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Site Assessment Screening Evaluation Report

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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

June 1997

SITE ASSESSMENT SCREENING EVALUATION REPORT
Former Robert E. Derecktor Shipyard
NETC-Newport, Rhode Island

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SITE ASSESSMENT SCREENING EVALUATION REPORT

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

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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E.0 EXECUTIVE SUMMARY

This Study Area 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 is blocked at some distance from its origin and 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 evaluation was performed to 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. Future receptors evaluated included industrial workers, excavation workers, trespassers and residential owners. The primary contributors to the risk evaluated in the analysis were arsenic (all areas) and PCBs (from surface soils north of Building 6).

Arsenic is a naturally occurring element in the soil and groundwater in the Rhode Island geologic formations. A risk-based acceptable level for arsenic in soils has been set for industrial properties by RIDEM. Many samples of soil at and upgradient of this and other sites on Aquidneck Island have been found to exceed this target level.

PCBs were found at elevated concentrations in soils north of Building 6. Industrial workers in this area may be exposed to these surface soils which will cause an increased risk of cancer which is above the EPA recommended target level for incremental cancer risk of one in one hundred thousand.

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, the likelihood for an interaction that would cause these receptors to be affected by the contaminants present is extremely low.

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, where the risk evaluation showed an increased risk from PCBs present in the soil. In addition, the soils under Building 42 are contaminated with paint residues; therefore it is recommended that they be removed before they present a potential for exposure to workers, visitors and trespassers on site. 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. These operations should be conducted with precautions appropriate for the remediation of contaminated and potentially contaminated materials. Continuance with a Remedial Investigation and Feasibility Study under CERCLA is not warranted for this site.

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 study area screening evaluation at the former Robert E. Derecktor of Rhode Island Inc. (Derecktor) Shipyard, in accordance with the Federal Facilities Agreement between the U.S. Navy, the U.S. Environmental Protection Agency and the Rhode Island Department of Environmental Management. This report is prepared to comply with that requirement, and is referred to as a Site Assessment Screening Evaluation Report (SASE).

The Derecktor Shipyard is located on part of the Naval Education & Training Center (NETC) in Newport, Rhode Island. Although the property was owned by the Navy, it was leased to the Rhode Island Port Authority and subleased to Robert E. Derecktor for use as a privately operated ship maintenance and construction yard. The Derecktor lease period was from 1979 to 1992.

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) 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; the final report, prepared by SAIC and the University of Rhode Island, was submitted in May 1997.

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 human and ecological 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.

The study area boundaries were set based on the findings of the Preliminary Assessment and the locations of the areas of concern defined within that assessment. However, the PA also identified two areas of potential concern outside the study area boundaries, which are UST locations at Building 62 and Building 5. It is the Navy's intention to address these areas in accordance with the RIDEM UST regulations, and not as part of the Installation Restoration (IR) program, of which the SASE is a part. UST investigations at Building 62 commenced in May 1997.

1.2 REPORT ORGANIZATION

Section 2 of this report describes the history of the site and summarizes the findings of previous investigations on and around the site. Section 2 also presents the areas of concern identified in the PA, describes actions NETC took to address the immediate concerns for 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.

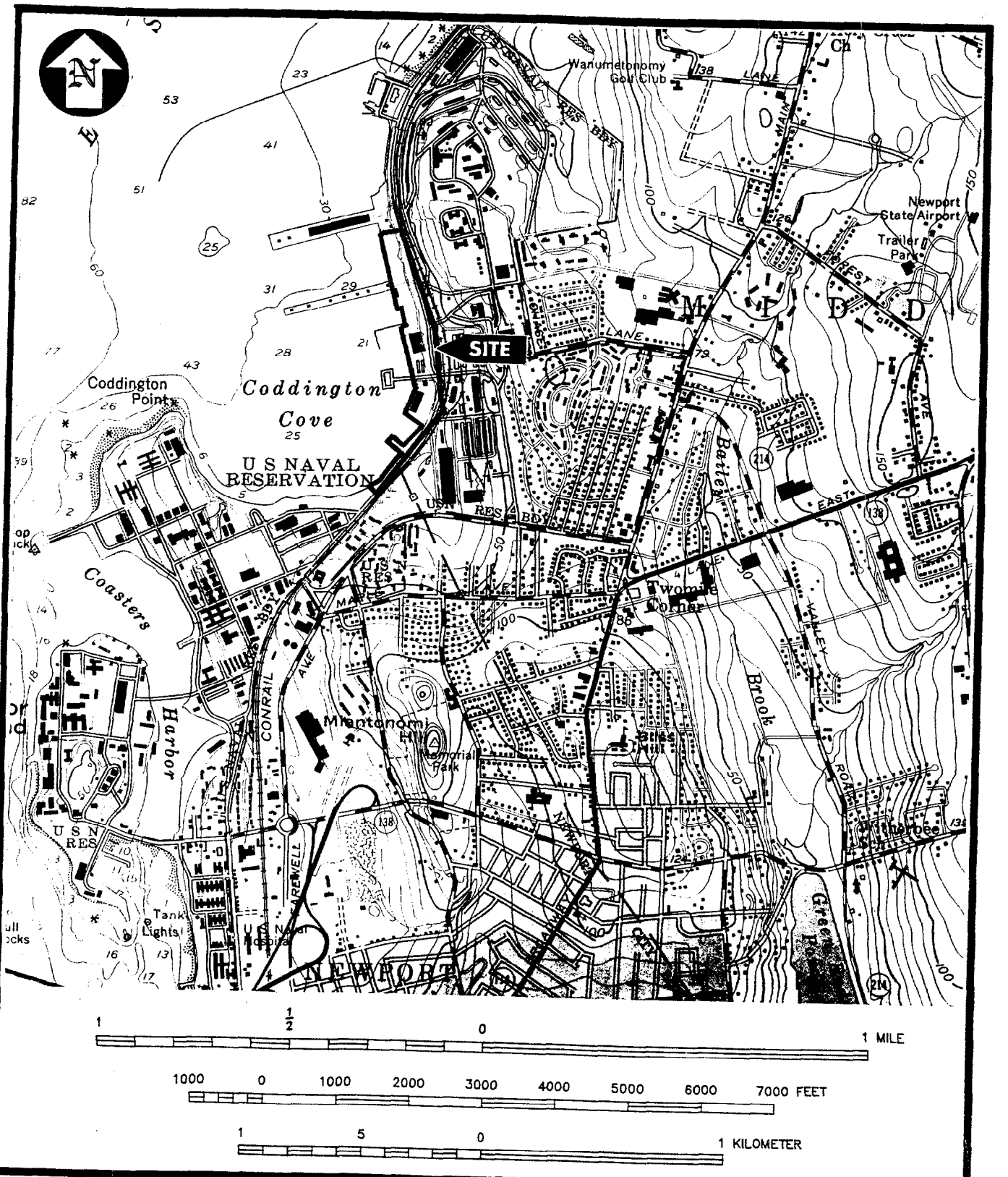
Section 4 presents the findings of the investigation. This section is formatted to follow Section 3; for example, data presented in Section 4.2 was collected during investigations described in Section 3.2.

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 evaluation, including risk-based 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 final Derecktor Shipyard Marine Ecological Risk Assessment Report (SAIC/URI May 1997).

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



SITE LOCATION MAP
DERECKTOR SHIPYARD
NEWPORT, RHODE ISLAND

Brown & Root Environmental

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 the Naval Education & Training Center (NETC). The western boundary of the parcel is frontage on 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.

Buildings 6, 40, 41, 42, and 234 were all constructed by the Navy. Building 6 was constructed in 1942 of concrete blocks, and was used by the Navy for warehouse and storage space. Building 40 was built in 1951, as a Quonset hut. Prior to the lease of Building 40 to RIPAEDC, the building was occupied by Coddington Yachts, Inc. Building 41 was constructed in 1951, and was used by the Navy as a storehouse. Building 42 was used as a cold storage warehouse, and was constructed in 1952. Building 234 was constructed by the Navy in 1956, and was known as the transit shed. Supplies and materials were stockpiled and assembled in this building prior to being loaded on ships. Building 234 was also used by the Newport Shipyard Inc. prior to the Derecktor lease.

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 were included in the excessing package. The Robert E. Derecktor Shipyards of Rhode Island Inc. operated from 1979 until January 1992, when the corporation filed for Chapter 11 bankruptcy.

During the lease period, Derecktor dismantled Buildings 40 and 41 and removed them from their location south of Building 42 and re-assembled them near Pier 1. These are identified in the PA as the Huts numbered 1 through 4. Derecktor also constructed a large addition to Building 234. The new oversize Building 234 was used as a setup area such that ships could be constructed inside. During bankruptcy auctions, this building was dismantled and sold as scrap material, leaving only the slab foundation and what remained of the original Building 234 structure in place.

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 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 passes over paved areas and is discharged to Coddington Cove via storm drainage systems.

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 the 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. Several residential lots along portions of Valley Road, Brookdale Road, and Chestnut Hill Road (on the western side of Middletown) were identified as not being connected to a public water main pipeline. The homes on these lots likely rely on private water supply sources for potable water needs (Holden, 1997a). In relation to the former Robert E. Derecktor Shipyard, the nearest private well location may be on Valley Road, approximately 0.6 miles east and upgradient of the site. Private well locations on Chestnut Hill Road and Brookdale Road are approximately 1.0 mile east of the shipyard (Holden, 1997e). The nearest non-community and community supply wells are located approximately 1.6 miles to 2.3 miles southeast of the shipyard on Aquidneck Avenue, Green End Avenue, Ward Avenue and Prospect Avenue.

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 on 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 drops as a result of evaporation and the uptake of water by 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 REPORT

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. Some of these liquids were reportedly placed in a small pit on the northern side of Building 42, which has since been filled.

- 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. 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 Public Works Department (PWD) performed a preliminary removal 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 PWD contracted with OHM Corporation to perform a removal action to excavate and dispose of sand blast grit that was known to be present on the ground to the north and east of Building 42. OHM removed approximately 16,600 cubic yards of this material, and covered the exposed ground with a sand and crushed stone mix. Contaminated material was transported and disposed of at McAllister Point Landfill prior to final cap construction. As a part of this effort, the embankment to the east of Building 42 was excavated and repaired. The final closure report prepared by OHM is included in this SASE report as Appendix F2.

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 Derecktor 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 identify the location of storm drain outlets that could not be determined in the PA. The PA did not recommend an evaluation of the complete nature and extent of contamination at the site.

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 by NETC PWD and other entities. Other actions are addressed by this 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 (TPH). 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, as well as Coddington Cove and Jamestown reference areas, has been performed as a part of the Marine Ecological Risk Assessment, Derecktor Shipyard (final report SAIC and URI GSO, May 1997).

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 PWD. 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 sand blast 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 sand blast 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 Navy has eliminated the area around Building 62 from the study area because its only association with the shipyard was as parking. However, 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.

Table 2-1 contains a list of the permitted USTs located at Derecktor Shipyard and their status, as listed in the RIDEM master list of USTs. No material evidence of any other USTs present at the facility has been found. Copies of the two 10,000-gallon UST closure certificates are presented in Appendix F1. One was located at Building 5; the second was located at Building 234. The 10,000-gallon tanks were both removed by Lincoln Environmental. The closure assessment report on the removals was received by RIDEM on January 11, 1995.

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. The Middletown fire department and Building Inspector's office was consulted to determine the availability of records for Derecktor Shipyard. The fire department reported no UST or AST information on file for this site (Holden, 1997b). The Building Inspector's office stated that the town does not maintain UST and AST information (Holden, 1997d).

The NETC fire department was consulted to determine the availability of records for Derecktor Shipyard. The fire department reported no UST or AST information on file for this site (Holden, 1997c). The fire department has spill contingency plans for the USTs and ASTs currently in use. The RIDEM Compliance and Inspection Division was contacted, and reported no AST information was available for Derecktor Shipyard.

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 this 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. Building 4 is located outside the study area as described in the SASE work plan and the SASE report. Building 6 was cleaned and has undergone extensive remodelling. The building is currently in use by the Naval Underwater Weapons Center (NUWC). The building floors do not have major cracks present, and the likely path followed by releases inside Building 42 is the floor drain system, as detailed in Section 4.2.

TABLE 2-1
SUMMARY OF PERMITTED USTs
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

FAC ID	Application Date	Tank No.	Install Date	Status (date)	Volume (gallons)	Location (Building No.)	Contents
00820	04/85	1	04/81	R (1/95)	10,000	5	#2 Fuel
	04/85	2	04/81	R (1/95)	10,000	234	#2 Fuel
	04/85	3	Unknown	R (6/87)	6,000	62	Unknown
	04/85	4	Unknown	R (6/87)	6,000	62	Diesel
	04/85	5	Unknown	R (6/87)	3,000	62	Unknown
	04/85	6	Unknown	R (6/87)	3,000	62	Unknown
	04/85	7	Unknown	R (6/87)	250	62	Unknown
	04/85	8	Unknown	R (6/87)	250	Unknown	Gasoline
	04/85	9	Unknown	R (6/87)	500	62	Gasoline

NOTES:

R = Removed
Source: RIDEM UST Section, file search February 1997

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. Any field modifications that were made are described in this section.

The objective of the field investigation was to obtain adequate data to identify the presence of contamination and to 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 of test pits and sample collection
- 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 their geographical locations. The work plan provides further descriptions of the four sub-areas and their former uses.

Table 3-1 presents a summary of the types 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 also presented in the table. Further details are presented 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. 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 results from the analysis of the waste removed from the sumps and pits are presented in Appendix G. 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, piping routes and 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 (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. Due to their close proximity to one another, four of these boxes were randomly selected for further investigations; it was determined that the findings from these four boxes could be representative of the whole group. One "dry well" was also found to have an unconsolidated bottom. In addition, two other suspect sumps were identified for further investigation. These were sump S42-5, which appeared to be a collection tank from floor drains and other sumps in Building 42, and Sump S234-7, which contained a floor drain, and was proximal to a former UST location. These locations were all identified as potential discharge points and are described in Table 3-2.

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 because of 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 soil samples 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 because of access problems 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 3-1.

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.

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 sand blast 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 comprehensive maps of underground drainage systems. These maps and back-up information are presented in Section 4 of this report.

3.3 TEST PIT EXCAVATION

A large volume of spent sand blast 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 near the South Waterfront shoreline, 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 sand blast 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 3-1.

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 backfill. 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 sand blast 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. Stressed vegetation areas were not 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. An examination of UST records at RIDEM indicated that only one 10,000-gallon UST was located in the vicinity of Building 234.

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 Corporation 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 the dry well that was sampled, as described in Section 3.1.2).

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 in an area reported to be the former location of a 10,000 gallon aboveground fuel tank. One test pit was excavated at the request of RIDEM, to the east (upgradient) of Huts 1 & 2. This test pit was excavated to assist in 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, backfilled, 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 to 1 feet below ground surface or below the 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 was 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 basis for selecting 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, 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 were 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 backfilled 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. Boring logs are presented in Appendix C of this report.

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 4 inches of the soil cover was extruded from the sample to minimize interference of PAH compounds from the asphalt in the soil sample.

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 sandpacks 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 percent 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 groundwater 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 4-day period. This 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), off site and upgradient of Building 234.

Groundwater samples were analyzed for TCL volatile organic compounds, total TAL metals, butyltin compounds, and TCL semivolatile 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 Standard Operating Procedure for low-flow sample collection (SOP GW-001, 8/3/95) was adhered to strictly during groundwater sample collection. 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 SASE goal is to provide a preliminary determination of the 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, which was expanded during the SASE during the SASE to include cultural and terrestrial ecological settings.

3.5.1 Cultural Setting

The cultural setting of the site was evaluated to determine whether on-site contamination posed a potential threat to 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 whether off-site residential, recreational, and water receptors were present within this area.

3.5.2 Off-Shore Ecological Setting

The ecology of the marine environment adjacent to the site was evaluated as a part of the Marine Ecological Risk Assessment for Derecktor Shipyard, which was submitted to the Navy in May 1997.

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 of contaminants present in soils, sediments, and surface waters at the site.
- Determine the presence of contamination of environmental media that may pose a threat to 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 nearby areas, and on 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 assessing of population structure or community analyses. Since the objective is to provide an inventory of terrestrial fauna on site, the survey was 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. A limited trapping effort was performed to identify smaller animals that leave no obvious physical evidence of their presence.

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.

Existing vegetation and wildlife on the site were inventoried based on field observations made between August 15 and August 22, 1996. Additionally, on-site wildlife observations were recorded by an on-site field biologist throughout the July through September fieldwork activities.

Plant communities on the site were identified and delineated with approximate plant community boundaries sketched on a base map for use in identifying random sample plots. A qualitative approach to provide vegetation community composition data was performed. Dominant vegetation based on aerial cover was recorded for the tree canopy, sapling/shrub, and herbaceous ground cover vegetation strata. Dominance was estimated visually within a 30-foot diameter plot for tree canopy and sapling shrub strata, while a square meter sample plot was used for the herbaceous layer. Because of the small size of most of the on-site vegetation areas, typically two to three plots were collected per area. A few additional plots were established as necessary to ensure at least minimal representation of each plant community occurrence.

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 wildlife list. The survey conducted in August may not have identified as many birds, reptiles, or amphibians compared to a survey conducted in the spring.

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 plus or minus 0.1 foot. Tops of PVC well risers were located to plus or minus 0.01 foot vertically.

TABLE 3-1
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)	None	7 Days (Analysis)
	TCL VOCs (CLP SOW OLM03.0)	Cool to 4° c.	14 Days (Analysis)
	TCL SVOCs (CLP SOW OLM03.0) [1]	Cool to 4° c.	7 Days (Extraction)
	TCL PCBs/Pesticides (CLP SOW OLM03.0)	Cool to 4° c.	7 Days (Extraction)
	TPH by IR (EPA 418.1)	Cool to 4° c.	28 Days (Analysis)
	TAL Metals (CLP SOW ILM03.0)	Cool to 4° c.	6 Months (Analysis) [3]
	TCLP Metals (SW/1311 40 CFR Part 261)	Cool to 4° c.	6 Months (Analysis) [3]
	Butytlin Compounds (Wade 1990)	Cool to 4° c.	7 Days (Analysis)
Groundwater	TCL VOCs (CLP SOW OLM03.0)	HCl to pH<2, Cool to 4° c.	14 Days (Analysis)
	TCL SVOCs (CLP SOW OLM03.0) [1]	Cool to 4° c.	7 Days (Extraction)
	TCL PCBs/Pesticides (CLP SOW OLM03.0)	Cool to 4° c.	7 Days (Extraction)
	TPH by IR (EPA 418.1)	HCl to pH <2	28 Days (Analysis)
	TAL Metals (CLP SOW ILM02.1)	HNO_3 to pH <2	6 Months (Analysis) [3]
	Butytlin Compounds (Wade 1990)	Cool to 4° c.	Not Applicable
	Specific Conductance (EPA 120.1) [2]	Not Applicable	Not Applicable
	pH (EPA 150.1) [2]	Not Applicable	Not Applicable
	Temperature (EPA 170.1) [2]	Not Applicable	Not Applicable
	Dissolved Oxygen (EPA 360.1) [2]	Not Applicable	Not Applicable
	Turbidity (EPA 180.1) [2]	Not Applicable	Not Applicable
	Salinity (Standard Methods) [2]	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 3-2
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 3-2
SUMMARY OF UICs AND SAMPLES COLLECTED
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND
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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 3-1.
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 3-3
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 slag stockpile and 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 & 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 WELL INSTALLATIONS
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	South side of Building 234 slab, in area of slag stockpile and suspected chemical discharge.	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. DERECKTOR 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

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. The findings of the investigations have been separated as follows:

- Findings from inspecting of sumps and potential discharge areas
- Findings from investigating underground drainage systems
- Findings from excavating test pit excavation and collecting samples
- Findings from investigating geologic and hydrogeologic conditions
- Findings from evaluating cultural and ecological settings

Screening analytical data is presented in Appendix A. Laboratory analytical data is presented in Appendix B. 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 investigation of 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 and the Building 234 Area.

Six sumps (one of which was a dry well) were found in the Central Shipyard. Locations of these sumps are depicted on Figure 4-1. Results of the inspections of these sumps are presented in Table 4-1 due to their size and close proximity to one another.

Twenty-five sumps (15 of which were equipment boxes, and two of which were large utility trenches - the Eastern Utility Trench (E.U.T) and the Western Utility Trench (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 show which of the sumps were identified as potential subsurface discharge areas.

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. This table describes detected constituents reported by the analytical laboratory in October and November of 1996. These results have been validated "level D", which is equivalent to EPA Tier III validation. A complete set of data from laboratory analysis of the samples discussed in this section is presented in Appendix B.

Table 4-3B presents a comparison of these analytical results to the RIDEM direct exposure criteria for industrial/commercial properties (RIDEM 8/96). This comparison is made, not to indicate risk of exposure, but to provide a comparison to an available benchmark. Human health risks of contaminant exposure are evaluated in Section 6 this report.

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 six 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 (1,290J mg/kg), nickel (150 mg/kg), and barium (1,620 mg/kg). In addition, a trace of mercury was detected (0.6 mg/kg). The analysis for total petroleum hydrocarbons indicated a presence (1,600 mg/kg) of oil in the sample.

These analytical results were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic (13.9 mg/kg), beryllium (1.5 mg/kg), lead (1290J mg/kg), and zinc (11,900 mg/kg).

Building 42 is supported on pilings and there is a crawl space under the floor where these pilings are visible. This crawl space is approximately 3 to 4 feet high at the highest point, 2 feet high under S422 and one foot high under S42-1. The bottom of the crawl space is composed of compacted soil and compacted stone. The crawl space was entered to collect soil samples under Sump S42-1. The subsurface material under sump S42-1 prevented the penetration of sampling tools (hand augers and a steel trowel) beyond the first (0 to 6 inch) sample interval. Therefore, deeper sample intervals were not obtained.

4.1.2 S42-2

A second sump (S42-2) within Building 42 was found to have a drain hole at its center, apparently installed to allow material caught in it to drain onto the ground in the crawl space below. The crawl space was entered to find 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 compacted stone 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 these soil samples are presented in Table 4-3A. These results indicate the presence of moderate to high concentrations of PAH compounds and phthalate compounds. In general, PAH concentrations were higher in the deeper of the two sample intervals collected, while metals concentrations were higher in the more shallow of the two sample intervals collected. Butyltin compounds were detected at low concentrations. PCBs (Aroclor 1260, detected at 140 ug/kg, 0 to 0.5 feet), and four pesticide compounds were detected. Low concentrations of TPH were detected (430 mg/kg, 0.0 to 0.5 feet 230 mg/kg 0.5 to 1.0 feet) in these samples.

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 soil samples. Upgradient soil samples are discussed in Section 4.3.2 of this report. In addition, mercury was detected at trace concentrations (0.18 mg/kg).

These analytical results were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic (10 and 9 mg/kg) and benzo(a)pyrene (3900 ug/kg).

4.1.3 S42-3

A third sump (S42-3) was found in the northeast corner of Building 42. This sump appeared to have once been a dip tank. It was constructed of steel and contained a divider and two steel baskets with handles that were clearly designed to be used to lift material in and out of the sump. The crawl space was entered to inspect piping from S42-3. This inspection revealed that piping from the floor drains in the northern storage room of Building 42 discharge into S42-3, then out the south side of S42-3. This run appears to have accepted discharges from S42-3 and piped them to sump S42-5. The piping run from S42-3 to S42-5 was found intact, and no discharges to the ground under or near the sump were noticeable. Therefore, no soil samples were collected under the sump.

4.1.4 S42-4

The fourth sump (S42-4) 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 section of the crawl space under S-42-4 was inaccessible; its height in this area was only 6 inches. Therefore, no soil samples were collected under this sump.

4.1.5 S42-5

Sump S42-5 was found outside the southeast corner of the building. Its cover was exposed during the 1995 removal of sand blast 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

ceiling 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 appeared to be poured concrete, as indicated by probing with hand augers and steel rods. However, the integrity of the floor could not be thoroughly visually inspected because all the water in the vault could not be removed without a much larger effort than was deemed necessary. Instead of a complete confined-space cleaning and investigation of the floor of the vault, it was determined that the vault would be assumed to be a potential discharge point, and borings would be installed adjacent to, and down-gradient to identify contaminants that would have entered the soil from the vault if it had served as a discharge point. Some soil was present on the floor of the vault under the hatch opening, but the type of soil at that location indicated that the soil in the vault most likely fell into it when the cover was removed.

Three soil samples from the soil on the floor of the vault, S42-5-0005, S42-5-0510 and S42-5-1015, (assumed to be soils introduced from above as discussed previously) were collected using a hand auger operated through the cover opening. Laboratory analyses of these soil samples are presented on Table 4-3A. These samples indicate elevated concentrations of metals, particularly copper (273 mg/kg), nickel (61.9 mg/kg), and zinc (658 mg/kg). Also detected were low concentrations of PAH compounds, one PCB compound (Aroclor 1254, detected at 36 ug/kg), and low concentrations of butyltin compounds. Concentrations of TPH in these samples were 610(J) mg/kg (0.0 to 0.5 feet), not detected (0.5 to 1.0 feet) and 230(J) mg/kg (1.0 to 1.5 feet).

In addition to the samples collected inside the vault, three shallow borings (SB08, SB09, and SB10) were drilled adjacent to the west and south walls of the vault to collect subsurface soil samples. Locations are 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 analyses of the two samples collected from borings installed outside the vault (SB09-1416 and SB10-1416) are presented in Table 4-3A. These results indicate the presence of traces of PAH compounds and metals. TPH was detected at 17,000 mg/kg in the soil sample collected from 14 to 16 feet below ground surface. This result appears to be high, however, the method required by the state of Rhode Island for TPH analysis is subject to interferences from silty soils, organic materials and other physical conditions of the soil. The absence of detected PAH compounds in this sample, which typically accompany TPH contamination, indicates that the TPH result is not indicative of the actual condition. 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.

The analytical results from the soil samples collected from the borings and inside the sump were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic and beryllium.

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 4.2.1.2 of this report.

4.1.6 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. In addition, a boring could not be advanced through the top of the dry well using a drilling rig because the weight of the rig on the ground this close to the dry well would cause the well to collapse.

Therefore, three shallow borings (SB01, SB02, and SB03) were drilled adjacent to and downgradient of the dry well to collect subsurface soil samples from below the expected discharge point. Locations of these borings are 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 analyses of the samples collected from SB01 and SB03 are presented in Table 4-3A. These results indicated the presence of traces of three PAH compounds and several metals. Traces of TPH were detected (64 mg/kg and 82.5 mg/kg). 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.

The analytical results from the soil samples collected from the borings were compared with soil direct

exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic and beryllium.

4.1.7 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. The sample was comprised of black sand with some gravel. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analyses of these samples are presented in Table 4-3A. These results indicate the presence of traces of a phthalate compound and one PCB compound (Aroclor 1242, detected at 9.4 ug/kg, S234-1-0510). 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 4.1 ug/kg). TPH was not detected.

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.

The analytical results from these samples were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria were exceeded for arsenic only.

4.1.8 S234-2

This sump is a shallow concrete trench measuring only six inches deep. The bottom appeared to be competent, and no subsurface soil samples were collected.

4.1.9 S234-3

This sump is a trench containing two large brackets, indicating that it may have been a holding pit for equipment. The sides and bottom are constructed of concrete. The bottom is competent, and water-tight. Therefore, no subsurface soil samples were collected near this pit.

4.1.10 S234-4

This sump is a trench, approximately six feet deep that 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. 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 analyses of these samples is presented in Table 4-3A. These results indicated the presence of only one organic compound, bis(2-ethyl-hexyl)phthalate. The TPH concentrations were 19,000 mg/kg (0 to 0.5 feet), 11,000 mg/kg (0.5 to 1.0 feet) and 9,200 mg/kg (1.0 to 1.5 feet). However, no supporting PAH compounds were detected in theses samples. 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.

The analytical results from these samples were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for TPH only. However, correlation between semivolatile organic compounds and TPH results was not good.

4.1.11 S234-5

This sump is a trench constructed of steel with welded seams. The sides and bottom are competent and water-tight. Therefore, no subsurface soil samples were collected.

4.1.12 S234-6

This sump is a trench, which has two levels; the maximum depth is approximately ten feet. The sides and bottom are constructed of concrete. The bottom is competent, and the entire sump was found to be water-tight to the top of grade. Therefore, no subsurface soil samples were collected in this area.

4.1.13 S234-7

This sump is a trench located 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 constructed of poured concrete in good condition. However, due to the presence of the floor drains in this area, the sump was identified as a potential discharge area.

Therefore, three shallow borings (SB14, SB15, and SB16) 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, 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 from SB14 and SB15 are summarized in Table 4-3A. PAH compounds were present at low concentrations, indicating the presence of heavier fuel oils or other oil-based material. Trace concentrations of TPH was detected in soil samples collected under the sump (51.5 mg/kg and 43.6 mg/kg respectively). 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 analytical results from the soil samples collected from the borings were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic only.

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.

4.1.14 S234-8

This sump is concrete, and is located in the center of the slab for Building 234, south of the W.U.T. and E.U.T. This sump appears to have acted as a central collection sump for building drainage. Four pipes are located in the sump. Three of these appear to be connected to floor drains in the utility trenches, other drains, and clean-out access points located on the slab. There is a single 8-inch steel exit pipe connected to two pumps located on the western side of the sump. The sides and bottom of the sump are constructed of concrete, and appear to be water-tight. No soil samples were collected from under the sump because the bottom was found to be intact after removal of standing water, and there was no infiltration of groundwater.

The piping from this sump was investigated as a part of the site-wide investigations of drainage systems and outfalls, as described in Section 4.2.1.3 of this report.

4.1.15 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 contiguous physical barrier existed to prevent liquid from discharging to the subsurface. After dismantling one of these boxes, it was determined that the bottoms were not made of poured concrete, but were open to the soil. Therefore, samples were collected from four of the equipment boxes to determine if releases that may have occurred in the southern portion of Building 234 had impacted the soils under the foundation.

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. All samples were screened with the Photovac 10S50 gas chromatograph on site. After screening, two representative samples were shipped to the laboratory for full analysis. Sample collection procedures are described in Section 3.1 of this report.

Laboratory analyses of samples from SB04 and SB06 are summarized in Table 4-3A. These results indicate the presence of toluene, which was detected at trace concentrations. Traces of TPH were detected in soil samples collected below the equipment boxes (18 mg/kg and 49 mg/kg). 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 4.3.2.2 of this report.

The analytical results from the soil samples collected from the borings were compared with soil direct exposure criteria (RIDEM, 1996). Those concentrations that exceeded these criteria are presented on Table 4-3B. These criteria are exceeded for arsenic in one sample only.

The results from the analysis of these samples indicate that there was no appreciable chemical impact to the soils from whatever activities occurred in this area. Collection of soil samples from the remaining eleven equipment boxes will not provide useful information regarding the overall condition of the site. The findings of this and other portions of the investigation indicate that while it is possible, it is highly unlikely that these equipment boxes would have allowed chemical fluids to enter the soil under the foundation. The bulk of any fluid releases inside the building would have been captured by drains and cleanouts leading to Sump 234-8, and discharged from there. The results of the samples collected from the four boxes selected randomly is a strong indicator of the condition of the remaining eleven.

In addition, there is no evidence (either historical or based on observations made during the Preliminary Assessment or this SASE investigation) that would indicate that releases occurred in these areas. The equipment boxes were utility hookup points (electrical, compressed air, and water), and inadvertent or purposeful introduction of fuels or chemicals to these boxes could have had dangerous results to the personnel nearby.

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-five 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. Of the forty-five catch basins found at the site, four were found to be blocked or filled with debris, including soil, gravel, concrete, wood, and residual quantities of sand blast grit. All the catch basins inspected were found to be made of brick and mortar, or poured concrete and appeared to have consolidated bottoms.

In general, catch basins were not found to be obviously contaminated with oils or other contaminants, although the PA report states that oil and other evidence of chemical disposal was present in some of the catch basins during the inspection in 1993.

The primary storm drain lines were inspected with robotic video cameras, and were found to be made of concrete piping in good condition.

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 building floor drains, catch basins, and sump drains in the Northern Waterfront, Central Waterfront, and Building 234 Area. No points of collection were identified in the South Waterfront.

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 drains the pavement areas and discharges from seven outfalls (OF3X, OF#0, OF#1, OF#2, OF#2A, OF#3, and OF#3A) to Narragansett Bay. An eighth 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 OF#X and OF#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 OF#3B. A separate system collects water from the floor drains 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 (Figure 4-3). Roof drains on the western side of Building 42 were observed to discharge through OF#6 and OF#7. Outfall 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 OF#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 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 (former reported location of bilgewater disposal pit - ENSR, 1993) .
- Roof drains on the eastern perimeter of Building 42.
- Interior drainage from catch basin N42-2 (within Huts 1 & 2 - former suspected oil and chemical disposal - ENSR, 1993).
- Surface drainage from catch basin E42-1 (and OF#13), E42-2, and E42-3.

As described in the work plan and Section 3 of this report, Huts 1&2 are the former location of a vehicle maintenance area. There is a catch basin in the floor of one of the western-most huts (CB-N-42-2), where significant staining was noted during the PA. This catch basin was found to be connected to one of the primary outfalls (3B), as shown on Figure 4-3.

Drainage from these areas discharges 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 remainder of the drainage pattern for Building 6 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 floor drains and sump S42-3 discharge to sump S42-5, which is outside the southeastern corner of Building 42. Sump S42-5 is a concrete holding tank or vault with no identified discharge location.

Engineering records for the Building 42 Area were researched several times. Design or as-built plans for the sanitary disposal system from this building were not found during any of the records searches. 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 inside Building 42, sump S42-3, and the floor drains and toilets in the lavatories in Building 42. This led the investigators to believe that S42-5 is a collection tank for those systems. However, as mentioned

previously, no discharge equipment was found. Any discharges or leaks within the storage areas of Building 42 would most likely have drained into this holding tank via the floor drains and subsequently mixed with water from the roof drains and sanitary waste from the bathrooms. It is not known how this material was disposed of.

A 6-inch ID PVC discharge pipe is located at the ground surface at the southern wall of Building 42. Visual inspections revealed that the pipe is connected to the lavatory on the other side of the wall. This pipe is broken off at the exterior side of the wall, and its destination when functional is not known. It should be noted that this lavatory is in poor condition, and it appears that the mechanical systems within it have not been functional for several years.

Historic Huts 1 & 2 Drainage System

Aerial photographs indicate that Huts 1&2 were previously located in the area south of Building 42 prior to Derecktor Shipyard operations. Four catch basins are present that appear to have drained the former location of these Quonset huts, but as stated in the Preliminary Assessment report, at least one of these catch basins was above the ground surface so it could not function properly. In addition, the PA report noted that there was a sludge - like material present during the PA inspection, but at the time of the SASE, these four catch basins were full of debris, including wood, stones, soil, concrete rubble, metal, and plastics fragments. These four catch basins are identified as CB-42-1, CB-42-2, CB-42-3, and CB-42-4 on Figure 4-3.

The four catch basins that were filled with material were cleaned out using a vactor and hand tools. These were found to have small diameter piping leading away from them, but after these pipes were cleaned to the extent possible, no outlets were found. The four catch basins were cleared to the best extent possible using "jet rod" equipment. After cleaning, CB 42-1 and 42-2 retained water and do not to function properly as part of the drainage system. Historic naval site drawings created prior to Derecktor Shipyard operations indicate that CB 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 on these historic drawings and no outfall 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.

The pipe located between CB-42-1 and CB-42-2 is blocked with soil, and is of unknown origin. This

pipe may be the remains of the roof drain from the former locations of Huts 1 2, or might once have been part of the S42-5 system.

Video tracking of CB-42-3 traced the invert pipe 16 feet north and then to the east. This drainage pipe could not be tracked beyond this point without excavating of the area. No discharge points 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 discharge points.

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 these huts. 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 series of sumps, two utility trenches and a sub-slab drainage system under the 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 OF#11 also appears to receive flowage from upgradient off-site areas.

Catch basin CB-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 sump or vault receives drainage from floor drains in the E.U.T, W.U.T., 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 the drain line from sump S234-8 discharge was also 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. These turns and others further down the line were the turns entangling the jet rod equipment.

The laboratory analysis of marine sediment sampling performed by the University of Rhode Island found a rare PCB compound, decachlorobiphenyl (trade name: Deka) in the sediment offshore of OF# 10B. Tests were performed to find this compound in all soil and water samples collected during this on-shore SASE investigation, but decachlorobiphenyl was not detected at any on-shore 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 Deka in the marine sediments. This analysis has been completed, and no PCBs were detected. However, some PAHs associated with No. 2 fuel oil were detected in the sediment within S234-8. These findings suggest that the decachlorobiphenyl may have been discharged from the greenport ferry, which was tied up on the south side of the pier to Building A18 and used as work space near the end of the Derecktor lease period.

Information on points of collection and/or input areas for OFs #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.

The Preliminary Assessment report noted the presence of large quantities of two types of sand blast grit used as general fill at various locations around the site. However, a series of removal actions resulted in removing most of this material. Remnant quantities of this material (less than several cubic feet scattered at various locations) remain at the site in the Building 234 Area, and no sand blast grit was found in large quantities in the subsurface investigations performed. Soil samples were collected in the former fill areas, as identified in Tables 3-3 and 3-4, and results from the IR analyses are presented in the following sections.

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 B.

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.

Table 4-4A presents summaries of contaminants detected by laboratory analysis in the surface soils. For the purposes of making relative comparisons, Table 4-4B was developed to present a summary of contaminant concentrations that exceed the RIDEM direct exposure criteria for soils in commercial/industrial settings (RIDEM 8/96). This comparison is made, not to indicate risk of

exposure, but to provide a comparison to an available benchmark. Human health risks from contaminant exposure are evaluated in Section 6 of this report.

Table 4-4C presents a summary of contaminants detected by laboratory analysis in the subsurface soils. Similar to the comparison made for surface soils, Table 4-4D presents a summary of contaminant concentrations that exceed the RIDEM direct exposure criteria for soils in commercial/industrial settings.

Table 4-5A presents a summary of metals detected by the toxicity screening leaching procedure (TCLP) applied to soil samples collected. Table 4-5B presents a comparison of these results to the RIDEM GA Leachability Standards (RIDEM 8/96). The reader should note that these leachability criteria are standards for properties with GA groundwater designation, and this site is located within an area with a current groundwater designation of GB (RIGIS 6-97). No leachability criteria have been set for the contaminant detected, however, one would expect them to be less stringent than those criteria expressed in Table 4-5B.

Surface and subsurface soil analyses are presented separately because risk summaries must be developed separately based on these different media.

Geologic conditions specific to each sub-area and the 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 July 1994 Draft Final Remedial Investigation report 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-staurolite 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 laboratory analysis of soils collected from these locations are discussed in Section 4.3.2.2, and complete analytical results are presented in Appendix B.

4.3.2.1 Geology

The uppermost surficial materials at both 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 4-4C presents a summary of contaminants detected in subsurface soil samples in these borings. These results have undergone Tier III validation by B&R Environmental.

The laboratory analyses 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, two butyltin compounds were detected in the surface soil at MW10, which was unexpected. No organic contaminants were detected in the subsurface soils collected from these borings.

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 16.2J mg/kg respectively. A trace of mercury (0.08J mg/kg) was detected at MW1, and a trace of cadmium (0.61J 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. TPH was detected in MW-01 (0 to 2 feet bgs) at a concentration of 260 mg/kg.

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 shallow 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 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 Environmental 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.

4.3.3.1 Geology

The uppermost surficial materials in the North Waterfront 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 4-4A presents a summary of contaminants detected in surface soil samples in the borings and test pits installed in the North Waterfront. Table 4-4C presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results have undergone Tier III validation by B&R Environmental.

Traces of toluene were detected in the surface soils at TP18 through 21, 23, 24, and MW11, indicating the possibility of minor fuel releases in these areas.

Acetone was detected at TP 18, 19, 20, 21, 22, 23, and 24. These samples were all analyzed by the laboratory in a single Sample Data Group (SDG). Acetone is a common laboratory contaminant, which was found in blank samples during analysis of samples in other SDGs, resulting in a qualification of those results with a "U". Since these samples where acetone was detected were all in the same SDG and this was the only SDG where acetone was not reported as a blank contaminant, it is reasonable to assume that it is an artifact of the laboratory analysis, although it was not found in the blank. Traces of benzene, chlorobenzene, and trichloroethene (TCE) were also detected in the surface soils at TP16. Traces of xylenes were detected in surface soils from TP23 and TP24. In the subsurface soil samples, TCE was detected in TP23 (9 to 10 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 numerous surface soil samples) (maximum concentration 110 ug/kg), and various PAH compounds. 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 for locating a contaminant plume expected to be migrating onto the site. TPH was also detected in this sample, at a concentration of 103 mg/kg. Subsurface soil samples were not collected for laboratory analysis of organic compounds. However, subsurface soil samples were analyzed using the on-site GC, and these results are presented in Appendix A.

Total petroleum hydrocarbons were detected in surface soils at TP16 (4,900 mg/kg); TP18 (115 mg/kg); TP19 (310 mg/kg); TP20 (200 mg/kg); TP23 (290 mg/kg); and TP27 (61 mg/kg). TPH was detected in subsurface soils at MW04 (89 mg/kg, 16 to 18 feet bgs) and at TP16 (1200 mg/kg11 to 12 feet bgs).

Butyltin compounds were detected in surface soils at TP16, 18, 22, 23, and 24. Concentrations were highest in samples collected at TP16 (total of 96 ug/kg); other locations were below 36 ug/kg (total). Traces of butyltins were also found in subsurface soil samples collected from TP16, MW02, MW03, MW11, and MW12.

One PCB compound was detected in the surface soil (Aroclor 1260, detected at 24J 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 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 4.3.4.2, 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 rock quality designation (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 4-4A presents a summary of contaminants detected in surface soil samples in the borings and test pits

installed at the Central Shipyard area. Table 4-4C presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results have undergone Tier III validation by B&R Environmental.

The Preliminary Assessment noted that the south exterior wall of Building 42 was heavily stained. This condition no longer exists. Furthermore, the soils adjacent to the southern wall showed no obvious evidence of impact, and opportunistic vegetation that is taking over this area does not appear to be stressed in any way.

Carbon disulfide was the only VOC detected in subsurface soils. No VOCs were detected in surface soil samples collected.

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 MW07.

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 were present in the screening samples evaluated in the field, subsurface soil samples from this location 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 MW06 (72 mg/kg); TP12 (2000J 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); 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 (15.8 ug/kg) and MW05 (4.9J 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 and 32J ug/kg at TP15. One of four sources may have caused the PCB detection at TP14. 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. Aroclor 1260 was detected (13J ug/kg) in subsurface soil from TP25 at 10 to 11 feet bgs.

Pesticides were detected at several locations. Most notable were high concentrations of pesticides in the surface soils at TP14. 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. 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 (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 Environmental 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 ground which is subrounded to angular, 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. This boring is directly below the concrete slab that was cored 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. The piping was old discards from a previous UST removal, and the pipes were no longer connected to anything. In addition, the floor drain located at S234-7 was not found to exit this side of the building, and therefore, the test pit was terminated.

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 well 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 4-4A presents a summary of contaminants detected in surface soil samples in the borings and test pits installed at the Building 234 Area. Table 4-4C presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results have undergone Tier III validation by B&R Environmental.

Traces of two 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 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, 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 and various PAH compounds. The phthalate compound was detected at high concentrations in the surface soil at TP07 (8,700 ug/kg). Concentrations of bis(2-ethylhexyl)phthalate were detected at 22,000 ug/kg at a depth of 9 to 10 feet bgs (TP08).

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 (54 mg/kg, 10 to 12 feet bgs).

Butyltin compounds were detected in surface soils at TP09 (total of 13J ug/kg) and MW08 (6.9J ug/kg). Butyltin compounds were also found in one subsurface soil sample, collected from TP08 (2.9J 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 24J ug/kg in the surface soil collected at TP10. Aroclor 1254 was detected at 38J 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. 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 (75J mg/kg, at 4 to 6 feet bgs) and zinc was slightly elevated in that test pit (117 mg/kg at 9 to 10 feet bgs). TCLP analysis of the surface soil sample from TP08 indicated leaching of lead (lead concentrations were close to, or in excess of, 100 mg/l in leachate collected).

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 Environmental site geologist. Analytical results from soils from these borings and test pits are discussed in Section 4.3.6.2, 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 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 4-4A presents a summary of contaminants detected in surface soil samples in the test pits installed at the South Waterfront. Table 4-4C presents a summary of contaminants detected in subsurface soil samples in these borings and test pits. These results have undergone Tier III validation by B&R Environmental.

No volatile organic compounds were detected in surface and subsurface soils.

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), TP04, 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 (2.4 ug/kg) and TP06 (total of 5.5 ug/kg). A trace of tetrabutyltin was also found in one subsurface soil sample, collected from TP05 (5.5 ug/kg, at 5 to 7 feet bgs).

One PCB compound was detected in two surface soil samples: Aroclor 1260 was detected at 25J ug/kg in the surface soil collected at TP04, and at 15J 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 (172J mg/kg); TP04 (501J 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 119J 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 have undergone Tier III validation by B&R Environmental.

Samples were collected using low-flow, low-stress, groundwater sample collection methods, using submersible pumps, as described in Section 3.0 of this report.

Two chlorinated solvents were 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.

No semivolatile organic compounds were detected in surface and subsurface soils. 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.

Table 4-6B presents a summary of chemical constituents detected in groundwater at concentrations exceeding RIDEM objectives for groundwater designated as GA (RIDEM 8/96). The reader should note that this site is within an area with a current groundwater designation of GB (RIGIS 6-97). This table is presented only as a brief comparison to existing standards. It does not indicate exceedances of regulatory criteria applicable to this site.

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 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 1 foot to approximately 30 feet, depending on 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 becomes lower 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 (RIGIS 1997). Groundwater classified as GB may not be suitable for drinking water without treatment, because of 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. This site is not only located within an area that has been urbanized since the 1950s, but much of the site is fill, and is within 200 feet of the ocean. Groundwater is tidally influenced, which further precludes the groundwater from possible use as a drinking water supply.

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 site groundwater. 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 5 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 inland. 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) was evaluated in a separate study, the Marine Ecological Risk Assessment for Derecktor Shipyard, dated May 1997.

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, Central Shipyard, Building 234 Area, and the South Waterfront. Figure 4-13 also depicts areas that are paved, unpaved, and vegetated.

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 Waterfront, Central Shipyard, and Building 234 Areas consists mostly of sheet piling shoreline, except for the 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 slopes steeply 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. The wetland swale is technically off site but was included in the vegetation description of this area due to its proximity to the study area border.

Areas presently vegetated were historically maintained by naval operations before Derecktor Shipyard sub-leased the property. 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 western 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 off-site 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 arrowood, 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 (*Thelypterus*), 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

Several areas in the Central Shipyard were 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 vegetation includes 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 fragments of dune/beach vegetation along near shore areas (Area 7, Figure 4-13).

The upland vegetation exists primarily on a soil berm with a relatively steep embankment leading 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 operations. The concrete debris is also present, although to a lesser extent, approximately 300 feet south 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 (*Onethera biennis*), sweet white clover, and timothy (*Phleum pratense*).

The fragments of dune/beach vegetation consist 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 areas and an off-site area. The off site area, which is well to the north of the site, is described for comparison purposes as is one of the least disturbed areas nearby which appears to be representative of the west shoreline of Aquidneck Island. 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 OF# 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 arrowood, bittersweet, grape (*Vitis* spp.), and poison ivy. The dune/beach vegetation that parallels the upland vegetation and is set back 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 range of terrestrial, wetland, and avian species that utilize the site. The limited on-site vegetation 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. Two small off-site wetland vegetation areas (shown on Figure 4-13 as areas 2 and 8) offer the nearest fresh water sources for the small mammals that have limited home ranges.

Species lists for birds, mammals, and reptiles that were observed on site are presented in Tables 4-7 and 4-8. The list should not be considered a conclusive list of wildlife that may utilize the on-site habitats. Table 4-8 (mammals and reptiles) provides an indicator of the area of the site where the species were observed. Other site areas were qualified as "potential presence" based mostly on the potential for utilization of the habitats (either transient or permanent) by the listed species.

4.5.4.1 Birds

During the 1996 field investigation, the most frequently 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 off shore include the great egret (*Casmerodius albus*), double-crested cormorant (*Phalacrocorax auritus*), mallard duck (*Anas platyrhynchos*), and black-crowned night heron (*Nycticorax nycticoray*). A list of upland and seabirds observed on site 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, raccoon (*Procyon lotor*) tracks were observed on the beach of the South Waterfront. The Penn Central right-of-way may provide an access corridor between off-site and on-site areas. A list of mammals that were observed 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 4-8). It should be noted that the wildlife survey was conducted in August 1996 and that a spring season audible calls survey was not conducted, which may have identified amphibians present on or near the site.

4.5.4.4 Endangered Species

According to the USFWS (U.S. DOI, 1996) and Rhode Island Natural Heritage Program (RIDEM, 1996), no species of special concern or ecologically significant natural communities are present at or near the site. However, possible exceptions are 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 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 the 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 Coddington Cover shoreline was developed. Before then,, it is assumed that the property was used as farmland. Much of the property in the Central Shipyard was beach area that filled was with the installation of the sheet piling wall and piers.

No groundwater supply wells exist on site. As described previously, the 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 an industrial port; the potential for exposure to site contaminants could continue to exist for site workers or passers-by (adult). However, if the port is used by the general public, a potential exposure could exist for children, as well. Future use of the property for residential purposes is highly unlikely.

