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REMEDIAL INVESTIGATION FOR SITE 17 BUILDING 32 GOULD ISLAND VOLUME 1 OF 3
TEXT, TABLES AND FIGURES NAVSTA NEWPORT RI
12/01/2006
TETRA TECH NUS, INC.

Remedial Investigation

for

Site 17: Building 32, Gould Island

Naval Station Newport
Newport, Rhode Island

Naval Facilities Engineering Command
Mid-Atlantic

Contract Number N62472-03-D-0057
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LIST OF ACRONYMS

ACH	Air changes per hour
AST	Aboveground storage tank
BCA	bias-corrected accelerated
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BHC	Benzenehexachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CLT	central limit theorem
cm	centimeter
COPC	Contaminant of Potential Concern
CSF	cancer slope factor
CTE	Central Tendency Exposure
DABS	Dermal Absorption Factors
DAD	Dermally Absorbed Dose
DA_{event}	Dose absorbed per unit area per event
DDD	dichloro diphenyl dichloroethane
DDE	dichloro diphenyl dichloroethylene
DDT	dichloro diphenyl trichloroethane
dL	deciliter
EBS	Environmental Baseline Survey
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
ESTCP	Environmental Security Technology Certification Program
FID	Flame ionization detector
GA	State of Rhode Island Classification for Drinking Water source
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IC/DEC	Industrial/commercial direct exposure criteria
IEUBK	Integrated Exposure Uptake Biokinetic model
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System

kg	kilogram
Kp	Permeability Coeffient
L	Liter
LNAPL	Light non-aqueous phase liquid
LOAEL	Lowest observed adverse effect level
LUCIP	Land-use control implementation plan
m^3	cubic meters
MCL	Maximum Contaminant Level
ME	Monitoring event
µg	microgram
µg/dL	micrograms per deciliter
µg/kg	micrograms per kilogram
µg/l or µg/L	micrograms per liter
µg/L	Microgram per liter
mg	milligram
mg/cm^2	milligram per square centimeter
mg/kg	milligrams per kilogram
mg/l or mg/L	milligrams per liter
MSL	Mean sea level
MVUE	Minimum variance un-biased estimator
MW	Monitoring well
NCBC	Naval Construction Battalion Center
NCEA	National Center for Environmental Assessment
NGVD	National Geodetic Vertical Datum
NOAEL	no observed adverse effect level
OABS	Oral Absorption Factors
OSWER	Office of Solid Waste and Emergency Response
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Project action limit
PID	Photo ionization detector
QAPP	Quality assurance project plan
PCB	polychlorinated biphenyl
PCE	Tetrachloroethene
1,1,1-TCA	1,1,1-trichloroethane
PRG	Preliminary Remediation Goal
QDC	Quonset Development Corporation
RAGS HHEM	Risk Assessment Guidance for Superfund: Human Health Risk Evaluation Manual

RBC	Risk-Based Concentration
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RIDEM	Rhode Island Department of Environmental Management
RIDOT	Rhode Island Department of Transportation
RIEDC	Rhode Island Economic Development Corporation
RME	Reasonable Maximum Exposure
SIM	Selective Ion Monitoring
SSL	Soil Screening Level
SVOC	Semi Volatile Organic Compound
SVOCs	Semi Volatile Organic Compounds
TAL	(CLP) Target Analyte List for Inorganics
TCE	Trichloroethene
TCL	Target compound list
TEF	Toxicity Equivalence Factor
TPH	Total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Concentration Limit
UST	Underground storage tank
VC	Vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VF	Volatilization Factor
VOC	Volatile Organic Compound
VOC	Volatile Organic Compounds
Yr	Year

EXECUTIVE SUMMARY

Site 17, located at the northern end of Gould Island, includes the former Building 32 and the immediate surroundings. The site was home to a Navy torpedo overhaul shop in the 1940s until it ceased major operations in the 1950s. During that time, operations included degreasing, parts washing, electroplating, sandblasting, testing, and other operations. The site occupies approximately 6 acres and is bordered by state property to the south and is surrounded by a portion of the East Passage of Narragansett Bay to the east, north, and west. The site buildings have been demolished, and the island is generally unoccupied, but accessed by trespassers occasionally.

The building and facilities were demolished in the period from 1999 through 2002. The concrete roadways were removed at that time, and polychlorinated biphenyls (PCBs) were found in soil near transformer buildings around Building 32. PCB-contaminated concrete and soil were removed under Toxic Substances Control Act (TSCA) removal actions in the same time period.

The Remedial Investigation (RI) efforts conducted included the collection of 87 soil samples from borings and test pits, 14 groundwater samples from monitoring wells, 9 groundwater “discrete zone samples” from bedrock fracture zones, 66 sediment samples from intertidal and subtidal areas around Gould Island, 21 biota samples (clams and mussels as were available at sample stations), 9 aqueous samples from standing water in test pits and in underground utilities found, two samples of soil and sludge from these utilities, and two samples of concrete. In addition, data gathered for the RI included groundwater flow information, information on ecological receptors present and likely to be present, geotechnical information on soils and bedrock pertinent to groundwater and contaminant movement, information on sediment characterization, and over 300 soil samples for headspace screening analysis and soil characterization. Data collected previously by the United States Environmental Protection Agency (EPA) was used to the extent possible in the risk assessments for the site.

Physical Features Found

The site was radically altered by the construction of the overhaul shop in the 1940s. The former hillside at the north end of the island was cut down approximately 20-30 feet, to the current elevation. That material was used as fill to construct the firing pier and other structures at the north end of the site. This resulted in the placement of fill where former Buildings 41, 50, and 44 were located. A till layer is also present under the fill at the northern portion of the site. The bedrock at the site is characterized as metamorphosed sedimentary rock, predominantly phyllite.

The groundwater at the site flows generally from south to north across the site. However, overburden groundwater appears to flow to the northeast, whereas the bedrock groundwater appears to flow to the northwest. Tidal influence was noted in both the overburden and bedrock aquifers at the site. Packer testing results indicated that the bedrock aquifer did not yield appreciable amounts of water.

Overall, contaminants appear to have been released to the sumps and equipment trenches in Building 32, as well as through drains and waste discharge systems at the site. For the most part, the building systems appear to have collected and routed the waste materials from the source locations to the sediments near the shoreline during operations at the site, with one exception, in the area of the southwest corner of Building 32.

Three primary pathways of contaminant transport were identified: The first is the storm drainage system and "trench drain" that gathered groundwater and storm water from the roadway and storage areas (acid storage shed, dust collection building) outside the southwest corner of Building 32. This drain discharged that water to the shoreline at the southeast corner of Building 32. The second pathway is the floor drain system from the electroplating room and other portions of the building that appears to have gravity-drained wastes from the building to the shoreline to the east. The third pathway is the sanitary waste system upgrade installed in approximately 1956 and 1957: sewer system upgrades were installed to redirect some waste to the northwest shoreline. Some mixing of electroplating materials with the sewer waste appears to have occurred. At this location a junction box and dry well were found, constructed with a gravel bottom positioned to allow liquids to filter to the bay.

In addition, a release of PCBs appears to have affected the sediment at the north shoreline in the small boat basin or "Stillwater Area". PCB removals were conducted on-shore in this area, but some amount of PCBs were apparently lost to the subtidal area, either through erosion after collapse of the shoreline structure in this area, or overland prior to collapse.

Contaminants Found

Activities associated with former site operations have resulted in the presence of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, PCBs, petroleum hydrocarbons, metals, and cyanide in site soils and adjacent sediments. Additionally, VOCs, SVOCs, petroleum hydrocarbons, and metals were detected in the site's groundwater at low concentrations. Tetracholoroethene and pentachlorophenol were the only contaminants that exceeded the Groundwater Objectives for GA aquifers established in the Rhode Island Department of Environmental Management (RIDEM) Remediation Regulations, and to federal Maximum Contaminant Levels (MCLs)).

Soil results show the presence of specific, definable locations where elevated concentrations of contaminants (fuel oil, polynuclear aromatic hydrocarbons (PAHs), metals, and PCBs) are present in soil. Most of these locations are sumps, isolated from the surrounding soils by the Building 32 foundation. However, one location is outside the foundation, at the former position of the dust collection building.

In groundwater, low concentrations of VOCs and SVOCs were detected in several monitoring wells across the site, with no discernable pattern. Highest concentrations included pentachlorophenol and tetrachloroethene, both of which only minimally exceeded the respective GA Groundwater Objective and MCL. It was noted that the upgradient groundwater wells contained low concentrations of PAHs. Metals did not exceed drinking water standards. A low concentration of petroleum was detected in the well at the former location of Building 44, a former fuel storage facility. This is likely a remnant constituent from the historic fuel release that occurred at Building 44, where there is an ongoing long-term monitoring program being conducted under the RIDEM Underground Storage Tank (UST) regulations.

Accumulated water in test pits TP-06 and TP-08 showed the presence of fuel components (benzene, toluene, and xylenes), and petroleum hydrocarbons and PAHs, likely artifacts of the fuel releases in these areas (area near southwest corner of Building 32). Water from test pits also showed metal concentrations (chromium, lead, zinc, and copper), possibly a result of sandblasting, dust storage, or electroplating chemical storage in the area of the southwest corner of Building 32.

Sediment data collected indicate elevated concentrations of metals, PAHs, and PCBs in specific locations along the shoreline and in the subtidal sediment. These are identified as the Stillwater Area to the north of the site, the northeast shoreline, which received waste discharges from Building 32 operations, and, to a lesser degree, the northwest shoreline, which also received waste discharges from Building 32 operations.

PCB concentrations in sediments were noted to be highest in the subtidal sediment at the Stillwater Area, north of the site. PCBs detected in the sediments and in the soil at the site include primarily Aroclor 1260. Aroclor 1260 was the PCB mixture that had been found in soil and concrete near transformer buildings 53, 54, 56, 59, 60, and 61 when they were demolished. The distribution of PCBs in sediment samples indicates a gradient, with highest concentrations in the north areas and lower concentrations to the south, along the entire eastern shoreline of Gould Island, continuing well south of the site. PCBs were also found in clams and mussels at the discharge locations.

The PCBs in sediments of the Stillwater Area are likely to remain in this area until the physical properties of the shoreline change. The breakwater protecting this shoreline has deteriorated, and hydraulic forces that can mobilize these sediments will increase as this barrier degrades. In addition, the rigging platform

at the north shoreline has also partially collapsed, and erosion from the shoreline may cover the contaminated sediments and debris from the rigging platform.

PAHs were also found in sediment, and may be related to former degreasing operations in the overhaul shop, or they may be a remnant of fuel piping and storage at Building 44. PAHs were found in sumps and vaults within the Building 32 foundation, and some of these sumps were previously noted to have floor drains that connected to the drains exiting to the northeast shoreline. Some PAHs at outfall locations near SD-304 and SD-305 are likely a result of releases at the southwest corner of Building 32, carried to the shoreline through pipelines and sewer systems.

Metals and cyanide were found at sediment sample locations where outfalls once discharged to the subtidal shoreline. The elevated concentrations of heavy metals present in the sediment near existing and historic outfalls can be traced back through pipeline transport from the electroplating rooms and dust storage shed, where high concentrations of heavy metals were found in soil samples. It is noted that cyanide was also found in the subtidal sediment sample near the former landfill at Gould Island (SD311). This indicates a second possible source of cyanide in the area.

Risk Assessment:

The Baseline Human Health Risk Assessment evaluated exposure to surface soil, subsurface soil, groundwater, sediment, and shellfish.

Non-cancer risks estimated for adult recreational visitors, trespassers, and current industrial workers at the study area were below the non-cancer target risk level of 1.0.

The non-cancer risks to the current and future child recreational visitors, future industrial workers, future construction workers, and fishermen (both recreational and subsistence fishermen ingesting shellfish) were estimated to be above the target risk level of 1.0. These risks are driven by specific contaminants including chromium (intertidal sediments); cadmium (subsurface soil); PCBs, arsenic, and thallium (shellfish ingestion); and PAHs and PCBs within excavation trenches (groundwater and soil).

The cancer risks estimated for the future recreational visitors and trespassers exposed to surface soils and intertidal sediments, current industrial workers exposed to surface soils, as well as recreational fishermen consuming clams and mussels from the site, were within or below the EPA cancer risk target range of 1E-4 to 1E-6. The cancer risk for the current industrial workers, future industrial workers, and the current and future recreational fishermen exceeded the RIDEM acceptable risk level of 1E-5.

The cancer risks to the future construction workers and current and future subsistence fishermen were estimated to be above the EPA cancer risk target range of 1E-4 to 1E-6. These unacceptable risks are driven by specific contaminants, including: PCBs, pesticides, PAHs, and pentachlorophenol (shallow groundwater) and PCBs, PAHs, beta-BHC and arsenic (shellfish).

It should be noted that the subsistence fishing scenario is not known to currently exist and is unlikely in the future because of the unrealistic assumption that 180 meals per year would be obtained from waters adjacent to Site 17. To do so would require either year-round habitation at Gould Island, or travel to this location by boat, ignoring many other more suitable fishing areas in favor of this single location. In addition, some of the contaminants which predict risk to fishermen (PAHs, arsenic) are found at similar concentrations in reference shellfish samples collected in Rhode Island waters.

Based on the non-cancer and cancer evaluations, the following contaminants with non-cancer hazard quotients greater than 1.0 or cancer risks greater than 10-6 in a scenario with total cancer risks greater than the EPA cancer risk range were identified as COCs: chromium in sediment; cadmium in subsurface soils; PAHs, gamma-BHC, heptachlor epoxide, 2-methylnaphthalene, naphthalene, and PCBs in trench air; PCBs, beta-BHC, thallium, and arsenic in clams; PCBs, PAHs, and arsenic in mussels; and PAHs and pentachlorophenol in shallow groundwater.

Exposure to lead, measured through blood lead models for worker exposures, was found to be below EPA's level of concern.

A screening ecological risk assessment was performed to evaluate the possibility of ecological risks to the terrestrial and marine receptors exposed to contaminants associated with the site. This screening assessment was conducted to determine contaminants of potential ecological concern and to determine whether a baseline ecological risk assessment should be conducted.

No contaminants of potential concern (COPCs) were identified to pose risk of adverse effects to plants or soil invertebrate animals. A food chain model was used to estimate contaminant uptake into higher trophic level organisms, such as herring gulls, raccoons, rodents, and other birds. The food chain model did not identify any site-related COPCs in surface soil or sediment.

For the marine exposures, SVOCs (primarily PAHs), pesticides, PCBs, and metals detected in the sediment were determined to be COPCs which may pose risk of adverse effects to marine organisms at the site, and warrant additional evaluation.

The Remedial Investigation concludes that:

1. Elevated concentrations of soil contaminants are present within vaults and sumps in the foundation of Building 32. These soils are confined, and can be easily obtained through excavation.

2. Apparent “hot spots” of metals and petroleum in soil are present in the southwest corner of Building 32, near the former location of the dust collection storage building and acid storage shed. Although the area is limited in extent, the source of the petroleum in this area is unknown at this time, and additional focused investigations may be necessary to accurately quantify the affected area.

3. Tetrachloroethene and Pentachlorophenol are present in groundwater at concentrations exceeding the federal MCLs. While there is no drinking water exposure route present or expected at this location, the site is within a GA aquifer so these contaminants will need to be taken into consideration in a Feasibility Study for the site.

4. Residual contaminants may also be present in underground utilities at the site, including the sewer systems, the trench drain, and other drainage systems under and around Building 32.

5. The groundwater beneath Gould Island is classified by RIDEM Rules and Regulations as GA, suitable for use as a current or potential source of drinking water. Overall, groundwater contaminant levels do not exceed the RIDEM GA Groundwater Objectives and federal MCLs, with the exception of two contaminants, pentachlorophenol and tetrachloroethene, both found in the shallow overburden groundwater. Based on the hydraulic gradient of the aquifer, and the soil conditions found, it appears that the till is providing a confining layer against contaminant movement into the deep overburden at the site, and that groundwater flow to the north and east would eventually direct dissolved contaminants through the less dense fill and upper layers of overburden to the shoreline, where the dissolved contaminants would disperse through dilution, without effects to ecological receptors.

6. SVOCs (primarily PAHs), pesticides, PCBs, and metals are present in the intertidal and subtidal sediments may pose risks to ecological receptors. A baseline ecological risk assessment is necessary to quantify actual risks to ecological receptors from these contaminants in the sediments near the site.

7. PAHs, PCBs, and metals are present in the intertidal sediment and subtidal shellfish that are predicted to pose risk to humans from future recreational use of the site, as well as current recreational collection and ingestion of shellfish.

8. The highest concentrations of contaminants in sediment are localized around three former source discharge areas.

9. The unstable shoreline and deteriorated structures to the north of the site pose the possibility of future disturbance and mobilization of PCB - contaminated sediments.

The report recommends that a Phase 2 Remedial Investigation be conducted to provide a baseline ecological risk assessment (BERA) and to close data gaps found. This will include detailed evaluation of risk to ecological receptors from contaminants present, as well as additional evaluations of sediments of the Stillwater Basin area to the north of the site, resolution of extent of fuel contamination at the southwest corner of Building 32, and clarification of the source of this contamination. Details of these investigations will be identified in a work plan developed in consultation with the stakeholders. After the Phase 2 RI is completed, the site should move forward to the FS and ROD phases, in accordance with CERCLA.

1.0 INTRODUCTION

This report presents the Remedial Investigation (RI) for the Building 32 area (the site) on Gould Island, which is located in Jamestown, Rhode Island and owned by the Naval Station-Newport (NAVSTA), formerly Naval Education and Training Center (NETC). The Building 32 area has been designated as Site 17 through Navy correspondence following the Phase 1 Study Area Screening Evaluation (SASE) conducted in April 2000. The RI is submitted in accordance with the Federal Facilities Agreement (FFA) between the U.S. Navy, the U.S. Environmental Protection Agency (EPA), and Rhode Island Department of Environmental Management (RIDEM), which directs the implementation of the Installation Restoration Program (IRP) for NAVSTA. The RI has been conducted by Tetra Tech NUS (TtNUS) on behalf of the Navy under the Comprehensive Long -Term Environmental Action Navy (CLEAN) Contract No. N62467-03-D-0072, Contract Task Order (CTO) 035.

The purpose of the RI is to determine the nature and extent of contamination associated with the past use and disposal of chemicals and chemical wastes at Site 17. The investigation focuses on environmental contamination at and near the former Building 32 area, which is located on the northern portion of Gould Island in Narragansett Bay. The RI was conducted in accordance with general United States U. S. EPA guidance and the Work Plan for Remedial Investigation at Site 17 (the Work Plan, TtNUS, 2004).

Site 17 is centered on the former Building 32, which was a torpedo overhaul shop. Building 32 contained an electroplating shop, machine shops, degreasing shops, grinding and buffing shops, and other workshops used for torpedo service and maintenance during and after the Second World War. All above-ground structures in the vicinity were demolished in 2001 and 2002. Site 17 is currently described as the “Building 32 Area” and its exact boundaries are not yet defined. This RI will further determine the extent of contamination and the site boundaries may be adjusted to encompass the area where site-related contaminants have come to reside.

Some investigations and removal actions were previously conducted at this and other release sites in the area. A detailed description of these activities is presented in the Background Summary Report for Site 17, which is located in Appendix A of this RI Report. The Background Summary Report describes past industrial activities that apparently resulted in the presence of chlorinated solvents, fuel-related contaminants, and metals in the soil, groundwater, soil gas, and marine sediment at the site, and PCBs in the soil and marine sediments at the site. To determine the nature and extent of these contaminants, as well as the nature and extent of other contaminants that had not yet been identified, the RI was conducted through a focused program of investigation that was based on previous investigation findings, known and suspected contaminant migration pathways, and site background information.

Other environmental release sites on Gould Island are on property owned by the State of Rhode Island, and managed under the Formerly Used Defense Sites (FUDS) Program operated by the Army Corps of Engineers (Corps of Engineers) (refer to Section 1.4.2). The New England District of the Corps of Engineers reported in both 2002 and 2003 that a Phase II Engineering Evaluation for Contamination was initiated for FUDS sites on Gould Island, but has been put on hold pending discussion with RIDEM on the scope of further investigations.

1.1 REPORT ORGANIZATION

This RI report has been divided into eight sections, with tables and figures presented following of the text. This section of the report, Section 1.0, provides background information about NAVSTA and the Building 32 area, including the location, description, and history of NAVSTA and the site, and a discussion of previous investigations conducted at the site. Section 2.0 of the report provides an overview of the field investigations that were conducted to assess the contamination and physical conditions at the Building 32 area. Section 3.0 provides a description of the site physical characteristics, including regional physiography, regional and site-specific geology, and regional and site-specific hydrology and hydrogeology. Section 4.0 discusses the nature and extent of contamination at the site. Section 5.0 presents a discussion of the fate and transport of contaminants at the site. Sections 6.0 and 7.0 present the results of the human health risk assessment, respectively. Section 8.0 presents the summary and conclusions of this RI.

1.2 OBJECTIVES AND SCOPE OF THE INVESTIGATION

The general objectives of the RI are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. This information is necessary to determine whether, and to what extent, a threat to human health or the environment exists from site related contaminants, and to determine if the development and evaluation of remedial action alternatives are necessary to address these contaminants.

The scope of the investigation for this site was developed to meet site-specific RI objectives. However, the specific objectives of each sampling investigation were refined based upon the findings of the previous investigations and remaining data needs. Remedial objectives for the Building 32 area investigation include the following: determining background values soil and groundwater quality in the area; determining the nature and extent of surface soil contamination and subsurface soil contamination at the site; determining the nature and extent of groundwater contamination; determining the nature and extent of sediment and biota contamination in the marine environment adjacent to the site; determining the fate and

transport of site-related contaminants identified at the site; and determining the risks posed by site contaminants to human health and the environment.

1.3 NAVSTA BACKGROUND INFORMATION

This section presents an overall description of NAVSTA as well as its history, a summary of response actions taken at Site 17, and a summary of previous environmental investigations conducted at the site.

1.3.1 NAVSTA Description

NAVSTA is located approximately 60 miles southwest of Boston, Massachusetts and 25 miles south of Providence, Rhode Island. It occupies approximately 1,063 acres, with portions of the facility located in the City of Newport and Towns of Middletown and Portsmouth, Rhode Island. The NAVSTA facility layout is long and narrow, following the western shoreline of Aquidneck Island for nearly 6 miles facing the east passage of Narragansett Bay. A general location map of the current extent of NAVSTA is provided as Figure 1-1.

1.3.2 NAVSTA History

NAVSTA is located immediately north of Newport, Rhode Island (Figure 1-1) on the west shore of Aquidneck Island facing the east passage of Narragansett Bay, as stated above. Extensive background information for these areas has already been gathered in the Initial Assessment Study (IAS) (Envirodyne Engineers, 1983), Confirmation Study (CS) (Loureiro Engineering Associates, 1985), and the SASE report (TtNUS, 2000). The history of the base (indented paragraphs below) is excerpted from the IAS (IAS, pp. 5-6 to 5-14):

> The Newport area was first used by the Navy during the Civil War when the Naval Academy was moved from Annapolis, Maryland to Newport in order to protect it from Confederate troops. The Naval Academy operated at Newport for about four years before returning to Annapolis.
>
> In 1869, the experimental Torpedo Station at Goat Island was established. This was the Navy's first permanent activity at Newport. The station was responsible for developing torpedoes and conducting experimental work on other forms of naval ordinance.
>
> In 1881, Coasters Harbor Island was acquired by the Navy from the City of Newport and used for training purposes. In 1884, the Naval War College was established on the island. A causeway

and bridge linking the island to the mainland was constructed in 1892. In 1884, the USS Constellation was permanently anchored as a training ship for the Naval War College.

The Melville, Rhode Island area was established as a coaling station for the steam-powered ships in 1900. The Navy purchased 160 acres of land and constructed the Narragansett Bay Coal Depot. With the advent of ships burning liquid fuel, it became necessary to add oil tanks. Consequently, in 1910, four fuel oil tanks were added in the Melville area.

In 1913, the Navy established the Naval Hospital on the mainland of Aquidneck Island, directly adjacent to Coasters Harbor Island. At this time, the main hospital building was constructed.

The outbreak of World War I caused a significant increase in military activity in Newport. Some 1,700 men were sent to Newport and housed in tents on Coddington Point and Coasters Harbor Island. A bridge was built at this time connecting Coddington Point with Coasters Harbor Island. In 1918, Coddington Point was purchased by the Navy. Much of the naval base organization was then transferred to Coddington Point. During the war, numerous destroyers and cruisers were fueled by the Melville coal depot and fuel tanks. By this time, a pipeline had been extended to the north fueling pier and two additional oil tanks constructed.

Following World War I, fuel oil gradually replaced the use of coal by the Navy fleet. In 1921, the Coal Depot was changed to the Navy Fuel Depot. In 1931, the coal barges and coaling equipment were sold to the highest bidder.

In 1923, some two hundred buildings, which were part of the emergency war camps established on Coddington Point, were stripped and sold for scrap. The station was put on caretaker status in 1933. The base remained relatively inactive until the onset of World War II.

Reactivation of the naval base occurred in the late 1930s as a result of military build-up in Europe. Just prior to the reactivation, a 1938 hurricane and storm surge destroyed or severely damaged over 100 buildings and much of the sea walls. In 1940, Coddington Cove was acquired for use as a supply station, and hundreds of Quonset huts were constructed throughout the base. Additional barracks were constructed on Coasters Harbor Island, increasing the base housing capacity to over 3,500 men. Power plant facilities were also constructed at this time. Coddington Point was reactivated to house thousands of recruits. The Anchorage housing complex in the Coddington Cove area was constructed in 1942. In the Melville area, additional fuel facilities were constructed along with a Motor Torpedo Squadron Boat Training Center and nets for harbor defense were constructed. Tank Farms 1 through 5 were constructed during this time period. The Fire Fighting

School, Fire Control Training Building, and the Steam Engineering Building were constructed in 1944.

The Torpedo Station at Goat Island was very active during World War II and expanded its operation to Gould Island. The Torpedo Station employed more than 13,000 people and manufactured 80 percent of all torpedoes used by the U.S. during the war. The Station was the largest single industry ever operated in Rhode Island.

Following World War II, naval activities at Newport converted to a peace time status. This resulted in a reduction of naval activity. Some 300 Quonset huts and buildings were removed, and the entire naval complex was consolidated into a single naval command designated the U.S. Naval Base in 1946.

The Naval Base adjusted to its peace time status by increasing its activities in the fields of research and development, specialized training, and preparedness for modern warfare. There was a brief period during the Korean War when some 25,000 sailors trained at Newport.

In 1951, the Torpedo Station was permanently disestablished after 83 years of service. Future manufacture of torpedoes was to be awarded to private industry. In place of the Torpedo Station, a new research and development facility, the Naval Underwater Ordinance Station, was established and given the responsibility of overseeing the private contractors. The Officer Candidate School was also established in 1951.

In 1952, the Training Station and other naval schools were disestablished, and the U.S. Naval Station and the U.S. Naval Schools Command were established.

In 1955, Pier 1 was constructed, with Pier 2 being added in 1957. Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. Some 55 naval warships and auxiliary craft were homeported at Newport. New housing and bachelor quarters were added in the late 1950s and early 1960s.

Major expansion of the Naval War College occurred during the late 1950's and early 1970's, transforming the college into a major university. In July of 1971, the Naval Schools Command was restructured and named the Naval Officer Training Center (NOTC).

In April of 1973, the Shore Establishment Realignment Program (SER) was announced and resulted in the largest reorganization of naval forces in the Newport area. The fleet stationed in

Newport was relocated to other naval stations on the east coast. SER resulted in the disestablishment of the Naval Communication Station and the Fleet Training Center and related activities. The Public Works Center, Naval Supply Center, Naval Station and Naval Base were absorbed by NOTC. In April of 1974, NOTC was changed to the NETC.

From 1974 to the present, research and development and training have been the primary activities at Newport. The base was renamed Naval Station Newport ("NAVSTA" in this RI report) in 1998. The major commands currently located at NAVSTA include the Naval Education and Training Center, Surface Warfare Officers School Command, Naval Undersea Warfare Center, and the Naval War College.

1.3.3 Previous Investigations at NAVSTA

Previous investigations at NAVSTA that pertain to Site 17 included an Initial Assessment Study (IAS) in 1983 and a Confirmation Study (CS) in 1986.

The IAS, conducted for the Navy in 1983 by Envirodyne Engineers, Inc., St. Louis, Missouri, identified 18 sites at the naval base where contamination was suspected that may have posed a threat to human health or the environment. Six of these sites (including the Gould Island Electroplating Shop) were judged to require further study and were investigated under a CS conducted by Loureiro Engineering Associates, Avon, Connecticut, and completed in 1986.

During the period of 1986 to the present, numerous investigations and remedial actions have been conducted under the Navy's Installation Restoration Program for NAVSTA. These activities are documented in the Administrative Record for NAVSTA, updated in November 2005.

In addition, the U.S. EPA conducted sediment sampling in the area of Gould Island in September 2003 as part of a sampling event that also included samples from Coasters' Harbor Island. This activity is discussed further in Section 1.4.4 of this RI report, and the resulting analytical data is presented in Appendix B.

Other investigations that are specific to Site 17 are also listed in Section 1.4.4.

1.3.4 History of Response Actions Pertaining to Site 17

This section presents a brief chronology of the response actions previously conducted that are pertinent to environmental issues at Site 17. The following chronology is based on information in previous environmental reports prepared for the Navy, and on information obtained from review of RIDEM files.

September 11, 1980 - The Naval Assessment and Control of Installation Pollutants (NACIP) program was initiated. The purpose of this program is to systematically identify, assess, and control environmental contamination from past use and from disposal of hazardous substances at Navy and Marine Corps installations.

March 1983 - The IAS of NAVSTA was completed. Eighteen potentially contaminated sites were identified under the IAS, including the Gould Island Electroplating Shop (Study Area 17).

1984 - The Defense Environmental Restoration Program (DERP) was established to promote and coordinate efforts for the evaluation and cleanup of contamination at the Department of Defense (DOD) installations. A major element of the program was the establishment of the IRP. The IRP focuses on the investigation and cleanup of contaminated sites in compliance with the procedural and substantive requirements of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by Superfund Amendments and Reauthorization Act (SARA), as well as regulations promulgated under these acts or by applicable state law.

May 1986 - The Confirmation Study for NAVSTA was completed at six sites, including Study Area 17 - Gould Island Electroplating Shop.

1988 - A Technical Review Committee (TRC) was convened to facilitate communication of information with regard to actions to be undertaken at NAVSTA. TRC members include representatives from the U.S. Navy, U.S. EPA - Region I, Rhode Island Department of Environmental Management (RIDEM), the City of Newport, the Towns of Portsmouth and Middletown, and local citizens groups.

November 21, 1989 - NAVSTA was listed on the National Priority List as the “Naval Education and Training Center (NETC)”.

1990 - A Community Relations Plan was issued for NAVSTA by the Navy. Public Information Repositories were also established to allow public access to NAVSTA documents. These are located in the public libraries in Newport, Middletown, Portsmouth, and Jamestown, Rhode Island.

November 1991 - The Draft Phase I RI and Risk Assessment Report on the four NAVSTA sites (McAllister Point Landfill, Old Fire Fighting Training Area, Tank Farm Four, and Tank Farm Five) and Melville North Landfill was completed.

1992 - A waste inventory was performed in 1992 to determine the contents of miscellaneous drums and other containers located in the buildings at Site 17. Bulk hazardous materials were subsequently removed.

July 1992 - A Draft SASE Work Plan for investigation of six suspected sites at NAVSTA was completed, which included the Gould Island Electroplating Shop (Study Area 17).

December 1992 - The Final SASE Work Plan for investigation of three suspected sites at NAVSTA was completed, which included the Gould Island Electroplating Shop (Study Area 17).

1995 – The Navy established the Restoration Advisory Board (RAB), in order to provide ongoing information to the citizens in towns where Navy IR sites are present.

1993 to 1998 – The Navy directed IR efforts at higher priority sites, including McAllister Landfill (Site 1), Tank Farms 4 and 5 (Sites 12 and 13), Old Fire Fighting Training Area (Site 9), and Dereckter Shipyard (Site 19).

1998 – The Navy revised the SASE Work Plan for the Gould Island Electroplating Shop. As documented in correspondence between the U. S. Navy and the U. S. EPA, the site is redefined from “the Electroplating Shop at Building 32” to the Building 32 Area at Gould Island.

2000 – Several small buildings adjacent to Building 32 were confirmed to house electrical transformers that contained polychlorinated biphenyl (PCB) oil. The PCB transformers were removed prior to building demolition in 2000. Concrete chip sampling for PCB contamination was subsequently conducted on the floors and walls of the transformer vault buildings under Toxic Substances Control Act (TSCA) regulations. This effort led to additional soil testing, concrete and soil removal actions, and other investigations in 2001 and 2002 (see below).

March and April 2000 - The first phase of a SASE was conducted at Building 32. The SASE reported chlorinated solvents and polynuclear aromatic hydrocarbons (PAHs)

found in soil gas, and elevated levels of metals found in sludge and soil samples collected.

May 2000 - A number of buildings on Site 17 were removed due to their state of deterioration and the physical hazards they presented. This work commenced on May 1, 2000 and consisted of asbestos abatement, hazardous materials removals, and demolition of buildings to the slab elevation only.

December 2000 - The Draft Final SASE for Building 32 was completed, which included the Gould Island Electroplating Shop (Study Area 17).

2001 and 2002 - PCB sampling was conducted at the transformer locations and surrounding roadways, under TSCA regulations. Elevated levels of PCBs were found in transformer Buildings 53, 54, 56, 60 and 61, Building 58 Deep Well House, Building 59 Switch House, Building 52 Riggers Storage Building, on the road which encircles Building 32, and on the beach and in the sediment adjacent to Transformer Vault 54. Oil containing 430,000 ppm of PCBs was also found beneath Building 54, and free product containing PCBs was found on the water table. The transformer buildings were demolished in 2001 and 2002. Approximately five thousand cubic yards of contaminated soil, concrete and sediment were removed from these locations under actions carried out under TSCA and RIDEM regulations. Although PCBs were not found in groundwater collected from wells installed downgradient of the former building foundation (TtNUS, 2001), trace levels of PCBs (0.229-0.324 mg/L) were found in pooled groundwater in excavations completed in September 2003 (TtFW, 2004) (also refer to Appendix A).

September 2003 – The U.S. EPA conducted marine sediment sampling adjacent to Gould Island. Samples were analyzed for total metals, cyanide, and PCBs. PCB, lead, and copper concentrations were detected in exceedance of sediment quality criteria (Appendix B).

July 2004 – The Final RI Work Plan for Site 17, Building 32, Gould Island was completed.

1.4 BUILDING 32 AREA BACKGROUND INFORMATION

This section presents the site description and history for the Building 32 area, and summarizes the findings of previous environmental investigations conducted at the site.

1.4.1 Site Description

Gould Island is located in the East Passage of Narragansett Bay, approximately 1.5 miles west of Newport, Rhode Island. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres (Figure 1-2). Building 32 (Site 17), located on the northeast end of Gould Island, served as a torpedo overhaul shop and has been inactive since the 1950s (Figure 1-3).

Appendix A of this report contains the Background Summary Report for Site 17. The report presents a detailed summary of the Building 32 area (the site). This summary includes a physical description of the area, the buildings that were present there, a history, a review of pertinent environmental investigations, and details on removal actions conducted at the site.

To summarize from Appendix A, the site is located on the north portion of Gould Island, and occupies approximately 6 acres of land. In 2001 and 2002, the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place. Some of this demolition material was used to backfill an excavation area at the former Building 44 area, and the remainder was moved off site for land disposal elsewhere.

The north end of Gould Island where the site lies is a series of man-made structures, built on a combination of filled land and a natural island formation. The area is subject to prevailing wind exposure and currents almost year round. Sedimentation is not evident in the intertidal areas, but some has occurred in the boat basin adjacent to the firing pier (Figure 1-3). The intertidal shoreline is subject to wave action and consists of a mixture of deteriorated steel sheetpile wall and a stony beachface. Figure 1-3 depicts the sheet pile shoreline. Figure 1-4 depicts the historical shoreline and original topography of the Island.

The subject of this RI is the Building 32 area, and lacking further definition, the investigation area is generally discussed as the area on the north end of the Island. This area was developed from coastal agricultural land in the early 1940s. Aerial photography from the 1940s (Appendix A) shows that over 80 percent of the surface soils of Gould Island were re-worked during development of the facilities there. At the east shoreline of the Island (and south of the site), the overburden is very thin or nonexistent, and bedrock is exposed in places and is eroding under the normal wave action, forming a shingle style beach face. Bedrock is undulating, brittle, and highly fractured, allowing available water to seep through the fractures. There is no pervasive dip or strike to the exposed bedrock on the east shore, due to the extreme undulations.

1.4.2 Site History

Gould Island was purchased by the U.S. Government in 1918 (Presidential Proclamation, 1918). The southern end of the island was immediately developed as a torpedo storage and seaplane station (Snyder, Enright, 2003). The northern end of the Island, where the site resides was developed in the 1940s as a weapons support center for naval vessels. Ownership of the southern three-fourths of the island was transferred to the State of Rhode Island in the late 1970s. NAVSTA retains ownership of the northern section. A fence separates the two properties (Figure 1-3).

To summarize from Appendix A, Building 32 housed electroplating, machining, parts washing, buffing, grinding, and other machinery operations during the 1940s until 1951 (EEI, 1983). Other structures on the property included transformer buildings, power plant, an acetylene generator building, an administration building, and various structures used for loading and unloading personnel, torpedoes, and other materials from small vessels.

Historic information (U.S. Navy, 1959) indicates that four water supply wells were drilled on Gould Island in the early 1940s. These wells were installed at different locations in an effort to find a usable fresh water supply. Two of the wells were reportedly advanced to a depth of 330 feet, while the remaining two wells were advanced to a depth of approximately 530 feet. The wells' yields were deemed inadequate to support Island needs, and therefore a fresh water supply line was extended from Aquidneck Island (U.S. Navy, 1943 and U.S. Navy, 1959). The locations of these wells are presented on historic maps, provided in Appendix C of this RI Report.

A number of targeted environmental investigations and removal actions have been performed at the site to date, as described in Appendix A of this RI Report. Based on the documentation from these efforts, the following environmental conditions were deemed likely to exist at the onset of the RI:

Groundwater Contamination – Groundwater in the area of Building 44 (north of Building 32, and shown on Figure 1-3) was found to contain low concentrations of petroleum, chlorinated solvents, PAHs, and metals. Groundwater movement at the site is likely to reflect surface topography, discharging to the bay which surrounds the site on three sides. RIDEM reports that TPH and free product were found at Building 33, west of Building 32 (RIDEM, 2006). RIDEM also states that PCBs were found in groundwater in the former locations of Building 53 and 54, which are former transformer buildings, demolished and remediated under TSCA and RIDEM regulations (Appendix A and Section 1.3.4 above). While PCBs were not detected in groundwater monitoring wells downgradient of Building 54 (TtNUS, 2001), trace levels of PCBs (<1 mg/L) were detected in standing water in excavations completed for removal of PCB-contaminated soil at Building 54 (TtFW, 2004).

Vadose Zone Contamination – Chlorinated solvents, toluene, and PAHs were found, but not quantified, in soil gas samples from the vadose zone in the area north of Building 32 in 1997 and under the Building 32 foundation in 2000.

Soil Contamination – Soils containing PCBs at concentrations below 10 milligrams per kilogram (mg/kg) are likely to be present at the former locations of Buildings 52, 53, 54, 56, 59, 60, and 61, which surround Building 32. Additionally, some oil (probable #2 fuel) was encountered in the excavation for the Building 56 foundation, west of Building 32 (Foster Wheeler, 2003).

Sediment Contamination – Based on historical records, wastes from solvent cleaners and electroplating operations were likely discharged to Narragansett Bay from the east side of Building 32 through a floor drain system. Low concentrations of cyanide and heavy metals were found in sediment samples taken in Narragansett Bay near the outfall of a discharge pipe east of Building 32 in 1986.

PCB contamination in soils near Building 54 was remediated easterly from the release area (Building 54) out to the shoreline, but not extended beyond that point. PCBs in excess of 1 mg/kg are likely to be present in marine sediments east of this area.

1.4.3 Waste Discharge Systems

Architectural and design drawings for the construction of Building 32, found in the archives of the NAVSTA records, were reviewed to determine waste discharge patterns. These drawings show that floor drains, sewer drains, and storm drain systems were originally planned to discharge east from Building 32, through a series of pipes to the intertidal and subtidal areas of the constructed shoreline. The drawings suggest that these systems would function on gravity alone.

Further review of these records shows upgrades to the sewer systems in approximately 1957. These upgrades included installation of concrete septic tanks and discharge of sewer waste to the ocean on the west shoreline of the island. Floor drains and storm drains did not appear to be altered by these upgrades. Historical drawings evaluated as a part of the RI are presented in Appendix C of this report.

1.4.4 Previous Site Investigations

Previous investigations of the site are summarized in Appendix A. Further details of these investigations can be found in their originating reports:

- Initial Assessment Study – Envirodyne Engineers, 1993

- Verification Study and Confirmation Study – Louriero Engineering, 1984 and 1986
- Building 44 UST Closure Assessment – Environmental Resource Associates, 1994
- Building 44 Phase 1 Environmental Assessment – Q3G, 1995 and 1996
- Building 32 Underground Storage Tank (UST) Site Investigation Report - Brown and Root Environmental, 1997
- UST Site Investigation of Building 44 Area - Brown and Root Environmental, 1997
- Building 44 Corrective Action Excavation - TtNUS, 2000
- Building 44 Interim Monitoring – TtNUS, 2001 and 2002
- Study Area Screening Evaluation (SASE) for Building 32 – TtNUS, 2000
- Phase 1 PCB Sampling – Foster Wheeler, 2002
- Phase 2 PCB Contaminated Concrete and Soil Remediation – Foster Wheeler, 2002

In September 2003, U.S. EPA personnel conducted sediment sampling at Gould Island as part of a sampling event that also included sampling in the vicinity of Coasters' Harbor Island. Samples collected at Gould Island were located in the vicinity of the Building 32 acid-resistant drain outfall, the former ferry slip area, several island perimeter locations, and a deep water location. Sediment samples were collected with dredges from the 0- to 6-inch depth interval. Samples were analyzed for PCBs, total metals, and cyanide at the U.S. EPA New England Regional Laboratory in Chelmsford, Massachusetts.

Analytical results of the sediment samples reported concentrations of Aroclor-1260, copper, lead, and manganese that exceeded sediment quality criteria. Aroclor-1260 was detected in ten samples at concentrations that exceeded National Oceanic and Atmospheric Administration (NOAA) Effects-Range-Low (ERL) and Effects-Range-Medium (ERM) criteria. The maximum concentration detected was 2,000 µg/kg in a sample collected east of the former Building 32's acid-resistant discharge pipe. Concentrations of Aroclor-1260 in sediment samples generally decreased from the north end of the Island towards the south end.

Metals in excess of criteria were detected in four sediment samples. Maximum concentrations of copper (100 mg/kg) and lead (67 mg/kg) were detected in the sample locations on the northwest shoreline and adjacent to former Building 32, respectively. Manganese was detected at a maximum concentration of 280 mg/kg in a sample collected from a deep water location, approximately 2,000 feet east of Gould Island.

1.4.5 Previous UST Investigations and Actions

This section summarizes environmental investigations and actions that have been conducted at the site under RIDEM UST regulations.

1989 - The Navy investigated Building 44 (former Pump House), and the associated tanks including five 50,000-gallon underground, concrete, fuel oil storage tanks; two 5,000-gallon steel USTs, one holding ethyl alcohol and one "HRT Oil Tank" north of Building 32 (Q3G, 1996). Investigation revealed that PCBs and TPH were found at levels exceeding regulatory standards on the floor of the pump house and in the oil in some of the tanks. The Navy closed the tanks in place, and demolished Building 44 (RIDEM, 2006). Additional information on the closure and continued monitoring of the Building 44 area, as well as PCB/TSCA removal actions is provided in Appendix A of this report.

1995 - Building 33 (Power Plant) underground storage tank removal. Under RIDEM regulations, the Navy removed three underground storage tanks, (lube oil, used lube oil, and diesel) from a vault on the west side of Building 33. A separate gasoline tank was also removed. RIDEM reported that free product was found beneath the vault. The source of the free product was believed to be from the direction of Building 32/44 (RIDEM, 2006).

1996 – An investigation of Building 33 revealed that drainage from sumps and an underground vault that held three USTs discharged to a point north of this Building (RIDEM, 2006).

2000 - Building 44/Building 32 Underground Storage Tank Removal Action. Under RIDEM regulations, elevated levels of TPH and other contaminants and the presence of free product resulted in the removal of approximately 9,000 cubic yards of contaminated soils at the former location of the five concrete, fuel oil USTs associated with Building 44, and at the former location of the two 5,000-gallon steel USTs (ethyl alcohol and HRT) associated with Building 32 (RIDEM, 2006).

2000 – A release of diesel fuel from a UST adjacent to Building 32 (south end, adjacent to generator room) resulted in the removal of the tank and associated contaminated soil (RIDEM, 2006).

2.0 STUDY AREA INVESTIGATIONS

This section describes the field investigation activities implemented as part of the RI for Site 17, Building 32 Area at Gould Island, and conducted between May and September 2005. All activities were conducted in accordance with the Work Plan for Remedial Investigation, Site 17, Building 32, Gould Island (TtNUS 2004).

The Field Sampling Plan portion of the Work Plan was prepared to direct the collection of data needed to provide a foundation for the RI report and risk assessments. The data will be used to describe the nature and extent of contamination at the site, provide exposure point concentrations for the human health risk assessment, and provide exposure data for the first tier of an ecological risk assessment.

Separate discussions for each of the field investigation activities conducted at the site are provided in Sections 2.1 through 2.8 of this report. An overview of the investigation activities for each major field task is presented, including an identification of sample numbers, locations, analyses, and rationale, for those tasks that included sample collection. Also provided is a discussion of field observations and measurements if applicable. Samples were collected and analyzed according to the quality assurance/quality control criteria defined in the Quality Assurance Project Plan prepared as part of the Work Plan (TtNUS, Inc., 2004).

2.1 SOIL BORING INVESTIGATION

A soil investigation was conducted at the site through a series of soil borings. This effort was conducted to characterize the soil and to determine the nature and extent of subsurface soil contamination. This section of the report includes an overview of the soil boring investigation and a summary of the field measurements and observations made during the drilling activities. A description of the site geology based on the data collected during the RI is provided in Section 3.2. Analytical data for subsurface soil samples are discussed in Section 4.0.

2.1.1 Overview of Soil Boring Investigation

A total of 28 soil borings were advanced across the site and soils were sampled in each to characterize the soils and to aid in determination of the nature and extent of the subsurface soil contamination. Also, soil samples were collected from seven additional borings advanced to construct groundwater monitoring wells. The boring and monitoring well locations are shown on Figure 2-1. Boring logs are presented in Appendix D1.

The soil boring investigation was performed in accordance with the procedures specified in the approved Work Plan, except for the following field modifications approved by the Navy:

- The Work Plan states that direct push techniques (DPT) would be used for the installation of shallow borings (noted as “SB”). Thirty-three such shallow borings were specified to be advanced to the top of bedrock, anticipated to be a maximum depth of 20 feet below ground surface. However, during installation of the first monitoring wells (MW-04 and MW-06) a dense layer of till was observed approximately 10 feet below ground surface, and this till extended beyond 60 feet below ground surface in most areas. It was recognized that the till would prevent effective use of DPT drilling equipment, and a Field Modification Request (FMR) was submitted to the Navy recommending other methods be used for advancement of borings (FMR No. 1, Appendix D-7).

- Due to the density and thickness of the till, different drilling methods were attempted and used where appropriate. A combination of drive-and-wash as well as air rotary drilling was attempted to be used to advance borings through till (FMR No. 2, Appendix D-7). Hollow-stem augers were used to advance borings through the uppermost overburden (fill materials), for the purpose of soil sampling (FMR No. 3, Appendix D-7).

- The deeper soil borings installed for soil sample collection were advanced using 6-1/4 inches inner diameter (I.D.) hollow stem augers into the soil to the top of till, and then by drive and wash drilling, which uses a drop hammer to drive steel casing into the soils. The use of 6-1/4 inches I.D. hollow stem augers to the top of till permitted the use of 5 inches I.D. casing for drive and wash drilling into the till, which then allowed for telescoping 4 inches I.D. casing through the 5 inches casing, if the larger casing met with refusal. For deep borings in till, it was found that these techniques were most suitable.

- Hollow-stem augers were occasionally used to advance borings to bedrock prior to coring the rock. In these cases, augers were advanced until weathered rock was encountered, then 4-inch casing was telescoped through the augers and seated in the bedrock prior to coring.

- Drive-and-wash drilling was used to advance all borings that were to receive overburden monitoring well installations at the site.

- Selected borings were sampled less frequently than the continuous sampling specified in the Work Plan, as summarized below. Borings B300, B304, and B305, which were sampled continuously to the top of bedrock, encountered dense glacial till from a depth of approximately 8 feet below ground surface (bgs) to the top of bedrock, encountered between 46 feet and 84 feet

bgs at these three borings. The high density of the till made split spoon sampling difficult and resulted in equipment failure on several occasions. Because of these difficulties, and because there was no evidence of contamination found within the till, a field modification to the Work Plan was made to lessen the sampling frequency within the till layer (see FMR no. 5, Appendix D7). Rather than continuous soil sampling, a 5- or 10-foot sampling interval was adopted for selected borings, and, rather than continuing to the top of bedrock, selected borings were drilled to a target depth of 4 feet below into the top of till. After this change was made, some of the borings anticipated to be terminated in the top of till did not encounter the till unit above bedrock. All borings were continued to either top of bedrock or to approximately 4 feet into top of till. Table 2-1 presents depths of borings, depths to bedrock and the sample frequency for each soil boring conducted. Those borings that were altered based on the FMR described above are shaded, as described in the footnote.

- Five of the 33 planned soil borings were noted in the Work Plan as locations to be determined in the field. At the end of the drilling program, TtNUS could not recommend additional areas to be investigated through borings, and RIDEM requested test pits be conducted in the southwest portion of the site. It was agreed with the USEPA and RIDEM, through weekly status reports and meetings, that the five borings and associated samples would be exchanged with a series of test pits in the requested area, with associated samples collected as described in Section 2.3 of this Report.

Based on borings advanced at the site during the RI, bedrock was encountered at depths ranging from 8 to 84 feet below grade. The borings advanced for construction of bedrock groundwater monitoring wells were continued 30 feet into bedrock by coring at 10-foot intervals, using double wall core barrels for core recovery and evaluation. Information pertaining to the bedrock drilling program is provided in Section 2.2. Continuous split spoon sampling to the top of bedrock was conducted in 15 borings: B300B, B301B, B303B, B304B, B305B, SB315, SB321 to SB328, and SB333. Continuous split spoon sampling to 4 feet into the top of the till layer was conducted in 11 borings: SB309, SB311, SB313, SB316, SB319, SB320, SB332, SB334, and SB336 to SB338. Split spoon sampling at 5-foot intervals to the top of bedrock was conducted in eight borings: B302B, SB310, SB312, SB314, SB317, SB318, SB331, and SB335. Split spoon sampling at 10-foot intervals to the top of bedrock was conducted in B306B.

The physical characteristics of each soil sample were described using the Unified Soil Classification System (USCS) and recorded on boring logs, presented in Appendix D1. In addition to sample characteristics, other pertinent observations such as water levels, sample moisture, depth changes in lithology, fill material, staining, and visual contaminants or odors were recorded on the boring logs. General observations such as sample type and number, sample time, depth, interval, and recovery, and drilling and sampling equipment and methods used were also recorded on each boring log. As each split-

spoon sampler was opened, the soils were monitored for organic vapors using a flame ionization detector (FID) and/or a photoionization detector (PID). These readings were also recorded on borings logs.

Two sample aliquots were collected from each 2-foot long split-spoon interval. One aliquot was used for jar headspace screening for organic vapors, and the second aliquot was stored for possible laboratory analysis. (Results from jar headspace screening for organic vapors were recorded on sample log sheets). At least two soil samples for laboratory analysis were collected from each boring, in accordance with the Work Plan. One sample was taken from the 2-foot depth interval, and the second sample for laboratory analysis was selected based on screening results, position of the water table, and visual, olfactory, or soil conditions noted. Additional soil samples were collected from selected borings and depths based upon the soil conditions encountered.

Following collection of the jar headspace screening aliquot, the volatile organic compound (VOC) soil sample for laboratory analysis was collected as a grab sample from the most heavily contaminated portion of the split-spoon sampler, based on the initial organic vapor screening results and/or visual observations. If no organic vapor detections and no visual evidence of contamination were noted, the grab VOC sample was collected from the center of the target sample interval. The samples for the remaining laboratory analyses were collected as a "composite" of the target depth interval (e.g., the entire 2-foot interval was uniformly mixed before the remaining samples were collected). Observed geologic conditions possibly affecting contaminant distribution, such as potential confining layers, coarse-grained (relatively high porosity/permeability) soils, or the vadose zone above the water table, were taken into account when selecting the VOC sample location from the split-spoon sampler. Remaining soils from each boring were contained in a roll-off container until they could be properly characterized and disposed of off-site.

The soil samples were analyzed for VOCs and percent moisture; metals, cyanide; semi-volatile organic compounds (SVOCs); pesticides; polychlorinated biphenyls (PCBs); and total petroleum hydrocarbons (TPH) measured as gasoline range organics (GRO) and diesel range organics (DRO). Details on these analyses are discussed in Section 4 of this report. A summary of soil samples collected and selected for laboratory analysis is presented in Table 2-2, which also cites visual, olfactory and screening results indicating possible presence of contamination. These indicators of potential contamination are depicted on Figure 2-2.

As presented on Table 2-2, no staining or odors were noted during the drilling operations. Only low concentrations of VOCs were detected in some soil samples collected from the borings. However, during test pitting operations, oil staining, odors and sheens were found in soils associated with the “Trench Drain” at the southwest corner of Building 32, as described in Section 2.3 of this report, and noted on Table 2-2.

All borings that were not completed as monitoring wells were abandoned by backfilling with a mix of sand, and bentonite-cement-grout. This backfill material was used in order to re-seal the bottoms of the foundations in the sumps where borings were drilled, and to reduce potential hazards from possible sinkhole formation.

2.1.2 Soil Boring Investigation Field Measurements and Observations

During the soil boring and sampling investigation, all of the field measurements and observations were recorded in a field notebook and/or on boring logs. Recorded field measurements and observations included jar headspace screening results for organic vapors measured with a PID and/or FID, geologic soil descriptions and visual/olfactory signs of potential contamination (i.e., discolored soils, odors, etc.). Table 2-2 includes a summary of headspace readings and visual/olfactory observations of potential contamination for all soil samples collected. Field measurements and observations from the Phase I soil boring program are also presented in the soil boring logs and well construction logs included in Appendix D1.

Prior to installation of the borings through the foundation of Building 32, a water-cooled hole saw was used to cut six-inch diameter holes in the foundation where borings were to be conducted. This effort was only conducted on surface concrete, and not concrete at the bottom of sumps that had been filled after demolition. The concrete cores were extracted and inspected for discoloration and staining. Such evidence was sought in order to determine if phases had formed from reactions after exposure of the concrete to plating solutions. No discoloration of the concrete cores was noted, and surface stains were not present. It should be noted that the concrete slab had been exposed to weather for a period of over 1 year prior to cutting these cores.

The most prevalent overburden materials encountered during the soil boring effort were dark gray to black silty sands and gravels, and dark gray to black dense glacial till. These two materials were compositionally identical; the distinction between the two was based upon the greater density of the till. Where both of these layers were present, the silty sand and gravel layer always overlaid the till layer. Where the till was present, it was always found immediately above the bedrock. The silty sand and gravel layer was encountered in all of the borings except SB324, in which the till was encountered at a depth of 2 feet. Till was encountered in all of the borings except SB318, SB320, SB322, SB323, SB326 to SB328, SB332, SB337, and SB338, located at the south end of Building 32. In these borings the silty sand and gravel layer was found overlying the bedrock, which occurred at depths of 15 feet or less bgs. At these boring locations, bedrock is likely to have been exposed or partially excavated during development and construction of Building 32 and the associated subsurface utilities. The silty sand and gravel layer is likely to have been re-worked soil from cut and fill operations used to level the site when Building 32 was constructed. This would account for the material being identical to the till underneath, but less compact.

More discussion on the cut and fill operations, as well as the geology and soil conditions is presented in Section 3 of this report.

Artificial fill materials consisting of construction debris (i.e., concrete, gravel, bricks, wood) were encountered in boring B306 completed in the area of the former Building 44, north of the Building 32 foundation. This boring was completed in order to assess the impact of potential leaks from former underground storage tanks (USTs). The fill material was present to a depth of 12 feet. A PID headspace reading of 2.4 ppm was recorded in soils sampled from a depth of 10 to 12 feet (Table 2-2). The boring exhibited no signs of petroleum contamination (i.e., stained soils, odors).

Borings SB300, SB305, SB309 to SB315, SB321 to SB326, SB327, SB328, SB331, SB332, SB334, SB335, SB337, and SB338 all encountered dark gray to black silty sand and gravel from the ground surface (or from below the Building 32 concrete foundation) to depths ranging from 2 feet to 39 feet bgs. Dense glacial till or bedrock was present beneath the silty sand and gravel. There were minor positive detections measured in PID headspace readings associated with several of these borings: 6.7 ppm at 10 feet bgs in SB305; 4.2 ppm (16 feet bgs) and 4.1 ppm (21 feet bgs) in SB310; 9.6 ppm (5 feet bgs) in SB322; 6.1 ppm (7 feet bgs) in SB323; 3.6 ppm (7 feet bgs) in SB324; 3.2 ppm (6 feet bgs) in SB327; 2.5 ppm (1 foot bgs) in SB337; and 9.1 ppm (1 foot bgs) in SB338. None of these borings exhibited odors or visual evidence of contamination such as stained soils.

Borings SB316 to SB320 were completed in and around the former location of a solvent washer and drain lines. A solvent odor and a PID headspace reading of 118.5 ppm were noted in boring SB317 at a depth of 5.5 feet bgs. This boring encountered brown to black silty sand and gravel from the ground surface to a depth of 5.5 feet bgs and a layer of concrete from 5.5 feet to 7 feet bgs. Since this boring was conducted within the former sump of the solvent washer, it is presumed that this concrete layer was the floor of this sump, not removed during building demolition. The headspace reading and solvent odors were immediately attributed to sediments in the sump previously sampled during the SASE (Sample No. DR-07) Till was present at a depth of 10 feet bgs. Boring SB318 encountered fill consisting of gravel mixed with silt, sand, and brick fragments from the ground surface to a depth of 7 feet bgs. This indicates that some remnant solvent contamination may have been present in the sub-floor sump where the solvent washers were stationed when the sump was backfilled. PID headspace reading of 7.2 ppm was recorded at 6 feet bgs. Black silty sand and gravel were present from a depth of 7 feet to the top of bedrock at 12 feet bgs. There were no elevated headspace readings recorded in SB316, SB319, or SB320. Silty sand and gravel were encountered in SB316 from the surface to 11 feet bgs, underlain by till to the top of bedrock at 15 feet bgs; SB319 encountered silty sand and gravel to a depth of 5 feet and till to the top of bedrock at 8 feet bgs; and SB320 encountered silty sand and gravel to the top of bedrock at 9 feet bgs.

Boring SB333 was completed in the sump of the former sandblasting booth within Building 32. Fill consisting of brown silt, sand, gravel, and wood fragments was present from the surface to a depth of 6 feet bgs. A solvent odor and an elevated organic vapor headspace reading (232 ppm) were encountered at a depth of 5 feet bgs. Concrete fragments were encountered from 4 feet to 5.5 feet bgs indicating that this was the bottom of the sump. Sand, silt, and gravel was present from 6 -9 feet bgs. Till was present from a depth of 9 feet bgs to the top of rock at 14 feet bgs.

Boring SB336 was completed in the Hydro Test Tank area and encountered charred material and a tar odor at the ground surface. A PID reading of 8.6 ppm was recorded at the surface, and 13.3 ppm at a depth of 7 feet. The subsurface consisted of dark gray to black gravel and silty sand to a depth of 9 feet, where till was encountered.

Boring SB301 was completed on the hill southwest (upgradient) of the electroplating shop in order to conduct an initial characterization of background soils. Minor elevated headspace readings were noted in soils encountered at a depth of 12 feet bgs (6.3 ppm) and at 20 feet bgs (2.3 ppm). Samples from the boring exhibited no odors or soil staining. The subsurface materials in this boring consisted of light to dark brown silt, sand, and gravel to a depth of approximately 14 feet and dark gray silty sand and gravel to the top of bedrock at 33 feet bgs.

Boring SB302 was completed between Buildings 32 and 33 to assess the impacts of a former coal pile and the surrounding activities. The boring encountered concrete fragments at a depth of 6 feet bgs, possibly a storm sewer pipe. Elevated headspace readings were recorded in soils from 7 feet bgs (12 ppm) and 22 feet bgs (122 ppm). There were no odors or visual signs of contamination associated with these headspace readings. The subsurface materials consisted of silty sand and gravel to a depth of 15 feet bgs and till to the top of bedrock at 50 feet bgs.

Boring SB303 was completed near a solvent tank drain line east of the Building 32 foundation, approximately 40 feet from the shoreline of Narragansett Bay. The subsurface materials at this location consisted of brown silty sand and gravel to a depth of 4 feet bgs and dark gray to black silty sand and gravel to the top of bedrock at 13 feet bgs. The soils from this boring exhibited no elevated headspace readings, odors, or visual evidence of contamination.

Boring B304 was completed west of Building 44 in an area where trichloroethene (TCE) had been detected in soil gas sampling. A fuel odor was detected in soils sampled from a depth of 7 to 8 feet bgs, which corresponds to the depth of the water table at this location. The associated PID headspace reading for this sample was 176 ppm. The subsurface materials consisted of black silty sand and gravel to a depth of 9 feet, and dense till from 9 feet to the bedrock interface at 84 feet bgs.

2.2 GROUNDWATER INVESTIGATION

A groundwater investigation was conducted to evaluate the nature and extent of groundwater contamination and to provide information on the hydrogeology at the site. This section provides an overview of the groundwater investigation, including summaries of the monitoring well installation methods, well construction details, groundwater sampling methodology, and field measurements and observations associated with the groundwater investigation conducted at the site. A description of the site hydrogeology based on the data collected during the Phase I investigation is provided in Section 3.3. The RI soil boring and well boring logs are presented in Appendix D1; groundwater monitoring well construction logs are presented in Appendix D2; packer test data are presented in Appendix D3. A detailed evaluation of groundwater analytical data is presented in Section 4.0.

The groundwater investigation included the installation of five shallow monitoring wells (MW300S, MW301S, MW302S, MW304S, and MW305S) screened either across the water table in the overburden or entirely below the water table within the overburden, and seven bedrock wells (MW300B, MW301B, MW302B, MW303B, MW304B, MW305B, and MW306B) screened entirely within the bedrock. The well locations were chosen in order to investigate areas of suspected groundwater contamination based upon historical information, and to provide information on background groundwater quality and the direction(s) of groundwater flow. The drilling was performed by a drilling subcontractor under the supervision of a TtNUS field geologist. Figure 2-1 shows the locations of the groundwater monitoring wells. Table 2-3 presents a summary of wells installed. Table 2-4 presents details on the construction of the wells installed as a part of this RI.

At each well location, a deep boring was advanced into bedrock, and soil samples were collected as described in Section 2.1.1 of this report. After completion of the deep boring, a bedrock monitoring well was constructed as described in this section. After construction of the bedrock monitoring well, a second co-located boring was advanced near the bedrock well for the installation of an overburden well. Soil descriptions and headspace screening results from the deep boring of the pair were used to determine the target depth and screen length for the overburden well.

The monitoring wells, both overburden and bedrock, were constructed of 2-inch inside diameter (I.D.), flush-threaded, Schedule 40 PVC screen and riser. The screen for each overburden well was 10 feet long and 10-slot (0.010 inch), and for each bedrock well the screen was 30 feet long and 20-slot (0.020 inch). The well annulus for both the overburden and the bedrock wells was backfilled with No.1 silica (quartz) sand filter-pack to at least 1 foot above the top of the well screen, and a minimum 2-foot thick seal consisting of bentonite chips was placed above the sand pack. A portland cement/bentonite slurry grout was placed in the well annulus from the top of the bentonite seal to the ground surface, except in overburden wells MW300S, MW304S, and MW305S, where the backfill above the filter-pack consisted

entirely of the bentonite seal due to the shallow depth of these wells. Each well was completed with a 4.25-inch I.D. steel stick-up protective casing with a locking cap.

It is important to note that much of the commonly used sand filter-pack sizing criteria have primarily been developed for water supply wells or wells which are to be installed in uniform water-bearing geologic materials that are considered to be aquifers (i.e., water bearing units that yield significant quantities of water to wells). The descriptions on the boring logs (see Appendix D1) indicate that the overburden formation materials are not very uniform and include a significant percentage of fines. Thus, although an attempt was made to install wells from which representative, sediment-free groundwater samples could be collected, there are no defined well design criteria that would have assured truly sediment-free or low turbidity groundwater in the wells at this site.

2.2.1 Bedrock Well Installation

Wells were advanced into rock by bedrock coring. Drill casing (4.25- inch ID) was seated by driving or spinning the casing up to 2 feet into the bedrock surface. A 3.75-inch diameter borehole was advanced approximately 30 feet into bedrock using HQ sized coring equipment. Due to the generally soft nature of the bedrock and the resulting potential for borehole cave-in, the bedrock wells were constructed as screened wells rather than as open boreholes. The use of HQ coring instead of the smaller diameter NX or NQ, as specified in the Work Plan, was necessary in order to accommodate screen and sand pack within the borehole. A nominal 3-inch diameter bedrock core was recovered and logged by the field geologist at the completion of each 5-foot core run. The change from the Work Plan was requested of the Navy through FMR No. 4, provided in Appendix D-7 of this Report.

The recovered rock core was described using standard rock description methods. The description included the rock type; the degree of rock weathering; the degree of rock brokenness; and the presence of planar features such fractures, joints, bedding planes, and other lithologic contacts. The Rock Quality Designation (RQD) was also calculated and recorded on the boring log.

The bedrock boreholes for MW300B, MW304B, and MW305B were packer tested to determine the locations of water-bearing zones, to collect discrete zone groundwater samples, and to measure hydraulic conductivity. Although the Work Plan stated that all borings to be completed as bedrock wells would be packer tested, a subset of three wells was selected to conduct this effort. Other wells were not selected for packer testing due to the similarity and uniformity of the rock cores, and the lack of what would be interpreted as water-bearing fractures.

A “double packer” set-up was used. The interval between the packers was approximately 10 feet; however, this spacing was modified when necessary based on the spacing and frequency of fractures

identified in the rock core. The entire length of the bedrock hole, to the extent practicable, was packer tested. The test intervals were selected in order to isolate potential water-bearing zones within the borehole.

Once the packer set-up was assembled and installed to the initial interval to be tested, the packers were inflated to isolate the testing interval. Prior to initiating any borehole packer tests, low-flow groundwater samples were collected for VOC analysis. Three groundwater samples were selected from each of the three bedrock holes to be sent to the laboratory for VOC analysis, for a total of nine discrete zone groundwater samples (see Section 4). These analyses were conducted on a 24-hour turnaround time to determine if any of the zones exhibited elevated concentrations of VOCs which could then be target zones for bedrock well screens. However, no VOCs were detected in the quick-turnaround VOC samples, and therefore no specific zones were targeted for construction of the bedrock well screens.

Each interval was packer tested following the collection of groundwater samples. Clean water was pumped into the borehole through the packer assembly until the desired testing pressure was achieved. The test began when the water pressure stabilized at the desired testing pressure. Flow meter readings were taken at 15 to 30 second intervals for a minimum of 5 minutes. If no measurable flow occurred during the pumping portion of the test, a holding test was performed for several minutes as a check. For the holding test, the flow or bypass valve was shut to completely isolate the system, and the water pressure gauge was checked for a drop in pressure over time. Each interval was tested at three pressures. When the testing at one interval was completed, the downhole packer assembly was moved to the next interval to be tested, and the testing procedures repeated. The TtNUS field representative recorded gauge pressures, water flow meter readings, and test times on packer test report forms, included in Appendix D3.

Following packer testing, each of the bedrock monitoring wells was screened the entire 30–foot length of the cored interval in order to maximize the resulting yield of the well, since there were no high-yielding water-bearing zones encountered, nor any zones exhibiting evidence of VOC contamination.

2.2.2 Overburden Well Installation

The overburden monitoring wells were installed using a combination of hollow-stem auger and standard drive-and-wash drilling methods. The use of hollow-stem augering was restricted to the depths that were not to be screened. The well screen depths for overburden wells were chosen based upon information obtained from split-spoon soil sampling conducted at the deep boring in each well cluster. As previously mentioned in Section 2.1.1, split-spoon soil sampling was conducted in all of the deep (bedrock) well borings to the depth of the bedrock. Soil samples submitted for laboratory analyses were collected as describe in Section 2.1.1. Each split-spoon was monitored using an FID and/or PID and all field

observations and measurements were recorded in a field notebook or on boring logs. Drill cuttings from each borehole were collected and transferred to a centrally located roll-off container.

Table 2-4 summarizes the construction details of the monitoring wells. The monitoring well construction logs are included in Appendix D2. Overburden monitoring wells MW300S, MW301S, MW304S, and MW305S were screened across the water table since the deep borings at these locations did not exhibit any evidence of contamination at any specific zone within the overburden. Overburden monitoring well MW302S was screened below the water table from 14 to 24 feet bgs in order to intercept a zone of potential contamination encountered in soils from the deep boring at 21 feet bgs, where an elevated PID reading was recorded in jar headspace measurements.

2.2.3 Groundwater Monitoring Well Development and Synoptic Water Level Measurements

Following monitoring well installation activities, each newly installed monitoring well was developed with a submersible centrifugal (whale) pump, with the exception of monitoring well MW-304S. This well was developed with a peristaltic pump due to a whale pump failure. During well development, water quality parameters (stabilization criteria) were monitored, including: pH, conductivity, temperature, dissolved oxygen, and turbidity. The objective of the well development program was to remove fine-grained sediments from the vicinity of the well screen, pumping until the water quality parameters stabilized, including achieving a turbidity of less than 5 NTUs.

All monitoring wells were developed within these criteria with the exception of monitoring well MW-304S, which was not able to sustain continuous pumping. After 6 hours of multiple well evacuations and allowing for recharge, monitoring well MW-304S achieved a turbidity of 13.2 NTU (visually clear). This is not atypical for overburden wells as some fines within the formation may not all be trapped by the sand pack installed around the well during active pumping and surging. Although the goal of 5 NTU was not reached during well development, the turbidity goal of 5 NTU was reached during the low-flow sampling activities at this well. Prior to collection of the sample, the well was pumped at a lower flow rate, per the low-flow SOP, and the 5 NTU goal was achieved. Therefore, while the well may not develop to a 5 NTU goal, more importantly, the sample itself was not compromised by turbidity.

Table 2-5A provides a summary of the well development data collected, including the final stabilization criteria readings.

A synoptic groundwater level measurement round was conducted on August 30, 2005. The synoptic round was initially planned for after well development and prior to sampling, however schedules were adjusted and it was conducted at the end of the field program. The timing of the synoptic round as stated

in the Work Plan was for planning purposes only, and was set to minimize field time and to avoid impact to the wells during sampling and development. The shift in scheduling for the synoptic groundwater measurements had no bearing on the data collected.

Depths to groundwater ranged from approximately 5.62 to 9.07 feet below top of PVC riser pipes in onsite monitoring wells. Depths to groundwater measured in the upgradient monitoring wells MW-301B and MW-301S were 24.45 and 23.31 feet below the top of PVC risers, respectively. Groundwater levels were converted to elevations and interpreted groundwater contour maps were generated, as discussed in Section 3.3. The entire water column was gauged in each monitoring well with an oil-water interface probe to check for the presence of both light non-aqueous phase liquids (LNAPLs) and dense non-aqueous phase liquids (DNAPLs). No non-aqueous phase liquids (NAPLS) were detected in any of the monitoring wells gauged during the investigation.

A subcontracted surveyor licensed in the State of Rhode Island surveyed the elevation and location of each of the groundwater monitoring wells, in reference to the Rhode Island Grid System. The elevations of each well's outer protective casing and the top of the PVC inner riser pipe were surveyed to the nearest one-hundredth of a foot (0.01 foot). The ground adjacent to each well was surveyed to the nearest one-tenth of a foot (0.1 foot). The well coordinates and elevations are provided in Table 2-4. Well locations are presented on Figure 2-1.

2.2.4 Groundwater Sample Collection

Groundwater samples were collected from the 12 new monitoring wells installed and from two previously installed monitoring wells, MW303S and MW306S. Groundwater sampling was conducted between July 19 and July 27, 2005. Figure 2-1 presents the groundwater monitoring well locations.

Newly installed wells were sampled no less than 3 days following well development. Prior to initiating groundwater sampling activities the groundwater level of each monitoring well was measured to the nearest 0.01 foot using an electronic water sensing device. The water level indicator and probe were decontaminated before each use with a tap-water/non-phosphate detergent wash and a distilled/deionized water rinse. Additionally, an oil/water interface probe was used in each well to check for the presence of NAPLs. The entire water column in the tested wells was monitored with an oil/water interface probe for the presence of separate phase petroleum products, including both LNAPLs or "floaters", and DNAPLs or "sinkers". No NAPLs were encountered in any of the wells during the field investigation.

Low-flow (low-stress) groundwater sampling was conducted using the "EPA Region I Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, Revision 2", dated July 30, 1996, as amended 2002. Prior to sample collection the monitoring wells were purged using

decontaminated bladder pumps that operated using compressed nitrogen. New Teflon bladders were used in each monitoring well. The intake of the purge and sample tubing was placed at the midpoint of the saturated screen for all monitoring wells sampled. Approximately 2 to 9 gallons of groundwater were purged from each monitoring well prior to stabilization of sampling criteria, as presented in Table 2-5B. Drawdown greater than 0.3 feet was noted in the following monitoring wells: MW-301S (0.48 feet at 200 mL/min), MW-301B (0.79 feet at 140 mL/min), MW-302S (5.35 feet at 140 mL/min), MW-304S (5.40 feet at 100 mL/min), MW-305B (0.44 feet at 60 mL/min), and MW-306B (1.75 feet at 100 mL/min).

Field measurements of groundwater sampling criteria were collected every 3 to 5 minutes (or as appropriate) during purging of the monitoring wells to determine stabilization prior to sample collection. These parameters included the water level, flow rate, temperature, specific conductance, pH, oxidation reduction potential (ORP), dissolved oxygen, and turbidity. No FID positive detections, odors, or sheens were noted during the purging and sampling event, or during previous well development activities. All field measurements and notable observations made during groundwater sampling were recorded on “low flow” groundwater sample logsheets (Appendix D3).

Groundwater samples were submitted for analysis of VOCs, SVOCs, Polycyclic Aromatic Hydrocarbons (PAHs), pesticides/PCBs, GRO/TPH, metals, cyanide, alkalinity, sulfides, and total organic carbon (TOC). Groundwater sample logsheets, sample collection summary sheets, and chain-of-custody forms are contained in Appendix D3.

2.2.5 Hydraulic Conductivity Testing

Hydraulic conductivity was planned to be evaluated through three separate efforts. Packer testing, described in Section 2.2.1, was conducted to determine conductivity through specific zones in the bedrock. Tidal fluctuations were measured in on-site wells to evaluate hydraulic connection to the seawater, as described in Section 3.3.6.4 of this report. Finally, rising head and/or falling head conductivity tests were scoped in the Work Plan. These tests were initiated at the end of the field investigation program, but were not completed due to equipment failure, and could not be repeated due to worsening weather conditions at the end of the program. The data collected are described in Section 3.6 of this report, and an assessment of additional data needs is provided in Section 8 of this report.

2.2.6 Deep Well House

A deep groundwater production well remains within a chamber in the foundation of the former Building 58. This building was demolished in 2002 with the other buildings on site. The chamber is accessed through steel bulkhead doors currently mounted flush to the ground surface, and is approximately 6 feet in depth, 8 feet long and 8 feet wide. The deep well house was opened and inspected during the field investigation.

It was found that extensive demolition would be required to open, develop, and sample this well. In addition, the well would have to be properly abandoned or restored to prevent it from becoming a physical hazard to trespassers at the site. The Navy has not determined the future of the deep well and therefore the planned sampling was not conducted.

2.3 INVESTIGATION OF SUBSURFACE WASTE DISCHARGE SYSTEMS AND STORAGE FACILITIES

An investigation was performed to confirm the presence, purpose, and potential contaminants associated with selected subsurface waste discharge systems and storage facilities identified on historic drawings and records, or those that were identified during the field investigation with unknown purpose(s). This included the investigation of the following former systems and areas primarily associated with Building 32:

- The Sub-Slab Drainage System (see “planned drain lines” shown on east side of Building 32)
- Selected manholes and sumps
- The Building 32 Septic System
- The Transformer Area (Building 56)
- The Dust Collection Area (see Building 57, Dust Collector on Figure 2-3)
- The Acid Storage Area
- The Storm Water “Trench Drain”
- The Sandblast Booth Sump

Investigation activities included: test pitting; inspecting manholes; tracking and clearing selected pipes with a “jet rod”, which uses pressurized water to clean the pipe and advance a cutting head; correlating structures to building drains; and collecting and analyzing soil, sludge, and water samples. Investigation areas including test pit locations and associated visual/olfactory evidence of contamination are presented on Figure 2-2.

2.3.1 Overview

Between June 2 and July 26, 2005, thirteen test pits were excavated and investigated at the site. Associated activities included documenting each test pit with photographs, sampling, and backfilling of each test pit. Using a backhoe, test pits were excavated to depths ranging from approximately 3 to 10 feet bgs. The soil descriptions, size of the excavations, depths to water (if applicable), and the presence of pipes, oil, staining, or odor were recorded in field notebooks or sample logsheets. A summary of test pit soil samples, including visual and olfactory observations and screening results is included together with soil samples collected from soil borings, on Table 2-2. Appendix D contains sketches of test pits and associated photographs.

Test pits TP-01 through TP-04 were excavated along portions of the eastern edge of the Building 32 foundation in order to intercept and investigate discharge pipes associated with the former Sub-Slab Drainage System. A series of excavations comprised test pit TP-05 in order to confirm the presence and location of a former Septic System. Test pit TP-06 was excavated within the foundation of former Building 32 in order to investigate the Sand Blasting Area Sump located in the Electroplating Room. Test pits TP-07 and TP-08 were excavated in the area of former Building 56 (near the southwestern edge of the Building 32 foundation) in order to investigate the former Transformer Area. Test pit TP-09 was excavated in the area of Building 57 (and near the southwestern edge of the Building 32 foundation) in order to investigate the former Dust Collection Shed Area. A series of three excavations comprised test pit TP-10, located along the southwest edge of the foundation, in order to investigate the former Acid Storage Shed Area. Three excavations were completed for test pit TP-11, and one test pit each was completed for TP-12 and TP-13, in order to locate a “trench drain” appearing on a 1942 design drawing for former Building 32 (Appendix C). The locations of the test pits are depicted in Figure 2-3.

Six manholes were investigated during the field investigation in order to identify their function. The first manhole investigated (MH-01) was located in the foundation of former Building 32, approximately 10 feet northeast of the Electroplating Area. The second and third manholes investigated (MH-02 and MH-03) were located in series, within 5 feet of each other, on the western edge of the foundation. The fourth manhole investigated (MH-04) was located on the northwestern edge of the foundation. The fifth and sixth manholes investigated were found during the series of excavations for test pit TP-05 (and are labeled “TP05-MH” and “concrete manhole” on Figure 2-3). Numerous other manholes are present at the site, presumed to be electrical and phone conduit manholes associated with these utilities.

Soil and sludge samples were collected from test pits, sumps, pipes, and manholes found during the investigation in accordance with the Work Plan. The portion of each sample selected for VOC analysis was collected directly from the test pit, decontaminated backhoe bucket, or manhole, and was transferred into 40-mL glass vials using a pre-cleaned syringe. The remainder of each sample was transferred into a decontaminated stainless steel bowl using a pre-cleaned plastic scoop, homogenized, and transferred into the appropriate sample containers. Soil samples were submitted for laboratory analysis of VOCs, SVOCs/PAHs, pesticides/PCBs, GRO/DRO, metals, and cyanide.

Aqueous samples were collected by directly dipping the sample containers into the accumulated water. Aqueous samples were collected from the following eight test pits: TP-02, TP-05, TP-06, TP-08, TP-10, TP-11, TP-12, and TP-13, and from three manholes: MH-01, MH-02, and MH-03. Other test pits did not encounter or accumulate standing water. Test pit and manhole water samples were submitted for analysis of VOCs, SVOCs/PAHs, pesticides/PCBs, TPH, GRO, metals, and cyanide. The sample from MH-01 was submitted for LNAPL analysis. A summary of samples collected from test pits, sumps, pipes, and manholes is presented in Table 2-6. Analytical data for these samples are discussed in Section 4.0.

2.3.2 Test Pit Excavations and Investigation of Manholes and the Subsurface Waste Discharge Systems

This section provides a detailed description of the subsurface waste discharge systems and storage facilities investigation.

2.3.2.1 Test Pit TP-01

Test pit TP-01 was excavated along the southeastern edge of the Building 32 foundation in order to intercept the discharge pipe from the electroplating shop shown on the historic plumbing drawing dated 1942 (Appendix C). The plumbing drawing indicates this 6-inch diameter acid-resistant waste drain originated from the trenches and floor drains of the electroplating room and discharged to the east into Narragansett Bay.

The trench for test pit TP-01 was approximately 2.5 feet wide, 10 feet long, and 7 feet deep. The subsurface materials encountered consisted of a fine to medium silty-sand, with traces of gravel, brick, and concrete intermixed from ground surface to depth. Groundwater was not encountered in test pit TP-01. (Refer also to field log sheets and photographs presented in Appendix D.)

Three 8-inch clay pipes were observed exiting from underneath the Building 32 foundation in test pit TP-01. Two of the clay pipes appeared to function as storm drains and were located at a depth of 3 feet bgs. The two pipes converged and continued north along the east side of the concrete foundation and joined the storm drain pipe in test pit TP-02 (discussed below). The third (broken) clay pipe appeared to be the exit pipe for the floor drain for the Electroplating room and exited underneath the foundation at 6 feet bgs. This was confirmed by “jet rodding” into an open floor drain located in the Electroplating room. The “jet rod” water flowed south through the under-slab piping, then east towards the Bay, and discharged from underneath the foundation through a broken clay pipe observed in test pit TP-01. This piping layout is reflected in the plumbing floor plan drawing (#4313-50) dated 1942 (Appendix C). The water flow observed from the jet rod activities in this pipe appeared clear, indicating no noticeable residue inside the floor drain pipe.

After the floor drain pipe exited the cover of the concrete foundations it was converted into a cast iron pipe, which continued underground in an easterly direction towards the Bay. The drain pipe was “jet rodded” east to confirm the pipe discharged into the Bay. The “jet rod” water was observed discharging under the rock rip-rap, which had been placed during a removal of PCB-contaminated soils, and subsequent to the installation of the pipe. It is likely the drain pipe was broken during the installation of the rip-rap. A broken steel pipe was observed in the Bay in line with the drain pipe located underneath the rip-rap; this pipe observed in the Bay was likely the original discharge point for the Electroplating room.

A grab sample (G32-SOTP01-01-0007) was collected in test pit TP-01 of the soil underneath the broken clay drain pipe, approximately 7 feet below ground surface. Adequate water was not retained from the jet rod effort to collect an aqueous sample.

After the soil sample was collected, approximately 1 cubic foot of hydraulic cement was mixed and injected into the broken pipe exiting the foundation. After the cement had time to set, approximately 3 cubic yards of soil were removed from underneath the broken pipe to assure any potential contaminants flowing through the pipe with the jet rod water would not remain in the ground. These soils were containerized on site for disposal off site at a later date. The excavation was then backfilled and compacted with the excavator bucket.

2.3.2.2 Test Pit TP-02

Test pit TP-02 was also excavated along the southeastern edge of the Building 32 foundation to intercept a sanitary waste drain shown on the historic plumbing drawing dated 1957 (Appendix C). The plumbing drawing indicates the sanitary waste drain discharged to the east into the Bay.

The trench for test pit TP-02 was approximately 2.5 feet wide, 10 feet long, and 7 feet deep. Fine to medium silty-sand intermixed with traces of gravel, brick, and concrete, were encountered during the excavation, from ground surface to depth. Groundwater was not encountered in test pit TP-02. (Refer also to field log sheets and photographs presented in Appendix D.)

Two 8-inch clay pipes were observed exiting underneath the foundation in test pit TP-02. The first clay pipe appeared to function as a storm drain and was located approximately 3.5 feet bgs. The storm drain pipes from test pits TP-01 and TP-03 (discussed below) converged with the storm drain pipe in test pit TP-02. The storm drain pipe continued in an easterly direction and appeared to terminate at a Bay discharge point on the eastern shore of the site.

The second (broken) clay pipe exited underneath the foundation at 6 feet bgs and appeared to function as the original sewer drain for the lavatory located north and adjacent to the Electroplating room (Figure 2-3). This was determined by “jet rodding” a 4-inch drain pipe located on the east side of manhole MH-01. The “jet rod” water, along with an oily residue, traveled in an easterly direction and was found to discharge through the broken clay pipe into test pit TP-02.

The drain pipe exited the cover of the concrete foundation and was converted into a cast iron drain pipe, which continued underground in an easterly direction towards the Bay. This pipe was confirmed to discharge to the east shoreline of the Bay by pumping small amounts of clean water through it.

A saturated soil sample (G32-SOTP02-02-0007) was collected in test pit TP-02 from underneath the broken drain pipe after it was flushed with the “jet rod”. This was a grab sample taken at approximately 7 feet bgs. An aqueous sample (G32-AQTP02-0006) was also collected of the jetrod cleanout water and oily residue discharging into the test pit from the broken clay pipe.

After samples were collected, approximately 1 cubic foot of hydraulic cement was mixed and injected into the broken pipe exiting the foundation. After the cement had time to set, approximately 5 cubic yards of soil were removed from underneath the broken pipe to assure any potential contaminants flowing through the pipe with the jet rod water would not remain in the ground. These soils were containerized on site for disposal off site at a later date. The excavation was then backfilled and compacted with the excavator bucket.

2.3.2.3 Manhole MH-01

Manhole MH-01 was so named during the evaluation and cleanout of the drain exiting Building 32 at TP-02. Manhole MH-01 is not shown on the historic plumbing drawings and appears to have functioned as a sewage interceptor sump for the lavatory toilet drains located near the Electroplating room. (Refer to historic plumbing drawings provided in Appendix C, and to field log sheets and photographs presented in Appendix D.)

During the cleaning of the drain pipe in TP-02, manhole MH-01 was opened and observed to be approximately three-quarters full of water with light NAPL (LNAPL) at the surface. The liquid in the manhole was pumped out using a vacuum truck. Within 24 hours the water level in the manhole recharged to approximately 75 percent of its original level. Water was removed a second time, and water level returned again, although this may have been from a rain event that took place overnight. After water was removed a third time at a later date, the water level remained low enough to evaluate equipment inside the manhole.

Lavatory toilet drains were located approximately 10 feet south/southwest of manhole MH-01. “Jet-rodding” into one of the toilet drains confirmed a connection to a 4-inch pipe located on the south side of manhole MH-01. Upon removal of the liquid in the manhole/sump, a sump pump with a float device was observed on the bottom, which appeared to be designed to pump effluent in a northerly direction. This discharge pipe was later found to lead to the septic system (discussed below) based on its direction of travel and obvious patchwork markings in the concrete slab floor in this area. The concrete shows that a cut in the slab was made from the manhole toward the main septic line to install pipes after the foundation was laid. This is consistent with historical information later found that indicates the sewer system was upgraded in 1957, which is reflected in the sanitary sewer and septic tanks plan drawing (#746805) dated 1956 (Appendix C).

The original lavatory toilets in this area were designed to drain by gravity east through the drain intercepting test pit TP-02 and terminate at a Bay discharge point on the eastern shore of the site (plumbing drawing dated 1942). The upgrade designed in 1957 allowed effluent to be drained north, and west, to a new septic system and discharge area (Figure 2-3). The septic system and discharge area were evaluated with test pit TP-05, described elsewhere in this section. Although manhole MH-01 was not shown on the design drawing for the plumbing upgrades, it is likely to have been added for the purpose of installing the ejector pump, likely needed due to the distance from the lavatory to the new septic system at the location of test pit TP-05.

Manhole MH-01 also appeared to function as a collection area from the sump under the sand blasting booth. A 2-inch pipe was observed entering manhole MH-01, approximately 12 inches above the lavatory toilet drain influent, from the direction of the sand blasting booth. However, the presence of a drain at the bottom of the sump in the sand blasting booth could not be confirmed, due to the presence of a thick layer of saturated mud, approximately 6 to 8 inches deep, at the bottom of the sump, which the vacuum truck was unable to remove.

A sample of LNAPL (G32-AQMH01) was collected from the surface of the water before the manhole was pumped out, and a soil/sludge sample (G32-OTSMH01) was collected from the bottom of the manhole immediately after it was pumped out. The LNAPL sample was submitted for analysis of VOCs, PCBs, GRO, and DRO. The analytical data for these samples are presented in Section 4.0.

2.3.2.4 Test Pit TP-03

Test pit TP-03 was excavated along the eastern central edge of the Building 32 foundation in order to intercept a discharge pipe shown on the historic plumbing drawing dated 1942 (Appendix C). The plumbing drawing indicates this waste drain discharged to the east into the Bay.

The trench for test pit TP-03 was approximately 2.5 feet wide, 10 feet long, and 7 feet deep. Fine to medium silty-sand intermixed with traces of gravel, brick, and concrete were encountered during the excavation from ground surface to depth. Groundwater was not encountered in test pit TP-03. (Refer also to field log sheets and photographs presented in Appendix D.)

Three 8-inch clay pipes were observed exiting underneath the foundation in test pit TP-03. Two of the clay pipes appeared to function as storm drains and were located at a depth of 4 feet bgs. The two pipes converged and continued south along the east side of the concrete foundation and joined with the storm drain pipe in test pit TP-02 (as discussed above). The third clay pipe observed in test pit TP-03 appeared to function as a floor drain and exited underneath the foundation at 8 feet bgs. An attempt was made to

“jet rod” into the floor drain pipe in a westerly direction towards its point of origin, however the clay pipe had collapsed and the pressurized water was unable to enter the pipe.

The drain pipe exited the cover of the concrete foundation and was converted into a cast iron pipe, which continued underground in an easterly direction towards the Bay. The cast iron drain pipe was “jet rodded” toward the east and pressurized water could be heard flowing underneath the rip-rap shoreline. Similar to test pit TP-01, it appears the pipe was broken in this area during the rip-rap installation. A broken steel pipe was observed under the water surface in the Bay and in line with the pipe located underneath the rip-rap; this pipe observed in the Bay was likely the original discharge point for the drain pipe observed in test pit TP-03.

A soil sample (G32-SOTP03-01-0007) was collected from underneath the broken drain pipe where it exited the building foundation, at approximately 7 feet bgs. No water was present for collection of an aqueous sample.

After the soil sample was collected, approximately 1 cubic foot of hydraulic cement was mixed and injected into the broken pipe exiting the foundation. After the cement had time to set, the excavation was backfilled and compacted with the excavator bucket.

2.3.2.5 Test Pit TP-04

Test pit TP-04 was also excavated along the eastern edge of the Building 32 foundation in order to intercept a discharge pipe shown on historic plumbing drawings (Appendix C).

The trench for test pit TP-04 was approximately 2.5 feet wide, 10 feet long, and 7 feet deep. Fine to medium silty-sand intermixed with traces of gravel, brick, and concrete were encountered during the excavation from ground surface to depth. Electric cables were observed at a depth of 2 feet bgs. Groundwater was not encountered in test pit TP-04. (Refer also to field log sheets and photographs presented in Appendix D.)

In test pit TP-04, one 8-inch clay pipe was observed exiting from underneath the building foundation. This pipe appeared to function as a floor drain and was located at a depth of 4 feet bgs. An attempt was made to “jet rod” into the pipe in a westerly direction towards its point of origin, however the clay pipe had collapsed and the pressurized water was unable to enter the pipe.

After the clay pipe exited the cover of the concrete foundation, it was converted into a steel pipe, which continued underground in an easterly direction towards the Bay.

A soil sample (G32-SOTP04-01) was collected underneath the broken drain pipe where it exited the building, at approximately 4 feet bgs. No water was present for collection of an aqueous sample.

After the soil sample was collected, approximately 1 cubic foot of hydraulic cement was mixed and injected into the broken clay pipe exiting the foundation. After the cement had time to set, the excavation was backfilled and compacted with the excavator bucket.

2.3.2.6 Test Pit TP-05

Test pit TP-05 was comprised of a series of excavations in order to investigate the septic system that was installed in 1957 (Refer to plumbing drawings dated 1957 and provided in Appendix C, and field log sheets and photographs presented in Appendix D). The lines of excavation with the types of pipe observed are shown in Figure 2-3.

The soil encountered during the excavation consisted of a fine to medium silty-sand. An 8-inch clay pipe was observed leading west into a pre-cast concrete box with an attached 5-inch steel vent pipe that discharged above the ground surface. The 8-inch clay pipe continued into a concrete manhole (3 feet in diameter and 3 feet in depth) with a vented cover, and terminated at a Bay discharge point on the western shore of the site. A gravel base was observed underneath the concrete manhole and extended to the shoreline, a distance of approximately 10 feet. This concrete manhole and the surrounding gravel appeared to serve as a leaching pit. The gravel and base of the concrete manhole appeared to be at an elevation that might allow flushing during tidal cycles as water may enter and exit the manhole through the bottom of the gravel base and then percolate through the surrounding gravel into the Bay.

One soil sample (G32-SOTP05-01-0000) and one aqueous sample (G32-AQTP05) were collected from inside the concrete manhole, and one soil sample (G32-SOTP05-03-0002) was collected from underneath the gravel area surrounding the concrete manhole. Additionally, a soil sample (G32-SOTP05-02-0000) was collected in the vicinity of the vent pipe at approximately 2 feet bgs.

A second manhole (TP05-MH, Figure 2-3), located approximately 50 feet east-southeast of the leaching pit, was observed in test pit TP-05. This manhole was supported by a solid concrete base, and had dimensions of 2 feet in diameter and 9 feet in depth. “Jet rodding” into manhole MH-04 located approximately 10 feet west of the northwest corner of the Building 32 foundation confirmed a connection with TP05-MH. An 8 inch clay pipe 8 to 9 feet bgs was observed leading from manhole TP05-MH in a northeasterly direction, to manhole MH-04. The manhole located 10 feet west of the foundation served as a sewer intercept for former Building 32, as reflected in the NAVSTA drawing dated 1957. A connection between manhole TP05-MH and the former septic system is suspected, although this could not be confirmed during the investigation.

A soil sample (G32-SOTP05-MH) was collected from the bottom of manhole TP05-MH.

During excavation of test pit TP-05 additional pipes were observed that did not appear to be associated with the septic system. An 8-inch clay pipe (suspected storm drain) was observed leading west into a steel pipe, which terminated at a discharge point on the western shore of the site. A 12-inch steel pipe encased in concrete, appearing to originate from former Building 33, was uncovered and traced in a northwest direction to a Bay discharge point on the western shore of the site. A 5-inch steel pipe (possibly associated with the fire suppression system) was located 3 to 4 feet bgs and led in a north to northwest direction.

Photographs of the area were taken prior to backfilling the excavations. Since no continued input to this system was found, the discharge pipes were not blocked.

2.3.2.7 Test Pit TP-06

Test pit TP-06 was excavated in the former Sand Blasting Booth in order to investigate a concrete sump that was filled in with soil and debris. Refer to field log sheets and photographs presented in Appendix D.

The dimensions of the sump were 7 feet in width by 6 feet in length by 6 feet in depth, where a concrete bottom was encountered. The excavation material encountered consisted of soil, cement rubble, scrap metal, machine parts, and wooden pieces. Stairs constructed of rebar were observed protruding from one side of the sump. Water with an oily sheen was encountered at approximately 3 feet bgs. A vacuum truck removed the liquid to determine if a drain was located at the bottom of the sump. However, the bottom could not be inspected due to a thick layer of saturated mud, approximately 6 to 8 inches deep, on the concrete base that the vacuum truck was unable to remove. However, at the request of Rhode Island Department of Environmental Management (RIDEM), the sump was monitored for recharge to determine if the bottom was sealed. After a period of 6 days recharge was not observed indicating the bottom of the sump was sealed.

An aqueous sample (G32-AQTP06) was collected of the oily sheen before the water was pumped out, and a soil sample (G32-SOTP06-01-0002) was collected from the excavated soil at approximately 2 feet bgs. The sump was backfilled with the material removed from it for safety reasons.

2.3.2.8 Test Pits TP-07 and TP-08

Test pits TP-07 and TP-08 were excavated along the southwestern edge of the Building 32 foundation, at the request of RIDEM, in order to investigate the former Transformer Area (Building 56). (Refer to field log sheets and photographs presented in Appendix D.)

The trench for test pit TP-07 was approximately 2.5 feet wide, 10 feet long, and 4 feet deep. A dark grey sandy soil with coarse gravel was encountered during the excavation. A brick footer (causing refusal) and a tar-paper pipe were observed at 2 feet bgs toward the southern end of the test pit. Water was observed entering the excavation at the southern end, which was the common side between test pits TP-07 and TP-08. The bottom of the excavation was moist at 4 feet bgs.

One soil sample (G32-SOTP07) was collected from test pit TP-07 adjacent to the observed pipe covered with tar-paper material, at approximately 2.5 feet bgs.

The trench for test pit TP-08 was excavated in an area previously found to be impacted by petroleum and covered by plastic sheeting. A suspected fire suppressant waterline was observed on the ground surface in this area. The trench was approximately 2.5 feet wide, 10 feet long, and 4 feet deep. Dark grey sandy soil with coarse gravel was encountered during the excavation. The pipe found in test pit TP-07 covered with a tar-paper material was also observed in this test pit at approximately 2.5 feet bgs. Oil staining with a petroleum odor was observed in the soil. Groundwater was observed entering the trench from the western corner where a sheen was noted.

A composite soil sample (G32-SOTP08) was collected from the area around the tar-paper pipe and from the western end of the test pit and one aqueous sample (G32-AQTP08) was collected in the vicinity of the stained soil where water had accumulated.

2.3.2.9 Test Pit TP-09

Test pit TP-09 was excavated near the southwestern corner of the Building 32 foundation in order to investigate the former Dust Collection Building Area (Building 57, Figure 2-3).

The concrete foundation of the former Dust Collection Building was uncovered during the excavation. Test pit TP-09 was comprised of two trenches, each approximately 2.5 feet wide, 8 feet long, and 4 feet deep, which were excavated on each side of the foundation. Sandy soil with coarse gravel was encountered during the excavation in both trenches. A pipe surrounded by stained soil with a petroleum

odor was observed in the southernmost trench (Refer to field log sheets and photographs presented in Appendix D).

One soil sample was collected from the stained soil in the southern trench (G32-SOTP09-01-0002) and one soil sample was collected from the trench located on the northern side of the foundation (G32-SOTP09-02-0002).

2.3.2.10 Test Pit TP-10

Three separate trenches comprised test pit TP-10 (TP-10A, TP-10B, and TP-10C), also located near the southwestern corner of the Building 32 foundation, in order to investigate the former Acid Storage Shed Area (Figure 2-3).

The trenches were approximately 2.5 feet wide, 10 feet long, and 3 feet deep. In each trench, grey sandy soil was encountered, as well as a 10-inch clay stormwater drain pipe, encased in bricks (observed at 3 feet bgs). In test pit TP-10A, the drain pipe was observed entering the trench at a 45-degree angle and continued to travel through (or perpendicular to) test pits TP-10B and TP-10C, parallel to the foundation. A petroleum odor was detected in test pit TP-10C, which was located near test pit TP-08 (see Section 2.3.2.8 of this report) (Refer to field log sheets and photographs presented in Appendix D).

Three soil samples were collected from stained soil observed in all three trenches (G32-SOTP10-01-0002, G32-SOTP10-02-0002, and G32-SOTP10-03-0002), each sample at approximately 2 feet bgs. One aqueous sample (G32-AQTP10-02) was also collected from test pit TP-10C from the bottom of the test pit where water had accumulated.

2.3.2.11 Test Pits TP-11, TP-12, and TP-13

Test Pits TP-11, TP-12, and TP-13 were excavated outside the southern wall of the Building 32 foundation to confirm the presence and flow direction of the stormwater trench drain, which was also observed in test pit TP-10 (Refer to field log sheets and photographs presented in Appendix D).

<u>Test Pit TP-11</u>

Similar to test pit TP-10, three separate trenches were excavated for test pit TP-11 (TP-11A, TP-11B, and TP-11C). The trenches were approximately 2.5 feet wide, 10 feet long, and 3 feet deep. In each trench the 10-inch clay trench drain pipe was observed surrounded by an orange-stained gravel material at 2.5 feet bgs, which was also the depth to groundwater. The trench drain was oriented perpendicular to each

test pit trench, and parallel to the Building 32 foundation. The materials encountered in test pit TP-11A consisted of grey-blue, coarse, sandy soil with some silt and gravel in the 0 to 2.5-foot layer. The materials encountered in test pit TP-11B consisted of a grey to dark-grey sandy soil with wooden planks, bricks, plastic sheeting, and plywood. The materials encountered in test pit TP-11C consisted of a grey-blue sandy soil with tan-yellow sand at the 2 to 4-foot layer. Other materials observed included gravel, brick fragments, sticks, and wooden boards (2 feet by 6 feet by 8 feet) at a depth of 1 foot bgs, as well as boulders measuring between 12 and 24 inches in diameter. A sheen was observed on the water in test pit TP-11C.

A composite sample (G32-SOTP11-01) was collected from each trench in test pit TP-11, from the soils in the vicinity of the orange-stained gravel area surrounding the clay pipe. An aqueous sample (G32-AQTP11) was collected from the bottom of test pit TP-11C where water with a sheen had accumulated.

Test Pit TP-12

The trench for test pit TP-12 was approximately 2.5 feet wide, 15 feet long, and 3.5 feet deep. The material encountered consisted of a tan sandy soil with coarse gravel. A petroleum odor was detected and a suspected oil product was observed floating on the groundwater, which was observed at 2.5 feet bgs. The 10-inch clay stormwater trench drain pipe was observed at 2.5 feet bgs, surrounded by gravel, and oriented perpendicular to the trench and parallel to the Building 32 foundation.

One soil sample (G32-SOTP12-01) was collected from test pit TP-12, adjacent to the clay pipe, and one aqueous sample (G32-AQTP12) was collected from the bottom of the test pit where water had accumulated.

Test Pit TP-13

The trench for test pit TP-13 was approximately 2.5 feet wide, 15 feet long, and 4 feet deep. The subsurface materials consisted of dark grey sandy soil, with groundwater observed at a depth of 3 feet bgs. Brown staining in the soil was noted toward the south end of the trench at the water interface. The 10-inch clay stormwater trench drain pipe was observed at 2.5 feet bgs, oriented perpendicular to the trench and parallel to the Building 32 foundation.

One soil sample (G32-SOTP13-01) was collected from test pit TP-13, adjacent to the trench drain pipe and in the area of stained soil, and one aqueous sample (G32-AQTP13) was collected from the bottom of the test pit where water had accumulated.

General Summary

The observations discussed for test pits TP-10 through TP-13 appear to have confirmed that a storm drain, referred to as the “Trench Drain” (P.W. DWG, 7612-83) exists near the southwest corner of former Building 32, which travels parallel to the foundation toward the south, then east, and terminates at the shoreline to discharge to the Bay near the southeast corner of former Building 32. An outfall pipe was observed on the eastern shore of the site, in line with the trench drain encountered in test pits TP-11, TP-12, and TP-13. It is noted that sediment sample station SD-304F, described in Section 2.5 of this report, is located at this discharge point.

2.3.2.12 Manholes MH-02 and MH-03

Two electrical manholes were investigated during the field activities. These manholes were located on the grass, within 5 feet of each other, near the west-central edge of the Building 32 foundation in the vicinity of the former Gyro Overhaul Room. The southernmost manhole (MH-02, Figure 2-3) was approximately 3 feet deep. A pipe inlet (conduit) was observed at approximately 2.5 feet bgs on the southeast side, with the corresponding outlet located on the northeast side. The pipe connected the two manholes, as observed by visual inspection, and then exited the northernmost manhole (MH-03, Figure 2-3) at approximately 2.5 feet bgs, traveling parallel to the foundation in a northwest direction. Water was noted at the bottom of both manholes at approximately 3 feet bgs. Phone and/or electrical cables were noted just below the water in manhole MH-03. Aqueous samples were collected from each of the manholes MH-02 and MH-03 (G32-AQMH-02 and G32-AQMH-03, respectively).

2.4 CONCRETE AND BEDROCK SAMPLING

Two concrete floor samples and one bedrock sample were collected during the RI field activities. The concrete samples were collected from the foundation floor near the former location of a mixing tank and electrical switching equipment (northeast corner of Building 32, Figure 2-1). The bedrock sample was collected to determine the nature of inorganics in the upgradient bedrock, per the request of the Navy.

The concrete samples G32-CO301-090905, G32-CO302-090905, and one duplicate sample were located in the Building 32 foundation, near the northeast corner, and were co-located with soil borings SB331 and SB311, respectively (Figures 2-1 and 2-3). The concrete samples were collected from the foundation using a decontaminated steel chisel and a 5-lb sledge hammer to drive out the concrete chip samples from the bedded cement to a depth of 0.25 feet below the floor surface, until sufficient sample volume was obtained. While the use of a hammer and chisel was a change from the use of a rotary drill hammer anticipated in the Work Plan, the planned depth of sample was acquired, and these sampling procedures met the project objectives without need for additional power sources at the island.

The concrete chips selected for VOC analysis were collected directly from the chipped concrete pile and transferred into the appropriate containers. The remainder of the material was mixed together and transferred into the appropriate containers using a pre-cleaned plastic scoop. Each concrete sample was then shipped to the laboratory for analysis of VOCs, SVOCs, PAHs, GRO, pesticides/PCBs, metals, and cyanide.

The upgradient bedrock sample (G32-BR01) was collected from an outcrop located approximately 100 feet south of the southeast corner of the Building 32 foundation (Figure 3-1). The bedrock sample was collected by hand, directly from the exposed, weathered rock of the outcrop, and placed into the appropriate sample jar. The bedrock sample was then shipped to the laboratory for analysis of metals only.

2.5 SEDIMENT INVESTIGATION

Sediment sample stations were selected to characterize present levels of site-related contaminants in the sediments near the site, as well as in areas such as sewerage outfalls and stormwater outfalls that are associated with Building 32. Table 2-7 provides a description of each sample station location and purpose. Figure 2-4 presents the locations of the sediment sample stations.

Sediment samples were collected between August 25 and September 2, 2005 from 25 stations located in the subtidal and intertidal zones along the shoreline of Gould Island. Sixteen stations were located in depositional areas proximal to the existing or suspected terminus of each outfall pipeline. Five additional stations were located in depositional areas downgradient of presumed release points, and four stations were located downgradient of outfall pipelines and presumed release points. All sediment sample locations were marked with buoys secured to the bottom by rope attached to screw-type earth anchors, or to two pieces of rebar driven at opposing angles. Each buoy was marked with the sample station identification number.

2.5.1 Overview of Sediment Investigation

Twenty-five sediment stations were sampled by divers using sediment core tube samplers. Most samples were collected with acetate sleeves that were manually inserted into the sediment by a diver to the target depth (either 6 or 12 inches). Once in place, the top core cap was installed creating a vacuum in the sleeve as the sleeve was removed from the sediment. Following sample retrieval, the bottom cap was then attached and the sample was transferred to the sediment sample collection team. Sleeves were labeled with the sample location and depth. In locations where refusal was encountered, sampling was attempted using an Art's Manufacturing & Supply (AMS) stainless steel core sampler. If refusal was again

encountered at a similar depth, sediment was retrieved from as deep as possible, sometimes by pushing the sleeve through the sediment at an angle. Sample recovery depths were recorded on sediment sample log sheets (Appendix D5).

Fifty-seven surficial sediment samples (0 to 6 inches) were collected; 49 from subtidal locations and eight from intertidal locations. Nine additional subsurface samples (6 to 12 inches) were collected from subtidal locations, where substrate conditions permitted.

At each of the 25 sample stations, divers collected either a single sediment sample or five sediment samples. Seventeen stations included a single sediment sample only: eight stations off the site's east shoreline (SD-304F, SD-305F, SD-306F, SD-307, SD-309F, SD-310F, SD-315, and SD-317), three stations off the site's west shoreline (SD-302F, SD-308F, and SD-313F), two in the stillwater basin (SD-312 and SD-316), and four off the southern shoreline (SD-301, SD-303, SD-311, and SD-314) (Table 2-7 and Figures 2-4 and 2-5).

Eight stations were designated for the collection of five sediment samples from each: five off the site's east shoreline (SD-304, SD-305, SD-306, SD-309, and SD-310) and three off the west shoreline (SD-302, SD-308, and SD-313). These eight sediment sample stations were located in the vicinity of confirmed outfall pipes or in areas where suspected outfall pipes were thought to have existed. The center of each of these sample stations was designated the target survey position, and the five surficial sediment samples were collected within a 12.5 foot radius around this surveyed position. Samples were designated according to the position from which they were collected with the letters A through E, as shown in the detail on Figure 2-4, and described below:

A: northern portion of sample area
B: western portion of sample area
C: eastern portion of sample area
D: central portion of sample area
E: southern portion of sample area

For each sample station designated for the collection of five sediment samples, ("five-sample" stations) the Work Plan anticipated placing each group of five samples at eight presumed outfall locations. Actual field conditions for some sample stations showed deterioration and loss of a portion or all of the outfall pipe in the subtidal areas, where depositional sediments were also present. For some sample stations, portions of the discharge pipe still remain, however due to deterioration over time, the pipe terminus is now at a different location that the expected location. In all cases, samples were still collected at the original planned locations as discussed in the Work Plan. Additionally, for all eight of these planned "five-sample" stations, a sixth sample was collected in close proximity (within 1 foot) to each associated pipe

terminus, as currently observed in the field (if located at all). If no pipe was found, the additional sample was placed at the shoreline where plan drawings noted the associated pipeline to be present (Appendices A and C). These eight additional sample stations were designated with the letter “F”.

Samples were collected using the methods described in the Work Plan. Approximately four to eight cores were needed at each sample location to collect sufficient sample volume for the required laboratory analyses. Sediment recovery in the cores ranged from 2 inches to 6 inches. The material collected at each station was homogenized in a stainless steel bowl and then transferred into pre-cleaned containers for analysis. The samples were stored on ice during collection and transport to the lab. All sampling apparatus was rinsed between sample locations with distilled water, isopropanol alcohol, and de-ionized water.

Sample Location Descriptions

Two sediment stations (SD-312 and SD-316) were located in the stillwater basin adjacent to the former rigging platform, north of Building 32.

Along the northeastern shoreline of Gould Island, ten sediment stations (SD-304, SD-304F, SD-305, SD-305F, SD-306, SD-306F, SD-309, SD-309F, SD-310, and SD-310F) were collected at the “confirmed” and “suspected” discharge locations of five outfall pipelines (“confirmed” discharge location refers to current-day pipe terminus, as observed during fieldwork. “Suspected” discharge location refers to original presumed pipe terminus, based on historical drawings, plans and information). In addition, one sediment station (SD-317) was collected adjacent to a portion of shoreline with significant erosion, and two sediment stations (SD-315 and SD-307) were collected downgradient of the former Building 54 transformer vault.

Six sediment stations (SD-302, SD-302F, SD-308, SD-308F, SD-313, and SD-313F) were located along the northwestern shoreline of the Island at the “confirmed” and “suspected discharge” locations of three outfall pipelines.

Four sediment stations (SD-301, SD-303, SD-311, and SD-314), were located in areas presumed to be downstream of the site, in accordance with the Work Plan. One sediment station (SD-311) was located along the western shoreline adjacent to a former power generating facility, two sediment stations (SD-301 and SD-314) were located off the southern end of the Island in depositional areas, and one sediment station (SD-303) was located adjacent to exposed bedrock on the eastern shoreline.

It is noted that within the sample station locations described above, three of these sediment stations (SD-305, SD-306, and SD-309) were moved from the originally scoped positions to positions further

offshore to find depositional sediments, due to refusal during sediment collection at the originally marked locations. Also, as described previously, the sample team collected samples from eight additional stations (SD-302F, SD-304F, SD-305F, SD-306F, SD-308F, SD-309F, SD-310F, and SD-313F), beyond those originally scoped, in intertidal locations associated with the remains of former discharge pipes. Locations were placed adjacent or as close as possible to any observed discharge pipe remnants.

2.5.2 Sediment Investigation Field Measurements and Observations

Several field measurements were collected with a YSI 650 MDS (Multiparameter Display System) data logger as part of the site sediment investigation. These measurements included water parameter readings which consisted of temperature, pH, specific conductivity, dissolved oxygen, and salinity. In addition, all field measurements and notable observations made during sediment sampling were recorded in the field notebook and are discussed below. The sediment sample log sheets are presented in Appendix D-5.

Sediment stations were located in either sand/silt areas, in cobble/gravel areas, or in eelgrass bed areas. The sediment samples consisted primarily of black, grey, or brown sand and silt with some gravel and shell fragments. Some stations had higher amounts of gravel and coarse sand (SD-305, SD-306, and SD-309). Sediment stations SD-305, SD-306, and SD-309 had to be shifted, 35 feet, 40 feet, and 30 feet, respectively, toward depositional sediment in deeper water (east) in order to collect a sufficient sample volume.

In the sediment sample from station SD-312, located in the stillwater basin, samplers noted the presence of a black sludge with a petroleum odor. Metal fragments were also present in this sample, as well as in samples from sediment station SD-317. At sediment station SD-304 (southeast of Building 32), a sheen was observed on the sediment core surface after collection. At sediment station SD-310 (northeast shoreline) a petroleum odor was detected.

A narrow band of eelgrass, 70 to 90 feet at widest, was documented on each side of the Island. Eelgrass was observed by samplers and as interpreted during a non-invasive eelgrass survey at sediment stations SD-301, SD-304, SD-305, SD-307, SD-309F, SD-311, and SD-313.

At numerous sediment stations, samplers documented in the sample tubes the presence of a variety of marine organisms that included crabs (SD-303, SD-306, SD-308, SD-311, and SD-313), worms/polychaetes (SD-308, SD-309, SD-310, SD-313, and SD-314), starfish (SD-305 and SD-306), small clams (SD-305, SD-306, and SD-308), horseshoe crabs (SD-306), snails (SD-308), and unidentified larval fish/invertebrates (SD-308).

Sediment stations were photographed and transects of the subtidal area were videotaped. Subtidal transect lines are presented on Figures 2-4 and 2-5. Detailed descriptions of the subtidal area are presented in Section 3.1 of this report.

2.5.3 Sediment Analysis

Sediment samples were analyzed for the full Target Compound List (TCL) organic analyses (VOCs, SVOCs, PAHs, pesticides, and PCBs), TAL metals, cyanide, GRO/DRO, grain size distribution analysis, total organic carbon (TOC), and acid volatile sulfides/simultaneously extractable metals (AVS/SEM) analyses. The AVS/SEM sediment samples were collected from the surface only (the oxic zone if it was visually identified). In addition, measurements of the surface water temperature, pH, specific conductivity, dissolved oxygen, and salinity were collected at each sediment sample location. Grain size distribution analysis is presented in Section 3.1 of this report. Chemical analytical results are presented in Section 4 of this report.

2.6 BIOTA INVESTIGATION

Hardshell Clam (*Mercenaria mercenaria*) or Blue Mussel (*Mytilus edulis*) samples were collected at 21 stations that were co-located with sediment stations ("shellfish sample locations" on Figure 2-4 and 2-5). Clams were sampled at each station, where available. If clams were not present, mussel samples were collected. Table 2-7 presents the location of each bivalve sample station and rationale for location selection. Clam samples were collected at locations ET-301, ET-302, ET-303, ET-304, ET-305, ET-306, ET-306F, ET-307, ET-308, ET-309, ET-310, ET-311, and ET-313. Clams were generally collected from subtidal locations with water depths ranging from 3 to 14 feet. One clam sample location (ET-306F) was located in the intertidal zone. Mussel samples were collected at locations ET-302F, ET-304F, ET-305F, ET-308F, ET-309F, ET-310F, ET-312, and ET-313F. Mussels were collected from the intertidal zone, with the exception of location ET-312 which was collected at a depth of 16 feet.

Clams or mussels were collected within a 12.5 foot radius around the target survey position at each of the aforementioned locations (Figure 2-4 inset). Divers located and collected shellfish by hand. At each location, approximately 20 mussel specimens or six clam specimens of the same size were collected as one sample. The shellfish were subsequently scrubbed in seawater to remove any exterior sediment, patted dry, and then shucked. All collected specimens were characterized according to species type, and the following morphologic features were measured: shell length, shell width, shell breadth, total weight, and shucked tissue weight. Shell length, width, and breadth were measured using dial calipers in millimeters. Total weight and tissue weight were measured to the nearest hundredth of a gram (Table 2-8). Tissue composites from each sample location were placed in pre-cleaned glass jars with

Teflon-lined lids, labeled, and immediately frozen prior to shipment to the analytical laboratory. Bivalve tissues were frozen whole after collection and were subsequently homogenized by the analytical laboratory, prior to analysis. Biota sample information is documented in sample collection log sheets, presented in Appendix D5. Photographs of cleaned shellfish prior to shucking are provided in Appendix D9.

Biota tissue analyses included: SVOCs, PAHs, pesticides, PCBs, metals, and cyanide. In addition, the lipid content of tissue was determined for use in bioaccumulation factor calculations. Details on chemical analysis and results are presented in Section 4 of this report.

