fugitive Dust	NA	1.39E-08	1.76E-08	NA	3.80E-07
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	6.69E-06	6.39E-06	NA	4.39E-05
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	NA	6.05E-09	9.30E-09	NA	1.36E-07
Dermal Contact	NA	4.78E-02	7.51E-02	NA	1.99E-01
Inhalation of Fugitive Dust	NA	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	4.78E-02	7.51E-02	NA	1.99E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-34
 CUMULATIVE RISKS - CURRENT EXPOSURE - BUILDING 234
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DEREKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	NA	1.00E-06	1.27E-06	NA	1.37E-05
Dermal Contact	NA	8.86E-06	8.07E-06	NA	4.86E-05
Inhalation of Fugitive Dust	NA	2.78E-08	3.52E-08	NA	7.63E-07
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	9.89E-06	9.37E-06	NA	6.31E-05
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	NA	7.81E-09	1.16E-08	NA	1.83E-07
Dermal Contact	NA	6.85E-02	1.08E-01	NA	2.85E-01
Inhalation of Fugitive Dust	NA	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Groundwater					
Incidental Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Volatiles	NA	NA	NA	NA	NA
TOTAL	NA	6.85E-02	1.08E-01	NA	2.85E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-35
CUMULATIVE RISKS - FUTURE EXPOSURE - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	2.44E-05	3.98E-07	5.04E-07	NA	5.46E-06
Dermal Contact	9.36E-05	3.66E-06	3.33E-06	NA	2.01E-05
Inhalation of Fugitive Dust	6.88E-06	4.31E-08	5.46E-08	NA	1.18E-06
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	9.38E-08	NA
Dermal Contact	NA	NA	NA	1.66E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	7.46E-10	NA
Groundwater					
Incidental Ingestion	3.02E-04	NA	NA	NA	3.55E-05
Dermal Contact	1.17E-06	NA	NA	NA	2.30E-07
Inhalation of Volatiles	4.11E-04	NA	NA	NA	NA
TOTAL	8.39E-04	4.10E-06	3.89E-06	2.61E-07	6.24E-05
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	2.66E-07	1.69E-09	2.31E-09	NA	4.33E-08
Dermal Contact	3.68E-01	1.62E-02	2.55E-02	NA	6.75E-02
Inhalation of Fugitive Dust	*	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	1.35E-02	NA
Dermal Contact	NA	NA	NA	2.57E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
Groundwater					
Incidental Ingestion	3.12E+00	NA	NA	NA	2.39E-01
Dermal Contact	7.82E-03	NA	NA	NA	1.77E-04
Inhalation of Volatiles	4.39E-02	NA	NA	NA	NA
TOTAL	3.54E+00	1.62E-02	2.55E-02	3.92E-02	3.07E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-36
 CUMULATIVE RISKS - FUTURE EXPOSURE - CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	3.23E-04	5.27E-06	6.67E-06	NA	7.22E-05
Dermal Contact	9.87E-04	3.86E-05	3.51E-05	NA	2.12E-04
Inhalation of Fugitive Dust	9.61E-06	6.02E-08	7.63E-08	NA	1.65E-06
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	2.48E-07	NA
Dermal Contact	NA	NA	NA	4.55E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	7.76E-09	NA
Groundwater					
Incidental Ingestion	1.29E-03	NA	NA	NA	1.51E-04
Dermal Contact	4.28E-06	NA	NA	NA	1.24E-07
Inhalation of Volatiles	2.20E-05	NA	NA	NA	NA
TOTAL	2.63E-03	4.39E-05	4.19E-05	7.11E-07	4.37E-04
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	8.85E-06	5.57E-08	7.23E-08	NA	1.49E-06
Dermal Contact	1.75E+00	7.70E-02	1.21E-01	NA	3.21E-01
Inhalation of Fugitive Dust	*	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	8.92E-02	NA
Dermal Contact	NA	NA	NA	6.79E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
Groundwater					
Incidental Ingestion	2.00E+01	NA	NA	NA	1.53E+00
Dermal Contact	5.05E-02	NA	NA	NA	1.25E-03
Inhalation of Volatiles	3.66E-02	NA	NA	NA	NA
TOTAL	2.18E+01	7.70E-02	1.21E-01	1.57E-01	1.85E+00

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-37
 CUMULATIVE RISKS - FUTURE EXPOSURE - SOUTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DEREKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	5.18E-05	8.43E-07	1.07E-06	NA	1.16E-05
Dermal Contact	1.49E-04	5.83E-06	5.31E-06	NA	3.20E-05
Inhalation of Fugitive Dust	2.21E-06	1.39E-08	1.76E-08	NA	3.80E-07
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	2.96E-07	NA
Dermal Contact	NA	NA	NA	5.38E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	2.41E-09	NA
TOTAL	2.03E-04	6.69E-06	6.39E-06	8.36E-07	4.39E-05
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	9.26E-07	6.05E-09	9.30E-09	NA	1.36E-07
Dermal Contact	1.08E+00	4.78E-02	7.51E-02	NA	1.99E-01
Inhalation of Fugitive Dust	*	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	9.88E-02	NA
Dermal Contact	NA	NA	NA	8.68E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
TOTAL	1.08E+00	4.78E-02	7.51E-02	1.86E-01	1.99E-01

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values
 NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-38
 CUMULATIVE RISKS - FUTURE EXPOSURE - BUILDING 234
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DEREKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	6.62E-05	1.08E-06	1.37E-06	NA	1.48E-05
Dermal Contact	2.24E-04	8.77E-06	7.98E-06	NA	4.81E-05
Inhalation of Fugitive Dust	3.99E-06	2.50E-08	3.17E-08	NA	6.86E-07
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	2.16E-07	NA
Dermal Contact	NA	NA	NA	3.86E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	1.73E-09	NA
Groundwater					
Incidental Ingestion	3.50E-04	NA	NA	NA	4.11E-05
Dermal Contact	1.16E-06	NA	NA	NA	3.35E-08
Inhalation of Volatiles	8.78E-05	NA	NA	NA	NA
TOTAL	7.34E-04	9.87E-06	9.38E-06	6.03E-07	1.05E-04
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	1.22E-06	7.90E-09	1.17E-08	NA	1.86E-07
Dermal Contact	1.55E+00	6.84E-02	1.07E-01	NA	2.85E-01
Inhalation of Fugitive Dust	*	*	*	NA	*
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	1.07E-01	NA
Dermal Contact	NA	NA	NA	6.44E-02	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
Groundwater					
Incidental Ingestion	1.29E+01	NA	NA	NA	9.84E-01
Dermal Contact	3.24E-02	NA	NA	NA	8.03E-04
Inhalation of Volatiles	4.02E-02	NA	NA	NA	NA
TOTAL	1.45E+01	6.84E-02	1.07E-01	1.72E-01	1.27E+00

* = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values
 NA = Not Applicable, Pathway is not applicable for the respective media

TABLE 6-39
CUMULATIVE RISKS - UPGRADIENT SAMPLES
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Exposure Route	Resident	Trespasser Adult	Trespasser Adolescent	Excavation Worker	Occupational Worker
INCREMENTAL CANCER RISK					
Surface Soil					
Incidental Ingestion	4.77E-05	7.77E-07	9.85E-07	NA	1.07E-05
Dermal Contact	1.83E-04	7.14E-06	6.50E-06	NA	3.92E-05
Inhalation of Fugitive Dust	8.89E-07	5.57E-09	7.05E-09	NA	1.53E-07
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	4.65E-07	NA
Dermal Contact	NA	NA	NA	8.91E-07	NA
Inhalation of Fugitive Dust	NA	NA	NA	3.95E-09	NA
Groundwater					
Incidental Ingestion	4.42E-04	NA	NA	NA	5.19E-05
Dermal Contact	1.47E-06	NA	NA	NA	4.26E-08
Inhalation of Volatiles	8.81E-06	NA	NA	NA	NA
TOTAL	6.84E-04	7.93E-06	7.49E-06	1.36E-06	1.02E-04
HAZARD INDEX					
Surface Soil					
Incidental Ingestion	1.05E-06	6.81E-09	1.00E-08	NA	1.61E-07
Dermal Contact	1.38E+00	6.10E-02	9.59E-02	NA	2.54E-01
Inhalation of Fugitive Dust				NA	
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	1.42E-01	NA
Dermal Contact	NA	NA	NA	1.43E-01	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
Groundwater					
Incidental Ingestion	5.96E+01	NA	NA	NA	4.56E+00
Dermal Contact	1.51E-01	NA	NA	NA	3.74E-03
Inhalation of Volatiles	1.46E-02	NA	NA	NA	NA
TOTAL	6.12E+01	6.10E-02	9.59E-02	2.85E-01	4.82E+00

* = Chemical-Specific Risks are presented in Appendix A

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values

NA = Not Applicable, Pathway is not applicable for the respective media

7.0 ECOLOGICAL ASSESSMENT

An ecological assessment for the Derecktor Shipyard was conducted to ascertain if viable exposure scenarios exist by which site-related contaminants may pose a risk to terrestrial ecological receptors associated with the site. This ecological assessment was of a qualitative nature and was not intended to be an ecological risk assessment; it was meant to identify if ecological exposure pathways potentially associated with the site warrant conducting additional studies and preparing a formal terrestrial ecological risk assessment.

As presented below, this ecological assessment addressed the ecological characteristics of the site (Section 7.1), identified the contaminants of potential ecological concern (Section 7.2), and assessed the existence of potential ecological exposure pathways (Section 7.3).

7.1 ECOLOGICAL CHARACTERIZATION OF THE SITE

Based on the on-shore ecological characteristics of the site, as described in Section 4.5 of this report, the following subsections identify and discuss the potential terrestrial wildlife habitats and ecological receptors present at or near the site.

7.1.1 Site Areas and Potential Terrestrial Wildlife Habitats

As previously indicated, the site was divided into four areas for the purposes of the SASE. These four areas were identified as the North Waterfront Central Shipyard Building 234 area, and the South Waterfront.

Vegetation types dispersed throughout and adjacent to the site are characteristic of fragmented, developed landscapes of a lightly industrialized/residential area. Approximately 80 percent of the shipyard is covered by buildings or pavement, with the remaining area providing minimal habitat value.

Vegetation associated with the North Waterfront includes an upland shrub/vine complex, an upland tree/shrub and wetland complex, and a small early successional grassland/invasive weed plot. The wetland vegetation is off site in a drainage swale adjacent to the Penn Central railroad right-of-way.

In the Central Shipyard, the main vegetation area present is an early successional grassland/invasive weed area of approximately one acre near the southern end of Building 42. In addition, a small area of upland tree/shrub and wetland complex exists at the northeastern corner of the Central Shipyard.

Most of the Building 234 is covered by the building foundation or asphalt. Vegetation areas include two small early successional grassland/invasive weed areas.

The vegetation areas in the South Waterfront include a narrow corridor of upland shrub/scrub species, which parallels a dune/beach strip along Narragansett Bay. The upland vegetation exists primarily on a soil berm with a relatively steep embankment. Certain portions of the upland and beach areas have been significantly disturbed. The areas south and west of the fence line are primarily maintained as lawn.

The majority of the site is encircled by chain-link fence which separates it from upland areas. The western perimeter facing Narragansett Bay is not fenced.

Most of the terrestrial surroundings of the shipyard consist of NETC property with minimal habitat value. Some wetland vegetation exists along a narrow unnamed creek to the east of the South Waterfront on the eastern side of the Penn Central railroad right-of-way. A small area of wetland vegetation is also present off site to the south of the fence line of the South Waterfront.

A detailed description of the vegetation areas present at or near the site is included in Section 4.5.

7.1.2 Potential Terrestrial Ecological Receptors

As indicated in Section 4.5, the limited on-site vegetation areas may provide cover, foraging, and nesting/breeding areas for small mammals, birds, reptiles, and amphibians. However, the highly fragmented habitat, ruderal vegetation, large open paved areas, limited fresh water availability, chain-link fence around most of the site, and the minimal habitat value of the vegetation areas surrounding the site are expected to limit the assemblage of terrestrial, wetland, and avian wildlife species that utilize the area.

Following is a brief discussion of the general feeding habits and habitat requirements of the terrestrial vertebrate species that were identified in Section 4.5 as being present or expected at the site and/or

the surrounding area. These wildlife species represent potential ecological receptors of concern for the site.

In general, the information presented below was obtained from DeGraaf and Rudis (1986). For specific information obtained from additional sources, references are indicated. In addition, the following indicators have been included for each vertebrate species in relation to their presence at the site: **O** - *observed*, **S** - *signs detected*, **P** - *potential presence*, and **R** - *reported but not confirmed*. In the case of birds, general statements have also been included on the probable residency status of each species in relation to the site.

MAMMALS

White-footed mouse (*Peromyscus leucopus*) **O** - Omnivore, granivore; preferred habitat ranges from interiors and edges of forests to clearcuts, pastures, and buildings.

Eastern cottontail (*Sylvilagus floridanus*) **O** - Herbivore; herbaceous and shrubby vegetation represent the preferred habitat; dense woods are avoided.

Eastern chipmunk (*Tamias striatus*) **O** - Granivore, omnivore; tree or shrub vegetation with abundant undergrowth cover represent the preferred habitat.

Raccoon (*Procyon lotor*) **S** - Opportunistic omnivore; preferred habitats are wooded areas interrupted by fields, water courses, and wetlands near human habitation.

Red Fox (*Vulpes vulpes*) **R,S** - Opportunistic omnivore, consuming animals ranging from insects to small vertebrates, as well as berries and other fruits when available; a mixture of forest and open areas is the preferred habitat.

Domestic cat (*Felis domestica*) **O** - This is a domesticated carnivore that is not considered to represent a wildlife species and, therefore, will not be further addressed in the Ecological Assessment.

Star-nosed Mole (*Condylura cristata*) **P** - Mostly insectivore, but also feeds on other invertebrates and, occasionally, small fish; also consumes small amounts of vegetable material; preferred habitat is low wet ground near water bodies.

Northern short-tailed shrew (*Blarina brevicauda*) **P** - Mainly feeds on worms and insects, as well as other invertebrates, small vertebrates, and some plant material; found both in timbered and fairly open habitats; prefers low vegetation, loose leaf litter, and high humidity, i.e., common along stream banks and where moist loose humus exists.

Eastern mole (*Scalopus aquaticus*) **P** - Mostly vermivore and insectivore, but also feeds on other invertebrates and some plant material (Martin *et al.*, 1951); preferred habitats are pastures and other open fields with loamy/sandy moist soils containing earthworms.

Woodchuck (*Marmota monax*) **P** - Mostly herbivore, but occasional small amounts of insects may be consumed; preferred habitat is open land, including pastures, meadows, cultivated fields, open brushy hillsides and edges of woodlands.

Meadow vole (*Microtus pennsylvanicus*) **P** - Mainly herbivore and granivore, but occasionally carnivore; preferred habitats are pastures and fields with herbaceous vegetation and loose organic soils, in proximity or association with water bodies and wetlands.

House mouse (*Mus musculus*) **P** - Omnivore; commonly found in fields, where it may burrow during warm weather, but moves into buildings during the winter weather.

BIRDS

Herring gull (*Larus argentatus*) **O** - Carnivore, scavenger; feeding on the surface and shoreline of water bodies, and at landfills. Probably a permanent resident at or near the site.

Ring-billed gull (*Larus delawarensis*) **O** - Insectivore and vermivore, occasionally consuming bird eggs and mice; also scavenger; found near water bodies. Probably more predominant as a winter resident at or near the site.

Black-capped chickadee (*Parus atricapillus*) **O** - Omnivore, insectivore; habitats include heavily forested woodlands, residential areas, and city parks, with available dead standing trees for nesting. Probably a permanent resident at or near the site.

American crow (*Corvus brachyrhynchos*) **O** - Omnivore, scavenger; inhabits the interior and edges of forests and woodlots, often adjacent to cultivated grain fields where they frequently

feed; during the winter, flocks often congregate in coastal areas where food is more accessible. Probably a permanent resident at or near the site.

Barn swallow (*Hirundo rustica*) O - Mainly insectivore (flying insects), occasional frugivore; found in rural areas and farmlands, often in association with barns and other buildings suitable for nesting. Probably a resident at or near the site only during the breeding season.

Tree swallow (*Tachycineta bicolor*) O - Insectivore (flying insects), supplemented by berries and grains in the winter; preferred habitats include meadows, marshes, and areas in or near water bodies; large coastal flocks are common in the autumn. Probably a resident at or near the site only during the breeding season.

Chimney swift (*Chaetura pelagica*) O - Insectivore (flying insects); found in the vicinity of buildings, in which it nests. Probably a resident at or near the site only during the breeding season.

American goldfinch (*Carduelis tristis*) O - Omnivore, granivore; preferred habitat includes open weedy fields, with scattered woody growth for nesting. Probably a permanent resident at or near the site.

American robin (*Turdus migratorius*) O - Omnivore; found in habitats ranging from open woodlands to orchards and fields; preferred feeding habitat includes grassy fields, lawns, gardens and orchards. Probably a permanent resident at or near the site.

Brown-headed cowbird (*Molothrus ater*) O - Mainly granivore, but also insectivore; found in open woodlands, forest edges, agricultural land, and suburban areas; preferred feeding habitat are grain fields and cattle pastures. Probably a permanent resident at or near the site.