The land abutting the site is 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; 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 Figures 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 southwest of the South Waterfront (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	Contents	UIC
S42-1	5.5'x 5'x 4.5'	Steel walls and bottom	2-inch ID[5] drain pipe in outlet sealed with cement	Yes - former	Paint mixing and thinning	Oily liquid, oily sludge	No
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	Oily liquid, oily sludge, insulation/ cork debris	No
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	Oily liquid, oily sludge, insulation/ cork debris	No
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	Oily liquid, oily sludge, insulation/ cork debris	No
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	Water	Possibly
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	Some soil, concrete debris	Yes

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.
5 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	Contents	UIC
S234-1	20'x 0.6'x 0.8'	Concrete sides, soil bottom	None	Yes	Utility trench	electrical conduit, scrap metal,scrap wood	No
S234-2	14.5'x 1.9'x 0.8'	Concrete sides and bottom	None	No	Unknown	scrap metal, wood, liquid	No
S234-3	22'x 5.7'x 1.9'	Concrete sides and bottom	None	No	Mounting brackets present indicate a holding pit for equipment	scrap metal, wood, soil, liquid	No
S234-4	Various, 6' depth	Concrete sides, soil bottom	None	Yes	Shape indicates former housing for lifting equipment	scrap metal, wood, soil	No
S234-5	12.6'x 1.6'x 1.5'	Steel walls and bottom, welded seams	None	No	Unknown	scrap metal, wood, soil, liquid	No
S234-6	7'x 30'x 12'	Concrete walls and bottom	None	No	Unknown	scrap metal, wood, soil, concrete debris, liquid, oily sludge, possible sandblast grit, slag	No
S234-7	Various, shallow trench less than 1' depth	Concrete walls and bottom	Floor drain present, confirmed to lead to S234-8	Possibly	Unknown	scrap metal, wood, soil, concrete debris, gravel	No
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)	liquid, oily sludge	No

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
PAGE TWO

Identifier	Dimensions[1]	Construction	Outlet Piping Present	Potential Discharge Point	Former Use	Contents	UIC
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	scrap metal, wood, soil	No
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	scrap metal, wood, soil, insulation, concrete debris, possible sandblast grit, slag	No
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	scrap metal, wood, soil, insulation, concrete debris, possible sandblast grit	No

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
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	S42-1	S42-2	S42-2	S42-5	S42-5	S42-5	S42-5
Sample Number	DSY-S-S42-1-0005	DSY-S-S42-2-0005	DSY-S-S42-2-0510	DSY-S-S42-5-0005	DSY-S-S42-5-0510	DSY-S-S42-5-1015	DSY-SB-09-1416
Sample Description	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 ft	Boring, 14.0-16.0 ft
Volatile Organics (ug/kg)							
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	1 J
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	260 J	300 J	190 J	ND
Acenaphthylene	ND	ND	370 J	ND	ND	ND	ND
Anthracene	ND	ND	610 J	ND	35 J	ND	ND
Benzo(a)anthracene	460 J	110 J	4300	85 J	150 J	82 J	84 J
Benzo(a)pyrene	380 J	110 J	3900	110 J	150 J	130 J	73 J
Benzo(b)fluoranthene	860 J	190 J	4900	210 J	320 J	190 J	130 J
Benzo(g,h,i)perylene	450 J	150 J	2600	ND	ND	ND	ND
Benzo(k)fluoranthene	230 J	71 J	3200	60 J	95 J	81 J	65 J
bis(2-Ethylhexyl)Phthalate	5500	ND	ND	100 J	120 J	100 J	ND
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	48 J
Chrysene	560 J	130 J	4700	91 J	170 J	96 J	88 J
Di-n-butylphthalate	2800	100 J	ND	ND	ND	ND	ND
Di-n-octylphthalate	990 J	ND	ND	ND	ND	ND	ND
Fluoranthene	1000 J	170 J	6200	170 J	320 J	180 J	130 J
Indeno(1,2,3-cd)pyrene	330 J	96 J	ND	ND	ND	ND	ND
Phenanthrene	1000 J	130 J	1200 J	100 J	220 J	83 J	120 J
Pyrene	1500 J	220 J	6400	160 J	380 J	160 J	170 J
Butyltin Compounds (ug/kg)							
Dibutyltin	440	8.5 J	5.9 J	434	50	27 J	ND
Monobutyltin	160	2.5 J	2 J	27 J	21 J	6.5 J	ND
Tetrabutyltin	6.5 J	ND	ND	2.8 J	ND	ND	ND
Tributyltin	1000	8.6 J	12.2 J	165	41 J	31 J	ND

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

TABLE 4-3A
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	S42-1	S42-2	S42-2	S42-5	S42-5	S42-5	S42-5
Sample Number	DSY-S-S42-1-0005	DSY-S-S42-2-0005	DSY-S-S42-2-0510	DSY-S-S42-5-0005	DSY-S-S42-5-0510	DSY-S-S42-5-1015	DSY-SB-09-1416
Sample Description	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 ft	Boring, 14.0-16.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	8.6	ND	ND	3.9	ND	ND	ND
4,4'-DDE	24	ND	ND	ND	ND	ND	ND
4,4'-DDT	27	14	ND	10 J	9.8 J	16 J	ND
alpha-Chlordane	4.1	ND	ND	ND	ND	4.6 J	ND
Aroclor-1242	ND	ND	ND	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	33 J	23 J	36 J	ND
Aroclor-1260	260	140	57	ND	ND	ND	ND
Dieldrin	22	16	6.3	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ND	6.4	ND	ND	ND	ND	ND
gamma-Chlordane	6.8	ND	ND	ND	ND	6.4 J	ND
Heptachlor	ND	ND	ND	ND	ND	6.4 J	ND
Heptachlor Epoxide	ND	4.7	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	10900	8440	5500	18600	18200	15800	9530
Arsenic, total	13.9	10	9	11.4	9.2	8.3	15.7
Barium, total	1620	62.4	44	279	211	136	19.4
Beryllium, total	1.5	0.39 J	0.3 J	2	1.5	1.9	0.45 J
Cadmium, total	28.9	1 J	1 J	ND	ND	ND	ND
Chromium, total	278	21.5 J	15.6 J	53.7	47.6	38.6	13.1
Cobalt, total	31.7	7.2	5.8	16.1	12.1	14	12
Copper, total	2120	89.8	69.8	273	193	195	18.5
Iron, total	122000	21400	23900	39300	39300	30900	25700
Lead, total	1290 J	82.8 J	63 J	240 J	65.1 J	105 J	16.1 J
Manganese, total	1260	248	182	279 J	301 J	342 J	366 J
Mercury, total	0.6	0.18	0.1	ND	ND	ND	ND
Nickel, total	150	17.3	13.7	54.4 J	47.1 J	61.9 J	18
Selenium, total	3.4 J	ND	ND	2 J	1.7 J	1.5 J	ND
Tin, total	67.4 J	ND	ND	20	15.3	23.4	ND
Vanadium, total	23.5 J	13.8	12.3 J	29.1	28.5	23.5	17.5 J
Zinc, total	11900	727	593	658	593	534	50.9
TPH USING IR (mg/kg)	1600	430	230	610 J	ND	230 J	17000

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

TABLE 4-3A
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	S42-5	Dry Well	Dry Well	S234-1	S234-1	S234-1	S234-4
Sample Number	DSY-SB-10-1416	DSY-SB-01-0911	DSY-SB-03-0911	DSY-S-S234-1-0005	DSY-S-S234-1-0510	DSY-S-S234-1-1015	DSY-S-S234-4-0005
Sample Description	Boring, 14.0-16.0 ft	Boring, 9 -11 ft	Boring, 9 -11 ft	Soil, 0.0-0.5 ft	Soil, 0.5-1.0 ft	Soil, 1.0-1.5 ft	Soil, 0.0-0.5 ft
Volatile Organics (ug/kg)							
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	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	74	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	81	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	61	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)Phthalate	ND	140J	150J	54 J	130 J	ND	550 J
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	ND	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND	4.1 J	ND	ND
Tetrabutyltin	ND	ND	ND	ND	ND	ND	ND
Tributyltin	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-3A
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	S42-5	Dry Well	Dry Well	S234-1	S234-1	S234-1	S234-4
Sample Number	DSY-SB-10-1416	DSY-SB-01-0911	DSY-SB-03-0911	DSY-S-S234-1-0005	DSY-S-S234-1-0510	DSY-S-S234-1-1015	DSY-S-S234-4-0005
Sample Description	Boring, 14.0-16.0 ft	Boring, 9 -11 ft	Boring, 9 -11 ft	Soil, 0.0-0.5 ft	Soil, 0.5-1.0 ft	Soil, 1.0-1.5 ft	Soil, 0.0-0.5 ft
Pesticides/PCBs (ug/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
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND
Aroclor-1242	ND	ND	ND	ND	9.4 J	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	13000	11100	10400	5390	5000	4220	3000
Arsenic, total	17.8	24	17	4	3.9	3.4	2.7
Barium, total	20.2	8.3	6.3	9.2	9.5	5.3	12.9
Beryllium, total	0.52	0.25	ND	0.2 J	0.19 J	ND	ND
Cadmium, total	1.1 J	1	0.72	ND	ND	ND	ND
Chromium, total	18.4	15.9	13.6	7.9	5.8 J	5.8 J	9.1
Cobalt, total	12.1	14.7	11.8	6.9	6.6	3.4	4.5
Copper, total	12.4	16.2	16.1	15.7	16.2	7	17.8
Iron, total	31100	36000	32300	15100	14900	12100	10100
Lead, total	8.2 J	12.5	15.5	9.2 J	4.8 J	2.6 J	43.7 J
Manganese, total	311 J	551	451	279 J	251 J	126 J	119 J
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	24.7	21.2	21.2	11.9 J	9.4 J	7.8 J	7.1 J
Selenium, total	ND	ND	ND	ND	1.1 J	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	22.8 J	8.9	ND	7	6.6	6.8	6
Zinc, total	50.1	19.4	17.6	36.7	28.3	22.4	177
TPH USING IR (mg/kg)	ND	64	82.5	ND	ND	ND	19000 J

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

TABLE 4-3A
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	S234-4	S234-4	S234-7	S234-7	Equipment Boxes	Equipment Boxes
Sample Number	DSY-S-S234-4-0510	DSY-S-S234-4-1015	DSY-S-SB14-0103	DSY-S-SB15-0103	DSY-S-SB04-0406	DSY-S-SB06-0204
Sample Description	Soil, 0.5-1.0 ft	Soil, 1.0-1.5 ft	Soil, 1-3 ft	Soil, 1-3 ft.	Soil, 4-6 ft	Soil, 2-4 ft.
Volatile Organics (ug/kg)						
1,1,1-Trichloroethane	ND	1 J	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	1J
Semivolatile Organics (ug/kg)						
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	ND	67J	ND	ND	ND
Benzo(a)pyrene	ND	ND	58J	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	100J	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	ND	210J	130J	800	200J
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	62J	110J	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	93J	110J	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	110J	160J	ND	ND
Pyrene	ND	ND	96.5J	100J	ND	ND
Butyltin Compounds (ug/kg)						
Dibutyltin	ND	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	8.8J	ND	ND	ND
Tetrabutyltin	ND	ND	ND	ND	ND	ND
Tributyltin	ND	ND	ND	ND	ND	ND

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

TABLE 4-3A
CHEMICAL CONSTITUENTS DETECTED IN SUMPS AND BORINGS
AT POTENTIAL DISCHARGE AREAS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	S234-4	S234-4	S234-7	S234-7	Equipment Boxes	Equipment Boxes
Sample Number	DSY-S-S234-4-0510	DSY-S-S234-4-1015	DSY-S-SB14-0103	DSY-S-SB15-0103	DSY-S-SB04-0406	DSY-S-SB06-0204
Sample Description	Soil, 0.5-1.0 ft	Soil, 1.0-1.5 ft	Soil, 1-3 ft	Soil, 1-3 ft.	Soil, 4-6 ft	Soil, 2-4 ft.
Pesticides/PCBs (ug/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-1242	ND	ND	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND
Endrin Aldehyde	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
Metals (mg/kg)						
Aluminum, total	3900	2940	10450	10700	3270	3990
Arsenic, total	3.5	3.4	17.8	16.1	3.5	7.7
Barium, total	ND	ND	20.9	10.1	4	6.6
Beryllium, total	ND	ND	0.45	0.32	ND	ND
Cadmium, total	ND	ND	1	0.97	ND	ND
Chromium, total	5.9 J	5.4 J	13.8	14.5	8.1	60.2
Cobalt, total	4.3	2.9	10.2	12.8	3.9	6.3
Copper, total	6.7	3.9	17.5	19.9	4.1	38.8
Iron, total	11500	9360	24300	28400	9520	29200
Lead, total	2.5 J	ND	21	5.3	1.5	1.3
Manganese, total	92.2 J	86.2 J	327	289	93.2	236
Mercury, total	ND	ND	ND	ND	ND	ND
Nickel, total	8.9 J	5.8 J	16.8	21.9	7.2	30.1
Selenium, total	0.89 J	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND
Vanadium, total	6.6	5.9	ND	ND	ND	ND
Zinc, total	25.2	17	15.8	14	7	10.7
TPH USING IR (mg/kg)	11000 J	9200 J	51.5	43.6	18	49.9

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

TABLE 4-3B
CONSTITUENTS DETECTED IN SUMPS AND BORINGS AT POTENTIAL DISCHARGE AREAS
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	S42-1	S42-2	S42-2	S42-5	S42-5
Sample Number	Direct Exposure	DSY-S-S42-1-0005	DSY-S-S42-2-0005	DSY-S-S42-2-0510	DSY-S-S42-5-0005	DSY-S-S42-5-0510
Sample Description	Criteria (see text)	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
Semivolatile Organics (ug/kg)						
Benzo(a)pyrene	800			3900		
Metals (mg/kg)						
Arsenic, total	3.8	13.9	10	9	11.4	9.2
Beryllium, total	1.3	1.5			2	1.5
Lead, total	500	1290 J				
Zinc, total	10000	11900				
TPH USING IR (mg/kg)	2500					

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

TABLE 4-3B
CONSTITUENTS DETECTED IN SUMPS AND BORINGS AT POTENTIAL DISCHARGE AREAS
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	S42-5	S42-5	S42-5	Dry Well	Dry Well
Sample Number	Direct Exposure	DSY-S-S42-5-1015	DSY-SB-09-1416	DSY-SB-10-1416	DSY-SB-01-0911	DSY-SB-03-0911
Sample Description	Criteria (see text)	Soil, 1.0-1.5 ft	Boring, 14.0-16.0 ft	Boring, 14.0-16.0 ft	Boring, 14.0-16.0 ft	Boring, 14.0-16.0 ft
Semivolatile Organics (ug/kg)						
Benzo(a)pyrene	800					
Metals (mg/kg)						
Arsenic, total	3.8	8.3	15.7	17.8	24	17
Beryllium, total	1.3	1.9				
Lead, total	500					
Zinc, total	10000					
TPH USING IR (mg/kg)	2500		17000			

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

TABLE 4-3B
CONSTITUENTS DETECTED IN SUMPS AND BORINGS AT POTENTIAL DISCHARGE AREAS
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	RIDEM	S234-1	S234-1	S234-4	S234-4	S234-4
Sample Number	Direct Exposure	DSY-S-S234-1-0005	DSY-S-S234-1-0510	DSY-S-S234-4-0005	DSY-S-S234-4-0510	DSY-S-S234-4-1015
Sample Description	Criteria (see text)	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 ft
Semivolatile Organics (ug/kg)						
Benzo(a)pyrene	800					
Metals (mg/kg)						
Arsenic, total	3.8	4	3.9			
Beryllium, total	1.3					
Lead, total	500					
Zinc, total	10000					
TPH USING IR (mg/kg)	2500			19000 J	11000 J	9200 J

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

TABLE 4-3B
CONSTITUENTS DETECTED IN SUMPS AND BORINGS AT POTENTIAL DISCHARGE AREAS
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	RIDEM	S234-7	S234-7	Equipment Boxes
Sample Number	Direct Exposure	DSY-S-SB14-0103	DSY-S-SB15-0103	DSY-S-SB06-0204
Sample Description	Criteria (see text)	Soil, 1.0-3.0 ft	Soil, 1.0-3.0 ft	Soil, 2 - 4 ft
Semivolatile Organics (ug/kg)				
Benzo(a)pyrene	800			
Metals (mg/kg)				
Arsenic, total	3.8	17.8	16.1	7
Beryllium, total	1.3			
Lead, total	500			
Zinc, total	10000			
TPH USING IR (mg/kg)	2500			

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW01	MW10	MW02	MW03	MW04	MW11	MW12
Sample Number	DSY-S-MW01-0002	DSY-S-MW10-0002	DSY-S-MW02-0002	DSY-S-MW03-0002	DSY-S-MW04-0002	DSY-S-MW11-0002	DSY-S-MW12-0002
Sample Description	Boring, 0.0-2.0 ft	Boring, 0.0-2.0 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Boring, 0.5-1.5 ft
Volatile Organics (ug/kg)							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	1 J	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
4-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	55 J	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	ND	ND	46 J	ND	ND	ND	80 J
Carbazole	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	120 J	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	53 J	63 J	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND
Pyrene	54 J	59 J	ND	ND	ND	ND	ND
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	50 J	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND	ND	ND	ND
Tetrabutyltin	ND	ND	ND	ND	ND	ND	ND
Tributyltin	ND	6.62 J	ND	ND	ND	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW01	MW10	MW02	MW03	MW04	MW11	MW12
Sample Number	DSY-S-MW01-0002	DSY-S-MW10-0002	DSY-S-MW02-0002	DSY-S-MW03-0002	DSY-S-MW04-0002	DSY-S-MW11-0002	DSY-S-MW12-0002
Sample Description	Boring, 0.0-2.0 ft	Boring, 0.0-2.0 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Boring, 0.5-1.5 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	27	ND	ND	ND	ND	ND
4,4'-DDT	ND	32	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	2	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Ketone	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	2.4	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	13100 J	13200	4620	4460 J	3440	4220 J	4690
Arsenic, total	19.5	20.3	3	3.3	4.9	3.8	2.8
Barium, total	36.3	20.1	5.4	5.9	6.4	9.3	ND
Beryllium, total	0.76	0.43 J	ND	ND	ND	ND	ND
Cadmium, total	ND	0.61 J	ND	ND	ND	ND	ND
Chromium, total	16.4	15	7.8	8.8	ND	ND	7.4
Cobalt, total	18.4	10.5	4.4	ND	4.6	8	2.6
Copper, total	11.2 J	15	8.9	13.6 J	9.2	15.7 J	3.1
Iron, total	28200 J	26900	12800	13100 J	12100	11900 J	11500
Lead, total	18.3	16.2 J	3.7 J	20.1	7 J	4.8	2.3 J
Manganese, total	1580	338 J	137 J	111	149	268	81.4 J
Mercury, total	0.08 J	ND	ND	0.06	ND	ND	ND
Nickel, total	21.4 J	19.2	13.1 J	9.7 J	8.2	9.4 J	9.8 J
Selenium, total	ND	ND	0.78 J	ND	ND	ND	1 J
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	21.7 J	22.2 J	7.4	7.7	6.6	6.4	7.4
Zinc, total	49.7	54	28.8	49.2	22.8	22.8	22.8
TPH USING IR (mg/kg)	260 J	ND	ND	ND	ND	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	Haz Waste Storage	TP16	TP18	TP19	TP20	TP21	TP22
Sample Number	DSY-S-SB11-0002	DSY-S-TP16-0001	DSY-S-TP18-0001	DSY-S-TP19-0001	DSY-S-TP20-0001	DSY-S-TP21-0001	DSY-S-TP22-0001
Sample Description	Boring, 0.5 to 1.5 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	115	100	77	110	75
Benzene	ND	1 J	ND	ND	ND	ND	ND
Chlorobenzene	ND	3 J	ND	ND	ND	ND	ND
Toluene	ND	2 J	3.25	1 J	2 J	1 J	ND
Total Xylenes	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	2 J	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	114.5	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
4-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	ND	ND	107.5	66 J	44 J	68 J	65 J
Carbazole	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	55 J	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	180	ND	ND	ND	ND
Pyrene	ND	1400 J	ND	ND	ND	ND	ND
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	33	5.25	ND	ND	ND	ND
Monobutyltin	ND	33	ND	ND	ND	ND	ND
Tetrabutyltin	ND	ND	ND	ND	2.5 J	3.7 J	5.8 J
Tributyltin	ND	30 J	14.05	ND	ND	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	Haz Waste Storage	TP16	TP18	TP19	TP20	TP21	TP22
Sample Number	DSY-S-SB11-0002	DSY-S-TP16-0001	DSY-S-TP18-0001	DSY-S-TP19-0001	DSY-S-TP20-0001	DSY-S-TP21-0001	DSY-S-TP22-0001
Sample Description	Boring, 0.5 to 1.5 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/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
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	24 J	ND	ND	ND	ND	ND
Dieldrin	ND	16	ND	ND	ND	ND	ND
Endrin	5.7	26	ND	ND	ND	ND	ND
Endrin Ketone	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	4300	8290	5265	4920	5980	3950	4810
Arsenic, total	ND	4.7	4.6	2.6 J	4.5 J	5.1 J	5.3 J
Barium, total	7.2	49.4	19.85	5.1	13.5	8.3	9.5
Beryllium, total	ND	1.1	0.205	ND	0.23 J	0.21 J	ND
Cadmium, total	ND	0.85 J	ND	ND	ND	ND	ND
Chromium, total	6.7	24.1	6.8	7.9	7.7	5.2	5.8
Cobalt, total	ND	14.7	8	3.4	8.6	9.1	7.9
Copper, total	8	111	24.9	4.3	20.8	19.3	18.8
Iron, total	12900	19600	16400	11200	18100	15900	15900
Lead, total	8J	85.5	17.7	3.7 J	14.2 J	9.5 J	9.8 J
Manganese, total	135J	187	291.5	84.1 J	306 J	322 J	259 J
Mercury, total	ND	ND	0.0375	ND	ND	ND	ND
Nickel, total	ND	68.5	ND	ND	ND	ND	ND
Selenium, total	ND	0.99 J	0.5	ND	ND	0.66 J	ND
Tin, total	ND	12.2 J	ND	ND	ND	ND	ND
Vanadium, total	8.4	22.4	9.55	8.6	10.2	7.6	8.4
Zinc, total	26.4	883	77.1	48	41	40.6	44.4
TPH USING IR (mg/kg)	ND	4900	115	310	200	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP23	TP24	TP27	TP28	MW05	MW06	MW07
Sample Number	DSY-S-TP23-0001	DSY-S-TP24-0102	DSY-S-TP27-0001	DSY-S-TP28-0001	DSY-S-MW05-0002	DSY-S-MW06-0002	DSY-S-MW07-0002
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 1.0-2.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft
Volatile Organics (ug/kg)							
2-Butanone	ND	9.75	ND	ND	ND	ND	ND
Acetone	92 J	66	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	4 J	3.75	ND	ND	ND	ND	ND
Total Xylenes	2 J	3.75	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	943.5	ND	ND	ND
Anthracene	ND	ND	ND	971	ND	ND	ND
Benzo(a)anthracene	ND	121.5	ND	605	ND	130 J	ND
Benzo(a)pyrene	ND	117	ND	530	ND	120 J	ND
Benzo(b)fluoranthene	ND	130.5	ND	805	ND	180 J	ND
Benzo(g,h,i)perylene	ND	ND	ND	1030	ND	72 J	ND
Benzo(k)fluoranthene	ND	ND	ND	1030	ND	86 J	ND
bis(2-Ethylhexyl)Phthalate	110 J	70	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	951	ND	ND	ND
Chrysene	ND	117	ND	580	ND	140 J	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	135.5	ND	1160	ND	300 J	ND
Fluorene	ND	ND	ND	951	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	380	ND	71 J	ND
Phenanthrene	ND	122	ND	640	ND	120 J	ND
Phenol	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	1090	ND	230 J	ND
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	ND	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND	ND	ND	ND
Tetrabutyltin	3.8 J	5.9	ND	ND	ND	ND	ND
Tributyltin	9.9 J	ND	ND	ND	ND	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP23	TP24	TP27	TP28	MW05	MW06	MW07
Sample Number	DSY-S-TP23-0001	DSY-S-TP24-0102	DSY-S-TP27-0001	DSY-S-TP28-0001	DSY-S-MW05-0002	DSY-S-MW06-0002	DSY-S-MW07-0002
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 1.0-2.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	19.5	ND	ND	ND
4,4'-DDT	ND	ND	ND	50.5	ND	ND	ND
alpha-Chlordane	ND	ND	ND	8.1	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Ketone	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	3.625	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	3.4	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	7830	4950	3840	9650	8180	12300	13100
Arsenic, total	8.8 J	5.6	ND	10.85	5.35	10.4	23.9
Barium, total	15.1 J	12.95	7.1 J	28	12.45	14.8 J	12.1
Beryllium, total	0.31 J	0.22	ND	0.385	0.26	0.45	0.38 J
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	9.2	6.2	5.3 J	12.5	9.8	15.8 J	15.8
Cobalt, total	9.8	9	6.4 J	7.7	8.95	22.7	14.7
Copper, total	19.3	19.7	16.4 J	20.55	15.15	30.2	19.5
Iron, total	19400	17550	13200	19700	18500	30600	31000
Lead, total	10.8 J	7.4	13.8 J	112	13.5	18.1 J	9.2 J
Manganese, total	340 J	364.5	218 J	331.5	297.5	619	448
Mercury, total	0.05 J	ND	ND	ND	ND	ND	0.12
Nickel, total	17 J	11.375	8.9 J	16.15	14.9	24.9	24.9
Selenium, total	0.63 J	0.66	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	12.2 J	8.95	6.5	39.5	8.75	14.5	14.5
Zinc, total	42.4	39.6	30.3 J	61.5	33.35	88.5 J	54.8 J
TPH USING IR (mg/kg)	290	ND	61	103	ND	72	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area
Sample Location	TP11	TP12	TP14	TP15	TP17	MW08	MW09
Sample Number	DSY-S-TP11-0001	DSY-S-TP12-0001	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-MW08-0002	DSY-S-MW09-0002
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft
Volatile Organics (ug/kg)							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	3 J	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	180 J	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	83 J	ND	ND
4-Methylphenol	ND	ND	ND	ND	500 J	ND	ND
Acenaphthene	ND	ND	ND	92 J	ND	52 J	ND
Anthracene	ND	ND	ND	130 J	ND	110 J	51 J
Benzo(a)anthracene	ND	ND	ND	410 J	140 J	200 J	470 J
Benzo(a)pyrene	ND	ND	ND	86 J	140 J	170 J	410 J
Benzo(b)fluoranthene	ND	ND	ND	410 J	230 J	230 J	660 J
Benzo(g,h,i)perylene	ND	ND	ND	110 J	130 J	88 J	190 J
Benzo(k)fluoranthene	ND	ND	ND	360 J	ND	87 J	270 J
bis(2-Ethylhexyl)Phthalate	ND	ND	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	97 J	ND	37 J	ND
Chrysene	ND	ND	ND	420 J	120 J	220 J	580 J
Di-n-butylphthalate	ND	ND	ND	ND	ND	51 J	64 J
Di-n-octylphthalate	ND	ND	ND	ND	ND	62 J	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	62 J
Fluoranthene	ND	ND	ND	870 J	330 J	460 J	770 J
Fluorene	ND	ND	ND	65 J	ND	50 J	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	150 J	140 J	80 J	190 J
Phenanthrene	ND	ND	ND	580 J	130 J	420 J	180 J
Phenol	ND	ND	ND	ND	1200 J	ND	ND
Pyrene	ND	ND	ND	740 J	300 J	460 J	750 J
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	ND	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND	ND	ND	ND
Tetrabutyltin	ND	ND	ND	8.8 J	ND	ND	ND
Tributyltin	ND	ND	ND	4.8 J	ND	6.9 J	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area
Sample Location	TP11	TP12	TP14	TP15	TP17	MW08	MW09
Sample Number	DSY-S-TP11-0001	DSY-S-TP12-0001	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-MW08-0002	DSY-S-MW09-0002
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	ND	ND	4.3	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	6.2	ND	ND	5.2 J
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	38 J	ND
Aroclor-1260	ND	ND	71000*	32 J	ND	ND	ND
Dieldrin	ND	ND	470	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Ketone	ND	ND	1100	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	2300	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	12100	13200	14400	12700	5820	10100	5260
Arsenic, total	24.4	20.1	9.5	19.3	3.9	19.2	5.3
Barium, total	17.1	21.4	19.8	24	14.5	67	12.9
Beryllium, total	0.41 J	0.42 J	0.31 J	0.47	0.23 J	3.5	ND
Cadmium, total	0.97 J	0.88 J	1.2 J	1 J	0.75 J	ND	ND
Chromium, total	15.6	18.2	19	16.8	11	40.2 J	13.7 J
Cobalt, total	14.4 J	14.4 J	12 J	12.2 J	7.6 J	23.9	7
Copper, total	25.6	31.8	33	29.6	23.1	262	25.5
Iron, total	31800	32500	32900	31200	23200	32900	16900
Lead, total	10.3	14.7	24.8	27.4	26.2	189 J	23.4 J
Manganese, total	445 J	421 J	318 J	349 J	325 J	489	307
Mercury, total	ND	ND	ND	ND	ND	0.07	ND
Nickel, total	23.7	27.1	27.4	24.4	15.6	113	17.8
Selenium, total	0.87 J	0.74 J	ND	1.2	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	40.6 J	ND
Vanadium, total	17.8 J	18.9 J	21.2 J	21.8 J	13.7 J	13.1	16.7
Zinc, total	51.2	70.2	123	71	60	831 J	175 J
TPH USING IR (mg/kg)	ND	2000 J	1700	68	170	270	77

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location	TP07	TP08	TP09	TP10	TP26	TP01	TP02
Sample Number	DSY-S-TP07-0001	DSY-S-TP08-0001	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP26-0001	DSY-S-TP01-0001	DSY-S-TP02-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Toluene	1 J	1.5	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	46 J	ND	ND	ND
Anthracene	ND	ND	ND	65 J	ND	ND	ND
Benzo(a)anthracene	170 J	ND	ND	250 J	60 J	58 J	71 J
Benzo(a)pyrene	200 J	ND	ND	210 J	50 J	55 J	46 J
Benzo(b)fluoranthene	410 J	56.5	ND	340 J	66 J	88 J	81 J
Benzo(g,h,i)perylene	ND	ND	ND	160 J	ND	42 J	ND
Benzo(k)fluoranthene	ND	ND	ND	140 J	ND	38 J	41 J
bis(2-Ethylhexyl)Phthalate	8700	ND	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	56 J	ND	ND	ND
Chrysene	310 J	108	ND	290 J	46 J	53 J	61 J
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	75	ND	470	140 J	71 J	150 J
Fluorene	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	150 J	ND	42 J	ND
Phenanthrene	ND	41.5	ND	350 J	82 J	ND	120 J
Phenol	ND	ND	ND	ND	ND	ND	ND
Pyrene	320 J	72	ND	560	110 J	73 J	130 J
Butyltin Compounds (ug/kg)							
Dibutyltin	ND	ND	ND	ND	ND	ND	ND
Monobutyltin	ND	ND	ND	ND	ND	ND	ND
Tetrabutyltin	ND	ND	11.4 J	ND	ND	ND	ND
Tributyltin	ND	ND	2.1 J	ND	ND	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location	TP07	TP08	TP09	TP10	TP26	TP01	TP02
Sample Number	DSY-S-TP07-0001	DSY-S-TP08-0001	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP26-0001	DSY-S-TP01-0001	DSY-S-TP02-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	3.1	ND	ND	ND	ND	ND
4,4'-DDT	ND	8.6	ND	5	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND	ND	ND	ND
Aroclor-1260	ND	ND	ND	24 J	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endrin Ketone	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	3.9	ND	ND	ND
Heptachlor	ND	ND	ND	4.5	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	4930	6125	11300	10000	3810	8090	7770
Arsenic, total	3.9	6.15	23.6	15.8	2.6	14.6 J	15.3 J
Barium, total	8.9	44.4	18	28.1	13.5	12.3 J	18.7 J
Beryllium, total	0.18 J	0.225	0.44	0.54	0.29 J	0.3 J	1.1 J
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	12.3	15.5	16	18.4	6.4	10.5 J	14.9 J
Cobalt, total	5.4	8.25	21.4	13.5	3.3	8.9 J	11.8 J
Copper, total	16.8	26.8	26.4	35	12.9	13 J	59.6 J
Iron, total	14500	20300	37200	26700	7770	21300	23600
Lead, total	17.2 J	51.5	12.8 J	62.5 J	9.7	13.5 J	48.7 J
Manganese, total	195	300.5	597	448	157	286 J	423 J
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	12.6 J	17.25	28.2	26.7	7.8	17.2 J	32.8 J
Selenium, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	10.1 J	13.05	20 J	23.2 J	6.8	12.3	11.3
Zinc, total	63.6	128.5	75.3	139	44.3	40.8 J	225 J
TPH USING IR (mg/kg)	ND	ND	ND	61	320	ND	ND

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP03	TP04	TP05	TP06
Sample Number	DSY-S-TP03-0001	DSY-S-TP04-0001	DSY-S-TP05-0001	DSY-S-TP06-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)				
2-Butanone	ND	ND	ND	ND
Acetone	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND
Toluene	ND	ND	ND	1 J
Total Xylenes	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND
Semivolatile Organics (ug/kg)				
2,2'-oxybis(1-Chloropropane)	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND
Benzo(a)anthracene	ND	160 J	93 J	210 J
Benzo(a)pyrene	ND	97 J	81 J	180 J
Benzo(b)fluoranthene	ND	260 J	120 J	270 J
Benzo(g,h,i)perylene	ND	99 J	54 J	ND
Benzo(k)fluoranthene	ND	86 J	66 J	150 J
bis(2-Ethylhexyl)Phthalate	ND	ND	ND	ND
Carbazole	ND	ND	ND	ND
Chrysene	ND	250 J	94 J	230 J
Di-n-butylphthalate	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
Fluoranthene	ND	280 J	220 J	460 J
Fluorene	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	82 J	49 J	110 J
Phenanthrene	ND	89 J	94 J	280 J
Phenol	ND	ND	ND	ND
Pyrene	ND	280 J	140 J	380 J
Butyltin Compounds (ug/kg)				
Dibutyltin	ND	ND	ND	2.7 J
Monobutyltin	ND	ND	ND	ND
Tetrabutyltin	ND	ND	ND	ND
Tributyltin	ND	ND	2.4 J	2.8 J

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

TABLE 4-4A
CHEMICAL CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP03	TP04	TP05	TP06
Sample Number	DSY-S-TP03-0001	DSY-S-TP04-0001	DSY-S-TP05-0001	DSY-S-TP06-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)				
4,4'-DDD	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	6.1
4,4'-DDT	ND	ND	ND	14
alpha-Chlordane	ND	ND	ND	ND
Aroclor-1254	ND	ND	ND	ND
Aroclor-1260	ND	25 J	ND	15 J
Dieldrin	ND	ND	ND	ND
Endrin	ND	ND	ND	ND
Endrin Ketone	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND
Heptachlor Epoxide	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND
Metals (mg/kg)				
Aluminum, total	9120	6870	33300	11100
Arsenic, total	11.2	9.7 J	13.1	13.3
Barium, total	22.8	35.6 J	420	52.1
Beryllium, total	0.71	2.5 J	2	0.45
Cadmium, total	ND	ND	ND	0.48 J
Chromium, total	16.2	24.7 J	53.5	21.6
Cobalt, total	11.7	16.8 J	18.3	11.1
Copper, total	49.7	145 J	76.4	45.2
Iron, total	23500	22200	58100	26200
Lead, total	35.5 J	119 J	51 J	41.3 J
Manganese, total	343	296 J	299	350
Mercury, total	0.17	ND	ND	ND
Nickel, total	30.3	70.8 J	60.1	24.3 J
Selenium, total	ND	ND	1.2 J	1.4 J
Tin, total	9.3 J	27.4 J	ND	ND
Vanadium, total	13.8	9.7	52.7 J	21.7 J
Zinc, total	172 J	501 J	896	284
TPH USING IR (mg/kg)	94	110 J	ND	110

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

TABLE 4-4B
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	RIDEM	MW01	MW10	MW04	TP16	TP20	TP21
Sample Number	Direct Exposure	DSY-S-MW01-0002	DSY-S-MW10-0002	DSY-S-MW04-0002	DSY-S-TP16-0001	DSY-S-TP20-0001	DSY-S-TP21-0001
Sample Description	Criteria	Boring, 0.0-2.0 ft	Boring, 0.0-2.0 ft	Boring, 0.5-1.5 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
Aroclor-1260	10,000						
Dieldrin	400						
Metals (mg/kg)							
Arsenic, total	3.8	19.5	20.3	4.9	4.7	4.5 J	5.1 J
Beryllium, total	1.3						
TPH USING IR (mg/kg)	2500				4900		

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

TABLE 4-4B
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	TP22	TP23	MW06	MW07	TP11	TP12
Sample Number	Direct Exposure	DSY-S-TP22-0001	DSY-S-TP23-0001	DSY-S-MW06-SS01	DSY-S-MW07-0001	DSY-S-TP11-0001	DSY-S-TP12-0001
Sample Description	Criteria	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
Aroclor-1260	10,000						
Dieldrin	400						
Metals (mg/kg)							
Arsenic, total	3.8	5.3 J	8.8 J	10.4	23.9	24.4	20.1
Beryllium, total	1.3						
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4B
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	RIDEM	TP14	TP15	TP17	MW08	MW09	TP07
Sample Number	Direct Exposure	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-MW08-0002	DSY-S-MW09-0002	DSY-S-TP07-0001
Sample Description	Criteria	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
Aroclor-1260	10,000	71000*					
Dieldrin	400	470					
Metals (mg/kg)							
Arsenic, total	3.8	9.5	19.3	3.9	19.2	5.3	3.9
Beryllium, total	1.3				3.5		
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4B
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	RIDEM	TP09	TP10	TP01	TP02	TP03	TP04
Sample Number	Direct Exposure	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP01-0001	DSY-S-TP02-0001	DSY-S-TP03-0001	DSY-S-TP04-0001
Sample Description	Criteria	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)							
Aroclor-1260	10,000						
Dieldrin	400						
Metals (mg/kg)							
Arsenic, total	3.8	23.6	15.8	14.6 J	15.3 J	11.2	9.7 J
Beryllium, total	1.3						2.5 J
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4B
CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		South Waterfront	South Waterfront
Sample Location	RIDEM	TP05	TP06
Sample Number	Direct Exposure	DSY-S-TP05-0001	DSY-S-TP06-0001
Sample Description	Criteria	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Pesticides/PCBs (ug/kg)			
Aroclor-1260	10,000		
Dieldrin	400		
Metals (mg/kg)			
Arsenic, total	3.8	13.1	13.3
Beryllium, total	1.3	2	
TPH USING IR (mg/kg)	2500		

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES FORMER ROBERT E. DERECKTOR SHIPYARD SITE ASSESSMENT SCREENING EVALUATION NETC NEWPORT RHODE ISLAND

Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW10	MW02	MW02	MW02	MW03	MW03	MW04
Sample Number	DSY-S-MW10-0810	DSY-S-MW02-1820	DSY-S-MW02-2426	DSY-S-MW02-3436	DSY-S-MW03-0810	DSY-S-MW03-1618	DSY-S-MW04-0810
Sample Description	Boring, 8.0-10.0 ft	Boring, 18.0-20.0 ft	Boring, 24.0-26.0 ft	Boring, 34.0-36.0 ft	Boring, 8.0-10.0 ft	Boring, 16.0-18.0 ft	Boring, 8.0-10.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ND	2 J	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	1 J	ND	ND
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	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	ND	ND	84 J	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	45 J	ND	42 J	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	42 J	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	41 J	ND	ND
Butyltin Compounds (ug/kg)							
Tetrabutyltin	ND	ND	ND	ND	ND	ND	ND
Tributyltin	ND	2.2 J	ND	1.4 J	ND	2.9 J	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW10	MW02	MW02	MW02	MW03	MW03	MW04
Sample Number	DSY-S-MW10-0810	DSY-S-MW02-1820	DSY-S-MW02-2426	DSY-S-MW02-3436	DSY-S-MW03-0810	DSY-S-MW03-1618	DSY-S-MW04-0810
Sample Description	Boring, 8.0-10.0 ft	Boring, 18.0-20.0 ft	Boring, 24.0-26.0 ft	Boring, 34.0-36.0 ft	Boring, 8.0-10.0 ft	Boring, 16.0-18.0 ft	Boring, 8.0-10.0 ft
Pesticides/PCBs (ug/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	2.1	ND	ND
Aroclor-1260	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	2.1	ND	ND
Heptachlor	ND	ND	3.8	ND	ND	3.3	ND
Metals (mg/kg)							
Aluminum, total	11700	4890	7320	18200	4400 J	11100 J	2430
Arsenic, total	38.5	4.3	4	6.6	7	9.9	3
Barium, total	13.9	3.2	7.6	7.1	7.5	9	ND
Beryllium, total	0.36 J	ND	ND	0.33 J	ND	0.23 J	ND
Cadmium, total	1.5 J	ND	ND	ND	ND	ND	ND
Chromium, total	15.2	10.9 J	12.3	27.1 J	10.3	18.1	ND
Cobalt, total	16.6	5.2	7.1	19.8	6.7	15.4	ND
Copper, total	19.4	8.6	11.4	30.9	11.5 J	23.5	ND
Iron, total	37100	13500	18600	40600	15500 J	26800 J	7440
Lead, total	6.6 J	6 J	3.1 J	10 J	2.7	29.2	2.1 J
Manganese, total	746 J	97.9	159 J	385	113	370	89.2
Mercury, total	ND	ND	ND	ND	0.07	ND	ND
Nickel, total	28.9	8.9	15.8 J	39.5	12 J	22.7 J	5.5
Selenium, total	ND	ND	1.2 J	1 J	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	20.6 J	11	12.9	17.2 J	11	19.3 J	5.5
Zinc, total	68.6	37	35.4	71.3	30.8	52.8	13.7
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW04	MW04	MW11	MW11	MW11	MW11	MW12
Sample Number	DSY-S-MW04-1618	DSY-S-MW04-3234	DSY-S-MW11-0103	DSY-S-MW11-1113	DSY-S-MW11-2729	DSY-S-MW11-2931	DSY-S-MW12-0709
Sample Description	Boring, 16.0-18.0 ft	Boring, 32.0-34.0 ft	Boring, 1.0-3.0 ft	Boring, 11.0-13.0 ft	Boring, 27.0-29.0 ft	Boring, 29.0-31.0 ft	Boring, 7.0-9.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	3	ND
Acetone	ND	ND	ND	ND	ND	187.5	ND
Carbon Disulfide	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	2 J	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	2 J	4	ND
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	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	ND	ND	ND	ND	ND	ND	44 J
Chrysene	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	270 J	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
Naphthalene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND
Butyltin Compounds (ug/kg)							
Tetrabutyltin	ND	ND	ND	ND	ND	ND	4.6 J
Tributyltin	ND	ND	ND	14.05	ND	19.8	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW04	MW04	MW11	MW11	MW11	MW11	MW12
Sample Number	DSY-S-MW04-1618	DSY-S-MW04-3234	DSY-S-MW11-0103	DSY-S-MW11-1113	DSY-S-MW11-2729	DSY-S-MW11-2931	DSY-S-MW12-0709
Sample Description	Boring, 16.0-18.0 ft	Boring, 32.0-34.0 ft	Boring, 1.0-3.0 ft	Boring, 11.0-13.0 ft	Boring, 27.0-29.0 ft	Boring, 29.0-31.0 ft	Boring, 7.0-9.0 ft
Pesticides/PCBs (ug/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
Aroclor-1260	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	ND	1.65	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	6000	10100	6570 J	6105	7540 J	16500	3840
Arsenic, total	7.3	4.9	3.7	3.2	14.6	14	4.3
Barium, total	3.9	6.6	24.7	14.35	8.6	3.7	ND
Beryllium, total	ND	ND	0.32 J	0.25	0.24 J	0.265	ND
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	10.7 J	18.2 J	10	6.85	18.3	23.8	6.5 J
Cobalt, total	5.9	9.6	8.5	5.15	10.2	11.15	4.5
Copper, total	10.6	24.1	15.5 J	15.3	19.3	26.15	7.9
Iron, total	17000	24100	14200 J	13850	32000 J	41300	12000
Lead, total	8.3 J	23.4 J	7.4	6.4	3.6	10.7	ND
Manganese, total	149	155	376	180.5	203	307	97.5 J
Mercury, total	ND	ND	ND	0.0375	ND	0.23	ND
Nickel, total	11.9	24.9	12.6 J	10.65	18.6 J	31.7	9.4 J
Selenium, total	ND	1.1 J	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	11.5	10.9 J	9.7	8.45	14.9 J	21.35	6.4
Zinc, total	37.9	50.1	32.7	27.25	49.6	67.3	22
TPH USING IR (mg/kg)	89	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW12	MW12	TP16	TP16	TP18	TP18	TP19
Sample Number	DSY-S-MW12-2123	DSY-S-MW12-2931	DSY-S-TP16-0506	DSY-S-TP16-1112	DSY-S-TP18-0507	DSY-S-TP18-1011	DSY-S-TP19-0507
Sample Description	Boring, 21.0-23.0 ft	Boring, 29.0-31.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	ND	NA	ND	NA	NA	NA
Acetone	ND	ND	NA	ND	NA	NA	NA
Carbon Disulfide	ND	ND	NA	ND	NA	NA	NA
Ethylbenzene	ND	ND	NA	ND	NA	NA	NA
Total Xylenes	ND	ND	NA	ND	NA	NA	NA
Trichloroethene	ND	ND	NA	ND	NA	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	ND	ND	NA	ND	NA	NA	NA
Anthracene	ND	ND	NA	ND	NA	NA	NA
Benzo(a)anthracene	ND	ND	NA	ND	NA	NA	NA
Benzo(a)pyrene	ND	ND	NA	ND	NA	NA	NA
Benzo(b)fluoranthene	ND	ND	NA	ND	NA	NA	NA
Benzo(g,h,i)perylene	ND	ND	NA	ND	NA	NA	NA
Benzo(k)fluoranthene	ND	ND	NA	ND	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	ND	57 J	NA	ND	NA	NA	NA
Chrysene	ND	ND	NA	ND	NA	NA	NA
Di-n-butylphthalate	ND	ND	NA	ND	NA	NA	NA
Fluoranthene	ND	ND	NA	ND	NA	NA	NA
Fluorene	ND	ND	NA	ND	NA	NA	NA
Indeno(1,2,3-cd)pyrene	ND	ND	NA	ND	NA	NA	NA
Naphthalene	ND	ND	NA	ND	NA	NA	NA
Phenanthrene	ND	ND	NA	ND	NA	NA	NA
Pyrene	ND	ND	NA	1600 J	NA	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	ND	ND	NA	5.1 J	NA	NA	NA
Tributyltin	ND	ND	NA	ND	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW12	MW12	TP16	TP16	TP18	TP18	TP19
Sample Number	DSY-S-MW12-2123	DSY-S-MW12-2931	DSY-S-TP16-0506	DSY-S-TP16-1112	DSY-S-TP18-0507	DSY-S-TP18-1011	DSY-S-TP19-0507
Sample Description	Boring, 21.0-23.0 ft	Boring, 29.0-31.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	ND	NA	ND	NA	NA	NA
4,4'-DDE	ND	ND	NA	ND	NA	NA	NA
4,4'-DDT	ND	ND	NA	ND	NA	NA	NA
Aldrin	ND	ND	NA	4.4 J	NA	NA	NA
alpha-Chlordane	ND	ND	NA	ND	NA	NA	NA
Aroclor-1260	ND	ND	NA	ND	NA	NA	NA
Endrin	ND	ND	NA	15	NA	NA	NA
gamma-Chlordane	ND	ND	NA	ND	NA	NA	NA
Heptachlor	ND	ND	NA	3.1 J	NA	NA	NA
Metals (mg/kg)							
Aluminum, total	7770	17200	2470	7820	3300	3860	2620
Arsenic, total	5.6	7.6	3.1 J	16.6	4.4 J	3.8 J	2.7 J
Barium, total	13	5.5	ND	6.3	ND	ND	ND
Beryllium, total	0.28 J	0.23 J	ND	0.27 J	ND	ND	ND
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	14.2	23	2.2	12.3	3.4	4.3	3.6
Cobalt, total	9.7	12.7	ND	9.4 J	ND	6	ND
Copper, total	17.2	25.1	ND	15.2	7.3	10.4	6.2
Iron, total	18600	43100	8170	23600	10900	11100	8340
Lead, total	4 J	5.7 J	1.6 J	16.1	2.7	4.6	2.1
Manganese, total	274 J	382 J	102	262 J	75	421	55.4
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	18.3 J	31.2 J	5.1	18.3	6.9	6.8	5.2
Selenium, total	0.79 J	1.3 J	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	13	17.4	5.6	14.2 J	7.1	6.5	6.2
Zinc, total	37.3	73.4 J	14.6	50.5	18.2	20.6	16.4
TPH USING IR (mg/kg)	ND	ND	ND	1200	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	TP19	TP20	TP20	TP21	TP21	TP22	TP22
Sample Number	DSY-S-TP19-1011	DSY-S-TP20-0507	DSY-S-TP20-1011	DSY-S-TP21-0507	DSY-S-TP21-1011	DSY-S-TP22-0506	DSY-S-TP22-1112
Sample Description	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA
Total Xylenes	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	NA	NA	NA	NA	NA	NA	NA
Tributyltin	NA	NA	NA	NA	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	TP19	TP20	TP20	TP21	TP21	TP22	TP22
Sample Number	DSY-S-TP19-1011	DSY-S-TP20-0507	DSY-S-TP20-1011	DSY-S-TP21-0507	DSY-S-TP21-1011	DSY-S-TP22-0506	DSY-S-TP22-1112
Sample Description	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)							
Aluminum, total	2950	4070	3350	3010	3740	7700	10000
Arsenic, total	3 J	3.9 J	4.3 J	3.1 J	2.7 J	8.1	7
Barium, total	ND	ND	ND	ND	ND	17.6	24.9
Beryllium, total	ND	ND	ND	ND	ND	0.3 J	0.35 J
Cadmium, total	ND	ND	ND	ND	ND	ND	0.65 J
Chromium, total	3.4	4	4.4	2.8	4.8	7.6	14.6
Cobalt, total	5.7	ND	5.8	ND	5	9.9	13.8 J
Copper, total	ND	6.2	6.7	5.4	5.8	17.7	16.8
Iron, total	8020	11200	12000	9380	10600	18400	25600
Lead, total	1.9 J	3.2	4	3.4	3.6	6.3	8.6
Manganese, total	83.6	70.4	173	93.2	125	322	549 J
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	9.2	7.5	7.8	6.8	11.4	16.6	25
Selenium, total	ND	ND	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	6.2	8.1	7.6	6.2	7.9	12.8	16.1 J
Zinc, total	23.6	21.9	24.5	17.7	24.8	34.3	52.2
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	TP23	TP23	TP24	TP24	TP27	TP27	TP28
Sample Number	DSY-S-TP23-0507	DSY-S-TP23-0910	DSY-S-TP24-0507	DSY-S-TP24-1011	DSY-S-TP27-0507	DSY-S-TP27-1011	DSY-S-TP28-0507
Sample Description	Test Pit, 5.0-7.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	NA	ND	NA	NA	NA	NA	NA
Acetone	NA	16	NA	NA	NA	NA	NA
Carbon Disulfide	NA	ND	NA	NA	NA	NA	NA
Ethylbenzene	NA	ND	NA	NA	NA	NA	NA
Total Xylenes	NA	ND	NA	NA	NA	NA	NA
Trichloroethene	NA	1 J	NA	NA	NA	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	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	65 J	NA	NA	NA	NA	NA
Chrysene	NA	ND	NA	NA	NA	NA	NA
Di-n-butylphthalate	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
Naphthalene	NA	ND	NA	NA	NA	NA	NA
Phenanthrene	NA	ND	NA	NA	NA	NA	NA
Pyrene	NA	ND	NA	NA	NA	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	NA	ND	NA	NA	NA	NA	NA
Tributyltin	NA	ND	NA	NA	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	TP23	TP23	TP24	TP24	TP27	TP27	TP28
Sample Number	DSY-S-TP23-0507	DSY-S-TP23-0910	DSY-S-TP24-0507	DSY-S-TP24-1011	DSY-S-TP27-0507	DSY-S-TP27-1011	DSY-S-TP28-0507
Sample Description	Test Pit, 5.0-7.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-7.0 ft
Pesticides/PCBs (ug/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	ND	NA	NA	NA	NA	NA
alpha-Chlordane	NA	ND	NA	NA	NA	NA	NA
Aroclor-1260	NA	ND	NA	NA	NA	NA	NA
Endrin	NA	ND	NA	NA	NA	NA	NA
gamma-Chlordane	NA	ND	NA	NA	NA	NA	NA
Heptachlor	NA	ND	NA	NA	NA	NA	NA
Metals (mg/kg)							
Aluminum, total	6060	5810	5920	6600	3480	2570	12800
Arsenic, total	5.5	4.6 J	5.1	3.4	ND	ND	13.7 J
Barium, total	10.1	10.1	10.9	12.7	ND	ND	13.7 J
Beryllium, total	0.22 J	0.24 J	0.23 J	0.27 J	ND	ND	0.35 J
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	8.4	7	9.5	9	5.7 J	3.7 J	14.2 J
Cobalt, total	8.9	8.3	7 J	7.2 J	4 J	3 J	14.3 J
Copper, total	18.2	19.9	13.4	19.6	5 J	4.1 J	22.1 J
Iron, total	18900	16200	18200	17100	10400	6970	27100
Lead, total	7.3	6.2 J	6.3	7.9	2.5 J	1.6 J	15.4 J
Manganese, total	308	218 J	210 J	213 J	106 J	55.4 J	302 J
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	14.1	ND	14.4	14.3	6.2 J	5.2 J	19.1 J
Selenium, total	1.1	ND	0.6 J	ND	ND	0.83 J	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	9.3	7.6	10.9 J	9.5 J	6.4	4.3	16.4
Zinc, total	35.1	33.2	36.8	35.4	18.6 J	13.6 J	44.4 J
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP28	MW05	MW05	MW05	MW05	MW06	MW07
Sample Number	DSY-S-TP28-1314	DSY-S-MW05-1012	DSY-S-MW05-2224	DSY-S-MW05-3234	DSY-S-MW05-4446	DSY-S-MW06-0406	DSY-S-MW07-0810
Sample Description	Test Pit, 13.0-14.0 ft	Boring, 10.0-12.0 ft	Boring, 22.0-24.0 ft	Boring, 32.0-34.0 ft	Boring, 44.0-46.0 ft	Boring, 4.0-6.0 ft	Boring, 8.0-10.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	NA	ND	ND	ND	ND	ND	ND
Acetone	NA	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	ND	ND	ND	ND	ND	ND
Ethylbenzene	NA	ND	ND	ND	ND	ND	ND
Total Xylenes	NA	ND	ND	ND	ND	ND	ND
Trichloroethene	NA	ND	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	NA	ND	ND	ND	ND	ND	280 J
Anthracene	NA	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	NA	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	NA	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	NA	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	NA	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	NA	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)Phthalate	NA	ND	ND	ND	ND	ND	ND
Chrysene	NA	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	NA	ND	ND	ND	ND	ND	ND
Fluoranthene	NA	ND	ND	ND	ND	ND	ND
Fluorene	NA	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	NA	ND	ND	ND	ND	ND	ND
Naphthalene	NA	ND	ND	ND	ND	ND	49 J
Phenanthrene	NA	ND	ND	ND	ND	ND	48 J
Pyrene	NA	ND	ND	ND	ND	ND	ND
Butyltin Compounds (ug/kg)							
Tetrabutyltin	NA	ND	ND	ND	ND	ND	ND
Tributyltin	NA	4.9 J	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP28	MW05	MW05	MW05	MW05	MW06	MW07
Sample Number	DSY-S-TP28-1314	DSY-S-MW05-1012	DSY-S-MW05-2224	DSY-S-MW05-3234	DSY-S-MW05-4446	DSY-S-MW06-0406	DSY-S-MW07-0810
Sample Description	Test Pit, 13.0-14.0 ft	Boring, 10.0-12.0 ft	Boring, 22.0-24.0 ft	Boring, 32.0-34.0 ft	Boring, 44.0-46.0 ft	Boring, 4.0-6.0 ft	Boring, 8.0-10.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	NA	ND	ND	ND	ND	ND	ND
4,4'-DDE	NA	ND	ND	ND	ND	ND	ND
4,4'-DDT	NA	ND	ND	ND	ND	ND	ND
Aldrin	NA	ND	ND	ND	ND	ND	ND
alpha-Chlordane	NA	ND	ND	ND	ND	ND	ND
Aroclor-1260	NA	ND	ND	ND	ND	ND	ND
Endrin	NA	ND	ND	ND	ND	ND	ND
gamma-Chlordane	NA	ND	ND	ND	ND	ND	ND
Heptachlor	NA	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	9240	6490	4820	6840	6990	19900	8890
Arsenic, total	7.7 J	7.1 J	6.3 J	8	ND	11.1	20.3
Barium, total	26.2 J	12.6 J	ND	14.7	14.3	5.5 J	17.2
Beryllium, total	0.35 J	0.3 J	ND	0.22	0.23	ND	0.41 J
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	11.9 J	8.7 J	7.7 J	11.7 J	10.4 J	25.6 J	10.5
Cobalt, total	10.8 J	7.3 J	3.9 J	10.2	6.7	24	10.2
Copper, total	18.6 J	13.9 J	5.1 J	15	10	21.2	17.3
Iron, total	20800	16100	14300	20500	14500	43600	25200
Lead, total	8 J	12.8 J	2.1 J	4.3 J	3.9 J	13.3 J	7.6 J
Manganese, total	320 J	310 J	86.2 J	227	156	495	396
Mercury, total	ND	ND	ND	ND	ND	ND	0.07
Nickel, total	17.9 J	13.4 J	10.4 J	16.9	13.9	39.7	18.8
Selenium, total	ND	ND	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	13.7	8.9	10.5	10.9	10.9	17.7	13
Zinc, total	42.5 J	31.9 J	31.3 J	37.9 J	31.1 J	72 J	40.6 J
TPH USING IR (mg/kg)	ND	4100	ND	ND	ND	83	160