2.7 OFFSHORE OUTFALL TRACKING/UNDERWATER IMAGING

Underwater video surveys were conducted to locate any existing outfall locations originating from the Building 32 interior drainage system. In addition, the surveys were used to characterize sediment types, locate sediment sample stations, and evaluate the marine habitat. Surveys were conducted along weighted measurement tapes by divers utilizing an underwater video camera. Video was recorded along two transects (inshore and offshore transects) off both the east and west shorelines of the north end of Gould Island and off the former rigging platform area in the stillwater basin (see Figures 2-4 and 2-5). Inshore and offshore transects were approximately 50 feet and 100 feet offshore, respectively. Two 1,000-foot transects, split into 700-foot and 300-foot segments were conducted on the east side of the Island. Two continuous 700-foot transects were conducted along the western side and two continuous 185-foot transects were conducted along the former rigging platform area (see Figure 2-5). A total of approximately 2.5 hours of digital video was recorded to document the bottom conditions (Appendix E2). A description of the findings is presented in Section 3.1 of this report.

2.8 NON-INVASIVE EELGRASS SURVEY

The extent of eelgrass areas encountered during the underwater surveys in the study area was mapped. Weighted buoys were placed every 20 to 40 feet along offshore and near-shore extents of eelgrass, as determined by divers swimming shore-perpendicular transects. Buoy locations were then mapped with dGPS equipment with an accuracy of 1 to 3 meters. The eelgrass bed edge was, for the most part, rather distinct. Eelgrass coverage was typically greater than 80 percent as visually estimated using Braun-Blanquet Cover Abundance Scale (Braun-Blanquet, 1932) and seagrass percentage cover photoguide (Short, et al, 2002). Mapped eelgrass areas are presented on Figures 2-4 and 2-5.

3.0 PHYSICAL CHARACTERISTICS

This section presents information on the regional physiography, and the regional and site-specific geology, hydrology, and hydrogeology in support of the Site 17 RI.

3.1 REGIONAL PHYSIOGRAPHY

This section is divided into seven subsections: climate, setting and topography, threatened and endangered species, terrestrial habitats, soil types, marine habitats, and sediment grain size distribution. Geology and hydrogeology of the site and of the region are addressed in separate sections following this discussion.

3.1.1 Climate

The climate at NAVSTA Newport is presented below. Much of the climatological information was obtained from the IAS report, and is referenced below. NAVSTA Newport is situated in a temperate climate zone characterized by wide variations in seasonal temperatures. Atmospheric conditions are influenced by the naval station's proximity to Narragansett Bay and the Atlantic Ocean, which affect the area's temperatures. Winter temperatures are somewhat higher and summer temperatures lower, than more inland areas. The orientation of Narragansett Bay exposes the Bay water and coastline to southerly sea breezes in summer months and nor'easter storms in the winter (SAIC 2000).

Temperature, precipitation and snowfall data collected at the Newport, Rhode Island meteorological station (the station) between 1957 and 2000 are summarized below. This data was provided by the Northeast Regional Climate Center (NRCC) at Cornell University (NRCC 2000).

According to records, the average annual temperature has varied between a maximum of 58.5 and a minimum of 43.2 degrees Fahrenheit (°F). January and February were the coldest months, with a mean minimum temperature of approximately 23.6°F. July and August were the warmest months, with a mean maximum temperature of approximately 78.2°F.

The average annual precipitation for the station was 45.31 inches. For the period between 1957 and 2000, the average monthly precipitation ranged from 2.87 inches for July to 4.50 inches for March. The wettest months on average were March, April, November, and December. The average seasonal snowfall was approximately 21.6 inches, whereas, in the nearby inland area of Providence, Rhode Island the average seasonal snowfall was 35.5 inches. In Newport, January and February each averaged approximately 7.1 inches of snow. In Providence, the average monthly snowfall amounts for January and February were 9.8 and 10.2 inches, respectively.

According to records from July 1996 through June 2000, the average wind speed measured at the Newport State Airport located in Middletown, Rhode Island was 9.1 miles per hour (mph). The prevailing wind direction between November and December has been west-northwest. In January and February, the prevailing wind direction has been from the north (NRCC, 2000). These winds are due to high-pressure weather systems off of the Canadian Shield (SAIC, 2000). The prevailing wind direction between May and August has been from the south-southwest (NRCC, 2000). Bermuda high-pressure systems drive the winds from the southwest during spring and summer months (SAIC, 2000).

3.1.2 Setting and Topography

As described in Section 1 of this report, NAVSTA Newport is located in the Narragansett Bay Basin. NAVSTA Newport occupies approximately 1,063 acres, with portions of the facility located in the City of Newport and Towns of Middletown and Portsmouth, Rhode Island. The facility follows the western shoreline of Aquidneck Island for nearly 6 miles, facing the East Passage of Narragansett Bay (Figure 1-1). Gould Island is located in the East Passage of Narragansett Bay in Rhode Island, approximately 1.5 miles west of Newport, Rhode Island. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres (Figure 1-2). Building 32 (Site 17), located on the northeast end of Gould Island, served as a torpedo overhaul shop that has been inactive since the 1950's (Figure 1-3).

The Islands in Narragansett Bay are elongated and generally oriented in a north-south direction as a result of glacial movement. Elevations at NAVSTA Newport range from near mean sea level (MSL) to approximately 170 feet above MSL in the Melville North area (USGS, 1975). Areas at low elevations are susceptible to flooding during storm surges.

Ground surface elevations on the site range from 0 to 20 feet above local Naval Base mean low water (MLW). Topography is generally level, with the western half of the north end of the Island leveled at approximately 18 feet MLW and the Building 32 area constructed at less than 10 feet MLW. The historical topography and shoreline of the Island was quite different as shown in Figure 1-4. The north end of Gould Island had steeply sloping sides to elevations above 30 feet. However, cut-and fill operations are evident in historical construction drawings presented in Appendix C (P.W. Drawing nos. 3861-46 and 3859-46). These drawings indicate that the original shoreline was extended to the east and north for the purposes of construction of Building 32 and other facilities (piers, loading platforms, firing piers, tank systems, etc) in this area. It is most likely that the fill for the shoreline was material removed from the hillsides to the south. The dramatic soil working is evident on historical air photos provided in Appendix C.

Before it was obtained for use by the Navy, this property was occupied by a family farm, and few permanent structures were present in the area (Figure 1-4).

3.1.3 Threatened and Endangered Species

In order to identify threatened and endangered species at the site, requests were provided to the National Oceanic and Atmospheric Administration (NOAA) and US Fish and Wildlife Service (USFWS) to provide recorded information on endangered species present at Gould Island. It is recognized that this location is a small portion of a large estuary, but it is necessary to identify local receptors to contaminants on the island. Responses from these requests indicated that no federally listed or proposed threatened or endangered species or critical habitat under the jurisdiction of these agencies are recorded to exist within the project investigation area.

According to the Rhode Island Geographical Information System (RIGIS), there are no threatened or endangered species present on Gould Island. Based on field observations made at the Island, there is low potential for habitation of federal threatened or endangered species there. The great blue heron (*Ardea herodias*) and the herring gull (*Larus argentatus*) are avian species that have been identified as target receptors of concern; however, neither of these birds is identified on the federal or state endangered or threatened species list for Rhode Island (RIDEM, 1999). Additional detail on species observed and anticipated to visit at the site is provided in Appendix E of this report.

It is recognized that animals, particularly marine animals and migrating birds may visit the site, although there is no record of their presence in the standard reference lists investigated for this report. The site is a likely stopover location for migratory waterfowl, predatory birds and other birds. Harbor seals are common in the area in winter, though they have not been observed on the island. Sea turtles are sighted in Narragansett Bay, but are highly mobile creatures and feed in the water column throughout a large area. However, special consideration must be given to contaminants at the site that have the propensity to bioaccumulate and or biomagnify in higher trophic-level animals. These contaminants include PCBs, pesticides and accumulative metals such as mercury. The food chain model described in Section 7 of this report evaluates the contaminants found in the different media sampled at the site, and the likelihood of their ability to affect higher trophic-level organisms.

3.1.4 Terrestrial Habitats

This section describes the terrestrial habitat features observed during the period of 2002 through 2005. Reference information is provided in Appendix E-1 of this report.

Gould Island was purchased from private landowners by the Navy in 1918 (Presidential Proclamation 1918). Prior to that date, the land was used agriculturally. Air photos taken in the early 1940s show that most of the vegetation was removed from the Island and the soils were nearly completely reworked.

Ownership of the southern three-fourths of the Island has been transferred from the Navy to the State of Rhode Island. The southern portion of the Island has not been maintained for many years and therefore a tangled succession of native and non-native plants have colonized the area, forming a scrub/shrub and medium sized tree cover across most of the property. Some foundations as well as intact buildings remain in various states of disrepair, hidden with undergrowth and dense vegetation. Naval Station Newport retains ownership of the northern end of the Island, where Building 32 was located. A chain-link fence separates the two areas. The intertidal shoreline is subject to wave action and consists of a mixture of a deteriorated steel sheet pile marine retaining wall, rip-rap concrete blocks and debris, and a rocky beach face.

In 2001 and 2002, most of the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place. Therefore, much of the ground surface remains as concrete cover. Roadways and some of the smaller building foundations were removed (Appendix A). The former building foundation pads and the torpedo firing pier cover approximately 46 percent of the total Navy property on Gould Island. The only structure still remaining is Building 35, located on the firing pier, to the north of the former Building 32.

The north portion of the Island is a weathered point of land, subject to prevailing wind exposure and currents, almost year-round. The habitat on this portion of the Island consists primarily of open field vegetation consisting of grasses and forbs. The field habitat comprises approximately 37 percent of the Navy property and has an abundance of non-native volunteer and invasive species typical of recently disturbed sites in New England. Dominant plants include grasses and legumes from the hydroseed mix that was applied after building demolition was completed, such as perennial rye grass *(Lolium perenne*), crown vetch (*Coronilla varia*), and birdsfoot trefoil (*Lotus corniculatus*). Other species that were probably present before the recent disturbance include spotted knapweed (*Centaurea maculosa*), bittersweet (*Celastrus orbiculatus*), Multiflora rose (*Rosa multiflora*), and autumn olive (*Elaegnus umbellate*). Two narrow bands of scrub/shrub habitat are present above the upper shoreline on the east and west sides of the Island. These scrub/shrub bands consist primarily of autumn olive and Japanese honeysuckle (*Lonicera japonica*) and cover approximately 17 percent of the Navy property. Many of these plants provide important bird nesting habitat. It is expected that through natural habitat succession, the Navy property will soon resemble the scrub/shrub and tree habitat on the southern portion of the Island, which provides quality habitat for a variety of nesting birds.

Gould Island is an important location for colonial nesting birds. An annual colonial nesting bird count conducted by the RIDEM Division of Fish and Wildlife during spring/early summer has identified 22 bird species present on Gould Island. Some of the species present include Double-crested Cormorant (*Phalacrocorax auritus)*, Great Egret (*Ardea albus)*, Herring Gull (*Larus argentatus)*, Great Black-backed Gull (*Larus marinus),* and Black-crowned Night Heron (*Nycticorax nycticorax*). A variety of songbirds also nest on Gould Island each year. Mammals observed or reported to be present on the Island include the eastern cottontail (*Sylvilagus floridanus)*, red fox (*Vulpes vulpes)*, and white-tailed deer (*Odocorleus viginianus)*. See

Appendix E-1, Gould Island Ecological Characterization, for a more detailed description of the Navy property habitats and the flora and fauna present on Gould Island.

3.1.5 Marine Habitats

This section describes the marine habitat features found during the marine investigations and mapping conducted in the vicinity of the site in August and September 2005. Reference information is presented in Appendix E-2 of this report. Figure 3-1 presents a summary of the findings described in this section.

3.1.5.1 Primary Features

Shoreline features located at the north end of Gould Island include a breakwater and a stillwater basin. The depth of the basin is approximately 21 feet at mean low water. The shoreline habitat along the northern sections of the Island include riprap, deteriorating sheet pilings, and block walls. Rocky/gravel beaches are present along the eastern and western sides of the Island. A section of exposed bedrock is present on the eastern shoreline. A sandy beach is located on the southern end of the Island.

Primary currents at Gould Island are directly related to the tidal stage. Currents flow north during flood tides and south during ebb tides. Based on field observations, tidal current velocities around the Island ranged from a minimum of 0.0 knots at slack low tide to between 0.5 and 1 knot at the southern end of the Island. However, geomorphic evidence seems to indicate that there is a small net southern flow. This evidence consists of the presence of sand deposits in the intertidal and subtidal areas at the southern end of the Island. It is presumed that this sediment is transported along both sides of the Island. Similar deposits were not observed at the northern end of the Island. The absence of these deposits may also be a result of the type of shoreline, steep seawalls and revetments.

The marine habitat in the vicinity of Gould Island includes intertidal and subtidal environments, sand-or silt-substrate with small eelgrass beds.

Mapping efforts defined a narrow band of eelgrass, up to 90 feet at the widest, on both sides (east and west) of the northern end of the Gould Island (Figure 3-1). Both the east and west side eelgrass beds extend to the south of the study area. The west side eelgrass bed also extended north of the study area, although subtidal topography indicates it is not likely to extend very far in this direction. In the southern portion of Gould Island, where the full extent of eelgrass was not mapped, eelgrass was also observed up to and more than 25 feet around sediment stations SD-301 and SD-311 (Figure 3-1). No eelgrass was observed at sediment stations SD-303 (eastern shoreline) or SD-314 (southeast end of island).

Eelgrass bed boundaries were distinct and coverage was typically greater than 80 percent, as estimated visually using a Braun-Blanquet Cover Abundance Scale (Braun-Blanquet, 1932) and seagrass percentage cover photo guide (Short et al, 2002).

Species observed by the sampling team during the collection of sediment samples included a variety of invertebrate and fish species. Invertebrate species included quahogs (Mercenaria mercenaria), mussels (Mytilus edulis), a soft shell clam (Mya arenaria), hairy sea cucumbers (Sclerodactyla briareus), lobsters (Homarus americanus), purple sea urchins (Arbacia punctulata), and several species of crabs. Fish species included cunner (Tautogolabrus adspersus), tautog (Tautog onitis), scup (Stenotomus chrysops), striped bass (Morone saxatilis), summer flounder (Paralichthys dentatus), winter flounder (Pleuronectes americanus), menhaden (Brevoorita tyrannus), and silversides (Menidia sp.). In addition, a tropical transcient, snowy grouper (Epinephelus niveatus), was also observed at one sediment station (SD303).

3.1.5.2 Offshore Outfall Tracking/Underwater Imaging Field Measurements and Observations

During the sediment sampling effort, the subtidal environment was inspected by divers and bottom conditions were videotaped on transects along the shoreline (Section 2.7). This section provides a summary of the observations made during this effort. Appendix E-2 presents details on the subtidal survey. Transects that were videotaped are shown on Figure 3-1.

East Side Offshore Transects

The 300-foot offshore transect's southern endpoint was located proximal to the former ferry slip, southeast of Building 32. At this point, the bottom substrate consisted of medium to fine sand with shell fragments interspersed with patches of macroalgae. Occasional isolated shoots of eelgrass were also encountered. Debris, consisting of pilings and metal debris (potential remnants of the former ferry slip), were observed in the area of the former ferry slip. An abandoned lobster cage was observed north of the former ferry slip area. Habitat observed at the northern endpoint of the 300-foot offshore transect was similar to the southern endpoint. Biota observed along this transect included clams and cunner.

The southern endpoint of the 700-foot offshore transect segment was characterized by a gravelly sand/silt bottom substrate with little algae. In the area of the former dock, more macroalgae was observed. In addition, a circular structure overgrown with algae were observed in the southern former dock area and a flat metal structure was observed protruding at an angle from the bottom in the northern former dock area. Towards the northern endpoint, assorted metal and wood debris was observed. One piece of debris had what appeared to be a circular cut-out for a piling. A spider crab and a lobster residing under a piece of wood debris were observed in this area. Several areas containing patches of mussel and clam shells were also observed along

the transect line. Two sections of pipe were observed at the northern endpoint of the transect, 100 feet east of the rigging platform area. To establish a sediment sampling location, the pipes were tracked towards the east until they terminated at broken sections (Section 2.7).

East Side Inshore Transects

The southern endpoint of the 700-foot inshore transect was located 100 feet south of the former ferry slip area and the associated substrate was characterized by boulders and cobble with a thick cover of macroalgae and patches of silt and sand. Biota observed at this point included cunner, starfish, orange sponges, a spider crab, and purple sea urchins. Three hundred feet north of the southern endpoint, eelgrass beds were observed along the transect line. Spiral tufted bryozoan were also observed in this area. Towards the northern end of the 700-foot transect line, the eelgrass beds thinned out and the bottom was characterized by barren silt and sand. A juvenile winter flounder was observed in this area.

The 300-foot inshore transect line was characterized by a rocky bottom (boulders and cobble) with macroalgae and patches of silt and sand. A patch of mussel shells was observed at the northern endpoint of this transect. Biota observed included starfish, orange sponges, and cunner. A circular metal plate consisting of alternating dark- and light- colored materials was observed towards the southern endpoint of the transect.

West Side Offshore Transects

The southern endpoint of the 700-foot offshore transect was characterized by a barren bottom covered with mussel and clam shells. Biota observed included hermit crabs and a spider crab. The former seawater intake structure was observed at the 375 foot measurement tape increment. Debris observed adjacent to the intake structure included a large metal structure with a pipe or piling attached. Proceeding north along the transect, an isolated pipe fragment was observed 100 feet from the northern endpoint. This pipe fragment appeared to be similar in size to the pipe outfalls located at sediment stations SD-308F and SD-313F.

West Side Inshore Transects

The first 400 feet from the southern endpoint were characterized by eelgrass beds as well as boulders and cobbles covered with macroalgae. Biota observed in this area included purple sea urchins, starfish, and cunner. The saltwater intake structure was evident at the 375-foot mark. At the 400-foot mark eelgrass beds diminished in density to patches. Boulders and cobbles covered with macroalgae, and patches of sand and silt became more pronounced towards the northern end of the transect. Purple sea urchins were evident in this area.

Stillwater Basin Transects

Both stillwater basin transects encountered various types of scattered debris, including pieces of wood, granite blocks, concrete, metal rods, brick, and pilings. The bottom substrate was barren and silty, and lacked algae cover. Biota observed included mussel beds, starfish, spider crabs, cunner, and sponges.

3.1.6 Grain Size

Analysis of grain size distribution was conducted on aliquots of sediment samples collected as described in Section 2.7 of this report. The term sediment is used in this report to describe the surface of the land that is under water seaward of the former Building 32 facility at this site (below high tide). This material is a mix of sand, gravel, clay, silt and cobbles, as well as old shell material. Results from the grain size distribution analyses are summarized below. Analytical data is presented in Appendix E-3.

These results indicate that grain size differs based on the general location within the study area. Overall, coarse-grained materials, sand or sand and gravel, are the predominant materials observed in sediment samples (Figure 1, Appendix E-3). The grain sizes are fairly coarse, with sand and gravel content ranging from 74 to 96 percent of total sample material. In general, a gradation exists in the gravel content observed in samples, with gravel comprising a larger component of the material nearshore, in the intertidal zone, and with gravel content decreasing as distance from the shoreline increases into the subtidal zone. Samples collected in the intertidal zone, typically designated by an “F” in the station identifier (i.e., SD-308F, SD-310F, and SD-313F) have the highest gravel content of any samples, ranging from 42 to 61 percent. Exceptions include samples from the stillwater basin area, characterized by sample stations SD-312 and SD-316, where the fines content (silt and clay) comprises an increased portion of the sediment material, ranging from 25 to 51 percent of sediment. Sediment samples from locations SD-302 and SD-306 also had a relatively high fines content (>20 percent passing the #200 sieve) comprising 21 percent at SD-302 and 26 to 32 percent at SD-306. At the southern end of the Island, in the area of sample station SD-314, an increase in gravel content was observed, ranging from 39 to 45 percent, which is comparable to intertidal zone samples described above.

These results indicate, with the exception of a few locations mentioned above, a predominance of coarse material and a relatively low percentage of fine material observed at most of the sample stations. It is important to note that all the samples described above were collected using core tube sampling equipment that do not capture or collect material larger than approximately 2.5 inches in diameter. This results in a percentage of large gravel, cobbles, or boulder material withheld from the grain size analysis as it would be too large to fit within the sampling device. This is particularly important in the stillwater area, as divers inspections revealed a large amount of debris near the failed rigging platform, including large stone, concrete blocks and various materials dropped from the collapsed rigging platform.

3.1.7 Soil Types

According to the United States Department of Agriculture (USDA) Soil Survey of Rhode Island (issued 1981), four soil map units occur on Gould Island: beaches (Ba), Newport silt loam (NeA and NeC), and Urban land (Ur). The northern portion of the Island, where the site is located, is all characterized as Ur. However, the historic air photos provided in Appendix C show evidence of reworking of nearly all the soils on the Island during the period of the early- to mid-1940s. This would indicate that most of or all the soils on the Island should be designated as Udorthents-Urban Land Complex (UD) and Ur. Areas designated "UD" consist of soils that have been disturbed by cutting and filling, and areas covered by buildings or pavement. Areas designated "Ur" primarily consist of sites for buildings, paved roads, and parking lots. As some of the Island's former concrete roadways and building foundations are now removed, these soils may be changed from Ur to UD designations, indicating their alteration by cutting and filling, but no longer paved and covered.

3.2 GEOLOGY

This section presents a brief overview of the regional geology, as well as site-specific geology. Much of the regional geologic information summarized in this section was presented in the IAS report prepared by Envirodyne Engineers, Inc. (1983). The site-specific geologic information is based on data collected during investigations identified in Section 2.0.

3.2.1 Regional Geology

Regional geologic information pertinent to the RI for Site 17 is presented below. This discussion is presented in two subsections: overburden and bedrock geology.

3.2.1.1 Regional Overburden Geology

The geology of the region, in general, consists of glacially-derived unconsolidated deposits overlying Pennsylvanian-age sedimentary bedrock (USDA, 1981; Hermes et al, 1994). Wisconsin-age glaciers covered the region with ice several thousand feet thick. During ice advances, sediment and bedrock were eroded and carried beneath the ice sheet. As the glaciers melted and receded, unconsolidated glacial materials of variable thickness were deposited throughout the Narragansett Basin area. These glacial materials included till and sorted sand, silt, and gravel (USDA, 1981; EEI, 1983).

Till is the most extensive of the glacial deposits in Rhode Island. This glacial deposit is unstratified and widely heterogeneous in grain size distribution, typically comprised of fine (clay/silt/sand) and coarse (pebbles/cobbles/boulders) fractions (USDA, 1981). In southern New England, the late Wisconsinan surface

till is predominant. Published reports indicate that the surface till forms a discontinuous mantle over bedrock uplands and beneath stratified drift deposits. In general, the surface till comprises a loose sandy unit containing boulders and cobbles, and lenses of stratified sediments. However, surface tills vary in composition. The physical characteristics of surface till generally reflect local bedrock and older surficial materials from which the deposit was derived (Melvin et al, 1992).

Regionally, the Upland till plains, the Narragansett till plains, and the Charlestown and Block Island end moraines are till deposits in Rhode Island. Gould Island is located on the Narragansett till plain. This glacial till deposit may have been derived from a sedimentary and meta-sedimentary rock provenance (USDA 1981).

Stratified drift or outwash, composed of sorted sand, silt, and gravel deposits was laid down by glacial meltwaters as the ice sheet receded. The eroded materials carried by the glacial meltwater were deposited in irregular layers of various thicknesses. Regionally, large deposits of outwash are located in Providence and East Greenwich (USDA, 1981).

3.2.1.2 Regional Bedrock Geology

Narragansett Basin is an ancient structural basin originating near Hanover, Massachusetts. This basin is a complex synclinal mass of Pennsylvanian-aged, non-marine sedimentary rocks, and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. The basin's approximate length is 55 miles; its width varies from 15 to 25 miles. The western margin of the basin is in the western portion of Providence, Rhode Island, and the eastern margin extends 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 may be near the mouth of Narragansett Bay. Gould Island is situated at the southeastern end of the Narragansett Basin.

The rocks within Narragansett Basin chiefly consist of conglomerates, sandstones, shales, and anthracite. Total thickness of the strata in the basin has been estimated at 12,000 feet. Many folds and some faults occur throughout the basin, but the character and amount of the folding and faulting was not evaluated as part of this report. Refer to Hermes et al (1994) for a depiction of the faults mapped in the surrounding area.

The bedrock of the Narragansett Basin has been divided into six units, which are, in descending stratigraphic order: the Dighton Conglomerate, the Purgatory Conglomerate, the Rhode Island Formation, the Wamsutta Formation, the Sachuest Arkose, and the Pondville Conglomerate. The Rhode Island Formation immediately underlies all of Gould Island. Refer to Hermes et al (1994) for a detailed depiction of the bedrock geology of Rhode Island.

The Rhode Island Formation is the most extensive and thickest of the Pennsylvanian formations in Rhode Island. The majority of the Narragansett Basin is underlain by this formation. In northern Rhode Island, the Rhode Island Formation is not metamorphosed and primarily consists of gray to black, fine- to coarse-grained quartz arenite, litharenite, shale, and conglomerate. However, in the southern portion of the Basin, such as in the vicinity of NAVSTA Newport, this unit has been metamorphosed. Metasedimentary rocks, including metaconglomerates and metasandstones, as well as schist, carbonaceous schist, phyllites, and graphite are present within the formation (Hermes et al, 1994).

No bedrock exposures have been observed at the site. However, bedrock is exposed south of the former Building 32 on the east side of the Island, along the shoreline. Bedrock in the vicinity of Gould Island is mainly metamorphic rock, predominately phyllites and schists, which are exposed at outcrops at the main-base area of NETC, approximately two miles to the east of Gould Island.

3.2.2 Site Geology

This section summarizes the overburden and bedrock geology beneath Site 17. It describes the general nature of the unconsolidated geological units, a description of the bedrock, and identification of potential preferential contaminant pathways in various geological units. The geologic summary is based on data from published maps as well as data generated during the field investigation detailed in Section 2.0 of this report.

According to the Soil Survey of Rhode Island, four soil map units occur on Gould Island: beaches (Ba), Newport silt loam (NeA and NeC), and Urban land (Ur). The northern end of the Island, where the site is located, is mapped as Urban land (Ur). Urban land is land that is mostly covered by urban structures such as streets, buildings, and parking lots. Presumably, the soils reworked during site development were originally Newport silt-loam with characteristics similar to that unit.

Newport silt loam is mapped south of the site. Newport silt loam consists of well-drained soils found on the crests and side slopes of drumlins and glacial till plains. These soils formed in compact glacial till derived mainly from dark sandstone, conglomerate, argillite, and phyllite. Typically, the surface layer is very dark brown silt loam approximately eight inches thick. The subsoil is olive-brown and olive silt loam, 16 inches thick. The substratum is olive-gray silt loam that contains flat rock fragments and extends to a depth of 60 inches or more. Ten to 15 percent of the Ne map units, and thirty percent of the NP map unit consist of other soils (Bc, Ps, Pm, and UD). Permeability is moderate to moderately rapid in the surface layer and subsoil, and slow to very slow in the substratum. Available water capacity is moderate, and runoff is medium to rapid, depending on the slope. The soil is very strongly acid to medium acid.

Beach soils (Ba) occur on some of the shores of the Island. This map unit consists of long, narrow areas of sand dunes or escarpments. It also includes sandy, gravelly, or cobbly areas that are exposed during low tide,

which are common on the Gould Island shoreline. Slopes range from zero to eight percent. About five percent of the Ba map unit includes rock outcrops.

Subsurface investigation activities performed at the site during the RI included the drilling and sampling of 28 soil borings, the installation of 12 monitoring wells, and excavation of 13 test pits. Information regarding overburden stratigraphy and bedrock was obtained from drilling operations and test pit excavations. The locations of the soil borings, monitoring wells, and test pits are shown on Figures 2-1 and 2-2 of this report. Using the information from available boring logs, two geologic cross-sections were prepared for the site and are presented as Figures 3-2 and 3-3. The cross-section orientations are presented on each figure. Boring logs, test pit logs, and monitoring well construction logs generated during the RI are presented in Appendix D.

The overburden materials encountered at the site during the RI subsurface investigation were divided into three unconsolidated units: fill; silty sand and gravel; and glacial till. Each of these units is described below.

Fill

Historical records indicate that the original topography of the site was altered for the construction of the Gould Island facilities. The alteration mainly consisted of lowering the original grade of the Island by as much as 30 feet where buildings were to be constructed. The northern shore of the Island was extended, presumably with the excavated soil, to create the land then occupied by the fuel tank farm (Building 44), the rigging area, docks and the tramway leading to the torpedo test facility and Building 35.

The greatest thickness of fill was encountered in the boring for MW-306B. This boring is located within the tank farm area north of Building 32 in land that historical records indicate as being man-made. It is also near an excavation area that was backfilled with construction debris from the demolition of the buildings on the Navy-held portion of Gould Island in 2001 and 2002. The fill encountered in this boring consisted of a mixture of construction debris (brick and wood), silty sand, and gravel, and was present to a depth of at least 12 feet, but less than 20 feet (samples were collected at 10 foot intervals in this boring). A layer of reinforced concrete was encountered from 6.5 to 9 feet bgs (refer to Figure 3-2).

Minor amounts of fill were encountered in borings SB318, SB333, and SB334, which were all advanced through the Building 32 foundation. SB318 was in the former location of a solvent tank; SB333 was at the former location of the sand blasting booth; and SB334 was in a trench area where oily grit was previously found. In these borings, the fill consisted of brick and/or wood fragments in a mixture of silt, sand, and gravel. The fill was found no deeper than approximately 7 feet bgs.

Silty Sand and Gravel

This unit consists of dark gray to black silt, sand, gravel, and rock fragments. This unit was classified separately from the till unit based on its lower density, although it is compositionally identical to the till unit. This unit overlies the till unit where till is present, and was found at all the boring locations where continuous samples were collected. In the boring for MW306B, samples were collected every 10 feet for the purposes of installing the bedrock monitoring well. There is some uncertainty at this location as to whether the silty sand and gravel are present above the till, but it is likely that this is the case, as this is an area where cut/fill from the south end of Building 32 was spread for the purposes of site development.

The thickness of the silty sand and gravel unit varies across the site. In the southeastern portion of the site, where the encountered depths to bedrock were relatively shallow, the thickness of the unit varies from 2 feet (SB324) to 13 feet (SB323 and SB337); in the northwestern portion of the site, where the encountered depths to bedrock were the greatest, the thickness varies from 9 feet (SB300B) to up to 22 feet, based on projected depth of sand silt and gravel in SB306B.

Till

The till unit consists of dark gray to black silt, fine to coarse sand, fine to coarse gravel, and rock fragments in varying proportions. Till was encountered in a majority of the borings across the site. Where it was present, it was the unit immediately overlying bedrock. The till unit was differentiated from the silty sand and gravel unit by its higher density. As defined, glacial till consists of an unstratified mixture of clay, silt, sand, gravel, and boulders.

The thickness of the till unit varies across the site. In the northern portion of the site, where the encountered depths to bedrock is greatest, the till is approximately 74 feet thick in MW304B, 40 feet thick in MW306B, and 51 feet thick in MW305B. In the southeastern portion of the site, where the encountered depths to bedrock were relatively shallow, the till, where present, is generally less than 10 feet thick. Till was not encountered in borings SB303B, SB322, SB323, SB326, SB327, SB328, SB332, SB337, and SB338, which are all located in the southeastern portion of the site. In these borings, the silty sand and gravel unit directly overlies bedrock.

Bedrock

The bedrock beneath the site as encountered during the RI drilling and rock coring activities consists of metamorphosed sedimentary rock, predominantly phyllite. The hardness and the degree of foliation of the rock varied with location, and the color of the rock varied from black to gray to greenish gray. At MW302B, MW303B, and MW305B, the rock consisted of dark gray to black phyllite. In MW300B, the rock was not as well foliated, giving it a more slate-like appearance. A trace amount of pyrite was noted in the rock at

MW300B, MW302B, and MW305B. In SB304, the borehole encountered dark gray phyllite containing a trace of pyrite to a depth of approximately 97 feet, where the rock graded into a coarser grained, less foliated rock, interpreted as metasandstone to the end of the boring at 124 feet bgs. At MW306B, the rock consisted of dark gray phyllite from a depth of 65 feet to 83 feet; very weathered phyllite and clayey silt from 84 to 85 feet; and green-gray, coarser grained, harder metasandstone from 85 feet to 95 feet at the end of the boring. Quartz veins were noted in the core for MW300B (63 feet), MW301B (47 feet and 59 feet), and MW305B (75 feet). In all of the boreholes that were terminated at the top of bedrock, the rock encountered was described in the boring logs as phyllite. These rock types are consistent with those described for the Rhode Island Formation.

The bedrock surface at all of the bedrock monitoring well locations was described as weathered. The thickest weathered zones were encountered in the borings for MW300B and MW302B: approximately 14 feet and 18 feet thick, respectively. Due to the softness of the phyllite bedrock, the transition from weathered rock to competent rock was gradual and not clearly defined in these boreholes. The bedrock surface was harder at MW301B, MW303B, MW304B, MW305B, and MW306B. The weathered zones in these boreholes ranged from approximately 3 feet to 6 feet thick.

The degree of rock brokenness of the cores from all of the boreholes ranged from very broken (rock pieces less than 2 inches long) to broken (rock pieces between 2 inches and 1 foot long). The brokenness of the rock was a reflection of its softness and fissile nature.

As shown on geologic cross-sections A-A' and B-B' (Figures 3-2 and 3-3), the bedrock surface dips steeply to the west-northwest. The depth to bedrock encountered in borings across the site ranged from 8 feet at the southeastern end of the site (SB-325 and SB326) to 84 feet at the northwestern end (MW-304B). Bedrock elevations ranged from 10 feet in MW301B to -72 feet in MW304B. MW301B is located on a hill approximately 200 feet southwest of Building 32. The areas of shallow bedrock generally correspond with areas where the greatest amount of soil was excavated and removed prior to construction of the buildings. Figure 3-4 presents interpreted bedrock surface elevation contours based on borings advanced at the site during the RI.

3.3 HYDROLOGY AND HYDROGEOLOGY

The primary purpose of the geologic investigation was to provide a structural context to understand groundwater flow and potential contaminant migration beneath the site. In light of the regional and site geology described above, Section 3.3 describes the regional and site hydrogeology, and also includes a summary of regional and site surface water hydrology.

3.3.1 Regional Surface Water Hydrology

The information presented in this section was largely developed for the Old Fire Fighting Training Area (Site 09) located at Coasters Harbor Island, approximately 2 miles to the south of Gould Island (TtNUS 2001). This discussion is pertinent to the East Passage of Narragansett Bay.

NAVSTA Newport is located within the Narragansett Bay drainage basin. The basin covers an area of approximately 1,850 square miles, of which 850 square miles are in Rhode Island (USDA 1981). All surface water drainage from the Narragansett Bay drainage basin empties into Narragansett Bay.

Narragansett Bay occupies three former river valleys which have been drowned by the advance of the Atlantic Ocean. Narragansett Bay is 20 miles long and 11 miles wide and has a surface area of 102 square miles. The shape of the former river valleys has changed little since the last glaciation. The Bay is divided into an eastern and western passage by Conanicut Island. The average depth of the Bay is 30 feet. In the western passage, the average depth is 25 feet, while in the eastern passage, the average depth is 50 feet. The eastern passage, which NAVSTA Newport fronts, allows deep water access up to the south end of Prudence Island. In the eastern passage, channel depth exceeds 80 feet from Gould Island seaward, and depths in excess of 150 feet occur near the mouth of the Bay.

Freshwater flows into the Bay at an average rate of 1,239 cubic feet per second (cfs) from a drainage area of 1,850 square miles. This accounts for 90 percent of the annual flow of fresh water into the Bay. The other 10 percent is provided by direct rainfall into the Bay and sewage effluent. An average precipitation of some 43 inches per year of precipitation falls directly into the Bay. The freshwater input into the Bay is small compared to the large volume of saline water in the Bay. The relatively small freshwater input into the Bay results in the Bay water being well mixed with only small salinity gradients through the Bay. Salinity ranged from about 22 parts per thousand (ppt) in the Providence River to 32 ppt at the mouth of the Bay.

Tides are semi-diurnal in Narragansett Bay with a mean range of 3.6 feet at the mouth of the Bay and 4.6 feet at the head. About 13 percent of the volume of water in the Bay is exchanged each tidal cycle (Oviatt and Nixon, 1973). This is over 250 times the mean tidal river flow into the Bay during a tidal cycle. The tidal movement is the single most important factor in water circulation in the Bay. Tidal currents range in velocity from 0.07 to 2.3 feet per second (Atlantic Scientific, 1982). The faster velocities occur in the east and west passages near the mouth of the Bay, while slower velocities occur in the upper bay.

3.3.2 Regional and Area Surface Water Classifications

All surface waters of Rhode Island have been categorized according to water use classifications considering public health, recreation, propagation and protection of fish and wildlife, as well as economic and social benefit. According to RIDEM's Water Quality Regulations and Water Quality Classification Descriptions, each class is defined by the most sensitive water uses to be protected (RIDEM, 1997). Generally, all waters shall be suitable for aquacultural uses, navigation, and industrial cooling, and have good aesthetic value.

Most of Narragansett Bay, including the area surrounding Gould Island, is described as Class "SA". This water quality classification denotes the water quality goal for the waterbody. Class "SA" seawaters are designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat (RIDEM, 1997).

3.3.3 Site Surface Water Hydrology

Narragansett Bay borders the Site to the north, west, and east. A hill rises to the south of the site, and the general site topography slopes slightly from the southwest to the northeast. No surface water bodies are present on the site. A marshy area exists near the southern corner of the Building 32 foundation that may become inundated during periods of heavy precipitation. The shoreline consists mainly of manmade materials, including concrete slabs, degrading steel and wooden pilings, and building rubble. There is a sandy beach at the far southern point of Gould Island.

Surface water runoff from the site evaporates, infiltrates into the site soils, or flows into Narragansett Bay. Surface water runoff generally flows from southwest to northeast across the site. Remaining building foundations, paved roads, and an existing storm drain network beneath the site redirect the surface water flow before it is discharged into Narragansett Bay.

Wetlands

Gould Island is designated an upland area. Published maps do not indicate the presence of wetlands on the Island other than the shoreline intertidal zone (USDOI, 1975).

3.3.4 Regional Groundwater Hydrogeology

A summary of regional groundwater hydrogeology is presented below. Much of the regional information described in the IAS report (EEI, 1983) was obtained from the Groundwater Map of the Prudence Island and Newport Quadrangles, Rhode Island (1964). Information from both references was used in the following description of the regional groundwater hydrogeology.

Many areas on Aquidneck Island, on which most of NAVSTA Newport is located, obtain their water supply from wells. Areas relying on groundwater are mostly on the east side of Middletown, but there are wells throughout Aquidneck Island. Most groundwater wells are used for domestic needs, although small industries and businesses use some wells. Production wells were installed at Gould Island, but were not found to provide enough water for industrial processes, and a fresh water supply was extended from Newport.

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

Seasonal groundwater level fluctuations are common in the area. During the early spring the water table rises due to recharge from snowmelt and rainfall. In late spring and summer, the water table usually declines because rainfall either evaporates or is used by plants before it can reach the water table. During autumn the water table generally rises.

The unconsolidated glacial deposits range in thickness from less than 1 foot near rock exposures to about 50 feet at Aquidneck Island. This pattern is reflected at Gould Island as well. The glacial deposits consist mostly of till and outwash.

The yield of wells completed in the unconsolidated deposits varies, depending upon the type and thickness of the water-bearing deposits penetrated. Till can only yield small supplies; yields from outwash are usually much greater. Yields range from less than one to as much as 120 gallons per minute, as reported from a public supply well on Prudence Island. The upper limits of the referenced well yield are most likely for a well completed in outwash, not till. Under normal weather conditions, till wells yield a few hundred gallons of water per day and are adequate for domestic supplies. However, these wells are subject to going dry during seasonal or unusually severe droughts.

Bedrock wells in the Newport area range in depth from 14 to 1,300 feet, with an average depth of 135 feet. Yields from bedrock wells range from less than 1 to as much as 55 gallons per minute. Most bedrock wells yield less than 10 gallons per minute. The yields in the bedrock wells vary considerably over short distances because the joints and fractures that transmit water to the wells occur randomly. Joints and fractures are most numerous and widest near the top of the bedrock and become fewer and narrower with depth. Bedrock wells seldom go dry, but yields can be extremely low if not enough fractures and joints occur in the area of the well.

Chemical characteristics of the groundwater are similar throughout the area, and the water is generally satisfactory for most ordinary uses. Most groundwater in the area is soft or only moderately hard, with groundwater from till generally containing less mineral matter and being softer than groundwater from bedrock. Wells yielding water with high iron content occur throughout the area, being most numerous around Newport and Middletown and the northern part of Portsmouth.

In scattered locations near the shoreline, over-pumping has led to salt water intrusion in some wells. Bedrock wells are not as easily contaminated with salt water as wells completed in unconsolidated deposits, but the chance of contamination increases as the depth of the well below sea level increases.

The groundwater at NAVSTA Newport is very shallow, being less than 10 feet bgs in most areas. Therefore potential contaminants that may be released at the ground surface have a relatively short distance to travel before reaching the shallow groundwater table. Those pollutants that do migrate into the groundwater will migrate with groundwater flow and discharge into Narragansett Bay. Coastal sites such as exist at NAVSTA Newport are quite close to the shoreline, and the groundwater only has to migrate a short distance before discharging into Narragansett Bay.

The soils occurring at most of NAVSTA Newport have a permeability that is moderate to moderately rapid, and 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 and although it will restrict groundwater movement, it may not represent a complete barrier to the vertical migration of water. However, it is presumed that groundwater will follow a path of least resistance and this pathway in this case would be directly through less dense material to the Bay waters. There are also isolated areas where the bedrock occurs at the surface. Contamination is possible in these areas through the joints and fractures that commonly occur in the bedrock.

Information obtained from the NAVSTA Newport Installation Restoration Program indicates that the depth to groundwater ranged from approximately 4 to 28 feet below ground surface at NAVSTA Newport sites investigated prior to 1994. Slug tests conducted on monitoring wells at these sites indicated that the hydraulic conductivity of the till unit encountered above the bedrock ranged from 0.22 to 0.44 feet per day and the upper bedrock hydraulic conductivity ranged from 0.029 to 0.21 feet per day. Bedrock test data produced hydraulic conductivity values higher than those normally attributed to shale (3.28×10^{-4} to 3.28×10^{-8} feet per day (Driscoll 1987).

3.3.5 Groundwater Classifications

RIDEM has classified groundwater in Rhode Island to protect and restore the quality of the State's groundwater resources for use as drinking water and other beneficial uses, and to assure protection of the

public health and welfare, and the environment. The RIDEM Groundwater Quality Regulations were promulgated in May 1992 (Regulation 12-100-006) and amended in May 1995.

The majority of the groundwater beneath Site 17 has been classified by RIDEM as “GA”, with specific locations designated “GA-NA” (Figure 3-5). GA groundwater is deemed suitable for use as potable water. The designation of GA-NA is defined as “not attainable” and prescribed for the specific areas at Gould Island due to the presumption or presence of disposal of oil or hazardous materials. One of the GA-NA locations is positioned over the location of the former electroplating rooms in Building 32, another is positioned over the former landfill at Gould Island, south of Site 17, located on State property. The third is positioned at the location of a former weapons storage bunker on the south-east shoreline of the Island (also located on State property).

3.3.6 Site Groundwater Hydrogeology

A limited hydrogeology evaluation was conducted for this phase of the remedial investigation. Based on the initial field information gathered during the field investigations, significant levels of contaminants were not found that would merit detailed hydrogeological evaluations. Additional hydrogeological evaluations can be conducted if groundwater contaminants or conditions are identified that merit further investigation.

The subsections below describe the packer testing bedrock wells installed and conducting long term head monitoring to determine tidal fluctuations of the on site groundwater monitoring wells.

3.3.6.1 Site Hydrogeology Overview

Initial evaluations of the geological conditions at the site noted a thick, dense layer of till that overlies weathered phyllite bedrock over the northern portion of the site. In the southern portion of the site, bedrock is relatively shallow, a result of cut and fill operations conducted during construction of Building 32. Across the site, a layer of fill, consisting of silty sand and gravel is present, likely reworked soils placed approximately 8 feet thick for the purpose of construction of the facilities there (refer to Section 3.2, above). Based on the evaluation of these materials and descriptions provided in the boring logs (Appendix D1), contaminants released to the ground surface that were not captured by the storm drainage system would likely pass through the fill, and either pool on top of the till or pass over the till with groundwater flow and discharge to the Bay.

The presence of the Bay on three sides of the site and the topography of the ground surface, bedrock, that of the land prior to development (Figure 1-4) indicates that shallow groundwater will flow east, north, or west and discharge to Narragansett Bay. The presence and thickness of till, while it may not provide a complete barrier

to water or chemicals, will discourage flow of water from the shallow overburden (fill unit) into the till unit, and following a path of least resistance, will flow to the nearest shoreline for discharge.

Finally, it should be noted that because most of the site was paved until 2001, there is likely to have been little infiltration of water from the ground surface from precipitation. Some minor groundwater flow is likely to occur from the south, although this water would also have been likely to drain to east and west shorelines as well, and only a small amount of water would be transported to the site from the south.

3.3.6.2 Packer Testing

Packer testing was conducted in three monitoring wells (MW-300B, MW-304B, and MW-305B) in order to identify any water bearing zones in the cored sections of bedrock.

The results for the packer test performed in monitoring well MW-300B indicate the four intervals tested had negligible infiltration rates at pressures ranging from 5 to 20-pounds per square inch (psi). The tested intervals were: 54 to 63 feet; 57 to 67 feet; 67 to 77 feet; and 77 to 84 feet bgs.

The results for the packer tests performed in monitoring well MW-304B indicated that the upper interval, from 103 to 113-feet bgs depth interval yielded an average hydraulic conductivity of $2.0X10^{-5}$ cm/sec. A second tested interval from 113 to 120 feet bgs yielded negligible infiltration rates at pressures ranging from 5 to 20-psi.

The results for the packer test performed in monitoring well MW-305B indicated that one interval, from 64 to 74 feet bgs yielded an average hydraulic conductivity of $2.5X10^{-5}$ cm/sec. A second interval, from 72 to 82 feet bgs yielded an average hydraulic conductivity of $2.1X10^{-5}$ cm/sec. The third interval, from 84 to 95 feet bgs yielded an average hydraulic conductivity of $3.1x10^{-5}$ cm/sec.

Section 2.2.1 describes the packer testing operation.

3.3.6.3 Groundwater Contouring

A partial round of groundwater level measurements was conducted on August 30, 2005. Table 3-1 presents the depth to groundwater measurements collected and the associated groundwater elevations (in feet, Navy Mean Low Water), as noted in Appendix D. These measurements were used to develop groundwater contour maps, which provide an indication of likely groundwater flow patterns. Figure 3-6A presents overburden groundwater contours, and Figure 3-6B presents bedrock groundwater contours based on these elevation measurements.

In the southern portion of the site, groundwater contours are limited by the number of wells available in this area. The contours clearly show that water levels are highest in the area of co-located wells MW301S/MW301B to the south, and generally follow the existing topography of the site. The ground surface at the southwest corner of Building 32 tends to accumulate water, likely due to groundwater outbreak from the hillside to the south and west. It is also likely that this is the reason for the trench drain installed in this area and found in test pits 10 through 13 (Section 2.5 of this report). Over time, the gravel around these drains tends to become blocked with silt, preventing flow of the groundwater or surface water into those drains. This would result in ponding of water in this area, as was observed during field investigations in 2005.

In upland areas of higher elevations at the center of the Island (MW-302, MW-301), bedrock groundwater elevations were lower than those measured in the associated overburden wells, which indicates a downward vertical flow of groundwater, from overburden to bedrock. At lower elevations, closer to the edge of the Island (MW-304), the bedrock groundwater elevations were higher than those measured in the associated overburden well, which indicates an upward vertical flow of groundwater from the bedrock to the overburden. However, it should be noted that the overburden wells are all screened in the shallow overburden, and not deep within the till. The actual exchange of groundwater between shallow overburden and bedrock is likely to be hindered and even deflected by the presence of the till, directing that discharge water to the surrounding ocean.

3.3.6.4 Tidal Influence on Groundwater

Groundwater monitoring wells at the site were fitted with temporary transducers to measure head during the period of September 2 to 9, 2005. During the same period, a transducer was installed at the pier piling near Building 35 to measure tidal effects on groundwater fluctuation. These measurements were to be used to determine tidal fluctuation in the groundwater during this period, and to evaluate the lag time between tidal cycles and the corresponding rise and fall of the water table in the wells.

The transducer installed at the dock, intended to measure actual tidal fluctuation failed, and data was not obtained from this device. In addition, the transducer installed in well MW-306B initially gave erratic readings and was re-started. The readings from the second start were initially acceptable, but became erratic after five tidal cycles. However, the transducers installed in the other monitoring wells recorded water levels for the period evaluated. Head measurements were graphed to determine tidal fluctuations.

Groundwater fluctuations likely associated with tide were noted in all wells, overburden and bedrock, with the exception of MW-301S and MW-305S. Fluctuations in the overburden wells were between 1.4 feet (MW-304S) and 0.2 feet (MW-300S). The overburden wells where the greatest fluctuation occurred were those located closest to the water. Wells MW-305S, located at the center of the site, and MW-301S, located upgradient and to the south of the site, were not affected by tidal fluctuations. An overall downward trend of

overburden groundwater levels were noted in all the overburden wells, likely evidence of recent rain event prior to the test period.

Groundwater level fluctuations associated with tide were clearly evident in all the tested bedrock wells. All the bedrock wells with the exception of MW-301B showed a fluctuation of more than 0.5 feet, and several wells showed fluctuations of more than 1.0 foot.

These tests clearly show that the bedrock aquifer underlying the site, and under the standing water of the Bay, is influenced by tide, and therefore is hydraulically connected to the waters of Narragansett Bay. In addition, the site overburden wells located close to the shoreline of the Bay are similarly influenced by tidal fluctuations, and are therefore also hydraulically connected to the waters of the Bay.

3.3.7 Area Water Use

During the Navy's previous use of the island, a series of four groundwater wells were installed at Gould island, reportedly all over 200 feet in depth. These wells could not produce adequate water supply for the industrial processes conducted at the site, and a mixture of saltwater and water piped from Aquidneck Island, presumably from the available municipal water supply, was eventually used. Plumbing drawings show the use of salt water in fire suppression systems, and separate freshwater lines for other systems (Appendix C).

Public water in the City of Newport and Town of Middletown is supplied and managed by the Newport Water Department. The Town of Portsmouth purchases water from the Newport Water Department but operates its own distribution system. Approximately two thirds of Portsmouth is serviced by public water, with the remaining one third supplied water from private water wells. While no specific records exist as to private well use in the information reviewed, in general, the majority of private wells are reportedly located on the eastern portion of Aquidneck Island, primarily in Middletown (Personal Communication, Town of Portsmouth, 1992; Quinlan, 1997).

The Newport Water Department receives its water supply from a series of seven surface water reservoirs located on Aquidneck Island and two surface water reservoirs (Tiverton and Fall River) on the mainland. The seven surface water reservoirs on Aquidneck Island are Lawton Valley Reservoir; St. Marys Pond; Sisson Pond; Easton North Pond; Easton South Pond; Paradise or Nelsons Pond; and Gardners Pond.

Each of these reservoirs is supplied water via rainfall and runoff, and is not augmented by groundwater supply wells. The Newport Water Department stated that the safe yield of the reservoir system is approximately 11 to 13 million gallons per day (mgd). Water use in 1991 was 7.07 mgd, and adequate capacity reportedly exists for projected water usage on Aquidneck Island for the next 10 to 20 years or more (Personal Communication,

Newport Water Department, 1992). The Lawton Valley, Sisson Pond, St. Marys Pond, and Easton North Pond surface water reservoirs are in within 3 miles of the northern boundaries of NAVSTA Newport.

Locations of active public and private groundwater supply wells were not sought for this study, as the site is remote to the Newport-Middletown areas to the east and to Jamestown (Conanicut Island) to the west.

3.4 LAND USE

The site is located on the north portion of Gould Island, and occupies approximately 6 acres. This is a former industrial property, currently not in use. Building 32 contained an electroplating shop, machine shops, degreasing shops, grinding and buffing shops, and other workshops used for torpedo service and maintenance during and after the Second World War. In 2001 and 2002, the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place.

Currently the site remains vacant. The Navy patrols the area, which is also reportedly posted to keep off government property. However, there is evidence that the property is occasionally visited by trespassing fishermen. The site is only accessible by boat, the nearest land mass being Jamestown (Conanicut Island), 1600 yards (approximately ¾ mile) to the west. Newport and Middletown lie approximately 1 mile to the east. The Navy reports that they will continue to hold this property for the foreseeable future for possible industrial or military use. Thus, likely future use is limited to trespassers, industrial workers, and construction workers. Other potential future uses of the site include use by recreational visitors. There is no foreseeable future residential use at Gould Island due to its location and lack of adequate fresh water supply.

The remainder of the Island property is held by the State of Rhode Island is a State Wildlife Management Area. Some buildings are still present, and others have deteriorated to the point of collapse. Having not been maintained for many years, invasive vegetation in this area is so dense that it likely discourages recreational access. However, this area is unoccupied and is not patrolled. The beach areas are also likely to be visited by individuals and small groups traveling by boat.

3.5 SUBSURFACE UTILITIES

Subsurface utilities are present at the site from the original construction of the facilities as well as from upgrades made during operations at the site. NAVSTA Public Works Department stated that all utilities are disconnected to the Island south of the “Barge Landing” so designated on Figure 2-1.

During demolition of the above-ground structures, all above-ground utilities were removed and taken off the Island (Appendix A of this report). The subsurface utilities found during this RI included waste disposal pipelines, including clay and iron butt-end sewer drains; roof drains; roadway storm drains; as well as specific

drains from industrial processes. Remnant fire suppression systems remain underground as do phone and presumably electric lines (present in manholes) to and from former transformer buildings demolished as described in Appendix A.

A series of sewer disposal system upgrades were designed in 1957. Those that pertain to Building 32 are presented in drawings P.W.DWG 12980-136 and P.W.DWG 12963-136, presented in Appendix C. However, it is uncertain how many of these upgrades were completed, or if they were completed in accordance with the design drawings. The new (1957) waste disposal route from lavatories and the kitchen areas in Building 32 was verified during the RI activities, as described in Section 2.4 through a series of test pit excavations; however, the large septic holding tank that is shown on the design drawing was not found, and instead a smaller system appeared to be in place. Test Pit # TP-05 was excavated in the area where the holding tank was designed to be in place, however this test pit found only a small precast concrete box connected to a manhole-drywell with an outfall to the shoreline to the west (refer to Figure 2-3). This may indicate that the use of Building 32 was already declining after the design was completed, and a lower use system was actually installed, as shown in field records for Test Pit TP- 05. It may also indicate that the system was altered a second time at some unknown date. The manhole MH01, located at the entrance to the southern lavatory of Building 32 does not appear in the sewer improvements design drawings (P.W.DWG 12980-136), indicating that other changes were done either “as built” or at a later time.

Storm drains were designed to flow directly to the Bay, as shown on design drawing P.W.DWG 7612-83, in Appendix C. This drawing shows a “trench drain” which appears to collect road runoff as well as groundwater discharge from the hillside located to the south of the southwest corner of Building 32, and route that water to the Bay. The outfall pipe from this drain appears to be present in the aerial photo dated February 9, 1943. During the RI field activities, the outfall from this pipe was not found, but the shoreline where it is shown on historic photos has deteriorated severely, and all shoreline structures have are gone. However, this is the location where sediment sample station SD-304F was collected. The trench drain was investigated as described in Section 2. 4, sediment samples were collected as described in Section 2.7.

Overall, underground utilities are still present, at the site and foundations are likely intact, although much damage to road and street drains has likely occurred during previous demolition of the concrete roadways. Demolition or backfill of the manholes will eventually be required as they will deteriorate over time. As noted above, manholes present at the site are those that were installed for the purposes of locating high voltage lines and phone lines through underground conduit. Also present at the site are manholes that were access points to sewer system upgrades, routing and discharging stormwater and sewer water that were constructed approximately in the late 1950s. The road and street drains directing storm water to the Bay were found to be clay or ceramic 8 to 10 inches or less inside-diameter, and therefore pose less of a physical hazard as they deteriorate.

4.0 NATURE AND EXTENT OF CONTAMINATION

This section of the report presents a discussion of the nature and extent of contamination based on the results of samples collected from groundwater, soil, sediment and biological tissue (biota) during the investigations described in Section 2.0.

Samples collected were analyzed in accordance with the Final RI work plan. Chemical classes evaluated included volatile organic compounds (VOCs) using EPA method SW-846-8260B), semivolatile organic compounds (SVOCs) using EPA method SW-846-8270C, pesticides/polychlorinated biphenyls (PCBs) using EPA methods SW-846-8081A/8082, petroleum hydrocarbons (see below), target analyte list metals using EPA methods SW-846-6020/6010B/7471A/7470A, and cyanide using EPA method SW-846-9012A. In addition, different media were analyzed for other parameters as described below:

- Sediment samples were analyzed for acid volatile sulfides with simultaneously extractable metals (AVS/SEM) using the Allen and Fu method, total organic carbon (TOC) using the Lloyd Kahn method, percent moisture ASTM-D422, and grain size distribution (ASTM 422-63) .

- Biota samples were analyzed for lipid content using solvent extraction and gravimetric procedures Biota samples were not analyzed for VOCs as they would most likely be lost in the processing of tissues for analysis.

- Groundwater samples were analyzed for alkalinity (EPA method 310.1) and sulfides (EPA method 376.1).

All samples were analyzed for SVOC in full scan mode. In addition, the samples were analyzed for SVOC by selective ion monitoring (SIM) for a sub-set of the target compounds. The SIM analysis provides lower detection/reporting limits. Since two results were obtained for this subset of target compounds, one result was selected to best meet the project action limits. If both results were non-detected the non-detected result with the lower detection limit obtained by the SIM analysis was reported. If the results were positive, the result from the SIM analysis was reported except when the result exceeded the SIM calibration range, or was rejected during data validation. In these cases the results from the full scan analysis were reported.

Petroleum hydrocarbons were analyzed using a GC/FID method (EPA Method 8015B) modified for quantification of extractable petroleum hydrocarbons in the C-9 to C-36 range. These results were reported as diesel range organics (DRO). In addition, gasoline range organic compounds (GRO) were analyzed in most samples for which VOCs were analyzed. The GRO analysis includes petroleum hydrocarbons in the C-5

to C-12 range. Both DRO and GRO results are discussed in the text of this section as petroleum hydrocarbons.

Tables of all the chemical analytical data collected as described in this section are provided in Appendix F-1 through F-4 of this report.

All the sample data were validated according to established US EPA Region I data validation guidelines. A Tier II data validation was performed on the VOC, SVOC, pesticide/PCB, GRO/DRO, TAL metals AVS/SEM and cyanide analyses. Tier II validation included evaluation of the following parameters:

- Data Completeness
- Preservation and Technical Holding Times
- GC/MS Instrument Performance Check (Tuning) (VOC, SVOC)
- Initial and Continuing Calibrations
- Blanks
- Surrogate Standards (organics)
- Internal Standards (VOCs, SVOCs)
- Laboratory Control Sample/Laboratory Control Sample Duplicate
- Field Duplicates
- Matrix Spike/Matrix Spike Duplicates
- ICP interferences (metals)
- ICP dilution analyses (metals)
- Target Compound Identification
- Compound Quantitation and Reported Quantitation Limits
- System Performance

Based on this validation process, several analytical results were qualified due to limitations inherent to sample matrix interferences or to field and or laboratory problems. Sample results qualified with a “J” are considered approximate because of limitations identified during data validation. The qualifier “EB” denotes that possible field contamination detected in the rinsate blank may have affected the sample result. Positive results for samples qualified “EB” may be biased high or be a false positive. Results for some analytes were rejected, either due to results not meeting QC limits in the matrix spike and matrix spike duplicate analysis, or due to percent difference above criteria between the two quantitation columns used for the pesticide PCB analyses. Analytical results that are rejected are reported with the value reported by the laboratory, but with an “R” qualifier. These values are reported in the data tables in the appendix but are not used in statistical summaries or detailed data analysis.

A Tier I validation was conducted on TOC, grain size distribution, alkalinity and sulfides analyses. The Tier I validation was limited to evaluation of the data completeness only.

In general, data were acceptable for use as in this RI. Qualifications on the reported data are documented in the data validation memoranda for each data package provided by the analytical laboratory. Data validation memoranda are presented in Appendix F-7.

The discussions in this section contain summaries of analytical results along with comparisons of detected contaminant levels to applicable standards, and/or background concentrations. Comparison criteria were selected as described in the work plan, and based on available upgradient samples. Soil samples from site stations were compared against upgradient soil samples, groundwater samples from the site stations were compared against the two groundwater wells installed upgradient of the site. Sediment sample results were compared with data from reference stations at Jamestown. These reference samples were recently collected and analyzed using similar methods as part of monitoring work conducted at Derecktor Shipyard and McAllister Landfill (2004). A presentation of the reference data used in this section is presented in Appendix F-5.

Data discussions in this section focus on the maximum concentrations of chemical constituents detected. Concentrations of chemical constituents detected compared as described above are presented in summary tables in this section, pertinent to each environmental media. Analytical results for field duplicate samples were averaged with the original sample results. Sample stations where this calculation was performed are identified with the suffix “-AVG”. For field duplicate results where an analyte was detected in one of the duplicate pair but not the other, one-half the detection limit reported was used to represent the undetected concentration.

Separate sections discuss the following media:

- Surface soil,
- subsurface soil from borings,
- subsurface soil from test pits,
- groundwater from monitoring wells,
- aqueous samples collected from test pits, manholes and sumps,
- sludge samples collected from sumps,
- samples collected from concrete,
- samples collected from intertidal and subtidal sediment, and
- biological tissue samples (mussels and clams).

Aqueous samples from test pits and from manholes were separated from groundwater samples collected from monitoring wells in this section. This separation is made because groundwater samples collected from wells are compared with drinking water criteria. Groundwater wells are designed and installed to reflect a drinking water supply well, and as such groundwater taken from those wells is considered to be comparable to those criteria. Water that accumulates in test excavations or is present in a manhole or septic vault is not comparable to those criteria because results are influenced by suspended solids, colloids and other interferences. These aqueous samples therefore constitute their own media and should not be held to the same standard as would groundwater taken from natural formations and available for use in accordance with GA standards set by RIDEM.

4.1 SOIL ASSESSMENT

This section presents the nature and extent of contamination in soil at the site based on samples collected as part of the RI activities, as described in Section 2 of this report. Soils data collected are presented based on the type of sample collected. Discussions and data tables present detected contaminants in soil as follows: Surface soils (Table 4-1A), subsurface soils from borings (Table 4-1B), and subsurface soil samples collected from test pits (Table 4-1C). These data were compared with data from soil samples collected from upgradient stations (Table 4-1D). In addition, soil and sludge samples collected from manholes are discussed in this section (Table 4-1E).

Summary statistics are provided in Appendix F-1 of this report, in tables corresponding to the Section 4 tables (cited above). In addition, a complete presentation of all the soil data collected in this RI (including non-detected results) is presented in Appendix F-1. Data validation memoranda are presented in Appendix F-8.

4.1.1 Results from Surface Soil Samples Collected

The results from surface soil samples collected during the investigation are discussed in this section. The locations of the soil borings where surface soils were collected are depicted on Figure 2-1. Contaminant-specific concentrations are compared to RIDEM residential and Industrial/Commercial Direct Exposure Criteria as well as upgradient levels are presented in Table 4-1A. Average concentrations of detected analytes in the upgradient soil samples were calculated and are presented in Table 4-1D. Surface soil analytical results exceeding criteria are presented on Figure 4-1A. Summary statistics for these detected contaminants are presented in Appendix F-1.

Eighteen surface soil samples were collected from a depth of 0 to 2 feet bgs at 18 soil boring locations. Six of the locations were in sumps within the building foundation (SB313, SB315, SB317, SB318, SB334, and

SB335). Three of the locations were beneath the concrete slab of the building foundation (SB311, SB312, and SB327). The remaining nine locations were along the perimeter of the Building 32 foundation.

4.1.1.1 VOCs

Eighteen surface soil samples were collected and analyzed for VOCs, which were detected in four of the 18 samples. The VOC levels were low, and none exceeded the RIDEM industrial/commercial or Residential Direct Exposure Criteria. The maximum concentration of any VOC detected in surface soil was 3 (or 3J) µg/Kg, reported at locations SB337 (2-butanone) and SB302B (trichloroethene). No apparent distribution pattern was noted for the VOCs in surface soils (Table 4-1A).

4.1.1.2 SVOCs

Seventeen surface soil samples were collected and analyzed for SVOCs. The surface sample from SB-317 was not analyzed for SVOCs. A number of SVOCs, primarily PAHs, phthalates, and phenols were detected in the samples collected. The RIDEM industrial/commercial direct exposure screening values were exceeded in six of the 17 samples collected. Concentrations of SVOCs exceeding the industrial/commercial values were limited to locations SB313 (East Equipment Trench Sump), SB318 (East Solvent Tank Sump), SB332 (between the Electroplating Room and Acid Storage Shed), SB334 (Equipment Trench Sump), SB335 (West Equipment Trench Sump), and SB336 (Hydro Test Tank Sump). The RIDEM direct exposure criteria for residential use soils were exceeded in three additional samples, SB302B, SB309B, and SB303B, all located on the exterior of former Building 32. Figure 4-1A shows the sample locations. Table 4-1A provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

PAHs that exceeded the RIDEM industrial/commercial criteria included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. No phthalates or phenols exceeded the RIDEM industrial/commercial criteria in the surface soil samples. The maximum SVOC concentrations were found most often in the sample from location SB313, in the East Equipment Trench Sump (Fig 4-1A).

PAHs that exceeded the RIDEM residential criteria included: acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h) anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

4.1.1.3 Pesticides/PCBs

Seventeen surface soil samples were collected and analyzed for pesticides/PCBs. Pesticides/PCBs were detected in ten of the seventeen samples collected. No pesticides/PCBs were detected at concentrations exceeding the RIDEM industrial/commercial or Residential Direct Exposure Criteria. The maximum concentrations of detected pesticides/PCBs were found at five separate locations: SB334 (Equipment Trench Sump): 4,4'-DDE (64 µg/kg), endrin (170J µg/kg), endrin ketone (270J µg/kg); SB336 (Hydro Test Tank Sump): endosulfan sulfate (46J µg/kg), methoxychlor (250J µg/kg), Aroclor-1260 (700J µg/kg; SB318: 4,4'-DDT (27J µg/kg), endrin aldehyde (16J µg/kg); SB302B: alpha-chlordane (2.1J µg/kg); and SB303B: beta-BHC (3.1J µg/kg).

4.1.1.4 Petroleum Hydrocarbons

Seventeen surface soil samples were analyzed for Petroleum Hydrocarbons. Petroleum hydrocarbons were detected in 15 of the samples. Extractable petroleum hydrocarbons, reported as diesel range organics were detected at a concentration exceeding the RIDEM industrial/commercial criterion at three locations: SB313 (East Equipment Trench Sump), SB334 (Equipment Trench Sump), and SB336 (Hydro Test Tank Sump, Figure 4-1A). The maximum concentration detected was 14,000J mg/kg at location SB313. Petroleum hydrocarbons were detected at a concentration exceeding the residential criterion at five locations: SB313, SB318, SB334, SB335, and SB336. Gasoline Range Organics were not detected in any of the surface soil samples.

4.1.1.5 Metals and Cyanide

Eighteen surface soil samples were collected and analyzed for metals. Cyanide and a number of metals were detected, including those associated with electroplating: cadmium, chromium, copper, lead, nickel, and zinc. The RIDEM industrial/commercial direct exposure screening value for one metal (lead) was exceeded at one location (SB334, Equipment Trench Sump, Figure 4-1A). Table 4-1A provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

The maximum concentrations of cyanide and metals associated with electroplating operations were found at five locations: SB303B (along the southeast wall of Building 32): chromium (26.5 mg/kg); SB334 (Equipment Trench Sump): lead (750J mg/kg), nickel (22.4J mg/kg); SB336 (Hydro Test Tank): cadmium (7.6J mg/kg), zinc (213 mg/kg); and SB337 (between the Electroplating Room and Building 57): cyanide (0.12 mg/kg). Metals that exceeded the RIDEM residential criteria included beryllium, lead, and manganese. Concentrations of metals exceeding the RIDEM residential direct exposure screening values were limited to locations SB303B, SB313, SB318, SB334, and SB336.

4.1.1.6 Summary

Surface soil samples were collected from 0 to 2 feet bgs at 18 locations. The following contaminants were detected in the surface soils at concentrations which exceeded industrial/commercial and/or residential criteria:

- PAHs (14 compounds)
- TPH, reported as Diesel-Range organics
- Beryllium
- Lead
- Manganese

Industrial criteria were exceeded at six locations. Five of these six locations are sumps or equipment trenches fitted within the former Building 32 foundation. Residential criteria were exceeded at nine locations. No VOCs or pesticides/PCBs were detected in the surface soil samples at concentrations exceeding the residential or industrial criteria.

Most of the detected SVOCs were found at their maximum concentration in the sample from the East Equipment Trench. The highest petroleum hydrocarbon concentrations were found in samples from the East Equipment Trench, the West Equipment Trench, and the Hydro Test Tank (Figure 4-1A). The maximum concentrations of metals associated with electroplating operations (cadmium, copper, chromium, lead, nickel, zinc, and cyanide) were found in samples from along the southeast wall of Building 32, in the Equipment Trench, the Hydro Test Tank, and between the Electroplating Room and Building 57.

4.1.2 Results from Subsurface Soil Samples Collected from Soil Borings

The results from subsurface soil samples collected from soil borings during the investigation are discussed in this section. The location of the soil borings are depicted on Figure 2-1. Contaminant-specific comparisons of detected subsurface concentrations to both residential and industrial Direct Exposure Criteria as well as upgradient levels are presented in Table 4-1B. Average concentrations of detected analytes in the upgradient soil samples were calculated and are presented in Table 4-1D. Soil boring analytical results exceeding criteria are presented on Figure 4-1B. Summary statistics for these detected contaminants are presented in Appendix F-1.

Fifty-one subsurface soil samples were collected from 34 soil boring locations. Sample depths ranged from 2 to 54 feet bgs. Forty of the samples were collected at depths ranging from 2 to 12 feet bgs. Eleven samples were collected at depths ranging from 12 to 54 feet bgs.

4.1.2.1 VOCs

Fifty-one subsurface soil samples from soil borings were collected and analyzed for VOCs. VOCs were detected in 20 of the 51 samples collected. No VOCs were detected at concentrations exceeding the RIDEM Industrial/Commercial Direct Exposure Criteria. The maximum concentrations of detected VOCs were found at seven separate locations: SB303B: methylene chloride (5B µg/kg); SB304B: isopropylbenzene (68J µg/kg), methyl acetate (2J µg/kg); SB306B: carbon disulfide (4 µg/kg); SB314: cis-1,2-dichloroethene (3J µg/kg); SB322: trans-1,2-dichloroethene (1J µg/kg), trichloroethene (59 µg/kg); SB324: m+p-xylenes (9J µg/kg), toluene (16J µg/kg), total xylenes (13J µg/kg); and SB333: benzene (3 µg/kg), ethylbenzene (4 µg/kg). These results are supported by PID readings and "solvent odor" at same depth (4 to 6 feet)

4.1.2.2 SVOCs

Forty-seven subsurface soil boring samples were collected and analyzed for SVOCs. A number of SVOCs, primarily PAHs, phthalates, and phenols were detected. The RIDEM industrial/commercial direct exposure screening values were exceeded in three of the 47 samples collected. Concentrations of SVOCs exceeding the industrial/commercial values were limited to locations SB306B (adjacent to former fuel USTs), SB333 (Sand Blasting Booth), and SB336 (Hydro Test Tank, Figure 4-1B). Table 4-1B provides contaminants detected in samples collected.

PAHs that exceeded the RIDEM industrial/commercial criteria included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. No phthalates or phenols exceeded the RIDEM industrial/commercial criteria. The maximum SVOC concentrations were found most often in the sample from 10 to 12 feet bgs at location SB306B and the sample from 4 to 6 feet bgs at location SB333.

PAHs that exceeded the RIDEM residential criteria included: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. Locations where SVOCs exceeded the RIDEM residential direct exposure screening values were limited to locations SB306B, SB317, SB318, SB333, and SB336 (Figure 4-1B). Some field observations were noted for two of these locations (Table 2-2).

4.1.2.3 Pesticides/PCBs

Forty-seven subsurface soil boring samples were collected and analyzed for pesticides/PCBs. Pesticides/PCBs were detected in nine of the 47 samples collected. No pesticides/PCBs were detected at concentrations exceeding the RIDEM industrial/commercial or Residential Direct Exposure Criteria. The

maximum concentrations of detected pesticides/PCBs were found at five separate locations: SB306B (adjacent to former fuel USTs): Aroclor-1254 (460J µg/kg), endosulfan sulfate (140E µg/kg), endrin aldehyde (16 µg/kg); SB318 (East Solvent Tank Sump): 4,4'-DDE (5.175J µg/kg), endosulfan I (2.875 µg/kg), endrin (7.925J µg/kg); SB320 (along drain line from Solvent Tanks): methoxychlor (67J µg/kg); SB322: alpha-chlordane (2.5J µg/kg); SB333 (Sand Blasting Booth): 4,4'-DDT (30 µg/kg), endrin ketone (31J µg/kg).

4.1.2.4 Petroleum Hydrocarbons

Fifty-one subsurface soil boring samples were collected and analyzed for Petroleum Hydrocarbons. Petroleum hydrocarbons were detected in 14 of 51 samples collected. No RIDEM industrial/commercial criteria were exceeded for petroleum hydrocarbons. Extractable petroleum hydrocarbons, reported as diesel range organics, were detected at a concentration exceeding the residential criterion in only one sample. This result was reported at 1,300 mg/kg in the sample collected from 10 to 12 feet bgs at SB306B (adjacent to former fuel USTs, Fig 4-1B). Gasoline Range Organics were detected in one sample. This result was reported at 140 J mg/kg in the sample collected from 6 to 8 feet bgs at SB304B (near the northwest corner of Building 32). This sample also showed a fuel odor and elevated PID reading during sampling (Table 2-2).

4.1.2.5 Metals and Cyanide

Forty-eight samples were collected and analyzed for metals from the subsurface soil. Cyanide and a number of metals were detected, including those associated with electroplating: cadmium, chromium, copper, lead, nickel, and zinc. The RIDEM industrial/commercial direct exposure screening values were exceeded in three of the 48 samples collected. Concentrations of metals exceeding the industrial/commercial values were limited to locations SB323 (Electroplating Room), SB332 (between the Electroplating Room and Acid Storage Shed), and SB333 (Sand Blasting Booth, Figure 4-1B). Table 4-1B provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

Arsenic was the only metal that exceeded the RIDEM industrial/commercial criteria. The maximum concentrations of metals associated with electroplating operations were found in the sample collected from 4 to 6 feet bgs at SB333. The maximum concentration of cyanide was found in the sample collected from 4 to 6 feet bgs at SB319 (along the drain line from the Sand Blasting Booth).

Metals that exceeded the RIDEM residential criteria included arsenic, beryllium, cadmium, lead, and manganese. These samples were collected at locations SB320, SB323, SB332, and SB333.

4.1.2.6 Summary of Subsurface Soil Data from Soil Borings

Fifty-one subsurface soil samples were collected from 34 borings, at depths ranging from 2 to 54 feet bgs. The following constituents were detected in the subsurface soils at concentrations which exceeded RIDEM industrial/commercial and/or Residential Direct Exposure Criteria:

- PAHs (14 compounds)
- TPH, Reported as Diesel-Range Organics
- Antimony
- Arsenic
- Beryllium
- Cadmium
- Lead
- Manganese

Industrial/commercial criteria were exceeded at five locations, at depths to 12 feet bgs. Residential criteria were exceeded at nine locations, at depths to 17 feet bgs. No VOCs or Pesticides/PCBs were detected in the subsurface soil samples at concentrations exceeding the residential or industrial criteria.

Trichloroethene was detected in eleven samples at nine locations. These locations do not show a clear concentration gradient or distribution pattern, but show evidence of use in the electroplating room and at the northwest corner of Building 32. Isopropylbenzene was found northwest of the northwest corner of Building 32.

The maximum SVOC concentrations were found most often in samples from SB306B (adjacent to the former fuel USTs, 10 to 12 feet bgs) and SB333 (in the sump under the former sand blasting booth, 4 to 6 feet bgs). The highest petroleum hydrocarbon concentration was also found in the sample from 10 to 12 feet bgs at location SB306B (adjacent to the former fuel USTs). Metals associated with electroplating operations (cadmium, copper, chromium, lead, nickel, zinc) were found at their maximum concentration in the sample collected from 4 to 6 feet bgs at SB333, within the sump under the former Sand Blasting Booth. Cyanide was found at its maximum concentration in the sample from 4 to 6 feet bgs at SB319 (along the drain line from the Sand Blasting Booth).

4.1.3 Results for the Soil Samples Collected from Test Pits

The analytical results for the soil samples collected from test pits during the investigation are discussed in this section. The locations of the test pits excavated are depicted on Figure 2-2. Test pit soil analytical results that exceed RIDEM direct exposure criteria are presented in Figure 4-1C.

Chemical constituent concentrations were compared to the RIDEM Direct Exposure Criteria established for residential and industrial use, and upgradient levels obtained from soil boring SB-301B. Contaminant-specific comparisons of detected test pit soil concentrations to both residential and industrial Direct Exposure Criteria, and to upgradient levels are presented in Table 4-1C. A summary of the analytical results for upgradient soil samples are presented in Table 4-1D. Summary statistics are presented in Appendix F, Table F-1C.

The majority of the test pit locations were selected in areas with known or suspected waste or discharge points, which is consistent with the analytical results. Test pits TP-01 through TP-04 were excavated to intercept waste discharge pipes from former site operations. Test pit TP-05 was excavated to explore a sanitary waste discharge system, which was suspected to be connected to manhole MH-01. This manhole contained high levels of petroleum (Section 4.1.4). Test pits TP-06 through TP-13 were excavated at the southwest corner of Building 32. Part of this area was previously found to be impacted by petroleum (Appendix A).

4.1.3.1 VOCs

Nineteen samples were collected and analyzed for VOCs from the test pits. Twenty-one VOCs were detected in 13 of those samples. The RIDEM residential and Industrial/Commercial Direct Exposure Criteria for VOCs were not exceeded in any of the samples collected. Table 4-1C provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

The soil sample collected from the subsurface upgradient sample location did not contain detectable concentrations of VOCs, and therefore detected concentrations could not be compared to reference concentrations.

In all, 21 VOCs were detected in soil samples collected from the test pits. In general, the highest concentrations were detected in TP-09, which was found to contain cis-1,2 dichloroethene (170J µg/kg), ethylbenzene (99J µg/kg), isopropylbenzene (400J µg/kg), methyl acetate (450J µg/kg), and methyl cyclohexane (140J µg/kg). Chlorobenzenes were detected in TP-12 at concentrations up to 3 µg/kg, and gasoline components were detected in Test pits TP-02 and TP-07, at concentrations less than 10 µg/kg. The solvent TCE was detected in TP-02 at a trace concentration (0.8 µg/kg). Field observations of potential

contamination in soil (e.g. staining, odors and/or sheen) were also noted in each of the test pits discussed above (TP-02, 07, 09, and -12) as summarized on Table 2-2.

4.1.3.2 SVOCs

Nineteen samples were collected and analyzed for SVOCs from the test pits. Twenty-six SVOCs, primarily PAHs, were detected. Phthalates and phenols were also detected in these samples. The RIDEM Industrial/Commercial Direct Exposure Criteria for five of the PAHs were exceeded in 3 of the 26 samples collected. These criteria were exceeded in samples from TP-06, TP-08 and TP-09 (Figure 4-1C). Table 4-1C provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

Most of the maximum concentrations detected were found in TP-06, located in the sump under the former sandblast booth in the electroplating room (6-feet bgs). These included PAHs (ranging from 1,800J µg/kg (acenaphthylene) to 360,000 µg/kg (phenanthrene) as well as 1,1-biphenyl (4,300 µg/kg), 4-methyl phenol (660J µg/kg) carbazole (37,000 µg/kg), and phenol (610J µg/kg).

Maximum concentrations of phthalates were found in TP-09 (2-feet bgs), located near the former dust collection building. These included bis(2-ethylhexyl)phthalate (130J µg/kg) and di-n-butyl phthalate (98J µg/kg).

The soil sample collected from the subsurface upgradient sample location did not contain detectable concentrations of SVOCs and therefore detected concentrations could not be compared to reference concentrations.

Residential Direct Exposure Criteria were exceeded in the test pits TP-06, TP-08, TP-09 and TP-13. All SVOCs that exceeded the residential criteria were limited to PAHs. These PAHs are anticipated to be associated with petroleum which was also found in this area (Section 4.1.3.4). These findings corroborate the field observations of potential contamination in soil samples (e.g. staining, odors, and/or sheen) in test pits TP-06, -08, -09, and -13 (Table 2-2).

4.1.3.3 Pesticides/PCBs

Nineteen samples were collected and analyzed for pesticides and PCBs from the test pits. PCBs were reported in 5 of these samples, and pesticides were reported in 4 of these samples. Detected contaminants included nine pesticides and three PCB (Aroclor) compounds. The Residential Direct Exposure Criteria and the Industrial Direct Exposure Criteria for pesticides and PCBs were not exceeded in any of the test pit soil samples collected. Concentrations of Pesticides and PCBs were found in TP-04, TP-05, TP-06, TP-07, TP-08

and TP-09 (Figure 4-1C). Table 4-1C provides contaminants detected in samples collected. Summary statistics for these detected contaminants are presented in Appendix F-1.

Pesticides and PCBs were not detected in the soil sample collected from the subsurface upgradient location.

Maximum concentrations of PCBs included Aroclor-1016 (40 µg/kg), Aroclor-1254 (390 µg/kg), and Aroclor-1260 (600 µg/kg) (Figure 4-1C). Aroclor 1016 was only detected at 1 location, TP-05, northwest of Building 32. Aroclor 1254 was detected at two locations, TP-06 (within the Building 32 foundation and TP-08 (outside the Building 32 foundation). Aroclor 1260 was detected in two test pits, TP-07 and TP-09, both located outside the Building 32 foundation.

Low concentrations of pesticides were detected in 4 of the test pits. Pesticides detected included 4,4'-DDD, endrin aldehyde, endrin ketone, heptachlor epoxide, methoxychlor, beta-BHC, alpha-BHC, alpha-chlordane, and endosulfan sulfate. Highest concentrations were found in Test Pit TP-06, excavated within the building foundation.

4.1.3.4 Petroleum Hydrocarbons

Petroleum hydrocarbons, detected as DRO, were detected in all test pits soil samples at concentrations between 30 mg/kg (TP-03), and 4,800 mg/kg (TP-06). Petroleum hydrocarbons detected as GRO were detected in soil samples collected from five of the 19 test pits, however, neither the Residential nor Industrial/Commercial DEC for GRO were exceeded. The highest GRO concentration observed in test pit soil samples was detected in test pit TP-10A (180 mg/kg).

The sample collected from the subsurface upgradient sample location did not contain detectable concentrations of petroleum.

Residential Direct Exposure Criteria for petroleum were exceeded in soil samples collected from the following test pits: TP-05-01, TP-05-02, TP-06, TP-09, TP-10A, and TP-10B (Figure 4-1C).

Industrial/Commercial Exposure Criteria for petroleum (DRO only) were exceeded in two soil samples collected from the following test pits: TP-06 (4,800 mg/kg) and TP-10B (3,500 mg/kg). These findings corroborate the field observations of potential contamination in soil samples (e.g. FID/PID readings, staining, odors, and/or sheen) in all test pits noted above, except TP-05 (Table 2-2).

4.1.3.5 Metals and Cyanide

Metals were detected in all soil samples collected from the test pits. The discussion below focuses on heavy metals detected, and does not discuss expected mineral content of the soils. The maximum concentration of each metal detected and the corresponding test pit is presented below:

Overall, the metals detected in the upgradient soil sample were detected at higher concentrations in test pit soil samples. Antimony, cadmium, cyanide, mercury, selenium, silver, and thallium were not detected in the upgradient soil sample. Cyanide, selenium, silver, and thallium were also not detected in any of the test pit soil samples. Mercury was detected in two test pit soil samples.

Metal concentrations that exceeded the Residential Direct Exposure Criteria were found in Test Pits TP-06 arsenic, cadmium, and lead, and in TP-09 antimony, arsenic, cadmium, and lead. Metal concentrations that exceeded the Industrial Direct Exposure Criteria were limited to arsenic, cadmium and lead (Figure 4-1C).

The highest concentrations of heavy metals detected were found in Test Pit TP-09 at a depth of 2-feet bgs: these included antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, vanadium, and zinc. Most notable were the concentrations of cadmium (5,670J mg/kg), and lead (2,700J mg/kg) detected in TP-09 at 2 feet below ground surface. This test pit was excavated around the sand blast dust collection structure, noted on Figure 4-1C as Building 57.

4.1.3.6 Summary of Soil Data from Test Pit Samples

An evaluation of the soil analytical results obtained from test pit samples indicate presence of the following constituents above RIDEM criteria:

- PAHs (14 compounds)
- TPH, Reported as Diesel-Range organics
- Antimony
- Arsenic
- Beryllium
- Cadmium
- Lead
- Manganese

Cyanide was not detected in soils collected from test pits.

VOC concentrations were detected in test pit samples whereas they were not detected in upgradient soil boring samples. However, neither the Residential nor Industrial Direct Exposure Criteria was exceeded in any of the test pit soil samples submitted for VOC analysis. Test pit TP-09 had the highest VOC concentrations detected.

SVOCs (PAHs) were found to be present at several soil sample locations and in sumps and vaults within the Building 32 foundation at levels exceeding the RIDEM Direct Exposure Criteria for residential and industrial/commercial use. Test pits TP-06 and TP-08 had the highest SVOC (PAHs) concentrations. The presence of elevated levels of PAHs, which are fuel components, in test pits TP-06, TP-08, and TP-09 are consistent with field observations of likely residual petroleum in these excavations (Table 2-2).

Pesticides and PCBs were detected at elevated concentrations in test pit samples whereas these constituents were not detected in upgradient samples. The highest concentrations were noted in test pit TP-06. Neither the Residential nor Industrial/Commercial Direct Exposure Criteria were exceeded in any of the test pit soil samples submitted for pesticides or PCB analysis.

Petroleum hydrocarbons, as DRO, were detected in all test pits soil samples, with a maximum concentration detected of 4,800 mg/kg (TP-06). Two locations, TP-06 and TP-10B, exceeded the Industrial/Commercial Direct Exposure Criteria for DRO.

Metals were present in the test pit soil samples and within sumps and vaults at concentrations exceeding the Direct Exposure Criteria for residential and industrial use. Overall test pit TP-09 had the highest metal concentrations, including lead at 2,700 mg/kg and cadmium at 5,670 mg/kg. Cyanide was not detected in any test pit soil samples collected during the investigation.

The presence of maximum concentrations of heavy metals in test pits TP-06 and TP-09, such as arsenic, cadmium, chromium, lead, and copper, are possibly a result of sandblasting, dust storage, or electroplating chemical storage or disposal in these areas.

Test pit TP-06 was excavated in the sump underneath the sandblasting booth that was filled in with soil and debris, and is not representative of site soils. The sump was observed to have concrete walls and bottom and the material within consisted of fill, stone, metal parts and building rubble. Test pit TP-08 was excavated to investigate the former transformer area (Building 56), and test pit TP-09 was excavated along the edge of the foundation of the former Dust Collection Shed Area. Test pits TP-06, TP-09, TP-10, and TP-11 appeared to be impacted by petroleum. Other test pits TP-07, TP-12, and TP-13, located downgradient, were less impacted, but traces of petroleum were also present.

4.1.4 Results from Soil and Sludge Samples Collected from Manholes

The analytical results for the soil and sludge samples collected from manholes during the investigation are discussed in this section. The locations of the manholes are depicted on Figure 2-2. Data from sludge samples are provided on Table 4-1E.

Soil samples were collected from two manholes during the investigation. A soil/sludge sample was collected from the bottom of manhole MH-01 and a soil sample was collected from the bottom of manhole MH-05. Manhole MH-01 appears to have functioned as a sewage interceptor sump for the toilet drains located near the electroplating operations area and as a drain for the sump in the Sand Blasting Room. Manhole MH-05 was discovered during the excavation of the septic system area (test pit TP-05) and is suspected to be associated with this system. Because there were only two soil samples collected from the manholes, these samples are discussed individually in this section.

Contaminant concentrations found in soil and sludge samples collected from within manholes were not compared with RIDEM criteria or background soil concentrations. Because these samples were collected from within waste systems, they are presumed to be waste products and thus not comparable to soil criteria.

4.1.4.1 Manhole MH-01

The analytical results for the soil/sludge sample collected from manhole MH-01 are presented in this section. These results were not compared to Industrial/Commercial Direct Exposure Criteria, as they were determined to be sludge, contained within a structure, and not appropriate for a comparison against a soil criteria (exposures would not be similar to those anticipated for exposure to soil).

VOCs - Toluene, ethylbenzene, and xylene were present at low concentrations indicating the presence of fuel contamination in manhole MH-01. Cylcohexane, methylcyclohexane, and isopropylbenzene were also present at low concentrations in manhole MH-01. The presence of cyclohexane is typically an artifact of plastics, although there is a limited market for cyclohexane as a solvent, a rubber component, or an insecticide. Isopropylbenzene is a product of rubber, vinyl, or plastic materials; and methylcyclohexane is typically associated with lubricating oils and greasers, cleaners, or solvents.

SVOCs - Twenty-two SVOCs were detected in the soil/sludge sample collected from manhole MH-01. Seventeen of these were PAHs with maximum concentrations ranging from 700 µg/kg (acenaphthylene) to 38,000 µg/kg (naphthalene). PAHs are components of petroleum and their presence in manhole MH-01 was predicted by the presence of oily water and oily sludge.

In addition, bis(2-ethylhexyl)phthalate, carbazole, dibenzofuran, di-n-butyl phalate, and di-n-octyl phalate were detected in the soil/sludge sample collected from manhole MH-01. Phthalates are typically an artifact of plastics. Carbazole and dibenzofuran are compounds primarily found in coal tar.

Pesticides and PCBs - Pesticides and PCBs were detected in the soil/sludge sample collected from manhole MH-01. Pesticides detected were limited to 4,4'DDD, 4,4'-DDE, 4,4'DDT, alpha-chlordane, delta-bhc, endrin aldehyde, endrin ketone, and gamma-chlordane. Only one PCB compound was detected in this sample, Aroclor-1260. The concentration of the Aroclor 1260 was low (170 µg/kg).

Petroleum Hydrocarbons - Petroleum hydrocarbons, detected as DRO at 2,400J mg/kg, were noted in the soil/sludge sample collected from manhole MH-01. GRO was not detected in the soil/sludge sample collected from manhole MH-01.

Metals and Cyanide - Metals were detected in the soil/sludge sample collected from manhole MH-01, although their concentrations were lower than anticipated (Table 4-1E). Metals detected included cadmium, chromium, copper, lead, mercury, nickel, and zinc. The most notable concentrations were lead (1010J mg/kg and zinc (2,080J mg/kg). Other metals were detected as presented in Table 4-1E. These metals may be a result of electroplating materials or from sandblasting operations, however the concentrations are not indicative of continued release or a source. However, cyanide was detected in the soil/sludge sample collected from manhole MH-01 at 0.56 mg/kg. The presence of cyanide in the manhole does indicate that electroplating materials were released to this sump.

4.1.4.2 Manhole MH-05

The analytical results for the soil sample collected from manhole MH-05 are presented in this section.

VOCs - VOCs were not detected in the soil sample collected from manhole MH-05.

SVOCs - SVOCs were detected in the soil sample collected from manhole MH-05, most of which were PAHs ranging in concentrations from 37.5 µg/kg (2-methylnaphthalene) to 1,885J µg/kg (pyrene).

Bis(2-ethylhexyl)phthalate, carbazole, and dibenzofuran were also detected in manhole MH-05. Phthalates are typically an artifact of plastics. Carbazole and didenzofuran are compounds primarily found in coal tar. Eighteen of the twenty SVOCs detected in this sample were also found at higher concentrations in manhole MH-01. This corroborates the suspected connection between these manholes based on field observations discussed in Section 2.3.

Pesticides and PCBs – Pesticides detected at this location included 4,4'DDT, endrin aldehyde, and endrin ketone. All these compounds were also detected at higher concentrations in the soil sample collected from manhole MH-01, which also corroborates the suspected connection between these manholes that was surmised based on field observations discussed in Section 2.3.

One PCB Aroclor was detected at this location, further indicating a connection between the two manholes. Aroclor-1260 was detected, although at a low concentration (33.75 µg/kg).

Petroleum Hydrocarbons - Petroleum hydrocarbons, detected as DRO at 1,960J mg/kg, were detected in the soil sample collected from manhole MH-05. DRO was also detected at higher concentrations in manhole MH-01. GRO were not detected in the soil/sludge sample collected from manhole MH-05.

Metals and Cyanide – Heavy metals including cadmium, chromium, copper, lead, mercury, nickel, and zinc were detected in the soil sample collected from manhole MH-05, although all were detected at low concentrations. These metals were all detected at higher concentrations in the soil sample collected from manhole MH-01, which corroborates the suspected connection between these manholes based on field observations discussed in Section 2.3. Further, cyanide was detected in the soil sample collected from manhole MH-05 at very low concentrations (0.17J mg/kg).

4.1.4.3 Summary of Soil/Sludge Data from Manholes

Petroleum-related contaminants (DRO and PAHs), pesticides and PCB/Aroclor-1260, as well as other compounds which are possibly artifacts of coal tar and plastics were detected in the soil/sludge sample collected from manhole MH-01. In addition, heavy metals including cadmium, copper, chromium, nickel, and lead were detected at high concentrations in the sludge from MH-01. These organic compounds and metals were also detected at lower concentrations in the soil sample collected from manhole MH-05, which corroborates the suspected connection between these manholes based on field observations discussed in Section 2.3.

4.1.5 Background Soil Samples

Limited background samples were made available for this RI. It was recognized in the early stages of project scoping that most of the soil on the island has been reworked, altering the natural soil conditions and limiting the implementing of a "true" background soil evaluation on the island itself. However, a pair of soil borings was advanced upgradient of the site to install upgradient monitoring wells (MW-301S and 301B). During the advancement of the deeper boring, one surface soil and one subsurface soil sample were collected from the 0 to 1-foot interval and the 10 to 12-foot interval, respectively. These samples were submitted for laboratory analysis, and are considered local background samples.

Results from these local background samples are presented in Table 4-1D and in Appendix F-6A and F-6B. While summary statistics are presented in the Appendix tables, it is noted that these are a standard output from the database, but for the background soils, these statistics have little significance, since there is only one sample in each group (surface and subsurface).

The comparison of the local background sample concentrations to the RIDEM Direct Exposure Criteria in Table 4-1D shows that one contaminant in the upgradient surface soil sample was found to exceed the RIDEM criteria. The concentration of chrysene in the surface soil sample was 630 µg/kg, which exceeds the Residential Direct Exposure Criteria. For the background subsurface soil sample, no constituents exceeded the RIDEM Direct Exposure Criteria.

Constituent concentrations reported in the two local background samples were also compared to RIDEM leachability criteria, at RIDEM's request. For organics, no constituents in local background samples exceeded the leachability criteria (RIDEM, 2004). For inorganics, leaching TCLP or SPLP analysis is necessary to conduct a direct comparison. Since these analyses were not scoped under this phase of the RI, the total metals analytical results were used, applying the "Rule of Twenty" approach. The Rule of Twenty is based on the assumption that all of the metals present in the sample would be dissolved by the leaching test and then detected by that analysis. If the total concentration of the metal in question does not exceed 20x the leachability criteria, that sample cannot provide enough of that metal to exceed the criteria if the leaching test was performed. This assumption can be made because the leaching analysis uses a 20-fold dilution of the leaching extract. Using the Rule of Twenty, the metals concentrations detected in the local background soil samples could not exceed RIDEM leachability criteria, except for lead. Lead was detected in the surface soil at the background location at 84 mg/kg, and the leachability criteria is 0.04 mg/L. Using the Rule of Twenty, this sample could provide an extract of 4.2 mg/L of lead, which would exceed the criteria. However, even soil containing as little as 1 mg/kg lead could, in theory, exceed the highly conservative RIDEM leachability criteria of 0.04 mg/L, and thus application of this rule for lead is not conclusive. Regardless, since the lead concentrations in the local background soil are well below the Direct Exposure Criteria, and considering that no area of the island was unaltered by development during the 1940s, these samples are considered adequate to provide an indication of the local background conditions.

4.2 AQUEOUS SAMPLE RESULTS

This section presents the results from analysis of groundwater and other aqueous samples collected at the site. Groundwater samples were collected from monitoring wells using the "EPA Region I Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells Revision 2", dated July 30, 1996, as amended 2002. Other aqueous samples were collected from test pits and manholes, from areas where water had accumulated, using dippers and other tools as described in Section 2.3. Results from

analysis of groundwater samples from monitoring wells and those from test pits and manholes are presented in the subsections that follow.

Analytical results of contaminants detected is presented in this section for groundwater collected from monitoring wells (Table 4-2A), These data were compared with data from groundwater samples collected from upgradient wells MW-301S and MW-301B (Table 4-2B). In addition, aqueous samples collected from manholes and test pits are presented in this section (Table 4-2C and 4-2D, respectively).

Summary statistics are provided in Appendix F-2 of this report, in tables corresponding to the Section 4 tables (cited above). In addition, a complete presentation of all the groundwater data collected in this RI (including non-detected results) is presented in Appendix F-2. Data validation memoranda are presented in Appendix F-8.

4.2.1 Results from Groundwater Samples Collected from Monitoring Wells

The analytical results obtained from the groundwater samples collected from the 14 monitoring wells during the investigation are discussed in this section. Samples were collected from seven monitoring wells screened in the shallow overburden material and seven monitoring wells screened within the bedrock. The monitoring well locations are depicted on Figure 2-1. Selected groundwater sample analytical results are presented on Figure 4-2.

Groundwater contaminant concentrations were compared to the Groundwater Objectives for GA aquifers established in the RIDEM Remediation Regulations, to federal Maximum Contaminant Levels (MCLs), and to the upgradient levels obtained from monitoring wells MW-301B and MW-301S. Contaminant-specific comparisons of concentrations detected in groundwater samples are presented in Table 4-2A. A summary of analytical results obtained from upgradient monitoring wells are presented in Table 4-2B.

4.2.1.1 Volatile Organic Compounds (VOCs)

Four VOCs were detected in two of the twelve groundwater samples collected. These included: MW-300S, benzene (3J µg/L), tetrachloroethene (6J µg/L), and toluene (1J µg/L); and MW-304S, trichloroethene (1 µg/L). The tetrachloroethene concentration, detected in MW-300S exceeded the GA Groundwater Objective and MCL for this contaminant.

The VOCs detected in monitoring wells MW-300S and MW-304S exceeded upgradient levels measured at MW-301S and MW-301B.

Monitoring well MW-300S is located east of the foundation approximately 25-feet east of test pit TP-04 (Figure 2-1), and is hydraulically downgradient of Building 32. Monitoring well MW-304S is located approximately 50-feet northwest from the northwest corner of the foundation. Traces of TCE were previously detected in shallow overburden wells in the former location of Building 44 and were detected in soil gas studies conducted in this area in 2000 and prior (Appendix A).

Chloroform was detected in the upgradient bedrock well (MW-301B). Chloroform is a common artifact of laboratory analysis and its presence in the upgradient sample is not likely a reflection of the groundwater in this area.

4.2.1.2 Semivolatile Organic Compounds (SVOCs)

Fifteen SVOCs were detected in groundwater samples collected during the investigation (Table 4-2A). Of these, eight were PAHs, four were phenol compounds, one was a phthalate compound and two other compounds, carbazole and dibenzofuran. SVOCs in groundwater were limited to three of the wells sampled, MW-300B, MW-300S, and MW-306S. No SVOCs were detected in groundwater samples collected from the other wells on site.

In MW-300B, bis(2-ethylhexyl)phthalate was detected at a trace concentration (2J µg/L) other SVOCs were not detected.

PAHs were detected in MW-300S and MW-306S. The other contaminants including carbazole, dibenzofuran, and the phenolic compounds were detected only in MW-306S. The concentration of pentachlorophenol (7 µg/L) measured in MW-306S exceeded the GA Groundwater Objective and MCL of 1.0 µg/L. MW-306S is a renamed well previously installed in the former location of the Building 44 fuel tanks (Appendix A).

It should be noted that low concentrations of PAHs were also detected in the samples collected from the upgradient groundwater monitoring wells MW-301B and MW-301S (Table 4-2B).

4.2.1.3 Pesticides/PCBs

Pesticides and PCBs were not detected in any of the groundwater samples collected from monitoring wells during the investigation.

4.2.1.4 Petroleum Hydrocarbons

The groundwater sample collected from monitoring well MW-306S contained petroleum measured as DRO (0.49 mg/L), whereas this analyte was not detected in any other monitoring well. The trace level of petroleum in this monitoring well is likely a remnant constituent from the historic fuel release that occurred at Building 44. This area is under a long-term monitoring program under the RIDEM UST regulations.

The groundwater sample collected from monitoring well MW-304S contained trace concentrations of petroleum (measured as GRO - 0.05 mg/L), whereas this analyte was not detected in any other monitoring well. MW-304S is a shallow overburden well located at the northwest shoreline of Gould Island.

4.2.1.5 Metals and Cyanide

Fifteen metals were detected in groundwater samples collected from monitoring wells. Metals most frequently detected exceeding the upgradient levels include barium, calcium, iron, magnesium, manganese, and sodium. Most of these elements are likely naturally present from the mineral content of the groundwater.

Metals detected less frequently but exceeding the upgradient concentrations include aluminum (2 samples), arsenic (3 samples), cadmium (3 samples), copper (5 samples), nickel (4 samples), potassium (6 samples), vanadium (4 samples), and zinc (3 samples). Some of these metals particularly copper, cadmium, and nickel may be a result of industrial operations at the site. Highest concentrations of these heavy metals were found in MW-300S: copper (10.2J µg/L), MW-303B: cadmium (0.62 µg/L), and MW-303S: nickel (60.2 µg/L).

Cyanide was not detected in any of the groundwater samples collected from monitoring wells during the investigation.

The Federal MCLs and State GA Groundwater Objectives for metals were not exceeded in any of the groundwater samples collected from monitoring wells during the investigation.

4.2.1.6 Summary

The following constituents were detected in groundwater above drinking water criteria:

- Tetrachloroethene
- Pentachlorophenol

Low concentrations of VOCs were detected in several monitoring wells across the site, with no discernable pattern. Highest concentrations included tetrachloroethene (PCE) at MW-300S at 6J µg/L, which exceeded the GA Groundwater Objective and MCL. Trichloroethene (TCE), toluene and other VOCs were also detected at low concentrations at various locations at the site.

SVOCs, primarily PAHs and phenolic compounds, were found in the site groundwater at concentrations exceeding upgradient groundwater concentrations. Pentachlorophenol was detected in monitoring well MW-306S exceeding the GA Groundwater Objective and MCL. Monitoring wells MW-301S (upgradient of the site) and MW-306S (at the former Building 44 UST location) contained the highest concentrations of SVOCs detected onsite.

A low concentration of petroleum measured as DRO (0.49 mg/L) was detected in the groundwater sample from the former location of USTs at the north end of Building 32. The trace level of petroleum in this monitoring well is likely a remnant constituent from the historic fuel release that occurred at Building 44. This area is under a long-term monitoring program under the RIDEM UST regulations. The groundwater sample collected from monitoring well MW-304S contained petroleum measured as GRO (0.05 mg/L); this analyte was not detected in any other monitoring well.

Metal concentrations were generally comparable between onsite monitoring wells and generally elevated compared to upgradient levels. Higher concentrations of salts (calcium, magnesium, potassium, and sodium) may be a result of a hydraulic connection with sea water from the bay. Drinking water criteria for metals were not exceeded in any of the groundwater samples collected from monitoring wells during the investigation.

Cyanide was not detected in any of the groundwater samples collected from monitoring wells during the investigation.

4.2.2 Results from Aqueous Samples Collected from Test Pits

The analytical results for the aqueous samples collected from test pits during the investigation are discussed in this section. This section is arranged by constituent analytical groups, and not by location. The test pit locations are presented on Figure 2-2. Selected test pit analytical results are presented on Figure 4-2.

Aqueous contaminant concentrations detected in test pit samples were not compared to upgradient levels or to drinking water criteria. The drinking water criteria are not believed to be applicable to aqueous test pit samples due to the nature of the water that accumulates in excavations. Levels of colloids and suspended solids are commonly present within the test pit water. These conditions will result in high concentrations of metal and hydrophobic contaminants (PAHs, PCBs, and pesticides) from that which would be found in samples collected from groundwater monitoring wells. Monitoring wells are constructed and sampled in order

to mimic the water that would be drawn from a drinking water well, and therefore only groundwater taken from a properly constructed well should be used for comparison to drinking water criteria.

Concentrations of metals detected in aqueous test pit samples were compared with metal concentrations measured in upgradient wells. Contaminant-specific detected concentrations are presented in Table 4-2C. Summary statistics are presented with the entire data set in Appendix F-2

4.2.2.1 VOCs

Seven aqueous samples were collected and analyzed for VOCs from test pits. Ten VOCs were detected at low concentrations in three of the seven samples collected (samples from test pits TP-06, TP-08 and TP-10b). The highest concentrations of VOCs were found in the sample taken from Test pit TP-06, located within the building foundation (Figure 4-2).

VOCs detected included 2-butanone, 2-hexanone, acetone, benzene, methyl acetate, toluene, xylenes, and cis-1,2-dichloroethene. Of these, the most notable were benzene, toluene, and xylene, found in TP06 and TP08, likely a result of fuel release in this area, and cis-1,2-dichloroethene, which is a breakdown product of the solvent trichloroethene, found in TP-10b.

4.2.2.2 SVOCs

Twenty-eight SVOC compounds were detected in water samples collected from test pit excavations. All seven of the aqueous samples collected from the test pit excavations contained some SVOC contaminants. Most of the SVOCs detected were PAHs, which ranged from non-detect to 310 µg/L (naphthalene in TP-06). In addition to the PAHs, five phenols were detected, and several other SVOCs that are not categorized (Table 4-2C).

The phenolic compounds were all detected in one sample, collected from Test Pit TP-06, which is a sump in the foundation of Building 32 that contained unknown building materials. The highest concentrations of PAHs were found in TP-08, located outside the southwest corner of Building 32, and in a location where there was evidence of a fuel release. Lower concentrations of PAHs were found in waters taken from test pits TP-10B, 11B, and 13, which were excavated into the “trench drain” which drains the area at the southwest corner of Building 32 to the east.

Test pits TP-05 (northwest of building 32) and TP- 12 (southeast of building 32) had the fewest SVOCs detected, and the lowest concentrations detected.

4.2.2.3 Pesticides/PCBs

Five pesticide compounds were detected in aqueous samples collected from two test pits (TP-06 and TP-08). All these pesticides were detected at trace concentrations.

One PCB compound was detected in waters collected from Test Pit TP-08. Aroclor 1260 was detected in this test pit at a concentration of 8 µg/L. It should be noted that this Aroclor was not detected in soil from this location, instead Aroclor 1254 was detected in the soils at a concentration of 220 µg/kg. Aroclor 1260 was detected in soil from TP-09, located immediately to the south.

PCBs were not detected in other aqueous test pit samples collected.

4.2.2.4 Petroleum Hydrocarbons

Petroleum hydrocarbons, measured as DRO and GRO, were detected in three of the seven aqueous samples collected from the test pits. Concentrations of GRO ranged from 1.6 mg/L to 81 mg/L and concentrations of DRO ranged from 4.8 mg/L to 210 mg/L.

Petroleum hydrocarbons were limited to the samples collected from TP-06, TP-08 and TP-10B (Figure 4-2).

4.2.2.5 Metals and Cyanide

Metals were detected in all the aqueous samples collected from the test pits. Concentrations of metals in waters taken from test pits were anticipated to be higher than in those taken from groundwater monitoring wells due to the turbidity of the water and disturbance of the soil matrix.

Some of the metals are present as a result of natural presence of mineral content of the soil, entrained within the water samples. However, elevated levels of heavy metals were present in the water sample collected from Test Pit TP-08. These included chromium (81.3 µg/L), copper (336J µg/L), lead (1,000 µg/L), mercury (0.66J µg/L), nickel (146 µg/L), and zinc (1,160 µg/L). Test pit TP-08 is located north of the former dust collector building (Figure 4-2). Cadmium was also elevated, with a concentration of 126 µg/L in the aqueous sample from Test Pit TP-10B, located in the trench drain downgradient of TP-08 and the former dust collector building.

Metal concentrations detected in test pits were elevated compared to levels detected in upgradient groundwater wells. In general, test pit TP-05 had the lowest metal concentrations and test pit TP-08 had the highest metal concentrations. Cyanide was not detected in any aqueous sample collected from test pits during

the investigation. The high residual sodium in the aqueous sample from TP-05 indicates that this area is tidally impacted.

4.2.2.6 Summary

VOCs were detected in water samples taken from test pits at the site. Fuel components (benzene, toluene, and xylenes) were detected in test pits TP-06 and TP-08 and are likely artifacts of the fuel releases in these areas. 2-Butanone and acetone were detected, but are considered common artifacts of laboratory analysis and their detection during analysis is not likely a reflection of the water in the test pits.

SVOC concentrations, primarily PAHs, were elevated compared to upgradient levels. Test pits TP-06 and TP-08 had the highest PAH concentrations and the greatest distribution of non-PAH SVOCs. PAHs were found in water taken from TPs 10, 11, and 13, excavated into the “trench drain” south of Building 32. In addition, PAHs were detected in the aqueous sample collected from test pit TP-02, likely the result of the wash water that contained an oily sheen from the drain line that exited the building foundation and originated from manhole MH-01. This wash water and the soils that it contacted were removed from the excavation and removed from the site (Section 2.3).

Pesticides and PCBs were detected in aqueous samples collected from test pits TP-06 and TP-08 at trace concentrations. The presence of Aroclor 1260 in test pit TP-08 is likely an artifact of the nearby former transformer (Building 56).

Petroleum measured as GRO and DRO was detected water samples from test pits TP-06 and TP-08. These findings corroborate indications of petroleum (sheens and odors) found during test pit excavation in these areas.

Test pit TP-06 was excavated into the sump underneath the former sandblasting booth, and was found to be filled in with soil and debris and appeared to be impacted by petroleum (a sheen) noted during excavation. Test pit TP-08 was located in the area where remnant fuel was found in earlier investigations (Appendix A). A trench drain, which is speculated to have diverted road runoff and groundwater from the southwest corner of Building 32 to the bay at sediment station SD-304F, was observed in test pits TP-10, TP11B, TP12B, and TP-13. PAHs are components of petroleum and their presence in these test pit samples are indicative of past use and release of fuel products in this area.

Test pit TP-08 was excavated on the northwestern edge of the foundation for former Building 32 in an area previously impacted by a petroleum spill (Appendix A). The presence of maximum concentrations of heavy metals such as chromium, lead, zinc, and copper are possibly a result of sandblasting, dust storage, or electroplating chemical storage in this area.

4.2.3 Results from Aqueous and LNAPL Samples Collected from Manholes

Analytical results for aqueous samples collected from the water found in manholes MH-02 and MH-03, and the LNAPL sample collected from manhole MH-01, are discussed in this section. This summary is presented by constituent analytical groups, and not by location. The manhole locations are depicted on Figure 2-2. Selected manhole analytical results are presented in Figure 4-2. Analytical results for these samples are presented in Table 4-2D. Summary statistics are presented with the entire data set in Appendix F-2.

Evaluations of the analytical data are limited to detected compounds and maximum detects. The analytical results were not compared to groundwater criteria.

4.2.3.1 VOCs

Two VOCs, O-xylene (2,900 µg/L) and p-xylene (4,600 µg/L, were detected in the LNAPL sample collected from manhole MH-01. No other VOCs were detected, but the laboratory reported a detection level of 10,000U µg/L due to the matrix. The presence of these VOCs and the petroleum results provided below indicate this NAPL was likely an old gasoline or No. 2 fuel product.

VOCs were not detected in the aqueous samples collected from manholes MH-02 and MH-03.

4.2.3.3 SVOCs

The LNAPL sample collected from manhole MH-01 was not submitted for SVOC analysis.

Eighteen SVOCs (17 PAHs and carbazole) were detected in the aqueous sample collected from manhole MH-02. PAHs ranged in concentrations between 0.72 µg/L (2-methylnaphthalene) to 40 µg/L (naphthalene). Carbazole was detected at 2J µg/L in the aqueous sample collected from manhole MH-02.

Eleven PAHs were detected in the aqueous sample collected from manhole MH-03. These PAHs ranged in concentrations between 0.15 µg/L (acenaphthene) to 0.6 µg/L (fluoranthene).

4.2.3.4 Pesticides and PCBs

Pesticides and PCBs were not detected in the LNAPL sample collected from manhole MH-01 nor the aqueous samples collected from manholes MH-02 and MH-03.

4.2.3.5 Petroleum Hydrocarbons

Petroleum hydrocarbons were detected in the LNAPL sample collected from manhole MH-01 as diesel range organics (DRO, 900,000 mg/L) and gasoline range organics (GRO, 6,100 mg/L), indicating that the NAPL was likely an old gasoline or no. 2 fuel product.

Petroleum hydrocarbons were not detected in aqueous samples collected from manholes MH-02 and MH-03.

4.2.3.6 Metals and Cyanide

The LNAPL sample collected from manhole MH-01 was not submitted for metals or cyanide analysis.

Seventeen metals were detected in the aqueous sample collected from manhole MH-02 (Table 4-2D) including: arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium and zinc.

Fourteen metals were detected in the aqueous sample collected from manhole MH-03 (Table 4-2D) including: barium, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc.

Cyanide was not detected in aqueous samples collected from manholes MH-02 and MH-03.

Heavy metals were present in the aqueous samples from the manholes, as noted above, but were not particularly elevated, and did not indicate that these manholes were part of a release source or migration pathway.

4.2.3.7 Summary

The high concentrations of xylenes and petroleum hydrocarbons (GRO and DRO) detected in the LNAPL sample from manhole MH-01 corroborate suspected petroleum contamination in this manhole based on field observations discussed in Section 2.3.

The presence of heavy metals and PAHs in aqueous samples from manholes MH-02 and MH-03 is likely an artifact of past site operations. These contaminants may have been entrained in precipitation runoff and distributed into manholes MH-02 and MH-03. However, the observed concentrations do not indicate that these manholes were necessarily part of a release area or a migration pathway.

4.2.4 Upgradient Groundwater Samples

Two soil borings were advanced upgradient of the site to install upgradient monitoring wells (MW-301S and 301B). Groundwater samples were collected from these wells in the same manner as those at the site. Based on the vertical difference of hydraulic head, the groundwater samples from these wells are considered upgradient.

Results from these upgradient samples are presented in Table 4-2B. The comparison of the upgradient groundwater concentrations to the RIDEM Groundwater Objectives for GA groundwater and to Federal MCLs shows no exceedances of these standards.

While summary statistics were calculated from these results and are presented in Appendix F6-C, it is noted that these are a standard output from the database, but for the upgradient groundwater these statistics have little significance, since there are only two samples in this group.

4.3 CONCRETE SAMPLE RESULTS

The analytical results for the concrete samples collected during the investigation are presented in this section. Only two concrete samples were collected as a part of this assessment, and therefore, they are presented individually in this section. The concrete samples were collected near the former location of a mixing tank and electrical switching equipment located on the northeast corner of the foundation. Concrete sample results are presented in Table 4-3. Summary statistics are provided in Appendix F-5 of this report, (Table F-5.1). In addition, a complete presentation of all the data collected from these stations (including non-detected results) is presented in Appendix F-5. Data validation memoranda are presented in Appendix F-8.

4.3.1 Concrete Sample CO-301

VOCs

Three VOCs were detected in the concrete sample collected from location CO-301: acetone (34J µg/kg), methyl cyclohexane (1J µg/kg), and toluene (1J µg/kg).

SVOCs

In the SVOC sample collected from location CO-301, 12 PAHs were detected at concentrations ranging from 570 µg/kg (anthracene) to 4700J µg/kg (dibenzo(a,h)anthracene). These PAHs may be a result of use of fuels in the area or a result of a treated flooring material previously present in this location.

Pesticides and PCBs

Pesticides and PCBs were not detected in the concrete sample collected from location CO-301.

Petroleum Hydrocarbons

Petroleum hydrocarbons, detected as DRO at 46 mg/kg, were noted in the concrete sample collected from location CO-301. GRO was not detected in the concrete sample collected from location CO-301.

Metals and Cyanide

The following metals were detected in the concrete sample collected from location CO-301: aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, thallium, vanadium, and zinc. Concentrations of these metals do not appear to be elevated.

Cyanide was not detected in the concrete sample collected from location CO-301.

4.3.2 Concrete Sample CO-302

VOCs

Acetone (17J µg/kg), carbon disulfide (5.3J µg/kg), and methylene chloride (32.5 µg/kg) were detected in the concrete sample collected from CO-302.

Acetone and methylene chloride are common artifacts of laboratory analysis, and carbon disulfide is commonly used in manufacturing processes (although it is also naturally occurring in coastal sediments).

SVOCs

In the SVOC sample collected from location CO-301, 12 PAHs were detected at concentrations ranging from 1,050J µg/kg (benzo(g,h,i)perylene) to 1,625 µg/kg (pyrene). These PAHs may be a result of use of fuels in the area or a result of a treated flooring material previously present in this location. Butyl benzyl phthalate (1.875J µg/kg) was also detected in this sample.