Purple finch (*Carpodacus purpureus*) O - Mostly granivore, but also consumes other plant material and some invertebrates; found in open woodlands, forest edges, parks, and residential areas. Probably a permanent resident at or near the site.

Northern mockingbird (*Mimus polyglottos*) O - Mainly frugivore, feeding also on seeds and insects; found in woodland edges and in pastures, with a scattered variety of fruit-bearing vegetation. Probably a permanent resident at or near the site.

Gray catbird (*Dumetella carolinensis*) O - Frugivore and insectivore; preferred habitat is low dense woody vegetation along woodland borders, water bodies, and buildings. Probably a resident at or near the site only during the breeding season.

Cedar waxwing (*Bombycilla cedrorum*) O - Mostly frugivore, feeding also on some insects; inhabits in open woodlands, orchards, and shade trees, and is also commonly found in agricultural areas and near water. Probably a permanent resident at or near the site.

Common grackle (*Quiscalus quiscula*) O - Omnivore; preferred feeding habitats are open fields, lawns, and shores of ponds. Probably a permanent resident at or near the site.

Northern cardinal (*Cardinalis cardinalis*) O - Mostly granivore, feeding also on fruits and insects; found in forest edges, open woodlands and swamps, and parks, and residential areas, where heavy underbrush is available. Probably a permanent resident at or near the site.

Great egret (*Casmerodius albus*) O (off-shore) - Carnivore (Martin *et al.*, 1951); habitats include marshes, ponds, shores, and mud flats (Peterson, 1980). Probably a resident at or near the site only during the summer, with possibly a localized breeding area nearby (Peterson, 1980).

Double-crested cormorant (*Phalacrocorax auritus*) O (off-shore) - Carnivore (Martin *et al.*, 1951); habitats include coast, islands, bays, lakes, and rivers (Peterson, 1980). Probably a resident at or near the site only during the summer, with possibly a localized breeding area nearby (Peterson, 1980).

Mallard duck (*Anas platyrhynchos*) O (off-shore) - Mostly granivore, feeding also on other plant material and invertebrates; found in grain fields, meadows, and in association with wetlands (including coastal marshes) and shallow water bodies. Probably a permanent resident at or near the site.

Black-crowned night-heron (*Nycticorax nycticorax*) O (on pier) - Carnivore; found in fresh, brackish, and salt water areas; during the winter, commonly found in coastal wetlands and islands. Probably a permanent resident at or near the site.

REPTILES

Eastern garter snake (*Thamnophis sirtalis sirtalis*) **O** - Mostly vermivore, feeding also on other invertebrates and small vertebrates; terrestrial, ubiquitous, found in almost all damp environments.

Eastern hognose snake (*Heterodon platyrhinos*) **P** - Feeds on toads and other amphibians, as well as invertebrates; preferred habitat associated with sandy soils, such as beaches, open fields, and dry open woods.

Northern brown snake (*Storeria d. dekayi*) **P** - Carnivore, feeding mostly on invertebrates and occasionally on minnows and small amphibians; ubiquitous in urban and rural areas, dry or moist situations, including vacant lots, parks, trash piles, open fields, damp woods, wetlands, and along railroad tracks and roadsides.

Eastern smooth green snake (*Opheodrys v. vernalis*) **P** - Mostly insectivore, feeding also on other invertebrates and salamanders; preferred habitats include upland areas, grassy fields, meadows, open woods, abandoned farmland, sphagnum bogs and marshes, and in vines and brambles.

Eastern milk snake (*Lampropeltis t. triangulum*) **P** - Carnivore, feeding on small mammals, reptiles, birds and their eggs, and invertebrates; found in various habitats from sea level to mountain elevations, usually under brush, wood or other cover, in farmlands, woods, meadows, bogs, river bottoms, and outbuildings.

AMPHIBIANS

Eastern American toad (*Bufo a. americanus*) **P** - Feeds on terrestrial invertebrates, with some incidental ingestion of vegetable matter; found in various habitats from sea level to mountain elevations, including gardens, yards with cover, and moist upland woods.

Green frog (*Rana clamitans melanota*) **P** - Adults are carnivorous, feeding on various terrestrial and aquatic invertebrates, as well as small fish and other frogs; tadpoles are herbivorous; riparian, inhabiting margins of shallow permanent or semipermanent fresh water bodies; rarely found more than a few meters from the water.

It should be noted that, from this list of faunal species, only the birds, three species of small mammals, and the eastern garter snake were reported as "observed", while the majority of the remaining species were qualified as of "potential presence" based mostly on their reported geographical distribution ranges and not on the availability of habitat at the site.

According to the U.S. Fish and Wildlife Service (U.S. DOI, 1996) and the Rhode Island Natural Heritage Program (RI DEM, 1996), there are no species of special concern or ecologically significant natural communities at or near the former Derecktor Shipyard, with the possible exception of occasional transient bald eagles (*Haliaeetus leucocephalus*) or peregrine falcons (*Falco peregrinus*).

Other potential terrestrial receptors of concern associated with the site include invertebrate species and plants. Terrestrial invertebrates are present at the site and are likely to represent a component of the diets of various vertebrate species in the area; however, a survey of invertebrate species is beyond the scope of this assessment and, therefore, was not conducted. Plant species encountered at the site are identified in Section 4.5.

7.2 CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

The identification of contaminants of potential ecological concern (COPECs) was based only on the analytical results for exposed surface soil sample locations. The basis for this approach was that soil covered by pavement or concrete under buildings or sumps does not provide an available exposure pathway for ecological receptors, and it is anticipated that such areas of covered soil will remain covered.

The following subsections identify the exposed surface soil sample locations at the site, identify the COPECs, and discuss the main fate, transport, and ecotoxicological characteristics of the COPECs.

7.2.1 Exposed Surface Soil Sample Locations by Site Areas

Following are the exposed surface soil sample locations identified for each of the four areas of the site and the upgradient off-site area. All surface soil sample depths were 0 to 1 feet deep, except at location TP24 in which the sample depth was 1 to 2 feet.

<u>Site Area</u>	<u>Exposed Surface Soil Sample Locations</u>
North Waterfront	TP16, TP18, TP24 (sample depth: 1 to 2 feet), TP28
Central Shipyard	MW05, MW07, TP11, TP12, TP14, TP15, TP17
Building 234 Area	MW09, TP07, TP08, TP09, TP10
South Waterfront	TP01, TP02, TP03, TP04, TP05, TP06
Upgradient Off-Site Area	MW01, MW10

7.2.2 Identification of Contaminants of Potential Ecological Concern

To identify the COPECs from the analytes detected in the surface soil samples collected at the Former Derektor Shipyard, a detected analyte concentrations screening was performed against appropriate ecological soil benchmarks and upgradient off-site concentrations. The benchmark values selected for the screening process are presented on Table 7-1.

If the site concentration of an analyte exceeded the corresponding benchmark concentration, then the analyte concentration was compared to the maximum upgradient off-site concentration. Only the analytes that exceeded both the benchmark and the maximum upgradient off-site concentration were considered to represent COPECs. The comparison of both inorganic and organic analyte site concentrations against their corresponding upgradient off-site concentrations was considered to be appropriate for the screening process because, in general, the off-site terrain to the east of the site represents an upgradient adjoining area from which contaminants can potentially migrate into the site. In the few cases where an appropriate benchmark was not available for a certain analyte, that analyte was not carried further through the screening process, although it is recognized that such analyte may still represent a COPEC.

For the purposes of this ecological assessment, and given the general interspersion of buildings, paved areas, isolated exposed surface soil locations and vegetated areas at the site, the screening of analyte concentrations detected in surface soil samples was conducted considering samples individually (including duplicates) to maintain a greater degree of flexibility and ecological relevance on the interpretation of the data.

Tables 7-2 A through 7-2 D present the concentrations of the analytes detected in the surface soil samples, as well as the corresponding benchmark values and upgradient off-site concentrations. For each site area, these tables identify the detected analytes that exceeded both the corresponding

benchmark and the upgradient off-site concentration. Such analytes are listed below and are considered to represent the overall COPECs for the site:

- Semivolatile Organic Compounds: 2,4-dimethylphenol; 2-methylphenol; 4-methylphenol; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; pyrene; and phenol.
- Pesticides/PCBs: Aroclor-1260, dieldrin, endrin ketone, and methoxychlor.
- Metals: aluminum, chromium, copper, iron, lead, mercury, nickel, tin, vanadium, and zinc.

7.2.3 Fate, Transport and Ecotoxicological Characteristics of the Contaminants of Potential Ecological Concern

Based on the information presented in Section 7.2.2, various polynuclear aromatic hydrocarbons (PAHs) and other semivolatile organic compounds, as well as three pesticides, one polychlorinated biphenyl (PCB) and numerous metals, were identified as COPECs for the site. Following is a discussion of the main fate, transport, and ecotoxicological characteristics of these contaminants. Section 5.0 of this report contains a comprehensive discussion of fate and transport characteristics for the overall contamination present at the site.

Polynuclear Aromatic Hydrocarbons (PAHs)

Polynuclear aromatic hydrocarbons identified as COPECs for the site include anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene and pyrene.

Although PAHs occur naturally, primarily as a result of forest fires, microbial synthesis, and volcanic activities, several industrial activities are associated with significant production of PAHs and localized areas of high contamination. PAHs with low molecular weight and containing two to three aromatic rings, such as naphthalene, fluorene, phenanthrene, and anthracene, are highly mobile in the environment; higher molecular weight PAHs are relatively immobile because of their large molecular volume and their extremely low volatility and solubility. PAHs in the environment are persistent. The

aqueous solubility and the octanol-water partition coefficient ($\text{Log } K_{ow}$) tend to decrease and increase, respectively, as the molecular weight of PAHs increases; thus, higher molecular weights in PAHs are generally associated with increased solubility in fats (Eisler, 1987a).

When released into the atmosphere, as may occur during open burning operations, PAHs tend to become associated with particulate materials. PAHs may readily photo-decompose in the atmosphere; however, most of the PAHs released into the atmosphere will be transported, even over relatively long distances, and then be deposited onto soil or vegetation (Eisler, 1987a). PAHs tend to adsorb to soil particles, and runoff of contaminated soil particles is a feasible mechanism of migration (Ney, 1990). Some PAHs may leach from contaminated soils and cause groundwater contamination. The absorption of PAHs from soil by various plant roots and translocation to the shoots has been documented (U.S. EPA, 1980a), as well as the microbial biodegradation of PAHs in soil (Eisler, 1987a).

PAHs can enter the body of animals by inhalation, dermal contact, or ingestion. Poor absorption of PAHs through the gastrointestinal tract of mammals has been reported (Eisler, 1987a). In spite of their high lipid (fats) solubility, many PAHs show little tendency for bioaccumulation and biomagnification, probably because PAHs are rapidly and extensively metabolized (U.S. EPA, 1980a; Eisler, 1987a).

Unsubstituted lower molecular weight PAHs, containing 2 or 3 fused benzene rings (naphthalene, fluorenes, phenanthrenes, and anthracenes), exhibit significant acute toxicity and other adverse effects to some organisms, but are generally noncarcinogenic; the higher molecular weight PAHs, containing four to seven rings, indeno(1,2,3-cd)pyrene, are significantly less acutely toxic, but many have been demonstrated to be carcinogenic, mutagenic, or teratogenic to a wide variety of organisms, including fish and other aquatic life, amphibians, birds, and mammals (Eisler, 1987a). Responses to individual PAHs are variable within one species and among different species, and are significantly modified by many inorganic and organic compounds, including other PAHs. Differences in responses may also be attributable to differences in the ability to absorb and assimilate PAHs from food (Eisler, 1987a; Maughan, 1993).

PAHs may potentially cause adverse effects to vegetation, fish, and wildlife. Adverse effects of PAHs reported in numerous species under laboratory conditions include carcinogenic effects, as well as effects on survival, growth, and metabolism. Some PAHs are transformed to intermediate metabolites within the organisms; these metabolites, and not the PAHs themselves, have been identified as the carcinogenic, mutagenic, and teratogenic agents (Eisler, 1987a; Maughan, 1993).

A critical point of interaction between PAHs and amphibians/reptiles involves the transformation of these compounds by cytochrome-dependent monooxygenase systems. Induction of mixed-function oxidase activity has been reported to occur in the liver of leopard frog (*Rana pipiens*) and garter snake as a result of exposure to benzo(a)pyrene. Amphibians, in general, appear to be more resistant to PAH-induced carcinogenesis in comparison to mammals (Eisler, 1987a).

Mallard ducks fed for a period of 7 months with a diet containing 4,000 mg PAHs/kg (mostly as naphthalenes, naphthenes, and phenanthrene) had higher liver weight and increased blood flow to the liver, although no visible toxic effects or mortality occurred during the exposure period. In addition, embryotoxic effects have been reported for PAHs when applied externally to the surface of mallard duck eggs (Eisler, 1987a).

PAHs have been shown to have carcinogenic, toxic, and sublethal effects on laboratory mammals. Based on their effects on mammals, PAHs are often divided in two groups: carcinogenic and noncarcinogenic (Maughan, 1993).

Among the four to seven ring PAHs, several have been shown to be potent carcinogens that cause mammalian tumors both at the point of administration and systemically; their effects have been demonstrated in nearly every tissue tested, regardless of the route of administration (Eisler, 1987a; Maughan, 1993). In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals. Some reported carcinogenic effects include cancer of the mammary gland, leukemia, lung adenoma, stomach tumors, and hepatomas. Effective inhibitors of PAH-induced tumor development include selenium, vitamin E, ascorbic acid, butylated hydroxytoluene, and hydroxyanisole (Eisler, 1987a).

Acute and chronic exposure to various carcinogenic PAHs has resulted in destruction of hematopoietic and lymphoid tissues, ovotoxicity, antispermatogenic effects, adrenal necrosis, changes in the intestinal and respiratory epithelia, and other effects (Eisler, 1987a). Available information on the effects of noncarcinogenic PAHs suggests that these compounds are not potent teratogens or reproductive toxins. Documented noncarcinogenic internal effects include damage to the liver and kidney, and noncarcinogenic external effects include destruction of sebaceous glands, hyperkeratosis (hardening of the skin), and ulceration (Maughan, 1993).

Chronic toxicity studies of PAHs with laboratory mammals have indicated that predominant effects include reproductive impairment, reduced fertility, and embryonic or fetal effects, and effects that

significantly reduce the ability of young animals to survive to reproductive age as a result of skin cancer, lung cancers, or tumors that directly affect the reproductive systems (Maughan, 1993).

Reports indicate that unsubstituted PAHs do not accumulate in mammalian adipose tissues, despite their high lipid solubility, probably because they tend to be rapidly and extensively metabolized (Eisler, 1987a).

As indicated above, plants can absorb PAHs from soils through their roots, and then translocate them to other plant parts such as developing shoots. PAHs of lower molecular weights are more readily absorbed by plants than PAHs with higher molecular weights, probably due to their higher solubility in water. Documented phytotoxic effects of PAHs are rare. Most plants can catabolize benzo(a)pyrene, and possibly other PAHs. Some plants contain chemicals known to protect against PAH effects, and PAHs synthesized by plants may act as plant growth hormones (Eisler, 1987a; Maughan, 1993).

2,4-Dimethylphenol

Coal is a natural source of dimethylphenols. Also, dimethylphenols have been identified as naturally occurring constituents of some plants such as tea, tobacco, marijuana, and the Siberian pine (*Abies sibirica*). Artificial release sources of 2,4-dimethylphenol into the environment are associated with coal processing, coal tar refining, and industrial use in the manufacturing of plastics, resins, pharmaceuticals, pesticides, disinfectants, solvents, and other chemicals. 2,4-dimethylphenol may also be released in asphalt and roadway runoff, gasoline and diesel exhaust, domestic sewage, and tobacco smoke. If spilled on soil, 2,4-dimethylphenol would adsorb moderately to the soil and has been reported to biodegrade in a few days, depending on the type of soil and the temperature. 2,4-dimethylphenol may also undergo direct photolysis (Howard, 1989).

2,4-dimethylphenol has been reported to be a cancer-promoting agent on dermal application on rats. Dermal exposure has been reported to be more toxic to rats than oral dosing. At high doses, dimethylphenols have been shown to cause pathological changes in the liver, kidneys, and heart. 2,4-dimethylphenol is also known to be an ATP-blocking agent (Clement Associates, 1985). A half-life of less than one day in the body of bluegills has been reported for 2,4-dimethylphenol residues (Clement Associates, 1985), thus this compound would seem unlikely to undergo bioaccumulation. However, information addressing the possibility of bioaccumulation in terrestrial food chains was not found.

2-Methylphenol

2-methylphenol, also known as 2-cresol, occurs in small quantities in petroleum, coal, and wood. Artificial release sources of 2-methylphenol into the environment are associated with coal tar and petroleum refining, wood pulping, metal refining and manufacturing, manufacturing of organic chemicals, plastics and resins, and its use as a disinfectant, solvent, and textile scouring agent. 2-methylphenol can also be found in municipal sewage, auto and diesel exhaust, and tobacco smoke. Also, 2-methylphenol is a product of the photooxidation of toluene. 2-methylphenol should be relatively mobile in most soils, except when iron oxide and pH levels are high. 2-methylphenol biodegrades rapidly in water, and complete biodegradation has been reported to have occurred in 8 days when applied to soil at 500 ppm (Howard, 1989).