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	MW07	MW07	MW07	TP11	TP11	TP12	TP12
Sample Number	DSY-S-MW07-1618	DSY-S-MW07-2224	DSY-S-MW07-3436	DSY-S-TP11-0507	DSY-S-TP11-1213	DSY-S-TP12-0507	DSY-S-TP12-1213
Sample Description	Boring, 16.0-18.0 ft	Boring, 22.0-24.0 ft	Boring, 34.0-36.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	ND	ND	NA	ND	NA	NA
Acetone	ND	ND	ND	NA	ND	NA	NA
Carbon Disulfide	ND	4 J	ND	NA	ND	NA	NA
Ethylbenzene	ND	ND	ND	NA	ND	NA	NA
Total Xylenes	ND	ND	ND	NA	ND	NA	NA
Trichloroethene	ND	ND	ND	NA	ND	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	ND	ND	ND	NA	ND	NA	NA
Anthracene	ND	ND	ND	NA	ND	NA	NA
Benzo(a)anthracene	ND	ND	ND	NA	ND	NA	NA
Benzo(a)pyrene	ND	ND	ND	NA	ND	NA	NA
Benzo(b)fluoranthene	ND	ND	ND	NA	ND	NA	NA
Benzo(g,h,i)perylene	ND	ND	ND	NA	ND	NA	NA
Benzo(k)fluoranthene	ND	ND	ND	NA	ND	NA	NA
bis(2-Ethylhexyl)Phthalate	ND	ND	ND	NA	ND	NA	NA
Chrysene	123	ND	ND	NA	ND	NA	NA
Di-n-butylphthalate	ND	ND	ND	NA	ND	NA	NA
Fluoranthene	49	ND	ND	NA	ND	NA	NA
Fluorene	ND	ND	ND	NA	ND	NA	NA
Indeno(1,2,3-cd)pyrene	ND	ND	ND	NA	ND	NA	NA
Naphthalene	ND	ND	ND	NA	ND	NA	NA
Phenanthrene	ND	ND	ND	NA	ND	NA	NA
Pyrene	43.5	ND	ND	NA	ND	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	ND	ND	ND	NA	ND	NA	NA
Tributyltin	ND	ND	ND	NA	ND	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	MW07	MW07	MW07	TP11	TP11	TP12	TP12
Sample Number	DSY-S-MW07-1618	DSY-S-MW07-2224	DSY-S-MW07-3436	DSY-S-TP11-0507	DSY-S-TP11-1213	DSY-S-TP12-0507	DSY-S-TP12-1213
Sample Description	Boring, 16.0-18.0 ft	Boring, 22.0-24.0 ft	Boring, 34.0-36.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	110.9	28 J	7.4 J	NA	ND	NA	NA
4,4'-DDE	6.4	ND	ND	NA	ND	NA	NA
4,4'-DDT	50.9	ND	ND	NA	ND	NA	NA
Aldrin	ND	ND	ND	NA	ND	NA	NA
alpha-Chlordane	ND	ND	ND	NA	ND	NA	NA
Aroclor-1260	ND	ND	ND	NA	ND	NA	NA
Endrin	ND	ND	ND	NA	5.5	NA	NA
gamma-Chlordane	ND	ND	ND	NA	ND	NA	NA
Heptachlor	ND	ND	ND	NA	ND	NA	NA
Metals (mg/kg)							
Aluminum, total	9460	5800	7350	9950	12600	11700	14300
Arsenic, total	19.65	5	3.9	22	36.9	24.1	37.3
Barium, total	14.45	ND	13.2	15.9	17.5	13.8	11.3
Beryllium, total	0.38	ND	0.26 J	0.53	0.48	0.52	0.44 J
Cadmium, total	ND	ND	ND	ND	1.2 J	ND	ND
Chromium, total	11.65	8.2	10.3	8.9	17.8	10.4	12.6
Cobalt, total	11.4	4.6	6.4	11.4	20.2 J	12.7	18.5
Copper, total	17.45	5.9	11.4	18.1	27.4	18.6	26
Iron, total	27300	15100	15100	25800	40100	30200	35000
Lead, total	36.1	2.6 J	4.5 J	8.5 J	11.3	12.1	21.2
Manganese, total	350	92.5	147	323	612 J	315	514
Mercury, total	0.0875	ND	ND	ND	ND	ND	ND
Nickel, total	20.4	11.5	13.9	20.1	33.1	23.2	30.4
Selenium, total	ND	ND	ND	ND	0.83 J	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	1.6 J
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	12.7	12.3	11.5	16.8 J	18.5 J	17.1 J	18.8 J
Zinc, total	59.35	28 J	32.2 J	41.9	65.1	50.9	66.1
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP13	TP13	TP14	TP15	TP15	TP17	TP17
Sample Number	DSY-S-TP13-0506	DSY-S-TP13-1011	DSY-S-TP14-0506	DSY-S-TP15-0506	DSY-S-TP15-1112	DSY-S-TP17-0507	DSY-S-TP17-1112
Sample Description	Test Pit, 5.0-6.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	NA	NA	NA	NA	NA	NA
Acetone	ND	NA	NA	NA	NA	NA	NA
Carbon Disulfide	ND	NA	NA	NA	NA	NA	NA
Ethylbenzene	ND	NA	NA	NA	NA	NA	NA
Total Xylenes	ND	NA	NA	NA	NA	NA	NA
Trichloroethene	ND	NA	NA	NA	NA	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	ND	NA	NA	NA	NA	NA	NA
Anthracene	ND	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ND	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	ND	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	ND	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	ND	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ND	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	ND	NA	NA	NA	NA	NA	NA
Chrysene	ND	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	ND	NA	NA	NA	NA	NA	NA
Fluoranthene	ND	NA	NA	NA	NA	NA	NA
Fluorene	ND	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	ND	NA	NA	NA	NA	NA	NA
Naphthalene	ND	NA	NA	NA	NA	NA	NA
Phenanthrene	119	NA	NA	NA	NA	NA	NA
Pyrene	ND	NA	NA	NA	NA	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	15.8	NA	NA	NA	NA	NA	NA
Tributyltin	ND	NA	NA	NA	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	TP13	TP13	TP14	TP15	TP15	TP17	TP17
Sample Number	DSY-S-TP13-0506	DSY-S-TP13-1011	DSY-S-TP14-0506	DSY-S-TP15-0506	DSY-S-TP15-1112	DSY-S-TP17-0507	DSY-S-TP17-1112
Sample Description	Test Pit, 5.0-6.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	ND	NA	NA	NA	NA	NA	NA
4,4'-DDE	ND	NA	NA	NA	NA	NA	NA
4,4'-DDT	ND	NA	NA	NA	NA	NA	NA
Aldrin	ND	NA	NA	NA	NA	NA	NA
alpha-Chlordane	ND	NA	NA	NA	NA	NA	NA
Aroclor-1260	ND	NA	NA	NA	NA	NA	NA
Endrin	ND	NA	NA	NA	NA	NA	NA
gamma-Chlordane	ND	NA	NA	NA	NA	NA	NA
Heptachlor	ND	NA	NA	NA	NA	NA	NA
Metals (mg/kg)							
Aluminum, total	11100	9310	18800	10200	7360	6420	8330
Arsenic, total	17.05	15.7	4.8 J	11.4	6.1 J	13.6	8.7
Barium, total	24.55	14.5	ND	15	9.4	8.5	16.1
Beryllium, total	0.41	0.54	0.38 J	0.49	0.39 J	0.4 J	0.24 J
Cadmium, total	0.4875	ND	ND	ND	ND	ND	ND
Chromium, total	13.8	9.6	19	10.1	6.8	6.3	7.2
Cobalt, total	10.5	9	24.7	13.6	8.5	16.2	10.6
Copper, total	11	15.8	31.1	23.7	14.3	25.7	16
Iron, total	25050	26000	43800	25200	17300	17700	20400
Lead, total	11.55	24.1	49.4	11.2	5.7	13	10.5
Manganese, total	556.5	373	727	326	225	340	524
Mercury, total	ND	0.07	ND	ND	ND	ND	ND
Nickel, total	15.75	14.4	36.3	22.8	13.8	14.6	18
Selenium, total	0.885	ND	ND	ND	ND	ND	ND
Silver, total	ND	ND	1.7 J	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	17.9	16.2	20.9 J	15.9 J	11.4	9.7	11.9 J
Zinc, total	39.55	47.9	77.4	50.6	35.4	41.5	38.8
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	TP25	TP25	MW08	MW09	MW09	MW09	MW09
Sample Number	DSY-S-TP25-0507	DSY-S-TP25-1011	DSY-S-MW08-0810	DSY-S-MW09-1012	DSY-S-MW09-2022	DSY-S-MW09-3032	DSY-S-MW09-3638
Sample Description	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Boring, 8.0-10.0 ft	Boring, 10.0-12.0 ft	Boring, 20.0-22.0 ft	Boring, 30.0-32.0 ft	Boring, 36.0-38.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	NA	ND	3 J	3	ND	ND	ND
Acetone	NA	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	ND	ND	ND	ND	ND	ND
Ethylbenzene	NA	ND	ND	ND	ND	ND	ND
Total Xylenes	NA	ND	ND	ND	ND	ND	ND
Trichloroethene	NA	ND	3 J	ND	ND	ND	ND
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	NA	ND	ND	ND	ND	ND	ND
Anthracene	NA	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	NA	47 J	ND	61.5	ND	ND	ND
Benzo(a)pyrene	NA	42 J	ND	41.5	ND	ND	ND
Benzo(b)fluoranthene	NA	70 J	ND	129	ND	ND	ND
Benzo(g,h,i)perylene	NA	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	NA	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)Phthalate	NA	ND	ND	ND	ND	ND	ND
Chrysene	NA	67 J	ND	47.5	ND	ND	ND
Di-n-butylphthalate	NA	ND	ND	ND	ND	ND	ND
Fluoranthene	NA	97 J	100 J	130	ND	ND	ND
Fluorene	NA	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	NA	ND	ND	ND	ND	ND	ND
Naphthalene	NA	ND	ND	ND	ND	ND	ND
Phenanthrene	NA	81 J	51 J	77.5	ND	ND	ND
Pyrene	NA	120 J	100 J	114	ND	ND	ND
Butyltin Compounds (ug/kg)							
Tetrabutyltin	NA	ND	ND	ND	ND	ND	ND
Tributyltin	NA	ND	ND	ND	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	TP25	TP25	MW08	MW09	MW09	MW09	MW09
Sample Number	DSY-S-TP25-0507	DSY-S-TP25-1011	DSY-S-MW08-0810	DSY-S-MW09-1012	DSY-S-MW09-2022	DSY-S-MW09-3032	DSY-S-MW09-3638
Sample Description	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Boring, 8.0-10.0 ft	Boring, 10.0-12.0 ft	Boring, 20.0-22.0 ft	Boring, 30.0-32.0 ft	Boring, 36.0-38.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	NA	ND	ND	ND	ND	ND	ND
4,4'-DDE	NA	ND	ND	ND	ND	ND	ND
4,4'-DDT	NA	ND	ND	ND	ND	ND	ND
Aldrin	NA	ND	ND	ND	ND	ND	ND
alpha-Chlordane	NA	ND	ND	ND	ND	ND	ND
Aroclor-1260	NA	13 J	ND	ND	ND	ND	ND
Endrin	NA	ND	ND	ND	ND	ND	ND
gamma-Chlordane	NA	ND	ND	ND	ND	ND	ND
Heptachlor	NA	ND	ND	ND	ND	ND	ND
Metals (mg/kg)							
Aluminum, total	11100	10800	11200	8680	11100	16300	16700
Arsenic, total	15.6	13	20.7	18.4	9.8	9.7	4.4
Barium, total	18.5	18.4	9.3 J	9.9	17.7 J	3.1	4.7 J
Beryllium, total	0.44 J	0.38 J	0.3	0.315	0.3	ND	0.21
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	10.1	13	16.1 J	13.45	16.5 J	21.6 J	20.8 J
Cobalt, total	13.1	10.1 J	13.7	10	13	15.9	16.1
Copper, total	27.9	25.1	23.9	20.9	16.2	30.9	41.5
Iron, total	27400	24800	25700	29600	31800	36800	40400
Lead, total	26.4	18.6	17.3 J	24	6.8 J	17.8 J	3.1 J
Manganese, total	377	378 J	502	248.5	462	391	728
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	22.7	20	24.5	19.05	25.3	32.5	33.2
Selenium, total	ND	0.86 J	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	17.6 J	15.2 J	13.1	14.6	15.2	13.4	12.3
Zinc, total	62.1	56.7	59 J	70.15	63.2 J	66.3 J	53.8 J
TPH USING IR (mg/kg)	ND	150	490	54.25	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	TP08	TP08	TP09	TP09	TP10	TP10	TP26
Sample Number	DSY-S-TP08-0406	DSY-S-TP08-0910	DSY-S-TP09-0406	DSY-S-TP09-0910	DSY-S-TP10-0507	DSY-S-TP10-1213	DSY-S-TP26-0305
Sample Description	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 3.0-5.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	ND	ND	NA	NA	NA	NA	ND
Acetone	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
Total Xylenes	ND	ND	NA	NA	NA	NA	150
Trichloroethene	ND	ND	NA	NA	NA	NA	ND
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	ND	ND	NA	NA	NA	NA	14000
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	ND	22000	NA	NA	NA	NA	ND
Chrysene	54 J	ND	NA	NA	NA	NA	ND
Di-n-butylphthalate	ND	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
Butyltin Compounds (ug/kg)							
Tetrabutyltin	ND	2.9 J	NA	NA	NA	NA	ND
Tributyltin	ND	ND	NA	NA	NA	NA	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	TP08	TP08	TP09	TP09	TP10	TP10	TP26
Sample Number	DSY-S-TP08-0406	DSY-S-TP08-0910	DSY-S-TP09-0406	DSY-S-TP09-0910	DSY-S-TP10-0507	DSY-S-TP10-1213	DSY-S-TP26-0305
Sample Description	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 3.0-5.0 ft
Pesticides/PCBs (ug/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
Aroclor-1260	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
Metals (mg/kg)							
Aluminum, total	7660	4900	17100	23300	3610	10000	1690
Arsenic, total	8.7	3.2	11.7	15.9	3	17.3	1.2 J
Barium, total	18.4	7.2	13.2	16	5.4	17.3	9.7
Beryllium, total	0.67	0.2 J	0.37 J	0.46	ND	0.27 J	ND
Cadmium, total	ND	ND	ND	ND	ND	0.66 J	ND
Chromium, total	18.2	9.3	22.5	32.5	6.2 J	13	2.2 J
Cobalt, total	9.9	4.1	14	25	3.1	11.3	1.1 J
Copper, total	46.1	9.5	22.1	39	6	18	34.9
Iron, total	22300	13000	36200	50000	10600	25100	4060
Lead, total	67.2 J	7.1 J	12.9 J	34.6 J	4.1 J	7.7 J	3.2 J
Manganese, total	305	150	398	2450	78.6	344	108
Mercury, total	ND	ND	ND	ND	ND	ND	ND
Nickel, total	31.6	10.2 J	27.7	48.1	8.9 J	19.7 J	2.3 J
Selenium, total	ND	ND	1.4 J	ND	ND	ND	ND
Silver, total	ND	ND	ND	1.6 J	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	13.5 J	8.4 J	19.6 J	19.5 J	7.5 J	15.9 J	4.4 J
Zinc, total	158	31.4	58.3	84.6	21.2	44	10 J
TPH USING IR (mg/kg)	ND	ND	ND	ND	ND	ND	2200

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP26	TP26	TP01	TP01	TP02	TP02	TP03
Sample Number	DSY-S-TP26-0406	DSY-S-TP26-0910	DSY-S-TP01-0507	DSY-S-TP01-1112	DSY-S-TP02-0709	DSY-S-TP02-1516	DSY-S-TP03-0305
Sample Description	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 7.0-9.0 ft	Test Pit, 15.0-16.0 ft	Test Pit, 3.0-5.0 ft
Volatile Organics (ug/kg)							
1,2-Dichloroethene (total)	NA	NA	NA	ND	NA	NA	NA
Acetone	NA	NA	NA	ND	NA	NA	NA
Carbon Disulfide	NA	NA	NA	ND	NA	NA	NA
Ethylbenzene	NA	NA	NA	ND	NA	NA	NA
Total Xylenes	NA	NA	NA	ND	NA	NA	NA
Trichloroethene	NA	NA	NA	ND	NA	NA	NA
Semivolatile Organics (ug/kg)							
2-Methylnaphthalene	NA	NA	NA	ND	NA	NA	NA
Anthracene	NA	NA	NA	ND	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	ND	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	ND	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	43 J	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	ND	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	ND	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	NA	NA	NA	ND	NA	NA	NA
Chrysene	NA	NA	NA	ND	NA	NA	NA
Di-n-butylphthalate	NA	NA	NA	ND	NA	NA	NA
Fluoranthene	NA	NA	NA	59 J	NA	NA	NA
Fluorene	NA	NA	NA	ND	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	ND	NA	NA	NA
Naphthalene	NA	NA	NA	ND	NA	NA	NA
Phenanthrene	NA	NA	NA	ND	NA	NA	NA
Pyrene	NA	NA	NA	67 J	NA	NA	NA
Butyltin Compounds (ug/kg)							
Tetrabutyltin	NA	NA	NA	ND	NA	NA	NA
Tributyltin	NA	NA	NA	ND	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP26	TP26	TP01	TP01	TP02	TP02	TP03
Sample Number	DSY-S-TP26-0406	DSY-S-TP26-0910	DSY-S-TP01-0507	DSY-S-TP01-1112	DSY-S-TP02-0709	DSY-S-TP02-1516	DSY-S-TP03-0305
Sample Description	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 7.0-9.0 ft	Test Pit, 15.0-16.0 ft	Test Pit, 3.0-5.0 ft
Pesticides/PCBs (ug/kg)							
4,4'-DDD	NA	NA	NA	ND	NA	NA	NA
4,4'-DDE	NA	NA	NA	ND	NA	NA	NA
4,4'-DDT	NA	NA	NA	ND	NA	NA	NA
Aldrin	NA	NA	NA	ND	NA	NA	NA
alpha-Chlordane	NA	NA	NA	ND	NA	NA	NA
Aroclor-1260	NA	NA	NA	ND	NA	NA	NA
Endrin	NA	NA	NA	ND	NA	NA	NA
gamma-Chlordane	NA	NA	NA	ND	NA	NA	NA
Heptachlor	NA	NA	NA	ND	NA	NA	NA
Metals (mg/kg)							
Aluminum, total	10100	10200	7040	5860	10500	7450	7940
Arsenic, total	42	17.8	7.2 J	7.7 J	16 J	7.8 J	ND
Barium, total	28.7	33.6	16.6 J	ND	14.6 J	18 J	14.6
Beryllium, total	0.44 J	0.51	0.36 J	ND	0.37 J	0.34 J	0.39 J
Cadmium, total	ND	ND	ND	ND	ND	ND	ND
Chromium, total	14.8	20.1	9.4 J	6.6 J	12 J	10.9 J	11
Cobalt, total	11.5	11.5	8 J	4.4 J	11.6 J	9.1 J	8.5
Copper, total	21.9	34.7	17.8 J	7 J	21.5 J	21.2 J	18
Iron, total	25500	24700	18100	16800	25500	19700	18600
Lead, total	75 J	28.4 J	30 J	7.6 J	21.2 J	34.2 J	5.5 J
Manganese, total	342	363	257 J	104 J	299 J	353 J	283
Mercury, total	0.06	ND	ND	ND	ND	ND	0.11
Nickel, total	18.8 J	25.5 J	13.5 J	10.7 J	24.4 J	18.9 J	17.7
Selenium, total	0.81 J	ND	ND	ND	ND	ND	ND
Silver, total	ND	ND	ND	ND	ND	ND	ND
Tin, total	ND	ND	ND	ND	ND	ND	ND
Vanadium, total	18.2 J	16.2 J	12	9	15.2	13.9	15
Zinc, total	80.1	117	67.3 J	52.5 J	66.2 J	74.8 J	57.7 J
TPH USING IR (mg/kg)	ND	ND	ND	72	ND	ND	ND

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP03	TP04	TP05	TP05	TP06	TP06
Sample Number	DSY-S-TP03-0608	DSY-S-TP04-0607	DSY-S-TP05-0507	DSY-S-TP05-1213	DSY-S-TP06-0507	DSY-S-TP06-1213
Sample Description	Test Pit, 6.0-8.0 ft	Test Pit, 6.0-7.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Volatile Organics (ug/kg)						
1,2-Dichloroethene (total)	ND	NA	ND	NA	NA	NA
Acetone	ND	NA	ND	NA	NA	NA
Carbon Disulfide	ND	NA	ND	NA	NA	NA
Ethylbenzene	ND	NA	ND	NA	NA	NA
Total Xylenes	ND	NA	ND	NA	NA	NA
Trichloroethene	ND	NA	ND	NA	NA	NA
Semivolatile Organics (ug/kg)						
2-Methylnaphthalene	ND	NA	50 J	NA	NA	NA
Anthracene	ND	NA	ND	NA	NA	NA
Benzo(a)anthracene	ND	NA	91 J	NA	NA	NA
Benzo(a)pyrene	ND	NA	79 J	NA	NA	NA
Benzo(b)fluoranthene	ND	NA	110 J	NA	NA	NA
Benzo(g,h,i)perylene	ND	NA	46 J	NA	NA	NA
Benzo(k)fluoranthene	ND	NA	78 J	NA	NA	NA
bis(2-Ethylhexyl)Phthalate	ND	NA	ND	NA	NA	NA
Chrysene	ND	NA	100 J	NA	NA	NA
Di-n-butylphthalate	ND	NA	ND	NA	NA	NA
Fluoranthene	ND	NA	320 J	NA	NA	NA
Fluorene	ND	NA	ND	NA	NA	NA
Indeno(1,2,3-cd)pyrene	ND	NA	53 J	NA	NA	NA
Naphthalene	ND	NA	ND	NA	NA	NA
Phenanthrene	ND	NA	100 J	NA	NA	NA
Pyrene	ND	NA	180 J	NA	NA	NA
Butyltin Compounds (ug/kg)						
Tetrabutyltin	ND	NA	5.5 J	NA	NA	NA
Tributyltin	ND	NA	ND	NA	NA	NA

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

TABLE 4-4C
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP03	TP04	TP05	TP05	TP06	TP06
Sample Number	DSY-S-TP03-0608	DSY-S-TP04-0607	DSY-S-TP05-0507	DSY-S-TP05-1213	DSY-S-TP06-0507	DSY-S-TP06-1213
Sample Description	Test Pit, 6.0-8.0 ft	Test Pit, 6.0-7.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Pesticides/PCBs (ug/kg)						
4,4'-DDD	ND	NA	ND	NA	NA	NA
4,4'-DDE	ND	NA	6.5	NA	NA	NA
4,4'-DDT	7.4	NA	7	NA	NA	NA
Aldrin	ND	NA	ND	NA	NA	NA
alpha-Chlordane	ND	NA	ND	NA	NA	NA
Aroclor-1260	ND	NA	ND	NA	NA	NA
Endrin	ND	NA	ND	NA	NA	NA
gamma-Chlordane	ND	NA	ND	NA	NA	NA
Heptachlor	ND	NA	2.1	NA	NA	NA
Metals (mg/kg)						
Aluminum, total	5730	8380	10800	12100	14900	13400
Arsenic, total	6.8	12.3 J	22	23.2	16.8	21.6
Barium, total	9.2	14.6 J	16.2	13.9	8.2	14.3 J
Beryllium, total	0.33 J	0.28 J	0.5	0.38 J	0.21 J	0.39 J
Cadmium, total	ND	ND	ND	ND	ND	0.56 J
Chromium, total	9.3	10.2 J	14.8	15	19.3	16.5
Cobalt, total	6.6	9.2 J	12.7	29.9	13.5	16.3
Copper, total	52.5	19.6 J	26	18.9	20.2	23.6
Iron, total	16100	21300	29500	30800	37000	34100
Lead, total	21.8 J	52.3 J	31.2 J	10.6 J	10 J	15.8 J
Manganese, total	226	366 J	385	800	436	512
Mercury, total	0.12	ND	0.06	ND	ND	ND
Nickel, total	17.4	17 J	22.6 J	30.9	28	24.1 J
Selenium, total	ND	ND	0.89 J	ND	0.85 J	ND
Silver, total	ND	ND	ND	ND	1.2 J	ND
Tin, total	ND	9.2 J	ND	ND	ND	ND
Vanadium, total	10.6	13.1	23.8 J	17 J	16.2 J	18.3 J
Zinc, total	67.8 J	67.7 J	61.4	59.3	59.5	57
TPH USING IR (mg/kg)	540	ND	ND	ND	ND	ND

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	RIDEM	MW10	MW02	MW02	MW02	MW03	MW03
Sample Number	Direct Exposure	DSY-S-MW10-0810	DSY-S-MW02-1820	DSY-S-MW02-2426	DSY-S-MW02-3436	DSY-S-MW03-0810	DSY-S-MW03-1618
Sample Description	Criteria (see text)	Boring, 8.0-10.0 ft	Boring, 18.0-20.0 ft	Boring, 24.0-26.0 ft	Boring, 34.0-36.0 ft	Boring, 8.0-10.0 ft	Boring, 16.0-18.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	38.5	4.3	4	6.6	7	9.9
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	RIDEM	MW04	MW04	MW11	MW12	MW12	MW12
Sample Number	Direct Exposure	DSY-S-MW04-1618	DSY-S-MW04-3234	DSY-S-MW11-2729	DSY-S-MW12-0709	DSY-S-MW12-2123	DSY-S-MW12-2931
Sample Description	Criteria (see text)	Boring, 16.0-18.0 ft	Boring, 32.0-34.0 ft	Boring, 27.0-29.0 ft	Boring, 7.0-9.0 ft	Boring, 21.0-23.0 ft	Boring, 29.0-31.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	7.3	4.9	14.6	4.3	5.6	7.6
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	RIDEM	TP16	TP18	TP20	TP20	TP22	TP22
Sample Number	Direct Exposure	DSY-S-TP16-1112	DSY-S-TP18-0507	DSY-S-TP20-0507	DSY-S-TP20-1011	DSY-S-TP22-0506	DSY-S-TP22-1112
Sample Description	Criteria (see text)	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	16.6	4.4 J	3.9 J	4.3 J	8.1	7
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	Central Shipyard
Sample Location	RIDEM	TP23	TP23	TP24	TP28	TP28	MW05
Sample Number	Direct Exposure	DSY-S-TP23-0507	DSY-S-TP23-0910	DSY-S-TP24-0507	DSY-S-TP28-0507	DSY-S-TP28-1314	DSY-S-MW05-1012
Sample Description	Criteria (see text)	Test Pit, 5.0-7.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 13.0-14.0 ft	Boring, 10.0-12.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	5.5	4.6 J	5.1	13.7 J	7.7 J	7.1 J
TPH USING IR (mg/kg)	2500						4100

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	MW05	MW05	MW06	MW07	MW07	MW07
Sample Number	Direct Exposure	DSY-S-MW05-2224	DSY-S-MW05-3234	DSY-S-MW06-0406	DSY-S-MW07-0810	DSY-S-MW07-2224	DSY-S-MW07-3436
Sample Description	Criteria (see text)	Boring, 22.0-24.0 ft	Boring, 32.0-34.0 ft	Boring, 4.0-6.0 ft	Boring, 8.0-10.0 ft	Boring, 22.0-24.0 ft	Boring, 34.0-36.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	6.3 J	8	11.1	20.3	5	3.9
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	TP11	TP11	TP12	TP12	TP13	TP14
Sample Number	Direct Exposure	DSY-S-TP11-0507	DSY-S-TP11-1213	DSY-S-TP12-0507	DSY-S-TP12-1213	DSY-S-TP13-1011	DSY-S-TP14-0506
Sample Description	Criteria (see text)	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 10.0-11.0 ft	Test Pit, 5.0-6.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	22	36.9	24.1	37.3	15.7	4.8 J
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	TP15	TP15	TP17	TP17	TP25	TP25
Sample Number	Direct Exposure	DSY-S-TP15-0506	DSY-S-TP15-1112	DSY-S-TP17-0507	DSY-S-TP17-1112	DSY-S-TP25-0507	DSY-S-TP25-1011
Sample Description	Criteria (see text)	Test Pit, 5.0-6.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 10.0-11.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	11.4	6.1 J	13.6	8.7	15.6	13
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	RIDEM	MW08	MW09	MW09	MW09	TP08	TP09
Sample Number	Direct Exposure	DSY-S-MW08-0810	DSY-S-MW09-2022	DSY-S-MW09-3032	DSY-S-MW09-3638	DSY-S-TP08-0406	DSY-S-TP09-0406
Sample Description	Criteria (see text)	Boring, 8.0-10.0 ft	Boring, 20.0-22.0 ft	Boring, 30.0-32.0 ft	Boring, 36.0-38.0 ft	Test Pit, 4.0-6.0 ft	Test Pit, 4.0-6.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	20.7	9.8	9.7	4.4	8.7	11.7
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location	RIDEM	TP09	TP10	TP26	TP26	TP01	TP01
Sample Number	Direct Exposure	DSY-S-TP09-0910	DSY-S-TP10-1213	DSY-S-TP26-0406	DSY-S-TP26-0910	DSY-S-TP01-0507	DSY-S-TP01-1112
Sample Description	Criteria (see text)	Test Pit, 9.0-10.0 ft	Test Pit, 12.0-13.0 ft	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 11.0-12.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	15.9	17.3	42	17.8	7.2 J	7.7 J
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	RIDEM	TP02	TP02	TP03	TP04	TP05	TP05
Sample Number	Direct Exposure	DSY-S-TP02-0709	DSY-S-TP02-1516	DSY-S-TP03-0608	DSY-S-TP04-0607	DSY-S-TP05-0507	DSY-S-TP05-1213
Sample Description	Criteria (see text)	Test Pit, 7.0-9.0 ft	Test Pit, 15.0-16.0 ft	Test Pit, 6.0-8.0 ft	Test Pit, 6.0-7.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Metals (mg/kg)							
Arsenic, total	3.8	16 J	7.8 J	6.8	12.3 J	22	23.2
TPH USING IR (mg/kg)	2500						

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

TABLE 4-4D
CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES
AT CONCENTRATIONS EXCEEDING RIDEM SOIL STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		South Waterfront	South Waterfront
Sample Location	RIDEM	TP06	TP06
Sample Number	Direct Exposure	DSY-S-TP06-0507	DSY-S-TP06-1213
Sample Description	Criteria (see text)	Test Pit, 5.0-7.0 ft	Test Pit, 12.0-13.0 ft
Metals (mg/kg)			
Arsenic, total	3.8	16.8	21.6
TPH USING IR (mg/kg)	2500		

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

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

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

o = observed
os = observed off-shore

TABLE 4-8
OBSERVED MAMMAL AND REPTILE 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
White-footed mouse	*Peromyscus leucopus*	p	o	p	p
Eastern Cottontail	*Sylvilagus floridanus*	p	p	p	o
Eastern Chipmunk	*Tamias striatus*	o	p	p	p
Raccoon	*Procyon lotor*	p	p	p	s
Domestic cat	*Felis domestica*	p	p	p	o
Eastern garter snake	*Thamnophis s. sirtalis*	p	o	p	p

o = observed
s = sign (scat, tracks, den, etc.)
p = potential presence

TABLE 4-5A
TCLP METALS
DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW10	MW10	MW02	MW02	MW02	MW02	MW04
Sample Number	DSY-S-MW10-0002	DSY-S-MW10-0810	DSY-S-MW02-1820	DSY-S-MW02-2426	DSY-S-MW02-3436	DSY-S-MW02-0002	DSY-S-MW04-0810
Sample Description	Boring, 0.0-2.0 ft	Boring, 8.0-10.0 ft	Boring, 18.0-20.0 ft	Boring, 24.0-26.0 ft	Boring, 34.0-36.0 ft	Boring, 0.5-1.5 ft	Boring, 8.0-10.0 ft
Arsenic	ND	ND	ND	ND	ND	ND	ND
Barium	141	105	53.8	373	352	609	307
Cadmium	ND	5.4	ND	ND	ND	ND	ND
Chromium	17.8	41.1	ND	ND	ND	ND	ND
Lead	5.8	1.6	24.7	ND	48.8	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	4.6	ND	ND	ND	ND	ND	ND
Silver	8.2	6.9	ND	ND	ND	ND	7.5

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	MW04	MW04	MW04	MW12	MW12	MW12	MW12
Sample Number	DSY-S-MW04-1618	DSY-S-MW04-3234	DSY-S-MW04-0002	DSY-S-MW12-0002	DSY-S-MW12-0709	DSY-S-MW12-2123	DSY-S-MW12-2931
Sample Description	Boring, 16.0-18.0 ft	Boring, 32.0-34.0 ft	Boring, 0.5-1.5 ft	Boring, 0.5-1.5 ft	Boring, 7.0-9.0 ft	Boring, 21.0-23.0 ft	Boring, 29.0-31.0 ft
Arsenic	ND	ND	ND	ND	ND	ND	ND
Barium	250	415	278	592	330	605	421
Cadmium	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	7.4	ND	ND	ND	ND	ND
Lead	45.4	12.2	5.7	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	6.9	ND	ND	ND	ND	ND
Silver	ND	7.8	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront
Sample Location	TP16	TP16	TP18	TP20	TP21	TP24	TP27	TP28
Sample Number	DSY-S-TP16-0001	DSY-S-TP16-1112	DSY-S-TP18-0001	DSY-S-TP20-0001	DSY-S-TP21-0001	DSY-S-TP24-0102	DSY-S-TP27-0001	DSY-S-TP28-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 11.0-12.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 1.0-2.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Arsenic	ND	ND	ND	ND	ND	3.9	ND	ND
Barium	193	ND	119.75	203	167	139.75	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	16.6	6.8
Lead	71.8	6.1	12.25	9.7	ND	ND	ND	70.25
Mercury	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	SB-11	MW05	MW05	MW05	MW05	MW05	MW06
Sample Number	DSY-SB-11-0002	DSY-S-MW05-1012	DSY-S-MW05-2224	DSY-S-MW05-3234	DSY-S-MW05-4446	DSY-S-MW05-0002	DSY-S-MW06-0406
Sample Description	Boring, 0.0-2.0 ft	Boring, 10.0-12.0 ft	Boring, 22.0-24.0 ft	Boring, 32.0-34.0 ft	Boring, 44.0-46.0 ft	Boring, 0.5-1.5 ft	Boring, 4.0-6.0 ft
Arsenic	4.4	8.8	ND	ND	ND	3.3	ND
Barium	150	ND	ND	184	122	ND	55
Cadmium	ND	ND	ND	ND	ND	ND	ND
Chromium	40.5	21.5	8.5 J	ND	ND	ND	ND
Lead	4.5	23.5	ND	3	ND	ND	5.1
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	6.7	ND	ND
Silver	18.6	ND	ND	ND	ND	ND	8.6

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	MW06	MW07	MW07	MW07	MW07	MW07	S42-1
Sample Number	DSY-S-MW06-0002	DSY-S-MW07-0001	DSY-S-MW07-0810	DSY-S-MW07-1618	DSY-S-MW07-2224	DSY-S-MW07-3436	DSY-S-S42-1-0005
Sample Description	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Boring, 8.0-10.0 ft	Boring, 16.0-18.0 ft	Boring, 22.0-24.0 ft	Boring, 34.0-36.0 ft	Soil, 0.0-0.5 ft
Arsenic	ND	5.7 J	18.6	25.7	4.2 J	ND	10.2
Barium	121	ND	ND	ND	ND	ND	400
Cadmium	ND	ND	ND	ND	ND	ND	114
Chromium	13.6	ND	7.3 J	ND	ND	14.6	12.8
Lead	6.2	ND	ND	ND	ND	ND	12.6
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	5.8
Silver	7.6	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	S42-2	S42-2	S42-5	S42-5	TP11	TP12	TP13
Sample Number	DSY-S-S42-2-0005	DSY-S-S42-2-0510	DSY-S-S42-5-0510	DSY-S-S42-5-1015	DSY-S-TP11-1213	DSY-S-TP12-0001	DSY-S-TP13-0506
Sample Description	Soil, 0.0-0.5 ft	Soil, 0.5-1.0 ft	Soil, 0.5-1.0 ft	Soil, 1.0-1.5 ft	Test Pit, 12.0-13.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 5.0-6.0 ft
Arsenic	7.7	ND	ND	ND	67.2	ND	ND
Barium	151	238	455	ND	366	306	177.25
Cadmium	4.8	6.1	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	60 J	56.2	12.8	5.25
Mercury	0.19	ND	ND	ND	ND	ND	ND
Selenium	ND	5.4	ND	ND	18	7.7	ND
Silver	ND	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area
Sample Location	TP14	TP15	TP17	TP25	S42-5	S42-5	MW08
Sample Number	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-TP25-1011	DSY-SB-09-1416	DSY-SB-10-1416	DSY-S-MW08-0810
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 10.0-11.0 ft	Boring, 14.0-16.0 ft	Boring, 14.0-16.0 ft	Boring, 8.0-10.0 ft
Arsenic	ND	ND	ND	ND	13.5	24.6	ND
Barium	154	186	ND	ND	186	158	61.5
Cadmium	ND	ND	ND	ND	ND	6.6	ND
Chromium	ND	ND	ND	ND	13.4	29.5	ND
Lead	37.2	21.1	13.1	21.9	7.8	4.2	2.6
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	4	ND	ND	ND	ND
Silver	ND	ND	ND	ND	11.8	20.4	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	MW08	MW09	MW09	MW09	MW09	MW09	S234-1
Sample Number	DSY-S-MW08-0002	DSY-S-MW09-0001	DSY-S-MW09-1012	DSY-S-MW09-2022	DSY-S-MW09-3032	DSY-S-MW09-3638	DSY-S-S234-1-0005
Sample Description	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Boring, 10.0-12.0 ft	Boring, 20.0-22.0 ft	Boring, 30.0-32.0 ft	Boring, 36.0-38.0 ft	Soil, 0.0-0.5 ft
Arsenic	6.3	ND	ND	ND	ND	ND	ND
Barium	272	129	84.8	83.8	69.6	91.6	503
Cadmium	4	ND	ND	ND	ND	ND	ND
Chromium	8.7	ND	ND	ND	ND	ND	ND
Lead	81.3	16.4	18.8	1.9	5.4	2.8	ND
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	S234-1	S234-1	S234-4	S234-4	S234-4	TP07	TP08
Sample Number	DSY-S-S234-1-0510	DSY-S-S234-1-1015	DSY-S-S234-4-0005	DSY-S-S234-4-0510	DSY-S-S234-4-1015	DSY-S-TP07-0001	DSY-S-TP08-0001
Sample Description	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	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Arsenic	ND	ND	ND	ND	ND	ND	ND
Barium	373	331	453	639	554	90.7	403
Cadmium	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	45.95
Lead	ND	ND	ND	16.6 J	ND	9.6	102.25
Mercury	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location	TP08	TP08	TP09	TP10	TP26	TP26	TP01	TP02
Sample Number	DSY-S-TP08-0406	DSY-S-TP08-0910	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP26-0001	DSY-S-TP26-0305	DSY-S-TP01-0001	DSY-S-TP02-0001
Sample Description	Test Pit, 4.0-6.0 ft	Test Pit, 9.0-10.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 3.0-5.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND
Barium	128	69.9	128	152	411	133	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	11.8 J
Lead	ND	ND	ND	41.6	29	ND	16.1	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	8.1	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5A
TCLP METALS DETECTED IN SOILS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area	South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location	TP04	TP05	TP05	TP06
Sample Number	DSY-S-TP04-0001	DSY-S-TP05-0001	DSY-S-TP05-0507	DSY-S-TP06-0001
Sample Description	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 5.0-7.0 ft	Test Pit, 0.0-1.0 ft
Arsenic	ND	ND	ND	ND
Barium	ND	184	156	190
Cadmium	ND	3.5 J	ND	ND
Chromium	18.4	ND	6.5 J	ND
Lead	16.1	ND	ND	8.9
Mercury	ND	ND	ND	ND
Selenium	ND	ND	ND	ND
Silver	ND	ND	ND	ND

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated quantitation
* - Dilution results
All values are expressed in ug/l

TABLE 4-5B
TCLP METALS DETECTED IN SOILS
AT CONCENTRATIONS EXCEEDING RIDEM GA LEACHABILITY STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	North Waterfront	North Waterfront	North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location	RIDEM	MW02	MW04	TP16	TP28	S42-1	S42-5	TP11
Sample Number	GA Leachability	DSY-S-MW02-3436	DSY-S-MW04-1618	DSY-S-TP16-0001	DSY-S-TP28-0001	DSY-S-S42-1-0005	DSY-S-S42-5-1015	DSY-S-TP11-1213
Sample Description	Criteria (see text)	Boring, 34.0-36.0 ft	Boring, 16.0-18.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Soil, 0.0-0.5 ft	Soil, 1.0-1.5 ft	Test Pit, 12.0-13.0 ft
Cadmium	30					114		
Lead	40	48.8	45.4	71.8	70.25		60 J	56.2

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated
All values are expressed un ug/l

TABLE 4-5B
TCLP METALS DETECTED IN SOILS
AT CONCENTRATIONS EXCEEDING RIDEM GA LEACHABILITY STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Building 234 Area	Building 234 Area	Building 234 Area
Sample Location	RIDEM	TP11	MW08	TP08	TP10
Sample Number	GA Leachability	DSY-S-TP11-1213	DSY-S-MW08-0002	DSY-S-TP08-0001	DSY-S-TP10-0001
Sample Description	Criteria (see text)	Test Pit, 12.0-13.0 ft	Boring, 0.5-1.5 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Cadmium	30				
Lead	40	56.2	81.3	102.25	41.6

NOTES:
NA - Not Analyzed ND - Not Detected J - Estimated
All values are expressed un ug/l

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

Area	Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront	North Waterfront	North Waterfront	Central Shipyard
Sample Location	MW01	MW104	MW02	MW03	MW04	MW11	MW12	MW05
Sample Number	DSY-A-MW01-01	DSY-A-MW104-01	DSY-A-MW02-01	DSY-A-MW03-01	DSY-A-MW04-01	DSY-A-MW11-01	DSY-A-MW12-01	DSY-A-MW05-01
Sample Description	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Volatile Organics (ug/l)								
1,2-Dichloroethene (total)	ND	180	5 J	ND	ND	18	16	ND
Acetone	ND	ND	ND	7.5	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	32.5	ND	ND	16	ND
Vinyl Chloride	ND	100	ND	ND	ND	ND	ND	ND
Butyltin Compounds (ug/l)								
Monobutyltin	0.33	ND	ND	ND	ND	ND	ND	ND
Metals (ug/l)								
Aluminum, total	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic, total	ND	19.8	ND	5.3	5.1 J	13.2	ND	ND
Barium, total	ND	44.6	44.4	ND	ND	15.8	ND	49.1
Calcium, total	34350	46900	62500	23650	80200	51300	22000	126000
Chromium, total	13.5	7.2 J	ND	ND	ND	7.3 J	ND	ND
Copper, total	ND	12.7	ND	5.6	ND	ND	ND	ND
Iron, total	ND	1880	ND	309.15	ND	414 J	ND	1260
Lead, total	ND	14.6	ND	ND	ND	ND	ND	ND
Magnesium, total	13350	7470	31600	11850	6700	13000	24000	40000
Manganese, total	22.9	4300	230	19.975	371	373	125	1360
Nickel, total	ND	ND	ND	7.95	ND	9.6 J	ND	ND
Potassium, total	1415	3510	17100	1900	3050	5890	15700	2490
Sodium, total	32300	119000	200000	71400	29700	80100	60300	379000
Zinc, total	ND	ND	68.3	21.8	ND	21.3	ND	ND

NOTES:
NA - Not Analyzed, ND - Not Detected' J - Estimated quantitation

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

Area	Central Shipyard	Building 234 Area	Building 234 Area
Sample Location	MW07	MW08	MW09
Sample Number	DSY-A-MW07-01	DSY-A-MW08-01	DSY-A-MW09-01
Sample Description	Groundwater	Groundwater	Groundwater
Volatile Organics (ug/l)			
1,2-Dichloroethene (total)	ND	13	ND
Acetone	ND	ND	ND
Trichloroethene	ND	4 J	3 J
Vinyl Chloride	ND	ND	ND
Butyltin Compounds (ug/l)			
Monobutyltin	ND	ND	ND
Metals (ug/l)			
Aluminum, total	1240	ND	1010
Arsenic, total	57.6	15.6	ND
Barium, total	51.7	ND	99.3
Calcium, total	14100	28400	42000
Chromium, total	12.8 J	30.3 J	57.6 J
Copper, total	ND	ND	5.9 J
Iron, total	18400	5660	2600
Lead, total	1.8 J	ND	ND
Magnesium, total	5430	6530	12800
Manganese, total	753	3410	830
Nickel, total	ND	ND	ND
Potassium, total	3570	3990	7650
Sodium, total	142000	45000	103000
Zinc, total	ND	ND	ND

NOTES:
NA - Not Analyzed, ND - Not Detected' J - Estimated quantitation

TABLE 4-6B
CHEMICAL CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT CONCENTRATIONS EXCEEDING RIDEM STANDARDS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Upgradient Area	North Waterfront	North Waterfront
Sample Location	RIDEM	MW10	MW03	MW12
Sample Number	GA Groundwater	DSY-A-MW104-01	DSY-A-MW03-01	DSY-A-MW12-01
Sample Description	Objective (see text)	Groundwater	Groundwater	Groundwater
Volatile Organics (ug/l)				
1,2-Dichloroethene (total)	70	180		
Trichloroethene	5		32.5	16
Vinyl Chloride	2	100		

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

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

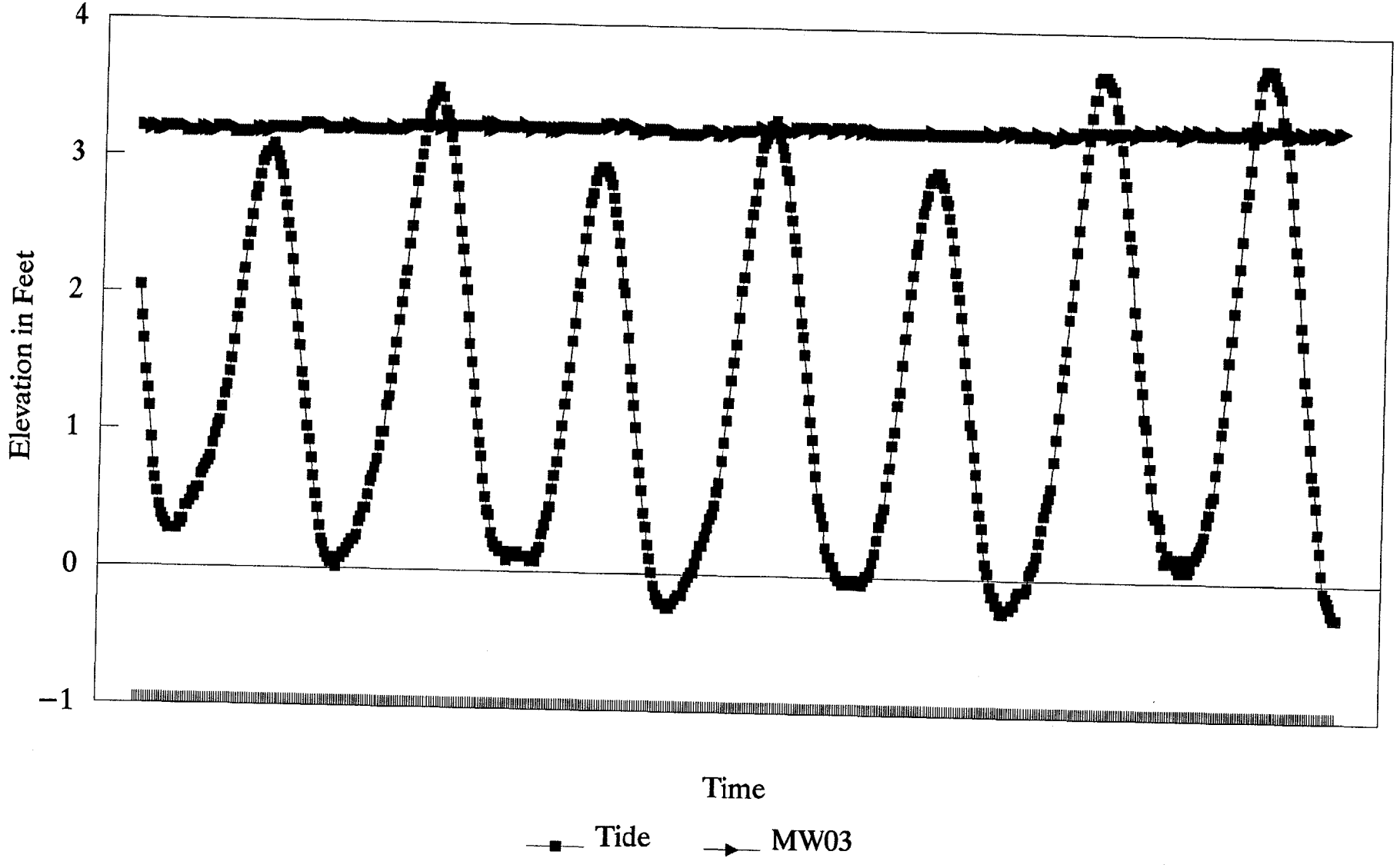


FIGURE 4-8
Tidal Fluctuation of MW04 (North Waterfront
Site Assessment Screening Evaluation
Former Robert E. Derecktor Shipyard
NETC Newport Rhode Island

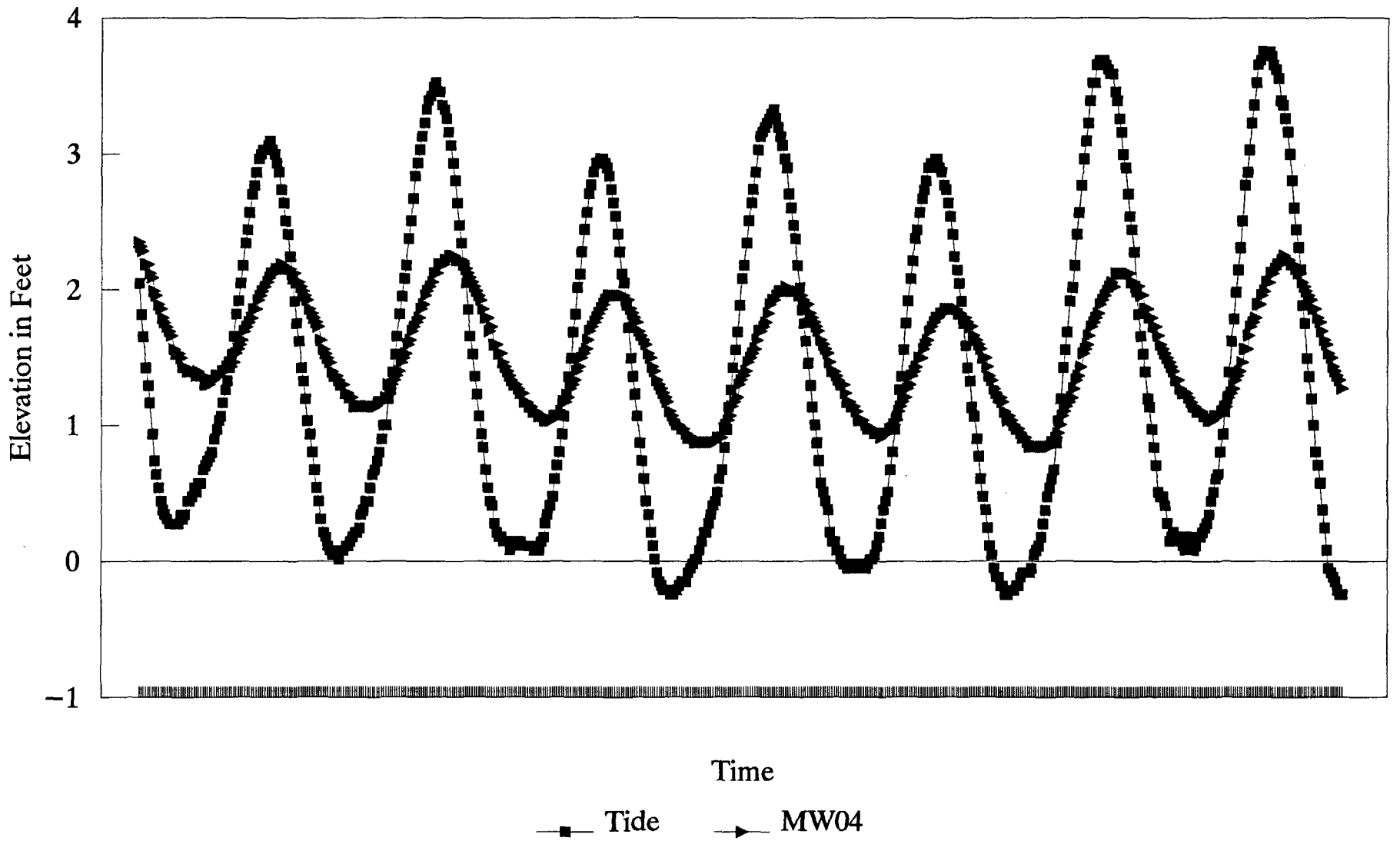


FIGURE 4–9
Tidal Fluctuation of MW11 (North Waterfront)
Site Assessment Screening Evaluation
Former Robert E. Derecktor Shipyard
NETC Newport Rhode Island