Pesticides and PCBs

Only one pesticide 4,4'DDE (4.05 µg/kg) was detected in the concrete sample collected from location CO-302. The concrete sample collected from location CO-302 did not contain detectable concentrations of PCBs.

Petroleum Hydrocarbons

Petroleum hydrocarbons, detected as DRO at 214 mg/kg, were noted in the concrete sample collected from location CO-302. The concrete sample collected from location CO-302 did not contain detectable concentrations of GRO.

Metals and Cyanide

The following metals were detected in the concrete sample collected from location CO-302: aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, thallium, vanadium, and zinc. Concentrations of these metals do not appear to be elevated.

Cyanide was not detected in the concrete sample collected from location CO-302.

Summary

The concrete samples were collected in north end of Building 32 to evaluate possible impacts from an above ground storage tank, and possible PCB switching equipment in this area. No PCBs were detected in either of the samples collected. The presence of acetone and methylene chloride in concrete samples is likely a laboratory artifact as these materials are commonly used as laboratory solvents. Carbon disulfide, toluene and methylcyclohexane may have been used in shop areas for parts cleaning or other purposes.

Presence of PAHs in the concrete is an uncertainty. The concrete floor of the building was once covered with a wood parquet mat to provide a non-conductive surface. It is unknown if this material was treated with preservatives such as would have been common at the time of construction (creosote, containing a mix of PAHs). Such preservatives could have entrained themselves over time into the surface concrete, providing such a signature in the concrete samples.

4.4 SEDIMENT INVESTIGATION

The sediment samples were collected by TtNUS in August and September 2005. The sediment sample locations are shown on Figures 2-3 and 2-4. The discussion of the sediment analytical results is organized by

geographic areas and tidal zones. Geographic areas include the northeastern shoreline, the northwestern shoreline, the Stillwater basin, and the southern shoreline. Tidal zones include the intertidal and subtidal zones. Intertidal zone is defined as the area expected to be vertically up gradient of mean low water (MLW) and down gradient at mean high water (MHW). Actual MLW and MHW were not determined as a part of this study.

Sediment samples were collected from eight intertidal locations and 58 subtidal locations on the Gould Island shoreline. The samples were collected from the 0- to 0.5- foot depth interval and the 0.5- to 1.0- foot depth interval, where possible. All samples were collected by divers using acetate sleeve tubes as described in Section 2.7.

Sample location identifiers include the site identifier (G32), the sample matrix (SD), the sample location (i.e.: 301A), and the sample collection interval (i.e.: 000.5). Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, total petroleum hydrocarbons (TPH), gasoline range organics (GRO), acid volatile sulfide/simultaneously extracted metal (AVS/SEM), total organic carbon (TOC), and grain size distribution. Analytical results for field duplicate samples were averaged with the original sample results. Sample stations where this calculation was performed are identified with the suffix “-AVG”.

SVOCs include polycyclic aromatic hydrocarbons (PAHs), phthalates, and phenols. PAHs can be further differentiated in high molecular weight and low molecular weight PAHs. High weight PAHs include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene'). Low molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene.

As described in Section 4.0, a tier II validation was conducted on the sediment data collected. Based on this validation, some results were rejected. Results for the SVOC hexachlorocyclopentadiene were rejected (R) in three samples due to the laboratory not meeting QC limits in the matrix spike and matrix spike duplicate analysis. Results for the pesticides 4,4’-DDE, 4,4’-DDT, beta-BHC, endosulfan sulfate, endrin aldehyde, endrin ketone, and gamma-chlordane were rejected (R) in selected samples due to results exceeding criteria between the two quantitation columns.

Concentrations of contaminants measured in the sediment were compared to the average concentration of 11 reference samples collected as part of the Derecktor Shipyard and McAllister Point Landfill investigations conducted in 2004 (TtNUS, 2004A and TtNUS, 2004B). Gould Island sediment concentrations and reference concentration comparisons are made for 11 SVOCs, 22 metals, TOC, and AVS/SEM. No reference comparisons are made for VOC, pesticide, PCB (Aroclor), TPH, and GRO analytes because these analyses were not conducted for the reference.

Concentrations of contaminants measured in the sediment were also compared to National Oceanic and Atmospheric Administration (NOAA) Effects Range-Medium (ERM) and Effects Range-Low (ERL) criteria. Criteria exist for 13 SVOCs, one pesticide, total Aroclor, nine metals, and TOC. Analytical results for detected constituents and comparisons for intertidal and subtidal sediment samples are presented in Tables 4-3A and 4-3B, respectively.

AVS and SEM were measured in the sediment to determine bioavailability of metals present in the sediment. The presence of AVS has been found to bind metals in sedimentary environments and restrict them from being metabolized by the receptor organism. A ratio of SEM: AVS less than 1 indicates the presence of AVS that would thus restrict the metal from becoming available to benthic organisms. While these analyses are presented in Tables 4-4a and 4-4b, the data are not discussed in this section but in the ecological risk assessment, Section 7 of this report.

Total organic carbon was also measured in sediment samples collected. High levels of TOC indicate presence of natural organic materials (plant matter, etc) in the sediment which tend to bind with some organic contaminants. PCBs and long-chain hydrocarbons have the propensity to bind with sediments inhibiting their transport except with those sediment particles. This propensity favors smaller organic sediment particles, and not larger and smooth sand particles. Therefore, PCB and PAH compounds tend to accumulate with mucky organic sediments and stay in place better than in locations where there are loose sands and gravels. Generally, those stations with a TOC value of less 5,000 mg/Kg (0.5 percent TOC) in Table 4-4A and 4-3B are comprised mainly of sand or sand and gravel and contain little organic carbon to slow the transport of contaminants.

4.4.1 Northeastern Intertidal Shoreline

Five sediment samples (G32-SD304F-000.5, G32-SD305F-000.5, G32-SD306F-000.5, G32-SD309F-000.5, and G32-SD310F-000.5) were collected from the northeastern intertidal shoreline. This area is closest to former Building 32, and is presumed to receive discharges from floor drains, storm drains, and waste handling systems in former Building 32 (Figure 4-3A). Data from analysis of intertidal sediment are presented in Table 4-4A.

VOCs

Two VOCs, TCE and carbon disulfide, were detected in intertidal sediments collected along the northeastern shoreline. TCE was detected in one sample (G32-SD309F-000.5-AVG) at a concentration of 2 J µg/kg. This sample was collected at the midpoint of the northeastern shoreline east of former Building 32. Carbon disulfide was detected in five samples at a maximum concentration of 6.25 µg/kg in sample G32-SD309F-

000.5-AVG. Acetone is a common laboratory contaminant. Carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

The highest concentrations of SVOCs were present predominantly in two of the five intertidal sediment samples collected along the northeastern shoreline. Samples and the SVOCs detected included: G32-SD309F-000.5-AVG [2-methylnaphthalene, acenaphthene, anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, bis(2-ethylhexyl)phthalate, carbazole, dibenzo(a,h)anthracene, dibenzofuran, fluorine, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene], G32-SD304F-000.5 [acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, high molecular weight PAHs, low molecular weight PAHs, and pyrene] and G32-SD310F-000.5 [4-methylphenol and phenol].

Reference concentrations were exceeded in all five samples collected in the intertidal northeastern shoreline sediment samples for the following compounds: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, and pyrene. Reference concentrations were exceeded for anthracene in four samples and for phenanthrene in three samples.

ERL criteria were exceeded in sample G32-SD309F-000.5-AVG for four compounds (acenaphthene, anthracene, fluorine, and phenanthene) and in sample G32-SD304F-000.5 for two compounds (benzo(a)anthracene and fluoranthene). No ERM exceedances were noted.

Pesticides/PCB

Analytical results for pesticides and PCBs indicated that intertidal sediments collected along the northeastern shoreline had elevated concentrations of these compounds. Seven pesticides and two Aroclors (Aroclor-1248 and Aroclor-1260) were detected in these samples. Aroclor-1248 was detected in two samples (G32-SD305F-000.5 and G32-SD309F-000.5). Aroclor-1260 was detected at elevated concentrations in three of the five samples collected in intertidal sediments along the northeastern shoreline. Samples G32-SD304F-000.5 and G32-SD305F-000.5, collected on the southernmost portion of the northeastern shoreline, had the highest concentrations (360 µg/kg and 280 µg/kg). Sample G32-SD310F-000.5 had non-detect results for all pesticides and PCBs. Samples where pesticides and PCBs were detected included: G32-SD309F-000.5-AVG [alpha-BHC, Aroclor-1248, delta-BHC, and endrin aldehyde], G32-SD304F-000.5 [Aroclor-1260, endosulfan sulfate, endrin ketone, and total Aroclor], G32-SD306F-000.5 [beta-BHC], and G32-SD305F-000.5 [gamma-Chlordane].

ERL criteria were exceeded for Aroclor-1260 in four samples (G32-SD304F-000.5, G32-SD305F-000.5, G32-SD306F-000.5, and G32-SD309F-000.5). ERM criteria for Aroclor-1260 were exceeded in three samples (G32-SD304F-000.5, G32-SD305F-000.5, and G32-SD306F-000.5).

Metals

Analytical results of intertidal sediments detected the highest concentrations of metals in the southernmost station (SD304F) located along the northeastern intertidal shoreline. The concentration of lead detected at this station was the highest among samples collected as part of the Gould Island RI. Station SD306F also had an elevated lead concentration and the only mercury detection. The highest concentrations of metals present in intertidal sediment collected along the northeastern shoreline were detected in the following samples: G32-SD304F-000.5 [antimony, cadmium, chromium, lead, and thallium], G32-SD305F-000.5 [aluminum, cobalt , copper, iron, magnesium, manganese, and nickel], G32-SD306F-000.5 [mercury, sodium, and vanadium], G32-SD309F-000.5 [calcium and zinc], and G32-SD310F-000.5 [arsenic, barium, beryllium, and potassium].

Reference concentrations for the following elements were exceeded in the following number of samples collected in the intertidal northeastern shoreline: aluminum (five samples), antimony (one), arsenic (four), barium (three), beryllium (one), cadmium (two), calcium (five), chromium (five), copper (five), iron (five), lead (five), magnesium (five), manganese (five), mercury (one), nickel (five), potassium (four), sodium (three), thallium (two), vanadium (five), and zinc (four).

ERL criteria were exceeded for cadmium (G32-SD304F-000.5), chromium (G32-SD304F-000.5), copper (G32-SD304F-000.5 and G32-SD305F-000.5), lead (G32-SD304F-000.5 and G32-SD306F-000.5), and mercury (G32-SD306F-000.5). ERM criteria were exceeded for chromium (G32-SD304F-000.5), lead (G32-SD304F-000.5), and mercury (G32-SD306F-000.5).

Petroleum Hydrocarbons

The range of TPH detected in intertidal sediment samples along the northeastern shoreline was 53 J to 25 mg/kg. The maximum TPH concentration (53 J mg/kg) was detected in sample G32-SD306F-000.5 collected adjacent to the southeast corner of the former Building 32. GRO was not detected in intertidal sediments along the northeastern shoreline.

AVS/SEM and TOC

SEM/AVS ratios of <1 were observed for all intertidal sediment stations located on the northeastern shoreline, indicating that bioavailablility of metals in this area is restricted.

A TOC concentration of less than 5,000 mg/kg was detected in sample G32-SD304F-000.5. A low concentration of organic matter at this station indicates favorable conditions for the transport of PAHs and PCBs. Samples G32-SD306F-000.5, G32-SD309F-000.5-AVG, and G32-SD310F-000.5 had TOC concentrations that exceeded the reference TOC concentration.

Summary

Presence of SVOCs, particularly PAHs, at stations SD309F and SD310F may be the result of the fuel releases previously addressed at former Building 44 area (Appendix A). The metals in the area of stations SD304F, SD305F, and SD306F could likely be an artifact of discharges, both via floor drain system and storm water carried through the storm "trench" drain from the area of the electroplating room, acid storage shed, and dust collector building which all discharge in this area. PAHs and PCBs in this area could also be associated with discharges from these drainage systems.

4.4.2 Northeastern Subtidal Shoreline

Thirty one samples were collected from the northeastern subtidal shoreline. This area is closest to former Building 32, and is presumed to receive discharges from floor drains, storm drains, and waste handling systems in former Building 32 (Figure 4-3B). Data from analysis of subtidal sediment samples is provided in Table 4-4B.

VOCs

Five VOCs were detected in subtidal sediments collected along the northeastern shoreline. VOCs were detected in the southernmost samples collected off the northeastern shoreline, proximal to the southeast corner of former Building 32. VOCs were detected in surficial samples, with the exception of TCE which was detected in a sample collected from the 0.5 to 1.0 foot interval. Samples and the VOCs detected at their maximum concentrations included: G32-SD304D-0.51.0 [1,1-dichloroethene (6 µg/kg)], and G32-SD306E-000.5-AVG [TCE (1 J µg/kg)]. 2-Butanone and acetone were detected but are believed to be laboratory artifacts. Carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

The majority of the highest concentrations of SVOCs were detected in one sample, G32-SD310D-000.5, located south of the former dock and east of former Building 38. The maximum concentrations of SVOCs present in sediment along the northeastern subtidal shoreline were detected in the following samples: G32-SD310D-000.5 [1,1-biphenyl, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene,

benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzofuran, fluorene, fluoranthene, high molecular weight PAHs, indeno(1,2,3-cd)pyrene, low molecular weight PAHs, naphthalene, phenanthrene, pyrene], G32-SD306C-000.5 [dibenzo(a,h)anthracene], G32-SD306B-000.5 [4-methylphenol and phenol], G32-SD304D-000.5-AVG [bis(2-ethylhexyl)phthalate], and G32-SD304D-0.51.0 [acenaphthylene].

Reference concentrations for the following compounds were exceeded in the following number of samples collected in the subtidal northeastern shoreline: anthracene (27 samples), benzo(a)anthracene (31), benzo(a)pyrene (31), benzo(b)fluoranthene (31), benzo(k)fluoranthene (31), chrysene (31), fluoranthene (28), high molecular weight PAHs (31), low molecular weight PAHs (31), phenanthrene (25), and pyrene (31).

ERL criteria were exceeded for all 13 SVOC compounds for which criteria exist. Criteria exceedances were noted in 15 of the 31 samples collected from the northeastern subtidal shoreline. The samples with the most exceedances (12) were G32-SD310D-000.5 and G32-SD306C-000.5. Ten exceedances occurred for sample G32-SD304D-0.51.0, nine for sample G32-SD304A-000.5, seven for G32-SD304B-000.5, and six for sample G32-SD306E-000.5-AVG.

ERM criteria were exceeded in sample G32-SD310D-000.5 for four compounds (acenaphthalene, anthracene, fluorene, and phenanthrene) and in sample G32-SD306C-000.5 for one sample (phenanthrene).

Analytical results indicated that four locations (G32-SD307-000.5, G32-SD309A-000.5 through G32-SD309D-000.5, G32-SD315-000.5, and G32-SD317-000.5) had low concentrations of SVOCs. No exceedances of the ERL or ERM criteria were noted in these locations.

Pesticides/PCB

Aroclor-1260 was detected at elevated concentrations in 19 of the 31 samples collected in subtidal sediments along the northeastern shoreline. Samples G32-SD304B-000.5, G32-SD304C-000.5, G32-SD304D-000.5, and G32-SD305D-000.5, collected on the southernmost portion of the northeastern shoreline, had the highest concentrations (3,600 µg/kg, 3,800 µg/kg, 3,300 µg/kg, and 2200 µg/kg, respectively).

The highest concentrations of pesticides and PCBs present in subtidal sediment along the northeastern shoreline were detected the following samples: G32-SD315-000.5 [4,4'-DDE], G32-SD305C-000.5 [aldrin], G32-304C-000.5 [Aroclor-1260, endosulfan sulfate, gamma-Chlordane, and total Aroclor], G32-SD304D-000.5-AVG [beta-BHC and endrin ketone], G32-SD305E-000.5 [delta-BHC], G32-SD305D-000.5 [dieldrin], G32-SD304A-000.5 [endosulfan I], G32-SD305B-000.5 [endrin aldehyde and methoxychlor], and G32-SD305D-0.51.0 [gamma-BHC (Lindane)].

ERL criteria for 4,4'-DDE was exceeded in one sample, G32-SD315-000.5. ERM criteria for Aroclor-1260 were exceeded in 13 samples and ERL criteria were exceeded for Aroclor-1260 in 19 samples.

Metals

Analytical results indicated that the subtidal sediments located on the northeastern shoreline contained 11 out of 23 of the maximum concentrations for metals detected in subtidal sediment samples collected as part of the Gould Island RI. Stations with elevated concentrations of metals included SD317 (cadmium, chromium, iron, manganese, and zinc) and SD306 (barium, lead, and thallium). Cyanide was detected at two stations, SD304 and SD310. The highest concentrations of metals present in subtidal sediment collected along the northeastern shoreline were detected in the following samples: G32-SD304B-000.5 [potassium], G32-SD304E-000.5 [antimony, cyanide, and mercury], G32-SD305D-000.5 (copper), G32-SD306A-000.5 [aluminum, magnesium, thallium, and vanadium], G32-SD306B-000.5 [barium and lead], G32-SD309A-000.5 (selenium), G32-SD309E-000.5 [calcium and sodium], G32-SD310B-000.5 [cobalt and nickel], G32-SD310C-000.5 (beryllium), and G32-SD317-000.5 [arsenic, cadmium, chromium, iron, manganese, and zinc]. Seven of these maximum concentrations were detected at station locations SD306, which was collected at the potential location of an outfall pipe discharge. Five and four of these maximum locations were detected at stations SD317 and SD304, respectively. Station SD317 was located at a section of the shoreline marked by extensive erosion and station SD304 was located at a potential location of an outfall pipe discharge south of the former ferry slip.

Reference concentrations for the following elements were exceeded in the following number of samples collected in the subtidal northeastern shoreline: aluminum (22 samples), antimony (16), arsenic (two), barium (eight), beryllium (16), cadmium (four), calcium (31), chromium (13), cobalt (one), copper (19), iron (31), lead (21), magnesium (26), manganese (29), nickel (14), potassium (two), selenium (16), sodium (two), thallium (12), vanadium (30), and zinc (eight).

ERL criteria were exceeded for the following elements and corresponding samples: cadmium (G32-SD310C-000.5 and G32-SD317-000.5), copper (G32-SD305D-000.5 and G32-SD317-000.5), and lead (G32-SD304C-000.5, G32-SD305B-000.5, G32-SD305D-000.5, G32-SD306A-000.5, G32-SD306B-000.5, G32-SD306C-000.5, G32-SD306D-000.5-AVG, G32-SD309E-000.5, G32-SD310B-000.5, and G32-SD317-000.5).

ERM criteria were exceeded for cadmium (G32-SD317-000.5) and lead (G32-SD306A-000.5 and G32-SD306B-000.5).

Petroleum Hydrocarbons

The range of TPH detected in subtidal sediment samples along the northeastern shoreline was 69 to 21 mg/kg. The maximum TPH concentration (69 mg/kg) was detected in sample G32-SD304C-000.5 collected south of the former ferry slip area. GRO was not detected in subtidal sediments along the northeastern shoreline.

AVS/SEM and TOC

SEM/AVS ratios of <1 were observed in all subtidal sediment samples in this area, with the exception of three, indicating that bioavailablility of metals in this area is restricted. Ratios >1 were detected in samples G32-SD306A-000.5 (3.5), G32-SD304E-000.5 (1.2), and G32-SD306B-000.5 (1).

A TOC concentration of less than 5,000 mg/kg was detected in samples G32-SD305D-000.5 (4,800 J mg/kg), G32-SD306B-000.5 (3,800 mg/kg), and G32-SD317-000.5 (3,000 mg/kg). Low concentrations of organic carbon at these stations indicate less favorable conditions for the sediments in these areas to bind or sorb contaminants such as PAHs and PCBs. Twelve samples had TOC concentrations that exceeded the reference TOC concentration.

Summary

Presence of SVOCs, particularly PAHs in the subtidal area of the northeast shoreline could be a result of fuel storage and use in this area. Chemical constituents in the area of stations SD304 and SD305 (particularly PCBs and metals) are likely an artifact of former discharges, from drainage systems removing waste and water from the electroplating shop, acid storage shed, and dust collector building at the southwest corner of Building 32.

4.4.3 Northwestern Intertidal Shoreline

Three samples (G32-SD302F-000.5, G32-SD308F-000.5, G32-SD313F-000.5) were collected from the northwestern intertidal shoreline. There are outfalls in this area originating from Building 32 sewer systems (Figure 4-3A). Data from analysis of intertidal sediment samples are provided in Table 4-4A.

VOCs

Two VOCs were detected in intertidal sediments collected along the northwestern shoreline. Acetone was detected in one sample and carbon disulfide was detected in three samples.

Acetone is a common laboratory solvent. The maximum concentrations of these solvents were detected in G32-SD302F-000.5 (200 J µg/kg) and G32-SD308F-000.5 (3 J µg/kg), respectively. Carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

Twenty-one of the 22 maximum SVOC concentrations detected in Gould Island intertidal sediment samples were present in one sample, G32-SD313F-000.5, collected along the northernmost outfall location on the northwestern shoreline, and most of these were of PAHs. Other compounds detected from station SD313 included carbazole and dibenzofuran. Analytical results detected bis(2-ethylhexyl)phthalate in sample G32-SD302F-000.5.

Reference concentrations were exceeded in all three samples collected in the intertidal northwestern shoreline sediment samples for the following compounds: anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, high molecular weight PAHs, low molecular weight PAHs, phenanthrene, and pyrene.

ERL criteria were exceeded in sample SD313F-000.5 for ten compounds, sample SD308F-000.5 for nine compounds, and sample SD302F-000.5 for seven SVOC compounds.

ERM criteria was exceeded in one sample, G32-SD313F-000.5 for one compound (pyrene).

Pesticides/PCB

Analytical results of samples collected from this portion of the site indicated the presence of two pesticides and no PCBs. Endrin ketone was detected at a maximum concentration of 5.2 J µg/kg in sample G32-SD308F-000.5 and methoxychlor was detected once at a concentration of 7.3 J µg/kg in sample G32-SD313F-000.5.

Metals

Analytical results indicated that the highest intertidal concentrations of arsenic, calcium, cyanide (detected only at station SD313F), iron, nickel, and thallium were detected on the northwestern intertidal shoreline. The highest concentrations of metals present in intertidal sediment samples collected along the northwestern shoreline were detected in the following samples: G32-SD302F-000.5 (aluminum, barium, beryllium, cobalt,

lead, magnesium, potassium, sodium, vanadium, and zinc), G32-SD308F-000.5 (calcium), and G32-SD313F-000.5 (arsenic, chromium, copper, cyanide, iron, manganese, nickel, and thallium).

Reference concentrations for the following elements were exceeded in the following number of samples collected in the intertidal northwestern shoreline: aluminum (one sample), arsenic (one), barium (one), calcium (three), chromium (one), copper (three), iron (three), lead (three), magnesium (one), manganese (three), nickel (two), thallium (one), vanadium (one), and zinc (one).

ERL criteria were exceeded for copper in samples G32-SD302F-000.5 and G32-SD313F-000.5, and for nickel in sample G32-SD313F-000.5.

No ERM exceedances were noted.

Petroleum Hydrocarbons

The range of TPH detected in intertidal sediment samples along the northwestern shoreline was 68 to 38 J mg/kg. The maximum TPH concentration (68 mg/kg) was detected in sample G32-SD313F-000.5 collected at the northernmost station on the northwestern shoreline. GRO was not detected in intertidal sediments along the northwestern shoreline.

AVS/SEM and TOC

SEM/AVS ratios of <1 were observed for all intertidal sediment stations located on the northwestern shoreline, indicating that bioavailablility of metals in this area is restricted.

TOC concentrations detected along the northwestern shoreline were equal to or above 5,000 mg/kg, indicating that the presence of organic carbon in this location is potentially binding PAHs. Sample G32-SD308F-000.5 had a TOC concentration that exceeded the reference TOC concentration.

Summary

The presence of PAHs, heavy metals (particularly chromium, copper, and nickel), and cyanide in the sample taken at station SD313F indicates that wastes from the electroplating area may have been transported with the septic waste to discharge in this area. However, PCBs do not appear to have impacted this area.

4.4.4 Northwestern Subtidal Shoreline

Fifteen samples were collected from the northwestern subtidal shoreline. Sample stations were collocated with three outfall pipes located on the northwestern shoreline. These outfalls were located approximately 100 to 300 feet west of the former Building 32's foundation on a 150 foot portion of the northwestern shoreline. Outfalls in this area originate in former Building 32 sewer systems, however, they terminate in the intertidal area, between 50 and 100 feet from the subtidal sediment stations (4-3B). Data from analysis of subtidal sediment samples are provided in Table 4-4B.

VOC

Two VOCs were detected in subtidal sediments collected along the northwestern shoreline. Acetone was detected in 15 samples and carbon disulfide was detected in seven samples. The maximum concentration of acetone was 240 JEB µg/kg detected in sample G32-SD302E-000.5 and the maximum concentration of carbon disulfide was 6 µg/kg, detected in sample G32-SD-302A-000.5. Acetone is a common laboratory solvent and carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

Twenty of the 21 maximum SVOC concentrations detected in Gould Island subtidal northwestern shoreline sediment samples were present in one sample, G32-SD308E-000.5, and most of these were of PAHs. Other compounds detected in station SD308E included carbazole and dibenzofuran. Analytical results detected phenol in sample G32-SD308A-000.5.

All nine reference concentrations were exceeded in all 15 samples collected in the subtidal northwestern shoreline.

ERL criteria were exceeded for the following compounds for the corresponding number of samples: 2-methylnaphthalene (one sample), acenaphthene (10), anthracene (five), benzo(a)anthracene (four), benzo(a)pyrene (one), chrysene (one), dibenzo(a,h)anthracene (one), fluoranthene (one), fluorene (seven), naphthalene (one), phenanthrene (five), and pyrene (one).

ERM criteria were exceeded for phenanthrene and acenaphthene in sample G32-SD308E-000.5.

Pesticides/PCB

Analytical results of the 15 samples collected from this portion of the site indicated the presence of one pesticide and one PCB Aroclor. Beta-BHC was detected in seven samples and Aroclor-1260 was detected only at station SD302. Beta-BHC was detected at a maximum concentration of 6.8 J µg/kg in sample G32-SD308A-000.5 and Aroclor-1260 was detected at a maximum concentration of 46 µg/kg in sample G32-SD302A-000.5.

ERL criteria were exceeded in the two samples that contained Aroclor-1260, noted above. No ERM exceedances were noted.

Metals

Analytical results indicated that the highest subtidal concentrations of aluminum, arsenic, magnesium, nickel, potassium, sodium, and vanadium were detected on the northwestern subtidal shoreline. The highest concentrations of metals present in subtidal sediment collected along the northwestern shoreline were detected in the following samples: G32-SD302A-000.5 (aluminum, arsenic, barium, beryllium, chromium, cobalt, magnesium, mercury, potassium, sodium, vanadium, and zinc), G32-SD302D-000.5, G32-SD313C-000.5 (copper, iron, manganese, and nickel), G32-SD313D-000.5-AVG (cadmium), and G32-SD313E-000.5 (calcium). Thirteen of these maximum concentrations were detected in samples collected at station location SD302, which was located at the probable location of the middle of three outfall pipe discharges on the northwestern shoreline. Six of these maximum locations were detected at station SD313, which was located at the northernmost potential location of an outfall pipe discharge on the northwestern shoreline.

Reference concentrations for the following elements were exceeded in the following number of samples collected in the subtidal northwestern shoreline: aluminum (15 samples), arsenic (nine), barium (eight), beryllium (one), cadmium (seven), calcium (15), chromium (six), cobalt (one), copper (six), iron (15), lead (four), magnesium (15), manganese (15), mercury (two), nickel (seven), potassium (five), sodium (four), vanadium (14), and zinc (two).

ERL criteria were exceeded for the following elements and corresponding samples: cadmium (G32-SD313D-000.5-avg), copper (G32-SD313C-000.5), and nickel (G32-SD313C-000.5).

The ERM criteria was exceeded for only one element, cadmium in sample G32-SD313D-000.5-AVG.

Petroleum Hydrocarbons

The range of TPH detected in subtidal sediment samples along the northwestern shoreline was 45 to 15 J mg/kg. The maximum TPH concentration (45 mg/kg) was detected in sample G32-SD308C-000.5 collected adjacent to the southeast corner of the former Building 32. GRO was not detected in subtidal sediments along the northwestern shoreline.

AVS/SEM and TOC

SEM/AVS ratios of <1 were observed in all samples, with the exception of two, for subtidal sediment stations located on the northwestern shoreline, indicating that bioavailablility of metals in this area is restricted. Ratios >1 were detected in samples G32-SD302D-000.5 (1.8) and G32-SD313E-000.5 (1.5).

A TOC concentration of less than 5,000 mg/kg was detected in seven samples of the 15 samples collected along the northwestern shoreline. A low concentration of organic matter at these stations indicates favorable conditions for the transport of PAHs and PCBs. Three samples had TOC concentrations that exceeded the reference TOC concentration.

Summary

The presence of PAHs and heavy metals (particularly cadmium, copper, and nickel), in the sample taken at station SD313 indicates that wastes from the electroplating area may have been transported with the septic waste to discharge in this area. PCBs were detected in only two samples collected at station SD302.

4.4.5 Stillwater Basin

Four samples (G32-SD312-000.5, G32-SD312-0.51.0, G32-SD316-000.5, and G32-SD316-0.51.0) were collected from the stillwater basin area (Figure 4-3B). Data from analysis of subtidal sediment samples is provided in Table 4-4B.

VOCs

Four VOCs were detected in samples collected from the Stillwater basin area. All maximum concentrations were detected in sample G32-SD312-0.51.0, which was collected from the 0.5 to 1.0 foot interval. Compounds and the maximum concentrations detected included 1,3-dichlorobenzene (3 J µg/kg), 1,4-dichlorobenzene (11 J µg/kg), acetone (120 JEB µg/kg), and carbon disulfide (16 µg/kg). Acetone is a

common laboratory solvent and carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

The Stillwater basin sediments were found to contain the highest concentrations of SVOCs among all sediment samples collected at part of the Gould Island RI. Sixteen of the 23 maximum SVOC concentrations were detected in the Stillwater basin. Sample G32-SD312-0.51.0, which was collected at the 0.5 to 1.0 foot interval had the highest concentrations of SVOCs among the samples collected in the Stillwater basin area. Compounds detected in sample G32-SD312-0.51.0 included: 2-methylnaphthalene, 4-methylphenol, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, high molecular weight PAHs, indeno(1,2,3-cd)pyrene, low molecular weight PAHs, naphthalene, phenanthrene, phenol, and pyrene.

Eleven reference concentrations were exceeded in all four samples collected in the Stillwater basin area. ERL criteria were exceeded for the following compounds for the corresponding number of samples: acenaphthene (four samples), acenaphthylene (four), anthracene (four), benzo(a)anthracene (three), benzo(a)pyrene (three), chrysene (three), dibenzo(a,h)anthracene (two), fluoranthene (four), fluorene (four), phenanthrene (four), and pyrene (four).

ERM criteria were exceeded only at station SD312. Analytical results for sample G32-SD312-0.51.0 showed that this sample had the most ERM criteria exceedances (nine compounds) followed by sample G32-SD312-000.5 (five compounds). ERM criteria were exceeded for the following compounds for the corresponding number of samples: acenaphthylene (one sample), anthracene (one), benzo(a)anthracene (two), benzo(a)pyrene (one), chrysene (two), fluoranthene (two), fluorene (one), phenanthrene (two), and pyrene (two).

Pesticides/PCB

The highest concentrations of Aroclor-1260 detected in samples collected as part of the Gould Island RI were detected in the four samples collected in the Stillwater basin area. Samples G32-SD312-000.5, G32-SD312-0.51.0, G32-SD316-000.5, and G32-SD316-0.51.0 contained concentrations of 8,900 µg/kg, 41,000 µg/kg, 22,000 µg/kg, and 22,000 µg/kg, respectively. The maximum concentration of Aroclor-1260 was detected in a sample collected from the 0.5 to 1.0 foot interval.

PCBs present in sediment samples collected in the Stillwater basin were detected in samples: G32-SD312-0.51.0 [4,4'-DDE, Aroclor-1260, beta-BHC, endosulfan sulfate, and total Aroclor] and G32-SD316-0.51.0 [4,4'-DDT, endrin aldehyde, and gamma-Chlordane].

ERL and ERM criteria were exceeded for total Aroclor in all four samples and for 4,4'-DDE in three samples collected in the Stillwater basin area.

Metals

The maximum concentrations of the eighteen metals present in subtidal sediment collected in the stillwater basin were detected in the following samples: G32-SD312-0.51.0 [calcium, and sodium], G32-SD316-000.5, and G32-SD316-0.51.0 [aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, vanadium, and zinc]. Fifteen of these maximum concentrations were detected in one sample, G32-SD316-0.51.0. Two of the maximum concentrations were detected in another sample, G32-SD312-0.51.0. Both of these samples were collected from the deeper sample interval, 0.5 to 1.0 feet.

Reference concentrations for the following elements were exceeded in the following number of samples collected in the Stillwater basin area: aluminum (four samples), arsenic (four), barium (four), beryllium (three), calcium (four), chromium (four), copper (four), iron (four), lead (four), magnesium (four), manganese (four), mercury (two), nickel (three), potassium (four), sodium (four), vanadium (four), and zinc (four).

ERL criteria were exceeded for the following elements and corresponding samples: copper (two samples), lead (two), and mercury (two).

The ERM criteria were not exceeded for any elements.

Petroleum Hydrocarbons

The range of TPH detected in sediment samples collected in the Stillwater basin area was 230 to 76 mg/kg. The maximum TPH concentration (230 mg/kg) was detected in sample G32-SD316-0.51.0. GRO was not detected in sediments collected in the Stillwater basin area.

AVS/SEM and TOC

All SEM/AVS ratios in the Stillwater basin samples were <1, indicating that bioavailablility of metals in this area is restricted. Ratios ranged from 0.46 µmo/g to 0.033 µmo/g.

TOC concentrations detected in the stillwater basin were all above 5,000 mg/kg, indicating that the presence of organic carbon in this location is potentially inhibiting the transport of PAHs and PCBs. All four samples had TOC concentrations that exceeded the reference TOC concentration with the maximum concentration, 20,000 J mg/kg, detected in sample G32-SD316-000.5.

Summary

The presence of elevated concentrations of PCBs, PAHs, and metals in this area could be related to a number of factors. First, this has been a relatively protected area since the 1940s, with the breakwater providing a depositional zone for sediments in a down-bay transportation route. However, it was also constructed to be a loading-and-unloading area, and material was likely regularly lost over the side over the course of construction and operations of Gould Island facilities. Finally, a PCB removal was conducted at the former rigging storage building in 1999-2000, and the PCBs found at station SD312 may be a result of a portion of this release. Finally, as noted on figures in this section, the rigging platform has failed overtime, the retaining seawall has released backfilled soil to the subtidal slope, and concrete and metal debris are present on the bottom of the Stillwater area (refer to photography, Appendix E-2).

4.4.6 Southern Shoreline

Eight samples (G32-SD301-000.5, G32-SD301-0.51.0, G32-SD303-000.5, G32-SD303-0.51.0, G32-SD311-000.5, G32-SD311-0.51.0, G32-SD314-000.5, and G32-SD314-0.51.0) were collected from the subtidal area along the southern shoreline, on both east and west sides of the island (Figure 4-3C). Data from analysis of these sediment samples are provided in Table 4-4B.

VOC

Two VOCs were detected in samples collected along the southern shoreline. Acetone was detected at a maximum concentration of 230 J µg/kg and carbon disulfide was detected at a maximum concentration of 3 J µg/kg, both in sample G32-SD311-000.5. Acetone is a common laboratory solvent and carbon disulfide is a common material associated with manufacturing processes, but can also be found naturally in coastal and ocean waters (ATSDR, 2005).

SVOCs/PAHs

In samples collected along the southern shoreline, the highest concentrations of all SVOCs, except two, were present in sample G32-SD303-000.5 collected at the midpoint of the eastern shoreline. This sample was located in a relatively hard bottom location adjacent to bedrock outcroppings evident on the shoreline.

Elevated levels of SVOCs were also detected in one sample station with samples collected from the surface and at depth. This station was located at the southwestern end of the island and in an area of depositional sediments.

Twenty-three of the 24 maximum SVOC concentrations detected in sediment along the southern shoreline were detected in sample G32-SD303-000.5, and most of these were of PAHs. Other compounds detected in station SD308E included 1,1-biphenyl, bis(2-ethylhexyl)phthalate, carbazole and dibenzofuran. Analytical results detected 4-methylphenol and phenol in sample G32-SD301-000.5.

Reference concentrations were exceeded in all eight sediment samples collected on the southern shoreline for the following compounds: anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, high molecular weight PAHS, low molecular weight PAHs, and pyrene.

ERL criteria were exceeded in sample G32-SD303-000.5 for 12 compounds, in samples G32-SD301-000.5 and G32-SD3010.51.0 for seven compounds each, in samples G32-SD314-000.5-AVG and G32-SD314-0.51.0 for four compounds each, and in sample G32-SD311-000.5 for one compound. ERL criteria were exceeded for the following compounds for the corresponding number of samples: 2-methylnaphthalene (one sample), acenaphthene (five), anthracene (five), benzo(a)anthracene (three), benzo(a)pyrene (one), chrysene (one), dibenzo(a,h)anthracene (one), fluoranthene (four), fluorene (five), naphthalene (one), phenanthrene (five), and pyrene (three).

In sample G32-SD303-000.5, the ERM criteria were exceeded for six compounds. ERM criteria were exceeded for the following compounds for the corresponding number of samples: acenaphthene (one sample), anthracene (one), benzo(a)anthracene (one), fluorene (one), phenanthrene (one), and pyrene (one).

Pesticides/PCB

Analytical results of the eight samples collected from this portion of the site indicated the presence of four pesticides and one PCB Aroclor. Aroclor-1260 was detected in three samples, two from station SD303 and one from station SD314. Samples in which pesticides were detected included G32-SD301-000.5 (beta-BHC) and G32-SD-314-000.5-AVG (endosulfan sulfate, endrin ketone, and gamma-Chlordane). Aroclor-1260 and total Aroclor were detected at a maximum concentration of 230 µg/kg in sample G32-SD314-000.5-AVG.

ERL criteria were exceeded in three samples for total Aroclor. ERM criteria were exceeded in one sample (G32-SD314-000.5-AVG) for total Aroclor.

Metals

Fourteen of the maximum concentrations detected in sediment samples collected along the southern shoreline were detected in one sample station, SD303, located midway along the east shoreline. The maximum concentrations of the 19 metals present in subtidal sediment collected along the southern shoreline were detected in the following samples: G32-SD303-000.5 (aluminum, chromium, iron, magnesium, manganese, potassium, thallium, vanadium, and zinc), G32-SD303-0.51.0 (barium, calcium, cobalt, and sodium), G32-SD311-0.51.0 (antimony, arsenic, copper, cyanide, and lead), G32-SD311-000.5 (beryllium), and G32-SD314-0.51.0 (nickel).

Reference concentrations for the following elements were exceeded in the following number of samples collected along the southern shoreline: aluminum (five samples), antimony (one), barium (two), beryllium (one), calcium (six), chromium (four), copper (two), iron (eight), lead (four), magnesium (four), manganese (eight), nickel (four), potassium (two), vanadium (eight), and zinc (two).

No ERL or ERM criteria exceedances were noted in the southern shoreline sediment samples.

Petroleum Hydrocarbons

The range of TPH detected in subtidal sediment samples along the southern shoreline was 33 J to 14 J mg/kg. The maximum TPH concentration (33 J mg/kg) was detected in sample G32-SD301-000.5 collected on the southwestern corner of Gould Island in an area of depositional sediment. GRO was not detected in subtidal sediments along the northwestern shoreline.

AVS/SEM and TOC

All SEM/AVS ratios in sediment samples collected along the southern shoreline were <1, indicating that bioavailablility of metals in this area is restricted. Ratios ranged from 0.45 to 0.1085.

TOC concentrations detected in samples collected along the southern shoreline were all above or equal to 5,000 mg/kg, indicating that the presence of organic carbon in these locations are potentially inhibiting the transport of PAHs and PCBs. Three of the eight samples had TOC concentrations that exceeded the reference TOC concentration.

Summary

Chemical constituents in the samples collected from the southern shoreline of Gould Island indicate overall improved conditions from those detected in the northern areas. The presence of cyanide in the sample

collected at station SD311 maybe an artifact of the landfill on the RIDEM-owned portion of Gould Island. There were reports in historical records that electroplating wastes were disposed of in this landfill (Appendix A). Cyanide was also detected in station SD301, south of station SD311. The occurrence of cyanide at this station may also be related to historic Naval operations previously located at this end of the island. PAHs in this area are more within the range of reference conditions. Low concentrations of PAHs were detected in the depositional areas in the south shoreline of the island.

4.4.7 Sediment Reference Samples

Concentrations of contaminants measured in the sediment samples were compared to the average concentration of 11 reference samples, collected as part of the Derecktor Shipyard and McAllister Point Landfill investigations conducted in 2004 (TtNUS, 2004A and TtNUS, 2004B). Gould Island sediment sample concentrations and reference sample concentrations are compared for 11 SVOCs, 22 metals, TOC, and AVS/SEM. No reference comparisons are made for VOCs, pesticides, Aroclors, TPH, or GRO analytes because these analyses were not conducted for the reference samples.

Data for the reference sediment samples are presented in Appendix F6-D. Figure F-6-1 presents the locations of these sample stations. Most reference sample stations are located on the east shoreline of Jamestown Island, and two are located in Castle Hill Cove, a depositional cove on the southern extreme end of Brenton Cove (a.k.a. Newport Harbor).

A comparison of the NOAA ERL and ERM values to the reference concentrations measured shows that the averages of the reference concentrations measured at these stations do not exceed any of the ERL or ERM values published by NOAA (compare “Ref” column to ERL and ERM columns on Table 4-4A and 4-4B). Comparison of the NOAA values to individual concentrations measured as shown in Appendix F6-D shows that none of the reference samples exceeded any of the ERM values. However, at one reference sample station, concentrations of arsenic, copper, lead, mercury, and zinc, as well as several PAHs and total PCBs exceeded the associated ERL values for these constituents (DSY-SD-CH01, located at Castle Hill Cove). These exceedances are minor, and are indicative of background metals and anthropogenic contaminants that are present in depositional areas of Narragansett Bay. High molecular weight PAHs were found to exceed the NOAA ERL value at a second reference sample station, at Jamestown’s Cranston Cove (2,461 µg/kg, at MCA-JCC-D-01). This also is a very minor exceedance of the NOAA value.

The NOAA ERL values are concentrations of contaminants below which adverse effects rarely occur. ERM values are concentrations of contaminants above which effects frequently occur. These values are generally accepted for comparison of chemical data, but are not standards that must be met.

4.4.8 Sediment Summary

In the intertidal sediment samples collected, the following constituents were found to exceed NOAA screening criteria:

- PAHs (10 compounds)
- Gamma-chlordane
- PCBs
- Antimony
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel

In the subtidal sediment samples collected, the following constituents were found to exceed NOAA screening criteria:

- PAHs (13 compounds)
- DDE
- DDT
- Gamma Chlordane
- PCBs
- Antimony
- Cadmium
- Copper
- Lead
- Mercury
- Nickel

4.5 BIOTA INVESTIGATION

Natural populations of hard clams and blue mussels were collected as part of the marine sampling effort for the Gould Island RI. Hard clams (*Mercenaria mercenaria*) or blue mussel (*Mytilus edulis*) were collected at eight intertidal and 13 subtidal stations. The discussion of the biota analytical results is organized by Gould Island geographic areas and tidal zone the samples where collected. Geographic areas include the

northeastern shoreline, the northwestern shoreline, the Stillwater basin, and the southern shoreline. Tidal zones include the intertidal and subtidal zones. Sample locations are illustrated on Figures 4-AA, 4-4B, and 4-4C.

Sample location identifiers include the site identifier (G32), the sample matrix (ET), the sample location (i.e.: 301), and the sample collection date (i.e.: 090105). Samples were analyzed for SVOCs/PAHs, pesticides/PCBs, TCL metals, and percent lipids. Analytical results for field duplicate samples were averaged with the original sample results. Sample stations where this calculation was performed are identified with the suffix "-AVG". Analytical results for clam and mussel samples are presented in Tables 4-4A and 4-4B.

TtNUS performed a Tier II data validation on the analytical results. Analytical results for several substances were qualified due to limitations discovered during the data validation process. Sample results qualified with a "J" are considered approximate because of limitations identified during data validation. The qualifier "EB" denotes that possible field contamination detected in the rinsate blank. Positive results for samples qualified this way may be biased high or be a false positive. Non-detected results for SVOCs 2,4-dinitrophenol and 4,6-dinitro-2-methylphenol were rejected (R) in all tissue samples due to poor laboratory control sample/laboratory control sample precision.

4.5.1 Northeastern Intertidal Biota

Mussels were collected from four biota sample stations (G32-ET304F-090205, G32-ET305F-090105, G32-ET309F-090105, and G32-ET310F-090105) and clams were collected from one biota sample station (G32-ET306F-090105) adjacent to former discharge pipes located along the northeastern intertidal shoreline (Figure 4-4A). Data from analysis of mussels are provided in Table 4-5A. Data from analysis of clams are provided in Table 4-5B. This area is closest to Building 32, and is presumed to receive discharges from floor drains, storm drains, and waste handling systems in Building 32.

SVOCs/PAHs

Five SVOCs were detected in biota samples collected from the northeastern shoreline. PAHs were predominantly detected in mussel sample G32-ET304F-090205, collected at the southernmost sample station along this shoreline. The maximum concentrations of these SVOCs were present in the following samples: G32-ET304F-090205 (fluoranthene, isophorone, and pyrene), G32-ET310F-090105 (2-methylphenol), and G32-ET306F-090105 (benzaldehyde).

Pesticides/PCBs

One pesticide and one PCB Aroclor were detected in mussel samples collected along the northeastern shoreline. Endrin was detected in one sample (G32-ET305F-090105). Aroclor-1260 was detected in two samples, at a maximum concentration of 160 µg/kg in sample G32-ET304F-090105. The other PCB detection was in sample G32-ET305F-090105 (98 µg/kg).

Metals

Twelve metals were detected in biota samples collected from the northeastern intertidal shoreline. Of these metals, lead was only detected in one sample (mussel sample G32-ET304F-090205) and chromium was detected in two samples (mussel sample G32-ET305F-090105 and clam sample G32-ET306F-090105). The maximum concentrations of the 12 metals were detected in the following samples: G32-ET309F-090105 (arsenic, magnesium, sodium, and vanadium), G32-ET310F-090105 (cadmium and zinc), G32-ET306F-090105 (calcium, chromium, and thallium), and G32-ET304F-090205 (iron, lead, and potassium).

Percent Lipids

Percent lipids results ranged from a maximum of 1.6 percent (mussel sample G32-ET310F-090105) to a minimum of 0.2 percent (clam sample G32-ET306F-090105).

Summary

The presence of Aroclor-1260 in the mussel sample taken at stations ET304F and ET305F indicates that the PCBs in the sediment are being taken up by local shellfish. Concentrations of metals do not appear elevated, and do not show a specific distribution toward any particular station within this area.

4.5.2 Northeastern Subtidal Biota

Clams were collected from six biota sample stations (G32-ET304-082905, G32-ET305-082905-AVG, G32-ET306-090105, G32-ET307-090105, G32-ET309-090105, and G32-ET310-090105) along the northeastern subtidal shoreline (Figure 4-4B). This area is close to Building 32, and is presumed to receive discharges from floor drains, storm drains, and waste handling systems in Building 32. Data from analysis of clams is provided in Table 4-5B.

SVOCs/PAHs

Three SVOCs were detected in clam samples collected along the northeastern subtidal shoreline. Benzaldehyde was the most predominant compound and was detected in all six samples, at a maximum concentration of 27,000 JEB µg/kg. 4-chloro-3-methylphenol and bis(2-ethylhexyl)phthalate were detected once in G32-ET309-090105 and G32-ET304-082905, respectively.

Pesticides/PCBs

Three pesticides and one PCB Aroclor were detected in clam samples collected along the northeastern subtidal shoreline. Two of the pesticides, beta-BHC and gamma-BHC (Lindane), and Aroclor-1260 were detected in one sample (G32-ET304-082905). The third pesticide, endrin aldehyde, was detected once in sample G32-ET310-090105.

Metals

Seventeen metals were detected in clam samples collected from the northeastern subtidal shoreline. Of these metals, lead was only detected in one sample (G32-ET305-082905-AVG) and chromium, cobalt, copper, mercury, and nickel were detected in two samples (G32-ET304-082905 and G32-ET305-082905-AVG). The maximum concentrations of the 17 metals were detected in the following samples: G32-ET307-090105 (arsenic, beryllium, cadmium, and manganese), G32-ET305-082905-AVG (calcium, chromium, copper, iron, lead, and vanadium), G32-ET304-082905 (cobalt, mercury, nickel, and sodium), and G32-ET306-090105 (magnesium, potassium, and zinc).

Percent Lipids

Percent lipids results ranged from 1.1 percent (G32-ET310-090105) to 0.5 percent (G32-ET307-090105).

Summary

The presence of Aroclor-1260 in clam samples taken at station ET304 indicates that PCBs in the sediment are being taken up by local shellfish. Concentrations of heavy metals in clams appear to show some correlation to sediment station SD305, which is near the former outfall from the electroplating shop.

4.5.3 Northwestern Intertidal Biota

Mussels were collected from three biota sample stations (G32-ET302F-090205, G32-ET308F-090205, and G32-ET313F-090205) located adjacent to former discharge pipes on the northwestern intertidal shoreline (Figure 4-4A). Mussel tissue data is provided in Table 4-5A.

SVOCs/PAHs

Two SVOCs were detected in mussel samples collected from the northwestern intertidal shoreline. 2-methylphenol was detected in each sample at a maximum concentration of 600 J µg/kg and benzaldehyde was detected in two samples at a maximum concentration of 2,400 JEB µg/kg.

Pesticides/PCBs

No pesticides or PCBs were detected in the mussel samples collected from the northwestern intertidal shoreline.

Metals

Eleven metals were detected in mussel samples collected from the northwestern intertidal shoreline. Beryllium and thallium were detected in one sample, G32-ET302F-090205. The maximum concentrations of the 11 metals were detected in the following samples: G32-ET308F-090205 (arsenic, cadmium, vanadium, and zinc), G32-ET302F-090205 (beryllium, iron, potassium, and thallium), and G32-ET313F-090205 (calcium, magnesium, and sodium).

Percent Lipids

The percent lipids results were similar among these samples. The maximum percent lipids result was 0.5 percent in sample G32-ET302F-090205.

Summary

Lack of detected heavy metals in mussel tissue samples indicates concentrations of these contaminants found in sediment are not being taken up by shellfish in this area.

4.5.4 Northwestern Subtidal Biota

Clams were collected from three biota sample stations (G32-ET302-082905, G32-ET308-082905, and G32-ET313-082905) located on the northwestern subtidal shoreline (Figure 4-4B). Data from analysis of clam tissue samples collected are provided in Table 4-5B.

SVOCs/PAHs

One SVOC, benzaldehyde, was detected in each of the clam samples collected from the northwestern subtidal shoreline. This compound was detected at a maximum concentration of 8,700 JEB in sample G32-ET302-082905.

Pesticides/PCBs

No pesticides or PCBs were detected in the clams samples collected from the northwestern subtidal shoreline.

Metals

Sixteen metals were detected in clam samples collected from the northwestern subtidal shoreline. Beryllium was detected in one sample (G32-ET302-082905) and mercury was detected in two samples (G32-ET302-082905 and G32-ET313-082905). The maximum concentrations of the 16 metals were detected in the following samples: G32-ET302-082905 (arsenic, beryllium, calcium, cobalt, copper, mercury, nickel, potassium, vanadium, and zinc), G32-ET313-082905 (cadmium and manganese), and G32-ET308-082905 (chromium, iron, magnesium, and sodium).

Percent Lipids

Percent lipids results were similar to those detected at other locations, ranging from 0.8 to 0.6 percent.

Summary

Low concentrations of heavy metals were detected in the clam samples collected from stations ET302 and ET308. Sediment station SD313, located approximately 100 feet north of SD302 and SD308, showed elevated concentrations of heavy metals.

4.5.5 Stillwater Basin

Mussels were collected from one biota sample station in the Stillwater basin area (Figure 4-4B). This biota sample had some of the highest concentrations of contaminants in comparison to other biota samples collected as part of the Gould Island RI. Clams were not found in this area. Data from analysis of mussels is presented in Table 4-5A.

SVOCs/PAHs

Nine PAHs were detected in the mussel sample collected from the Stillwater basin area, more than were detected in any other biota sample collected as part of the Gould Island RI. The PAHs detected included: anthracene, benzaldehyde, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene.

Pesticides/PCBs

One pesticide, gamma-Chlordane (8 J µg/kg) and one PCB Aroclor, Aroclor-1260 (440 µg/kg) were detected in the mussel sample collected from the Stillwater basin.

Metals

Twelve metals were detected in the mussel sample collected from the Stillwater basin area. These metals included arsenic, calcium, chromium, cobalt, copper, magnesium, manganese, mercury, potassium, sodium, vanadium, and zinc.

Percent Lipids

The percent lipids result was 1.2 percent for the mussel sample collected in the Stillwater basin area.

Summary

Presence of Aroclor-1260 in the mussel tissue sample collected from this area indicates that the shellfish are taking up PCBs found at this location in the sediment. PAHs, also found in mussel tissue are typically metabolized and do not bioaccumulate.

4.5.6 Southern Shoreline

Clams were collected from three biota sample stations (G32-ET301-090205-AVG, G32-ET303-090105, and G32-ET311-090205) located in subtidal portions of the southern shoreline (Figure 4-4C). Data from analysis of clams is presented in Table 4-5B.

SVOCs/PAHs

Two SVOCs were detected in clam samples collected from the southern shoreline samples. 2,4-dimethylphenol was detected only in sample G32-ET311-090205 at a concentration of 2,000 J µg/kg and benzaldehyde was detected in all three samples at a maximum concentration of 37,000 JEB µg/kg in sample G32-ET303-090105.

Pesticides/PCBs

No pesticides or PCBs were detected in the clam samples collected from the southern shoreline.

Metals

Eleven metals were detected in clam samples collected from the southern shoreline. Beryllium and vanadium were detected in one sample (G32-ET303-090105) and chromium was only detected in one sample (G32-ET311-090205). The 11 metals present in the clam samples were detected in the following samples: G32-ET303-090105 (arsenic, beryllium, cadmium, calcium, manganese, vanadium, and zinc) and G32-ET311-090205 (chromium, magnesium, potassium, and sodium).

Percent Lipids

The maximum percent lipids result detected was 1.1 percent in sample G32-ET303-090105.

Summary

Distribution of chemical constituents in this area do not indicate any contaminant uptake based on the data collected. Low concentrations of cadmium and chromium were detected in separate samples in different areas, however these do not show correlation to sediment conditions found.

4.6 SUMMARY OF NATURE AND EXTENT OF CONTAMINATION

This section presents a summary of findings, correlated with soil gas data collected prior to the RI.

4.6.1 Soils

Eighteen surface soil samples were collected across the site from a depth of 0 to 2 feet bgs. Fifty-one subsurface soil samples were collected from 34 borings, at depths ranging from 2 to 54 feet bgs. Nineteen subsurface soil samples were collected from test pits excavated in various locations at the site. The following constituents were detected in the surface and/or subsurface soils at concentrations which exceeded RIDEM Industrial/Commercial and/or Residential Direct Exposure Criteria:

- PAHs (14 compounds)
- TPH, Reported as Diesel-Range Organics
- Antimony (subsurface soil only)
- Arsenic (subsurface soil only)
- Beryllium (subsurface soil only)
- Cadmium (subsurface soil only)
- Lead (subsurface soil only)
- Manganese (subsurface soil only)

Trichloroethene (TCE) was detected in 15 soil samples at eleven locations at levels that do not exceed RIDEM criteria. These locations do not show a clear concentration gradient or distribution pattern, but show evidence of solvent use in the electroplating room and at the northwest corner of Building 32. The presence of TCE at the northwest corner of Building 32 coincides with findings from a soil gas study by Quad Three Group (Q3G), conducted in 1994, showing low levels of TCE in the soil gas at the northwest corner of the site. This soil gas study was extended to the south throughout the building footprint as part of the SASE in 2000, and this second study did not show widespread TCE contamination at the site. The presence of low concentrations of TCE found in soil samples from various locations throughout the site indicates an on-site use of TCE, but no major release area and no excessive concentrations present in the subsurface at the site.

Other VOCs were found in soil and fill within the sumps in the building slab (TP-06, SB-318, SB 317), also at levels below RIDEM criteria. Isopropylbenzene was found northwest of the northwest corner of Building 32 and in soils at the southwest corner of Building 32.

SVOCs detected at levels exceeding RIDEM criteria were limited mostly to PAHs, with highest concentrations found in samples from SB306B (adjacent to the former fuel USTs, 10 to 12 feet bgs) and SB333 (in the sump

under the former sand blasting booth, 4 to 6 feet bgs). PAHs were found to be present in the site soil and in sumps and vaults within the Building 32 foundation exceeding the RIDEM Direct Exposure Criteria for residential and industrial use. Test pits TP-06 and TP-08 had the highest PAH concentrations. The presence of PAHs in test pits TP-06, TP-08, and TP-09 is consistent with field observations of residual petroleum in soil in these excavations.

It should be noted that there are no RIDEM criteria for detected Pest/PCBs, with the exception of Dieldrin, and Total Aroclors. However, PCBs were detected at concentrations below these criteria (concentrations ranging from 40 µg/kg to 700 µg/kg) in 14 samples collected. Six of the 14 samples where PCBs were detected were collected from within trenches, filled during demolition of the building. Three of the samples with PCB detections coincide with former transformer buildings where PCB removals were conducted, and two more are nearby and downgradient (TP-09 and TP-05). The remaining three locations (SB322, SB306 and SB310) are not associated with known PCB sources.

Where present, pesticides were generally associated with fill within the trenches, backfilled during the demolition of the building. Source of these pesticides is unknown at this time.

Petroleum hydrocarbons (primarily DRO) were detected in all test pit soil samples, with a maximum concentration of 4,800 mg/kg at TP-06. The Industrial/Commercial Direct Exposure Criteria for DRO was exceeded at TP-06 and TP-10B. Elevated concentrations of petroleum (DRO) were also found in the former location of the Building 44 USTs (SB306B, 1300 mg/kg).

Elevated levels of several metals associated with electroplating operations (cadmium, copper, chromium, lead, nickel, zinc) were found in the soils collected near the dust collection storage shed (TP-09) and in the soil sample collected from 4 to 6 feet bgs at SB333, within the sump under the former Sand Blasting Booth. A soil sample from test pit TP-09 had the highest metal concentrations, including lead at 2,700 mg/kg and cadmium at 5,670 mg/kg, both exceeding the RIDEM Industrial/Commercial Direct Exposure Criteria, together with arsenic. The presence of maximum concentrations of heavy metals in test pits TP-06 and TP-09, such as arsenic, cadmium, chromium, lead, and copper, is possibly a result of sandblasting, dust storage, or electroplating chemical storage or disposal in these areas.

Cyanide was reported present at very low levels in two soil samples (SB316, SB319), collected alongside the waste drain line from the Sand Blasting Booth toward TP-02 and the eastern outfall. The highest concentration was 0.54 mg/kg. Cyanide was not detected in any test pit soil sample collected during the investigation.

4.6.2 Manholes

The high concentrations of xylenes and petroleum hydrocarbons (GRO and DRO) detected in the LNAPL sample from manhole MH-01 corroborate suspected petroleum contamination in this manhole based on field observations discussed in Section 2.3. The chamber under MH-01 is a waste discharge sump discussed further in Section 5 of this report. Fuels appear to have accumulated in this sump which were removed and disposed of as described in Section 2.3.2.3.

Petroleum-related contaminants (DRO and PAHs), pesticides and one PCB Aroclor, as well as other compounds which are possibly artifacts of coal tar and plastics were detected in the soil/sludge sample collected from manhole MH-01. In addition, heavy metals including cadmium, copper, chromium, nickel, and lead were detected at high concentrations in the sludge from MH-01. These organic compounds and metals were also detected at lower concentrations in the soil sample collected from manhole MH-05, which corroborates the suspected connection between these manholes based on field observations discussed in Section 2.3.

The presence of heavy metals and PAHs in aqueous samples from manholes MH-02 and MH-03 is likely an artifact of past site operations. These contaminants may have been entrained in precipitation runoff and distributed into manholes MH-02 and MH-03. However, the observed concentrations do not indicate that these manholes were part of a release area or a migration pathway.

4.6.3 Groundwater from Wells and Aqueous Samples from Test Pits

The following constituents, VOCs, were detected in groundwater at concentrations above drinking water criteria:

- Tetrachloroethene
- Pentachlorophenol

Low concentrations of VOCs were detected in several monitoring wells across the site, with no discernable distribution pattern. Highest concentrations included tetrachloroethene (PCE) at MW-300S at 6J µg/L, which exceeded the GA Groundwater Objective and MCL. TCE, toluene and other VOCs were detected at various locations at the site. Fuel components (benzene, toluene, and xylenes) were detected in water samples from test pits TP-06 and TP-08 and are likely artifacts of the fuel releases in these areas. 2-Butanone and acetone were also detected, but are considered common artifacts of laboratory analysis and their presence in samples collected at the site are not likely representative of water that had collected in the test pits.

SVOCs, primarily PAHs and phenolic compounds, were found in the site groundwater at concentrations exceeding upgradient groundwater concentrations. Pentachlorophenol was detected in monitoring well MW-306S exceeding the GA Groundwater Objective and MCL. Monitoring wells MW-301S (upgradient of the site) and MW-306S (at the former Building 44 UST location) contained the highest concentrations of SVOCs detected onsite. Test pits TP-06 and TP-08 had the highest PAH concentrations and the greatest distribution of non-PAH SVOCs. PAHs were found in water taken from test pits TP-10, TP-11, and TP-13, excavated into the "trench drain" south of Building 32. PAHs detected in the aqueous sample collected from test pit TP-02 are likely the result of the wash water that contained an oily sheen from the drain line that exited the building foundation and originated from manhole MH-01.

Pesticides and PCBs were detected in aqueous samples collected from test pits TP-06 and TP-08 at trace concentrations. The presence of Aroclor 1260 in test pit TP-08 is likely an artifact of the nearby former transformer (Building 56).

A low concentration of petroleum measured as DRO (0.49 mg/L) was detected in the groundwater sample taken from the former location of USTs at the north end of Building 32. The trace level of petroleum in this monitoring well is likely a remnant constituent from the historic fuel release that occurred at Building 44. The groundwater sample collected from monitoring well MW-304S contained petroleum measured as GRO (0.05 mg/L); this analyte was not detected in any other monitoring well. GRO and DRO were also detected in water taken from test pits TP-06 and TP-08. These findings corroborate indications of petroleum (sheens and odors) found during test pit excavation in these areas.

Metal concentrations were generally comparable between groundwater samples from onsite monitoring wells, and generally elevated compared to upgradient levels. Metals concentrations reported in aqueous samples from test pits were higher than in groundwater monitoring well samples, likely due to the suspended soils stirred up during excavation. Groundwater data collected from monitoring wells should not be compared with data from water standing in excavations. In general the aqueous sample from test pit TP-05 had the lowest metal concentrations, and test pit TP-08 had the highest metal concentrations. Higher concentrations of salts (calcium, magnesium, potassium, and sodium) in groundwater may be a result of a hydraulic connection with sea water from the bay. The high residual sodium in TP-05 indicates that this area is tidally impacted.

Cyanide was not detected in any of the groundwater samples collected during the investigation.

Drinking water criteria for metals were not exceeded in any of the groundwater samples collected from monitoring wells or test pits during the investigation.

4.6.4 Concrete

Two concrete samples (plus one duplicate) were collected from the north end of Building 32 to evaluate possible impacts from a former above-ground storage tank, and possible PCB switching equipment in this area. No PCBs were detected in either of the samples collected. The presence of acetone and methylene chloride in concrete samples is likely a laboratory artifact as these chemicals are commonly used as laboratory solvents. Carbon disulfide, toluene and methylcyclohexane, also detected at trace concentrations, may have been used in shop areas for parts cleaning or other purposes.

Low concentrations of PAHs were also reported in the concrete samples. The concrete floor of the building was once covered with a wood parquet mat to provide a non-conductive surface to the factory floor. It is unknown if this material was treated with preservatives such as creosote, containing a mix of PAHs which would have been common at the time of construction, or if the PAHs in the concrete are a result of use of these materials in the overhaul shop operations. Such preservatives could have entrained themselves over time into the surface concrete, resulting in such a signature in the concrete samples.

4.6.5 Sediment and Biota

Sediment data collected indicate concentrations of elevated metals, PAHs and PCBs at some sample locations along the shoreline and in the subtidal sediment. These are identified as the Stillwater area to the north of the site, the northeast shoreline, which received waste discharges from Building 32 operations, and, to a lesser degree, the northwest shoreline, which also received waste discharges from Building 32 operations.

PCB concentrations were noted to be highest in the Stillwater area, north of the site. PCBs detected in the sediments and in the soil at the site included primarily Aroclor 1260, and to a lesser extent Aroclor 1254. The PCBs in sediment were identified mostly as Aroclor 1260. Concentrations of Aroclor 1260 in all sediment samples collected by TtNUS were mapped together with data collected by the USEPA in 2003 (refer to Appendix B). The concentrations and extent of total Aroclor measured in these data sets are presented in Figure 4-5. The concentrations and extent of Aroclor 1260 measured in these data sets are presented in Figure 4-6.

Data presented on these figures indicate a concentration gradient from highest concentrations in the north areas to lower concentrations to the south. However, it is recognized that there is no available data north of Station SD-416, and additional information from the northern sections of the Stillwater area, and data north of that location may be necessary to confirm this observation. A review of Figures 4-5 and 4-6 also indicates that most of the PCBs in the sediment are Aroclor 1260. Review of the Draft Project Closeout Report for PCB-contaminated Soils and Concrete Remediation (TtFW 2004), indicates that Aroclor 1260 was also the PCB

mixture found in soil and concrete near Buildings 53, 54, 56, 59, 60, and 61. It is reasonable to conclude that the Aroclor 1260 PCBs present in the sediment are likely a result of these on-shore releases.

Biota samples from stations ET-304 (clams) and ET-312 (mussels) show that in these areas where the highest concentrations of PCBs were found in sediments, these PCBs are being accumulated to some degree in the bivalve tissues.

Metals and cyanide were found in sediment locations where outfalls once discharged to the subtidal shoreline. The elevated concentrations of heavy metals present in the sediment near existing and historic outfalls can be traced back through pipeline transport from the electroplating rooms and dust storage shed, where high concentrations of heavy metals were found in soil samples. However, cyanide was also found in SD-311, the subtidal sediment sample collected near the former landfill at Gould Island, indicating a second possible source of cyanide.

PAHs in sediment may be a result of former use and release of naptha, oils and general degreasing operations in the overhaul shop, or they may be a remnant of fuel piping and storage at Building 44. PAHs were found in sumps and vaults within the Building 32 foundation, and some of these sumps were previously noted to have floor drains that connected to the drains exiting to the northeast shoreline. PAHs near some outfall locations (SD-304 and SD-305) are likely a result of fuels present in soil at the southwest corner of Building 32, which were transported to the shoreline through pipelines and sewer systems.

Evaluation of toxicity and effects from these contaminants is presented in Sections 6 and 7 of this report. Likely fate and transport mechanisms available to these contaminants are described in Section 5.

5.0 CONTAMINANT FATE AND TRANSPORT

Activities associated with former site operations have resulted in the presence of VOCs, SVOCs, pesticides and PCBs, petroleum hydrocarbons, metals, and cyanide in site soils and adjacent marine sediments. Additionally, VOCs, SVOCs, petroleum hydrocarbons, and metals were detected in the site's groundwater at low concentrations compared to the Groundwater Objectives for GA aquifers established in the RIDEM Remediation Regulations and to federal Maximum Contaminant Levels (Section 4.2).

The transport and ultimate fate of the contaminants detected onsite are governed by a variety of physical, chemical, and biological processes that are dependent upon the properties of both the contaminants and the media into which they are released. A qualitative evaluation of contaminant fate and transport is presented in this section based on existing site conditions, interpretations of chemicals presence in the environmental media, physical state of soil and groundwater contaminants, general fate and transport mechanisms, and the interpretation of the site's geologic and hydrogeologic conditions. Significantly more information would be required to provide definitive quantitative analyses.

Section 5.1 presents a summary of the contaminants present at the site. Section 5.2 summarizes the general fate and transport processes and contaminant properties that influence fate and transport. The probable contaminant fate and of each group of contaminants found at the site are discussed in some detail in Sections 5.2 through 5.6. Section 5.7 presents a summary of these evaluations.

5.1 OVERVIEW OF CONTAMINANTS AT SITE 17

Chemical contaminants were found in soil both under the building foundation, near the foundation on the south west corner of Building 32, in a former tank location north of Building 32, and in sumps and vaults within the foundation of Building 32. From these locations, contaminants have been transported via building drainage systems to the bay. There seems to have been very little widespread contamination, and these drainage systems appear to have been effective at directing chemical disposal to the ocean environment. Contamination in the sumps and vaults within the foundation of Building 32 appear to be largely isolated from the soils underneath. It is important to note that although soil borings were advanced through these vaults and into the soils beneath, the borings were abandoned by backfill with a cement–grout mixture, which should continue to provide a barrier to any possible migration of contamination from the vaults to the subsurface materials.

Predominant contaminants detected included PAHs, PCBs, and metals. Low concentrations of volatile organic compounds were detected in soil gas (prior studies) soil and groundwater, but these generally did not exceed screening criteria. Pesticides were also detected, but the elevated concentrations were

limited to waste material remaining in sumps and sub-slab vaults, and are not thought to be representative of site conditions.

There is evidence of a fuel release in the soil at the south west corner of Building 32. Fuels were found in the soils outside the footprint of the building, as well as within the vault under the former sandblast booth, and within the manhole MH-01. What is not clear is whether these three items are related to each other. While it appears that they may have separate origins, it is clear that the associated contaminants (PAHs and TPH) have followed separate transportation routes to the surrounding media. Contaminants outside the building are available for transport to the south and east via the “trench drain” (Section 2 of this report) and contaminants inside the building are controlled to the larger extent by the drainage systems for the building (through floor drains and toilet drains both to the east and to the north west via sewer disposal systems. These routes are detailed later in this section. As described in Section 4 of this report, LNAPL was observed on the liquid surface in manhole MH-01. Sheens were noted on pooled water inside some of the test pits excavated at the southwest corner of Building 32. NAPL was not encountered in any of the monitoring wells or test pits during the investigation.

PCBs were detected in soil on site at low concentration, and in sediments near the shoreline at elevated concentrations. The distribution of the PCBs found correlates to areas where PCBs were removed from the site in 1999-2002. The PCB removals were conducted to address transformer buildings and former releases from those buildings, however, once the cleanup goals for that project were met, the efforts were terminated. The concentrations of PCBs detected in the soil are below the cleanup goals for the previous removal actions, and those actions did not pursue PCB contamination into the marine sediment. While PCBs were not detected in groundwater collected from monitoring wells, previous samples have noted low concentrations (<1.0 mg/L) in pooled water standing in excavations conducted at PCB removal areas (Section 4.6).

Metals and cyanide were found in soil and sediment at the southwest corner of Building 32, in drainage systems from the electroplating areas of Building 32 and at the locations where these systems discharge to the bay. Metals are presumed to have originated through electroplating chemicals used and disposed of from the building systems, as well as from sandblast dust storage, and acid use and storage in the same areas.

5.2 FATE AND TRANSPORT PROCESSES

The fate and transport processes of concern with respect to the site are those that govern the migration of soil contaminants (once released or deposited) to other media (groundwater, surface water, and sediments). Once these contaminants have entered into other media, other fate and transport

mechanisms occur that may cause further chemical migration or transformations. This generalized discussion of fate and transport processes is provided so that the observed site-specific contamination conditions can be better characterized and understood.

5.2.1 General Fate and Transport Processes of Chemicals in Soil

A variety of processes occur that may cause organic and inorganic chemicals in soil to become immobilized, degraded, or to mobilize to another environmental medium. Some of these processes include leaching, erosion and volatilization.

Open Channel Flow - Open channel flow is flow of a liquid in a conduit in which the upper surface of the liquid (i.e. the free surface) is in contact with the atmosphere. A few occurrences of open channel flow are flow in sewer and other waste discharge, and storm drains, and other discharge waste drain pipes. This transportation pathway can be available to solids moved by mechanical means, as well as for liquids entering these systems through accidental or purposeful releases.

Runoff/Erosion – In situations where the chemicals remain adsorbed (bound) to soil particles because of the soil or chemical characteristics, chemicals may still be mobilized from contaminated areas to other uncontaminated environmental media. Contaminants can be conveyed over land by runoff that occurs during precipitation events (solubilized in rainwater or adsorbed to suspended particles), or through the erosion of contaminated soils that are present on unstable slopes or topographic features.

To a much lesser extent, contaminated soil particles may be mobilized by wind, wave, or gravity-induced detachment and transport. The majority of the site is covered either by grass or the concrete foundation associated with former Building 32. Therefore, the extent that soil particles may be mobilized by wind is considered to be limited.

Leaching – Chemicals may be mobilized and transported downward through the soil strata by rain water, snowmelt, or other liquids that infiltrate through the soils. The leaching of chemicals from soils and the subsequent mobilization are controlled by soil properties (i.e., adsorptive capacity, organic carbon content, clay content, or specific surface area) and by chemical properties (i.e., solubility and ability to partition to other phases).

Entrapment – Contaminants released to the ground surface may become bound to soil or other particles by advective forces or by adsorption. These bonding forces can be strong or weak, depending on the soils and the chemical constituents. In the example of a fuel oil release, some of the oil will remain trapped within the soils before it passes all the way down to the groundwater table. Thus a large release

will pass through the soil to impact the water table directly, leaving a smear zone on the soil in the release area, whereas a small release will result only in stained soils on the ground surface. Small soil particles in the saturated zone may be transported slowly with groundwater flow, depending on the size of the surrounding soils in the formation but are more likely to remain trapped within those soils. In this manner, contaminants that do not dissolve in the groundwater will likely remain bound within the soil matrix until released by a physical or chemical interruption.

Volatilization – Chemicals having high Henry's Law coefficients or vapor pressures will readily partition (volatilize) to the ambient air rather than remain associated with solid or liquid phases. Once in the air, the chemicals may undergo physical transport by advection or diffusion, or they may be transformed through chemical processes such as hydrolysis or photolysis. Volatile organic compounds include chlorinated aliphatic and aromatic hydrocarbons. The partitioning of these compounds depends not only on volatility and solubility, but on temperature, soil moisture content, and the presence of organic matter.

5.2.2 General Fate and Transport Processes of Chemicals in Groundwater

Contaminants occur in groundwater in two principal phases: dissolved (disassociated molecules) and suspended solids (adsorbed to mobile particles). These physical phases dictate how contaminants generally migrate with groundwater movement.

For chemicals that have migrated downward into groundwater from the unsaturated soils through precipitation infiltration and leaching, additional natural processes come into play that affect the contaminants' fate and transport in the subsurface environment. Geologic conditions greatly influence contaminant migration, providing physical pathways or barriers that could increase or retard migration.

The major contaminant transport processes in groundwater typically consist of advection, dispersion, and molecular diffusion. Advection, the bulk movement of groundwater, is the principal mechanism for contaminant transported in an aquifer. Dispersion and diffusion are secondary processes for dissolved contaminant transport. Two transformation processes are important in determining the ultimate fate of contaminants in groundwater: degradation and retardation. Each of the transport and transformation processes is briefly described below:

Advection - The dominant transport process in aquifers consists of the movement of dissolved or suspended phase contaminants with the bulk flow of the water. Advective transport results from the entrainment of chemicals in a flow field, and it is driven by a potential gradient, such as pressure or hydraulic head. Advection of dissolved contaminants in an isotropic, homogenous, porous medium results in the contaminants being transported with and migrating at the same velocity as groundwater.

Dispersion – Dispersion is a mixing process that results from velocity variations within bodies of moving fluids. In groundwater environments variable velocity regimes are caused by nonidealities in the media, and these nonidealities exist at a variety of scales. For example, velocity variations at the microscopic scale arise from: 1) fluids moving faster through the centers of pores than along the edges, 2) fluids moving faster through large pore spaces than through narrow ones, and 3) some fluid particles following more tortuous flow paths than others as they travel around individual soil particles. At the macroscopic scale, velocity variations result from the presence of layers or lenses of materials having contrasting hydraulic conductivities.

The mixing due to dispersion increases as aquifer heterogeneity increases, and it results in dilution of the solute body as contaminated water mixes with uncontaminated water along the margins of the plume. Dispersion also results in the spreading of a contaminant plume over a larger area (both parallel and perpendicular to the direction of flow) than would be expected by advection alone.

Molecular Diffusion – Diffusion is movement in response to a concentration gradient. Dissolved contaminants will move from areas of high concentration to areas of low concentration within an aquifer even if the groundwater is not moving, because the process is driven by the random thermal motion of the contaminant molecules. Because this transport process occurs on the molecular scale, its impact is usually small compared to the more rapid processes of advection and dispersion. Diffusion is the dominant transport mechanism only in low-permeability environment.

Retardation – In groundwater, adsorption-desorption reactions lead to retardation of the rates at which contaminants migrate with advective groundwater flow. During contaminant migration through an aquifer, an organic molecule may adsorb to stationary soil particles, to iron oxyhydroxide or to organic coating on the particles, thus slowing the chemical's transport with the groundwater flow. Only after desorption will a contaminant rejoin the groundwater flow. The retardation factor (R) is governed by the partition coefficient (Kp) of organic compounds or by the distribution coefficient (Kd) of metals between the sorbed state and the dissolved state. These coefficients are available in reference books or may be measured in the laboratory using site-specific samples.

Single parameter distribution coefficients (K_ds) are often used to quantify the tendency for a solute to sorb to media surfaces. These distribution coefficients are based on a linear model of adsorption — i.e. it is assumed the mass of solute sorbed increases in a linear fashion as the dissolved concentration of the solute increases. This assumption is reasonable for nonionic organic solutes; however, ionic solutes tend to display nonlinear adsorption behavior at high concentrations because the number of charged adsorption sites on a surface is limited. Therefore, single parameter distribution coefficients often are not adequate in describing the adsorption of ionic solutes in all but dilute solutions.

Nonionic organic solutes such as BTEX compounds and PAHs sorb primarily to organic coatings on mineral surfaces. Nonionic organic solute K_ds can be estimated from the fraction of organic carbon in the soil and the octanol-water partition coefficient (K_{ow}) of the solute. As a result, the octanol water partition coefficient can be used as an index for evaluating the relative tendencies for different organic solutes to sorb to the same surface.

Preferential Flow – In aquifer systems, preferential pathways for groundwater flow occur due to heterogeneities in the subsurface soils and the bedrock matrix. Geologic materials that are more permeable (soils or bedrock fractures) allow the preferential flow of groundwater and chemicals through those geologic units.

Non-Aqueous Phase Liquid (NAPL) Migration – Organic liquids such as jet fuel and gasoline have densities less than water and are referred to as LNAPLs (light nonaqueous phase liquids). Chlorinated solvents have densities greater than water and are examples of DNAPLs (dense nonaqueous phase liquids). The transport of NAPLs in subsurface environments is a complex process that is strongly influenced by the geology of the system. When a NAPL is spilled on the ground surface or released beneath it, the NAPL will migrate downward through the unsaturated zone toward the water table, primarily by gravity-driven flow. The presence of low permeability layers will inhibit downward migration and force the NAPL to move laterally. If the layer is continuous, downward movement may cease. If the layer is discontinuous, the NAPL will eventually spill over its edge and continue to migrate downward toward the water table.

As the NAPL moves downward, the quantity of mobile free product decreases and the quantity trapped within soil pores increases. Depending on the volume of NAPL released, it may or may not reach the water table. If the NAPL reaches the water table and its density is less than water, it will remain in pockets at the top of the water column. If the density of the NAPL is greater than water, it will continue to move downward through the water column under the influence of gravity, migrating laterally along the top of any low permeability units it encounters along the way. Once again, downward migration may cease if the low permeability stratum is continuous; otherwise, its downward migration will resume when it encounters the end of the stratum or near vertical preferential flow paths within the stratum. The direction of DNAPL transport in aquifers is driven primarily by gravity and the occurrence of relatively high and low permeability features; as a result, the direction of DNAPL transport may or may not coincide with the direction of groundwater flow. DNAPL zones in aquifers may be located upgradient or downgradient from their point of release, and in stratified media they likely consist of multiple subhorizontal pools that are resting on top of low conductivity layers. The subhorizontal pools are typically connected to one another and to a pool at the base of the aquifer by vertical DNAPL stringers.

As water moves through NAPL pools above or below the water table, the more soluble constituents partition into the water to generate a plume of dissolved contamination and the more volatile contaminants partition to the vapor phase. Depending on the local hydrogeology and the composition of the NAPL, the rate of dissolution may be so slow that the NAPL causes significant groundwater contamination for centuries or more.

Biological Degradation – Organic contaminants may be degraded by biological or non-biological means. Degradation decreases the concentration of a solute in a plume, but it does not necessarily slow the rate of plume movement.

In biological degradation (biodegradation), microorganisms utilize available chemicals to obtain needed energy and nutrients through reduction-oxidation (redox) reactions (or simply, through the transfer of electrons). Depending on the microorganisms and contaminants present, biodegradation can occur in groundwater under either aerobic or anaerobic conditions.

Under aerobic conditions, carbon (as organic compounds, whether naturally occurring or anthropogenic) is oxidized by microorganisms to provide a net energy gain that is necessary for growth and reproduction. Typically, low-molecular weight and soluble organic compounds are readily degraded by bacteria and fungi. Aromatic hydrocarbons (i.e., BTEX compounds) are used by microorganisms as a primary substrate (electron donor). Dissolved oxygen is used as the primary electron acceptor (chemical reduction) by the aerobic microorganisms.

Once the oxygen is depleted, anaerobic microorganisms (bacteria) use other available electron acceptors and causing those chemicals to be transformed to a reduced state. Nitrate is converted to nitrogen gas or ammonia, ferric iron (Fe [III]) to ferrous iron ([II]), manganese ([IV]) to manganese ([II]), sulfate to sulfide ion, chlorinated solvents to compounds with one less chlorine atom, and carbon dioxide to methane.

Through sequential reductive dechlorination of chlorinated ethenes, tetrachloroethene may be degraded to ethane through the following sequence:

- tetrachloroethene - trichloroethene - 1,1-dichloroethene; cis-1,2-dichloroethene; or trans-1,2-dichloroethene - vinyl chloride - ethene - ethane

- or vinyl chloride may degrade to complete mineralization (CO_2, H_20, and CL^-)

Through the degradation processes, chemicals that were not originally present at the site may be produced. In some cases, these daughter products may be more toxic than the original compounds released at the site.

Abiotic Degradation - Mechanisms of abiotic degradation include hydrolysis, oxidation, and reduction. Hydrolysis is the process where a chemical molecule and a water molecule are both split and recombine to form new chemicals. Oxidation consists of the loss of electrons by an organic compound or by a metal ion. Reduction is the chemical reaction whereby an organic compound or a metal gains electrons. Thus subsurface contaminants may be degraded or transformed by these abiotic processes that occur naturally. The dominance or effectiveness of these transformation processes are governed by factors such as temperature, pH, solubility, etc.

5.2.3 General Fate and Transport Processes of Chemicals in Sediment

Some processes discussed above can also affect fate and transport of chemicals in marine sediment. These processes are summarized below:

Point Source Discharge - Discharge of wastes via the outfall pipes were once likely to be a significant contaminant source to the shoreline around Gould Island. However, this was allowed and even considered the preferred method for chemical waste disposal for manufacturing processes well into the 1970s when discharges were more tightly regulated. However, residual contaminants present are not actively pumped or added to these discharge pipes at the site and therefore this pathway is considered discontinued. No material flow from the pipes was evident during the field investigation conducted at the site.

Groundwater flow – Groundwater is presumed to flow from on shore areas to the marine environment. Typically groundwater discharges to the intertidal and subtidal areas, and is influenced only by the hydraulic pressure or head from upgradient of the shoreline. Because the site is located on an island, groundwater flow from the upland areas to the shoreline is anticipated to be less than what would be seen in a mainland environment, simply because there is less upgradient influence to supply the overburden aquifer. At this site, it is reduced further, because the flow from the upland area will likely follow the steepest gradient, and therefore precipitation water added to the center of the island will shed to the east and to the west first and very little is likely to migrate over the lower gradient to the north and south.

Dissolution – Chemicals that are soluble in water that are discharged to marine sediment will be dissolved in seawater, and depending on the size and mixing of the receiving waters, they are not likely to be found at detectable concentrations. In a situation such as exists at Site 17, the discharge of groundwater is quite

small in relation to the size and dilution capacity of the receiving waters, and therefore is not anticipated to provide detectable concentrations of contaminants.

Erosion & Transport – Similar to those processes that occur in soils, chemicals that remain adsorbed (bound) to soil particles because of the soil or chemical characteristics, may remain so even in the marine environment. Chemicals that are not soluble in water and have the propensity to do so will bind to sediment particles and be transported from high energy environments (such as a wave-washed shoreline) to a low energy environment. The intertidal zone of a marine environment has a high energy level since wave action is constantly disturbing the soil matrix and pulling fine materials out. The subtidal area tends to accumulate these smaller particles to which the chemical constituents are adhered.

Once entrained in the water column, sediments are subject to the transport mechanisms governing the surface water. The water currents in the area are tidal, but also wind-driven. SAIC (1997) reported that the orientation of Narragansett Bay makes bay waters and the coastline particularly exposed to summer southerly winds, as well as winter north winds. Current patterns in the bay have been studied, and it has been reported that the winds and tide both equally direct water currents, and mixing energy, and suggest that wind events can permeate the entire water column and at times provide more force than tidal flow in the bay (Weisburg, 1976).

It has been reported that a prevailing north to south current is present in the area, although this was not clearly evident to the divers performing the work at the shoreline. Given that the bay is actually a large estuary, fed by freshwater provided via landmass on the east west and predominantly north sides, it would stand to reason that there must be a net north to south flow. If there is a prevailing current in the area these small particles will be transported downstream based on their size and density. High molecular weight PAHs and PCBs in particular exhibit this behavior in marine sediments.

Encapsulation – Once in the sediment bed, the settled particle can be eroded and transported when the shear stress exerted on the bed by waves or flows, acting either alone or together, exceed a critical minimum shear value. The critical shear stress also varies according to sediment size, mineralogy, and chemistry. If sediment is deposited in locations where the critical shear stress is not exceeded, or is exceeded only infrequently, the sediment will slowly consolidate, increasing in both density and strength. As bed density increases, so the stress threshold for erosion increases and the sediment deposit becomes more stable and less likely to be eroded by natural forces.

Sediments deposited on a seafloor can be covered in a relatively short amount of time, depending on the deposition rate in that area. Deposition rates in Coddington Cove, approximately two miles to the east were estimated at up to 2.2 cm/year (SAIC, URI 1997). Deposition at Gould Island is anticipated to be

quite a bit less, based on its location in the center of the East Passage of Narragansett Bay, which is a higher energy location. However, the presumption is that sediments liberated from the site will be dispersed to low energy areas, though if they are dispersed enough in transport they may not be found at detectable concentrations.

Biological Degradation – Once bedded into the sediment, biological processes can break down some of the chemical constituents. This process, detailed in Section 5.1.2 (above) is similar for sediment as it is for contaminants in groundwater. If anything, it is likely to occur faster in the marine environment because there is generally a higher level of microbial activity in surficial marine sediments than in subsurface soils.

Chemical Change - Sediments both in the suspended and depositional state, can undergo chemical transformations through molecular diffusion and abiotic and biotic degradation similar to those in saturated soils. In addition, the geochemical conditions of the surface water can also influence the state that the chemical exists, either in an insoluble state or in a dissolved state, or can cycle back and forth between the soluble and insoluble states.

In addition, certain contaminants may also migrate through surface water and sediments by contaminants that have accumulated in tissues of mobile biota by absorption/ingestion of contaminated sediments or contaminated surface water. Contaminants that have biomagnified or bioaccumulated through the food chain can migrate off-site with the animal.

Biological Uptake

Chemical contaminants that are lipophylic and hydrophobic may remain bound to sediment particles for extended periods of time until ingested by browsing or filter feeding organisms. Once brought into the food chain these contaminants may be accumulated in fatty tissues of animals, and passed up through the different trophic levels. PCBs and pesticides are primary examples of contaminants that can affect animals in higher trophic levels in this manner. This process is not likely to move these contaminants physically through the environment on a mass scale, however, there can be a general effect of dispersing them across a wide area as they are picked up by predators with wide feeding ranges. Accumulation effects on ecological receptors is further addressed in Section 7 of this report.

5.3 FATE AND TRANSPORT OF SELECTED VOCs

There is evidence of fuel releases in the southwest corner of Building 32 at Gould Island. Volatile components of the fuel will partition into the vapor phase and/or dissolve into infiltrating water. The

degree of partitioning depends upon the relative volatility and solubility of the constituents in the fuel. The more volatile, water soluble, and therefore mobile VOCs detected onsite consisted of petroleum-related BTEX compounds (benzene, toluene, ethylbenzene, and xylene) and chlorinated solvents such as trichloroethene and tetrachloroethene.

BTEX was detected onsite as summarized below:

- Benzene was detected in two subsurface soil samples at concentrations ranging from 3 to 120 µg/kg. The maximum concentration of benzene detected in soil was noted in the sample collected from test pit TP-06, which is within an enclosed chamber and not considered to be in contact with site soils. Benzene was detected in the groundwater sample collected from monitoring well MW-300S at 3J µg/L.

- Toluene was detected in eight subsurface soil samples at concentrations ranging from 1J to 16J µg/kg. Toluene was detected in the groundwater sample collected from monitoring well MW-300S at 1J µg/L.

- Ethylbenzene was detected in five subsurface soil samples at concentrations ranging from 1J to 99J µg/kg. Ethylbenzene was not detected in any of the groundwater samples.

- Total xylenes were detected in three subsurface soil samples at concentrations ranging from 1J to 13J µg/kg. Total xylenes were not detected in groundwater samples.

The scarcity and low concentrations of BTEX compounds in the soils, groundwater, and sediments indicate the bulk of the soluble and volatile petroleum hydrocarbons have already been removed. Apparently, nearly all of the BTEX mass in the release area has partitioned to the vapor phase or dissolved phase and has been degraded or transported out of the system, leaving behind a relatively immobile petroleum residue, evident and present as PAHs and longer chain petroleum hydrocarbons. BTEX compounds were not detected in the surface soil and sediment samples collected during the investigation.

As stated elsewhere in this report, TPH and PAHs, but not the volatile fractions of petroleum are present in the former location of the USTs at Building 44, to the north of the site. The lack of BTEX detected in groundwater in this area (MW-306S, 306B) indicates that either lighter fuels were not stored there, or any light fractions released have either attenuated or been addressed through remedial actions conducted as described in the Building 44 documentation.

Trichloroethene (TCE) was detected in 12 subsurface soil samples at concentrations ranging from 0.8J to 59 µg/kg, and three surface soil samples at concentrations ranging from 0.7J to 3J µg/kg. TCE was detected in one intertidal and one subtidal sediment location at 2J µg/kg (SD309F) and 1J µg/kg (SD306), respectively. Both sediment stations are located on the east shoreline of the site. TCE was detected in the groundwater sample collected from monitoring well MW-304S at 1 µg/L, located at the northwest shoreline of the site. The presence of the TCE in this groundwater sample, albeit minor, coincides with findings from a soil gas study by Quad Three Group, conducted in 1994, showing low levels of TCE in the soil gas at the northwest corner of the site. This soil gas study was extended to the south throughout the building footprint in 2000, and this second study did not show widespread TCE contamination at the site. The presence of low concentrations of TCE found in soil samples from various locations throughout the site indicates an on-site use of TCE, but no major release area and no excessive concentrations present in the subsurface at the site.

Two other chlorinated VOCs were detected at levels that exceeded MCLs in groundwater at the site. Pentachlorophenol (MW306S, 7µg/L) and tetrachloroethene (MW-300S, 6 µg/L) were detected in groundwater from shallow overburden wells, located in the north and east portions of the site. The VOCs were not detected in the co-located deep bedrock wells. Based on the general groundwater flow the north and east (Figures 3-6A, 3-6B), dissolved contaminants would migrate with groundwater toward the shoreline, where they would disperse through dilution, upon mixing with the waters of the Bay. As discussed in Section 3.3.6, the thick dense till layer that overlies bedrock likely impedes downward migration of contaminants into till and bedrock.

Similar to the BTEX conditions, it would appear that either very small amounts of chlorinated solvents were released at the site or the material has transported itself off site since the release. Based on the very low concentrations of residual solvents detected in the soils both in headspace screening samples, and in laboratory analytical samples, it would appear that there were no widespread releases to the ground surface, but leaks and spills from stored materials on site were either addressed through housekeeping practices or captured by the waste drainage systems present (floor drains and storm drains). Thus only very small concentrations of these materials are left in the soil and groundwater. The remaining materials in the soil will continue to degrade and partition trace concentrations to the vapor or dissolved phase at relatively low rates.

5.4 FATE AND TRANSPORT OF SELECTED SVOCs

Petroleum-related PAHs are much less volatile and soluble than BTEX compounds; as a result, these contaminants are likely to remain long after VOC portions are gone. PAHs were found present at high concentrations in many of the soil samples collected during the investigation.

The highest PAH concentration detected in subsurface soil samples was observed in soil boring SB-306B at 50,000 µg/kg of phenanthrene. By contrast, the highest PAH concentration detected in groundwater samples was observed in monitoring well MW-306B at 7J µg/L of naphthalene. The relatively low concentrations found in groundwater are likely due to the low solubilities of these compounds and their strong affinities to sorb to soil particles (Table 5-1). The PAHs detected in soils that are not within the sumps and vaults of the building foundation will continue to leach into the groundwater, but the solubility and adsorptive characteristics of these contaminants should continue to keep groundwater PAH concentrations relatively low. The PAHs within the sumps and vaults in the building foundation are believed to be segregated from the soil and groundwater, and are likely to remain so.

Groundwater flowing beneath the site ultimately moves through the intertidal sediments and discharges into Narragansett Bay. Elevated levels of organic carbon in the sediments will enhance the adsorption of dissolved PAHs brought there by groundwater; however, measured PAH concentrations in intertidal sediments are significantly higher than would be expected from groundwater discharge alone.

Because PAHs in the sediment are so high, and because they were not generally present in groundwater it appears that they have been discharged from open channel flow via the underground waste discharge system. It is also possible that to a lesser extent PAHs may have been released as a result of wind and water erosion of shoreline structures and fill, which is evident on the entire north and east shorelines of the site. In addition, it is anticipated that there has been some influence from off-site sources such as fuel leaks and spills from past vessel activities attending the island as well as past and current vessel activities in the bay.

5.5 FATE AND TRANSPORT OF PESTICIDES AND PCBs

Similar to the SVOCs, pesticides and PCBs are relatively non-volatile and generally insoluble in water.

Pesticides were only infrequently detected at shallow soil depths within sumps and vaults in the footprint of the building and to some extent in surface soil at the site. Surface soils bearing adsorbed pesticides could be mobilized through fugitive dust emissions and surface runoff, but past concrete cover at the site and current vegetation at the site is likely to have minimized this occurrence. Overall, pesticides present at the site are likely to have been a result of intended application rather than bulk releases to the ground or ocean waters. Because pesticide presence on site is sparse, minimal pesticide migration is likely to have occurred.

PCBs were detected as Aroclor 1260 below the regulatory criteria in approximately one third of the surface soil samples with a maximum detect of 5,700 µg/kg in soil boring SB-336; and approximately one

eighth of the subsurface soil samples with a maximum detect of 600 µg/kg in test pit TP-09. Aroclor 1254 (at the former UST location at Building 44, and in the sump under the former electroplating booth, and in TP-08 near the former Building 56) and Aroclor 1016 (dry well at TP-05) were also detected in soil samples at the site. PCBs were detected at low concentrations (<1.0 mg/L) in standing water in excavations conducted during PCB removal operations in 2004, but PCBs were not detected in groundwater wells sampled during the RI.

PCBs in sediment were identified only as Aroclor 1260, and were present above the screening criteria in one half of the intertidal sediment samples with a maximum detect of 360 µg/kg in location SD304F; and approximately one half of the subtidal sediment samples with a maximum detect of 41,000 µg/kg in location SD312.

Because PCBs are nonvolatile, have low solubility (only 0.049 to 0.24 mg/L), and adsorb readily to organic matter and fine-grained soils, they are expected to be relatively immobile in the subsurface soils and bedded sediment. Biodegradation of PCBs does occur, but usually the degradation rate is very low. PCBs are expected to be persistent in the site soils.

Similar to SVOCs, pesticides and PCBs are generally insoluble in water, exhibit relatively low mobility, and are unlikely to migrate with groundwater to discharge into surface water and sediments. The presence of PCBs in soil but not in groundwater collected from monitoring wells attests to this limitation, and shows that residual PCBs in the soil are not mobile via groundwater flow.

The presence of pesticides and PCBs in sediment are likely are the result of open channel flow from the underground waste discharge system, and or overland runoff from release areas. Possibly to a lesser effect is water erosion of the shoreline structures, resulting in erosion of PCB-contaminated soils, particularly in the area near the Rigging Platform at the north end of the site where a release occurred in the past (Appendix A).

PCBs are expected to be persistent in the sediments and if left in depositional areas with no outside forces, are likely to be covered over time beneath the sediment surface as continuing sedimentation occurs. Disturbance of this sediment bedload would result in a conveyance down-current through sediment transport processes such as mixing and advection. PCBs and pesticides are both subject to accumulation in fatty tissues of predatory animals through the food chain. Effects of such accumulation is addressed in Section 7 of this report.

5.6 FATE AND TRANSPORT OF PETROLEUM HYDROCARBONS

When a petroleum-based fuel or solvents are spilled on the ground surface or released beneath it, the organic liquid will percolate downward under the force of gravity toward the water table. If a sufficient volume of material is released it will reach the water table and directly contaminate the groundwater, forming a layer of non-aqueous phase liquid (NAPL) either on the surface of the groundwater or within it. The residual material trapped within the pore spaces of the soil above the water table can serve as a source of secondary contamination, as it may be available to move slowly out of the soil pores as dissolved phase liquid. The extent of this secondary contamination will vary depending on the NAPL, the degree of degradation, the soil matrix itself, and the mass already transported.

The field observations and analytical data from soil samples indicate residual oil, detected as GRO and DRO, is present near the water table primarily on the southwest portion of the site, and to some extent in some of the sumps and vaults within the Building 32 foundation. These former trench or tank areas are not considered representative of site soils. In addition, one subsurface soil sample collected from soil boring SB-306 located near the former fuel USTs contained elevated concentrations (1,300 mg/kg) of petroleum contamination.

Petroleum hydrocarbons were detected in every intertidal and subtidal sediment sample at low concentrations. Gasoline Range Organics were not detected in intertidal and subtidal sediments. Groundwater and aqueous samples contained only trace concentrations of petroleum contamination.

It appears that the mass of petroleum contamination in the south west corner of Building 32 has been depleted by dissolution, volatilization, entrapment, and other mechanisms. As a result of these processes, the fraction of the soil pore space occupied by NAPL decreased, and its mobility has been reduced. The remaining immobile petroleum residue is held in place by the capillary pressure of the soil matrix, and is unlikely to act as a significant continuous source of groundwater contamination.

5.7 FATE AND TRANSPORT OF SELECTED METALS AND CYANIDE

The metals detected in site soils may be the result of past site operations but also may, in part, represent those that occur naturally as components of soil minerals. When subjected to precipitation infiltration metals can be leached from the soils and conveyed into the underlying groundwater. Metals may also be leached from the soils into groundwater through the seasonal rise and fall of the water table.

Once metals are leached from the surface soils into the vadose zone and into the saturated soils (i.e., groundwater aquifer), the dissolved-phase metals will continue to migrate with groundwater flow. Other

natural reactions may occur that retard (i.e., sorption, reduction-oxidation reactions, etc.) the rate at which the metals migrate in the subsurface.

Once in the aqueous phase, the metals will be conveyed with the ambient groundwater flow. As groundwater migrates through the site, some of the metals will undergo transformation processes that result in their return to an insoluble state. Reduction-oxidation, precipitation, and adsorption reactions can cause the dissolved phase ions to leave the aqueous phase. However, some of these metals will continue to migrate with groundwater and will discharge into the bay. As dissolved metals are discharged to the sediments, some of the metals will likely be adsorbed and removed from the aqueous phase because of interactions with organic materials, sulfides, or oxyhydroxides.

Dissolved metals that migrate with site groundwater and discharge to sediments and surface water undergo various transformation processes. The metal ions may be adsorbed to the organics-rich sediments or to the fine-grained particles in sediments. Metals bound to sediments will be buried over time beneath the benthic surface with continuing wave action or will be conveyed down current through sediment transport processes such as mixing and advection.

Arsenic, cadmium, and lead were the only metals detected in soils at concentrations exceeding the RIDEM Direct Exposure Criteria established for industrial use (Section 4). The MCLs was not exceeded for any metal in groundwater samples (Section 4). The elevated concentrations of chromium and lead in soil are likely due to past electroplating operations. Additionally, chromium, which is also associated with electroplating operations, was detected in a sediment sample exceeding the ERM criteria (Section 4). Mercury was also detected exceeding the ERM (Section 4) but is not believed to be related to site activities. It is difficult to determine if the elevated arsenic concentrations are likely attributable to past onsite releases or if it is occurring elevated naturally. A more detailed fate and transport for arsenic, cadmium, chromium, and lead is provided below. Cyanide is also included as it was detected in site soils and surrounding sediment and is also likely attributable to past electroplating operations.

5.7.1 Arsenic

Arsenic can occur in the +5, +3, +1, 0, and –3 valence states. However, under oxidizing to mildly reducing conditions in the pH range of 4 to 9, the dominant species is As(V). Dissolved arsenic concentrations in oxidizing environments are usually not controlled by arsenic mineral solubility. Instead, the mobility of As(V) is controlled by adsorption onto iron, manganese, and aluminum oxyhydroxide surfaces. Iron, manganese, and aluminum oxyhydroxides are common mineral weathering products that occur as colloids, soil particles, and mineral coatings in aquifers. If the adsorption capacity of these

oxyhydroxide surfaces is not surpassed, arsenic movement will be strongly retarded by the high affinity of these surfaces for As(V). The affinity for As(V) increases as the pH of the system decreases.

Under more reducing conditions As(III) is the dominant species. Although ferric oxyhydroxides are stable over a wide range of pH and Eh, and they limit the mobility of both arsenic species, As(III) sorbs less strongly to metal oxyhydroxides than does As(V), so it is more mobile. If the redox potential is low enough, oxyhydroxides may no longer be stable and As(III) mobility may be even greater. However, if hydrogen sulfide is present in a strong reducing environment (such as would exist in anoxic subtidal sediment), the precipitation of arsenic sulfides will limit dissolved arsenic concentrations. Arsenic mobility is greatest when the system is mildly reducing and hydrogen sulfide is absent. Under these conditions iron would be in the soluble Fe(II) form, arsenic would be in the mobile As(III) form, and arsenic mineral solubility would not limit the concentrations of dissolved arsenic in solution.

Arsenic concentrations in surface soil samples were slightly elevated compared to upgradient levels. The majority of the upgradient exceedances were detected in samples collected from sumps and vaults within the Building 32 foundation, and are not considered representative of site soils. Arsenic concentrations were slightly elevated in subsurface soil samples, with the exception of high arsenic concentrations noted in soil boring SB-333, and test pit TP-09. Arsenic was detected at low concentrations in three groundwater samples. Arsenic was not detected in the upgradient groundwater sample. The traces of arsenic dissolved in groundwater suggest the arsenic in the soil is relatively immobile.

Arsenic concentrations in the intertidal and subtidal sediments were generally comparable to those found in the site's soils. Potential sources of sediment contamination include: outflow from the underground waste discharge lines, wind and water erosion of arsenic-laden soil particles, and other off-site sources.

5.7.2 Cadmium

Cadmium only occurs in the +2 valence state, and it is one of the most mobile metal contaminants. In general, the mobility of cadmium in soil, with a pH of seven or less increases directly proportional to increasing pH. At a pH of seven or higher the mobility of cadmium is significantly reduced. Since Cd^{2+} is a cation, adsorption increases with pH as the surface sites on organic matter, oxyhydroxide, and pH-dependent clay minerals become more negatively charged.

Cadmium concentrations exceeded upgradient levels in approximately half the surface soil samples. Cadmium concentrations in subsurface soil samples were comparable to upgradient levels, with the exception of high cadmium concentrations noted in soil boring SB-333, and test pits TP-06 and TP-09.

Test pit TP-06 was located in the former sand blasting sump and is not considered representative of site soils.

Elevated levels of cadmium were detected in three groundwater samples collected from monitoring wells MW-302S (0.17J µg/L), MW-303B (0.62 µg/L), and MW-306B (0.12J µg/L). The traces of cadmium dissolved in groundwater suggest the cadmium in the soil is relatively immobile.

Cadmium concentrations in both the subtidal and intertidal sediments are generally comparable to soil levels detected onsite. However, the presence of cadmium in sludge sample from the manhole MH-01 near the electroplating room, and the presence of cadmium in the dry well at TP-05 and in subtidal sediments offshore of the outfall from the drywell all provides evidence that although cadmium is not detected at high concentrations in the environment, this is a signature component of material released from the electroplating rooms.

5.7.3 Chromium

Chromium occurs in the +3 and +6 valence states. In general, Cr(VI) is soluble and mobile and Cr(III) is insoluble and immobile. Cr(III) is the dominant species under reducing and mildly oxidizing conditions when the pH is between 4 and 9. Over this range of pH values, Cr(VI) predominates only under strong oxidizing conditions.

Cr(VI) minerals are relatively soluble; therefore, dissolved concentrations of Cr(VI) are limited primarily by adsorption reactions with clay mineral and oxyhydroxide surfaces. Cr(VI) is relatively mobile in most environments because it is not strongly adsorbed to these surfaces. However, under slightly oxidizing to reducing conditions Cr(VI) will be reduced to Cr(III) which will precipitate as the insoluble mineral $Cr(OH)_3$. The rate of reduction depends on the pH and the availability of reductants such as organic matter, Fe(II), and sulfide. If the oxidizing capacity of the chromium exceeds the reducing capacity of the aquifer, Cr(VI) will remain relatively stable and mobile. Mn(III) and Mn(IV) minerals may also enhance the stability of Cr(VI) in the environment by oxidizing Cr(III) to Cr(VI).

The stable redox state of chromium under most environmental conditions is Cr(III). Dissolved concentrations of Cr(III) are primarily controlled by the precipitation of $Cr(OH)_3$. $Cr(OH)_3$ is highly insoluble, so there is usually very little dissolved Cr(III) in natural waters. Nevertheless, dissolved Cr(III) concentrations can exceed those predicted by solubility alone, because Cr(III) species can form soluble complexes with water soluble organic matter.

Chromium concentrations detected in the surface soils were only slightly elevated compared to upgradient levels. Chromium concentrations detected in subsurface soils were also only slightly elevated compared to upgradient concentrations, with higher concentrations noted in samples collected from the southwest portion of the site near the former electroplating area. Chromium was not detected in groundwater samples.

Chromium concentrations detected in the sediment samples were generally comparable to soil samples with the exception the sample collected from location SD304F, where the NOAA ERM screening value was exceeded. This apparent "hot spot" is most likely attributable to open channel flow from the waste discharge "trench drain" line taking street drainage from the south west corner of Building 32 to the intertidal area.

5.7.4 Lead

Lead only occurs in the +2 valence state, and it is one of the least mobile metal contaminants. The mobility of Pb^{2+} is limited in most soil and groundwater systems because: 1) several insoluble lead minerals can control its solubility over a broad range of pH and solution compositions, and 2) Pb^{2+} has a strong affinity for clay, organic matter, and oxyhydroxide surfaces. Since Pb^{2+} is a cation, adsorption increases with pH as the surface sites on organic matter, oxyhydroxide, and pH-dependent clay minerals become more negatively charged. The mobility of lead is greater in low pH environments because most lead minerals are more soluble under acidic conditions, and the net charges on pH-dependent surfaces are positive. Although lead is relatively immobile under most environmental conditions, it can be mobile in any system if the amount entering the environment exceeds the immobilization capacity of the system.

Elevated lead concentrations were detected in the surface soil samples collected from the southwestern portion of the site where petroleum was detected in soils, and proximal to the former acid storage shed and the former sandblast dust collector. In addition, lead was detected at elevated concentrations in samples collected from sumps and vaults within the foundation of Building 32, which are not considered representative of site soils. The lead concentrations detected in the remaining surface soil samples were comparable to upgradient levels. Lead concentrations in intertidal and subtidal soil samples were generally elevated compared to reference concentrations. Lead was not detected in groundwater samples. These observations suggest the lead in the soils is relatively immobile.

A hotspot of lead was noted in the intertidal sediments at stations SD-304F, where the NOAA ERM screening value was exceeded. This apparent "hot spot" is most likely attributable to open channel flow from the waste discharge "trench drain" line taking street drainage from the south west corner of Building 32 to the intertidal area. Elevated concentrations were also noted in subtidal sediments at

stations SD-304, 305, and 306, all likely influenced by discharges from waste drains from the electroplating room, sewer system and the trench drain. Other areas where lead exceeded screening criteria in sediments include subtidal sediments in the Stillwater area to the north of the site, and in the northeast portion of the site.

5.7.5 Cyanide

Cyanide is a singularly charged anion consisting of one carbon atom and one nitrogen atom joined with a triple bond. Cyanide may occur as hydrogen cyanide, alkali and alkaline earth metal cyanides (e.g. calcium, potassium, and sodium cyanide), and metallocyanide complexes (e.g. cadmium, copper, and zinc cyanide). In these forms, it is used in the electroplating processes, and waste material discharged from the electroplating areas is likely to have included these metallocyanide complexes.

Cyanide was detected infrequently at trace concentrations (< I mg/kg) in surface and subsurface soils, and in intertidal and subtidal sediments. Cyanide was not detected in groundwater samples, and thus the fate and transport discussion of cyanide is limited to soil and sediment.

The fate of cyanides in soil is dependent on cyanide concentrations, pH, temperature, metal content, concentrations of microbes, availability of nutrients, and acclimation of microbes.

Cyanides are generally not persistent is soils. Volatilization of hydrogen cyanide would be a significant loss mechanism for cyanides from soil surfaces at a pH <9.2. Cyanide has a low adsorption capability. However, it is usually not detected in groundwater, due to fixation by trace minerals through complexation or transformation by soil microorganisms.

Hydrogen cyanide and the alkali metal cyanides are not likely to be strongly sorbed onto sediments and suspended solids because of their high water solubilities. Soluble metal cyanides may show somewhat stronger sorption than hydrogen cyanide, with the extent of sorption increasing with decreasing pH and increasing iron oxide, clay, and organic material contents of sediment and suspended solids. However, sorption is generally insignificant even for soluble metal cyanides when compared to volatilization and biodegradation. Insoluble metal cyanides may accumulate in bottom sediments, but residues are generally as low as <1 mg/kg, which is consistent with cyanide concentrations detected in sediment samples.

Thus cyanides discharged from the site during its operations were probably mostly dissolved into the seawaters and dispersed. Some traces of cyanides remain, in sediment near the sewer outfall (SD-313) and the trench drain outfall (SD-304).

Additionally, cyanide was detected in subtidal sediment midway along the island to the south on the west shoreline. This location is situated near the former landfill on the island, and may be a result of leaching from that landfill, and not a result of discharges from the sewer drain at the northwest shoreline of the island.

5.8 SUMMARY

Activities associated with former site operations have resulted in the presence of VOCs, SVOCs, pesticides and PCBs, petroleum hydrocarbons, metals, and cyanide in site soils and adjacent sediments. Additionally, VOCs, SVOCs, petroleum hydrocarbons, and metals were detected in the site's groundwater at low concentrations compared to the Groundwater Objectives for GA aquifers established in the RIDEM Remediation Regulations and to federal Maximum Contaminant Levels.

Since activities have ceased, most of the volatile and soluble petroleum hydrocarbons have apparently partitioned to the vapor phase or dissolved phase and have been degraded or transported off-site, leaving behind a relatively insoluble and recalcitrant petroleum residue. Only very low concentrations of solvents were detected, and no breakdown products were detected. This indicates that very little releases to the ground have occurred at the site.

The much less soluble and less volatile polycyclic aromatic hydrocarbons (PAHs) are still present at high concentrations in the soils along the southwestern portion of the site, which is associated with petroleum contamination. These contaminants may leach into the groundwater, but the solubility and adsorptive properties of these contaminants prevent this from occurring at a very high rate. Groundwater PAH concentrations are anticipated to remain low.

Cyanide was detected infrequently at trace concentrations (< 1 mg/kg) in surface and subsurface soils, and in intertidal and subtidal sediments. Cyanide was not detected in groundwater samples. Cyanide is not likely to remain as a site contaminant, but it may provide assistance with tracking migration of contaminated sediments associated with the site.

Pesticides, PCBs, metals in soils are relatively non-volatile organic compounds and are generally insoluble in water. Therefore, there is very limited leaching of these chemicals out of the surface soil into groundwater. However, their transport either through erosion of soil to the sediment, or erosion of sediment in high energy areas at the shoreline to lower energy areas will cause continued transportation of these materials to and within the marine environment, where they are made available to ecological receptors.

The high concentrations of PCBs in the Stillwater area are likely to remain in this area until the physical properties of the shoreline change. The breakwater located to the north that is protecting this shoreline has deteriorated, and will continue to deteriorate, and hydraulic forces that can transport these sediments will rise as this barrier degrades. In addition, the rigging platform at the north shoreline has also partially collapsed, allowing soils behind the former sheet piling to erode into this area. Continued short-term erosion from the shoreline will tend to cover the contaminated sediments and debris from the rigging platform unless it is repaired.

If the breakwater and shoreline improvements are not maintained in the long-term, the fill areas at the north end of the island will eventually erode back to the position of the former shoreline that was present before these improvements were constructed in the 1940s (refer to Appendix C for construction drawings showing the former topography and shorelines that were altered for construction at Gould Island). Such long-term erosion would eventually result in the shoreline receding to as far as the north end of the Building 32 foundation. The fill and soils from this area would be slowly removed from the intertidal areas and eventually be deposited as bedload sediment at the south end of Gould Island.

6.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section presents a description of the risk assessment methods employed for the Gould Island site, as well as a summary of the results. The objective of the baseline Human Health Risk Assessment (HHRA) is to estimate potential current and future human health risks from the presence of contamination in the soil, sediment, groundwater, surface water, and biota and to provide the basis for determining appropriate remedial measures (if applicable) for these media as part of a feasibility study.

The HHRA evaluates non-cancer health hazards, cancer risks, and lead exposures through quantitative assessments. The potential for non-carcinogenic health effects is assessed by comparing an exposure estimate (dose) to a reference dose (RfD). Ratios of the intake to the RfD below unity indicate that adverse non-carcinogenic effects are unlikely. Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable.

Risks from lead exposure are not evaluated using the same methodology as other contaminants. Estimations of blood-lead concentrations are used to evaluate potential adverse health effects. Infants and young children are extremely susceptible to adverse effects from exposure to lead. Since children are a more sensitive subpopulation than adults, exposure to lead by adults in a residential or recreational scenario is not generally evaluated and the receptor of concern for these scenarios is the young child. Evaluation of the young child in a residential or recreation scenario is considered protective of adults, including pregnant women. Exposures to lead by commercial workers are evaluated by use of an approach that focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios. Therefore the receptor of concern in commercial worker scenarios is the fetus of the pregnant worker. Evaluation of the fetus of the pregnant worker is considered protective of non-pregnant workers. Blood-lead levels (either fetal or young child) greater than 10 µg/dL are considered to be a "concern." EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL.

Section 6.1 provides an overview of the risk assessment process. Sections 6.2 through 6.5 outline the methodology and results of the HHRA. Appendix G presents supporting materials for the HHRA. Table 6-1 presents an overview of the various media, exposure points, potential receptors, and exposure pathways evaluated in this risk assessment. A detailed discussion of the potential receptors, exposure locations, and exposure pathways listed in Table 6-1 is presented in Section 6.3. An analysis of the uncertainties is presented in Section 6.6. Section 6.7 summarizes the HHRA for the Gould Island study

area. The risk assessment conducted for this RI follows the most recent guidance from the EPA (EPA, 1989b and 1991a), including regional EPA guidance (EPA, 1989a, 1994c, 1995, 1996c, and 1999). Tables were prepared following the standard format in accordance with Risk Assessment Guidance for Superfund (RAGS HHEM) Part D (EPA, 1997c). These tables are presented in Appendix G-1. Table 6-1 is also included in Appendix G-1 as Table 1.

6.1 OVERVIEW OF RISK ASSESSMENT PROCESS

A risk assessment provides the framework for developing information necessary to determine the need for remediating and developing potential remedial alternatives for a site. A baseline HHRA consists of five major components, as follows:

- Data evaluation and identification of chemicals of potential concern (COPCs);
- Exposure assessment;
- Toxicity assessment;
- Risk characterization; and
- Characterization of uncertainty in the risk estimates.

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in environmental media; contaminants 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 receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete and no potential risks will be considered for human receptors.

The data evaluation component of the HHRA is primarily concerned with selecting COPCs and calculating exposure point concentrations (EPCs). Both current and historical study area data are considered in developing a list of COPCs. The media/area-specific data are analyzed and COPCs are selected that are representative of the type expected for potential human health exposure. The EPCs provide the chemical input for each of the exposure pathways. A discussion of the process and site-specific issues is contained in Section 6.2.