Dermal application of methylphenols (cresols) promotes skin tumors in mice. Cresols are highly irritating to the skin, mucous membranes, and eyes. Cresols can impair liver and kidney function, and cause central nervous system and cardiovascular disturbances (Clement Associates, 1985). Evidence is not available to indicate that methylphenols bioaccumulate in wildlife species. Also, no alterations in reproductive capabilities or other subtle changes in wildlife species have been attributed to methylphenols (Clement Associates, 1985).

4-Methylphenol

4-methylphenol, also known as 4-cresol, occurs in petroleum, and as a volatile from plants. Artificial release sources of 2-methylphenol into the environment are associated with coal tar refining, metal refining, chemical manufacturing, and its use as a disinfectant. 4-methylphenol is also found in emissions from autos and diesel engines, wood pulping, brewing, glass fibre manufacture, and in tobacco smoke. 4-methylphenol is also a product of the photooxidation of toluene. 4-methylphenol is relatively mobile in some soils and, therefore, may leach into the groundwater. It rapidly biodegrades in soil, with complete degradation having been reported in 7 days when applied at a rate of 500 ppm (Howard, 1989).

Dermal application of methylphenols (cresols) promotes skin tumors in mice. Cresols are highly irritating to the skin, mucous membranes, and eyes. Cresols can impair liver and kidney function and cause central nervous system disturbances (Clement Associates, 1985). Evidence is not available to indicate that methylphenols bioaccumulate in wildlife species. Also, no alterations in reproductive

capabilities or other subtle changes in wildlife species have been attributed to methylphenols (Clement Associates, 1985).

Phenol

Phenol is a normal constituent of animal wastes and can be found in the decomposition of organic matter. Artificial release sources of phenol into the environment are associated with phenol manufacturers and various other industries that use this product (resins, plastics, fibers, adhesives, iron and steel, aluminum, leather, and rubber industries). Phenol is also found in auto exhaust, disinfectants, medicinal products, and tobacco smoke. When released to soil, phenol generally biodegrades rapidly (2 to 5 days), even in subsurface soils; however, biodegradation is slower under anaerobic conditions than under aerobic conditions. Phenol is highly soluble and shows poor adsorption to soil. Phenol in near-surface soil should undergo relatively rapid evaporation into the atmosphere, and may also directly photodegrade (Howard, 1989).

When applied to the skin of mice that has already been exposed to known carcinogens, phenol appears to have some tumor-promoting effects. Phenol may be a weak carcinogen by itself, and may also be mutagenic. Subchronic exposure to phenol, by inhalation or ingestion, has caused liver, kidney, lung, and/or heart damage in experimental animals. Phenol may also cause irritation to eyes and mucous membranes, and may cause systemic damage to the nervous system (Clement Associates, 1985). Bioaccumulation of phenol is unlikely (Ney, 1990).

Dieldrin

Dieldrin has low water solubility and is extremely persistent. Dieldrin is not expected to leach into groundwater, and will reach surface water mostly via runoff. Dieldrin can photo-rearrange to photodieldrin. Dieldrin strongly adsorbs to soil particles and can persist for periods of more than 7 years; small amounts may volatilize from soil or be carried on dust particles into the air. Biodegradation and hydrolysis apparently are not significant processes in the fate of dieldrin (Howard, 1991). Bioconcentration, bioaccumulation, and biomagnification of dieldrin in the food chain are highly likely (Ney, 1990).

After ingestion by animals, dieldrin is rapidly absorbed from the gastro-intestinal tract. Following absorption, it is transported from the liver to different sites in the body, having been detected in the brain, blood (including erythrocytes), liver, and especially the adipose tissue. Dieldrin can be

metabolized to a variety of more polar compounds, and it has been shown capable of crossing the placenta to the fetus. Dieldrin toxicity appears to be strongly related to effects on the central nervous system. In addition, the subacute or chronic toxicity of dieldrin to mice, rats, dogs, and, to some extent, monkeys, has been reported to be related to shortened life span, increased liver-to-body weight ratio, various changes in liver histology, induction of hepatic enzymes, carcinogenicity, and teratogenicity (U.S. EPA, 1980c). Gray bats have been reported to have died from dieldrin toxicity; residue concentrations reached 21 ppm in the brain and 27 ppm in the whole body. Dieldrin has been reported to cause thinning of the shell of barn owl eggs, without causing overall reproductive impairment, and has been associated, in conjunction with DDE, with population declines of white-faced ibis in Texas. Changes in breeding behavior and greater vulnerability to predation have been reported in bird species as a result of sub-lethal exposures to dieldrin. Mallard ducks exposed to either dieldrin or DDT have been found to be more sensitive to the duck hepatitis virus, showing increased mortality rates (Peterle, 1991).

Endrin ketone

Endrin, one of the cyclodiene group of pesticides, undergoes isomerization to form endrin ketone when exposed to light (Howard, 1991; U.S. EPA, 1980d). Additional information specific to endrin ketone was not found in the available literature. However, following is a discussion on the fate, transport, and ecotoxicological characteristics of endrin.

There are no known natural sources of endrin. The presence of this compound in the environment has been from its use as an insecticide, avicide, and rodenticide. Endrin has been used on agricultural crops, control of birds on buildings, and mice on orchards (Howard, 1991). Endrin is very insoluble in water and very persistent in the environment (Howard, 1991; U.S. EPA, 1980d). Endrin adsorbs strongly onto soil particles and can persist for periods of up to 14 years or longer; biodegradation may be enhanced in flooded soils or under anaerobic conditions. Leaching of endrin from soil into groundwater may be possible under certain circumstances, and small amounts may volatilize from soil or be carried by dust particles into the air. Runoff of contaminated soil particles can carry endrin into surface waters, where it does not hydrolyze or biodegrade but may undergo photo-isomerization to endrin ketone. Bioconcentration, bioaccumulation, and food web biomagnification of endrin are reported to occur (Howard, 1991; Ney, 1990); where populations of organisms resistant to endrin have been found, top predators tend to be absent (U.S. EPA, 1980d).

Endrin ranks the highest in acute and subacute toxicities to mallard ducks when compared to aldrin, dieldrin, heptachlor, toxaphene, chlordane, endosulfan, DDT, Aroclor 1254, and mirex. Endrin has been reported as a cause of mortality among white pelicans in the wild, and endrin residues have been found, together with residues of several other organochlorine pesticides, in the carcasses of dead herons, mostly great blue herons. Deaths of California quail, chukar partridge, barn owl, saw whet owl, flicker, goshawk, Cooper's hawk, sharp-shinned hawk, great horned owl, and house finch have been attributed to endrin used for rodent control in orchards; brain residues of more than 0.8 ppm have been found in postmortem analyses of these individuals. Behavior changes and greater vulnerability to predation have been reported in bird species as a result of sub-lethal exposures to endrin (Peterle, 1991).

In mammals, endrin has been classified as "very highly hazardous" since exposure to very small amounts may induce severe systemic toxicity or death; endrin is the most acutely toxic of the cyclodiene pesticides. The central nervous system is the main target of acute endrin poisoning in mammals; under chronic exposure, compensatory mechanisms can occur to cope with the initial nervous system injury until damage to liver or other organs intervenes. Chronic toxicity of endrin is greater than that of other organochlorine pesticides. Chronic toxicity effects associated with endrin include convulsions; increase in the relative weights of specific organs; hypertension; incoordination; muscle tremors; pathologic changes in brain, liver, kidneys, heart, and lungs; and death. Various chronic toxicity effects and significant mortality has been reported on deer mice, rabbits, rats, and dogs. Increased mortality of mice after starvation periods suggests possible translocation of endrin from adipose tissues. Rats appear to be more tolerant than rabbits and dogs to multiple doses of endrin, and female rats appear to be more sensitive than male rats to the effects of endrin (U.S. EPA, 1980d). Lethal doses of endrin have also been reported for mule deer and domestic goat (Hudson *et al.*, 1984).

Methoxychlor

Methoxychlor has low water solubility (Ney, 1990). When released to soil, methoxychlor tends to be moderately mobile to immobile, remaining primarily in the upper soil layer and not leaching significantly. Residual amounts of methoxychlor have been detected in soils 12 to 14 months after applications. Methoxychlor degrades faster in flooded/anaerobic soil in comparison to non-flooded/aerobic soil. Under anaerobic conditions, biodegradation appears to be the dominant removal mechanism. The percentage of methoxychlor removed from soil by runoff may be small, however, this process may be important in the transport of the compound into surface water; once in water, methoxychlor has been

reported to adsorb to suspended and bottom sediments. Volatilization and chemical hydrolysis may also occur in soils. Although volatilization of methoxychlor from terrestrial surfaces occurs at a slow rate, this mechanism may be an important transport process since the compound is persistent in air and can be transported for long distances. Methoxychlor may undergo an environmental cycling process involving volatilization, removal from air via precipitation, followed by re-volatilization (Howard, 1991).

Developing gull eggs injected with 2 to 100 ppm methoxychlor resulted in feminization of male hatchlings that had developed abnormal ovarian tissues and the oviduct. A direct estrogenic effect has also been demonstrated in rats by increased uterine weights following injection of methoxychlor in ovariectomized females. Methoxychlor has also been reported to act as a neurotoxicant (Peterle, 1991).

Aroclor-1260

Aroclors is the trademark name of polychlorinated biphenyl (PCB) mixtures. PCBs are not naturally occurring compounds. PCB mixtures contain chlorinated biphenyls with a varying number of substituted chlorine atoms on the aromatic rings. There are ten classes of chlorinated biphenyls, ranging from monochlorobiphenyls to decachlorobiphenyls, comprising a total of 209 possible isomers. The commercial Aroclor products are complex mixtures of chlorobiphenyls, and are identified numerically depending on the percent of chlorine in the mixture. Aroclor-1260 has a chlorine percent of 60 percent. Chlorobiphenyls with five or more chlorine atoms are generally referred to as "higher chlorobiphenyls", which are the chlorobiphenyls with the greater persistence in the environment. Aroclor-1260 contains chlorobiphenyls with five to eight chlorine atoms, with the majority being hexachlorobiphenyls (U.S. EPA, 1980b).

Aroclors tend to adsorb to organic matter in soils, as well as to sediments. Volatility of Aroclors is low. Aroclors are extremely stable compounds that undergo slow chemical and microbial degradation processes in the environment. Aroclors are persistent compounds, with the persistence increasing with the degree of chlorination. Due to their extremely high liposolubility, Aroclors bioaccumulate and biomagnify through food chains (Eisler, 1986a; Ney, 1990).

Bioaccumulation and biomagnification of Aroclors, particularly of the higher-chlorinated congeners, occurs through food chains and is specially pronounced in organisms at the higher trophic levels such as fish-eating birds and carnivorous mammals. In general, toxicity and persistence of Aroclors

increases with the degree of chlorination. In addition, Aroclors of higher molecular weights are more resistant to metabolization by organisms of higher trophic levels, and tend to bioaccumulate in adipose tissues such as the brain and liver (Maughan, 1993).

Laboratory animals exposed to Aroclors in their diets have shown increased incidence of cancer; reproductive impairment; pathological effects such as lesions on the liver, stomach, and skin; and immunological impairment (Eisler, 1986a; Maughan, 1993). Relatively low levels of Aroclors in the diets of a variety of wildlife species have been shown to cause metabolic changes, reproductive impairment, disruption of normal patterns of growth, behavioral changes, and mortality in sensitive species (Eisler, 1986a; Maughan, 1993).

As a group, birds tend to be more resistant to acute toxic effects of Aroclors than mammals (Eisler, 1986a). For mallard duck, an acute LD₆₀ value of 1,975 mg/kg diet has been reported for Aroclor 1260 (Eisler, 1986a). Reproductive failure in some bird species has been reported to occur at dietary levels of Aroclors between 5 and 10 mg/kg (Maughan, 1993). Also, some studies suggest that migratory flesh-eating birds feeding on a PCB-contaminated food chain might consume enough toxicant to cause qualitative changes in their semen in a given breeding season; when coupled with altered courtship, reductions on egg fertilization and reproductive fitness of the individuals may occur (Eisler, 1986a).

Among mammals, mink is highly susceptible to relatively low dietary levels of PCBs (Eisler, 1986a). Dietary concentrations of 3.57 mg/kg of Aroclor 1254 have been reported to cause death in all mink in 105 days, and concentrations of 0.64 mg/kg over 160 days have caused death, extreme weakness, and reproductive failure (Maughan, 1993). Raccoons are less sensitive than mink to Aroclor 1254; a daily dietary level of 50 mg/kg of PCB over an 8 day period has been reported to have an observable effect, reducing blood cholesterol and sleep time, and increasing microsomal enzyme production (Eisler, 1986a; Maughan, 1993).

Mutagenic, carcinogenic, and teratogenic properties of PCBs have been documented; in addition, PCBs may enhance the carcinogenicity of other chemicals (Eisler, 1986a).

Aluminum

The presence of aluminum in soils can be the result of the weathering of rocks with minerals that contain this element (Smith, 1980). Aluminum is a trace element which is naturally present in the soil

solution (Kabata-Pendias and Pendias, 1992). Anthropogenic sources of aluminum in the environment are associated with the various industrial uses of aluminum, which include the following: structural building, consumer durables, canning, containers and packaging, automotive, roadway signs and fencing, paint additives, abrasives, brewing and paper industries, and food processing (Patty, 1963).

The mobility of aluminum in soil is strongly affected by pH. In acid soils with pH below 5.5, the mobility of aluminum increases sharply; a sudden increase of aluminum solubility is observed mainly at the narrow range of the pH from 4.5 to 4.0. Therefore, factors affecting the acidity of the soil, including acid precipitation, are likely to influence the solubility of aluminum. Mobile aluminum in acid soils can be taken up rapidly by plants, creating chemical stress. Although aluminum is normally present in plants, high concentrations of aluminum can cause toxicity manifested as shallow rooting, drought susceptibility and poor use of subsoil nutrients, as well as reduced yield of crops and forest decline (Kabata-Pendias and Pendias, 1992).

Aluminum toxicity appears influenced by the route of exposure and the chemical form of aluminum. Some injected and oral doses of soluble aluminum forms have been reported toxic and even fatal to rabbits and other experimental animals. The observed toxicity of soluble forms of aluminum seems associated with the anionic acidic component of soluble aluminum salts. Insoluble forms generally appear to be non-toxic. The relatively low toxicity of aluminum may be, at least in part, associated with its lack of significant absorption from either the alimentary or the respiratory tracts. No significant retention of aluminum in body tissues was reported in rats after four generations of aluminum feeding (Patty, 1963).

Chromium

The natural presence of chromium in soils is associated with the weathering of parent rocks containing chromium minerals. The chromium content of surface soils may increase due to pollution from various sources, which include the metallurgy and chemical industries, as well as several industrial wastes, electroplating sludges, chromium pigment and tannery waste, and leather manufacturing wastes, municipal sewage sludges, oil drilling operations, and emissions from coal combustion, municipal incinerators, cement production, cooling towers, and textile manufacturing. Runoff from urban and residential areas, as well as chromium from phosphates used as fertilizers, may also be important sources of chromium in soils (Eisler, 1986b; Kabata-Pendias and Pendias, 1992).

Most of the soil chromium occurs naturally as trivalent chromium. Its compounds are considered to be very stable in soils since trivalent chromium is slightly mobile only in very acid media, precipitating almost completely at pH 5.5. On the other hand, hexavalent chromium is very soluble and unstable in soils and is easily mobilized in both alkaline and acid soils. However, soluble hexavalent chromium readily converts to insoluble trivalent chromium under normal soil conditions, which accounts for the generally low chromium availability to plants (Kabata-Pendias and Pendias, 1992). Chromium can also be present in the +2, +4 and +5 forms, but these are also unstable forms that are rapidly converted to trivalent chromium (Eisler, 1986b). In addition to pH, the behavior of chromium in soil is also influenced by the redox-potential and organic matter (Kabata-Pendias and Pendias, 1992).

Although present in plant tissues, chromium does not appear to have an essential role in plant metabolism. However, chromium is an essential element in human and animal nutrition, being involved in the glucose and cholesterol metabolism (Kabata-Pendias and Pendias, 1992).

Hexavalent chromium is the most biologically active chromium form (Eisler, 1986b). Readily soluble hexavalent chromium in soils can be toxic to plants and animals. The elevated chromium content of soils in some areas has been reported to cause decreased plant growth, several toxicity symptoms, and may have an antagonistic interaction with various plant nutrients (Kabata-Pendias and Pendias, 1992). In animals, high environmental concentrations of chromium have been reported to be mutagenic, teratogenic, and carcinogenic. Biomagnification of chromium in food chains has not been reported, and concentrations are usually highest at the lowest trophic levels (Eisler, 1986b). Chromium toxicity has been reported on livestock grazing on grass with elevated chromium content due to chromium-rich sewage sludge used as soil amendment (Kabata-Pendias and Pendias, 1992); however, in general, chromium absorbed by plants tends to remain primarily in the roots and is poorly translocated to the leaves (Clement Associates, 1985). The kidneys and liver have been reported to suffer damage in animals and humans due to chromium exposure; in addition, mucous membranes of the respiratory system may be damaged by the inhalation of hexavalent chromium salts (Clement Associates, 1985).