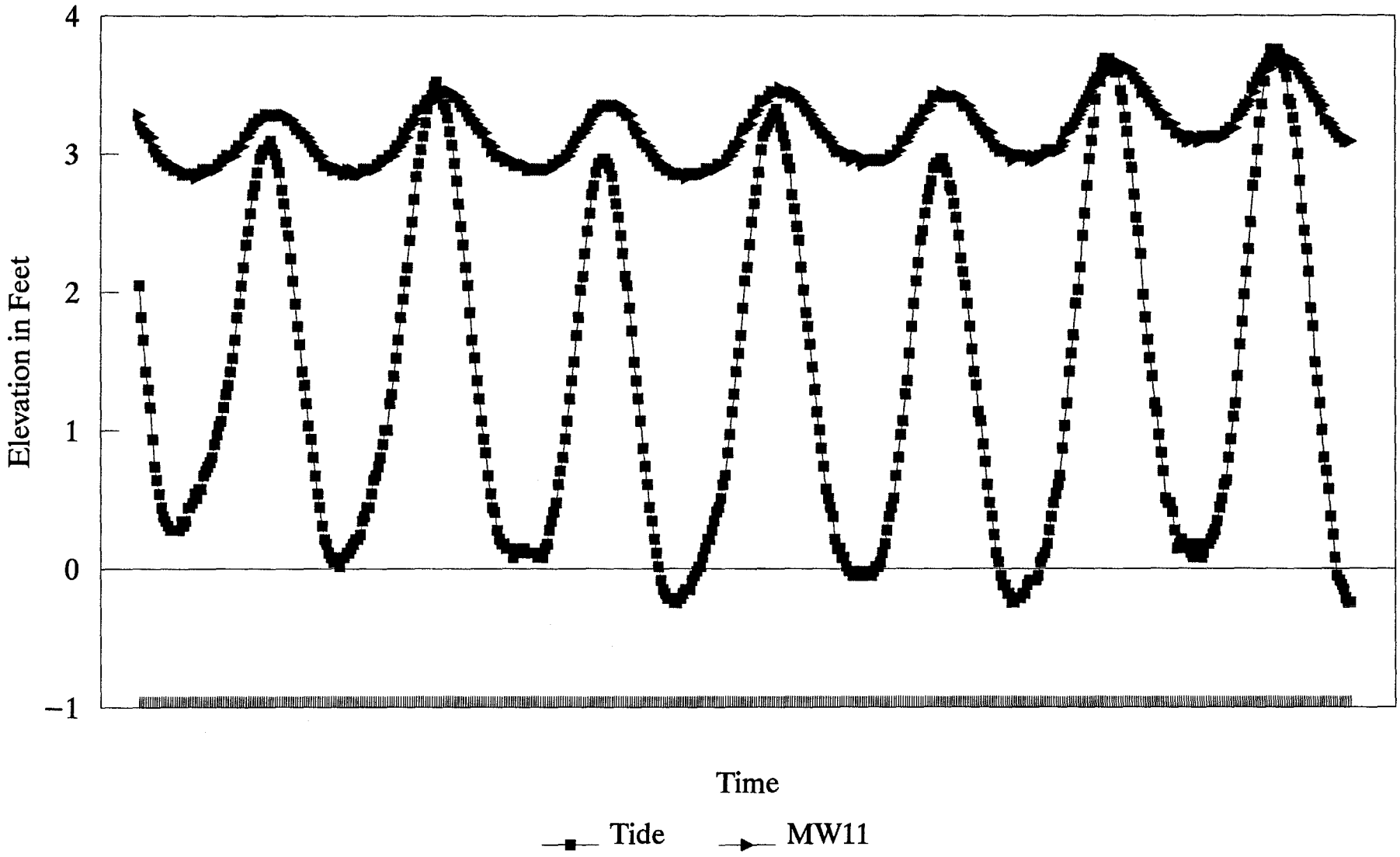


FIGURE 4-10
Tidal Fluctuation of MW05 (Central Shipyard – Bedrock)
Site Assessment Screening Evaluation
Former Robert E. Derecktor Shipyard
NETC Newport Rhode Island

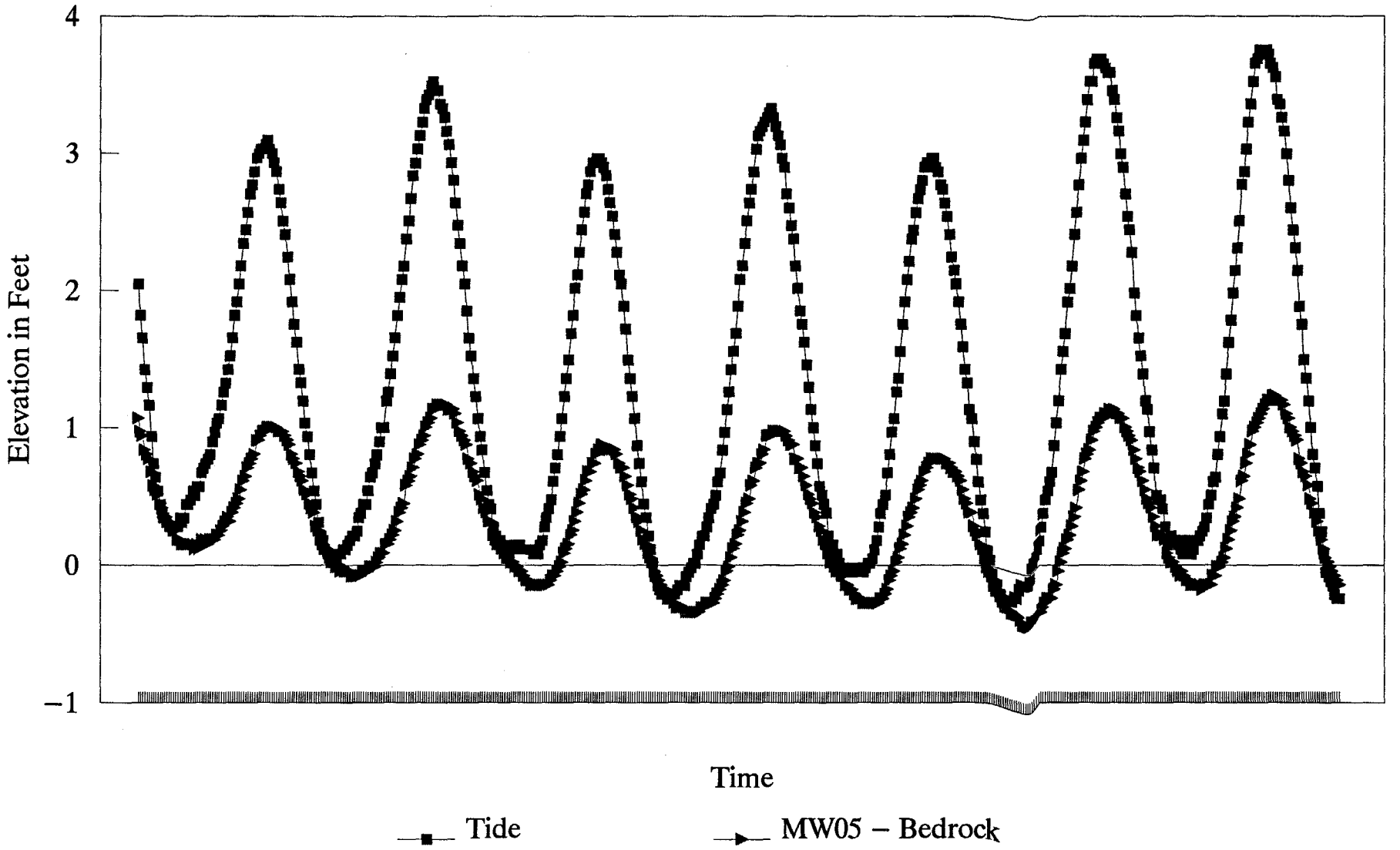


FIGURE 4-11
Tidal Fluctuation of MW07 (Central Shipyard)
Site Assessment Screening Evaluation
Former Robert E. Derecktor Shipyard
NETC Newport Rhode Island

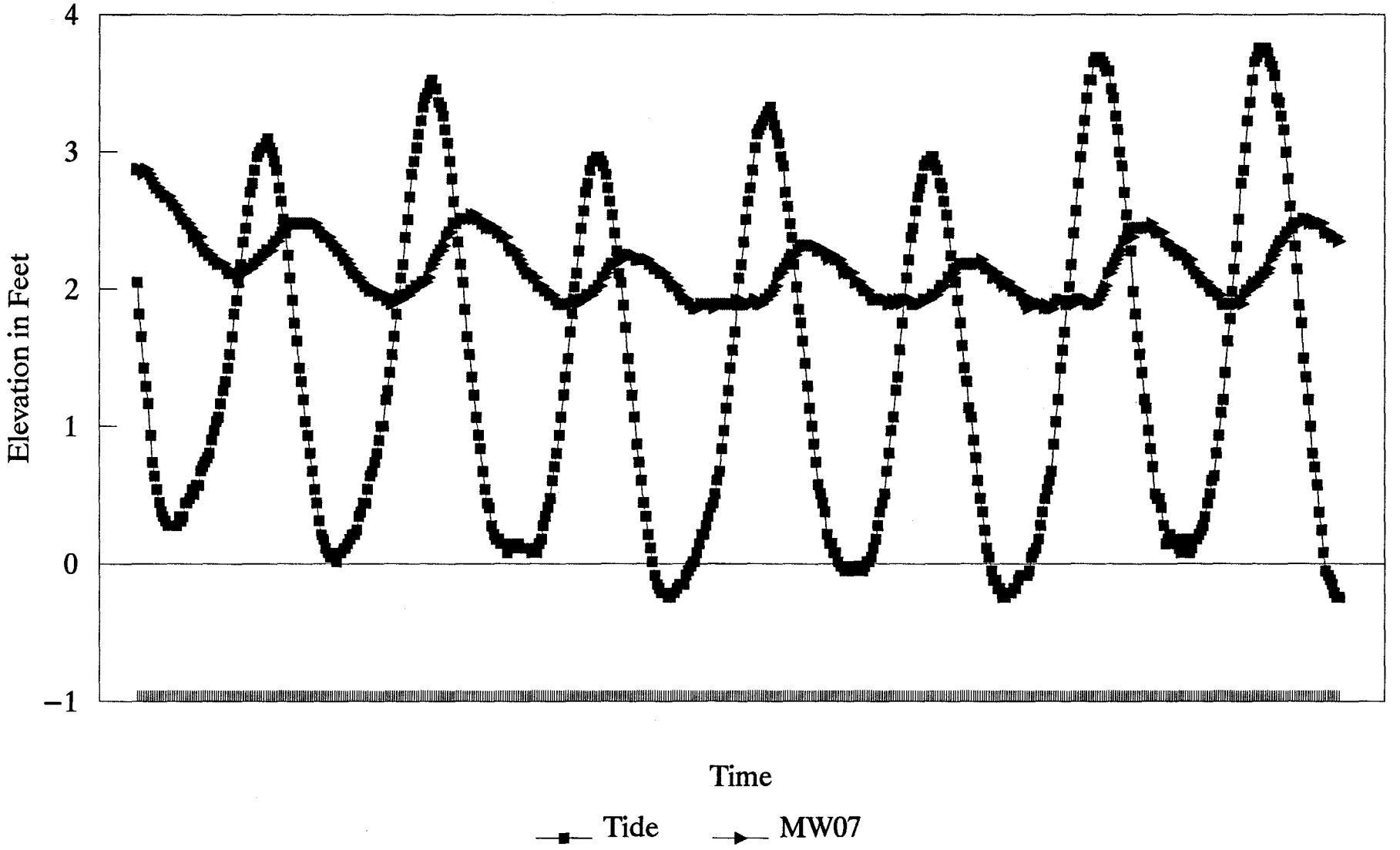
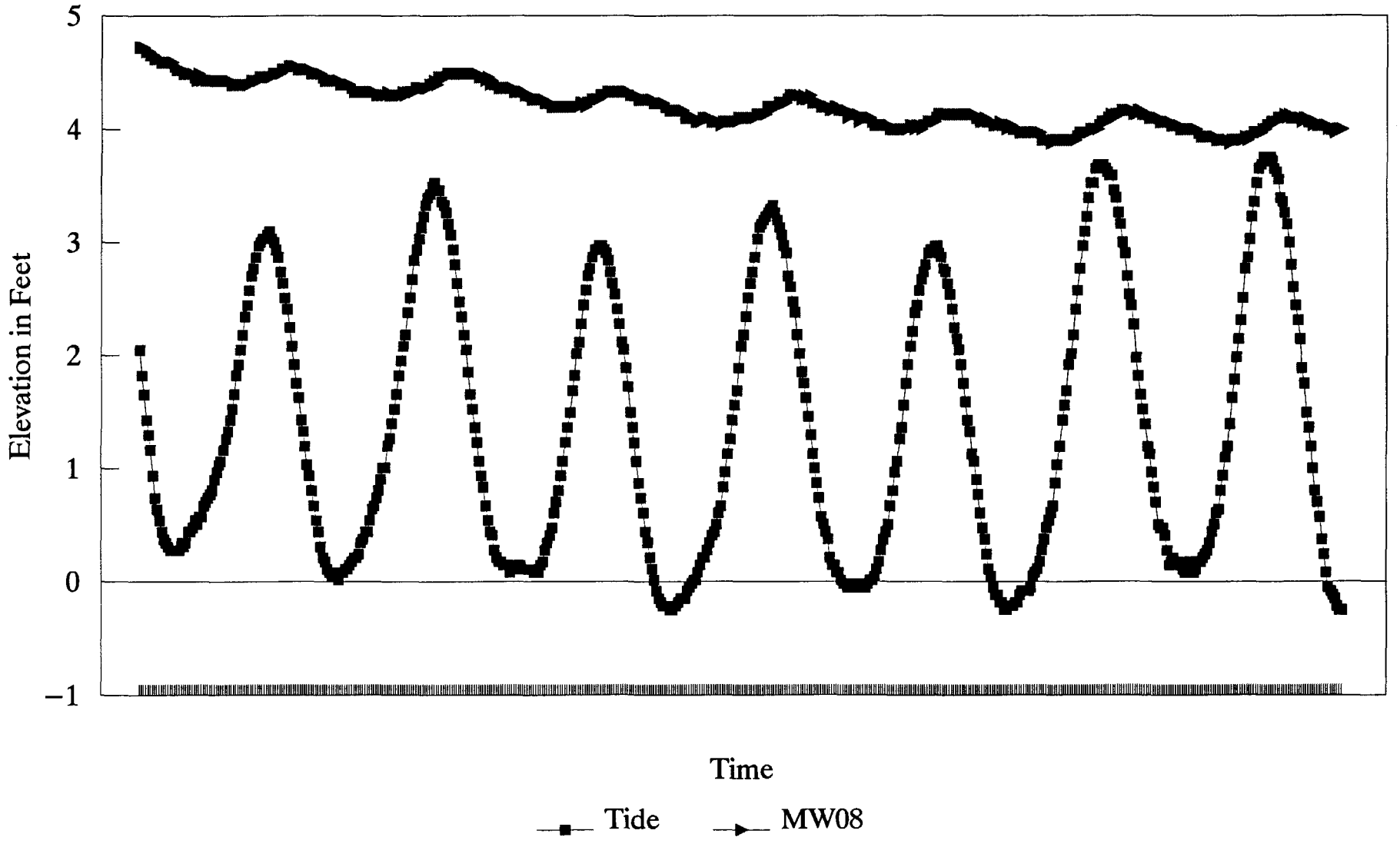


FIGURE 4–12
Tidal Fluctuation of MW08 (Building 234 Area)
Site Assessment Screening Evaluation
Former Robert E. Derecktor Shipyard
NETC Newport Rhode Island



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 exhibits 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, 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. No elevated concentrations of metals were 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 analyses, 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 a 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 effect 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 breaking down 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. 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. The human health risk assessment was conducted based on current conditions at the site, particularly regarding the location and extent of the surface soils present, and was not intended to address possible future site development and exposure scenarios resulting from changes to the existing conditions.

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 area presented in Tables 4-4A (surface soil) and Tables 4-4C (subsurface soil). Groundwater samples were collected at the North Waterfront, 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, 1997a). 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-07 or a hazard quotient (HQ) of 0.1.

- Comparison to risk-based criteria (RBC) for groundwater (EPA, 1997a). 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-07 or a hazard quotient (HQ) of 0.1.

- 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 (R) 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 - aluminum, Aroclor-1260, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene dieldrin, iron, indeno(1,2,3-cd)pyrene, manganese (Table 6-12)
- Subsurface Soils - aldrin, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, iron (Table 6-13)
- Groundwater - arsenic, 1,2-DCE, manganese, 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 - aluminum, Aroclor-1260, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dieldrin, iron, indeno(1,2,3-cd)pyrene, manganese (Table 6-15)
- Subsurface Soils - aluminum, Aroclor-1260, arsenic, beryllium, benzo(a)pyrene, benzo(b)fluoranthene, iron, manganese (Table 6-16)
- Groundwater - arsenic, iron (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 - aluminum, Aroclor-1260, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chromium, iron, indeno(1,2,3-cd)pyrene, manganese (Table 6-18)

- Subsurface Soils - aluminum, arsenic, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, iron, manganese (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 - aluminum, Aroclor-1254, Aroclor-1260, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, chromium, dibenz(a,h)anthracene, iron, indeno(1,2,3-cd)pyrene, manganese (Table 6-20)
- Subsurface Soils - aluminum, arsenic, beryllium, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, chromium, iron, manganese (Table 6-20)

- Groundwater - arsenic, chromium, 1,2-DCE, iron, manganese, TCE (Table 6-2)

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 Section 6.3.5.

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 (1997b, 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/(mg/kg/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 only applicable to PCBs, cadmium, and dioxins/furans as per EPA Region I. PCBs were the only one of these three selected as COPCs at DSY sites. The $ABSEFF_{Oral}$ is 50 percent for PCBs.

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, 1997b). All other carcinogenic PAHs have SFs based on their potency relative to B(a)P's, and these factors are published by EPA (1997a). Benzo(a)pyrene, dibenz(a,h)anthracene, benz(a)anthracene, benzo(k)fluoranthene, indeno 1,2,3-cd)pyrene, and chrysene and benzo(b)fluoranthene were the carcinogenic PAHs selected as COPCs at the designated areas. The relative potential factors are as follows: benz(a)anthracene (0.1), benzo(b)fluoranthrene and benzo(b)fluoranthene (0.1), benzo(k)fluoranthrene (0.01, chrysene (0.001), dibenzo(a,h)anthracene (1.0), and indeno(1,2,3-cd) pyrene (0.1).

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 24 and 30 days/year, respectively. 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 (assuming an on-site industrial groundwater supply is available).

- Adolescent and Adult Trespasser - A trespasser is an adult or adolescent who trespasses at the site for 24 and 30 days/year, respectively. 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.). Note: Because the site is industrial, in a GB aquifer and within 200 feet of the ocean, exposure to groundwater through an on-site potable water supply is highly unlikely and evaluation of groundwater exposure to residential receptors seems inappropriate.

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 the

industrial scenario, the assumption of surface cover (approximately 20% vegetation) would resemble the type of vegetation, paving, and buildings that are currently in place. For fugitive dust emissions under the residential scenario, the assumption of surface cover (approximately 80% vegetation) would resemble the type of vegetation in a future typical residential scenario. 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, acetone, phenols, and toluene. 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 and dermal contact. Inhalation of volatiles (during hand washing) for the industrial exposure is expected to be low based on frequency of contact. These exposure routes were evaluated using future industrial 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):

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

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

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

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

where:

CA	=	Chemical concentration in air (mg/m^3)
CS	=	Chemical concentration in soil (mg/kg or μg/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 (1×10^{-6} kg/mg for inorganics; 1×10^{-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):

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

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

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

where:

CW	=	Concentration of contaminant in groundwater (μg/L)
$IR_{groundwater}$	=	Groundwater ingestion rate (l/day)
CF_1	=	Conversion factor (mg/10^3 μg)
CF_2	=	Conversion Factor (l/10^3 cm^3)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
EV	=	Event Frequency (events/day)
AT	=	Averaging time (years)
SA	=	Surface area (cm^2)
BW	=	Body weight (kg)
DA_{event}	=	Dose absorbed per unit area per event (mg/event-cm^2)
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 Table 6-29. As discussed in Subsection 6.3.2, the potential receptor for this scenario was future industrial workers. EPA or conventional values were selected for all input parameters.

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 Aluminum

Noncarcinogenic Toxicity

Aluminum is not generally regarded as an industrial poison. Inhalation of finely divided powder has been reported as a cause of pulmonary fibrosis. Aluminum in aerosols has been implicated in Alzheimer's disease. As with other metals, the powder and dust are the most dangerous forms (Sax and Lewis, 1989). Most hazardous exposures to aluminum occur in refining and smelting processes. Aluminum dust is a respiratory and eye irritant (Genium, 1990).

6.3.5.2 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 1997b). 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 (1997b) derived an RfD of 0.3 mg/kg/day for chronic oral exposure, based on an NOAEL of 0.8 mg/kg/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 1997b). Oral exposure to high levels in well water is associated with increased risk of skin cancer (Tseng 1977; EPA 1997b). 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 (1997b) classifies inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen), and recommends an oral unit risk of 0.00005 mg/L in drinking water, based on the incidence of skin cancer in the Tseng (1977) study. The EPA (1997b) 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 mg/m^3 was derived for inorganic arsenic from the incidence of lung cancer in occupationally exposed men (EPA 1997b).

6.3.5.3 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 1997b) was based on an NOAEL in a lifetime drinking water study in rats and an uncertainty factor of 100 (EPA 1997b). 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 (1997b) 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 (1997b) derived an oral slope factor of 4.3 per mg/kg/day (EPA 1997b) from a statistically nonsignificant increase in total tumors in a lifetime drinking water study in rats. An inhalation unit risk of 0.0024 per mg/m^3, equivalent to 8.4 per mg/kg/day (EPA 1997b) (assuming an inhalation rate of 20 m^3/day and body weight of 70 kg for humans), was derived from an occupational study.

6.3.5.4 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 (1997b) 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 (1997b) 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 1997b) was based on the increased incidence of liver tumors in a dietary study in male mice.

6.3.5.5 Chromium

Noncarcinogenic Toxicity

In nature, chromium (III) predominates over chromium (VI) (Langård and Norseth 1986). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Chromium (III) is considered a nutritionally essential trace element and is considerably less toxic than chromium (VI). No effects were observed in rats consuming 1800 mg chromium (III)/kg/day in the diet for over two years (EPA 1995). The NOEL of 1800 mg/kg/day and an uncertainty factor of 1000 was the basis for a verified chronic oral RfD of 1 mg/kg/day (EPA 1997b). The same NOEL and an uncertainty factor of 100 was the basis for a provisional subchronic oral RfD of 1 mg/kg/day (EPA 1995).

Acute oral exposure of humans to high doses of chromium (VI) induced neurological effects, GI hemorrhage and fluid loss, and kidney and liver effects. Parenteral dosing of animals with chromium (VI) is selectively toxic to the kidney tubules. An NOAEL of 2.4 mg chromium (VI)/kg/day in a one-year drinking water study in rats and an uncertainty factor of 500 was the basis of a verified RfD of 0.005 mg/kg/day for chronic oral exposure (EPA 1997b). The same NOAEL and an uncertainty factor of 100 was the basis of a provisional subchronic oral RfD of 0.02 mg/kg/day (EPA 1995).

Occupational (inhalation and dermal) exposure to chromium (III) compounds induced dermatitis (ACGIH 1991). Similar exposure to chromium (VI) induced ulcerative and allergic contact dermatitis, irritation of the upper respiratory tract including ulceration of the mucosa and perforation of the nasal septum, and possibly kidney effects. Inhalation RfC values were not located.

A target organ was not identified for chromium (III). The kidney appears to be the principal target organ for repeated oral dosing with chromium (VI). Additional target organs for dermal and inhalation exposure include the skin and respiratory tract.

Carcinogenicity

Data were not located regarding the carcinogenicity of chromium (III). The EPA (1997b) classifies chromium (VI) in cancer weight-of-evidence Group A (human carcinogen), based on the consistent observation of increased risk of lung cancer in occupational studies of workers in chromate production or the chrome pigment industry. Parenteral dosing of animals with chromium (VI) compounds consistently induced injection-site tumors. There is no evidence that oral exposure to chromium (VI) induces cancer. An inhalation unit risk of 0.012 per mg/m^3, equivalent to 42 per mg/kg/day, assuming humans inhale 20 m^3/day and weigh 70 kg, was based on increased risk of lung cancer deaths in chromate production workers.

6.3.5.6 1,2-Dichloroethene

Noncarcinogenic Toxicity

Repeated oral exposure of rats to cis-1,2-dichloroethene was associated with signs of anemia (decreased hematocrit and hemoglobin) (EPA 1997b). Inhalation exposure to isomeric mixtures of 1,2-dichloroethene induced narcosis, and mixed isomers of 1,2-dichloroethene were used as an anesthetic gas (ACGIH 1991). The EPA (1997b) presented a provisional chronic oral RfD of 0.01 mg/kg/day (EPA 1995) based on an NOAEL for signs of anemia in rats and an uncertainty factor of 3,000. A provisional subchronic oral RfD of 0.1 mg/kg/day was derived from the same NOAEL and an uncertainty factor of 300. Target organs appear to be the erythrocyte for oral exposure and the CNS for inhalation exposure.

The oral $LD_{50/30}$ for trans-1,2-dichloroethene in rats was 1275 mg/kg; death was preceded by CNS and respiratory depression (ACGIH 1991). Histopathologic examination revealed lesions in the lungs and heart. Prolonged oral administration induced clinicopathologic evidence of mild liver damage (EPA 1997b). An NOAEL for this effect in a 90-day drinking water study in mice and an uncertainty factor of 1,000 was the basis for a verified chronic oral RfD of 0.02 mg/kg/day. A provisional subchronic oral RfD of 0.2 mg/kg/day was derived from the same NOAEL and an uncertainty factor of 100 (EPA 1995). The target organs for inhalation exposure to trans-1,2-dichloroethene are the CNS, heart, and lungs; the liver appears to be the principal target of oral exposure.

The oral reference dose for total 1,2-dichloroethene is 0.009 mg/kg/day (EPA 1997).

Carcinogenicity

The EPA (1997) classifies cis-1,2-dichloroethene as a cancer weight-of-evidence Group D compound (not classifiable as to carcinogenicity to humans), based on an absence of human or animal cancer data. Quantitative estimates of cancer risk are not derived for Group D chemicals.

Data regarding the carcinogenicity of trans-1,2-dichloroethene were not located.

6.3.5.7 Dieldrin/Aldrin

Noncarcinogenic Toxicity

Dieldrin has an established EPA (1997b) 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. Aldrin exhibits similar noncarcinogenic effects and has an established oral RfD (EPA, 1997b) of 3E-05 (mg/kg/day).

Carcinogenicity

Both aldrin and dieldrin are carcinogens, 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. Neither appears to be mutagenic when tested in a number of systems. Aldrin and dieldrin are both toxic to the reproductive system and teratogenic. 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. Both chemicals are acutely toxic; the oral LD_{50} is around 50 mg/kg, and the dermal LD_{50} is about 100 mg/kg.

6.3.5.9 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 (1995). 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.

6.3.5.10 Manganese

Noncarcinogenic Toxicity

Manganese is nutritionally required in humans for normal growth and health (EPA 1997b). 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 (1997a) from the oral RfD via intake of food of 1.4E-01 mg/kg/day (EPA 1997b). The EPA (1997b) presented a verified chronic inhalation RfC of 0.00005 mg/m^3 based on an LOAEL for respiratory symptoms and psychomotor disturbances in occupationally exposed humans and an uncertainty factor of 1,000. The EPA (1997b) presented the same value as a subchronic inhalation RfC. The inhalation RfC is equivalent to 0.000014 mg/kg/day (EPA 1997b), assuming humans inhale 20 m^3 of air/day and weigh 70 kg. The CNS and respiratory tract are target organs of inhalation exposure to manganese.

Carcinogenicity

The EPA (1997b) 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.

6.3.5.11 POLYAROMATIC HYDROCARBONS (PAHs)

Polyaromatic hydrocarbons (PAHs) are a large class of ubiquitous natural and anthropogenic chemicals, all with similar chemical structures (ATSDR 1990). There are six individual carcinogenic PAHs listed among the chemicals of potential concern (COPCs) for DSY.

Although quantitative absorption data for the PAHs were not located, benzo(a)pyrene was readily absorbed across the GI (Rees et al. 1971) and respiratory epithelia (Kotin et al. 1969; Vainich et al. 1976). The high lipophilicity of other compounds in this class suggests that other PAHs also would be readily absorbed across GI and respiratory epithelia.

Benzo(a)pyrene was distributed widely in the tissues of treated rats and mice, but primarily to tissues high in fat, such as adipose tissue and mammary gland (Kotin et al. 1969; Schlede et al. 1970a). Patterns of tissue distribution of other PAHs would be expected to be similar because of the high lipophilicity of the members of this class.

Studies of the metabolism of benzo(a)pyrene provide information relevant to other PAHs because of the structural similarities of all members of the class. Metabolism involves microsomal mixed function oxidase hydroxylation of one or more of the phenyl rings with the formation of phenols and dihydrodiols, probably via formation of arene oxide intermediates (EPA 1979a). The dihydrodiols may be further oxidized to diol epoxides, which, for certain members of the class, are known to be the ultimate carcinogens (LaVoie et al. 1982). Conjugation with glutathione or glucuronic acid, and reduction to tetrahydrotetrols are important detoxification pathways. Metabolism of naphthalene resulted in the formation of 1,2-naphthoquinone, which induced cataract formation and retinal damage in rats and rabbits.

Excretion of benzo(a)pyrene or dibenzo(a,h)anthracene residues was reported to be rapid, although quantitative data were not located (EPA 1979b). Excretion occurred mainly via the feces, probably largely due to biliary secretion (Schlede et al. 1970a, 1970b). The EPA (1980a) concluded that accumulation in the body tissues of PAHs from chronic low level exposure would be unlikely.

Noncarcinogenic Toxicity

None of the PAHs selected as COPCs exhibit noncarcinogenic effects.

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, 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 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. 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 1997b). 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, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were classified in Group B2 (probable human carcinogens).
The EPA (1997b) 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 (1980a) 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 the other carcinogenic PAHs were based on benzo(a)pyrene 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). The most defensible RPFs and the associated oral and inhalation slope factors are presented in Table 6-23.
Listed below are individual PAH toxicological profiles, if available.

BENZO(B)FLUORANTHENE

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.

A Clement's RFP has been developed (Clement International, 1990) for benzo(b)fluoranthene which allows the estimation of Slope Factors (SFs) of 7.3E-01 and 6.1E-01 per mg/kg/day for the oral and inhalation routes respectively. The EPA (1995) 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.

BENZO(G,H,I)PERYLENE

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

The EPA (1995) has classified benzo(g,h,i)perylene in cancer weight-of-evidence Group D (Not classifiable as to Human Carcinogenicity, inadequate or no evidence).

BENZO(K)FLUORANTHENE

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

A Clement's RFP has been developed (Clement International, 1990) for benzo(k)fluoranthene which allows the estimation of 7.3E-02 and 6.1E-02 per mg/kg/day for the SF for the oral and inhalation route respectively. The EPA (1997b) has classified benzo(k)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.

CHRYSENE

Chrysene is absorbed by the oral route of exposure. Absorption may also occur following dermal exposure. Data are not available to determine whether chrysene is absorbed via the lungs. Absorbed chrysene is distributed to several tissues, i.e. it was found in five tissues in a study reported in 1983. It is accumulated preferentially in the adipose and mammary tissue.
There is no information on other toxic effects of chrysene in human and laboratory animals following inhalation, oral and dermal exposures. (ATSDR 1987, draft).

A Clement's RFP has been developed for chrysene. This allows the estimation of SFs of 7.3E-03 and 6.1E-03 per mg/kg/day for the oral and inhalation routes respectively.
The EPA (1997b) has classified chrysene 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 tumors and malignant lymphoma in mice and chromosomal abnormalities in hamsters.

INDENO(1,2,3-CD)PYRENE

Little information was found on the toxicity of indeno(1,2,3-cd)pyrene. Because of its structural similarity its properties should resemble benzo(a)pyrene.

A Clement's RFP has been developed for indeno(1,2,3-cd)pyrene. This allows the estimation of SFs of 7.3E-01 and 6.1E-01 per mg/kg/day for the oral and inhalation routes respectively. The EPA (1997b) has classified indeno(1,2,3-cd)pyrene 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 tumors in mice following lung implants.

6.3.5.12 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 (1997b) 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 (1997b) 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 1997b). The EPA (1997b) 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.

6.3.5.13 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 (1995) 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 1995) 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 incremental cancer 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 6-30 through 6-33. Cumulative risk for future exposure scenarios at each area of the site are presented on Tables 6-34 through 6-37. Cumulative risks for current and future exposure scenarios for the upgradient area, also termed "background" are presented for comparison purposes on Table 6-38.

6.4.3.1 North Waterfront

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 9E-06. For this receptor exposure scenario, the incidental ingestion of surface soil exposure pathway has an incremental cancer risk of 9E-06. 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-07 and 9E-07, respectively, which are below 1E-06.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.1), current adult trespasser (0.01), and adolescent trespasser (0.02) 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.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-39 (Appendix H) for current exposure scenarios at the North Waterfront area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the current occupational worker, fetal blood-lead levels were estimated using EPA's interim approach for estimating risks associated with adult exposures to lead (EPA, 1996). Based on an assumed exposure to the maximum detected soil concentration (lead was not detected in groundwater), 95 percent of an exposed population of pregnant women would be expected to have fetal blood-lead levels of 4.4 ug/dL or less, which is below 10 ug/dL, the protection level most often considered during initial baseline risk evaluation.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 3E-05. For this receptor exposure scenario, the exposure pathway associated with incidental ingestion of soil has an incremental cancer risk of 3E-05, with arsenic and benzo(a)pyrene contributing the significant portion of ingestion risk.

The estimated carcinogenic risk for the future industrial worker exposure scenario is 4E-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 incidental ingestion of surface soil exposure pathway has an incremental cancer risk of 6E-06. 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 4E-07 and 5E-07, respectively, which are below 1E-06. The estimated carcinogenic risk for the future excavation worker exposure scenario is 1E-07, which is below 1E-06.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future industrial worker (0.08), future excavation worker (0.05), future adult trespasser (0.008), and future adolescent trespasser (0.02) 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 1.1, which is greater than a value of 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic, via incidental ingestion of surface soil, is the principal contributor to noncarcinogenic risk for this receptor.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-40 (Appendix H) for future exposure scenarios at the North Waterfront area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the future residential child, blood-lead levels were estimated using the IEUBK model (EPA, 1994). Based on an assumed exposure to the maximum detected soil concentration (lead was not detected in groundwater), children exposed to surface soil would not be expected to exhibit significant increases in blood-lead levels (blood-lead levels greater than the 10 ug/dL benchmark value would be expected in only 0.29 percent of a population of exposed children, age 0 through 6 years).

6.4.3.2 Central Shipyard

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 2E-04. For this receptor exposure scenario, the dermal contact with surface soil exposure pathway has an incremental cancer risk of 1E-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 3E-05 and 3E-05, respectively. For these receptor exposure scenarios, the dermal contact with surface soil exposure pathway is associated with incremental cancer risks of 3E-05 and 2E-05, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers. Aroclor 1260 is the COPC responsible for the dermal carcinogenic risk and Aroclor 1260 and arsenic contribute the significant portion of ingestion carcinogenic risk.

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 Aroclor-1260 in surface soil.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.2), current adult trespasser (0.02), and adolescent trespasser (0.04) 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.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-41 (Appendix H) for current exposure scenarios at the Central Shipyard area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil and groundwater were estimated using methods for estimating blood-lead. For the current occupational worker, fetal blood-lead levels were estimated using EPA's interim approach for estimating risks associated with adult exposures to lead (EPA, 1996). Based on an assumed exposure to the maximum detected soil and groundwater concentrations, 95 percent of an exposed population of pregnant women would be expected to have fetal blood-lead levels of 4.3 ug/dL or less, which is below 10 ug/dL, the protection level most often considered during initial baseline risk evaluation.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 9E-04. For this receptor exposure scenario, the exposure pathway associated with dermal contact with soil and incidental ingestion of soil have cancer risks of 6E-04 and 3E-04, respectively. Aroclor 1260 is the COPC responsible for the dermal carcinogenic risk and Aroclor 1260 and arsenic contribute the significant portion of ingestion carcinogenic risk.

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 portions of ingestion risk. The dermal contact with surface soil exposure pathway has an

incremental cancer risk of 1E-04, with Aroclor 1260 contributing the significant portion of dermal risk. 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.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future excavation worker (0.1), future adult trespasser (0.02), and future adolescent trespasser (0.04) 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 (2.6) and the future industrial worker (1.4) are greater than 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Arsenic and iron (via surface soil ingestion and via groundwater ingestion) exhibited hazard quotients (HQs) greater than 1.0 or were principal contributors to the noncarcinogenic risks for these receptors.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-42 (Appendix H) for future exposure scenarios at the Central Shipyard area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil and groundwater were estimated using methods for estimating blood-lead. For the future residential child, blood-lead levels were estimated using the IEUBK model (EPA, 1994). Based on an assumed exposure to the maximum detected soil and groundwater concentrations,

children would not be expected to exhibit significant increases in blood-lead levels (blood-lead levels greater than the 10 ug/dL benchmark value would be expected in less than 0.01 percent of a population of exposed children, age 0 through 6 years).

6.4.3.3 South Waterfront

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 1E-05. For this receptor exposure scenario, the incidental ingestion of surface soil exposure pathway has an incremental cancer risk of 1E-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 9E-07 and 1E-06, respectively. For these receptor exposure scenarios, the ingestion of surface soil exposure pathway is associated with incremental cancer risks of 9E-07 and 1E-06, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.2), current adult trespasser (0.02), 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.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-43 (Appendix H) for current exposure scenarios at the South Waterfront area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the current occupational worker, fetal blood-lead levels were estimated using EPA's interim approach for

estimating risks associated with adult exposures to lead (EPA, 1996). Based on an assumed exposure to the maximum detected soil concentration (lead was not sampled in groundwater), 95 percent of an exposed population of pregnant women would be expected to have fetal blood-lead levels of 4.4 ug/dL or less, which is below 10 ug/dL, the protection level most often considered during initial baseline risk evaluation.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 5E-05. For this receptor exposure scenario, the exposure pathway associated with incidental ingestion of surface soil has a cancer risk of 5E-05, with arsenic and beryllium contributing the significant portion of ingestion carcinogenic risk. The surface soil ingestion exposure route contributes 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 2E-07, which is below a benchmark value of 1E-06.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future industrial worker (0.2), future excavation worker (0.1), future adult trespasser (0.02), and future 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.

The cumulative HI for the future residential receptor (3.0) is greater than 1.0, the benchmark below which adverse noncarcinogenic effects can be ruled out. Iron and arsenic, via ingestion of surface soil, were the principal contributors to the noncarcinogenic risk for this receptor.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-44 (Appendix H) for future exposure scenarios at the South Waterfront area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the future residential child, blood-lead levels were estimated using the IEUBK model (EPA, 1994). Based on an assumed exposure to the maximum detected soil concentration (lead was not sampled in groundwater), children exposed to surface soil would not be expected to exhibit significant increases in blood-lead levels (blood-lead levels greater than the 10 ug/dL benchmark value would be expected in only 0.35 percent of a population of exposed children, age 0 through 6 years).

6.4.3.4 Building 234

Current Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the current industrial worker exposure scenario is 1E-05. For this receptor exposure scenario, the incidental ingestion of surface soil exposure pathway has an incremental cancer risk of 1E-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-06 and 1E-06, respectively. For these receptor exposure scenarios, the ingestion of surface soil exposure pathway is associated with incremental cancer risks of 1E-06 and 1E-06, respectively. This exposure route contributes the most significant portion of the cumulative carcinogenic risk for the current adult and adolescent trespassers. The principal COPC contributing to this cancer risk is arsenic in surface soil.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the current industrial worker (0.2), current adult trespasser (0.02), 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.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-45 (Appendix H) for current exposure scenarios at the Building 234 area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the current occupational worker, fetal blood-lead levels were estimated using EPA's interim approach for estimating risks associated with adult exposures to lead (EPA, 1996). Based on an assumed exposure to the maximum detected soil concentration (lead was not detected in groundwater), 95 percent of an exposed population of pregnant women would be expected to have fetal blood-lead levels of 4.7 ug/dL or less, which is below 10 ug/dL, the protection level most often considered during initial baseline risk evaluation.

Future Exposure Scenarios

Carcinogenic Risks

The estimated carcinogenic risk for the future resident exposure scenario is 7E-05. For this receptor exposure scenario, the exposure pathway associated with surface soil ingestion has a cancer risk of 7E-05, with arsenic and beryllium contributing the significant portion of ingestion risk. The surface soil ingestion exposure route contributes 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. The ingestion of surface soil exposure pathway has an incremental cancer risk of 2E-05. The groundwater ingestion and surface soil exposure routes contribute the major portion of the cumulative carcinogenic risk for the future industrial worker, with arsenic contributing the significant portion of ingestion risks.

The estimated carcinogenic risks for the future adult trespasser and the adolescent trespasser are 1E-06 and 2E-06, respectively. For these receptor exposure scenarios, the ingestion of surface soil exposure pathway is associated with incremental cancer risks of 1E-06 and 1E-06, respectively. The estimated carcinogenic risk for the future excavation worker exposure scenario is 3E-07, which is below a benchmark value of 1E-06.

Noncarcinogenic Risks

The estimated values of the cumulative hazard index (HI) for the future excavation worker (0.1), future adult trespasser (0.02), and future adolescent trespasser (0.04) 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 (2.6) 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) and iron and manganese (via surface soil ingestion) exhibited hazard quotients (HQs) greater than 1.0 or were principal contributors to the noncarcinogenic risk for these receptors.

A chemical-specific summary of estimated carcinogenic and noncarcinogenic risks is presented in Table 6-46 (Appendix H) for future exposure scenarios at the Building 234 area.

Although concentrations of lead were below risk-based screening levels, risks due to exposures to lead in surface soil were estimated using methods for estimating blood-lead. For the future residential child, blood-lead levels were estimated using the IEUBK model (EPA, 1994). Based on an assumed exposure to the maximum detected soil concentration (lead was not detected in groundwater), children exposed to surface soil would not be expected to exhibit significant increases in blood-lead levels (blood-lead levels greater than the 10 ug/dL benchmark value would be expected in only 1.39 percent of a population of exposed children, age 0 through 6 years).

6.4.3.5 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-05. For this receptor exposure scenario, the incidental ingestion of surface soil exposure pathway has an incremental cancer risk of 1E-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. Beryllium contributed a minor portion of the cumulative carcinogenic risk from surface soil exposure in the background area, at the South Waterfront area, and in the Building 234 area.

The estimated carcinogenic risks at background locations for the current adult trespasser and the adolescent trespasser are 9E-07 and 1E-06, respectively. For these receptor exposure scenarios, the ingestion of surface soil exposure pathway is associated with incremental cancer risks of 9E-07 and 1E-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 Central Shipyard area, the South Waterfront area, and the Building 234 area. 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 approximately an order of magnitude over background risks.

Arsenic is the major contributor to background risk, and is a naturally occurring element in soil. Beryllium is a minor contributor to background risk, and is also 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 (0.2 - surface soil exposure), current adult trespasser (0.02), and adolescent trespasser (0.04) 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 5E-05. Arsenic contributes the most significant portion of the cumulative carcinogenic risk for the future resident (surface soil ingestion, 5E-05). 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. Beryllium contributed a minor portion of the cumulative carcinogenic risk from future residential surface soil exposure in the background area, at the South Waterfront area, and in the Building 234 area.

The estimated carcinogenic risk at background locations for the future industrial worker exposure scenario is 6E-05. Arsenic contributes the most significant portion of the cumulative carcinogenic risk for the future industrial worker (groundwater ingestion, 5E-05; and surface soil ingestion, 1E-05). This is similar to the case for the industrial worker carcinogenic risks estimated at most areas of concern. As discussed above, Aroclor 1260 also contributed a significant portion of carcinogenic risks at the Central Shipyard, but was not associated with background risks. At the North Waterfront area, TCE contributed to groundwater carcinogenic risk, but was 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 5E-07. This background receptor risk was greater than the excavation worker risks estimated for each area. For the future excavation worker, neither the background area nor the areas of concern displayed risks above 1E-06.

For all future 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 Central Shipyard area, the South Waterfront area, and the Building 234 area. At the Central Shipyard area, the carcinogenic risk from arsenic in groundwater is slightly greater than (but within an order of magnitude of) the risk 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 approximately an order of magnitude over background risks for future residents and occupational workers, and approximately an order of magnitude over the 1E-06 benchmark for future adult and adolescent trespassers.

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 (0.2), future adult trespasser (0.02), and future adolescent trespasser (0.04) 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 (2.4) and the future industrial worker (1.6) are greater than 1.0. These background HI values exceeded or were within 20 percent of those of residential and industrial receptors at each area of concern. Manganese (via ingestion of groundwater) and iron (via ingestion of surface soil) were the principal contributors to the HI for the background exposure scenarios, with minor contributions from arsenic to both exposure pathways. 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. For simplicity, data qualified with an "R" were considered unusable and eliminated from the quantitative risk assessment. Aerial 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 number of background samples collected as a part of this project was very few. These background samples are considered unusable in terms of comparison to site concentrations of chemicals in the COPC selection process. True background has not been established at DSY and contributes to the uncertainty associated with what is considered site-related chemical contamination, and what is considered contamination attributable to off-site practices.

The COPC selection process has several uncertainties associated with it. All screening values were set at a level of 1E-07 for carcinogens, and a level of 0.1 for non-carcinogens. This process is conservative in nature and may add COPCs that may not contribute significantly to the carcinogenic and noncarcinogenic risks at the sites. Aluminum was selected as COPC in soils at all the sites, however, the contribution to the risk was insignificant. The maximum concentration of each site related chemical was compared to the screening value. Using the maximum value may add COPCs that may not contribute significantly to the risk (see aluminum discussion above). This contributes to uncertainty and is conservative in nature. The consideration that all chromium (no speciation data were collected) at the site is hexavalent may overestimate the risk at several of the sites. The use of surrogates or the lack of screening for those chemicals that had no surrogates adds uncertainties to the COPC selection process and ultimately the risks for the site. These processes may over- or under-estimate the risks at the four sites.

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.

Uncertainties are associated with the oral RfD for iron. Iron is the primary contributor to the noncarcinogenic HI exceeding 1.0 in at several of the sites. The homeostatic mechanisms that regulate the absorption of iron from the GI tract can affect (attenuate or enhance) iron uptake in humans. Therefore, the oral RfD would not be constant under all conditions (i.e., tolerance to iron would vary with the body's physiological status).

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. However, dermal exposure for soil was only estimated for PCBs, at DSY, lowering the uncertainty. Region I EPA applies dermal exposure to only cadmium, PCBs, and dioxin/furans which lowers the uncertainty associated with dermal exposure. 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 wind speed and vegetative cover, and that dispersion concentrations can be estimated from source area, downwind distance to receptors, and region-wide meteorological factors. Most of the inputs into the equations or

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.

Arsenic was the main driver for a majority of both carcinogenic and noncarcinogenic risks at the four sites. There is uncertainty associated with whether these risks are related to the sites or related to other non-site related activities. Due to the lack of adequate background, risks attributable to the sites may be overestimated to a significant degree.