The exposure assessment identifies potential human exposure pathways. Exposure routes are identified by medium, based on information on study area chemical concentrations, chemical release mechanisms, human activity patterns, and other pertinent information, to develop a conceptual site model. A discussion of the exposure assessment is contained in Section 6.3. Section 6.3.1 presents the conceptual site

model. Section 6.3.2 presents the potential routes of exposure. Section 6.3.3 presents potential human receptors and the relevant exposure assumptions. Section 6.3.4 presents exposure pathways and the equations for estimating chemical intake.

The toxicity assessment presents the available human health criteria for all the selected COPCs. This assessment is contained in Section 6.4. Quantitative toxicity indices are presented where they are available. A discussion of health effects and dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs) is presented.

The risk characterization section (Section 6.5) describes how the estimated intakes are combined with the toxicity information to estimate risks. Uncertainties associated with the risk assessment process are discussed qualitatively in Section 6.6. Section 6.7 summarizes the HHRA for the Gould Island study area.

6.2 DATA EVALUATION

Data evaluation is a site-specific task that uses a variety of information to determine which of the detected chemicals in each medium are most likely to present a risk to potential receptors and at what concentrations. This section presents the approaches for identification of COPCs, distributional analysis of the data, and EPCs.

The end result of this qualitative selection process is a list of COPCs and representative EPCs. EPCs are defined as the contaminant concentrations at the point of exposure. The methodology used to identify COPCs for the Gould Island RI Report is provided in Section 6.2.1. Section 6.2.2 presents the identified COPCs for each medium. The methodologies used to determine EPCs for the selected COPCs are presented in Section 6.2.3.

The media of human health concern selected for the site are as follows:

- Surface Soil (Represents samples of exposed surface soil between 0 and 2 feet depth),
- Subsurface Soil (Represents soil between 0 and 10 feet depth),
- Shoreline (Intertidal) Sediment,
- Groundwater (monitoring wells),
- Shallow Groundwater (test pits),
- Clams, and
- Mussels.

The available database considered for use in this risk assessment includes regional background sediment sample results from 2004 and background and site-associated sample results from August 2005 investigations described in Section 2 of this RI report. Data utilized in this risk assessment are comprised of validated analytical results of known or sufficient quality for use in quantitative risk calculations. The site data were collected by Tetra Tech NUS in August 2005. Surface soil samples are comprised of locations less than or equal to 2 feet in depth, and subsurface soil samples are less than 10 feet in depth. The subsurface soil data corresponds to a hypothetical future scenario where soil disturbance during construction activities could result in the re-mixing and re-distribution of subsurface soils to the ground surface, allowing potential human exposures to currently deeper soil contaminants, although the likelihood of this scenario may be low.

Samples of bedrock, concrete, waste, sludge and soil within concrete sumps, or waste water were not included in the HHRA evaluation. Off-shore sediments (below mean low tide) pose little risk of exposure to humans and were not used for human health screening or risk calculation since the exposure scenarios limit expected interaction with these media. Naragansett Bay is an active recreational and commercial fishing area. However, because of migration and movement habits, finfish are not considered appropriate site-specific media.

Appendix G-2 provides lists of sample locations for each data set.

6.2.1 Selection of COPCs

The selection of COPCs was based on chemical-specific concentrations, occurrence, distribution, and toxicity. COPCs were selected to represent site contamination and to provide the framework for the quantitative HHRA. COPCs include only those chemicals with positive detections, and are limited to those chemicals that exceed a selection criterion. The current use and foreseeable future use of the property is industrial/military. There is no foreseeable future residential use at Gould Island, however recreational use is considered a foreseeable future use of the property. Residential criteria were used at this site as a conservative screening tool to be protective of both recreational and industrial site uses. For this risk assessment, EPA Region IX residential preliminary remediation goals (PRGs), EPA Region IX tap water PRGs, EPA's OSWER draft subsurface vapor intrusion guidance Table 2c target groundwater concentrations, EPA Region III risk-based concentrations (RBCs) for fish ingestion, as well as applicable RIDEM direct exposure criteria for media sampled at the site provided the basis for screening criteria used to reduce the number of chemicals and exposure routes considered in a risk assessment, following EPA Region I guidance and direction. The premise of this screening step is that risk is typically dominated by a few chemicals and that, although dozens may actually be detected, some of those chemicals may contribute minimally to the total risk.

The chemicals detected at the site were grouped by media for screening against applicable criteria. Maximum detected concentrations in each medium at the Gould Island study area were compared to the risk-based screening criteria. A chemical was selected as a COPC if the maximum detected concentration was greater than the associated risk-based concentration (RBC) based on a target cancer risk of 1×10^{-6} or a noncancer hazard quotient (HQ) of 0.1.

Surface soils, subsurface soils, and intertidal sediments were compared to EPA Region IX residential soil criteria. Groundwater from monitoring wells was screened against EPA's OSWER draft subsurface vapor intrusion guidance Table 2c target groundwater concentrations. Shallow groundwater concentrations (from test pit sampling) were screened against EPA Region IX residential tap water criteria. Shellfish analytical results were screened against Region III fish ingestion RBCs.

In addition to the risk-based screening criteria, chemical data were compared to documented regional sediment background conditions and site-specific reference samples. The analytical results of background surface and subsurface soil and groundwater samples collected as part of the August 2005 site investigation activities, and the results of regional background sediment samples collected for Derecktor Shipyard and McAllister Point Landfill monitoring during 2004 and 2005 are presented in Appendix F-5. None of the contaminants detected in soils, intertidal sediments, or groundwater were present exclusively below average detected background concentrations. Background comparison could not be performed for shellfish data sets because of lack of adequate background samples.

Available validated data for all contaminants from the 2005 sampling investigation were used to identify COPCs for the study area. Lists of samples included in the HHRA are presented in Appendix G-2. Analytical results for these samples are presented in Appendix F. Section 4.0 of this RI Report discusses sample collection, the fixed laboratory analysis by EPA Contract Laboratory Program (CLP) methods, and the analytical results.

For this HHRA, subsurface soil was considered as an exposure medium for future potential receptors assuming exposure to a combination of surface soil and subsurface soil to a depth of 10 feet below ground surface (bgs) (total soil exposure).

Analytical results qualified as rejected, "R", during the data validation process, were not considered because of their potential unreliability. Soil data for samples collected from depths greater than 10 feet were not used in the COPC selection process. Ten feet represents the maximum assumed depth for potential human exposure during excavation/construction. Current exposure to surface soil was limited to exposed surface soil (surface soil not covered by concrete or pavement). Groundwater samples collected from monitoring wells were screened separately from groundwater samples obtained from test pits

because of potentially differing exposure routes (vapor intrusion into indoor air spaces versus direct contact by excavation workers). Surface soil samples collected from beneath concrete were evaluated only under the future scenario.

Total Aroclor concentrations were determined on a sample-specific basis by summing individual detected Aroclor concentrations.

Additional COPCs were included when one or more members of a compound class exceeded RBC screening criteria but other members were detected at levels below screening criteria. COPCs were considered for inclusion based on related chemicals of the same family being present in the case of carcinogenic polynuclear aromatic hydrocarbons (PAHs), the chemical degradation families (such as DDT-series analogs, PCE/TCE/1,1,1-TCA breakdown products), or a commercial formulation (such as technical chlordane components). For example, if DDT was detected above the RBC criterion and DDD was present below the RBC criterion, then both chemicals were retained as COPCs in that medium.

Frequency of detection was not used as a COPC selection criterion. Essential nutrients, including calcium, magnesium, potassium, and sodium, were not selected as COPCs.

Since EPA Region I does not advocate quantitative risk assessment of the health effects of aluminum, iron, cobalt, and copper, these metals were not selected as COPCs. The EPA Region IX PRGs for copper and iron are based on provisional oral RfDs. EPA Region I does not endorse their use because these provisional oral RfDs were based on concentrations needed to protect against a deficiency of the metal, rather than on quantitative estimates related to the hazard posed by overexposure (EPA, 1999).

The criteria used to identify COPCs are presented in Appendix G-1, Tables 2.1 through 2.7. Chemicals with maximum concentrations greater than the COPC screening levels are discussed in Section 6.2.2. Discussions of the criteria used for COPC selection are provided in the remainder of this section.

Criteria for the Selection of COPCs in Soil and Sediment

COPCs for soils and intertidal sediment were selected for the Gould Island study area. The soil samples that were included in the HHRA evaluation of potential future industrial workers and construction workers were collected from depths of 0 to 10 feet bgs. This soil depth is used to account for soil to which these receptors may be potentially exposed, particularly in the future when soils currently located at depth may be brought to the surface during excavation or construction activities. The soil samples that were included in the HHRA evaluation of recreational visitors, trespassers, and current industrial workers at the Gould Island study area were collected from depths of 0 to 2 feet bgs. Sediment samples that were

included in the HHRA evaluation were collected from the intertidal zone, which represents sediments to which recreational visitors and trespassers may be exposed while swimming or wading in near shore areas of Gould Island.

The following screening criteria were used to identify soil and sediment COPCs:

- **EPA Region IX Preliminary Remedial Goals (PRGs) for Soil and Sediment Exposures.** EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). PRG concentrations for soil contact for residential land use were used conservatively as COPC selection criteria for the Gould Island study area. The current use and foreseeable future use of the property is industrial/military. There is no foreseeable future residential use at Gould Island, however recreational use is considered a possible foreseeable future use of the property. Residential criteria were used at this site as a conservative screening tool to be protective of both recreational and industrial site uses. These values were developed using the current EPA Region IX Preliminary Remedial Goals Table (EPA, 2004c), which identifies concentrations of potential concern for nearly 600 chemicals in various media (air, drinking water, and soil) using certain reasonably maximum exposure default assumptions.

  The EPA Region IX residential soil exposure values were calculated based on the methodology presented in Risk Assessment Guidance for Superfund, Human Health Risk Evaluation Manual, Part B (EPA, 1991b) and consider the ingestion, dermal, and inhalation exposure pathways. For carcinogenic chemicals, the values used for COPC screening are based on a 1E-6 target incremental lifetime cancer risk. The criteria for non-carcinogenic chemicals are based on a target HQ of 1.0. These EPA Region IX residential soil exposure values for non-carcinogenic chemicals were adjusted to COPC screening levels based on a target HQ of 0.1, which is one-tenth of the suggested cumulative target non-carcinogenic risk for a potential receptor. The estimation of cumulative target non-carcinogenic risks is described in greater detail in Section 6.5.

  Total chromium present was screened using the EPA Region IX PRG value for hexavalent chromium. The EPA Region IX PRG for hexavalent chromium was selected to be conservative in the absence of chromium speciation data. For PCBs, individual Aroclors were compared to screening criteria for individual Aroclors. All detected Aroclors were accepted as COPCs if at least one Aroclor was detected at maximum concentrations exceeding COPC screening levels.

- **EPA Soil Lead Guidance.** EPA Region IX has developed residential PRG concentrations for lead, based on the EPA's Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (EPA, 1994b). The EPA's Integrated

Exposure Uptake and Biokinetic (IEUBK) model, which estimates the risk to a child resident, is the basis for this soil screening level. The lead screening level based on residential land use was applied as a conservative approach for the Gould Island study area.

- **Rhode Island Direct Exposure Criteria.** RIDEM has developed direct contact criteria for residential soils. These criteria are applicable to both residential and unrestricted recreational scenarios. These values were calculated based on the ingestion exposure pathway. For carcinogenic chemicals, the values are based on a 1E-6 target incremental lifetime cancer risk. The criteria for non-carcinogenic chemicals are based on a target HQ of 1.0.

Background Concentrations

In addition to the above risk-based screening criteria, concentrations of metals and SVOCs in the background soil and sediment samples were compared to site soils and sediments. A basewide background study is in process; however, the data from that study are not yet available and therefore are not used in this RI. Once the data from the basewide background soil study are available, that data will be used in future studies of the Gould Island Site.

As part of the investigation activities conducted, surface and subsurface soil samples were collected from an upgradient location (MW301S and 301B). The samples were analyzed for SVOCs and metals. The media-specific data and data summaries including average and maximum background concentrations for VOCs, SVOCs, pesticides, PCBs, and metals are presented in Appendix F-5. The average background concentrations for SVOCs and metals in surface soils and subsurface soils are presented in Appendix G-1, Tables 2.1 and 2.2, respectively.

Regional sediment background samples were collected during the sediment investigations for Derecktor Shipyard and the McAllister Point Landfill long-term monitoring during 2004 and 2005 (TtNUS 2005, TtNUS 2006). These samples were obtained from subtidal areas in Castlehill Cove in Newport, Jamestown Potter Cove, and in the vicinity of Jamestown Island. The samples were analyzed for SVOCs and metals. The reference data and data summaries including average and maximum background concentrations for SVOCs and metals are presented in Appendix F-6. The average background concentrations for SVOCs and metals in sediment are presented in Appendix G-1, Table 2.3.

Limited reference shellfish data (mussels only) is available from NOAA, and is discussed in uncertainty sections rather than using a direct comparison. Reference shellfish data available are presented in Appendix F-4D

Criteria for the Selection of COPCs in Groundwater

COPCs for groundwater were selected for the Gould Island study area. The groundwater samples that were included in the HHRA evaluation were collected either from monitoring wells or test pits. These two subsets were evaluated separately.

The following screening criteria were used to identify groundwater COPCs:

- **EPA Region IX Preliminary Remedial Goals (PRGs) for Tap Water Ingestion.** EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). PRG concentrations for tap water were used conservatively as COPC selection criteria for shallow groundwater at the Gould Island study area. The current use and foreseeable future use of the property is industrial/military. There is no foreseeable future use of groundwater at Gould Island as a drinking water source, however, to present conservative screening criteria the Region IX PRGs for tap water were used at this site. These values were developed using the current EPA Region IX Preliminary Remedial Goals Table (EPA, 2004c), which identifies concentrations of potential concern for nearly 600 chemicals in various media (air, drinking water, and soil) using certain reasonably maximum exposure default assumptions.

  The EPA Region IX tap water values for carcinogens are calculated using an age-adjusted exposure equation, which assumes that a receptor uses a water supply for household purposes at a frequency of 350 days per year for a 30-year exposure period. The EPA Region IX criteria for non-carcinogens are based on an adult exposure. The screening values for tap water ingestion, which also incorporate exposure via inhalation of volatiles, were developed using the current EPA Region IX PRG Table (EPA, 2004c). For carcinogenic chemicals, the values used for COPC screening are based on a 1E-6 target incremental lifetime cancer risk. The criteria for non-carcinogenic chemicals are based on a target HQ of 1.0. These EPA Region IX tap water values for non-carcinogenic chemicals were adjusted to COPC screening levels based on a target HQ of 0.1, which is one-tenth of the suggested cumulative target non-carcinogenic risk for a potential receptor. The estimation of cumulative target non-carcinogenic risks is described in greater detail in Section 6.5.

  Total chromium present was screened using the EPA Region IX PRG value for hexavalent chromium. The EPA Region IX PRG for hexavalent chromium was selected to be conservative, in the absence of chromium speciation data. For PCBs, individual Aroclors were compared to screening criteria for individual Aroclors. All detected Aroclors were accepted as COPCs if the maximum concentration of at least one Aroclor exceeded COPC screening levels.

- **EPA Lead Guidance.** EPA Region IX has not developed risk-based concentrations for lead in groundwater. Since lead was detected at the site, TtNUS has adopted EPA's Office of Solid Waste and Emergency Response (OSWER) drinking water action level of 15 µg/L (EPA, 1994a and 1998). The EPA IEUBK model (EPA, 1994a), which estimates the risk to a child exposed to lead in drinking water, is the basis for this drinking water action level.

- **EPA Subsurface Vapor Intrusion Guidance.** Target groundwater concentrations based on potential residential indoor air exposures were used conservatively as COPC selection criteria for groundwater from monitoring wells at the Gould Island study area. The current use and foreseeable future use of the property is industrial/military. There is no foreseeable future use of the site as residential; however, to present conservative screening criteria the EPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (EPA 2002) Table 2c target groundwater concentrations based on residential exposures to indoor air were used for groundwater from monitoring wells at this site.

  EPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (EPA 2002) Table 2c presents target groundwater concentrations based on a 1E-6 target incremental lifetime cancer risk for residential indoor air exposures. The target concentrations for non-carcinogenic chemicals are based on a target HQ of 1.0. These Table 2c values for non-carcinogenic chemicals were adjusted to COPC screening levels based on a target HQ of 0.1. The table 2c values assume conservative generic attenuation factors that reflect generally reasonable worst-case conditions for a first-pass screening of groundwater data.

- **Federal Maximum Contaminant Levels (MCLs).** Federal MCLs are standards promulgated under the Safe Drinking Water Act and are designed for the protection of human health (direct ingestion). Federal MCLs are developed based on laboratory or epidemiological studies and apply to drinking water supplies. They are designed in a manner similar to the EPA Region IX PRGs (for the prevention of human health effects associated with lifetime exposure of an average adult who consumes 2 liters of water per day). However, MCLs also reflect the technical feasibility of removing the contaminant from water. The use of MCLs as COPC selection criteria is designed to be protective of the use of groundwater as a drinking water source. It should also be noted that primary (health-based) MCLs are used to identify COPCs. Secondary MCLs, designed to protect aesthetic drinking water qualities (color, odor, taste, etc.), are not used to select COPCs.

- **Rhode Island GA Groundwater Objectives.** Rhode Island GA groundwater objectives are standards designed to be protective of use of the groundwater as a drinking water source. For

most contaminants, the associated Rhode Island GA groundwater objective is the same as the federal MCL. In a few cases, the state has developed a GA groundwater objective for a contaminant that does not have a federal MCL.

Groundwater Background Concentrations

In addition to the above risk-based screening criteria, concentrations of metals and SVOCs in the background groundwater samples were compared to site groundwater concentrations.

As part of the investigation activities conducted by EPA, groundwater samples were collected from an upgradient location (MW301S and 301B). The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. The data and data summary, including average and maximum background concentrations for SVOCs and metals in groundwater, are presented in Appendix F-6. The average background concentrations for SVOCs and metals in groundwater are presented in Appendix G-1, Tables 2.4 and 2.5. A discussion of study area data in comparison to the established inorganic and organic background levels is provided in the uncertainties section (6.6).

Criteria for the Selection of COPCs in Shellfish

The following screening criteria were used to identify shellfish COPCs:

- **EPA Region III Risk-Based Concentrations (RBCs) for Fish Ingestion.** EPA Region III RBCs for fish ingestion were used for shellfish COPC selection (EPA, 2005b) at the Gould Island study area. These values were developed using the current EPA Region III Risk-Based Concentrations Table (EPA, 2005b), which identifies concentrations of potential concern for approximately 400 chemicals in various media (air, water, fish tissue, and soil) using certain reasonably maximum exposure default assumptions. The EPA Region III criteria are calculated assuming that an adult receptor ingests 54 grams of fish per day averaged over 350 days per year for a 30-year exposure period.

6.2.2 Identification of COPCs

Appendix G-1, Tables 2.1 through 2.7 identify the COPCs selected for quantitative risk assessment for the Gould Island study area. COPCs were identified based on a comparison of study area data to the COPC screening criteria defined in Section 6.2.1. With the exception of soil data collected from depths greater than 10 feet bgs, and subtidal sediment data, all validated CLP data were used to identify COPCs. Data for soils at depths greater than 10 feet bgs were not used because human exposure to

deeper soils is considered unlikely. Data for subtidal sediments were not used because human exposure to subtidal sediments is considered unlikely.

6.2.2.1 Surface Soil COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations in exposed surface soils (depths of 0 to 2 feet bgs and not covered by pavement or concrete) collected from the Gould Island study area to risk-based COPC screening criteria for residential land use, as shown in Appendix G-1, Table 2.1:

- Polynuclear aromatic hydrocarbons (PAHs): benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; and indeno[1,2,3-cd]pyrene;

- Metals: arsenic, beryllium, manganese, and vanadium.

No surface soil COPC was eliminated as a result of comparison to the respective background concentration.

6.2.2.2 Subsurface Soil COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations in subsurface soils (from depths of 0 to 10 feet bgs) within the Gould Island study area to risk-based COPC screening criteria for residential land use, as shown in Appendix G-1, Table 2.2:

- PAHs: 2-methylnaphthalene; acenaphthene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenzo(a,h) anthracene; fluoranthene; fluorine; indeno[1,2,3-cd]pyrene; naphthalene; phenanthrene; and pyrene.
- SVOCs: carbazole and dibenzofurans.
- Volatile organic compounds (VOCs); trichloroethene.
- Total Aroclors: 1254 and 1260.
- Metals: antimony, arsenic, beryllium, cadmium, chromium, lead, manganese, and vanadium.

In addition, because Aroclors 1254 and 1260 were detected at concentrations above screening criteria, Aroclor 1016 was also retained as a COPC.

No subsurface soil COPC was eliminated as a result of comparison to background concentrations.

6.2.2.3 Intertidal Sediment COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations in intertidal sediment within the Gould Island study area to risk-based COPC screening criteria for residential land use, as shown in Appendix G-1, Table 2.3:

- PAHs: benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; and dibenzo(a,h)anthracene
- Total Aroclors: 1260
- Metals: antimony, arsenic, beryllium, chromium, lead, manganese, thallium, and vanadium

In addition, because several carcinogenic PAHs were detected at concentrations above screening criteria, the PAH indeno[1,2,3-cd]pyrene was also retained as a COPC; and because Aroclor 1260 was detected at concentrations above screening criteria, Aroclor 1248 was also retained as a COPC. No intertidal sediment COPC was eliminated as a result of comparison to background concentrations.

6.2.2.4 Groundwater Monitoring Wells COPCs

The following chemical was identified as a COPC based on a comparison of maximum concentrations in groundwater collected from monitoring wells in the Gould Island study area to risk-based COPC screening criteria for protection of indoor air exposures, as shown in Appendix G-1, Table 2.4:

- Tetrachloroethene

No groundwater COPC was eliminated as a result of comparison to background concentrations.

6.2.2.5 Shallow Groundwater (Testpits) COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations in groundwater collected from testpits in the Gould Island study area to risk-based COPC screening criteria for tap water ingestion, as shown in Appendix G-1, Table 2.5:

- Polynuclear aromatic hydrocarbons (PAHs): 2-methylnaphthalene, acenaphthene; acenaphthylene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)

fluoranthene; chrysene; dibenzo(a,h)anthracene; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; naphthalene; phenanthrene, and pyrene

- Semi-volatile organic compounds (SVOCs): 1,1-biphenyl, 2,4-dimethylphenol, 4-methylphenol, carbazole, dibenzofuran, and pentachlorophenol
- VOCs: benzene
- Total Aroclors: 1260
- Pesticides: DDE, gamma-BHC, and heptachlor epoxide
- Metals: arsenic, barium, cadmium, lead, manganese, nickel, vanadium, and zinc

In addition, because the pesticide DDE was detected at concentrations above screening criteria, DDD was also retained as a COPC.

No testpit groundwater COPC was eliminated as a result of comparison to background concentrations.

6.2.2.6 Clam Tissue COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations detected in clam tissue collected from the Gould Island study area to risk-based COPC screening criteria for fish ingestion, as shown in Appendix G-1, Table 2.6:

- Pesticides: beta-BHC and gamma-BHC
- Total Aroclors: Aroclor 1260
- Metals: arsenic, cadmium, chromium, manganese, and thallium

6.2.2.7 Mussel Tissue COPCs

The following chemicals were identified as COPCs based on a comparison of maximum concentrations detected in mussel tissue collected from the Gould Island study area to risk-based COPC screening criteria for fish ingestion, as shown in Appendix G-1, Table 2.7:

- Polynuclear aromatic hydrocarbons (PAHs): benzo(a)anthracene; benzo(a)pyrene; and benzo(b) fluoranthene
- Total Aroclors: Aroclor 1260
- Metals: arsenic

In addition, because several carcinogenic PAHs were detected at concentrations above screening criteria, chrysene was also retained as a COPC.

6.2.3 Exposure Point Concentrations

According to EPA regional guidance (EPA, 1994c), risk assessments are conducted using an exposure point concentration (EPC) for each COPC. The EPC represents an estimated concentration to which a receptor is assumed to be continuously exposed while in contact with an environmental medium. In accordance with EPA Region I guidance, two bounding estimates of each exposure scenario are considered. The first is identified as a central tendency exposure (CTE) receptor. The second class of receptor is called the reasonable maximum exposure (RME). The CTE scenario represents an “average case” exposure scenario. The RME scenario represents a “reasonable worst case” exposure scenario. The exposure point concentration is generally defined as the 95 percent upper confidence limit (UCL) on the mean under both RME and CTE scenarios and is calculated using the latest risk assessment guidance from EPA (EPA, 1994c and 2004d).

Validated laboratory data were used to calculate EPCs for all data. Estimated values (J qualified) and biased values (L and K qualified) were used as the reported value. Rejected results (R qualified) were eliminated from further consideration. Blank-qualified results were treated as non-detects. A value of one-half of the detection limit is substituted for non-detected (U qualified) values in the calculation of the 95 percent UCL on the mean. The average concentration reported for field duplicate pair samples was used to calculate EPCs. Sample lists for each media evaluated are provided in Appendix G-2.

TtNUS calculated the 95 percent UCL on the mean for the risk assessment using a TtNUS-modified version of EPA's ProUCL (Version 3.00.02, EPA, August 2004c) software. The modifications enable ProUCL to calculate 95 percent UCLs on the mean for several compounds at once, rather than one at a time.

ProUCL calculates 95 percent UCLs on the mean using 15 different computation methods, five parametric and ten non-parametric. Parametric methods rely on the estimation of parameters (such as the mean or the standard deviation) describing the distribution of the variable of interest in the population; non-parametric methods do not.

The five parametric UCL computation methods include:

1. Student’s-t UCL,
2. approximate gamma UCL using chi-square approximation,
3. adjusted gamma UCL (adjusted for level significance),
4. Land’s H-UCL, and

5. Chebyshev inequality based UCL (using Minimum Variance Un-biased Estimators (MVUEs) of parameters of a lognormal distribution).

The ten non-parametric methods included in ProUCL are:

1. the central limit theorem (CLT) based UCL,
2. modified-t statistic (adjusted for skewness) based UCL,
3. adjusted-CLT (adjusted for skewness) based UCL,
4. Chebyshev inequality based UCL (using sample mean and sample standard deviation),
5. Jackknife method based UCL,
6. UCL based upon standard bootstrap,
7. UCL based upon percentile bootstrap,
8. UCL based upon bias - corrected accelerated (BCA) bootstrap,
9. UCL based upon bootstrap-t, and
10. UCL based upon Hall's bootstrap.

ProUCL then suggests which 95 percent UCL on the mean is most appropriate for the data set. Flow charts to map the logic used by ProUCL to select the most appropriate 95 percent UCL on the mean are provided in Appendix G-3. After the 95 percent UCL on the mean was calculated, it was compared to the maximum detected concentration within the data set.

In data sets in which the calculated 95 percent UCL on the mean exceeded the maximum detected concentration, the maximum detected concentration was used as the reasonable maximum exposure point concentration; the lesser of the mean or maximum concentration detected was used for the central tendency exposure point concentration (see Section 6.3.3). This is a common problem in small data sets or data sets with high detection limits. Support documentation for the calculation of the 95 percent UCLs on the mean is presented in Appendix G-3. Exposure point concentrations used in the risk assessment are presented in Appendix G-1, Tables 3.1 through 3.7.

EPCs for lead were calculated differently because the lead models are designed to accept the mean lead value and estimate the upper percentile of blood lead concentrations from this quantity. Therefore, in the case of lead, the arithmetic mean of the lead concentration was selected as the EPC.

EPCs for exposure to air in excavated trenches by construction workers were estimated from shallow groundwater concentrations found in aqueous samples collected from testpits. There are no well-established models available for estimating migration of volatiles from groundwater into a construction/utility trench. To estimate the EPC for air in a construction trench, the HHRA used an

approach suggested by the Virginia Department of Environmental Quality (VDEQ, 2004), which is based on a combination of a vadose zone model (to estimate volatilization of gases from contaminated groundwater into a trench) and a box model (to estimate dispersion of the contaminants from the air inside the trench into the above-ground atmosphere). The VDEQ methodology is described in the following paragraphs.

The airborne concentration of a contaminant in a trench can be estimated using the following equation:

$C_{air} = C_{GW} \times VF$

where:

C_{air} = air concentration of contaminant in the trench µg/m^3

C_{GW} = concentration of contaminant in groundwater µg/L

VF = volatilization factor L/m^3

It is assumed that a construction project could result in an excavation of 15 feet bgs or less. For this particular site, depth to groundwater in the area of the test pits is approximately 3 feet bgs. Therefore, it is assumed that such trenches at this site would be no more than 3 feet deep. If the depth to groundwater at a site is less than 15 feet, the VDEQ model assumes that a worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater. The worker would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench.

The following equation is used to calculate the volatilization factor (VF) for a trench less than 15 feet deep:

$VF = (K_i \times A \times F \times 10^{-3} \times 10^{4} \times 3{,}600) / (ACH \times V)$

where:

K_i	=	overall mass transfer coefficient of contaminant (cm/s)
A	=	area of the trench (m^2)
F	=	fraction of floor through which contaminant can enter (unitless)
ACH	=	air changes per hour (h^{-1}) = 2 h^{-1}
V	=	volume of trench (m^3)
10^{-3}	=	conversion factor (L/cm^3)
10^{4}	=	conversion factor (cm^2/m^2)
3,600	=	conversion factor (seconds/hour)

Studies of urban canyons suggest that if the ratio of trench width, relative to wind direction, relative to trench depth is less than or equal to 1, a circulation cell or cells will be set up within the trench that limits the degree of gas exchange with the atmosphere and, based upon measured ventilation rates of buildings, the air changes per hour (ACH) is assumed to be 2. Based upon the ratio of trench depth to the average wind speed, if the ratio of trench width to trench depth is greater than 1, the air exchange between the trench and above-ground atmosphere is not restricted, and the ACH is assumed to be 360. The exposure assessment performed for this HHRA assumed the trench was 3 feet wide and 3 feet deep, therefore the width-to-depth ratio is equal to 1 and the ACH is set at 2. Since the model is very sensitive to this particular assumption, an additional exposure assessment was performed for this HHRA that assumed the trench was 4 feet wide and 3 feet deep. Under this assumption the width-to-depth ratio is greater than 1, therefore the ACH is set at 360. The results of the latter are discussed in the uncertainty section (Section 6.6.1).

K_i is calculated using the following equation:

$$K_i = 1 / \{(1/k_iL) + [(RT) / (H_i\ k_iG)]\}$$

where:

K_i	=	overall mass transfer coefficient of containment (cm/s)
k_iL	=	liquid-phase mass transfer coefficient of i (cm/s)
R	=	ideal gas constant (atm-m^3/mole-°K) = 8.2×10^{-5}
T	=	average system absolute temperature (°K) (Default = 283°K)
H_i	=	Henry's Law constant of i (atm-m^3/mole)
k_iG	=	gas-phase mass transfer coefficient of i (cm/s)

The average system absolute temperature is based on the average annual temperature for Rhode Island of 50°F. The formulas for calculating k_iL and k_iG are as follows:

$$k_iL = (MWO_2/MW_i)^{0.5} \times (T/298) \times kL,O_2$$

where:

k_iL	=	liquid-phase mass transfer coefficient of component i (cm/s)
MWO_2	=	molecular weight of oxygen (g/mole)
MW_i	=	molecular weight of component i (g/mole)
kL,O_2	=	liquid-phase mass transfer coefficient of oxygen at 25°C (cm/s) = 0002 cm/s

$$k_iG = (MWH_2O/MW_i)^{0.335} \times (T/298)^{1.005} \times kG,H_2O$$

where:

k_iG = gas-phase mass transfer coefficient of component i (cm/s)

MWH_2O = molecular weight of water (g/mole)

kG,H_2O = gas-phase mass transfer coefficient of water vapor at 25°C (cm/s)= 0.833 cm/s (Superfund Exposure Assessment Manual, U.S. EPA, 1988).

Chemical properties were obtained from the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (U.S. EPA, 2002a) and are presented in Appendix G-4. The modeled EPCs for trench air based on both a 3-foot wide trench and a 4-foot wide trench are presented in Appendix G-4, Tables 1 and 2 and Tables 3 and 4, respectively. The modeled EPCs for trench air based on a 3-foot wide trench are presented in Appendix G-1, Table 3.5B with the groundwater concentrations used to develop them. Alternate modeled EPCs and risk calculations based on a 4-foot wide trench are included in Appendix G-4 and discussed in Section 6.6.1.

6.3 EXPOSURE ASSESSMENT

The exposure assessment defines and evaluates the exposures that may be experienced by a receptor population. To have an exposure, several factors must be present: there must be a source of contamination, there must be a mechanism through which a receptor can come into contact with the contaminants in that medium, and there must actually (or potentially) be a receptor present at the point of contact.

The exposure assessment presented consists of several sections that characterize the physical site setting and the receptors of concern, identify the potential contaminant migration and exposure pathways, and present the equations used to quantify exposure in terms of contaminant intake (dose). Appendix G-5 contains sample calculations for the exposure assessment. Exposure assumptions for each scenario are presented in Appendix G-1, Tables 4.1 through 4.6. Intakes are presented in Appendix G-1, Tables 7.1 through 7.7 and 8.1 through 8.7.

6.3.1 Conceptual Site Model for Human Health Risk

This section discusses the general conceptual site model for the Gould Island study area as it pertains to contaminant exposure and risk to human receptors. A conceptual site model facilitates a consistent and comprehensive evaluation of the risks to human health by creating a framework for identifying the exposure routes or pathways by which human health may be impacted by contaminants predicted to exist at the source areas. A conceptual site model depicts the relationships between the following elements necessary to construct a complete exposure pathway:

- Sources of contamination and potential COPCs;
- Contaminant release mechanisms and transport pathways;
- Exposure mechanisms and exposure routes; and
- Receptors.

The conceptual site model was developed to provide the basis for identifying the potential risks to human health. The model considers the current and future conditions within the study area, and the actual or potential receptors that might come into contact with the COPCs.

The conceptual site model first considers the contaminant sources assumed to be available, either currently or in the future. For this model, contamination in the soil and groundwater within the study area, resulting from past industrial activities, is considered the source. Contaminants may be released from this source by mechanisms such as wind, water erosion, leaching to the subsurface, or excavation within areas of contamination. Once released from the source, contaminants are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to contaminants in environmental media via a variety of mechanisms. The exposure mechanisms considered include recreation, working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

The conceptual site model also indicates those exposure routes that are carried through the quantitative risk assessment for each receptor. An objective of developing the conceptual site model is to focus attention on those pathways that contribute the most to the potential impacts on human health and to provide the rationale for screening out other exposure pathways that are minor components of the overall risk.

Sources of Contamination and Potential COPCs. As discussed in Section 1.0, Site 17 is centered on the former Building 32, which was a Torpedo Overhaul Shop. Building 32 contained an electroplating shop, machine shops, degreasing shops, grinding and buffing shops, and other workshops used for torpedo service and maintenance during and after the Second World War. Past industrial activities have apparently resulted in the presence of chlorinated solvents, fuel-related contaminants, and metals in the soil, groundwater, soil gas, and marine sediment at the site, and PCBs in the soil and marine sediments at the site. In addition, it appears that in some shellfish samples at the Gould Island study area, contaminants (PCBs) may have accumulated in tissue.

Contaminant Release Mechanisms and Transport Pathways. Chemicals may be released from the study area by a variety of mechanisms. These mechanisms include: stormwater runoff and subsequent surface soil erosion; soluble chemicals infiltration and subsequent migration through the subsurface soil

to the water table, where the chemicals may migrate downgradient; wind erosion of surface soil from unpaved areas; disturbance of contaminants in soil through excavation activities or animal burrowing activities; and by open channel flow via existing drainage systems. Contaminant fate and transport mechanisms available for contaminants at this site are discussed in detail in Section 5 of this report.

Exposure Mechanisms and Exposure Routes. The potential for exposure to the contamination within the Gould Island study area is based on several factors, including current and future land uses, human activity patterns, site access controls, and chemical behavior in the environment. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under current and future site conditions. The future scenario accounts for possible changes in land use and site characteristics that may alter exposure and/or concentrations of COPCs in a given medium, in addition to the exposures that may result from current uses of the land.

The exposure assessment is based on the assumption that, in general, chemical compositions for environmental media are identical under current and future site conditions.

The exposure routes through which receptors may be exposed are: incidental ingestion and dermal contact with contaminated soils and inhalation of dust; incidental ingestion and dermal contact with contaminated sediment; inhalation of volatile contaminants in groundwater that may volatilize into future indoor air spaces; incidental ingestion and dermal contact with contaminated shallow groundwater, inhalation of volatile contaminants in shallow groundwater that may volatilize into construction trenches; and ingestion of contaminated shellfish. A summary of the potentially significant exposures identified for quantitative evaluation is provided in Appendix G-1, Table 1.

The Gould Island study area is described in Section 1.3 and is shown on Figures 1-2 through 1-4. The site study area is located on the north portion of Gould Island and occupies approximately 6 acres. In 2001 and 2002, the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place. Some of this demolition material was used to backfill an excavation area at the former Building 44 area, and the remainder was moved offsite for land disposal elsewhere. Current use and zoning were considered in the determination of current and reasonably anticipated future uses. Current land use and zoning suggest that future use of the area will remain unchanged.

Exposed Populations. The Gould Island study area is located on a remote island approximately one-half mile east of the Town of Jamestown and one mile west of the City of Newport. Access is limited to those traveling by boat. The Island is visited by industrial/military workers, and by trespassers. There

are currently no working facilities at the site; however, the Navy's planned future use is industrial/commercial use.

Receptors. Several potential receptor populations were considered for inclusion in the exposure assessment, as follows: recreational visitors; trespassers; fishermen; industrial workers; and construction workers. The current use and foreseeable future use of the property is industrial/military. However, it is possible that a future use could be recreational. There is no foreseeable future residential use at Gould Island. Therefore, future on-site residents were excluded in the HHRA for the study area.

Possible exposures of recreational visitors and trespassers to site-related contaminants would be through passive recreational activities, including walking, hiking, picnicking, hunting, or fishing within the Gould Island study area. Recreational visitors and trespassers are assumed to be exposed to soils at depths of 0 to 2 feet bgs, and to intertidal sediments at the shoreline, through ingestion and dermal contact. Recreational visitors and trespassers may also be exposed to soils through inhalation of dust.

Possible exposures of recreational or subsistence fishermen to site-related contaminants would be through ingestion of contaminated shellfish from the study area.

Possible current and future exposures of industrial workers to site-related contaminants would be through commercial/industrial activities at the study area. Currently workers are present infrequently (less than 52 days per year) at the study area. Navy plans to retain the Gould Island property, but has no planned future use for the property. Because future use is the same as current use, and because access requires transportation by boat, it is unlikely workers will be present at the site on a more frequent basis within the foreseeable future. However, for purposes of evaluation of the industrial worker exposures, the industrial worker scenario was defined as an indoor/outdoor worker in direct contact with soils for 250 days per year under the RME scenario and 219 days per year under the CTE scenario. These scenarios are protective of industrial workers who may be present less frequently. Current industrial workers are assumed to be exposed to soils at depths of 0 to 2 feet bgs through ingestion, dermal contact, and inhalation of dust. Future industrial workers are assumed to be exposed to soils at depths of 0 to 10 feet bgs through ingestion, dermal contact, and inhalation of dust, and to volatile COPCs in groundwater through inhalation of indoor air.

Possible future exposures of construction workers to site-related contaminants would be through excavation activities at the study area. The construction worker may be in direct contact with soils as deep as 10 feet bgs on a short-term basis (approximately 6 months). This receptor can be exposed to surface soil and subsurface soil through ingestion, dermal contact, and inhalation of dust, and shallow groundwater through ingestion, dermal contact, and inhalation of volatile COPCs.

6.3.2 Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of a receptor's behavior or lifestyle causing an exposure to a contaminated medium. This HHRA defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium. The exposure routes considered in this HHRA are direct contact with soil and sediment, direct contact with groundwater, air inhalation, and shellfish ingestion. These are discussed in detail below.

6.3.2.1 Direct Contact with Soil and Sediment

Receptors may come into direct contact with soil or sediment contaminated by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be exposed via inadvertent ingestion of a small amount of soil or sediment or via dermal absorption of certain contaminants in the soil or sediment.

Because of the limited guidance available to estimate soil and sediment exposure via dermal contact, dermal risks can be evaluated quantitatively only for contaminants with available soil absorption factors. Several of these chemicals were selected as COPCs for the Gould Island study area. Therefore, dermal risks associated with soil and sediment were quantitatively addressed in the risk assessment. Dermal contact with other chemicals detected in the study area soil or sediment may or may not result in a significant exposure. It should be noted that organics such as PAHs, which were detected frequently in the soil samples and were selected as COPCs, tend to strongly adhere to organic matter in soil. For these chemicals to be percutaneously absorbed, they must first desorb from soil and then diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, and chemical-specific properties.

6.3.2.2 Direct Contact with Groundwater

Receptors may come into direct contact with shallow groundwater during excavation activities. During the receptor's period of contact, the individual may be exposed via inadvertent ingestion of a small amount of groundwater or via dermal absorption of certain contaminants in the groundwater.

6.3.2.3 Inhalation of Air

This pathway is based on the scenario that as part of daily living, a receptor is surrounded by an airspace that contains suspended particulates and volatile organic vapors originating from the source areas. Exposure of the receptor occurs upon inhalation of the ambient air.

A qualitative comparison of maximum detected soil concentrations and EPA Generic Soil Screening Levels (SSLs) for inhalation, based on intermedia transfer from soil to air (EPA, 1996a), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. Generic SSLs for inhalation are modeled soil concentrations based on a back-calculation of dust concentrations associated with a one-in-one-million (10^{-6}) cancer risk for carcinogens, or a HQ of one (1.0) for non-carcinogens. These concentrations are derived from equations combining EPA toxicity data with default exposure information assumptions chosen to be protective of human health for most site conditions. Generally, at sites where contaminant concentrations fall below SSLs, no further action or study is warranted under CERCLA. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential recreational or industrial receptors at the Gould Island study area. Appendix G-6, Tables 1 and 2, present the inhalation SSLs for residential land-use.

As shown on Table 1 of Appendix G-6, all reported surface soil concentrations within the study area are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a). Based on the qualitative screening, no further quantitative evaluation of exposures to fugitive dust and VOCs released from surface soil is warranted.

As shown on Table 2 of Appendix G-6, maximum reported cadmium and chromium subsurface soil within the study area exceeded the EPA Generic SSLs for transfers from soil to air (EPA, 1996a). Based on this qualitative screening, a quantitative evaluation of exposures to fugitive dust from subsurface soil is warranted for those receptors expected to contact subsurface soils (construction workers and future industrial workers).

Future indoor air concerns were evaluated through EPA's Subsurface Vapor Intrusion Guidance (EPA, 2002b). As recommended in EPA's OSWER draft *Guidance for Evaluating the Vapor Intrusion Indoor Air Pathway from Groundwater and Soils* (EPA, 2002b), a tiered approach was used to address the vapor intrusion pathway. Appendix G-7 presents the Tier 1 and Tier 2 evaluations of the groundwater monitoring well data. Tier 1 results for the groundwater monitoring well data indicate six groundwater COPCs detected that are both toxic by the inhalation pathway and volatile. These six contaminants are benzene, PCE, TCE, 2-methylnaphthalene, naphthalene, and dibenzofuran. For a Tier 2 evaluation, because

indoor air data are not available, groundwater data were screened against the target levels provided in Table 2c of the draft Guidance. The Table 2c values are target groundwater concentrations corresponding to target indoor air concentrations that are associated with cancer risk level of $1x10^{-6}$ for residential indoor air exposures. During the Tier 2 evaluation, among the contaminants identified as volatile and toxic in the Tier 1 screening step, using maximum detected concentrations, the maximum concentration of just one contaminant (PCE) in groundwater monitoring well data exceeds the initial screening criteria at the 10^{-6} target cancer risk level. This screening value (5 µg/L) is based on the MCL for PCE, rather than an indoor air risk-based concentration. The maximum detected groundwater monitoring well PCE concentration (6 µg/L) corresponds to a potential $5x10^{-6}$ risk level for residential indoor air exposures. The 95% UCL PCE concentration (3.0 µg/L) is less than the Table 2c value. None of the contaminants are present at concentrations greater than the 10^{-5} or 10^{-4} target cancer risk levels shown on Tables 2b and 2a of the draft Guidance.

Based on the Tier 1 and Tier 2 evaluations, because the receptor of concern at this Site is a future industrial worker, rather than a resident; all groundwater concentrations are below Table 2c screening values except PCE; the maximum PCE levels are only slightly above the Table 2c level; and the 95% UCL concentration of PCE is below the Table 2c value; the vapor intrusion pathway was considered incomplete. Therefore, further evaluation of the indoor air pathway for future industrial workers is not warranted.

Construction workers may contact volatile contaminants in trench air during excavation activities. This is of particular concern where volatile contaminants are detected in shallow groundwater. As described in section 6.2.3, EPCs for air in a construction trench were modeled from shallow groundwater concentrations using an approach suggested by the Virginia Department of Environmental Quality (VDEQ, 2004).

6.3.2.4 Ingestion of Shellfish

Receptors may come into contact with contaminated shellfish (clams or mussels) through dietary consumption. The individual may be exposed through intentional ingestion of shellfish collected as opportunity presents itself. This area is open to shell fishing under state regulations and therefore, shellfish may be collected by persons diving from boats or by raking the bottom substrate. Persons collecting shellfish are categorized as recreational fisherman or subsistence fisherman.

6.3.3 Potential Receptors

Potential receptors have been identified under current and future land use conditions. These receptors were identified by analyzing the interaction of current and anticipated future land use practices with the identified sources of contamination.

The following receptor groups have been defined for this risk assessment:

- Current and Future Recreational Receptor
- Current and Future Trespasser (adolescent)
- Current Industrial Worker
- Future Industrial Worker
- Future Construction Worker
- Current and Future Fisherman

Table 6-1 presents receptors and exposure pathways identified for the Gould Island study area, and provides the rationale for the quantitative evaluation of selected exposure pathways.

Two bounding estimates of each exposure scenario were considered according to or consistent with EPA Region I guidance. The first is identified as a central tendency exposure (CTE) receptor, which was developed using both regional guidance (EPA, 1994c) and professional judgment regarding site-specific conditions. The second class of receptor is called the reasonable maximum exposure (RME) and was developed according to EPA guidance (EPA, 1989b and 1994c). The CTE scenario uses average values for exposure parameters and represents an “average case” exposure scenario. The RME scenario uses values that represent the upper distribution or “high-end” of population exposure for exposure parameters. The RME scenario is intended to provide an upper bound of the possible risk. The RME is conceptually the “high end” exposure, above the 90th percentile of the population distribution, but not higher than the individual in the population with the highest exposure. Therefore, the RME scenario represents a “reasonable worst case” exposure scenario.

Exposure scenarios for each of the receptor groups defined above are discussed below.

6.3.3.1 Recreational Visitors, Exposure to Soil and Sediment

Adult and child recreational visitors were evaluated for current and future exposures to the surface soil and intertidal sediment at the study area through ingestion and dermal contact. Recreational visitors were assumed to be adults and small children, walking, hiking, picnicking, hunting or fishing.

Site-specific considerations were used to determine exposure frequencies for recreational visitors. The exposure assumptions for recreational visitors were 4 hours per day for 24 days per year for the CTE evaluation, and 8 hours per day for 48 days per year for the RME evaluation. Adult receptors were assumed to ingest an average of 50 mg of soil and sediment per day for 9 years for the CTE evaluation, and 100 mg of soil and sediment per day for 24 years for the RME evaluation. Child receptors were assumed to ingest an average of 100 mg of soil and sediment per day for 2 years for the CTE evaluation, and 200 mg of soil and sediment per day for 6 years for the RME evaluation. The fraction of soil and sediment intake derived from the contaminated source was set at one. The proposed exposure duration values were based on EPA guidance for RME and CTE evaluation (EPA, 1997b). Values for small children for the RME evaluation reflect the entire age span for the receptor evaluated. The associated CTE values reflect a short period of time (basically one third of the RME value).

Hands, forearms, lower legs, feet, and head were assumed to be available for dermal contact with soil and sediment for young children. Hands, forearms, lower legs, and head were assumed to be available for dermal contact with soil and sediment for adults. The calculated available skin surface areas for dermal contact with soil and sediment for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,800 cm^2, respectively. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.07 mg/cm^2 and 0.01 mg/cm^2 were used as soil-to-skin adherence factors for adult exposures for the RME and CTE evaluations, respectively. The adult recreational RME soil-to-skin adherence factor of 0.07 mg/cm^2 corresponds to the 50th percentile weighted adherence values for gardeners. The adult recreational CTE soil-to-skin adherence factor of 0.01 mg/cm^2 corresponds to the 50th percentile weighted adherence values for residential groundskeepers. Values of 0.2 mg/cm^2 and 0.04 mg/cm^2 were used as soil-to-skin adherence factors for child exposures for the RME and CTE evaluations, respectively. The child recreational RME soil-to-skin adherence factor of 0.2 mg/cm^2 corresponds to the 50th percentile weighted adherence values for children playing in wet soil. The child recreational CTE soil-to-skin adherence factor of 0.04 mg/cm^2 corresponds to the 50th percentile weighted adherence values for children playing in dry soil and daycare children. The adherence factors have been recommended in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) (EPA, 2004b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook. Sediment-to-skin adherence factors were set equal to soil-to-skin adherence factors for these receptors.

Appendix G-1, Tables 4.1A through 4.1D, present the exposure parameters for adult and child recreational visitor exposures to soil and sediment.

6.3.3.2 Trespassers, Exposure to Soil and Sediment

Possible exposures of trespassers to site-related contaminants in surface soil and sediment would be through passive recreational activities within the Gould Island study area through ingestion and dermal contact. Trespassers were assumed to be adolescents between the ages of 7 to 18 years.

The exposure frequency assumptions for trespassers were 24 days per year for the CTE evaluation and 48 days per year for the RME evaluation. Trespassers were assumed to ingest an average of 50 mg of soil and sediment per day for 6 years for the CTE evaluation, and 100 mg of soil and sediment per day for 12 years for the RME evaluation. The fraction of soil and sediment intake derived from the contaminated source was set at one. The proposed exposure duration value for the RME evaluation reflects the entire age span for the receptor evaluated. The associated CTE value reflects one-half of the RME value.

Hands, forearms, lower legs, and feet were assumed to be available for dermal contact with soil and sediment. The calculated available skin surface area for dermal contact with soil and sediment was 4,050 cm^2, assuming the average total surface area for male and female adolescents, ages 7 through 17, is 1.31 m^2, and the exposed surface area is 31 percent of the total. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.4 mg/cm^2 and 0.04 mg/cm^2 were used as soil-to-skin adherence factors for the RME and CTE evaluations, respectively. The RME soil-to-skin adherence factor of 0.4 mg/cm^2 corresponds to the 95th percentile weighted adherence values for children playing in dry soil. The CTE soil-to-skin adherence factor of 0.04 mg/cm^2 corresponds to the 50th percentile weighted adherence values for children playing in dry soil. Values of 3.3 mg/cm^2 and 0.2 mg/cm^2 were used as sediment-to-skin adherence factors for the RME and CTE evaluations, respectively. The RME sediment-to-skin adherence factor of 3.3 mg/cm^2 corresponds to the 95th percentile weighted adherence values for children playing in wet soil. The CTE sediment-to-skin adherence factor of 0.2 mg/cm^2 corresponds to the 50th percentile weighted adherence values for children playing in wet soil. The adherence factors have been recommended in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) (EPA, 2004b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

Appendix G-1, Tables 4.2A and 4.2B, present the exposure parameters for trespasser exposures to soil and sediment.

6.3.3.3 Current and Future Industrial Workers, Exposure to Soil

Currently workers are present infrequently (less than 52 days per year) at the study area. Navy plans to retain the Gould Island property, but has no planned future use for the property. As future plans currently stand and because access requires transportation by boat, it is unlikely workers will be present at the site on a more frequent basis within the foreseeable future. However, for purposes of evaluation of the industrial worker exposures, both the current and future industrial worker scenarios were defined as indoor/outdoor workers in direct contact with soils on a frequent basis. These scenarios represent conservative scenarios.

The current adult industrial worker was evaluated for exposures to surface soils (0 to 2 feet bgs) at the study area through ingestion and dermal contact. In the future, contaminated soils currently located at depth may be brought to the surface through excavation and land development. The future adult industrial worker was evaluated for exposures to subsurface soils at the study area to a depth of 10 feet bgs through ingestion, dermal contact and inhalation of fugitive dust.

Possible exposures of industrial workers to site-related contaminants would be through inadvertent contact. Industrial workers were assumed to be exposed to site media for 219 days per year for the CTE evaluation, and for 250 days per year for the RME evaluation. These receptors were assumed to ingest an average of 50 mg of soil per day for 9 years for the CTE evaluation, and 100 mg of soil per day for 25 years for the RME evaluation. Head, hands, and forearms were expected to be available for dermal contact with soils. The calculated available skin surface area for these body parts was 3,300 cm^2. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.2 mg/cm^2 and 0.02 mg/cm^2 were used as soil-to-skin adherence factors for adult industrial workers for the RME and CTE evaluations, respectively. The RME value corresponds to the 50th percentile weighted adherence values for heavy equipment operators and utility workers. The CTE value corresponds to the 50th percentile weighted adherence values for commercial groundskeepers (EPA, 2004b). Future industrial workers were assumed to inhale dust for 8 hours per day at a rate of 1.6 m^3 per hour and 0.6 m^3 per hour for the RME and CTE evaluations, respectively.

Appendix G-1, Table 4.3 presents the exposure parameters for current industrial worker exposures to soil (and for future worker exposures to surface soil). Appendix G-1, Tables 4.4A and 4.4B present the exposure parameters for future industrial worker exposures to soil (subsurface soil).

6.3.3.4 Construction Workers, Exposure to Soil and Shallow Groundwater from Testpits

The adult construction worker was evaluated for exposures to shallow groundwater (as encountered in test pits) and soils at the study area to 10 feet bgs. This person can have contact with surface and subsurface soil through ingestion, dermal contact, inhalation of fugitive dust, as well as to shallow groundwater through incidental ingestion, dermal contact, and to VOC through inhalation of air within a trench. Because groundwater is located at 3-5 feet bgs across the site, it is unlikely that excavation will occur below that depth. It is also unlikely that workers would be working in trenches in contact with groundwater and vapors emanating from groundwater 8 hours per day on a daily basis. Therefore, this scenario is presented as a conservative estimate of exposures to construction workers.

Possible exposures of construction workers to site-related contaminants would be through inadvertent contact during a project lasting no more than one year. Construction workers were assumed to be exposed to site media for 52 days per year for the CTE evaluation, and for 130 days per year for the RME evaluation. These receptors were assumed to ingest an average of 100 mg of soil per day and 25 ml of groundwater per day for the CTE evaluation, and 200 mg of soil per day and 50 ml of groundwater per day for the RME evaluation. Head, hands, and forearms were expected to be available for dermal contact with soils and groundwater. The calculated available skin surface area for these body parts was 3,300 cm^2. No attempt was made to vary a receptor's skin surface area for the RME and CTE evaluations. Values of 0.3 mg/cm^2 and 0.1 mg/cm^2 were used as soil-to-skin adherence factors for adult construction workers for the RME and CTE evaluations, respectively. The RME value corresponds to the 50th percentile weighted adherence values for archeologists and reed gatherers. The CTE value corresponds to the 50th percentile weighted adherence values for commercial gardeners and construction workers (EPA, 2004b). Construction workers were assumed to inhale dust from soil and volatile contaminants in vapors from groundwater for 8 hours per day at a rate of 3.3 m^3 per hour and 1.5 m^3 per hour for the RME and CTE evaluations, respectively. Appendix G-8 provides the calculation of the particulate emission factor (PEF) used in the calculation of dust exposures in the construction worker scenario.

Appendix G-1, Tables 4.5A through 4.5D present the exposure parameters for future construction worker exposures to soil, groundwater, and to vapors from groundwater.

6.3.3.5 Fishermen, Exposure to Clams or Mussels

Possible exposures of recreational or subsistence fishermen to site-related contaminants would be through ingestion of contaminated shellfish (mussels and clams) from the study area. Adults and children consuming the shellfish were assumed to obtain their seafood intake from a single species (either clams

or mussels, but not both) obtained from within the study area. The RME scenario approximates a subsistence level of consumption. The CTE scenario provides a recreational scenario.

Adult receptors were assumed to ingest shellfish from the study area for 9 years for the CTE (recreational) evaluation and 24 years for the RME (subsistence) evaluation. Child receptors were assumed to ingest shellfish from the study area for 2 years for the CTE (recreational) evaluation and 6 years for the RME (subsistence) evaluation.

Adult fishermen were assumed to ingest 150,000 mg of shellfish per serving, while child consumers of shellfish ate 48,000 mg per serving. Under the RME subsistence scenario, adults and children were assumed to ingest 180 servings per year. Under the CTE recreational scenario, adults and children were assumed to ingest 20 servings per year.

Appendix G-1, Tables 4.6A and 4.6B present the exposure parameters for adult and child fishermen exposures to shellfish. The same assumptions are used for both clams and mussels.

6.3.4 Exposure Pathways

An exposure pathway consists of four elements: a source and mechanism of release; a route of contaminant transport through an environmental medium; a contact point for a human receptor; and an exposure route at the point of contact. All four components must be present for the exposure pathway to be considered complete. This section summarizes the potentially complete exposure pathways that were quantitatively evaluated in the risk assessment and provides the rationale for those pathways that were not evaluated. Appendix G-1, Table 1 presents a summary of the potentially complete exposure pathways and receptors.

The primary routes of exposure for potential human receptors within the Gould Island study area are incidental ingestion of and dermal contact with soil, sediment, and groundwater, inhalation of fugitive dust from subsurface soils, inhalation of volatiles in vapors from shallow groundwater, and ingestion of shellfish. Other potential exposure routes, including those associated with using groundwater as potable water, inhalation of fugitive dust by recreational visitors, trespassers, and current industrial workers, and inhalation of indoor air vapors were not considered for the following reasons:

- The shallow aquifer at the Gould Island study area is not used as a potable water supply and there is no current or future anticipated residential use of the site. Thus, domestic groundwater exposures are eliminated. In addition, groundwater at Gould Island is not used or expected to be

used in the future as a potable water supply because of the assumed brackish conditions, as well as productivity constraints. There is currently no water service to Gould Island.

- Potential exposures to volatile emissions and fugitive dust from surface soils within the Gould Island study area are considered to be minimal, based on the qualitative comparison of Gould Island data to the EPA Generic SSLs for transfers from soil to air, discussed in Section 6.3.2, thereby eliminating the need for quantitative evaluation of this exposure pathway for receptors expected to contact surface soils.

- Potential exposures to groundwater contaminants volatilizing into future indoor air spaces are not considered, based on the evaluation of the vapor intrusion pathway, discussed in Section 6.3.2, thereby eliminating the need for quantitative evaluation of this exposure pathway for receptors inhaling indoor air in potential future buildings on-site.

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of EPA guidance documents that are cited in the specific intake estimation sections that follow.

Exposures depend on the predicted concentrations of chemicals in environmental media, and on local land use practices, both of which are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Appendix G-1, Table 1 presents a summary of the exposure pathways evaluated in the quantitative risk assessment. The recreational visitor, trespasser, fishermen, and industrial worker scenarios are applicable under both current and future land use conditions. The construction worker and future industrial worker indoor air exposure scenarios are applicable under future land use conditions only.

Exposure model parameters are presented in Appendix G-1, Tables 4.1 through 4.6. Appendix G-1, Tables 4.1A, 4,1B, 4.1C, and 4.1D present soil and sediment exposure parameters for the recreational visitor scenario for adults and children. Appendix G-1, Tables 4.2A and 4.2B present soil and sediment exposure parameters for the adolescent trespasser scenario. Appendix G-1, Table 4.3 presents soil exposure parameters for the current industrial worker scenario. Appendix G-1, Tables 4.4A and 4.4B present soil exposure parameters for the future industrial worker scenario. Appendix G-1, Tables 4.5A and 4.5B present soil exposure parameters for the construction worker scenario. Appendix G-1, Table 4.5C presents groundwater exposure parameters for the construction worker scenario. Appendix G-1, Table 4.5D presents trench air exposure parameters for the construction worker scenario. Appendix G-1,

Tables 4.6A and 4.6B present shellfish exposure parameters for the fishermen scenario for adults and children. The values reflect current EPA guidance and comments received from EPA Region I. All parameters are referenced in footnotes on each table. These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in Appendix G-1, Tables 3.1 through 3.7, to calculate intakes, which are used to determine risks. Individual chemical intakes for each receptor/exposure route combination are presented in Appendix G-1, Tables 7.1 through 7.7 and 8.1 through 8.7. The equations used to quantify intakes are presented below.

6.3.4.1 Incidental Ingestion of Soil and Sediment

For soil, this pathway is evaluated for child and adult recreational visitors, trespassers, industrial workers, and construction workers. For sediment, this pathway is evaluated for child and adult recreational visitors and trespassers. In general, intakes associated with soil and sediment ingestion were calculated using the following equation:

Average Daily Dose (Lifetime and Chronic) Following Ingestion of Soil or Sediment (mg/kg-day):

$$Intake = \frac{CxIRxOABSx\ FIxEFxEDxC\ F}{BWxAT}$$

where:

Intake	=	Intake of contaminant from soil or sediment (mg/kg/day)
C	=	Exposure concentration for soil or sediment (mg/kg)
IR	=	Ingestion Rate (mg/day)
OABS	=	Oral Absorption factor
FI	=	Fraction Ingested from contaminated source (decimal fraction)
EF	=	Exposure Frequency (days/yr)
ED	=	Exposure Duration (yr)
CF	=	Conversion Factor (10^{-6} kg/mg)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days);
		for noncarcinogens, AT=ED*365 days/yr;
		for carcinogens, AT=70 yr*365 days/yr

Appendix G-1, Tables 4.1A, 4.1B, 4.2A, 4.3, 4.4A and 4.5A contain summaries of the input parameters for incidental ingestion of soil. Appendix G-1, Tables 4.1C, 4.1D, and 4.2B contain summaries of the input parameters for incidental ingestion of sediment. The oral relative absorption factor was set equal to one

for all contaminants, assuming that absorption from soil is equal to absorption from the media used to develop toxicity values.

6.3.4.2 Dermal Contact with Soil and Sediment

Dermal contact exposures to soil were evaluated for child and adult recreational visitors, trespassers, industrial workers, and construction workers. Dermal contact exposures to sediment were evaluated for child and adult recreational visitors and trespassers.

The following equation was used to estimate the dermal exposure dose for soil and sediment:

Dermally Absorbed Dose (Lifetime and Chronic) Following Dermal Contact with Soil (mg/kg/day):

$$DAD = \frac{DA_{event} \ x \ EF \ x \ ED \ x \ EV \ x \ SA}{BW \ x \ AT}$$

where:

DAD	=	Dermally Absorbed Dose (mg/kg-day)
DA_{event}	=	Absorbed Dose per Event (mg/cm^2-event)
EV	=	Event Frequency (events/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
SA	=	Surface Area (cm^2)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days);
		for noncarcinogens, AT=ED*365 days/yr;
		for carcinogens, AT=70 yr*365 days/yr

The calculation of the dose absorbed per unit area per event (DA_{event}) is as follows:

$$DA_{event} = CS \ x \ AF \ x \ DABS \ x \ CF$$

where:

DA_{event}	=	Absorbed Dose per Event (mg/cm^2-event)
CS	=	Concentration in soil or sediment (mg/kg)
AF	=	Soil or Sediment-to-skin adherence factor (mg/cm^2-event)
DABS	=	Dermal Absorption fraction (unitless)
CF	=	Conversion factor (10^{-6} kg/mg)

Chemical-specific dermal absorption factors (DABS), presented in EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) (EPA, 2004b), were used to estimate exposure doses. Unfortunately, limited information regarding dermal absorption is available. The DABS values that are available for the COPCs are presented in Appendix G-1, Table 5.1. For all other COPCs, TtNUS qualitatively evaluated dermal exposures.

The input parameters for dermal contact with soil are summarized in Appendix G-1, Tables 4.1A, 4.1B, 4.2A, 4.3, 4.4A, and 4.5A. Appendix G-1, Tables 4.1C, 4.1D, and 4.2B contain summaries of the input parameters for dermal contact with sediment.

6.3.4.3 Estimating Potential Exposure from Inhalation of Fugitive Dust

Inhalation of fugitive dust was evaluated for future industrial workers and construction workers. The following equation is used to calculate potential risks from inhalation of fugitive dust.

Average Daily Dose (Lifetime and Chronic) Following Inhalation of COPC (mg/kg-day):

$$ADD = \frac{CSx\ {}^{1}\!/_{PEF}\ x\ IR\ x\ AAF_i\ x\ ET\ x\ EF\ x\ ED}{BWxAT}$$

where:

ADD	=	Average Daily Dose (mg/kg-day)
CS	=	Soil concentration (mg/kg soil)
PEF	=	Particulate Emission factor (m^3/kg)
IR	=	Inhalation rate (m^3/hr)
AAF_i	=	Inhalation Absorption factor (unitless)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (year)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days)

The input parameters for inhalation of fugitive dust are summarized in Appendix G-1, Tables 4.4B and Table 4.5B.

6.3.4.4 Estimating Potential Exposure from Ingestion of Groundwater

This pathway is evaluated for construction workers exposed to shallow groundwater during future construction excavation work.

The following equation is used to calculate potential risks from ingestion of groundwater.

Average Daily Dose (Lifetime and Chronic) Following Ingestion of Water (mg/kg-day):

$$ADD = \frac{CW \ x \ IR \ x \ EF \ x \ ED \ x \ AAF_O}{BWxAT}$$

where:

ADD	=	Average Daily Dose (mg/kg-day)
CW	=	Water concentration (mg/L)
IR	=	Water ingestion rate (L/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (year)
AAF_o	=	Oral-water AAF (unitless)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The input parameters for ingestion of groundwater are summarized in Appendix G-1, Table 4.5C.

6.3.4.5 Estimating Potential Exposure from Dermal Contact with Groundwater

This pathway is evaluated for construction workers exposed to shallow groundwater during future construction/excavation work.

Calculation of the average daily dose from dermal exposure to water follows EPA guidance (EPA, 2004b) that differentiates between organics and inorganics, as presented below. The following equations are used to estimate the average daily dose (lifetime and chronic) and the dermally absorbed dose (DAD) following dermal contact with groundwater:

$$ADD = DAD \ x \ AAF_d$$

where:

ADD	=	Average Daily Dose
DAD	=	Dermally Absorbed Dose (mg/kg-day)
AAF_d	=	Absorption Adjustment Factor - Dermal-water (dimensionless)

$$DAD = \frac{DAevent \ x \ EV \ x \ EF \ x \ ED \ x \ SA}{BW \ x \ AT}$$

where:

DAD	=	Dermally Absorbed Dose (mg/kg-day)
DA_{event}	=	Absorbed Dose per Event (mg/cm^2-event)
EV	=	Event Frequency (events/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
SA	=	Surface Area (cm^2)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days)

The calculation of the dose absorbed per unit area per event (DA_{event}) is as follows for inorganics:

$$DAevent = CW \ x \ PC \ x \ ET \ x \ CF$$

where:

DA_{event}	=	Absorbed Dose per Event (mg/cm^2-event)
CW	=	Concentration in Water (mg/L)
PC	=	Permeability Coefficient (kp) (cm/hr)
ET	=	Exposure Time (hr/event)
CF	=	Conversion factor (L/1000 cm^3)

The calculation of DA_{event} is as follows for organics:

$$DA_{event} = 2FA \ x \ PC \ x \ CW \ x \ CF \sqrt{\frac{6 \ x \ T \ x \ ET}{\pi}}$$

[If ET < t*]

$$DAevent = FA \ x \ PC \ x \ CW \ x \ CF \ x \left[\frac{ET}{1+B} + 2 \ x \ T \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$$

[If ET > t*]

where:

DA_{event}	=	Absorbed Dose per Event (mg/cm^2-event)
FA	=	Fraction Absorbed (dimensionless, chemical specific)
PC	=	Permeability Coefficient (kp)(cm/hour)
CW	=	Concentration in Water (mg/L)
ET	=	Exposure Time (hr/event)
T	=	Lag Time (hr)
t*	=	Time to Steady State (hr)
B	=	Dimensionless Constant
CF	=	Conversion Factor (L/1000 cm^3)

The input parameters for dermal contact with groundwater are summarized in Appendix G-1, Table 4.5C. Appendix G-1, Table 5.3 presents chemical-specific parameters for dermal contact with water.

6.3.4.6 Estimating Potential Exposure via Inhalation of Volatiles

Inhalation of volatiles was evaluated for future construction workers exposed to volatiles from shallow groundwater (as sampled in testpits) in excavation trenches.

The following equation is used to calculate potential risks from inhalation of volatile contaminants in trench air.

Average Daily Dose (Lifetime and Chronic) Following Inhalation of COPC (mg/kg-day):

$$ADD = \frac{CA \, x \, IR \, x \, AAF_i \, x \, ET \, x \, EF \, x \, ED}{BWxAT}$$

where:

ADD	=	Average Daily Dose (mg/kg-day)
CA	=	Air concentration (mg/m^3)
IR	=	Inhalation Rate (m^3 /hr)
AAF_i	=	Inhalation Absorbtion factor (unitless)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (year)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days)

The input parameters for inhalation of volatiles are summarized in Appendix G-1, Table 4.5D.

6.3.4.7 Estimating Potential Exposure from Ingestion of Shellfish

This pathway is evaluated for fishermen.

The following equation is used to calculate potential risks from ingestion of shellfish (clams and mussels). Average Daily Dose (Lifetime and Chronic) Following Ingestion of Shellfish (mg/kg-day):

$$ADD = \frac{CS \, x \, IR \, xFIx \, EF \, x \, EDxCF}{BWxAT}$$

where:

ADD	=	Average Daily Dose (mg/kg-day)
CS	=	Shellfish Tissue concentration (mg/kg)
IR	=	Shellfish Ingestion Rate (mg/day)
FI	=	Fraction Ingested from Contaminated Source (unitless)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (year)
CF	=	Conversion Factor (10^{-6} kg/mg)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days)

The input parameters for ingestion of shellfish are summarized in Appendix G-1, Tables 4.6A and 4.6B.

6.4 TOXICITY ASSESSMENT

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects (Section 6.5).

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity

of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the COPCs.

The entire toxicological database is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and reference doses (RfDs) for non-carcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of the toxicity data used to derive CSFs and RfDs comes from animal studies.

For non-carcinogenic effects, the most appropriate animal model (the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicological similarity.

CSFs for chemicals described as carcinogenic to humans or likely to be carcinogenic to humans are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for chemicals described as having suggestive evidence of carcinogenic potential for which the data are sufficient; CSFs are not derived for chemicals described as having inadequate information to assess carcinogenic potential or chemicals described as not likely to be carcinogenic to humans. (An explanation of these weight-of-evidence narratives is provided in Section 6.4.2). Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Brief summaries of the toxicity profiles for the major COPCs are presented in Appendix G-9. These profiles present a summary of the available literature on carcinogenic and non-carcinogenic effects associated with human exposure to each listed chemical. For more detailed information see www.epa.gov/iris or www.atsdr.cdc.gov.

6.4.1 Non-carcinogenic Effects

For non-carcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. Therefore, for non-carcinogens, a range of exposures exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for non-carcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

To derive an RfD, EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms.

Inhalation RfDs are based on a conversion of Inhalation Reference Concentrations (RfCs), available from EPA's Integrated Risk Information System (IRIS) database (EPA, 2006). The Reference Concentration, measured in units of mg/m^3, is the concentration of chemical in air at which a 70-kilogram adult with an inhalation rate of 20 m^3/day would receive the Reference Dose. Published Reference Concentrations were converted into Inhalation Reference Doses as follows:

Inhalation RfD (mg/kg-day) = RfC (mg/m^3) x 20 m^3/day / 70 kg

The IRIS database was consulted as the primary source for RfD values, as well as for CSFs. EPA intends that IRIS supersedes all other sources of toxicity information for risk assessment. Additional sources for the dose-response values used in the risk assessment were the EPA National Center for Environmental Assessment (NCEA) in Cincinnati, Ohio, and the Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1997a). The current EPA Region IX Preliminary Remediation Goals (PRGs) Table (EPA, 2004c) provides a source of NCEA values. If no RfD is available from any of these sources, non-carcinogenic risks are not quantified and potential exposures are addressed in the uncertainty section (Section 6.6).

Oral reference doses for the COPCs for the Gould Island study area are presented in Appendix G-1, Table 5.1. Inhalation reference doses for the soil COPCs that exceeded SSLs for inhalation and the volatile groundwater COPCs are presented in Appendix G-1, Table 5.2. These tables also include the primary target organs affected by each listed chemical, where information is available. This information may be used in the risk characterization (Section 6.5) to segregate risks by target organ effects when the total Hazard Index is greater than unity.

PCB risk characterization is generally addressed by evaluating total Aroclor concentrations. The PCB non-cancer risk estimates presented in this assessment were based on total Aroclor concentrations. Section 6.2.1 discusses the calculation of total Aroclor concentrations. For non-carcinogenic risk, oral RfDs are available for only two PCB commercial Aroclor formulations, Aroclor 1016 and Aroclor 1254. The oral RfD for Aroclor 1016 is 7.00E-05 mg/kg/day and the oral RfD for Aroclor 1254 is 2.00E-05 mg/kg/day. PCB non-cancer risk can be evaluated using the total Aroclor concentration and the RfD for the more toxic Aroclor (Aroclor 1254). This approach is conservative and tends to overestimate risks associated with the lighter Aroclors. Within the Gould Island study area, the heavier Aroclors, Aroclor 1254 and Aroclor 1260, generally comprise the majority of the total Aroclor concentrations. For evaluating non-cancer risks, the use of total Aroclors, in combination with the RfD for Aroclor 1254 is not likely to significantly overestimate risks.

6.4.2 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a slope factor and a weight-of-evidence narrative consistent with EPA's 2005 Guidelines for Carcinogenic Risk Assessment (EPA, 2005a). These newly revised guidelines use standard narrative descriptors (Carcinogenic to Humans, Likely to Be Carcinogenic to Humans, Suggestive Evidence of Carcinogenic Potential, Inadequate Information to Assess Carcinogenic Potential, and Not Likely to Be Carcinogenic to Humans) to describe the likelihood that a chemical is a human carcinogen and are based on an evaluation of the available data from human and animal studies.

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined in the IRIS glossary as: "An upper-bound, approximately a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100" (EPA, 2006). Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds described as carcinogenic to humans and likely to be carcinogenic to humans, although some compounds described as having suggestive evidence of carcinogenic potential also have slope factors and some likely carcinogens, such as lead, have none. Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for oral routes. Oral CSFs for COPCs at the Gould Island study area are presented in Appendix G-1, Table 6.1. The primary source of information for these values is the EPA IRIS database, followed by the other EPA sources described for non-carcinogens in Section 6.4.1.

Dermal CSFs are derived from the corresponding oral values. To derive the dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Appendix G-1, Table 6.1. The absorption efficiencies were obtained from EPA's Table 4.1, "Summary of Gastrointestinal Absorption Efficiencies and Recommendations for Adjustment of Oral Slope Factors for Specific Compounds" of the EPA's Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (EPA, 2004b).

Inhalation CSFs are based on a conversion of Inhalation Unit Risks, available from the IRIS database. Inhalation Unit Risk, measured in units of $(\mu g/m^3)^{-1}$, is the incremental lifetime cancer risk per unit

chemical concentration in air for a 70-kilogram adult with lifetime exposure at an inhalation rate of 20 m^3/day. Published unit risks were converted into inhalation CSFs as follows:

Inhalation CSF $(mg/kg\text{-}day)^{-1}$ = Unit Risk $(mg/m^3)^{-1}$ x 70 kg / 20 m^3/day

Inhalation CSFs for the soil COPCs that exceeded SSLs for inhalation and the volatile groundwater COPCs are presented in Appendix G-1, Table 6.2.

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other carcinogenic PAHs had insufficient data with which to calculate a CSF. EPA has published provisional guidance to assess PAHs (EPA, 1993). Estimated orders of potential potency (rather than a toxicity equivalence factor or TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this HHRA are presented in Appendix G-10 and are those proposed for use by EPA Region I (EPA, 1994c). EPA has determined that the oral CSF for benzo(a)pyrene is 7.3 $(mg/kg/day)^{-1}$. Oral CSFs for other carcinogenic PAHs were determined by multiplying the oral CSF for benzo(a)pyrene by the estimated order of potential potency for the PAH. These oral CSFs for PAHs became the basis for deriving the dermal CSFs used to evaluate dermal risk from PAHs.

The toxicity and cancer risk characterization for PCBs was conducted according to guidance presented in the EPA technical guidance document PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures (EPA, 1996b). The guidance document suggests a methodology for the risk evaluation of the total Aroclor concentration in an environmental medium.

6.5 RISK CHARACTERIZATION

This section provides a characterization of the potential human health risks associated with the potential exposure to COPCs in various media within the Gould Island study area. Section 6.5.1 outlines the methods used to estimate the type and magnitude of health risks, and Section 6.5.2 presents the risk characterization results for the current and potential future land use conditions within the Gould Island study area.

6.5.1 Risk Characterization Methodology

Potential human health risks resulting from exposure to COPCs were estimated using algorithms established by EPA. The methods described by EPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of chemical concentration, human exposure parameters, and toxicity.

Risks from hazardous chemicals are calculated for either carcinogenic or non-carcinogenic effects. Some carcinogenic chemicals may also exhibit non-carcinogenic effects. Potential impacts are then characterized for both types of health effects.

6.5.1.1 Non-carcinogens

The hazards associated with the effects of non-carcinogenic chemicals are evaluated by comparing an exposure level or intake to an RfD. The ratio of the intake to the RfD is called the hazard quotient (HQ)

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

and is defined as follows (EPA, 1989b):

where:	HQ	=	Hazard Quotient (unitless)
	Intake	=	Intake (mg/kg/day), a function of exposure and chemical concentration
	RfD	=	Reference dose (mg/kg/day)

If the ratio of the intake to the RfD exceeds unity, there exists a potential for non-carcinogenic (toxic) effects to occur. A Hazard Index (HI) is generated by summing the individual HQs for all COPCs. If the value of the HI exceeds unity, there is a potential for non-carcinogenic health effects associated with that particular chemical mixture, and therefore it is necessary to segregate the HQs by target organ effects. The HQ should not be construed as a probability, but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than an RfD.

6.5.1.2 Chemical Carcinogens

Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. At low doses, the incremental lifetime cancer risk (ILCR) is determined as follows (EPA, 1989b):

$$ILCR = Intake \times CSF$$

where:	ILCR	=	Incremental lifetime cancer risk, expressed as a unitless probability
	Intake	=	Intake (mg/kg/day)
	CSF	=	Cancer slope factor $(mg/kg/day)^{-1}$

Risks below 1E-6 (less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable.

Risks are estimated for all carcinogenic compounds regardless of the class designation described in Section 6.4.2.

6.5.1.3 Lead

Risks from lead exposure are not evaluated with the same methodologies used for other contaminants. Blood-lead concentration is the most widely used index of internal lead body burdens associated with potential adverse health effects. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects to children from this chemical is believed to be in the range of 10 micrograms/deciliter (µg/dL) to 15 µg/dL. Blood-lead levels greater than 10 µg/dL are considered to be a "concern."

The EPA Technical Review Work Group Model for Lead (EPA, 2003) was used to address exposures to lead in subsurface soil. Exposure concentrations, as well as default parameters for some input parameters, were used in the evaluation. Because the output of this model is a range of predicted blood-lead concentrations, it is appropriate to input the average soil lead concentration rather than 95 percent UCL on the mean value. Entering a 95 percent UCL on the mean tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average subsurface soil lead concentrations for the exposure areas.

Exposures to lead by non-residential adults (industrial workers) are evaluated by use of a slope-factor approach developed by the EPA Technical Review Work Group for Lead. The slope factor approach focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios. The model estimates the 95th percentile blood-lead concentration among fetuses born to women having site exposures. These concentrations are then compared to the established blood-lead level of concern of 10 µg/dL. An additional step in the process estimates the probability that fetal blood-lead levels will exceed 10 µg/dL. EPA's stated goal for lead is that individuals

exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL. The fetus of the pregnant worker is the most sensitive receptor in an industrial worker scenario. Evaluation of this receptor is protective of all adult workers.

Lead was not identified as a COPC in surface soil. Therefore, no evaluation of child lead exposures was warranted.

The results of the adult lead exposure evaluation are discussed in Section 6.5.2. The input parameters used, the results of the lead model, and estimated blood-lead levels are presented in Appendix G-11.

6.5.2 Risk Characterization Results

A summary of the quantitative risk assessment for the study area is provided in this section. Sample calculations are provided in Appendix G-5. Appendix G-1, Tables 7.1 through 7.7, and Tables 8.1 through 8.7 present non-cancer and cancer risk estimates, respectively, for each receptor and medium. Appendix G-1, Tables 9.1 through 9.7 present summaries of cancer risks and health hazard indices from all applicable media and pathways for each exposure scenario. Appendix G-1, Tables 10.1 through 10.7 reduce the information developed in Appendix G-1, Tables 9.1 through 9.7 to the major risk drivers only for scenarios with cancer risks greater than 1E-04 or hazard indices greater than 1.0. Results of the evaluation of estimated lead exposures are presented in Appendix G-11. Table 6-2 summarizes the RME non-cancer and cancer results and provides primary contributors to unacceptable risks, as well as lead evaluation results for the evaluated scenario, the future industrial worker. Primary contributors to unacceptable risks, as shown on Table 6-2, represent the contaminants of concern (COCs) identified in the HHRA.

6.5.2.1 Non-carcinogenic Risks

Hazard indices (HI) developed for the Gould Island study area receptors, including child and adult recreational visitors, trespassers, industrial workers, construction workers, and fishermen are shown in the table below:

Summary of Hazard Indices

Exposure Scenario		Hazard Index	
		RME Case	CTE Case
Recreational Visitors	(Adult) Surface soil	0.0035	0.00081
	Sediment	0.28	0.011
	Total	0.28	0.012
	(Child) Surface soil	0.028	0.0068
	Sediment	2.4	0.095
	Total	**2.4**	**0.10**

Exposure Scenario		Hazard Index	
		RME Case	CTE Case
Trespassers	(Adolescents) Surface soil Sediment **Total**	0.0061 0.5 **0.5**	0.0012 0.017 **0.018**
Current Industrial Workers	(Adult) Surface soil	0.019	0.0074
Future Industrial Workers	(Adult) All soil Dust **Total**	1.4 0.00014 **1.4**	0.51 0.000044 **0.51**
Construction Workers	(Adult) All soil Dust Groundwater Trench air **Total**	1.4 0.068 1.4 561 **564**	0.26 0.01 0.22 32.4 **20.4**
Fishermen*	(Adult) Clams (Child) Clams	13 18	1.5 2.0
	(Adult) Mussels (Child) Mussels	23 34	2.9 3.8

*(RME = subsistence fishermen; CTE = recreational fishermen)

RME and CTE HIs are less than or equal to unity for adult recreational visitors, trespassers, and current industrial workers at the study area. This indicates that adverse non-carcinogenic health effects are unlikely for adult recreational visitors, trespassers, and current industrial workers at the study area, even under the estimated maximum exposure conditions.

RME HIs are greater than unity for child recreational visitors, future industrial workers, construction workers, and subsistence fishermen (both adults and children) at the study area. CTE HIs are greater than unity for future industrial workers, construction workers, and recreational fishermen. CTE HIs are less than unity for child recreational visitors. Further examination of these results reveals that the individual hazard quotient for chromium in sediment at the study area exceeds unity for child recreational visitors. The organ-specific hazard index for the kidney and the individual hazard quotients for cadmium in subsurface soil at the study area exceed unity for future industrial workers under the RME scenario and for construction workers under the RME scenario. The organ-specific hazard indices for skin, eye, immune system, kidney, liver, blood, lungs, and total body weight and the individual hazard quotients for 2-methylnaphthalene, naphthalene, fluoranthene, and PCBs in trench air at the study area exceed unity for construction workers under both the RME and CTE scenarios. The organ-specific hazard indices for skin, eye, immune system, and blood and the Individual hazard quotients for PCBs and arsenic exceed unity for both adult and child fishermen ingesting clams at a subsistence level (the RME scenario). The individual hazard quotient for thallium also exceeds unity for child fishermen ingesting clams at a subsistence level. Under both the child and adult recreational fishermen scenarios (CTE) the organ-specific hazard indices for skin and blood and the individual hazard quotients for arsenic exceed unity.

The organ-specific hazard indices for skin, eye, immune system, and blood and the individual hazard quotients for PCBs and arsenic exceed unity for both adult and child fishermen ingesting mussels at either a subsistence level or a recreational level. These exceedances of unity by organ-specific hazard indices and individual contaminants indicate that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for these receptors. For construction workers' exposure to groundwater, the hazard index exceeds unity; however, no organ-specific hazard indices exceed unity.

6.5.2.2 Carcinogenic Risks

Incremental cancer risk estimates developed for the Gould Island study area receptors, including child and adult recreational visitors, trespassers, industrial workers, construction workers, and fishermen are shown in the table below:

Summary of Cancer Risks

Exposure Scenario		Incremental Cancer Risk	
		RME Case	CTE Case
Recreational Visitors	(Adult) Surface soil	1.7E-6	1.3E-7
	Sediment	1.2E-6	8.7E-8
	Total	2.9E-6	2.2E-7
	(Child) Surface soil	3.4E-6	2.4E-7
	Sediment	2.3E-6	1.6E-7
	Total	5.7E-6	4.0E-7
	(Lifetime)	8.6E-6	6.2E-7
Trespassers	(Adolescents) Surface soil	2.3E-6	1.4E-7
	Sediment	6.8E-6	1.6E-7
	Total	9.1E-6	3.0E-7
Current/Future Industrial Workers	(Adult) Surface soil	1.1E-5	1.2E-6
Future Industrial Workers	(Adult) All soil	1.1E-5	1.1E-6
	Dust	2.8E-7	3.4E-8
	Total	1.1E-5	1.1E-6
Construction Workers	(Adult) All soil	4.0E-7	7.1E-8
	Dust	5.7E-6	8.6E-7
	Groundwater	1.8E-3	7.1E-4
	Trench air	3.6E-4	2.0E-5
	Total	2.2E-3	7.3E-4
Fishermen*	(Adult) Clams	1.4E-3	6.5E-5
	(Child) Clams	5.1E-4	1.9E-5
	(Lifetime)	1.9E-3	8.4E-5
	(Adult) Mussels	1.4E-3	6.4E-5
	(Child) Mussels	5.1E-4	1.9E-5
	(Lifetime)	1.9E-3	8.3E-5

*(RME = subsistence fishermen; CTE = recreational fishermen)

The EPA targeted cancer risk range is 10^{-4} to 10^{-6}. Cancer risks for the adult and child recreational visitor are added together for a lifetime exposure. Cancer risks for the adult and child fishermen are also added together for lifetime exposures.

The RME and CTE cancer risk estimates for the recreational visitors and trespassers exposed to surface soils and intertidal sediments at the Gould Island study area, and current industrial workers exposed to surface soils, and for future industrial workers exposed to subsurface soils at the Gould Island study area do not exceed the EPA targeted cancer risk range (10^{-4} to 10^{-6}). None of the cancer risk estimates for recreational fishermen exceed the EPA cancer risk range (10^{-4} to 10^{-6}).

The RME and CTE cancer risk estimates for the future construction workers exposed to shallow groundwater and to trench air resulting from volatilization of shallow groundwater exceed the EPA targeted cancer risk range (10^{-4} to 10^{-6}). The cancer risk estimates for subsistence fishermen (children and adults; both scenarios for clams and for mussels) exceed the EPA targeted cancer risk range (10^{-4} to 10^{-6}).

See Tables 8.1 through 8.7 in Appendix G-1 for details on cancer risk calculations. As detailed in Appendix G-1, Tables 9.1 through 9.7, the major contributors to cancer risk at the study area are PAHs and pentachlorophenol in shallow groundwater; PAHs, gamma-BHC, heptachlor epoxide, and PCBs in trench air; arsenic, PCBs, and beta-BHC in clams; and arsenic, PCBs, and PAHs in mussels. Individual RME cancer risk estimates for each of these major contributors is greater than 1E-6 under the scenarios described above as exceeding the EPA targeted cancer risk range.

6.5.2.3 Exposure to Lead

Lead was identified as a COPC in subsurface soil within the Gould Island study area. Lead was detected in samples collected from 0 to 10 feet bgs within the Gould Island study area at a maximum concentration of 2,700 mg/kg. The average lead concentration in this dataset was 66 mg/kg. In soil samples collected from 0 to 2 foot bgs within the Gould Island study area, lead was not detected at concentrations exceeding the COPC selection criteria of 400 mg/kg, and therefore is not considered a COPC for surface soil. As stated in Section 6.5.1, average lead concentrations are used as exposure point concentrations in the adult worker lead model.

Exposure to lead in subsurface soils by future adult industrial workers at the Gould Island study area was evaluated by use of a slope-factor approach developed by the EPA Technical Review Work Group for Lead (EPA, 2003). The exposure point concentration of 66 mg/kg for soil collected from 0 to 10 feet bgs at the Gould Island study area, as well as several default parameters, were used to estimate blood-lead

levels for future adult industrial workers contacting subsurface soil at the Gould Island study area. The model estimated that the 95th percentile blood-lead concentration among fetuses born to women exposed to soil at the Gould Island study area would be 4.2 to 5.7 µg/dL. This is less than EPA's established level of concern of 10 µg/dL. The probability that the fetal blood-lead concentration exceeds 10 µg/dL is 0.2 to 0.7 percent. EPA's target probability is 5 percent or less. The results of the slope-factor approach indicate that adverse effects are not anticipated for fetuses of pregnant workers exposed to lead in subsurface soil at the Gould Island study area.

In conclusion, exposures to lead in subsurface soil at the study area do not exceed EPA's target level of concern.

6.6 UNCERTAINTIES ANALYSIS

There are uncertainties associated with all HHRAs. This section summarizes these uncertainties, and discusses how they may affect the final risk numbers discussed in Section 6.5.

There is uncertainty associated with all steps of the risk assessment process. Uncertainty in the data evaluation is associated with sampling adequacy, the current status of the predictive databases for development of screening values, the procedures used to include or exclude constituents as chemicals of potential concern, and the methods used and the assumptions made to determine exposure point concentrations. The selection of chemicals of potential concern is based on exposure assumptions and toxicity information, which in turn have associated uncertainties. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing data to support dose-response relationships and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty (as described above) throughout the risk assessments, assumptions were made so that the final calculated risks would be conservative estimates that are protective of public health. Thus, the resultant uncertainty in the numerical risk assessments is in how much lower the actual risks are.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the variance that can be attributed to sampling techniques and laboratory analysis of contaminants. For example, this type of uncertainty is associated with analytical

data collected for each location. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty refers to estimates of toxicity and exposure. Often this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without considering uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over-predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (1E-6), the interpretation of no significant risk is straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (1E-4), a conclusion can be difficult unless uncertainty is considered. The risk estimates alone may indicate unacceptable risk; however, if uncertainty is biased toward over-predicting risk, actual risks could fall within acceptable range.

EPA guidance on risk assessment (EPA, 1992 and 1994c) requires risk assessors to use exposure and toxicity assumptions from the "high end" and the "central tendency" of their distributions. These values correspond to the RME and CTE scenarios. The RME is conceptually the “high end” exposure above the 90th percentile of the population distribution but not higher than the individual in the population with the highest exposure. The CTE reflects the central (average) estimates of exposure.

Uncertainties within the components of the HHRA for the Gould Island study area are discussed below.

6.6.1 Uncertainty in Data Evaluation

Uncertainty is associated with analytical data collected and analyzed for the study area.

There is a minor amount of uncertainty associated with the selection of COPCs in the quantitative risk assessment. Conservative screening values were used to select COPCs; thus, it is unlikely that any contaminant that may pose a risk was eliminated from the risk assessment calculations. There were chemicals detected for which EPA has little or no information regarding the chemical's toxicity. In general, toxicity values from similar chemicals were substituted. These substitutions add uncertainty to the risk assessment. There are many compounds that are not part of EPA's recommended routine list of analytes. If a compound is not on EPA's routine analyte list, it most likely will not be reported even if present in the environment. This too can have an impact on the selection of COPCs.

A COPC was selected if the maximum detected concentration in soils, sediments, groundwater or shellfish tissue exceeded its respective risk-based screening criterion. Frequency of detection was not used to eliminate COPCs. Even if the compound was detected at a very low frequency, i.e., less than 5 percent, if the maximum detected concentration exceeded the screening criterion, the compound was still retained for evaluation in the risk assessment. The majority of the COPCs identified in groundwater monitoring well samples were detected in only one of twelve samples. Since potential exposures to this media were limited to vapor intrusion into indoor air spaces, and this pathway was deemed incomplete, the absence of using frequency of detection as a COPC selection criterion did not impact the risk results. Several COPCs identified in the groundwater testpit dataset, the clam tissue dataset, and the mussel tissue dataset were detected in a single sample; however, because these datasets are relatively small, even a single sample represents greater than 5 percent of the samples. Based on this review of the data, the absence of using frequency of detection as a COPC selection criterion did not result in a significant increase in the number of COPCs evaluated in this risk assessment. Therefore, this does not significantly contribute to the uncertainty of the risk assessment.

Concentrations of site contaminants detected in soil, sediment, and groundwater were compared to background concentrations. Maximum detected concentrations were compared to average background concentrations. None of the contaminants detected in soils, sediment, or groundwater were present exclusively below average detected background concentrations. Therefore, no contaminants were eliminated as COPCs based on this comparison.

A basewide background study is in process; however, the data from that study are not yet available and therefore are not used in this RI. Once the data from the basewide background study are available, that data will be used in future studies of the Gould Island Site. Because the basewide background study is not yet available and the site background data is limited, this HHRA is unable to attribute any of the estimated risks to background conditions. It is however, possible that some of the contaminants included in the calculations may in fact be attributable to background conditions.

The NOAA Mussel Watch Program reported concentrations of a variety of contaminants in blue mussels at reference stations in Rhode Island (Table F-4D, Appendix F). Maximum concentrations reported at the NOAA reference stations of benzo(a)anthracene, benzo(a)pyrene, chrysene, and arsenic (identified as COPCs in mussels from the Gould Island study area) were 30.75 µg/kg at Dyer Island, 53.69 µg/kg at Dyer Island, 125.86 µg/kg at Patience Island, and 16.43 mg/kg at Block Island, respectively. Maximum site mussel concentrations of benzo(a)anthracene, benzo(a)pyrene, chrysene, and arsenic were 66 µg/kg, 33 µg/kg, 66 µg/kg, and 2.6 mg/kg, respectively. Thus it is possible that the PAH and arsenic concentrations detected in mussel tissue from the Gould Island study area represent background conditions.

Uncertainty arises from calculation of exposure point concentrations. The surface soil, intertidal sediment, testpit groundwater, and mussel tissue datasets from the study area consisted of relatively small numbers of samples. The surface soil dataset consisted of only nine samples. The intertidal sediment dataset consisted of only eight samples. The shallow groundwater (testpit) dataset consisted of only eight samples. The mussel tissue dataset consisted of only eight samples. These small datasets make the estimation of the upper 95 percent confidence limit on the mean somewhat uncertain. PCBs were detected in only one of the 13 clam tissue samples analyzed, yet risks from PCBs in clam tissue were major risk drivers. Similarly, PAHs were generally detected in just one of the eight mussel tissue samples, yet risks from PAHs in mussel tissue were major risk drivers.

Uncertainty also arises in the use of models to predict trench air concentrations based on shallow groundwater data. The accuracy of these models can be affected by the size of the trench and ambient air conditions as well as the accuracy of the groundwater dataset. The main uncertainties associated with the model are the dimensions of the trench and the air exchange rate (ACH). The model assumes that if the ratio of the width of the trench to the depth of the trench is less than or equal to 1 then the air exchange rate is 2/hr. If the ratio is greater than 1 the ACH is 360/hr. Consequently the dimensions of the trench have a great impact on the resulting air concentrations. For this HHRA, trenches were assumed to be 3 feet deep based on the depth to groundwater in the area of the test pits. Since a 3-foot wide trench results in a width-to-depth ratio of 1, the ACH in this model is set at 2/hr. In contrast a 4-foot wide trench results in a width-to-depth ratio greater than 1 and an ACH set at 360/hr.

The modeled EPCs for trench air based on both a 3-foot wide trench and a 4-foot wide trench are presented in Appendix G-4. The difference between the resulting EPCs is approximately two orders of magnitude. The modeled EPCs for trench air based on the more conservative 3-foot wide trench are presented in Appendix G-1, Table 3.5B with the groundwater concentrations used to develop them and are used in the risk calculations in Appendix G-1 for construction workers exposed to trench air. Alternate EPCs and risk calculations based on a 4-foot wide trench are included in Appendix G-4. The results of the

later are Hazard Indices and cancer risks approximately two orders of magnitude less than those based on the 3-foot wide trench. In addition to uncertainty based on the trench dimensions, the model used to predict trench air concentrations uses the maximum reported shallow groundwater concentrations for many of the COPCs because of the relatively small size of the dataset. Use of maximum concentrations also biases the risk estimates toward overestimation of risk.

The difference in estimated risk using the two trench dimensions constitutes a significant uncertainty, and the trench air model could be replaced with quantitative soil gas data. The soil gas concentrations could be used as exposure point concentrations for future construction workers.

6.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises from the selection of receptors and selection of exposure parameters. Each is discussed below.

Exposure Routes and Receptor Identification. The selection of exposure routes and receptor groups was based on discussions with the Navy and the EPA. This may either under- or over-estimate the risks, with the final result dependent on how well the receptors were defined.

Selection of Exposure Parameters. Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, EPA guidelines on the RME receptor were used that generally consist of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Many of the exposure parameters were determined from statistical analyses of human population characteristics. Often the database used to summarize a particular exposure parameter (body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (dermal absorption of organic chemicals from soil), there is greater uncertainty.

Many of the quantities used to calculate exposures and risks in this report were selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. In order to evaluate a central tendency estimate of exposure, EPA has suggested

the use of the CTE receptor, whose intake variables are set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Many of the parameters were estimated using professional judgment, although EPA Region I default parameters were used where available (EPA, 1994c).

The HHRA included an evaluation of current and future industrial workers assumed to be present 250 days per year on an ongoing basis. Currently workers are present infrequently (less than 52 days per year) at the study area. Navy plans to retain the Gould Island property, but has no planned future use for the property. As future plans currently stand and because access requires transportation by boat, it is unlikely workers will be present at the site on a more frequent basis within the foreseeable future. Therefore, risks to current and future industrial workers are likely to be overestimates of actual current or future workers.

The HHRA included and evaluation of future excavation workers exposed on a short-term basis (approximately 6 months) to surface soil and subsurface soil through ingestion, dermal contact, and inhalation of dust, and shallow groundwater through ingestion, dermal contact, and inhalation of volatile COPCs. The construction worker was assumed to be in direct contact with soils as deep as 10 feet bgs. Because groundwater is located at 3-5 feet bgs across the site, it is unlikely that excavation will occur below that depth. It is also unlikely that workers would be working in trenches in contact with groundwater and vapors emanating from groundwater on a daily basis. As noted in Section 6.6.1, there is a great deal of uncertainty regarding the model used to estimate trench air concentrations. In addition, the frequency of exposure (130 days per year under the RME scenario and 52 days/year under the CTE scenario) and the daily time of exposure (8 hours per day) to groundwater and groundwater vapors within trenches are biased high. Therefore, it is highly likely that the risks from exposures to groundwater and groundwater vapors within trenches are also biased high. Furthermore, because of the shallow depth to groundwater and resulting shallow depth of trenches, workers standing in the trenches would presumably spend much of the day with their heads above the sides of the trench breathing air which is even more dilute than that found within the trench itself.

Under the RME fishermen scenario, the assumption is made that all seafood consumed by the receptor (180 servings per year) comes from a single source, i.e., the receptor's total dietary intake of seafood consists of only clams (or mussels) from the Gould Island study area, and he does not eat other uncontaminated of seafood or clams (or mussels) from other locations. This assumption, therefore, is likely to overestimate risks for receptors who eat less seafood or who eat seafood from other sources. It should be noted that this is a very conservative estimate of seafood ingestion rates.

6.6.3 Uncertainty in the Toxicological Evaluation

A toxicity evaluation is a chemical's hazard identification and dose-response assessment. The hazard identification deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard identification of carcinogenicity is an evaluation of the weight-of-evidence that a chemical causes cancer. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data suggest the nature of the effects (the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose-related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized. Uncertainty in the dose-response evaluation includes determining a slope factor for the carcinogenic assessment and deriving an RfD for the non-carcinogenic assessment. The slope factor is an upper bound estimate of the human cancer risk per milligram of contaminant per milligram of body weight per day. The RfD is an estimate with uncertainty (spanning perhaps an order of magnitude of daily exposure to humans) below which a person is likely to be without appreciable risk of adverse effect over a lifetime. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are similar in age and genotype so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed.

Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and from the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model,

which is used in nearly all quantitative estimations of human risk from animal data, is based on a non-threshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic (William and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For non-cancer effects, additional uncertainty factors may be applied in deriving the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for non-cancer effects arises from the use of an effect level in estimating an RfD, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimating an RfD for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in deriving RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty also arises in the dose-response assessment for values derived for several principal chemicals of concern by using studies with limitations. For example, Group B2 PAHs for which no toxicity data are available are evaluated using benzo(a)pyrene toxicity data with estimated orders of potential potency. This may either underestimate or overestimate the carcinogenic risks associated with PAHs.

Uncertainty is associated with the exclusion of chemicals without toxicity data from the quantitative risk assessment. No screening toxicity values for fish ingestion were available for lead or 4-chloro-3-methylphenol. Lead was detected in both clam and mussel tissue. 4-chloro-3-methylphenol was detected in clam tissue. The lack of approved toxicity values (RfDs or CSFs) prevents the quantitative evaluation of 4-chloro-3-methylphenol detected in clam tissue. Exclusion of these contaminants from this risk assessment may result in an underestimation of risks. No evaluation of lead in shellfish was included in the HHRA. This may result in an underestimation of risks for fishermen ingesting shellfish.

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. Hexavalent chromium (chromium IV) is considered to be more toxic than the trivalent state, which is more common. Chromium III results from the weathering of minerals and is the most stable

state of environmental chromium. Chromium IV in the environment is man-made, the result of contamination by industrial emissions, and is the more toxic (RAIS, 2006). Additionally, chromium IV in soil is expected to be reduced to trivalent chromium by organic matter (IRIS, 2006). Therefore, risks for this chemical are probably overestimated to some degree.

Some uncertainty is associated with the evaluation of arsenic in shellfish, which was assumed to be present in its inorganic state. Arsenic was identified as one of the major contributors of risk from both clam and mussel ingestion by fishermen. Arsenic risks in shellfish were based on EPA's oral slope factor, which in turn is based on studies performed using arsenic trioxide. However, arsenic in seafood exists in an organic state known as arsenobetaine. Approximately 80 to 90 percent of the arsenic available in seafood is in the organic form, which is not toxic (taken from Guidance Document for Arsenic in Shellfish, USFDA, January 1993). Therefore, the levels of risk estimated for arsenic in seafood at the Gould Island study area are overestimates by as much as a factor of 10 because they are not based on toxicity values for arsenobetaine, but rather on inorganic arsenic, which has been demonstrated to be much more toxic than arsenobetaine.

Uncertainty is associated with evaluating exposures to lead. Exposures of future industrial workers to lead are evaluated by use of the EPA Technical Review Work Group Model for lead. This approach focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soils in non-residential scenarios. Uncertainty is associated with estimating maternal blood-lead concentrations and with the relationship between maternal blood-lead concentrations and fetal blood-lead concentrations.

Uncertainty in the final calculations of risk results from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when cancer risks for several substances are summed across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity was made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be evaluated for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

6.7 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

This section and Table 6-2 present a summary of the major risk assessment findings for the Gould Island study area. Six potential receptor groups were evaluated: child and adult recreational visitors, trespassers, current and future industrial workers, construction workers, and fishermen.

6.7.1 Non-carcinogenic Risks

RME and CTE HIs are less than or equal to unity for adult recreational visitors, trespassers, and current industrial workers at the study area. For this reason, adverse non-carcinogenic health effects are not anticipated for adult recreational visitors, trespassers, and current industrial workers at the study area.

RME HIs are greater than unity for child recreational visitors, future industrial workers, future construction workers, and current and future fishermen (both adults and children, both recreational and subsistence) at the study area. Further examination of these results reveals that the individual hazard quotient for chromium in intertidal sediment at the study area exceeds unity for child recreational visitors. The individual hazard quotients for cadmium in subsurface soil at the study area exceed unity for future industrial workers (for the RME scenario only) and construction workers (for RME scenarios only). The individual hazard quotients for 2-methylnaphthalene, naphthalene, fluoranthene, and PCBs in trench air at the study area exceed unity for construction workers under both the RME and CTE scenarios. Individual hazard quotients for PCBs and arsenic in clams exceed unity for both adult and child fishermen ingesting clams at a subsistence level (the RME scenario). The individual hazard quotient for thallium in clams exceeds unity for child fishermen ingesting clams at a subsistence level. Under both the child and adult recreational fishermen scenarios (CTE) the individual hazard quotients for arsenic in clams exceed unity. Individual hazard quotients for PCBs and arsenic in mussels exceed unity for both adult and child fishermen ingesting clams at either a subsistence level or a recreational level. These exceedances of unity by individual contaminants indicate that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for these receptors.

6.7.2 Carcinogenic Risks

Cancer risk estimates for recreational visitors and trespassers, current industrial workers exposed to surface soils, future industrial workers exposed to subsurface soils, and recreational fishermen consuming clams or mussels from within the study area do not exceed the targeted EPA cancer risk range (10^{-4} to 10^{-6}).

The RME and CTE cancer risk estimates for the future construction workers exposed to shallow groundwater and vapors, in trench air from COPCs in shallow groundwater, and the cancer risk estimates for subsistence fishermen (children and adults; both scenarios for clams and for mussels) exceed the EPA cancer risk range (10^{-4} to 10^{-6}). The major contributors to cancer risk at the study area are PAHs and pentachlorophenol in shallow groundwater; PAHs, PCBs, gamma-BHC, and heptachlor epoxide in trench air; arsenic, PCBs, and beta-BHC in clams; and arsenic, PCBs, and PAHs in mussels.

6.7.3 Exposure to Lead

Exposures to lead in subsurface soil at the study area for a future pregnant adult worker were evaluated by using a slope-factor developed by the EPA Technical Review Work Group for Lead (EPA, 2003). This model was used to estimate the 95th percentile blood-lead level for women having study area exposures, the 95th percentile blood-lead concentration among fetuses born to women having study area exposures, and the probability that the fetal blood-lead concentration exceeds 10 µg/dL. The probability that the fetal blood-lead concentration would exceed 10 µg/dL was less than the acceptable level of 5 percent established by EPA. These results indicate that adverse effects are not likely for fetuses of future pregnant industrial workers exposed to lead in subsurface soil at the study area.

6.7.4 Human Health Risk Assessment Contaminants of Concern

Based on the non-cancer and cancer evaluations, the following contaminants with non-cancer hazard quotients greater than 1.0 or cancer risks greater than 10^{-6} in a scenario with total cancer risks greater than the EPA cancer risk range were identified as COCs: chromium in sediment; cadmium in subsurface soils; cadmium and chromium in dust from subsurface soils; PAHs, 2-methylnaphthalene, naphthalene, and PCBs in trench air; PCBs, beta-BHC, thallium, and arsenic in clams; PCBs, PAHs, and arsenic in mussels; and PAHs and pentachlorophenol in shallow groundwater.

7.0 ECOLOGICAL RISK ASSESSMENT

7.1 INTRODUCTION

The goal of this Ecological Risk Assessment (ERA) is to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through historical activities at Site 17, on Gould Island in Jamestown, Rhode Island. This ERA contains information that enables risk managers to conclude either that ecological risks at the site are most likely negligible, or that further information is necessary to evaluate potential ecological risks at the site.

The ERA methodology follows guidance presented in the following guidance documents:

- Final Guidelines for Ecological Risk Assessment [United States Environmental Protection Agency (USEPA), 1998].
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997).
- Navy Policy for Conducting Ecological Risk Assessments [Department of Navy (DON), 1999].

Figure 7-1 is the Ecological Risk Assessment Tiered Approach.

This ERA consists of Steps 1, 2, and 3a of the eight steps in accordance with the above guidance documents. The first two steps are the screening-level ecological risk assessment (SERA), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step in the baseline ecological risk assessment (BERA) and consists of refining the conservative assumptions following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. The remaining steps of the ERA process require revision to the Work Plan and Field Sampling Plan prior to initiation, and are not included in this ERA.

Soil samples that were used in the ERA were collected by TtNUS in 2005. Sediment samples that were used in the ERA were collected by EPA in 2003 and by TtNUS in 2005.

7.2 PROBLEM FORMULATION

Problem formulation is the first phase of an ERA and discusses the goals, breadth, and focus of the assessment. It includes general descriptions of Site 17 with emphasis on the habitats and ecological

receptors present. This phase also involves characterization of site-related chemicals, chemical sources, migration routes, and an evaluation of routes of chemical exposure.

7.2.1 Environmental Setting

Section 3 presents a detailed description of the terrestrial and marine habitats present at Site 17. The following presents a summary of that information. See Appendix E, Gould Island Ecological Characterization, for a more detailed description of the Navy property habitats and the flora and fauna present on Gould Island.

The southern portion of the island has not been maintained for many years and therefore a tangled succession of native and non-native plants have colonized the area, forming a scrub/shrub and medium sized tree cover across most of the property. Naval Station Newport retains ownership of the northern end of the island, where Building 32 was located. Most of the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place. Roadways and some of the smaller building foundations were removed. The former building foundation pads and the torpedo firing pier cover approximately 46 percent of the total Navy property on Gould Island.

The habitat on the northern portion of the island consists primarily of open field vegetation consisting of grasses and forbs. The field habitat comprises approximately 37 percent of the Navy property and has an abundance of non-native volunteer and invasive species typical of recently disturbed sites in New England. Two narrow bands of scrub/shrub habitat are present above the upper shoreline on the east and west sides of the island. These scrub/shrub bands cover approximately 17 percent of the Navy property. Many of these plants provide important bird nesting habitat. It is expected that through natural habitat succession, the Navy property will soon resemble the scrub/shrub and tree habitat on the southern portion of the island that provides quality habitat for a variety of nesting birds.

Gould Island is an important location for colonial nesting birds. An annual colonial nesting bird count conducted by the RIDEM Division of Fish and Wildlife during spring/early summer has identified 22 bird species present on Gould Island. A variety of songbirds also nest on Gould Island each year and mammals observed or reported to be present on the island include the eastern cottontail (*Sylvilagus floridanus)*, red fox (*Vulpes vulpes)*, and white-tailed deer (*Odocorleus viginianus)*.

The marine habitat in the vicinity of Gould Island includes intertidal and subtidal environments, sand-or silt-substrate with small eelgrass beds. Mapping efforts defined a narrow band of eelgrass, 70 to 90 feet at the widest, on both sides (east and west) of the northern end of the island. Eelgrass beds were also observed extending 25 feet around sediment stations SD-301 and SD-311, located on the southwestern

end of the island and the western shoreline, respectively. No eelgrass was observed at sediment stations SD-303 (eastern shoreline) or SD-314 (southeast end of the island). A variety of invertebrate and fish species were observed by the sampling team during the collection of sediment samples.

7.2.2 Potential Sources of Contamination

Section 5 presents a detailed description of the potential sources of contamination at the site. This section provides a brief summary of that information.

Site 17 is centered on the former Building 32, which was a torpedo overhaul shop. Building 32 contained an electroplating shop, machine shops, degreasing shops, grinding and buffing shops, and other workshops used for torpedo service and maintenance during and after the Second World War. Past industrial activities apparently resulted in the presence of chlorinated solvents, fuel-related chemicals, and metals in the soil, groundwater, soil gas, and marine sediment at the site, and PCBs in the soil and marine sediments at the site.

Chemical constituents were found in soil both under the Building 32 foundation, near the foundation on the south west corner of Building 32, in a former tank location north of Building 32, and in sumps and vaults within the foundation of Building 32. From these locations, chemicals likely have been transported via building drainage systems to the bay. Also, chemicals in soil that were not associated with a drainage system may have been transported to the bay via overland runoff or migration through groundwater.

There is evidence of a fuel release in the soil at the south west corner of Building 32. Fuels were found in the soils outside the footprint of the building, as well as within the vault under the former sandblast booth, and within the manhole MH-01. The associated chemicals (PAHs and TPH) have followed separate transportation routes to the surrounding media. Chemicals outside the building are available for transport to the south and east via the “trench drain” and chemicals inside the building are controlled to the larger extent by the drainage systems for the building through floor drains and toilet drains both to the east and to the northwest via sewer disposal systems (Section 5 of this report).

PCBs were detected in soil on site at low concentrations and in sediments near the shoreline at elevated concentrations. The distribution of the PCBs correlates to areas where PCBs were removed from the site in 1999-2002. The PCB removals were conducted to address transformer buildings and former releases from those buildings. However, once the cleanup goals for that project were met, the efforts were terminated.

Metals and cyanide were found in soil and sediment at the southwest corner of Building 32, in drainage systems from the electroplating areas of Building 32, and at the locations where these systems discharge to the bay. Metals are presumed to have originated through electroplating chemicals used and disposed of from the building systems, as well as from sandblast dust storage and acid use and storage in the same areas.

7.2.3 Potential Exposure Pathways

As discussed above, the contaminated media to which ecological receptors may be exposed include surface soil, sediment, and groundwater after it discharges to surface water. The following sections describe these potential exposure pathways in more detail.

7.2.3.1 Surface Soil

Terrestrial ecological receptors such as plants, soil invertebrates, mammals, birds, and reptiles can be exposed to contaminated surface soil through direct exposure (plants) or direct contact (animals) as they search for food and burrow into the soil. Mammals, birds, and reptiles can also ingest surface soil and food items that have accumulated chemicals. Some terrestrial receptors such as burrowing mammals or deep-rooted trees could be exposed to shallow layers of contaminated subsurface soils.

7.2.3.2 Sediment

Marine ecological receptors, such as fish and benthic invertebrates (including gastropods, bivalves, crustaceans, etc.) can be exposed to sediment contamination through direct contact and incidental sediment ingestion. Mammals and birds may also be exposed to the sediment, although to a lesser degree through direct contact and incidental sediment ingestion, or through the ingestion of food items (i.e., clams, mussels) that have accumulated chemicals. Finally, marine plants such as eelgrass may be exposed to chemicals in the sediment through direct exposure.

7.2.3.3 Surface Water

Marine ecological receptors, such as fish and benthic invertebrates can be exposed to surface water contamination through direct contact and surface water ingestion. Mammals and birds also can be exposed to surface water contamination through direct contact and surface water ingestion although the saline water will limit the drinking water pathway for many birds and mammals. Surface water samples were not collected as part of the investigations because of the tidal nature of the bay and the extremely large mixing zone that is associated with tidal waters. Therefore, as a conservative measure, the

groundwater data were evaluated to determine potential risks to marine organisms after the groundwater discharges to surface water. Risks to mammals and birds from direct contact or surface water ingestion were not evaluated, however, because the groundwater would be diluted very rapidly after discharging to the surface water so the amount of chemical exposure for birds and mammals would be insignificant.

7.2.4 Endpoints

7.2.4.1 Assessment Endpoints

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997). The selection of these endpoints is based on the habitats present, the migration pathways of probable chemicals, and the routes that chemicals may take to enter receptors. Based on the habitat description at Site 17, preliminary assessment endpoints for the ERA were selected and are presented on Table 7-1. The following paragraphs discuss why the assessment endpoints were selected for the ERA.

Soil invertebrates – Soil invertebrates include earthworms, the juvenile stages of many insects, and other small organisms that live in or on the surface soil. These organisms are present in the soil in terrestrial habitats at the site. Soil invertebrates promote plant growth by aiding in the formation of soil and through redistribution and decomposition of organic matter. Soil invertebrates also serve as a food source for many mammals and birds. Chemicals can accumulate from the soil into the tissues of soil invertebrates that are consumed by other organisms.

Terrestrial Vegetation – Terrestrial vegetation at the site consists of herbs (grasses, rushes, ferns, and other non-woody plants), shrubs, and trees. These plants serve as a source of food and shelter for many organisms and help prevent soil erosion and excessive surface runoff. Plants can also accumulate some chemical from the soil that are consumed by other organisms.

Herbivorous Birds and Mammals – Herbivorous birds and mammals forage at the site and in turn serve as a food source for higher trophic level carnivores. Their role in the community is essential because, without them, higher trophic-level animals could not exist. They are exposed to and accumulate chemicals that are present in the plants they consume.

Insectivorous Birds and Mammals - Insectivorous birds and mammals consume soil invertebrates and insects and in turn serve as a food source for higher trophic level carnivores. These birds and mammals are exposed to, and can accumulate, chemicals that are present in the food items they consume.

Piscivorous Birds and Mammals – Piscivorous birds and mammals consume fish and marine invertebrates. They are present along the shoreline at the site and are exposed to, and can accumulate, chemicals that are present in the food items they consume.

Benthic Invertebrates - Benthic invertebrates, including gastropods, bivalves, shellfish, crustaceans, as well as smaller invertebrates (i.e., worms, smaller arthropods, etc.) serve as a food source for higher trophic level organisms (i.e., fish, birds, mammals). They also can accumulate chemicals, which are then transferred to higher trophic level organisms that consume invertebrates. Benthic macroinvertebrates are present in Narragansett Bay adjacent to the site.