Copper

Copper occurs naturally in the environment at low concentrations, and acts as an essential micronutrient for both plants and animals; however, slightly high concentrations of copper can be toxic (Smith, 1980; U.S. EPA, 1985). Contamination of soil by copper can result from the use of copper-containing materials, such as fertilizers and other agricultural products, as well as from municipal wastes, smelter and other industrial emissions, and corrosion of copper alloy construction materials,

electric wires, pipes. Under contamination conditions, surface soils seem particularly prone to accumulate copper (Kabata-Pendias and Pendias, 1992).

The chemical speciation and solubility of copper is a function of the pH of the system. As pH increases, the solubility of copper decreases reaching a minimum at a pH between 8 and 10; as the pH increases further, then the solubility of anionic copper increases (Knox *et al.*, 1993). Many copper compounds and complexes are readily soluble, thus copper is among the more mobile heavy metals in soil and other surface environments. The environmental mobility of copper is mainly limited by adsorption to organic matter, clays, and other materials (Clement Associates, 1985).

Plants growing in soils contaminated with copper concentrate high levels of the metal in their tissues, and bioaccumulation has been reported to occur in herbivores (Peterle, 1991; U.S. EPA, 1976). Apparently, copper generally does not biomagnify (Clement Associates, 1985). Among wildlife living near a zinc smelter, copper, cadmium, and zinc were reported to be highest in carrion insects, then fungi and shrews; metal levels were higher in shrews than mice (Peterle, 1991).

Copper itself does not appear to have mutagenic, teratogenic, or carcinogenic effects in animals or humans. Inhalation of copper dusts can cause upper respiratory tract irritation and damage. Dietary levels of other trace elements, such as molybdenum, sulfur, zinc, and iron, can affect the level of dietary copper that produces certain deficiency or toxicity symptoms. Ingested copper salts may cause gastrointestinal symptoms, and chronic exposure may result in anemia (Clement Associates, 1985).

Sheep have been reported to be very susceptible to copper toxicosis, and poisoning may be acute or chronic. Acute toxicity is caused by direct action of copper salts on the gastrointestinal tract, resulting in gastroenteritis, shock, and death. Chronic exposure to copper via ingestion has been reported to result in absorption and accumulation of this metal by the liver, which may develop into impaired liver function, deficiency or excess of other trace nutrients, and an acute hemolytic condition. Toxic effects from copper have also been reported on swine, which include anemia, jaundice, and high copper concentrations in liver and serum. Ruminant cattle has been reported to be more tolerant to high concentrations of dietary copper than sheep or swine (Clement Associates, 1985).

Iron

Iron is abundant in nature, being concentrated mainly in rocks. The iron content of soils is both inherited from parent rocks and the result of soil processes (Kabata-Pendias and Pendias, 1992).

Anthropogenic sources in the environment are associated with the mining and handling of iron, its various industrial applications, and the use of iron-containing products (Patty, 1963).

In soils, iron is believed to occur mainly in the forms of oxides and hydroxides as small particles or associated with the surfaces of other minerals. In soil horizons rich in organic matter, iron appears to be mainly in a chelated form (Kabata-Pendias and Pendias, 1992). In general, iron has relatively low mobility in soil (Clement Associates, 1985). The general rule governing the mobilization and fixation of iron is that oxidizing and alkaline conditions promote the precipitation of iron, whereas acid and reducing conditions promote the solution of iron compounds. Iron compounds are greatly involved in the behavior of some macronutrients and of many trace elements; conversely, heavy metals are also known to influence the bioavailability of iron (Kabata-Pendias and Pendias, 1992).

Iron is an essential nutrient in plants and animals. Soil rich in soluble iron forms may cause toxic effects in plants. Plant injury due to iron toxicity is most likely to occur on strongly acid soils, on acid sulfate soils, and on flooded soils. Symptoms of iron toxicity in plants are not specific and usually differ among plant species and stages of growth. However, damaged leaves with high iron tissue concentrations are common manifestations of toxicity, as well as are abnormal ratios of iron to other elements and, particularly, to heavy metals (Kabata-Pendias and Pendias, 1992).

Excessive ingestion of iron produces toxic effects in animals, primarily associated with gastrointestinal symptoms. High doses may also cause damage to the liver, convulsions, or death. Chronic ingestion of iron may lead to hemosiderosis or hemochromatosis. Inhalation of iron-containing dusts may have toxic effects on the respiratory system (Clement Associates, 1985).

Lead

Lead is ubiquitous in the environment and is a characteristic trace constituent of rocks, soils, water, air, plants, and animals; however, anthropogenic activities have resulted in an increase in lead residues throughout the environment (Eisler, 1988).

Lead is not essential to living organisms, and is toxic in most of its chemical forms. In general, organolead compounds are more toxic than inorganic lead compounds. Lead can be absorbed by plants or incorporated into the bodies of animals by inhalation, ingestion, dermal absorption, and placental transfer to the fetus (Eisler, 1988; Smith, 1980). Terrestrial plants and invertebrates can take up lead

from contaminated soils (Eisler, 1988; Smith, 1980). In general, although lead is concentrated by biota, food chain biomagnification appears to be negligible (Eisler, 1988).

Lead adversely affects survival, growth, reproduction, development, and metabolism of most species under controlled conditions. In general, organolead compounds are more toxic than inorganic lead compounds, and the younger immature organisms are most susceptible (Eisler, 1988). Lead can exert deleterious effects on hematopoiesis through derangement of hemoglobin synthesis, resulting in a shortened life span of circulating erythrocytes and anemia. Two enzymes that are essential in heme formation, and which are extremely sensitive to lead (usually resulting in decreased enzymatic activity), are delta aminolevulinic acid dehydratase (ALAD) and ferrochelatase (or heme synthetase) (Eisler, 1988).

The solubility of lead is low. Uptake of lead by terrestrial plants is limited by the low bioavailability of lead from soils; adverse effects seem to occur only at total lead concentrations of several hundred mg/kg in the soil (Eisler, 1988).

Death and delayed metamorphosis has been reported in amphibians exposed to high lead water concentrations (Eisler, 1988).

Lead poisoning in birds can be associated with impaired hematopoiesis; weakness; loss of appetite and starvation; impaired reproduction; neurotoxicity; impaired locomotion; accumulation in and damage to kidneys, liver, and bone; increased susceptibility to predation; and mortality. Trialkyllead salts are ten to a hundred times more toxic to birds than are inorganic lead salts; trialkyllead salts tend to accumulate in lipophilic soft tissues in the yolk and developing embryo, and have high potential as neurotoxicants (Eisler, 1988).

In mammals, organic lead compounds are more toxic than inorganic compounds, young animals are more sensitive than older animals, and the effects can be modified by nutrition and temperature. Lead toxicity can be associated with impairment of the central nervous system, gastrointestinal tract, muscular system, and hematopoietic function; reproductive impairment; loss of appetite; disturbed sleep patterns; visual impairment; increased susceptibility to infections; renal malfunction; peripheral nerve diseases affecting motor nerves of the extremities; reduced growth; reduced life span; and abnormal social behavior. Lead can cross the placenta and cause toxicity in the fetus during pregnancy, and can be passed in the milk to the newborn during lactation (Eisler, 1988).

Mercury

Mercury occurs naturally in the environment; however, human activities have markedly increased the mercury burdens in the environment (Eisler, 1987b; Smith, 1980). The water solubility of different forms of mercury ranges from low (elemental mercury and mercurous chloride), to high (methylmercury chloride), to very high (mercuric chloride) (Eisler, 1987b; Ney, 1990).

Microorganisms in the soil can convert various forms of mercury to methylmercury, which is then available for uptake and transfer in the food chain. Mercury in the soil can enter surface waters via runoff (Peterle, 1991).

Mercury and its compounds have no known normal metabolic function, and their presence in the cells of organisms represents contamination from natural and/or anthropogenic sources. Chemical speciation is probably the most important variable influencing the fate and ecotoxicology of mercury. Organic mercury compounds are more readily absorbed by organisms, are more soluble in lipids, pass more readily through biological membranes, are slower to be excreted, and are more toxic than inorganic mercury compounds. Methylmercury is the mercury species most hazardous to organisms because of these characteristics (Eisler, 1987b).

Mercury, especially methylmercury, can be bioconcentrated and bioaccumulated in organisms, and can be biomagnified through the food web of aquatic and terrestrial ecosystems. In organisms near the top of the food chain, almost all mercury accumulated is in the methylated form. In birds, mercury concentrations are generally higher in species that eat fish and other birds. In mammals, higher mercury concentrations have been recorded among fish-eaters (river otter, mink, and raccoon) in comparison to herbivores (beaver) (Eisler, 1987b).

The effects of mercury toxicity occur at all levels of the food chain, from reduced photosynthesis in algae to several toxic effects on vertebrates (Peterle, 1991). Mercury bioaccumulates in organisms and biomagnifies through the food chain (Eisler, 1987b). Mercury causes neurotoxic and other toxic effects, is mutagenic, carcinogenic, and teratogenic; mercury can cross the placenta in mammals and can be present in the milk (Eisler, 1987b; Peterle, 1991). At low concentrations, mercury reportedly affects reproduction, growth, development, behavior, blood and serum chemistry, motor coordination, vision, hearing, and metabolism (Eisler, 1987b). Organomercury compounds, especially methylmercury, are always more toxic than inorganic mercury compounds, and generally the early developmental stages of organisms are the most sensitive (Eisler, 1987b).

Earthworms (*Eisenia foetida*) exposed to soil containing methylmercury concentrations of 5.0 mg/kg have been reported to have a significant reduction in the number of segments regenerated after 12 weeks, and contained 85 mg/kg of mercury on a whole body fresh weight basis; regeneration was reported normal at a soil concentration of 1.0 mg/kg, although body burdens of up to 27 mg/kg were recorded. Soil contamination with methylmercury at these levels may pose a greater hazard to the predators of earthworms than to the earthworms (Eisler, 1987b).

Signs of mercury poisoning in birds includes muscular incoordination, slowness, fluffed feathers, withdrawal, hyporeactivity, falling eyelid, and behavioral changes. Organomercury compounds can interact with pesticides such as DDE to produce additive or synergistic toxicity, and with selenium to produce less-than-additive toxicity (Eisler, 1987b).

Mercury toxicity in mammals is associated with impairment of the normal functions of the central nervous system and gastrointestinal system. Higher incidence of stillbirths and mortality have also been reported in relation to mercury toxicity in mammals. In animals that have died from mercury poisoning, residues have been predominantly detected in brain, liver, blood, and kidney (Eisler, 1987b).

Nickel

Sources of nickel in the environment include weathering of rocks, as well as anthropogenic sources such as industrial discharges and burning coal and other fossil fuels. Nickel can strongly adsorb to particulate matter and may remain in a non-toxic form (U.S. EPA, 1986). Although elemental nickel is seldom found in nature and is not soluble in water, many nickel compounds are highly soluble in water. Nickel is almost always found in the divalent oxidation state, particularly in aquatic environments (Clement Associates, 1985). The divalent cation is generally considered the most toxic form of nickel, although several other oxidation states of the metal may occur (U.S. EPA, 1986). Uptake of nickel from the soil by plants can occur (Clement Associates, 1985). Bioconcentration, bioaccumulation, and food web biomagnification of nickel have been reported (Peterle, 1991; U.S. EPA, 1986).

Inhalation studies with animals suggest that nickel subsulfide and nickel carbonyl are carcinogenic in rats. Carcinogenic potential appears to be inversely related to the aqueous solubility of the nickel compounds, insoluble compounds being carcinogenic whereas soluble nickel forms generally are not. Mammalian cell transformation data indicate that several nickel compounds are mutagenic and can cause chromosomal alterations. Studies with experimental animals have suggested that nickel and

nickel compounds have relatively low acute and chronic oral toxicity (Clement Associates, 1985). However, nickel residues have been reported to specifically accumulate in the liver of exposed animals, particularly in birds and mammals (Peterle, 1991).

Tin

Tin is a naturally occurring metal present in some minerals. Although tin in soils is largely derived from tin in the bedrock, soil surface horizons generally contain fairly similar amounts of this element (Eisler, 1989; Kabata-Pendias and Pendias, 1992). Environmental pollution by tin is associated with the manufacture and use of numerous tin products, and the incineration of municipal wastes. The use of metallic tin artifacts dates back 5,000 years. Presently, tin is used on tinned food cans, various metal alloys, and in certain toothpastes with stannous fluoride. Inorganic tin compounds are also used in a variety of industrial processes such as the strengthening of glass, as a base for colors, as catalysts in various chemical reactions, as stabilizers in perfumes and soaps, and as dental anti-caries agents. Organotin use has increased rapidly in antifouling marine paints, in molluscicides, and in agricultural products, which often have caused adverse effects on nontarget biota (Eisler, 1989).

Soluble tin generally follows the behavior of iron and aluminum and remains in the weathered rock residue along with hydroxides of these metals. Tin has the ability to form complexes with organic substances, both soluble and insoluble. There is some evidence that inorganic tin is methylated in the aquatic environment to various methyl forms (Kabata-Pendias and Pendias, 1992).

Plants growing in soils with high tin contamination may accumulate high levels of tin in their tissues. High tin concentrations can be very toxic to both higher plants and fungi (Kabata-Pendias and Pendias, 1992).

In animals, inorganic tin compounds are generally not highly toxic due to their low solubility, poor absorption, low accumulation, and rapid excretion. In addition, inorganic tin has been reported to be essential for growth in rats (Eisler, 1989).

Of the 260 known organotin compounds, all but a few are manufactured, and many have been reported to be toxic. Synthetic organic compounds were first produced commercially in the 1960s, and may cause a variety of effects on animals, including impaired behavior and reduced growth, reproduction and survival. Carcinogenicity has not been reported. Organotins can alter enzyme activity levels in many organs and tissues including brain, liver, and kidney. Trialkyltins appear to be

the most toxic. However, significant differences in resistance to organotin compounds have been reported among and within species. Birds seem to be relatively resistant to organotins when compared to small mammals (Eisler, 1989).

Abiotic and biological degradation of organotins can occur through sequential dealkylation or dearylation, ultimately producing inorganic tin. In general, ultraviolet light and biological cleavage are the main factors that limit the persistence of organotin compounds in the environment. Organotins would be expected to bioaccumulate in lipid-rich biota tissues; however, the ability of microorganisms, algae, and higher organisms to reduce various organotins to metabolites that can be rapidly excreted seems to preclude food chain biomagnification (Eisler, 1989).

Vanadium

Vanadium is a naturally occurring metal present in rocks. It usually does not form its own minerals, but rather replaces other metals in crystal structures. In general, vanadium is distributed in soil profiles rather uniformly and the variation in vanadium content of soil is inherited from the parent rock materials. Vanadium pollution of soils can be associated with various industrial activities, including the industrial processing of certain mineral ores (ore smelters, cement, and phosphate rock plants), and burning of coals and oils. Combustion of fuel oils has been identified as an especially important source of vanadium in soil, as evidenced by reported high vanadium concentrations in soil in the vicinity of a crude oil refinery, a thermal power station at a graphite industry, and near densely inhabited areas (Kabata-Pendias and Pendias, 1992).

The geochemical characteristics and behavior of vanadium are strongly dependent on its oxidation state (+2, +3, +4 and +5) and on the acidity of the media. It has been reported that iron oxides commonly hold a considerable fraction of the vanadium in soil that may be available to plants, but clay minerals and organic acids may also be important. In general, vanadium tends to be associated with organic matter. Much of the vanadium in soil, and particularly the vanadyl cation (VO^{2+}), is mobilized as complexes with humic acids. Also, anionic vanadium forms are known to be mobile in soils and to be relatively more toxic to soil microbiota. Surface horizons of some podzolic soils are reported to contain less vanadium as a result of extensive leaching into lower horizons (Kabata-Pendias and Pendias, 1992).

Thus, the extent to which vanadium is transported is largely determined by the chemical species present and by environmental factors determining its solubility and binding to organic materials. In

addition, some vanadium compounds are volatile, and atmospheric transport of fumes as well as particulates can occur (Clement Associates, 1985).

Some bioaccumulation of vanadium has been reported. However, in mammals, it appears that excess vanadium can be rapidly excreted in the urine (Clement Associates, 1985).

It is not yet conclusive that vanadium is essential for the growth of higher plants; however, this element is essential for algal growth. Soluble vanadium in soil appears to be easily taken up by roots, and some species have a great ability to accumulate this metal. Plant uptake is usually a linear function of the vanadium concentration in soil and is highly dependent on the pH level, being more accentuated under acidic conditions. Phytotoxicity due to high vanadium concentrations has not been reported under field conditions; however, some phytotoxic effects, i.e., general dwarfing, reduced root length, and chlorosis have been reported in some plants under greenhouse conditions (Kabata-Pendias and Pendias, 1992).

Available data do not suggest that vanadium has carcinogenic, mutagenic, teratogenic, or reproductive effects in experimental animals. However, vanadium has been reported to be toxic to experimental animals by all routes of administration. Its toxicity generally increases with valence number, with pentavalent forms being the most toxic. Death of albino mice has been reported to occur from oral administration of high vanadium doses, with the lethal dose varying depending on the chemical form of the metal (Clement Associates, 1985). Chronic oral exposure to vanadium has reportedly caused diminished weight gains and gross pathological changes on rats, as well as death at the highest doses used in the experiment. The manifestation of vanadium toxicity in rats has been reported to be affected by the nutritional balance of the diet. Also, weight gain has been reported to be a possible response from well tolerated doses. Vanadium exposure may have effects in the vascular and central nervous systems, as well as in organs such as the liver, spleen, and kidneys (Patty, 1963). Effects on various enzyme systems may occur, especially under chronic exposure (Clement Associates, 1985). Under inhalation exposure to vanadium, rabbits have shown symptoms associated with irritation of mucous membranes (Patty, 1963).