6.6 GENERAL RISK ASSESSMENT REFERENCES

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TABLE 6-1
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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
aluminum, total	M	SS	2/2	13100 - 13200	14/14	3440 - 9650	5410	G DSY-S-TP28-0001-A
arsenic, total	M	SS	2/2	19.5 - 20.3	12/14	2.6 - 10.85	4.58	G DSY-S-TP28-0001-A
barium, total	M	SS	2/2	20.1 - 36.3	13/14	5.1 - 49.4	13.3	DSY-S-TP16-0001
beryllium, total	M	SS	2/2	0.43 - 0.76	6/14	0.205 - 1.1	0.23	DSY-S-TP16-0001
cadmium, total	M	SS	1/2	0.61 - 0.61	1/14	0.85 - 0.85	0.317	DSY-S-TP16-0001
calcium, total	M	SS	2/2	313 - 1310	13/14	237 - 1780	483	DSY-S-TP16-0001
chromium	M	SS	2/2	15 - 16.4	12/14	5.2 - 24.1	8.08	DSY-S-TP16-0001
cobalt, total	M	SS	2/2	10.5 - 18.4	13/14	2.6 - 14.7	6.96	DSY-S-TP16-0001
copper, total	M	SS	2/2	11.2 - 15	14/14	3.1 - 111	21.4	DSY-S-TP16-0001
iron, total	M	SS	2/2	26900 - 28200	14/14	11200 - 19700	15000	G DSY-S-TP28-0001-A
lead, total	M	SS	2/2	16.2 - 18.3	14/14	2.3 - 112	21.6	G DSY-S-TP28-0001-A
magnesium, total	M	SS	2/2	2510 - 2580	14/14	1320 - 2570	1880	DSY-S-TP23-0001
manganese, total	M	SS	2/2	338 - 1580	14/14	81.4 - 340	222	DSY-S-TP23-0001
mercury, total	M	SS	1/2	0.08 - 0.08	2/14	0.0375 - 0.05	0.0334	DSY-S-TP23-0001
nickel, total	M	SS	2/2	19.2 - 21.4	8/14	8.2 - 68.5	13.5	DSY-S-TP16-0001
potassium, total	M	SS	2/2	255 - 362	14/14	209 - 483	297	DSY-S-TP16-0001
selenium, total	M	SS	0/2	-	6/12	0.5 - 1	0.58	DSY-S-MW12-SS01
sodium, total	M	SS	0/2	-	7/14	19.7 - 172	30.6	DSY-S-TP16-0001
tin, total	M	SS	0/2	-	1/14	12.2 - 12.2	4.29	DSY-S-TP16-0001
vanadium, total	M	SS	2/2	21.7 - 22.2	14/14	6.4 - 39.5	11.5	G DSY-S-TP28-0001-A
zinc, total	M	SS	2/2	49.7 - 54	14/14	22.8 - 883	99.4	DSY-S-TP16-0001
4,4'-DDE	P	SS	1/2	27 - 27	1/14	19.5 - 19.5	3.02	G DSY-S-TP28-0001-A
4,4'-DDT	P	SS	1/2	32 - 32	1/14	50.5 - 50.5	5.24	G DSY-S-TP28-0001-A
alpha-chlordane	P	SS	0/2	-	1/14	8.1 - 8.1	1.42	G DSY-S-TP28-0001-A
Aroclor-1260	P	SS	0/2	-	1/14	24 - 24	17.9	DSY-S-TP16-0001
dieldrin	P	SS	0/2	-	1/14	16 - 16	2.76	DSY-S-TP16-0001
endrin	P	SS	0/2	-	2/14	5.7 - 26	3.73	DSY-S-TP16-0001
gamma-chlordane	P	SS	0/2	-	1/14	3.625 - 3.625	1.1	G DSY-S-TP28-0001-A
heptachlor epoxide	P	SS	0/2	-	1/14	3.4 - 3.4	1.08	G DSY-S-TP28-0001-A
2,2'-oxybis(1-chloropropa	S	SS	0/2	-	1/14	114.5 - 114.5	652	G DSY-S-TP18-0001-A
acenaphthene	S	SS	0/2	-	1/14	943.5 - 943.5	652	G DSY-S-TP28-0001-A
anthracene	S	SS	0/2	-	1/14	971 - 971	654	G DSY-S-TP28-0001-A
benz(a)anthracene	S	SS	0/2	-	1/14	605 - 605	628	G DSY-S-TP28-0001-A
benzo(a)pyrene	S	SS	0/2	-	1/14	530 - 530	623	G DSY-S-TP28-0001-A
benzo(b)fluoranthene	S	SS	1/2	55 - 55	1/14	805 - 805	643	G DSY-S-TP28-0001-A
benzo(g,h,i)perylene	S	SS	0/2	-	1/14	1030 - 1030	659	G DSY-S-TP28-0001-A
benzo(k)fluoranthene	S	SS	0/2	-	1/14	1030 - 1030	659	G DSY-S-TP28-0001-A
bis(2-ethylhexyl)phthalat	S	SS	0/2	-	8/14	44 - 110	595	DSY-S-TP23-0001
carbazole	S	SS	0/2	-	1/14	951 - 951	653	G DSY-S-TP28-0001-A
chrysene	S	SS	0/2	-	1/14	580 - 580	626	G DSY-S-TP28-0001-A
dibutyltin	S	SS	1/2	50 - 50	2/14	5.25 - 33	24.1	DSY-S-TP16-0001
fluoranthene	S	SS	2/2	53 - 63	1/14	1160 - 1160	668	G DSY-S-TP28-0001-A
fluorene	S	SS	0/2	-	1/14	951 - 951	653	G DSY-S-TP28-0001-A
indeno(1,2,3-cd)pyrene	S	SS	0/2	-	1/14	380 - 380	612	G DSY-S-TP28-0001-A
monobutyltin	S	SS	0/2	-	1/14	33 - 33	25.5	DSY-S-TP16-0001
phenanthrene	S	SS	0/2	-	1/14	640 - 640	631	G DSY-S-TP28-0001-A
pyrene	S	SS	2/2	54 - 59	2/14	1090 - 1400	334	DSY-S-TP16-0001

TABLE 6-1
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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
tetrabutyltin	S	SS	0/2	-	4/14	2.5 - 5.8	19	DSY-S-TP22-0001
tributyltin	S	SS	1/2	6.62 - 6.62	3/14	9.9 - 30	23.4	DSY-S-TP16-0001
acetone	V	SS	0/2	-	6/14	75 - 115	44.8	G DSY-S-TP18-0001-A
benzene	V	SS	0/2	-	1/14	1 - 1	5.14	DSY-S-TP16-0001
chlorobenzene	V	SS	0/2	-	1/14	3 - 3	5.29	DSY-S-TP16-0001
hexachloroethane	V	SS	0/2	-	1/14	55 - 55	647	DSY-S-TP20-0001
phenol	V	SS	0/2	-	1/14	180 - 180	656	G DSY-S-TP18-0001-A
toluene	V	SS	0/2	-	6/14	1 - 4	4.05	DSY-S-TP23-0001
TPH	V	SS	1/2	260 - 260	7/14	61 - 4900	453	DSY-S-TP16-0001
trichloroethene	V	SS	0/2	-	1/14	2 - 2	5.21	DSY-S-TP16-0001
xylene (total)	V	SS	0/2	-	2/14	1 - 2	4.93	DSY-S-TP23-0001

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS 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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
aluminum, total	M	SS	2/2	13100 - 13200	8/8	5820 - 14400	11500	DSY-S-TP14-0001
arsenic, total	M	SS	2/2	19.5 - 20.3	8/8	3.9 - 24.4	14.6	DSY-S-TP11-0001
barium, total	M	SS	2/2	20.1 - 36.3	8/8	12.1 - 24	17	DSY-S-TP15-0001
beryllium, total	M	SS	2/2	0.43 - 0.76	8/8	0.23 - 0.47	0.366	DSY-S-TP15-0001
cadmium, total	M	SS	1/2	0.61 - 0.61	5/8	0.75 - 1.2	0.708	DSY-S-TP14-0001
calcium, total	M	SS	2/2	313 - 1310	8/8	426 - 1230	931	DSY-S-TP14-0001
chromium	M	SS	2/2	15 - 16.4	8/8	9.8 - 19	15.3	DSY-S-TP14-0001
cobalt, total	M	SS	2/2	10.5 - 18.4	8/8	7.6 - 22.7	13.4	DSY-S-MW06-SS01
copper, total	M	SS	2/2	11.2 - 15	8/8	15.15 - 33	26	DSY-S-TP14-0001
iron, total	M	SS	2/2	26900 - 28200	8/8	18500 - 32900	29000	DSY-S-TP14-0001
lead, total	M	SS	2/2	16.2 - 18.3	8/8	9.2 - 27.4	18	DSY-S-TP15-0001
magnesium, total	M	SS	2/2	2510 - 2580	8/8	2310 - 4740	3590	DSY-S-TP14-0001
manganese, total	M	SS	2/2	338 - 1580	8/8	297.5 - 619	403	DSY-S-MW06-SS01
mercury, total	M	SS	1/2	0.08 - 0.08	1/8	0.12 - 0.12	0.0538	DSY-S-MW07-0001
nickel, total	M	SS	2/2	19.2 - 21.4	8/8	14.9 - 27.4	22.9	DSY-S-TP14-0001
potassium, total	M	SS	2/2	255 - 362	8/8	241 - 606	345	DSY-S-TP17-0001
selenium, total	M	SS	0/2	-	3/8	0.74 - 1.2	0.581	DSY-S-TP15-0001
sodium, total	M	SS	0/2	-	1/7	87.9 - 87.9	34.7	DSY-S-TP17-0001
vanadium, total	M	SS	2/2	21.7 - 22.2	8/8	8.75 - 21.8	16.4	DSY-S-TP15-0001
zinc, total	M	SS	2/2	49.7 - 54	8/8	33.35 - 123	69	DSY-S-TP14-0001
4,4'-DDD	P	SS	0/2	-	1/8	4.3 - 4.3	24.4	DSY-S-TP15-0001
4,4'-DDT	P	SS	1/2	32 - 32	1/8	6.2 - 6.2	24.6	DSY-S-TP15-0001
Aroclor-1260	P	SS	0/2	-	2/8	32 - 71000	8890	DSY-S-TP14-0001
dieldrin	P	SS	0/2	-	1/8	470 - 470	60.3	DSY-S-TP14-0001
endrin ketone	P	SS	0/2	-	1/8	1100 - 1100	139	DSY-S-TP14-0001
methoxychlor	P	SS	0/2	-	1/8	2300 - 2300	296	DSY-S-TP14-0001
2,2'-oxybis(1-chloroprop	S	SS	0/2	-	1/8	180 - 180	844	DSY-S-TP15-0001
2-methylphenol	S	SS	0/2	-	1/8	83 - 83	833	DSY-S-TP17-0001
4-methylphenol	S	SS	0/2	-	1/8	500 - 500	885	DSY-S-TP17-0001
acenaphthene	S	SS	0/2	-	1/8	92 - 92	833	DSY-S-TP15-0001
anthracene	S	SS	0/2	-	1/8	130 - 130	838	DSY-S-TP15-0001
benz(a)anthracene	S	SS	0/2	-	3/8	130 - 410	862	DSY-S-TP15-0001
benzo(a)pyrene	S	SS	0/2	-	3/8	86 - 140	820	DSY-S-TP17-0001
benzo(b)fluoranthene	S	SS	1/2	55 - 55	3/8	180 - 410	879	DSY-S-TP15-0001
benzo(g,h,i)perylene	S	SS	0/2	-	3/8	72 - 130	816	DSY-S-TP17-0001
benzo(k)fluoranthene	S	SS	0/2	-	2/8	86 - 360	855	DSY-S-TP15-0001
carbazole	S	SS	0/2	-	1/8	97 - 97	833	DSY-S-TP15-0001
chrysene	S	SS	0/2	-	3/8	120 - 420	862	DSY-S-TP15-0001
fluoranthene	S	SS	2/2	53 - 63	3/8	300 - 870	964	DSY-S-TP15-0001
fluorene	S	SS	0/2	-	1/8	65 - 65	829	DSY-S-TP15-0001
indeno(1,2,3-cd)pyrene	S	SS	0/2	-	3/8	71 - 150	822	DSY-S-TP15-0001
phenanthrene	S	SS	0/2	-	3/8	120 - 580	881	DSY-S-TP15-0001
phenol	S	SS	0/2	-	1/8	1200 - 1200	973	DSY-S-TP17-0001
pyrene	S	SS	2/2	54 - 59	3/8	230 - 740	936	DSY-S-TP15-0001
tetrabutyltin	S	SS	0/2	-	1/8	8.8 - 8.8	22.8	DSY-S-TP15-0001
TPH	S	SS	1/2	260 - 260	5/8	68 - 2000	513	DSY-S-TP12-0001
tributyltin	S	SS	1/2	6.62 - 6.62	1/8	4.8 - 4.8	22.3	DSY-S-TP15-0001

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS 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, total	M	SS	2/2	13100 - 13200	6/6	6870 - 33300	12700	DSY-S-TP05-0001
arsenic, total	M	SS	2/2	19.5 - 20.3	6/6	9.7 - 15.3	12.9	DSY-S-TP02-0001
barium, total	M	SS	2/2	20.1 - 36.3	6/6	12.3 - 420	93.6	DSY-S-TP05-0001
beryllium, total	M	SS	2/2	0.43 - 0.76	6/6	0.3 - 2.5	1.18	DSY-S-TP04-0001
cadmium, total	M	SS	1/2	0.61 - 0.61	1/6	0.48 - 0.48	0.326	DSY-S-TP06-0001
calcium, total	M	SS	2/2	313 - 1310	6/6	504 - 8780	2470	DSY-S-TP05-0001
chromium	M	SS	2/2	15 - 16.4	6/6	10.5 - 53.5	23.6	DSY-S-TP05-0001
cobalt, total	M	SS	2/2	10.5 - 18.4	6/6	8.9 - 18.3	13.1	DSY-S-TP05-0001
copper, total	M	SS	2/2	11.2 - 15	6/6	13 - 145	64.8	DSY-S-TP04-0001
iron, total	M	SS	2/2	26900 - 28200	6/6	21300 - 58100	29200	DSY-S-TP05-0001
lead, total	M	SS	2/2	16.2 - 18.3	6/6	13.5 - 119	51.5	DSY-S-TP04-0001
magnesium, total	M	SS	2/2	2510 - 2580	6/6	2190 - 2730	2530	DSY-S-TP05-0001
manganese, total	M	SS	2/2	338 - 1580	6/6	286 - 423	333	DSY-S-TP02-0001
mercury, total	M	SS	1/2	0.08 - 0.08	1/6	0.17 - 0.17	0.0492	DSY-S-TP03-0001
nickel, total	M	SS	2/2	19.2 - 21.4	6/6	17.2 - 70.8	39.3	DSY-S-TP04-0001
potassium, total	M	SS	2/2	255 - 362	6/6	291 - 4050	985	DSY-S-TP05-0001
selenium, total	M	SS	0/2	-	2/3	1.2 - 1.4	1.01	DSY-S-TP06-0001
sodium, total	M	SS	0/2	-	3/6	113 - 965	240	DSY-S-TP05-0001
tin, total	M	SS	0/2	-	2/6	9.3 - 27.4	8.63	DSY-S-TP04-0001
vanadium, total	M	SS	2/2	21.7 - 22.2	6/6	9.7 - 52.7	20.3	DSY-S-TP05-0001
zinc, total	M	SS	2/2	49.7 - 54	6/6	40.8 - 896	353	DSY-S-TP05-0001
4,4'-DDE	P	SS	1/2	27 - 27	1/6	6.1 - 6.1	2.44	DSY-S-TP06-0001
4,4'-DDT	P	SS	1/2	32 - 32	1/6	14 - 14	3.76	DSY-S-TP06-0001
Aroclor-1260	P	SS	0/2	-	2/6	15 - 25	18	DSY-S-TP04-0001
benz(a)anthracene	S	SS	0/2	-	5/6	58 - 210	240	DSY-S-TP06-0001
benzo(a)pyrene	S	SS	0/2	-	5/6	46 - 180	218	DSY-S-TP06-0001
benzo(b)fluoranthene	S	SS	1/2	55 - 55	5/6	81 - 270	278	DSY-S-TP06-0001
benzo(g,h,i)perylene	S	SS	0/2	-	3/6	42 - 99	258	DSY-S-TP04-0001
benzo(k)fluoranthene	S	SS	0/2	-	5/6	38 - 150	205	DSY-S-TP06-0001
chrysene	S	SS	0/2	-	5/6	53 - 250	256	DSY-S-TP04-0001
dibutyltin	S	SS	1/2	50 - 50	1/6	2.7 - 2.7	21.1	DSY-S-TP06-0001
fluoranthene	S	SS	2/2	53 - 63	5/6	71 - 460	339	DSY-S-TP06-0001
indeno(1,2,3-cd)pyrene	S	SS	0/2	-	4/6	42 - 110	217	DSY-S-TP06-0001
phenanthrene	S	SS	0/2	-	4/6	89 - 280	268	DSY-S-TP06-0001
pyrene	S	SS	2/2	54 - 59	5/6	73 - 380	309	DSY-S-TP06-0001
tributyltin	S	SS	1/2	6.62 - 6.62	2/6	2.4 - 2.8	17.5	DSY-S-TP06-0001
toluene	V	SS	0/2	-	1/6	1 - 1	4.92	DSY-S-TP06-0001
TPH	V	SS	1/2	260 - 260	3/6	94 - 110	67.4	DSY-S-TP04-0001

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS 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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
aluminum, total	M	SS	2/2	13100 - 13200	7/7	3810 - 11300	7360	DSY-S-TP09-0001
arsenic, total	M	SS	2/2	19.5 - 20.3	7/7	2.6 - 23.6	10.9	DSY-S-TP09-0001
barium, total	M	SS	2/2	20.1 - 36.3	7/7	8.9 - 67	27.5	DSY-S-MW08-SS01
beryllium, total	M	SS	2/2	0.43 - 0.76	6/7	0.18 - 3.5	0.754	DSY-S-MW08-SS01
calcium, total	M	SS	2/2	313 - 1310	7/7	521 - 2790	981	DSY-S-MW08-SS01
chromium	M	SS	2/2	15 - 16.4	7/7	6.4 - 40.2	17.5	DSY-S-MW08-SS01
cobalt, total	M	SS	2/2	10.5 - 18.4	7/7	3.3 - 23.9	11.8	DSY-S-MW08-SS01
copper, total	M	SS	2/2	11.2 - 15	7/7	12.9 - 262	57.9	DSY-S-MW08-SS01
iron, total	M	SS	2/2	26900 - 28200	7/7	7770 - 37200	22300	DSY-S-TP09-0001
lead, total	M	SS	2/2	16.2 - 18.3	7/7	9.7 - 189	52.3	DSY-S-MW08-SS01
magnesium, total	M	SS	2/2	2510 - 2580	7/7	1170 - 3380	2330	DSY-S-TP09-0001
manganese, total	M	SS	2/2	338 - 1580	7/7	157 - 597	356	DSY-S-TP09-0001
mercury, total	M	SS	1/2	0.08 - 0.08	1/7	0.07 - 0.07	0.0343	DSY-S-MW08-SS01
nickel, total	M	SS	2/2	19.2 - 21.4	7/7	7.8 - 113	31.9	DSY-S-MW08-SS01
potassium, total	M	SS	2/2	255 - 362	7/7	227 - 397	328	DSY-S-TP26-0001
sodium, total	M	SS	0/2	-	5/7	19 - 163	49.5	DSY-S-MW08-SS01
tin, total	M	SS	0/2	-	1/7	40.6 - 40.6	8.91	DSY-S-MW08-SS01
vanadium, total	M	SS	2/2	21.7 - 22.2	7/7	6.8 - 23.2	14.7	DSY-S-TP10-0001
zinc, total	M	SS	2/2	49.7 - 54	7/7	44.3 - 831	208	DSY-S-MW08-SS01
4,4'-DDE	P	SS	1/2	27 - 27	1/7	3.1 - 3.1	1.96	G DSY-S-TP08-0001-A
4,4'-DDT	P	SS	1/2	32 - 32	3/7	5 - 8.6	3.69	G DSY-S-TP08-0001-A
Aroclor-1254	P	SS	0/2	-	1/7	38 - 38	20.4	DSY-S-MW08-SS01
Aroclor-1260	P	SS	0/2	-	1/7	24 - 24	18.5	DSY-S-TP10-0001
gamma-chlordane	P	SS	0/2	-	1/7	3.9 - 3.9	1.33	DSY-S-TP10-0001
heptachlor	P	SS	0/2	-	1/7	4.5 - 4.5	1.41	DSY-S-TP10-0001
acenaphthene	S	SS	0/2	-	2/7	46 - 52	262	DSY-S-MW08-SS01
anthracene	S	SS	0/2	-	3/7	51 - 110	254	DSY-S-MW08-SS01
benz(a)anthracene	S	SS	0/2	-	5/7	60 - 470	240	DSY-S-MW09-0001
benzo(a)pyrene	S	SS	0/2	-	5/7	50 - 410	224	DSY-S-MW09-0001
benzo(b)fluoranthene	S	SS	1/2	55 - 55	6/7	56.5 - 660	303	DSY-S-MW09-0001
benzo(g,h,i)perylene	S	SS	0/2	-	3/7	88 - 190	284	DSY-S-MW09-0001
benzo(k)fluoranthene	S	SS	0/2	-	3/7	87 - 270	293	DSY-S-MW09-0001
bis(2-ethylhexyl)phthalat	S	SS	0/2	-	1/7	8700 - 8700	1710	DSY-S-TP07-0001
carbazole	S	SS	0/2	-	2/7	37 - 56	261	DSY-S-TP10-0001
chrysene	S	SS	0/2	-	6/7	46 - 580	273	DSY-S-MW09-0001
di-n-butylphthalate	S	SS	0/2	-	2/7	51 - 64	264	DSY-S-MW09-0001
di-n-octylphthalate	S	SS	1/2	120 - 120	1/7	62 - 62	282	DSY-S-MW08-SS01
dibenz(a,h)anthracene	S	SS	0/2	-	1/7	62 - 62	282	DSY-S-MW09-0001
fluoranthene	S	SS	2/2	53 - 63	5/7	75 - 770	446	DSY-S-MW09-0001
fluorene	S	SS	0/2	-	1/7	50 - 50	280	DSY-S-MW08-SS01
indeno(1,2,3-cd)pyrene	S	SS	0/2	-	3/7	80 - 190	282	DSY-S-MW09-0001
phenanthrene	S	SS	0/2	-	5/7	41.5 - 420	326	DSY-S-MW08-SS01
pyrene	S	SS	2/2	54 - 59	6/7	72 - 750	375	DSY-S-MW09-0001
tetrabutyltin	S	SS	0/2	-	1/7	11.4 - 11.4	22.9	DSY-S-TP09-0001
tributyltin	S	SS	1/2	6.62 - 6.62	2/7	2.1 - 6.9	19	DSY-S-MW08-SS01
xylene (total)	S	SS	0/2	-	1/7	3 - 3	5.04	DSY-S-MW08-SS01
toluene	V	SS	0/2	-	2/7	1 - 1.5	4.21	G DSY-S-TP08-0001-A
TPH	V	SS	1/2	260 - 260	4/7	61 - 320	115	DSY-S-TP26-0001

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

TABLE 6-5

OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN SUBSURFACE SOIL - NORTH 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, total	M	SB	1/1	11700 - 11700	37/37	2430 - 18200	6670	DSY-S-MW02-3436
arsenic, total	M	SB	1/1	38.5 - 38.5	35/37	2.7 - 16.6	5.84	DSY-S-TP16-1112
barium, total	M	SB	1/1	13.9 - 13.9	24/37	3.2 - 26.2	7.86	DSY-S-TP28-1314
beryllium, total	M	SB	1/1	0.36 - 0.36	18/37	0.22 - 0.35	0.19	DSY-S-TP22-1112
cadmium, total	M	SB	1/1	1.5 - 1.5	1/37	0.65 - 0.65	0.328	DSY-S-TP22-1112
calcium, total	M	SB	1/1	834 - 834	37/37	311.5 - 3480	839	DSY-S-MW02-1820
chromium	M	SB	1/1	15.2 - 15.2	36/37	2.2 - 27.1	9.87	DSY-S-MW02-3436
cobalt, total	M	SB	1/1	16.6 - 16.6	30/37	3 - 19.8	7.3	DSY-S-MW02-3436
copper, total	M	SB	1/1	19.4 - 19.4	34/37	4.1 - 30.9	13.7	DSY-S-MW02-3436
iron, total	M	SB	1/1	37100 - 37100	37/37	6970 - 43100	17900	DSY-S-MW12-SS16
lead, total	M	SB	1/1	6.6 - 6.6	36/37	1.6 - 29.2	7.14	DSY-S-MW03-1618
magnesium, total	M	SB	1/1	3980 - 3980	37/37	921 - 7680	2460	DSY-S-MW02-3436
manganese, total	M	SB	1/1	746 - 746	37/37	55.4 - 549	213	DSY-S-TP22-1112
mercury, total	M	SB	0/1	-	4/37	0.0375 - 0.23	0.0449	G DSY-S-MW11-2931-A
nickel, total	M	SB	1/1	28.9 - 28.9	36/37	5.1 - 39.5	14	DSY-S-MW02-3436
potassium, total	M	SB	1/1	338 - 338	37/37	132 - 1190	314	DSY-S-MW12-SS12
selenium, total	M	SB	0/1	-	9/34	0.6 - 1.3	0.568	DSY-S-MW12-SS16
sodium, total	M	SB	0/1	-	3/36	23.05 - 117	26	DSY-S-TP20-1011
vanadium, total	M	SB	1/1	20.6 - 20.6	37/37	4.3 - 21.35	10.5	G DSY-S-MW11-2931-A
zinc, total	M	SB	1/1	68.6 - 68.6	37/37	13.6 - 73.4	35.3	DSY-S-MW12-SS16
aldrin	P	SB	0/1	-	1/19	4.4 - 4.4	1.13	DSY-S-TP16-1112
alpha-chlordane	P	SB	0/1	-	2/17	2 - 2.1	1.06	DSY-S-MW03-0810
endrin	P	SB	0/1	-	1/17	15 - 15	2.6	DSY-S-TP16-1112
gamma-chlordane	P	SB	0/1	-	2/17	2.1 - 2.4	1.09	DSY-S-MW03-0.501
heptachlor	P	SB	0/1	-	4/19	1.65 - 3.8	1.37	DSY-S-MW02-2426
benz(a)anthracene	S	SB	0/1	-	1/19	121.5 - 121.5	463	G DSY-S-TP24-0102-A
benzo(a)pyrene	S	SB	0/1	-	1/19	117 - 117	463	G DSY-S-TP24-0102-A
benzo(b)fluoranthene	S	SB	0/1	-	1/19	130.5 - 130.5	464	G DSY-S-TP24-0102-A
bis(2-ethylhexyl)phthalate	S	SB	0/1	-	5/19	44 - 84	434	DSY-S-MW02-2426
chrysene	S	SB	0/1	-	1/19	117 - 117	463	G DSY-S-TP24-0102-A
di-n-butylphthalate	S	SB	0/1	-	3/19	42 - 270	453	DSY-S-MW04-1618
fluoranthene	S	SB	0/1	-	2/19	42 - 135.5	456	G DSY-S-TP24-0102-A
phenanthrene	S	SB	0/1	-	1/19	122 - 122	463	G DSY-S-TP24-0102-A
pyrene	S	SB	0/1	-	2/19	41 - 1600	253	DSY-S-TP16-1112
tetrabutyltin	S	SB	0/1	-	3/19	4.6 - 5.9	21.6	G DSY-S-TP24-0102-A
tributyltin	S	SB	0/1	-	5/19	1.4 - 19.8	20.3	G DSY-S-MW11-2931-A
1,2-dichloroethene (total)	V	SB	0/1	-	1/19	3 - 3	8.29	G DSY-S-MW11-2931-A
2-butanone	V	SB	0/1	-	1/19	9.75 - 9.75	8.83	G DSY-S-TP24-0102-A
acetone	V	SB	0/1	-	3/19	16 - 187.5	28.6	G DSY-S-MW11-2931-A
carbon disulfide	V	SB	0/1	-	1/19	2 - 2	8.39	DSY-S-MW02-1820
toluene	V	SB	0/1	-	1/19	3.75 - 3.75	8.51	G DSY-S-TP24-0102-A
TPH	V	SB	0/1	-	2/19	89 - 1200	109	DSY-S-TP16-1112
trichloroethene	V	SB	0/1	-	4/19	1 - 4	7.55	G DSY-S-MW11-2931-A
xylene (total)	V	SB	0/1	-	2/19	2 - 3.75	8.33	G DSY-S-TP24-0102-A

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS 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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
aluminum, total	M	SB	1/1	11700 - 11700	26/26	4820 - 19900	10100	DSY-S-MW06-0406
arsenic, total	M	SB	1/1	38.5 - 38.5	25/26	3.9 - 37.3	14.8	DSY-S-TP12-1213
barium, total	M	SB	1/1	13.9 - 13.9	23/26	5.5 - 24.55	12.9	G DSY-S-TP13-0506-A
beryllium, total	M	SB	1/1	0.36 - 0.36	22/26	0.22 - 0.54	0.352	DSY-S-TP13-1011
cadmium, total	M	SB	1/1	1.5 - 1.5	5/26	0.4875 - 1.2	0.517	DSY-S-TP11-1213
calcium, total	M	SB	1/1	834 - 834	26/26	363 - 3630	1050	DSY-SB-09-1416
chromium	M	SB	1/1	15.2 - 15.2	26/26	6.3 - 25.6	12	DSY-S-MW06-0406
cobalt, total	M	SB	1/1	16.6 - 16.6	26/26	3.9 - 24.7	12.1	DSY-S-TP14-0506
copper, total	M	SB	1/1	19.4 - 19.4	26/26	5.1 - 31.1	17.7	DSY-S-TP14-0506
iron, total	M	SB	1/1	37100 - 37100	26/26	14300 - 43800	26000	DSY-S-TP14-0506
lead, total	M	SB	1/1	6.6 - 6.6	26/26	2.1 - 49.4	14	DSY-S-TP14-0506
magnesium, total	M	SB	1/1	3980 - 3980	26/26	1900 - 7130	3270	DSY-S-MW06-0406
manganese, total	M	SB	1/1	746 - 746	26/26	86.2 - 727	367	DSY-S-TP14-0506
mercury, total	M	SB	0/1	-	3/26	0.07 - 0.08749	0.0349	G DSY-S-MW07-1618-A
nickel, total	M	SB	1/1	28.9 - 28.9	26/26	10.4 - 39.7	20.4	DSY-S-MW06-0406
potassium, total	M	SB	1/1	338 - 338	26/26	116 - 566	312	DSY-S-MW07-3436
selenium, total	M	SB	0/1	-	3/24	0.83 - 0.885	0.478	G DSY-S-TP13-0506-A
silver, total	M	SB	0/1	-	2/26	1.6 - 1.7	0.714	DSY-S-TP14-0506
sodium, total	M	SB	0/1	-	3/25	88.65 - 228	39.8	DSY-S-MW07-3436
vanadium, total	M	SB	1/1	20.6 - 20.6	26/26	8.9 - 22.8	15.1	DSY-SB-10-1416
zinc, total	M	SB	1/1	68.6 - 68.6	26/26	28 - 82.5	49.5	DSY-SB-03-0911
4,4'-DDD	P	SB	0/1	-	3/16	7.4 - 110.9	10.8	G DSY-S-MW07-1618-A
4,4'-DDE	P	SB	0/1	-	1/16	6.4 - 6.4	2.3	G DSY-S-MW07-1618-A
4,4'-DDT	P	SB	0/1	-	1/16	50.9 - 50.9	5.08	G DSY-S-MW07-1618-A
Aroclor-1260	P	SB	0/1	-	1/16	13 - 13	19.7	DSY-S-TP25-1011
endrin	P	SB	0/1	-	1/16	5.5 - 5.5	2.24	DSY-S-TP11-1213
2-methylnaphthalene	S	SB	0/1	-	1/16	280 - 280	320	DSY-S-MW07-0810
benz(a)anthracene	S	SB	0/1	-	2/16	47 - 84	297	DSY-SB-09-1416
benzo(a)pyrene	S	SB	0/1	-	3/16	42 - 74	284	DSY-SB-01-0911
benzo(b)fluoranthene	S	SB	0/1	-	3/16	70 - 130	289	DSY-SB-09-1416
benzo(g,h,i)perylene	S	SB	0/1	-	1/16	61 - 61	302	DSY-SB-01-0911
benzo(k)fluoranthene	S	SB	0/1	-	1/16	65 - 65	305	DSY-SB-09-1416
butylbenzylphthalate	S	SB	0/1	-	1/16	48 - 48	304	DSY-SB-09-1416
chrysene	S	SB	0/1	-	3/16	67 - 123	294	G DSY-S-MW07-1618-A
fluoranthene	S	SB	0/1	-	3/16	49 - 130	294	DSY-SB-09-1416
naphthalene	S	SB	0/1	-	1/16	49 - 49	306	DSY-S-MW07-0810
phenanthrene	S	SB	0/1	-	4/16	48 - 120	288	DSY-SB-09-1416
pyrene	S	SB	0/1	-	3/16	43.5 - 170	298	DSY-SB-09-1416
tetrabutyltin	S	SB	0/1	-	1/16	15.8 - 15.8	24.2	G DSY-S-TP13-0506-A
tributyltin	S	SB	0/1	-	1/16	4.9 - 4.9	23.5	DSY-S-MW05-1012
carbon disulfide	V	SB	0/1	-	1/16	4 - 4	5.69	DSY-S-MW07-2224
toluene	V	SB	0/1	-	1/16	1 - 1	5.5	DSY-SB-09-1416
TPH	V	SB	0/1	-	5/16	83 - 17000	1370	DSY-SB-09-1416

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

TABLE 6-7

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			
			FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATION	MEAN	LOCATION OF MAXIMUM
aluminum, total	M	SB	1/1	11700 - 11700	18/18	1690 - 23300	10100	DSY-S-TP09-0910
arsenic, total	M	SB	1/1	38.5 - 38.5	17/18	1.2 - 42	12.6	DSY-S-TP26-0406
barium, total	M	SB	1/1	13.9 - 13.9	18/18	3.1 - 33.6	13.1	DSY-S-TP26-0910
beryllium, total	M	SB	1/1	0.36 - 0.36	13/18	0.2 - 0.67	0.296	DSY-S-TP08-0406
cadmium, total	M	SB	1/1	1.5 - 1.5	3/18	0.6525 - 0.97	0.371	DSY-SB-15-0103
calcium, total	M	SB	1/1	834 - 834	18/18	322 - 5190	1280	DSY-S-MW09-3638
chromium	M	SB	1/1	15.2 - 15.2	18/18	2.2 - 60.2	18	DSY-SB-06-0204
cobalt, total	M	SB	1/1	16.6 - 16.6	17/18	1.1 - 25	10.6	DSY-S-TP09-0910
copper, total	M	SB	1/1	19.4 - 19.4	18/18	4.1 - 46.1	24.8	DSY-S-TP08-0406
iron, total	M	SB	1/1	37100 - 37100	18/18	4060 - 50000	26200	DSY-S-TP09-0910
lead, total	M	SB	1/1	6.6 - 6.6	17/18	1.5 - 75	18.8	DSY-S-TP26-0406
magnesium, total	M	SB	1/1	3980 - 3980	18/18	534 - 8600	3540	DSY-S-TP09-0910
manganese, total	M	SB	1/1	746 - 746	18/18	78.6 - 2450	434	DSY-S-TP09-0910
mercury, total	M	SB	0/1	-	1/18	0.06 - 0.06	0.0276	DSY-S-TP26-0406
nickel, total	M	SB	1/1	28.9 - 28.9	17/18	2.3 - 48.1	22.2	DSY-S-TP09-0910
potassium, total	M	SB	1/1	338 - 338	18/18	108 - 593	313	DSY-S-MW09-2022
selenium, total	M	SB	0/1	-	2/18	0.81 - 1.4	0.476	DSY-S-TP09-0406
silver, total	M	SB	0/1	-	1/18	1.6 - 1.6	0.654	DSY-S-TP09-0910
sodium, total	M	SB	0/1	-	9/17	14.5 - 353	52.2	DSY-S-TP08-0910
vanadium, total	M	SB	1/1	20.6 - 20.6	18/18	4.4 - 19.6	13.3	DSY-S-TP09-0406
zinc, total	M	SB	1/1	68.6 - 68.6	18/18	10 - 158	60	DSY-S-TP08-0406
heptachlor	P	SB	0/1	-	1/12	4 - 4	1.26	DSY-S-TP26-0305
2-methylnaphthalene	S	SB	0/1	-	3/12	66 - 14000	1460	DSY-S-TP26-0305
anthracene	S	SB	0/1	-	1/12	900 - 900	389	DSY-S-TP26-0305
benz(a)anthracene	S	SB	0/1	-	3/12	48 - 133.5	449	DSY-SB-14-0103-AV
benzo(a)pyrene	S	SB	0/1	-	3/12	41.5 - 129	447	DSY-SB-14-0103-AV
benzo(b)fluoranthene	S	SB	0/1	-	3/12	80 - 150	458	DSY-SB-14-0103-AV
benzo(g,h,i)perylene	S	SB	0/1	-	1/12	45 - 45	466	DSY-S-TP08-0406
benzo(k)fluoranthene	S	SB	0/1	-	1/12	68 - 68	468	DSY-S-TP08-0406
bis(2-ethylhexyl)phthalate	S	SB	0/1	-	1/12	22000 - 22000	2170	DSY-S-TP08-0910
chrysene	S	SB	0/1	-	4/12	47.5 - 131	440	DSY-SB-14-0103-AV
di-n-butylphthalate	S	SB	0/1	-	1/12	50 - 50	460	DSY-SB-04-0406
fluoranthene	S	SB	0/1	-	5/12	93 - 130	444	G DSY-S-MW09-1012-A
fluorene	S	SB	0/1	-	1/12	2100 - 2100	489	DSY-S-TP26-0305
indeno(1,2,3-cd)pyrene	S	SB	0/1	-	1/12	41 - 41	466	DSY-S-TP08-0406
naphthalene	S	SB	0/1	-	1/12	2200 - 2200	498	DSY-S-TP26-0305
phenanthrene	S	SB	0/1	-	6/12	51 - 4800	677	DSY-S-TP26-0305
pyrene	S	SB	0/1	-	6/12	87 - 460	315	DSY-S-TP26-0305
tetrabutyltin	S	SB	0/1	-	1/12	2.9 - 2.9	23	DSY-S-TP08-0910
1,2-dichloroethene (total)	V	SB	0/1	-	2/12	3 - 3	9.33	G DSY-S-MW09-1012-A
benzene	V	SB	0/1	-	1/12	1 - 1	9.31	DSY-SB-06-0204
ethylbenzene	V	SB	0/1	-	1/12	66 - 66	10.6	DSY-S-TP26-0305
toluene	V	SB	0/1	-	1/12	1 - 1	9.31	DSY-SB-06-0204
TPH	V	SB	0/1	-	3/12	54.25 - 2200	256	DSY-S-TP26-0305
trichloroethene	V	SB	0/1	-	1/12	3 - 3	9.52	DSY-S-MW08-0810
xylene (total)	V	SB	0/1	-	1/12	150 - 150	17.6	DSY-S-TP26-0305

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

TABLE 6-8

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, total	M	SB	1/1	11700 - 11700	11/11	5730 - 14900	9460	DSY-S-TP06-0507
arsenic, total	M	SB	1/1	38.5 - 38.5	10/11	6.8 - 23.2	12.9	DSY-S-TP05-1213
barium, total	M	SB	1/1	13.9 - 13.9	10/11	8.2 - 18	12.9	DSY-S-TP02-1516
beryllium, total	M	SB	1/1	0.36 - 0.36	10/11	0.21 - 0.5	0.332	DSY-S-TP05-0507
cadmium, total	M	SB	1/1	1.5 - 1.5	1/11	0.56 - 0.56	0.309	DSY-S-TP06-1213
calcium, total	M	SB	1/1	834 - 834	11/11	812 - 3490	1410	DSY-S-TP02-1516
chromium	M	SB	1/1	15.2 - 15.2	11/11	6.6 - 19.3	12.3	DSY-S-TP06-0507
cobalt, total	M	SB	1/1	16.6 - 16.6	11/11	4.4 - 29.9	11.8	DSY-S-TP05-1213
copper, total	M	SB	1/1	19.4 - 19.4	11/11	7 - 52.5	22.4	DSY-S-TP03-0608
iron, total	M	SB	1/1	37100 - 37100	11/11	16100 - 37000	24300	DSY-S-TP06-0507
lead, total	M	SB	1/1	6.6 - 6.6	11/11	5.5 - 52.3	21.8	DSY-S-TP04-0607
magnesium, total	M	SB	1/1	3980 - 3980	11/11	1950 - 4820	2960	DSY-S-TP06-0507
manganese, total	M	SB	1/1	746 - 746	11/11	104 - 800	366	DSY-S-TP05-1213
mercury, total	M	SB	0/1	-	3/11	0.06 - 0.12	0.0455	DSY-S-TP03-0608
nickel, total	M	SB	1/1	28.9 - 28.9	11/11	10.7 - 30.9	20.5	DSY-S-TP05-1213
potassium, total	M	SB	1/1	338 - 338	11/11	121 - 365	268	DSY-S-TP05-1213
selenium, total	M	SB	0/1	-	2/6	0.85 - 0.89	0.679	DSY-S-TP05-0507
silver, total	M	SB	0/1	-	1/11	1.2 - 1.2	0.623	DSY-S-TP06-0507
sodium, total	M	SB	0/1	-	6/11	9 - 412	103	DSY-S-TP03-0608
tin, total	M	SB	0/1	-	1/11	9.2 - 9.2	4.2	DSY-S-TP04-0607
vanadium, total	M	SB	1/1	20.6 - 20.6	11/11	9 - 23.8	14.9	DSY-S-TP05-0507
zinc, total	M	SB	1/1	68.6 - 68.6	11/11	52.5 - 74.8	62.8	DSY-S-TP02-1516
4,4'-DDE	P	SB	0/1	-	1/3	6.5 - 6.5	3.38	DSY-S-TP05-0507
4,4'-DDT	P	SB	0/1	-	2/3	7 - 7.4	5.4	DSY-S-TP03-0608
heptachlor	P	SB	0/1	-	1/3	2.1 - 2.1	1.33	DSY-S-TP05-0507
2-methylnaphthalene	S	SB	0/1	-	1/3	50 - 50	693	DSY-S-TP05-0507
benz(a)anthracene	S	SB	0/1	-	1/3	91 - 91	707	DSY-S-TP05-0507
benzo(a)pyrene	S	SB	0/1	-	1/3	79 - 79	703	DSY-S-TP05-0507
benzo(b)fluoranthene	S	SB	0/1	-	2/3	43 - 110	668	DSY-S-TP05-0507
benzo(g,h,i)perylene	S	SB	0/1	-	1/3	46 - 46	692	DSY-S-TP05-0507
benzo(k)fluoranthene	S	SB	0/1	-	1/3	78 - 78	703	DSY-S-TP05-0507
chrysene	S	SB	0/1	-	1/3	100 - 100	710	DSY-S-TP05-0507
fluoranthene	S	SB	0/1	-	2/3	59 - 320	743	DSY-S-TP05-0507
indeno(1,2,3-cd)pyrene	S	SB	0/1	-	1/3	53 - 53	694	DSY-S-TP05-0507
phenanthrene	S	SB	0/1	-	1/3	100 - 100	710	DSY-S-TP05-0507
pyrene	S	SB	0/1	-	2/3	67 - 180	699	DSY-S-TP05-0507
tetrabutyltin	S	SB	0/1	-	1/3	5.5 - 5.5	18.5	DSY-S-TP05-0507
TPH	V	SB	0/1	-	2/3	72 - 540	214	DSY-S-TP03-0608

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

TABLE 6-9

OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN GROUNDWATER - NORTH 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
arsenic, total	M	GW	1/2	19.8 - 19.8	3/5	5.1 - 13.2	5.52	DSY-A-MW11-01
barium, total	M	GW	1/2	44.6 - 44.6	2/5	15.8 - 44.4	17.6	DSY-A-MW02-01
calcium, total	M	GW	2/2	34350 - 46900	5/5	22000 - 80200	47900	DSY-A-MW04-01
chromium	M	GW	2/2	7.2 - 13.5	1/5	7.3 - 7.3	3.86	DSY-A-MW11-01
copper, total	M	GW	1/2	12.7 - 12.7	1/5	5.6 - 5.6	3.12	DSY-A-MW03-01-AVG
iron, total	M	GW	1/2	1880 - 1880	2/5	309.15 - 414	200	DSY-A-MW11-01
magnesium, total	M	GW	2/2	7470 - 13350	5/5	6700 - 31600	17400	DSY-A-MW02-01
manganese, total	M	GW	2/2	22.9 - 4300	5/5	19.975 - 373	224	DSY-A-MW11-01
nickel, total	M	GW	0/2	-	2/5	7.95 - 9.6	6.21	DSY-A-MW11-01
potassium, total	M	GW	2/2	1415 - 3510	5/5	1900 - 17100	8730	DSY-A-MW02-01
sodium, total	M	GW	2/2	32300 - 119000	5/5	29700 - 200000	88300	DSY-A-MW02-01
zinc, total	M	GW	0/2	-	3/5	21.3 - 68.3	25.5	DSY-A-MW02-01
1,2-dichloroethene (total)	V	GW	1/2	180 - 180	3/5	5 - 18	9.8	DSY-A-MW11-01
acetone	V	GW	0/2	-	1/5	7.5 - 7.5	8.5	DSY-A-MW03-01-AVG
trichloroethene	V	GW	0/2	-	2/5	16 - 32.5	12.7	DSY-A-MW03-01-AVG

UNITS ARE IN UG/L

TABLE 6-10

OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN GROUNDWATER - CENTRAL SHIPYARD

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, total	M	GW	1/2	1240 - 1240	1/2	1240 - 1240	624	DSY-A-MW07-01
arsenic, total	M	GW	1/2	57.6 - 57.6	1/2	57.6 - 57.6	29.8	DSY-A-MW07-01
barium, total	M	GW	2/2	49.1 - 51.7	2/2	49.1 - 51.7	50.4	DSY-A-MW07-01
calcium, total	M	GW	2/2	14100 - 126000	2/2	14100 - 126000	70100	DSY-A-MW05-01
chromium	M	GW	1/2	12.8 - 12.8	1/2	12.8 - 12.8	7.9	DSY-A-MW07-01
iron, total	M	GW	2/2	1260 - 18400	2/2	1260 - 18400	9830	DSY-A-MW07-01
lead, total	M	GW	1/2	1.8 - 1.8	1/2	1.8 - 1.8	1.15	DSY-A-MW07-01
magnesium, total	M	GW	2/2	5430 - 40000	2/2	5430 - 40000	22700	DSY-A-MW05-01
manganese, total	M	GW	2/2	753 - 1360	2/2	753 - 1360	1060	DSY-A-MW05-01
potassium, total	M	GW	2/2	2490 - 3570	2/2	2490 - 3570	3030	DSY-A-MW07-01
sodium, total	M	GW	2/2	142000 - 379000	2/2	142000 - 379000	261000	DSY-A-MW05-01

UNITS ARE IN UG/L

TABLE 6-11

OCCURRENCE AND DISTRIBUTION OF CHEMICALS IN GROUNDWATER - 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, total	M	GW	0/2	-	1/2	1010 - 1010	531	DSY-A-MW09-01
arsenic, total	M	GW	1/2	19.8 - 19.8	1/2	15.6 - 15.6	8.8	DSY-A-MW08-01
barium, total	M	GW	1/2	44.6 - 44.6	1/2	99.3 - 99.3	58.1	DSY-A-MW09-01
calcium, total	M	GW	2/2	34350 - 46900	2/2	28400 - 42000	35200	DSY-A-MW09-01
chromium	M	GW	2/2	7.2 - 13.5	2/2	30.3 - 57.6	44	DSY-A-MW09-01
copper, total	M	GW	1/2	12.7 - 12.7	1/2	5.9 - 5.9	4.2	DSY-A-MW09-01
iron, total	M	GW	1/2	1880 - 1880	2/2	2600 - 5660	4130	DSY-A-MW08-01
magnesium, total	M	GW	2/2	7470 - 13350	2/2	6530 - 12800	9670	DSY-A-MW09-01
manganese, total	M	GW	2/2	22.9 - 4300	2/2	830 - 3410	2120	DSY-A-MW08-01
potassium, total	M	GW	2/2	1415 - 3510	2/2	3990 - 7650	5820	DSY-A-MW09-01
sodium, total	M	GW	2/2	32300 - 119000	2/2	45000 - 103000	74000	DSY-A-MW09-01
1,2-dichloroethene (total)	V	GW	1/2	180 - 180	1/2	13 - 13	9	DSY-A-MW08-01
trichloroethene	V	GW	0/2	-	2/2	3 - 4	3.5	DSY-A-MW08-01

UNITS ARE IN UG/L

TABLE 6-12
SELECTION OF COPCS IN SURFACE SOIL - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SS	3440 - 9650	7800	6370	Y
arsenic, total	M	SS	2.6 - 10.85	0.043	6.49	Y
barium, total	M	SS	5.1 - 49.4	550	23.1	N
beryllium, total	M	SS	0.205 - 1.1	0.015	0.358	Y
cadmium, total	M	SS	0.85 - 0.85	3.9	0.372	N
calcium, total	M	SS	237 - 1780		868	NA
chromium	M	SS	5.2 - 24.1	39	10.7	N
cobalt, total	M	SS	2.6 - 14.7	470	8.54	N
copper, total	M	SS	3.1 - 111	310	34.1	N
iron, total	M	SS	11200 - 19700	2300	16800	Y
lead, total	M	SS	2.3 - 112	400	48.9	N
magnesium, total	M	SS	1320 - 2570		2050	NA
manganese, total	M	SS	81.4 - 340	180	266	Y
mercury, total	M	SS	0.0375 - 0.05	2.3	0.0414	N
nickel, total	M	SS	8.2 - 68.5	160	19.1	N
potassium, total	M	SS	209 - 483		344	NA
selenium, total	M	SS	0.5 - 1	39	0.727	N
sodium, total	M	SS	19.7 - 172		50.9	NA
tin, total	M	SS	12.2 - 12.2	4700	5.08	N
vanadium, total	M	SS	6.4 - 39.5	55	15.1	N
zinc, total	M	SS	22.8 - 883	2300	141	N
4,4'-DDE	P	SS	19.5 - 19.5	190	3.85	N
4,4'-DDT	P	SS	50.5 - 50.5	190	6.45	N
alpha-chlordane	P	SS	8.1 - 8.1	49	1.8	N
Aroclor-1260	P	SS	24 - 24	0.0319	18.8	Y
dieldrin	P	SS	16 - 16	4	3.5	Y
endrin	P	SS	5.7 - 26	2300	5.15	N
gamma-chlordane	P	SS	3.625 - 3.625	49	1.31	N
heptachlor epoxide	P	SS	3.4 - 3.4	7	1.28	N
2,2'-oxybis(1-chloropropane)	S	SS	114.5 - 114.5	910	115	N
acenaphthene	S	SS	943.5 - 943.5	470000	944	N
anthracene	S	SS	971 - 971	2300000	954	N
benz(a)anthracene	S	SS	605 - 605	88	605	Y
benzo(a)pyrene	S	SS	530 - 530	8.8	530	Y
benzo(b)fluoranthene	S	SS	805 - 805	88	805	Y
benzo(g,h,i)perylene	S	SS	1030 - 1030		971	NA
benzo(k)fluoranthene	S	SS	1030 - 1030	880	971	Y
bis(2-ethylhexyl)phthalate	S	SS	44 - 110	4600	110	N
carbazole	S	SS	951 - 951	3200	948	N
chrysene	S	SS	580 - 580	8800	580	N
dibutyltin	S	SS	5.25 - 33		31.6	NA
fluoranthene	S	SS	1160 - 1160	310000	1010	N
fluorene	S	SS	951 - 951	310000	948	N
indeno(1,2,3-cd)pyrene	S	SS	380 - 380	88	380	Y
monobutyltin	S	SS	33 - 33		26.4	NA
phenanthrene	S	SS	640 - 640		640	NA
phenol	S	SS	180 - 180	4700000	180	N
pyrene	S	SS	1090 - 1400	230000	481	N

TABLE 6-12
SELECTION OF COPCS IN SURFACE SOIL - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
tetrabutyltin	S	SS	2.5 - 5.8		5.8	N
tributyltin	S	SS	9.9 - 30	230	27.6	N
acetone	V	SS	75 - 115	780000	115	N
benzene	V	SS	1 - 1	2200	1	N
chlorobenzene	V	SS	3 - 3	160000	3	N
hexachloroethane	V	SS	55 - 55	4600	55	N
toluene	V	SS	1 - 4	1600000	4	N
TPH	V	SS	61 - 4900		920	NA
trichloroethene	V	SS	2 - 2	5800	2	N
xylene (total)	V	SS	1 - 2	16000000	2	N

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, INGESTION OF SURFACE SOIL, ADJUSTED TO ACANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE, 1994

TABLE 6-13
SELECTION OF COPCS IN SUBSURFACE SOIL - NORTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SB	2430 - 18200	7800	7980	N
arsenic, total	M	SB	2.7 - 16.6	0.043	6.87	Y
barium, total	M	SB	3.2 - 26.2	550	11.9	N
beryllium, total	M	SB	0.22 - 0.35	0.015	0.222	Y
cadmium, total	M	SB	0.65 - 0.65	3.9	0.349	N
calcium, total	M	SB	311.5 - 3480		988	NA
chromium	M	SB	2.2 - 27.1	39	12.6	N
cobalt, total	M	SB	3 - 19.8	470	8.53	N
copper, total	M	SB	4.1 - 30.9	310	15.8	N
iron, total	M	SB	6970 - 43100	2300	20800	Y
lead, total	M	SB	1.6 - 29.2	400	9.61	N
magnesium, total	M	SB	921 - 7680		2910	NA
manganese, total	M	SB	55.4 - 549	180	268	N
mercury, total	M	SB	0.0375 - 0.23	2.3	0.0507	N
nickel, total	M	SB	5.1 - 39.5	160	16.8	N
potassium, total	M	SB	132 - 1190		364	NA
selenium, total	M	SB	0.6 - 1.3	39	0.637	N
sodium, total	M	SB	23.05 - 117		30.5	NA
vanadium, total	M	SB	4.3 - 21.35	55	11.9	N
zinc, total	M	SB	13.6 - 73.4	2300	41.1	N
aldrin	P	SB	4.4 - 4.4	3.8	1.28	Y
alpha-chlordane	P	SB	2 - 2.1	49	1.19	N
endrin	P	SB	15 - 15	2300	3.06	N
gamma-chlordane	P	SB	2.1 - 2.4	49	1.24	N
heptachlor	P	SB	1.65 - 3.8	14	1.69	N
benz(a)anthracene	S	SB	121.5 - 121.5	88	122	Y
benzo(a)pyrene	S	SB	117 - 117	8.8	117	Y
benzo(b)fluoranthene	S	SB	130.5 - 130.5	88	131	Y
bis(2-ethylhexyl)phthalate	S	SB	44 - 84	4600	84	N
chrysene	S	SB	117 - 117	8800	117	N
di-n-butylphthalate	S	SB	42 - 270	780000	270	N
fluoranthene	S	SB	42 - 135.5	310000	136	N
phenanthrene	S	SB	122 - 122		122	NA
pyrene	S	SB	41 - 1600	230000	319	N
tetrabutyltin	S	SB	4.6 - 5.9		5.9	NA
tributyltin	S	SB	1.4 - 19.8	230	19.8	N
1,2-dichloroethene (total)	V	SB	3 - 3	70000	3	N
2-butanone	V	SB	9.75 - 9.75	4700000	9.75	N
acetone	V	SB	16 - 187.5	780000	57.6	N
carbon disulfide	V	SB	2 - 2	780000	2	N
toluene	V	SB	3.75 - 3.75	160000	3.75	N
TPH	V	SB	89 - 1200		120	NA
trichloroethene	V	SB	1 - 4	5800	4	N
xylene (total)	V	SB	2 - 3.75	16000000	3.75	N

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, INGESTION OF SURFACE SOIL, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE 1994

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 RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
arsenic, total	M	GW	5.1 - 13.2	0.005	13.2	Y
barium, total	M	GW	15.8 - 44.4	260	44.4	N
calcium, total	M	GW	22000 - 80200		71900	NA
chromium	M	GW	7.3 - 7.3	3700	6.56	N
copper, total	M	GW	5.6 - 5.6	150	4.96	N
iron, total	M	GW	309.15 - 414	1100	414	N
magnesium, total	M	GW	6700 - 31600		31600	NA
manganese, total	M	GW	19.975 - 373	84	371	Y
nickel, total	M	GW	7.95 - 9.6	73	8.51	N
potassium, total	M	GW	1900 - 17100		17100	NA
sodium, total	M	GW	29700 - 200000		200000	NA
zinc, total	M	GW	21.3 - 68.3	1100	68.3	N
1,2-dichloroethene (total)	V	GW	5 - 18	5.5	18	Y
acetone	V	GW	7.5 - 7.5	370	7.5	N
trichloroethene	V	GW	16 - 32.5	0.16	32.5	Y

UNITS ARE IN UG/L

SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.

COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.