Fish and other Marine Organisms - Fish and other marine organisms are present in Narragansett Bay adjacent to the site. Fish and other marine organisms feed on invertebrates, plants, and/or other fish and are exposed to, and can accumulate, chemicals from the food items they consume or from the surface water/sediment in which they live.

USEPA guidance (USEPA, 1997) states that "it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals from the site." Therefore, the ERA focuses on the endpoints tending to yield the highest risks, which should account for endpoints that have lower risks.

Large carnivorous birds and mammals such as seals, soaring birds, and even large reptiles such as sea turtles, while present in the area, were not selected as assessment endpoints because their home range is much larger than the site and only a very small percentage of their food would come from the site. Even though the home range for terrestrial carnivorous mammals such as the red fox is limited by the size of the island (52 acres), risks are greater to small mammals and birds that obtain all of their food from the site. Finally, although eelgrass beds are present around the site, they were not selected as assessment endpoints because impacts to eelgrass were not evaluated quantitatively in this ERA. Potential impacts to eelgrass are discussed in the uncertainty analysis.

7.2.4.2 Measurement Endpoints

Measurement endpoints are estimates of biological impacts (e.g., mortality, growth, reproduction) that are used to evaluate the assessment endpoints. Table 7-1 presents a summary of the assessment endpoints along with the corresponding measurement endpoint.

7.2.4.3 Selection of Receptor Species

Many receptors in the soil and marine environments at the site are adequately described in general categories such as soil invertebrates, benthic invertebrates, vegetation, and fish. This is due to the nature of the threshold values, effects values, or criteria that are typically used to characterize risk for such organisms. For vertebrate receptors, selection of a particular species is required so that intake through eating and drinking can be estimated. To be conservative, chosen representative species have small home ranges. The availability of exposure parameters such as body mass, feeding rate, and drinking rate also are factors in selecting surrogate species. The following surrogate species were used for the food chain modeling, which is discussed in Section 7.4:

- Herbivorous mammal: meadow vole
- Herbivorous bird: bobwhite quail
- Insectivorous mammal: short-tailed shrew
- Insectivorous bird: American woodcock
- Piscivorous mammal: raccoon
- Piscivorous bird: herring gull

Receptor profiles for the above species are presented in Appendix H.1.

7.2.4.4 Conceptual Site Model

A conceptual site model (CSM) in ERA problem formulation is a written description of predicted relationships between ecological entities and the stressors to which they may be exposed (USEPA, 1998). The CSM consists of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response, and a diagram that illustrates the relationships (USEPA, 1998). Figure 7-2 is a pictorial presentation of these relationships.

7.3 ECOLOGICAL EFFECTS EVALUATION

The preliminary ecological effects assessment is an investigation of the relationship between the exposure to a chemical and the potential for adverse effects resulting from exposure. In this step, screening levels for toxicity of the chemicals to ecological receptors were compiled.

7.3.1 Terrestrial Plants/Invertebrates and Marine Organisms

Potential risks to terrestrial plants/invertebrates and marine organisms (i.e., fish, benthic invertebrates, and non-benthic invertebrates) resulting from exposure to chemicals were evaluated by comparing chemical concentrations to ecological screening levels. Tables 7-2, 7-3, and 7-4 provide the sources for the surface soil, sediment, and surface water screening levels, respectively, that were used for this ERA to evaluate potential risks to ecological receptors. Additional reference information for these values is provided in Appendix H. These toxicity values are expressed in units of concentration because the media of concern are in direct contact with the terrestrial plants/invertebrates and marine organisms (i.e., fish, benthic invertebrates, and non-benthic invertebrates). The following text presents a brief description of the screening levels and then lists the order of preference of the sources and the rationale for the preference.

7.3.1.1 Surface Soil

Table 7-2 presents the surface soil screening levels. Columns for the soil screening levels are divided into screening values developed to protect plants and values developed to protect invertebrates. Some of the values were developed to protect both plants and invertebrates. The following paragraphs briefly describe each of the sources of the screening levels.

USEPA published interim final Ecological Soil Screening levels (Eco SSLs) for a few chemicals (USEPA, 2003 and 2005). The Eco SSLs were developed for invertebrates, plants, mammals, and birds for each chemical for which adequate data were available; for some chemicals, adequate data were only available to develop Eco SSL values for some of the receptors.

The Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson et al., 1997a) and the Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision (Efroymson, et al., 1997b) were developed by the Oak Ridge National Laboratory (ORNL). These benchmarks were intended to be used as screening values, and as such, may be overly conservative. They are based on a 20 percent reduction in growth, reproduction, or activity (for invertebrates) or growth and yield (for plants) as the threshold for significant effects (Efroymson R.A. et al., 1997a, b).

The Canadian Soil Quality Guidelines were developed by the Canadian Council of Ministers of the Environment (CCME) and were derived using toxicological data to determine the threshold level for key receptors (CCME, 1997). The values are calculated for four land uses: agricultural, residential/parkland, commercial, and industrial. Exposure from direct soil contact is used to derive guidelines for the

residential/parkland, commercial, and industrial land uses; the soil guidelines for the agricultural land use incorporates direct soil contact and soil and food ingestion (CCME, 1997).

The Intervention Values and Target Values – Soil Quality Standards were developed by the Netherlands Ministry of Housing, Spatial Planning, and Environment, Department of Soil Protection and will be referred to as the Dutch Screening Values (MHSPE, 2000). The Dutch Screening Values for surface soil consist of Target Values and Intervention Values. The Target Values are the soil quality levels that are ultimately desired (MHSPE, 2000). The values for heavy metals, arsenic, and fluoride were derived from analysis of field data from relatively pollution-free rural areas; therefore, they are not risk-based. The Intervention Values indicate the "concentration levels of the contaminants in the soil above which the functionality of the soil for human, plant, or animal life is seriously impaired or threatened" (MHSPE, 2000).

The Region 5 Ecological Screening Levels (ESL) are the lowest of available plant, invertebrates, and wildlife values. The values were compiled and/or developed by USEPA Region 5.

The following presents the order of preference that was used for selecting the final plant screening value presented in Table 7-2:

1. Eco SSL for plants
2. ORNL Plant Benchmarks
3. Canadian Soil Quality Guidelines
4. Dutch Target Values
5. Region 5 ESLs

The following presents the order of preference that was used for selecting the final invertebrate screening value presented in Table 7-2:

1. Eco SSL for earthworms
2. ORNL Invertebrate Benchmarks
3. Canadian Soil Quality Guidelines
4. Dutch Target Values
5. Region 5 ESLs

7.3.1.2 Sediment

Table 7-3 presents the sediment screening levels. Primarily, the screening values developed from saltwater data because the surface water surrounding Gould Island is saline. However, freshwater values were used, when necessary and are footnoted in Table 7-3. The following paragraphs briefly describe each of the sources of the screening levels.

USEPA (2003) had developed freshwater and saltwater sediment quality benchmarks for dieldrin to protect benthic organisms. The values were calculated using equilibrium partitioning. A total organic carbon value of 1 percent was used to calculate the saltwater value for dieldrin in Table 7-3.

Long and Morgan (1991) developed sediment screening levels using freshwater, marine and estuarine studies. These values were further refined by Long et al., (1995) using additional data, but only included marine and estuarine studies. Long et al. (1995) established three effects levels, as follows:

- *Below Effects Range-Low (ER-L):* Minimal-effects range (adverse effects would be rarely observed);

- *Between ER-L and Effects Range-Median (ER-M):* Possible-effects range (adverse effects would occasionally occur); and

- *Above the ER-M:* Probable-effects range (adverse effects would probably occur).

The Florida Department of Environmental Protection (MacDonald, 1994) has developed screening values in a manner similar to Long et al. (1995), except that the Florida values also incorporate chemical concentrations observed or predicted to be associated with no adverse biological effects (no effects data). Both sets of screening values were developed for estuarine and marine waters to protect aquatic organisms, including benthic macroinvertebrates, fish, and shellfish. These guidelines establish the following two effects levels:

- *Threshold Effects Level (TEL):* The TEL is the geometric mean of the 15th percentile in the effects data set and the 50th percentile in the no effects data set. It represents the upper limit of the range of sediment contaminant concentrations that are dominated by no effects data.

- *Probable Effects Level (PEL):* The PEL is the geometric mean of the 50th percentile in the effects data set and the 85th percentile in the no effects data set. It represents the lower limit of the range

of sediment contaminant concentrations that are usually or always associated with adverse biological effects.

Buchman (1999) developed a table that presents sediment screening levels from various sources, both freshwater and saltwater. The sources include Long and Morgan (1991), Long et al. (1995), and McDonald (1994) values, which are discussed above. In addition, Buchman presented Apparent Effects Threshold (AET) values which are generally defined as the concentration of a given chemical above which statistically significant biological effects are always expected to occur. AETs have been developed as part of several studies, but the specific studies that were selected for the chemicals were not identified in Buchman (1999).

The publication "ECO Update-Ecotox Thresholds" was prepared by USEPA for use as benchmark screening values in the first step of a baseline risk assessment (USEPA, 1996). The sediment Ecotox Thresholds include Sediment Quality Benchmarks (SQBs) that have been established using equilibrium partitioning. The SQBs are based on an assumption of 1 percent organic carbon [10,000 mg/kg total organic carbon (TOC)]. The SQBs calculated in USEPA (1996) are based on freshwater data.

Jones et al., (1997) developed sediment quality benchmarks using equilibrium partitioning, similar to what was done for the Ecotox SQBs described above. They termed the values secondary chronic values (SCVs) (Table 3 in Jones et al., 1997). The SCVs are based on an assumption of 1 percent organic carbon, using various surface water screening levels. As footnoted on the table in Jones et al., (1997), some of the values are polar nonionic organic compounds, for which the equilibrium partitioning model is likely to provide a conservative estimate of exposure.

The following presents the order of preference that was used for selecting the sediment screening values presented in Table 7-3:

1. Sediment Quality Benchmark for dieldrin
2. ER-L from Long et al. (1995)
3. TEL from McDonald (1994)
4. ER-L from Long and Morgan (1991)
5. AET from Buchman (1999)
6. SQBs presented in the Ecotox Thresholds
7. SCVs in Jones et al.(1997)

7.3.1.3 Surface Water

Table 7-4 presents the surface water screening levels. Primarily, screening values developed from saltwater data are presented in the attachment, because the surface water surrounding Gould Island is saltwater. However, freshwater values were used, when necessary. The following paragraphs briefly describe each of the sources of the screening levels.

The Recommended Water Quality Criteria were developed by USEPA to provide states with guidance for developing their own criteria (USEPA, 2002). These values are set to protect the majority of aquatic organisms from adverse impacts from contaminants in the surface water. The recommended Water Quality Criteria for most metals are based on the dissolved portion of the metals.

Buchman (1999) developed a table the presented sediment screening levels from various sources, both freshwater and saltwater. For surface water, the values are older USEPA WQC or lowest observed effects levels (LOELs). When only LOELs were available, they were multiplied by 0.1 to estimate a no observed effects level and footnoted in Appendix H.2.

Suter and Tsao (1996) calculated benchmarks were using Tier II methodology as described in the USEPA's Proposed Water Quality Guidance for the Great Lakes System (USEPA, 1993). Tier II values were developed so that aquatic benchmarks could be established with fewer data than are required for the USEPA AWQC.

The following presents the order of preference that was used for selecting the surface water screening value presented in Table 7-4:

1. USEPA Water Quality Criteria
2. Saltwater values in Buchman (1999)
3. Suter and Tsao (1996)

7.3.2 Mammals and Birds

Risk to mammals and birds from exposure to chemicals in surface soil and sediment were determined using food chain models to estimate the Chronic Daily Intake (CDI) which was compared to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs were developed from NOAELs and LOAELs obtained from wildlife studies, if available. The majority of the TRVs were obtained from the ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996) and the USEPA Ecological Screening Levels, but were supplemented with other toxicity information when

necessary. Only chemicals considered to be important bioaccumulative chemicals by USEPA (USEPA, 2000) were included in the food chain model with the exception of a few organic chemicals that were detected in the clam or mussel tissue samples. Organic chemicals that were detected in the tissue samples, with the exception of phthalates which are common laboratory contaminants, were included in the food chain model even if they are not considered bioaccumulative chemicals. Appendix H.2 presents the TRVs for the mammals and birds that were used in the ERA and the sources of the TRVs.

7.4 CHARACTERIZATION OF EXPOSURE

This portion of the ERA includes identification of chemical concentration data used as the exposure point concentrations (EPCs) to represent ecological exposure in various media. Terrestrial plants and invertebrates are exposed to chemicals in the surface soil, and marine receptors are exposed to chemicals in the groundwater (after it discharges to and mixes with surface water) and sediment through ingestion and/or direct contact. Maximum concentrations were used as the EPCs for comparison to the screening values in order to select COPCs. Several of the surface soil samples were collected under the concrete slab or were collected in small sump areas (see Table 7-5). These samples were not included in the ecological risk assessment because either the exposure pathway is not complete, or they represent a very small area. Also, although the concentrations of the individual Aroclors are included on the COPC selection tables, only the total PCB results are discussed in the text and included in the food chain models.

Total exposure of terrestrial wildlife to chemicals in soil and sediment (and associated food items such as plants, invertebrates, and clams/mussels) were estimated for the surrogate wildlife species listed in Section 7.2.4.3 using the following equation:

$$CDI = \frac{[(Cf * If) + (Cs * Is)] * H}{BW}$$

Where:

CDI	=	Chronic daily intake (mg/kg-day)
Cf	=	Chemical concentration in food – (see discussion below)
Cs	=	Chemical concentration in surface soil or sediment (mg/kg)
If	=	Food ingestion rate (kg/day)
Is	=	Incidental surface soil or sediment ingestion rate (kg/day)
H	=	Portion of food intake from the contaminated area (unitless)
BW	=	Body weight (kg)

The factor “H” is the contaminated area (i.e., site) divided by the home range (HR) of the receptor and represents the percent of time spent in this area and therefore the percent of food that the receptor will obtain from the site. For example, if the site is 1 acre and the home range of the receptor is 10 acres, that receptor can be expected to obtain 10 percent of its food from the site. Typically the “H” factor is 1.0 to be conservative, especially at the screening level stage of the ERA process.

Chemical concentrations in food items for insectivorous and herbivorous receptors were calculated using soil-to-invertebrate or soil-to-plant bioaccumulation factors (BAFs) from published sources, or regression equations from the USEPA Ecological Screening Level Guidance Document (USEPA, 2005). The following equation was used to calculate the chemical concentration in plants or invertebrates when BAFs were used:

$$Cf = Cs * BAF$$

Where:

Cf	=	Chemical concentration in food (mg/kg)
Cs	=	Chemical concentration in surface soil (mg/kg)
BAF	=	Soil to biota bioaccumulation factor (unitless)

Because clam and mussel samples were collected at the site, the chemical concentrations in food items for piscivorous birds and mammals were equal to the concentrations in the combined mussel and clam dataset.

The exposure assumptions (i.e., ingestion rate, body weight) were obtained primarily from the Wildlife Exposure Factors Handbook (USEPA, 1993) with other sources used as necessary. Table 7-5 summarizes the exposure factors that were used for the food chain model and Appendix H.1 presents the derivation of those parameters. Note that dry-weight food ingestion rates were used in the food chain model. The sources of the BAFs are presented in Appendix H.3.

The following input parameters were used in the CDI equation for the surrogate species:

- Maximum surface soil, sediment, and tissue concentrations
- Conservative BAFs
- Conservative receptor body weights and ingestion rate

For refining the conservative exposure assumptions in Step 3a (see Section 7.6), the following input parameters were used:

- Average surface soil, sediment, and tissue concentrations
- Less conservative BAFs
- Less conservative receptor body weights and ingestion rates

7.5 RISK CHARACTERIZATION

The risk characterization is the final phase of an ERA that compares exposure to ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor was evaluated. An ecological effects quotient (EEQ) approach was used to characterize the potential risk to ecological receptors. This approach characterizes the potential effects by comparing exposure concentrations/doses to effects data. When EEQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most benchmarks are developed using conservative exposure assumptions and/or studies. The EEQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an exposure point concentration exceeds or is less than a benchmark.

The EEQs for surface soil receptors were calculated as follows:

$$EEQ = \frac{Css}{SSSL}$$

where:

EEQ	=	Ecological Effects Quotient (unitless)
Css	=	Chemical concentration in surface soil (µg/kg or mg/kg)
SSSL	=	Surface soil screening level (µg/kg or mg/kg)

The EEQs for marine receptors were calculated as follows:

$$EEQ = \frac{Cgw}{SwSL} \text{ or } \frac{Csd}{SdSL}$$

where:

EEQ	=	Ecological Effects Quotient (unitless)
Cgw	=	Chemical concentration in groundwater (µg/L)
Csd	=	Chemical concentration in sediment (µg/kg or mg/kg)

SwSL = Surface water screening level (µg/L)

SdSL = Sediment screening level (µg/kg or mg/kg)

The EEQs for terrestrial wildlife were calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where:

EEQ = Ecological effects quotient (unitless)

CDI = Chronic daily intake dose (mg/kg-day)

TRV = Toxicity reference value (NOAEL or LOAEL) (mg/kg-day)

7.5.1 Selection of Chemicals of Potential Concern

The final part of the screening evaluation is selection of chemicals of potential concern (COPCs). Chemicals that are not selected as COPCs are assumed to present negligible risk to ecological receptors and are not considered for further evaluation in the ERA. Chemicals that are retained as COPCs are evaluated further in Step 3a to determine if they are carried through as chemicals of concern (COCs). Ecological COPCs were selected using the following procedures:

- Chemicals with EEQs greater than 1.0 (using screening values and maximum chemical concentrations) were retained as COPCs for further evaluation because they have a potential to cause risk to ecological receptors.

- Chemicals with EEQs greater than 1.0 based on the food chain model using NOAELs and the conservative exposure scenario were retained as COPCs because they have the potential to cause risk to higher trophic level mammals and birds.

- Chemicals without screening values were retained as COPCs but are only evaluated qualitatively.

- Calcium, magnesium, potassium, and sodium were not retained as COPCs because they are essential nutrients that can be tolerated by living systems even at high concentrations. No evidence indicates that these chemicals are related to site operations, and they are not considered hazardous chemicals.

Tables 7-7 through 7-11 present the COPC selection tables for each of the assessment endpoints. Table 7-12 is an overall summary of the chemicals that were retained as COPCs for each assessment endpoint.

7.5.1.1 Risks to Terrestrial Invertebrates and Plants

Table 7-7 presents the chemicals that were retained as COPCs in surface soil for potential risks to plants and invertebrates. In summary:

- One volatile organic chemical (VOC) and two semivolatile organic chemicals (SVOCs) were retained as COPCs because no surface soil screening levels were available.

- Eleven SVOCs, three pesticides, and three inorganics were retained as COPCs because the maximum concentrations exceeded the screening levels.

- Two inorganics were retained as COPCs because their criteria are based on the soil pH and no soil pH data were available.

7.5.1.2 Risks to Marine Organisms

Sediment

Table 7-8 presents the chemicals that were retained as COPCs in sediment for potential risks to benthic invertebrates. In summary:

- One SVOC, and three inorganics were retained as COPCs because no sediment screening levels were available.

- Two VOCs, twenty SVOCs [plus high molecular weight (HMW) and low molecular weight (LMW) PAHs], thirteen pesticides, total Aroclors, and nine inorganics were retained as COPCs because the maximum concentrations exceeded the sediment screening levels.

Groundwater

Table 7-9 presents the chemicals in groundwater that were retained as surface water COPCs by comparing the maximum detected concentrations in groundwater wells to surface water screening benchmarks. This was done to evaluate potential risks to marine organisms after the groundwater discharges to the surface water. In summary:

- Two SVOCs were retained as COPCs because no surface water screening levels were available.
- One SVOC and eight inorganics were retained as COPCs because the maximum concentrations exceeded the surface water screening levels.

7.5.1.3 Risks to Mammals and Birds

The bioaccumulative chemicals detected in the surface soil and sediment are designated as “BIO” on Tables 7-7 and 7-8. Tables 7-10 and 7-11 summarize the results of the conservative inputs food chain modeling for terrestrial and piscivorous receptors, respectively. Appendix H.4 presents the calculation worksheets. The following summarizes the results of the food chain modeling using maximum concentrations and conservative input parameters:

- Soil herbivorous receptors – One inorganic was retained as a COPC because the NOAEL EEQs were greater than 1.0 in the conservative scenario food chain model (see Table 7-10).

- Soil insectivorous receptors – Two PAHs, total PCBs and four inorganics were retained as COPCs because the NOAEL EEQs were greater than 1.0 in the conservative scenario food chain model (see Table 7-10).

- Piscivorous receptors – Total PCBs, and six inorganics were retained as COPCs because the NOAEL EEQs were greater than 1.0 in the conservative scenario food chain model (see Table 7-11).

7.6 STEP 3A REFINEMENT

Step 3a consists of a refinement of the conservative exposure assumptions/concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may not be retained as a COPC in soil based on risks to soil invertebrates and plants but may be retained for evaluating risks to wildlife.

7.6.1 Terrestrial Plants and Invertebrates

One VOC (2-butanone) in the surface soil samples was retained as a COPC because a screening level was not available. Generally, VOCs are not considered toxic to plants and invertebrates at low concentrations as indicated by the relatively high screening levels for other VOCs such as trichloroethene (3,000 µg/kg [CCME, 1997]). Therefore, the concentration of 2-butanone (3 µg/kg) is not likely to impact terrestrial plants or invertebrates. Also, 2-butanone was only detected in one of nine samples and is a common laboratory contaminant. For these reasons, 2-butanone is not a chemical of ecological concern that warrants further evaluation at this site.

PAHs are the primary chemicals of ecological concern for this site (for the SVOCs). Eleven PAHs were retained as COPCs in the soil because they were detected at concentrations that exceeded screening levels for risks to plants or invertebrates while two SVOCs (carbazole and dibenzofuran) were retained because they did not have screening levels. The concentrations of PAHs were greatest at location G32-SB332 which is located in the south-western portion of the site, between the concrete pad and the location of former acid storage shed. The area is currently vegetated (see photograph in Appendix D.9) and likely represents a relatively small area of habitat for ecological receptors (see Figure 4-1 and Appendix F). Fluoranthene and pyrene also were detected at concentrations that slightly exceeded the soil screening level at a few additional locations (G32-SB302B, -SB309, and -SB338). All of the fluoranthene detections at these three locations were equal to or lower than its background concentration (1100 µg/kg) and the pyrene detections were just slightly greater than or lower than its background concentration (880 µg/kg). Therefore, the detections of those two PAHs in the three samples may not be related to site activities. Carbazole and dibenzofuran were detected at relatively low concentrations compared to the PAHs, with maximum concentrations of 280 µg/kg and 290 µg/kg, respectively. Their maximum detected concentrations were also at location G32-SB332, as discussed above for the PAHs. All of the remaining carbazole detections were less than its background concentration (72 µg/kg), and dibenzofuran was only detected in one additional sample at a concentration of 120 µg/kg. In summary, SVOCs related to site activities that may potentially impact plants and/or invertebrates are limited to a small area at the site. The fact that the area is currently vegetated indicates that significant impacts to plants are not occurring and even if there were slight impacts, the impacts are not great enough to warrant retaining SVOCs for further evaluation in a baseline ERA.

Although three pesticides were retained as COPCs because they were detected at concentrations that exceeded screening levels, they are not considered chemicals of ecological concern for further evaluation at the site. They were only detected in 1 of 9 samples each, at very low concentrations (<5 µg/kg) and are not widespread across the site. Therefore, based on the low detected concentrations and low

frequency of detection of pesticides, impacts to plants and invertebrates from pesticides are expected to be low and not great enough to warrant retaining pesticides for further evaluation in a baseline ERA.

The USEPA Eco-SSL document for aluminum indicates that aluminum should be identified as a COPC only at sites where the soil pH is less than 5.5 (USEPA, 2003a). Also, according to the Eco-SSL for iron (USEPA, 2003b), iron is essential for plant growth, and is generally considered to be a micronutrient. Because plants regulate its uptake, iron is not expected to be toxic to plants in well aerated soils with pH levels between 5 and 8 S.U. (USEPA, 2003b). All of the aluminum detections were just slightly greater than or were less than its background concentration (8,850 mg/kg) while most of the iron detections, including the mean concentration, were less than its background concentration (12,300 mg/kg). Also note that the concentrations of aluminum and iron are much lower than the mean background concentrations of aluminum (100,000 mg/kg) and iron (30,000 mg/kg) in soil samples collected from Rhode Island as reported in the USEPA Ecological Soil Screening Level Guidance Document (USEPA, 2005). Although pH data were not collected at the site, aluminum and iron are typically not considered to be toxic to terrestrial plants or invertebrates because their bioavailability is low, and at Site 17 aluminum and iron do not appear to be site-related. Therefore, any potential impacts to plants and invertebrates from aluminum and iron are expected to be low and not great enough to warrant retaining them for further evaluation in a baseline ERA.

Chromium, vanadium, and zinc were detected at concentrations exceeding the conservative screening levels. However, their maximum detections (26.5 mg/kg, 28.7 mg/kg, and 82.8 mg/kg, respectively) were much lower than the Canadian Soil Quality Guidelines (SQG) which were developed to protect plants and invertebrates. The SQGs are 64 mg/kg for chromium, 130 mg/kg for vanadium, and 200 mg/kg for zinc (CCME 1999a, b, and c). Therefore, concentrations of chromium, vanadium, and zinc are not expected to impact plants or invertebrates at the site so they are not retained for further evaluation in a baseline ERA.

7.6.2 Marine Organisms

The following sections presents the Step 3a refinement for sediment invertebrates exposed to chemicals in the sediment and marine organisms exposed to chemicals in the groundwater after it discharges to the bay.

7.6.2.1 Sediment

Of the seven VOCs that were detected in the sediment, two were retained as COPCs in sediment because their concentrations exceeded their respective screening levels (acetone and carbon disulfide).

Both VOCs are common laboratory contaminants and are not likely to be related to site activities. Additionally, carbon disulfide is found naturally in coastal and ocean waters (ASTDR, 2005). For these reasons, VOCs are not chemicals of ecological concern that warrant further evaluation at this site.

Thirteen pesticides and two Aroclors were retained as COPCs in sediment because their concentrations exceeded their respective screening levels. Of these chemicals, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, delta-BCH, dieldrin, endosulfan I, endrin aldehyde, endrin ketone, gamma-BHC, and methoxychlor were detected in four or less of 66 samples and are not widespread across the site. The other pesticides were detected more frequently in 21 of 66 samples (beta-BHC), 17 of 66 samples (endosulfan sulfate) and 13 of 66 samples (gamma-chlordane). The greatest concentrations of pesticides (i.e., >100 µg/kg) were at locations SD312 and SD316, where the concentrations of PCBs and PAHs also were elevated. Therefore, although benthic invertebrates may be impacted by pesticides in the sediment at several locations across the site, the greatest potential for impacts are by locations SD312 and SD316.

Total Aroclors were detected in 45 of 90 samples. In the subtidal sediment, the greatest concentrations of PCBs were found at locations SD312 and SD316, with total Aroclor concentrations of 41,000 µg/kg and 22,000 µg/kg, respectively. These concentrations are much greater than the screening level for PCBs (22.7 µg/kg), as well as the Effects Range-Median (ER-M) of 180 µg/kg, which is a concentration above which adverse effects to benthic invertebrates would frequently occur. Other locations with total Aroclor concentrations greater than 1,000 µg/kg include SD304 and SD305, with concentrations of 3,800 µg/kg and 2,200 µg/kg, respectively. The maximum total Aroclor concentration in the intertidal sediment was 360 µg/kg at location SD304F. Because the concentrations of PCBs listed above, and because PCB concentrations at several other locations, were greater than the ER-M adverse effects to benthic invertebrates from PCBs are possible.

Twenty SVOCs (plus LMW and HMW PAHs) were retained as COPCs in the sediment samples because they were detected at concentrations that exceeded screening levels. In addition, carbazole was retained as a COPC because it did not have a screening level. Seventeen of the SVOCs are PAHs and the remaining four are 4-methylphenol, carbazole, dibenzofuran, and phenol. The locations with elevated levels of carbazole and dibenzofuran generally corresponded to the same locations where concentrations of PAHs were elevated.

The samples with elevated levels of 4-methylphenol and phenol were generally found in samples with lower concentrations of PAHs. The source of the phenols is not known because 4-methylphenol and phenol were detected at very low frequencies and at relatively low concentrations in the groundwater and soil samples at Site 17. There may be some adverse impacts to benthic invertebrates from

4-methylphenol and phenol in the sediment at select locations, but these chemicals do not appear to be site-related.

HMW PAHs and LMW PAHs were evaluated instead of the individually detected PAHs in the sediment as part of the Step 3a refinement. This was done because the toxicity of PAHs has been reported to be additive and several studies have reported toxicity data for total PAHs (Di Toro, et al., 2000). Several samples had concentrations of HMW PAHs and LMW PAHs that were greater than the screening levels as well as the ER-M values. The greatest concentrations of PAHs were found at SD312, but elevated concentrations (i.e., greater than the ER-M) were found at subtidal stations SD303, SD304, SD306, SD308, SD310, and SD316 and intertidal stations SD308F and SD310F. Although there may be some adverse impacts to benthic invertebrates from PAHs in the sediment locations where the screening levels were exceeded, there is a greater likelihood for impacts at locations where the ER-M is exceeded.

Table 7-13 presents the SEM and AVS data for the sediment samples collected at the site with the cells in the SEM/AVS column shaded grey if the ratio of SEM to AVS is equal to or greater than 1.0. Table 7-13 also presents the sediment screening level with the cells in the bulk chemistry columns shaded black if the concentration is greater than the screening level. The results of the analysis indicated that the SEM metals (cadmium, copper, lead, mercury, nickel, and zinc) in most of the samples are not likely to be bioavailable because the SEM/AVS ratio was greater than 1.0 in only 5 of 66 samples. With the exception of the maximum SEM/AVS ratio of 3.5, all the ratios were less than 2.0. In three of those five samples, the bulk chemistry concentrations were very low (i.e., less than the screening levels). The SEM/AVS ratio is only an indicator of potential bioavailability of metals so a ratio of greater than 1.0 does not indicate any certainty that there will be an adverse effect on benthic invertebrates, only that the metals might be bioavailable. However, because of the low bulk chemistry concentrations in those three samples, potential impacts to benthic invertebrates in those sample locations are unlikely. Also, several other locations had bulk chemistry concentrations that were greater than their respective screening level but the SEM/AVS ratios were less than 1.0 indicating that potential impacts to benthic invertebrates in those sample locations are unlikely. One exception may be cadmium with a concentration of 398 mg/kg at SD317. Although the SEM/AVS ratio was less than one at this location, the extremely elevated cadmium detection in the bulk chemistry sample compared to the ER-M of 9.6 mg/kg indicates that potential impacts to sediment invertebrates are possible at this location. Finally, at SD306A and SD306B, the SEM/AVS ratios were greater than 1.0, and the concentrations of lead in the bulk chemistry samples were much greater than the screening levels, as well as the ER-M. This is an indication that sediment invertebrates may be impacted by lead at those locations.

A few other metals, other than the SEM metals, were retained as COPCs because they were detected at concentrations that exceeded screening levels (antimony, chromium, manganese, and selenium) or they

did not have screening levels (beryllium, cyanide, and thallium). All of the beryllium detections were less than the background concentration, so any impacts from beryllium would not be site-related (see Table 7-8 and Appendix F-6-D). The concentration of chromium (3,910 mg/kg) only exceeded the screening level (and the ER-M) at one location, SD304F, which is the same intertidal location where the greatest concentrations of antimony (43.5 mg/kg) and lead (21,200 mg/kg) were found. Therefore, there may be impacts to benthic invertebrates from chromium at that location. With the exception of the maximum detected concentration (43.5 mg/kg) and a detection of 33.8J at SD311 (0.5 to 1 foot), the remaining antimony detections were less than 5 mg/kg, just slightly greater than the screening level (2 mg/kg) but much lower than the ER-M (25 mg/kg). Antimony was not detected in the 0 to 0.5 foot samples from SD311. Therefore, impacts to sediment invertebrates from antimony in the sediment are not likely to be significant at most locations because only 2 of 90 samples had antimony detections greater than the ER-M. Manganese concentrations in 4 of 90 samples were greater than the screening level of 260 mg/kg with a maximum detected concentration of 418 mg/kg. Therefore, there may be some isolated impacts to sediment invertebrates at those four locations. Selenium concentrations were greater than its screening level at locations SD304, SD305, SD306, and SD309, all of which are located on the eastern part of Site 17, so there may be impacts to benthic invertebrates from chromium at that location (see Figures 4-3A and B). These are the same locations where concentrations of other parameters such as other metals, PAHs, and PCBs are elevated. Finally, cyanide and thallium do not have screening levels but because of their relatively low frequency of detection (11/90 for cyanide and 19/90 for thallium) and relatively low maximum detected concentrations (0.44 mg/kg for cyanide and 2.5J mg/kg for thallium), impacts from these chemicals are not likely to be significant.

7.6.2.2 Groundwater

The groundwater data at Site 17 was compared to surface water screening levels to determine whether there was the potential for groundwater exiting the site to impact marine receptors in the offshore area. This evaluation is conducted as a conservative screen, but it is understood that there is a large amount of water mixing at the groundwater to surface water interface. A dilution factor has not been developed for this site, but as described below, use of a very conservative dilution factor of 50 results in none of the chemical concentrations in groundwater exceeding a surface water screening level.

Carbazole and dibenzofuran were retained as COPCs because screening levels were not available for those chemicals and phenol was retained as a COPC because its maximum concentration exceeded the screening level. All three chemicals were only detected in one groundwater well, G32-MW306S, which is located near the former fuel underground storage tanks. Although, screening levels are not available for carbazole or dibenzofuran, the low detected concentrations, 5 µg/L and 2 µg/L, respectively, are not likely to impact marine receptors once the groundwater exits the site and mixes with surface water. Similarly,

phenol had an EEQ of less than three so it is not likely to impact marine receptors once the groundwater exits the site and mixes with surface water.

Eight metals were retained as COPCs because their maximum detections exceeded screening levels. Aluminum, barium, iron, and manganese had the greatest EEQs ranging from 14 to 44; using average chemicals concentrations in the groundwater, however, the EEQs for these four metals ranged from 3.2 to 16. In accordance with USEPA (1993), dissolved metal more closely approximates the bioavailable fraction of metal in the water column than does total recoverable metal. The groundwater samples were not filtered so the bioavailable fraction of the metals is not known but the concentrations of the metals are expected to be much lower in the dissolved fraction of the water. Therefore, the chemicals in the groundwater are not expected to impact marine receptors assuming at least a 50x dilution factor after the groundwater discharges from the site and mixes with the surface water. The 50x dilution factor is very conservative given the large amount of water in the bay as well as the rapid mixing that is expected to occur.

7.6.3 Mammals and Birds

As presented in Section 7.5.1.3, the EEQs from the terrestrial food chain modeling were greater than 1.0 for several chemicals using maximum chemical concentrations and conservative exposure assumptions. Therefore, as part of the Step 3a refinement, risks for this pathway were recalculated using average chemical concentrations in surface soil, sediment, and tissue samples and less conservative exposure assumptions (i.e., average ingestion rates, average body weights) (see Table 7-5).

Table 7-14 presents the NOAEL and LOAEL EEQs from the terrestrial food chain models for herbivorous and insectivorous receptors and Table 7-15 presents the NOAEL and LOAEL EEQs from the terrestrial food chain models for piscivorous receptors using less conservative exposure parameters. The following bullets summarize the results for the various receptors:

- Soil herbivorous receptors: No chemicals had NOAEL EEQs greater than 1.0 using the less conservative exposure parameters.

- Soil insectivorous receptors: Zinc had a NOAEL EEQ greater than 1.0 for the woodcock using the less conservative exposure parameters; but the LOAEL EEQ was less than 1.0

- Piscivorous receptors: No chemicals had NOAEL EEQs greater than 1.0 using the less conservative exposure parameters.

The only NOAEL EEQ greater than 1.0 in the less conservative food chain model was an EEQ of 2.6 for zinc for the woodcock. The average concentration of zinc used in the food chain model was 46.4 mg/kg which is just slightly greater than the background zinc concentration of 43.7 mg/kg. In fact, four samples have zinc concentrations less than the background concentration and the other five have zinc concentrations that are just slightly greater than the background concentration. Also, the food chain model is still conservative because the dose is based on the assumption that insectivorous birds obtain all of their food from the site, which is not likely to occur so actual risks to insectivorous birds are not likely. Therefore, potential risks to insectivorous birds from zinc are similar to background risks.

7.7 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section presents some of the general uncertainties associated with ecological risk assessment.

7.7.1 Uncertainty in Measurement and Assessment Endpoints

Measurement endpoints were used to evaluate the assessment endpoints that were selected for this ERA, but the measures of effects were not the same as the assessment endpoints. Therefore, the measures were used to predict effects to the assessment endpoints by selecting surrogate species that were evaluated. For example, risks to a herring gull were used to assess risks to other piscivorous wildlife. However, estimating risks to a gull may either under or overprotect other piscivorous wildlife populations, resulting from differences in ingestion rates, toxicity, food preferences, etc., between the different species.

Several endpoints were not quantitatively evaluated in the ERA. For example, risks to reptiles and amphibians were not quantitatively evaluated because exposure factors are not established for most species, and toxicity data are very limited. No reptiles or amphibians were observed at the site during the habitat survey, so the uncertainty in not evaluating risks to these receptors is low. As discussed earlier in the ERA, several eelgrass beds are present offshore of Gould Island. A non-invasive eelgrass survey was conducted in August 2005, and the report along with figures showing the locations of the eelgrass beds is presented in Appendix E. No attempt was made to try to correlate chemical concentrations in the sediment with locations of eelgrass beds because there are many variables that influence the ability of eelgrass to grow, including depth of water, sediment type, wave action, etc. However, note that eelgrass was present at several locations with elevated levels of PAHs, PCBs, and/or metals including SD304 and SD306.

7.7.2 Uncertainty in Exposure Characterization

The chemical doses to mammals and birds are calculated using an equation that incorporates ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors are obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary between species, especially between species inhabiting different areas.

Bioaccumulation of chemicals into various biological media (i.e., plants, invertebrates) depends on characteristics of the media such as pH, organic carbon, etc. The bioaccumulation factors that were used for the ERA came from a variety of sources, as indicated in Appendix H.3. All the values were from the literature because no site-specific values are available. There are uncertainties associated with accumulation factors from the literature because they may either underpredict of overpredict tissue concentrations, depending upon how representative the factors are for site conditions.

Clam and mussel samples were collected from the bay surrounding the site to obtain actual tissue data to input into the food chain models for piscivorous wildlife. This reduced some of the uncertainty in the exposure characterization. Many of the samples were collected from subtidal areas, however, and are not as easily accessible to most wildlife species as are intertidal clams and mussels. This was conservative for many chemicals as their greatest detected concentrations were found in the subtidal samples, especially the mussel samples from location G32-ET312.

The SEM/AVS ratio is an indicator of potential bioavailability of select metals in the sediment. It is based on equilibrium partitioning theory which predicts that SEM metals partition in sediment between AVS (principally iron monosulfide), interstitial (pore) water, benthic organisms, and other sediment phases such as organic carbon (USEPA, 2005). If the SEM/AVS ratio is less than one, the metals are not expected to be bioavailable. If the ratio is greater than 1.0, the metals may be bioavailable, but other factors such as TOC may inhibit the bioavailability of the metals. There is uncertainly in this approach for several reasons. Sediment characteristics can change during sampling collection and handling (possible resulting in the loss of AVS) so the SEM/AVS results may not be representative of actual field conditions. Also, AVS concentrations may vary seasonally, with the greatest AVS concentrations typically in the late summer and lowest AVS concentrations typically in the winter/spring timeframe. However, studies have shown that cadmium and zinc form more stable sulfide solid phases than iron and if this is also true for sulfide complexes of copper, nickel, silver, and lead, the issue of seasonal/spatial variations in AVS becomes of less concern (USEPA, 2005).

It is noted that prior to the onsite trenches being backfilled, surface water collected in the trenches. Also, wildlife, including juvenile birds, reportedly were observed to be swimming in the water. Although surface

water samples were not collected from these areas during the RI because surface water is no longer present in the backfilled trenches, the birds or other wildlife were likely exposed to some levels of chemicals in the previously existing surface water.

7.7.3 Uncertainty in Ecological Effects Data

Uncertainty exists in the ecological effects data, including the screening levels and wildlife TRVs. Several of the screening levels are very conservative, and in some cases are below background levels. Therefore, their utility in evaluating potential risks for those chemicals is somewhat limited. For example, the screening level for chromium in soil is 0.4 mg/kg, which is well below background levels.

The NOAELs/LOAELs used for the wildlife endpoints species are based on species other than the test study species (i.e., rats, mice, ducks). Uncertainty exists in the application of toxicity data across species because the chemical may be more or less toxic to the endpoint species than it was to the test study species.

7.7.4 Uncertainty in Risk Characterization

The potential for adverse risks may be anticipated if an EEQ is greater than or equal to 1.0 regardless of the magnitude of the EEQ. Although the relationship between the magnitude of an EEQ and toxicity is not necessarily linear, the magnitude of an EEQ can be used as rough approximation of the likelihood of potential risks, especially if there is sufficient confidence in the screening level used. Uncertainty exists in how the predicted risks to a species at the site translate into risk to the population in the area as a whole.

7.8 SUMMARY/CONCLUSIONS

This section presents a summary of the conclusions of the ecological risk assessment that was conducted for the site.

7.8.1 Risks to Terrestrial Plants and Invertebrates

The following presents a summary of the conclusions of the evaluation of risks to terrestrial plants and invertebrates:

- None of the VOCs were retained for further evaluation for ecological risk at the site because their concentrations in the soil were not likely great enough to be considered toxic to plants and invertebrates and/or because they were common laboratory contaminants.

- Several PAHs were retained as COPCs in the soil because they were detected at concentrations that exceeded screening levels for risks to plants or invertebrates while two SVOCs did not have screening levels. The site-related SVOCs that were detected at concentrations that may potentially impact plants and/or invertebrates are limited to a small area at the site. This area is currently vegetated, which indicates that significant impacts to plants are not occurring. It is not likely that invertebrates are being impacted because they are typically less sensitive to chemicals than plants. Even if there were slight impacts to plants and/or invertebrates, the impacts are not great enough to warrant retaining SVOCs for further evaluation in a baseline ERA.

- Three pesticides were retained as COPCs in soil because they were detected at concentrations that exceeded screening levels but they were only detected in 1 of 9 samples each, at very low concentrations (<5 µg/kg) and are not widespread across the site. Therefore, based on the low detected concentrations and low frequency of detection of pesticides, impacts to plants and invertebrates from pesticides are expected to be low and not great enough to warrant retaining pesticides in soil for further evaluation in a baseline ERA.

- Three metals (chromium, vanadium, and zinc) were detected in soil at concentrations exceeding the conservative screening levels and two other metals (aluminum and iron) are considered potentially toxic to invertebrates and/or plants in soils with low pH. The maximum detected concentrations of chromium, vanadium, and zinc were much lower than the Canadian SQGs which were developed to protect plants and invertebrates. Also, although pH data were not collected at the site, aluminum and iron are typically not considered to be toxic to terrestrial plants or invertebrates because their bioavailability is low, and at Site 17 aluminum and iron do not appear to be site-related. Therefore, metals are not expected to impact plants or invertebrates at the site, and/or are not related to site activities so they are not retained for further evaluation in a baseline ERA.

7.8.2 <u>Marine Organisms</u>

7.8.2.1 Sediment

- The VOCs that were retained as COPCs were detected at very low frequencies and/or are common laboratory contaminants and are not likely to be related to site activities. Therefore, VOCs are not chemicals of ecological concern that warrant further ecological risk evaluation.

- Thirteen pesticides and two Aroclors were retained as COPCs in sediment because their concentrations exceeded their respective screening levels. Although benthic invertebrates may

be impacted by pesticides in the sediment at several locations across the site, the greatest potential for impacts are at locations SD312 and SD316 from total Aroclors. The concentrations of PCBs at several other locations (refer to Tables 4-4A and 4-4B) were greater than the ER-M so adverse effects to benthic invertebrates at those locations are also possible.

- Of the 21 SVOCs that were retained as COPCs in the sediment samples, seventeen were PAHs and the remaining four were 4-methylphenol, carbazole, dibenzofuran, and phenol. Although there may be potential impacts to sediment invertebrates from the non-PAH SVOCs, those impacts would generally occur at the same locations where the concentrations of PAHs are elevated. In the case of 4-methylphenol and phenol, these chemicals may not be site-related. The greatest concentrations of PAHs were found at SD312, but elevated concentrations (i.e., greater than the ER-M) were found at subtidal stations SD303, SD304, SD306, SD308, SD310 and SD316 and intertidal stations SD308F and SD310F. Therefore, there may be some adverse impacts to benthic invertebrates from PAHs at several sediment locations.

- Based on the SEM and AVS, the SEM metals in most of the samples are not likely to be bioavailable because the SEM/AVS ratio was greater than 1.0 in only 5 of 66 samples. At SD306A and SD306B, the SEM/AVS ratios were greater than 1.0, and the concentrations of lead in the bulk chemistry samples were much greater than the screening levels, as well as the ER-M. Therefore, sediment invertebrates may be impacted by lead at those locations. Also, cadmium had an elevated concentration of 398 mg/kg at SD317. Although the SEM/AVS ratio was less than one at this location, the extremely elevated cadmium detection in the bulk chemistry sample compared to the ER-M of 9.6 mg/kg indicates that potential impacts to sediment invertebrates are possible at this location. A few other metals were detected at concentrations that exceeded their screening levels and ER-M in one or more samples and may impact benthic invertebrates at the locations of those samples. Those metals include antimony, chromium, manganese, and selenium.

7.8.2.2 Groundwater

The groundwater data at Site 17 was compared to surface water screening levels to determine whether there was the potential for groundwater exiting the site to impact marine receptors in the offshore area. Although several chemicals were detected in the groundwater samples at concentrations that exceeded surface water screening levels, the chemicals in the groundwater are not expected to impact marine receptors after the groundwater discharges from the site and mixes with the surface water.

7.8.3 Mammals and Birds

The only NOAEL EEQ greater than 1.0 in the less conservative food chain model was an EEQ of 2.6 for zinc for the woodcock. The average concentration of zinc used in the food chain model is just slightly greater than the background zinc concentration so potential risks to insectivorous birds from zinc are similar to background risks.

8.0 SUMMARY AND CONCLUSIONS

This section provides a summary of the Site 17 RI activities, findings and conclusions. In addition, recommendations for removal actions and continuance of the site into a Phase 2 RI and Feasibility Study are described.

8.1 SUMMARY OF THE REMEDIAL INVESTIGATION

This section summarizes the findings of the RI, and presents a conceptual site model for the site based on those findings. This section is organized to follow the body of the report, provided as Sections 1 through 7. Figure 8-1 presents an overview of the site and findings of the RI.

8.1.1 Objectives

The general objectives of the RI are to determine the nature and extent of site contamination, sources of contamination, potential contaminant migration pathways, potential contaminant receptors, and associated exposure pathways. The scopes of the sampling efforts for this site were developed to meet site-specific RI/FS objectives as follows:

- Determine the site background soil, sediment, and groundwater quality,
- Determine the nature and extent of site surface soil contamination,
- Determine the nature and extent of site subsurface soil contamination,
- Determine the primary contaminant transportation routes,
- Determine the nature and extent of site-related groundwater contamination,
- Determine the nature and extent of site-related sediment and biota contamination in the marine, environment adjacent to the site,
- Determine the fate and transport of site contaminants in affected media, and
- Determine the risks posed by site contaminants to humans and the environment.

8.1.2 Site Description and History

Site 17 includes the former Building 32, located at the northern end of Gould Island, and the immediate surroundings. The site occupies approximately 6 acres and is bordered by state property to the south, and is surrounded by a portion of the East Passage of Narragansett Bay to the east, north, and west. The site buildings have been demolished, and the island is generally unoccupied, but used by trespassers occasionally.

The site is generally flat, with surface elevations ranging from 8 to 15 feet above Navy Mean Low Water (MLW). With the exception of the remaining building slab foundations, the site is entirely vegetated, and this vegetation is not anticipated to be cultivated or maintained in the near future.

The site was home to a Navy torpedo overhaul shop from World War II, which ceased major operations in the 1950s. During that time, operations included degreasing, parts washing, electroplating, sandblasting, testing, and other operations.

The site was identified as a study area in the Initial Assessment Study in 1986. A verification step conducted in 1987 included collection of two sediment and two mussel samples at the northeast shoreline of Gould Island. These samples confirmed the presence of heavy metals and cyanide in the sediments and shellfish. Stored chemicals and electroplating baths were removed and cleaned in 1992.

The building and facilities were demolished in the period from 1999 through 2002. The concrete roadways were removed at that time, and PCB releases were found near transformer buildings around Building 32. PCB-contaminated concrete and soil were removed under TSCA removal actions in the same time period.

Prior to the initiation of the RI field effort, the following site-related investigations had been conducted:

- Initial Assessment Study and Verification Step (IAS) – 1986-1987: Found heavy metals in the sediment and bivalve tissues at the shoreline where wastes were presumed to have discharged.

- Study Area Screening Evaluation (SASE) – 1999-2000: Found TCE and PAHs in soil gas under Building 32. Found metals in surface soil in the southwest corner of Building 32.

- Other investigations of one former UST at the south end of Building 32: Addressed through the UST program. A release of diesel fuel from the UST resulted in removal of the tank and associated contaminated soil.

- Building 44:

  - TPH contamination from a series of 7 fuel tanks (Building 44 and Building 32) led to removal of approximately 9,000 cubic yards of petroleum-contaminated soil, and subsequent groundwater monitoring program in this area (also addressed through the UST program).

- Soil gas study conducted at former building 44 area showed fuel components and one location where TCE was detected (Q3G, January 1997)

- Found traces of TCE in groundwater samples during monitoring at wells installed for Building 44.

- PCB Investigations: Conducted for former transformer buildings under the Toxic Substances Control Act (TSCA).

  - PCB sampling was conducted at the transformer locations and surrounding roadways under TSCA regulations.

  - Oil containing 430,000 mg/kg of PCBs was found beneath transformer Building 54 and free product containing PCBs was found on the water table. PCBs were found in concrete and soil in, under, and near transformer buildings, which were demolished in 2001 and 2002.

  - Approximately five thousand cubic yards of contaminated soil, concrete and sediment were removed from these locations under actions carried out under TSCA and RIDEM regulations.

  - Although PCBs were not found in groundwater collected from wells installed downgradient of the former building foundation (TtNUS, 2001), trace levels of PCBs (0.229 to 0.324 mg/L PCBs) were found in pooled groundwater in excavations completed in September 2003 (TtFW, 2004).

- Sediment sampling and analysis: Conducted by EPA in 2003 at the eastern subtidal slope near Gould Island.

- In addition, RIDEM reports that TPH and free product were found near Building 33, to the west of Building 32 (RIDEM, 2006).

These previous investigations are summarized in Appendix A and Appendix B of this report. In general, data from these investigations were used to direct investigation efforts for this RI, but most of this previously existing data were not used in the RI report or risk assessments. Data from the IAS were considered to be too old to be representative of the current site conditions. The SASE soil gas data were qualitative and not quantitative, thus not adequate for risk analysis. The SASE surface soil samples and

sludge samples from the pits and sumps in the building were all collected from areas that were altered during demolition and roadway removal, and were considered not likely to be representative of current site conditions. PCB data collected during the TSCA removal program were limited by the analyte group (PCBs only), and did not provide detection limits useful for risk assessment at the site.

EPA data from sediment sample analysis in 2003 were used in the RI, as the sampling was deemed to be recent enough to support the risk evaluations and the data were of similar quality and scope to be comparable to the data collected during the RI. However, since there were no intertidal sediment data collected by EPA in 2003, the sediment data were not used for human health risk assessment and these data were only used for the ecological risk assessments.

8.1.3 Remedial Investigation Field Efforts

The RI field activities conducted included the collection of 87 soil samples from borings and test pits, 14 groundwater samples from monitoring wells, 9 groundwater "discrete zone samples" from bedrock fracture zones, 66 sediment samples from intertidal and subtidal areas around Gould Island, 21 biota samples (clams and mussels as were available at sample stations), 9 aqueous samples from standing water in test pits and in underground utilities, two samples of soil and sludge from these utilities, and two samples of concrete.

In addition, data gathered for the RI included groundwater flow information, information on ecological receptors present and likely to be present, geotechnical information on soils and bedrock pertinent to groundwater and contaminant movement, information on sediment characterization, and over 300 soil samples for headspace screening analysis and soil characterization.

8.1.4 Geology and Hydrogeology

The geologic and hydrogeologic conditions at the site have been determined using data developed during this RI. This evaluation indicates that the site was constructed by cut and fill operations, cutting the natural soil from the hillside at the south end of the site, and filling the subtidal waters to the north to create a level area large enough to construct Building 32 and its support systems. As a result, the site is underlain by fill, consisting of a mix of silty sand and gravel, and glacial till, consisting of silt, sand and gravel. The thickness of the fill ranges from about 6 to 12 feet, the greater thickness at the northern end of the site. The till unit was found to be non-existent at the south end of the site, and up to 74 feet thick at the north end of the site. The lack of till to the south is further evidence that this area was excavated down to bedrock before preparing the site by filling and leveling for building construction.

The bedrock at the site is characterized as metamorphosed sedimentary rock, predominantly phyllite. This rock was found to be weathered in the top 3 to 18 feet. As a result of the softness of the weathered zone, the transition from overburden to bedrock was not clearly defined in two of the seven bedrock wells installed.

The groundwater elevations indicate that the groundwater at the site in general flows from south to north across the site. However, overburden groundwater appears to flow to the northeast, whereas the bedrock groundwater appears to flow to the northwest. A tidal influence study indicates that a tidal influence is felt in both the overburden and bedrock aquifers at the site.

Packer testing results indicated that the bedrock aquifer did not yield appreciable amounts of water. The average hydraulic conductivities measured in the packer tests ranged from negligible to 3.1×10^{-5} cm/sec.

Both upward and downward vertical groundwater gradients were measured at monitoring well clusters during the investigation. The vertical gradients observed at the site indicate an upward vertical flow of water from the bedrock to the overburden. At higher elevations upgradient (south) of the site, groundwater elevations indicated a downward vertical flow of groundwater from the overburden to the bedrock aquifer. However, actual exchange of groundwater between shallow overburden and bedrock is likely to be hindered by the presence of a dense till, where it was not excavated. The area south of Building 32, where till was not present, appears to have groundwater outbreak from the hillside; the interaction of the overburden and bedrock aquifers in this area is not known.

8.1.5 Nature and Extent of Contamination

Activities associated with former site operations have resulted in the presence of VOCs, SVOCs, pesticides, PCBs, petroleum hydrocarbons, metals, and cyanide in site soils and adjacent sediments. Additionally, VOCs, SVOCs, petroleum hydrocarbons, and metals were detected in the site's groundwater at low concentrations.

Surface Soil

Surface soil samples were collected from 0 to 2 feet bgs at 18 locations. SVOCs, metals, and extractable petroleum hydrocarbons were detected in the surface soils at concentrations that exceeded industrial/commercial and/or residential screening criteria. Industrial criteria were exceeded at six locations. Five of these six locations are sumps or equipment trenches fitted within the former Building 32 foundation. No VOCs or pesticides/PCBs were detected in the surface soil samples at concentrations exceeding the residential or industrial criteria (It is noted that for detected pesticides, the residential and industrial criteria exist only for dieldrin.). Most of the detected SVOCs were found at their maximum

concentrations in the sample from the East Equipment Trench. The highest petroleum hydrocarbon concentrations were found in samples from the East Equipment Trench, the West Equipment Trench, and the Hydro Test Tank (Figure 4-1A).

The maximum concentrations of metals associated with electroplating operations (cadmium, copper, chromium, lead, nickel, and zinc), as well as a trace level of cyanide, were found in samples from along the southeast wall of Building 32, or in fill placed in the sumps and equipment trenches.

Subsurface Soil

Subsurface soil samples were collected from 34 borings and 9 test pits at depths ranging from 2 to 54 feet bgs. Industrial/commercial screening criteria for metals and SVOCs were exceeded at five locations, at depths to 12 feet bgs. In general, test pits were excavated at the southwest corner of Building 32, and soil borings were used to evaluate soils across the remainder of the property.

No VOCs or pesticides/PCBs were detected in the subsurface soil samples at concentrations exceeding the residential or industrial criteria (Only the pesticide dieldrin has an existing criteria). The VOC, trichloroethene (TCE), was detected in eleven samples, collected at nine locations, at low or trace concentrations. These locations do not show a clear concentration gradient or distribution pattern, but show evidence of TCE use in the former electroplating room and at the northwest corner of Building 32.

For soil samples collected from borings, the maximum SVOC concentrations were found most often in samples from the sump under the former sand blasting booth, 4 to 6 feet bgs (SB333) and in samples adjacent to the former fuel USTs, 10 to 12 feet bgs (SB306). The highest petroleum hydrocarbon concentration was also found in the sample from 10 to 12 feet bgs adjacent to the former fuel USTs. Metals associated with electroplating operations (cadmium, copper, chromium, lead, nickel, and zinc) were found at their maximum concentrations in the sample collected from 4 to 6 feet bgs at SB333, within the sump under the former Sand Blasting Booth. A trace level of cyanide was found in the sample from 4 to 6 feet bgs at SB319 (under the building foundation, along the drain line from the Sand Blasting Booth).

For soil samples collected from test pits, PAHs were found to be present in the site soil and in sumps and vaults within the Building 32 foundation at concentrations exceeding the RIDEM Direct Exposure Criteria for residential and industrial use. Test pits TP-06 (the same location as SB333, above) and TP-08 at the southwest corner of Building 32 had the highest SVOC concentrations (all PAHs). The presence of elevated levels of PAHs, which are fuel components, in test pits in this area are consistent with field observations of likely residual petroleum found in these excavations. The maximum concentration of petroleum in soil, measured as diesel range organics (DRO), was 4,800 mg/kg at test pit TP-06.

Metals were present in the test pit soil samples and within sumps and vaults at concentrations exceeding the Direct Exposure Criteria for residential and industrial use. Test pit TP-09, excavated around the former dust collection building, had the highest metal concentrations, including lead at 2,700 mg/kg and cadmium at 5,670 mg/kg. The presence of heavy metals in test pits TP-06 and TP-09, such as arsenic, cadmium, chromium, lead, and copper, is possibly a result of sandblasting, dust storage, or electroplating chemical storage or disposal in these areas. Cyanide was not detected in any test pit soil sample collected during the investigation.

These findings show that elevated concentrations of contaminants are present in subsurface soil at specific, definable locations. Most of these locations are sumps, isolated from the surrounding soils by the building foundation. The area of the former dust collection building, located outside the foundation, is a single exception.

Groundwater

Generally, low concentrations of VOCs and SVOCs were detected in several monitoring wells across the site, with no discernable distribution pattern. Highest concentrations included pentachlorophenol, detected in monitoring well MW-306S (7 µg/L), and tetrachloroethene (PCE) at MW-300S (6J µg/L), both of which exceeded the respective GA Groundwater Objective and MCL. TCE, toluene, and other VOCs were detected in groundwater at various locations at the site. It was noted that the upgradient groundwater wells contained low concentrations of PAHs.

A trace level of petroleum, measured as DRO (0.49 mg/L), was also detected in the shallow well located at the former location of USTs at the north end of Building 32 (MW-306S). The trace level of petroleum in groundwater from this monitoring well is likely a remnant constituent from the historic fuel release that occurred at Building 44. This area, and any residual petroleum contamination present, is being addressed in a long-term monitoring program being conducted under the RIDEM UST regulations.

Concentrations of metals in groundwater samples from monitoring wells were generally comparable between onsite monitoring wells, and generally elevated compared to upgradient levels. Higher concentrations of mineral salts (calcium, magnesium, potassium, and sodium) are likely to be a result of a hydraulic connection with sea water from the bay. Drinking water criteria for metals were not exceeded in any of the groundwater samples collected from monitoring wells during the investigation. Cyanide was not detected in any of the groundwater samples collected.

Samples of accumulated water in test pits were also collected, if available. Fuel components (the VOCs, benzene, toluene, and xylenes, and PAHs and petroleum hydrocarbons) were detected in aqueous samples from test pits TP-06 and TP-08 and are likely artifacts of the fuel releases in these areas.

Pesticides and PCBs were detected at trace concentrations in aqueous samples collected from test pits TP-06 and TP-08. The presence of Aroclor 1260 in test pit TP-08 is likely an artifact of the former transformer (Building 56) nearby. Maximum concentrations of metals, including heavy metals such as chromium, lead, zinc, and copper, were detected in water from test pit TP-08, and are possibly a result of previous sandblasting, dust storage, or electroplating chemical storage in this area.

Samples from Manholes

Soil/sludge, LNAPL, and water samples were collected from selected manholes that were part of the underground utilities system. Petroleum-related contaminants (DRO, GRO, and PAHs), pesticides, and PCB Aroclor-1260 were detected in the soil/sludge sample collected from manhole MH-01, near the electroplating room. In addition, heavy metals including cadmium, copper, chromium, nickel, and lead were detected at high concentrations in this soil//sludge sample. A small amount of free product was found and sampled in MH-01 and was removed with a large quantity of water and taken off site for disposal. The organic compounds and metals in the soil/sludge from MH-01 were also detected in the soil sample from MH-05, at lower concentrations, corroborating the suspected connection between the two manholes.

Concrete

Two concrete samples were collected from the north end of the Building 32 foundation. The VOCs detected (carbon disulfide, toluene, and methylcyclohexane) in concrete samples may have been used in shop areas for parts cleaning or other purposes. PAHs were also detected in the concrete. The concrete floor of the building was once covered with a wood parquet mat to provide a non-conductive surface. It is unknown if this material was treated with preservatives, which would have been common at the time of construction (creosote, containing a mix of PAHs). Such preservatives could have entrained themselves into the surface concrete over time, resulting in low concentrations of PAHs in the concrete samples.

Sediment

Sediment data from the RI indicate elevated concentrations of metals, PAHs, and PCBs at some sample locations along the shoreline and in the subtidal sediment. These are identified as the Stillwater Area to the north of the site, the northeast shoreline, which received waste discharges from Building 32 operations, and, to a lesser degree, the northwest shoreline, which also received waste discharges from Building 32 operations. In addition, trace levels of VOCs were found at the north and northeast shoreline.

PCB concentrations in sediments were noted to be highest in the Stillwater Area, north of the site. PCBs detected in the sediments and in the soil at the site include primarily Aroclor 1260. Aroclor 1260 was the

PCB mixture that was found in soil and concrete near Buildings 53, 54, 56, 59, 60, and 61. The distribution of PCBs in sediment samples indicates a gradient, with highest concentrations in the Stillwater Area and lower concentrations to the south. However, it is recognized that there are no available data north of Station SD-416; additional information from the northern sections of the Stillwater Area, and data north of that location may be necessary to determine the limits of contaminants to the north.

Metals and cyanide were found in sediment locations where outfalls once discharged to the subtidal shoreline. The elevated concentrations of heavy metals and cyanide present in the sediment near existing and historic outfalls can be traced back through pipeline transport from the electroplating rooms and dust storage shed, where high concentrations of heavy metals were found in soil samples. It is noted that cyanide was also found in the subtidal sediment sample near the former landfill at Gould Island (SD-311), indicating a second possible source of cyanide in the area.

PAHs in sediment may be a result of former use and release from general degreasing operations in the overhaul shop, or they may be a remnant of fuel piping and storage at Building 44. PAHs were found in sumps and vaults within the Building 32 foundation, and some of these sumps were previously noted to have floor drains that connected to the drains exiting to the northeast shoreline. PAHs present in sediments near outfall locations (SD-304 and SD-305) are likely a result of fuel-contaminated soil at the southwest corner of Building 32 that was transported to the shoreline through pipelines and sewer systems.

Clams and Mussels

Biota samples from stations ET-304 (clams) and ET-312 (mussels) show that in these areas where the highest concentrations of PCBs were found in the sediment, PCBs are being accumulated to some degree in the bivalve tissues. Traces of heavy metals (chromium and cadmium) were found in some tissue samples. Other contaminants do not appear to be particularly elevated in collected biota samples.

8.1.6 Fate and Transport

Section 5 of this report presents in detail the fate and transport processes that are likely to affect contaminants found at the site. The following is a summary of that information.

Disposal Routes

Contaminants appear to have been released to the sumps and equipment trenches in Building 32, as well as through drains and waste discharge systems at the site. For the most part, the building systems appear to have caught and routed the waste materials from the source locations to the sediments near the

shorelines of the site. These systems include floor drains, sump drains, sanitary systems, and stormwater drainage systems.

Three primary pathways of contaminant transport were identified: The first is the storm drainage system and “trench drain” that gathered groundwater and runoff from the roadway and storage areas (acid storage shed, dust collection building) outside the southwestern corner of Building 32, and discharged that water to the shoreline near the southeast corner of Building 32. The second contaminant transport pathway is a system of original sanitary and waste drains from lavatories and the electroplating room that appear to have gravity-drained wastes from the building to the shoreline to the east. The third pathway is the sanitary waste system upgrade constructed in 1956 and 1957. At that time, sewer system upgrades were installed to provide collection chambers and pumps to route sanitary waste to discharge at the northwest shoreline. The redirection of the waste flow was confirmed through this investigation, but the shoreline installation was either built differently from the design, or altered again at a later date. Investigations confirmed that wastes from the southwest lavatory were collected in a manhole (MH-01), and pumped to the northwest to a junction box and dry well constructed at the northwest shoreline. The dry well had a gravel bottom and appeared to be constructed to drain or filter to the ocean. Other systems appeared to be tied in to the dry well and others were crossing the pipelines. Further excavation during the RI activities would have damaged the shoreline extensively, and the excavation was halted after confirming the connection between this dry well and Building 32. A pipe connection was also found between one drain in the electroplating room and MH-01.

In addition, an overland release of PCBs to sediments appears to have occurred to the north of Building 32, near the former rigging platform. This is the former location of a PCB-contaminated soil removal action conducted in 1999-2002. PCBs have likely been transported overland with runoff, and deposited in sediments in this area.

Chemical Fate and Transport

Regarding VOCs, only very low concentrations of chlorinated solvents were detected at the site, and no breakdown products were detected. This indicates that very minor releases to the soil and groundwater have occurred at the site. Traces of fuel-related VOCs were also detected, although their concentrations indicate older releases that have degraded over time.

The much less soluble and less volatile PAHs are still present at high concentrations in the soils along the southwestern corner of Building 32, where petroleum was found. These contaminants may leach into the groundwater, but the low solubility and adsorptive properties of PAHs prevent this from occurring at a very high rate. Groundwater PAH concentrations are currently low and are anticipated to remain low. However, when test pits are excavated into petroleum/PAH-contaminated areas, PAHs and petroleum

contaminants bound within the soil may be liberated into standing shallow waters that collect in the excavations.

Cyanide was detected infrequently, and at trace concentrations (< 1 mg/kg), in surface and subsurface soils, and in intertidal and subtidal sediments. Cyanide was not detected in groundwater samples. Cyanide is not likely to remain as a site contaminant. However, because it is commonly associated with electroplating operations, the presence of cyanide in sediment samples could aid in tracking the migration of site-related contaminated sediments.

Pesticides, PCBs, and metals found in soils are non-volatile or relatively non-volatile compounds and are generally insoluble in water. Therefore, there is very limited leaching of these chemicals from soils into groundwater. However, through erosion and migration of contaminated soils, these compounds could be transported from soils to marine sediments, and could also migrate with sediment within the marine environment, particularly in disturbed or high energy areas at the shoreline.

The PCBs in subtidal sediments of the Stillwater area are likely to remain in this area until the physical properties of the shoreline change. The breakwater protecting this shoreline has deteriorated, and will continue to deteriorate unless repaired. Hydraulic forces that can mobilize these sediments will increase as this breakwater barrier further degrades. In addition, the rigging platform at the north shoreline has also partially collapsed, allowing soils behind the former sheet piling to erode and re-deposit as sediments in this area. Such erosion from the shoreline may initially cover the contaminated sediments and debris from the rigging platform, however, over time, continued erosion may re-expose these sediments, subjecting them to potential mobilization to other areas.

8.1.7 Human Health Risk Assessment

The baseline human health risk assessment (HHRA) provided in Section 6 evaluated exposures to surface soil, subsurface soil, groundwater, sediment, and shellfish (clams and mussels only). The following receptors were included:

- Current and future recreational visitors,
- Current and future trespassers,
- Current industrial workers,
- Future industrial workers,
- Future construction workers,
- Current and future subsistence fishermen, and
- Current and future recreational fishermen.

Current and future industrial workers are differentiated as follows: Current industrial receptors are presumed to be exposed to surface soil only. Future industrial receptors are anticipated to be exposed to surface and subsurface soil after site development, as well as to indoor air.

Surface soil and subsurface soil data were compared to EPA generic Soil Screening Levels for inhalation. Based on this comparison, the inhalation of fugitive dust was not evaluated further for receptors exposed to surface soils. This pathway was included in the evaluation of future industrial workers and construction workers exposed to subsurface soils.

Potential indoor air concerns for future industrial workers were evaluated through EPA's Vapor Intrusion Guidance. Based on this evaluation, the indoor air pathway was incomplete. There are currently no groundwater-drinking water supplies at the island, and no such future use is planned for groundwater at this location; therefore, there is no anticipated exposure via a potable water source.

Non-cancer risks estimated for adult recreational visitors, trespassers, and current industrial workers at the study area were below the non-cancer target risk level of 1.0.

The non-cancer risks to the current and future child recreational visitors, future industrial workers, future construction workers, and fishermen (both recreational and subsistence) were estimated to have a hazard index above the target of 1.0. These non-cancer risks are driven by specific contaminants, as follows:

- Current and future recreational exposure to children – exposure to chromium in intertidal sediments,
- Future industrial workers – exposure to cadmium in soil,
- Future construction workers – exposure to cadmium in subsurface soil, PAHs and PCBs in shallow groundwater, and
- Current and future shellfish ingestion (both recreational and subsistence fishing) by adults and children – exposure to PCBs and metals including arsenic and thallium.

A high non-cancer hazard index for the future construction worker exposed to shallow groundwater in test pits or trenches was calculated for the reasonable maximum exposure (RME), largely because of the presumption that naphthalene, 2-methylnapthalene, fluoranthene, and Aroclor 1260 in the shallow groundwater will be available for inhalation by the worker within the trench. For this scenario, maximum shallow groundwater concentrations from test pit samples were used.

The cancer risks estimated for the recreational visitors and trespassers exposed to surface soils and intertidal sediments, current industrial workers exposed to surface soil, future industrial workers exposed

to subsurface soils, as well as recreational fisherman consuming clams and mussels from the site, were within or below the EPA cancer risk target range of 1E-4 to 1E-6.

The cancer risks to the future construction workers were estimated to be above the EPA cancer risk target range of 1E-4 to 1E-6. These unacceptable risks are driven by exposure to cadmium and chromium in subsurface soil (dust), and PAHs, PCBs, pesticides, and pentachlorophenol in shallow groundwater.

The high cancer risk for the future construction workers exposed to shallow groundwater (test pits) is the result of ingestion and dermal contact with PAHs and pentachlorophenol in groundwater, and inhalation of PAHs, Aroclor 1260, gamma-BHC, and heptachlor epoxide in trench air.

In addition, cancer risks to persons ingesting shellfish on a subsistence level (current and future) as defined in this report are estimated to be above the EPA cancer risk target level of 1E-4 to 1E-6. These unacceptable risks are driven by exposure to PCBs, arsenic, beta-BHC, and PAHs. Cancer risks to persons ingesting shellfish on a recreational level as defined in this report are within the EPA cancer risk target level of 1E-4 to 1E-6.

Exposure to lead, measured through blood lead models for worker exposures, was found to be below EPA's level of concern.

8.1.8 Ecological Risk Assessment

The ecological risk assessment (ERA) was performed to evaluate ecological risks to the terrestrial and marine receptors exposed to contaminants associated with the site. This assessment was a "screening" assessment, to determine contaminants of potential ecological concern, and to assist in determining whether a baseline ecological risk assessment should be conducted.

For terrestrial exposures, no COPCs were retained for further evaluation in a Baseline Ecological Risk Assessment based on ecological receptors exposure to constituents in surface soil samples collected.

For the marine exposures, PAHs, pesticides, PCBs, and several metals (antimony, cadmium, chromium, lead, manganese, and selenium) were determined to be COPCs that may pose risks of adverse effects to marine organisms at one or more of the marine sediment locations at the site. In addition, 4-methylphenol, phenol, carbazole, and dibenzofuran were all retained as COPCs.

Based on the concentrations of these constituents, additional evaluation of the marine sediments through performance of a Baseline Ecological Risk Assessment (BERA) is warranted.

8.2 CONCEPTUAL SITE MODEL

Using the information provided in this report, a conceptual site model has been developed to better summarize the understandings of the site conditions and the risks that the site poses.

The conceptual model for this site was developed in the work plan around three two-dimensional views of the site and its surrounding landforms. These figures, provided as Figures 8-2A and 8-2B, formulate the first tier conceptual site model. Figure 8-2A presents a plan view of the island and its surrounding influences, and Figure 8-2B presents cross-sectional views. These views show scale height and subtidal slopes of the island. These figures illustrate, on the simplest level, contaminant inputs to the environment at the site, based on data collected.

The second-tier conceptual site model diagram is presented on Figure 8-3. This is a schematic diagram that illustrates the general movement of contaminants based on the mechanical systems and physical properties found at the site. Specific sources, flow paths, and discharge areas are identified within the diagram for reference.

Pertinent information specific to the chemical constituents found and the predicted risks they pose to the different receptors is presented on Tables 8-1 through 8-5. These tables provide the third tier (fate and transport of contaminants) and fourth tier (predicted risks) conceptual site model. Predicted human health risks and risk drivers are presented for each media on Table 8-6, to complete the portion of the fourth tier conceptual site model for the human receptors. Similar detail for ecological risk is not currently available since the baseline ecological risk assessment is not complete at this point.

8.3 DATA LIMITATIONS AND UNCERTAINTIES

This section identifies site characterization data limitations and risk assessment uncertainties associated with the Site 17 RI.

8.3.1 Site Characterization Data Limitations

Site characterization data limitations and uncertainties for the site are discussed below. Although the soil and sediment sample data sets are considered representative of the site conditions, a review of the sample data and the distribution of sample locations indicates potential data limitations exist.

Soil and Groundwater

Although samples were collected across the site, the horizontal distribution of sample locations is not completely uniform. For example, because the investigation focused on the locations of former activities at the site, some specific efforts focused on the southwest corner of Building 32 and the discharge areas to the shoreline. The collection of samples focused in areas associated with disposal locations tends to bias the sample database and hence, receptor risks, to represent areas of higher contamination. The activity patterns of trespassers and recreational visitors at the site would vary from event to event and would result in an integrated exposure to soil locations that is essentially averaged over a larger portion of the site, rather than an exposure to specific selected locations. Hence, the impact of focused sampling tends to bias risks high, in favor of areas of contamination, while long-term receptors would actually incur a lesser degree of exposure as a result of frequenting other, less impacted areas of the site.

Elevated concentrations of arsenic have previously been identified on Aquidneck Island, approximately 1.5 miles east of the site. Arsenic concentrations in soil are part of the focus of a background soil investigation, under way as of the publication date of this report.

No site-specific background study was conducted, so background comparison tests were limited to the available upgradient soil and groundwater sample data.

The overall soil sampling distribution, while it included a focused, non-random sampling strategy, extensively characterized the site and is unlikely to have missed any significant hot spots within the study area.

Groundwater samples were limited to the positions designated in the work plan phase of the investigation. Bedrock groundwater samples were not collected at the southwest corner of Building 32, as additional borings designated as “potential” in the work plan phase were replaced with test pit excavations, at the request of RIDEM. Some bedrock groundwater information may be useful in the area of the former electroplating room and immediately downgradient.

Sediment and Biota

Sediment contaminant concentrations were compared to reference concentrations measured at sample stations on the shoreline of Jamestown Island and Castle Hill Cove. Although a detailed statistical background evaluation was not conducted between the site data sets and reference data set, a clear signature of elevated concentrations of metals and PCBs was noted in locations that received waste discharges and overland releases from the site.

The sample distribution was good on the east and west sides of the site, showing a limited extent of contamination near the discharge areas. The sample group in the north portion of the site (Stillwater area) was limited. The extent of contamination in this area is not defined.

Indications are that the PCBs found in depositional sediments at the south end of Gould Island are similar in nature to those found at the site. However, some of these PCBs could have been released from structures or activities elsewhere on the island or elsewhere in Narragansett Bay, and their association with Building 32 is not absolute.

There are uncertainties associated with some contaminants detected in shellfish tissue, particularly metals, as there is limited reference data available for shellfish to segregate site-related contaminants from some anthropogenic contaminants. Some PAHs and metals are reported at similar concentrations in blue mussels, at reference stations monitored by NOAA over the period of 1987 through 2003. However, based on site data from this RI, a correlation of elevated concentrations of PCBs in sediments and in associated shellfish samples (one clam sample and one mussel sample) is indicated at the northeast shoreline and stillwater area.

8.3.2 Risk Characterization Uncertainties

At this site, the distribution of sampling locations in some media of interest affects whether the data set is considered representative of potential site conditions for exposed receptors, and thus impacts the uncertainty for risk estimation. Significant uncertainties associated with the HHRA and the screening level ERA are discussed in detail in their respective sections.

The subsistence exposure for shellfish ingestion was used for the RME risk estimate (180 meals per year), and the recreational exposure was used for CTE risk estimate (20 meals per year). It should be noted that the subsistence fishing scenario is not known to currently exist and is unlikely in the future because of the unrealistic assumption that 180 meals per year would be obtained from waters adjacent to Site 17. To do so would require either year-round habitation at Gould Island, or travel to this location by boat, ignoring all other shellfishing areas in favor of this single location. In addition, some of the contaminants supporting this risk are found in mussels at similar concentrations at Rhode Island reference stations monitored by NOAA.

In addition, arsenic is present in fish and shellfish tissue in an organic form of arsenobetanine, which is non-toxic. The risk calculations are performed based on the assumption that detected arsenic is present as inorganic arsenic. Since 80 to 90 percent of the arsenic in seafood is in the organic form, the risk values for seafood ingestion from this site are biased high, and could be overestimated by as much as a factor of 10 (FDA 1993).

Uncertainties of the ecological risk characterization will be evaluated in further detail as a part of the Baseline Ecological Risk Assessment.

8.4 CONCLUSIONS

Based on the RI findings, conclusions for the media of interest at the site are as follows:

Soil

Elevated concentrations of soil contaminants are present within vaults and sumps in the foundation of former Building 32. These soils are confined, and can be easily obtained through excavation. In addition, apparent “hot spots” of metals and petroleum in soil are present in the southwest corner of Building 32, near the former locations of the dust collection storage building and acid storage shed. Although the area is limited in extent, the source of the petroleum in this area is unknown at this time, and additional focused investigations may be necessary to accurately quantify the affected area.

Residual contaminants may also be present in underground utilities present at the site, including the sewer systems, the trench drain, and other drainage systems under and around Building 32.

There is a predicted elevated risk to the current industrial worker, as the result of the presence of PAHs and arsenic in surface soil at the site. There is a predicted unacceptable risk to future industrial workers and future construction workers, caused by PAHs and metals in subsurface soil. PAHs and metals in surface soil also may affect ecological receptors, although this cannot be quantified without a baseline ecological risk assessment.

Groundwater

The groundwater beneath Gould Island is classified as GA, indicating that it should be suitable for use as a current or potential source of drinking water, as described in the RIDEM Rules and Regulations for Groundwater Quality. Overall, groundwater contaminant levels do not exceed the RIDEM GA Groundwater Objectives and federal MCLs, with the exception of two contaminants, pentachlorophenol and tetrachloroethene, both found in the shallow overburden groundwater at low concentrations, although exceeding the GA Groundwater objectives and MCLs. Based on the estimated local hydraulic gradient of the shallow overburden aquifer, it is likely that these contaminants are moving toward the northeast shoreline with groundwater flow. As the contaminants move with groundwater to the northeast, they will discharge to the bay, and be lost through dilution upon discharge to the surface water.

Trichloroethene (TCE) was detected at trace concentrations in soil samples collected from the southwest corner of Building 32. There are currently no groundwater monitoring wells in this area to evaluate potential concentrations of TCE in the bedrock aquifer, and this may be considered a data gap.

There are no known current groundwater exposure pathways that are predicted to pose a risk to human receptors. There are currently no groundwater drinking water supplies at the island, and no such future use is planned for groundwater at this location; therefore, there is no anticipated exposure via a potable water source. Potential future exposures to volatiles in groundwater through vapor intrusion into indoor air spaces were eliminated as a complete exposure pathway. Human health risks from groundwater are limited to future construction workers digging within the water table; these risks are driven by PAHs, PCBs, and pentachlorophenol. Although there is no risk measured from these contaminants, the presence of pentachlorophenol and tetrachloroethene in groundwater at concentrations above the MCLs provides merit for groundwater remedial actions to be evaluated in a Feasibility Study.

Sediment

PCBs, PAHs, and metals are present in the intertidal and subtidal sediments, and are predicted to pose risks to ecological receptors (benthic invertebrates and shellfish). A baseline ecological risk assessment is necessary to quantify actual risks to ecological receptors from the sediments near the site.

Chromium is present in the intertidal sediment and is predicted to pose a human health risk from future recreational use of the site by children. There are no known current exposure pathways that are predicted to pose elevated risk to human receptors.

The unstable shoreline and deteriorated structures to the north of the site pose the possibility of future disturbance and mobilization of contaminated sediments.

Shellfish

PCBs were found in clams and mussels at two sample stations. Concentrations measured were below FDA standards for food sources. However, application of recreational and subsistence fishing ingestion scenarios suggests a possible risk of health effects to these receptors, repeatedly eating shellfish collected from this area. These risks are driven by PCBs, PAHs, arsenic, and thallium found in shellfish samples collected.

8.5 RECOMMENDATIONS

Based on the data collected as described in this report, it is recommended that a Phase 2 Remedial Investigation (Phase 2 RI) be performed prior to proceeding to the Feasibility Study Phase. The Phase 2 RI will include additional data collected to close data gaps identified (above) and to conduct a Baseline Ecological Risk Assessment (BERA).

The BERA consists of steps 3 through 8 of the Ecological Risk Assessment Guidance for Superfund. For marine sediment, PAHs, PCBs, and several metals (antimony, cadmium, chromium, lead, manganese, and selenium) were determined to be COPCs and may pose risk of effects to marine organisms at one or more of the sediment locations at the site. The purpose of the BERA is to quantify these possible risks through testing of marine sediment from the site for toxicity to sediment invertebrates in a laboratory setting. From the BERA results, preliminary remediation goals (PRGs) can be calculated that will be protective of marine organisms.

Data gaps identified include the extent of fuel contamination at the southwest corner of Building 32, and the extent of PCB contamination in sediments in the Stillwater Basin Area to the north of the site. The source of the fuel contamination has not been identified, and may have originated to the west (upgradient) of the fence line, or may have originated within Building 32 itself. Additional limited testing in this area will resolve the potential source, and the aerial extent of the fuel contamination. The characterization of sediments in the Stillwater Basin Area is based on only two sediment sample stations. This is a depositional area and both vertical and horizontal extent of contamination should be characterized.

Following completion of the Phase 2 RI, the site should move forward to a Feasibility Study Phase (FS), following which a Proposed Remedial Action Plan (PRAP) and Record of Decision (ROD) can be prepared.

TABLES

TABLE 2-1

SAMPLING FREQUENCY AND DEPTH OF SOIL BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Location	Sample Frequency	Revised Target Depth	Comments (1)	Depth to Bedrock*	Total Depth of Boring*
MW300B	Continuous	30 feet into BR	Completed in accordance with the Work Plan	54	84
MW300S	See 300B	OB well screen	Completed in accordance with the Work Plan	NA	15
MW301B	Continuous	30 feet into BR	Completed in accordance with the Work Plan	34	67
MW301S	See 301B	OB well screen	Completed in accordance with the Work Plan	NA	30.5
MW302B	5 foot intervals	30 feet into BR	In roadway	50	84
MW302S	See 302B	OB well screen	In roadway	NA	24.5
MW303B	Continuous	30 feet into BR	Shallow bedrock	13	49
MW304B	Continuous	30 feet into BR	Completed in accordance with the Work Plan	84	120
MW304S	See 304B	OB well screen	Completed in accordance with the Work Plan	NA	15
MW305B	Continuous	30 feet into BR	Completed in accordance with the Work Plan	62	95
MW305S	See 305B	OB well screen	Completed in accordance with the Work Plan	NA	14.3
MW306B	10 foot intervals	30 feet into BR	NE of Building 44 area	60	94
SBs:					
307	NA	NA	Originally Scoped as TBD location, replaced with test pits	NA	NA
308	NA	NA	Originally Scoped as TBD location, replaced with test pits	NA	NA
309	Continuous	4 feet into till	Target possible TCE area	NA	46
310	5 foot intervals	Bedrock	Target possible TCE area, to BR	75	77
311	Continuous	4 feet into till	Target possible TCE Under slab	NA	21
312	5 foot intervals	Bedrock	Target possible TCE Under slab, continue to bedrock	43	43
313	Continuous	4 feet into till	Target possible PAHs/metals under trench	NA	14
314	5 foot intervals	Bedrock	Target possible TCE Under slab	47	49
315	Continuous	Bedrock	Target possible TCE Under slab	26	30
316	Continuous	Bedrock	Determine possible drain line leakage	14	16
317	5 foot intervals	Bedrock	Under parts washer to top of BR	20	22
318	5 foot intervals	Bedrock	Under parts washer to top of BR	12	12
319	Continuous	Bedrock	Determine possible drain line leakage	8	10
320	Continuous	Bedrock	Determine possible drain line leakage	9	10
321	Continuous	Bedrock	Electroplating Room and Drain, to BR	12	14
322	Continuous	Bedrock	Electroplating Room and Drain, to BR	10	12
323	Continuous	Bedrock	Electroplating Room and Drain, to drain depth	13	14
324	Continuous	Bedrock	Electroplating Room and Drain, to drain depth	9	10
325	Continuous	Bedrock	Electroplating Room and Drain, to drain depth	8	11
326	Continuous	Bedrock	Electroplating Room and Drain, to BR	8	11
327	Continuous	Bedrock	Electroplating Room and Drain, to drain depth	9	11
328	Continuous	Bedrock	Electroplating Room and Drain, to BR	10	10
329	NA	NA	Originally Scoped as TBD location, replaced with test pits	NA	NA
330	NA	NA	Originally Scoped as TBD location, replaced with test pits	NA	NA
331	5 foot intervals	Bedrock	Mixing tank, to BR	57	59
332	Continuous	Bedrock	To top of till	7	10
333	Continuous	Bedrock	Electroplating Room sump under sandblast booth, to BR	14	16
334	Continuous	Bedrock	Under equipment trench to top of till	11	12
335	5 foot intervals	Bedrock	Target possible PAHs/metals under trench	36	37
336	Continuous	4 feet into till	Hydro Test Tank area	NA	14
337	Continuous	Bedrock	Near Building 57 (Dust Collector)	13	14
338	Continuous	Bedrock	Near Building 57 (Dust Collector)	15	16
339	NA	NA	Originally Scoped as TBD location, replaced with test pits	NA	NA

Shaded cells indicate change from Work Plan.
* Depths are measured as feet below ground surface.
(1) - For target areas, refer to Figure 2-1

NA	Not Applicable.
BR	Bedrock
OB	Overburden
TBD	To Be Determined.

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB300	0 – 2	0		G32-SB300B-0002	6/1/05	0907
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	0		G32-SB300B-0608	6/1/05	1031
	8 – 10	0		NA		
	10 – 12	0		NA		
	12 – 14	0		NA		
	14 – 16	0		NA		
	16 – 18	0		NA		
	18 – 20	0		NA		
	20 – 22	0		NA		
	22 – 24	0		NA		
	24 – 26	0		NA		
	26 – 28	0		NA		
	28 – 30	0		NA		
	30 – 32	0		NA		
	32 – 34	0		NA		
	34 – 36	0		NA		
	36 – 38	0		NA		
	38 – 40	0		NA		
	40 – 42	0		NA		
	42 – 44	0		NA		
	44 – 46	0		NA		
	46 – 48	0		NA		
	48 – 50	0		NA		
	50 – 52	0		NA		
	52 – 54			NA		
	54 – 56			NA - Bedrock		
	56 – 58			NA – Bedrock (C-1)		
	58 – 60			NA – Bedrock		
	60 – 62			NA – Bedrock (C-2)		
	62 - 64			NA - Bedrock		
	64 – 66			NA – Bedrock (C-3)		
	66 – 68			NA - Bedrock		
	68 – 70			NA – Bedrock (C-4)		
	70 – 72			NA - Bedrock		
	72 – 74			NA – Bedrock (C-5)		
	74 - 76			NA - Bedrock		
	76 – 78			NA – Bedrock		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB300 (cont.)	78 – 80			NA – Bedrock (C-6)		
	80 – 82			NA – Bedrock		
	82 – 84			NA – Bedrock (C-7)		
SB301	0 – 2	0		G32-SB301B-0002	7/13/05	0752
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	6.3		G32-SB301B-1012	7/13/05	0904
	12 – 14	0		NA		
	14 – 16	0		NA		
	16 – 18	0		NA		
	18 – 20	2.3		NA		
	20 – 22	0		NA		
	22 – 24	0		NA		
	24 – 26	0		NA		
	26 – 28	0		NA		
	28 – 30	0		NA		
	30 – 32	0		NA		
	32 – 34	0		NA		
	34 – 36	0		NA		
	36 – 38			NA – Bedrock		
	38 – 40			NA – Bedrock (C-1)		
	40 – 42			NA – Bedrock		
	42 – 44			NA – Bedrock		
	44 – 46			NA – Bedrock (C-2)		
	46 – 48			NA – Bedrock		
	48 – 50			NA – Bedrock (C-3)		
	50 – 52			NA – Bedrock		
	52 – 54			NA – Bedrock		
	54 – 56			NA – Bedrock (C-4)		
	56 – 58			NA – Bedrock		
	58 – 60			NA – Bedrock (C-5)		
	60 – 62			NA – Bedrock		
	62 – 64			NA – Bedrock		
	64 – 66			NA – Bedrock (C-6)		
	66 – 67			NA – Bedrock		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB302	0 – 2	0		G32-SB302B-0002	7/5/05	0955
	5 – 7	12		G32-SB302B-0507	7/5/05	1039
	10 – 12	0		NA		
	14 – 16	0		NA		
	20 – 22	122		NA		
	25 – 27	0.6		G32-SB302B-2527	7/5/05	1154
	30 – 32	0		NA		
	35 – 37	0		NA		
	40 – 42	0		NA		
	45 – 47	0		NA		
	50 – 52	0		NA		
	54 – 56			NA - Bedrock		
	56 – 58			NA - Bedrock (C-1)		
	58 – 60			NA - Bedrock		
	60 – 62			NA - Bedrock (C-2)		
	62 – 64			NA - Bedrock		
	64 – 66			NA - Bedrock (C-3)		
	66 – 68			NA - Bedrock		
	68 – 70			NA - Bedrock		
	70 – 72			NA - Bedrock (C-4)		
	72 – 74			NA - Bedrock		
	74 - 76			NA - Bedrock (C-5)		
	76 – 78			NA - Bedrock		
	78 – 80			NA - Bedrock		
	80 – 82			NA - Bedrock (C-6)		
	82 – 84			NA - Bedrock (C-7)		
SB303	0 – 2	0		G32-SB303B-0002	7/11/05	1044
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		G32-SB303B-1012	7/11/05	1240
	12 – 14	0		NA		
	14 – 16	0		NA		
	18 – 20			NA - Bedrock		
	20 – 22			NA - Bedrock (C-1)		
	22 – 24			NA - Bedrock		
	24 – 26			NA - Bedrock (C-2)		
	26 – 28			NA - Bedrock		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB303 (cont.)	28 – 30			NA - Bedrock		
	30 – 32			NA - Bedrock (C-3)		
	32 – 34			NA - Bedrock		
	34 – 36			NA - Bedrock (C-4)		
	36 – 38			NA - Bedrock		
	38 – 40			NA - Bedrock (C-5)		
	40 – 42			NA - Bedrock		
	42 – 44			NA - Bedrock		
	44 – 46			NA - Bedrock (C-6)		
	46 – 48			NA - Bedrock		
	48 – 49			NA - Bedrock		
SB304	0 – 2	0		G32-SB304B-0002	6/1/05	0913
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	176	Fuel Odor	G32-SB304B-0608	6/1/05	1042
	8 – 10	0		NA		
	10 – 12	0		NA		
	12 – 14	0		NA		
	14 – 16	0		NA		
	16 – 18	0		NA		
	18 – 20	0		NA		
	20 – 22	0		NA		
	22 – 24	0		NA		
	24 – 26	0		NA		
	26 – 28	0		NA		
	28 – 30	0		NA		
	30 – 32	0		NA		
	32 – 34	0		NA		
	34 – 36	0		NA		
	36 – 38	0		NA		
	38 – 40	0		NA		
	40 – 42	0		NA		
	42 – 44	0		NA		
	44 – 46	0		NA		
	46 – 48	0		NA		
	48 – 50	0		NA		
	50 – 52	0		NA		
	52 – 54	0		NA		
	54 – 56	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB304 cont.	56 – 58	0		NA		
	58 – 60	0		NA		
	60 – 62	0		NA		
	62 – 64	0		NA		
	64 – 66	0		NA		
	66 – 68	0		NA		
	68 – 70	0		NA		
	70 – 72	0		NA		
	72 – 74	0		NA		
	74 - 76	0		NA		
	76 – 78	0		NA		
	78 – 80	0		NA		
	80 – 82	6.3		NA		
	82 – 84	0		NA		
	84 – 86	0		NA		
	86 – 88	0		NA		
	88 – 90	0		NA		
	90 – 92			NA - Bedrock		
	92 – 94			NA – Bedrock (C-1)		
	94 – 96			NA – Bedrock		
	96 – 98			NA – Bedrock (C-2)		
	98 – 100			NA – Bedrock		
	100 – 102			NA – Bedrock		
	102 – 104			NA – Bedrock (C-3)		
	104 – 106			NA – Bedrock		
	106 – 108			NA – Bedrock (C-4)		
	108 – 110			NA – Bedrock		
	110 – 112			NA – Bedrock		
	112 – 114			NA – Bedrock (C-5)		
	114 – 116			NA – Bedrock		
	116 – 118			NA – Bedrock (C-6)		
	118 – 120			NA - Bedrock		
SB305	0 – 1			Concrete & gravel		
	1 – 3	0		NA		
	3 – 5	0		G32-SB305B-0305	6/8/05	1512
	5 – 7	0		NA		
	7 – 9	0		NA		
	9 - 11	6.7		G32-SB305B-0911	6/9/05	0755
	11 – 13	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB305 (cont.)	13 – 15	0		NA		
	15 – 17	0		NA		
	17 – 19	0		NA		
	19 – 21	0		NA		
	21 – 23	0		NA		
	23 – 25	0		NA		
	25 – 27	0		NA		
	27 – 29	0		NA		
	29 – 31	1.6		NA		
	31 – 33	0.6		NA		
	33 – 35	0		NA		
	36 – 38	2.5		NA		
	38 - 40	0		NA		
	40 – 41			NA		
	41 – 43	0		NA		
	43 – 45	0		NA		
	45 – 46			NA		
	46 – 48			NA		
	48 – 50	0		NA		
	50 – 52	0		NA		
	52 – 54			NA		
	54 – 56	0		NA		
	56 – 58	1.5		NA		
	58 – 63			NA - Bedrock		
	63 – 65			NA - Bedrock		
	65 – 67			NA – Bedrock (C-1)		
	67 – 69			NA – Bedrock		
	69 – 71			NA – Bedrock		
	71 – 73			NA – Bedrock (C-2)		
	73 – 75			NA – Bedrock		
	75 – 77			NA – Bedrock		
	77 – 79			NA – Bedrock (C-3)		
	79 – 81			NA – Bedrock (C-4)		
	81 – 83			NA – Bedrock (C-5)		
	83 – 85			NA – Bedrock		
	85 – 87			NA – Bedrock		
	87 – 89			NA – Bedrock (C-6)		
	89 – 91			NA – Bedrock		
	91 – 93			NA – Bedrock (C-7)		
	93 – 95			End of boring		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB306	0 - 2			NA		
	10 – 12	2.4		G32-SB306B-1012	6/23/05	1400
	20 - 22	0		NA		
	30 – 32	0		NA		
	40 - 42	0		NA		
	50 - 52	0		G32-SB306B-5052	6/24/05	1144
	60 - 62	0		NA - Bedrock		
	62 – 64			NA - Bedrock		
	64 – 66			NA - Bedrock		
	66 – 68			NA - Bedrock (C-1)		
	68 – 70			NA - Bedrock		
	70 – 72			NA - Bedrock (C-2)		
	72 – 74			NA – Bedrock		
	74 - 76			NA - Bedrock (C-3)		
	76 – 78			NA – Bedrock		
	78 – 80			NA - Bedrock (C-4)		
	80 – 82			NA - Bedrock (C-5)		
	82 – 84			NA – Bedrock		
	84 – 86			NA - Bedrock (C-6)		
	86 – 88			NA – Bedrock		
	88 – 90			NA – Bedrock		
	90 – 92			NA - Bedrock (C-7)		
	92 – 94			NA - End of boring (C-8)		
SB309	0 – 2	0		G32-SB309-0002	7/12/05	0737
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		NA		
	12 – 14	0		NA		
	14 – 16	0		NA		
	16 – 18	0		NA		
	18 – 20	0		NA		
	20 – 22	0		NA		
	22 – 24	0		NA		
	24 – 26	0		NA		
	26 – 28	0		NA		
	28 – 30	0		NA		
	30 – 32	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB309 (cont.)	32 – 34	0		NA		
	34 – 36	0		NA		
	36 – 38	0		NA		
	38 – 40	0		G32-SB309-3840	7/12/05	1141
	40 – 42	0		NA		
	42 – 44	0		NA		
	44 – 46	0		NA		
	46 – 48	0		End of boring		
SB310	0 – 2	0		G32-SB310-0002	7/12/05	1523
	5 – 7	0		NA		
	10 – 12	0.4		NA		
	15 – 17	4.2		NA		
	20 – 22	4.1		NA		
	25 – 27	0.2		NA		
	30 – 32	0		NA		
	35 – 37	0		NA		
	40 – 42	0		G32-SB310-4042	7/13/05	0954
	45 – 47	0		NA		
	50 – 52			NA		
	55 – 57			NA		
	60 – 62	0		NA		
	65 – 67	0		NA		
	70 – 72	0.2		NA		
	75 – 77			End of boring		
SB311	0 - 1			Concrete/gravel		
	1 – 3	0		G32-SB311-0103	6/29/05	1048
	3 – 5	0		NA		
	5 – 7	0		NA		
	7 – 9	0		NA		
	9 - 11	0		NA		
	11 – 13	0		NA		
	13 – 15	0		NA		
	15 – 17	0		NA		
	17 – 19	0		G32-SB311-1719	6/29/05	1302
	19 – 21	0		NA		
SB312	0 – 1			Concrete/gravel		
	1 – 3	0		G32-SB312-0103	6/29/05	1436
	6 – 8	0		NA		
	11 – 13	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB312 (cont.)	16 – 18	0		NA		
	21 – 23	0		NA		
	26 – 28	0		NA		
	31 – 33	0		NA		
	36 – 38	0		G32-SB312-3638	6/30/05	1402
	41 – 43			Bedrock/End Of Boring		
SB313	0 – 2	0		G32-SB313-0002	7/5/05	0804
	2 – 4	0		NA		
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		G32-SB313-1012	7/5/05	0926
	12 – 14	0		End of boring		
SB314	0 - 2			Concrete/Gravel		
	2 – 4	0		G32-SB314-0204	7/8/05	0839
	7 – 9	0		NA		
	12 – 14	0		NA		
	17 – 19	0		G32-SB314-1719	7/8/05	0931
	22 – 24	0		NA		
	27 – 29	0		NA		
	32 – 34	0		NA		
	37 – 39			NA		
	42 – 44	0		NA		
	47 – 49			End of boring		
SB315	0 – 2	0		Concrete		
	2 – 4	0		G32-SB315-0204	6/15/05	1153
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		G32-SB315-0810	6/15/05	1330
	10 – 12	0		NA		
	12 – 14	0		NA		
	14 – 16	0		NA		
	16 – 18	0		NA		
	18 – 20	0		NA		
	20 – 22	0		NA		
	25 – 27	0		NA		
	28 – 30	0		End of boring		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB316	0 – 2			Concrete and gravel		
	2 – 4	0		G32-SB316-0203	6/22/05	1136
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		NA		
	12 – 14	0		G32-SB316-1214	6/22/05	1218
	14 - 16	0		End of boring		
SB317	0 – 2	0		G32-SB317-0002	6/22/05	1335
	5 – 7	118.5	Solvent Odor	NA		
	10 – 12	0		NA		
	15 – 17	0		G32-SB317-1517	6/22/05	1446
	20 - 22			End of boring		
SB318	0 – 2	0		G32-SB318-0002	6/21/05	1401
	5 – 7	7.2		NA		
	10 – 12	0		G32-SB318-1012 – End of boring	6/21/05	1444
SB319	0 – 2			Concrete and gravel		
	2 – 4			NA		
	4 – 6	0		G32-SB319-0406	6/22/05	0824
	6 – 8			G32-SB319-0608	6/22/05	0840
	8 – 10			Bedrock- End of boring		
SB320	0 – 2			Concrete and gravel		
	2 – 4			NA		
	4 – 6	0		G32-SB320-0406	6/21/05	1223
	6 – 8	0		NA		
	8 – 10	0		G32-SB320-0810	6/21/05	1250
SB321	0 - 2			Concrete and gravel		
	2 – 4	0		G32-SB321-0204	6/23/05	0837
	4 – 6	0		NA		
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		G32-SB321-1012	6/23/05	0927
	12 - 14			Bedrock – End of boring		
SB322	0 - 2			Concrete and gravel		
	2 – 4	0		G32-SB322-0204	6/20/05	1330
	4 – 6	9.6		NA		
	6 – 8	0.6		G32-SB322-0608	6/20/05	1357
	8 – 10	0		NA		
	10 – 12			End of boring		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB323	0 - 2			Concrete and gravel		
	2 – 4	0		G32-SB323-0204	6/21/05	0811
	4 – 6	0		NA		
	6 – 8	6.1		NA		
	8 – 10	0		NA		
	10 – 12	1.9		G32-SB323-1012	6/21/05	0858
	12 – 14	0		End of boring		
SB324	0 - 2			Concrete and gravel		
	2 – 4	0		G32-SB324-0204	6/20/05	0930
	4 – 6	1.0		NA		
	6 – 8	3.6		NA		
	8 – 10	0		G32-SB324-0810	6/20/05	1037
SB325	0 – 1			NA		
	1 – 3	2.6		NA		
	3 – 5	0		G32-SB325-0305	6/17/05	0803
	5 – 7	0.5		NA		
	7 – 9	0		G32-SB325-0709	6/17/05	0843
	9 - 11			End of boring		
SB326	0 – 2			Concrete		
	2 – 4	0		NA		
	4 – 6	0		G32-SB326-0406	6/15/05	0902
	6 – 8	0		G32-SB326-0608	6/15/05	0926
	8 - 10	0		End of boring		
SB327	0 – 1			NA - Concrete and gravel		
	1 – 3	0		G32-SB327-0103	6/16/05	0925
	3 – 5	0		NA		
	5 – 7	3.2		NA		
	7 – 9			G32-SB327-0709	6/16/05	1010
	9 - 11			NA - End of boring		
SB328	0 – 2			NA - Concrete and gravel		
	2 – 4			NA		
	4 – 6			G32-SB328-0406	6/21/05	1041
	6 – 8			NA		
	8 – 10			G32-SB328-0810	6/21/05	1111
SB331	0 – 2			NA – Concrete and gravel		
	2 – 4	0		G32-SB331-0204	6/24/05	1538
	7 – 9	0		NA		
	12 – 14	0		NA		
	17 – 19	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB331 (cont.)	22 – 24	0		NA		
	27 – 29	0		NA		
	32 – 34	0		NA		
	37 – 39	0		NA		
	42 – 44	0		NA		
	47 – 49	0		NA		
	52 – 54	0		G32-SB331-5254	6/27/05	1455
	57 – 59			NA – Bedrock – End of boring		
SB332	0 – 2	0.1		G32-SB332-0002	7/14/05	1409
	2 – 4	0.1		NA		
	4 – 6	0.1		G32-SB332-0406	7/14/05	1423
	6 – 8	0.1		NA		
	8 - 10			NA - End of boring		
SB333	0 – 2	0		NA		
	2 – 4			NA		
	4 – 6	232	Solvent odor	G32-SB333-0406	6/23/05	1037
	6 – 8	0		NA		
	8 – 10	0		NA		
	10 – 12	0		NA		
	12 – 14	0		G32-SB333-1214	6/23/05	1134
	14 - 16			NA – Bedrock – End of boring		
SB334	0 – 2	0		G32-SB334-0002	6/22/05	0929
	2 – 4	0		NA		
	4 – 6			NA		
	6 – 8			G32-SB334-0608	6/22/05	1021
	8 – 10			NA		
	10 - 12			NA – End of boring		
SB335	0 – 2	0		G32-SB335-0002	7/5/05	1032
	5 – 7	0				
	10 – 12	0		G32-SB335-1012	7/5/05	1112
	15 – 17	0		NA		
	20 – 22	0		NA		
	30 – 32	0		NA		
	35 - 37			End of boring		
SB336	0 – 2	8.6	Tar odor	G32-SB336-0002	7/6/05	1437
	2 – 4	0		NA		
	4 – 6	2.0		NA		
	6 – 8	13.3		G32-SB336-0608	7/6/05	1118
	8 – 10	10.3		NA		
	10 – 12	0		NA		

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
SB336 cont.	12 – 14	0		End of boring		
SB337	0 – 2	2.5		G32-SB337-0002	7/14/05	1115
	2 – 4	0.8		NA		
	4 – 6	0.4		NA		
	6 – 8	0.3		NA		
	8 – 10	0.1		NA		
	10 – 12	0		G32-SB337-1012	7/14/05	1254
	12 - 14			NA – End of boring		
SB338	0 – 2	9.1		G32-SB338-0002	7/14/05	0910
	2 – 4	0		NA		
	4 – 6	0.3		NA		
	6 – 8	0.2		NA		
	8 – 10	0		NA		
	10 – 12	0		G32-SB338-1012	7/14/05	1001
	12 – 14	0		NA		
	14 - 16			NA		
Test Pit 1	0-6	0		NA		
	6-7	0		G32-SO-TP01-01-0007	6/2/05	1400
Test Pit 2	0-6	0		G32-SO-TP02-01-0006	6/2/06	0900
	6-7	4.1	Oily residue in pipe from MH-01	G32-SO-TP02-02-0007	6/2/05	1450
Test Pit 3	0-6	0		NA		
	6-7	34		G32-SO-TP03-01-0007	6/2/05	1400
Test Pit 4	0-2	0		NA		
	2-6	0		G32-SO-TP04-01	7/22/05	0850
Test Pit 5	0-10	0	Several discharge pipes in this area	G32-SO-TP05-01-0000 G32-SO-TP05-02-0000 G32-SO-TP05-03-0002	7/21/05	0830 0900 0905
Test Pit 6	0-3	NR	1	G32-SO-TP06-01-0002	7/21/05	1040
	3	NR	3	NA		
	3-6	NR	1,3	NA		
Test Pit 7	0-4	NR	1,2	G32-SOTP07	7/22/05	0900
Test Pit 8	0-4	NR	1,2,3	G32-SOTP08	7/22/05	0845
Test Pit 9	0-4	NR	1,2	G32-SOTP09-01 G32-SOTP09-02	7/21/05	1035 1030
Test Pit 10A	0-3	NR	1,2	G32-SOTP10-01	7/21/05	1100
Test Pit 10B	0-3	NR	1,2	G32-SOTP10-02	7/21/05	1110
Test Pit 10C	0-3	NR	1,2	G32-SOTP10-03	7/21/05	1120
Test Pit 11-A, B, C	0-3	NR	1,2,3	G32-SOTP11-01 and dup	7/21/05	1330

TABLE 2-2

SUMMARY OF SOIL BORING AND TEST PIT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Boring No.	Depth Interval (ft)	FID/PID Reading (ppmv) *	Comments	Laboratory Sample ID	Sample Date	Sample Time
Test Pit 12	0-4	NR	1,2,3,4	G32-SOTP12 and dup	7/21/05	1405
Test Pit 13	0-4	NR	1	G32-SOTP13	7/21/05	NR

Notes: ppmv – parts per million by volume of air
ft – feet below ground surface
* - readings of 0 ppmV indicate no positive response on FID/PID during jar headspace screening.
FID – Flame Ionization Detector.
PID – Photo Ionization Detector.
NR – Not Recorded

Comment 1 – Soil Staining Noted – Also see Figure 2-2
Comment 2 – Odors noted – Also see Figure 2-2
Comment 3 – Sheen noted – Also see figure 2-2
Comment 4 – Free Product Noted – Also see Figure 2-2

TABLE 2-3

GROUNDWATER MONITORING WELL SUMMARY: SCREENED INTERVAL AND PURPOSE
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

BORING/WELL NUMBER	LOCATION	WELL SCREEN INTERVAL*	PURPOSE OF INSTALLATIONS
MW300S/MW300B	Located on East Side of Building 32.	MW300S screened in overburden across the water table. MW300B packer tested and sampled via discrete zone sampling: No zones of contamination, final screen length 30 feet.	Assess impacts of shop to groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics.
MW301S/MW301B	Upgradient Location - Located on hill/berm southwest of electroplating shop in densely vegetated area.	MW301S screened in overburden at top of water table. MW301B cored 30 feet into bedrock and screened across this distance.	Establish reference groundwater quality in overburden and shallow bedrock, and assist determination of groundwater flow dynamics.
MW302S/MW302B	Between Building 32 and 33, in area of potential impacts from former coal pile and leaks or releases from floor drains, cracked floor slab, etc.	Determined by headspace screening results of soil samples collected: MW302S screened in overburden at the top of the water table and at top of till layer. MW302B cored 30 feet into bedrock and screened across this distance.	Assess impacts of former coal pile and surrounding building's activities to downgradient groundwater quality in overburden and bedrock, and assist determination of groundwater flow dynamics.
MW303B	East of Building 32, in area of potential impacts from leaks or releases from former solvent tank discharge pipe, floor drains, etc. and coupled with existing shallow well, MW03S.	MW303B cored 30 feet into bedrock and screened across this distance. No headspace readings were detected during drilling through overburden in this area.	Assess impacts of shop and discharge pipe to downgradient groundwater quality in overburden and bedrock and to assist determination of groundwater flow dynamics.
MW304S/MW304B	West of Building 44 and former tramway, in area where TCE was previously found in soil gas samples (refer to Appendix A)	MW304S screen determined by headspace screening results of soil samples collected: VOCs detected at top of water table, well screened across water table. MW304B packer tested and sampled via discrete zone sampling: No zones of contamination found, final screen length 30 feet.	Assess impacts of shop and former storage area groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics.
MW305S/MW305B	Located on the northwest corner of Building 32	MW305S screen determined by headspace screening results of soil samples collected: Trace VOCs detected at top of water table, well screened across water table. MW305B packer tested and sampled via discrete zone sampling: No zones of contamination found, final screen length 30 feet.	Assess impacts of shop to groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics.
MW306B	Located in the area of Building 44, in area of potential impacts from leaks or releases from former USTs and coupled with existing shallow well MW-001R.	MW-306B cored 30 feet into bedrock and screened across this distance. Traces of VOCs in headspace readings were detected at the top of the water table while drilling through overburden in this area.	Assess impacts of shop and former fuel USTs to downgradient groundwater quality in overburden and bedrock and to assist determination of groundwater flow dynamics.

Note:

* Per the Work Plan, well screen intervals in overburden were determined based on conditions encountered during drilling. Additional wells were to be installed at any location deemed necessary if multiple zones of contaminants and /or confining layers were detected in the overburden.