Zinc

There are both natural and anthropogenic sources of zinc in the environment (Eisler, 1993). The solubilization of zinc minerals during the weathering of rocks produces mobile Zn^{2+} , especially in acid, oxidizing environments. Zinc is, however, also easily absorbed by mineral and organic components and

thus, in most soil types, its accumulation in the surface horizons is observed (Kabata-Pendias and Pendias, 1992).

Major sources of anthropogenic zinc in the environment include electroplaters, smelting and ore processors, mine drainage, several industrial activities, domestic and industrial sewage, combustion of fossil fuels and solid wastes, corrosion of zinc alloys and galvanized surfaces, erosion of agricultural soils, and road surface runoff. Soluble zinc complexes are readily transported in neutral and acidic waters (Eisler, 1993).

Zinc is an essential micronutrient in organisms, and is ubiquitous in the tissues of plants and animals. However, zinc can be toxic when present at high concentrations. Soluble chemical species of zinc, and particularly the aquo ion form, are the most bioavailable and most toxic. The patterns of zinc metabolism, toxicity, and accumulation can be affected by interactions with cadmium, copper, lead, nickel, and other metals, as well as by organic and biological agents (Eisler, 1993).

Zinc has the capacity to bioconcentrate and bioaccumulate in organisms (Eisler, 1993). However, zinc does not appear to biomagnify. Since zinc is an essential nutrient and is actively bioaccumulated, the environmental concentrations of zinc probably exhibit natural seasonal fluctuations (Clement Associates, 1985).

Sensitive terrestrial plants have been reported to die when soil zinc concentrations are above 100 mg/kg, and adverse effects on earthworm survival have been documented at zinc concentrations over 470 mg/kg. A 2-week LC_{50} value of 662 mg/kg of zinc in artificial soil has been reported for the earthworm *Eisenia foetida*. Reductions in populations of soil invertebrates have been attributed to high zinc concentrations in soils. Amphibian embryos have been reported to be more sensitive to zinc than are older stages (Eisler, 1993).

Reported effects of zinc toxicity in birds include death; reduced food intake; reduced egg deposition; inhibition of chick growth; immunosuppression; zinc accumulation in tissues; histopathologic effects on the pancreas, kidney, and liver; alterations of the zinc, copper, and iron metabolism; diarrhea; muscular weakness and loss of muscular control; and increased vulnerability to predation (Eisler, 1993).

From tests conducted with laboratory animals and livestock, mammals appear to be comparatively resistant to zinc toxicity. Nevertheless, excessive zinc intake can cause significant toxic effects (Eisler,

1993). Accidental zinc poisoning has been reported in cattle, causing severe enteritis and, in some cases, death. Postmortem findings showed severe pulmonary emphysema with changes in the myocardium, kidneys and liver; actually, zinc concentrations in the liver were extremely high. In horses and their offspring, excessive exposure to zinc has been associated with bone changes, joint afflictions, and lameness. In pigs, experimental dietary exposure to high zinc concentrations was reported to have caused decreased food intake and weight gain, as well as death at the highest concentrations; severe gastrointestinal changes and brain damage, both of which were accompanied by hemorrhages, were observed, as well as changes in the joints and high zinc concentrations in the liver (Clement Associates, 1985).

European ferrets (*Mustela putorius furo*) fed diets supplemented with 500 mg Zn/kg ration for up to 197 days were reported to survive with no significant histopathology. However, diets supplemented with 1,500 mg Zn/kg ration caused reduced food intake; loss of body weight; reductions in erythrocyte number, hemoglobin, and hematocrit; and mortality by day 21. Diets supplemented with 3,000 mg Zn/kg ration caused ferrets to die between days 9 and 13. Postmortem examination of dead ferrets revealed blood in the intestine and high zinc concentrations in the liver and kidney, as well as histopathological changes in these organs (Eisler, 1993).

7.3 POTENTIAL ECOLOGICAL EXPOSURE PATHWAYS

The preceding information on the ecological characterization of the site (Section 7.1) and the contaminants of potential ecological concern (Section 7.2) is integrated in the following subsections in order to: identify the potential ecological exposure pathways and associated receptors; discuss the potential for contaminant exposure in the four site areas; and define an appropriate ecological conceptual model for the site.

7.3.1 Potential Ecological Exposure Pathways and Associated Receptors

Contaminant exposure pathways for ecological receptors at the site are expected to be associated with exposed surficial soils, which in this study were represented by soil sample depths from 0 to 1 feet. Soils covered by pavement or concrete are not expected to provide an available exposure pathway for ecological receptors. Also, ecological receptors are generally not expected to be exposed to contaminants in deep soils or groundwater, although some burrowing wildlife species and deep-rooted plants may represent occasional exceptions to this assumption.

Contaminant exposure pathways for wildlife species associated with the site include inhalation, dermal contact, and ingestion of contaminated soil and/or prey with bioaccumulated contaminants. In the case of plants, exposure to soil contaminants may occur primarily via direct root absorption, but may also occur through the above-ground parts of the plant (shoot system) via the air exposure pathway, involving volatilized soil contaminants and deposition of air-borne contaminated soil particles.

Although surficial soil contaminants may potentially reach ecological receptors via the air exposure pathway (through volatilization or in air-borne soil particles), this pathway generally would not be expected to represent the major exposure pathway at the site, and the analytical data requirements and lack of appropriate toxicological information would not permit its evaluation.

The importance of dermal exposure to surface soil contaminants in animals is likely to depend on the animal species and the specific dermal surface characteristics. However, in general, it is expected that the dermal exposure pathway would be of secondary importance when compared to the potential exposure associated with the ingestion of contaminated soil or prey items. In addition, due to the lack of appropriate toxicological information and other data requirements, is generally not feasible to evaluate this exposure pathway for wildlife receptors.

In general, ingestion of surface soil contaminants is likely to represent the exposure pathway of greater importance for animal receptors associated with the site. Such exposure may occur via ingestion of contaminated soil and/or prey items. In addition to the exposure dose and intrinsic toxicity of a contaminant, several other factors are likely to influence the actual exposure of the receptor and its response to the contaminant. Such factors include: the chemical form of the contaminant; the absorption efficiency of the contaminant through the gastrointestinal tract; whether the contaminant is metabolized and, if so, the metabolization rate and the potential toxicity of the metabolites; whether the contaminant is excreted and, if so, the rate of excretion; and whether the contaminant is bioaccumulated in the tissues of the organism.

It is possible that the exposure to COPECs that biomagnify through food webs (such as Aroclor-1260, pesticides, mercury, and nickel) may be significant for receptors at higher trophic levels. However, ample foraging ranges and diversified diets of receptors at high trophic levels are likely to markedly attenuate the potential impacts of biomagnification of such COPECs in relation to the site.

7.3.2 Potential for Receptor Exposure to Contaminants of Potential Ecological Concern at the Four Site Areas

As indicated in Section 7.3.1, potential contaminant exposure pathways for ecological receptors at the site are expected to be associated with exposed surficial soils. Therefore, in addition to the actual presence of COPECs in the surface soil, the potential for contaminant exposure at each of the four site areas is expected to be proportional to the extent of exposed surface soil and the presence of vegetated areas.

Following is a discussion of the potential for receptor exposure to COPECs at the North Waterfront, Central Shipyard, Building 234 area, and South Waterfront. Approximate percents of exposed surface soil within each of the site areas have been estimated based on Figure 4-13, and are included in the discussion.

The North Waterfront has a limited extent of exposed surface soil, representing approximately 20.8 percent of this site area. The limited exposed surface soil within the North Waterfront is associated with an upland shrub/vine complex, an upland tree/shrub complex, and a small early successional grassland/invasive weed plot. COPECs identified for the North Waterfront Area include benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; pyrene; phenol; chromium; copper; lead; mercury; nickel; vanadium; and zinc (Table 7-2 A).

The Central Shipyard has an estimated 10 percent of exposed surface soil, which is associated with an early successional grassland/invasive weed area of approximately 1 acre, and with a small area of shrub vegetation. COPECs identified for the Central Shipyard include 2,4-dimethylphenol; 2-methylphenol; 4-methylphenol; anthracene; benzo(a)anthracene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; pyrene; phenol; Aroclor-1260; dieldrin; endrin ketone; methoxychlor; aluminum; chromium; copper; iron; mercury; nickel; and zinc (Table 7-2 B).

The only exposed surface soil in the Building 234 area is associated with two small early successional grassland/invasive weed areas, which represent approximately 10.4 percent of the Building 234 area. COPECs identified for the Building 234 area include benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene;

indeno(1,2,3-cd)pyrene; phenanthrene; pyrene; chromium; copper; iron; lead; nickel; vanadium; and zinc (Table 7-2 C).

The South Waterfront is not covered by buildings or pavement, and is the site area with the greatest expanse of exposed surface soil. The vegetation associated with the South Waterfront is a narrow corridor of upland shrub/scrub, which parallels a dune/beach strip along Narragansett Bay. COPECs identified for the South Waterfront include anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; pyrene; aluminum; chromium; copper; iron; lead; mercury; nickel; tin; vanadium; and zinc (Table 7-2 D).

Tables 7-3 A through D present maximum hazard quotients (HQs) for the COPECs identified for each of the site areas. These maximum HQs were calculated based on the maximum exposed surface soil concentrations of the COPECs identified in each site area (Tables 7-2 A through D) and the benchmark values selected for the COPEC screening process (Table 7-1). In addition, Tables 7-3 A through D also present maximum hazard indices (HIs) for each of the site areas based on their corresponding maximum HQs. As part of a conservative approach and because of the general interspersed nature of buildings, paved areas, isolated exposed surface soil locations, and vegetated areas at the site, it was considered more appropriate to generate maximum HQs and HIs instead of average HQs and HIs based on average concentrations, which would likely hold little ecological relevance given the characteristics of the site. Therefore, the use of maximum HQs and HIs allowed for a greater degree of flexibility, resolution, and ecological relevance on the interpretation of the data.

As presented on Tables 7-3 A through D, two HI values were calculated for each of the four site areas. The unadjusted maximum HI for a site area represents the direct sum of all the corresponding COPEC HQs, while the adjusted maximum HI is the result of multiplying the unadjusted HI by the corresponding percent (expressed in a decimal manner) of exposed surface soil present in the site area. Thus, the adjusted maximum HI values take into consideration the extents of exposed surface soil in the site areas, allowing for a more realistic assessment and comparison of the potentials for ecological exposure and associated risk.

The following adjusted maximum HIs were estimated:

<u>Site Area</u>	<u>Adjusted Maximum Hazard Index</u>
North Waterfront	$346.43 \times 0.208 = 72.06$
Central Shipyard	$1,203.59 \times 0.100 = 120.36$
Building 234 Area	$176.73 \times 0.104 = 18.38$
South Waterfront	$1,104.07 \times 1.00 = 1,104.07$

Based on the extent of exposed surface soil and the adjusted maximum HIs, the South Waterfront would be the area expected to represent the greatest relative potential for ecological exposure and associated risk at the site. By considering as major contributors to the HI value those COPECs with maximum HQs equal to or greater than 10, the major contributors to the South Waterfront HI (unadjusted or adjusted) are aluminum, chromium, vanadium, and zinc at sample location TP05, and nickel and tin at sample location TP04. The individual maximum HQs for all other COPECs in the South Waterfront were below 10 (Table 7-3 D). Of the total of 20 COPECs identified for the South Waterfront Area, the maximum concentrations of nine of the COPECs were detected at sample location TP06. Of the remaining COPECs, five of the maximum concentrations were detected at location TP05, five at location TP04, and one at location TP03. As presented on Figure 4-13, sample location TP06 is the South Waterfront sample location that is closest to the southern end of the paved and constructed portion of the site, with stations TP05, TP04, and TP03, respectively, being located progressively farther away to the south. These sample locations are situated within areas of grassland/shrub or shrub vegetation within the South Waterfront.

The maximum COPEC concentrations detected at sample location TP06 in the South Waterfront corresponded all to PAHs, while all the maximum COPEC concentrations detected at sample location TP05 corresponded to metals. Four of the maximum COPEC concentrations detected at sample location TP04 corresponded to metals, and one corresponded to a PAH. The only maximum COPEC concentration detected at sample location TP03 corresponded to mercury (Table 7-3 D). At sample location TP01, none of the contaminant concentrations detected met the criteria for COPEC identification, concentration above benchmark and maximum background concentration, while at sample location TP02, six analyte concentrations met these criteria (three PAHs, copper, nickel, and zinc), but none represented maximum analyte concentrations for the South Waterfront (Table 7-2 D).

Therefore, based on the information presented on Table 7-3 D, the potential for ecological risk in the South Waterfront appears to be primarily related to metals, with an additional component of potential risk due to PAHs. The major contributors to potential ecological risk appear to be aluminum, chromium, vanadium, zinc, nickel, and tin. In addition, the potential for ecological risk in the South Waterfront seems to be related mostly to the northern half of this site area which, as indicated in Section 4.5, appears to be significantly disturbed, with concrete debris being present.

It should be noted, however, that numerous metals were detected in one or both of the off-site upgradient sample locations at concentrations that exceeded, sometimes substantially, the benchmarks selected for the COPEC screening process. As can be recognized in Tables 7-2 A through D, off-site upgradient concentrations for the following metals exceeded benchmark values: aluminum, chromium, iron, manganese, mercury, nickel, tin, vanadium, and zinc. In the case of copper, the maximum off-site upgradient concentration was equal to the benchmark. Off-site upgradient concentrations of organic compounds did not exceed any of the corresponding benchmarks selected for the COPEC screening process. In addition, the off-site upgradient concentrations of aluminum, chromium, vanadium, zinc, nickel, and tin, which were the metals identified to be the major contributors to potential ecological risk in the South Waterfront, exceeded the corresponding metal concentrations detected at numerous South Waterfront sample locations.

The high concentrations of metals detected in the surface soil at the off-site upgradient locations and within the South Waterfront may be largely the result of the parent geologic materials and/or the industrialized and urbanized surroundings. The railroad Penn Central right-of-way and the Defense Highway, which are located along the site and directly upgradient from the South Waterfront, are also likely to represent important sources of contamination for the South Waterfront, and the overall site, particularly in relation to PAHs and various metals.

Site-related contribution of contaminants to the South Waterfront may also exist since the highest concentrations of COPECs exist in the northern half of this site area next to the Building 234 area, which is the southern end of the paved and constructed portion of the shipyard (Figure 4-13). COPECs with maximum HQs greater than 10 in the Building 234 area were vanadium, chromium, zinc, and nickel (Table 7-3 C). However, with the exception of zinc, the maximum surface soil concentrations of metals within the Building 234 area were all detected in sample locations TP09 and TP10, situated in the small grassland at the northern corner of the Building 234 area, between the railroad right-of-way and Defense Highway, far from the South Waterfront. In the case of zinc, the maximum surface

soil concentration in the Building 234 Area was detected at sample location MW09, in the grassland area abutting the northern end of the South Waterfront.

In addition to the COPECs with maximum HQs greater than 10 in the Building 234 area (vanadium, chromium, zinc, and nickel), there were 13 other COPECs in this site area, which included ten PAHs and three metals, all with maximum HQs below 10 (Table 7-3 C). With one exception, all of the maximum concentrations of these PAHs were associated with sample location MW09, adjacent to the South Waterfront (Figure 4-13). Conversely, maximum concentrations of phenanthrene, copper, iron, and lead were detected in either sample location TP09 or TP10, in the small grassland between the railroad right-of-way and Defense Highway in the northern corner of the Building 234 area, far from the South Waterfront.

The COPECs with maximum HQs equal to or greater than 10 in the North Waterfront were benzo(b)fluoranthene, fluoranthene, pyrene, chromium, nickel, vanadium, and zinc (Table 7-3 A). All of the maximum concentrations of these COPECs were detected at either sample location TP28 or TP16, which are adjacent to the Defense Highway; TP28 is in a small lawn area, and TP16 is at the edge of a strip of shrub vegetation (Figure 4-13). The other nine COPECs identified in the North Waterfront had maximum HQs below 10, and included five PAHs, phenol, and three metals. The maximum concentrations of the five PAHs were all associated with sample location TP28, while the maximum concentrations of the three metals were associated with either sample location TP16 or TP28. Phenol was only detected at sample location TP18, which is situated on dirt that was previously covered by asphalt.

The COPECs with maximum HQs greater than 10 in the Central Shipyard included Aroclor-1260, aluminum, chromium, 4-methylphenol, methoxychlor, nickel, zinc, phenol, and endrin ketone (Table 7-3 B). The maximum concentrations of these COPECs, except for 4-methylphenol and phenol, were all detected at sample location TP14, which is situated at the edge of shrub/tree vegetation near the railroad right-of-way and a paved road off of the Defense Highway (Figure 4-13). 4-methylphenol and phenol were only detected at sample location TP17, situated on a dirt area without vegetation. The other 16 COPECs identified in the Central Shipyard had maximum HQs below 10, and included ten PAHs, two other semivolatile organic compounds, dieldrin, and three metals. The maximum concentrations of these ten PAHs were all detected at sample location TP15, which is situated in a small weed area surrounded by concrete and asphalt that corresponds to the former location of a tank storage pad. The two other SVOCs, 2,4-dimethylphenol and 2-methylphenol, were only detected at the sample location TP17, where 4-methylphenol and phenol were also detected. The maximum

concentrations of copper and iron were detected at sample location TP14 near the railroad right-of-way, while the maximum concentration of mercury was detected at sample location TP15 in the small weed area surrounded by concrete and asphalt.