TABLE 6-15
SELECTION OF COPCS IN SURFACE SOIL - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SS	5820 - 14400	7800	14400	Y
arsenic, total	M	SS	3.9 - 24.4	0.043	20.1	Y
barium, total	M	SS	12.1 - 24	550	20.7	N
beryllium, total	M	SS	0.23 - 0.47	0.015	0.426	Y
cadmium, total	M	SS	0.75 - 1.2	3.9	0.956	N
calcium, total	M	SS	426 - 1230		1120	NA
chromium	M	SS	9.8 - 19	39	17.4	N
cobalt, total	M	SS	7.6 - 22.7	470	17.6	N
copper, total	M	SS	15.15 - 33	310	30.2	N
iron, total	M	SS	18500 - 32900	2300	32900	Y
lead, total	M	SS	9.2 - 27.4	400	26.1	N
magnesium, total	M	SS	2310 - 4740		4090	NA
manganese, total	M	SS	297.5 - 619	180	485	Y
mercury, total	M	SS	0.12 - 0.12	2.3	0.0865	N
nickel, total	M	SS	14.9 - 27.4	160	27.4	N
potassium, total	M	SS	241 - 606		426	NA
selenium, total	M	SS	0.74 - 1.2	39	0.917	N
sodium, total	M	SS	87.9 - 87.9		70.6	NA
vanadium, total	M	SS	8.75 - 21.8	55	19.3	N
zinc, total	M	SS	33.35 - 123	2300	95.9	N
4,4'-DDD	P	SS	4.3 - 4.3	270	4.3	N
4,4'-DDT	P	SS	6.2 - 6.2	190	6.2	N
Aroclor-1260	P	SS	32 - 71000	0.0319	71000	Y
dieldrin	P	SS	470 - 470	4	470	Y
endrin ketone	P	SS	1100 - 1100	2300	1100	N
methoxychlor	P	SS	2300 - 2300	39000	2300	N
2,2'-oxybis(1-chloropropane)	S	SS	180 - 180	910	180	N
2-methylphenol	S	SS	83 - 83	390000	83	N
4-methylphenol	S	SS	500 - 500	39000	500	N
acenaphthene	S	SS	92 - 92	470000	92	N
anthracene	S	SS	130 - 130	2300000	130	N
benz(a)anthracene	S	SS	130 - 410	88	410	Y
benzo(a)pyrene	S	SS	86 - 140	8.8	140	Y
benzo(b)fluoranthene	S	SS	180 - 410	88	410	Y
benzo(g,h,i)perylene	S	SS	72 - 130		130	NA
benzo(k)fluoranthene	S	SS	86 - 360	880	360	N
carbazole	S	SS	97 - 97	3200	97	N
chrysene	S	SS	120 - 420	8800	420	N
fluoranthene	S	SS	300 - 870	310000	870	N
fluorene	S	SS	65 - 65	310000	65	N
indeno(1,2,3-cd)pyrene	S	SS	71 - 150	88	150	Y
phenanthrene	S	SS	120 - 580		580	NA
phenol	S	SS	1200 - 1200	4700000	1200	N
pyrene	S	SS	230 - 740	230000	740	N
tetrabutyltin	S	SS	8.8 - 8.8		8.8	NA
TPH	S	SS	68 - 2000		2000	NA
tributyltin	S	SS	4.8 - 4.8	230	4.8	N

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE 1994

TABLE 6-16
SELECTION OF COPCS IN SUBSURFACE SOIL - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SB	4820 - 19900	7800	11400	Y
arsenic, total	M	SB	3.9 - 37.3	0.043	20.8	Y
barium, total	M	SB	5.5 - 24.55	550	14.9	N
beryllium, total	M	SB	0.22 - 0.54	0.015	0.398	Y
cadmium, total	M	SB	0.4875 - 1.2	3.9	0.614	N
calcium, total	M	SB	363 - 3630		1300	NA
chromium	M	SB	6.3 - 25.6	39	13.6	N
cobalt, total	M	SB	3.9 - 24.7	470	14.4	N
copper, total	M	SB	5.1 - 31.1	310	20	N
iron, total	M	SB	14300 - 43800	2300	29500	Y
lead, total	M	SB	2.1 - 49.4	400	20.1	N
magnesium, total	M	SB	1900 - 7130		3650	NA
manganese, total	M	SB	86.2 - 727	180	420	Y
mercury, total	M	SB	0.07 - 0.08749	2.3	0.04	N
nickel, total	M	SB	10.4 - 39.7	160	23.1	N
potassium, total	M	SB	116 - 566		363	NA
selenium, total	M	SB	0.83 - 0.885	39	0.525	N
silver, total	M	SB	1.6 - 1.7	39	0.788	N
sodium, total	M	SB	88.65 - 228		51.2	NA
vanadium, total	M	SB	8.9 - 22.8	55	16.4	N
zinc, total	M	SB	28 - 82.5	2300	55.4	N
4,4'-DDD	P	SB	7.4 - 110.9	270	16.6	N
4,4'-DDE	P	SB	6.4 - 6.4	190	2.65	N
4,4'-DDT	P	SB	50.9 - 50.9	190	5.75	N
Aroclor-1260	P	SB	13 - 13	0.0319	13	Y
endrin	P	SB	5.5 - 5.5	2300	2.55	N
2-methylnaphthalene	S	SB	280 - 280	310000	280	N
benz(a)anthracene	S	SB	47 - 84	88	84	N
benzo(a)pyrene	S	SB	42 - 74	8.8	74	Y
benzo(b)fluoranthene	S	SB	70 - 130	88	130	Y
benzo(g,h,i)perylene	S	SB	61 - 61		61	NA
benzo(k)fluoranthene	S	SB	65 - 65	880	65	N
butylbenzylphthalate	S	SB	48 - 48	1600000	48	N
chrysene	S	SB	67 - 123	8800	123	N
fluoranthene	S	SB	49 - 130	310000	130	N
naphthalene	S	SB	49 - 49	310000	49	N
phenanthrene	S	SB	48 - 120		120	NA
pyrene	S	SB	43.5 - 170	230000	170	N
tetrabutyltin	S	SB	15.8 - 15.8		15.8	NA
toluene	S	SB	1 - 1	1600000	1	N
tributyltin	S	SB	4.9 - 4.9	230	4.9	N
carbon disulfide	V	SB	4 - 4	780000	4	N
TPH	V	SB	83 - 17000		3880	NA

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE, 1994

TABLE 6-17
SELECTION OF COPCS IN GROUNDWATER - CENTRAL SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	GW	1240 - 1240	3700	1240	N
arsenic, total	M	GW	57.6 - 57.6	0.005	57.6	Y
barium, total	M	GW	49.1 - 51.7	260	51.7	N
calcium, total	M	GW	14100 - 126000		126000	NA
chromium	M	GW	12.8 - 12.8	18	12.8	N
iron, total	M	GW	1260 - 18400	1100	18400	Y
lead, total	M	GW	1.8 - 1.8	15	1.8	N
magnesium, total	M	GW	5430 - 40000		40000	NA
manganese, total	M	GW	753 - 1360	84	1360	N
potassium, total	M	GW	2490 - 3570		3570	NA
sodium, total	M	GW	142000 - 379000		379000	NA

UNITS ARE IN UG/L
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 15 UG/L IS FROM EPA 1996 DRINKING WATER STANDARDS

TABLE 6-18
SELECTION OF COPCS IN SURFACE SOIL - SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SS	6870 - 33300	7800	26400	Y
arsenic, total	M	SS	9.7 - 15.3	0.043	14.6	Y
barium, total	M	SS	12.3 - 420	550	226	N
beryllium, total	M	SS	0.3 - 2.5	0.15	2.5	Y
cadmium, total	M	SS	0.48 - 0.48	3.9	0.395	N
calcium, total	M	SS	504 - 8780		8780	NA
chromium	M	SS	10.5 - 53.5	39	47.9	Y
cobalt, total	M	SS	8.9 - 18.3	470	17.2	N
copper, total	M	SS	13 - 145	310	145	N
iron, total	M	SS	21300 - 58100	2300	43600	Y
lead, total	M	SS	13.5 - 119	400	119	N
magnesium, total	M	SS	2190 - 2730		2710	NA
manganese, total	M	SS	286 - 423	180	380	Y
mercury, total	M	SS	0.17 - 0.17	2.3	0.155	N
nickel, total	M	SS	17.2 - 70.8	160	70.8	N
potassium, total	M	SS	291 - 4050		4050	NA
selenium, total	M	SS	1.2 - 1.4	39	1.4	N
sodium, total	M	SS	113 - 965		538	NA
tin, total	M	SS	9.3 - 27.4	4700	16.4	N
vanadium, total	M	SS	9.7 - 52.7	55	46.6	N
zinc, total	M	SS	40.8 - 896	2300	896	N
4,4'-DDE	P	SS	6.1 - 6.1	190	4.52	N
4,4'-DDT	P	SS	14 - 14	190	14	N
Aroclor-1260	P	SS	15 - 25	0.0319	21.2	Y
benz(a)anthracene	S	SS	58 - 210	88	210	Y
benzo(a)pyrene	S	SS	46 - 180	8.8	180	Y
benzo(b)fluoranthene	S	SS	81 - 270	88	270	Y
benzo(g,h,i)perylene	S	SS	42 - 99		99	NA
benzo(k)fluoranthene	S	SS	38 - 150	880	150	Y
chrysene	S	SS	53 - 250	8800	250	N
dibutyltin	S	SS	2.7 - 2.7		2.7	NA
fluoranthene	S	SS	71 - 460	310000	460	N
indeno(1,2,3-cd)pyrene	S	SS	42 - 110	88	110	Y
phenanthrene	S	SS	89 - 280		280	NA
pyrene	S	SS	73 - 380	230000	380	N
tributyltin	S	SS	2.4 - 2.8		2.8	NA
toluene	V	SS	1 - 1	1600000	1	N
TPH	V	SS	94 - 110		110	NA

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.

COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.

LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE, 1994

TABLE 6-19
SELECTION OF COPCS IN SUBSURFACE SOIL - SOUTH WATERFRONT
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SB	5730 - 14900	7800	11700	Y
arsenic, total	M	SB	6.8 - 23.2	0.043	17	Y
barium, total	M	SB	8.2 - 18	550	18	N
beryllium, total	M	SB	0.21 - 0.5	0.15	0.389	Y
cadmium, total	M	SB	0.56 - 0.56	3.9	0.352	N
calcium, total	M	SB	812 - 3490		1900	NA
chromium	M	SB	6.6 - 19.3	39	14.9	N
cobalt, total	M	SB	4.4 - 29.9	470	16.7	N
copper, total	M	SB	7 - 52.5	310	31	N
iron, total	M	SB	16100 - 37000	2300	29300	Y
lead, total	M	SB	5.5 - 52.3	400	39.4	N
magnesium, total	M	SB	1950 - 4820		3580	NA
manganese, total	M	SB	104 - 800	180	534	Y
mercury, total	M	SB	0.06 - 0.12	2.3	0.0806	N
nickel, total	M	SB	10.7 - 30.9	160	23.8	N
potassium, total	M	SB	121 - 365		307	NA
selenium, total	M	SB	0.85 - 0.89	39	0.89	N
silver, total	M	SB	1.2 - 1.2	39	0.725	N
sodium, total	M	SB	9 - 412		412	NA
tin, total	M	SB	9.2 - 9.2	4700	4.98	N
vanadium, total	M	SB	9 - 23.8	55	17.6	N
zinc, total	M	SB	52.5 - 74.8	2300	66.6	N
4,4'-DDE	P	SB	6.5 - 6.5	190	6.5	N
4,4'-DDT	P	SB	7 - 7.4	190	7.4	N
heptachlor	P	SB	2.1 - 2.1	14	2.1	N
2-methylnaphthalene	S	SB	50 - 50	310000	50	N
benz(a)anthracene	S	SB	91 - 91	88	91	Y
benzo(a)pyrene	S	SB	79 - 79	8.8	79	Y
benzo(b)fluoranthene	S	SB	43 - 110	88	110	Y
benzo(g,h,i)perylene	S	SB	46 - 46		46	NA
benzo(k)fluoranthene	S	SB	78 - 78	880	78	N
chrysene	S	SB	100 - 100	8800	100	N
fluoranthene	S	SB	59 - 320	310000	320	N
indeno(1,2,3-cd)pyrene	S	SB	53 - 53	88	53	N
phenanthrene	S	SB	100 - 100		100	NA
pyrene	S	SB	67 - 180	230000	180	N
tetrabutyltin	S	SB	5.5 - 5.5		5.5	NA
TPH	V	SB	72 - 540		540	NA

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.

COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.

TABLE 6-20
SELECTION OF COPCS IN SURFACE SOIL - BUILDING 234
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SS	3810 - 11300	7800	11200	Y
arsenic, total	M	SS	2.6 - 23.6	0.043	23.6	Y
barium, total	M	SS	8.9 - 67	550	67	N
beryllium, total	M	SS	0.18 - 3.5	0.015	1.65	Y
calcium, total	M	SS	521 - 2790		1810	NA
chromium	M	SS	6.4 - 40.2	39	31.4	Y
cobalt, total	M	SS	3.3 - 23.9	470	23.9	N
copper, total	M	SS	12.9 - 262	310	225	N
iron, total	M	SS	7770 - 37200	2300	30000	Y
lead, total	M	SS	9.7 - 189	400	99	N
magnesium, total	M	SS	1170 - 3380		2880	N
manganese, total	M	SS	157 - 597	180	474	Y
mercury, total	M	SS	0.07 - 0.07	2.3	0.0507	N
nickel, total	M	SS	7.8 - 113	160	97.1	N
potassium, total	M	SS	227 - 397		375	NA
sodium, total	M	SS	19 - 163		89.4	NA
tin, total	M	SS	40.6 - 40.6	4700	28.5	N
vanadium, total	M	SS	6.8 - 23.2	55	18.9	N
zinc, total	M	SS	44.3 - 831	2300	817	N
4,4'-DDE	P	SS	3.1 - 3.1	190	2.33	N
4,4'-DDT	P	SS	5 - 8.6	190	8.42	N
Aroclor-1254	P	SS	38 - 38	0.0319	26.3	Y
Aroclor-1260	P	SS	24 - 24	0.0319	20.3	Y
gamma-chlordane	P	SS	3.9 - 3.9	49	2.32	N
heptachlor	P	SS	4.5 - 4.5	14	2.66	N
acenaphthene	S	SS	46 - 52	470000	52	N
anthracene	S	SS	51 - 110	2300000	110	N
benz(a)anthracene	S	SS	60 - 470	88	339	Y
benzo(a)pyrene	S	SS	50 - 410	8	313	Y
benzo(b)fluoranthene	S	SS	56.5 - 660	88	457	Y
benzo(g,h,i)perylene	S	SS	88 - 190		190	NA
benzo(k)fluoranthene	S	SS	87 - 270	880	270	N
bis(2-ethylhexyl)phthalate	S	SS	8700 - 8700	4600	3990	Y
carbazole	S	SS	37 - 56	3200	56	N
chrysene	S	SS	46 - 580	8800	401	N
di-n-butylphthalate	S	SS	51 - 64	780000	64	N
di-n-octylphthalate	S	SS	62 - 62	160000	62	N
dibenz(a,h)anthracene	S	SS	62 - 62	8	62	Y
fluoranthene	S	SS	75 - 770	310000	660	N
fluorene	S	SS	50 - 50	310000	50	N
indeno(1,2,3-cd)pyrene	S	SS	80 - 190	88	190	Y
phenanthrene	S	SS	41.5 - 420	310000	420	N
pyrene	S	SS	72 - 750	310000	552	N
tetrabutyltin	S	SS	11.4 - 11.4		11.4	NA
tributyltin	S	SS	2.1 - 6.9	230	6.9	N
toluene	V	SS	1 - 1.5	1600000	1.5	N
TPH	V	SS	61 - 320		320	NA
xylene (total)	V	SS	3 - 3	16000000	3	N

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG
SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.
COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.
LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE 1994

TABLE 6-21

SELECTION OF COPCS IN SUBSURFACE SOIL - BUILDING 234

SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD

NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	SB	1690 - 23300	7800	12400	Y
arsenic, total	M	SB	1.2 - 42	0.043	25.3	Y
barium, total	M	SB	3.1 - 33.6	550	19.3	N
beryllium, total	M	SB	0.2 - 0.67	0.015	0.364	Y
cadmium, total	M	SB	0.6525 - 0.97	3.9	0.437	N
calcium, total	M	SB	322 - 5190		1750	NA
chromium	M	SB	2.2 - 60.2	39	27.2	Y
cobalt, total	M	SB	1.1 - 25	470	13	N
copper, total	M	SB	4.1 - 46.1	310	29.9	N
iron, total	M	SB	4060 - 50000	2300	30900	Y
lead, total	M	SB	1.5 - 75	400	27.6	N
magnesium, total	M	SB	534 - 8600		4500	NA
manganese, total	M	SB	78.6 - 2450	180	651	Y
mercury, total	M	SB	0.06 - 0.06	2.3	0.0302	N
nickel, total	M	SB	2.3 - 48.1	160	26.9	N
potassium, total	M	SB	108 - 593		393	NA
selenium, total	M	SB	0.81 - 1.4	39	0.55	N
silver, total	M	SB	1.6 - 1.6	39	0.726	N
sodium, total	M	SB	14.5 - 353		81.9	NA
vanadium, total	M	SB	4.4 - 19.6	55	15.1	N
zinc, total	M	SB	10 - 158	2300	88.9	N
heptachlor	P	SB	4 - 4	14	1.59	N
2-methylnaphthalene	S	SB	66 - 14000	310000	4200	N
anthracene	S	SB	900 - 900	2300000	623	N
benz(a)anthracene	S	SB	48 - 133.5	88	134	Y
benzo(a)pyrene	S	SB	41.5 - 129	8.8	129	Y
benzo(b)fluoranthene	S	SB	80 - 150	88	150	Y
benzo(g,h,i)perylene	S	SB	45 - 45		45	NA
benzo(k)fluoranthene	S	SB	68 - 68	880	68	N
bis(2-ethylhexyl)phthalate	S	SB	22000 - 22000	4600	5670	Y
chrysene	S	SB	47.5 - 131	8800	131	N
di-n-butylphthalate	S	SB	50 - 50	780000	50	N
fluoranthene	S	SB	93 - 130	310000	130	N
fluorene	S	SB	2100 - 2100	310000	905	N
indeno(1,2,3-cd)pyrene	S	SB	41 - 41	88	41	N
naphthalene	S	SB	2200 - 2200	310000	927	N
phenanthrene	S	SB	51 - 4800		2220	NA
pyrene	S	SB	87 - 460	230000	460	N
tetrabutyltin	S	SB	2.9 - 2.9		2.9	NA
1,2-dichloroethene (total)	V	SB	3 - 3	70000	3	N
benzene	S	SB	1 - 1	2200	1	N
ethylbenzene	V	SB	66 - 66	780000	15	N
toluene	V	SB	1 - 1	1600000	1	N
TPH	V	SB	54.25 - 2200		694	NA
trichloroethene	V	SB	3 - 3	5800	3	N
xylene (total)	V	SB	150 - 150	16000000	26	N

UNITS FOR INORGANICS ARE IN MG/KG, UNITS FOR ORGANICS ARE IN UG/KG

SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.

COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.

LEAD SCREENING VALUE OF 400 MG/KG IS FROM OSWER DIRECTIVE, 1994

TABLE 6-22
SELECTION OF COPCS IN GROUNDWATER - BUILDING 234
SITE ASSESSMENT SCREENING EVALUATION - FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

CHEMICAL	ANALYTE TYPE	MEDIUM	SITE SAMPLES RANGE OF DETECTED CONCENTRATION	SCREENING VALUE	REPRESENTAIVE CONCENTRATION	SELECTED AS COPC
aluminum, total	M	GW	1010 - 1010	3700	1010	N
arsenic, total	M	GW	15.6 - 15.6	0.005	15.6	Y
barium, total	M	GW	99.3 - 99.3	260	99.3	N
calcium, total	M	GW	28400 - 42000		42000	NA
chromium	M	GW	30.3 - 57.6	18	57.6	Y
copper, total	M	GW	5.9 - 5.9	150	5.9	N
iron, total	M	GW	2600 - 5660	1100	5660	Y
magnesium, total	M	GW	6530 - 12800		12800	NA
manganese, total	M	GW	830 - 3410	84	3410	Y
potassium, total	M	GW	3990 - 7650		7650	NA
sodium, total	M	GW	45000 - 103000		103000	NA
1,2-dichloroethene (total)	V	GW	13 - 13	5.5	13	Y
trichloroethene	V	GW	3 - 4	1.6	4	Y

UNITS ARE IN UG/L

SCREENING VALUES ORIGINATE FROM EPA REGION 3 RBCS FOR RESIDENTIAL EXPOSURE, TAP WATER INGESTION, ADJUSTED TO A CANCER RISK LEVEL OF 1E-07 OR A NONCANCER HAZARD QUOTIENT OF 0.1.

COPC SELECTION IS BASED ON A COMPARISON OF MAXIMUM DETECTED CONCENTRATION TO THE SCREENING VALUE.

TABLE 6-23

DOSE-RESPONSE PARAMETERS - POTENTIAL CHEMICALS OF CONCERN
SITE ASSESSMENT SCREENING EVALUATION
FORMER ROBERT E. DERECKTOR SHIPYARD
NETC NEWPORT, RHODE ISLAND

Substance	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												
Aluminum	1.00E+00	–	–	–	–	–	–	–	–	–	–	–
Arsenic (total)	3.00E-04	S	–	–	–	1.50E+00	Skin - humans	A	–	1.51E+01	Lung - Occupational	A
Beryllium	5.00E-03	–	–	–	–	4.30E+00	Various - rats	B2	–	8.40E+00	Lung - Occupational	B2
Chromium (VI)	5.00E-03	K	–	–	–	–	–	–	–	4.20E+01	Lung - Occupational	A
Iron	3.00E-01 E	L, P	–	–	–	–	–	–	–	–	–	–
Manganese	2.30E-02	CNS	–	1.43E-05	CNS	–	–	–	–	–	–	–
PESTICIDES/PCBs												
Aldrin	3.00E-05	L	–	–	–	1.70E+01	Liver - mice	B2	–	1.71E+01		B2
Aroclor-1254	2.00E-05	S, H, RS	1.00E-05	–	–	2.00E+00	Liver - rats	B2	4.00E+00	–	–	B2
Aroclor 1260	–	–	–	–	–	2.00E+00	Liver - rats	B2	4.00E+00	–	–	B2
Dieldrin	5.00E-05	RS	–	–	–	1.6E+01	Liver - mice	B2	–	1.6E+01	Various - mice/rats	B2
SEMIVOLATILE ORGANIC COMPOUNDS												
Benz(a)anthracene	–	–	–	–	–	7.30E-01	Various - mice/rats	B2	–	6.10E-01	Various - mice/rats	B2
Benzo(a)pyrene	–	–	–	–	–	7.30E+00 E	Various - mice/rats	B2	–	6.10E+00	Various - mice/rats	B2
Benzo(b)fluoranthene	–	–	–	–	–	7.30E-01	Various - mice/rats	B2	–	6.10E-01	Various - mice/rats	B2
Benzo(k)fluoranthene	–	–	–	–	–	7.30E-02	Various - mice/rats	B2	–	6.10E-02	Various - mice/rats	B2
Bis(2ethylhexylphthalate)	2.00E-02	L	–	–	–	1.40E-02	Liver - mice	B2	–	–	–	B2
Dibenz(a,h)anthracene	–	–	–	–	–	7.30E+00	Various - mice/rats	B2	–	6.10E+00	Various - mice/rats	B2
Indeno(1,2,3-cd)pyrene	–	–	–	–	–	7.30E-01	Various - mice/rats	B2	–	6.10E-01	Various - mice/rats	B2
VOLATILE ORGANIC COMPOUNDS												
1,2-Dichloroethene (Total)	9.00E-03	L	–	–	–	–	–	–	–	–	–	–
Trichloroethene	6.00E-03	L, K	–	–	–	1.1E-02 W	Liver, Kidney	C-B2	–	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
$AT_{non\text{-}cancer}$	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. DERECKTOR 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
$AT_{non\text{-}cancer}$	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
IR_{soil}	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
$AT_{non\text{-}cancer}$	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
$AT_{non\text{-}cancer}$	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
$AT_{non\text{-}cancer}$	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
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					
Incidential Ingestion	NA	6.77E-07	8.58E-07	NA	9.28E-06
Dermal Contact	NA	8.44E-09	7.69E-09	NA	4.63E-08
Inhalation of Fugitive Dust	NA	1.67E-12	1.21E-12	NA	4.58E-11
Subtotal	NA	6.86E-07	8.65E-07	NA	9.33E-06
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	6.86E-07	8.65E-07	NA	9.33E-06
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	NA	1.08E-02	2.35E-02	NA	1.12E-01
Dermal Contact	NA	*	*	NA	*
Inhalation of Fugitive Dust	NA	4.63E-07	5.79E-07	NA	9.65E-06
Subtotal	NA	1.08E-02	2.35E-02	NA	1.12E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	1.08E-02	2.35E-02	NA	1.12E-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 6-31
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					
Incidential Ingestion	NA	4.73E-06	5.99E-06	NA	6.48E-05
Dermal Contact	NA	2.50E-05	2.27E-05	NA	1.37E-04
Inhalation of Fugitive Dust	NA	3.00E-12	2.17E-12	NA	8.24E-11
Subtotal	NA	2.97E-05	2.87E-05	NA	2.02E-04
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	2.97E-05	2.87E-05	NA	2.02E-04
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	NA	1.95E-02	4.27E-02	NA	2.03E-01
Dermal Contact	NA	*	*	NA	*
Inhalation of Fugitive Dust	NA	5.97E-07	7.46E-07	NA	1.24E-05
Subtotal	NA	1.95E-02	4.27E-02	NA	2.03E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	1.95E-02	4.27E-02	NA	2.03E-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 - SOUTH 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					
Incidential Ingestion	NA	8.78E-07	1.11E-06	NA	1.20E-05
Dermal Contact	NA	7.46E-09	6.79E-09	NA	4.09E-08
Inhalation of Fugitive Dust	NA	1.31E-11	9.50E-12	NA	3.60E-10
Subtotal	NA	8.86E-07	1.12E-06	NA	1.21E-05
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	8.86E-07	1.12E-06	NA	1.21E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	NA	2.19E-02	4.79E-02	NA	2.28E-01
Dermal Contact	NA	*	*	NA	*
Inhalation of Fugitive Dust	NA	5.30E-07	6.62E-07	NA	1.10E-05
Subtotal	NA	2.19E-02	4.79E-02	NA	2.28E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	2.19E-02	4.79E-02	NA	2.28E-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 - BUILDING 234
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					
Incidential Ingestion	NA	1.08E-06	1.36E-06	NA	1.48E-05
Dermal Contact	NA	7.71E-09	7.01E-09	NA	4.22E-08
Inhalation of Fugitive Dust	NA	7.17E-12	5.19E-12	NA	1.96E-10
Subtotal	NA	1.08E-06	1.37E-06	NA	1.48E-05
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	1.08E-06	1.37E-06	NA	1.48E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	NA	2.09E-02	4.57E-02	NA	2.18E-01
Dermal Contact	NA	*	*	NA	*
Inhalation of Fugitive Dust	NA	8.33E-07	1.04E-06	NA	1.73E-05
Subtotal	NA	2.09E-02	4.57E-02	NA	2.18E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Inhalation of Fugitive Dust	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	NA
Subtotal	NA	NA	NA	NA	NA
TOTAL	NA	2.09E-02	4.57E-02	NA	2.18E-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 - FUTURE 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					
Incidential Ingestion	2.59E-05	4.22E-07	5.34E-07	NA	5.78E-06
Dermal Contact	1.69E-07	6.61E-09	6.02E-09	NA	3.63E-08
Inhalation of Fugitive Dust	4.06E-12	1.01E-12	7.27E-13	NA	2.76E-11
Subtotal	2.61E-05	4.28E-07	5.40E-07	NA	5.82E-06
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	9.92E-08	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	3.58E-13	NA
Subtotal	NA	NA	NA	9.92E-08	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	3.52E-05
Dermal Contact	NA	NA	NA	NA	1.42E-07
Subtotal	NA	NA	NA	NA	3.54E-05
TOTAL	2.61E-05	4.28E-07	5.40E-07	9.92E-08	4.12E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	1.10E+00	8.08E-03	1.77E-02	NA	8.42E-02
Dermal Contact	*	*	*	NA	*
Inhalation of Fugitive Dust	2.55E-06	3.71E-07	4.64E-07	NA	7.73E-06
Subtotal	1.10E+00	8.08E-03	1.77E-02	NA	8.42E-02
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	5.20E-02	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	*	NA
Subtotal	NA	NA	NA	5.20E-02	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	3.30E-01
Dermal Contact	NA	NA	NA	NA	1.21E-03
Subtotal	NA	NA	NA	NA	3.32E-01
TOTAL	1.10E+00	8.08E-03	1.77E-02	5.20E-02	4.16E-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 - 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					
Incidential Ingestion	2.87E-04	4.67E-06	5.92E-06	NA	6.40E-05
Dermal Contact	6.39E-04	2.50E-05	2.27E-05	NA	1.37E-04
Inhalation of Fugitive Dust	1.14E-11	2.82E-12	2.04E-12	NA	7.74E-11
Subtotal	9.26E-04	2.97E-05	2.87E-05	NA	2.01E-04
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	2.70E-07	NA
Dermal Contact	NA	NA	NA	3.01E-10	NA
Inhalation of Fugitive Dust	NA	NA	NA	1.04E-12	NA
Subtotal	NA	NA	NA	2.71E-07	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	1.51E-04
Dermal Contact	NA	NA	NA	NA	6.19E-07
Subtotal	NA	NA	NA	NA	1.52E-04
TOTAL	9.26E-04	2.97E-05	2.87E-05	2.71E-07	3.53E-04
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	2.61E+00	1.92E-02	4.19E-02	NA	2.00E-01
Dermal Contact	*	*	*	NA	*
Inhalation of Fugitive Dust	4.66E-06	6.76E-07	8.45E-07	NA	1.41E-05
Subtotal	2.61E+00	1.92E-02	4.19E-02	NA	2.00E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	1.03E-01	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	4.39E-06	NA
Subtotal	NA	NA	NA	1.03E-01	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	1.24E+00
Dermal Contact	NA	NA	NA	NA	5.08E-03
Subtotal	NA	NA	NA	NA	1.24E+00
TOTAL	2.61E+00	1.92E-02	4.19E-02	1.03E-01	1.44E+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 6-36
CUMULATIVE RISKS - FUTURE EXPOSURE - SOUTH 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					
Incidential Ingestion	5.39E-05	8.78E-07	1.11E-06	NA	1.20E-05
Dermal Contact	1.91E-07	7.46E-09	6.79E-09	NA	4.09E-08
Inhalation of Fugitive Dust	5.30E-11	1.31E-11	9.50E-12	NA	3.60E-10
Subtotal	5.41E-05	8.86E-07	1.12E-06	NA	1.21E-05
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	2.25E-07	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	8.54E-13	NA
Subtotal	NA	NA	NA	2.25E-07	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NS
Dermal Contact	NA	NA	NA	NA	NS
Subtotal	NA	NA	NA	NA	NS
TOTAL	5.41E-05	8.86E-07	1.12E-06	2.25E-07	1.21E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	2.98E+00	2.19E-02	4.79E-02	NA	2.28E-01
Dermal Contact	*	*	*	NA	*
Inhalation of Fugitive Dust	3.65E-06	5.30E-07	6.62E-07	NA	1.10E-05
Subtotal	2.98E+00	2.19E-02	4.79E-02	NA	2.28E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	9.58E-02	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	5.59E-06	NA
Subtotal	NA	NA	NA	9.58E-02	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	NS
Dermal Contact	NA	NA	NA	NA	NS
Subtotal	NA	NA	NA	NA	NS
TOTAL	2.98E+00	2.19E-02	4.79E-02	9.58E-02	2.28E-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 6-37
CUMULATIVE RISKS - FUTURE EXPOSURE - BUILDING 234
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					
Incidential Ingestion	7.22E-05	1.18E-06	1.49E-06	NA	1.61E-05
Dermal Contact	4.19E-07	1.64E-08	1.49E-08	NA	8.99E-08
Inhalation of Fugitive Dust	4.19E-11	1.04E-11	7.52E-12	NA	2.85E-10
Subtotal	7.26E-05	1.19E-06	1.50E-06	NA	1.62E-05
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	3.28E-07	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	3.70E-12	NA
Subtotal	NA	NA	NA	3.28E-07	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	4.10E-05
Dermal Contact	NA	NA	NA	NA	1.68E-07
Subtotal	NA	NA	NA	NA	4.11E-05
TOTAL	7.26E-05	1.19E-06	1.50E-06	3.28E-07	5.73E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	2.57E+00	1.89E-02	4.14E-02	NA	1.97E-01
Dermal Contact	1.93E-02	8.52E-04	1.34E-03	NA	3.55E-03
Inhalation of Fugitive Dust	4.55E-06	6.61E-07	8.26E-07	NA	1.38E-05
Subtotal	2.59E+00	1.98E-02	4.27E-02	NA	2.01E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	1.18E-01	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	6.81E-06	NA
Subtotal	NA	NA	NA	1.18E-01	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	1.14E+00
Dermal Contact	NA	NA	NA	NA	4.63E-03
Subtotal	NA	NA	NA	NA	1.14E+00
TOTAL	2.59E+00	1.98E-02	4.27E-02	1.18E-01	1.34E+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 6-38
CUMULATIVE RISKS - CURRENT AND FUTURE SCENARIO - BACKGROUND
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					
Incidential Ingestion	5.29E-05	8.61E-07	1.09E-06	NA	1.18E-05
Dermal Contact	*	*	*	NA	*
Inhalation of Fugitive Dust	2.53E-10	6.33E-12	4.58E-12	NA	1.74E-10
Subtotal	5.29E-05	8.61E-07	1.09E-06	NA	1.18E-05
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	4.77E-07	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	3.25E-12	NA
Subtotal	NA	NA	NA	4.77E-07	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	5.19E-05
Dermal Contact	NA	NA	NA	NA	2.13E-07
Subtotal	NA	NA	NA	NA	5.21E-05
TOTAL	5.29E-05	8.61E-07	1.09E-06	4.77E-07	6.39E-05
HAZARD INDEX					
Surface Soil					
Incidential Ingestion	2.42E+00	1.78E-02	3.90E-02	NA	1.86E-01
Dermal Contact	*	*	*	NA	*
Inhalation of Fugitive Dust	1.50E-04	2.20E-06	2.75E-06	NA	4.59E-05
Subtotal	2.42E+00	1.78E-02	3.90E-02	NA	1.86E-01
Subsurface Soil					
Incidential Ingestion	NA	NA	NA	1.53E-01	NA
Dermal Contact	NA	NA	NA	*	NA
Inhalation of Fugitive Dust	NA	NA	NA	7.81E-06	NA
Subtotal	NA	NA	NA	1.53E-01	NA
Groundwater					
Incidential Ingestion	NA	NA	NA	NA	1.38E+00
Dermal Contact	NA	NA	NA	NA	5.27E-03
Subtotal	NA	NA	NA	NA	1.38E+00
TOTAL	2.42E+00	1.78E-02	3.90E-02	1.53E-01	1.57E+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

7.0 ECOLOGICAL ASSESSMENT

An ecological assessment for the Derecktor Shipyard was conducted to ascertain if viable complete 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 whether ecological exposure pathways potentially associated with the site warrant conducting additional studies and preparing a formal terrestrial ecological risk assessment. In addition, the ecological assessment was conducted based on current conditions at the site, particularly regarding the location and extent of exposed surface soil areas, and was not intended to address possible future ecological exposure scenarios resulting from changes to the existing conditions.

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 description of the site contained in Section 4.5 of this report, the following general characteristics of the site should be emphasized: very limited and fragmented presence of natural wildlife habitat and native vegetation; small size of the vegetated areas and their general encirclement by paved and constructed areas; presence of stockpiles of excavated material and construction debris; absence of areas of natural wildlife habitat and native vegetation in the surrounding area; presence of an adjoining highway; and location of the site within an industrial/residential area. These characteristics, which translate into the limited natural habitat value of the site, were determinants in the approach and conclusions of this ecological assessment.

The following subsections identify and discuss the potential terrestrial wildlife habitats and ecological receptors present at the site.

7.1.1 Site Areas and Potential Terrestrial Wildlife Habitats

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 of minimal natural wildlife habitat value.

As previously indicated, the site was divided into four areas: North Waterfront, Central Shipyard, Building 234 Area, and South Waterfront.

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 Area 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 several slender (3 to 10 feet wide) and fragmented dune/beach strips situated along the shoreline of 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 that 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 in a drainage swale located 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 Sections 4.5, 7.1 and 7.1.1, the site provides minimal natural wildlife habitat, which is expected to significantly limit the range of wildlife species that use the site for cover, foraging, and/or nesting/breeding areas.

A brief discussion follows the general feeding habits and habitat requirements of the terrestrial vertebrate species that were actually observed at the site, or of which clear signs were detected (see Section 4.5). Given the limited natural habitat value of the site, only these wildlife species were considered to 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 the case of birds, the probable residency status of each species in relation to the site has also been indicated.

MAMMALS

White-footed mouse (*Peromyscus leucopus*), observed - Omnivore, granivore; preferred habitat ranges from interiors and edges of forests to clearcuts, pastures, and buildings.

Eastern cottontail (*Sylvilagus floridanus*), observed - Herbivore; herbaceous and shrubby vegetation represent the preferred habitat; dense woods are avoided.

Eastern chipmunk (*Tamias striatus*), observed - Granivore, omnivore; tree or shrub vegetation with abundant undergrowth cover represent the preferred habitat.

Raccoon (*Procyon lotor*), signs detected - Opportunistic omnivore; preferred habitats are wooded areas interrupted by fields, water courses, and wetlands near human habitation.

Domestic cat (*Felis domestica*), observed - This is a domesticated carnivore that is not considered to represent a wildlife species and, therefore, will not be addressed further.

BIRDS

Herring gull (*Larus argentatus*), observed - Carnivore, scavenger; feeding on the surface and shoreline of water bodies, and at landfills. The site is located within the permanent geographical range of this species.

Ring-billed gull (*Larus delawarensis*), observed - Insectivore and vermivore, occasionally consuming bird eggs and mice; also scavenger; found near water bodies. The site is located within the winter geographical range of this species.

Black-capped chickadee (*Parus atricapillus*), observed - Omnivore, insectivore; habitats include heavily forested woodlands, residential areas, and city parks, with available dead standing trees for nesting. The site is located within the permanent geographical range of this species.

American crow (*Corvus brachyrhynchos*), observed - 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. The site is located within the permanent geographical range of this species.

Barn swallow (*Hirundo rustica*), observed - Mainly insectivore (flying insects), occasional frugivore; found in rural areas and farmlands, often in association with barns and other buildings suitable for nesting. The site is located within the geographical range reported for the breeding period of this species.

Tree swallow (*Tachycineta bicolor*), observed - 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. The site is located within the geographical range reported for the breeding period of this species.

Chimney swift (*Chaetura pelagica*), observed - Insectivore (flying insects); found in the vicinity of buildings, in which it nests. The site is located within the geographical range reported for the breeding period of this species.

American goldfinch (*Carduelis tristis*), observed - Omnivore, granivore; preferred habitat includes open weedy fields, with scattered woody growth for nesting. The site is located within the permanent geographical range of this species.

American robin (*Turdus migratorius*), observed - Omnivore; found in habitats ranging from open woodlands to orchards and fields; preferred feeding habitat includes grassy fields, lawns, gardens and orchards. The site is located within the permanent geographical range of this species.

Brown-headed cowbird (*Molothrus ater*), observed - 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. The site is located within the permanent geographical range of this species.

Purple finch (*Carpodacus purpureus*), observed - Mostly granivore, but also consumes other plant material and some invertebrates; found in open woodlands, forest edges, parks, and residential areas. The site is located within the permanent geographical range of this species.

Northern mockingbird (*Mimus polyglottos*), observed - Mainly frugivore, feeding also on seeds and insects; found in woodland edges and in pastures, with a scattered variety of fruit-bearing vegetation. The site is located within the permanent geographical range of this species.

Gray catbird (*Dumetella corolinensis*), observed - Frugivore and insectivore; preferred habitat is low dense woody vegetation along woodland borders, water bodies, and buildings. The site is located within the geographical range reported for the breeding period of this species.

Cedar waxwing (*Bombycilla cedrorum*), observed - 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. The site is located within the permanent geographical range of this species.

Common grackle (*Quiscalus quiscula*), observed - Omnivore; preferred feeding habitats are open fields, lawns, and shores of ponds. The site is located within the permanent geographical range of this species.

Northern cardinal (*Cardinalis cardinalis*), observed - 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. The site is located within the permanent geographical range of this species.

Great egret (*Casmerodius albus*), observed (off-shore) - Carnivore (Martin *et al.*, 1951); habitats include marshes, ponds, shores, and mud flats (Peterson, 1980). The site is located within the geographical range reported for this species during the summer period; a localized breeding area may be situated within the same general geographical area of the site (Peterson, 1980).

Double-crested cormorant (*Phalacrocorax auritus*), observed (off-shore) - Carnivore (Martin *et al.*, 1951); habitats include coast, islands, bays, lakes, and rivers (Peterson, 1980). The site is located within the geographical range reported for this species during the summer period; a localized breeding area may be situated within the same general geographical area of the site (Peterson, 1980).

Mallard duck (*Anas platyrhynchos*), observed (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. The site is located within the permanent geographical range of this species.

Black-crowned night-heron (*Nycticorax nycticorax*), observed (on pier) - Carnivore; found in fresh, brackish, and salt water areas; during the winter, commonly found in coastal wetlands and islands. The site is located within the permanent geographical range of this species.

REPTILES

Eastern garter snake (*Thamnophis sirtalis sirtalis*), observed - Mostly vermivore, feeding also on other invertebrates and small vertebrates; terrestrial, ubiquitous, found in almost all damp environments.

According to the USFWS (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. Therefore, as previously indicated, the ecological assessment was conducted based on current conditions and was not intended to address possible future ecological exposure scenarios resulting from changes to the existing conditions.

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 is a list of the exposed surface soil sample locations identified for each of the four areas of the site and for the upgradient off-site area. All surface soil sample depths were 0 to 1 feet, except at the following sample locations: location TP24 (1 to 2 feet), location MW05 (0.5 to 1.5 feet), and upgradient off-site locations (0 to 2 feet).

Site Area	Exposed Surface Soil Sample Locations
North Waterfront	TP16, TP18, TP24, 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

A brief description of the setting of each of these exposed surface soil sample locations is provided below:

North Waterfront	TP16	barren soil at the edge of asphalt, where an above-ground storage tank was previously located
	TP18	barren soil in area where asphalt had been removed
	TP24	small grassy/weedy area
	TP28	narrow island of grassy/weedy vegetation bordered by a parking lot and roadway
Central Shipyard	MW05	barren sand and gravel mixture, deposited after sandblast removal action in 1995
	MW07	early successional grassland/invasive weed area of approximately 1 acre
	TP11	early successional grassland/invasive weed area of approximately 1 acre
	TP12	disturbed barren soil with gravel, adjacent to a roadway
	TP14	weedy area at edge of shrub vegetation
	TP15	disturbed barren fill material, in an area where above-ground storage tanks were previously located
	TP17	barren soil
Building 234 Area	MW09	weedy area, with soil, gravel and rocks
	TP07	grassy/weedy area, with gravel, rocks and debris
	TP08	grassy/weedy area, with gravel, rocks and debris
	TP09	island of grassy/weedy vegetation bordered by roadway and railroad right-of-way
	TP10	island of grassy/weedy vegetation bordered by roadway and railroad right-of-way
South Waterfront	TP01 through TP06 located in stockpiled soils and construction debris, with invasive herbaceous and shrub vegetation; debris and general disturbance are more prominent towards sample location TP05 and TP06	
Upgradient Off-Site Area	MW01 and MW10 located in cultivated lawn areas	

Figure 4-13 shows Test Pits 13 and 25 in exposed soils north and east of Building 42, however these soils are comprised of crushed stone and sand which was placed in this area after removal of blasting sand in 1995. Because this material is clean fill placed after a removal action, it is not appropriate to evaluate these samples representative of potential exposure areas.

7.2.2 Identification of Contaminants of Potential Ecological Concern

To identify the COPECs from the analytes detected in the exposed surface soil samples collected at the former Derecktor Shipyard, a screening of detected analyte concentrations was performed against appropriate ecological soil benchmarks. The benchmark values selected for the screening process are presented on Table 7-1. These benchmarks were selected from numerous literature and database sources, in which primary support references are cited for the selected benchmark values. Although benchmark values were identified for most of the analytes detected at the site, appropriate benchmarks could not be identified for some analytes based on the available sources of information.

In certain cases, as indicated on Table 7-1, the benchmark value selected for a compound was also used as a surrogate for another, chemically-related compound. Also, as noted on Table 7-1, there were a few instances in which the benchmark selected for an analyte was derived from a solution concentration (on ppb or ppm equivalence) with a toxicological basis. This approach was considered appropriate under the conservative assumption that the analyte present in the soil sample from the site could potentially dissolve entirely into the soil solution and, therefore, its concentration could be comparable to a solution-based benchmark value.

If the site concentration of an analyte exceeded the corresponding benchmark concentration, then the analyte was considered to represent a COPEC for the site. The fate, transport, and ecotoxicological characteristics of such COPECs are discussed in Section 7.2.3. In the cases where appropriate benchmarks were not available for specific analytes, those analytes were also considered to represent COPECs and their characteristics are also discussed in Section 7.2.3.

Although an appropriate screening ecological benchmark was not available for the general parameter of total petroleum hydrocarbons (TPH), benchmarks were available for various individual analytes that are commonly encompassed by the TPH parameter, particularly polynuclear aromatic hydrocarbons (PAHs), benzene, toluene, and xylenes. It should be noted that the specific mixture of compounds that is measured under TPH may vary because this parameter is defined by the method used in its determination. Therefore, ecotoxicological discussions for specific individual analytes are more

appropriate and relevant than ecotoxicological discussions based on the general TPH parameter and, thus, this parameter was not considered to represent a COPEC in this assessment.

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 exposed surface soil samples was conducted considering samples individually to maintain a greater degree of flexibility and ecological relevance on the interpretation of the data. For specific sampling locations where duplicate samples were collected, the analytical results represent the averages of the two corresponding samples for each location. In the calculation of such averages, half of the sample quantitation/detection limit was considered in instances where analytical results indicated no detection.

Table 7-2 presents the concentrations of the analytes detected in the exposed surface soil samples at the site, as well as the corresponding benchmark values and upgradient off-site concentrations. For each of the sample locations within the individual site areas, this table identifies (in bold print) the detected analyte concentrations that exceeded the corresponding benchmark values. The analytes that exceeded benchmark values were all metals and, for the site in general, included: aluminum, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc. These analytes, together with those organic compounds for which appropriate screening benchmarks were not available (see Table 7-1), are considered to represent the overall COPECs for the site and, as indicated earlier, their fate, transport, and ecotoxicological characteristics are discussed in Section 7.2.3 below.

The analytes for which appropriate screening benchmarks were not available, and thus were considered COPECs, included the following organic compounds: 2-butanone; acetone; 2,2-oxybis(1-chloropropane); 2-methylphenol; 4-methylphenol; carbazole; chlordane (alpha and gamma); endrin; endrin ketone; methoxychlor; and Aroclor-1260. However, it should be noted that, in general, these analytes were detected merely in a few isolated sample locations in the North Waterfront, Central Shipyard and/or Building 234 areas; only Aroclor-1260 was also detected in the South Waterfront area.

Finally, Table 7-2 also identifies the upgradient off-site concentrations that exceeded benchmark values, and identifies (in bold italic print) the site concentrations that exceeded both the corresponding benchmark and maximum upgradient off-site concentrations. As can be seen on this table, various metals that were detected at the upgradient off-site locations exceeded their corresponding benchmarks. It should be noted that, in general, the off-site terrain to the east of the site represents

an upgradient adjoining industrial/residential area from which contaminants can potentially migrate into the site.

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, several organic compounds for which appropriate screening benchmarks were not available, together with 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 contains a comprehensive discussion of fate and transport characteristics for the overall contamination present at the site.

2-Butanone

An appropriate screening benchmark supported by a primary reference was not found for 2-butanone in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the North Waterfront area, where it was detected at sample location TP24.

2-Butanone is also known as methyl ethyl ketone or MEK. This compound is used in large quantities in various industries, particularly as a solvent for lacquers, adhesives, rubber cement, printing inks, paint removers and cleaning solutions, and as a catalyst and carrier. Stack and fugitive emissions, as well as wastewater associated with industrial uses of the compound, represent release sources into the environment. In addition, MEK may be a product of photooxidation reactions in polluted air, and may be released by the combustion of gasoline and tobacco. Natural sources of MEK include volcanos, forest fires, and processes of biological degradation. MEK released to the soil will partially evaporate into the atmosphere from near-surface soil and may leach into groundwater (Howard, 1990). Because of its high water solubility, volatilization of MEK from wet soil is probably limited. MEK has a low octanol/water partition coefficient and, therefore, is probably not readily adsorbed to soil particles (Clement Associates, 1985). MEK generally does not significantly hydrolyze in soil; however, slow biodegradation of this compound in soil and groundwater has been reported in screening studies (Howard, 1990). High doses of MEK may affect the nervous system and cause irritation of the eyes, nose, and skin. An LD-50 of 2,750,000 μg/kg has been reported for the rat (Clement Associates, 1985).

Acetone

An appropriate screening benchmark supported by a primary reference was not found for acetone in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the North Waterfront area, where it was detected at sample locations TP18 and TP24.

Acetone is produced in large quantities and used in numerous industries. Acetone may be released into the environment as stack and fugitive emissions, and in wastewater associated with its production and industrial uses. Acetone may also be a product of photooxidation reactions in polluted air, and may be emitted by the combustion of wood and tobacco. Acetone has been identified in vegetation and insects as a naturally occurring metabolite. Volcanos and forest fires are other natural sources of acetone emissions. Acetone released onto soil will volatilize and may also leach into the groundwater. Evidence exists suggesting that acetone biodegrades fairly rapidly in soils (Howard, 1990). Acetone is highly soluble in water and has a low octanol/water partition coefficient; therefore, acetone is probably not readily adsorbed to soil particles (Clement Associates, 1985).

Acetone did not show evidence of causing teratogenic effects in a chicken egg injection study. Rats consuming acetone doses of 18 mg/kg/day for 4 months were reported to show reductions in food consumption and growth. Modified avoidance and escape behaviors have also been reported in rats exposed to acetone in air for a period of 2 weeks (Clement Associates, 1985).

2,2'-Oxybis(1-chloropropane)

An appropriate screening benchmark supported by a primary reference was not found for 2,2'-oxybis(1-chloropropane) in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the North Waterfront and Central Shipyard areas, where it was detected at sample locations TP18 and TP15, respectively. However, information on fate, transport, and ecotoxicological characteristics specific to this analyte was also not found in available literature and databases.

2-Methylphenol

An appropriate screening benchmark supported by a primary reference was not found for 2-methylphenol in available sources of information. Therefore, it is recognized that the possibility exists

that this analyte may represent a COPEC for the Central Shipyard area, where it was detected at sample location TP17.

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, and it 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

An appropriate screening benchmark supported by a primary reference was not found for 4-methylphenol in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the Central Shipyard area, where it was detected at sample location TP17.

4-Methylphenol, also known as 4-cresol, occurs in petroleum, and as a volatile from plants. Artificial release sources of 4-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 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).

Carbazole

An appropriate screening benchmark supported by a primary reference was not found for carbazole in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the North Waterfront, Central Shipyard and Building 234 areas, where it was detected at sample locations TP28, TP15, and TP10, respectively.

Synonyms of carbazole include the following: 9-azafluorene, dibenzopyrrole, and diphenylenimine. The molecular structure of carbazole is very similar to that of the PAH fluorene, with exception of the presence of nitrogen and hydrogen (NH) in the place of CH_2 in between the two benzene rings of the molecule. Carbazole is insoluble in water. Uses of carbazole include: dye intermediate, manufacture of ultraviolet-sensitive photographic plates, and reagent for lignin, carbohydrates, and formaldehyde (Budavari, 1989). Coal tar pitch fumes are a source of carbazole emissions into the air (Verschueren, 1983). Additional information specific to carbazole was not found in available literature and databases.

Chlordane (alpha and gamma)

An appropriate screening benchmark supported by a primary reference was not found for chlordane in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the North Waterfront and Building 234 areas, where it was detected at sample locations TP28 (alpha- and gamma-chlordane) and TP10 (gamma-chlordane), respectively.

Chlordane is an organochlorine pesticide, which has been used on field crops and to control structural pests in homes (Clement Associates, 1985). Technical-grade chlordane is a mixture of various chlorinated hydrocarbons with approximately 24 percent gamma-chlordane, 19 percent alpha-chlordane, 10 percent heptachlor, and 47 percent other closely related chlorinated hydrocarbon compounds (U.S. EPA, 1980a). Chlordane released to soil binds tightly to soil particles and can persist

for long periods of time, with a mean half-life of 3.3 years having been reported. Although chlordane generally is expected to be immobile or only slightly mobile in soil, leaching to groundwater can occur. Thus, chlordane is very persistent in the environment and, apparently, is biotransformed only very slowly (Clement Associates, 1985; Howard, 1991). Atmospheric transport of chlordane vapors and contaminated soil particles can occur (Clement Associates, 1985).

In general, bioconcentration, bioaccumulation, and biomagnification of chlordane are expected to be significant (Howard, 1991; Ney, 1990). Although the potential bioaccumulation of chlordane or oxychlordane (an epoxide metabolite) in terrestrial insectivores is of concern, this pesticide does not appear to be extensively concentrated in the higher trophic levels of terrestrial food chains (Clement Associates, 1985).

Toxicological data indicate that technical-grade chlordane and the individual purified alpha and gamma chlordane isomers exhibit approximately equal toxicity. Toxic effects of chlordane in animals have been associated with impairment in the uptake and utilization of glucose, delay in maturation, tremors and disorientation, and neurotoxicity (U.S. EPA, 1980a). Chlordane has been reported to cause liver tumors in mice, as well as adverse reproductive effects (Clement Associates, 1985). Chlordane has also been implicated in the mortality of wildlife; brain residues of 3.4 ppm and 5.8 ppm have been detected in two red-shouldered hawks and one barn owl, respectively, reportedly killed by chlordane (Peterle, 1991). Mammalian metabolism of the chlordane isomers results in the formation of the metabolite oxychlordane, which is approximately 20 times more toxic than the parent compounds and is extremely persistent in the adipose tissue (U.S. EPA, 1980a).