TABLE 2-4

GROUNDWATER MONITORING WELL CONSTRUCTION DETAILS SUMMARY
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Well	Well Type	Diameter (inches)	Screened Interval (feet bgs)	Reference Elevations			Horizontal Coordinates	
				Ground	Outer Casing	Inner PVD Riser Pipe	Northing	Easting
MW300S	Overburden	2	4 – 14	13.1	15.18	14.87	165328.20	542487.27
MW300B	Bedrock	2	53 – 83	13.0	14.09	13.87	165340.13	542486.37
MW301S	Overburden	2	19.5 – 29.5	44.9	44.90	44.71	164665.31	542367.11
MW301B	Bedrock	2	37 – 67	44.3	44.30	44.05	164671.22	542360.40
MW302S	Overburden	2	14 – 24	12.4	14.55	14.36	165074.26	542340.47
MW302B	Bedrock	2	54 – 84	12.6	14.56	14.34	165083.60	542335.03
MW303B	Bedrock	2	19 – 49	11.6	14.87	14.71	165039.15	542631.64
MW304S	Overburden	2	4 – 14	12.2	14.78	14.58	165333.17	154153.98
MW304B	Bedrock	2	89 – 119	12.0	14.36	13.91	165340.65	542152.05
MW305S	Overburden	2	4 – 14	13.1	15.37	15.10	165304.90	542286.34
MW305B	Bedrock	2	65 – 95	13.0	16.02	15.75	165297.27	542287.93
MW306B	Bedrock	2	64 - 94	12.5	15.16	14.98	165527.50	542344.30

TABLE 2-5A

SUMMARY OF STABILIZATION CRITERIA FROM WELL DEVELOPMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Well ID	Well Development Date	Pump Intake Depth	Pump Type	Initial Clock Time	Final Clock Time	Water Depth Below MP (ft)	Purge Rate (mL/min)	Cum. Volume Purged (gal)	Temp (^oC)	Spec. Cond. (uS/cm)	pH	DO (mg/L)	Turbidity (NTU)	Comments
G32-MW300B	7/11/05-712/05	53-83	Whale Pump	930	900	8.5	1500	50	15.6	0.50	5.8		2.4	
G32-MW300S	7/11/2005	4-14	Whale Pump	1005	1345	12.0	600	50	15.7	1.30	6.9		4.5	
G32-MW301B	7/18/2005	36.5	Whale Pump	1230	1530	28.4	200	20	19.3	0.28	6.2	5.28	4.3	
G32-MW301S	7/18/2005	29	Whale Pump	840	1125	22.0	500	25	14.6	0.23	6.3	9.14	1.6	
G32-MW302B	7/13/2005	70	Whale Pump	755	1110	9.7	900	45	13.4	0.24	8.5	4.1	4.0	Dark grey/cloudy and then cleared after half an hour
G32-MW302S	7/19/2005	23.5	Whale Pump	840	1440	24.2	800	60	16.8	0.43	6.6	7.95	5.0	
G32-MW303B	7/13/2005	35	Whale Pump	1130	1420	8.9	1000	50	15.7	0.21	7.2	4.3	4.7	Dark grey/cloudy and then cleared after half an hour
G32-MW303S	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
G32-MW304B	7/14/2005	95	Whale Pump	1000	1430	4.7	600	50	18.4	0.21	7.9	3.49	4.0	Dark grey/cloudy and then cleared after half an hour
G32-MW304S	7/20/2005	10	Peristaltic	825	1430	15.5	800	35	20.7	5.67	6.9	8.32	13.2	
G32-MW305B	7/8/2005		Whale Pump	930	1100	NR	NR	45	NR	NR	NR	NR	NR	Visually clear
G32-MW305S	7/8/2005	10	Whale Pump	930	1100	8.5	NR	35	NR	NR	NR	NR	NR	Visually clear
G32-MW306B	7/12/2005	80	Whale Pump	915	1200	27.9	600	40	15.4	1.00	7.1	4	3.7	Initially cloudy then cleared
G32-MW306S	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	

Notes:
ND = Not Developed, previously installed well
NR = Not Recorded

TABLE 2-5B

SUMMARY OF STABILIZATION CRITERIA DURING GROUNDWATER WELL PURGING AND SAMPLING
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Well ID	Sample Date	Depth Sampled	Pump Type	Initial Clock Time	Final Clock Time	Water Depth Below MP (ft)	Purge Rate (mL/min)	Cum. Volume Purged (gal)	Temp (oC)	Spec. Cond. (mS/cm)	pH	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Comments
G32-MW300B	7/25/2005	63.0	Bladder Pump	1015	945	6.4	100	6	17.5	0.96	6.5	-172	0.3	1.0	
G32-MW300S	7/20/2005	13.0	Peristaltic	836	1042	10.1	220	7	17.4	1.84	6.3	44	1.7	4.6	
G32-MW301B	7/21/2005	52.0	Bladder Pump	920	1445	25.2	140	5	16.1	0.24	5.8	-406	0.3	5.0	
G32-MW301S	7/21/2005	28.0	Peristaltic	922	1104	20.7	200	5	14.5	0.34	6.3	53	7.2	4.0	
G32-MW302B	7/25/2005	70.0	Bladder Pump	930	1435	5.9	150	9	16.9	0.18	6.9	40	0.3	12.8	
G32-MW302S	7/26/2005	23.0	Peristaltic	910	1045	11.8	140	4	17.1	0.42	5.7	98	3.2	4.0	Initially dark gray and then cleared
G32-MW303B	7/19/2005	34.0	Bladder Pump	1005	1235	9.2	200	7	19.3	0.56	6.6	-431	0.3	4.9	Light brown and cloudy for the first two hours
G32-MW303S	7/25/2005	14.8	Peristaltic	954	1105	11.0	180	3	18.6	1.33	5.5	28	2.1	3.4	
G32-MW304B	7/27/2005	95.0	Bladder Pump	820	1230	4.6	100	4	21.9	0.23	7.6	-209	4.7	3.5	
G32-MW304S	7/27/2005	10.0	Peristaltic	840	1026	15.3	100	5	17.1	39.21	6.1	21	2.8	4.5	
G32-MW305B	7/19/2005	80.0	Bladder Pump	1330	1335	7.4	60	6	19.8	0.27	6.5	-78	0.4	4.2	
G32-MW305S	7/26/2005	10.0	Peristaltic	930	1100	9.2	100	2	21.6	1.05	7.6	-247	2.0	3.7	
G32-MW306B	7/27/2005	81.0	Bladder Pump	830	1300	10.2	100	5	22.1	0.82	7.2	-88	0.7	10.7	
G32-MW306S	7/27/2005	13.5	Peristaltic	1300	1345	8.4	330	3	15.5	23.16	9.7	-265	2.7	1.0	

TABLE 2-6

SUMMARY OF SAMPLES COLLECTED FROM TEST PITS, MANHOLES, AND UNDERGROUND UTILITIES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Location	Laboratory Sample ID	Sample Date	Sample Time	Sample Depth (feet BGS)	Description
Solids Samples					
Test Pit 1	G32-SOTP01-01-0007	6/2/2005	1400	7	Silty sand, fine to med with gravel, brick, & concrete noted and removed
Test Pit 2	G32-SOTP02-0006	6/2/2005	900	6	Silty sand, fine to med with gravel, brick, & concrete noted and removed
Test Pit 2	G32-SOTP02-02-0007	6/2/2005	1400	7	Silty sand, fine to med with gravel, brick, & concrete noted and removed
Test Pit 3	G32-SOTP03-01-0007	6/2/2005	1400	7	Silty sand, fine to med with gravel, brick, & concrete noted and removed
Test Pit 4	G32-SOTP04-01	7/22/2005	800	2	Silty sand, fine to med with gravel, brick, & concrete noted and removed
Test Pit 5	G32-SOTP05-01-0000	7/21/2005	830	10	Silty sand
Test Pit 5	G32-SOTP05-02-0000	7/21/2005	900	10	Silty sand
Test Pit 5	G32-SOTP05-03-0002	7/21/2005	905	2	Silty sand
Manhole Test Pit 5	G32-SOTP05-MH	7/26/2005	1350	7	Silty sand
Test Pit 6	G32-SOTP06-01-0002	7/21/2005	1040	2	Silty sand
Test Pit 7	G32-SOTP07	7/22/2005	900	2	Silty sand
Test Pit 8	G32-SOTP08	7/22/2005	845	2	Silty sand
Test Pit 9	G32-SOTP09-01-0002	7/21/2005	1035	2	Silty sand
Test Pit 9	G32-SOTP09-02-0002	7/21/2005	1030	2	Silty sand
Test Pit 10	G32-SOTP10-01-0002	7/21/2005	1100	2	Silty sand
Test Pit 10	G32-SOTP10-02-0002	7/21/2005	1110	2	Silty sand
Test Pit 10	G32-SOTP10-03-0002	7/21/2005	1120	2	Silty sand
Test Pit 11	G32-SOTP11-01	7/21/2005	1330	2	Silty sand
Test Pit 12	G32-SOTP12-01	7/21/2005	1405	2	Silty sand
Test Pit 13	G32-SOTP13-01	7/21/2005	NR	2	Silty sand
Manhole- MH-01	G32-OTSMH01	6/14/2005	1032	NR	Soil/sludge sample from manhole- MH-01
Aqueous Samples					
Test Pit 2	G32-AQTP02-0006	6/2/2005	1030	6	Oily water discharge
Test Pit 5	G32-AQTP05	7/21/2005	820	9	Septic system area
Test Pit 6	G32-AQTP06	7/21/2005	1030	3	Water with oily sheen in sand blast sump
Test Pit 8	G32-AQTP08	7/22/2005	930	2	Sheen on water
Test Pit 10	G32-AQTP10-02	7/21/2005	1130	3	Petroleum odor present
Test Pit 11	G32-AQTP11	7/21/2005	1330	3	Sheen on water- 15% of surface
Test Pit 12	G32-AQTP12	7/21/2005	1335	2.5	Oil sheen present with small globs of "oil" on water
Test Pit 13	G32-AQTP13	7/21/2005	1340	3	Brown staining
Manhole- MH-01	G32-AQMH01	6/2/2005	1300	1.5	Potential free product- top of water sitting in manhole
Manhole- MH-02	G32-AQMH02	6/14/2005	1007	3	Shallow manhole
Manhole- MH-03	G32-AQMH03	6/14/2005	1015	3	Oily sheen

Notes:
bgs= Below ground surface
TP= Test pit
MH= Manhole

TABLE 2-7

SEDIMENT AND BIOTA SAMPLE LOCATIONS AND PURPOSE
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 1 OF 2

SAMPLE LOCATION NUMBER	LOCATION DESCRIPTION	PURPOSE OF SAMPLES
SD301/ET301	At south end of Gould Island, in area of softer sand, presumably a depositional area for sediment transported down-bay.	Assess the downgradient depositional marine sediment. Assess contaminant load in biota at downgradient location.
SD302(A,B,C,D,E) ET302	At presumed sewer and storm drain discharge points on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD302F ET302F	At sewer and storm drain discharge points on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD303/ET303	South of Site 17 on east shoreline of Gould Island, this area is believed to be downgradient of the presumed release points.	Assess the downgradient depositional marine sediment. Assess contaminant load in biota at downgradient location.
SD304(A,B,C,D,E) ET304	At a presumed storm drain discharge, immediately south of other drain discharge points.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD304F ET304F	At a storm drain discharge, immediately south of other drain discharge points.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD305(A,B,C,D,E) ET305	At a presumed electroplating room drain discharge.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD305F ET305F	At electroplating room drain discharge.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD306(A,B,C,D,E) ET306	At a presumed sewer discharge shared by solvent tanks and degreasers.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD306F ET306F	At a sewer discharge shared by solvent tasks and degreasers.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD307/ET307	Downgradient of former Building 54 transformer vault.	Assess the downgradient depositional marine sediment. Assess contaminant load in biota at downgradient location.
SD308(A,B,C,D,E) ET308	At a presumed sewer and storm drain discharge points on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD308F ET308F	At a sewer and storm drain discharge point on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD309(A,B,C,D,E)/ ET309 and SD310(A,B,C,D,E)/ ET310	At presumed sewer and storm drain discharge points.	Assess the local sediment conditions and contaminant load in biota at the discharge point.

TABLE 2-7

SEDIMENT AND BIOTA SAMPLE LOCATIONS AND PURPOSE
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE LOCATION NUMBER	LOCATION DESCRIPTION	PURPOSE OF SAMPLES
SD309F, SD310F ET309F, ET310F	At sewer and storm drain discharge points.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD311/ET311	Southwest of Site 17 in an area presumed to be less affected by depositional sediment originating from the site.	A reference sample not within the depositional marine sediment area and not potentially impacted by the site, but within a similar position in the watershed.
SD312/ET312	At north end of Gould Island, under or near the rigging platform and within the boat basin, presumed to be a depositional area, but also affected by erosion of soil from the soils near former Buildings 41, 44, and the rigging house.	Assess the local sediment conditions and contaminant load in biota at the erosion area.
SD313(A,B,C,D,E)/ ET313	At a presumed drain discharge point on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD313F ET313F	At drain discharge point on west shoreline.	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD314	At south end of Gould Island, in area of softer sand, presumably a depositional area for sediment transported down-bay.	Assess the downgradient depositional marine sediment.
SD315	Downgradient of former Building 54 transformer vault	Assess the downgradient depositional marine sediment.
SD316	At north end of Gould Island, under or near the rigging platform and within the boat basin, presumed to be a depositional area, but also affected by erosion of soil from the soils near former Buildings 41, 44, and the rigging house.	Assess the local marine sediment conditions.
SD317	At northeast end of Gould Island, presumed to be a depositional area, but also affected by erosion of soil near former Building 50.	Assess the local marine sediment locations.

Note:

Sediment locations SD302, SD304, SD305, SD306, SD308, SD309, SD310 and SD313 had five samples associated with each designation, (A through E), as indicated above. The samples were oriented in an approximately 12.5-foot radius from the center “target” position (“D”), as referenced on Figure 2-4.
Each of these eight sediment station numbers were also used for another added station location, distinguished by the suffix “F,” and located adjacent
Or as close as possible to any associated discharge pipe remnants **as observed during the field sampling event**.

TABLE 2-8

SUMMARY OF BIOTA SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Station ID	Species	No. of Samples	Shell Length Range (mm)*	Total Tissue Weight (g)
G32-ET301-090205	Hardshell clams	6 bivalves	79.0 – 91.5	105.17
G32-ET302-082905	Hardshell clams	5 bivalves	71.1 – 90.8	130.07
G32-ET302F-090205	Blue mussels	20 bivalves	51.1 – 63.0	104.86
G32-ET303-090105	Hardshell clams	6 bivalves	79.0 – 105.1	223.22
G32-ET304-082905	Hardshell clams	7 bivalves	72.8 – 89.0	161.52
G32-ET304F-090205	Blue mussels	20 bivalves	36.5 – 52.0	62.37
G32-ET305-082905	Hardshell clams	5 bivalves	63.0 – 88.0	117.7
G32-ET305F-090105	Blue mussels	20 bivalves	40.0 – 53.5	77.15
G32-ET306-090105	Hardshell clams	6 bivalves	75.0 – 100.1	177.79
G32-ET306F-090105	Hardshell clams	6 bivalves	54.8 – 93.5	188.69
G32-ET307-090105	Hardshell clams	6 bivalves	81.5 – 91.0	204.83
G32-ET308-082905	Hardshell clams	8 bivalves	59.1 – 92.1	220.81
G32-ET308F-090205	Blue mussels	20 bivalves	39.3 – 56.1	67.27
G32-ET309-090105	Hardshell clams	6 bivalves	82.8 – 96.5	191.63
G32-ET309F-090105	Blue mussel	22 bivalves	43.0 – 57.1	53.83
G32-ET310-090105	Hardshell clams	6 bivalves	77.5 – 93.1	191.35
G32-ET310F-090105	Blue mussels	21 bivalves	43.2 – 54.9	71.72
G32-ET311-090205	Hardshell clams	7 bivalves	57.0 – 79.5	109.11
G32-ET312-082905	Blue mussels	21 bivalves	48.0 – 61.0	103.16
G32-ET313-082905	Hardshell Clams	6 bivalves	73.9 – 98.0	166.67
G32-ET313F-090205	Blue mussels	20 bivalves	43.1 – 56.0	79.97
G32-ETDUP01	Hardshell clams	5 bivalves	72.2 – 101.8	169.58
G32-ETDUP02	Hardshell clams	6 bivalves	79.0 – 91.5	105.17

* Other biota data recorded included shell width, shell breadth, and total weight.
mm = millimeters
g = grams
G32-ETDUP01 and G32-ETDUP02 are duplicate samples collected from stations G32-ET305-082905 and G32-ET301-09025, respectively.

TABLE 3-1

GROUNDWATER DEPTH AND ELEVATION DATA: AUGUST 30, 2005
SITE 17: BULDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

WELL ID	ELEVATION TOP OF PVC (feet- NMLW)	30 AUGUST 2005 DEPTH TO WATER (feet - BTPVC)	30 AUGUST 2005 GROUNDWATER ELEVATION (feet - NMLW)
MW300S	14.87	5.89	8.98
MW300B	13.87	NA	NA
MW301S	44.71	23.31	21.4
MW301B	44.05	24.45	19.6
MW302S	14.36	5.62	8.74
MW302B	14.34	6.22	8.12
MW303B	14.71	8.41	6.3
MW304S	14.58	9.07	5.51
MW304B	13.91	5.8	8.11
MW305S	15.1	7.2	7.9
MW305B	15.75	NA	NA
MW306B	14.98	8.32	6.66

Notes:
NA = No data available
NMLW = Navy Mean Low Water
BTPVC = Below top of PVC riser

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB300B	G32-SB302B	G32-SB303B	G32-SB304B	G32-SB309	G32-SB310	G32-SB311
DEPTH IN FEET				0-2	0-2	0-2	0-2	0-2	0-2	1-3
SAMPLE LOCATION TYPE				EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	UNDER SLAB
SAMPLE ID				G32-SB300B-0002	G32-SB302B-0002	G32-SB303B-0002	G32-SB304B-0002	G32-SB309-0002	G32-SB310-0002	G32-SB311-0103
SAMPLE DATE				20050601	20050705	20050711	20050601	20050712	20050712	20050629
VOLATILE ANALYSIS (µg/kg)										
2-BUTANONE		10000000	10000000	5 U	3 U	3 U	3 U	3 U	5 U	3 UJ
TRICHLOROETHENE		13000	520000	3 U	3 J	3 U	3 U	3 U	5 U	3 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				360 U	360 U	350 U	370 U	360 U	350 U	360 U
2,4,5-TRICHLOROPHENOL		330000	10000000	730 U	730 U	710 U	750 U	740 U	710 U	740 U
2,4,6-TRICHLOROPHENOL		58000	520000	360 U	360 U	350 U	370 U	360 U	350 U	360 U
2,4-DINITROPHENOL		160000	4100000	730 U	730 U	710 UJ	750 UJ	740 UJ	710 UJ	740 U
2-METHYLNAPHTHALENE	9.6	123000	10000000	19	11 J	3.8	51	7	3.5 U	3.6 UJ
4-METHYLPHENOL				360 U	360 U	350 U	370 U	360 U	350 U	360 U
4-NITROANILINE				730 UJ	730 UJ	710 U	750 U	740 UJ	710 UJ	740 UJ
4-NITROPHENOL				730 U	730 U	710 U	750 U	740 U	710 U	740 U
ACENAPHTHENE	71	43000	10000000	11	76 J	43	73	49	6	3.6 UJ
ACENAPHTHYLENE	9.9	23000	10000000	3.6 U	19 J	8.5	19	15	3.5 U	3.6 UJ
ANTHRACENE	160	35000	10000000	27	170 J	110	140	130	18	3.6 UJ
BENZO(A)ANTHRACENE	530	900	7800	90	450	310	330	400	71	3.6 UJ
BENZO(A)PYRENE	450	400	800	91	440 J	300	330	380	60	3.6 UJ
BENZO(B)FLUORANTHENE	640	900	7800	130	510	320 J	340 J	470	88	3.6 UJ
BENZO(G,H,I)PERYLENE	300	800	10000000	67	240 J	170	180	240	34	3.6 UJ
BENZO(K)FLUORANTHENE	320	900	78000	39	200 J	160	190	260	34	3.6 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	95	46000	410000	64 JEB	92 J	110 J	110 JEB	86 J	67 J	49 J
BUTYL BENZYL PHTHALATE				360 U	360 U	350 U	370 U	360 U	350 U	360 U
CARBAZOLE	72			360 U	61 J	40 J	51 J	55 J	350 U	360 U
CHRYSENE	630	400	780000	120	420	300	310 J	470	63	3.6 UJ
DIBENZO(A,H)ANTHRACENE	89	400	800	22 J	71 J	50	67 J	73	10	3.6 UJ
DIBENZOFURAN				360 U	360 U	350 U	370 U	360 U	350 U	360 U
DI-N-BUTYL PHTHALATE				360 U	39 J	350 U	370 UJ	360 U	350 U	360 U
FLUORANTHENE	1100	20000	10000000	170	980 J	560	450 J	890	120	4.4 J
FLUORENE	59	28000	10000000	11	56 J	45	50	46	3.8	3.6 UJ
HEXACHLOROCYCLOPENTADIENE				360 U	360 U	350 U	370 UJ	360 UJ	350 UJ	360 U
INDENO(1,2,3-CD)PYRENE	270	900	7800	58	220 J	150	190	220	31	3.6 UJ
NAPHTHALENE	12	54000	10000000	14	28 EBJ	5.1	61	9.2	5.4	3.6 UJ
PENTACHLOROPHENOL		5300	48000	730 U	730 U	710 U	750 U	740 U	710 U	740 U
PHENANTHRENE	610	40000	10000000	140	520 J	380	320 J	540	64	3.6 UJ
PYRENE	880	13000	10000000	150	900 J	390	480	710	97	3.6 UJ

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB300B	G32-SB302B	G32-SB303B	G32-SB304B	G32-SB309	G32-SB310	G32-SB311
DEPTH IN FEET				0-2	0-2	0-2	0-2	0-2	0-2	1-3
SAMPLE LOCATION TYPE				EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	EXPOSED SOIL	UNDER SLAB
SAMPLE ID				G32-SB300B-0002	G32-SB302B-0002	G32-SB303B-0002	G32-SB304B-0002	G32-SB309-0002	G32-SB310-0002	G32-SB311-0103
SAMPLE DATE				20050601	20050705	20050711	20050601	20050712	20050712	20050629
PESTICIDE/PCB ANALYSIS (µg/kg)										
4,4'-DDD				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
4,4'-DDE				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
4,4'-DDT				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
ALPHA-CHLORDANE				1.8 U	2.1 J	1.8 U	1.9 U	1.9 U	1.8 U	1.9 U
AROCLOR-1260				36 U	36 U	100	37 U	36 U	35 U	36 U
BETA-BHC				1.8 U	1.8 U	3.1 J	1.9 U	2 J	1.8 U	1.9 U
ENDOSULFAN SULFATE				3.6 U	3.6 UJ	3.5 U	3.7 U	3.6 U	3.5 U	3.6 UJ
ENDRIN				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
ENDRIN ALDEHYDE				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
ENDRIN KETONE				3.6 U	3.6 U	3.5 U	3.7 U	3.6 U	3.5 U	3.6 U
GAMMA-CHLORDANE				1.8 U	1.8 U	1.8 U	1.9 U	1.9 U	1.8 U	1.9 U
METHOXYCHLOR				18 U	18 U	18 U	19 U	19 U	18 U	67
TOTAL AROCLOR		10000	10000	36 U	36 U	100	37 U	36 U	35 U	36 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS	53	500	2500	22 J	85	99	130	49 J	15	13 U
METALS ANALYSIS (mg/kg)										
ALUMINUM	8850			4950 J	7470	8990	5710 J	6440	6540	6980
ARSENIC	3.2	7	7	5.1 J	4.5 J	3.2 J	2.1 J	2.7 J	3.2 J	2 J
BARIUM	35	5500	10000	25.4 J	37.9 J	75.2 J	22.7 J	29 J	29.1 J	23.9 J
BERYLLIUM	0.3	0.4	1.3	0.2	0.33	0.62	0.21	0.22	0.28	0.19
CADMIUM	0.24	39	1000	0.19 J	0.0054 UJ	0.0052 UJ	1.7 J	0.66 J	0.0048 UJ	0.0049 UJ
CALCIUM	731			1040	2490	6670	581	1410	2100	1430
CHROMIUM	11.1	1400	10000	10.5 J	9.6	26.5	8.5 J	12.5	8.5	10.1
COBALT	5.8			4 J	4 J	7.5 J	3.7 J	4.6 J	4.8 J	3.6 J
COPPER	21.2	3100	10000	20.1 J	21.7	11.6	31.4 J	17.1	13.5	11.4
CYANIDE		200	10000	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.14 UJ
IRON	12300			8700	13400	19500	9320	10800	10300	11700
LEAD	84.5	150	500	10.8 J	18.7 J	6.7 J	37.8 J	21.3 J	19.4 J	5.7 J
MAGNESIUM	2620			1930 J	2130	6920	1980 J	2250	2280	2780
MANGANESE	216	390	10000	150 J	259	473	92 J	169	224	133
MERCURY	0.033	23	610	0.019 J	0.045	0.0072 U	0.045 J	0.0086 J	0.011 J	0.0065 U
NICKEL	12.6	1000	10000	13.2 J	6.2 J	18.3 J	9.3 J	9 J	8.7 J	8.1 J
POTASSIUM	977			546	1180 J	4960 J	623	925 J	880 J	836 J
SODIUM	32.4			201	47.7	145	47.7	110	65	147
VANADIUM	20.4	550	10000	9.3 J	12.5 J	28.7	11.1 J	10.8 J	10.5 J	12 J
ZINC	43.7	6000	10000	56.6 J	48.4 J	58.8 J	69.8 J	82.8 J	28.9 J	21.4 J

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB312	G32-SB313	G32-SB317	G32-SB318	G32-SB327	G32-SB332	G32-SB334
DEPTH IN FEET				1-3	0-2	0-2	0-2	1-3	0-2	0-2
SAMPLE LOCATION TYPE				UNDER SLAB	WITHIN SUMP	WITHIN SUMP	WITHIN SUMP	UNDER SLAB	EXPOSED SOIL	WITHIN SUMP
SAMPLE ID				G32-SB312-0103	G32-SB313-0002	G32-SB317-0002	G32-SB318-0002	G32-SB327-0103-AVG	G32-SB332-0002	G32-SB334-0002
SAMPLE DATE				20050629	20050705	20050622	20050621	20050616	20050714	20050622
VOLATILE ANALYSIS (µg/kg)										
2-BUTANONE		10000000	10000000	3 UJ	5 U	4 U	4 UJ	3 U	3 U	5 UJ
TRICHLOROETHENE		13000	520000	3 U	5 U	4 U	2 J	3 U	0.7 J	5 UJ
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				350 U	5500 J	NA	710 J	350 U	370 U	3000 J
2,4,5-TRICHLOROPHENOL		330000	10000000	710 U	15000 U	NA	3400 U	720 U	750 U	14000 R
2,4,6-TRICHLOROPHENOL		58000	520000	350 U	7600 U	NA	1700 U	350 U	370 U	6800 R
2,4-DINITROPHENOL		160000	4100000	710 U	15000 UJ	NA	3400 U	720 U	750 UJ	14000 R
2-METHYLNAPHTHALENE	9.6	123000	10000000	3.5 U	19000	NA	2100	6.35	38	10000
4-METHYLPHENOL				350 U	7600 U	NA	1700 U	350 U	370 U	6800 U
4-NITROANILINE				710 UJ	15000 UJ	NA	3400 UJ	720 UJ	750 U	14000 R
4-NITROPHENOL				710 U	15000 U	NA	3400 U	720 U	750 U	14000 R
ACENAPHTHENE	71	43000	10000000	3.5 U	100000	NA	9400	2.925	480	28000
ACENAPHTHYLENE	9.9	23000	10000000	3.5 U	7600 U	NA	260 J	3.5 U	12	3300
ANTHRACENE	160	35000	10000000	3.5 U	140000	NA	19000	5	1700	49000
BENZO(A)ANTHRACENE	530	900	7800	3.5 U	210000	NA	42000	6.7	2900	91000
BENZO(A)PYRENE	450	400	800	3.5 U	160000	NA	24000	3.025	2400	71000
BENZO(B)FLUORANTHENE	640	900	7800	3.5 U	170000	NA	50000	7.15	2900	84000
BENZO(G,H,I)PERYLENE	300	800	10000000	3.5 U	96000 J	NA	13000	3.5 U	1400 J	33000
BENZO(K)FLUORANTHENE	320	900	78000	3.5 U	74000 J	NA	13000	2.775	1300	42000
BIS(2-ETHYLHEXYL)PHTHALATE	95	46000	410000	320 J	7600 U	NA	1700 U	72 J	370 U	6800 U
BUTYL BENZYL PHTHALATE				74 J	7600 U	NA	1700 U	350 U	370 U	6800 U
CARBAZOLE	72			350 U	65000	NA	6800	350 U	280 J	26000
CHRYSENE	630	400	780000	3.5 U	190000	NA	36000	7.7	3000	85000
DIBENZO(A,H)ANTHRACENE	89	400	800	3.5 U	26000 J	NA	3400	3.5 UJ	440 J	9200 J
DIBENZOFURAN				350 U	47000	NA	6200	350 U	290 J	22000
DI-N-BUTYL PHTHALATE				350 U	7600 UJ	NA	1700 U	45 J	370 U	6800 U
FLUORANTHENE	1100	20000	10000000	3.6	530000	NA	100000	18	6100	200000
FLUORENE	59	28000	10000000	3.5 U	77000	NA	10000	3.5 U	590	28000
HEXACHLOROCYCLOPENTADIENE				350 U	7600 UJ	NA	1700 U	350 UJ	370 U	6800 R
INDENO(1,2,3-CD)PYRENE	270	900	7800	3.5 U	92000 J	NA	14000	2.775	1500 J	35000
NAPHTHALENE	12	54000	10000000	3.5 U	44000	NA	3900	4.35	53	26000
PENTACHLOROPHENOL		5300	48000	710 U	15000 U	NA	270 J	720 U	750 U	14000 R
PHENANTHRENE	610	40000	10000000	3.5 U	460000	NA	74000	22.5	3900	180000
PYRENE	880	13000	10000000	3.5 U	360000	NA	66000	16.5	4800	140000

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB312	G32-SB313	G32-SB317	G32-SB318	G32-SB327	G32-SB332	G32-SB334
DEPTH IN FEET				1-3	0-2	0-2	0-2	1-3	0-2	0-2
SAMPLE LOCATION TYPE				UNDER SLAB	WITHIN SUMP	WITHIN SUMP	WITHIN SUMP	UNDER SLAB	EXPOSED SOIL	WITHIN SUMP
SAMPLE ID				G32-SB312-0103	G32-SB313-0002	G32-SB317-0002	G32-SB318-0002	G32-SB327-0103-AVG	G32-SB332-0002	G32-SB334-0002
SAMPLE DATE				20050629	20050705	20050622	20050621	20050616	20050714	20050622
PESTICIDE/PCB ANALYSIS (µg/kg)										
4,4'-DDD				3.5 U	19 U	NA	6.6 R	3.5 U	3.7 U	34 U
4,4'-DDE				3.5 U	19 U	NA	23 J	3.5 U	3.7 U	64
4,4'-DDT				3.5 U	19 U	NA	27 J	3.5 U	3.7 U	34 U
ALPHA-CHLORDANE				1.8 U	9.8 U	NA	1.7 U	1.8 U	1.9 U	18 U
AROCLOR-1260				35 U	270 J	NA	280 J	35 U	37 U	440 J
BETA-BHC				1.8 U	9.8 U	NA	24 R	1.8 U	1.9 U	18 U
ENDOSULFAN SULFATE				3.5 UJ	19 UJ	NA	51 R	3.5 U	3.7 U	34 U
ENDRIN				3.5 U	19 U	NA	18	3.5 U	3.7 U	170 J
ENDRIN ALDEHYDE				3.5 U	19 U	NA	16 J	3.5 U	3.7 U	34 U
ENDRIN KETONE				3.5 U	19 U	NA	29	3.5 U	3.7 U	270 J
GAMMA-CHLORDANE				1.8 U	9.8 U	NA	10 R	1.8 U	1.9 U	18 U
METHOXYCHLOR				18 U	270 R	NA	17 U	18 U	19 U	220 J
TOTAL AROCLOR		10000	10000	35 U	270	NA	280	35 U	37 U	440
PETROELUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS	53	500	2500	22	14000 J	NA	1300	13 U	85	11000 J
METALS ANALYSIS (mg/kg)										
ALUMINUM	8850			6750	6680	6610 J	8390 J	5785	4660	8830
ARSENIC	3.2	7	7	2.2 J	5.6 J	4.4 J	4.3 J	2.4 J	2.4 J	5.9 J
BARIUM	35	5500	10000	21.5 J	89.4 J	73.3 J	51.4 J	18.95 J	15.6 J	164 J
BERYLLIUM	0.3	0.4	1.3	0.21	0.22	0.26 J	0.25 J	0.20	0.17	0.3
CADMIUM	0.24	39	1000	0.0052 UJ	1.8 J	1.1 J	0.71 J	0.00485 UJ	0.64 J	2.5
CALCIUM	731			1090	59700	3780 J	15600 J	2615 J	1520	35300 J
CHROMIUM	11.1	1400	10000	9.3	15.7	12.1 J	13.3 J	8.45 J	6.2	22.1 J
COBALT	5.8			4.3 J	3.4 J	4.8 J	4.1 J	4.55 J	4.5 J	4.5 J
COPPER	21.2	3100	10000	16.9	54.5	53.6 J	34.4 J	16.75 J	19.2	56.6 J
CYANIDE		200	10000	0.44 U	0.13 U	0.12 U	0.11 U	0.12 U	0.12 U	0.11 U
IRON	12300			11600	21100	20000 J	19800 J	11500 J	8960	29600 J
LEAD	84.5	150	500	7.6 J	239	101 J	266 J	7.6 J	7.1 J	750 J
MAGNESIUM	2620			2510	4290	2500 J	3650 J	2300 J	1900	3760 J
MANGANESE	216	390	10000	138	244	174 J	214 J	162 J	132	290 J
MERCURY	0.033	23	610	0.0065 J	0.049	0.015	0.035	0.0088 UJ	0.0073 U	0.011 UJ
NICKEL	12.6	1000	10000	8.5 J	12.4 J	13.1 J	11.8 J	10.15 J	10.2 J	22.4 J
POTASSIUM	977			811 J	890 J	809	909	618.5	520 J	743
SODIUM	32.4			103	478	218	199	62.65	34.1	638
VANADIUM	20.4	550	10000	11.2 J	15 J	19.7 J	20.7 J	9.85 J	7.5 J	16.6 J
ZINC	43.7	6000	10000	21.3 J	159	106 J	103 J	21.8 J	23.1 J	158 J

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO
LOCATION ID				G32-SB335	G32-SB336	G32-SB337	G32-SB338
DEPTH IN FEET				0-2	0-2	0-2	0-2
SAMPLE LOCATION TYPE				WITHIN SUMP	WITHIN SUMP	EXPOSED SOIL	EXPOSED SOIL
SAMPLE ID				G32-SB335-0002	G32-SB336-0002	G32-SB337-0002	G32-SB338-0002
SAMPLE DATE				20050705	20050706	20050714	20050714
VOLATILE ANALYSIS (µg/kg)							
2-BUTANONE		10000000	10000000	3 U	6 U	3	3 U
TRICHLOROETHENE		13000	520000	3 U	6 U	3 U	3 U
SEMIVOLATILE ANALYSIS (µg/kg)							
1,1-BIPHENYL				360	2300 J	370 U	350 U
2,4,5-TRICHLOROPHENOL		330000	10000000	730 U	7400 U	740 U	720 U
2,4,6-TRICHLOROPHENOL		58000	520000	360 U	3600 U	370 U	350 U
2,4-DINITROPHENOL		160000	4100000	730 UJ	7400 U	740 UJ	720 UJ
2-METHYLNAPHTHALENE	9.6	123000	10000000	1200	7800	4.1	3.5 U
4-METHYLPHENOL				49 J	3600 U	370 U	350 U
4-NITROANILINE				730 UJ	7400 UJ	740 U	720 UJ
4-NITROPHENOL				730 U	7400 U	740 U	720 U
ACENAPHTHENE	71	43000	10000000	4300 J	27000	46	86
ACENAPHTHYLENE	9.9	23000	10000000	71 J	520 J	5.4	3.5 U
ANTHRACENE	160	35000	10000000	9200	44000	210	310
BENZO(A)ANTHRACENE	530	900	7800	19000	110000	350	520
BENZO(A)PYRENE	450	400	800	15000	91000	300	370
BENZO(B)FLUORANTHENE	640	900	7800	18000	120000	360	440
BENZO(G,H,I)PERYLENE	300	800	10000000	10000 J	56000 J	150	190
BENZO(K)FLUORANTHENE	320	900	78000	8400	51000 J	170	230
BIS(2-ETHYLHEXYL)PHTHALATE	95	46000	410000	360 UJ	3600 U	370 U	350 U
BUTYL BENZYL PHTHALATE				360 UJ	3600 U	370 U	350 U
CARBAZOLE	72			4100 J	23000	370 U	64 J
CHRYSENE	630	400	780000	18000	100000	310	450
DIBENZO(A,H)ANTHRACENE	89	400	800	2500 J	14000 J	47	62
DIBENZOFURAN				3900	16000	370 U	120 J
DI-N-BUTYL PHTHALATE				360 UJ	3600 UJ	370 U	350 U
FLUORANTHENE	1100	20000	10000000	41000	240000	700	1100
FLUORENE	59	28000	10000000	4200 J	26000	42	160
HEXACHLOROCYCLOPENTADIENE				360 UJ	3600 U	370 U	350 UJ
INDENO(1,2,3-CD)PYRENE	270	900	7800	10000 J	58000 J	140	180
NAPHTHALENE	12	54000	10000000	3400	17000	6.2	6.9
PENTACHLOROPHENOL		5300	48000	730 U	7400 U	740 U	720 U
PHENANTHRENE	610	40000	10000000	35000	150000	320	500
PYRENE	880	13000	10000000	28000	170000	490	810

TABLE 4-1A

SUMMARY OF ANALYTICAL RESULTS: SURFACE SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO
LOCATION ID				G32-SB335	G32-SB336	G32-SB337	G32-SB338
DEPTH IN FEET				0-2	0-2	0-2	0-2
SAMPLE LOCATION TYPE				WITHIN SUMP	WITHIN SUMP	EXPOSED SOIL	EXPOSED SOIL
SAMPLE ID				G32-SB335-0002	G32-SB336-0002	G32-SB337-0002	G32-SB338-0002
SAMPLE DATE				20050705	20050706	20050714	20050714
PESTICIDE/PCB ANALYSIS (µg/kg)							
4,4'-DDD				18 U	18 U	3.7 UJ	3.5 U
4,4'-DDE				18 U	18 U	3.7 UJ	3.5 U
4,4'-DDT				18 U	18 U	3.7 UJ	3.5 U
ALPHA-CHLORDANE				9.2 U	9.3 U	1.9 UJ	1.8 U
AROCLOR-1260				59 J	700 J	37 UJ	35 U
BETA-BHC				9.2 U	9.3 U	1.9 UJ	1.8 U
ENDOSULFAN SULFATE				18 UJ	46 J	3.7 UJ	3.5 U
ENDRIN				18 U	18 U	3.7 UJ	3.5 U
ENDRIN ALDEHYDE				18 U	18 U	3.7 UJ	3.8
ENDRIN KETONE				58 J	18 U	3.7 UJ	4.1 J
GAMMA-CHLORDANE				9.2 U	9.3 U	1.9 UJ	1.8 U
METHOXYCHLOR				92 U	250 J	19 UJ	18 U
TOTAL AROCLOR		10000	10000	59	700	37 U	35 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)							
DIESEL RANGE ORGANICS	53	500	2500	1200 J	5500 J	97	65
METALS ANALYSIS (mg/kg)							
ALUMINUM	8850			6720	5350	7710	5570
ARSENIC	3.2	7	7	3.7 J	4.6 J	3.2 J	2.5 J
BARIUM	35	5500	10000	42.3 J	104 J	20.1 J	14.7 J
BERYLLIUM	0.3	0.4	1.3	0.2	0.18	0.22	0.24
CADMIUM	0.24	39	1000	0.56 J	7.6 J	0.0051 UJ	0.0049 UJ
CALCIUM	731			22100	54500	1080	932
CHROMIUM	11.1	1400	10000	9.5	18	11.3	8.3
COBALT	5.8			3.5 J	3.6 J	5.5 J	7 J
COPPER	21.2	3100	10000	29.5	71.9	16	18
CYANIDE		200	10000	0.12 U	0.18 UJ	0.12	0.12 U
IRON	12300			12900	24700	16300	11400
LEAD	84.5	150	500	77.1	250	7.2 J	5.8 J
MAGNESIUM	2620			2520	2990	2840	2200
MANGANESE	216	390	10000	174	211	156	111
MERCURY	0.033	23	610	0.011 J	0.06	0.012 J	0.0066 U
NICKEL	12.6	1000	10000	11.2 J	11.4 J	13.5 J	18.1 J
POTASSIUM	977			1060 J	738 J	599 J	469 J
SODIUM	32.4			109	275	30.7	26.7
VANADIUM	20.4	550	10000	11.7 J	9.8 J	15.1 J	10 J
ZINC	43.7	6000	10000	47.2 J	213	27.4 J	21.9 J

Notes:
(1) REF = Reference (Upgradient) Soil Concentrations Detected
(2) Residential Direct Exposure Criteria (RIDEM 2004)
(3) Industrial/Commercial Direct Exposure Criteria (RIDEM 2004)

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB300B	G32-SB302B	G32-SB302B	G32-SB303B	G32-SB304B	G32-SB305B	G32-SB305B	G32-SB306B
TOP DEPTH				6	25	5	10	6	3	9	10
BOTTOM DEPTH				8	27	7	12	8	5	11	12
SAMPLE ID				G32-SB300B-0608	G32-SB302B-2527	G32-SB302B-0507	G32-SB303B-1012	G32-SB304B-0608	G32-SB305B-0305	G32-SB305B-0911	G32-SB306B-1012
SAMPLE DATE				20050601	20050705	20050705	20050711	20050601	20050608	20050609	20050623
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	4 U	3 UJ	3 U	3 U	3 U	3 U	3 U	4 U
1,2,4-TRICHLOROBENZENE		96000	10000000	4 U	3 UJ	3 U	3 U	3 U	3 U	3 U	4 U
1,2-DIBROMO-3-CHLOROPROPANE				4 U	3 UJ	3 U	3 UJ	3 UJ	3 U	3 U	4 U
1,2-DICHLOROBENZENE		510000	10000000	4 U	3 UJ	3 U	3 U	3 U	3 U	3 U	4 U
1,3-DICHLOROBENZENE		430000	10000000	4 U	3 UJ	3 U	3 U	3 U	3 U	3 U	4 U
1,4-DICHLOROBENZENE		27000	240000	4 U	3 UJ	3 U	3 U	3 U	3 U	3 U	4 U
ACETONE		7800000	10000000	4 UJ	180 U	5 UJ	6 UJ	79 UJ	3 UJ	3 UJ	33 UJ
BENZENE		2500	200000	4 U	3 U	3 U	3 U	3 U	3 U	3 U	4 U
CARBON DISULFIDE				4 U	3 U	3 U	3 U	2 J	3 U	3 U	4
CIS-1,2-DICHLOROETHENE				4 U	3 U	3 U	3 U	3 U	3 U	3 U	4 U
ETHYLBENZENE		71000	10000000	4 U	3 U	3 U	3 U	1 J	3 U	3 U	4 U
ISOPROPYLBENZENE				4 U	3 U	3 U	3 U	68 J	3 U	3 U	4 U
M+P-XYLENES				NA	NA	NA	NA	NA	NA	NA	NA
METHYL ACETATE				4 U	3 U	3 U	3 U	2 J	3 U	3 U	4 U
METHYL CYCLOHEXANE				4 U	3 U	3 U	3 UJ	11 U	3 U	3 U	4 U
METHYL TERT-BUTYL ETHER				4 U	3 U	3 U	3 U	3 U	3 U	3 U	4 U
METHYLENE CHLORIDE		45000	760000	10 U	19 U	14 U	5 B	11 U	4 U	5 U	14 U
O-XYLENE				4 U	3 U	3 U	3 U	3 UJ	3 U	3 U	4 U
P-XYLENE				4 U	3 U	3 U	3 U	3 UJ	3 U	3 U	4 U
TOLUENE		190000	10000000	4 U	3 U	3 U	3 U	3 U	3 U	3 U	11
TOTAL XYLENES		110000	10000000	4 U	3 U	3 U	3 U	2 UJ	3 U	3 U	4 U
TRANS-1,2-DICHLOROETHENE				4 U	3 U	3 U	3 U	3 U	3 U	3 U	4 U
TRICHLOROETHENE		13000	520000	4 U	3 U	3 U	3 U	2 J	3 U	3 U	4 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				390 U	360 U	380 U	360 U	210 J	360 U	370 U	520 J
2-METHYLNAPHTHALENE		123000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	770	3.6 U	3.7 UJ	1800 J
4-METHYLPHENOL				390 U	360 U	380 U	360 U	410 U	360 U	370 U	2100 U
ACENAPHTHENE		43000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	1400	3.6 U	3.7 UJ	7200
ACENAPHTHYLENE		23000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	94	3.6 U	3.7 UJ	2100 U
ANTHRACENE		35000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	570	3.6 U	3.7 UJ	16000
BENZALDEHYDE				390 UJ	360 UJ	380 UJ	360 UJ	410 UJ	360 UJ	370 UJ	2100 UJ
BENZO(A)ANTHRACENE		900	7800	3.9 U	3.6 UJ	3.8 U	3.6 UJ	320 J	3.6 U	3.7 UJ	30000
BENZO(A)PYRENE		400	800	3.9 U	3.6 UJ	3.8 U	3.6 UJ	130	3.6 U	3.7 UJ	25000
BENZO(B)FLUORANTHENE		900	7800	3.9 U	3.6 UJ	3.8 U	3.6 UJ	230	3.6 U	3.7 UJ	36000
BENZO(G,H,I)PERYLENE		800	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	24	3.6 U	3.7 UJ	12000

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB300B	G32-SB302B	G32-SB302B	G32-SB303B	G32-SB304B	G32-SB305B	G32-SB305B	G32-SB306B
TOP DEPTH				6	25	5	10	6	3	9	10
BOTTOM DEPTH				8	27	7	12	8	5	11	12
SAMPLE ID				G32-SB300B-0608	G32-SB302B-2527	G32-SB302B-0507	G32-SB303B-1012	G32-SB304B-0608	G32-SB305B-0305	G32-SB305B-0911	G32-SB306B-1012
SAMPLE DATE				20050601	20050705	20050705	20050711	20050601	20050608	20050609	20050623
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	87	3.6 U	3.7 UJ	11000
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	230 JEB	53 J	39 J	270 J	84 JEB	200 JEB	160 JEB	2100 U
BUTYL BENZYL PHTHALATE				390 U	360 U	380 U	56 J	410 U	360 U	370 U	2100 U
CARBAZOLE				390 U	360 U	380 U	360 U	1200	360 U	370 U	5500
CHRYSENE		400	780000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	290	3.6 U	3.7 UJ	25000
DIBENZO(A,H)ANTHRACENE		400	800	3.9 UJ	3.6 UJ	3.8 U	3.6 UJ	12 J	3.6 UJ	3.7 UJ	3200
DIBENZOFURAN				390 U	360 U	380 U	360 U	1800	360 U	370 U	4500
DI-N-BUTYL PHTHALATE				390 U	360 UJ	380 UJ	360 U	410 U	360 U	370 U	2100 U
FLUORANTHENE		20000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	2100	4.6	3.7 UJ	80000
FLUORENE		28000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	2800	3.6 U	3.7 UJ	7600
INDENO(1,2,3-CD)PYRENE		900	7800	3.9 U	3.6 UJ	3.8 U	3.6 UJ	30	3.6 U	3.7 UJ	12000
NAPHTHALENE		54000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	1200	3.6 U	3.7 UJ	4300
PHENANTHRENE		40000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	5200	3.6 U	3.7 UJ	50000
PHENOL		6000000	10000000	390 U	360 U	380 U	360 U	410 U	360 U	370 U	210 J
PYRENE		13000	10000000	3.9 U	3.6 UJ	3.8 U	3.6 UJ	1300	4.3	3.7 UJ	55000
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	4.1 U
4,4'-DDE				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	9 R
4,4'-DDT				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	4.1 U
ALDRIN				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
ALPHA-BHC				2 U	1.9 UJ	2 UJ	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
ALPHA-CHLORDANE				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.2 R
AROCLOR-1016				39 U	36 U	38 U	36 U	41 UJ	36 U	37 U	41 U
AROCLOR-1254				39 U	36 U	38 U	36 U	41 UJ	36 U	37 U	460 J
AROCLOR-1260				39 U	36 U	38 U	36 U	41 UJ	36 U	37 U	41 U
BETA-BHC				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
DELTA-BHC				2 UJ	1.9 R	2 R	1.8 U	2.1 UJ	1.8 UJ	1.9 UJ	2.1 UJ
DIELDRIN		40	400	3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	4.1 U
ENDOSULFAN I				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
ENDOSULFAN II				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	4.1 U
ENDOSULFAN SULFATE				3.9 U	3.6 UJ	3.8 UJ	3.6 U	4.1 UJ	3.6 U	3.7 U	140 E
ENDRIN				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 UJ	3.7 UJ	4.1 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB300B	G32-SB302B	G32-SB302B	G32-SB303B	G32-SB304B	G32-SB305B	G32-SB305B	G32-SB306B
TOP DEPTH				6	25	5	10	6	3	9	10
BOTTOM DEPTH				8	27	7	12	8	5	11	12
SAMPLE ID				G32-SB300B-0608	G32-SB302B-2527	G32-SB302B-0507	G32-SB303B-1012	G32-SB304B-0608	G32-SB305B-0305	G32-SB305B-0911	G32-SB306B-1012
SAMPLE DATE				20050601	20050705	20050705	20050711	20050601	20050608	20050609	20050623
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	16
ENDRIN KETONE				3.9 U	3.6 U	3.8 U	3.6 U	4.1 UJ	3.6 U	3.7 U	19 J
GAMMA-BHC (LINDANE)				2 U	1.9 UJ	2 UJ	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
GAMMA-CHLORDANE				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
HEPTACHLOR				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.1 U
HEPTACHLOR EPOXIDE				2 U	1.9 U	2 U	1.8 U	2.1 UJ	1.8 U	1.9 U	2.4 R
METHOXYCHLOR				20 U	19 U	20 U	18 U	21 UJ	18 UJ	19 UJ	21 U
TOTAL AROCLOR		10000	10000	39 U	36 U	38 U	36 U	41 U	36 U	37 U	460
TOXAPHENE				200 U	190 U	200 U	180 U	210 UJ	180 U	190 U	210 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	4.9 U	3.4 U	3.9 U	4.1 UJ	140 J	3.9 U	3.6 U	7.6 U
DIESEL RANGE ORGANICS		500	2500	18	13 U	21	13 U	220	13 U	15	1300
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			9040 J	5340	6180	8280	6250 J	5840 J	3460 J	7230 J
ANTIMONY		10	820	0.23 UJ	0.38 UJ	0.3 UJ	0.38 UJ	0.27 UJ	0.15 UJ	0.25 UJ	0.61 UJ
ARSENIC	2	7	7	2.9 J	1.9 J	2.2 J	2 J	2.4 J	1.5 J	1.6 J	4.2 J
BARIUM	22.7	5500	10000	15.2 J	19.8 J	13.4 J	17.4 J	22.7 J	34.5 J	11.8 J	82 J
BERYLLIUM	0.16	0.4	1.3	0.13	0.2	0.17	0.25	0.2	0.073	0.075	0.25 J
CADMIUM		39	1000	0.24 J	0.0053 UJ	0.0054 UJ	0.0052 UJ	0.21 J	0.0069 UJ	0.0051 U	0.7 J
CALCIUM	532			1150	873	933	1000	513	1060	453	44200 J
CHROMIUM	6.2	1400	10000	13.4 J	7.7	8.6	14.3	9.2 J	9.6 J	4.7 J	12.3 J
COBALT	2.9			4.8 J	5.2 J	3.3 J	7.8 J	4.7 J	3.6 J	2.2 J	3.1 J
COPPER	9.8	3100	10000	12.2 J	10	21.7	29.5	17.6 J	7.2 J	9.2 J	19 J
CYANIDE		200	10000	0.13 U	0.11 U	0.12 U	0.12 U	0.15 U	0.13 U	0.13 U	0.13 U
IRON	9260			18800	9270	10100	17800	10100	9610	6270	16000 J
LEAD	5.1	150	500	6.7 J	4 J	4.1 J	7.4 J	8.7 J	5.4 J	4 J	121 J
MAGNESIUM	1880			4270 J	2200	2180	3800	2250 J	2810 J	1360 J	4620 J
MANGANESE	115	390	10000	183 J	105	103	154	99.7 J	110 J	74.3 J	235 J
MERCURY		23	610	0.01 J	0.0062 U	0.0073 U	0.0068 U	0.019 J	0.0074 UJ	0.0069 UJ	0.27
NICKEL	6.5	1000	10000	8.7 J	12.3 J	13.9 J	20.2 J	10.1 J	7 J	4.5 J	8.4 J
POTASSIUM	680			767	636 J	469 J	733 J	782	2170	647	720
SODIUM	22.6			97.6	148	32.5	115	48.2	168	140	1410
VANADIUM	8.1	550	10000	15.6 J	9.3 J	8.2 J	12.8 J	10.6 J	12.7 J	5.5 J	15.1 J
ZINC	18.1	6000	10000	42.7 J	22.5 J	19.8 J	33 J	26.4 J	17.4 J	12.1 J	135 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB306B	G32-SB309	G32-SB310	G32-SB311	G32-SB312	G32-SB313	G32-SB314	G32-SB314
TOP DEPTH					38		17	36	10	17	2
BOTTOM DEPTH					40		19	38	12	19	4
SAMPLE ID				G32-SB306B-5052	G32-SB309-3840-AVG	G32-SB310-4042	G32-SB311-1719	G32-SB312-3638	G32-SB313-1012-AVG	G32-SB314-1719	G32-SB314-0204
SAMPLE DATE				20050624	20050712	20050713	20050629	20050630	20050705	20050708	20050708
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 U	2.5 U	3 U	3 UJ	3 U	3 UJ	3 U	3 U
1,2,4-TRICHLOROBENZENE		96000	10000000	3 U	2.5 U	3 U	3 UJ	3 U	3 UJ	3 U	3 U
1,2-DIBROMO-3-CHLOROPROPANE				3 U	2.5 UJ	3 UJ	3 UJ	3 U	3 UJ	3 U	3 U
1,2-DICHLOROBENZENE		510000	10000000	3 U	2.5 U	3 U	3 UJ	3 U	3 UJ	3 U	3 U
1,3-DICHLOROBENZENE		430000	10000000	3 U	2.5 U	3 U	3 UJ	3 U	3 UJ	3 U	3 U
1,4-DICHLOROBENZENE		27000	240000	3 U	2.5 U	3 U	3 UJ	3 U	3 UJ	3 U	3 U
ACETONE		7800000	10000000	14 UJ	4 UJ	6 UJ	22 UJ	7 UJ	3 UJ	14 UJ	3 UJ
BENZENE		2500	200000	3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
CARBON DISULFIDE				2 J	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
CIS-1,2-DICHLOROETHENE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 J	3 U
ETHYLBENZENE		71000	10000000	3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
ISOPROPYLBENZENE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
M+P-XYLENES				NA	NA	NA	NA	NA	NA	NA	NA
METHYL ACETATE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
METHYL CYCLOHEXANE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
METHYL TERT-BUTYL ETHER				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
METHYLENE CHLORIDE		45000	760000	17 U	20.5 UJ	20 UJ	19 U	16 U	19 UJ	17 UJ	47 U
O-XYLENE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
P-XYLENE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
TOLUENE		190000	10000000	3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
TOTAL XYLENES		110000	10000000	3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
TRANS-1,2-DICHLOROETHENE				3 U	2.5 U	3 U	3 U	3 U	3 U	3 U	3 U
TRICHLOROETHENE		13000	520000	3 U	2.5 U	3 U	3 U	3 U	3 U	17	3 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				380 UJ	375 U	370 U	360 U	350 U	380 UJ	380 U	370 U
2-METHYLNAPHTHALENE		123000	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	11.25 J	3.8 UJ	3.7 U
4-METHYLPHENOL				380 UJ	375 U	370 U	360 U	350 U	380 UJ	380 U	370 U
ACENAPHTHENE		43000	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	64.5 J	3.8 UJ	9.1
ACENAPHTHYLENE		23000	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	3.8 UJ	3.8 UJ	3.7 U
ANTHRACENE		35000	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	115 J	3.8 UJ	22
BENZALDEHYDE				380 UJ	375 UJ	370 UJ	360 UJ	350 UJ	380 UJ	380 UJ	370 UJ
BENZO(A)ANTHRACENE		900	7800	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	215 J	3.8 UJ	43
BENZO(A)PYRENE		400	800	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	170 J	3.8 UJ	22
BENZO(B)FLUORANTHENE		900	7800	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	210 J	3.8 UJ	31
BENZO(G,H,I)PERYLENE		800	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	66 J	3.8 UJ	4.5

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB306B	G32-SB309	G32-SB310	G32-SB311	G32-SB312	G32-SB313	G32-SB314	G32-SB314
TOP DEPTH					38		17	36	10	17	2
BOTTOM DEPTH					40		19	38	12	19	4
SAMPLE ID				G32-SB306B-5052	G32-SB309-3840-AVG	G32-SB310-4042	G32-SB311-1719	G32-SB312-3638	G32-SB313-1012-AVG	G32-SB314-1719	G32-SB314-0204
SAMPLE DATE				20050624	20050712	20050713	20050629	20050630	20050705	20050708	20050708
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	76.5 J	3.8 UJ	13
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	380 UJ	40 J	370 U	39 J	350 U	65 J	380 U	370 U
BUTYL BENZYL PHTHALATE				380 UJ	375 U	370 U	360 U	350 U	380 UJ	380 U	370 U
CARBAZOLE				380 UJ	375 U	370 U	360 U	350 U	43 J	380 U	370 U
CHRYSENE		400	780000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	195 J	3.8 UJ	42
DIBENZO(A,H)ANTHRACENE		400	800	3.8 UJ	3.8 UJ	3.7 UJ	360 U	3.5 UJ	22 J	3.8 UJ	3.7 U
DIBENZOFURAN				380 UJ	375 U	370 U	360 U	350 U	380 UJ	380 U	370 U
DI-N-BUTYL PHTHALATE				380 UJ	375 U	370 U	360 U	350 UJ	110 J	380 UJ	370 UJ
FLUORANTHENE		20000	10000000	10 J	3.75 UJ	3.7 UJ	3.9 J	3.5 UJ	385 J	4.3 J	120
FLUORENE		28000	10000000	3.8 UJ	3.75 UJ	3.7 UJ	360 U	3.5 UJ	64.5 J	3.8 UJ	8.9
INDENO(1,2,3-CD)PYRENE		900	7800	3.8 UJ	3.8 UJ	3.7 UJ	360 U	3.5 UJ	62 J	3.8 UJ	4.4
NAPHTHALENE		54000	10000000	5.1 J	3.75 UJ	3.7 UJ	360 U	3.5 UJ	18.5 EBJ	3.8 UJ	7.4 EB
PHENANTHRENE		40000	10000000	8.7 J	3.75 UJ	3.7 UJ	360 U	3.5 UJ	390 J	3.8 UJ	82
PHENOL		6000000	10000000	380 UJ	375 U	370 U	360 U	350 U	380 UJ	380 U	370 U
PYRENE		13000	10000000	7.8 J	3.75 UJ	3.7 UJ	360 U	3.5 UJ	350 J	3.8 UJ	89
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
4,4'-DDE				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
4,4'-DDT				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
ALDRIN				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
ALPHA-BHC				1.9 U	1.9 U	1.9 U	1.9 UJ	1.8 UJ	1.95 UJ	2 UJ	1.9 UJ
ALPHA-CHLORDANE				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
AROCLOR-1016				38 U	37.5 U	37 U	36 U	35 U	37.5 U	38 U	37 U
AROCLOR-1254				38 U	37.5 U	37 U	36 U	35 U	37.5 U	38 U	37 U
AROCLOR-1260				38 U	37.5 U	37 U	36 U	35 U	37.5 U	38 U	37 U
BETA-BHC				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
DELTA-BHC				1.9 UJ	1.9 U	1.9 U	1.9 R	1.8 R	1.95 R	2 R	1.9 R
DIELDRIN		40	400	3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
ENDOSULFAN I				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
ENDOSULFAN II				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
ENDOSULFAN SULFATE				3.8 U	3.75 U	3.7 U	3.6 UJ	3.5 UJ	3.75 UJ	3.8 UJ	3.7 UJ
ENDRIN				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB306B	G32-SB309	G32-SB310	G32-SB311	G32-SB312	G32-SB313	G32-SB314	G32-SB314
TOP DEPTH					38		17	36	10	17	2
BOTTOM DEPTH					40		19	38	12	19	4
SAMPLE ID				G32-SB306B-5052	G32-SB309-3840-AVG	G32-SB310-4042	G32-SB311-1719	G32-SB312-3638	G32-SB313-1012-AVG	G32-SB314-1719	G32-SB314-0204
SAMPLE DATE				20050624	20050712	20050713	20050629	20050630	20050705	20050708	20050708
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
ENDRIN KETONE				3.8 U	3.75 U	3.7 U	3.6 U	3.5 U	3.75 U	3.8 U	3.7 U
GAMMA-BHC (LINDANE)				1.9 U	1.9 U	1.9 U	1.9 UJ	1.8 UJ	1.95 UJ	2 UJ	1.9 UJ
GAMMA-CHLORDANE				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
HEPTACHLOR				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
HEPTACHLOR EPOXIDE				1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.95 U	2 U	1.9 U
METHOXYCHLOR				19 U	19 U	22 R	19 U	18 U	19.5 U	20 U	19 U
TOTAL AROCLOR		10000	10000	38 U	37.5 U	37 U	36 U	35 U	37.5 U	38 U	37 U
TOXAPHENE				190 U	190 U	190 U	190 U	180 U	195 U	200 U	190 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	4.2 U	3 U	4.1 U	3.8 U	3.4 U	3.8 U	3.8 U	4.3 U
DIESEL RANGE ORGANICS		500	2500	14 U	13.5 U	13 U	13 U	13 U	14 U	14 U	17
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			3350 J	4495	3640	7250	4070	5385	4010	7650
ANTIMONY		10	820	0.054 UJ	0.365 UJ	0.38 UJ	0.54 UJ	0.29 UJ	0.37 UJ	0.29 UJ	0.37 UJ
ARSENIC	2	7	7	1.4 J	2 J	1.8 J	5.9 J	1.6 J	2.1 J	1.6 J	2.7 J
BARIUM	22.7	5500	10000	12.1 J	14.85 J	14.3 J	18.4 J	17.6 J	18.6 J	11.2 J	22.1 J
BERYLLIUM	0.16	0.4	1.3	0.13 J	0.14	0.13	0.37	0.14	0.325	0.16	0.22
CADMIUM		39	1000	0.0053 UJ	0.00555 UJ	0.0053 UJ	0.0051 UJ	0.0055 UJ	0.0054 UJ	0.0052 UJ	0.0051 UJ
CALCIUM	532			700 J	903	979	1120	765	1095	676	2080
CHROMIUM	6.2	1400	10000	5.8 J	6.65	5.1	10.7 J	7	8.3	5.5	10.7
COBALT	2.9			4 J	6.45 J	3.9 J	17.8 J	4.2 J	5.5 J	4.2 J	4.2 J
COPPER	9.8	3100	10000	7.5 J	10.6	8.1	17.3	9.3	11.15	10.4	17.1
CYANIDE		200	10000	0.13 U	0.13 U	0.11 U	0.13 U	0.11 U	0.13 U	0.13 U	0.13 U
IRON	9260			7420 J	9045	6910	21400	7930	9940	7230	16000
LEAD	5.1	150	500	3.6 J	4 J	3.3 J	8.7 J	3.7 J	5 J	3.9 J	7.2 J
MAGNESIUM	1880			1610 J	2065	1560	2920	1970	2130	1490	2960
MANGANESE	115	390	10000	84 J	100.35	74.5	125	81.6	102.35	102	165
MERCURY		23	610	0.0076 U	0.00685 U	0.0068 U	0.0074 U	0.0066 U	0.0097 J	0.0077 U	0.0075 U
NICKEL	6.5	1000	10000	8 J	12.95 J	10.1 J	21.2 J	9.7 J	15.9 J	7.1 J	8.5 J
POTASSIUM	680			559	666 J	537 J	742 J	866 J	639.5 J	332 J	890 J
SODIUM	22.6			30.7 U	38.65	38.1	45.8	27.5	166	40.9	147
VANADIUM	8.1	550	10000	6.4 J	8 J	6.7 J	12.9 J	7.5 J	9.6 J	7.7 J	12.5 J
ZINC	18.1	6000	10000	17 J	19.95 J	16.8 J	30.9 J	19.5 J	25.05 J	15.5 J	23.2 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB315	G32-SB315	G32-SB316	G32-SB316	G32-SB317	G32-SB318	G32-SB319	G32-SB319
TOP DEPTH				2	8	12	2	15	10	4	6
BOTTOM DEPTH				4	10	14	3	17	12	6	8
SAMPLE ID				G32-SB315-0204	G32-SB315-0810	G32-SB316-1214-AVG	G32-SB316-0203	G32-SB317-1517	G32-SB318-1012-AVG	G32-SB319-0406	G32-SB319-0608-AVG
SAMPLE DATE				20050615	20050615	20050622	20050622	20050622	20050621	20050622	20050622
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
1,2,4-TRICHLOROBENZENE		96000	10000000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
1,2-DIBROMO-3-CHLOROPROPANE				3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
1,2-DICHLOROBENZENE		510000	10000000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
1,3-DICHLOROBENZENE		430000	10000000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
1,4-DICHLOROBENZENE		27000	240000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 UJ
ACETONE		7800000	10000000	7 UJ	3 UJ	7.5 UJ	13 UJ	30 UJ	13.5 UJ	30 UJ	27 UJ
BENZENE		2500	200000	3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
CARBON DISULFIDE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
CIS-1,2-DICHLOROETHENE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
ETHYLBENZENE		71000	10000000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 U
ISOPROPYLBENZENE				3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 U
M+P-XYLENES				NA	NA	NA	NA	NA	3 UJ	NA	NA
METHYL ACETATE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
METHYL CYCLOHEXANE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
METHYL TERT-BUTYL ETHER				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
METHYLENE CHLORIDE		45000	760000	3 U	4 U	6.5 U	19 U	22 U	12 U	15 U	15 U
O-XYLENE				3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 U
P-XYLENE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
TOLUENE		190000	10000000	1 J	1 J	3 U	4 U	5 U	3 U	3 U	3.5 U
TOTAL XYLENES		110000	10000000	3 U	3 U	3 U	4 U	5 U	3 UJ	3 U	3.5 U
TRANS-1,2-DICHLOROETHENE				3 U	3 U	3 U	4 U	5 U	3 U	3 U	3.5 U
TRICHLOROETHENE		13000	520000	3 U	3 U	3 U	4 U	3 J	3 U	3 U	3.5 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				360 U	360 U	370 U	NA	370 U	365 U	360 U	350 U
2-METHYLNAPHTHALENE		123000	10000000	3.6 UJ	3.6 UJ	3.7 UJ	NA	89	82	20	3.5 UJ
4-METHYLPHENOL				360 U	360 U	370 U	NA	370 U	365 U	360 U	350 U
ACENAPHTHENE		43000	10000000	3.6 UJ	3.6 UJ	4.85 J	NA	320 J	295	82	4.1 J
ACENAPHTHYLENE		23000	10000000	3.6 UJ	3.6 UJ	3.7 UJ	NA	10	17.5	74	6.25 J
ANTHRACENE		35000	10000000	3.6 UJ	3.6 UJ	5.9 J	NA	590	485	190	19 J
BENZALDEHYDE				360 UJ	360 UJ	370 UJ	NA	370 UJ	365 UJ	360 UJ	350 UJ
BENZO(A)ANTHRACENE		900	7800	3.6 UJ	3.6 UJ	5.25 J	NA	1000	715	220	18.5 J
BENZO(A)PYRENE		400	800	3.6 UJ	3.6 UJ	3.2 J	NA	780	595	190	9.3 J
BENZO(B)FLUORANTHENE		900	7800	3.6 UJ	3.6 UJ	3.75 J	NA	1000	700	230	14.15 J
BENZO(G,H,I)PERYLENE		800	10000000	3.6 UJ	3.6 UJ	3.7 UJ	NA	380	335 J	79	3.5 UJ

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB315	G32-SB315	G32-SB316	G32-SB316	G32-SB317	G32-SB318	G32-SB319	G32-SB319
TOP DEPTH				2	8	12	2	15	10	4	6
BOTTOM DEPTH				4	10	14	3	17	12	6	8
SAMPLE ID				G32-SB315-0204	G32-SB315-0810	G32-SB316-1214-AVG	G32-SB316-0203	G32-SB317-1517	G32-SB318-1012-AVG	G32-SB319-0406	G32-SB319-0608-AVG
SAMPLE DATE				20050615	20050615	20050622	20050622	20050622	20050621	20050622	20050622
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	3.6 UJ	3.6 UJ	3.7 UJ	NA	430	280	83	4.725 J
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	130 JEB	85 JEB	39 J	NA	99 J	365 U	39 J	350 U
BUTYL BENZYL PHTHALATE				360 U	360 U	370 U	NA	370 U	365 U	360 U	350 U
CARBAZOLE				360 UJ	360 UJ	370 U	NA	300 J	215 J	550	350 U
CHRYSENE		400	780000	3.6 UJ	3.6 UJ	5.65 J	NA	970	680	210	19 J
DIBENZO(A,H)ANTHRACENE		400	800	3.6 UJ	3.6 UJ	3.7 UJ	NA	140 J	104.5 J	24 J	3.5 UJ
DIBENZOFURAN				360 U	360 U	370 U	NA	240 J	185 J	210 J	350 U
DI-N-BUTYL PHTHALATE				360 U	360 U	370 U	NA	370 U	365 U	48 J	350 U
FLUORANTHENE		20000	10000000	6.6 J	3.6 UJ	20.9 J	NA	2500	1900	750	72.5 J
FLUORENE		28000	10000000	3.6 UJ	3.6 UJ	4.35 J	NA	330 J	290	280	21.5 J
INDENO(1,2,3-CD)PYRENE		900	7800	3.6 UJ	3.6 UJ	3.7 UJ	NA	400	295 J	80	3.5 UJ
NAPHTHALENE		54000	10000000	3.6 UJ	3.6 UJ	5.25 J	NA	250 J	210	31	3.5 UJ
PHENANTHRENE		40000	10000000	4.2 J	3.6 UJ	21.25 J	NA	2200	1700	930	92 J
PHENOL		6000000	10000000	360 U	360 U	370 U	NA	370 U	365 U	360 U	350 U
PYRENE		13000	10000000	6.9 J	3.6 UJ	14.85 J	NA	1600	1250	470	51.5 J
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
4,4'-DDE				3.6 U	3.6 U	3.7 U	NA	3.7 U	5.175 J	3.6 U	3.5 U
4,4'-DDT				3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
ALDRIN				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
ALPHA-BHC				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
ALPHA-CHLORDANE				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
AROCLOR-1016				36 U	36 U	37 U	NA	37 U	36.5 U	36 U	35 U
AROCLOR-1254				36 U	36 U	37 U	NA	37 U	36.5 U	36 U	35 U
AROCLOR-1260				36 U	36 U	37 U	NA	37 U	36.5 U	36 U	35 U
BETA-BHC				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
DELTA-BHC				1.8 UJ	1.8 UJ	1.95 UJ	NA	1.9 UJ	1.9 UJ	1.8 UJ	1.8 UJ
DIELDRIN		40	400	3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
ENDOSULFAN I				1.8 U	1.8 U	1.95 U	NA	1.9 U	2.875	1.8 U	1.8 U
ENDOSULFAN II				3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
ENDOSULFAN SULFATE				3.6 UJ	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
ENDRIN				3.6 U	3.6 UJ	3.7 U	NA	3.7 U	7.925 J	3.6 U	3.5 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB315	G32-SB315	G32-SB316	G32-SB316	G32-SB317	G32-SB318	G32-SB319	G32-SB319
TOP DEPTH				2	8	12	2	15	10	4	6
BOTTOM DEPTH				4	10	14	3	17	12	6	8
SAMPLE ID				G32-SB315-0204	G32-SB315-0810	G32-SB316-1214-AVG	G32-SB316-0203	G32-SB317-1517	G32-SB318-1012-AVG	G32-SB319-0406	G32-SB319-0608-AVG
SAMPLE DATE				20050615	20050615	20050622	20050622	20050622	20050621	20050622	20050622
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
ENDRIN KETONE				3.6 U	3.6 U	3.7 U	NA	3.7 U	3.65 U	3.6 U	3.5 U
GAMMA-BHC (LINDANE)				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
GAMMA-CHLORDANE				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
HEPTACHLOR				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
HEPTACHLOR EPOXIDE				1.8 U	1.8 U	1.95 U	NA	1.9 U	1.9 U	1.8 U	1.8 U
METHOXYCHLOR				18 UJ	18 UJ	19.5 U	NA	19 U	19 U	18 U	19.5
TOTAL AROCLOR		10000	10000	36 U	36 U	37 U	NA	37 U	36.5 U	36 U	35 U
TOXAPHENE				180 U	180 U	195 U	NA	190 U	190 U	180 U	180 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	4.6 U	4.4 U	4.4 U	4.1 U	4 U	4.25 U	3.9 U	5.95 U
DIESEL RANGE ORGANICS		500	2500	13 U	13 U	13.5 U	NA	40	30.5 J	19	13 U
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			4190 J	5860 J	8580 J	5660 J	11200 J	7970 J	5710 J	7625 J
ANTIMONY		10	820	0.13 UJ	0.32 UJ	0.056 J	0.048 UJ	0.053 UJ	0.341 UJ	0.05 UJ	0.0495 UJ
ARSENIC	2	7	7	1.9 J	2.4 J	2.6 J	2 J	2.7 J	2.4 J	2 J	2.3 J
BARIUM	22.7	5500	10000	13.9 J	18.2 J	18.6 J	17.3 J	20.3 J	20.6 J	40 J	14.45 J
BERYLLIUM	0.16	0.4	1.3	0.15	0.35	0.235 J	0.16 J	0.2 J	0.205 J	0.17 J	0.225 J
CADMIUM		39	1000	0.036 UJ	0.015 UJ	0.00545 UJ	0.0047 UJ	0.0052 UJ	0.049 J	0.0049 UJ	0.00485 UJ
CALCIUM	532			1130	496	1075 J	3870 J	1400 J	2790 J	1100 J	828.5 J
CHROMIUM	6.2	1400	10000	6.5 J	8.6 J	13.95 J	8.2 J	21.1 J	13.35 J	11.6 J	13.2 J
COBALT	2.9			3 J	4.7 J	8.45 J	7.3 J	6.2 J	8.45 J	7.2 J	9.55 J
COPPER	9.8	3100	10000	11 J	15.7 J	22.65 J	15 J	17.4 J	17.25 J	28.6 J	30.95 J
CYANIDE		200	10000	0.12 U	0.12 U	0.12 U	0.14	0.12 U	0.12 U	0.54	0.115 U
IRON	9260			7500	10900	17820 J	11200 J	24500 J	18400 J	10300 J	19250 J
LEAD	5.1	150	500	4 J	5.8 J	6.55 J	5.4 J	14 J	15.1 J	6.7 J	6.95 J
MAGNESIUM	1880			1580 J	2220 J	3765 J	2350 J	4970 J	3695 J	2600 J	3375 J
MANGANESE	115	390	10000	94.8 J	112 J	148.1 J	114 J	176 J	154 J	96.3 J	132.5 J
MERCURY		23	610	0.0063 UJ	0.0068 UJ	0.00745 U	0.0065 U	0.0073 U	0.00725 U	0.0066 U	0.0067 U
NICKEL	6.5	1000	10000	6.4 J	10.3 J	19.85 J	16 J	13.7 J	22.85 J	19.5 J	24.25 J
POTASSIUM	680			627	4.2 U	595	597	668	690	1580	465.5
SODIUM	22.6			212	6.9 U	58.325	86.7	73.9	115.75	104	110
VANADIUM	8.1	550	10000	7.4 J	12.3 J	12.35 J	9 J	13.9 J	11.15 J	14.2 J	8.85 J
ZINC	18.1	6000	10000	19.9 J	25.8 J	35.15 J	24.1 J	39.7 J	41.8 J	30.5 J	31.05 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB320	G32-SB320	G32-SB321	G32-SB321	G32-SB322	G32-SB322	G32-SB323	G32-SB323
TOP DEPTH				4	8	10	2	2	6	10	2
BOTTOM DEPTH				6	10	12	4	4	8	12	4
SAMPLE ID				G32-SB320-0406	G32-SB320-0810	G32-SB321-1012	G32-SB321-0204	G32-SB322-0204	G32-SB322-0608	G32-SB323-1012	G32-SB323-0204
SAMPLE DATE				20050621	20050621	20050623	20050623	20050620	20050620	20050621	20050621
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
1,2,4-TRICHLOROBENZENE		96000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
1,2-DIBROMO-3-CHLOROPROPANE				4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
1,2-DICHLOROBENZENE		510000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
1,3-DICHLOROBENZENE		430000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
1,4-DICHLOROBENZENE		27000	240000	4 UJ	2 U	3 U	3 U	4 U	3 UJ	3 U	3 U
ACETONE		7800000	10000000	8 UJ	7 UJ	7 UJ	8 UJ	4 UJ	10 UJ	18 UJ	13 UJ
BENZENE		2500	200000	4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
CARBON DISULFIDE				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
CIS-1,2-DICHLOROETHENE				4 UJ	2 U	3 U	3 U	2 J	1 J	3 U	3 U
ETHYLBENZENE		71000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
ISOPROPYLBENZENE				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
M+P-XYLENES				4 UJ	NA	NA	NA	NA	3 U	3 U	3 U
METHYL ACETATE				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
METHYL CYCLOHEXANE				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
METHYL TERT-BUTYL ETHER				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
METHYLENE CHLORIDE		45000	760000	13 UJ	8 U	15 U	16 U	5 U	4 U	10 U	11 U
O-XYLENE				4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
P-XYLENE				NA	2 U	3 U	3 U	4 U	NA	NA	NA
TOLUENE		190000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
TOTAL XYLENES		110000	10000000	4 UJ	2 U	3 U	3 U	4 U	3 U	3 U	3 U
TRANS-1,2-DICHLOROETHENE				4 UJ	2 U	3 U	3 U	1 J	1 J	3 U	3 U
TRICHLOROETHENE		13000	520000	4 UJ	2 U	2 J	6	3 J	59	3 U	2 J
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
2-METHYLNAPHTHALENE		123000	10000000	NA	3.7 UJ	3.6 UJ	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
4-METHYLPHENOL				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
ACENAPHTHENE		43000	10000000	NA	3.7 UJ	3.6 UJ	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
ACENAPHTHYLENE		23000	10000000	NA	3.7 UJ	3.6 UJ	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
ANTHRACENE		35000	10000000	NA	3.7 UJ	3.7 J	7.6	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
BENZALDEHYDE				NA	370 UJ	360 UJ	360 UJ	360 UJ	400 UJ	360 UJ	360 UJ
BENZO(A)ANTHRACENE		900	7800	NA	4.6 J	48 J	11	4.4 J	4 UJ	3.6 UJ	5.2 J
BENZO(A)PYRENE		400	800	NA	3.7 UJ	78 J	3.6 U	3.6 UJ	4 UJ	3.6 UJ	4.2 J
BENZO(B)FLUORANTHENE		900	7800	NA	3.7 UJ	95 J	6.2	3.6 UJ	4 UJ	3.6 UJ	6.5 J
BENZO(G,H,I)PERYLENE		800	10000000	NA	3.7 UJ	39 J	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB320	G32-SB320	G32-SB321	G32-SB321	G32-SB322	G32-SB322	G32-SB323	G32-SB323
TOP DEPTH				4	8	10	2	2	6	10	2
BOTTOM DEPTH				6	10	12	4	4	8	12	4
SAMPLE ID				G32-SB320-0406	G32-SB320-0810	G32-SB321-1012	G32-SB321-0204	G32-SB322-0204	G32-SB322-0608	G32-SB323-1012	G32-SB323-0204
SAMPLE DATE				20050621	20050621	20050623	20050623	20050620	20050620	20050621	20050621
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	NA	3.7 UJ	31 J	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	NA	370 U	360 U	360 U	360 U	400 U	80 J	140 J
BUTYL BENZYL PHTHALATE				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
CARBAZOLE				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
CHRYSENE		400	780000	NA	5.3 J	48 J	11	4.2 J	4 UJ	3.6 UJ	6.6 J
DIBENZO(A,H)ANTHRACENE		400	800	NA	3.7 UJ	11 J	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
DIBENZOFURAN				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
DI-N-BUTYL PHTHALATE				NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
FLUORANTHENE		20000	10000000	NA	17 J	22 J	41	15 J	7.6 J	5.1 J	14 J
FLUORENE		28000	10000000	NA	3.7 UJ	3.6 UJ	4	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
INDENO(1,2,3-CD)PYRENE		900	7800	NA	3.7 UJ	39 J	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
NAPHTHALENE		54000	10000000	NA	3.7 UJ	3.6 UJ	3.6 U	3.6 UJ	4 UJ	3.6 UJ	3.6 UJ
PHENANTHRENE		40000	10000000	NA	8.1 J	14 J	31	12 J	6.4 J	4.6 J	8.2 J
PHENOL		6000000	10000000	NA	370 U	360 U	360 U	360 U	400 U	360 U	360 U
PYRENE		13000	10000000	NA	13 J	21 J	30	11 J	5.7 J	3.8 J	14 J
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
4,4'-DDE				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
4,4'-DDT				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
ALDRIN				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
ALPHA-BHC				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
ALPHA-CHLORDANE				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.5 J	1.9 U	1.8 U
AROCLOR-1016				NA	37 U	36 U	36 U	36 U	40 U	36 U	36 U
AROCLOR-1254				NA	37 U	36 U	36 U	36 U	140 J	36 U	36 U
AROCLOR-1260				NA	37 U	36 U	36 U	36 U	40 U	36 U	36 U
BETA-BHC				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
DELTA-BHC				NA	1.9 UJ	1.9 UJ	1.8 UJ	1.9 UJ	2.1 UJ	1.9 UJ	1.8 UJ
DIELDRIN		40	400	NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
ENDOSULFAN I				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
ENDOSULFAN II				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
ENDOSULFAN SULFATE				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
ENDRIN				NA	3.7 U	3.6 U	3.6 U	3.6 U	6.1 J	3.6 U	3.6 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB320	G32-SB320	G32-SB321	G32-SB321	G32-SB322	G32-SB322	G32-SB323	G32-SB323
TOP DEPTH				4	8	10	2	2	6	10	2
BOTTOM DEPTH				6	10	12	4	4	8	12	4
SAMPLE ID				G32-SB320-0406	G32-SB320-0810	G32-SB321-1012	G32-SB321-0204	G32-SB322-0204	G32-SB322-0608	G32-SB323-1012	G32-SB323-0204
SAMPLE DATE				20050621	20050621	20050623	20050623	20050620	20050620	20050621	20050621
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
ENDRIN KETONE				NA	3.7 U	3.6 U	3.6 U	3.6 U	4 U	3.6 U	3.6 U
GAMMA-BHC (LINDANE)				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
GAMMA-CHLORDANE				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
HEPTACHLOR				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
HEPTACHLOR EPOXIDE				NA	1.9 U	1.9 U	1.8 U	1.9 U	2.1 U	1.9 U	1.8 U
METHOXYCHLOR				NA	67 J	19 U	18 U	19 U	21 U	19 U	18 U
TOTAL AROCLOR		10000	10000	NA	37 U	36 U	36 U	36 U	140	36 U	36 U
TOXAPHENE				NA	190 U	190 U	180 U	190 U	210 U	190 U	180 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	4.2 UJ	4.1 U	3.4 U	3.8 U	5.1 U	5.4 U	3.9 U	4.7 U
DIESEL RANGE ORGANICS		500	2500	NA	13 U	13 U	13 U	13 U	15 UJ	13 UJ	21 J
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			NA	15400 J	12900 J	5670 J	4440 J	5280	19900	5850
ANTIMONY		10	820	NA	0.053 UJ	0.054 UJ	0.051 UJ	0.054 UJ	0.61 UJ	0.92 UJ	0.48 UJ
ARSENIC	2	7	7	NA	5 J	4.1 J	1.8 J	1.3 J	2.2 J	23.1 J	2.2 J
BARIUM	22.7	5500	10000	NA	15.5 J	12.3 J	14.9 J	11.6 J	14.7 J	7.5 J	16.1 J
BERYLLIUM	0.16	0.4	1.3	NA	1 J	0.29 J	0.23 J	0.16 J	0.15	0.29	0.18
CADMIUM		39	1000	NA	0.12 J	0.16 J	0.005 UJ	0.0053 UJ	0.0061 UJ	0.43	0.0053 UJ
CALCIUM	532			NA	1950 J	3910 J	1020 J	762 J	931 J	2510 J	3040 J
CHROMIUM	6.2	1400	10000	NA	14.5 J	10.6 J	8.2 J	7.3 J	7.9 J	13.3 J	8.9 J
COBALT	2.9			NA	11.7 J	13.2 J	7.6 J	6.5 J	7.2 J	26.1 J	4.6 J
COPPER	9.8	3100	10000	NA	30.9 J	20.3 J	9.4 J	25.7 J	12.2 J	53 J	13.7 J
CYANIDE		200	10000	NA	0.12 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.12 U
IRON	9260			NA	38000 J	31300 J	11100 J	9030 J	11100 J	35700 J	10900 J
LEAD	5.1	150	500	NA	9.6 J	6.2 J	4.5 J	4.4 J	4.8 J	5.6 J	7.4 J
MAGNESIUM	1880			NA	7210 J	7050 J	2390 J	1830 J	2440 J	12900 J	2250 J
MANGANESE	115	390	10000	NA	233 J	259 J	107 J	79.5 J	106 J	254 J	126 J
MERCURY		23	610	NA	0.007 U	0.0065 U	0.0065 U	0.007 U	0.0084 U	0.0073 U	0.0065 U
NICKEL	6.5	1000	10000	NA	31.4 J	20.1 J	19.5 J	17.1 J	20.9 J	50.2 J	10.4 J
POTASSIUM	680			NA	545	473	546	491	579	281	610
SODIUM	22.6			NA	94.2	177	37 U	40.7 U	34.7	42.2	92
VANADIUM	8.1	550	10000	NA	34.6 J	44 J	9.8 J	8.2 J	9.6 J	71.6	10.4 J
ZINC	18.1	6000	10000	NA	63 J	45.9 J	28.1 J	19.4 J	29.2 J	46 J	37.3 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB324	G32-SB324	G32-SB325	G32-SB325	G32-SB326	G32-SB326	G32-SB327	G32-SB328
TOP DEPTH				2	8	3	7	4	6	7	4
BOTTOM DEPTH				4	10	5	9	6	8	9	6
SAMPLE ID				G32-SB324-0204	G32-SB324-0810	G32-SB325-0305-AVG	G32-SB325-0709	G32-SB326-0406	G32-SB326-0608	G32-SB327-0709	G32-SB328-0406
SAMPLE DATE				20050620	20050620	20050617	20050617	20050615	20050615	20050616	20050621
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 UJ	6 UJ	4 UJ	3 U	4 U	4 U	3 U	4 U
1,2,4-TRICHLOROBENZENE		96000	10000000	3 UJ	6 UJ	4 UJ	3 U	4 UJ	4 U	3 U	4 U
1,2-DIBROMO-3-CHLOROPROPANE				3 UJ	6 UJ	4 UJ	3 U	4 U	4 U	3 U	4 U
1,2-DICHLOROBENZENE		510000	10000000	3 UJ	6 UJ	4 UJ	3 U	4 U	4 U	3 U	4 U
1,3-DICHLOROBENZENE		430000	10000000	3 UJ	6 UJ	4 UJ	3 U	4 U	4 U	3 U	4 U
1,4-DICHLOROBENZENE		27000	240000	3 UJ	6 UJ	4 UJ	3 U	4 U	4 U	3 U	4 U
ACETONE		7800000	10000000	20 UJ	10 UJ	27 UJ	19 UJ	4 UJ	4 UJ	3 UJ	19 UJ
BENZENE		2500	200000	3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
CARBON DISULFIDE				0.7 J	6 UJ	2 J	3 U	4 U	4 U	3 U	4 U
CIS-1,2-DICHLOROETHENE				3 U	6 UJ	4 U	3 U	4 U	1 J	3 U	4 U
ETHYLBENZENE		71000	10000000	1 J	2 J	4 U	3 U	4 U	4 U	3 U	4 U
ISOPROPYLBENZENE				3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
M+P-XYLENES				5 U	9 J	4 U	3 U	NA	NA	3 U	4 U
METHYL ACETATE				3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
METHYL CYCLOHEXANE				3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
METHYL TERT-BUTYL ETHER				3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
METHYLENE CHLORIDE		45000	760000	15 U	6 UJ	27 U	15 U	11 U	4 U	16 U	12 U
O-XYLENE				5 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
P-XYLENE				NA	NA	NA	NA	4 U	4 U	NA	NA
TOLUENE		190000	10000000	8	16 J	4 U	3 U	1 J	4 U	3 U	4 U
TOTAL XYLENES		110000	10000000	8 U	13 J	4 U	3 U	4 U	4 U	3 U	4 U
TRANS-1,2-DICHLOROETHENE				3 U	6 UJ	4 U	3 U	4 U	4 U	3 U	4 U
TRICHLOROETHENE		13000	520000	3 U	6 J	11.5 J	3 U	4 U	4 U	3 U	4 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				360 U	NA	355 U	350 U	360 U	380 U	370 U	370 U
2-METHYLNAPHTHALENE		123000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
4-METHYLPHENOL				360 U	NA	355 U	350 U	360 U	380 U	370 U	370 U
ACENAPHTHENE		43000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	6.2 J	3.8 UJ	3.7 UJ	3.7 UJ
ACENAPHTHYLENE		23000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
ANTHRACENE		35000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	6.2 J	3.8 UJ	3.7 UJ	3.7 UJ
BENZALDEHYDE				360 UJ	NA	355 UJ	350 UJ	360 UJ	380 UJ	370 UJ	370 UJ
BENZO(A)ANTHRACENE		900	7800	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
BENZO(A)PYRENE		400	800	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
BENZO(B)FLUORANTHENE		900	7800	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
BENZO(G,H,I)PERYLENE		800	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	360 UJ	3.8 UJ	3.7 UJ	3.7 UJ

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB324	G32-SB324	G32-SB325	G32-SB325	G32-SB326	G32-SB326	G32-SB327	G32-SB328
TOP DEPTH				2	8	3	7	4	6	7	4
BOTTOM DEPTH				4	10	5	9	6	8	9	6
SAMPLE ID				G32-SB324-0204	G32-SB324-0810	G32-SB325-0305-AVG	G32-SB325-0709	G32-SB326-0406	G32-SB326-0608	G32-SB327-0709	G32-SB328-0406
SAMPLE DATE				20050620	20050620	20050617	20050617	20050615	20050615	20050616	20050621
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	65 J	NA	77.5 J	61 J	100 JEB	150 JEB	61 J	370 U
BUTYL BENZYL PHTHALATE				360 U	NA	355 U	350 U	360 UJ	380 U	370 U	370 U
CARBAZOLE				360 U	NA	355 U	350 U	360 UJ	380 UJ	370 U	370 U
CHRYSENE		400	780000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
DIBENZO(A,H)ANTHRACENE		400	800	3.6 UJ	NA	3.55 UJ	3.5 UJ	360 UJ	3.8 UJ	3.7 UJ	3.7 UJ
DIBENZOFURAN				360 U	NA	355 U	350 U	360 U	380 U	370 U	370 U
DI-N-BUTYL PHTHALATE				40 J	NA	44 J	40 J	360 UJ	380 U	50 J	68 J
FLUORANTHENE		20000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	17 J	4 J	3.7 UJ	3.7 UJ
FLUORENE		28000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 UJ	3.8 UJ	3.7 UJ	3.7 UJ
INDENO(1,2,3-CD)PYRENE		900	7800	3.6 UJ	NA	3.55 UJ	3.5 UJ	360 UJ	3.8 UJ	3.7 UJ	3.7 UJ
NAPHTHALENE		54000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	3.6 J	3.8 UJ	3.7 UJ	3.7 UJ
PHENANTHRENE		40000	10000000	3.6 UJ	NA	3.55 UJ	4.6 J	15 J	4.2 J	3.7 UJ	3.7 UJ
PHENOL		6000000	10000000	360 U	NA	355 U	350 U	360 U	380 U	370 U	370 U
PYRENE		13000	10000000	3.6 UJ	NA	3.55 UJ	3.5 UJ	14 J	4.6 J	3.7 UJ	3.7 UJ
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
4,4'-DDE				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
4,4'-DDT				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
ALDRIN				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
ALPHA-BHC				1.8 U	NA	1.85 U	1.8 U	1.9 UJ	1.9 U	1.9 U	1.9 U
ALPHA-CHLORDANE				1.8 U	NA	1.85 U	1.8 U	1.9 UJ	1.9 U	1.9 U	1.9 U
AROCLOR-1016				36 U	NA	35.5 U	35 U	36 U	38 U	37 U	37 U
AROCLOR-1254				36 U	NA	35.5 U	35 U	36 U	38 U	37 U	37 U
AROCLOR-1260				36 U	NA	35.5 U	35 U	36 U	38 U	37 U	37 U
BETA-BHC				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
DELTA-BHC				1.8 UJ	NA	1.85 UJ	1.8 UJ	1.9 UJ	1.9 UJ	1.9 UJ	1.9 UJ
DIELDRIN		40	400	3.6 U	NA	3.55 U	3.5 U	3.6 UJ	3.8 U	3.7 U	3.7 U
ENDOSULFAN I				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
ENDOSULFAN II				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
ENDOSULFAN SULFATE				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
ENDRIN				3.6 U	NA	3.55 U	3.5 U	3.6 UJ	3.8 UJ	3.7 U	3.7 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB324	G32-SB324	G32-SB325	G32-SB325	G32-SB326	G32-SB326	G32-SB327	G32-SB328
TOP DEPTH				2	8	3	7	4	6	7	4
BOTTOM DEPTH				4	10	5	9	6	8	9	6
SAMPLE ID				G32-SB324-0204	G32-SB324-0810	G32-SB325-0305-AVG	G32-SB325-0709	G32-SB326-0406	G32-SB326-0608	G32-SB327-0709	G32-SB328-0406
SAMPLE DATE				20050620	20050620	20050617	20050617	20050615	20050615	20050616	20050621
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
ENDRIN KETONE				3.6 U	NA	3.55 U	3.5 U	3.6 U	3.8 U	3.7 U	3.7 U
GAMMA-BHC (LINDANE)				1.8 U	NA	1.85 U	1.8 U	1.9 UJ	1.9 U	1.9 U	1.9 U
GAMMA-CHLORDANE				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
HEPTACHLOR				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
HEPTACHLOR EPOXIDE				1.8 U	NA	1.85 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U
METHOXYCHLOR				18 U	NA	18.5 U	18 U	19 UJ	19 UJ	19 U	19 U
TOTAL AROCLOR		10000	10000	36 U	NA	35.5 U	35 U	36 U	38 U	37 U	37 U
TOXAPHENE				180 U	NA	185 U	180 U	190 U	190 U	190 U	190 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	3.5 U	3.2 UJ	3.8 U	4.2 U	4.6 U	4.2 U	3.7 U	3.7 U
DIESEL RANGE ORGANICS		500	2500	13 U	NA	13 U	13 U	22 J	14 U	13 U	13 UJ
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			6220	NA	6125	13400	7180 J	5890 J	6950	6170
ANTIMONY		10	820	0.55 UJ	NA	0.595 UJ	0.89 UJ	0.31 UJ	0.24 UJ	0.59 UJ	0.44 UJ
ARSENIC	2	7	7	1.8 J	NA	2.6 J	3.8 J	2.2 J	2.5 J	3.1 J	2.4 J
BARIUM	22.7	5500	10000	12.5 J	NA	14.1 J	13.2 J	14 J	12.1 J	11.1 J	14.6 J
BERYLLIUM	0.16	0.4	1.3	0.26	NA	0.265	0.21	0.2	0.13	0.22	0.26
CADMIUM		39	1000	0.0048 UJ	NA	0.0049 UJ	0.32	0.074 UJ	0.017 UJ	0.038 J	0.0056 UJ
CALCIUM	532			1040 J	NA	1063 J	686 J	1060	1140	1120 J	624 J
CHROMIUM	6.2	1400	10000	9.5 J	NA	9.6 J	23.7 J	11 J	9 J	9.6 J	8.3 J
COBALT	2.9			7 J	NA	9.45 J	15.8 J	9.8 J	9.2 J	8 J	4.1 J
COPPER	9.8	3100	10000	10.1 J	NA	15.75 J	53.7 J	15.1 J	14.1 J	18.4 J	18.6 J
CYANIDE		200	10000	0.12 U	NA	0.13 U	0.12 U	0.13 U	0.13 U	0.12 U	0.12 U
IRON	9260			12900 J	NA	13700 J	30500 J	15800	12100	15500 J	11100 J
LEAD	5.1	150	500	4.3 J	NA	5.5 J	11 J	8.9 J	6.4 J	11.3 J	6.3 J
MAGNESIUM	1880			2630 J	NA	2800 J	6320 J	3250 J	2740 J	3520 J	2220 J
MANGANESE	115	390	10000	124 J	NA	115.5 J	220 J	139 J	112 J	135 J	111 J
MERCURY		23	610	0.0065 U	NA	0.0075 UJ	0.0062 U	0.0071 UJ	0.007 UJ	0.032 U	0.0073 UJ
NICKEL	6.5	1000	10000	17.7 J	NA	22.55 J	39.4 J	25.1 J	20.2 J	22.9 J	11 J
POTASSIUM	680			528	NA	575.5	434	656	766	445	569
SODIUM	22.6			58.2	NA	55.8	31.2	198	153	54.4	49
VANADIUM	8.1	550	10000	10.2 J	NA	10.45 J	12.6 J	10 J	9 J	9.7 J	9.8 J
ZINC	18.1	6000	10000	28.4 J	NA	28.4 J	73.2 J	40.7 J	34.8 J	40.1 J	23 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB328	G32-SB331	G32-SB331	G32-SB332	G32-SB333	G32-SB333	G32-SB334	G32-SB335
TOP DEPTH				8	2	52	4	12	4	6	10
BOTTOM DEPTH				10	4	54	6	14	6	8	12
SAMPLE ID				G32-SB328-0810	G32-SB331-0204	G32-SB331-5254	G32-SB332-0406	G32-SB333-1214	G32-SB333-0406	G32-SB334-0608	G32-SB335-1012
SAMPLE DATE				20050621	20050624	20050627	20050714	20050623	20050623	20050622	20050705
VOLATILE ANALYSIS (µg/kg)											
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 UJ	3 UJ	2 U	3 U	3 U	3 U	3 R	3 U
1,2,4-TRICHLOROBENZENE		96000	10000000	3 UJ	3 UJ	2 UJ	3 U	3 U	3 U	3 UJ	3 U
1,2-DIBROMO-3-CHLOROPROPANE				3 UJ	3 UJ	2 U	3 UJ	3 U	3 U	3 UJ	3 U
1,2-DICHLOROBENZENE		510000	10000000	3 UJ	3 UJ	2 U	3 U	3 U	3 U	3 UJ	3 U
1,3-DICHLOROBENZENE		430000	10000000	3 UJ	3 UJ	2 U	3 U	3 U	3 U	3 UJ	3 U
1,4-DICHLOROBENZENE		27000	240000	3 UJ	3 UJ	2 U	3 U	3 U	3 U	3 UJ	3 U
ACETONE		7800000	10000000	26 UJ	20 UJ	7 UJ	3 UJ	9 UJ	65 UJ	7 UJ	3 UJ
BENZENE		2500	200000	3 UJ	3 U	2 U	3 U	3 U	3	3 UJ	3 U
CARBON DISULFIDE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
CIS-1,2-DICHLOROETHENE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
ETHYLBENZENE		71000	10000000	3 UJ	3 U	2 U	3 U	3 U	4	3 UJ	3 U
ISOPROPYLBENZENE				3 UJ	3 U	2 U	3 U	3 U	0.8 J	3 UJ	3 U
M+P-XYLENES				3 UJ	NA	NA	NA	NA	NA	NA	NA
METHYL ACETATE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
METHYL CYCLOHEXANE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
METHYL TERT-BUTYL ETHER				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
METHYLENE CHLORIDE		45000	760000	10 UJ	10 U	8 UJ	12 UJ	13 U	3 U	10 UJ	26 U
O-XYLENE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
P-XYLENE				NA	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
TOLUENE		190000	10000000	3 UJ	3 U	2 U	3 U	3 U	8	3 UJ	3 U
TOTAL XYLENES		110000	10000000	3 UJ	3 U	2 U	3 U	3 U	5 U	3 UJ	3 U
TRANS-1,2-DICHLOROETHENE				3 UJ	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
TRICHLOROETHENE		13000	520000	2 J	3 U	2 U	3 U	3 U	3 U	3 UJ	3 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				NA	350 U	390 U	370 U	380 U	610 J	360 U	370 U
2-METHYLNAPHTHALENE		123000	10000000	NA	3.5 U	3.9 UJ	3.7 U	41	2200	9.7	3.7 U
4-METHYLPHENOL				NA	350 U	390 U	370 U	380 U	2200 U	360 U	370 U
ACENAPHTHENE		43000	10000000	NA	3.5 U	3.9 UJ	3.7 U	180	6100	59	19
ACENAPHTHYLENE		23000	10000000	NA	3.5 U	3.9 UJ	3.7 U	4.4	280	4	3.7 U
ANTHRACENE		35000	10000000	NA	3.5 U	3.9 UJ	5.7	350	12000	120	47
BENZALDEHYDE				NA	350 UJ	390 UJ	370 UJ	380 UJ	2200 UJ	360 UJ	370 UJ
BENZO(A)ANTHRACENE		900	7800	NA	3.6	3.9 UJ	7.3	620	23000	240	130
BENZO(A)PYRENE		400	800	NA	3.5 U	3.9 UJ	3.7 U	410	16000	210	87
BENZO(B)FLUORANTHENE		900	7800	NA	2.8 J	3.9 UJ	6	520	23000	260	120
BENZO(G,H,I)PERYLENE		800	10000000	NA	3.5 U	3.9 UJ	3.7 U	260	7700	96	26

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB328	G32-SB331	G32-SB331	G32-SB332	G32-SB333	G32-SB333	G32-SB334	G32-SB335
TOP DEPTH				8	2	52	4	12	4	6	10
BOTTOM DEPTH				10	4	54	6	14	6	8	12
SAMPLE ID				G32-SB328-0810	G32-SB331-0204	G32-SB331-5254	G32-SB332-0406	G32-SB333-1214	G32-SB333-0406	G32-SB334-0608	G32-SB335-1012
SAMPLE DATE				20050621	20050624	20050627	20050714	20050623	20050623	20050622	20050705
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)											
BENZO(K)FLUORANTHENE		900	78000	NA	3.5 U	3.9 UJ	3.7 U	300	8400	110	48
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	NA	110 J	75 J	80 J	380 U	2200 U	360 U	120 J
BUTYL BENZYL PHTHALATE				NA	350 U	390 U	370 U	380 U	2200 U	360 U	370 U
CARBAZOLE				NA	350 U	390 U	370 U	150 J	6300	49 J	370 U
CHRYSENE		400	780000	NA	3.5 U	3.9 UJ	6.7	480	21000	230	130
DIBENZO(A,H)ANTHRACENE		400	800	NA	3.5 U	390 U	3.7 U	86 J	2300	28 J	9.7
DIBENZOFURAN				NA	350 U	390 UJ	370 U	130 J	5400	360 U	370 U
DI-N-BUTYL PHTHALATE				NA	350 U	390 U	370 U	380 U	2200 U	360 U	370 UJ
FLUORANTHENE		20000	10000000	NA	11	5 J	18	1500	69000	600	290
FLUORENE		28000	10000000	NA	3.5 U	3.9 UJ	3.7 U	190	7200	53	19
INDENO(1,2,3-CD)PYRENE		900	7800	NA	3.5 U	3.9 UJ	3.7 U	270	8200	96	25
NAPHTHALENE		54000	10000000	NA	3.5 U	3.9 UJ	3.7 U	96	4800	23	6.7 EB
PHENANTHRENE		40000	10000000	NA	6.4	4.2 J	8.8	1100	62000	400 J	170
PHENOL		6000000	10000000	NA	350 U	390 U	370 U	380 U	2200 U	360 U	370 U
PYRENE		13000	10000000	NA	6.6	3.9 UJ	14	1000	43000	370 J	240
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDD				NA	3.5 U	3.9 U	3.7 U	3.8 U	4.4 U	3.6 U	3.7 U
4,4'-DDE				NA	3.5 U	3.9 U	3.7 U	3.8 U	14 R	3.7 J	3.7 U
4,4'-DDT				NA	3.5 U	3.9 U	3.7 U	3.8 U	30	3.6 U	3.7 U
ALDRIN				NA	1.8 U	2 U	1.9 U	2 U	2.3 U	1.8 U	1.9 U
ALPHA-BHC				NA	1.8 UJ	2 UJ	1.9 U	2 U	2.3 U	1.8 U	1.9 UJ
ALPHA-CHLORDANE				NA	1.8 U	2 U	1.9 U	2 U	2.3 U	1.8 U	1.9 U
AROCLOR-1016				NA	35 U	39 U	37 U	38 U	44 U	36 U	37 U
AROCLOR-1254				NA	35 U	39 U	37 U	38 U	330 J	36 U	37 U
AROCLOR-1260				NA	35 U	39 U	37 U	38 U	44 U	36 U	37 U
BETA-BHC				NA	1.8 U	2 U	1.9 U	2 U	5.2 R	1.8 U	1.9 U
DELTA-BHC				NA	1.8 R	2 R	1.9 U	2 UJ	2.3 UJ	1.8 UJ	1.9 R
DIELDRIN		40	400	NA	3.5 U	3.9 U	3.7 U	3.8 U	4.4 U	3.6 U	3.7 U
ENDOSULFAN I				NA	1.8 U	2 U	1.9 U	2 U	2.3 U	1.8 U	1.9 U
ENDOSULFAN II				NA	3.5 U	3.9 U	3.7 U	3.8 U	4.4 U	3.6 U	3.7 U
ENDOSULFAN SULFATE				NA	3.5 UJ	3.9 UJ	3.7 U	3.8 U	280 R	6.2 R	3.7 UJ
ENDRIN				NA	3.5 U	3.9 U	3.7 U	3.8 U	4.4 U	3.6 U	3.7 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-SB328	G32-SB331	G32-SB331	G32-SB332	G32-SB333	G32-SB333	G32-SB334	G32-SB335
TOP DEPTH				8	2	52	4	12	4	6	10
BOTTOM DEPTH				10	4	54	6	14	6	8	12
SAMPLE ID				G32-SB328-0810	G32-SB331-0204	G32-SB331-5254	G32-SB332-0406	G32-SB333-1214	G32-SB333-0406	G32-SB334-0608	G32-SB335-1012
SAMPLE DATE				20050621	20050624	20050627	20050714	20050623	20050623	20050622	20050705
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDRIN ALDEHYDE				NA	3.5 U	3.9 U	3.7 U	3.8 U	9.8 J	3.6 U	3.7 U
ENDRIN KETONE				NA	3.5 U	3.9 U	3.7 U	3.8 U	31 J	3.6 U	3.7 U
GAMMA-BHC (LINDANE)				NA	1.8 UJ	2 UJ	1.9 U	2 U	2.3 U	1.8 U	1.9 UJ
GAMMA-CHLORDANE				NA	1.8 U	2 U	1.9 U	2 U	24 R	1.8 U	1.9 U
HEPTACHLOR				NA	1.8 U	2 U	1.9 U	2 U	2.3 U	1.8 U	1.9 U
HEPTACHLOR EPOXIDE				NA	1.8 U	2 U	1.9 U	2 U	2.3 U	1.8 U	1.9 U
METHOXYCHLOR				NA	24	20 U	19 U	20 U	23 U	18 U	19 U
TOTAL AROCLOR		10000	10000	NA	35 U	39 U	37 U	38 U	330	36 U	37 U
TOXAPHENE				NA	180 U	200 U	190 U	200 U	230 U	180 U	190 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
GASOLINE RANGE ORGANICS		500	2500	4.1 UJ	3.4 U	3.3 U	4.2 U	3.1 U	13 U	5 U	3.4 U
DIESEL RANGE ORGANICS		500	2500	NA	13 U	14 U	13 U	14 U	270	38	13 U
METALS ANALYSIS (mg/kg)											
ALUMINUM	5120			NA	4800	3950	17000	13500 J	4860 J	5110 J	5430
ANTIMONY		10	820	NA	0.25 UJ	0.37 UJ	0.62 UJ	0.051 UJ	6.3 J	0.092 UJ	0.28 UJ
ARSENIC	2	7	7	NA	1.8 J	1.6 J	8.5 J	2.7 J	12.9 UJ	2.3 J	2.3 J
BARIUM	22.7	5500	10000	NA	15.3 J	12.9 J	9.7 J	15.7 J	140 J	14.7 J	16.9 J
BERYLLIUM	0.16	0.4	1.3	NA	0.14	0.14	0.24	0.24 J	0.14 J	0.26 J	0.21
CADMIUM		39	1000	NA	0.0048 UJ	0.0056 UJ	0.37 J	0.76 J	234 J	0.005 UJ	0.0051 UJ
CALCIUM	532			NA	957	844	5460	1170 J	53600 J	1430 J	1250
CHROMIUM	6.2	1400	10000	NA	6.5	6.2	14.5 J	20.5 J	82.5 J	8.4 J	8.1
COBALT	2.9			NA	3.2 J	4.1 J	21 J	10.1 J	7.4 J	6.7 J	4.6 J
COPPER	9.8	3100	10000	NA	11.5	11.9	43.5	25.6 J	313 J	12.4 J	11.8
CYANIDE		200	10000	NA	0.13 UJ	0.15 UJ	0.12 U	0.12 U	0.14 U	0.12 U	0.12 U
IRON	9260			NA	8900	8210	49300	31500 J	181000 J	10300 J	8700
LEAD	5.1	150	500	NA	5.8 J	3.6 J	13.1 J	15.8 J	242 J	8.7 J	5.8 J
MAGNESIUM	1880			NA	1870	1870	8780	6100 J	3680 J	2210 J	2000
MANGANESE	115	390	10000	NA	150	91.6	372	218 J	601 J	93 J	89.8
MERCURY		23	610	NA	0.0068 U	0.0074 U	0.0066 U	0.0074 U	0.034	0.0072 U	0.0068 U
NICKEL	6.5	1000	10000	NA	5.5 J	8.6 J	34.7 J	21.3 J	56.8 J	18.4 J	13.4 J
POTASSIUM	680			NA	640 J	631 J	249 J	472	690	538	535 J
SODIUM	22.6			NA	31.7	35.4	27	49.6 U	956	80.7	204
VANADIUM	8.1	550	10000	NA	7.6 J	6.9 J	44.2 J	17.4 J	13.2 J	8.2 J	9.7 J
ZINC	18.1	6000	10000	NA	21.2 J	18.8 J	48.8 J	51.5 J	415 J	26.6 J	20.4 J

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO
LOCATION ID				G32-SB336	G32-SB337	G32-SB338
TOP DEPTH				6	10	10
BOTTOM DEPTH				8	12	12
SAMPLE ID				G32-SB336-0608	G32-SB337-1012	G32-SB338-1012
SAMPLE DATE				20050706	20050714	20050714
VOLATILE ANALYSIS (µg/kg)						
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 U	3 U	3 U
1,2,4-TRICHLOROBENZENE		96000	10000000	3 U	3 U	3 U
1,2-DIBROMO-3-CHLOROPROPANE				3 U	3 UJ	3 UJ
1,2-DICHLOROBENZENE		510000	10000000	3 U	3 U	3 U
1,3-DICHLOROBENZENE		430000	10000000	3 U	3 U	3 U
1,4-DICHLOROBENZENE		27000	240000	3 U	3 U	3 U
ACETONE		7800000	10000000	130 UJ	7 UJ	6 UJ
BENZENE		2500	200000	3 U	3 U	3 U
CARBON DISULFIDE				3 U	3 U	3 U
CIS-1,2-DICHLOROETHENE				3 U	3 U	3 U
ETHYLBENZENE		71000	10000000	3 U	3 U	3 U
ISOPROPYLBENZENE				3 U	3 U	3 U
M+P-XYLENES				NA	NA	NA
METHYL ACETATE				3 U	3 U	3 U
METHYL CYCLOHEXANE				3 U	3 U	3 U
METHYL TERT-BUTYL ETHER				3 U	3 U	3 U
METHYLENE CHLORIDE		45000	760000	29 U	31 UJ	30 UJ
O-XYLENE				3 U	3 U	3 U
P-XYLENE				3 U	3 U	3 U
TOLUENE		190000	10000000	3 U	3 U	3 U
TOTAL XYLENES		110000	10000000	3 U	3 U	3 U
TRANS-1,2-DICHLOROETHENE				3 U	3 U	3 U
TRICHLOROETHENE		13000	520000	3 U	3 U	3 U
SEMIVOLATILE ANALYSIS (µg/kg)						
1,1-BIPHENYL				45 J	370 U	360 U
2-METHYLNAPHTHALENE		123000	10000000	210	3.7 UJ	3.6 U
4-METHYLPHENOL				380 U	370 U	360 U
ACENAPHTHENE		43000	10000000	560	3.7 UJ	3.6 U
ACENAPHTHYLENE		23000	10000000	47	3.7 UJ	3.6 U
ANTHRACENE		35000	10000000	1400	3.7 UJ	3.6 U
BENZALDEHYDE				380 UJ	370 UJ	360 UJ
BENZO(A)ANTHRACENE		900	7800	3600	3.7 UJ	3.6 U
BENZO(A)PYRENE		400	800	2300	3.7 UJ	3.6 U
BENZO(B)FLUORANTHENE		900	7800	2900	3.7 UJ	3.6 U
BENZO(G,H,I)PERYLENE		800	10000000	940	3.7 UJ	3.6 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO
LOCATION ID				G32-SB336	G32-SB337	G32-SB338
TOP DEPTH				6	10	10
BOTTOM DEPTH				8	12	12
SAMPLE ID				G32-SB336-0608	G32-SB337-1012	G32-SB338-1012
SAMPLE DATE				20050706	20050714	20050714
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)						
BENZO(K)FLUORANTHENE		900	78000	1300	3.7 UJ	3.6 U
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	63 J	52 J	360 U
BUTYL BENZYL PHTHALATE				380 U	370 U	360 U
CARBAZOLE				720	370 U	360 U
CHRYSENE		400	780000	3300	3.7 UJ	3.6 U
DIBENZO(A,H)ANTHRACENE		400	800	220 J	3.7 UJ	3.6 U
DIBENZOFURAN				440	370 U	360 U
DI-N-BUTYL PHTHALATE				380 UJ	370 U	360 U
FLUORANTHENE		20000	10000000	6000	3.7 UJ	3.6 U
FLUORENE		28000	10000000	540	3.7 UJ	3.6 U
INDENO(1,2,3-CD)PYRENE		900	7800	920	3.7 UJ	3.6 U
NAPHTHALENE		54000	10000000	450 EB	3.7 UJ	3.6 U
PHENANTHRENE		40000	10000000	5600	3.7 UJ	3.6 U
PHENOL		6000000	10000000	380 U	370 U	360 U
PYRENE		13000	10000000	7800	3.7 UJ	3.6 U
PESTICIDE/PCB ANALYSIS (µg/kg)						
4,4'-DDD				3.8 U	3.7 U	3.6 U
4,4'-DDE				3.8 U	3.7 U	3.6 U
4,4'-DDT				3.8 U	3.7 U	3.6 U
ALDRIN				2 U	1.9 U	1.9 U
ALPHA-BHC				2 UJ	1.9 U	1.9 U
ALPHA-CHLORDANE				2 U	1.9 U	1.9 U
AROCLOR-1016				38 U	37 U	36 U
AROCLOR-1254				38 U	37 U	36 U
AROCLOR-1260				38 U	37 U	36 U
BETA-BHC				2 U	1.9 U	1.9 U
DELTA-BHC				2 R	1.9 U	1.9 U
DIELDRIN		40	400	3.8 U	3.7 U	3.6 U
ENDOSULFAN I				2 U	1.9 U	1.9 U
ENDOSULFAN II				3.8 U	3.7 U	3.6 U
ENDOSULFAN SULFATE				3.8 UJ	3.7 U	3.6 U
ENDRIN				3.8 U	3.7 U	3.6 U

TABLE 4-1B

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM BORINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO
LOCATION ID				G32-SB336	G32-SB337	G32-SB338
TOP DEPTH				6	10	10
BOTTOM DEPTH				8	12	12
SAMPLE ID				G32-SB336-0608	G32-SB337-1012	G32-SB338-1012
SAMPLE DATE				20050706	20050714	20050714
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)						
ENDRIN ALDEHYDE				4.7	3.7 U	3.6 U
ENDRIN KETONE				5.1 J	3.7 U	3.6 U
GAMMA-BHC (LINDANE)				2 UJ	1.9 U	1.9 U
GAMMA-CHLORDANE				2 U	1.9 U	1.9 U
HEPTACHLOR				2 U	1.9 U	1.9 U
HEPTACHLOR EPOXIDE				2 U	1.9 U	1.9 U
METHOXYCHLOR				20 U	19 U	19 U
TOTAL AROCLOR		10000	10000	38 U	37 U	36 U
TOXAPHENE				200 U	190 U	190 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)						
GASOLINE RANGE ORGANICS		500	2500	3.8 U	3.9 U	NA
DIESEL RANGE ORGANICS		500	2500	100	13 U	13 U
METALS ANALYSIS (mg/kg)						
ALUMINUM	5120			6350	8400	3260
ANTIMONY		10	820	0.24 UJ	0.45 UJ	0.33 UJ
ARSENIC	2	7	7	2.2 J	2.4 J	2.2 J
BARIUM	22.7	5500	10000	17 J	16.4 J	10.4 J
BERYLLIUM	0.16	0.4	1.3	0.33	0.21	0.13
CADMIUM		39	1000	0.0054 UJ	0.0051 UJ	0.005 UJ
CALCIUM	532			2550	1000	652
CHROMIUM	6.2	1400	10000	8.3	12.1	4.7
COBALT	2.9			5.2 J	8.1 J	5.3 J
COPPER	9.8	3100	10000	13.6	18.3	14.4
CYANIDE		200	10000	0.13 U	0.12 U	0.12 U
IRON	9260			10700	17800	6590
LEAD	5.1	150	500	9.4 J	9.8 J	3.6 J
MAGNESIUM	1880			2360	3760	1390
MANGANESE	115	390	10000	116	149	64.1
MERCURY		23	610	0.0068 U	0.0074 U	0.0065 U
NICKEL	6.5	1000	10000	12.4 J	20.6 J	12 J
POTASSIUM	680			671 J	567 J	412 J
SODIUM	22.6			149	33.1	22.1
VANADIUM	8.1	550	10000	9.5 J	12.3 J	6.1 J
ZINC	18.1	6000	10000	30 J	34.6 J	15.8 J

Notes:

(1) REF = Reference (Upgradient) Soil Concentrations
(2) Residential Direct Exposure Criteria (RIDEM 2004)
(3) Industrial/Commercial Direct Exposure Criteria (RIDEM

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP01	G32-TP02	G32-TP02	G32-TP03	G32-TP04	G32-TP05	G32-TP05
TOP DEPTH				7	6	7	7	6	10	10
BOTTOM DEPTH				7.5	6.5	7.5	7.5	6.5	11	11
SAMPLE ID				G32-SOTP01-01-0007	G32-SOTP02-0006	G32-SOTP02-02-0007	G32-SOTP03-01-0007	G32-SOTP04-01	G32-SOTP05-03-0002	G32-SOTP05-01-0000
SAMPLE DATE				20050602	20050602	20050602	20050602	20050722	20050721	20050721
VOLATILE ANALYSIS (µg/kg)										
1,1,2,2-TETRACHLOROETHANE		1300	29000	3 U	3 U	2 U	2 U	4 U	3 U	2 U
1,2,4-TRICHLOROBENZENE		96000	10000000	3 U	3 U	2 U	2 U	4 U	3 U	2 U
1,2-DIBROMO-3-CHLOROPROPANE				3 UJ	3 U	2 UJ	2 UJ	4 U	3 U	2 U
1,2-DICHLOROBENZENE		510000	10000000	3 U	3 U	2 U	2 U	4 U	3 U	2 U
1,3-DICHLOROBENZENE		430000	10000000	3 U	3 U	2 U	2 U	4 U	3 U	2 U
1,4-DICHLOROBENZENE		27000	240000	3 U	3 U	2 U	2 U	4 U	3 U	2 U
ACETONE		7800000	10000000	6 UJ	3 UJ	4 J	2 UJ	4 UJ	10 UJ	15 UJ
BENZENE		2500	200000	3 UJ	3 U	2 UJ	2 UJ	4 U	3 U	2 U
CARBON DISULFIDE				3 UJ	3 U	2 UJ	2 UJ	4 U	4	2 U
CIS-1,2-DICHLOROETHENE				3 UJ	3 U	2 UJ	2 UJ	4 U	3 U	2 U
ETHYLBENZENE		71000	10000000	3 U	3 U	2 J	2 U	4 U	3 U	2 U
ISOPROPYLBENZENE				3 U	3 U	0.6 J	2 U	4 U	3 U	2 U
M+P-XYLENES				NA	NA	NA	NA	NA	NA	NA
METHYL ACETATE				3 UJ	3 U	2 UJ	2 UJ	4 U	3 U	2 U
METHYL CYCLOHEXANE				24 J	3 U	1 J	2 UJ	4 U	3 U	2 J
METHYL TERT-BUTYL ETHER				3 UJ	3 U	0.6 J	2 UJ	4 U	3 U	2 U
METHYLENE CHLORIDE		45000	760000	6 UJ	5 U	6 UJ	4 UJ	32 U	10 U	10 U
O-XYLENE				3 U	3 U	3	2 U	4 U	3 U	2 U
P-XYLENE				3 U	3 U	6	2 U	4 U	3 U	2 U
TOLUENE		190000	10000000	3 UJ	3 U	2 J	2 UJ	4 U	3 U	2 U
TOTAL XYLENES		110000	10000000	3 U	3 U	9	2 U	4 U	3 U	2 U
TRANS-1,2-DICHLOROETHENE				3 UJ	3 U	2 UJ	2 UJ	4 U	3 U	2 U
TRICHLOROETHENE		13000	520000	3 UJ	3 U	0.8 J	2 UJ	4 U	3 U	2 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				410 U	380 U	390 U	370 U	370 U	410 U	400 U
2-METHYLNAPHTHALENE		123000	10000000	22	5.9	9.4	4.7	7.5	16	43
4-METHYLPHENOL				410 U	380 U	390 U	370 U	370 U	410 U	400 U
ACENAPHTHENE		43000	10000000	130	59	81	37	57	14	39
ACENAPHTHYLENE		23000	10000000	27	8.9	22	7.4	3.7 U	41	74
ANTHRACENE		35000	10000000	320	140	180	90	130	22	26
BENZALDEHYDE				410 UJ	380 UJ	390 UJ	370 UJ	370 UJ	410 UJ	400 UJ
BENZO(A)ANTHRACENE		900	7800	660	370	300 J	260	340 J	47	60
BENZO(A)PYRENE		400	800	510	230 J	240 J	270	370	48	55
BENZO(B)FLUORANTHENE		900	7800	640	270 J	280 J	320	310 J	55	58
BENZO(G,H,I)PERYLENE		800	10000000	320 J	240	260	160	200	31	36