The COPEC with the greatest contribution to the Central Shipyard HI was Aroclor-1260 (Table 7-3 B). Except for sample locations TP14 and TP15, this contaminant was not detected at any other sample location within the Central Shipyard (Table 7-2 B). Only the Aroclor-1260 concentration at sample location TP14 exceeded the corresponding benchmark for the contaminant, providing the basis for the identification of this contaminant as a COPEC for the Central Shipyard. It should be noted that the high Aroclor-1260 concentration reported for sample location TP14 was from a dilution result. In addition, dieldrin, endrin ketone, and methoxychlor were detected within the Central Shipyard only at sample location TP14. As indicated above, sample location TP14 is situated at the edge of shrub/tree vegetation near the railroad right-of-way and a paved road off of the Defense Highway (Figure 4-13). Aroclor-1260, dieldrin, endrin ketone, and methoxychlor were not identified to be COPECs for any site area other than the Central Shipyard.

COPECs with maximum HQs greater than 10 were not detected in the early successional grassland/invasive weed area of approximately 1 acre which exists near the southern end of Building 42 in the Central Shipyard (Figure 4-13). Actually, none of the maximum concentrations of the COPECs identified for the Central Shipyard was associated with the sample locations within the grassland/invasive weed area, i.e., TP11, TP12, and MW07, (Tables 7-2 B and 7-3 B). The only COPECs identified for this portion of the Central Shipyard were chromium, copper, iron, mercury, nickel, and zinc, which in general were detected at concentrations comparable or slightly higher than the corresponding off-site upgradient concentration ranges (Table 7-2 B). In fact, chromium concentrations at sample locations MW07 and TP11, and zinc concentrations at sample location TP11, were below the corresponding maximum off-site upgradient concentrations.

7.3.3 Ecological Conceptual Model for the Site

Based on the discussions presented in Sections 7.3.1 and 7.3.2, relevant ecological exposure to COPECs in exposed surface soils at the site could potentially occur in the South Waterfront, particularly in the northern half of this site area. The potential risk associated with the exposure of ecological receptors in the South Waterfront would likely be primarily related to metals, with an additional component of potential risk due to PAHs. The major contributors to potential ecological risk would probably be aluminum, chromium, vanadium, zinc, nickel, and tin. However, the South Waterfront is

of limited habitat value and the northern half appears significantly disturbed, with concrete debris being present. In addition, off-site upgradient concentrations of numerous metals (including aluminum, chromium, vanadium, zinc, nickel, and tin) exceed the benchmarks selected for the COPEC screening process. Furthermore, the adjoining Penn Central railroad right-of-way and Defense Highway are likely to be contributors of contaminants, such as PAHs and some metals, to the South Waterfront and the site in general.

Because of its extent of approximately 1 acre, the early successional grassland/invasive weed area in the Central Shipyard is an additional portion of the site where relevant ecological exposure could conceivably occur. However, the metals identified as COPECs for this portion of the site and, in particular, the comparison of their concentrations to the corresponding off-site upgradient concentrations, indicate that the relative potential of ecological risk associated with this area is likely to be minimal.

Given the reduced extent of exposed surface soil present in other areas of the site and the general lack of associated wildlife habitat or its minimal value, relevant ecological exposure and risk are generally not anticipated to exist in association with the remaining portions of exposed surface soil in the shipyard.

7.4 CONCLUSIONS

Contaminant exposure pathways for terrestrial ecological receptors at the shipyard could potentially exist in association with the limited areas of exposed surficial soils, and could primarily involve the ingestion of contaminated soil and/or prey with bioaccumulated contaminants in the case of wildlife receptors, and direct root absorption in the case of plants.

However, given the surroundings of the site and since it is mostly covered by buildings or pavement, with the remainder being fragmented areas of nil or minimal habitat value, the overall likelihood of relevant ecological exposure and risk associated with the site is expected to be relatively minimal. Therefore, conducting a formal terrestrial ecological risk assessment for the site would be unnecessary and unjustified. Where concentrations of specific COPECs seem particularly high, such as for Aroclor-1260 at sample location TP14 in the Central Shipyard, and for various metals at sample locations TP04 and TP05 in the South Waterfront, additional limited studies may be warranted to confirm analytical results or further define the attribution, nature, and extent of the contamination, and to support decisions about the need for possible localized remedial actions.

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TABLE 7-1
BENCHMARKS SELECTED FOR SCREENING OF CONTAMINANTS OF
POTENTIAL ECOLOGICAL CONCERN IN EXPOSED SURFACE SOIL
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Volatile Organic Compounds ($\mu\text{g}/\text{kg}$)		
2-Butanone*	na	
Acetone*	na	
Methylene chloride*	< 300	U.S. EPA, 1995; screening level for flora and fauna.
Toluene*	100	U.S. EPA, 1995; screening level for flora and fauna.
Xylenes (total)	< 100	U.S. EPA, 1995; screening level for fauna, for unspecified xylene.
Semivolatile Organic Compounds ($\mu\text{g}/\text{kg}$)		
2,2'-Oxybis(1-chloropropane)	na	
2,4-Dimethylphenol	100	U.S. EPA, 1995; screening level for flora and fauna.
2-Chlorophenol	100	U.S. EPA, 1995; screening level for flora and fauna.
2-Methylphenol	100	U.S. EPA, 1995; screening level for flora and fauna.
4-Methylphenol	100	U.S. EPA, 1995; screening level for flora and fauna.
Acenaphthene	100	U.S. EPA, 1995; screening level for flora and fauna.
Anthracene	100	U.S. EPA, 1995; screening level for flora and fauna.
Benzo(a)anthracene	100	U.S. EPA, 1995; screening level for flora and fauna.
Benzo(a)pyrene	100	U.S. EPA, 1995; screening level for fauna.
Benzo(b)fluoranthene	100	U.S. EPA, 1995; screening level for flora and fauna.
Benzo(g,h,i)perylene	100	U.S. EPA, 1995; screening level for flora and fauna.
Benzo(k)fluoranthene	100	U.S. EPA, 1995; screening level for flora and fauna.
Bis(2-ethylhexyl)phthalate*	200,000	Benchmark for di-n-butylphthalate used as surrogate.
Carbazole	na	
Chrysene	100	U.S. EPA, 1995; screening level for flora and fauna.
Di-n-butylphthalate*	200,000	Will and Suter, 1995a; screening benchmark for plants.
Di-n-octylphthalate*	200,000	Benchmark for di-n-butylphthalate used as surrogate.
Dibenzo(a,h)anthracene	100	U.S. EPA, 1995; screening level for flora and fauna.
Fluoranthene	100	U.S. EPA, 1995; screening level for flora and fauna.
Fluorene	100	U.S. EPA, 1995; screening level for flora and fauna.
Indeno(1,2,3-cd)pyrene	100	U.S. EPA, 1995; screening level for flora and fauna.
Phenanthrene	100	U.S. EPA, 1995; screening level for flora and fauna.
Phenol	100	U.S. EPA, 1995; screening level for flora and fauna.
Pyrene	100	U.S. EPA, 1995; screening level for flora and fauna.

**TABLE 7-1
BENCHMARKS SELECTED FOR SCREENING OF ECOLOGICAL
CONTAMINANTS OF POTENTIAL CONCERN IN EXPOSED SURFACE SOIL
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND
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ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Butyltins ($\mu\text{g}/\text{kg}$)		
Tetrabutyltin	5,000	No <i>soil</i> benchmark available. <i>Sediment</i> concentration by Macauley et al. (1994) used as a surrogate. ¹
Tributyltin	5,000	No <i>soil</i> benchmark available. <i>Sediment</i> concentration by Macauley et al. (1994) used as a surrogate. ¹
Dibutyltin	5,000	No <i>soil</i> benchmark available. <i>Sediment</i> concentration by Macauley et al. (1994) used as a surrogate. ¹
Monobutyltin	5,000	No <i>soil</i> benchmark available. <i>Sediment</i> concentration by Macauley et al. (1994) used as a surrogate. ¹
Pesticides / PCBs ($\mu\text{g}/\text{kg}$)		
4,4'-DDD	< 100	U.S. EPA, 1995; screening level for flora and fauna.
4,4'-DDE	< 100	U.S. EPA, 1995; screening level for flora and fauna.
4,4'-DDT	< 100	U.S. EPA, 1995; screening level for flora and fauna.
Alpha-chlordane	< 100	U.S. EPA, 1995; screening level for flora and fauna, for unspecified chlordane.
Aroclor-1260	100	U.S. EPA, 1995; screening level for flora, unspecified PCBs. Lowest available benchmark selected due to bioaccumulation potential.
Dieldrin	< 100	U.S. EPA, 1995; screening level for flora and fauna.
Endrin	< 100	U.S. EPA, 1995; screening level for flora and fauna.
Endrin ketone	< 100	Benchmark for Endrin used as surrogate.
Gamma-chlordane	< 100	U.S. EPA, 1995; screening level for flora and fauna, for unspecified chlordane.
Heptachlor	50	USSR-SCST, 1984; maximum allowable concentration.
Heptachlor epoxide	< 100	U.S. EPA, 1995; screening level for flora and fauna.
Methoxychlor	< 100	U.S. EPA, 1995; screening level for flora and fauna.
Metals (mg/kg)		
Aluminum	50	Will and Suter, 1995a; screening benchmark for plants.
Antimony	5	Will and Suter, 1995a; screening benchmark for plants.
Arsenic	60	Will and Suter, 1995b; screening benchmark for earthworms.
Barium	440	U.S. EPA, 1995; screening level for flora and fauna.
Beryllium	10	Will and Suter, 1995a; screening benchmark for plants.
Cadmium	2.5	U.S. EPA, 1995; screening level for flora. Lowest available benchmark selected due to bioaccumulation potential.
Chromium	0.4	Will and Suter, 1995b; screening benchmark for earthworms.
Cobalt	100	U.S. EPA, 1995; screening level for flora.

**TABLE 7-1
 BENCHMARKS SELECTED FOR SCREENING OF ECOLOGICAL
 CONTAMINANTS OF POTENTIAL CONCERN IN EXPOSED SURFACE SOIL
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
 PAGE 3 OF 3**

ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Metals (mg/kg. Continued)		
Copper	15	U.S. EPA, 1995; screening level for flora.
Iron	14,000	Will and Suter, 1995b; geometric mean soil concentration in eastern U.S.
Lead	50	Will and Suter, 1995a; screening benchmark for plants.
Manganese	330	U.S. EPA, 1995; screening level for flora and fauna.
Mercury	0.058	U.S. EPA, 1995; screening level for flora and fauna. Unspecified if for organic and/or inorganic mercury forms. Lowest available benchmark selected due to bioaccumulation potential.
Nickel	2	U.S. EPA, 1995; screening level for flora.
Selenium	1.8	U.S. EPA, 1995; screening level for flora and fauna.
Silver	2	Will and Suter, 1995a; screening benchmark for plants.
Thallium	1	Will and Suter, 1995a; screening benchmark for plants.
Tin	0.89	U.S. EPA, 1995; screening level for flora and fauna.
Vanadium	0.5	U.S. EPA, 1995; screening level for flora.
Zinc	10	U.S. EPA, 1995; screening level for flora.
Total Petroleum Hydrocarbons (mg/kg)		
TPH	na	

NOTES:

- na - Appropriate benchmark for ecological screening was not available.
- 1 - A sediment concentration of 5 ng Sn/g (= 5,000 µg/kg) or greater has been suggested as being indicative of degraded conditions in estuarine environments, including possible ecological effects (Macauley *et al.*, 1994).
- * - Analyte is a common laboratory contaminant (U.S. EPA, 1992).

TABLE 7-2 A
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Analyte	Off-Site Range ²	Benchmark ³	Sample TP16	Sample TP18	Dupl. TP18	Sample TP24	Dupl. TP24	Sample TP28
Volatile Organic Compounds (µg/kg)								
2-Butanone*	ND	na	ND	ND	ND	14	ND	ND
Acetone*	5 J - 13	na	14	110	120	99	33	8 J
Methylene chloride*	14 - 19	< 300	3 J	5 J	4 J	6 J	6 J	21
Toluene*	ND	100	ND	ND	1 J	2 J	ND	ND
Xylenes, total	ND	< 100	ND	ND	ND	2 J	ND	ND
Semivolatile Organic Compounds (µg/kg)								
2,2'-Oxybis(1-chloropropane)	ND	na	ND	ND	39 J	ND	ND	ND
Benzo(a)anthracene	ND	100	ND	ND	ND	ND	53 J	710 J **
Benzo(a)pyrene	ND	100	ND	ND	ND	ND	44 J	680 J **
Benzo(b)fluoranthene	ND - 55 J	100	ND	ND	ND	ND	71 J	1,000 J **
Bis(2-ethylhexyl)phthalate*	90 J - 210 J	200,000	ND	150 J	65 J	97 J	43 J	1,500 J
Chrysene	ND	100	ND	ND	ND	ND	44 J	690 J **
Fluoranthene	53 J - 63 J	100	ND	ND	ND	ND	81 J	1,400 J **
Indeno(1,2,3-cd)pyrene	ND	100	ND	ND	ND	ND	ND	520 J **
Phenanthrene	ND	100	ND	ND	ND	ND	54 J	730 J **
Phenol	ND	100	ND	170 J **	ND	ND	ND	ND
Pyrene	54 J - 59 J	100	1,400 J **	ND	ND	ND	ND	1,300 J **
Butyltins (µg/kg)								
Tetrabutyltin	ND	5,000	ND	ND	ND	7.6 J	25 J	ND
Tributyltin	ND - 11 J	5,000	46.3 J	14 J	ND	ND	ND	ND
Dibutyltin	ND	5,000	51.1	21 J	12 J	ND	ND	ND
Monobutyltin	ND	5,000	51.9	ND	ND	ND	ND	ND

**TABLE 7-2 A
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 NORTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DEREKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample TP16	Sample TP18	Dupl. TP18	Sample TP24	Dupl. TP24	Sample TP28
Pesticides/PCBs (µg/kg)								
4,4'-DDE	ND - 27	< 100	ND	ND	ND	ND	ND	22
4,4'-DDT	ND - 32	< 100	ND	ND	ND	ND	ND	56 D
Alpha-chlordane	ND	< 100	ND	ND	ND	ND	ND	7.3
Aroclor-1260	ND	100	24 J	ND	ND	ND	ND	ND
Dieldrin	ND	< 100	16	ND	ND	ND	ND	ND
Endrin	ND	< 100	26	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	< 100	ND	ND	ND	ND	ND	4.2
Metals (mg/kg)								
Aluminum	13,100 - 13,200	50	8,290	5,280	5,250	4,940	4,960	9,100
Arsenic	19.5 - 20.3	60	4.7	4.2	5	5.7	5.5	10.9
Barium	20.1 - 36.3	440	49.4	28.6	11.1	13	12.9	26.6
Beryllium	0.43 - 0.76	10	1.1	0.18	0.23	0.25	0.19	0.38
Cadmium	ND - 0.61	2.5	0.85	ND	ND	ND	ND	ND
Chromium	15 - 16.4	0.4	24.1 **	6.6	7	6.3	6.1	12.0
Cobalt	10.5 - 18.4	100	14.7	8	8	9	9	7.3
Copper	11.2 - 15	15	111 **	22.9 **	26.9 **	20.7 **	18.7 **	20.4 **
Iron	26,900 - 28,200	14,000	19,600	15,400	17,400	17,700	17,400	19,100
Lead	16.2 - 18.3	50	85.5 **	20.6	14.8	7.5	7.3	115 **
Manganese	338 - 1,580	330	187	284	299	400	329	314
Mercury	ND - 0.08	0.058	0.1 **	ND	0.05	ND	ND	0.17 **

**TABLE 7-2 A
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 NORTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-site range ²	Benchmark ³	Sample TP16	Sample TP18	Dupl. TP18	Sample TP24	Dupl. TP24	Sample TP28
Metals (mg/kg, Continued)								
Nickel	19.2 - 21.4	2	68.5 **	13	14	15.7	14.9	14.5
Selenium	ND	1.8	0.99	0.64	ND	0.69	0.63	ND
Tin	ND - 13.4	0.89	12.2	ND	ND	ND	ND	ND
Vanadium	21.7 - 22.2	0.5	22.4 **	9.9	9.2	9	8.9	39 **
Zinc	49.7 - 54	10	883 **	76.4 **	77.8 **	40.1	39.1	59.6 **
Total Petroleum Hydrocarbons (mg/kg)								
TPH	ND - 260	na	4,900	170	ND	ND	ND	130

NOTES:

- 1 All sample depth intervals are 0 to 1 feet, except Sample TP24 and its duplicate for which the sample depth interval is 1 to 2 feet.
- 2 Data from the two off-site sample locations: MW01 and MW10.
- 3 Benchmark values as presented on Table 7-1.