Endrin and endrin ketone

Appropriate screening benchmarks supported by primary references were not found for endrin or endrin ketone in available sources of information. Therefore, it is recognized that the possibility exists that these analytes may represent COPECs. Endrin was detected at sample location TP16 in the North Waterfront area, while endrin ketone was detected at sample location TP14 in the Central Shipyard area.

Endrin is a cyclodiene pesticide that is an isomer of dieldrin (Clement Associates, 1985). When exposed to light, endrin undergoes isomerization to form endrin ketone (Howard, 1991; U.S. EPA, 1980c). Following is a discussion on the fate, transport, and ecotoxicological characteristics of endrin. However, information specific to endrin ketone was not found in the available literature.

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, and to control 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, 1980c). 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, 1980c).

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, 1980c). Lethal doses of endrin have also been reported for mule deer and domestic goat (Hudson *et al.*, 1984).

Methoxychlor

An appropriate screening benchmark supported by a primary reference was not found for methoxychlor in available sources of information. Therefore, it is recognized that the possibility exists that this analyte may represent a COPEC for the Central Shipyard area, where it was detected at sample location TP14.

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 ovarianectomized females. Methoxychlor has also been reported to act as a neurotoxicant (Peterle, 1991).

Aroclor-1260

An appropriate screening benchmark supported by a primary reference was not found for Aroclor-1260 in available sources of information. Therefore, it is recognized that the possibility exists that this

analyte may represent a COPEC. Aroclor-1260 was detected at sample location TP16 in the North Waterfront area, sample locations TP14 and TP15 in the Central Shipyard area, sample location TP10 in the Building 234 Area, and sample locations TP04 and TP06 in the South Waterfront area.

Aroclors are trademark names 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 LD_{50} 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 in 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).

Cobalt

Cobalt occurs naturally in minerals and rocks. Cobalt is commonly associated with iron minerals. In geochemical cycles, cobalt closely resembles iron and manganese. During weathering, cobalt is relatively mobile in oxidizing acid environments but, due to a high sorption by iron oxides, manganese oxides, clay minerals, and organic matter, cobalt generally does not migrate in a soluble phase. In most soils, the strong and selective adsorption of cobalt by iron oxides is reflected in the general similarity between the levels of iron and cobalt in the soil horizons. However, in soils rich with manganese minerals, the association of cobalt with manganese can dominate over other factors governing cobalt distribution (Kabata-Pendias and Pendias, 1992). Cobalt is an essential element and can be accumulated by plants and animals, though generally not to excessive concentrations. Photolysis, volatilization, and biotransformation are not important environmental fate processes for cobalt. Some atmospheric transport of cobalt and cobalt compounds can occur (Clement Associates, 1985).

Permanent-magnet alloys and high-temperature, high-strength alloys comprise the bulk uses of metallic cobalt. Other metal uses are for cemented tungsten carbides, high-speed steels, and alloyed hard-

facing rods. Salts and driers for lacquers, varnishes, paints, inks, pigments, enamels, glazes, electroplating, and feed represent important nonmetallic uses of cobalt (Patty, 1963).

The natural content of cobalt in soils is inherited from parent materials. Soils over ore deposits, mafic and serpentine rocks, and soils derived from clay deposits contain the highest natural amounts of this metal. Sources of cobalt pollution are related to nonferrous metal smelters and to industrial uses of the metal. Cobalt is also released into the atmosphere from coal and fuel oil burning. Roadside soils and street dusts are known to be enriched in cobalt (Kabata-Pendias and Pendias, 1992).

High levels of readily available cobalt, particularly in polluted soils, can affect plant growth and metabolic functions. The addition of 25 and 50 ppm of cobalt to soil has been reported toxic to rice plants, and a cobalt concentration of 140 μg/l was detected in the soil solution from serpentine soils where oat plants were affected by cobalt toxicity. Cereals are known as the most sensitive plants to high concentrations of cobalt. However, many plants (mainly of the families Cruciferae, Caryophyllaceae, Violaceae, Leguminosae, Boraginaceae, Myrtaceae, and Nyssaceae) grown on some cobalt-enriched soils, such as serpentine soils or soils over cobalt ore bodies, may accumulate large amounts of this metal, apparently developing a tolerance mechanism similar to that occurring in other metalliferous plant species. Notwithstanding, cobalt toxicity to animals attributed to consumption of natural feedstuffs has not been reported (Kabata-Pendias and Pendias, 1992).

Signs of acute poisoning in animals fed cobalt salts may include: diarrhea, loss of appetite, paralysis of the hind legs, albuminuria, anuria, cutaneous vasodilatation, hemorrhages in internal organs, hyperplastic bone marrow, and lowering of the body temperature prior to death (Patty, 1963). Acute toxicity has been reported in chickens at a cobalt concentration of 50 ppm in the diet (approximately 3 mg/kg of body weight) per day, and in sheep at 6 mg/kg of body weight per day. In sheep, however, daily cobalt doses of 3 mg/kg of body weight (approximately 1,000 times the normal daily intake) did not produce toxic effects, even after several weeks (Clement Associates, 1985). Although cobalt and its salts appear to have a cumulative toxic action under conditions in which elimination cannot keep pace with absorption of the metal, there is also some experimental evidence that a tolerance may be developed to cobalt when initial doses are sufficiently low to be well tolerated. Also, the components of the diet of an animal appear to have the potential to modify the toxicity of ingested cobalt (Patty, 1963).

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, and 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 have 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. 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 have 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).

Manganese

Manganese is one of the most abundant trace elements in the lithosphere, and its common range in rocks is 350 to 2,000 ppm, with the highest concentrations usually associated with mafic rocks. During weathering, manganese compounds are oxidized under atmospheric conditions and the released manganese oxides are reprecipitated and readily concentrated in the form of secondary minerals. The behavior of manganese in surficial deposits is governed by several environmental factors, of which Eh-pH conditions are most important. There is a high degree of association of manganese concretions with iron and some heavy metals (particularly Cobalt, nickel, copper, zinc and molybdenum). Manganese is likely to occur in soils as oxides and hydroxides, and it may form a number of simple and complex ions in the soil solution. In soil solutions, manganese is mainly involved in organic complexing, particularly by root exudates and soil microorganisms, which apparently exerts significant control on manganese mobility and bioavailability. Manganese compounds are important soil constituents because this element is essential in plant nutrition and controls the behavior of several other micronutrients (Kabata-Pendias and Pendias, 1992).

Oxidizing conditions in soil may greatly decrease the availability of manganese and associated micronutrients, whereas reducing conditions may lead to the ready availability of these elements even up to the toxic range. Microbiological soil activity is also largely responsible for the oxidation and reduction of manganese compounds, and for the formation of manganese concretions (Kabata-Pendias and Pendias, 1992). The presence of high concentrations of chlorides, nitrates, or sulfates may also increase the solubility and availability of manganese in soils. Lack of sufficient cation exchange sites, which are provided by organic matter or clay, can also result in greater manganese solubility and, thus, increased leaching to groundwater or surface water. In addition, atmospheric transport of manganese fumes or dusts can occur; these materials can then be returned to the ground surface by wet or dry deposition (Clement Associates, 1985).

Manganese is not uniformly distributed in soil substrata and it may be concentrated at certain spots that are usually enriched in several other trace elements. The variation of the natural content of manganese in surface soils is rarely correlated with soil typology, but is positively associated with clay contents. Higher manganese levels are often reported in soils over mafic rocks, and in soils rich in iron and /or organic matter. In addition to accumulating in the soil horizons with high iron oxides or hydroxides, manganese is also usually concentrated in top soils due to its fixation by organic matter (Kabata-Pendias and Pendias, 1992).

Uses of manganese include: as a reagent in steel making and component in special steel alloys; in the manufacture of dry-cell batteries (as MnO_2); as an oxidizing agent in the chemical industry (for the production of $KMnO_4$ and other manganese chemicals); in electric resistance coils (as manganin); in manganese-bronze and in certain alloys with desirable magnetic properties; in glassmaking and ceramics; in manganese salts as drying or oxidizing agents and as a laboratory reagents; in the dyeing, tanning and fertilizer industries; as a chemical catalyst; and as a trace element in animal feeds (Patty, 1963).

Although manganese has not commonly been considered as a polluting metal in soils, increases in the concentration of this metal have been reported in sludge-amended soils, particularly over long periods of sludge application (Kabata-Pendias and Pendias, 1992).

Toxic effects on plants growing on soils with high concentrations of manganese might be expected on acid soils of pH around 5.5 or lower. Manganese may also occur at higher pH levels in poorly drained soils. There are significant differences between plant species in their sensitivities to manganese. Most often, plants growing on acid soils tolerate high manganese concentrations. Tolerance to excess manganese in plants appears to be multigenic and apparently related to iron metabolism. Interactions of manganese with calcium, aluminum, silica, and nitrates have also been reported. Legumes appear to be more sensitive to manganese because its excess affects rhizobia nodule numbers and thus the efficiency of nitrogen fixation (Kabata-Pendias and Pendias, 1992).

The most common symptom of manganese toxicity in plants is iron chlorosis. Other symptoms include leaf puckering, necrotic brown spots, and an uneven distribution of chlorophyll in older leaves. In severely injured plants, browning of roots occurs. Symptoms of manganese toxicity in plants are more pronounced during hot weather (Kabata-Pendias and Pendias, 1992).

The dose level appears to be a determinant factor on the effects of long-term repeated oral administrations of manganese to test animals; manganese in the diet at a concentration of up to 100 ppm has been reported to stimulate growth, while a concentration of 600 ppm has been reported to be deleterious. In addition, the significance of the manganese levels seems to be strongly affected by the composition of the diets, as the relative amounts of other mineral and amino-acid constituents exert considerable effect on the biological activity of manganese. Inhalation exposures of rabbits to MnO_2 dust 4 hours daily for 3 to 6 months at levels of 10 to 20 mg/m^3 resulted in decreased hemoglobin and erythrocites in the blood; in addition, fibrotic changes in the lung resembling those caused by silicosis were observed (Patty, 1963; Clement Associates, 1985). Also, central nervous system effects have been reported in monkeys as a result of chronic inhalation exposure (Clement Associates, 1985).

Mercury

Mercury occurs naturally in the environment; however, human activities have markedly increased the mercury burdens in the environment (Eisler, 1987; 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, 1987; 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, 1987).

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, 1987).

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, 1987). 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, 1987; Peterle, 1991). At low concentrations, mercury reportedly affects reproduction, growth, development, behavior, blood and serum chemistry, motor coordination, vision, hearing, and metabolism (Eisler, 1987). 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, 1987).

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, 1987).

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, 1987).

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, 1987).

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).

Selenium

Selenium is widely distributed in nature, especially in association with sulfide minerals of various metals. The major source of selenium in the environment is the weathering of rocks, particularly Cretaceous sedimentary rocks. Anthropogenic sources of selenium include the combustion of fossil fuels, metal smelting, and agricultural practices. Soil concentrations of selenium rarely exceed 2 μg/g (ppm) dry weight, except in soils derived from sedimentary rock or soils that have been contaminated through human activities. Selenium in soil can reach surface waters when dissolved in drainage waters or via direct runoff of soil particles; also, soluble forms of the metal may leach into groundwater. Selenium can enter the atmosphere through volatilization from soils or through direct release by plants (Eisler, 1985; Lemly and Smith, 1987).

Selenium undergoes several chemical and biochemical transformations in the environment. Selenium in alkaline soils is usually present as soluble selenates, which tend to reduce slowly to less soluble selenites; selenate and selenite forms are readily absorbed by plants, reduced, and incorporated into amino acids (Eisler, 1985). Selenite forms can also adsorb onto clay and the organic carbon phase of particulates, or they can be reduced to elemental selenium (Eisler, 1985; Lemly and Smith, 1987). Elemental selenium is insoluble and largely unavailable to organisms. Hydrogen selenide is highly toxic

and unstable. Selenides of mercury, copper, cadmium, and silver are very insoluble and largely unavailable to organisms. In acid or neutral soils, the amount of biologically available selenium tends to decline steadily; in alkaline soils, selenium tends to remain bioavailable (Eisler, 1985).

Although selenium is an essential micronutrient for plants and animals, concentrations not greatly exceeding those required may produce toxic effects. Selenium can bioconcentrate and bioaccumulate in plants and animals, and undergoes biomagnification in food webs; these processes have been extensively documented, particularly in aquatic systems (Eisler, 1985; Lemly and Smith, 1987). Certain plants, when growing in selenium-rich soils, can accumulate selenium to very high concentrations without ill effects on themselves, but can cause adverse effects on animals feeding on them (Eisler, 1985). Selenium concentrations tend to be significantly higher in organisms from areas with high levels of selenium in soils or sediments; also, concentrations of selenium are higher in top-level predators, as well as in older organisms (Eisler, 1985; Lemly and Smith, 1987). Selenium has been recognized to biomagnify, particularly through aquatic food chains (Suter *et al.*, 1993).

Signs associated with chronic selenosis in birds and mammals include loss of appetite; histological changes in heart, kidney, and spleen; pulmonary congestion; edema; changes in liver chemistry; skin lesions; loss of hair and nails; enlarged organs (spleen, pancreas, and liver); ulceration of the upper intestinal tract; tooth decay; emaciation; reproductive anomalies; teratogenic effects; sudden collapse; and death (Eisler, 1985; U.S. EPA, 1984).

Reduced hatching of eggs has been reported to occur in Japanese quail exposed to dietary selenium at concentrations of 6 and 12 ppm. In adult mallard ducks, 10 ppm of dietary selenium as selenomethionine have reportedly caused reduced egg hatchability; however, 10 ppm of dietary selenium as sodium selenite did not have effects in the hatching of eggs. Mortality has been reported to occur in adult mallards within one month when fed with 100 ppm of dietary selenium (as sodium selenite) (Eisler, 1985).

The minimum toxic concentration of selenium in lifetime exposure of rats, which are considered a comparatively sensitive species, was reported to be 0.35 mg/kg of selenium in the diet as judged by changes in liver chemistry, and 0.75 mg/kg as judged by longevity and histological changes in heart, kidney, and spleen (Eisler, 1985). Based on experiments conducted with rats, a high protein diet apparently provides partial protection against selenium toxicity; thus, selenium toxicity may be greater during the period of maximal growth of the animal when dietary requirements for protein are high (U.S. EPA, 1984).

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 zinc, 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 mostly 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.

It should be noted that 2-butanone and acetone, which were considered as COPECs for the North Waterfront area because of the unavailability of appropriate screening benchmarks, are volatile organic compounds and, thus, inhalation could conceivably represent a viable exposure route to these contaminants for potential wildlife receptors. However, these contaminants were detected in isolated sampling locations associated with areas of minimal or no natural habitat value. 2-Butanone was only detected at sample location TP24, and acetone was detected at sample locations TP24 and TP18. Sample location TP24 is in a small grassy/weedy area, corresponding to an old lawn; sample location TP18 is in a barren soil area from which asphalt was removed.

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 with acceptable certainty 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 have the potential to biomagnify through food webs (such as Aroclor-1260, pesticides, mercury, and nickel) may be significant for receptors at higher trophic levels. However, the minimal natural wildlife habitat value of the site, together with the ample foraging ranges and diversified diets of potential receptors at high trophic levels, are likely to markedly attenuate the possible impacts of biomagnification of such COPECs in relation to the site.

As indicated at the beginning of this section, the ecological assessment conducted for the site was of a qualitative nature and mainly focused on identifying the potential existence of complete ecological exposure pathways. Therefore, the quantitative assessment of ecological risk based on the calculation

of dose-derived hazard quotients for individual target species was beyond the scope of this ecological assessment.

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 mainly 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 include the following analytes that exceeded benchmark concentrations: aluminum, chromium, copper, iron, lead, nickel, vanadium, and zinc (Table 7-3); as well as the following compounds for which a screening benchmark was not available: 2-butanone; acetone; 2,2′-oxybis(1-chloropropane); carbazole; chlordane (alpha and gamma); endrin; and Aroclor-1260.

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 the following analytes which exceeded benchmark concentrations: aluminum, chromium, iron, mercury, selenium, vanadium, and zinc (Table 7-3); as well as the following compounds for which a screening benchmark was not available: 2,2′-oxybis(1-chloropropane); 2-methylphenol; 4-methylphenol; carbazole; Aroclor-1260; endrin ketone, and methoxychlor.

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 the following analytes that exceeded benchmark concentrations: aluminum, chromium, cobalt, iron, lead, manganese, vanadium, and zinc (Table 7-3); as well as the following compounds for which a screening benchmark was not available: carbazole, Aroclor-1260, and gamma-chlordane.

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 several slender (3 to 10 feet wide) and fragmented dune/beach strips situated along the shoreline of Narragansett Bay. COPECs identified for the South Waterfront include the following analytes that exceeded benchmark concentrations: aluminum, chromium, cobalt, copper, iron, lead, mercury, nickel, selenium, vanadium, and zinc (Table 7-3); as well as Aroclor-1260 for which a screening benchmark was not available.

Several metals were detected in one or both of the upgradient off-site sample locations at concentrations that exceeded benchmark values. These metals included aluminum, chromium, cobalt, iron, manganese, vanadium and zinc (Table 7-3). As was the case for the site sample locations, the concentrations of organic compounds detected in the upgradient off-site samples did not exceed any of the corresponding benchmarks available for the COPEC screening process. Organic compounds for which screening benchmarks were unavailable were not detected in the upgradient off-site samples.

In addition to presenting the COPECs that exceeded benchmarks in each of the site areas and in the upgradient off-site area, Table 7-3 also presents the maximum concentrations of these COPECs and the exposed surface soil sample locations in which they were detected.

Taking into consideration the extents of exposed surface soil allows for a more realistic assessment and comparison of the potentials for ecological exposure and associated risk among the four site areas. Therefore, based on the extent of exposed surface soil, the South Waterfront would be the area expected to represent the greatest relative potential for ecological exposure and associated risk at the site.

In the South Waterfront, most of the maximum concentrations of the metal COPECs that exceeded benchmark values were detected in sample locations TP05 and TP04; only the maximum concentration of selenium was detected in sample location TP06, and the only detection of mercury in the South

Waterfront was detected in sample location TP03 (Tables 7-2 and 7-3). 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 herbaceous and shrub vegetation within the South Waterfront.

Therefore, the potential for ecological risk in the South Waterfront seems to be related mostly to the northern half of this site area. Based on the information presented on Tables 7-2 and 7-3, the potential for ecological risk in the South Waterfront appears to be primarily associated with metals, with an additional component of possible risk due to Aroclor-1260 that was detected at trace concentrations in sample locations TP04 and TP06, and for which no screening benchmark was available. With the exception of cobalt and manganese, all of the metal COPECs that exceeded benchmark values in the South Waterfront were detected at one or more locations at concentrations that also exceeded upgradient off-site concentrations. However, the upgradient off-site concentrations of several metals were above concentrations detected at several other of the South Waterfront sample stations. Also, it should once again be noted that the natural wildlife habitat value of the South Waterfront is limited and, as indicated in Section 4.5, the northern half of this site area appears to be significantly disturbed, with concrete debris being present.

It is possible that the high concentrations of metals detected in the surface soils at the upgradient off-site locations and within the South Waterfront are 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 various metals and PAHs.

Site-related contribution of contaminants to the South Waterfront may also exist since the highest COPEC concentrations detected in this site area corresponded to the northern half that abuts the Building 234 Area, which is the southern end of the paved and constructed portion of the shipyard (Figure 4-13). 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. However, the maximum surface soil concentrations of other metal COPECs within the Building 234 Area were all detected in sample locations TP09 or 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.

Metal COPECs detected above benchmark concentrations in sample locations MW07 and TP11, which are situated within the early successional grassland/invasive weed area of approximately 1 acre that exists near the southern end of Building 42 in the Central Shipyard (Figure 4-13), included the following: aluminum, chromium, iron, mercury, vanadium, and zinc (Table 7-2). These metal COPECs, in general, were detected in sample locations MW07 and TP11 at concentrations comparable to or slightly higher than the corresponding off-site upgradient concentration ranges (Table 7-2). In fact, with the exception of mercury, all of these metals were also determined to exceed the corresponding benchmark values at one or both of the upgradient off-site locations (Tables 7-2 and 7-3). Mercury only exceeded the benchmark concentration of 0.1 mg/kg at sample location MW07, where a concentration of 0.12 mg/kg was detected (Table 7-2). Organic contaminants were not detected in either MW07 or TP11.

Relevant ecological exposure and risk are not anticipated to exist in association with the remaining small portions of exposed surface soil in the shipyard, which offer minimal or no natural wildlife habitat.

7.3.3 Ecological Conceptual Model for the Site

As indicated in Section 7.1, general characteristics of the site include the following: very limited and fragmented presence of natural wildlife habitat and native vegetation; small size of the vegetated areas and their general encirclement by paved and constructed areas; presence of stockpiles of excavated material and construction debris; absence of areas of natural wildlife habitat and native vegetation in the surrounding area; presence of an adjoining highway; and location of the site within an industrial/residential area. These characteristics translate into the minimal natural wildlife habitat value of the site, significantly limiting the range of wildlife species that use the site for cover, foraging, and/or nesting/breeding areas.

Based on the discussions presented in Sections 7.3.1 and 7.3.2, ecological exposure to COPECs in exposed surface soils at the site could conceivably occur in the South Waterfront, particularly in the northern half of this site area. The possible risk associated with the exposure of ecological receptors in the South Waterfront would likely be primarily related to various metals, with an additional component of possible risk due to Aroclor-1260. However, the South Waterfront is of very limited natural wildlife habitat value and the northern half appears significantly disturbed, with concrete debris being present. In addition, several of the metal COPECs for the South Waterfront, i.e., aluminum, chromium, cobalt, iron, vanadium, and zinc have also been determined to be present at concentrations in excess of the corresponding screening benchmarks at the upgradient off-site sample locations, which

are presumed to be representative of the industrialized and urbanized conditions that surround the site. Furthermore, the adjoining Penn Central railroad right-of-way and Defense Highway are likely to be contributors of contaminants, including various 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 ecological exposure could conceivably occur. However, the relative potential of ecological risk associated with this area is likely to be minimal because of the limited natural habitat value of the area and the overall site. This determination is further supported by the fact that the metal COPECs detected in the early successional grassland/invasive weed area of the Central Shipyard were generally present at comparable concentrations in the upgradient off-site area.

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 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 conceivably 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, minimal natural wildlife habitat value is associated with the site. Given the surroundings of the site and since it is mostly covered by buildings or pavement, with the remainder being fragmented areas of no or minimal natural 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 (μg/kg)		
2-Butanone	na	
Acetone	na	
Benzene	211,000	Solution concentration (equivalence to ppb) reported to cause injury to barley plants (Currier, 1954).
Chlorobenzene	40,000	Benchmark based on LC-50 for two earthworm species tested by van Gestel and collaborators (1991), with a safety factor of 5 by Will and Suter (1995b).
Toluene	200,000	LOEC for fresh weight reduction in corn, and NOEC for germination reduction in soybean (Overcash et al., 1982).
Xylenes (total)	>1,000,000	Calculated EC-50 for lettuce growth; value derived for ortho-xylene (Hulzebos et al., 1993).
Trichloroethene	650,000	Solution concentration (equivalence to ppb) reported to cause reduction in seed germination of alfalfa, Timothy clover, black-eyed pea, and corn (Young, 1929).
Semivolatile Organic Compounds (μg/kg)		
2,2'-Oxybis(1-chloropropane)	na	
2-Methylphenol	na	
4-Methylphenol	na	
Acenaphthene	25,000	EC-50 for lettuce growth from seed (Hulzebos et al., 1993).
Anthracene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Benzo(a)anthracene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Benzo(a)pyrene	100,000	Dietary LOEC for reduction of dry weight of the isopod *Porcellio scaber*, and dietary NOEC for dry weight and length effects on the isopod *Oniscus asellus* (van Brummelen and Stuijfzand, 1993).
Benzo(b)fluoranthene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Benzo(g,h,i)perylene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Benzo(k)fluoranthene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Bis(2-ethylhexyl)phthalate	200,000	Benchmark for di-n-butylphthalate used as surrogate.
Carbazole	na	
Chrysene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Di-n-butylphthalate	200,000	LOEC value based on reductions of soybean germination, and fresh weight reductions of corn and soybean (Overcash et al., 1982).
Di-n-octylphthalate	200,000	Benchmark for di-n-butylphthalate used as surrogate.
Dibenzo(a,h)anthracene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Fluoranthene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Fluorene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Indeno(1,2,3-cd)pyrene	100,000	Benchmark for benzo(a)pyrene used as surrogate.

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

ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Semivolatile Organic Compounds (µg/kg, Continued)		
Phenanthrene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Phenol	30,000	Benchmark based on earthworm LC-50 value by Neuhauser et al. (1986), with a safety factor of 5 by Will and Suter (1995b).
Pyrene	100,000	Benchmark for benzo(a)pyrene used as surrogate.
Butyltin Compounds (µg/kg)		
Tetrabutyltin	5,000	No *soil* benchmark available. *Sediment* concentration by Macauley et al. (1994) used as a surrogate.[1]
Tributyltin	5,000	No *soil* benchmark available. *Sediment* concentration by Macauley et al. (1994) used as a surrogate.[1]
Dibutyltin	5,000	No *soil* benchmark available. *Sediment* concentration by Macauley et al. (1994) used as a surrogate.[1]
Monobutyltin	5,000	No *soil* benchmark available. *Sediment* concentration by Macauley et al. (1994) used as a surrogate.[1]
Pesticides / PCBs (µg/kg)		
4,4'-DDD	5,600	Benchmark for 4,4'-DDT used as surrogate.
4,4'-DDE	5,600	Benchmark for 4,4'-DDT used as surrogate.
4,4'-DDT	5,600	LOEL for population biomass reduction of earthworms (*Lumbricus terrestris*) (Thompson and Sans, 1974).
Alpha-chlordane	na	
Aroclor-1260	na	
Dieldrin	10,000	Concentration causing reductions in the percent of germination of soybean, cotton and corn (Rajanna, 1977).
Endrin	na	
Endrin ketone	na	
Gamma-chlordane	na	
Heptachlor	2,000,000	Concentration on treated seed causing reductions on hatching and general reproductive success of Canada geese (Blus et al., 1984).
Heptachlor epoxide	2,000,000	Benchmark for heptachlor used as surrogate.
Methoxychlor	na	
Metals (mg/kg)		
Aluminum	50	LOEC based on reduction of establishment of white clover seedlings (Mackay et al. 1990).
Arsenic	60	Value based on LOEC for growth and reproduction of the earthworm *Eisenia fetida* (Fischer and Koszorus, 1992).

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

ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Metals (mg/kg, Continued)		
Barium	500	LOEC based on reduction of shoot weight of barley (Chaudhry et al. 1977).
Beryllium	5	Nutrient solution concentration (ppm) causing 50 percent decrease in root length of collard and wheat (Gettier and Adriano, 1987).
Cadmium	3	10th percentile-based derivation of screening benchmark from 74 LOEC values from experiments reported in primary references, and which used a variety of plant species and endpoints (Will and Suter, 1995a).
Chromium	0.4	Value based on LOEC for earthworm survival (Abbasi and Soni, 1983), with a safety factor of 5 by Will and Suter (1995b).
Cobalt	15	Nutrient solution concentration (ppm) reported to cause toxicity to oats and sugar beets (Vergnano and Hunter, 1952).
Copper	50	Benchmark derivation based on lowest value (Ma, 1988; LOEC for cocoon production of *Allolobophora chlorotica*) identified from numerous experiments with earthworms reported in primary references, as described in Will and Suter (1995b).
Iron	14,000	Geometric mean concentration from survey of soils of the eastern U.S. considered to represent, as far as possible, "natural conditions" supporting native plant species (Shacklette and Boerngen, 1984).
Lead	50	LOEC for red oak seedlings (based on plant weight; Dixon, 1988) and American sycamore saplings (based on leaf weight; Carlson and Bazzaz, 1977).
Manganese	500	Lowest concentration tested causing stem weight reduction in bush bean plants (Wallace et al., 1977).
Mercury	0.1	Value based on LOEC for earthworm survival (Abbasi and Soni, 1983), with a safety factor of 5 by Will and Suter (1995b). Value is for combined inorganic and organic forms of mercury.
Nickel	30	10th percentile-based derivation of screening benchmark from 14 LOEC values from experiments reported in primary references, and which used a variety of plant species and endpoints (Will and Suter, 1995a).
Selenium	1	10th percentile-based derivation of screening benchmark from 13 LOEC values from experiments reported in primary references, and which used a variety of plant species and endpoints (Will and Suter, 1995a).

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

ANALYTE	BENCHMARK	REFERENCE/COMMENTS
Metals (mg/kg, Continued)		
Tin	40	Nutrient solution NOEC (ppm) for sugar beets grown in sand cultures (Schroeder et al., 1964).
Vanadium	10	Nutrient solution LOEC (ppm) reported to cause toxicity to soybeans (Schroeder et al., 1963).
Zinc	50	10th percentile-based derivation of screening benchmark from 14 LOEC values from experiments reported in primary references, and which used a variety of plant species and endpoints (Will and Suter, 1995a).
Total Petroleum Hydrocarbons (mg/kg)		
TPH	na	Refer to discussion in Section 7.2.2 regarding the TPH parameter.

NOTES:

na An appropriate screening ecological benchmark supported by a primary reference was not identified in available sources.

LOEC Lowest Observed Effect Concentration.

NOEC No Observed Effect Concentration.

LC-50 Lethal Concentration causing 50 percent mortality of tested organisms.

EC-50 Effective Concentration affecting 50 percent of tested organisms (selected endpoint is not lethality).

LOEL Lowest Observed Effect Level.

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).

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL SAMPLES AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT, RHODE ISLAND

Area		Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront
Sample Location		MW01	MW10	TP16	TP18	TP24
Sample Number	Benchmark	DSY-S-MW01-0002	DSY-S-MW10-0002	DSY-S-TP16-0001	DSY-S-TP18-0001	DSY-S-TP24-0102
Sample Description	(1)	Boring, 0.0-2.0 ft	Boring, 0.0-2.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 1.0-2.0 ft
Volatile Organics (ug/kg)						
2-Butanone	na	ND	ND	ND	ND	9.75
Acetone	na	ND	ND	ND	115	66
Benzene	211000	ND	ND	1 J	ND	ND
Chlorobenzene	40000	ND	ND	3 J	ND	ND
Toluene	200000	ND	ND	2 J	3.25	3.75
Total Xylenes	1000000	ND	ND	ND	ND	3.75
Trichloroethene	650000	ND	ND	2 J	ND	ND
Semivolatile Organics (ug/kg)						
2,2'-oxybis(1-Chloropropane)	na	ND	ND	ND	114.5	ND
2-Methylphenol	na	ND	ND	ND	ND	ND
4-Methylphenol	na	ND	ND	ND	ND	ND
Acenaphthene	25000	ND	ND	ND	ND	ND
Anthracene	100000	ND	ND	ND	ND	ND
Benzo(a)anthracene	100000	ND	ND	ND	ND	121.5
Benzo(a)pyrene	100000	ND	ND	ND	ND	117
Benzo(b)fluoranthene	100000	ND	55 J	ND	ND	130.5
Benzo(g,h,i)perylene	100000	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	100000	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)Phthalate	200000	ND	ND	ND	107.5	70
Carbazole	na	ND	ND	ND	ND	ND
Chrysene	100000	ND	ND	ND	ND	117
Di-n-butylphthalate	200000	ND	ND	ND	ND	ND
Di-n-octylphthalate	200000	ND	120 J	ND	ND	ND
Dibenzo(a,h)anthracene	100000	ND	ND	ND	ND	ND
Fluoranthene	100000	53 J	63 J	ND	ND	135.5
Fluorene	100000	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	100000	ND	ND	ND	ND	ND
Phenanthrene	100000	ND	ND	ND	ND	122
Phenol	30000	ND	ND	ND	180	ND
Pyrene	100000	54 J	59 J	1400 J	ND	ND
Butyllin Compounds (ug/kg)						
Dibutyltin	5000	ND	50 J	33	5.25	ND
Monobutyltin	5000	ND	ND	33	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Upgradient Area	Upgradient Area	North Waterfront	North Waterfront	North Waterfront
Sample Location		MW01	MW10	TP16	TP18	TP24
Sample Number	Benchmark	DSY-S-MW01-0002	DSY-S-MW10-0002	DSY-S-TP16-0001	DSY-S-TP18-0001	DSY-S-TP24-0102
Sample Description	(1)	Boring, 0.0-2.0 ft	Boring, 0.0-2.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 1.0-2.0 ft
Tetrabutyltin	5000	ND	ND	ND	ND	5.9
Tributyltin	5000	ND	6.62 J	30 J	14.05	ND
Pesticides/PCBs (ug/kg)						
4,4'-DDD	5600	ND	ND	ND	ND	ND
4,4'-DDE	5600	ND	27	ND	ND	ND
4,4'-DDT	5600	ND	32	ND	ND	ND
alpha-Chlordane	na	ND	ND	ND	ND	ND
Aroclor-1260	na	ND	ND	24 J	ND	ND
Dieldrin	10000	ND	ND	16	ND	ND
Endrin	na	ND	ND	26	ND	ND
Endrin Ketone	na	ND	ND	ND	ND	ND
gamma-Chlordane	na	ND	ND	ND	ND	ND
Heptachlor	2000000	ND	ND	ND	ND	ND
Heptachlor Epoxide	2000000	ND	ND	ND	ND	ND
Methoxychlor	na	ND	ND	ND	ND	ND
Metals (mg/kg)						
Aluminum, total	50	**13100 J**	**13200**	**8290**	**5265**	**4950**
Arsenic, total	60	19.5	20.3	4.7	4.6	5.6
Barium, total	500	36.3	20.1	49.4	19.85	12.95
Beryllium, total	5	0.76	0.43 J	1.1	0.205	0.22
Cadmium, total	3	ND	0.61 J	0.85 J	ND	ND
Chromium, total	0.4	**16.4**	**15**	***24.1***	**6.8**	**6.2**
Cobalt, total	15	**18.4**	10.5	14.7	8	9
Copper, total	50	11.2 J	15	***111***	24.9	19.7
Iron, total	14000	**28200 J**	**26900**	**19600**	**16400**	**17550**
Lead, total	50	18.3	16.2 J	***85.5***	17.7	7.4
Manganese, total	500	**1580**	338 J	187	291.5	364.5
Mercury, total	0.1	0.08 J	ND	ND	0.0375	ND
Nickel, total	30	21.4 J	19.2	***68.5***	ND	11.375
Selenium, total	1	ND	ND	0.99 J	0.5	0.66
Tin, total	40	ND	ND	12.2 J	ND	ND
Vanadium, total	10	**21.7 J**	**22.2 J**	***22.4***	9.55	8.95
Zinc, total	50	49.7	54	***883***	***77.1***	39.6
TPH USING IR (mg/kg)	na	260 J	ND	4900	115	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location		TP28	MW05	MW07	TP11	TP12
Sample Number	Benchmark	DSY-S-TP28-0001	DSY-S-MW05-SS01	DSY-S-MW07-0001	DSY-S-TP11-0001	DSY-S-TP12-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)						
2-Butanone	na	ND	ND	ND	ND	ND
Acetone	na	ND	ND	ND	ND	ND
Benzene	211000	ND	ND	ND	ND	ND
Chlorobenzene	40000	ND	ND	ND	ND	ND
Toluene	200000	ND	ND	ND	ND	ND
Total Xylenes	1000000	ND	ND	ND	ND	ND
Trichloroethene	650000	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)						
2,2'-oxybis(1-Chloropropane)	na	ND	ND	ND	ND	ND
2-Methylphenol	na	ND	ND	ND	ND	ND
4-Methylphenol	na	ND	ND	ND	ND	ND
Acenaphthene	25000	943.5	ND	ND	ND	ND
Anthracene	100000	971	ND	ND	ND	ND
Benzo(a)anthracene	100000	605	ND	ND	ND	ND
Benzo(a)pyrene	100000	530	ND	ND	ND	ND
Benzo(b)fluoranthene	100000	805	ND	ND	ND	ND
Benzo(g,h,i)perylene	100000	1030	ND	ND	ND	ND
Benzo(k)fluoranthene	100000	1030	ND	ND	ND	ND
bis(2-Ethylhexyl)Phthalate	200000	ND	ND	ND	ND	ND
Carbazole	na	951	ND	ND	ND	ND
Chrysene	100000	580	ND	ND	ND	ND
Di-n-butylphthalate	200000	ND	ND	ND	ND	ND
Di-n-octylphthalate	200000	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	100000	ND	ND	ND	ND	ND
Fluoranthene	100000	1160	ND	ND	ND	ND
Fluorene	100000	951	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	100000	380	ND	ND	ND	ND
Phenanthrene	100000	640	ND	ND	ND	ND
Phenol	30000	ND	ND	ND	ND	ND
Pyrene	100000	1090	ND	ND	ND	ND
Butyllin Compounds (ug/kg)						
Dibutyltin	5000	ND	ND	ND	ND	ND
Monobutyltin	5000	ND	ND	ND	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		North Waterfront	Central Shipyard	Central Shipyard	Central Shipyard	Central Shipyard
Sample Location		TP28	MW05	MW07	TP11	TP12
Sample Number	Benchmark	DSY-S-TP28-0001	DSY-S-MW05-SS01	DSY-S-MW07-0001	DSY-S-TP11-0001	DSY-S-TP12-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Boring, 0.5-1.5 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Tetrabutyltin	5000	ND	ND	ND	ND	ND
Tributyltin	5000	ND	ND	ND	ND	ND
Pesticides/PCBs (ug/kg)						
4,4'-DDD	5600	ND	ND	ND	ND	ND
4,4'-DDE	5600	19.5	ND	ND	ND	ND
4,4'-DDT	5600	50.5	ND	ND	ND	ND
alpha-Chlordane	na	8.1	ND	ND	ND	ND
Aroclor-1260	na	ND	ND	ND	ND	ND
Dieldrin	10000	ND	ND	ND	ND	ND
Endrin	na	ND	ND	ND	ND	ND
Endrin Ketone	na	ND	ND	ND	ND	ND
gamma-Chlordane	na	3.625	ND	ND	ND	ND
Heptachlor	2000000	ND	ND	ND	ND	ND
Heptachlor Epoxide	2000000	3.4	ND	ND	ND	ND
Methoxychlor	na	ND	ND	ND	ND	ND
Metals (mg/kg)						
Aluminum, total	50	**9650**	**8180**	**13100**	**12100**	***13200***
Arsenic, total	60	10.85	5.35	23.9	24.4	20.1
Barium, total	500	28	12.45	12.1	17.1	21.4
Beryllium, total	5	0.385	0.26	0.38 J	0.41 J	0.42 J
Cadmium, total	3	ND	ND	ND	0.97 J	0.88 J
Chromium, total	0.4	**12.5**	**9.8**	**15.8**	**15.6**	***18.2***
Cobalt, total	15	7.7	8.95	14.7	14.4 J	14.4 J
Copper, total	50	20.55	15.15	19.5	25.6	31.8
Iron, total	14000	**19700**	**18500**	***31000***	***31800***	***32500***
Lead, total	50	***112***	13.5	9.2 J	10.3	14.7
Manganese, total	500	331.5	297.5	448	445 J	421 J
Mercury, total	0.1	ND	ND	***0.12***	ND	ND
Nickel, total	30	16.15	14.9	24.9	23.7	27.1
Selenium, total	1	ND	ND	ND	0.87 J	0.74 J
Tin, total	40	ND	ND	ND	ND	ND
Vanadium, total	10	***39.5***	8.75	**14.5**	**17.8 J**	**18.9 J**
Zinc, total	50	***61.5***	33.35	***54.8 J***	**51.2**	***70.2***
TPH USING IR (mg/kg)	na	103	ND	ND	ND	2000 J

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area
Sample Location		TP14	TP15	TP17	MW09	TP07
Sample Number	Benchmark	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-MW09-0001	DSY-S-TP07-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)						
2-Butanone	na	ND	ND	ND	ND	ND
Acetone	na	ND	ND	ND	ND	ND
Benzene	211000	ND	ND	ND	ND	ND
Chlorobenzene	40000	ND	ND	ND	ND	ND
Toluene	200000	ND	ND	ND	ND	1 J
Total Xylenes	1000000	ND	ND	ND	ND	ND
Trichloroethene	650000	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)						
2,2'-oxybis(1-Chloropropane)	na	ND	180 J	ND	ND	ND
2-Methylphenol	na	ND	ND	83 J	ND	ND
4-Methylphenol	na	ND	ND	500 J	ND	ND
Acenaphthene	25000	ND	92 J	ND	ND	ND
Anthracene	100000	ND	130 J	ND	51 J	ND
Benzo(a)anthracene	100000	ND	410 J	140 J	470 J	170 J
Benzo(a)pyrene	100000	ND	86 J	140 J	410 J	200 J
Benzo(b)fluoranthene	100000	ND	410 J	230 J	660 J	410 J
Benzo(g,h,i)perylene	100000	ND	110 J	130 J	190 J	ND
Benzo(k)fluoranthene	100000	ND	360 J	ND	270 J	ND
bis(2-Ethylhexyl)Phthalate	200000	ND	ND	ND	ND	8700
Carbazole	na	ND	97 J	ND	ND	ND
Chrysene	100000	ND	420 J	120 J	580 J	310 J
Di-n-butylphthalate	200000	ND	ND	ND	64 J	ND
Di-n-octylphthalate	200000	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	100000	ND	ND	ND	62 J	ND
Fluoranthene	100000	ND	870 J	330 J	770 J	ND
Fluorene	100000	ND	65 J	ND	ND	ND
Indeno(1,2,3-cd)pyrene	100000	ND	150 J	140 J	190 J	ND
Phenanthrene	100000	ND	580 J	130 J	180 J	ND
Phenol	30000	ND	ND	1200 J	ND	ND
Pyrene	100000	ND	740 J	300 J	750 J	320 J
Butyllin Compounds (ug/kg)						
Dibutyltin	5000	ND	ND	ND	ND	ND
Monobutyltin	5000	ND	ND	ND	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Central Shipyard	Central Shipyard	Central Shipyard	Building 234 Area	Building 234 Area
Sample Location		TP14	TP15	TP17	MW09	TP07
Sample Number	Benchmark	DSY-S-TP14-0001	DSY-S-TP15-0001	DSY-S-TP17-0001	DSY-S-MW09-0001	DSY-S-TP07-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Boring, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Tetrabutyltin	5000	ND	8.8 J	ND	ND	ND
Tributyltin	5000	ND	4.8 J	ND	ND	ND
Pesticides/PCBs (ug/kg)						
4,4'-DDD	5600	ND	4.3	ND	ND	ND
4,4'-DDE	5600	ND	ND	ND	ND	ND
4,4'-DDT	5600	ND	6.2	ND	5.2 J	ND
alpha-Chlordane	na	ND	ND	ND	ND	ND
Aroclor-1260	na	71000*	32 J	ND	ND	ND
Dieldrin	10000	470	ND	ND	ND	ND
Endrin	na	ND	ND	ND	ND	ND
Endrin Ketone	na	1100	ND	ND	ND	ND
gamma-Chlordane	na	ND	ND	ND	ND	ND
Heptachlor	2000000	ND	ND	ND	ND	ND
Heptachlor Epoxide	2000000	ND	ND	ND	ND	ND
Methoxychlor	na	2300	ND	ND	ND	ND
Metals (mg/kg)						
Aluminum, total	50	***14400***	**12700**	**5820**	**5260**	**4930**
Arsenic, total	60	9.5	19.3	3.9	5.3	3.9
Barium, total	500	19.8	24	14.5	12.9	8.9
Beryllium, total	5	0.31 J	0.47	0.23 J	ND	0.18 J
Cadmium, total	3	1.2 J	1 J	0.75 J	ND	ND
Chromium, total	0.4	***19***	***16.8***	11	**13.7 J**	**12.3**
Cobalt, total	15	*12 J*	12.2 J	7.6 J	7	5.4
Copper, total	50	*33*	29.6	23.1	25.5	16.8
Iron, total	14000	***32900***	***31200***	**23200**	**16900**	**14500**
Lead, total	50	24.8	27.4	26.2	23.4 J	17.2 J
Manganese, total	500	318 J	349 J	325 J	307	195
Mercury, total	0.1	ND	ND	ND	ND	ND
Nickel, total	30	27.4	24.4	15.6	17.8	12.6 J
Selenium, total	1	ND	***1.2***	ND	ND	ND
Tin, total	40	ND	ND	ND	ND	ND
Vanadium, total	10	**21.2 J**	**21.8 J**	**13.7 J**	***16.7***	**10.1 J**
Zinc, total	50	***123***	***71***	***60***	***175 J***	***63.6***
TPH USING IR (mg/kg)	na	1700	68	170	77	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location		TP08	TP09	TP10	TP01	TP02
Sample Number	Benchmark	DSY-S-TP08-0001	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP01-0001	DSY-S-TP02-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)						
2-Butanone	na	ND	ND	ND	ND	ND
Acetone	na	ND	ND	ND	ND	ND
Benzene	211000	ND	ND	ND	ND	ND
Chlorobenzene	40000	ND	ND	ND	ND	ND
Toluene	200000	1.5	ND	ND	ND	ND
Total Xylenes	1000000	ND	ND	ND	ND	ND
Trichloroethene	650000	ND	ND	ND	ND	ND
Semivolatile Organics (ug/kg)						
2,2'-oxybis(1-Chloropropane)	na	ND	ND	ND	ND	ND
2-Methylphenol	na	ND	ND	ND	ND	ND
4-Methylphenol	na	ND	ND	ND	ND	ND
Acenaphthene	25000	ND	ND	46 J	ND	ND
Anthracene	100000	ND	ND	65 J	ND	ND
Benzo(a)anthracene	100000	ND	ND	250 J	58 J	71 J
Benzo(a)pyrene	100000	ND	ND	210 J	55 J	46 J
Benzo(b)fluoranthene	100000	56.5	ND	340 J	88 J	81 J
Benzo(g,h,i)perylene	100000	ND	ND	160 J	42 J	ND
Benzo(k)fluoranthene	100000	ND	ND	140 J	38 J	41 J
bis(2-Ethylhexyl)Phthalate	200000	ND	ND	ND	ND	ND
Carbazole	na	ND	ND	56 J	ND	ND
Chrysene	100000	108	ND	290 J	53 J	61 J
Di-n-butylphthalate	200000	ND	ND	ND	ND	ND
Di-n-octylphthalate	200000	ND	ND	ND	ND	ND
Dibenzo(a,h)anthracene	100000	ND	ND	ND	ND	ND
Fluoranthene	100000	75	ND	470	71 J	150 J
Fluorene	100000	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	100000	ND	ND	150 J	42 J	ND
Phenanthrene	100000	41.5	ND	350 J	ND	120 J
Phenol	30000	ND	ND	ND	ND	ND
Pyrene	100000	72	ND	560	73 J	130 J
Butyllin Compounds (ug/kg)						
Dibutyltin	5000	ND	ND	ND	ND	ND
Monobutyltin	5000	ND	ND	ND	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		Building 234 Area	Building 234 Area	Building 234 Area	South Waterfront	South Waterfront
Sample Location		TP08	TP09	TP10	TP01	TP02
Sample Number	Benchmark	DSY-S-TP08-0001	DSY-S-TP09-0001	DSY-S-TP10-0001	DSY-S-TP01-0001	DSY-S-TP02-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Tetrabutyltin	5000	ND	11.4 J	ND	ND	ND
Tributyltin	5000	ND	2.1 J	ND	ND	ND
Pesticides/PCBs (ug/kg)						
4,4'-DDD	5600	ND	ND	ND	ND	ND
4,4'-DDE	5600	3.1	ND	ND	ND	ND
4,4'-DDT	5600	8.6	ND	5	ND	ND
alpha-Chlordane	na	ND	ND	ND	ND	ND
Aroclor-1260	na	ND	ND	24 J	ND	ND
Dieldrin	10000	ND	ND	ND	ND	ND
Endrin	na	ND	ND	ND	ND	ND
Endrin Ketone	na	ND	ND	ND	ND	ND
gamma-Chlordane	na	ND	ND	3.9	ND	ND
Heptachlor	2000000	ND	ND	4.5	ND	ND
Heptachlor Epoxide	2000000	ND	ND	ND	ND	ND
Methoxychlor	na	ND	ND	ND	ND	ND
Metals (mg/kg)						
Aluminum, total	50	**6125**	**11300**	**10000**	**8090**	**7770**
Arsenic, total	60	6.15	23.6	15.8	14.6 J	15.3 J
Barium, total	500	44.4	18	28.1	12.3 J	18.7 J
Beryllium, total	5	0.225	0.44	0.54	0.3 J	1.1 J
Cadmium, total	3	ND	ND	ND	ND	ND
Chromium, total	0.4	**15.5**	**16**	***18.4***	**10.5 J**	**14.9 J**
Cobalt, total	15	8.25	***21.4***	13.5	8.9 J	11.8 J
Copper, total	50	26.8	26.4	35	13 J	***59.6 J***
Iron, total	14000	**20300**	***37200***	**26700**	**21300**	**23600**
Lead, total	50	***51.5***	12.8 J	***62.5 J***	13.5 J	48.7 J
Manganese, total	500	300.5	**597**	448	286 J	423 J
Mercury, total	0.1	ND	ND	ND	ND	ND
Nickel, total	30	17.25	28.2	26.7	17.2 J	***32.8 J***
Selenium, total	1	ND	ND	ND	ND	ND
Tin, total	40	ND	ND	ND	ND	ND
Vanadium, total	10	**13.05**	**20 J**	***23.2 J***	**12.3**	**11.3**
Zinc, total	50	***128.5***	***75.3***	***139***	40.8 J	***225 J***
TPH USING IR (mg/kg)	na	ND	ND	61	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location		TP03	TP04	TP05	TP06
Sample Number	Benchmark	DSY-S-TP03-0001	DSY-S-TP04-0001	DSY-S-TP05-0001	DSY-S-TP06-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Volatile Organics (ug/kg)					
2-Butanone	na	ND	ND	ND	ND
Acetone	na	ND	ND	ND	ND
Benzene	211000	ND	ND	ND	ND
Chlorobenzene	40000	ND	ND	ND	ND
Toluene	200000	ND	ND	ND	1 J
Total Xylenes	1000000	ND	ND	ND	ND
Trichloroethene	650000	ND	ND	ND	ND
Semivolatile Organics (ug/kg)					
2,2'-oxybis(1-Chloropropane)	na	ND	ND	ND	ND
2-Methylphenol	na	ND	ND	ND	ND
4-Methylphenol	na	ND	ND	ND	ND
Acenaphthene	25000	ND	ND	ND	ND
Anthracene	100000	ND	ND	ND	ND
Benzo(a)anthracene	100000	ND	160 J	93 J	210 J
Benzo(a)pyrene	100000	ND	97 J	81 J	180 J
Benzo(b)fluoranthene	100000	ND	260 J	120 J	270 J
Benzo(g,h,i)perylene	100000	ND	99 J	54 J	ND
Benzo(k)fluoranthene	100000	ND	86 J	66 J	150 J
bis(2-Ethylhexyl)Phthalate	200000	ND	ND	ND	ND
Carbazole	na	ND	ND	ND	ND
Chrysene	100000	ND	250 J	94 J	230 J
Di-n-butylphthalate	200000	ND	ND	ND	ND
Di-n-octylphthalate	200000	ND	ND	ND	ND
Dibenzo(a,h)anthracene	100000	ND	ND	ND	ND
Fluoranthene	100000	ND	280 J	220 J	460 J
Fluorene	100000	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	100000	ND	82 J	49 J	110 J
Phenanthrene	100000	ND	89 J	94 J	280 J
Phenol	30000	ND	ND	ND	ND
Pyrene	100000	ND	280 J	140 J	380 J
Butyllin Compounds (ug/kg)					
Dibutyltin	5000	ND	ND	ND	2.7 J
Monobutyltin	5000	ND	ND	ND	ND

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

Area		South Waterfront	South Waterfront	South Waterfront	South Waterfront
Sample Location		TP03	TP04	TP05	TP06
Sample Number	Benchmark	DSY-S-TP03-0001	DSY-S-TP04-0001	DSY-S-TP05-0001	DSY-S-TP06-0001
Sample Description	(1)	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft	Test Pit, 0.0-1.0 ft
Tetrabutyltin	5000	ND	ND	ND	ND
Tributyltin	5000	ND	ND	2.4 J	2.8 J
Pesticides/PCBs (ug/kg)					
4,4'-DDD	5600	ND	ND	ND	ND
4,4'-DDE	5600	ND	ND	ND	6.1
4,4'-DDT	5600	ND	ND	ND	14
alpha-Chlordane	na	ND	ND	ND	ND
Aroclor-1260	na	ND	25 J	ND	15 J
Dieldrin	10000	ND	ND	ND	ND
Endrin	na	ND	ND	ND	ND
Endrin Ketone	na	ND	ND	ND	ND
gamma-Chlordane	na	ND	ND	ND	ND
Heptachlor	2000000	ND	ND	ND	ND
Heptachlor Epoxide	2000000	ND	ND	ND	ND
Methoxychlor	na	ND	ND	ND	ND
Metals (mg/kg)					
Aluminum, total	50	**9120**	**6870**	***33300***	**11100**
Arsenic, total	60	11.2	9.7 J	13.1	13.3
Barium, total	500	22.8	35.6 J	420	52.1
Beryllium, total	5	0.71	2.5 J	2	0.45
Cadmium, total	3	ND	ND	ND	0.48 J
Chromium, total	0.4	**16.2**	***24.7 J***	***53.5***	***21.6***
Cobalt, total	15	11.7	**16.8 J**	**18.3**	11.1
Copper, total	50	49.7	***145 J***	***76.4***	45.2
Iron, total	14000	**23500**	**22200**	***58100***	**26200**
Lead, total	50	35.5 J	***119 J***	***51 J***	41.3 J
Manganese, total	500	343	296 J	299	350
Mercury, total	0.1	***0.17***	ND	ND	ND
Nickel, total	30	***30.3***	***70.8 J***	***60.1***	24.3 J
Selenium, total	1	ND	ND	***1.2 J***	***1.4 J***
Tin, total	40	9.3 J	27.4 J	ND	ND
Vanadium, total	10	**13.8**	9.7	***52.7 J***	**21.7 J**
Zinc, total	50	***172 J***	***501 J***	***896***	***284***
TPH USING IR (mg/kg)	na	94	110 J	ND	110

TABLE 7-2
ECOLOGICAL SCREENING OF DETECTED ANALYTES IN EXPOSED SURFACE SOIL AGAINST BENCHMARKS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT RHODE ISLAND

NOTES:

1) -	Benchmark values as presented on Table 7-1
na -	Appropriate benchmark for ecological screening not available
ND -	Analyte not detected above the sample quantitation/detection limit
J -	Quantitation is estimated during validation
* -	Dilution result
Bold -	Bold value exceeds corresponding benchmark concentration; analyte is considered to be a contaminant of potential ecological concern (COPEC).
Bold Italic -	Bold italic value is above benchmark *and* maximum upgradient concentration

TABLE 7-3
CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN
WHICH EXCEED BENCHMARK CONCENTRATIONS
FORMER ROBERT E. DERECKTOR SHIPYARD
SITE ASSESSMENT SCREENING EVALUATION
NETC NEWPORT, RHODE ISLAND

Area	COPEC	Benchmark (1)	Maximum Concentration (2)	Sample Location
North Waterfront	Aluminum, total	50	9650	TP28
	Chromium, total	0.4	24.1	TP16
	Copper, total	50	111	TP16
	Iron, total	14000	19700	TP28
	Lead, total	50	112	TP28
	Nickel, total	30	68.5	TP16
	Vanadium, total	10	39.5	TP28
	Zinc, total	50	883	TP16
Central Shipyard	Aluminum, total	50	14400	TP14
	Chromium, total	0.4	19	TP14
	Iron, total	14000	32900	TP14
	Mercury, total	0.1	0.12	MW07
	Selenium, total	1	1.2	TP15
	Vanadium, total	10	21.8 J	TP15
	Zinc, total	50	123	TP14
Building 234 Area	Aluminum, total	50	11300	TP09
	Chromium, total	0.4	18.4	TP10
	Cobalt, total	15	21.4	TP09
	Iron, total	14000	37200	TP09
	Lead, total	50	62.5 J	TP10
	Manganese, total	500	597	TP09
	Vanadium, total	10	23.2 J	TP10
	Zinc, total	50	175 J	MW09
South Waterfront	Aluminum, total	50	33300	TP05
	Chromium, total	0.4	53.5	TP05
	Cobalt, total	15	18.3	TP05
	Copper, total	50	145 J	TP04
	Iron, total	14000	58100	TP05
	Lead, total	50	119 J	TP04
	Mercury, total	0.1	0.17	TP03
	Nickel, total	30	70.8 J	TP04
	Selenium, total	1	1.4 J	TP06
	Vanadium, total	10	52.7 J	TP05
	Zinc, total	50	896	TP05
Upgradient Area	Aluminum, total	50	13200	MW10
	Chromium, total	0.4	16.4	MW01
	Cobalt, total	15	18.4	MW01
	Iron, total	14000	28200 J	MW01
	Manganese, total	500	1580	MW01
	Vanadium, total	10	22.2 J	MW10
	Zinc, total	50	54	MW10

COPEC - Contaminant of Potential Ecological Concern
1 - Benchmark values as presented on Table 7-1 (mg/kg)
2 - Concentrations as presented on Table 7-2 (mg/kg)
J - Estimated Quantitation Result

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 concurrence from the oversight parties, the U.S. EPA, RIDEM, and the NETC Restoration Advisory Board, has not yet been received.