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP01	G32-TP02	G32-TP02	G32-TP03	G32-TP04	G32-TP05	G32-TP05
TOP DEPTH				7	6	7	7	6	10	10
BOTTOM DEPTH				7.5	6.5	7.5	7.5	6.5	11	11
SAMPLE ID				G32-SOTP01-01-0007	G32-SOTP02-0006	G32-SOTP02-02-0007	G32-SOTP03-01-0007	G32-SOTP04-01	G32-SOTP05-03-0002	G32-SOTP05-01-0000
SAMPLE DATE				20050602	20050602	20050602	20050602	20050722	20050721	20050721
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)										
BENZO(K)FLUORANTHENE		900	78000	360	170	200	110	210	42	53
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	410 U	380 U	71 JEB	370 U	48 J	63 J	41 J
BUTYL BENZYL PHTHALATE				410 U	380 U	390 U	370 U	370 U	410 U	400 U
CARBAZOLE				92 J	380 U	41 J	370 U	370 U	410 U	400 U
CHRYSENE		400	780000	610	360	290 J	260	360	73	77
DIBENZO(A,H)ANTHRACENE		400	800	140 J	68 J	75 J	45 J	58	11	15
DIBENZOFURAN				43 J	380 U	390 U	370 U	370 U	410 U	400 U
DI-N-BUTYL PHTHALATE				410 U	380 U	390 U	370 U	39 J	60 J	400 U
FLUORANTHENE		20000	10000000	1300	520	520	310 J	580	95	130
FLUORENE		28000	10000000	110	57	70	29	47	4.1 U	26
INDENO(1,2,3-CD)PYRENE		900	7800	280 J	220	250	150	190	26	31
NAPHTHALENE		54000	10000000	39	8.2	20	10	8.4	8.6	16
PHENANTHRENE		40000	10000000	860	370 J	350 J	310	310 J	32	87
PHENOL		6000000	10000000	410 U	380 U	390 U	370 U	370 U	410 U	400 U
PYRENE		13000	10000000	1300	500	560	360 J	560	96	110
PESTICIDE/PCB ANALYSIS (µg/kg)										
4,4'-DDD				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
4,4'-DDE				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
4,4'-DDT				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
ALDRIN				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
ALPHA-BHC				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
ALPHA-CHLORDANE				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
AROCLOR-1016				41 U	38 U	39 U	38 U	37 U	41 U	40
AROCLOR-1254				41 U	38 U	39 U	38 U	37 U	41 U	40 U
AROCLOR-1260				41 U	38 U	39 U	38 U	37 U	41 U	40 U
BETA-BHC				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
DELTA-BHC				2.1 UJ	1.9 UJ	2 UJ	1.9 UJ	1.9 U	2.1 U	2.1 U
DIELDRIN		40	400	4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
ENDOSULFAN I				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
ENDOSULFAN II				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
ENDOSULFAN SULFATE				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
ENDRIN				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP01	G32-TP02	G32-TP02	G32-TP03	G32-TP04	G32-TP05	G32-TP05
TOP DEPTH				7	6	7	7	6	10	10
BOTTOM DEPTH				7.5	6.5	7.5	7.5	6.5	11	11
SAMPLE ID				G32-SOTP01-01-0007	G32-SOTP02-0006	G32-SOTP02-02-0007	G32-SOTP03-01-0007	G32-SOTP04-01	G32-SOTP05-03-0002	G32-SOTP05-01-0000
SAMPLE DATE				20050602	20050602	20050602	20050602	20050722	20050721	20050721
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)										
ENDRIN ALDEHYDE				4.1 U	3.8 U	3.9 U	3.8 U	4.6 J	4.1 U	4 U
ENDRIN KETONE				4.1 U	3.8 U	3.9 U	3.8 U	3.7 U	4.1 U	4 U
GAMMA-BHC (LINDANE)				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
GAMMA-CHLORDANE				2.1 U	1.9 U	2 U	1.9 UJ	1.9 U	2.1 U	2.1 U
HEPTACHLOR				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
HEPTACHLOR EPOXIDE				2.1 U	1.9 U	2 U	1.9 U	1.9 U	2.1 U	2.1 U
METHOXYCHLOR				21 U	19 U	20 U	19 U	18 R	21 U	21 U
TOTAL AROCLOR		10000	10000	41 U	38 U	39 U	38 U	37 U	41 U	40
TOXAPHENE				210 U	190 U	200 U	190 U	190 U	210 U	210 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)										
GASOLINE RANGE ORGANICS		500	2500	8.5 U	2.9 U	20 U	3.7 U	4.9 U	22 U	55
DIESEL RANGE ORGANICS		500	2500	170	21	87	30	31	150	650
METALS ANALYSIS (mg/kg)										
ALUMINUM	5120			5400 J	5970 J	4830 J	5200 J	7300	9230	10700
ANTIMONY		10	820	0.41 UJ	0.64 UJ	0.27 UJ	0.18 UJ	0.64 J	1.2 J	0.93 J
ARSENIC	2	7	7	2.5 J	2.2 J	2 J	2.7 J	3.1 J	3.4 J	4.2 J
BARIUM	22.7	5500	10000	20 J	21.4 J	20.8 J	18.7 J	25.5 J	19.2 J	38.5 J
BERYLLIUM	0.16	0.4	1.3	0.18	0.15	0.15	0.2	0.26	0.35	0.37
CADMIUM		39	1000	0.54 J	0.053 UJ	0.09 UJ	0.053 UJ	0.31 UJ	0.25 UJ	0.29 UJ
CALCIUM	532			1460	1780	899	973	1570 J	738 J	789 J
CHROMIUM	6.2	1400	10000	10.1 J	7.3 J	7 J	6.8 J	10.1 J	13.1 J	15.7 J
COBALT	2.9			5.1 J	3.9 J	4.2 J	3.8 J	5 J	5.1 J	6.8 J
COPPER	9.8	3100	10000	19.3 J	14.8 J	12.9 J	13.8 J	21.8 J	21.5 J	27.9 J
CYANIDE		200	10000	0.15 U	0.13 U	0.14 U	0.13 U	0.12 U	0.15 U	0.14 U
IRON	9260			9440	9680	8250	9340	14100 J	15000 J	16800 J
LEAD	5.1	150	500	21.9 J	13.9 J	18.5 J	10.6 J	35.8 J	14 J	51.2 J
MAGNESIUM	1880			1950 J	2260 J	1820 J	1930 J	2880	3490	3740
MANGANESE	115	390	10000	148 J	146 J	118 J	131 J	158	148	207
MERCURY		23	610	0.026 J	0.0082 J	0.014 J	0.0085 J	0.013 UJ	0.023 UJ	0.062 UJ
NICKEL	6.5	1000	10000	10.5 J	7.6 J	8.3 J	8.1 J	10.6 J	13.7 J	16.1 J
POTASSIUM	680			577	805	744	775	750 J	1190 J	2120 J
SODIUM	22.6			72.5	101	64.7	103	45.6 UJ	2120 J	2710 J
VANADIUM	8.1	550	10000	8.6 J	10.7 J	8.8 J	8.5 J	13 J	16.6 J	24.2 J
ZINC	18.1	6000	10000	50.9 J	35 J	34.7 J	25.3 J	41.3 J	44.8 J	56.7 J

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP05	G32-TP06	G32-TP07	G32-TP08	G32-TP09-01	G32-TP09-02	G32-TP10A
TOP DEPTH				10	6	2	2	2	2	2
BOTTOM DEPTH				11	6.5	2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP05-02-0000	G32-SOTP06-01-0002	G32-SOTP07	G32-SOTP08	G32-SOTP09-01-0002	G32-SOTP09-02-0002	G32-SOTP10-01-0002
SAMPLE DATE				20050721	20050721	20050722	20050722	20050721	20050721	20050721
VOLATILE ANALYSIS (µg/kg)										
1,1,2,2-TETRACHLOROETHANE		1300	29000	2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
1,2,4-TRICHLOROBENZENE		96000	10000000	2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
1,2-DIBROMO-3-CHLOROPROPANE				2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
1,2-DICHLOROBENZENE		510000	10000000	2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
1,3-DICHLOROBENZENE		430000	10000000	2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
1,4-DICHLOROBENZENE		27000	240000	2 U	4 U	3 U	4 U	4 UJ	590 U	520 U
ACETONE		7800000	10000000	15 UJ	120 J	12 UJ	24 UJ	10 UJ	590 UJ	520 UJ
BENZENE		2500	200000	2 U	2 J	3 U	4 U	4 U	590 U	520 U
CARBON DISULFIDE				2 U	6	3 U	4 U	4 U	590 U	520 U
CIS-1,2-DICHLOROETHENE				2 U	4 U	3 U	4 U	4 U	170 J	520 U
ETHYLBENZENE		71000	10000000	2 U	3 J	3 U	4 U	4 UJ	99 J	520 U
ISOPROPYLBENZENE				2 U	1 J	3 U	4 U	4 U	400 J	520 U
M+P-XYLENES				NA	NA	NA	NA	NA	NA	NA
METHYL ACETATE				2 U	4 U	3 U	4 U	4 U	450 J	100 J
METHYL CYCLOHEXANE				2 J	4 U	3 U	4 U	4 U	140 J	520 U
METHYL TERT-BUTYL ETHER				2 U	4 U	3 U	4 U	4 U	590 U	520 U
METHYLENE CHLORIDE		45000	760000	8 U	19 U	8 U	24 U	5 U	590 U	520 U
O-XYLENE				2 U	2 J	3 U	4 U	4 UJ	590 U	520 U
P-XYLENE				2 U	3 J	3 U	4 U	4 UJ	590 U	520 U
TOLUENE		190000	10000000	2 U	7	3 U	4 U	4 U	590 U	520 U
TOTAL XYLENES		110000	10000000	2 U	6	3 U	4 U	4 UJ	590 U	520 U
TRANS-1,2-DICHLOROETHENE				2 U	4 U	3 U	4 U	4 U	590 U	520 U
TRICHLOROETHENE		13000	520000	2 U	4 U	3 U	4 U	4 U	590 U	520 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				410 U	4300	360 U	86 J	410 U	58 J	460 U
2-METHYLNAPHTHALENE		123000	10000000	43	13000	7.2	340 J	98	350 J	450 J
4-METHYLPHENOL				410 U	660 J	360 U	390 U	410 U	520 U	460 U
ACENAPHTHENE		43000	10000000	27	52000	19	1100	370	540	180
ACENAPHTHYLENE		23000	10000000	57	1800 J	3.6 U	97	58	140	4.6 U
ANTHRACENE		35000	10000000	23	94000	49	1800	310	1000	38
BENZALDEHYDE				410 UJ	2500 UJ	360 UJ	390 UJ	410 UJ	79 J	460 UJ
BENZO(A)ANTHRACENE		900	7800	35	140000	160	4400	800	3400	82
BENZO(A)PYRENE		400	800	44	110000	160	3700 J	790 J	2500 J	73
BENZO(B)FLUORANTHENE		900	7800	50	100000	220	5200 J	910 J	3700 J	74
BENZO(G,H,I)PERYLENE		800	10000000	31	36000 J	91	1100 J	390	880 J	46

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP05	G32-TP06	G32-TP07	G32-TP08	G32-TP09-01	G32-TP09-02	G32-TP10A
TOP DEPTH				10	6	2	2	2	2	2
BOTTOM DEPTH				11	6.5	2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP05-02-0000	G32-SOTP06-01-0002	G32-SOTP07	G32-SOTP08	G32-SOTP09-01-0002	G32-SOTP09-02-0002	G32-SOTP10-01-0002
SAMPLE DATE				20050721	20050721	20050722	20050722	20050721	20050721	20050721
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)										
BENZO(K)FLUORANTHENE		900	78000	43	37000 J	130	1900 J	660 J	1600 J	62
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	53 J	2500 U	65 J	64 J	79 J	130 J	76 J
BUTYL BENZYL PHTHALATE				410 U	2500 U	360 U	390 U	410 U	520 U	460 U
CARBAZOLE				410 U	37000	360 U	890	91 J	530	460 U
CHRYSENE		400	780000	50	130000	150	3700	740	2500	97
DIBENZO(A,H)ANTHRACENE		400	800	13	8000 J	26	270 J	140	200 J	20
DIBENZOFURAN				410 U	39000 J	360 U	620	96 J	280 J	460 U
DI-N-BUTYL PHTHALATE				60 J	2500 U	56 J	58 J	71 J	98 J	55 J
FLUORANTHENE		20000	10000000	110	370000	270 J	9500	1500	6900	200
FLUORENE		28000	10000000	22	61000	23	990	190	390 J	130
INDENO(1,2,3-CD)PYRENE		900	7800	26	34000 J	84	1300 J	380	840 J	42
NAPHTHALENE		54000	10000000	16	44000 J	7.5	860	85	320	140
PHENANTHRENE		40000	10000000	77	360000	170	7500	820	5000	130
PHENOL		6000000	10000000	410 U	610 J	360 U	390 U	410 U	520 U	460 U
PYRENE		13000	10000000	73	260000	260	12000	2100	7800	150
PESTICIDE/PCB ANALYSIS (µg/kg)										
4,4'-DDD				4.2 U	48 J	3.6 U	3.9 U	4.1 R	5.2 U	4.6 U
4,4'-DDE				4.2 U	54 R	3.6 U	6.2 R	4.1 R	8.3 R	4.6 U
4,4'-DDT				4.2 U	5.1 U	3.6 U	3.9 U	4.1 R	5.2 U	4.6 U
ALDRIN				2.1 U	2.6 U	1.9 U	2 U	2.6 R	2.6 U	2.4 U
ALPHA-BHC				2.1 U	2.6 U	1.9 U	2 U	2.1 R	3 J	2.4 U
ALPHA-CHLORDANE				2.1 U	2.6 U	1.9 U	2 U	2.1 R	4.9	2.4 U
AROCLOR-1016				42 U	51 U	36 U	39 U	41 U	52 U	46 U
AROCLOR-1254				42 U	390	36 U	220	41 U	52 U	46 U
AROCLOR-1260				42 U	51 U	51	39 U	41 U	600	46 U
BETA-BHC				2.1 U	26 U	2.6 J	2 U	2.1 R	2.6 U	2.4 U
DELTA-BHC				2.1 U	2.6 U	1.9 U	2 U	2.1 R	2.6 U	2.4 U
DIELDRIN		40	400	4.2 U	13 R	3.6 U	3.9 U	4.1 R	5.2 U	4.6 U
ENDOSULFAN I				2.1 U	2.6 U	1.9 U	2 U	2.1 R	2.6 U	2.4 U
ENDOSULFAN II				4.2 U	5.8 R	3.6 U	3.9 U	4.1 R	5.2 U	4.6 U
ENDOSULFAN SULFATE				4.2 U	5.1 U	3.6 U	3.9 U	4.1 R	67	4.6 U
ENDRIN				4.2 U	5.1 U	3.6 U	3.9 U	4.1 R	5.2 U	4.6 U

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO	SO	SO
LOCATION ID				G32-TP05	G32-TP06	G32-TP07	G32-TP08	G32-TP09-01	G32-TP09-02	G32-TP10A
TOP DEPTH				10	6	2	2	2	2	2
BOTTOM DEPTH				11	6.5	2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP05-02-0000	G32-SOTP06-01-0002	G32-SOTP07	G32-SOTP08	G32-SOTP09-01-0002	G32-SOTP09-02-0002	G32-SOTP10-01-0002
SAMPLE DATE				20050721	20050721	20050722	20050722	20050721	20050721	20050721
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)										
ENDRIN ALDEHYDE				4.2 U	68 J	3.6 U	8.8	4.1 R	28 J	4.6 U
ENDRIN KETONE				4.2 U	340 J	3.6 U	11 J	4.1 R	15 J	4.6 U
GAMMA-BHC (LINDANE)				2.1 U	2.6 U	1.9 U	2 U	2.1 R	2.6 U	2.4 U
GAMMA-CHLORDANE				2.1 U	26 U	1.9 U	2 U	2.1 R	2.6 U	2.4 U
HEPTACHLOR				2.1 U	2.6 U	1.9 U	2 U	2.1 R	2.6 U	2.4 U
HEPTACHLOR EPOXIDE				2.1 U	20 J	1.9 U	2 U	2.1 R	2.6 U	2.4 U
METHOXYCHLOR				21 U	480 J	19 U	20 U	21 R	26 U	24 U
TOTAL AROCLOR		10000	10000	42 U	390	51	220	41 U	600	46 U
TOXAPHENE				210 U	260 U	190 U	200 U	210 R	260 U	240 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)										
GASOLINE RANGE ORGANICS		500	2500	13 U	11 U	78	6.3 U	24 U	120	180
DIESEL RANGE ORGANICS		500	2500	520	4800	140	91	1800	580	1200 J
METALS ANALYSIS (mg/kg)										
ALUMINUM	5120			8950	6060	7030	5330	5230	6630	8000
ANTIMONY		10	820	0.66 J	5.6 J	0.51 J	0.75 J	0.63 J	15.4 J	0.97 J
ARSENIC	2	7	7	3.6 J	10.1 J	2.7 J	4.5 J	2.5 J	11.4 J	4 J
BARIUM	22.7	5500	10000	33 J	273 J	28.1 J	37.7 J	24 J	51.5 J	45.9 J
BERYLLIUM	0.16	0.4	1.3	0.33	0.25	0.34	0.29	0.23	0.23	0.31
CADMIUM		39	1000	0.23 UJ	201 J	0.52 UJ	0.73 J	25.4 J	5670 J	23.7 J
CALCIUM	532			647 J	68200 J	677 J	5160 J	1100 J	1420 J	1090 J
CHROMIUM	6.2	1400	10000	13.5 J	51.4 J	8.5 J	8.6 J	10.9 J	340 J	14.8 J
COBALT	2.9			5.3 J	4.8 J	7.5 J	3 J	4.8 J	8.3 J	7.4 J
COPPER	9.8	3100	10000	24.5 J	116 J	20.2 J	14.3 J	25.6 J	424 J	25.7 J
CYANIDE		200	10000	0.14 U	0.18 U	0.12 U	0.13 U	0.13 U	0.18 U	0.16 U
IRON	9260			14600 J	49100 J	12600 J	11100 J	12500 J	57800 J	14700 J
LEAD	5.1	150	500	38.5 J	493 J	10.3 J	141 J	83.6 J	2700 J	138 J
MAGNESIUM	1880			3270	6080	2340	2110	1950	2790	3280
MANGANESE	115	390	10000	193	337	131	349	138	369	147
MERCURY		23	610	0.062 UJ	0.06 UJ	0.021 UJ	0.02 UJ	0.011 UJ	0.067 UJ	0.03 UJ
NICKEL	6.5	1000	10000	13.1 J	29.1 J	12.5 J	7.3 J	13.6 J	45.3 J	20.5 J
POTASSIUM	680			1070 J	1350 J	860 J	721 J	742 J	383 UJ	3950 J
SODIUM	22.6			2330 J	1860 J	36.5 UJ	124 J	41.6 UJ	61.2 UJ	61.6 UJ
VANADIUM	8.1	550	10000	20.6 J	20.9 J	12.8 J	8.8 J	11.2 J	24.9 J	18.5 J
ZINC	18.1	6000	10000	47.7 J	467 J	28.2 J	170 J	62.2 J	653 J	47.6 J

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO
LOCATION ID				G32-TP10B	G32-TP10C	G32-TP11B	G32-TP12	G32-TP13
TOP DEPTH				2	2	2	2	2
BOTTOM DEPTH				2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP10-02-0002	G32-SOTP10-03-0002	G32-SOTP11-01-AVG	G32-SOTP12-01-AVG	G32-SOTP13-01
SAMPLE DATE				20050721	20050721	20050721	20050721	20050721
VOLATILE ANALYSIS (µg/kg)								
1,1,2,2-TETRACHLOROETHANE		1300	29000	420 U	2 U	3.5 U	2.5 U	3 U
1,2,4-TRICHLOROBENZENE		96000	10000000	420 U	2 U	3	2.5 U	3 U
1,2-DIBROMO-3-CHLOROPROPANE				420 U	2 U	1 J	2.5 U	3 U
1,2-DICHLOROBENZENE		510000	10000000	420 U	2 U	1 J	2.5 U	3 U
1,3-DICHLOROBENZENE		430000	10000000	420 U	2 U	1 J	2.5 U	3 U
1,4-DICHLOROBENZENE		27000	240000	420 U	2 U	2 J	2.5 U	3 U
ACETONE		7800000	10000000	420 UJ	16 UJ	13 UJ	9.5 UJ	6 UJ
BENZENE		2500	200000	420 U	2 U	3.5 U	2.5 U	3 U
CARBON DISULFIDE				420 U	2 U	3.5 U	2.5 U	3 UJ
CIS-1,2-DICHLOROETHENE				420 U	2 J	3.5 U	2.5 U	3 U
ETHYLBENZENE		71000	10000000	420 U	2 U	3.5 U	2.5 U	3 U
ISOPROPYLBENZENE				420 U	6	3.5 U	2.5 U	3 U
M+P-XYLENES				NA	NA	NA	NA	NA
METHYL ACETATE				260 J	2 U	3.5 U	2.5 U	3 U
METHYL CYCLOHEXANE				420 U	2 J	3.5 U	2.5 U	3 U
METHYL TERT-BUTYL ETHER				420 U	2 U	3.5 U	2.5 U	3 U
METHYLENE CHLORIDE		45000	760000	420 U	5 U	15.5 U	11 UJ	16 UJ
O-XYLENE				420 U	2 U	3.5 U	2.5 U	3 U
P-XYLENE				420 U	2 U	1 J	2.5 U	3 U
TOLUENE		190000	10000000	420 U	2 U	3.5 U	2.5 U	3 U
TOTAL XYLENES		110000	10000000	420 U	2 U	1 J	2.5 U	3 U
TRANS-1,2-DICHLOROETHENE				420 U	2 U	3.5 U	2.5 U	3 U
TRICHLOROETHENE		13000	520000	420 U	2 U	3.5 U	2.5 U	3 U
SEMIVOLATILE ANALYSIS (µg/kg)								
1,1-BIPHENYL				390 U	81 J	410 U	355 U	370 U
2-METHYLNAPHTHALENE		123000	10000000	3.9 U	35	11.6 J	7.65 J	61
4-METHYLPHENOL				390 U	390 U	410 U	355 U	370 U
ACENAPHTHENE		43000	10000000	150	120	41 J	8.75	300 J
ACENAPHTHYLENE		23000	10000000	3.9 U	3.9 U	4.1 U	3.55 U	3.7 U
ANTHRACENE		35000	10000000	37	87	78.5 J	20	530
BENZALDEHYDE				390 UJ	390 U	410 UJ	355 UJ	370 UJ
BENZO(A)ANTHRACENE		900	7800	34	160	190	37.5	840
BENZO(A)PYRENE		400	800	31	160	180	28.5	580
BENZO(B)FLUORANTHENE		900	7800	26	210	245	43.5	730
BENZO(G,H,I)PERYLENE		800	10000000	19	70	83.5	14	310

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO
LOCATION ID				G32-TP10B	G32-TP10C	G32-TP11B	G32-TP12	G32-TP13
TOP DEPTH				2	2	2	2	2
BOTTOM DEPTH				2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP10-02-0002	G32-SOTP10-03-0002	G32-SOTP11-01-AVG	G32-SOTP12-01-AVG	G32-SOTP13-01
SAMPLE DATE				20050721	20050721	20050721	20050721	20050721
SEMIVOLATILE ANALYSIS (µg/kg) (cont.)								
BENZO(K)FLUORANTHENE		900	78000	24	94	98	16.5	370
BIS(2-ETHYLHEXYL)PHTHALATE		46000	410000	68 J	45 J	44 J	38 J	370 U
BUTYL BENZYL PHTHALATE				390 U	390 U	410 U	355 U	370 U
CARBAZOLE				390 U	60 J	410 U	355 U	250 J
CHRYSENE		400	780000	44	150	180	34.5	920
DIBENZO(A,H)ANTHRACENE		400	800	7	23	25.5	3.375	110
DIBENZOFURAN				390 U	75 J	410 U	355 U	220 J
DI-N-BUTYL PHTHALATE				58 J	390 U	59 J	46.5 J	47 J
FLUORANTHENE		20000	10000000	120	370	360 J	96	2100
FLUORENE		28000	10000000	210	150	41 J	11	330 J
INDENO(1,2,3-CD)PYRENE		900	7800	15	71	81.5	11.85 J	310
NAPHTHALENE		54000	10000000	100	39	16.1 J	10.45 J	38
PHENANTHRENE		40000	10000000	47	180	245 J	47	2600
PHENOL		6000000	10000000	390 U	390 U	410 U	355 U	370 U
PYRENE		13000	10000000	84	210	320	62.5	1700
PESTICIDE/PCB ANALYSIS (µg/kg)								
4,4'-DDD				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
4,4'-DDE				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
4,4'-DDT				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
ALDRIN				2 U	2 U	2.1 U	1.85 U	1.9 U
ALPHA-BHC				2 U	2 U	2.1 U	1.85 U	1.9 U
ALPHA-CHLORDANE				2 U	2 U	2.1 U	1.85 U	1.9 U
AROCLOR-1016				39 U	39 U	41 U	36 U	38 U
AROCLOR-1254				39 U	39 U	41 U	36 U	38 U
AROCLOR-1260				39 U	39 U	41 U	36 U	38 U
BETA-BHC				2 U	2 U	2.1 U	1.85 U	1.9 UJ
DELTA-BHC				2 U	2 U	2.1 U	1.85 U	1.9 U
DIELDRIN		40	400	3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
ENDOSULFAN I				2 U	2 U	2.1 U	1.85 U	1.9 U
ENDOSULFAN II				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
ENDOSULFAN SULFATE				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
ENDRIN				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U

TABLE 4-1C

SUMMARY OF ANALYTICAL RESULTS: SUBSURFACE SOIL SAMPLES FROM TEST PITS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref (1)**	**Residential DEC (2)**	**Ind./ Comm. DEC (3)**	SO	SO	SO	SO	SO
LOCATION ID				G32-TP10B	G32-TP10C	G32-TP11B	G32-TP12	G32-TP13
TOP DEPTH				2	2	2	2	2
BOTTOM DEPTH				2.5	2.5	2.5	2.5	2.5
SAMPLE ID				G32-SOTP10-02-0002	G32-SOTP10-03-0002	G32-SOTP11-01-AVG	G32-SOTP12-01-AVG	G32-SOTP13-01
SAMPLE DATE				20050721	20050721	20050721	20050721	20050721
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)								
ENDRIN ALDEHYDE				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
ENDRIN KETONE				3.9 U	3.9 U	4.1 U	3.6 U	3.8 U
GAMMA-BHC (LINDANE)				2 U	2 U	2.1 U	1.85 U	1.9 U
GAMMA-CHLORDANE				2 U	2 U	2.1 U	1.85 U	1.9 U
HEPTACHLOR				2 U	2 U	2.1 U	1.85 U	1.9 U
HEPTACHLOR EPOXIDE				2 U	2 U	2.1 U	1.85 U	1.9 U
METHOXYCHLOR				20 U	20 U	21 U	18.5 U	19 U
TOTAL AROCLOR		10000	10000	39 U	39 U	41 U	36 U	38 U
TOXAPHENE				200 U	200 U	210 U	185 U	190 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)								
GASOLINE RANGE ORGANICS		500	2500	54	30 UJ	3.7 U	19.5 UJ	3.5 U
DIESEL RANGE ORGANICS		500	2500	3500	250	45.5	54.5	42
METALS ANALYSIS (mg/kg)								
ALUMINUM	5120			9350	8460	8770	13350	8830
ANTIMONY		10	820	0.93 J	0.8 J	0.67 J	0.745 J	0.55 J
ARSENIC	2	7	7	3.2 J	3.2 J	3.55 J	4.55 J	2.9 J
BARIUM	22.7	5500	10000	12.4 J	25 J	23 J	26.1 J	20.2 J
BERYLLIUM	0.16	0.4	1.3	0.3	0.26	0.375	0.39	0.3
CADMIUM		39	1000	0.74 J	14.2 J	4.6 J	2 J	2.5 J
CALCIUM	532			765 J	1080 J	508.5 J	945 J	813 J
CHROMIUM	6.2	1400	10000	10.4 J	18.9 J	14.55 J	21.75 J	13.4 J
COBALT	2.9			4.1 J	6.8 J	6.85 J	10.6 J	9.4 J
COPPER	9.8	3100	10000	17.5 J	49 J	51.85 J	29.4 J	28.6 J
CYANIDE		200	10000	0.14 U	0.13 U	0.135 U	0.115 U	0.12 U
IRON	9260			24700 J	16700 J	15150 J	26000 J	17300 J
LEAD	5.1	150	500	9 J	60.8 J	24.75 J	18.15 J	12.9 J
MAGNESIUM	1880			4270	3250	3015	4640	3460
MANGANESE	115	390	10000	259	187	116	206.5	181
MERCURY		23	610	0.015 UJ	0.11 UJ	0.0285 UJ	0.01465 UJ	0.02 UJ
NICKEL	6.5	1000	10000	10.6 J	14.6 J	17.95 J	21.35 J	23.2 J
POTASSIUM	680			592 J	662 J	738.5 J	482 J	486 J
SODIUM	22.6			29.2 UJ	41.2 UJ	32.95 UJ	47.35 UJ	31.5 UJ
VANADIUM	8.1	550	10000	13.6 J	13.6 J	20.15 J	18.05 J	13 J
ZINC	18.1	6000	10000	33.4 J	81.7 J	58.35 J	54.2 J	66.4 J

Notes:

(1) REF = Reference (Upgradient) Soil Concentrations Detected

(2) Residential Direct Exposure Criteria (RIDEM 2004)

(3) Industrial/Commercial Direct Exposure Criteria (RIDEM 2004)

TABLE 4-1D

SUMMARY OF ANALYTICAL RESULTS, REFERENCE (UPGRADIENT) SOIL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Residential DEC (1)**	**Ind./Comm. DEC (2)**	SO	SO
LOCATION ID			G32-SB301B	G32-SB301B
TOP DEPTH			0	10
BOTTOM DEPTH			2	12
SAMPLE ID			G32-SB301B-0002	G32-SB301B-1012
SAMPLE DATE			20050713	20050713
SEMIVOLATILE ANALYSIS (µg/kg)				
2-METHYLNAPHTHALENE	123000	10000000	9.6	NA
ACENAPHTHENE	43000	10000000	71	NA
ACENAPHTHYLENE	23000	10000000	9.9	NA
ANTHRACENE	35000	10000000	160	NA
BENZO(A)ANTHRACENE	900	7800	530	NA
BENZO(A)PYRENE	400	800	450	NA
BENZO(B)FLUORANTHENE	900	7800	640	NA
BENZO(G,H,I)PERYLENE	800	10000000	300	NA
BENZO(K)FLUORANTHENE	900	78000	320	NA
BIS(2-ETHYLHEXYL)PHTHALATE	46000	410000	95 J	NA
CARBAZOLE			72 J	NA
CHRYSENE	400	780000	630	NA
DIBENZO(A,H)ANTHRACENE	400	800	89	NA
FLUORANTHENE	20000	10000000	1100	NA
FLUORENE	28000	10000000	59	NA
HIGH MOLECULAR WEIGHT PAHS			3229	NA
INDENO(1,2,3-CD)PYRENE	900	7800	270	NA
LOW MOLECULAR WEIGHT PAHS			2911.5	NA
NAPHTHALENE	54000	10000000	12	NA
PHENANTHRENE	40000	10000000	610	NA
PYRENE	13000	10000000	880	NA
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)				
Diesel Range Organics	500	2500	53	NA
METALS (mg/kg)				
ALUMINUM			8850	5120
ARSENIC	7	7	3.2 J	2 J
BARIUM	5500	10000	35 J	22.7 J
BERYLLIUM	0.4	1.3	0.3	0.16
CADMIUM	39	1000	0.24 J	NA
CALCIUM			731	532
CHROMIUM	1400	10000	11.1	6.2
COBALT			5.8 J	2.9 J
COPPER	3100	10000	21.2	9.8
IRON			12300	9260
LEAD	150	500	84.5	5.1 J
METALS (mg/kg) (cont.)				
MAGNESIUM			2620	1880
MANGANESE	390	10000	216	115
MERCURY	23	610	0.033 J	NA
NICKEL	1000	10000	12.6 J	6.5 J
POTASSIUM			977 J	680 J
SODIUM			32.4	22.6
VANADIUM	550	10000	20.4	8.1 J
ZINC	6000	10000	43.7 J	18.1 J

Notes:

(1) Residential Direct Exposure Criteria (RIDEM 2004)

(2) Industrial/Commercial Direct Exposure Criteria (RIDEM 2004).

NA - Not analyzed.

TABLE 4-1E

SUMMARY OF ANALYTICAL RESULTS: MANHOLE SLUDGE SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	SL	SL
LOCATION ID	G32-OTSMH01	G32-TP05
SAMPLE ID	G32-OTSMH01	G32-SOTP05-MH-AVG
SAMPLE DATE	20050614	20050726
VOLATILE ANALYSIS (µg/kg)		
CARBON DISULFIDE	2 J	4.5 U
CYCLOHEXANE	2 J	4.5 U
ETHYLBENZENE	4	4.5 U
ISOPROPYLBENZENE	2 J	4.5 U
METHYL CYCLOHEXANE	5	4.5 U
O-XYLENE	10	4.5 U
P-XYLENE	16	4.5 U
TOLUENE	6	4.5 U
TOTAL XYLENES	26	4.5 U
SEMIVOLATILE ANALYSIS (µg/kg)		
2-METHYLNAPHTHALENE	730	37.5
ACENAPHTHENE	4500	132 J
ACENAPHTHYLENE	700	46 J
ANTHRACENE	5300 J	270 J
BENZO(A)ANTHRACENE	24000	730 J
BENZO(A)PYRENE	16000	625 J
BENZO(B)FLUORANTHENE	25000	1010 J
BENZO(G,H,I)PERYLENE	4400 J	370 J
BENZO(K)FLUORANTHENE	11000	435 J
BIS(2-ETHYLHEXYL)PHTHALATE	3500 JEB	57.5 J
CARBAZOLE	2600 J	102 J
CHRYSENE	21000	785 J
DIBENZO(A,H)ANTHRACENE	3700 J	175 J
DIBENZOFURAN	1400 J	59 J
DI-N-BUTYL PHTHALATE	320 J	385 U
DI-N-OCTYL PHTHALATE	1500 J	385 UJ
FLUORANTHENE	38000 E	1430 J
FLUORENE	2500 J	112 J
INDENO(1,2,3-CD)PYRENE	4500 J	360 J
NAPHTHALENE	1500	48.5 J
PHENANTHRENE	29000	815 J
PYRENE	35000	1885 J

TABLE 4-1E

SUMMARY OF ANALYTICAL RESULTS: MANHOLE SLUDGE SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	SL	SL
LOCATION ID	G32-OTSMH01	G32-TP05
SAMPLE ID	G32-OTSMH01	G32-SOTP05-MH-AVG
SAMPLE DATE	20050614	20050726
PESTICIDE/PCB ANALYSIS (µg/kg)		
4,4'-DDD	35 J	3.85 U
4,4'-DDE	43 J	3.85 U
4,4'-DDT	47 J	3.15 J
ALPHA-CHLORDANE	38 J	2 U
AROCLOR-1260	170 J	33.75
DELTA-BHC	7.4 J	2 U
ENDRIN ALDEHYDE	29 J	5.5 J
ENDRIN KETONE	86 J	5.05 J
GAMMA-CHLORDANE	50	2 U
TOTAL AROCLOR	170	33.75
PETROELUM HYDROCARBON ANALYSIS (mg/kg)		
DIESEL RANGE ORGANICS	2400 J	1960 J
METALS ANALYSIS (mg/kg)		
ALUMINUM	1750 J	7045
ANTIMONY	13.1 J	1.4 J
ARSENIC	10.6 J	3.7 J
BARIUM	451 J	40.1 J
BERYLLIUM	0.052	0.30
CADMIUM	37 J	1.45 J
CALCIUM	36800	1925 J
CHROMIUM	113 J	18.6 J
COBALT	15.1 J	5.1 J
COPPER	397 J	89.35 J
CYANIDE	0.56	0.17 J
IRON	81600	25100 J
LEAD	1010 J	102.55 J
MAGNESIUM	7070 J	2555
MANGANESE	947 J	203
MERCURY	0.24 J	0.435 J
NICKEL	70.4 J	16.85 J
POTASSIUM	237	901 J
SODIUM	442	143 J
VANADIUM	7.3 J	65.1 J
ZINC	2080 J	207.5 J

TABLE 4-2A

SUMMARY OF ANALYTICAL RESULTS: GROUNDWATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref[1]**	**MCL[2]**	**GAGWO[3]**	GW	GW	GW	GW	GW	GW	GW	GW	GW
LOCATION ID				G32-MW300B	G32-MW300S	G32-MW302B	G32-MW302S	G32-MW303B	G32-MW303S	G32-MW304B	G32-MW304S	G32-MW305B
DEPTH IN FEET				53-83	4-12	54-84	14-24	14-49	3-13	89-119	4-14	65-95
SAMPLE ID				G32-MW300B	G32-MW300S-AVG	G32-MW302B	G32-MW302S-AVG	G32-MW303B	G32-MW303S	G32-MW304B	G32-MW304S	G32-MW305B
SAMPLE DATE				20050725	20050720	20050725	20050726	20050719	20050725	20050727	20050727	20050719
VOLATILE ANALYSIS (µg/L)												
BENZENE		5	5	1 U	3 J	1 U	1 U	1 UJ	1 U	1 U	1 U	1 UJ
TETRACHLOROETHENE		5	5	1 U	6 J	1 U	1 U	1 UJ	1 U	1 U	1 U	1 UJ
TOLUENE		1000	1000	1 U	1 J	1 U	1 U	1 UJ	1 U	1 U	1 U	1 UJ
TRICHLOROETHENE		5	5	1 U	1 UJ	1 U	1 U	1 UJ	1 U	1 U	1	1 UJ
SEMIVOLATILE ANALYSIS (µg/L)												
2,4-DICHLOROPHENOL				10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE				0.1 U	0.10 U	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-METHYLPHENOL				10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	0.15			0.1 U	0.13	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ANTHRACENE				0.1 U	0.10 U	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE		6	6	2 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CARBAZOLE				10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN				10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	0.65			0.1 U	0.135 J	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
FLUORENE				0.1 U	0.10 U	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE	0.11		20	0.1 U	0.17	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PENTACHLOROPHENOL		1	1	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
PHENANTHRENE	0.25			0.1 U	0.18	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PHENOL				10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PYRENE	0.49			0.1 U	0.11	0.1 U	0.10 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PETROLEUM HYDROCARBON ANALYSIS (mg/L)												
GASOLINE RANGE ORGANICS				0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 UJ	0.05 U	0.051	0.05 U
DIESEL RANGE ORGANICS				0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
METALS ANALYSIS (µg/L)												
ALUMINUM	396			197 J	340 J	450 J	38.2 J	243 J	25.7 UJ	1180 J	151 J	158 J
ARSENIC		10		5.4	1.6 U	5.8 U	1.8 UJ	4.2	1.7 J	1.6 U	1.6 U	1.6 U
BARIUM	29.7	2000	2000	34.5	49.55	25.6 J	49.9 J	39.6	34.7	36.5 J	119 J	30.2
CADMIUM		5	5	0.19 UJ	0.355 U	0.1 UJ	0.17 J	0.62	0.37 U	0.1 UJ	1.6 UJ	0.13 UJ
CALCIUM	22100			26000	64150	17500	28650	21100	50900	27200	381000	12300
COBALT	68.3			26.7	14.25	13 J	15.45 J	33.1	36.9	1.6 J	13.8 J	24.7
COPPER		1300		6.3 U	10.2 J	6.8 J	6.3 UJ	6.3 U	6.3 U	6.3 UJ	9.7 J	6.3 U

TABLE 4-2A

SUMMARY OF ANALYTICAL RESULTS: GROUNDWATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref[1]**	**MCL[2]**	**GAGWO[3]**	GW	GW	GW	GW	GW	GW	GW	GW	GW
LOCATION ID				G32-MW300B	G32-MW300S	G32-MW302B	G32-MW302S	G32-MW303B	G32-MW303S	G32-MW304B	G32-MW304S	G32-MW305B
DEPTH IN FEET				53-83	4-12	54-84	14-24	14-49	3-13	89-119	4-14	65-95
SAMPLE ID				G32-MW300B	G32-MW300S-AVG	G32-MW302B	G32-MW302S-AVG	G32-MW303B	G32-MW303S	G32-MW304B	G32-MW304S	G32-MW305B
SAMPLE DATE				20050725	20050720	20050725	20050726	20050719	20050725	20050727	20050727	20050719
METALS ANALYSIS (µg/L) (cont.)												
IRON	1380			18900	2595	7020 J	3240 J	16500	7500	2950 J	660 J	9180
MAGNESIUM	4900			6130	26650	3570	13200	4460	26900	3840	842000	3750
MANGANESE	230			1900	755	1030 J	329.5 J	877	469	210 J	4210 J	2180
NICKEL	26.5		100	60	23	18.1	23.05	55.9	60.2	3.8	18 J	29.1
POTASSIUM	5820			2810	11650	3240	5210	339000	4540	2450 U	63700 J	3110
SODIUM	13800			55300	130000	22300	51300	7700000	55900	17500	8550000	23400
VANADIUM				0.47 U	0.665 UJ	0.74 J	0.47 U	0.47 U	0.47 U	3	1.1 J	0.47 U
ZINC				86.1	166.5	38.3 UJ	27.5 UJ	98.8	80.8 U	14.3 UJ	45.6 UJ	46.2 U
MISCELLANEOUS ANALYSIS (mg/L)												
ALKALINITY	48.5			42	115	35	17.5	25	23	53	91	43
TOTAL ORGANIC CARBON				10 U	10 U	10 U	10 U	10 U	10 U	15	10 U	10 U

TABLE 4-2A

SUMMARY OF ANALYTICAL RESULTS: GROUNDWATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref[1]**	**MCL[2]**	**GAGWO[3]**	GW	GW	GW
LOCATION ID				G32-MW305S	G32-MW306B	G32-MW306S
DEPTH IN FEET				4-14	64-94	4-9
SAMPLE ID				G32-MW305S-AVG	G32-MW306B	G32-MW306S
SAMPLE DATE				20050726	20050727	20050727
VOLATILE ANALYSIS (µg/L)						
BENZENE		5	5	1 U	1 U	1 U
TETRACHLOROETHENE		5	5	1 U	1 U	1 U
TOLUENE		1000	1000	1 U	1 U	1 U
TRICHLOROETHENE		5	5	1 U	1 U	1 U
SEMIVOLATILE ANALYSIS (µg/L)						
2,4-DICHLOROPHENOL				10 U	10 U	1 J
2-METHYLNAPHTHALENE				0.10 U	0.1 U	1.4
4-METHYLPHENOL				10 U	10 U	2 J
ACENAPHTHENE	0.15			0.10 U	0.1 U	3.9
ANTHRACENE				0.10 U	0.1 U	0.98
BIS(2-ETHYLHEXYL)PHTHALATE		6	6	10 U	10 U	10 U
CARBAZOLE				10 U	10 U	5 J
DIBENZOFURAN				10 U	10 U	2 J
FLUORANTHENE	0.65			0.10 U	0.1 U	0.69
FLUORENE				0.10 U	0.1 U	2
NAPHTHALENE	0.11		20	0.10 U	0.14	9.4
PENTACHLOROPHENOL		1	1	20 U	20 U	7 J
PHENANTHRENE	0.25			0.10 U	0.14	3.4
PHENOL				10 U	10 U	16
PYRENE	0.49			0.10 U	0.1 U	0.33
PETROLEUM HYDROCARBON ANALYSIS (mg/L)						
GASOLINE RANGE ORGANICS				0.05 U	0.05 U	0.05 U
DIESEL RANGE ORGANICS				0.35 U	0.35 U	0.49
METALS ANALYSIS (µg/L)						
ALUMINUM	396			245 J	316 J	14 U
ARSENIC		10		8.7 U	3.7 U	7.1 UJ
BARIUM	29.7	2000	2000	29.85 J	177 J	121 J
CADMIUM		5	5	0.10 UJ	0.12 J	0.22 UJ
CALCIUM	22100			55450	151000	528000
COBALT	68.3			2.35 J	23 J	0.15 UJ
COPPER		1300		5.525 J	6.3 UJ	6.3 UJ

TABLE 4-2A

SUMMARY OF ANALYTICAL RESULTS: GROUNDWATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**Ref[1]**	**MCL[2]**	**GAGWO[3]**	GW	GW	GW
LOCATION ID				G32-MW305S	G32-MW306B	G32-MW306S
DEPTH IN FEET				4-14	64-94	4-9
SAMPLE ID				G32-MW305S-AVG	G32-MW306B	G32-MW306S
SAMPLE DATE				20050726	20050727	20050727
METALS ANALYSIS (µg/L) (cont.)						
IRON	1380			1940 J	6970 J	19 U
MAGNESIUM	4900			10650	28000	286000
MANGANESE	230			314 J	1080 J	1.8 UJ
NICKEL	26.5		100	2.45	17.2	2.3 J
POTASSIUM	5820			19750	6590	267000
SODIUM	13800			146000	44100	5130000
VANADIUM				0.47 U	0.47 U	1.1 J
ZINC				14.3 UJ	20.9 UJ	2.3 UJ
MISCELLANEOUS ANALYSIS (mg/L)						
ALKALINITY	48.5			325	44	84
TOTAL ORGANIC CARBON				14.5	10 U	14

Notes:

(1) Reference concentrations detected in upgradient wells.
(2) MCL - Federal Maximum Contaminant Level
(3) GAGWO - RIDEM Groundwater Objectives for GA Aquifers

TABLE 4-2B

SUMMARY OF ANALYTICAL RESULTS: REFERENCE (UPGRADIENT) GROUNDWATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	**MCL (1)**	**GAGWO(2)**	GW	GW
LOCATION ID			G32-MW301B	G32-MW301S
TOP DEPTH			37	19.5
BOTTOM DEPTH			67	29.5
SAMPLE ID			G32-MW301B	G32-MW301S
SAMPLE DATE			20050721	20050721
VOLATILE ANALYSIS (µg/L)				
CHLOROFORM	80		2 J	1 UJ
SEMIVOLATILE ANALYSIS (µg/L)				
ACENAPHTHENE			0.1 U	0.15
BENZO(A)ANTHRACENE			0.1 U	0.27
BENZO(A)PYRENE	0.2	0.2	0.1 U	0.14
BENZO(B)FLUORANTHENE			0.1 U	0.29
BENZO(G,H,I)PERYLENE			0.1	0.16
BENZO(K)FLUORANTHENE			0.1 U	0.11
CHRYSENE			0.1 U	0.27
FLUORANTHENE			0.1 U	0.65 J
HIGH MOLECULAR WEIGHT PAHS			0.1	1.38
INDENO(1,2,3-CD)PYRENE			0.1 U	0.14
LOW MOLECULAR WEIGHT PAHS			0.26	1.64
NAPHTHALENE		20	0.11	0.1 U
PHENANTHRENE			0.15	0.35
PYRENE			0.1 U	0.49
METALS ANALYSIS (µg/L)				
ALUMINUM			516 J	275 J
BARIUM	2000	2000	29.7	13.5 U
CALCIUM			18400	25800
COBALT			38.1	98.5
IRON			2280	473
MAGNESIUM			7330	2470
MANGANESE			291	168
NICKEL		100	27.7	25.3
POTASSIUM			7090	4540
SODIUM			19100	8490
MISCELLANEOUS (mg/L)				
ALKALINITY			42	55

Notes:
(1) MCL - Federal Maximum Contaminant Level.
(2) GAGWO - RIDEM Groundwater Objectives for GA Aquifers.

TABLE 4-2C

SUMMARY OF ANALYTICAL RESULTS: TEST PIT WATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	W	W	W	W	W	W	W	W
LOCATION ID	G32-TP02	G32-TP05	G32-TP06	G32-TP08	G32-TP10B	G32-TP11B	G32-TP12	G32-TP13
SAMPLE ID	G32-AQTP02-0006	G32-AQTP05	G32-AQTP06	G32-AQTP08	G32-AQTP10-02	G32-AQTP11	G32-AQTP12	G32-AQTP13
SAMPLE DATE	20050602	20050721	20050721	20050722	20050721	20050721	20050721	20050721
VOLATILE ANALYSIS (µg/L)								
2-BUTANONE	5 U	5 U	27	13	2 J	5 U	5 U	5 U
2-HEXANONE	5 UJ	5 U	2 J	5 U	5 U	5 U	5 U	5 U
ACETONE	5 U	5 UJ	160 J	16 UJ	6 UJ	5 UJ	5 UJ	5 UJ
BENZENE	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1	1 U	1 U	1 U
METHYL ACETATE	5 U	5 U	9	5 U	5 U	5 U	5 U	5 U
O-XYLENE	1 U	1 U	1 U	2	1 U	1 U	1 U	1 U
P-XYLENE	1 U	1 U	1 U	3	1 U	1 U	1 U	1 U
TOLUENE	1 U	1 U	4	1 U	1 U	1 U	1 U	1 U
TOTAL XYLENES	1 U	1 U	1 U	5	1 U	1 U	1 U	1 U
SEMIVOLATILE ANALYSIS (µg/L)								
1,1-BIPHENYL	10 U	10 U	8 J	33 J	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	10 UJ	10 U	160	100 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	0.1 U	0.1 U	38	160	4	0.1 U	0.1 U	0.1 U
2-METHYLPHENOL	10 U	10 U	44	100 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL	10 U	10 U	570	100 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	0.21	0.1 U	73	64 J	0.1 U	0.1 U	0.1 U	0.1 U
ACENAPHTHYLENE	0.1 U	0.1 U	1.4	100 U	0.1 U	0.1 U	0.1 U	0.1 U
ACETOPHENONE	10 U	10 U	24	100 U	10 U	10 U	10 U	10 U
ANTHRACENE	0.4	0.1 U	28	40 J	0.62	0.1 U	0.1 U	0.1 U
BENZALDEHYDE	10 UJ	10 UJ	32 J	100 UJ	10 UJ	10 UJ	10 UJ	10 UJ
BENZO(A)ANTHRACENE	0.86	0.1 U	11	53 J	0.68	0.2	0.1 U	0.25
BENZO(A)PYRENE	0.78	0.1 U	9.8	24 J	0.63	0.15	0.1 U	0.24
BENZO(B)FLUORANTHENE	1.2	0.1 U	8.4	43 J	0.74	0.31	0.11	0.3
BENZO(G,H,I)PERYLENE	0.6	0.1 U	4.6	16 J	0.39	0.17	0.1 U	0.2
BENZO(K)FLUORANTHENE	0.5	0.1 U	9.8	37 J	0.69	0.11	0.1 U	0.14
CARBAZOLE	10 U	10 U	130	41 J	10 U	10 U	10 U	10 U
CHRYSENE	0.95	0.1 U	11	61 J	0.87	0.26	0.1 U	0.25
DIBENZO(A,H)ANTHRACENE	0.17 J	0.1 UJ	2.5 J	100 U	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
DIBENZOFURAN	10 U	10 U	44	44 J	3 J	10 U	10 U	10 U
FLUORANTHENE	2.3	0.12 J	49	290	2.8 J	0.47 J	0.22 J	0.55 J
FLUORENE	0.16	0.1 U	53	78 J	3.4	0.1 U	0.1 U	0.1 U
INDENO(1,2,3-CD)PYRENE	0.56 J	0.1 U	4.6	19 J	0.38	0.15	0.1 U	0.17
ISOPHORONE	10 U	10 U	2 J	100 U	10 U	10 U	10 U	10 U
NAPHTHALENE	0.1 U	0.1 U	310	120	4.4	0.1 U	0.1 U	0.1 U

TABLE 4-2C

SUMMARY OF ANALYTICAL RESULTS: TEST PIT WATER SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	W	W	W	W	W	W	W	W
LOCATION ID	G32-TP02	G32-TP05	G32-TP06	G32-TP08	G32-TP10B	G32-TP11B	G32-TP12	G32-TP13
SAMPLE ID	G32-AQTP02-0006	G32-AQTP05	G32-AQTP06	G32-AQTP08	G32-AQTP10-02	G32-AQTP11	G32-AQTP12	G32-AQTP13
SAMPLE DATE	20050602	20050721	20050721	20050722	20050721	20050721	20050721	20050721
SEMIVOLATILE ANALYSIS (µg/L) (cont.)								
PENTACHLOROPHENOL	20 U	20 U	25	200 U	20 U	20 U	20 U	20 U
PHENANTHRENE	1.6	0.1 U	100	320	2.3	0.23	0.14	0.32
PHENOL	10 U	10 U	420	100 U	10 U	10 U	10 U	10 U
PYRENE	2.2	0.1 U	29	190	1.6	0.38	0.16	0.49
PESTICIDE/PCB ANALYSIS (µg/L)								
4,4'-DDD	0.1 U	0.1 U	0.13	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.43	0.29 J	0.1 U	0.1 U	0.1 U	0.1 U
AROCLOR-1260	1 U	1 U	1 U	8	1 U	1 U	1 U	1 U
ENDOSULFAN SULFATE	0.1 U	0.1 U	0.44 J	0.22 R	0.1 U	0.1 U	0.1 U	0.1 U
GAMMA-BHC (LINDANE)	0.05 U	0.05 U	0.05 U	0.44 J	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	0.05 U	0.05 U	0.14 J	0.61 R	0.05 U	0.05 U	0.05 U	0.05 U
TOTAL AROCLOR	1 U	1 U	1 U	8	1 U	1 U	1 U	1 U
PETROELUM HYDROCARBON ANALYSIS (mg/L)								
GASOLINE RANGE ORGANICS	0.05 U	0.05 U	2	81	1.6	0.05 UJ	0.05 U	0.05 U
DIESEL RANGE ORGANICS	0.53	0.35 U	4.8	210	38	0.35 U	0.35 U	0.35 U
METALS ANALYSIS (µg/L)								
ALUMINUM	77600	1840 J	1110 J	69300 J	11200 J	16600 J	23800 J	3180 J
ARSENIC	25.2 J	1.6 U	12.1 J	44.9 J	13.2	7.7	19.1	1.9 J
BARIUM	340 J	15.5 UJ	627 J	522 J	123	95.1	100	33.8
BERYLLIUM	2.1	0.15 U	0.15 U	4	0.72	1.2	3.7	0.27 J
CADMIUM	0.31 UJ	0.28 UJ	15.3 J	88.3 J	126	12.5	25.8	6.7
CALCIUM	52500	334000	469000	119000	26800	14300	17000	14700
CHROMIUM	81.3	1 UJ	3.7 J	81.3	20.9	21.4	32.2	3.6
COBALT	43.6 J	1.1 UJ	8.5 J	65.2 J	12.2	28	45.4	17
COPPER	200 J	6.3 U	47.5 J	336 J	146 J	79.7 J	139 J	15.4 J
IRON	113000	1880	3910	98900	18700	24600	79800	5820
LEAD	181 J	11 UJ	76.6 J	1000	358	67.1	57.3	4.4
MAGNESIUM	31500	923000	429	22200	7330	10200	13900	5750
MANGANESE	1680	30.5 J	21.1 J	2740	506	345	513	169
MERCURY	0.19	0.14 UJ	0.11 UJ	0.66 J	0.2 UJ	0.095 UJ	0.086 UJ	0.063 UJ
NICKEL	89.8 J	2.7	123	146	51.8	76.3	128	37.1
POTASSIUM	23900	411000	590000	36700 J	6220	4630	4690	2870
SODIUM	46700	8880000	1410000	64700	22100	16900	18200	17200
VANADIUM	120 J	5.8 J	3.1 J	126	51.3	37.7	63.2	6.4
ZINC	381 J	2.3 U	91.6 J	1160	406	212	854	233

TABLE 4-2D

SUMMARY OF ANALYTICAL RESULTS: AQUEOUS SAMPLES FROM MANHOLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	W	W	FP
LOCATION ID	G32-MH02	G32-MH03	G32-OTSMH01
SAMPLE ID	G32-AQMH02	G32-AQMH03	G32-AQMH01
SAMPLE DATE	20050614	20050614	20050602
VOLATILE ANALYSIS (µg/L)			
O-XYLENE	1 U	1 U	2900 J
P-XYLENE	1 U	1 U	4600 J
TOTAL XYLENES	1 U	1 U	7600 J
SEMIVOLATILE ANALYSIS (µg/L)			
2-METHYLNAPHTHALENE	0.72	0.1 U	
ACENAPHTHENE	3	0.15	
ACENAPHTHYLENE	0.89	0.1 U	
ANTHRACENE	6.4	0.1 U	
BENZO(A)ANTHRACENE	18	0.3	
BENZO(A)PYRENE	14	0.31	
BENZO(B)FLUORANTHENE	22	0.45	
BENZO(G,H,I)PERYLENE	7 J	0.24	
BENZO(K)FLUORANTHENE	10	0.2	
CARBAZOLE	2 J	10 U	
CHRYSENE	18 J	0.34	
DIBENZO(A,H)ANTHRACENE	4.8 J	0.1 UJ	
FLUORANTHENE	40	0.6	
FLUORENE	2.7	0.1 U	
INDENO(1,2,3-CD)PYRENE	7 J	0.23 J	
NAPHTHALENE	0.99	0.1 U	
PHENANTHRENE	20	0.35	
PYRENE	30	0.51	
PETROELUM HYDROCARBON ANALYSIS (mg/L)			
DIESEL RANGE ORGANICS	0.35 U	0.35 U	900000
GASOLINE RANGE ORGANICS	0.05 U	0.05 U	6100
METALS ANALYSIS (µg/L)			
ARSENIC	6.4	1.6 U	
BARIUM	161	73	
CADMIUM	54.2	14.7	
CALCIUM	58000	58700	
CHROMIUM	33	3.9 U	
COBALT	62.2	22.9	
COPPER	62.9	63.3	

TABLE 4-2D

SUMMARY OF ANALYTICAL RESULTS: AQUEOUS SAMPLES FROM MANHOLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	W	W	FP
LOCATION ID	G32-MH02	G32-MH03	G32-OTSMH01
SAMPLE ID	G32-AQMH02	G32-AQMH03	G32-AQMH01
SAMPLE DATE	20050614	20050614	20050602
METALS ANALYSIS (µg/L) (cont.)			
IRON	16000	8980	
LEAD	302	119	
MAGNESIUM	9010	5310	
MANGANESE	3990	2260	
MERCURY	0.11	0.064 U	
NICKEL	74.3	28.2	
POTASSIUM	11600	7320	
SODIUM	38000	30700	
VANADIUM	24.7	12.9	
ZINC	465	370	

TABLE 4-3

SUMMARY OF ANALYTICAL RESULTS: CONCRETE SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

MATRIX	Concrete	Concrete	Concrete
LOCATION ID	CO-301	CO-302	CO-301
DEPTH IN FEET	G32-CO301-0909905	G32-CO302-090905	G32-CODUP-01
SAMPLE ID	0-0.1	0-0.1	0-0.1
SAMPLE DATE	09092005	09092005	09092005
VOLATILE ANALYSIS (µg/kg)			
ACETONE	34 J	11 J	23 J
BROMOMETHANE	5 R	4 R	13 R
CHLOROMETHANE	5 R	4 R	13 R
DICHLORODIFLUOROMETHANE	5 R	4 R	13 R
METHYL CYCLOHEXANE	1 J	4 U	13 U
TOLUENE	1 J	4 U	13 U
SEMIVOLATILE ANALYSIS (µg/kg)			
ANTHRACENE	570 J	3300 U	3400 U
BENZO(A)ANTHRACENE	2200 J	3300 U	960 J
BENZO(A)PYRENE	1800 J	3300 U	770 J
BENZO(B)FLUORANTHENE	1500 J	3300 U	740 J
BENZO(G,H,I)PERYLENE	1000 J	3300 U	450 J
BENZO(K)FLUORANTHENE	2000 J	3300 U	810 J
BUTYL BENZYL PHTHALATE	3500 U	3300 U	2100 J
CHRYSENE	2200 J	3300 U	930 J
DIBENZO(A,H)ANTHRACENE	470 J	3300 U	3400 U
FLUORANTHENE	4200	350 J	1900 J
INDENO(1,2,3-CD)PYRENE	1000 J	3300 U	480 J
PHENANTHRENE	2400 J	3300 U	1300 J
PYRENE	3700	3300 U	1600 J
PESTICIDE/PCB ANALYSIS (µg/kg)			
4,4'-DDE	3.5 U	4.6	3.5 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)			
DIESEL RANGE ORGANICS	46	370	58
METALS ANALYSIS (mg/kg)			
ALUMINUM	8540	6930	9620
ARSENIC	3.5 J	2.2 J	2.6 J
BARIUM	32.3 J	94.0	31.4 J
BERYLLIUM	0.0061 U	0.0061 J	0.0058 U
CALCIUM	77000	65600	97300
CHROMIUM	8.4 J	9.5 J	10.1 J
COBALT	4.3 J	3.6 J	4.7 J
COPPER	9.9 J	10 J	11.1 J
IRON	10700	10400	12000
LEAD	6.6 J	4.9 J	6.6 J
MAGNESIUM	3720	2880	4250
MANGANESE	322	230	366
METALS ANALYSIS (mg/kg) (cont.)			
NICKEL	9.9 J	8.6 J	9.7 J
POTASSIUM	542	746	441
SODIUM	185 J	403 J	211 J
THALLIUM	1.1 J	0.92 J	1.5 J
VANADIUM	9.7 J	8.2 J	11.1 J
ZINC	19.6 J	17.0 J	24.2 J

TABLE 4-4A

SUMMARY OF ANALYTICAL RESULTS: INTERTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304F	G32-SD305F	G32-SD306F	G32-SD309F	G32-SD310F	G32-SD302F	G32-SD308F	G32-SD313F
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD304F-000.5	G32-SD305F-000.5	G32-SD306F-000.5	G32-SD309F-000.5-AVG	G32-SD310F-000.5	G32-SD302F-000.5	G32-SD308F-000.5	G32-SD313F-000.5
SAMPLE DATE				20050826	20050826	20050829	20050829	20050831	20050825	20050825	20050825
VOLATILE ANALYSIS (µg/kg)											
ACETONE				42 UJ	36 UJ	34 UJ	50 UJ	37 UJ	200 J	66 UJ	50 UJ
CARBON DISULFIDE				3 J	3 J	3 J	6.25	4 J	2 J	3 J	1 J
TRICHLOROETHENE				5 U	5 U	6 U	2 J	7 U	6 U	4 U	5 U
SEMIVOLATILE ANALYSIS (µg/kg)											
2-METHYLNAPHTHALENE		70	670	3.3 U	3.3 U	3.3 U	7.8 J	3.3 U	11	18	53
4-METHYLPHENOL				330 U	490	400	1245	1700	330 U	330 U	330 U
ACENAPHTHENE		16	500	7.5	3.3 U	4.2	38.2 J	3.3 U	69	88	210
ACENAPHTHYLENE		44	640	26	3.8	12	5.1 J	5	5.6	30	42
ANTHRACENE	13	85.3	1100	74	10	24	89 J	15	160	300	520
BENZO(A)ANTHRACENE	9.1	261	1600	420	22	56	215	34	380	1000	1600
BENZO(A)PYRENE	2.5	430	1600	210	25	68	180	31	270	510	760
BENZO(B)FLUORANTHENE	3.7			230 J	35	92	245	46	270 J	560	1200
BENZO(G,H,I)PERYLENE				54	11	31	74.5 J	16	110	150	270
BENZO(K)FLUORANTHENE	2.5			140	15	38	98.5	16	140	300	910
BIS(2-ETHYLHEXYL)PHTHALATE				53 J	53 J	51 J	62 J	42 J	56 J	46 J	51 J
CARBAZOLE				330 U	330 U	330 U	93 J	330 U	76 J	110 J	230 J
CHRYSENE	8.78	384	2800	310 EB	27 EB	61 EB	200 SBB	38 EB	320 EB	850	1500
DIBENZO(A,H)ANTHRACENE		63.4	260	22	3.6	10	26	4.3	37	56	100
DIBENZOFURAN				330 U	330 U	330 U	40 J	330 U	36 J	63 J	140 J
FLUORANTHENE	37	600	5100	800	49	96	435 J	70	830	3100	3400
FLUORENE		19	540	17	3.3 U	6	42 J	5.5	71	120	240
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	1446	149.6	385	1117.5	200.3	1637	3416	6420
INDENO(1,2,3-CD)PYRENE				60	11	29	78.5	15	110	170	280
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	1650.3	120.8	296.1	1324.4	189.6	2444.6	7181	8875
NAPHTHALENE		160	2100	5.8	3.3 U	3.9	19.3 J	6.1	18	25	110
PHENANTHRENE	31	240	1500	120	18	40	313 J	29	600	1100	1500
PHENOL				330 U	220 J	290 J	470	820	330 U	330 U	330 U
PYRENE	20.5	665	2600	600	40	110	375 J	59	680	2400	2800
PESTICIDE/PCB ANALYSIS (µg/kg)											
4,4'-DDT		1	7	6.2 R	5.8 R	4.9 R	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ALPHA-BHC				1.7 U	1.7 U	1.7 U	1.6 J	1.7 U	1.7 U	1.7 U	1.7 U
AROCLOR-1248				33 U	39 J	33 U	93.25	33 U	33 U	33 U	33 U
AROCLOR-1260				360	280	190 J	33 U	33 U	33 U	33 U	33 U
BETA-BHC				2.6 J	1.7 U	3.9	1.7 U	1.7 U	1.7 U	3 R	14 R
DELTA-BHC				1.7 U	1.7 U	1.7 U	0.98 J	1.7 U	1.7 U	1.7 U	1.7 U

TABLE 4-4A

SUMMARY OF ANALYTICAL RESULTS: INTERTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304F	G32-SD305F	G32-SD306F	G32-SD309F	G32-SD310F	G32-SD302F	G32-SD308F	G32-SD313F
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD304F-000.5	G32-SD305F-000.5	G32-SD306F-000.5	G32-SD309F-000.5-AVG	G32-SD310F-000.5	G32-SD302F-000.5	G32-SD308F-000.5	G32-SD313F-000.5
SAMPLE DATE				20050826	20050826	20050829	20050829	20050831	20050825	20050825	20050825
PESTICIDE/PCB ANALYSIS (µg/kg) (cont.)											
ENDOSULFAN SULFATE				7.3 J	6.9 J	4.2 R	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN ALDEHYDE				4.1 R	3.3 U	4.2 R	1.9 J	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN KETONE				7.8 J	6.4 J	3.3 U	3.3 U	3.3 U	3.3 U	5.2 J	5 J
GAMMA-CHLORDANE		0.5	6	1.7 U	2.7 J	2.5 R	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
METHOXYCHLOR				17 U	17 U	17 U	17 U	17 U	17 U	17 U	7.3 J
TOTAL AROCLOR		22.7	180	360	319	190	93.25	33 U	33 U	33 U	33 U
PETROELUM HYDROCARBON ANALYSIS (mg/kg)											
DIESEL RANGE ORGANICS				25	36 J	53 J	31 J	52 J	38 J	42	68
METALS ANALYSIS (mg/kg)											
ALUMINUM	5040			6930	7010	5640	5240	6090	6850	4400	3880
ANTIMONY	0.128	2	25	43.5 J	0.055 UJ	0.82 UJ	0.0985 UJ	0.055 UJ	0.26 UJ	0.056 UJ	2 UJ
ARSENIC	3.49	8.2	70	0.076 UJ	4.6 J	3.9 J	4.05 J	5.2 J	3.4 J	2.1 J	7.3 J
BARIUM	12.3			14.1 J	8.5 J	13.6 J	9.2 J	15.8 J	15.7 J	9.2 J	10.8 J
BERYLLIUM	0.395			0.34	0.32	0.37	0.33	0.41	0.35	0.25	0.23
CADMIUM	0.355	1.2	9.6	1.6 J	0.47 UJ	0.21 UJ	0.9125 J	0.36 UJ	0.31 UJ	0.41 UJ	0.6 UJ
CALCIUM	4270			17600 J	21900 J	33200 J	35300 J	25700 J	30100 J	39200 J	21000 J
CHROMIUM	13.2	81	370	3910	26.3 J	16.7 J	14.4 J	15.2 J	13.1 J	9.3 J	37.7 J
COBALT	4.05			2.8 J	3.9 J	2.9 J	2.65 J	2.9 J	3.5 J	1.8 J	2.9 J
COPPER	16.3	34	270	46.8	77.8	32.6	30.55	33.4	35.1	26.4	64.4
CYANIDE				0.12 U	0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.12 U	0.12 U	0.35 J
IRON	9400			35600	57300	21900	20750	25700	17800	22300	72100
LEAD	16.9	46.7	218	21200	17.7 J	177	32.8 J	32.6 J	23.4 J	18.9 J	17.9 J
MAGNESIUM	2930			3950	6340	3800	3595	4020	4450	2770	2770
MANGANESE	97.6			245 J	418 J	179 J	166.5 J	239 J	214 J	203 J	306 J
MERCURY	0.0811	0.15	0.71	0.0077 UJ	0.0072 U	0.74	0.0305 U	0.05 U	0.0068 U	0.0095 UJ	0.008 UJ
NICKEL	8.54	20.9	51.6	10.8 J	19 J	8.7 J	9.25 J	11 J	11.6 J	6.4 J	47.4 J
POTASSIUM	1040			1160	941	1240	1185	1430	958	742	757
SODIUM	4300			3440	2750	5820	5675	5330	3200	3070	2380
THALLIUM	0.793			1.7 J	1.1 J	0.16 J	0.13025 J	0.14 J	0.078 UJ	0.079 UJ	2.5 J
VANADIUM	13.1			15.2 J	16.5 J	22.6 J	18.5 J	21.6 J	15.1 J	10.8 J	11.3 J
ZINC	48.4	150	410	54.4 J	39.5 J	64.4 J	122.95 J	73 J	54.1 J	34.7 J	39.7 J
MISCELLANEOUS ANALYSIS (mg/kg)											
TOTAL ORGANIC CARBON	9060			3000	7400 J	15000 J	10950 J	13000 J	5000 J	29000 J	7500 J

TABLE 4-4A

SUMMARY OF ANALYTICAL RESULTS: INTERTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304F	G32-SD305F	G32-SD306F	G32-SD309F	G32-SD310F	G32-SD302F	G32-SD308F	G32-SD313F
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD304F-000.5	G32-SD305F-000.5	G32-SD306F-000.5	G32-SD309F-000.5-AVG	G32-SD310F-000.5	G32-SD302F-000.5	G32-SD308F-000.5	G32-SD313F-000.5
SAMPLE DATE				20050826	20050826	20050829	20050829	20050831	20050825	20050825	20050825
ACID VOLATILE SULFIDE/SIMULTANSOUSLY EXTRACTABLE METALS (µmo/g)											
SEM/AVS	8.04			0.51	0.02	0.14	0.055	0.15	0.075	0.14	0.81
ACID VOLATILE SULFIDE				0.9 J	7.9 J	7 J	18.5 J	14.3 J	10.2 J	5.7 J	0.83 J
COPPER	0.0876			0.1 J	0.083 UJ	0.19 J	0.19 J	0.2 J	0.33 J	0.34 J	0.28 J
LEAD	0.0593			0.22 J	0.028 UJ	0.28 J	0.0865 J	0.11 J	0.074 J	0.056 J	0.11 J
MERCURY	0.000038			0.00003 UJ	0.00003 U	0.0037	0.00015 U	0.00025 U	0.00003 U	0.00004 UJ	0.00004 UJ
ZINC	0.455			0.14 J	0.16 J	0.49 J	0.555 J	1.9 J	0.36 J	0.43 J	0.28 J

Notes:

(1) Ref - Reference Concentrations detected at unaffected stations (Jameston) see text.
(2) ERL - NOAA Effects - Range - Low
(3) ERM - NOAA Effects - Range - Medium

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD305
DEPTH IN FEET				0.5-1.0	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0
SAMPLE ID				G32-SD304D-0.51.0	G32-SD304D-000.5-AVG	G32-SD304A-000.5	G32-SD304B-000.5	G32-SD304C-000.5	G32-SD304E-000.5	G32-SD305D-0.51.0
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050826	20050826
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				6	5 U	6 U	9 U	6 U	6 U	8 U
1,3-DICHLOROBENZENE				5 U	5 U	6 U	9 U	6 U	6 U	8 U
1,4-DICHLOROBENZENE				5 U	5 U	6 U	9 U	6 U	6 U	8 U
2-BUTANONE				5 U	5 U	6 U	9 U	5 J	6 U	8 U
2-HEXANONE				5 U	5 U	6 U	9 U	6 U	6 U	8 U
ACETONE				16 JEB	19.5 JEB	18 JEB	43 JEB	18 JEB	12 JEB	20 JEB
CARBON DISULFIDE				12	2.5 J	4 J	3 J	7	2 J	7 J
TRICHLOROETHENE				5 U	5 U	6 U	9 U	6 U	6 U	8 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	330 U	330 U	330 U	330 U	330 U
2-METHYLNAPHTHALENE		70	670	19 J	8.325 J	9.8	20	8 J	4.7	5.1
4-METHYLPHENOL				330 U	330 U	330 U	330 U	330 U	330 U	330 U
ACENAPHTHENE		16	500	100 J	43.5 J	75	80	47	28	21
ACENAPHTHYLENE		44	640	20 J	16.5 J	14	10	9 J	6.7	6.1
ANTHRACENE	13	85.3	1100	310 J	129 J	330	220	100 J	84	68
BENZO(A)ANTHRACENE	9.1	261	1600	550	230 J	540	350	170 J	200	100
BENZO(A)PYRENE	2.5	430	1600	480	260 J	420 J	280 J	160 J	180	91
BENZO(B)FLUORANTHENE	3.7			610	380 J	600 J	360	220 J	240	120
BENZO(G,H,I)PERYLENE				300 J	146 J	290	190	96 J	97	58
BENZO(K)FLUORANTHENE	2.5			200 J	107.5 J	210	150	63 J	84	36
BIS(2-ETHYLHEXYL)PHTHALATE				43 J	62 J	44 J	61 J	34 J	330 U	43 J
CARBAZOLE				140 J	100 J	81 J	63 J	59 J	330 UJ	330 UJ
CHRYSENE	8.78	384	2800	550	200 J	490	320	130 J	130	68
DIBENZO(A,H)ANTHRACENE		63.4	260	90 J	44.5 J	89	57	27 J	30	17
DIBENZOFURAN				57 J	40 J	43 J	330 U	330 U	330 U	330 U
FLUORANTHENE	37	600	5100	1300	420 J	1300	720	410	320	200
FLUORENE		19	540	96 J	38.5 J	98	86	36 J	29	21
HEXACHLOROCYCLOPENTADIENE				330 UJ	330 UJ	330 UJ	330 UJ	330 R	330 UJ	330 UJ
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	3050	1494	2899	1867	949	1051	541
INDENO(1,2,3-CD)PYRENE				270 J	126 J	260	160	83 J	90	51
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	3831	1361.675	3661.8	2619	1266	1102.4	649.6
NAPHTHALENE		160	2100	36 J	30.85 J	15	13	16 J	10	8.4
PHENANTHRENE	31	240	1500	850	265 J	820	720	290 J	180	140
PHENOL				80 J	330 U	330 U	69 J	330 U	330 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD305
DEPTH IN FEET				0.5-1.0	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0
SAMPLE ID				G32-SD304D-0.51.0	G32-SD304D-000.5-AVG	G32-SD304A-000.5	G32-SD304B-000.5	G32-SD304C-000.5	G32-SD304E-000.5	G32-SD305D-0.51.0
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050826	20050826
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	1100	410 J	1000	750	350	440	180
4,4'-DDE		2.2	27	3.3 U	16 U	16 U	33 U	33 UJ	33 U	3.3 U
4,4'-DDT		1	7	3.3 U	16 U	16 U	33 U	33 UJ	33 U	3.3 U
ALDRIN				1.7 U	8.45 U	8.4 U	17 U	17 U	17 U	1.7 U
AROCLOR-1260				300 J	880 J	880 J	3600 J	3800 J	3300 J	350
BETA-BHC				1.7 U	7.625 J	7.8 R	17 U	17 U	17 U	2.8
DELTA-BHC				1.7 U	8.45 U	8.4 U	17 U	17 U	17 U	1.7 U
DIELDRIN				3.3 U	16 U	16 U	33 U	33 U	33 U	3.3 U
ENDOSULFAN I				1.7 U	8.45 U	8.2 J	17 U	17 UJ	17 U	1.7 U
ENDOSULFAN II				3.3 U	16 U	16 U	33 U	33 UJ	33 U	3.3 U
ENDOSULFAN SULFATE				7.5 J	26 J	26 J	67 J	79 J	58 R	9.4 J
ENDRIN ALDEHYDE				3.2 R	16 U	16 U	33 U	35 R	33 U	3.9 R
ENDRIN KETONE				6.7 R	13.5 J	16 U	33 U	33 UJ	33 U	3.3 U
GAMMA-BHC (LINDANE)				1.7 U	8.45 U	8.4 U	17 U	17 U	17 U	1.1 J
GAMMA-CHLORDANE		0.5	6	2.4 R	12 R	13 J	51 J	66	47 J	2 R
METHOXYCHLOR				17 U	84.5 U	84 U	170 U	170 U	170 U	17 U
TOTAL AROCLOR		22.7	180	300	880	880	3600	3800	3300	350
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				51	46	38	41	69	35	35
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			4290 J	5135 J	4590 J	6250 J	5960 J	5620 J	5000 J
ANTIMONY	0.128	2	25	1.9 J	2.85 J	2.6 J	3.1 J	3 J	4.2 J	2 J
ARSENIC	3.49	8.2	70	1.9 J	2.25 J	2.4 J	2 J	2.9 J	2.6 J	1.8 J
BARIUM	12.3			11.1 J	13.1 J	9.4 J	11.2 J	12.5 J	10.3 J	10.5 J
BERYLLIUM	0.395			0.38	0.43	0.4	0.47	0.53	0.45	0.42
CADMIUM	0.355	1.2	9.6	0.0056 UJ	0.0055 UJ	0.0057 UJ	0.0053 UJ	0.097 J	0.0056 UJ	0.0056 UJ
CALCIUM	4270			9760 J	24500 J	18700 J	26900 J	10600 J	11000 J	24900 J
CHROMIUM	13.2	81	370	8.8 J	10.8 J	13.7 *	12.9 J	16.2	11.7 J	17.4
COBALT	4.05			2.4 J	2.95 J	2.9 J	2.7 J	3.7 J	3.1 J	2.4 J
COPPER	16.3	34	270	14.8 J	25.15 J	23.1 J	15.7 J	22.7 J	23.2 J	26 J
CYANIDE				0.13 UJ	0.115 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.14 J	0.12 UJ
IRON	9400			9470	11500	11300	14300	12600	12300	10900
LEAD	16.9	46.7	218	15.7 J	39.5 J	20.5 J	23.5 J	59.6 J	41.9 J	24.6 J
MAGNESIUM	2930			2390 J	2995 J	2770 J	3650 J	3050 J	2960 J	3440 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD304	G32-SD305
DEPTH IN FEET				0.5-1.0	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0
SAMPLE ID				G32-SD304D-0.51.0	G32-SD304D-000.5-AVG	G32-SD304A-000.5	G32-SD304B-000.5	G32-SD304C-000.5	G32-SD304E-000.5	G32-SD305D-0.51.0
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050826	20050826
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			86 J	108.5 J	99.1 J	134 J	111 J	118 J	114 J
MERCURY	0.0811	0.15	0.71	0.034 J	0.048 J	0.043 J	0.045 J	0.047 J	0.076 J	0.054 J
NICKEL	8.54	20.9	51.6	6.5 J	8.1 J	8.1 J	7.9 J	8.6 J	8.5 J	7.1 J
POTASSIUM	1040			768	886	861	1170	980	836	746
SELENIUM	0.06			4.4 J	5.8 J	5.4 J	6.5 J	5 J	6.2 J	5.6 J
SODIUM	4300			3370 J	3370 J	4040 J	3980 J	3140 J	3250 J	3240 J
THALLIUM	0.793			0.88 J	0.92 J	0.82 J	1.1 J	1 J	1.2 J	0.91 J
VANADIUM	13.1			13.9 J	18.3 J	15.6 J	18.5 J	16.5 J	18.4 J	16.6 J
ZINC	48.4	150	410	31.7 J	44.6 J	41 J	39.7 J	41.7 J	98.1 J	44.8 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			8200 J	6550 J	7000 J	5900 J	7200 J	7900 J	5400 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.72	0.265	0.073	0.064	0.29	1.2	0.46
ACID VOLATILE SULFIDE				1.2 J	5.3 J	11.5 J	10.5 J	3.1 J	2.6 J	2 J
CADMIUM	0.0013			0.0031 UJ	0.003 UJ	0.0036 UJ	0.0051 UJ	0.038 J	0.0031 UJ	0.0052 UJ
COPPER	0.0876			0.17 J	0.205 J	0.15 J	0.17 J	0.16 J	0.14 J	0.16 J
LEAD	0.0593			0.089 J	0.1895 J	0.095 J	0.11 J	0.16 J	2.1 J	0.23 J
MERCURY	0.000038			0.00017 J	0.00024 J	0.00021 J	0.00022 J	0.00023 J	0.00038 J	0.00027 J
NICKEL	0.041			0.26 J	0.3365 J	0.039 J	0.036 J	0.037 J	0.046 J	0.048 J
ZINC	0.455			0.34 J	0.535 J	0.56 J	0.36 J	0.49 J	0.85 J	0.49 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref** [1]	**ERL** [2]	**ERM** [3]	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD306	G32-SD306
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD305A-000.5	G32-SD305B-000.5	G32-SD305C-000.5	G32-SD305D-000.5	G32-SD305E-000.5	G32-SD306C-0.51.0	G32-SD306D-000.5-AVG
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050829	20050829
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
1,3-DICHLOROBENZENE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
1,4-DICHLOROBENZENE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
2-BUTANONE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
2-HEXANONE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
ACETONE				240 JEB	81 JEB	20 JEB	62 JEB	80 JEB	56 JEB	30 JEB
CARBON DISULFIDE				5 J	2 J	2 J	3 J	2 J	2 J	2.5 J
TRICHLOROETHENE				6 U	7 U	7 U	9 U	7 U	6 U	6 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	330 U	330 U	330 U	330 U	330 U
2-METHYLNAPHTHALENE		70	670	3.3 U	6.4	4.1	4.6	3.3 U	3.3 U	3.325
4-METHYLPHENOL				330 U	330 U	330 U	330 U	330 U	330 U	330 U
ACENAPHTHENE		16	500	4.5	25	25	16	12	6.8	19.35
ACENAPHTHYLENE		44	640	4	9	5	8.3	6.8	5.3	4.225
ANTHRACENE	13	85.3	1100	18	74	68	54	49	43	54.5 J
BENZO(A)ANTHRACENE	9.1	261	1600	37	140	110	81	80	99	104 J
BENZO(A)PYRENE	2.5	430	1600	34	130	100	70	72	130	88.5 J
BENZO(B)FLUORANTHENE	3.7			51	170	120	110	88	170	108 J
BENZO(G,H,I)PERYLENE				25	86	64	46	46	66	58 J
BENZO(K)FLUORANTHENE	2.5			17	59	45	30	37	60	36.5 J
BIS(2-ETHYLHEXYL)PHTHALATE				330 U	330 U	46 J	52 J	44 J	330 U	49 J
CARBAZOLE				330 U	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ
CHRYSENE	8.78	384	2800	26	110	73	74	53	83	70.5 J
DIBENZO(A,H)ANTHRACENE		63.4	260	7.3	25	18	14	13	20	16.7 J
DIBENZOFURAN				330 U	330 U	330 U	330 U	330 U	330 U	330 U
FLUORANTHENE	37	600	5100	71	290	230	270	150	120	256 J
FLUORENE		19	540	4.5	25	21	12	11	6.4	15.8
HEXACHLOROCYCLOPENTADIENE				330 U	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	218.3	793	583	465	426	688	532.7
INDENO(1,2,3-CD)PYRENE				21	73	53	40	37	60	50.5 J
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	212	901.4	711.3	692.6	502.5	447.5	681.05
NAPHTHALENE		160	2100	3.3 U	12	8.2	7.7	3.7	3.3 U	5.85
PHENANTHRENE	31	240	1500	36	190	160	110	110	46	136 J
PHENOL				330 U	41 J	330 U	330 U	330 U	330 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD306	G32-SD306
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD305A-000.5	G32-SD305B-000.5	G32-SD305C-000.5	G32-SD305D-000.5	G32-SD305E-000.5	G32-SD306C-0.51.0	G32-SD306D-000.5-AVG
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050829	20050829
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	74	270	190	210	160	220	186 J
4,4'-DDE		2.2	27	4.2 UJ	3.3 U	3.3 U	16 U	3.3 U	3.3 U	3.3 U
4,4'-DDT		1	7	4.2 UJ	3.3 U	3.3 U	16 U	3.3 U	3.3 U	3.3 U
ALDRIN				2.2 UJ	1.7 U	2 J	8.5 U	1.9 J	1.7 U	1.7 U
AROCLOR-1260				42 UJ	180	230	2200 J	220	33 U	93.25 J
BETA-BHC				2.2 UJ	1.7 U	2.1 J	8.5 U	4.1 J	1.7 U	1.7 U
DELTA-BHC				2.2 UJ	1.7 U	1.7 U	8.5 U	1.6 J	1.7 U	1.7 U
DIELDRIN				4.2 UJ	3.3 U	3.3 U	16 J	3.3 U	3.3 U	3.3 U
ENDOSULFAN I				2.2 UJ	1.7 U	1.7 U	8.5 U	1.7 U	1.7 U	1.7 U
ENDOSULFAN II				4.2 UJ	3.3 U	3.3 U	16 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN SULFATE				4.2 UJ	3.3 U	6.4 J	16 U	3.3 U	3.3 U	3.125 J
ENDRIN ALDEHYDE				4.2 UJ	5.8 J	3.3 U	20 R	3.3 U	3.3 U	3.3 U
ENDRIN KETONE				4.2 UJ	3.3 U	3.3 U	16 U	3.3 R	3.3 U	3.3 U
GAMMA-BHC (LINDANE)				2.2 UJ	1.7 U	1.7 U	8.5 U	1.7 U	1.7 U	1.7 U
GAMMA-CHLORDANE		0.5	6	2.2 UJ	1.7 U	1.7 U	8.5 U	1.9 J	1.7 U	1.7 U
METHOXYCHLOR				22 UJ	30	17 U	85 U	17 U	17 U	17 U
TOTAL AROCLOR		22.7	180	42 U	180	230	2200	220	33 U	93.25
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				25	36	49	28	31	30	30
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			4580	4730	5500 J	6020 J	6010 J	6600 J	6685 J
ANTIMONY	0.128	2	25	0.41 U	0.52 U	3.2 J	2.8 J	3.2 J	2.2 J	2.6 J
ARSENIC	3.49	8.2	70	2.9 J	4 J	2.1 J	2.3 J	2.1 J	2.1 J	2.1 J
BARIUM	12.3			12.5 J	11 J	8.7 J	10.7 J	10.3 J	11.8 J	14.05 J
BERYLLIUM	0.395			0.13	0.17	0.39	0.47	0.43	0.56	0.49
CADMIUM	0.355	1.2	9.6	0.61 J	0.69 J	0.0054 UJ	0.0055 UJ	0.0055 UJ	0.0053 UJ	0.0054 UJ
CALCIUM	4270			19000 J	33200 J	41100 J	36600 J	43300 J	9390 J	22450 J
CHROMIUM	13.2	81	370	12.8	14.6	14.1 J	16.2	15.5 J	10.5 J	11.6 J
COBALT	4.05			2.8 J	3 J	2.5 J	3 J	3.2 J	3.6 J	3.3 J
COPPER	16.3	34	270	15 J	21.5 J	23.3 J	38 J	23.8 J	16.6 J	16 J
CYANIDE				0.12 U	0.11 U	0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ
IRON	9400			10100 J	11400 J	13200	13200	13000	13000	13600
LEAD	16.9	46.7	218	31.6 J	55.5	35 J	48.8 J	29.4 J	25.3 J	77.35 J
MAGNESIUM	2930			2400	2590	3210 J	3360 J	3660 J	2830 J	3275 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD305	G32-SD306	G32-SD306
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD305A-000.5	G32-SD305B-000.5	G32-SD305C-000.5	G32-SD305D-000.5	G32-SD305E-000.5	G32-SD306C-0.51.0	G32-SD306D-000.5-AVG
SAMPLE DATE				20050826	20050826	20050826	20050826	20050826	20050829	20050829
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			91.2	102	123 J	127 J	124 J	116 J	128.5 J
MERCURY	0.0811	0.15	0.71	0.023 U	0.06	0.036 J	0.061 J	0.057 J	0.035 J	0.0345 J
NICKEL	8.54	20.9	51.6	6.4 J	8 J	7.6 J	9.3 J	9.8 J	9.1 J	8.75 J
POTASSIUM	1040			929 J	822 J	858	981	898	902	949
SELENIUM	0.06			0.066 U	0.064 U	7 J	7.6 J	6.6 J	5.9 J	5.65 J
SODIUM	4300			2840 J	3330 J	3570 J	3760 J	3490 J	2200 J	3070 J
THALLIUM	0.793			0.12 UJ	0.32 UJ	0.71 UJ	0.84 UJ	0.78 UJ	1.2 J	1.2 J
VANADIUM	13.1			15.5 J	15.4 J	15.3 J	20.6 J	19.4 J	16.3 J	19.85 J
ZINC	48.4	150	410	32.4 J	44 J	47 J	46.8 J	50 J	45.3 J	42.9 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			13000 J	10000 J	5400 J	4800 J	8600 J	7900 J	10400 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.15	0.12	0.064	0.34	0.1	0.084	0.205
ACID VOLATILE SULFIDE				3.8 J	8 J	7.4 J	5.9 J	7.3 J	6.1 J	4.95 J
CADMIUM	0.0013			0.0059 UJ	0.0016 UJ	0.00086 UJ	0.0025 UJ	0.0073 UJ	0.0063 UJ	0.00345 UJ
COPPER	0.0876			0.1 J	0.15 J	0.077 J	0.42 J	0.17 J	0.094 J	0.119 J
LEAD	0.0593			0.075 J	0.19 J	0.057 J	0.083 J	0.088 J	0.12 J	0.395 J
MERCURY	0.000038			0.00011 U	0.0003	0.00018 J	0.0003 J	0.00028 J	0.00017 J	0.00017 J
NICKEL	0.041			0.031 J	0.23 J	0.031 J	1.2 J	0.061 J	0.037 UJ	0.0365 UJ
ZINC	0.455			0.37 J	0.38 J	0.31 J	0.33 J	0.44 J	0.3 J	0.425 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref** [1]	**ERL** [2]	**ERM** [3]	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD306	G32-SD306	G32-SD306	G32-SD306	G32-SD307	G32-SD309	G32-SD309
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD306E-000.5-AVG	G32-SD306A-000.5	G32-SD306B-000.5	G32-SD306C-000.5	G32-SD307-000.5	G32-SD309A-000.5	G32-SD309B-000.5
SAMPLE DATE				20050829	20050829	20050829	20050829	20050830	20050829	20050829
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				6.5 U	6 U	6 U	8 U	5 U	6 U	6 U
1,3-DICHLOROBENZENE				6.5 U	6 U	6 U	8 U	5 U	6 U	6 U
1,4-DICHLOROBENZENE				6.5 U	6 U	6 U	8 U	5 U	6 U	6 U
2-BUTANONE				6.5 U	2 J	7	8 U	5 U	6 U	6 U
2-HEXANONE				6.5 U	6 U	6 U	8 U	5 U	6 U	6 U
ACETONE				80.5 JEB	190 JEB	34 JEB	93 JEB	45 JEB	46 JEB	140 JEB
CARBON DISULFIDE				6.5	6 U	2 J	2 J	1 J	6 U	6 U
TRICHLOROETHENE				1 J	6 U	6 U	8 U	5 U	6 U	6 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	330 U	41 J	330 U	330 U	330 U
2-METHYLNAPHTHALENE		70	670	4.275	3.3 U	3.3 U	110	3.3 U	4.2	3.3 U
4-METHYLPHENOL				330 U	330 U	400	330 U	43 J	330 U	170 J
ACENAPHTHENE		16	500	41 J	6.3	4.6	500	6.7	14	3.3 U
ACENAPHTHYLENE		44	640	11.85 J	6.6	5.3	12	6.2	3.3 U	3.3 U
ANTHRACENE	13	85.3	1100	173 J	22	17	830	15	45	9.6
BENZO(A)ANTHRACENE	9.1	261	1600	295 J	47	39	1100	30	56	16
BENZO(A)PYRENE	2.5	430	1600	260 J	43	26	820	33	43	17
BENZO(B)FLUORANTHENE	3.7			340 J	57	48	1000	49	48	26
BENZO(G,H,I)PERYLENE				168 J	35	29	380 J	13	30	12
BENZO(K)FLUORANTHENE	2.5			117.5 J	18	18	330	19	17	9.2
BIS(2-ETHYLHEXYL)PHTHALATE				40 J	39 J	330 U	35 J	330 U	47 J	330 U
CARBAZOLE				330 UJ	330 UJ	330 U	560 J	330 U	330 UJ	330 U
CHRYSENE	8.78	384	2800	285 J	29	27	1100	30	39	18
DIBENZO(A,H)ANTHRACENE		63.4	260	47 J	9.3	8.6	150	4	8.6	3.3 U
DIBENZOFURAN				330 U	330 U	330 U	300 J	330 U	330 U	330 U
FLUORANTHENE	37	600	5100	725 J	68	50	2700	70	110	36
FLUORENE		19	540	38 J	5.1	4.8	390	7.3	12	3.3 U
HEXACHLOROCYCLOPENTADIENE				330 UJ	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ	330 UJ
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	1661.5	264.3	217.6	5260	191	266.6	108
INDENO(1,2,3-CD)PYRENE				149 J	26	22	380 J	13	25	9.8
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	2001.175	223	172	9332	201.2	375.7	93.6
NAPHTHALENE		160	2100	8.05 J	3.3 U	4.3	290	4	9.5	3.3 U
PHENANTHRENE	31	240	1500	385 J	33	28	2400	40	92	17
PHENOL				330 U	36 J	370	330 U	36 J	330 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD306	G32-SD306	G32-SD306	G32-SD306	G32-SD307	G32-SD309	G32-SD309
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD306E-000.5-AVG	G32-SD306A-000.5	G32-SD306B-000.5	G32-SD306C-000.5	G32-SD307-000.5	G32-SD309A-000.5	G32-SD309B-000.5
SAMPLE DATE				20050829	20050829	20050829	20050829	20050830	20050829	20050829
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	615 J	82	58	2100	52	89	31
4,4'-DDE		2.2	27	3.3 U	3.5 U	4.3 U	3.3 U	4.1 U	3.3 U	4.2 U
4,4'-DDT		1	7	3.3 U	3.5 U	4.3 U	3.3 U	4.1 U	3.3 U	4.2 U
ALDRIN				1.7 U	1.8 U	2.2 U	1.7 U	2.1 U	1.7 U	2.2 U
AROCLOR-1260				45.25 J	230 J	100	520 J	41 U	33 U	42 U
BETA-BHC				1.7 U	1.8 U	2.2 U	1.7 U	4.1 J	1.7 U	2.2 U
DELTA-BHC				1.7 U	1.8 U	2.2 U	1.7 U	2.1 U	1.7 U	2.2 U
DIELDRIN				3.3 U	3.5 U	4.3 U	3.3 U	4.1 U	3.3 U	4.2 U
ENDOSULFAN I				1.7 U	1.8 U	2.2 U	1.7 U	2.1 U	1.7 U	2.2 U
ENDOSULFAN II				3.3 U	3.5 U	4.3 U	3.3 U	4.1 U	3.3 U	4.2 U
ENDOSULFAN SULFATE				3.3 U	7.8 J	4.3 U	11 J	4.1 U	3.3 U	4.2 U
ENDRIN ALDEHYDE				3.625	3.5 U	4.3 U	4.9 R	4.1 U	3.3 U	4.2 U
ENDRIN KETONE				3.3 U	3.4 J	4.3 U	3.3 U	4.1 U	3.3 U	4.2 U
GAMMA-BHC (LINDANE)				1.7 U	1.8 U	2.2 U	1.7 U	2.1 U	1.7 U	2.2 U
GAMMA-CHLORDANE		0.5	6	1.7 U	3.6	2.2 U	6	2.1 U	1.7 U	2.2 U
METHOXYCHLOR				17 U	18 U	22 U	17 U	21 U	17 U	22 U
TOTAL AROCLOR		22.7	180	45.25	230	100	520	41 U	33 U	42 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				38.5 J	32	35	28	33	31	24
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			6310 J	7640 J	7050	5840 J	4450	4850 J	4870
ANTIMONY	0.128	2	25	2.6 J	2.4 J	0.055 UJ	3 J	0.055 UJ	2.7 J	0.055 UJ
ARSENIC	3.49	8.2	70	2.25 J	1.9 J	3 J	1.8 J	1.6 J	1.8 J	2.6 J
BARIUM	12.3			12 J	16.2 J	27 J	11.9 J	7.5 J	7.9 J	21.1 J
BERYLLIUM	0.395			0.46	0.51	0.41	0.47	0.24	0.42	0.22
CADMIUM	0.355	1.2	9.6	0.00545 UJ	0.0056 UJ	0.3 UJ	0.0053 UJ	0.055 UJ	0.0053 UJ	0.069 UJ
CALCIUM	4270			7525 J	22000 J	11000 J	22300 J	34800 J	46700 J	20900 J
CHROMIUM	13.2	81	370	11.6 J	13.9 J	12.5	12.3 J	9.3	11.8 J	12.4
COBALT	4.05			3.75 J	4 J	3.4 J	3.3 J	2.1 J	2.3 J	2.7 J
COPPER	16.3	34	270	19.6 J	20.4 J	20.7	14.1 J	15.9	11.6 J	17.7
CYANIDE				0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.11 UJ
IRON	9400			12700	15800	17200 J	11700	11800 J	12800	13400 J
LEAD	16.9	46.7	218	38.3 J	419 J	690 J	61.6 J	24.9 J	14.9 J	16.6 J
MAGNESIUM	2930			2995 J	4220 J	3390	3040 J	3010	3050 J	3420

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD306	G32-SD306	G32-SD306	G32-SD306	G32-SD307	G32-SD309	G32-SD309
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD306E-000.5-AVG	G32-SD306A-000.5	G32-SD306B-000.5	G32-SD306C-000.5	G32-SD307-000.5	G32-SD309A-000.5	G32-SD309B-000.5
SAMPLE DATE				20050829	20050829	20050829	20050829	20050830	20050829	20050829
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			113 J	153 J	140 J	118 J	121 J	127 J	126 J
MERCURY	0.0811	0.15	0.71	0.04 J	0.045 J	0.066 J	0.045 J	0.023 J	0.03 J	0.037 J
NICKEL	8.54	20.9	51.6	9.2 J	9.1 J	9.8 J	8 J	6.4 J	8.1 J	10.4 J
POTASSIUM	1040			852.5	984	954 J	928	658 J	840	654 J
SELENIUM	0.06			4.9 J	6 J	0.066 UJ	6.6 J	0.065 UJ	7.9 J	0.066 UJ
SODIUM	4300			2665 J	3800 J	2870 J	3080 J	3330 J	3460 J	2920 J
THALLIUM	0.793			1.2 J	1.3 J	0.078 U	1.1 J	0.077 U	0.64 UJ	0.078 U
VANADIUM	13.1			14.95 J	24.1 J	19.1 J	17 J	17.3 J	17.4 J	16 J
ZINC	48.4	150	410	40.3 J	64.4 J	131 J	40.5 J	30.9 J	46.2 J	34 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			10900 J	12000 J	3800	7500 J	10000 J	7500 J	6900 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.17	3.5	1	0.36	0.38	0.11	0.16
ACID VOLATILE SULFIDE				3.3 J	0.61 UJ	4 J	3.6 J	1.1 J	5.4 J	2.7 J
CADMIUM	0.0013			0.0049 UJ	0.019 UJ	0.0061 UJ	0.0064 UJ	0.0014 UJ	0.0028 UJ	0.0029 UJ
COPPER	0.0876			0.16 J	0.14 J	0.39 J	0.21 J	0.11 J	0.091 UJ	0.08 UJ
LEAD	0.0593			0.078 J	1.1 J	2.3 J	0.24 J	0.052 J	0.069 J	0.048 UJ
MERCURY	0.000038			0.0002 J	0.00022 J	0.00033 J	0.00022 J	0.00011 J	0.00015 J	0.00018 J
NICKEL	0.041			0.073 UJ	0.031 UJ	0.57 J	0.48 J	0.024 UJ	0.2 UJ	0.032 UJ
ZINC	0.455			0.32 J	0.92 J	0.72 J	0.37 J	0.26 J	0.5 J	0.42 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD309	G32-SD309	G32-SD309	G32-SD310	G32-SD310	G32-SD310	G32-SD310
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD309C-000.5	G32-SD309D-000.5	G32-SD309E-000.5	G32-SD310A-000.5-AVG	G32-SD310B-000.5	G32-SD310C-000.5	G32-SD310D-000.5
SAMPLE DATE				20050829	20050829	20050829	20050831	20050831	20050831	20050831
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
1,3-DICHLOROBENZENE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
1,4-DICHLOROBENZENE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
2-BUTANONE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
2-HEXANONE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
ACETONE				40 JEB	88 JEB	56 JEB	17 JEB	110 JEB	25 JEB	100 JEB
CARBON DISULFIDE				7 U	1 J	2 J	6.5 U	5 U	7 U	7 U
TRICHLOROETHENE				7 U	5 U	6 U	6.5 U	5 U	7 U	7 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	330 U	325 U	330 U	330 U	68 J
2-METHYLNAPHTHALENE		70	670	3.3 U	3.3 U	5.1	4.025	3.3 U	3.3 U	220
4-METHYLPHENOL				47 J	330 U	330 U	120 J	330 U	330 U	330 U
ACENAPHTHENE		16	500	12	3.3 U	27	41 J	3.3 U	17	1300
ACENAPHTHYLENE		44	640	3.3 U	3.3 U	4.2	3.25 U	3.9	3.4	7.8
ANTHRACENE	13	85.3	1100	46	9.4	72	57.5 J	7.5	24	1300
BENZO(A)ANTHRACENE	9.1	261	1600	59	27	100	115	17	39	1400
BENZO(A)PYRENE	2.5	430	1600	47	28	83	104	21	42	980
BENZO(B)FLUORANTHENE	3.7			57	35	100	130	32	58	1200
BENZO(G,H,I)PERYLENE				34	24	52	52.5	13	26	410 J
BENZO(K)FLUORANTHENE	2.5			21	13	38	50	12	22	760
BIS(2-ETHYLHEXYL)PHTHALATE				330 U	330 U	330 U	325 U	330 U	330 U	330 U
CARBAZOLE				330 U	330 U	330 U	325 U	330 U	330 U	910
CHRYSENE	8.78	384	2800	38	18	75	107.5	22	41	1200
DIBENZO(A,H)ANTHRACENE		63.4	260	9.2	6.6	17	15	3.6	6.5	140
DIBENZOFURAN				330 U	330 U	330 U	325 U	330 U	330 U	510
FLUORANTHENE	37	600	5100	120	36	220	235 J	34	97	3400
FLUORENE		19	540	14	3.3 U	31	24 J	3.3 U	11	820
HEXACHLOROCYCLOPENTADIENE				330 UJ	330 UJ	330 UJ	325 UJ	330 U	330 UJ	330 UJ
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	293.2	169.6	511	624	132.6	255.5	6490
INDENO(1,2,3-CD)PYRENE				28	18	46	50	12	21	400 J
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	384	97.4	706.6	731.575	90.4	307	13677.8
NAPHTHALENE		160	2100	6	3.3 U	7.3	10.05 J	3.3 U	6.6	730
PHENANTHRENE	31	240	1500	94	20	180	170 J	16	72	3300
PHENOL				62 J	330 U	330 U	94 J	330 U	330 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref** [1]	**ERL** [2]	**ERM** [3]	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD309	G32-SD309	G32-SD309	G32-SD310	G32-SD310	G32-SD310	G32-SD310
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD309C-000.5	G32-SD309D-000.5	G32-SD309E-000.5	G32-SD310A-000.5-AVG	G32-SD310B-000.5	G32-SD310C-000.5	G32-SD310D-000.5
SAMPLE DATE				20050829	20050829	20050829	20050831	20050831	20050831	20050831
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	92	32	160	190 J	29	76	2600
4,4'-DDE		2.2	27	4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
4,4'-DDT		1	7	4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
ALDRIN				2.1 U	2.4 U	2.7 U	2.25 U	2.1 U	2.4 U	2.2 U
AROCLOR-1260				50	46 U	52 U	43 U	41	46 U	43 U
BETA-BHC				2.1 U	2.4 U	6.4	2.25 U	2.1 U	2.4 U	2.2 U
DELTA-BHC				2.1 U	2.4 U	2.7 U	2.25 U	2.1 U	2.4 U	2.2 U
DIELDRIN				4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
ENDOSULFAN I				2.1 U	2.4 U	2.7 U	2.25 U	2.1 U	2.4 U	2.2 U
ENDOSULFAN II				4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
ENDOSULFAN SULFATE				4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
ENDRIN ALDEHYDE				4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
ENDRIN KETONE				4.1 U	4.6 U	5.2 U	4.3 U	4.1 U	4.6 U	4.3 U
GAMMA-BHC (LINDANE)				2.1 U	2.4 U	2.7 U	2.25 U	2.1 U	2.4 U	2.2 U
GAMMA-CHLORDANE		0.5	6	2.1 U	2.4 U	2.7 U	2.25 U	2.1 U	2.4 U	2.2 U
METHOXYCHLOR				21 U	24 U	27 U	22.5 U	21 U	24 U	22 U
TOTAL AROCLOR		22.7	180	50	46 U	52 U	43 U	41	46 U	43 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				23	29	31	39.5	31	34	27
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			5310	5220	6300	5780	5630	6500	5470
ANTIMONY	0.128	2	25	0.056 UJ	0.11 UJ	0.41 UJ	0.173 UJ	0.26 UJ	0.92 UJ	0.32 UJ
ARSENIC	3.49	8.2	70	1.7 J	1.7 J	2.3 J	2.5 J	2.4 J	2.2 J	2 J
BARIUM	12.3			19 J	10.1 J	9.6 J	8.9 J	7.9 J	9.4 J	12.1 J
BERYLLIUM	0.395			0.21	0.22	0.31	0.285	0.28	0.79	0.23
CADMIUM	0.355	1.2	9.6	0.066 UJ	0.046 UJ	0.13 UJ	0.076 UJ	0.13 UJ	3.2 J	0.11 UJ
CALCIUM	4270			36800 J	49100 J	55200 J	29800 J	34100 J	42100 J	46100 J
CHROMIUM	13.2	81	370	10.4	11.2	13.5	14.6	21.4	16.5	10.5
COBALT	4.05			2.2 J	2.4 J	3.6 J	2.7 J	5 J	2.9	2.1 J
COPPER	16.3	34	270	11.3	13.9	15.1	20.7	24.5	20.7	14.7
CYANIDE				0.12 UJ	0.21 UJ	0.12 UJ	0.13 J	0.12 UJ	0.12 UJ	0.14 UJ
IRON	9400			11700 J	13100 J	13300 J	19850 J	23200 J	24700 J	13200 J
LEAD	16.9	46.7	218	9.3 J	9.5 J	127 J	9.85 J	178 J	11.7 J	13.2 J
MAGNESIUM	2930			3120	3510	4100	3560	3280	3890	3360

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD309	G32-SD309	G32-SD309	G32-SD310	G32-SD310	G32-SD310	G32-SD310
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD309C-000.5	G32-SD309D-000.5	G32-SD309E-000.5	G32-SD310A-000.5-AVG	G32-SD310B-000.5	G32-SD310C-000.5	G32-SD310D-000.5
SAMPLE DATE				20050829	20050829	20050829	20050831	20050831	20050831	20050831
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			120 J	135 J	150 J	163.5 J	156 J	179 J	139 J
MERCURY	0.0811	0.15	0.71	0.032 J	0.023 J	0.045 J	0.0295 J	0.025 J	0.027 J	0.036 J
NICKEL	8.54	20.9	51.6	6.4 J	6.8 J	8.7 J	9 J	14.8 J	11 J	5.9 J
POTASSIUM	1040			731 J	725 J	1060 J	838 J	881 J	964 J	868 J
SELENIUM	0.06			0.067 UJ	0.066 UJ	0.067 UJ	0.067 UJ	0.066 UJ	0.067 UJ	0.067 UJ
SODIUM	4300			4210 J	4120 J	5110 J	3300 J	3600 J	3580 J	4490 J
THALLIUM	0.793			0.79 UJ	0.22 UJ	0.96 UJ	1.055 UJ	1.1 UJ	0.34 UJ	0.23 UJ
VANADIUM	13.1			13 J	13.8 J	22.6 J	15.65 J	17.4 J	17.5 J	13.6 J
ZINC	48.4	150	410	35.1 J	39 J	42.1 J	40.15 J	65.8 J	44.9 J	51.6 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			11000 J	12000 J	5000 J	10400 J	7400 J	13000 J	15000 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.58	0.21	0.075	0.295	0.12	0.14	0.2
ACID VOLATILE SULFIDE				1.7 J	1.4 J	8.4 J	1.4 J	6.6 J	2.2 J	1.3 J
CADMIUM	0.0013			0.0045 UJ	0.004 UJ	0.0044 UJ	0.0023 UJ	0.0021 UJ	0.0023 UJ	0.0023 UJ
COPPER	0.0876			0.071 UJ	0.055 UJ	0.12 J	0.06175 J	0.077 J	0.063 UJ	0.057 UJ
LEAD	0.0593			0.05 UJ	0.059 J	0.076 J	0.0415 UJ	0.31 J	0.035 UJ	0.039 UJ
MERCURY	0.000038			0.00016 J	0.00011 J	0.00022 J	0.000145 J	0.00012 J	0.00013 J	0.00018 J
NICKEL	0.041			0.24 UJ	0.2 UJ	0.051 UJ	0.04 UJ	0.036 UJ	0.065 UJ	0.066 UJ
ZINC	0.455			0.99 J	0.24 J	0.43 J	0.265 J	0.43 J	0.31 J	0.26 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD310	G32-SD315	G32-SD317	G32-SD302	G32-SD302	G32-SD302	G32-SD302	G32-SD302
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD310E-000.5	G32-SD315-000.5	G32-SD317-000.5	G32-SD302A-000.5	G32-SD302B-000.5	G32-SD302C-000.5	G32-SD302D-000.5	G32-SD302E-000.5
SAMPLE DATE				20050831	20050831	20050830	20050825	20050825	20050825	20050825	20050825
VOLATILE ANALYSIS (µg/kg)											
1,1-DICHLOROETHENE				5 U	6 U	4 U	6 U	3 U	2 U	2 U	4 U
1,3-DICHLOROBENZENE				5 U	6 UJ	4 U	6 U	3 U	2 U	2 U	4 U
1,4-DICHLOROBENZENE				5 U	6 UJ	4 U	6 U	3 U	2 U	2 U	4 U
2-BUTANONE				5 U	6 U	4 U	6 U	3 U	2 U	2 U	4 U
2-HEXANONE				5 U	6 U	4 U	6 U	3 U	2 U	2 U	4 U
ACETONE				32 JEB	700 UJ	30 JEB	59 JEB	14 JEB	35 JEB	19 JEB	240 JEB
CARBON DISULFIDE				5 U	6 U	1 J	6	1 J	2 U	2 J	4 UJ
TRICHLOROETHENE				5 U	6 U	4 U	6 U	3 U	2 U	2 U	4 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				330 U	330 U	320 U	330 U	330 U	330 U	330 U	330 U
2-METHYLNAPHTHALENE		70	670	3.3 U	3.3 U	3.2 U	6.1	11	6.7	3.4	4.1
4-METHYLPHENOL				330 U	330 U	300 J	330 U	330 U	330 U	330 U	82 J
ACENAPHTHENE		16	500	3.8	5	3.2 U	23	52	48	12	12
ACENAPHTHYLENE		44	640	3.7	15	3.2 U	4.5	5.6	10	4.2	3.2 J
ANTHRACENE	13	85.3	1100	16	23	13	59	120	180	41	37
BENZO(A)ANTHRACENE	9.1	261	1600	35	74	17	120	230	280	75	72
BENZO(A)PYRENE	2.5	430	1600	27	53	15	98	160	220	65	65
BENZO(B)FLUORANTHENE	3.7			43	130	24	110 J	200 J	270	75 J	78 J
BENZO(G,H,I)PERYLENE				12	20	7.2	62	100	130	44	45
BENZO(K)FLUORANTHENE	2.5			15	46	8.6	44	58	84	27	27
BIS(2-ETHYLHEXYL)PHTHALATE				330 U	330 U	320 U	330 U	330 U	330 U	380 U	330 U
CARBAZOLE				330 U	330 U	320 U	35 J	71 J	81 J	330 U	330 U
CHRYSENE	8.78	384	2800	40	120	22	79	150	190	51	49
DIBENZO(A,H)ANTHRACENE		63.4	260	3.7	7.9	3.2 U	18	30	39	12	13
DIBENZOFURAN				330 U	330 U	320 U	330 U	330 U	330 U	330 U	330 U
FLUORANTHENE	37	600	5100	77	140	52	220	470	590	140	160
FLUORENE		19	540	3.7	7.8	5.2	24	49	63	17	14
HEXACHLOROCYCLOPENTADIENE				330 UJ	330 UJ	320 U	330 U	330 U	330 U	330 U	330 U
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	187.7	474.9	100.2	588	1024	1323	387	387
INDENO(1,2,3-CD)PYRENE				12	24	6.4	57	96	110	38	38
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	177.2	350.8	136.8	683.2	1455.6	1864.9	435	477.4
NAPHTHALENE		160	2100	3.3 U	3.3 U	4.6	6.6	18	7.2	4.4	7.1
PHENANTHRENE	31	240	1500	26	40	27	190	360	510	120	110
PHENOL				330 U	330 U	270 J	330 U	330 U	330 U	330 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD310	G32-SD315	G32-SD317	G32-SD302	G32-SD302	G32-SD302	G32-SD302	G32-SD302
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD310E-000.5	G32-SD315-000.5	G32-SD317-000.5	G32-SD302A-000.5	G32-SD302B-000.5	G32-SD302C-000.5	G32-SD302D-000.5	G32-SD302E-000.5
SAMPLE DATE				20050831	20050831	20050830	20050825	20050825	20050825	20050825	20050825
PESTICIDE/PCB ANALYSIS (µg/kg)											
PYRENE	20.5	665	2600	47	120	35	150	370	450	93	130
4,4'-DDE		2.2	27	4.1 U	5.1 J	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDT		1	7	4.1 U	10 R	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ALDRIN				2.1 U	2.4 U	2 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
AROCLOR-1260				41 U	500	39 U	46	33 U	33 U	33 J	33 U
BETA-BHC				2.1 U	4.7	2 U	1.7 U	1.7 U	1.8 R	1.7 U	1.7 U
DELTA-BHC				2.1 U	2.4 U	2 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
DIELDRIN				4.1 U	4.6 U	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN I				2.1 U	2.4 U	2 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
ENDOSULFAN II				4.1 U	4.6 U	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN SULFATE				4.1 U	12 J	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN ALDEHYDE				4.1 U	4.6 U	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN KETONE				4.1 U	4.6 U	3.9 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
GAMMA-BHC (LINDANE)				2.1 U	2.4 U	2 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
GAMMA-CHLORDANE		0.5	6	2.1 U	11	2 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
METHOXYCHLOR				21 U	24 U	20 U	17 U	17 U	17 U	17 U	17 U
TOTAL AROCLOR		22.7	180	41 U	500	39 U	46	33 U	33 U	33	33 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
DIESEL RANGE ORGANICS				44	38	21	28 J	20	33	15 J	21
METALS ANALYSIS (mg/kg)											
ALUMINUM	5040			6120	4890	5560	9100	5930	5500	7440	5390
ANTIMONY	0.128	2	25	0.054 UJ	0.18 UJ	0.46 UJ	0.72 U	0.33 U	0.44 U	0.74 U	0.43 U
ARSENIC	3.49	8.2	70	3 J	1.7 J	4.8 J	7.1 J	4.6 J	3.1 J	4 J	3.3 J
BARIUM	12.3			8.1 J	8.2 J	8.7 J	24.9 J	15 J	10.6 J	13.7 J	16.3 J
BERYLLIUM	0.395			0.27	0.27	0.27	0.45	0.25	0.19	0.24	0.11
CADMIUM	0.355	1.2	9.6	0.077 UJ	0.15 UJ	398	0.83 J	0.62 J	0.48 UJ	0.6 J	0.5 J
CALCIUM	4270			14800 J	19200 J	5630 J	16700 J	32300 J	8860 J	15200 J	22900 J
CHROMIUM	13.2	81	370	10.6	10.6	72.1	28.4	22.1	12.6	16	12.7
COBALT	4.05			2.7 J	2.3 J	2 J	4.5 J	3.1 J	3.1 J	3.6 J	3.4 J
COPPER	16.3	34	270	15.9	17.2	36.5	26.5 J	18.2 J	9.7 J	16.2 J	9.1 J
CYANIDE				0.12 UJ	0.13 UJ	0.12 UJ	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U
IRON	9400			19200 J	11000 J	71800 J	15200 J	10700 J	10800 J	13100 J	10600 J
LEAD	16.9	46.7	218	14.1 J	14 J	56.4 J	33.6 J	21.7 J	14.1 J	40.3 J	12.5 J
MAGNESIUM	2930			3900	3180	3660	4760	3040	3080	3930	3050