- * Analyte is a common laboratory contaminant (U.S. EPA, 1992).
- ** Sample concentration exceeds benchmark concentration and maximum background concentration; analyte considered to be a contaminant of potential ecological concern.

- ND Analyte not detected above the sample quantitation limit.
- NA Not analyzed.
- na Appropriate benchmark for ecological screening was not available.
- J Estimated quantitation.
- D Dilution result.
- Dupl. Field duplicate sample.

TABLE 7-2 B
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Analyte	Off-Site Range ²	Benchmark ³	Sample MW05	Dupl. MW05	Sample MW07	Sample TP11	Sample TP12	Sample TP14	Sample TP15	Sample TP17
Volatile Organic Compounds (µg/kg)										
2-Butanone*	ND	na	ND	2 J	ND	ND	ND	ND	ND	ND
Acetone*	5 J - 13	na	11	12	6 J	ND	ND	ND	ND	ND
Methylene chloride*	14 - 19	< 300	23	18	15	7 J	6 J	7 J	6 J	6 J
Semivolatile Organic Compounds (µg/kg)										
2,2'-Oxybis(1-chloropropane)	ND	na	ND	ND	ND	ND	ND	ND	180 J	410
2,4-Dimethylphenol	ND	100	ND	ND	ND	ND	ND	ND	ND	320 J **
2-Chlorophenol	ND	100	ND	ND	ND	ND	ND	ND	ND	40 J
2-Methylphenol	ND	100	ND	ND	ND	ND	ND	ND	ND	560 **
4-Methylphenol	ND	100	ND	ND	ND	ND	ND	ND	ND	2,400 **
Acenaphthene	ND	100	ND	ND	ND	ND	ND	ND	92 J	ND
Anthracene	ND	100	ND	ND	ND	ND	ND	ND	130 J **	ND
Benzo(a)anthracene	ND	100	ND	ND	ND	ND	ND	ND	410 **	140 J **
Benzo(a)pyrene	ND	100	ND	ND	ND	ND	ND	ND	86 J	ND

**TABLE 7-2 B
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample MW05	Dupl. MW05	Sample MW07	Sample TP11	Sample TP12	Sample TP14	Sample TP15	Sample TP17
Semivolatile Organic Compounds ($\mu\text{g}/\text{kg}$, Continued)										
Benzo(b)fluoranthene	ND - 55 J	100	ND	ND	ND	ND	ND	ND	410 **	280 J **
Benzo(g,h,i)perylene	ND	100	ND	ND	ND	ND	ND	ND	110 J **	56 J
Benzo(k)fluoranthene	ND	100	ND	ND	ND	ND	ND	ND	360 J **	ND
Bis(2-ethylhexyl)phthalate*	90 J - 210 J	200,000	ND	ND	ND	37 J	ND	ND	44 J	ND
Carbazole	ND	na	ND	ND	ND	ND	ND	ND	97 J	ND
Chrysene	ND	100	ND	ND	ND	ND	ND	ND	420 **	130 J **
Fluoranthene	53 J - 63 J	100	ND	ND	ND	ND	ND	ND	870 **	270 J **
Fluorene	ND	100	ND	ND	ND	ND	ND	ND	65 J	ND
Indeno(1,2,3-cd)pyrene	ND	100	ND	ND	ND	ND	ND	ND	150 J **	73 J
Phenanthrene	ND	100	ND	ND	ND	ND	ND	ND	580 **	140 J **
Phenol	ND	100	ND	ND	ND	ND	ND	ND	ND	1,200 **
Pyrene	54 J - 59 J	100	ND	ND	ND	ND	ND	ND	740 **	240 J **
Butyltins ($\mu\text{g}/\text{kg}$)										
Tetrabutyltin	ND	5,000	ND	ND	ND	ND	ND	ND	14.2 J	ND
Tributyltin	ND - 11 J	5,000	ND	ND	ND	ND	ND	ND	7.67 J	ND

**TABLE 7-2 B
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample MW05	Dupl. MW05	Sample MW07	Sample TP11	Sample TP12	Sample TP14	Sample TP15	Sample TP17
Pesticides/PCBs (µg/kg)										
4,4'-DDD	ND	< 100	ND	ND	ND	ND	ND	ND	4.3	ND
4,4'-DDT	ND - 32	< 100	ND	ND	ND	ND	ND	ND	6.2	ND
Aroclor-1260	ND	100	ND	ND	ND	ND	ND	71,000 D**	32 J	ND
Dieldrin	ND	< 100	ND	ND	ND	ND	ND	470 **	ND	ND
Endrin ketone	ND	< 100	ND	ND	ND	ND	ND	1,100 **	ND	ND
Methoxychlor	ND	< 100	ND	ND	ND	ND	ND	2,300 **	ND	ND
Metals (mg/kg)										
Aluminum	13,100 - 13,200	50	8,060	8,300	13,100	12,100	13,200	14,400 **	12,700	5,820
Arsenic	19.5 - 20.3	60	5.8	4.9	23.9	24.4	20.1	9.5	19.3	3.9
Barium	20.1 - 36.3	440	12.5	12.4	12.1	17.1	21.4	19.8	24	14.5
Beryllium	0.43 - 0.76	10	0.26	0.26	0.38	0.41	0.42	0.31	0.47	0.23
Cadmium	ND - 0.61	2.5	ND	ND	ND	0.97	0.88	1.2	1.0	0.75
Chromium	15 - 16.4	0.4	10	9.6	15.8	15.6	18.2 **	19 **	16.8 **	11.0
Cobalt	10.5 - 18.4	100	9.3	8.6	14.7	14.4	14.4	12	12.2	7.6
Copper	11.2 - 15	15	15.2 **	15.1 **	19.5 **	25.6 **	31.8 **	33 **	29.6 **	23.1 **
Iron	26,900 - 28,200	14,000	18,000	19,000	31,000 **	31,800 **	32,500 **	32,900 **	31,200 **	23,200
Lead	16.2 - 18.3	50	5.8	21.2	9.2	10.3	14.7	24.8	27.4	26.2
Manganese	338 - 1,580	330	323	272	448	445	421	318	349	325
Mercury	ND - 0.08	0.058	ND	ND	0.12 **	0.09 **	0.11 **	0.11 **	0.13 **	0.08

**TABLE 7-2 B
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 CENTRAL SHIPYARD
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
 PAGE 4 OF 4**

Analyte	Off-Site Range ²	Benchmark ³	Sample MW05	Dupl. MW05	Sample MW07	Sample TP11	Sample TP12	Sample TP14	Sample TP15	Sample TP17
Metals (mg/kg, Continued)										
Nickel	19.2 - 21.4	2	14.5	15.3	24.9 **	23.7 **	27.1 **	27.4 **	24.4 **	15.6
Selenium	ND	1.8	ND	ND	ND	0.87	0.74	ND	1.2	ND
Vanadium	21.7 - 22.2	0.5	8.6	8.9	14.5	17.8	18.9	21.2	21.8	13.7
Zinc	49.7 - 54	10	32.7	34	54.8 **	51.2	70.2 **	123 **	71 **	60 **
Total Petroleum Hydrocarbons (mg/kg)										
TPH	ND - 260	na	ND	ND	ND	ND	2,000	1,700	68	170

NOTES:

- 1 All sample depth intervals are 0 to 1 feet.
 - 2 Data from the two off-site sample locations: MW01 and MW10.
 - 3 Benchmark values as presented on Table 7-1.
- Analyte is a common laboratory contaminant (U.S. EPA, 1992).
 - ** Sample concentration exceeds benchmark concentration and maximum background concentration; analyte considered to be a contaminant of potential ecological concern.
- ND Analyte not detected above the sample quantitation limit.
 NA Not analyzed.
 na Appropriate benchmark for ecological screening was not available.
 J Estimated quantitation.
 D Dilution result.
 Dupl. Field duplicate sample.

TABLE 7-2 C
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
BUILDING 234 AREA
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Analyte	Off-Site Range ²	Benchmark ³	Sample MW09	Sample TP07	Sample TP08	Dupl. TP08	Sample TP09	Sample TP10
Volatile Organic Compounds (µg/kg)								
2-Butanone*	ND	na	ND	6 J	ND	3 J	ND	ND
Acetone*	5 J - 13	na	10 J	26	19	20	7 J	5 J
Methylene chloride*	14 - 19	< 300	31	10 J	11	11	9 J	6 J
Toluene*	ND	100	ND	1 J	2 J	1 J	ND	ND
Semivolatile Organic Compounds (µg/kg)								
Acenaphthene	ND	na	ND	ND	ND	ND	ND	46 J
Anthracene	ND	100	51 J	ND	ND	ND	ND	65 J
Benzo(a)anthracene	ND	100	470 **	170 J **	ND	ND	ND	250 J **
Benzo(a)pyrene	ND	100	410 **	200 J **	ND	ND	ND	210 J **
Benzo(b)fluoranthene	ND - 55 J	100	660 **	410 J **	38 J	77 J	ND	340 J **
Benzo(g,h,i)perylene	ND	100	190 J **	ND	ND	ND	ND	160 J **
Benzo(k)fluoranthene	ND	100	279 J **	ND	ND	ND	ND	140 J **
Bis(2-ethylhexyl)phthalate*	90 J - 210 J	200,000	250 J	8,700	1,600	380	2,700	930
Carbazole	ND	na	ND	ND	ND	ND	ND	56 J
Chrysene	ND	100	580 **	310 J **	ND	41 J	ND	290 J **
Di-n-butylphthalate*	ND	200,000	64 J	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	100	62 J	ND	ND	ND	ND	ND
Fluoranthene	53 J - 63 J	100	770 **	ND	50 J	100 J	ND	470 **
Indeno(1,2,3-cd)pyrene	ND	100	190 J **	ND	ND	ND	ND	150 J **
Phenanthrene	ND	100	180 J **	ND	36 J	47 J	ND	350 J **
Pyrene	54 J - 59 J	100	750 **	320 J **	72 J	72 J	ND	560 **

TABLE 7-2 C
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 BUILDING 234 AREA
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample MW09	Sample TP07	Sample TP08	Dupl. TP08	Sample TP09	Sample TP10
Butyltins (µg/kg)								
Tetrabutyltin	ND	5,000	ND	ND	ND	ND	19 J	ND
Tributyltin	ND - 11 J	5,000	ND	ND	ND	ND	3.5 J	ND
Pesticides/PCBs (µg/kg)								
4,4'-DDE	ND - 27	< 100	ND	ND	ND	4.5	ND	ND
4,4'-DDT	ND - 32	< 100	5.2	ND	8.9	8.3	ND	5
Aroclor-1260	ND	100	ND	ND	ND	ND	ND	24 J
Gamma-Chlordane	ND	< 100	ND	ND	ND	ND	ND	3.9
Heptachlor	ND	50	ND	ND	ND	ND	ND	4.5
Metals (mg/kg)								
Aluminum	13,100 - 13,200	50	5,260	4,930	5,910	6,340	11,300	10,000
Arsenic	19.5 - 20.3	60	5.3	3.9	4.9	7.4	23.6	15.8
Barium	20.1 - 36.3	440	12.9	8.9	46.8	42	18	28.1
Beryllium	0.43 - 0.76	10	ND	0.18	0.21	0.24	0.44	0.54
Chromium	15 - 16.4	0.4	13.7	12.3	15	16	16	18.4 **
Cobalt	10.5 - 18.4	100	7	5.4	7.9	8.6	21.4	13.5
Copper	11.2 - 15	15	25.5 **	16.8 **	26.7 **	26.9 **	26.4 **	35 **
Iron	26,900 - 28,200	14,000	16,900	14,500	19,500	21,100	37,200 **	26,700
Lead	16.2 - 18.3	50	23.4	17.2	52.8 **	50.2 **	12.8	62.5 **
Manganese	338 - 1,580	330	307	195	291	310	597	448

**TABLE 7-2 C
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 BUILDING 234 AREA
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample MW09	Sample TP07	Sample TP08	Dupl. TP08	Sample TP09	Sample TP10
Metals (mg/kg, Continued)								
Nickel	19.2 - 21.4	2	17.8	12.6	16.3	18.2	28.2 **	26.7 **
Vanadium	21.7 - 22.2	0.5	16.7	10.1	12.2	13.9	20	23.2 **
Zinc	49.7 - 54	10	175 **	63.6 **	131 **	126 **	75.3 **	139 **
Total Petroleum Hydrocarbons (mg/kg)								
TPH	ND - 260	na	77	ND	ND	ND	ND	61

NOTES:

- 1 All sample depth intervals are 0 to 1 feet.
 - 2 Data from the two off-site sample locations: MW01 and MW10.
 - 3 Benchmark values as presented on Table 7-1.
- Analyte is a common laboratory contaminant (U.S. EPA, 1992).
 - Sample concentration exceeds benchmark concentration and maximum background concentration; analyte considered to be a contaminant of potential ecological concern.
- ND Analyte not detected above the sample quantitation limit.
 NA Not analyzed.
 na Appropriate benchmark for ecological screening was not available.
 J Estimated quantitation.
 D Dilution result.
 Dupl. Field duplicate sample.

TABLE 7-2 D
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Analyte	Off-Site Range ²	Benchmark ³	Sample TP01	Sample TP02	Sample TP03	Sample TP04	Sample TP05	Sample TP06
Volatile Organic Compounds (µg/kg)								
Acetone*	5 J - 13	na	12	ND	25	6 J	12	11
Methylene chloride*	14 - 19	< 300	13	11	43	13	11	10
Semivolatile Organic Compounds (µg/kg)								
Anthracene	ND	100	ND	ND	ND	150 J **	ND	ND
Benzo(a)anthracene	ND	100	58 J	71 J	ND	120 J **	93 J	210 J **
Benzo(a)pyrene	ND	100	55 J	46 J	ND	84 J	81 J	160 J **
Benzo(b)fluoranthene	ND - 55 J	100	88 J	81 J	ND	120 J **	120 J **	270 J **
Benzo(g,h,i)perylene	ND	100	42 J	ND	ND	55 J	54 J	ND
Benzo(k)fluoranthene	ND	100	38 J	41 J	ND	86 J	66 J	150 J **
Bis(2-ethylhexyl)phthalate*	90 J - 210 J	200,000	75 J	170 J	ND	55 J	1,100	240 J
Chrysene	ND	100	53 J	61 J	ND	130 J **	94 J	230 J **
Fluoranthene	53 J - 63 J	100	71 J	150 J **	ND	320 J **	220 J **	460 J **
Indeno(1,2,3-cd)pyrene	ND	100	42 J	ND	ND	55 J	49 J	110 J **
Phenanthrene	ND	100	ND	120 J **	ND	160 J **	94 J	280 J **
Pyrene	54 J - 59 J	100	73 J	130 J **	ND	190 J **	140 J **	380 J **
Butyltins (µg/kg)								
Tributyltin	ND - 11 J	5,000	ND	ND	ND	ND	3.1 J	4.5 J
Dibutyltin	ND	5,000	ND	ND	ND	ND	ND	4.3 J

**TABLE 7-2 D
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 SOUTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
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Analyte	Off-Site Range ²	Benchmark ³	Sample TP01	Sample TP02	Sample TP03	Sample TP04	Sample TP05	Sample TP06
Pesticides/PCBs (µg/kg)								
4,4'-DDE	ND - 27	< 100	ND	ND	ND	ND	ND	6.1
4,4'-DDT	ND - 32	< 100	ND	ND	ND	ND	ND	14
Aroclor-1260	ND	100	ND	ND	ND	25 J	ND	15 J
Metals (mg/kg)								
Aluminum	13,100 - 13,200	50	8,090	7,770	9,120	6,870	33,300 **	11,100
Arsenic	19.5 - 20.3	60	14.6	15.3	11.2	9.7	13.1	13.3
Barium	20.1 - 36.3	440	12.3	18.7	22.8	35.6	420	52.1
Beryllium	0.43 - 0.76	10	0.3	1.1	0.71	2.5	2	0.45
Cadmium	ND - 0.61	2.5	ND	ND	ND	ND	ND	0.48
Chromium	15 - 16.4	0.4	10.5	14.9	16.2	24.7 **	53.5 **	21.6 **
Cobalt	10.5 - 18.4	100	8.9	11.8	11.7	16.8	18.3	11.1
Copper	11.2 - 15	15	13	59.6 **	49.7 **	145 **	76.4 **	45.2 **
Iron	26,900 - 28,200	14,000	21,300	23,600	23,500	22,200	58,100 **	26,200
Lead	16.2 - 18.3	50	13.5	48.7	35.5	119 **	51 **	41.3
Manganese	338 - 1,580	330	286	423	343	296	299	350
Mercury	ND - 0.08	0.058	0.05	ND	0.17 **	0.05	ND	ND

**TABLE 7-2 D
 ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES¹
 SOUTH WATERFRONT
 SITE ASSESSMENT SCREENING EVALUATION
 FORMER ROBERT E. DERECKTOR SHIPYARD
 NETC NEWPORT, RHODE ISLAND
 PAGE 3 OF 3**

Analyte	Off-Site Range ²	Benchmark ³	Sample TP01	Sample TP02	Sample TP03	Sample TP04	Sample TP05	Sample TP06
Metals (mg/kg, Continued)								
Nickel	19.2 - 21.4	2	17.2	32.8 **	30.3 **	70.8 **	60.1 **	24.3 **
Selenium	ND	1.8	ND	ND	0.85	ND	1.2	1.4
Tin	ND - 13.4	0.89	ND	ND	9.3	27.4 **	ND	ND
Vanadium	21.7 - 22.2	0.5	12.3	11.3	13.8	9.7	52.7 **	21.7
Zinc	49.7 - 54	10	40.8	225 **	172 **	501 **	896 **	284 **
Total Petroleum Hydrocarbons (mg/kg)								
TPH	ND - 260	na	ND	ND	94	110	ND	110

NOTES:

- 1 All sample depth intervals are 0 to 1 feet.
 - 2 Data from the two off-site sample locations: MW01 and MW10.
 - 3 Benchmark values as presented on Table 7-1.
- Analyte is a common laboratory contaminant (U.S. EPA, 1992).
 - Sample concentration exceeds benchmark concentration and maximum background concentration; analyte considered to be a contaminant of potential ecological concern.
- ND Analyte not detected above the sample quantitation limit.
 NA Not analyzed.
 na Appropriate benchmark for ecological screening was not available.
 J Estimated quantitation.
 D Dilution result.
 Dupl. Field duplicate sample.