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

As described in Section 4, 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 are probably 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 where transformers had reportedly been stored by Derecktor. In addition, the former "pipe shop" was located in the northeast corner of Building 6 and is suspected to have discharged to this area.

- Slightly elevated concentrations of PAHs and metals were found in the former location of a bilge water disposal area north of Building 42 (MW05).

- Slightly 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 at Building 62. 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 surface or 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 large quantities of concrete and other debris was noted, no chemical wastes were found. Possible 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, and 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 relocated to 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 accumulated during building demolition, rather than during the shipyard lease period.

Four catch basins were found, however, 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 once comprised the storm drain system in this area, and that this system was abandoned during the removal of the buildings from this location during 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 once have connected 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 been collected by 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 a similar manner as overburden groundwater.

8.3 RISKS TO RECEPTORS

The preliminary human health risk assessment was performed for surface soil, and subsurface soil exposure scenarios. This assessment indicates that the current uses of the property (industrial) can provide a sum of carcinogenic risk between 2.02E-04 (Central Shipyard) and 9.33E-06 (North Waterfront) for occupational workers. The dermal contact with surface soil exposure pathway provides the highest contribution to this risk. The principal contaminants contributing to this risk are PCBs (central shipyard) and arsenic (all areas).

PCBs were found at high concentrations in the surface soils north of Building 6. This area receives runoff from the railway east of the site, and is downgradient of the loading dock for Building 6, a location where transformers were reportedly staged (ENSR, 1993)

Arsenic occurs naturally in Rhode Island geologic formations. The highest concentration detected for this study was found in the subsurface soils in the boring upgradient of the site (MW10, 38.5 mg/kg). The RIDEM has established a direct exposure criteria for arsenic of 3.8 mg/kg for commercial and industrial properties.

Arsenic data for other sites at the NETC Naval base were reviewed in light of these findings. Arsenic concentrations at upgradient locations from Melville North Landfill, located in Portsmouth Rhode Island, was 11.6 mg/kg in the subsurface soil and 7 mg/kg in the surface soil. At the Old Firefighting Training area, concentrations of arsenic in background locations were measured between 4 mg/kg and 8 mg/kg. Surface soil concentrations of 5 to 14.7 mg/kg of arsenic were measured in samples collected upgradient of McAllister Point Landfill (TRC, 1994). At Tank Farms 4 and 5, arsenic was measured in subsurface soils at concentrations between 7 and 31.3 mg/kg (TRC, 1992). Analysis of one upgradient subsurface soil sample from Tank Farm 5 (MW03) was found to contain 23.1 mg/kg

arsenic. In marine sediments where concentrations of metals are expected to be higher, concentrations of arsenic were measured by the University of Rhode Island at off-shore sample stations at concentrations up to 42 mg/kg (SAIC and URI, 1997).

Surface soil concentrations of arsenic measured at the Derecktor site were generally between ND and 15 mg/kg, which are comparable to the concentrations measured at the other NETC sites. However, a few subsurface samples had concentrations at and upgradient of the site which stand out from the rest of the data set. While concentrations of arsenic upgradient of the Derecktor site are the highest of all the on-shore stations reviewed, soil concentrations of arsenic can occur naturally as high as 50 (EPA, 1983) and 75 mg/kg (USGS, 1984).

Arsenic is found in certain pesticides and herbicides and is used heavily in the treatment of wood, as a preservative against rot and insect damage. However, in these applications, there are other signature contaminants which appear concurrently, such as pesticides and other metals (copper and lead). The analytical results for samples collected at this site do not show a correlation of the elevated concentrations of arsenic at the site with elevated concentrations of pesticides. Arsenic is also found at smelting operations, which is not known to have occurred at this site.

Finally, arsenic was detected at concentrations considered to be elevated throughout the Derecktor site, without any discernable pattern, although samples collected from weathered rock resulted in the highest concentrations. Therefore, it is anticipated that the arsenic in the soils at Derecktor are naturally occurring.

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.

Because of the characteristics of the shipyard and its setting within an industrial/residential area, this site provides minimal natural wildlife habitat, which significantly limits the assemblage of wildlife species that may utilize the site for cover, foraging and/or nesting/breeding areas. While exposure of ecological receptors to contaminants of potential concern in exposed surface soils could conceivably occur in the South Waterfront, this area of the site is also of very limited natural wildlife habitat value, containing a large volume of stockpiled soils and construction debris. The disturbance associated with these extraneous materials is particularly prominent in the northern half of the South Waterfront, where most of the maximum concentrations of contaminants of potential ecological concern for this site area were detected (TP04 and TP05).

Because of its extent, the grass/invasive weed area in the Central Shipyard is an additional portion of the site where ecological exposure could conceivably occur. However, the relative potential of ecological exposure associated with this area is likely to be minimal because of the limited natural habitat value of the area and the overall site. Relevant ecological exposure and risk are also not anticipated to exist in association with the remaining small portions of exposed surface soil in the shipyard, which offers minimal to no natural wildlife habitat.

Therefore, under current conditions, the overall likelihood of relevant ecological exposure and risk associated with the site is expected to be minimal, and conducting further ecological evaluations is not warranted.

The human health and ecological evaluations were performed under the assumption that contaminated soils under sumps would be removed as described in Section 8.4 thus avoiding receptor exposure. In addition, it is assumed that contaminated soils that may be present in subsurface soils associated with catch basins CB42-1, 2, 3, and 4 will be removed as part of the storm water drainage system south of Building 42 as described in Section 8.4 thus avoiding 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. Such removal actions would be performed under a process known as an Engineering Evaluation and Cost Analysis (EECA), which involves pre-design and post-action sample collections in order to clearly delineate and confirm the effectiveness of the action. Removal actions are recommended for the following areas:

  - 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. After the contaminated soils are removed

at S42-1, the Navy may evaluate the need for monitoring wells in this area based on the vertical extent of contamination found during excavation.

- South of Building 234, at TP07 and TP08. This area was originally identified as an area of concern from chemical disposal that was evident during the performance of the Preliminary Assessment. While elevated concentrations of one particular contaminant was detected in this area, and the risk analysis does identify this contaminant as a COPC, it is only a slight contributor to overall risk for this area. It is suggested that a focused sample collection in this area be performed to confirm the presence of the contaminant detected, then a removal action can be planned if it is deemed necessary.

- 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.

REFERENCES

REFERENCES

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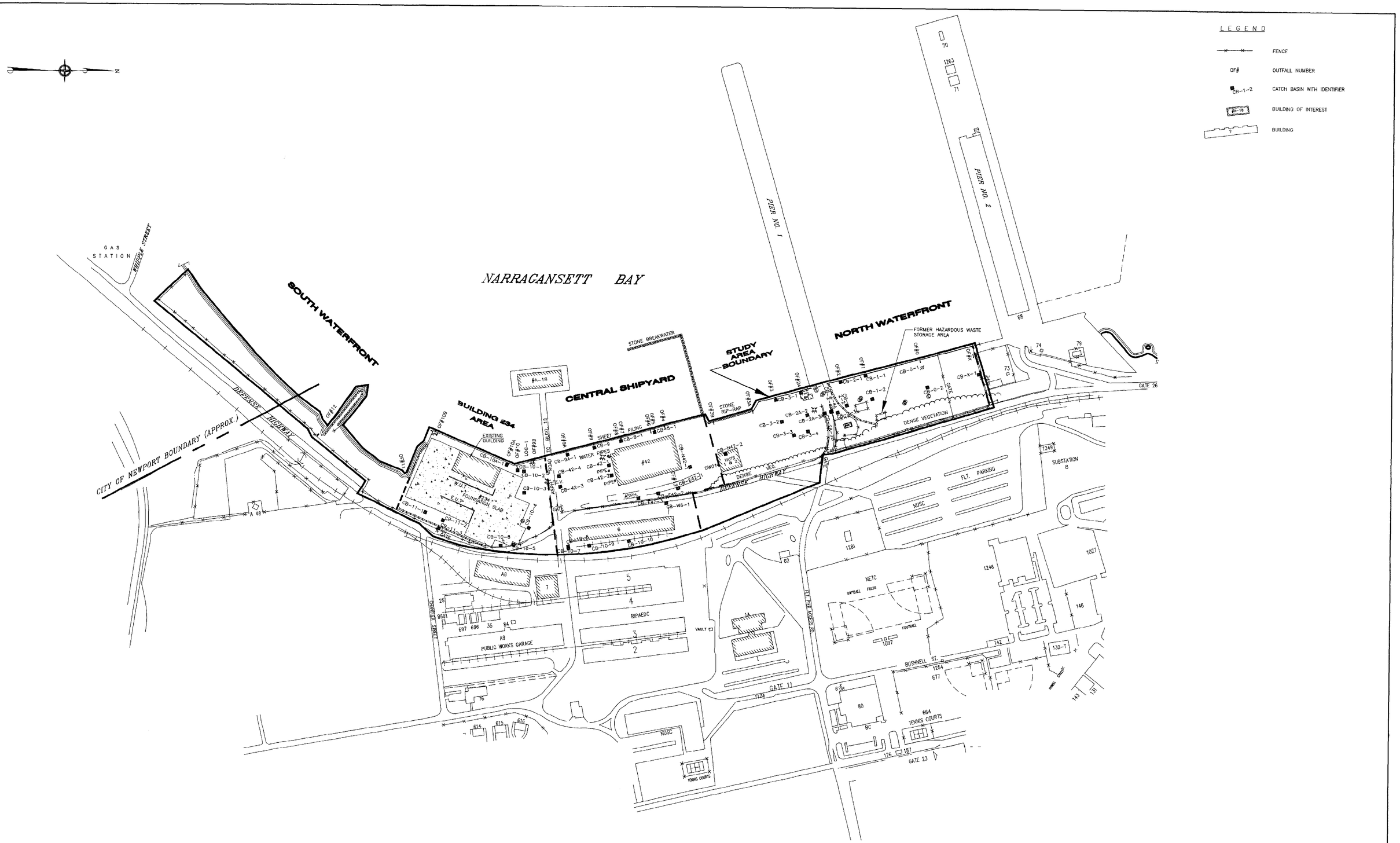

NOTES:

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

GRAPHIC SCALE

200' 0' 200' 400'

1 INCH = 200 FEET

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

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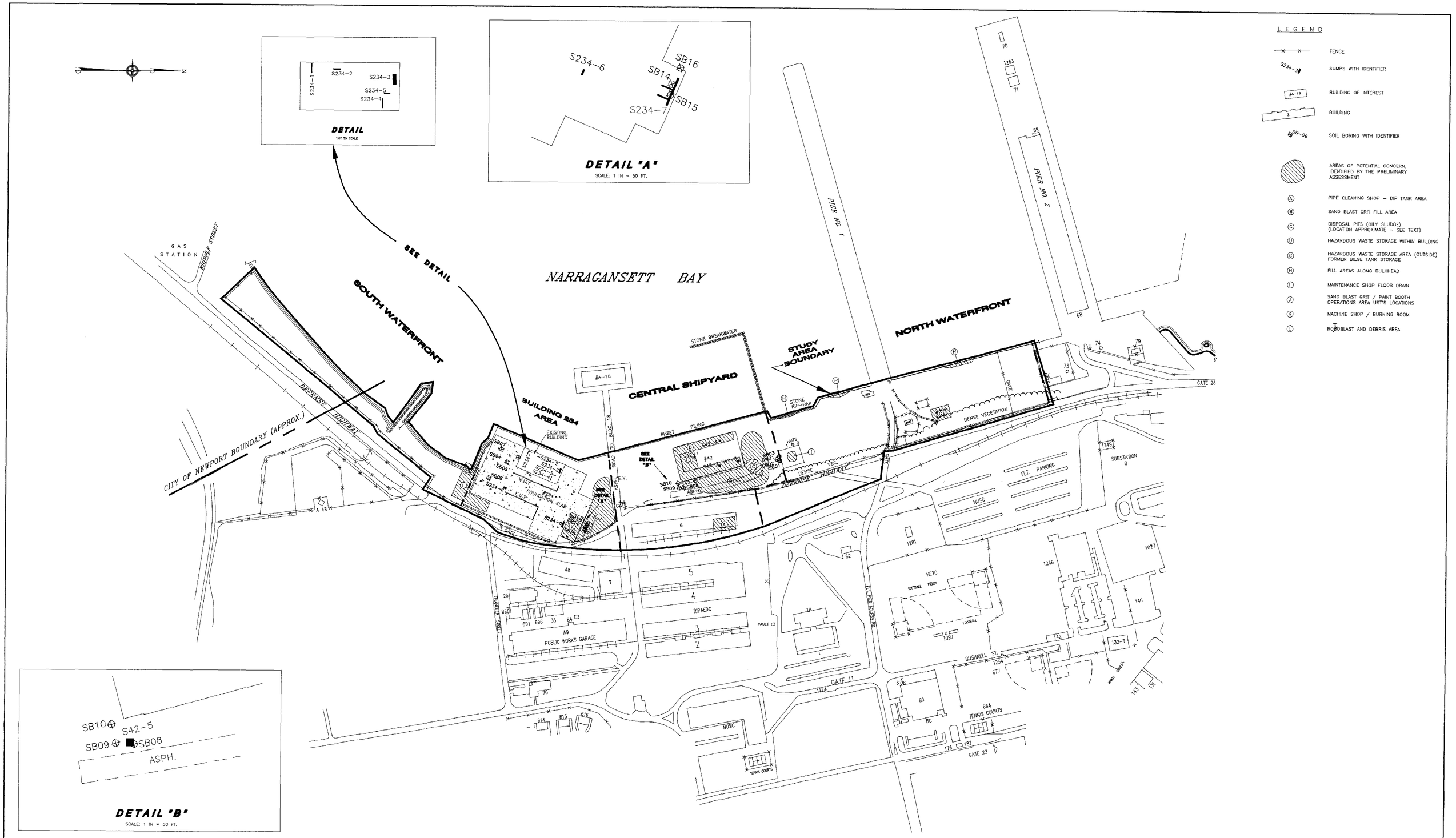

NOTES:

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

GRAPHIC SCALE

200' 0' 200' 400'

1 INCH = 200 FEET

DRAWN BY: D.W. MACDOUGALL	TITLE: SUMPS & SUSPECTED DISCHARGE POINTS SITE ASSESSMENT SCREENING EVALUATION REPORT FORMER ROBERT E. DERECKTOR SHIPYARD NEWPORT, RHODE ISLAND
PREPARED BY: K. O'NEILL	
CHECKED BY: S. PARKER	
	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS
	SCALE: 1" = 200' / DATE: MAY 29, 1997 / PROJ. NO: 7368 CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4-1 / ACFILE NAME: D:\DWG\NAVY\DERECKTOR\SASER\SUMP-UIC.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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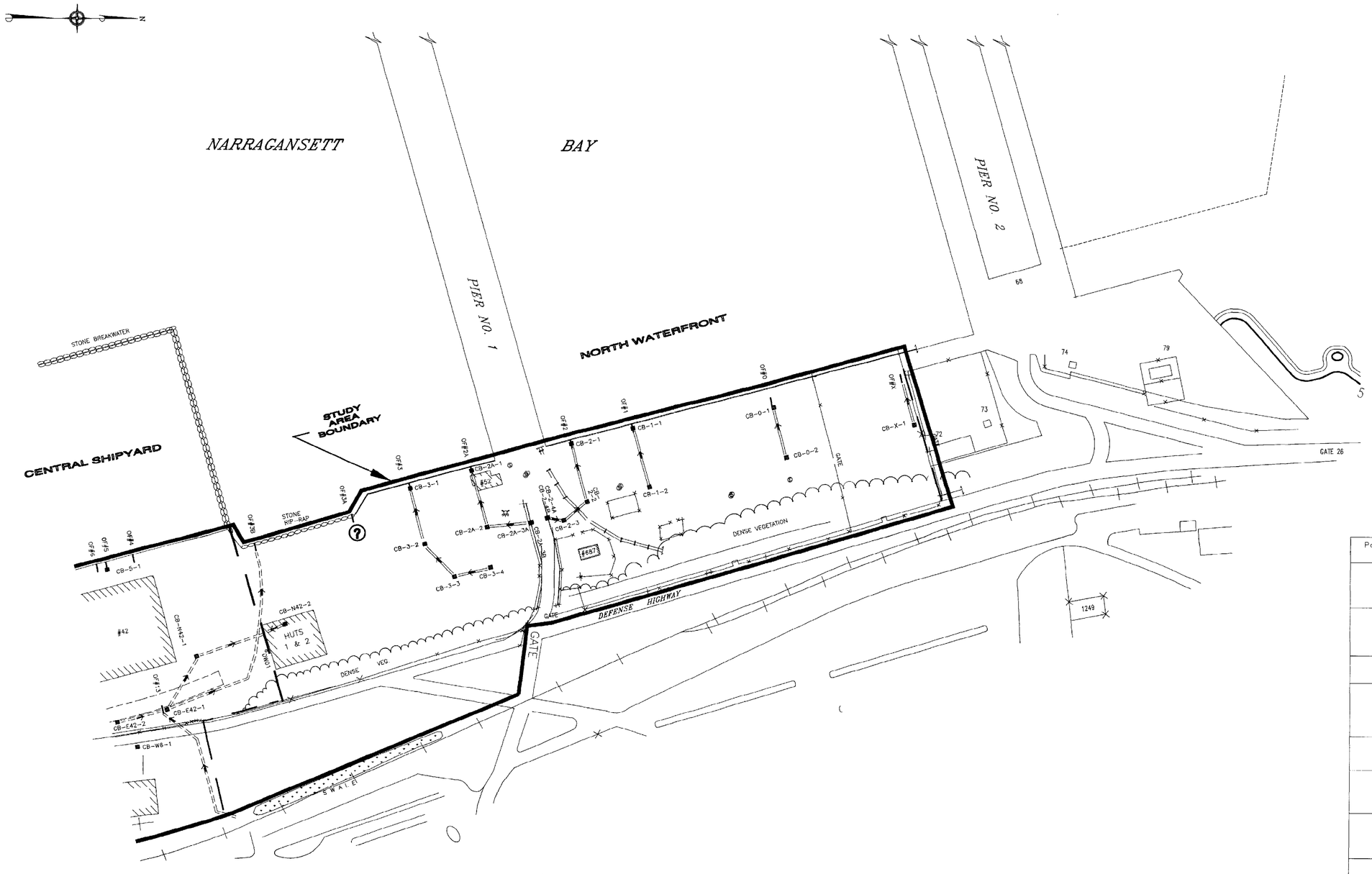

LEGEND

- 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)

Point of Discharge (Outfall No.)	Collection Point (Catch Basin)	Remarks
X 12" I.D.	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" I.D.	CB-1-1 CB-1-2	smoke tested
2 24" I.D.	CB-2-1 CB-2-2 CB-2-3 CB-2-4A CB-2-4B	smoke tested
2A 24" I.D.	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" I.D.	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

GRAPHIC SCALE

100' 0' 100' 200'

1 INCH = 100 FEET

DRAWN BY: R.G. DEWSNAP
PREPARED BY: K. O'NEILL
CHECKED BY: S. PARKER

PROJECT MANAGER: S. PARKER
PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
UNDERGROUND DRAINAGE SYSTEM – NORTH WATERFRONT AREA
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" = 100'
DATE: JAN. 24, 1997
PROJ. NO: 7368 CTO: 2682
DRAWING NO: FIGURE 4-2
ACFILE NAME: D:\DWG\NAVY\DERECKTOR\SASER\NO_SHPYD.DWG
REV: 0

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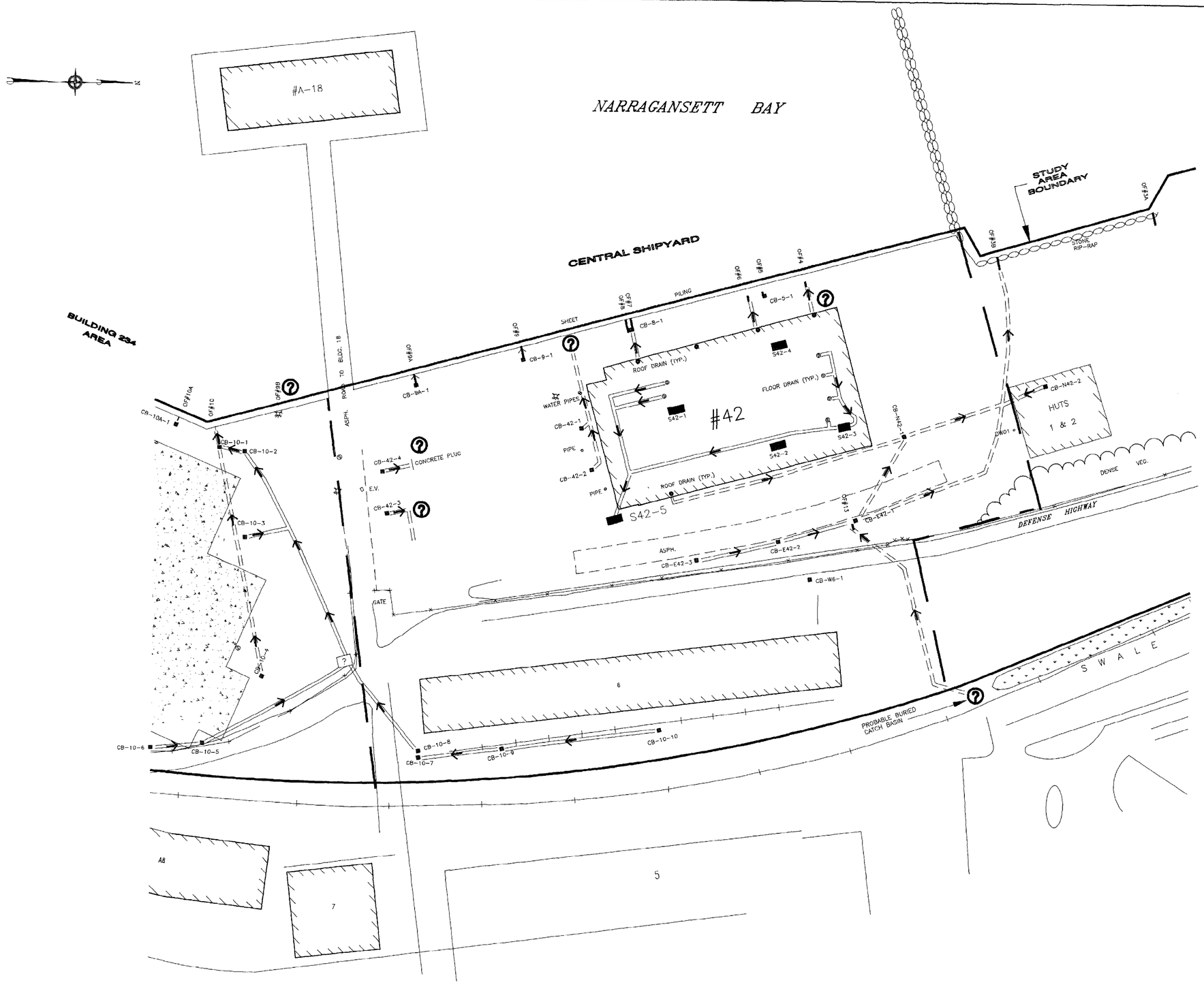

LEGEND

- FENCE
- OF# — OUTFALL NUMBER
- CB-1-2 — 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" I.D.	Building 42 roof drain (west)*	assumed, see text
5 12" I.D.	CB-5-1, surface drainage west of Building 42	visual observation
6 8" I.D.	Building 42 west roof drain	tracer study
7 8" I.D.	Building 42 west roof drain	tracer study
8 12" I.D.	CB-8-1, Surface drainage west of Building 42	visual observation
9 12" I.D.	CB-9-1, Surface drainage west of Building 42	visual observation
9A 12" I.D.	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 90o 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

GRAPHIC SCALE

60' 0' 60' 120'

1 INCH = 60 FEET

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

TITLE:
UNDERGROUND DRAINAGE SYSTEMS – CENTRAL SHIPYARD AREA
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" = 60' | DATE: JAN. 24, 1997 | PROJ. NO: 7368 CTO: 2682

DRAWING NO: FIGURE 4-3 | ACFILE NAME: B:\DWG\NAVY\DERECKTOR\SASER\GEN_SHYD.DWG | REV: 0

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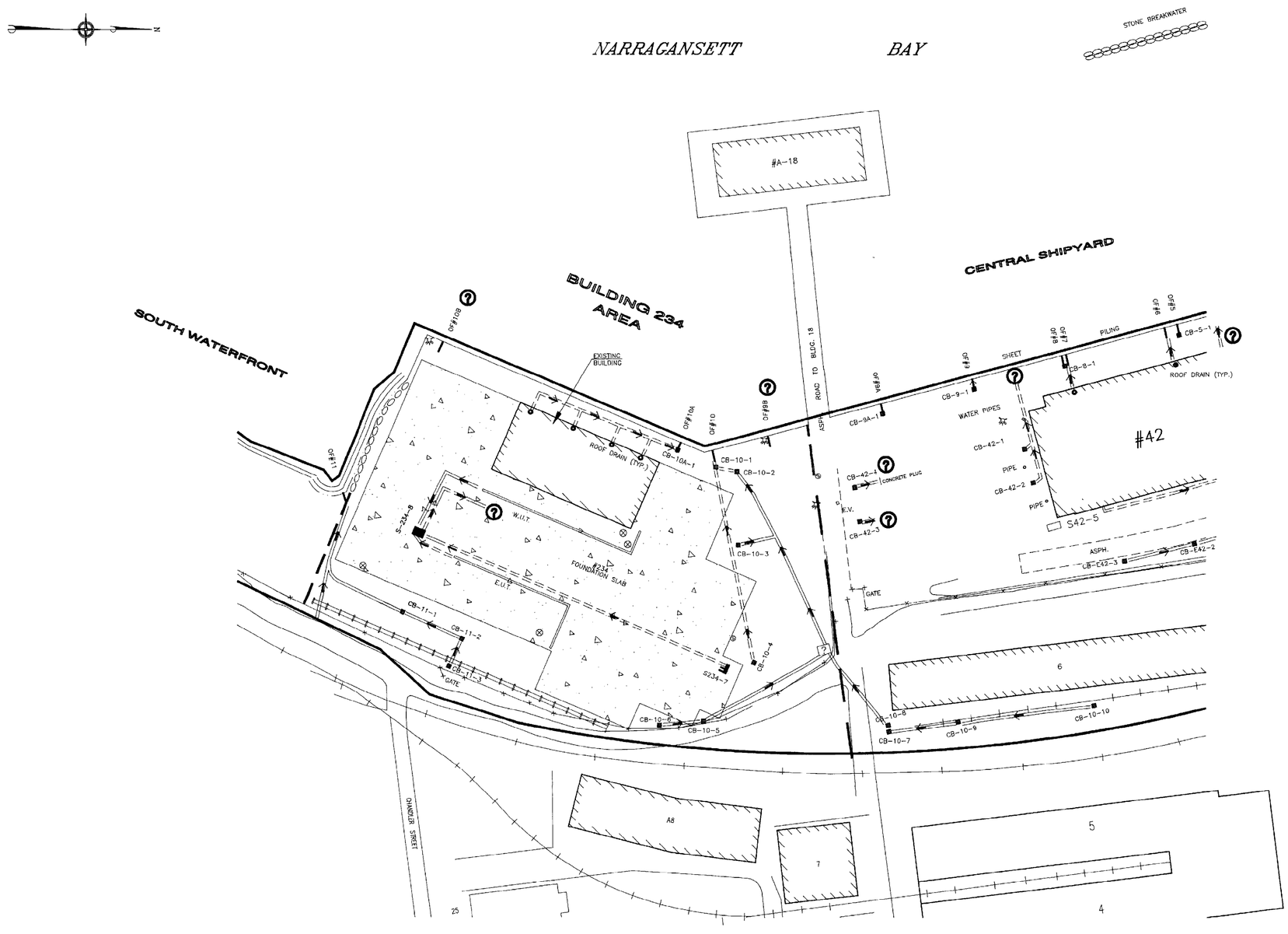

LEGEND

- FENCE
- OF# — OUTFALL NUMBER
- CB-1-2 — CATCH BASIN WITH IDENTIFIER
- #A-18 — BUILDING OF INTEREST
- 2 — 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
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 S234-8	E.U.T., W.U.T., S234-7, covered floor drains or cleanouts connected to S234-8	drains at bottom of sumps/trenches connected to S234-8, 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.

GRAPHIC SCALE

80' 0' 80' 160'

1 INCH = 80 FEET

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

TITLE:
UNDERGROUND DRAINAGE SYSTEM – BUILDING 234
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" = 80'
DATE: JAN. 24, 1997
PROJ. NO: 7368 CTO: 2682
DRAWING NO: FIGURE 4-4
ACFILE NAME: D:\DWG\NAVY\DERECTOR\SASER\BLDG-234.DWG
REV: 0

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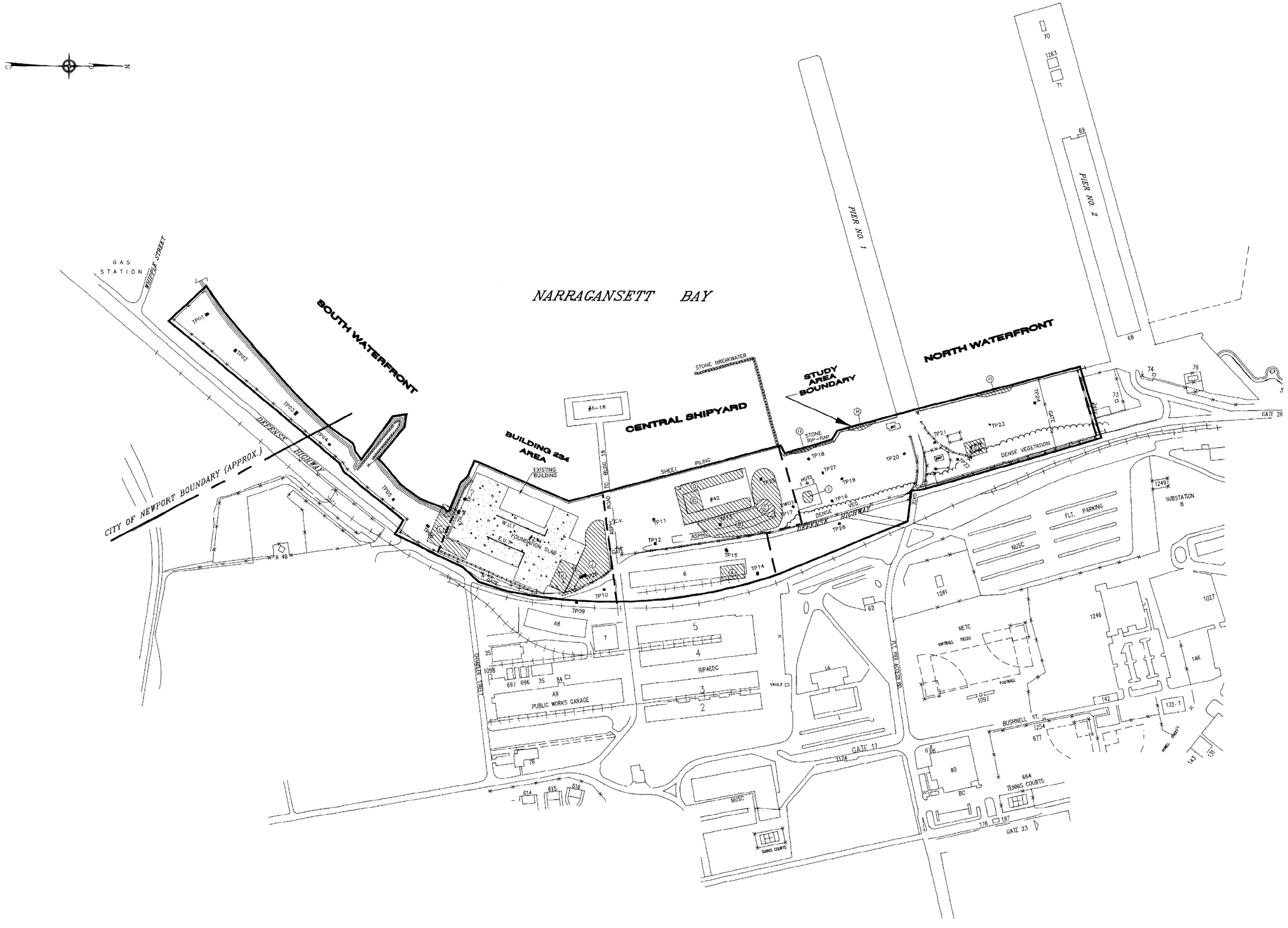

LEGEND

- FENCE
- TP19 — TEST PIT LOCATION WITH IDENTIFIER
- #A-16 — BUILDING OF INTEREST
- 2 — BUILDING
- AREAS OF POTENTIAL CONCERN, IDENTIFIED BY THE PRELIMINARY ASSESSMENT
- (A) PIPE CLEANING SHOP – DIP TANK AREA
- (B) SAND BLAST GRIT FILL AREA
- (C) DISPOSAL PITS (OILY SLUDGE) (LOCATION APPROXIMATE – SEE TEXT)
- (D) HAZARDOUS WASTE STORAGE WITHIN BUILDING
- (E) HAZARDOUS WASTE STORAGE AREA (OUTSIDE) FORMER BILGE TANK STORAGE
- (H) FILL AREAS ALONG BULKHEAD
- (I) MAINTENANCE SHOP FLOOR DRAIN
- (J) SAND BLAST GRIT / PAINT BOOTH OPERATIONS AREA UST'S LOCATIONS
- (K) MACHINE SHOP / BURNING ROOM
- (L) ROYDBLAST AND DEBRIS AREA

NOTES:

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

GRAPHIC SCALE

200' 0' 200' 400'

1 INCH = 200 FEET

DRAWN BY: D.W. MACDOUGALL	TITLE: TEST PIT LOCATIONS SITE ASSESSMENT SCREENING EVALUATION REPORT FORMER ROBERT E. DERECKTOR SHIPYARD NEWPORT, RHODE ISLAND
PREPARED BY: K. O'NEILL	
CHECKED BY: S. PARKER	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS
	SCALE: 1" = 200' / DATE: MAY 29, 1997 / PROJ. NO: 7368 CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4-5 / ACFILE NAME: D:\DWG\NAVY\DERECKTOR\SASER\TESTPITS.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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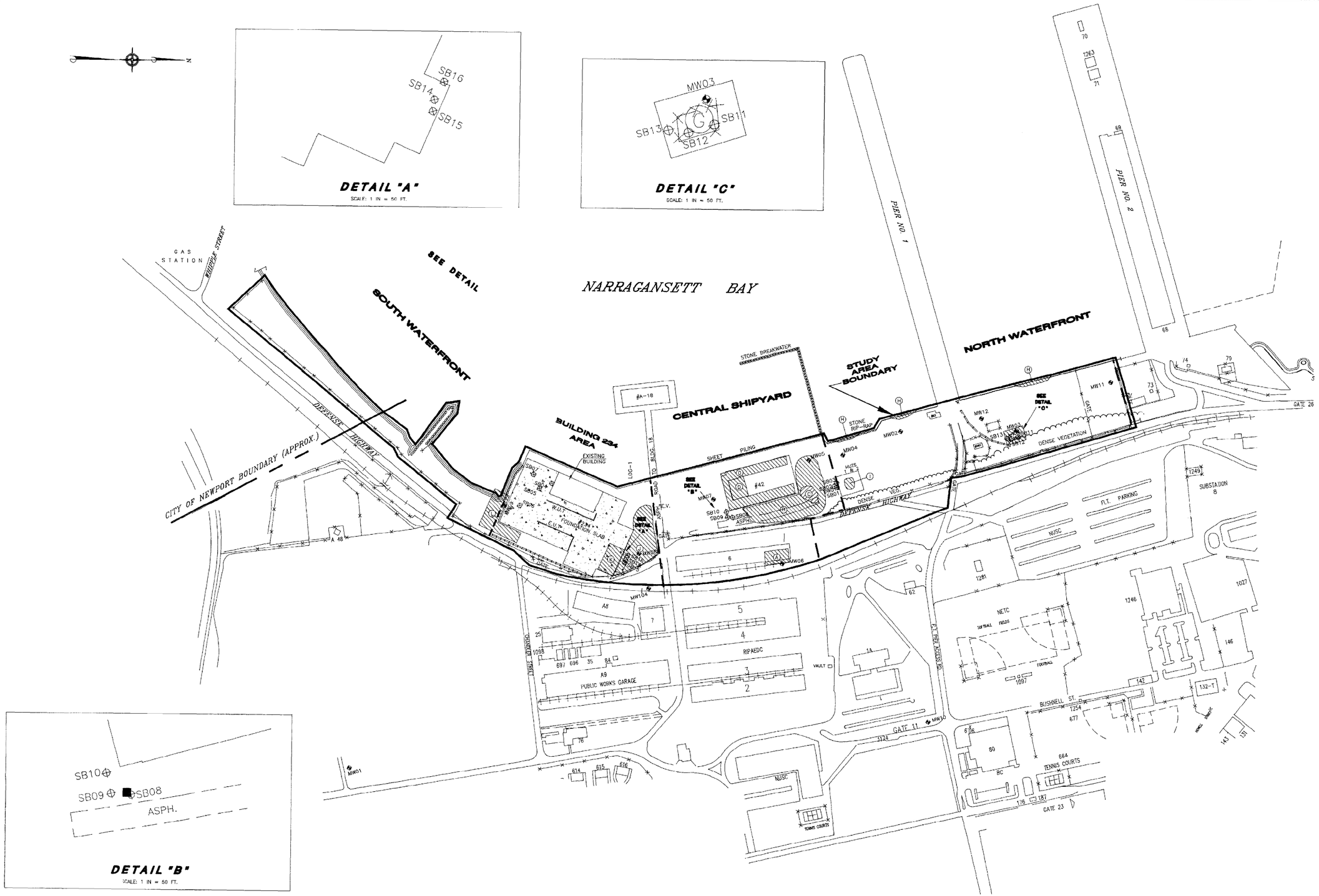

LEGEND

- FENCE
- MW01 — MONITORING WELL WITH IDENTIFIER
- SB13 — SOIL BORING WITH IDENTIFIER
- #A-18 — BUILDING OF INTEREST
- 2 — BUILDING
- AREAS OF POTENTIAL CONCERN, IDENTIFIED BY THE PRELIMINARY ASSESSMENT
- (A) PIPE CLEANING SHOP – DIP TANK AREA
- (B) SAND BLAST GRIT FILL AREA
- (C) DISPOSAL PITS (OILY SLUDGE) (LOCATION APPROXIMATE – SEE TEXT)
- (D) HAZARDOUS WASTE STORAGE WITHIN BUILDING
- (G) HAZARDOUS WASTE STORAGE AREA (OUTSIDE) FORMER BILGE TANK STORAGE
- (H) FILL AREAS ALONG BULKHEAD
- (I) MAINTENANCE SHOP FLOOR DRAIN
- (J) SAND BLAST GRIT / PAINT BOOTH OPERATIONS AREA UST'S LOCATIONS
- (K) MACHINE SHOP / BURNING ROOM
- (L) ROXOBLAST AND DEBRIS AREA

NOTES:

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

GRAPHIC SCALE

200' 0' 200' 400'

1 INCH = 200 FEET

DRAWN BY: D.W. MACDOUGALL	TITLE: BORINGS AND MONITORING WELL LOCATIONS SITE ASSESSMENT SCREENING EVALUATION REPORT FORMER ROBERT E. DERECKTOR SHIPYARD NEWPORT, RHODE ISLAND
PREPARED BY: K. O'NEILL	
CHECKED BY: S. PARKER	
	SOURCE: COMPILED FROM ACTUAL FIELD SURVEY PLAN BY LOUIS FEDERICI & ASSOC., PROVIDENCE, RI AND U.S. NAVY PLANS
	SCALE: 1" = 200' / DATE: MAY 29, 1997 / PROJ. NO: 7368 CTO: 2682
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 4–6 / ACFILE NAME: D:\DWG\NAVY\DERECKTOR\SASER\MW_LOCAT.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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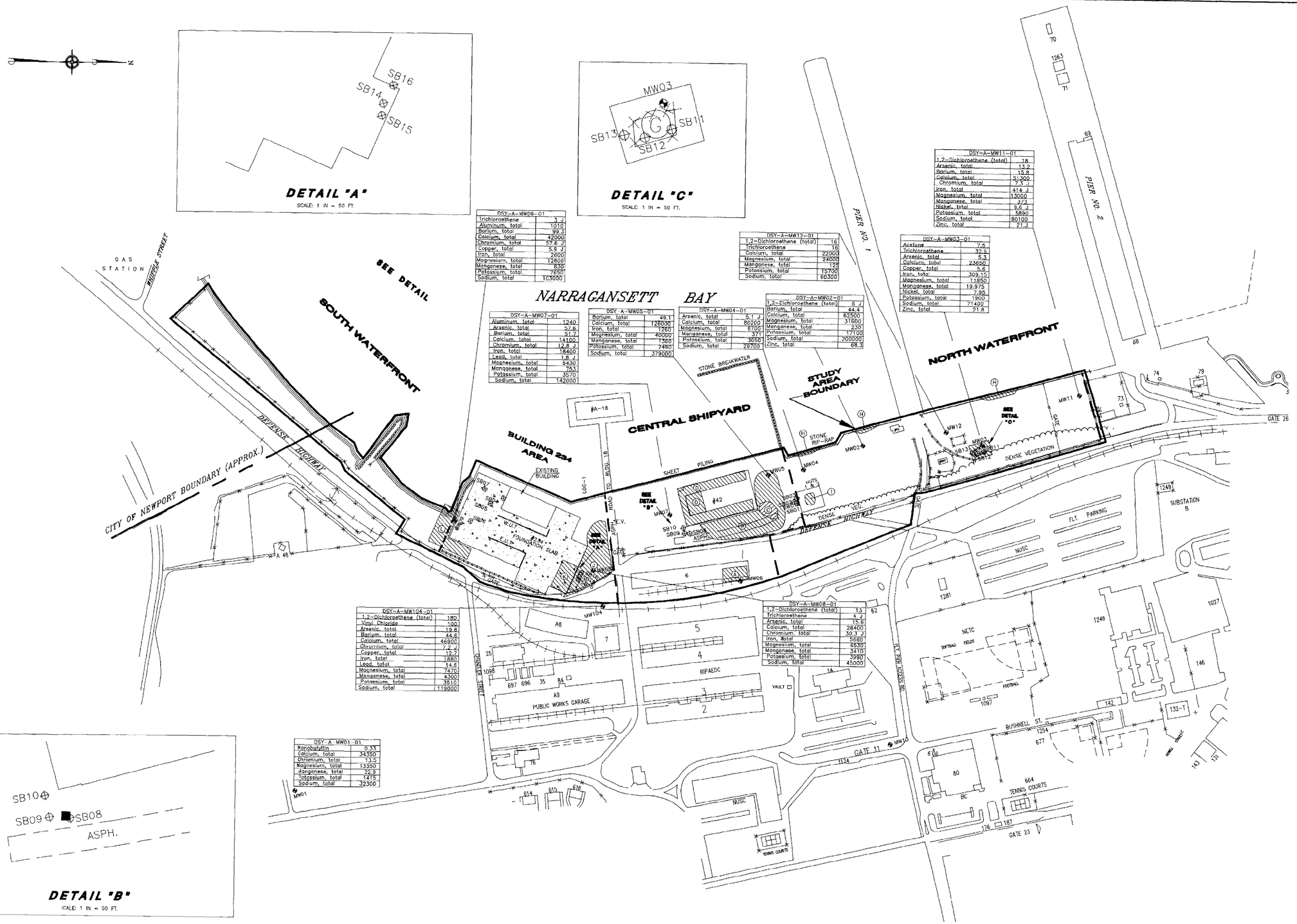


DSY-A-MW09-01	
Trichloroethene	3 J
Aluminum, total	1010
Barium, total	99.3
Calcium, total	42000
Chromium, total	57.6 J
Copper, total	5.6 J
Iron, total	2600
Magnesium, total	12800
Manganese, total	830
Potassium, total	7650
Sodium, total	103000

DSY-A-MW12-01	
1,2-Dichloroethene (total)	16
Trichloroethene	16
Calcium, total	22000
Magnesium, total	24000
Manganese, total	125
Potassium, total	15700
Sodium, total	60300

DSY-A-MW11-01	
1,2-Dichloroethene (total)	18
Arsenic, total	13.2
Barium, total	15.8
Calcium, total	51300
Chromium, total	7.3 J
Iron, total	414 J
Magnesium, total	13000
Manganese, total	373
Nickel, total	9.6 J
Potassium, total	5890
Sodium, total	80100
Zinc, total	21 J

DSY-A-MW03-01	
Acetone	7.5
Trichloroethene	32.5
Arsenic, total	5.3
Calcium, total	23600
Copper, total	5.6
Iron, total	309.15
Magnesium, total	11850
Manganese, total	19.975
Nickel, total	7.95
Potassium, total	1900
Sodium, total	71400
Zinc, total	21.8

DSY-A-MW07-01	
Aluminum, total	1240
Arsenic, total	57.6
Barium, total	51.2
Calcium, total	14100
Chromium, total	12.8 J
Iron, total	18400
Lead, total	1.8 J
Magnesium, total	5430
Manganese, total	753
Potassium, total	3570
Sodium, total	142000

DSY-A-MW06-01	
Barium, total	49.1
Calcium, total	126000
Iron, total	1260
Magnesium, total	40000
Manganese, total	1360
Potassium, total	7490
Sodium, total	379000

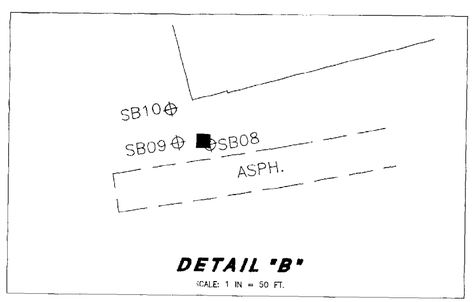
DSY-A-MW04-01	
Arsenic, total	5.1 J
Calcium, total	80200
Magnesium, total	8700
Manganese, total	371
Potassium, total	3050
Sodium, total	29700

DSY-A-MW02-01	
1,2-Dichloroethene (total)	5 J
Barium, total	44.4
Calcium, total	62500
Magnesium, total	31600
Manganese, total	230
Potassium, total	17100
Sodium, total	200000
Zinc, total	66.3

DSY-A-MW104-01	
1,2-Dichloroethene (total)	180
Vinyl Chloride	100
Arsenic, total	19.8
Barium, total	44.6
Calcium, total	46900
Chromium, total	7.2 J
Copper, total	12.7
Iron, total	1880
Lead, total	14.6
Magnesium, total	7470
Manganese, total	4300
Potassium, total	3510
Sodium, total	119000

DSY-A-MW08-01	
1,2-Dichloroethene (total)	13
Trichloroethene	4 J
Arsenic, total	13.6
Calcium, total	28400
Chromium, total	30.3 J
Iron, total	5660
Magnesium, total	8530
Manganese, total	3410
Potassium, total	3990
Sodium, total	45000

DSY-A-MW01-01	
Monobutyltin	0.33
Calcium, total	34350
Chromium, total	13.5
Magnesium, total	13350
Manganese, total	22.9
Potassium, total	1415
Sodium, total	32300



LEGEND

- FENCE
- MW01 MONITORING WELL WITH IDENTIFIER
- SB13 SOIL BORING WITH IDENTIFIER
- #A-18 BUILDING OF INTEREST
- BUILDING
- AREAS OF POTENTIAL CONCERN, IDENTIFIED BY THE PRELIMINARY ASSESSMENT
- (A) PIPE CLEANING SHOP – DIP TANK AREA
- (B) SAND BLAST GRIT FILL AREA
- (C) DISPOSAL PITS (OILY SLUDGE) (LOCATION APPROXIMATE – SEE TEXT)
- (D) HAZARDOUS WASTE STORAGE WITHIN BUILDING
- (E) HAZARDOUS WASTE STORAGE AREA (OUTSIDE) FORMER BILGE TANK STORAGE
- (H) FILL AREAS ALONG BULKHEAD
- (I) MAINTENANCE SHOP FLOOR DRAIN
- (J) SAND BLAST GRIT / PAINT BOOTH OPERATIONS AREA UST'S LOCATIONS
- (K) MACHINE SHOP / BURNING ROOM
- (L) ROBOBLAST AND DEBRIS AREA

NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN
3. ALL CONTAMINANT CONCENTRATIONS ARE EXPRESSED IN ug/l.

GRAPHIC SCALE

200' 0' 200' 400'

1 INCH = 200 FEET

DRAWN BY: D.W. MACDOUGALL
PREPARED BY: K. O'NEILL
CHECKED BY: S. PARKER
PROJECT MANAGER: S. PARKER
PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
CONTAMINANTS DETECTED IN GROUNDWATER
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: JUNE 12, 1997
PROJ. NO: 7368 CTO: 2682
DRAWING NO: FIGURE 4-6A
ACFILE NAME: \DWG\NAVY\DERECTOR\SASFR\CONT_MAP.DWG
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