TABLE 7-3 A
MAXIMUM HAZARD QUOTIENTS FOR CONTAMINANTS OF POTENTIAL
ECOLOGICAL CONCERN IN EXPOSED SURFACE SOIL SAMPLES
NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Contaminant of Potential Ecological Concern (COPEC)	Benchmark ¹	Maximum Concentration ²	Sample Location	Maximum Hazard Quotient ³
Benzo(a)anthracene	100	710 J	TP28	7.10
Benzo(a)pyrene	100	680 J	TP28	6.80
Benzo(b)fluoranthene	100	1,000 J	TP28	10.00
Chrysene	100	690 J	TP28	6.90
Fluoranthene	100	1,400 J	TP28	14.00
Indeno(1,2,3-cd)pyrene	100	520 J	TP28	5.20
Phenanthrene	100	730 J	TP28	7.30
Phenol	100	170 J	TP18	1.70
Pyrene	100	1,400 J	TP16	14.00
Chromium	0.4	24.1	TP16	60.25
Copper	15	111	TP16	7.40
Lead	50	115	TP28	2.30
Mercury	0.058	0.17	TP28	2.93
Nickel	2	68.5	TP16	34.25
Vanadium	0.5	39	TP28	78.00
Zinc	10	883	TP16	88.30
UNADJUSTED MAXIMUM HAZARD INDEX ⁴				346.43
ADJUSTED MAXIMUM HAZARD INDEX ⁵ : 346.43 x 0.208				72.06

NOTES:

- 1) Benchmark values as presented on Table 7-1. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 2) Concentrations as presented on Table 7-2 A. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 3) Maximum Hazard Quotient = maximum concentration/benchmark.
- 4) Unadjusted Maximum Hazard Index = Σ Maximum Hazard Quotients (see Section 7.3.2).
- 5) Adjusted Maximum Hazard Index: adjusted for percent of exposed surface soil present in site area (see Section 7.3.2).

TABLE 7-3 B
MAXIMUM HAZARD QUOTIENTS FOR CONTAMINANTS OF POTENTIAL
ECOLOGICAL CONCERN IN EXPOSED SURFACE SOIL SAMPLES
CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DEREKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Contaminant of Potential Ecological Concern (COPEC)	Benchmark ¹	Maximum Concentration ²	Sample Location	Maximum Hazard Quotient ³
2,4-Dimethylphenol	100	320 J	TP17	3.20
2-Methylphenol	100	560	TP17	5.60
4-Methylphenol	100	2,400	TP17	24.00
Anthracene	100	130 J	TP15	1.30
Benzo(a)anthracene	100	410	TP15	4.10
Benzo(b)fluoranthene	100	410	TP15	4.10
Benzo(g,h,i)perylene	100	110 J	TP15	1.10
Benzo(k)fluoranthene	100	360 J	TP15	3.60
Chrysene	100	420 J	TP15	4.20
Fluoranthene	100	870	TP15	8.70
Indeno(1,2,3-cd)pyrene	100	150 J	TP15	1.50
Phenanthrene	100	580	TP15	5.80
Phenol	100	1,200	TP17	12.00
Pyrene	100	740	TP15	7.40
Aroclor-1260	100	71,000 D	TP14	710.00
Dieldrin	< 100	470	TP14	4.70
Endrin ketone	< 100	1,100	TP14	11.00
Methoxychlor	< 100	2,300	TP14	23.00
Aluminum	50	14,400	TP14	288.00
Chromium	0.4	19	TP14	47.50
Copper	15	33	TP14	2.20
Iron	14,000	32,900	TP14	2.35
Mercury	0.058	0.13	TP15	2.24
Nickel	2	27.4	TP14	13.70
Zinc	10	123	TP14	12.30
UNADJUSTED MAXIMUM HAZARD INDEX ⁴				1,203.59
ADJUSTED MAXIMUM HAZARD INDEX ⁵ : 1,203.59 x 0.100				120.36

NOTES:

- 1) Benchmark values as presented on Table 7-1. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 2) Concentrations as presented on Table 7-2 B. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 3) Maximum Hazard Quotient = maximum concentration/benchmark.
- 4) Unadjusted Maximum Hazard Index = Σ Maximum Hazard Quotients (see Section 7.3.2).
- 5) Adjusted Maximum Hazard Index: adjusted for percent of exposed surface soil present in site area (see Section 7.3.2).

TABLE 7-3 C
MAXIMUM HAZARD QUOTIENTS FOR CONTAMINANTS OF POTENTIAL
ECOLOGICAL CONCERN IN EXPOSED SURFACE SOIL SAMPLES
BUILDING 234 AREA
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Contaminant of Potential Ecological Concern (COPEC)	Benchmark ¹	Maximum Concentration ²	Sample Location	Maximum Hazard Quotient ³
Benzo(a)anthracene	100	470	MW09	4.70
Benzo(a)pyrene	100	410	MW09	4.10
Benzo(b)fluoranthene	100	660	MW09	6.60
Benzo(g,h,i)perylene	100	190 J	MW09	1.90
Benzo(k)fluoranthene	100	279 J	MW09	2.79
Chrysene	100	580	MW09	5.80
Fluoranthene	100	770	MW09	7.70
Indeno(1,2,3-cd)pyrene	100	190 J	MW09	1.90
Phenanthrene	100	350 J	TP10	3.50
Pyrene	100	750	MW09	7.50
Chromium	0.4	18.4	TP10	46.00
Copper	15	35	TP10	2.33
Iron	14,000	37,200	TP09	2.66
Lead	50	62.5	TP10	1.25
Nickel	2	28.2	TP09	14.10
Vanadium	0.5	23.2	TP10	46.40
Zinc	10	175	MW09	17.50
UNADJUSTED MAXIMUM HAZARD INDEX ⁴				176.73
ADJUSTED MAXIMUM HAZARD INDEX ⁵ : 176.73 x 0.104				18.38

NOTES:

- 1) Benchmark values as presented on Table 7-1. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 2) Concentrations as presented on Table 7-2 C. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 3) Maximum Hazard Quotient = maximum concentration/benchmark.
- 4) Unadjusted Maximum Hazard Index = Σ Maximum Hazard Quotients (see Section 7.3.2).
- 5) Adjusted Maximum Hazard Index: adjusted for percent of exposed surface soil present in site area (see Section 7.3.2).

TABLE 7-3 D
MAXIMUM HAZARD QUOTIENTS FOR CONTAMINANTS OF POTENTIAL
ECOLOGICAL CONCERN IN EXPOSED SURFACE SOIL SAMPLES
SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Contaminant of Potential Ecological Concern (COPEC)	Benchmark ¹	Maximum Concentration ²	Sample Location	Maximum Hazard Quotient ³
Anthracene	100	150 J	TP04	1.50
Benzo(a)anthracene	100	210 J	TP06	2.10
Benzo(a)pyrene	100	160 J	TP06	1.60
Benzo(b)fluoranthene	100	270 J	TP06	2.70
Benzo(k)fluoranthene	100	150 J	TP06	1.50
Chrysene	100	230 J	TP06	2.30
Fluoranthene	100	460 J	TP06	4.60
Indeno(1,2,3-cd)pyrene	100	110 J	TP06	1.10
Phenanthrene	100	280 J	TP06	2.80
Pyrene	100	380 J	TP06	3.80
Aluminum	50	33,300	TP05	666.00
Chromium	0.4	53.5	TP05	133.75
Copper	15	145	TP04	9.67
Iron	14,000	58,100	TP05	4.15
Lead	50	119	TP04	2.38
Mercury	0.058	0.17	TP03	2.93
Nickel	2	70.8	TP04	35.40
Tin	0.89	27.4	TP04	30.79
Vanadium	0.5	52.7	TP05	105.40
Zinc	10	896	TP05	89.60
UNADJUSTED MAXIMUM HAZARD INDEX ⁴				1,104.07
ADJUSTED MAXIMUM HAZARD INDEX ⁵ : 1,104.07 × 1.00				1,104.07

NOTES:

- 1) Benchmark values as presented on Table 7-1. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 2) Concentrations as presented on Table 7-2 D. Concentrations are $\mu\text{g}/\text{kg}$ for organic compounds, and mg/kg for metals.
- 3) Maximum Hazard Quotient = maximum concentration/benchmark.
- 4) Unadjusted Maximum Hazard Index = Σ Maximum Hazard Quotients (see Section 7.3.2).
- 5) Adjusted Maximum Hazard Index: adjusted for percent of exposed surface soil present in site area (see Section 7.3.2).

8.0 SUMMARY AND CONCLUSIONS

This section summarizes the findings of the SASE investigation and provides initial recommendations for follow-up investigations and remediations. These recommendations are preliminary in that the comments and criticisms of the oversight parties, the U.S. EPA, RIDEM, and the NETC Restoration Advisory Board, have not yet been solicited.

As described in Section 2.0 of this report, the PA report documented poor housekeeping practices and a high potential for numerous types of contaminant releases. However, the residual contamination found during this study was lower than expected.

8.1 CONTAMINANTS DETECTED

Section 4.0 indicates that several different contaminant groups are associated with different locations. Contaminants present in the soils and groundwater are localized ("hot spots"), and do not represent a site-wide contamination situation. So called "hot spots" are summarized below:

- Elevated concentrations of phenolic compounds and PAHs were detected in the area around Huts 1 & 2 (TP16 and TP17). Surficial contamination in this area indicates that the contaminants can probably be associated with the former activities of the vehicle maintenance operations, which were performed in these huts.
- Elevated concentrations of PCBs, PAH compounds, and metals were found in unpaved areas northeast of Building 6 (TP14), which receives surface runoff from the Penn-Central Railway, the electrical transformer pad, and the paved areas east of Building 6. The former "pipe shop" was located in the northeast corner of Building 6 and is suspected to discharge to this area.
- Elevated concentrations of PAHs and metals were found in the former location of a bilge water disposal area north of Building 42 (MW05).
- Elevated concentrations of pesticides and leachable metals were detected in the area south of Building 42 (MW07 and TP11), which was a former bulk material storage area.

Elevated concentrations of phthalate compounds were detected in the soils south of Building 234 (TP07 and TP08), which was an area of suspected chemical discharge described in the PA report.

- High concentrations of semivolatile organic compounds and butyltin compounds were detected in the soils under Building 42, apparently due to past discharges from sumps within the building.
- Petroleum contaminants were found in the former parking area east (upgradient) of Huts 1 & 2, however, this contamination appears to be a result of upgradient releases from former USTs. This situation is being investigated as a part of a separate study.
- Low concentrations of fuel components were detected in the shallow soils north of Building 234, which are expected to be residual contaminants from former USTs in this area.

Many of the findings described above confirm the expectations stated in the PA report. However other findings disputed expectations.

- Sandblast grit, which was found widely scattered across the site during the PA, was removed in 1995 by OHM Corporation (Section 2.0). The results of soil analysis from samples collected under these former locations indicate that metals did not leach into the soils from the sand blast grit. In addition, no large subsurface deposits of sand blast grit were found.
- The soil piles in the South Waterfront were found to be most likely excavated soils from other portions of the base. While concrete and other evidence of demolition debris was noted, no large quantities of waste materials were present. Indications of sand blast grit were found in TP05 and TP06, but these were shallow and did not indicate extensive deposits.

8.2 PROBABLE CONTAMINANT DISCHARGE ROUTES

Section 4.2 of this report describes the subsurface drainage systems at the site. The storm drainage system was found to be largely intact, particularly the two primary drain systems in the Central Shipyard. One system collects water from the area north of Building 6, the east and north sides of

Building 42 and inside Huts 1 & 2, that discharge to OF#3B, which is located in the rip-rap shoreline north of the boat basin at Building 42. The second system collects water from the east side of Building 6, and the east and north sides of Building 234, and discharges it at OF#10, at the northwest corner of Building 234.

The catch basin inside Huts 1 & 2 was probably present before the huts were built on concrete block footings in this area. This catch basin is suspected to be a discharge point for material from activities inside Huts 1 & 2. As described above, this catch basin is connected to the primary drain system which discharges at Outfall 3B.

Only small reaches of the storm drain system were found clogged or inoperable, and these were cleared during the investigation. The nature of the clogs in the storm drains indicated that they had acquired a significant amount of material during building demolition.

Four catch basins were, however, found to be abandoned or to have drain lines that had been rerouted to unknown locations. These were CB-42-1 through CB-42-4, located to the south of Building 42. It is expected that these catch basins comprised the storm drain system in this area. This system was abandoned during the removal of the buildings from this location prior to the Derecktor lease.

Building 42 floor drains and sumps are connected to S42-5, which appears to be a sanitary system holding vault. There is no sign of discharge points from this vault.

Building 234 floor drains and one other pipe (possibly a roof drain) lead to a central building sump, identified in this report as S234-8. Pumping equipment and a discharge outlet is present in this sump, but despite repeated attempts to locate the discharge point, it was not found. It is expected to connect to one of the outfalls, or to the sanitary sewer system. Due to the lack of available drawings for this building and the presence of the foundation, the appropriate connections could not be identified.

Contaminants that were detected in soils and groundwater were present in areas that were not paved during the period of shipyard operations. In addition, the presence of the pavement at the site indicates that other discharges probably would have passed through the storm drain system to the near-shore portions of Narragansett Bay.

Groundwater is hydraulically connected to the seawater in Narragansett Bay. Overburden groundwater is expected to discharge through the bulkhead, advanced by hydraulic gradient from the hills east of

the site. Bedrock groundwater has not been adequately characterized with respect to probable flow pattern, although it is expected to behave in the same manner as overburden groundwater.

8.3 RISKS TO RECEPTORS

The preliminary human health risk assessment was performed for surface soil, subsurface soil, and groundwater exposure scenarios. This assessment indicates that the current uses of the property (industrial) can provide a sum of carcinogenic risk between 3.21E-04 (Central Shipyard) and 3.18E-05 (North Waterfront) for occupational workers. The dermal contact with surface soil exposure pathway provides the highest contribution to this risk. The principal contaminant contributing to this risk is arsenic. Similarly, the sum of carcinogenic risk for this exposure pathway for the upgradient samples collected provides a carcinogenic risk of 1.02E-04 for the same media and receptor. Again, arsenic is the prime contributor to this risk. Arsenic occurs naturally in Rhode Island geologic formations.

The estimated Hazard Index (HI) values for non-carcinogenic risk were below 1.0 for all areas of the site under current use exposure scenarios. Noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment when HI values are below 1.0.

Most of the site does not provide adequate habitat for ecological receptors to be at risk to the contaminants present. However, the South Waterfront does provide habitat where exposure is feasible. The potential risk associated with on-shore ecological receptors in the South Waterfront appears to be primarily related to metals and PAHs in the surface soils at TP05 and TP06.

The overall likelihood of relevant ecological exposure and risk associated with the site is minimal, and further ecological studies are not warranted.

These assessments were performed under the assumption that highly contaminated soils under sumps as well as any other highly contaminated soils not identified as part of this study would be removed from the site under controlled conditions, prior to receptor exposure.

8.4 RECOMMENDATIONS

The following recommendations are based on the findings of the study as described in this report and summarized above.

- Hot spot excavations may be warranted to remove contaminated soils in the areas described below. Actions in the following areas will reduce overall risk to receptors present.
 - The area around TP14 at Building 6: east to the railroad bed, south to the edge of pavement, and west and north to unidentified points. Delineation of this excavation could be determined by limited sample collection.
 - Portions of the crawl space under Building 42, particularly under S42-1. The fate of the building and the drainage systems needs to be determined, and either dismantled or reconstructed.
 - South of Building 234, at TP07 and TP08. Work in this area will require some precautions against undermining the existing foundation and the rip-rap shoreline embankment at these locations. Delineation of this excavation could be determined by limited sample collection.
- Sumps and trenches in the foundation of Building 234 should be filled with compacted gravel and finished to grade with concrete. If this foundation is to remain as the final surface grade, a new storm drainage system may be required.
- The outfall of S234-8 should be identified to support the findings of the Marine Ecological Risk Assessment and future studies. The pumping equipment and piping should be removed. The sump itself should be filled and abandoned.
- Catch Basins 42-1, 42-2, 42-3, and 42-4 are not functional. These catch basins and their associated piping should be cleaned and removed, or upgraded to provide adequate drainage in this area.