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northeast Shoreline	Northeast Shoreline	Northeast Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD310	G32-SD315	G32-SD317	G32-SD302	G32-SD302	G32-SD302	G32-SD302	G32-SD302
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD310E-000.5	G32-SD315-000.5	G32-SD317-000.5	G32-SD302A-000.5	G32-SD302B-000.5	G32-SD302C-000.5	G32-SD302D-000.5	G32-SD302E-000.5
SAMPLE DATE				20050831	20050831	20050830	20050825	20050825	20050825	20050825	20050825
METALS ANALYSIS (mg/kg) (cont.)											
MANGANESE	97.6			163 J	111 J	348 J	158	114	117	154	121
MERCURY	0.0811	0.15	0.71	0.007 U	0.026 J	0.0099 J	0.13	0.11	0.06	0.051	0.04
NICKEL	8.54	20.9	51.6	7.7 J	6.9 J	8.7 J	13.1 J	13 J	7.2 J	10 J	7.1 J
POTASSIUM	1040			795 J	819 J	787 J	2400 J	1320 J	974 J	1250 J	1080 J
SELENIUM	0.06			0.064 UJ	0.067 UJ	0.065 UJ	0.068 U	0.068 U	0.063 U	0.068 U	0.065 U
SODIUM	4300			2810 J	3890	2560 J	9580	4780 J	3940 J	4830 J	3260 J
THALLIUM	0.793			0.076 U	0.67 UJ	1.1 UJ	0.33 UJ	0.081 U	0.074 U	0.081 U	0.38 UJ
VANADIUM	13.1			15.5 J	19.6 J	14.6 J	28.4 J	17.8 J	16.7 J	17.1 J	17.9 J
ZINC	48.4	150	410	55.1 J	36.8 J	145 J	72.3	48.1	34.6 J	63.2	33.3 J
MISCELLANEOUS ANALYSIS (mg/kg)											
TOTAL ORGANIC CARBON	9060			12000 J	6800 J	3000	15000 J	5400 J	9400 J	7200 J	2400
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)											
SEM/AVS	8.04			0.91	0.071	0.16	0.13	0.15	0.13	1.8	0.22
ACID VOLATILE SULFIDE				0.57 J	6.6 J	3.8 J	5.4 J	5.7 J	4.7 J	3.4 J	1.8 J
CADMIUM	0.0013			0.002 UJ	0.0016 UJ	0.0021 UJ	0.0034 UJ	0.0017 UJ	0.0012 UJ	0.0098 UJ	0.0013 UJ
COPPER	0.0876			0.12 J	0.071 J	0.19 J	0.14 J	0.16 J	0.088 J	2.4 J	0.063 UJ
LEAD	0.0593			0.048 J	0.1 J	0.17 J	0.062 J	0.08 J	0.045 J	0.05 J	0.044 J
MERCURY	0.000038			0.00003 U	0.00013 J	0.00004 J	0.00065	0.00055	0.0003	0.00025	0.0002
NICKEL	0.041			0.1 UJ	0.026 UJ	0.078 UJ	0.058 J	0.058 J	0.14 J	3.2 J	0.026 J
ZINC	0.455			0.35 J	0.3 J	0.26 J	0.45 J	0.54 J	0.32 J	0.35 J	0.33 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref** [1]	**ERL** [2]	**ERM** [3]	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD313	G32-SD313
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD308A-000.5	G32-SD308B-000.5	G32-SD308C-000.5	G32-SD308D-000.5	G32-SD308E-000.5	G32-SD313D-000.5-AVG	G32-SD313A-000.5
SAMPLE DATE				20050825	20050825	20050825	20050825	20050825	20050825	20050825
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
1,3-DICHLOROBENZENE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
1,4-DICHLOROBENZENE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
2-BUTANONE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
2-HEXANONE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
ACETONE				76 JEB	27 JEB	27 JEB	94 JEB	24 JEB	51 JEB	99 JEB
CARBON DISULFIDE				3 U	3 U	3 U	3 U	3 U	1.5 J	3 U
TRICHLOROETHENE				3 U	3 U	3 U	3 U	3 U	4 U	3 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	330 U	330 U	54 J	330 U	330 U
2-METHYLNAPHTHALENE		70	670	3.7	3.3 U	14	3.8	280	3.3 U	3.5
4-METHYLPHENOL				480	330 U	200 J	330 U	330 U	43 J	330 U
ACENAPHTHENE		16	500	9.1	9.8	25	19	620	16.3 J	16
ACENAPHTHYLENE		44	640	3.3 U	3.3 U	3.4	3.3 U	9.9	3.3 U	4.6
ANTHRACENE	13	85.3	1100	48	28	98	44	880	64 J	52
BENZO(A)ANTHRACENE	9.1	261	1600	72	74	310 J	87	1200	142.5 J	120
BENZO(A)PYRENE	2.5	430	1600	64	63	290	74	960	100 J	100
BENZO(B)FLUORANTHENE	3.7			73 J	88	310	91	1100	132 J	140
BENZO(G,H,I)PERYLENE				47	42	180	58	300 J	59 J	64
BENZO(K)FLUORANTHENE	2.5			24	26	110	30	790	39.5 J	41
BIS(2-ETHYLHEXYL)PHTHALATE				330 U	330 U	330 U	330 U	330 U	330 U	330 U
CARBAZOLE				330 U	330 U	57 J	330 U	710 J	38 J	330 U
CHRYSENE	8.78	384	2800	47	53	210	59	1300	96.5 J	84
DIBENZO(A,H)ANTHRACENE		63.4	260	14	13	59	16	190	17.5 J	20
DIBENZOFURAN				330 U	330 U	330 U	330 U	350	330 U	330 U
FLUORANTHENE	37	600	5100	160	150	510	170	2400	245 J	250
FLUORENE		19	540	11	9.5	33	14	510	15.5	16
HEXACHLOROCYCLOPENTADIENE				330 U	330 U	330 U	330 U	330 U	330 U	330 U
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	377	395	1639	457	6160	638	624
INDENO(1,2,3-CD)PYRENE				36	36	170	42	320 J	51 J	55
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	477.2	392.9	1449.4	507.4	9519.9	781.95	677.7
NAPHTHALENE		160	2100	5.4	4.6	16	6.6	220	6.15	5.6
PHENANTHRENE	31	240	1500	90	81	290	110	2400	175 J	140
PHENOL				1400	330 U	180 J	330 U	330 U	50 J	39 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref** [1]	**ERL** [2]	**ERM** [3]	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD313	G32-SD313
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD308A-000.5	G32-SD308B-000.5	G32-SD308C-000.5	G32-SD308D-000.5	G32-SD308E-000.5	G32-SD313D-000.5-AVG	G32-SD313A-000.5
SAMPLE DATE				20050825	20050825	20050825	20050825	20050825	20050825	20050825
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	150	110	460	140	2200	260 J	190
4,4'-DDE		2.2	27	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDT		1	7	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ALDRIN				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
AROCLOR-1260				33 U	33 U	33 U	33 U	33 U	33 U	33 U
BETA-BHC				6.8 J	1.7 J	4.2 J	1.7 R	2 R	2.55 J	3.2
DELTA-BHC				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
DIELDRIN				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN I				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
ENDOSULFAN II				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN SULFATE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN ALDEHYDE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN KETONE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
GAMMA-BHC (LINDANE)				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 UJ	1.7 U
GAMMA-CHLORDANE		0.5	6	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
METHOXYCHLOR				17 U	17 U	17 U	17 U	17 U	17 U	17 U
TOTAL AROCLOR		22.7	180	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				31	27	45	27	41	31.5	36
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			5770	5540	5970	5250	5500	5555	6720
ANTIMONY	0.128	2	25	0.32 U	0.39 U	0.42 U	0.45 U	0.41 U	0.52 U	0.35 U
ARSENIC	3.49	8.2	70	2.9 J	2.7 J	3.9 J	3.9 J	3.2 J	4.05 J	3.8 J
BARIUM	12.3			9.4 J	10.4 J	10.3 J	11.1 J	12.7 J	13.4 J	14.1 J
BERYLLIUM	0.395			0.28	0.12	0.13	0.16	0.12	0.125	0.18
CADMIUM	0.355	1.2	9.6	0.54 UJ	0.48 UJ	0.56 UJ	0.63 J	0.46 UJ	12.3 J	0.64 UJ
CALCIUM	4270			25400 J	14700 J	34800 J	35600 J	36800 J	23350 J	17700 J
CHROMIUM	13.2	81	370	11	11.2	12.2	14.2	10.4	13.15	13.3
COBALT	4.05			3.1 J	3.4 J	3.4 J	3.2 J	2.7 J	3.1 J	3.8 J
COPPER	16.3	34	270	9.6 J	9 J	12.4 J	13 J	10.1 J	27.25 J	18
CYANIDE				0.12 U	0.12 U	0.12 U	0.12 U	0.11 U	0.12 U	0.11 U
IRON	9400			12300 J	11400 J	12600 J	13000 J	10600 J	18400 J	16400 J
LEAD	16.9	46.7	218	14 J	14.2 J	14.1 J	13.5 J	11.8 J	16.55 J	14.8 J
MAGNESIUM	2930			3230	3170	3690	3140	3590	3360	3590

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD308	G32-SD313	G32-SD313
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
SAMPLE ID				G32-SD308A-000.5	G32-SD308B-000.5	G32-SD308C-000.5	G32-SD308D-000.5	G32-SD308E-000.5	G32-SD313D-000.5-AVG	G32-SD313A-000.5
SAMPLE DATE				20050825	20050825	20050825	20050825	20050825	20050825	20050825
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			134	124	172	135	140	153.5 J	145
MERCURY	0.0811	0.15	0.71	0.013 UJ	0.054	0.018 UJ	0.012 UJ	0.011 UJ	0.017 UJ	0.018 UJ
NICKEL	8.54	20.9	51.6	7.2 J	7.5 J	8.3 J	8.9 J	6.8 J	9.5 J	8.7 J
POTASSIUM	1040			805 J	814 J	909 J	923 J	853 J	880.5 J	1200 J
SELENIUM	0.06			0.064 U	0.066 U	0.065 U	0.068 U	0.063 U	0.0705 U	0.064 U
SODIUM	4300			3190 J	3090 J	4420 J	3660 J	3670 J	3085 J	3820 J
THALLIUM	0.793			0.12 UJ	0.078 U	0.22 UJ	0.26 UJ	0.41 UJ	0.083 U	0.075 U
VANADIUM	13.1			16.2 J	17.5 J	15 J	22.8 J	14 J	12.45 J	17.6 J
ZINC	48.4	150	410	35.8 J	33.4 J	38.1 J	34.9 J	32 J	38.4 J	42.2 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			4800 J	2500	2500	6500 J	6000 J	3250 J	4800 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.22	0.032	0.14	0.25	0.18	0.39	0.085
ACID VOLATILE SULFIDE				3.1 J	7.1 J	2.6 J	1.9 J	2.5 J	1.45 J	12.3 J
CADMIUM	0.0013			0.00086 UJ	0.00088 UJ	0.00098 UJ	0.0016 UJ	0.0028 UJ	0.0165 J	0.00098 UJ
COPPER	0.0876			0.098 J	0.022 UJ	0.068 UJ	0.063 UJ	0.09 J	0.165 J	0.2 J
LEAD	0.0593			0.026 UJ	0.03 UJ	0.043 J	0.034 J	0.035 J	0.0455 J	0.075 J
MERCURY	0.000038			0.00006 UJ	0.00027	0.00009 UJ	0.00006 UJ	0.00005 UJ	0.00008 UJ	0.00009 UJ
NICKEL	0.041			0.36 J	0.015 J	0.027 J	0.044 J	0.037 J	0.0325 J	0.034 J
ZINC	0.455			0.21 J	0.21 J	0.29 J	0.4 J	0.28 J	0.29 J	0.74 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Stillwater Basin	Stillwater Basin	Stillwater Basin	Stillwater Basin	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD313	G32-SD313	G32-SD313	G32-SD312	G32-SD312	G32-SD316	G32-SD316	G32-SD301
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0
SAMPLE ID				G32-SD313B-000.5	G32-SD313C-000.5	G32-SD313E-000.5	G32-SD312-0.51.0	G32-SD312-000.5	G32-SD316-0.51.0	G32-SD316-000.5	G32-SD301-0.51.0
SAMPLE DATE				20050825	20050825	20050825	20050831	20050831	20050831	20050831	20050902
VOLATILE ANALYSIS (µg/kg)											
1,1-DICHLOROETHENE				5 U	5 U	6 U	8 U	5 U	8 U	8 U	4 UJ
1,3-DICHLOROBENZENE				5 U	5 U	6 U	3 J	5 U	8 UJ	8 UJ	4 U
1,4-DICHLOROBENZENE				5 U	5 U	6 U	11 J	5 U	8 UJ	8 UJ	4 U
2-BUTANONE				5 U	5 U	6 U	8 U	5 U	8 U	8 U	4 U
2-HEXANONE				5 U	5 U	6 U	8 U	5 U	8 U	8 U	4 U
ACETONE				38 JEB	96 JEB	99 JEB	120 JEB	45 JEB	42 JEB	71 JEB	18 UJ
CARBON DISULFIDE				1 J	1 J	3 J	16	8	12	10 J	4 U
TRICHLOROETHENE				5 U	5 U	6 U	8 U	5 U	8 U	8 U	4 U
SEMIVOLATILE ANALYSIS (µg/kg)											
1,1-BIPHENYL				330 U	330 UJ	330 U	330 U	330 U	330 U	320 U	330 U
2-METHYLNAPHTHALENE		70	670	4.5	6	4.2	59	31	6.8	10	10
4-METHYLPHENOL				330 U	95 J	210 J	35 J	330 U	330 U	320 U	330 U
ACENAPHTHENE		16	500	24	40	19	400	210	20	54	81
ACENAPHTHYLENE		44	640	3.6	7	5.3	810	300	52	74	7.5
ANTHRACENE	13	85.3	1100	65	110	58	3000	900	140	270	170
BENZO(A)ANTHRACENE	9.1	261	1600	290	210	100	4900	2000	200	590	320
BENZO(A)PYRENE	2.5	430	1600	320	180	92	2300	1200 J	300	490	320
BENZO(B)FLUORANTHENE	3.7			320 J	230	120	4900	2400 J	490	630	310 J
BENZO(G,H,I)PERYLENE				180	110	57	1100	380 J	99	120	140
BENZO(K)FLUORANTHENE	2.5			130	83	38	2300	1500 J	210	600	170
BIS(2-ETHYLHEXYL)PHTHALATE				330 UJ	330 UJ	330 U	330 U	330 U	330 U	320 U	46 J
CARBAZOLE				330 U	330 UJ	330 U	1400	530	64 J	130 J	89 J
CHRYSENE	8.78	384	2800	200	160	76	8700	4400	300	960	320 EB
DIBENZO(A,H)ANTHRACENE		63.4	260	58	35	17	250	120	35	43	42
DIBENZOFURAN				330 U	330 UJ	330 U	260 J	130 J	330 U	37 J	37 J
FLUORANTHENE	37	600	5100	440 J	270 J	240	28000	10000	700	2000 J	890
FLUORENE		19	540	20	45	19	800	260	31	72	77
HEXACHLOROCYCLOPENTADIENE				330 U	330 UJ	330 U	330 UJ	330 U	330 UJ	320 R	330 U
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	1668	1103	546	25750	12410	1744	3573	1762
INDENO(1,2,3-CD)PYRENE				170	95	46	1300	410 J	110	140	140
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	1215.4	1066.6	671.5	62369	23956	2839.8	5662	2655.5
NAPHTHALENE		160	2100	8.3	8.6	6	100	55	10	22	20
PHENANTHRENE	31	240	1500	200	310	150	7200	3600	280	960 J	690
PHENOL				330 U	39 J	250 J	35 J	330 U	330 U	320 U	330 U

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Stillwater Basin	Stillwater Basin	Stillwater Basin	Stillwater Basin	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD313	G32-SD313	G32-SD313	G32-SD312	G32-SD312	G32-SD316	G32-SD316	G32-SD301
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0
SAMPLE ID				G32-SD313B-000.5	G32-SD313C-000.5	G32-SD313E-000.5	G32-SD312-0.51.0	G32-SD312-000.5	G32-SD316-0.51.0	G32-SD316-000.5	G32-SD301-0.51.0
SAMPLE DATE				20050825	20050825	20050825	20050831	20050831	20050831	20050831	20050902
PESTICIDE/PCB ANALYSIS (µg/kg)											
PYRENE	20.5	665	2600	450 J	270 J	170	22000	8600	1600	2200 J	710
4,4'-DDE		2.2	27	3.3 U	3.3 U	3.3 U	230 J	53 R	220 J	69	32 U
4,4'-DDT		1	7	3.3 U	3.3 U	3.3 U	660 R	220 R	420 J	360 R	32 U
ALDRIN				1.7 U	1.7 U	1.7 U	54 U	26 U	50 U	2.5 U	17 U
AROCLOR-1260				33 U	33 U	33 U	41000	8900	22000	22000	33 U
BETA-BHC				1.7 U	2.3	2.4 J	57 J	26 U	50 U	4.6 J	17 U
DELTA-BHC				1.7 U	1.7 U	1.7 U	54 U	26 U	50 U	2.5 U	17 U
DIELDRIN				3.3 U	3.3 U	3.3 U	100 U	50 U	97 U	4.9 U	32 U
ENDOSULFAN I				1.7 U	1.7 U	1.7 U	54 U	26 U	50 U	2.5 U	17 U
ENDOSULFAN II				3.3 U	3.3 U	3.3 U	100 U	50 U	97 U	48 R	32 U
ENDOSULFAN SULFATE				3.3 U	3.3 U	3.3 U	640 J	50 U	380 J	340 J	32 U
ENDRIN ALDEHYDE				3.3 U	3.3 U	3.3 U	190 R	79 R	120 J	130 R	32 U
ENDRIN KETONE				3.3 U	3.3 U	3.3 U	100 U	50 U	97 U	4.9 U	32 U
GAMMA-BHC (LINDANE)				1.7 U	1.7 U	1.7 U	54 U	26 U	50 U	2.5 U	17 U
GAMMA-CHLORDANE		0.5	6	1.7 U	1.7 U	1.7 U	570	26 U	600	250	17 U
METHOXYCHLOR				17 U	17 U	17 U	540 U	260 U	500 U	25 U	170 U
TOTAL AROCLOR		22.7	180	33 U	33 U	33 U	41000	8900	22000	22000	33 U
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)											
DIESEL RANGE ORGANICS				20	35	34	220 J	200 J	230	76	20 J
METALS ANALYSIS (mg/kg)											
ALUMINUM	5040			5540	5870	5200	5880	5080	7780	6090	5230
ANTIMONY	0.128	2	25	0.44 U	1.1 U	0.55 U	0.058 UJ	0.35 UJ	0.056 UJ	0.055 UJ	0.39 UJ
ARSENIC	3.49	8.2	70	2.7 J	6.9 J	4.4 J	3.8 J	3.9 J	6.1 J	4.9 J	1.2 J
BARIUM	12.3			10.5 J	15.3 J	12.1 J	19.7 J	22.2 J	25.3 J	17 J	6.8 J
BERYLLIUM	0.395			0.15	0.16	0.19	0.43	0.35	0.59	0.46	0.23
CADMIUM	0.355	1.2	9.6	0.47 UJ	1.2 UJ	0.75 J	0.32 UJ	0.18 UJ	0.48 UJ	0.29 UJ	0.049 UJ
CALCIUM	4270			21400 J	16000 J	38300 J	70800 J	59700 J	10200 J	28900 J	1410 J
CHROMIUM	13.2	81	370	10.8	23.5	11.9	14.8	17.1	31.5	20.8	10.1 J
COBALT	4.05			3.4 J	4 J	2.8 J	2.9 J	2.4 J	3.8 J	3 J	2.2 J
COPPER	16.3	34	270	11.8	42.7	20.9 J	25.2	25.3	92.5	42.5	11
CYANIDE				0.12 U	0.11 U	0.12 U	0.13 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.12 U
IRON	9400			11200 J	27000 J	16100 J	12900 J	12100 J	17200 J	12500 J	10200
LEAD	16.9	46.7	218	13.2 J	21.3 J	15.8 J	23.4 J	18.3 J	90.6 J	90.6 J	9.5 J
MAGNESIUM	2930			3350	3840	3100	3290	3260	3760	3160	2860

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	Northwest Shoreline	Northwest Shoreline	Northwest Shoreline	Stillwater Basin	Stillwater Basin	Stillwater Basin	Stillwater Basin	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD313	G32-SD313	G32-SD313	G32-SD312	G32-SD312	G32-SD316	G32-SD316	G32-SD301
DEPTH IN FEET				0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0
SAMPLE ID				G32-SD313B-000.5	G32-SD313C-000.5	G32-SD313E-000.5	G32-SD312-0.51.0	G32-SD312-000.5	G32-SD316-0.51.0	G32-SD316-000.5	G32-SD301-0.51.0
SAMPLE DATE				20050825	20050825	20050825	20050831	20050831	20050831	20050831	20050902
METALS ANALYSIS (mg/kg) (cont.)											
MANGANESE	97.6			135	240	167	130 J	118 J	155 J	115 J	113 J
MERCURY	0.0811	0.15	0.71	0.022 UJ	0.02 UJ	0.02 UJ	0.052 J	0.042 J	0.22 J	0.19 J	0.0067 U
NICKEL	8.54	20.9	51.6	7.8 J	23.9 J	7.8 J	7.7 J	9.1 J	12.5 J	10.2 J	6.8 J
POTASSIUM	1040			922 J	991 J	917 J	1350 J	1140 J	1690 J	1450 J	655
SELENIUM	0.06			0.067 U	0.066 U	0.064 U	0.069 UJ	0.067 UJ	0.067 UJ	0.065 UJ	0.066 UJ
SODIUM	4300			3460 J	3680 J	4110 J	6700 J	6640 J	5410 J	6480	2250
THALLIUM	0.793			0.08 U	0.078 U	0.18 UJ	1.7 UJ	0.15 UJ	0.079 U	0.077 U	0.078 UJ
VANADIUM	13.1			16.9 J	16.1 J	13.2 J	17.6 J	15.1 J	25.6 J	20.4 J	13.9 J
ZINC	48.4	150	410	35 J	48.2 J	45.7 J	67.4 J	55.6 J	144 J	95.9 J	28.2 J
MISCELLANEOUS ANALYSIS (mg/kg)											
TOTAL ORGANIC CARBON	9060			2300 J	9000 J	10000 J	17000 J	16000 J	14000 J	20000 J	9300 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)											
SEM/AVS	8.04			0.22	0.17	1.5	0.04	0.033	0.46	0.051	0.12
ACID VOLATILE SULFIDE				1.3 J	8.5 J	0.61 UJ	19.8 J	33.7 J	13.3 J	22.1 J	0.88 J
CADMIUM	0.0013			0.0012 UJ	0.037 J	0.0031 UJ	0.0015 UJ	0.0018 UJ	0.0045 UJ	0.0072 UJ	0.002 UJ
COPPER	0.0876			0.069 UJ	0.49 J	0.21 J	0.13 J	0.33 J	1.2 J	0.2 J	0.039 UJ
LEAD	0.0593			0.028 UJ	0.19 J	0.13 J	0.068 J	0.075 J	0.54 J	0.12 J	0.019 UJ
MERCURY	0.000038			0.00011 UJ	0.0001 UJ	0.0001 UJ	0.00026 J	0.00021 J	0.0011 J	0.00095 J	0.00003 U
NICKEL	0.041			0.051 J	0.075 J	0.053 J	0.034 J	0.099 J	0.12 J	0.066 J	0.034 UJ
ZINC	0.455			0.23 J	0.62 J	0.5 J	0.56 J	0.62 J	4.2 J	0.73 J	0.11 J

Notes:

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD301	G32-SD303	G32-SD303	G32-SD311	G32-SD311	G32-SD314	G32-SD314
DEPTH IN FEET				0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD301-000.5	G32-SD303-0.51.0	G32-SD303-000.5	G32-SD311-0.51.0	G32-SD311-000.5	G32-SD314-0.51.0	G32-SD314-000.5-AVG
SAMPLE DATE				20050902	20050901	20050901	20050902	20050902	20050901	20050901
VOLATILE ANALYSIS (µg/kg)										
1,1-DICHLOROETHENE				5 U	5 U	6 U	5 U	6 U	6 U	6 U
1,3-DICHLOROBENZENE				5 UJ	5 U	6 U	5 U	6 U	6 U	6 U
1,4-DICHLOROBENZENE				5 UJ	5 U	6 U	5 U	6 U	6 U	6 U
2-BUTANONE				5 U	5 U	6 U	5 U	6 U	6 U	6 U
2-HEXANONE				5 U	5 U	6 U	5 U	6 U	6 U	6 U
ACETONE				120 J	340 U	140 J	11 UJ	230 J	71 UJ	200 J
CARBON DISULFIDE				1 J	5 U	6 U	1 J	3 J	6 U	6 U
TRICHLOROETHENE				5 U	5 U	6 U	5 U	6 U	6 U	6 U
SEMIVOLATILE ANALYSIS (µg/kg)										
1,1-BIPHENYL				330 U	330 U	44 J	330 U	330 U	330 U	330 UJ
2-METHYLNAPHTHALENE		70	670	9.6	3.3 U	130	3.3 U	3.3 U	7.7	11 J
4-METHYLPHENOL				2100 J	330 U	330 U	330 U	330 U	330 U	437.5 J
ACENAPHTHENE		16	500	68 J	13	1000	6.6	16	43	62.5 J
ACENAPHTHYLENE		44	640	8.9	5.6	11	3.3	3.3 U	3.9	6.25 J
ANTHRACENE	13	85.3	1100	170	29	1200	14	57	95	120 J
BENZO(A)ANTHRACENE	9.1	261	1600	430	64	1700	34	200	170	215 J
BENZO(A)PYRENE	2.5	430	1600	300 J	66	1400	36	130	150	185 J
BENZO(B)FLUORANTHENE	3.7			330	86	1200	50	210	180	235 J
BENZO(G,H,I)PERYLENE				160 J	38	850	24	36	83	108.5 J
BENZO(K)FLUORANTHENE	2.5			140 J	29	1200	18	79	79	98 J
BIS(2-ETHYLHEXYL)PHTHALATE				50 J	100 J	49 J	56 J	48 J	330 U	39.5 J
CARBAZOLE				82 J	330 U	600	330 U	330 U	43 J	81 J
CHRYSENE	8.78	384	2800	320 EBJ	80 EB	1600	34 EB	160 EB	160 EB	215 EBJ
DIBENZO(A,H)ANTHRACENE		63.4	260	46	10	190	5.9	14	22	29 J
DIBENZOFURAN				39 J	330 U	350	330 U	330 U	330 U	48 J
FLUORANTHENE	37	600	5100	890	140	3100	80	700	460	460 J
FLUORENE		19	540	70 J	13	690	5.4	16	40	59.5 J
HEXACHLOROCYCLOPENTADIENE				330 R	330 U	330 U	330 U	330 U	330 U	330 UJ
HIGH MOLECULAR WEIGHT PAHS	20	1700	9600	1876	407	8690	221.9	871	918	1184.5
INDENO(1,2,3-CD)PYRENE				150 J	34	850	20	42	74	99 J
LOW MOLECULAR WEIGHT PAHS	59.8	552	3160	2578.5	454.2	12281	220.3	1509	1277.6	1536.95
NAPHTHALENE		160	2100	12	3.6	350	3.3 U	3.3 U	18	17.7 J
PHENANTHRENE	31	240	1500	650	110	3000	43	210	290	400 J
PHENOL				83 J	330 U	330 U	330 U	38 J	330 U	56 J

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD301	G32-SD303	G32-SD303	G32-SD311	G32-SD311	G32-SD314	G32-SD314
DEPTH IN FEET				0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD301-000.5	G32-SD303-0.51.0	G32-SD303-000.5	G32-SD311-0.51.0	G32-SD311-000.5	G32-SD314-0.51.0	G32-SD314-000.5-AVG
SAMPLE DATE				20050902	20050901	20050901	20050902	20050902	20050901	20050901
PESTICIDE/PCB ANALYSIS (µg/kg)										
PYRENE	20.5	665	2600	700	140	2800	68	510	320	400 J
4,4'-DDE		2.2	27	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDT		1	7	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	6 R
ALDRIN				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
AROCLOR-1260				33 U	85	120	33 U	33 U	33 U	230
BETA-BHC				7.4 J	2.1 R	1.7 U	3	1.7 U	1.8	1.7 U
DELTA-BHC				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
DIELDRIN				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN I				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
ENDOSULFAN II				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDOSULFAN SULFATE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	2.825 J
ENDRIN ALDEHYDE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
ENDRIN KETONE				3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	5.7 J
GAMMA-BHC (LINDANE)				1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
GAMMA-CHLORDANE		0.5	6	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	3.15 J
METHOXYCHLOR				17 U	17 U	17 U	17 U	17 U	17 U	17 U
TOTAL AROCLOR		22.7	180	33 U	85	120	33 U	33 U	33 U	230
PETROLEUM HYDROCARBON ANALYSIS (mg/kg)										
DIESEL RANGE ORGANICS				33 J	29	32 J	32	26	14 J	17
METALS ANALYSIS (mg/kg)										
ALUMINUM	5040			4750	7740	8520	4710	4970	6980	6575
ANTIMONY	0.128	2	25	0.056 UJ	0.056 UJ	0.055 UJ	33.8 J	0.057 UJ	0.057 UJ	0.0565 UJ
ARSENIC	3.49	8.2	70	1.3 J	1.7 J	2.6 J	2.6 J	2.5 J	1.2 J	1.3 J
BARIUM	12.3			5.5 J	18 J	10.9 J	11.8 J	13.2 J	6.1 J	6.65 J
BERYLLIUM	0.395			0.23	0.3	0.34	0.34	0.4	0.3	0.255
CADMIUM	0.355	1.2	9.6	0.04 UJ	0.16 UJ	0.18 UJ	0.22 UJ	0.13 UJ	0.048 UJ	0.0745 UJ
CALCIUM	4270			1740 J	35000 J	31600 J	6620 J	8220 J	12000 J	22300 J
CHROMIUM	13.2	81	370	10.2 J	17.3 J	18.2 J	11.2 J	12 J	13.8 J	13.6 J
COBALT	4.05			2.2 J	3.2 J	3.2 J	2.5 J	2.7 J	3.1 J	2.85 J
COPPER	16.3	34	270	9.3	14.3	16.1	20.7	18	13.6	13.35
CYANIDE				0.3 J	0.12 UJ	0.12 UJ	0.31 J	0.12 U	0.12 UJ	0.12 UJ
IRON	9400			9520	16200	18700	11800	11800	15200	13500
LEAD	16.9	46.7	218	10.5 J	20.5 J	23.4 J	27.2	19.6 J	12.8 J	13.25 J
MAGNESIUM	2930			2830	4240	4430	2570	2840	3340	3265

TABLE 4-4B

SUMMARY OF ANALYTICAL RESULTS: SUBTIDAL SEDIMENT SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	**Ref (1)**	**ERL (2)**	**ERM (3)**	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline	South Shoreline
MATRIX				SD	SD	SD	SD	SD	SD	SD
LOCATION ID				G32-SD301	G32-SD303	G32-SD303	G32-SD311	G32-SD311	G32-SD314	G32-SD314
DEPTH IN FEET				0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5	0.5-1.0	0-0.5
SAMPLE ID				G32-SD301-000.5	G32-SD303-0.51.0	G32-SD303-000.5	G32-SD311-0.51.0	G32-SD311-000.5	G32-SD314-0.51.0	G32-SD314-000.5-AVG
SAMPLE DATE				20050902	20050901	20050901	20050902	20050902	20050901	20050901
METALS ANALYSIS (mg/kg) (cont.)										
MANGANESE	97.6			114 J	157 J	177 J	101 J	105 J	143 J	129.5 J
MERCURY	0.0811	0.15	0.71	0.01 UJ	0.066 U	0.055 U	0.019 U	0.024 U	0.035 U	0.0305 U
NICKEL	8.54	20.9	51.6	6.2 J	9.6 J	9.7 J	8.5 J	8 J	10.9 J	9.8 J
POTASSIUM	1040			658	1080	1220	768	942	644	759.5
SELENIUM	0.06			0.067 UJ	0.067 UJ	0.066 UJ	0.068 UJ	0.068 UJ	0.068 UJ	0.068 UJ
SODIUM	4300			2940	3670	3480	2370	3070	2470	3395
THALLIUM	0.793			0.079 UJ	0.079 UJ	0.17 J	0.08 UJ	0.08 UJ	0.08 UJ	0.08 UJ
VANADIUM	13.1			13.8 J	22.4 J	24.1 J	16.5 J	18 J	17.1 J	14.4 J
ZINC	48.4	150	410	29.5 J	49.2 J	57.9 J	42.1 J	38.9 J	42.3 J	40.7 J
MISCELLANEOUS ANALYSIS (mg/kg)										
TOTAL ORGANIC CARBON	9060			5200 J	10000 J	10000 J	5000 J	7200 J	7500 J	8100 J
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTABLE METALS (µmo/g)										
SEM/AVS	8.04			0.25	0.25	0.33	0.31	0.45	0.15	0.1085
ACID VOLATILE SULFIDE				0.88 J	1.9 J	1.3 J	1.1 J	0.97 J	1.3 J	4.45 J
CADMIUM	0.0013			0.002 UJ	0.0024 UJ	0.0022 UJ	0.0021 UJ	0.0023 UJ	0.002 UJ	0.00225 UJ
COPPER	0.0876			0.069 UJ	0.1 UJ	0.066 UJ	0.076 UJ	0.14 J	0.042 UJ	0.07025 J
LEAD	0.0593			0.031 J	0.078 J	0.074 J	0.055 J	0.057 J	0.033 J	0.045 J
MERCURY	0.000038			0.00005 UJ	0.00033 U	0.00027 U	0.00009 U	0.00012 U	0.00017 U	0.00015 U
NICKEL	0.041			0.17 UJ	0.39 UJ	0.026 UJ	0.022 UJ	0.043 UJ	0.022 UJ	0.2415 UJ
ZINC	0.455			0.19 J	0.4 J	0.35 J	0.29 J	0.24 J	0.16 J	0.295 J

(1) Ref - Reference Concentrations detected at unaffected stations (Jameston) see text.
(2) ERL - NOAA Effects - Range - Low
(3) ERM - NOAA Effects - Range - Medium

TABLE 4-5A

SUMMARY OF ANALYTICAL RESULTS: MUSSEL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	Northeast Intertidal	Northeast Intertidal	Northeast Intertidal	Northeast Intertidal	Stillwater Basin	Northwest Intertidal	Northwest Intertidal	Northwest Intertidal
MATRIX	ET	ET	ET	ET	ET	ET	ET	ET
LOCATION ID	G32-ET304F	G32-ET305F	G32-ET309F	G32-ET310F	G32-ET312	G32-ET302F	G32-ET308F	G32-ET313F
	G32-ET304F-090205	G32-ET305F-090105	G32-ET309F-090105	G32-ET3010F-090105	G32-ET312-082905	G32-ET302F-090205	G32-ET308F-090205	G32-ET313F-090205
SAMPLE DATE	20050902	20050901	20050901	20050901	20050829	20050902	20050902	20050902
SEMIVOLATILE ANALYSIS (µg/kg)								
2,4-DINITROPHENOL	4000 R	4000 R	4000 R	3900 R	3800 UJ	4000 R	3900 R	3800 R
2-METHYLPHENOL	2000 U	300 J	230 J	330 J	1900 U	220 J	600 J	400 J
ANTHRACENE	20 U	20 U	20 U	19 U	27	20 U	19 U	19 U
BENZALDEHYDE	2000 UJ	1400 JEB	1100 JEB	2300 JEB	820 JEB	2000 UJ	2400 JEB	960 JEB
BENZO(A)ANTHRACENE	20 U	20 U	20 U	19 U	66	20 U	19 U	19 U
BENZO(A)PYRENE	20 U	20 U	20 U	19 U	33	20 U	19 U	19 U
BENZO(B)FLUORANTHENE	20 U	20 U	20 U	19 U	43	20 U	19 U	19 U
CHRYSENE	20 U	20 U	20 U	19 U	66	20 U	19 U	19 U
FLUORANTHENE	37	20 U	20 U	19 U	210	20 U	19 U	19 U
HIGH MOLECULAR WEIGHT PAHS	20 U	20 U	20 U	19 U	208	20 U	19 U	19 U
ISOPHORONE	230 J	2000 U	2000 U	1900 U	1900 U	2000 U	1900 U	1900 U
LOW MOLECULAR WEIGHT PAHS	83	20 U	20 U	19 U	403	20 U	19 U	19 U
PHENANTHRENE	20 U	20 U	20 U	19 U	46	20 U	19 U	19 U
PYRENE	46	20 UJ	20 UJ	19 UJ	120	20 U	19 U	19 U
PESTICIDE/PCB ANALYSIS (µg/kg)								
AROCLOR-1260	160	98	95 U	96 U	440	99 U	99 U	99 U
BETA-BHC	5 U	5 U	4.9 U	5 U	5 U	8 R	5.1 U	5.1 U
ENDRIN	9.8 U	13 J	9.5 U	9.6 U	9.7 U	9.9 U	9.9 U	9.9 U
GAMMA-CHLORDANE	5 U	5 U	4.9 U	5 U	8 J	5.1 U	5.1 U	5.1 U
HEPTACHLOR EPOXIDE	5 U	5 U	4.9 U	3.3 R	5 U	5.1 U	5.1 U	5.1 U
TOTAL AROCLOR	160	98	95 U	96 U	440	99 U	99 U	99 U
METALS ANALYSIS (mg/kg)								
ARSENIC	1.7 J	1.3 J	2.6 J	1.7 J	1.8 J	1.9 J	2.4 J	1.9 J
BERYLLIUM	0.005 U	0.0057 U	0.0058 U	0.0054 U	0.0057 U	0.0056 J	0.0058 U	0.0051 U
CADMIUM	0.062 J	0.097 J	0.17 J	0.22 J	0.087 UJ	0.2 J	0.22 J	0.08 J
CALCIUM	1810 J	328 J	366 J	251 J	322 J	291 J	470 J	1800 J
CHROMIUM	0.16 UJ	0.14 J	0.18 UJ	0.18 UJ	0.29 J	0.17 UJ	0.12 UJ	0.11 UJ
COBALT	0.071 U	0.056 U	0.11 U	0.11 U	0.032 J	0.055 U	0.082 U	0.063 U
COPPER	1.2 UJ	0.85 UJ	1.5 UJ	1.2 UJ	0.95 J	2.4 UJ	1.4 UJ	1.2 UJ
IRON	73.7	33.5 U	67.7	35.9 U	16.5 UJ	43.3	31.8 U	29.4 U
LEAD	1.1 J	0.21 UJ	0.44 UJ	0.43 UJ	0.049 UJ	0.28 UJ	0.29 UJ	0.091 UJ
MAGNESIUM	650	678	731	679	733 J	620	649	724
MANGANESE	4.1 UJ	3.3 UJ	4.5 UJ	4.2 UJ	1.5 J	2.9 UJ	4.6 UJ	5.3 UJ
MERCURY	0.016 UJ	0.016 UJ	0.015 UJ	0.023 U	0.022	0.013 UJ	0.014 UJ	0.012 UJ

TABLE 4-5A

SUMMARY OF ANALYTICAL RESULTS: MUSSEL SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA	Northeast Intertidal	Northeast Intertidal	Northeast Intertidal	Northeast Intertidal	Stillwater Basin	Northwest Intertidal	Northwest Intertidal	Northwest Intertidal
MATRIX	ET	ET	ET	ET	ET	ET	ET	ET
LOCATION ID	G32-ET304F	G32-ET305F	G32-ET309F	G32-ET310F	G32-ET312	G32-ET302F	G32-ET308F	G32-ET313F
	G32-ET304F-090205	G32-ET305F-090105	G32-ET309F-090105	G32-ET3010F-090105	G32-ET312-082905	G32-ET302F-090205	G32-ET308F-090205	G32-ET313F-090205
SAMPLE DATE	20050902	20050901	20050901	20050901	20050829	20050902	20050902	20050902
METALS ANALYSIS (mg/kg) (cont.)								
POTASSIUM	2620 J	2140 J	2500 J	2290 J	2120	2830 J	2270 J	1870 J
SODIUM	3800 J	4400 J	4470 J	4200 J	4870 J	3650 J	4030 J	4110 J
THALLIUM	0.064 UJ	0.074 UJ	0.075 UJ	0.07 UJ	0.074 U	0.072 J	0.075 UJ	0.066 UJ
VANADIUM	0.38 J	0.16 J	0.65 J	0.3 J	0.24 J	0.13 UJ	0.25 J	0.14 J
ZINC	12.2	10.7	21	24.3	9.1 J	24.6	36.1	12.4
MISCELLANEOUS ANALYSIS (%)								
LIPIDS	0.4	1.5	0.3	1.6	1.2	0.5	0.4	0.3

TABLE 4-5B

SUMMARY OF ANALYTICAL RESULTS: CLAM SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA AND TIDAL ZONE	Northeast - Subtidal	Northeast - Subtidal	Northeast - Subtidal	Northeast - Subtidal	Northeast - Subtidal	Northeast - Subtidal	Northeast - Subtidal	Northwest - Subtidal
MATRIX	ET	ET	ET	ET	ET	ET	ET	ET
LOCATION ID	G32-ET304	G32-ET305	G32-ET306	G32-ET306F	G32-ET307	G32-ET309	G32-ET310	G32-ET302
SAMPLE ID	G32-ET304-082905	G32-ET305-082905-AVG	G32-ET306-090105	G32-ET306F-090105	G32-ET307-090105	G32-ET309-090105	G32-ET310-090105	G32-ET302-082905
SAMPLE DATE	20050829	20050829	20050901	20050901	20050901	20050901	20050901	20050829
SEMIVOLATILE ANALYSIS (µg/kg)								
2,4-DIMETHYLPHENOL	1900 UJ	1950 UJ	1900 UJ	2000 UJ	2000 UJ	2000 UJ	1900 UJ	2000 UJ
2,4-DINITROPHENOL	3900 UJ	3950 UJ	3900 R	4000 R	4000 R	4000 R	3900 R	4000 UJ
3-NITROANILINE	3900 U	3950 U	3900 U	4000 U	4000 R	4000 U	3900 U	4000 UJ
4-CHLORO-3-METHYLPHENOL	1900 U	1950 U	1900 U	2000 U	2000 U	560 J	1900 U	2000 U
BENZALDEHYDE	5400 JEB	2550 JEB	17000 JEB	18000 JEB	20000 JEB	27000 JEB	25000 JEB	8700 JEB
BIS(2-ETHYLHEXYL)PHTHALATE	210 J	1950 U	1900 U	2000 U	2000 U	2000 U	1900 U	2000 U
HEXACHLOROCYCLOPENTADIENE	1900 UJ	1950 UJ	1900 UJ	2000 UJ	2000 R	2000 UJ	1900 UJ	2000 R
PESTICIDE/PCB ANALYSIS (µg/kg)								
AROCLOR-1260	170	96 U	98 U	97 U	97 U	99 U	97 U	99 U
BETA-BHC	6.6	4.95 U	5 U	4.9 U	5 U	5.1 U	5 U	5.1 U
ENDRIN ALDEHYDE	9.4 U	9.6 U	9.8 U	9.5 U	9.7 U	9.9 U	13 J	9.9 U
GAMMA-BHC (LINDANE)	2.5 J	4.95 U	5 U	4.9 U	5 U	5.1 U	5 U	5.1 U
TOTAL AROCLOR	170	96 U	98 U	97 U	97 U	99 U	97 U	99 U
METALS ANALYSIS (mg/kg)								
ARSENIC	2 J	2.1 J	1.7 J	1.1 J	3.9 J	2.9 J	1.5 J	4.2 J
BERYLLIUM	0.0055 J	0.0053 U	0.0059 J	0.0051 U	0.012 J	0.006 J	0.0078 J	0.0081
CADMIUM	0.14 J	0.13525 J	0.026 UJ	0.087 J	0.73 J	0.03 UJ	0.043 UJ	0.12 J
CALCIUM	357 J	2190 J	274 J	8140 J	303 J	295 J	188 J	3450 J
CHROMIUM	0.29 J	0.475 J	0.24 UJ	2.9 J	0.35 UJ	0.16 UJ	0.14 UJ	0.28 J
COBALT	0.17	0.141	0.16 U	0.084 U	0.21 U	0.11 U	0.2 U	0.21
COPPER	1.2 J	1.93 J	0.85 UJ	0.89 UJ	6.8 UJ	0.68 UJ	1.8 UJ	2.1 J
IRON	12.8 UJ	23.3 J	26.1 U	47.2	35.1 U	21.9 U	25.1 U	19.9 J
LEAD	0.077 UJ	0.2185 J	0.034 UJ	0.21 UJ	0.32 UJ	0.039 UJ	0.073 UJ	0.035 UJ
MAGNESIUM	756 J	709.5 J	778	619	484	464	532	659 J
MANGANESE	0.82 UJ	9.25 J	1.9 UJ	6.3 UJ	12.5 J	2.8 UJ	2.3 UJ	4.8 J
MERCURY	0.0088 J	0.0051 J	0.0091 UJ	0.022 UJ	0.01 UJ	0.0082 UJ	0.0068 U	0.011 J
NICKEL	0.42	0.405	0.47 UJ	0.41 UJ	0.51 UJ	0.35 UJ	0.52 UJ	0.59
POTASSIUM	2220	2175	2900 J	2070 J	2820 J	2470 J	2470 J	2540
SODIUM	4700 J	4010 J	3080 J	4120 J	2920 J	2610 J	2810 J	3770 J
THALLIUM	0.067 U	0.069 U	0.066 UJ	0.18 J	0.072 UJ	0.073 UJ	0.075 UJ	0.067 U
VANADIUM	0.11 J	0.27 J	0.13 J	0.12 U	0.25 J	0.17 J	0.14 UJ	0.92 J
ZINC	10.6 J	15 J	16.9	9.2	13.6	7.1	13.2	16.1 J
MISCELLANEOUS ANALYSIS (%)								
LIPIDS	0.5	0.70	0.9	0.2	0.5	0.6	1.1	0.8

TABLE 4-5B

SUMMARY OF ANALYTICAL RESULTS: CLAM SAMPLES
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GEOGRAPHIC AREA AND TIDAL ZONE	Northwest - Subtidal	Northwest - Subtidal	South Shoreline - Subtidal	h Shoreline - Subtidal	h Shoreline - Subtidal
MATRIX	ET	ET	ET	ET	ET
LOCATION ID	G32-ET308	G32-ET313	G32-ET301	G32-ET303	G32-ET311
SAMPLE ID	G32-ET308-082905	G32-ET313-082905	G32-ET301-090205-AVG	G32-ET303-090105	G32-ET311-090205
SAMPLE DATE	20050829	20050829	20050902	20050901	20050902
SEMIVOLATILE ANALYSIS (µg/kg)					
2,4-DIMETHYLPHENOL	1900 UJ	1900 UJ	1950 UJ	2000 UJ	2000 J
2,4-DINITROPHENOL	3900 UJ	3900 UJ	3950 R	4000 R	4000 R
3-NITROANILINE	3900 U	3900 U	3950 U	4000 U	4000 U
4-CHLORO-3-METHYLPHENOL	1900 U	1900 U	1950 U	2000 U	2000 U
BENZALDEHYDE	4600 JEB	4400 JEB	5600 JEB	37000 JEB	1900 JEB
BIS(2-ETHYLHEXYL)PHTHALATE	1900 U	1900 U	1950 U	2000 U	2000 U
HEXACHLOROCYCLOPENTADIENE	1900 UJ	1900 UJ	1950 U	2000 UJ	2000 UJ
PESTICIDE/PCB ANALYSIS (µg/kg)					
AROCLOR-1260	98 U	98 U	97.5 U	95 U	98 U
BETA-BHC	5 U	5 U	5 U	4.9 U	5 U
ENDRIN ALDEHYDE	9.8 U	9.8 U	9.75 U	9.5 U	9.8 U
GAMMA-BHC (LINDANE)	5 U	5 U	5 U	4.9 U	5 U
TOTAL AROCLOR	98 U	98 U	97.5 U	95 U	98 U
METALS ANALYSIS (mg/kg)					
ARSENIC	0.75 J	1.8 J	1.4 J	3.3 J	1.3 J
BERYLLIUM	0.0057 U	0.0052 U	0.00535 U	0.0077 J	0.005 U
CADMIUM	0.06 UJ	0.21 J	0.138 J	0.15 J	0.027 UJ
CALCIUM	490 J	1850 J	524.5 J	760 J	299 J
CHROMIUM	6.1 J	0.29 J	0.275 UJ	0.18 UJ	0.59 J
COBALT	0.12	0.11	0.0985 U	0.16 U	0.074 U
COPPER	0.59 J	1.7 J	1.345 UJ	2.5 UJ	0.85 UJ
IRON	51.9 J	15.8 UJ	25.85 U	29 U	28.8 U
LEAD	0.043 UJ	0.035 UJ	0.185 UJ	0.29 UJ	0.051 UJ
MAGNESIUM	799 J	670 J	655.5	668	716
MANGANESE	4.4 J	6.2 J	15.375 J	38.6 J	2.8 UJ
MERCURY	0.0059 U	0.01 J	0.0165 UJ	0.012 UJ	0.011 UJ
NICKEL	0.46	0.5	0.535 UJ	0.49 UJ	0.39 UJ
POTASSIUM	1760	1840	2240 J	2410 J	2620 J
SODIUM	4840 J	4210 J	3825 J	3910 J	3930 J
THALLIUM	0.074 U	0.067 U	0.069 UJ	0.066 UJ	0.065 UJ
VANADIUM	0.17 J	0.2 J	0.088 UJ	1.2 J	0.099 UJ
ZINC	10.6 J	10.5 J	9.75	17.4	11
MISCELLANEOUS ANALYSIS (%)					
LIPIDS	0.6	0.7	0.15	1.1	0.1

TABLE 6-1

SELECTION OF EXPOSURE PATHWAYS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Soil	Soil	Surface Soil 0 to 2 feet bgs	Recreational visitor	Adult	Ingestion	Quant	Adult Recreational visitors may be exposed to contaminated surface soil through inadvertent contact.
						Dermal	Quant	Adult Recreational visitors may be exposed to contaminated surface soil through inadvertent contact.
						Inhalation	Qual	Adult Recreational visitors may be exposed to contaminated surface soil through contact with fugitive dust. A qualitative comparison of soil concentrations to SSLs for inhalation will be performed.
					Child	Ingestion	Quant	Child Recreational visitors may be exposed to contaminated surface soil through inadvertent contact.
						Dermal	Quant	Child Recreational visitors may be exposed to contaminated surface soil through inadvertent contact.
						Inhalation	Qual	Child Recreational visitors may be exposed to contaminated surface soil through contact with fugitive dust. A qualitative comparison of soil concentrations to SSLs for inhalation will be performed.
				Trespasser	Adolescent	Ingestion	Quant	Trespassers may be exposed to contaminated surface soil through inadvertent contact.
						Dermal	Quant	Trespassers may be exposed to contaminated surface soil through inadvertent contact.
						Inhalation	Qual	Trespassers may be exposed to contaminated surface soil through contact with fugitive dust. A qualitative comparison of soil concentrations to SSLs for inhalation will be performed.
				Industrial Worker	Adult	Ingestion	Quant	Workers may be exposed to contaminated soil through inadvertent contact.
						Dermal	Quant	Workers may be exposed to contaminated soil through inadvertent contact.
						Inhalation	Qual	Workers may be exposed to contaminated soil through contact with fugitive dust. A qualitative comparison of soil concentrations to SSLs for inhalation will be performed.
	Sediment	Sediment	Intertidal Sediment	Recreational visitor	Adult	Ingestion	Quant	Adult Recreational visitors are expected to be exposed to intertidal sediments while swimming, wading, boating, or fishing.
						Dermal	Quant	Adult Recreational visitors are expected to be exposed to intertidal sediments while swimming, wading, boating, or fishing.
						Inhalation	None	Contaminated sediment is unlikely to result in dust because of its' moisture content.
					Child	Ingestion	Quant	Child Recreational visitors are expected to be exposed to intertidal sediments while swimming, wading, boating, or fishing.
						Dermal	Quant	Child Recreational visitors are expected to be exposed to intertidal sediments while swimming, wading, boating, or fishing.
						Inhalation	None	Contaminated sediment is unlikely to result in dust because of its' moisture content.
				Trespasser	Adolescent	Ingestion	Quant	Trespassers are expected to be exposed to intertidal sediments while wading.
						Dermal	Quant	Trespassers are expected to be exposed to intertidal sediments while wading.
						Inhalation	None	Contaminated sediment is unlikely to result in dust because of its' moisture content.
	Shellfish	Shellfish	Shellfish	Fishermen	Adult	Ingestion	Quant	Adult subsistence or recreational fishermen are expected to ingest shellfish.
					Child	Ingestion	Quant	Children of subsistence or recreational fishermen are expected to ingest shellfish.

TABLE 6-1

SELECTION OF EXPOSURE PATHWAYS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Soil	All Soil (0-10 ft)	Industrial Worker	Adult	Ingestion	Quant	Future workers may be exposed to contaminated soil currently located at depth through inadvertent contact.
						Dermal	Quant	Future workers may be exposed to contaminated soil currently located at depth through inadvertent contact.
						Inhalation	Quant	Future workers may be exposed to contaminated soil currently located at depth through contact with fugitive dust.
				Construction Worker	Adult	Ingestion	Quant	Workers may be exposed to contaminated soil through inadvertent contact.
						Dermal	Quant	Workers may be exposed to contaminated soil through dermal contact during excavation work.
						Inhalation	Quant	Workers may be exposed to contaminated soil through contact with fugitive dust.
	Groundwater	Groundwater	Shallow Groundwater in Test Pits	Construction Worker	Adult	Ingestion	Quant	Workers may be exposed to contaminated groundwater through inadvertent contact.
						Dermal	Quant	Workers may be exposed to contaminated groundwater through dermal contact during excavation work.
		Air	Excavation Trenches	Construction Worker	Adult	Inhalation	Quant	Workers in trenches may be exposed to contaminated shallow groundwater through inhalation of volatile contaminants.
		Indoor air	Future on-site buildings	Industrial Worker	Adult	Inhalation	Qual	Concentrations of volatile contaminants in groundwater will be used to evaluate the indoor air pathway following EPA's Subsurface Vapor Intrusion Guidance (1).

Notes:
(1) OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (EPA, 2002).
Quant - Quantitative Analysis, see text.
Qual - Qualitative Analysis, see text.
None - No Analysis conducted, pathway is considered incomplete

TABLE 6-2

SUMMARY OF RECEPTOR RISKS AND HAZARDS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Scenario/ Receptor	Lead (1)	CR>1E-04 or HI>1	Total Cancer Risks (RME)	Major contributors to cancer risk above 1E-04 (individual cancer risk>1E-06)	Total Noncancer Hazard Index (RME)	Major contributors to noncancer Hazard Index (HI>1.0)
Adult Recreational Visitors		NO	2.9E-06	NA	0.3	NA
Child Recreational Visitors		YES	5.7E-06	NA	2.4	Chromium in sediment
Lifetime Recreational Visitors		NO	8.6E-06	NA	NA	NA
Trespassers		NO	9.1E-06	NA	0.5	NA
Current Industrial Workers		NO	1.1E-05	NA	0.02	NA
Future Industrial Workers	0.2-0.7%	YES	1.1E-05	NA	1.4	Cadmium in soil
Construction Workers		YES	2.2E-03	PAHs and Pentachlorophenol (groundwater); PAHs, Gamma-BHC, Heptachlor epoxide, and PCBs (trench air)	564	Cadmium (soil); 2-methylnaphthalene, Naphthalene, Fluoranthene, and PCBs (trench air)
Adult Fishermen - Clams		YES	1.4E-03	Arsenic, PCBs, beta-BHC	13	Arsenic and PCBs
Child Fishermen - Clams		YES	5.1E-04	Arsenic and PCBs	18	Arsenic, PCBs, Thallium
Lifetime Fishermen - Clams		YES	1.9E-03	Arsenic, PCBs, beta-BHC	NA	NA
Adult Fishermen - Mussels		YES	1.4E-03	Arsenic, PCBs, PAHs	23	Arsenic and PCBs
Child Fishermen - Mussels		YES	5.1E-04	Arsenic, PCBs, PAHs	34	Arsenic and PCBs
Lifetime Fishermen - Mussels		YES	1.9E-03	Arsenic, PCBs, PAHs	NA	NA

Notes:

(1) Probability that blood lead levels exceed 10 ug/dL; EPA's goal is that a probability of no more than 5% of individuals will have blood lead concentrations above 10 ug/dL.

NA- Not Applicable

RME - Reasonable Maximum Exposure.

TABLE 7-1

ASSESSMENT AND MEASUREMENT ENDPOINTS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Assessment Endpoint	Measurement Endpoint
Adverse effects on the survival, reproduction, and growth of soil invertebrates	• Survival, growth, and reproduction of soil invertebrates were evaluated by comparing the measured concentrations of chemicals in the surface soil to invertebrates soil screening levels.
Adverse effects on the survival, reproduction, and growth of terrestrial vegetation	• Survival, growth, and reproduction of terrestrial plants will be evaluated by comparing the measured concentrations of chemicals in the surface soil to soil screening levels (based on plants). • Because the site is heavily vegetated and the contamination appears to be sporadic across the site, site-specific studies for plants will not be conducted as part of the BERA. However, visual observations of the plant community and areas of stressed vegetation will be documented and used in a lines of evidence approach to evaluate the assessment endpoint for plants.
Adverse effects on the survival and reproduction of insectivorous birds and mammals	• Survival and reproduction of birds and mammals will be evaluated by comparing the average ingested dose from contaminants in the surface soil, surface water, and invertebrates collected from the soil to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs).
Adverse effects on the survival and reproduction of piscivorous birds and mammals	• Survival and reproduction of birds and mammals will be evaluated by comparing the average ingested dose from contaminants in the sediment, mussel, and clams collected from the site to NOAELs and LOAELs.
Adverse effects on the survival, reproduction, and growth of benthic invertebrates	• Survival, growth, and reproduction of benthic macroinvertebrates will be evaluated by comparing the measured concentrations of chemicals in the sediment to sediment screening values.
Adverse effects on the survival, reproduction, and growth of fish and marine organisms	• Survival, growth, and reproduction of aquatic organisms will be evaluated by comparing the measured concentrations of chemicals in the groundwater to surface water screening levels.

TABLE 7-2

SURFACE SOIL ECOLOGICAL SCREENING LEVELS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Analytes	Plant Screening Level	Source	Invertebrate Screening Level	Source
Volatile Organics (µg/kg)				
2-BUTANONE	89600	6	89600	6
TRICHLOROETHENE	3000	4	3000	4
Semivolatile Organics (µg/kg)				
2-METHYLNAPHTHALENE	600	4(7)	600	4(7)
ACENAPHTHENE	20000	2	700	4(8)
ACENAPHTHYLENE	700	4(8)	700	4(8)
ANTHRACENE	700	4(8)	700	4(8)
BENZO(A)ANTHRACENE	700	4(8)	700	4(8)
BENZO(A)PYRENE	700	4	700	4
BENZO(B)FLUORANTHENE	700	4(8)	700	4(8)
BENZO(G,H,I)PERYLENE	700	4(8)	700	4(8)
BENZO(K)FLUORANTHENE	700	4(8)	700	4(8)
BIS(2-ETHYLHEXYL)PHTHALATE	100000	2(2)	200000	3(3)
CARBAZOLE	NA		NA	
CHRYSENE	700	4(8)	700	4(8)
DIBENZO(A,H)ANTHRACENE	700	4(8)	700	4(8)
DIBENZOFURAN	NA		NA	
DI-N-BUTYL PHTHALATE	200000	2	200000	3(3)
FLUORANTHENE	700	4(8)	700	4(8)
FLUORENE	700	4(8)	30000	3
INDENO(1,2,3-CD)PYRENE	700	4(8)	700	4(8)
NAPHTHALENE	600	4	600	4
PHENANTHRENE	700	4(8)	700	4(8)
PYRENE	700	4(8)	700	4(8)
LOW MOLECULAR WEIGHT PAHS	NA		NA	
HIGH MOLECULAR WEIGHT PAHS	NA		NA	
Pesticides/PCBs (µg/kg)				
ALPHA-CHLORDANE	0.03	5(4)	0.03	5(4)
AROCLOR-1260	40000	2(1)	1300	4(1)
BETA-BHC	9	5	9	5
Pesticides/PCBs (µg/kg) (cont.)				
ENDRIN ALDEHYDE	0.04	5(9)	0.04	5(9)
ENDRIN KETONE	0.04	5(9)	0.04	5(9)
TOTAL AROCLOR	40000	2	1300	4
EXTRACTABLE PETROLEUM HYDROCARBONS	NA		NA	
TOTAL PETROLEUM HYDROCARBONS	NA		NA	

TABLE 7-2

SURFACE SOIL ECOLOGICAL SCREENING LEVELS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Analytes	Plant Screening Level	Source	Invertebrate Screening Level	Source
Metals (mg/kg)				
ALUMINUM	pH	1(5)	pH	1(5)
ARSENIC	18	1	60	3
BARIUM	500	2	330	1
BERYLLIUM	10	2	40	1
CADMIUM	32	1	140	1
CALCIUM	NA		NA	
CHROMIUM	1	2	0.4	3
COBALT	13	1	9	5
COPPER	100	2	60	3
CYANIDE	0.9	4	0.9	4
IRON	pH	1(6)	200	
LEAD	120	1	1700	1
MAGNESIUM	NA		NA	
MANGANESE	500	2	100	
MERCURY	0.3	2	0.1	3
NICKEL	30	2	200	3
POTASSIUM	NA		NA	
SODIUM	NA		NA	
VANADIUM	2	2	130	4
ZINC	50	2	100	3

Sources:
1 - Eco-SSL Benchmark (USEPA, 2003, 2005)
2 - ORNL Plant Benchmark (Efroymson, 1997a)
3 - ORNL Invertebrate Benchmark (Efroymson, 1997b)
4 - Canadian Soil Quality Guidelines (1997)
5 - Dutch Target Value (MHSPE, 2000)
6 - Region 5 Ecological Screening Levels (USEPA, 2003)

Notes:
(1) Based on total value.
(2) Used diethylphthalate as a surrogate.
(3) Used dimethylphthalate as a surrogate.
(4) Based on the value for chlordane.
(5) Aluminum is only considered a COPC for soils with a pH of less than 5.5.
(6) Iron is not considered to be toxic to plants with a soil pH between 5 and 8.
(7) Used naphthalene as a surrogate.
(8) Used benzo(a)pyrene as a surrogate.
(9) Used endrin as a surrogate.

TABLE 7-3

SEDIMENT ECOLOGICAL SCREENING LEVELS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Analyte	Sediment Criteria	Source
Volatile Organics (µg/kg)		
1,1-DICHLOROETHENE	27	7
1,3-DICHLOROBENZENE	110	5[4]
1,4-DICHLOROBENZENE	110	5[4]
2-BUTANONE	270	7
ACETONE	8.7	7
CARBON DISULFIDE	0.85	7
TRICHLOROETHENE	41	5
Semivolatile Organics (µg/kg)		
1,1-BIPHENYL	1100	6
2-METHYLNAPHTHALENE	70	2
4-METHYLPHENOL	100	5
ACENAPHTHENE	16	2
ACENAPHTHYLENE	44	2
ANTHRACENE	85.3	2
BENZO(A)ANTHRACENE	261	2
BENZO(A)PYRENE	430	2
BENZO(B)FLUORANTHENE	1800	5
BENZO(G,H,I)PERYLENE	670	5
BENZO(K)FLUORANTHENE	1800	5
BIS(2-ETHYLHEXYL)PHTHALATE	182	3
CARBAZOLE	NA	
CHRYSENE	384	2
DIBENZO(A,H)ANTHRACENE	63.4	2
DIBENZOFURAN	110	5
FLUORANTHENE	600	2
FLUORENE	19	2
INDENO(1,2,3-CD)PYRENE	600	5
NAPHTHALENE	160	2
PHENANTHRENE	240	2
PHENOL	130	5
PYRENE	665	2
LOW MOLECULAR WEIGHT PAHS	552	2
HIGH MOLECULAR WEIGHT PAHS	1700	2
Pesticides/PCBs (µg/kg)		
4,4'-DDE	2.2	2
4,4'-DDT	1.19	3
ALDRIN	9.5	5
ALPHA-BHC	0.32	3[2]
AROCLOR-1248	22.7	2[1]
AROCLOR-1260	22.7	2[1]
BETA-BHC	0.32	3[2]
DELTA-BHC	0.32	3[2]
DIELDRIN	0.02	1
ENDOSULFAN I	2.9	6
ENDOSULFAN SULFATE	5.4	6[5]
ENDRIN ALDEHYDE	0.02	4[3]
ENDRIN KETONE	0.02	4[3]
GAMMA-BHC (LINDANE)	0.32	3
GAMMA-CHLORDANE	2.26	3
METHOXYCHLOR	19	6
TOTAL AROCLOR	22.7	2[1]

TABLE 7-3

SEDIMENT ECOLOGICAL SCREENING LEVELS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Analyte	Sediment Criteria	Source
Petroleum Hydrocarbons (mg/kg)		
TOTAL PETROLEUM HYDROCARBONS	NA	
Metals (mg/kg)		
ALUMINUM	18000	5
ANTIMONY	2	4
ARSENIC	8.2	2
BARIUM	48	5
BERYLLIUM	NA	
CADMIUM	1.2	2
CALCIUM	NA	
CHROMIUM	81	2
COBALT	10	5
COPPER	34	2
CYANIDE	NA	
IRON	220000	5
LEAD	46.7	2
MAGNESIUM	NA	
MANGANESE	260	5
MERCURY	0.15	2
NICKEL	20.9	2
POTASSIUM	NA	
SELENIUM	1	5
SODIUM	NA	
THALLIUM	NA	
VANADIUM	57	5
ZINC	150	2

Sources:
1 - Sediment Quality Benchmark (USEPA, 2003)
2 - ER-L from Long et al. (1995)
3 - TEL from McDonald (1994)
4 - ER-L from Long and Morgan (1991)
5 - AET from Buchman (1999)
6 - SQB from Ecotox Thresholds (USEPA, 1996)
7 - SCV from Jones et al. (1997)

Notes:
(1) Total PCB value
(2) Used gamma-BHC as a surrogate.
(3) Used endrin as a surrogate.
(4) Used 1,4-dicolorobenzene as a surrogate.
(5) Used endosulfan mixed isomer as a surrogate.

TABLE 7-4

SURFACE WATER ECOLOGICAL SCREENING LEVELS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

	Surface Water Screening Level (ug/L)	
	Value	**Source**
Semivolatile Organic Compounds		
2-METHYLNAPHTHALENE	3(1)	2
ACENAPHTHENE	71(2)	2
ANTHRACENE	3(1)	2
CARBAZOLE	NA	
FLUORANTHENE	1.6(2)	2
FLUORENE	3(1)	2
NAPHTHALENE	23.5(1)	2
PHENANTHRENE	4.6	2
PYRENE	3(1)	2
Metals		
ALUMINUM	87(3)	1
ARSENIC	36(4)	1
BARIUM	4(3)	3
CADMIUM	8.8(4)	1
CALCIUM	NA	
COBALT	23(3)	3
COPPER	3.1(4)	1
IRON	1000(3)	1
MAGNESIUM	NA	
MANGANESE	120(3)	3
NICKEL	8.2(4)	1
POTASSIUM	NA	
SODIUM	NA	
VANADIUM	20(3)	3
ZINC	81(4)	1

Sources:
1 - USEPA Water Quality Criteria (USEPA, 2002)
2 - Saltwater values from Buchman (1999)
3 - Tier II Secondary Chronic Values (Suter and Tsao, 1996)

Notes:
(1) Calculated by multiplying the acute LOEL by 0.01 to estimate a chronic NOEL.
(2) Calculated by multiplying the chronic LOEL by 0.1 to estimated a chronic NOEL.
(3) Based on freshwater criteria.
(4) Based on dissolved criteria.

TABLE 7-5

EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Species/Exposure Inputs	Conservative Inputs		Average Inputs	
	Values	Units	Values	Units
Bobwhite Quail				
Body Weight = BW	1.540E-01	kg	1.751E-01	kg
Food Ingestion Rate = If	4.880E-03	kg/day	4.080E-03	kg/day
Soil Ingestion Rate = Is	6.783E-04	kg/day	2.489E-04	kg/day
Home Range = HR	Assume 100% on site		1.880E+01	acres
Meadow Vole				
Body Weight = BW	1.700E-02	kg	3.580E-02	kg
Food Ingestion Rate = If	3.756E-03	kg/day	3.488E-03	kg/day
Soil Ingestion Rate = Is	1.202E-04	kg/day	4.186E-05	kg/day
Home Range = HR	Assume 100% on site		6.590E-02	acres
American Woodcock				
Body Weight = BW	1.340E-01	kg	1.731E-01	kg
Food Ingestion Rate = If	2.686E-02	kg/day	2.132E-02	kg/day
Soil Ingestion Rate - Is	4.405E-03	kg/day	1.364E-03	kg/day
Home Range = HR	Assume 100% on site		6.100E+01	acres
Short-Tailed Shrew				
Body Weight = BW	1.500E-02	kg	1.610E-02	kg
Food Ingestion Rate = If	1.600E-03	kg/day	1.433E-03	kg/day
Soil Ingestion Rate - Is	4.801E-05	kg/day	1.289E-05	kg/day
Home Range = HR	Assume 100% on site		9.699E-01	acres
Raccoon				
Body Weight = BW	3.670E+00	kg	5.636E+00	kg
Food Ingestion Rate = If	2.370E-01	kg/day	1.840E-01	kg/day
Sediment Ingestion Rate = Is	2.228E-02	kg/day	1.730E-02	kg/day
Home Range = HR	Assume 100% on site		1.558E+03	acres
Herring Gull				
Body Weight = BW	9.510E-01	kg	1.092E+00	kg
Food Ingestion Rate = If	3.438E-02	kg/day	3.356E-02	kg/day
Sediment Ingestion Rate = Is	2.819E-03	kg/day	2.752E-03	kg/day
Home Range = HR	Assume 100% on site		1.000E+01	km-radius

Notes:
The exposure factors were derived as presented in Appendix H.
The soil/sediment ingestion rates were calculated by multiplying the food ingestion rates by the following incidental soil/sediment ingestion rates:

Species	Conservative	Average	Source
Bobwhite quail	13.90%	6.10%	1, 2
Meadow Vole	3.20%	1.20%	1
American Woodcock	16.40%	6.40%	1
Short-tailed Shrew	3%	0.90%	1
Raccoon	9.4%	9.4%	3
Herring Gull	8.2%	8.2%	1, 3

1 - Office of Emergency and Remedial Response. February.

2 - Based on the mourning dove.

3 - Beyer, N., E. Connor, and S. Gerould. 1994. Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management 58(2) pp. 375-382.

TABLE 7-6

SELECTION OF SURFACE SOIL SAMPLES FOR ECOLOGICAL RISK ASSESSMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Summary of surface soil samples collected				
Location	**Sample ID**	**Depth**	**Comment**	**Use for ERA**
SB 300B	G32-SB300B-0002	0-2	Exposed soil	Yes
SB 302B	G32-SB302B-0002	0-2	Exposed soil	Yes
SB 303B	G32-SB303B-0002	0-2	Exposed soil	Yes
SB304B	G32-SB304B-0002	0-2	Exposed soil	Yes
SB 309	G32-SB309-0002	0-2	Exposed soil	Yes
SB 310	G32-SB310-0002	0-2	Exposed soil	Yes
SB-311	G32-SB311-0103	1-3	Under Cement	No
SB-312	G32-SB312-0103	1-3	Under Cement	No
SB-313	G32-SB313-0002	0-2	Sump(1)	No
SB-317	G32-SB317-0002	0-2	Sump(1)	No
SB-318	G32-SB318-0002	0-2	Sump(1)	No
SB-327	G32-SB327-0103	1-3	Under Cement	No
SB-332	G32-SB332-0002	0-2	Exposed soil	Yes
SB-334	G32-SB334-0002	0-2	Sump(1)	No
SB-335	G32-SB335-0002	0-2	Sump(1)	No
SB-336	G32-SB336-0002	0-2	Sump(1)	No
SB-337	G32-SB337-0002	0-2	Exposed soil	Yes
SB-338	G32-SB338-0002	0-2	Exposed soil	Yes

1 - Surface soils in sumps represent contained hot spots of fill from building rubble.

ERA - Ecological Risk Assessment

TABLE 7-7

ECOLOGICAL COPC SELECTION - SURFACE SOIL
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration[1]	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Included in Food Chain Model?	Rationale for COPC Selection
Volatile Organics (µg/kg)													
2-BUTANONE	1/9	3	3	1.89	3	G32-SB337-0002	NA	89600	5	0.00003	NO	NO	BSL/NONBIO
TRICHLOROETHENE	2/9	0.7 J	3 J	1.69	1.85	G32-SB302B-0002	NA	3000	3	0.001	NO	NO	BSL/NONBIO
Semivolatile Organics (µg/kg)													
2-METHYLNAPHTHALENE	7/9	3.8	51	15.3	19.1	G32-SB304B-0002	9.6	600 [7]	3	0.09	NO	NO	BSL/NONBIO
ACENAPHTHENE	9/9	6	480	96.7	96.7	G32-SB332-0002	71	20000	2a	0.02	NO	YES	BSL/BIO
ACENAPHTHYLENE	6/9	5.4	19	9.36	13.2	2 SAMPLES	9.9	700 [8]		0.03	NO	YES	BSL/BIO
ANTHRACENE	9/9	18	1700	313	313	G32-SB332-0002	160	700 [8]		2.43	YES	YES	ASL/BIO
BENZO(A)ANTHRACENE	9/9	71	2900	602	602	G32-SB332-0002	530	700 [8]		4.14	YES	YES	ASL/BIO
BENZO(A)PYRENE	9/9	60	2400	519	519	G32-SB332-0002	450	700	3	3.43	YES	YES	ASL/BIO
BENZO(B)FLUORANTHENE	9/9	88	2900	618	618	G32-SB332-0002	640	700 [8]		4.14	YES	YES	ASL/BIO
BENZO(G,H,I)PERYLENE	9/9	34	1400 J	297	297	G32-SB332-0002	300	700 [8]		2	YES	YES	ASL/BIO
BENZO(K)FLUORANTHENE	9/9	34	1300	287	287	G32-SB332-0002	320	700 [8]		1.86	YES	YES	ASL/BIO
BIS(2-ETHYLHEXYL)PHTHALATE	6/9	64	110	119	88.2	2 SAMPLES	95	100000 [3]	2a	0.001	NO	NO	BSL/NONBIO
CARBAZOLE	6/9	40 J	280 J	121	91.8	G32-SB332-0002	72	NA		NA	YES	NO	NC/NONBIO
CHRYSENE	9/9	63	3000	605	605	G32-SB332-0002	630	700 [8]		4.29	YES	YES	ASL/BIO
DI-N-BUTYL PHTHALATE	1/9	39 J	39 J	164	39	G32-SB302B-0002	NA	200000	2a	0.0002	NO	NO	BSL/NONBIO
DIBENZO(A,H)ANTHRACENE	9/9	10	440 J	93.6	93.6	G32-SB332-0002	89	700 [8]		0.63	NO	YES	BSL/BIO
DIBENZOFURAN	2/9	120 J	290 J	186	205	G32-SB332-0002	NA	NA		NA	YES	NO	NC/NONBIO
FLUORANTHENE	9/9	120	6100	1230	1230	G32-SB332-0002	1100	700 [8]		8.71	YES	YES	ASL/BIO
FLUORENE	9/9	3.8	590	112	112	G32-SB332-0002	59	700	2b	0.84	NO	YES	BSL/BIO
INDENO(1,2,3-CD)PYRENE	9/9	31	1500 J	299	299	G32-SB332-0002	270	700 [8]		2.14	YES	YES	ASL/BIO
NAPHTHALENE	9/9	5.1	61	21	21	G32-SB304B-0002	12	600	3	0.10	NO	NO	BSL/NONBIO
PHENANTHRENE	9/9	64	3900	743	743	G32-SB332-0002	610	700 [8]		5.57	YES	YES	ASL/BIO
PYRENE	9/9	97	4800	981	981	G32-SB332-0002	880	700 [8]		6.86	YES	YES	ASL/BIO
Pesticides/PCBs (µg/kg)													
ALPHA-CHLORDANE	1/9	2.1 J	2.1 J	1.06	2.1	G32-SB302B-0002	NA	0.03 [4]	4	70	YES	YES	ASL/BIO
AROCLOR-1260	1/9	100	100	27.2	100	G32-SB303B-0002	NA	1300 [2]	3	0.08	NO	YES	BSL/BIO
BETA-BHC	2/9	2 J	3.1 J	1.28	2.55	G32-SB303B-0002	NA	9	4	0.34	NO	YES	BSL/BIO
ENDRIN ALDEHYDE	1/9	3.8	3.8	2.03	3.8	G32-SB338-0002	NA	0.04 [9]		95	YES	YES	ASL/BIO
ENDRIN KETONE	1/9	4.1 J	4.1 J	2.06	4.1	G32-SB338-0002	NA	0.04 [9]		103	YES	YES	ASL/BIO
TOTAL AROCLOR	1/9	100	100	27.2	100	G32-SB303B-0002	NA	1300	3	0.08	NO	YES	BSL/BIO
Inorganics (mg/kg)													
ALUMINUM	9/9	4660	8990	6450	6450	G32-SB303B-0002	8850	pH [5]	1a	NA	YES	NO	NC/NONBIO
ARSENIC	9/9	2.1 J	5.1 J	3.21	3.21	G32-SB300B-0002	3.2	18	1a	0.28	NO	YES	BSL/BIO
BARIUM	9/9	14.7 J	75.2 J	30	30	G32-SB303B-0002	35	330	1b	0.23	NO	NO	BSL/NONBIO
BERYLLIUM	9/9	0.17	0.62	0.277	0.277	G32-SB303B-0002	0.3	10	2a	0.06	NO	NO	BSL/NONBIO
CADMIUM	4/9	0.19 J	1.7 J	0.356	0.798	G32-SB304B-0002	0.24	32	1a	0.05	NO	YES	BSL/BIO
CALCIUM	9/9	581	6670	1980	1980	G32-SB303B-0002	731	NA		NA	NO	NO	NUT
CHROMIUM	9/9	6.2	26.5	11.3	11.3	G32-SB303B-0002	11.1	0.4	2b	66.3	YES	YES	ASL/BIO
COBALT	9/9	3.7 J	7.5 J	5.07	5.07	G32-SB303B-0002	5.8	9	4	0.83	NO	NO	BSL/NONBIO
COPPER	9/9	11.6	31.4 J	18.7	18.7	G32-SB304B-0002	21.2	60	2b	0.52	NO	YES	BSL/BIO

TABLE 7-7

ECOLOGICAL COPC SELECTION - SURFACE SOIL
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration(1)	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Included in Food Chain Model?	Rationale for COPC Selection
CYANIDE	1/9	0.12	0.12	0.0667	0.12	G32-SB337-0002	NA	0.9	3	0.13	NO	NO	BSL/NONBIO
IRON	9/9	8700	19500	12100	12100	G32-SB303B-0002	12300	pH (6)	1a	NA	YES	NO	NC/NONBIO
Inorganics (mg/kg) (cont.)													
LEAD	9/9	5.8 J	37.8 J	15	15	G32-SB304B-0002	84.5	120	1a	0.32	NO	YES	BSL/BIO
MAGNESIUM	9/9	1900	6920	2710	2710	G32-SB303B-0002	2620	NA		NA	NO	NO	NUT
MANGANESE	9/9	92 J	473	196	196	G32-SB303B-0002	216	500	2a	0.95	NO	NO	BSL/NONBIO
MERCURY	6/9	0.0086	0.045	0.0168	0.0234	2 SAMPLES	0.033	0.1	2b	0.45	NO	YES	BSL/BIO
NICKEL	9/9	6.2 J	18.3 J	11.8	11.8	G32-SB303B-0002	12.6	30	2a	0.61	NO	YES	BSL/BIO
POTASSIUM	9/9	469 J	4960 J	1190	1190	G32-SB303B-0002	977	NA		NA	NO	NO	NUT
SODIUM	9/9	26.7	201	78.7	78.7	G32-SB300B-0002	32.4	NA		NA	NO	NO	NUT
VANADIUM	9/9	7.5 J	28.7	12.8	12.8	G32-SB303B-0002	20.4	2	2a	14.4	YES	NO	ASL/NONBIO
ZINC	9/9	21.9 J	82.8 J	46.4	46.4	G32-SB309-0002	43.7	50	2a	1.66	YES	YES	ASL/BIO
Petroleum Hydrocarbons (mg/kg)													
EXTRACTABLE PETROLEUM HYDROCARBONS	2/2	22 J	130	76	76	G32-SB304B-0002	NA	NA		NA	NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	7/7	15	99	70.7	70.7	G32-SB303B-0002	53	NA		NA	NA	NA	NA

The chemical names are shaded if the chemicals were retained as COPCs for potential risks to plants or invertebrates, or if the chemicals are bioaccumulative and are included in the food chain model.

Sources:
1a - Eco-SSL Plant Benchmark (USEPA, 2003, 2005)
1b - Eco-SSL Invertebrate Benchmark (USEPA, 2005)
2a - ORNL Plant Benchmark (Efroymson, 1997a)
2b - ORNL Invertebrate Benchmark (Efroymson, 1997b)
3 - Canadian Soil Quality Guidelines (1999)
4 - Dutch Target Value (MHSPE, 2000)
5 - Region 5 Ecological Screening Levels (USEPA, 2003)

Footnotes:
(1) Nondetected values were counted as 1/2 the detection limit when calculating the mean concentration.
(2) Based on total value.
(3) The value for diethylphthalate is used as a surrogate.
(4) The value for chlordane is used as a surrogate.
(5) Aluminum is only considered a COPC for soils with a pH of less than 5.5.
(6) Iron is not considered to be toxic to plants with a soil pH between 5 and 8.
(7) The value for naphthalene is used as a surrogate.
(8) The value for benzo(a)pyrene is used as a surrogate.
(9) The value for endrin is used as a surrogate.

Rationale:
ASL = Above Screening Level
BSL = Below Screening Level
NC = No Screening Level Available
BIO = Bioaccumulative Chemical
NONBIO = Nonbioaccumulative Chemical
NUT = Essential Nutrient

TABLE 7-8

ECOLOGICAL COPC SELECTION - SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration[1]	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Included in Food Chain Model?	Rationale for COPC Selection
Volatile Organics (µg/kg)													
1,1-DICHLOROETHENE	1/66	6	6	2.83	6	G32-SD304D-0.51.0	NA	27	7	0.22	NO	NO	BSL/NONBIO
1,3-DICHLOROBENZENE	1/66	3 J	3 J	2.77	3	G32-SD312-0.51.0	NA	110 [3]	5	0.03	NO	YES	BSL/BIO
1,4-DICHLOROBENZENE	1/66	11 J	11 J	2.89	11	G32-SD312-0.51.0	NA	110	5	0.1	NO	YES	BSL/BIO
2-BUTANONE	3/66	2 J	7	2.86	4.67	G32-SD306B-000.5	NA	270	7	0.026	NO	NO	BSL/NONBIO
ACETONE	54/66	12	240	71.8	74.2	2 SAMPLES	NA	8.7	7	27.6	YES	NO	ASL/NONBIO
CARBON DISULFIDE	43/66	1	16	3.33	3.8	G32-SD312-0.51.0	NA	0.85	7	18.8	YES	NO	ASL/NONBIO
TRICHLOROETHENE	2/66	1 J	2 J	2.72	1.5	G32-SD309F-000.5-AVG	NA	41	5	0.05	NO	NO	BSL/NONBIO
Semivolatile Organics (µg/kg)													
1,1-BIPHENYL	4/66	41 J	68 J	158	51.8	G32-SD310D-000.5	NA	1100	6	0.06	NO	NO	BSL/NONBIO
2-METHYLNAPHTHALENE	43/66	3.325	280	18.1	26.9	G32-SD308E-000.5	NA	70	2	4	YES	NO	ASL/NONBIO
4-METHYLPHENOL	19/66	35 J	2100 J	248	452	G32-SD301-000.5	NA	100	5	21	YES	NO	ASL/NONBIO
ACENAPHTHENE	60/66	3.8	1300	88.3	97	G32-SD310D-000.5	11	16	2	81.3	YES	YES	ASL/BIO
ACENAPHTHYLENE	55/66	3.2 J	810	25.7	30.5	G32-SD312-0.51.0	85	44	2	18.4	YES	YES	ASL/BIO
ANTHRACENE	66/66	7.5	3000	205	205	G32-SD312-0.51.0	85	85.3	2	35.2	YES	YES	ASL/BIO
BENZO(A)ANTHRACENE	66/66	16	4900	367	367	G32-SD312-0.51.0	360	261	2	18.8	YES	YES	ASL/BIO
BENZO(A)PYRENE	66/66	15	2300	256	256	G32-SD312-0.51.0	470	430	2	5.35	YES	YES	ASL/BIO
BENZO(B)FLUORANTHENE	66/66	24	4900	360	360	G32-SD312-0.51.0	870	1800	5	2.72	YES	YES	ASL/BIO
BENZO(G,H,I)PERYLENE	66/66	7.2	1100	125	125	G32-SD312-0.51.0	200	670	5	1.64	YES	YES	ASL/BIO
BENZO(K)FLUORANTHENE	66/66	8.6	2300	186	186	G32-SD312-0.51.0	260	1800	5	1.28	YES	YES	ASL/BIO
BIS(2-ETHYLHEXYL)PHTHALATE	29/66	34 J	100 J	115	49.7	G32-SD303-0.51.0	NA	182	3	0.55	NO	NO	BSL/NONBIO
CARBAZOLE	26/66	35 J	1400	197	247	G32-SD312-0.51.0	NA	NA		NA	YES	NO	NC/NONBIO
CHRYSENE	66/66	18	8700	428	428	G32-SD312-0.51.0	430	384	2	22.7	YES	YES	ASL/BIO
DIBENZO(A,H)ANTHRACENE	64/66	3.6	250	38.3	39.4	G32-SD312-0.51.0	55	63.4	2	3.94	YES	YES	ASL/BIO
DIBENZOFURAN	17/66	36 J	510	160	146	G32-SD310D-000.5	NA	110	5	4.64	YES	NO	ASL/NONBIO
FLUORANTHENE	66/66	34	28000	1160	1160	G32-SD312-0.51.0	560	600	2	46.7	YES	YES	ASL/BIO
FLUORENE	62/66	3.7	820	81.5	86.6	G32-SD310D-000.5	21	19	2	43.2	YES	YES	ASL/BIO
INDENO(1,2,3-CD)PYRENE	66/66	6.4	1300	123	123	G32-SD312-0.51.0	130	600	5	2.17	YES	YES	ASL/BIO
NAPHTHALENE	55/66	3.6	730	36.2	43.2	G32-SD310D-000.5	9.3	160	2	4.56	YES	NO	ASL/NONBIO
PHENANTHRENE	66/66	16	7200	566	566	G32-SD312-0.51.0	160	240	2	30	YES	YES	ASL/BIO
PHENOL	23/66	35 J	1400	184	219	G32-SD308A-000.5	NA	130	5	10.8	YES	NO	ASL/NONBIO
PYRENE	66/66	29	22000	980	980	G32-SD312-0.51.0	570	665	2	33.1	YES	YES	ASL/BIO
HIGH MOLECULAR WEIGHT PAHS	66/66	100.2	25750	1880	1880	G32-SD312-0.51.0	3775	1700	2	15.1	YES	NA	ASL
LOW MOLECULAR WEIGHT PAHS	66/66	90.4	62369	3160	3160	G32-SD312-0.51.0	371.3	552	2	113	YES	NA	ASL
Pesticides/PCBs (µg/kg)													
4,4'-DDE	4/66	5.1 J	230 J	10.9	131	G32-SD312-0.51.0	NA	2.2	2	105	YES	YES	ASL/BIO
4,4'-DDT	1/66	420 J	420 J	10.3	420	G32-SD316-0.51.0	NA	1.19	3	353	YES	YES	ASL/BIO
ALDRIN	2/66	1.9 J	2 J	2.51	1.95	G32-SD305C-000.5	NA	9.5	5	0.21	NO	YES	BSL/BIO
ALPHA-BHC	1/66	1.6 J	1.6 J	2.49	1.6	G32-SD309F-000.5-AVG	NA	0.32 [4]	3	5	YES	YES	ASL/BIO
AROCLOR-1248	2/90	39 J	93.25	52.4	66.1	G32-SD309F-000.5-AVG	NA	22.7 [2]	2	4.11	YES	YES	ASL/BIO
AROCLOR-1260	44/90	33 J	41000	1320	2670	G32-SD312-0.51.0	NA	22.7 [2]	2	1806	YES	YES	ASL/BIO

TABLE 7-8

ECOLOGICAL COPC SELECTION - SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration[1]	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Included in Food Chain Model?	Rationale for COPC Selection
Pesticides/PCBs (µg/kg) (cont.)													
BETA-BHC	21/66	1.7 J	57 J	4.08	6.44	G32-SD312-0.51.0	NA	0.32 [4]	3	178	YES	YES	ASL/BIO
DELTA-BHC	2/66	0.98 J	1.6 J	2.49	1.29	G32-SD305E-000.5	NA	0.32 [4]	3	5	YES	YES	ASL/BIO
DIELDRIN	1/66	16 J	16 J	4.87	16	G32-SD305D-000.5	NA	0.02	1	800	YES	YES	ASL/BIO
ENDOSULFAN I	1/66	8.2 J	8.2 J	2.54	8.2	G32-SD304A-000.5	NA	2.9	6	2.83	YES	YES	ASL/BIO
ENDOSULFAN SULFATE	17/66	2.825 J	640 J	27.5	96	G32-SD312-0.51.0	NA	5.4 [5]	6	119	YES	YES	ASL/BIO
ENDRIN ALDEHYDE	4/66	1.9 J	120 J	5.02	32.8	G32-SD316-0.51.0	NA	0.02 [6]	4	6000	YES	YES	ASL/BIO
ENDRIN KETONE	7/66	3.4 J	13.5 J	5.3	6.71	G32-SD304D-000.5-AVG	NA	0.02 [6]	4	675	YES	YES	ASL/BIO
GAMMA-BHC (LINDANE)	1/66	1.1 J	1.1 J	2.48	1.1	G32-SD305D-0.51.0	NA	0.32	3	3.44	YES	YES	ASL/BIO
GAMMA-CHLORDANE	13/66	1.9 J	600	27.3	125	G32-SD316-0.51.0	NA	2.26	3	265	YES	YES	ASL/BIO
METHOXYCHLOR	2/66	7.3 J	30	25.1	18.6	G32-SD305B-000.5	NA	19	6	1.58	YES	YES	ASL/BIO
TOTAL AROCLOR	45/90	33	41000	1320	2610	G32-SD312-0.51.0	NA	22.7 [2]	2	1806	YES	YES	ASL/BIO
Inorganics (mg/kg)													
ALUMINUM	90/90	3700	9200	6100	6100	ARD2	11300	18000	5	0.51	NO	NO	BSL/NONBIO
ANTIMONY	18/90	1.9 J	43.5 J	2.84	6.76	G32-SD304F-000.5	NA	2	4	21.8	YES	NO	ASL/NONBIO
ARSENIC	65/90	1.2	7.3	4.98	3.03	G32-SD313F-000.5	8.9	8.2	2	0.89	NO	YES	BSL/BIO
BARIUM	90/90	5.5 J	27 J	14.2	14.2	G32-SD306B-000.5	NA	48	5	0.56	NO	NO	BSL/NONBIO
BERYLLIUM	66/90	0.11	0.79	0.376	0.322	G32-SD310C-000.5	0.9	NA		NA	YES	NO	NC/NONBIO
CADMIUM	14/90	0.097 J	398	5.16	30.1	G32-SD317-000.5	NA	1.2	2	332	YES	YES	ASL/BIO
CALCIUM	66/66	1410 J	70800 J	25800	25800	G32-SD312-0.51.0	22100	NA		NA	NO	NO	NUT
CHROMIUM	90/90	8.8 J	3910	60.3	60.3	G32-SD304F-000.5	30.3	81	2	48.3	YES	YES	ASL/BIO
COBALT	90/90	1.8 J	6.8	3.51	3.51	GISD12	7.4	10	5	0.68	NO	NO	BSL/NONBIO
COPPER	90/90	8.3	92.5	22.3	22.3	G32-SD316-0.51.0	75.1	34	2	2.72	YES	YES	ASL/BIO
CYANIDE	11/90	0.09	0.44	0.0893	0.264	ARD1B	NA	NA		NA	YES	NO	NC/NONBIO
IRON	90/90	8700	72100	16400	16400	G32-SD313F-000.5	19700	220000	5	0.33	NO	NO	BSL/NONBIO
LEAD	90/90	8.5	21200	278	278	G32-SD304F-000.5	65.7	46.7	2	454	YES	YES	ASL/BIO
MAGNESIUM	90/90	2300	6340	3700	3700	G32-SD305F-000.5	6620	NA		NA	NO	NO	NUT
MANGANESE	90/90	86 J	418 J	154	154	G32-SD305F-000.5	191	260	5	1.61	YES	NO	ASL/NONBIO
MERCURY	40/66	0.0099 J	0.74	0.0475	0.0715	G32-SD306F-000.5	0.26	0.15	2	4.93	YES	YES	ASL/BIO
NICKEL	89/90	5.9 J	47.4 J	9.85	9.93	G32-SD313F-000.5	16.4	20.9	2	2.27	YES	YES	ASL/BIO
POTASSIUM	90/90	644	3100	1230	1230	ARD1B	NA	NA		NA	NO	NO	NUT
SELENIUM	16/90	4.4 J	7.9 J	2.49	6.07	G32-SD309A-000.5	0.063	1	5	7.9	YES	YES	ASL/BIO
SODIUM	90/90	2200 J	18000	5200	5200	ARD1B	14700	NA		NA	NO	NO	NUT
THALLIUM	19/90	0.13025 J	2.5 J	2.98	0.986	G32-SD313F-000.5	NA	NA		NA	YES	NO	NC/NONBIO
VANADIUM	90/90	10.8 J	36	18.3	18.3	ARD1B	33.2	57	5	0.63	NO	NO	BSL/NONBIO
ZINC	90/90	28.2 J	145 J	53.7	53.7	G32-SD317-000.5	NA	150	2	0.97	NO	YES	BSL/BIO
AVS/SEM (umo/g)													
SEM/AVS	66/66	0.02	3.5	0.343	0.343	G32-SD306A-000.5	NA	NA		NA	NA	NA	NA
ACID VOLATILE SULFIDE	64/66	0.57 J	33.7 J	5.5	5.66	G32-SD312-000.5	NA	NA		NA	NA	NA	NA
CADMIUM	3/66	0.0165 J	0.038 J	0.00301	0.0305	G32-SD304C-000.5	NA	NA		NA	NA	NA	NA
COPPER	48/66	0.06175 J	2.4 J	0.186	0.243	G32-SD302D-000.5	NA	NA		NA	NA	NA	NA

TABLE 7-8

ECOLOGICAL COPC SELECTION - SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration(1)	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Included in Food Chain Model?	Rationale for COPC Selection
LEAD	56/66	0.031 J	2.3 J	0.177	0.206	G32-SD306B-000.5	NA	NA		NA	NA	NA	NA
AVS/SEM (umo/g) (cont.)													
MERCURY	40/66	0.00004 J	0.0037	0.000235	0.000355	G32-SD306F-000.5	NA	NA		NA	NA	NA	NA
NICKEL	33/66	0.015 J	3.2 J	0.144	0.24	G32-SD302D-000.5	NA	NA		NA	NA	NA	NA
ZINC	66/66	0.11 J	4.2 J	0.481	0.481	G32-SD316-0.51.0	NA	NA		NA	NA	NA	NA
Petroleum Hydrocarbons (mg/kg)													
TOTAL PETROLEUM HYDROCARBONS	66/66	14 J	230	42.4	42.4	G32-SD316-0.51.0	NA	NA		NA	NA	NA	NA
Miscellaneous Parameters													
TOTAL ORGANIC CARBON (mg/kg)	66/66	2300 J	29000 J	8690	8690	G32-SD308F-000.5	NA	NA		NA	NA	NA	NA

The chemical names are shaded if the chemicals were retained as COPCs for potential risks to benthic invertebrates or if the chemicals are bioaccumulative and are included in the food chain model.

Sources:
1 - Sediment Quality Benchmark (USEPA, 2003)
2 - ER-L from Long et al. (1995)
3 - TEL from McDonald (1994)
4 - ER-L from Long and Morgan (1991)
5 - AET from Buchman (1999)
6 - SQB from Ecotox Thresholds (USEPA, 1996)
7 - SCV from Jones et al. (1997)

Footnotes:
(1) Nondetected values were counted as 1/2 the detection limit when calculating the mean concentration.
(2) Total PCB value.
(3) 1,4-Dichlorobenzene is used as a surrogate.
(4) Gamma-BHC is used as a surrogate.
(5) Endosulfan mixed isomer is used as a surrogate.
(6) Endrin is used as a surrogate.

Rationale:
ASL = Above Screening Level
BSL = Below Screening Level
NC = No Screening Level Available
BIO = Bioaccumulative Chemical
NONBIO = Nonbioaccumulative Chemical
NUT = Essential Nutrient

TABLE 7-9

ECOLOGICAL COPC SELECTION - GROUNDWATER
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration[5]	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Rationale for COPC Selection
Volatile Organics (ug/L)												
BENZENE	1/12	3 J	3 J	0.708	3	G32-MW300S-AVG	NA	70 [2]	2	0.04	NO	BSL
TETRACHLOROETHENE	1/12	6 J	6 J	0.958	6	G32-MW300S-AVG	NA	45 [2]	2	0.13	NO	BSL
TOLUENE	1/12	1 J	1 J	0.542	1	G32-MW300S-AVG	NA	500 [2]	2	0.002	NO	BSL
TRICHLOROETHENE	1/12	1	1	0.542	1	G32-MW304S	NA	20 [1]	2	0.05	NO	BSL
Semivolatile Organics (ug/L)												
2,4-DICHLOROPHENOL	1/12	1 J	1 J	4.67	1	G32-MW306S	NA	2.2	3	0.45	NO	BSL
2-METHYLNAPHTHALENE	1/12	1.4	1.4	0.162	1.4	G32-MW306S	NA	3 [1]	2	0.47	NO	BSL
4-METHYLPHENOL	1/12	2 J	2 J	4.75	2	G32-MW306S	NA	5.6 [6]	3	0.36	NO	BSL
ACENAPHTHENE	2/12	0.13	3.9	0.378	2.02	G32-MW306S	0.15	71 [2]	2	0.05	NO	BSL
ANTHRACENE	1/12	0.98	0.98	0.128	0.98	G32-MW306S	NA	3 [1]	2	0.33	NO	BSL
BIS(2-ETHYLHEXYL)PHTHALATE	1/12	2 J	2 J	4.75	2	G32-MW300B	NA	360	2	0.006	NO	BSL
CARBAZOLE	1/12	5 J	5 J	5	5	G32-MW306S	NA	NA		NA	YES	NC
DIBENZOFURAN	1/12	2 J	2 J	4.75	2	G32-MW306S	NA	NA		NA	YES	NC
FLUORANTHENE	2/12	0.135 J	0.69	0.11	0.412	G32-MW306S	0.65	1.6 [2]	2	0.43	NO	BSL
FLUORENE	1/12	2	2	0.212	2	G32-MW306S	NA	3 [1]	2	0.67	NO	BSL
NAPHTHALENE	3/12	0.14	9.4	0.847	3.24	G32-MW306S	0.11	23.5 [1]	2	0.4	NO	BSL
PENTACHLOROPHENOL	1/12	7 J	7 J	9.75	7	G32-MW306S	NA	7.9	2	0.89	NO	BSL
PHENANTHRENE	3/12	0.14	3.4	0.348	1.24	G32-MW306S	0.35	4.6	2	0.74	NO	BSL
PHENOL	1/12	16	16	5.92	16	G32-MW306S	NA	5.6	3	2.86	YES	ASL
PYRENE	2/12	0.11	0.33	0.0783	0.22	G32-MW306S	0.49	3 [1]	2	0.11	NO	BSL
Petroleum Hydrocarbons (mg/L)												
GASOLINE RANGE ORGANICS	1/12	0.051	0.051	0.0272	0.051	G32-MW304S	NA	NA		NA	NA	NA
TOTAL PETROLEUM HYDROCARBONS	1/12	0.49	0.49	0.201	0.49	G32-MW306S	NA	NA		NA	NA	NA
Inorganics (ug/L)												
ALUMINUM	10/12	38.2 J	1180 J	278	332	G32-MW304B	516	87 [3]	1	13.6	YES	ASL
ARSENIC	3/12	1.7 J	5.4	2.34	3.77	G32-MW300B	NA	36 [4]	1	0.15	NO	BSL
BARIUM	12/12	25.6 J	177 J	62.3	62.3	G32-MW306B	29.7	4 [3]	4	44.3	YES	ASL
CADMIUM	3/12	0.12 J	0.62	0.208	0.303	G32-MW303B	NA	8.8 [4]	1	0.07	NO	BSL
CALCIUM	12/12	12300	528000	114000	114000	G32-MW306S	25800	NA		NA	NO	NUT
COBALT	11/12	1.6 J	36.9	17.1	18.6	G32-MW303S	98.5	23 [3]	4	1.60	YES	ASL
COPPER	4/12	5.525 J	10.2 J	4.79	8.06	G32-MW300S-AVG	NA	3.1 [4]	1	3.29	YES	ASL
IRON	11/12	660 J	18900	6460	7040	G32-MW300B	2280	1000 [3]	1	18.9	YES	ASL
MAGNESIUM	12/12	3570	842000	105000	105000	G32-MW304S	7330	NA		NA	NO	NUT
MANGANESE	11/12	210 J	4210 J	1110	1210	G32-MW304S	291	120 [3]	4	35.1	YES	ASL
NICKEL	12/12	2.3 J	60.2	26.1	26.1	G32-MW303S	27.7	8.2 [4]	1	7.34	YES	ASL
POTASSIUM	11/12	2810	339000	60700	66100	G32-MW303B	7090	NA		NA	NO	NUT
SODIUM	12/12	17500	8550000	1830000	1830000	G32-MW304S	19100	NA		NA	NO	NUT
VANADIUM	4/12	0.74 J	3	0.66	1.48	G32-MW304B	NA	20 [3]	4	0.15	NO	BSL
ZINC	3/12	86.1	166.5	41.4	117	G32-MW300S-AVG	NA	81 [4]	1	2.06	YES	ASL

TABLE 7-9

ECOLOGICAL COPC SELECTION - GROUNDWATER
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Mean Concentration(5)	Average of Positive Detects	Sample of Maximum Detect	Background Concentration	Screening Level	Source	Ecological Effects Quotient	COPC?	Rationale for COPC Selection
Miscellaneous Parameters (mg/L)												
ALKALINITY	12/12	17.5	325	74.8	74.8	G32-MW305S-AVG	55	NA		NA	NA	NA
TOTAL ORGANIC CARBON	3/12	14	15	7.38	14.5	G32-MW304B	NA	NA		NA	NA	NA

The chemical names are shaded if the chemicals were retained as COPCs for potential risks to benthic invertebrates or if the chemicals are bioaccumulative and are included in the food chain model.

Sources:
1 - USEPA Water Quality Criteria (USEPA, 2002)
2 - Saltwater values from Buchman (1999)
3 - RIDEM freshwater criteria (RIDEM, 2000)
4 - Tier II Secondary Chronic Values (Suter and Tsao, 1996)

Footnotes:
(1) Calculated by multiplying the acute LOEL by 0.01 to estimate a chronic NOEL.
(2) Calculated by multiplying the chronic LOEL by 0.1 to estimate a chronic NOEL.
(3) Based on freshwater criteria.
(4) Based on dissolved criteria.
(5) Nondetected values were counted as 1/2 the detection limit when calculating the mean concentration.
(6) Phenol was used as a surrogate.

Rationale:
ASL = Above Screening Level
BSL = Below Screening Level
NC = No Screening Level Available
NUT = Essential Nutrient

TABLE 7-10

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		American Woodcock		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Semivolatile Organic Compounds								
ACENAPHTHENE	1.2E-03	1.2E-04	2.8E-04	1.4E-04	4.0E-02	4.0E-03	2.0E-03	1.0E-03
ACENAPHTHYLENE	2.6E-04	2.6E-05	4.6E-05	4.6E-06	1.6E-03	1.6E-04	2.0E-05	2.0E-06
ANTHRACENE	1.3E-02	1.3E-03	1.4E-03	1.4E-04	1.4E-01	1.4E-02	1.3E-03	1.3E-04
BENZO(A)ANTHRACENE	8.4E-03	8.4E-04	2.8E-01	2.8E-02	2.4E-01	2.4E-02	1.3E+00	1.3E-01
BENZO(A)PYRENE	1.0E-02	1.0E-03	8.3E-02	8.3E-03	2.0E-01	2.0E-02	1.8E-01	1.8E-02
BENZO(B)FLUORANTHENE	2.1E-02	2.1E-03	5.5E-02	5.5E-03	2.4E-01	2.4E-02	5.4E-02	5.4E-03
BENZO(G,H,I)PERYLENE	1.2E-02	1.2E-03	1.9E-02	1.9E-03	1.2E-01	1.2E-02	1.5E-02	1.5E-03
BENZO(K)FLUORANTHENE	5.2E-03	5.2E-04	5.7E-03	5.7E-04	1.1E-01	1.1E-02	1.3E-02	1.3E-03
CHRYSENE	8.6E-03	8.6E-04	2.9E-01	2.9E-02	2.5E-01	2.5E-02	1.3E+00	1.3E-01
DIBENZO(A,H)ANTHRACENE	1.9E-03	1.9E-04	1.2E-02	1.2E-03	3.7E-02	3.7E-03	2.5E-02	2.5E-03
FLUORANTHENE	6.2E-02	6.2E-03	5.7E-02	2.9E-02	5.1E-01	5.1E-02	3.6E-02	1.8E-02
FLUORENE	1.4E-03	1.4E-04	4.4E-04	2.2E-04	4.9E-02	4.9E-03	3.5E-03	1.8E-03
INDENO(1,2,3-CD)PYRENE	5.9E-03	5.9E-04	6.5E-03	6.5E-04	1.3E-01	1.3E-02	1.6E-02	1.6E-03
PHENANTHRENE	4.0E-02	4.0E-03	4.6E-01	4.6E-02	3.3E-01	3.3E-02	2.9E-01	2.9E-02
PYRENE	6.5E-02	6.5E-03	1.1E-01	6.4E-02	4.0E-01	4.0E-02	4.8E-02	2.9E-02
Pesticides/PCBs								
ALPHA-CHLORDANE	5.1E-06	1.0E-06	5.8E-06	2.9E-06	1.0E-03	2.0E-04	2.5E-04	1.2E-04
BETA-BHC	5.6E-05	1.4E-05	3.6E-04	7.3E-05	5.7E-03	1.4E-03	4.2E-03	8.3E-04
ENDRIN ALDEHYDE	2.7E-03	2.7E-04	1.0E-03	1.0E-04	2.9E-01	2.9E-02	1.6E-02	1.6E-03
ENDRIN KETONE	2.9E-03	2.9E-04	1.1E-03	1.1E-04	3.1E-01	3.1E-02	1.7E-02	1.7E-03
AROCLOR-1260	2.5E-03	2.5E-04	1.1E-02	1.1E-03	1.8E+00	1.8E-01	2.5E+00	2.5E-01
TOTAL AROCLOR	2.5E-03	2.5E-04	1.1E-02	1.1E-03	1.8E+00	1.8E-01	2.5E+00	2.5E-01
Metals								
ARSENIC	1.3E-02	6.3E-03	7.5E-02	1.7E-02	1.4E-01	7.1E-02	9.4E-02	2.1E-02
CADMIUM	2.3E-02	5.3E-03	2.5E-01	2.8E-02	1.8E+00	4.1E-01	1.8E+00	2.0E-01
CHROMIUM	5.7E-02	9.7E-03	1.8E-01	7.3E-03	9.4E-01	1.6E-01	4.0E-01	1.6E-02
COPPER	8.1E-03	6.1E-03	1.6E-01	1.3E-01	9.1E-02	6.9E-02	1.6E-01	1.2E-01
LEAD	1.4E-01	5.2E-03	1.5E-01	3.9E-03	2.6E+00	9.6E-02	3.7E-01	9.3E-03
MERCURY	1.1E+00	1.1E-01	1.6E+00	3.1E-01	2.9E+01	2.9E+00	3.1E+00	6.2E-01
NICKEL	1.4E-03	1.0E-03	8.5E-03	4.2E-03	5.8E-02	4.2E-02	5.3E-02	2.7E-02
ZINC	1.5E-01	1.6E-02	8.1E-02	4.0E-02	5.2E+00	5.8E-01	2.4E-01	1.2E-01

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 7-11

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
PISCIVOROUS RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

	Piscivorous Receptors EEQs			
	Herring Gull		Raccoon	
Chemical	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**
Volatile Organics				
1,3-DICHLOROBENZENE	NV	NV	6.1E-07	6.1E-08
1,4-DICHLOROBENZENE	NV	NV	2.2E-06	2.2E-07
Semivolatile Organics				
2,4-DIMETHYLPHENOL	NV	NV	2.6E-02	8.6E-03
2-METHYLPHENOL	NV	NV	7.7E-03	2.6E-03
4-CHLORO-3-METHYLPHENOL	NV	NV	7.2E-03	2.4E-03
ACENAPHTHENE	1.9E-03	1.9E-04	4.5E-04	2.3E-04
ACENAPHTHYLENE	1.2E-03	1.2E-04	7.0E-05	7.0E-06
ANTHRACENE	4.9E-03	4.9E-04	2.0E-04	2.0E-05
BENZALDEHYDE	NV	NV	6.0E-02	6.0E-03
BENZO(A)ANTHRACENE	8.5E-03	8.5E-04	2.0E-01	2.0E-02
BENZO(A)PYRENE	4.0E-03	4.0E-04	1.6E-02	1.6E-03
BENZO(B)FLUORANTHENE	8.0E-03	8.0E-04	8.1E-03	8.1E-04
BENZO(G,H,I)PERYLENE	1.6E-03	1.6E-04	9.3E-04	9.3E-05
BENZO(K)FLUORANTHENE	3.4E-03	3.4E-04	1.9E-03	1.9E-04
CHRYSENE	1.4E-02	1.4E-03	3.4E-01	3.4E-02
DIBENZO(A,H)ANTHRACENE	3.7E-04	3.7E-05	1.1E-03	1.1E-04
FLUORANTHENE	4.5E-02	4.5E-03	1.5E-02	7.3E-03
FLUORENE	1.2E-03	1.2E-04	4.0E-04	2.0E-04
INDENO(1,2,3-CD)PYRENE	1.9E-03	1.9E-04	1.1E-03	1.1E-04
ISOPHORONE	NV	NV	9.9E-04	8.3E-05
PHENANTHRENE	1.2E-02	1.2E-03	4.7E-02	4.7E-03
PYRENE	3.5E-02	3.5E-03	1.9E-02	1.1E-02
Pesticides/PCBs				
4,4'-DDE	7.6E-02	1.3E-02	1.7E-03	3.5E-04
4,4'-DDT	1.4E-01	2.4E-02	3.2E-03	6.4E-04
ALDRIN	NV	NV	6.1E-05	1.2E-05
ALPHA-BHC	8.5E-06	2.1E-06	6.9E-04	6.9E-05
AROCLOR-1248	1.5E-03	1.5E-04	5.7E-02	5.7E-03
AROCLOR-1260	7.6E-01	7.6E-02	4.1E+00	4.1E-01
BETA-BHC	7.3E-04	1.8E-04	1.9E-03	3.9E-04
DELTA-BHC	8.5E-06	2.1E-06	6.9E-04	6.9E-05
DIELDRIN	6.7E-04	5.9E-05	6.5E-03	7.6E-05
ENDOSULFAN I	2.4E-06	2.4E-07	3.3E-04	3.3E-05
ENDOSULFAN SULFATE	1.9E-04	1.9E-05	2.6E-02	2.6E-03
ENDRIN	4.5E-02	4.5E-03	9.1E-03	9.1E-04
ENDRIN ALDEHYDE	8.3E-02	8.3E-03	1.7E-02	1.7E-03
ENDRIN KETONE	4.0E-03	4.0E-04	8.9E-04	8.9E-05
GAMMA-BHC (LINDANE)	4.7E-05	4.7E-06	2.1E-05	2.1E-06
GAMMA-CHLORDANE	9.7E-04	1.9E-04	9.1E-04	4.5E-04
METHOXYCHLOR	NV	NV	4.6E-05	2.3E-05
TOTAL AROCLOR	7.6E-03	7.6E-02	4.1E+00	4.1E-01
Inorganics				
ARSENIC	7.7E-02	3.8E-02	3.0E-01	6.9E-02
CADMIUM	8.2E-01	1.9E-01	3.2E+00	3.6E-01
CHROMIUM	4.4E+00	7.6E-01	1.0E+01	4.1E-01
COPPER	7.5E-03	5.7E-03	6.0E-02	4.6E-02
LEAD	3.9E+01	1.4E+00	2.7E+01	6.9E-01
MERCURY	4.7E-01	4.7E-02	1.8E-01	3.7E-02
NICKEL	2.1E-03	1.5E-03	8.1E-03	4.1E-03
SELENIUM	5.9E-02	2.9E-02	2.4E-01	1.5E-01
ZINC	1.2E-01	1.3E-02	2.0E-02	1.0E-02

Cells are shaded if the value is greater than 1.0
NV - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 7-12

SUMMARY OF CHEMICALS RETAINED AS COPCS FOR ECOLOGICAL RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

PARAMETER	PLANTS/SOIL INVERTEBRATES	BENTHIC INVERTEBRATES	AQUATIC ORGANISMS	BOBWHITE QUAIL	MEADOW VOLE	AMERICAN WOODCOCK	SHORT-TAILED SHREW	HERRING GULL	RACCOON
Step 2 COPCs									
Volatile Organics									
1,1-DICHLOROETHENE		X							
2-BUTANONE	X	X							
ACETONE		X							
CARBON DISULFIDE		X							
Semivolatile Organics									
2-METHYLNAPHTHALENE		X							
4-METHYLPHENOL		X							
ACENAPHTHENE		X							
ACENAPHTHYLENE		X							
ANTHRACENE	X	X							
BENZO(A)ANTHRACENE	X	X					X		
BENZO(A)PYRENE	X	X							
BENZO(B)FLUORANTHENE	X	X							
BENZO(G,H,I)PERYLENE	X	X							
BENZO(K)FLUORANTHENE	X	X							
CARBAZOLE	X	X	X						
CHRYSENE	X	X					X		
DIBENZO(A,H)ANTHRACENE		X							
DIBENZOFURAN	X	X	X						
FLUORANTHENE	X	X							
FLUORENE		X							
INDENO(1,2,3-CD)PYRENE	X	X							
NAPHTHALENE		X							
PHENANTHRENE	X	X							
PHENOL		X	X						
PYRENE	X	X							
HIGH MOLECULAR WEIGHT PAHs		X							
LOW MOLECULAR WEIGHT PAHs		X							
Pesticides/PCBs									
4,4'-DDE		X							
4,4'-DDT		X							
ALPHA-BHC		X							
ALPHA-CHLORDANE	X								
AROCLOR-1248		X							

TABLE 7-12

SUMMARY OF CHEMICALS RETAINED AS COPCS FOR ECOLOGICAL RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

PARAMETER	PLANTS/SOIL INVERTEBRATES	BENTHIC INVERTEBRATES	AQUATIC ORGANISMS	BOBWHITE QUAIL	MEADOW VOLE	AMERICAN WOODCOCK	SHORT-TAILED SHREW	HERRING GULL	RACCOON
AROCLOR-1260		X				X	X		X
BETA-BHC		X							
DELTA-BHC		X							
DIELDRIN		X							
ENDOSULFAN I		X							
ENDOSULFAN SULFATE		X							
ENDRIN ALDEHYDE	X	X							
ENDRIN KETONE	X	X							
GAMMA-BHC (LINDANE)		X							
GAMMA-CHLORDANE		X							
METHOXYCHLOR		X							
TOTAL AROCLOR		X				X	X		X
Inorganics									
ALUMINUM	X		X						
ANTIMONY		X							
BARIUM			X						
BERYLLIUM		X							
CADMIUM		X				X	X		X
CHROMIUM	X	X						X	X
COBALT			X						
COPPER		X	X						
CYANIDE		X							
IRON	X		X						
LEAD		X				X		X	X
MANGANESE		X	X						
MERCURY		X		X	X	X	X		
NICKEL		X	X						
SELENIUM		X							
THALLIUM		X							
VANADIUM	X								
ZINC	X		X			X			

TABLE 7-12

SUMMARY OF CHEMICALS RETAINED AS COPCS FOR ECOLOGICAL RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

PARAMETER	PLANTS/SOIL INVERTEBRATES	BENTHIC INVERTEBRATES	AQUATIC ORGANISMS	BOBWHITE QUAIL	MEADOW VOLE	AMERICAN WOODCOCK	SHORT-TAILED SHREW	HERRING GULL	RACCOON
STEP 3A COPCs									
Semivolatile Organics									
CARBAZOLE		X							
DIBENZOFURAN		X							
HIGH MOLECULAR WEIGHT PAHs		X							
LOW MOLECULAR WEIGHT PAHs		X							
Pesticides/PCBs									
BETA-BHC		X							
ENDOSULFAN SULFATE		X							
GAMMA-CHLORDANE		X							
TOTAL AROCLOR		X							
Inorganics									
ANTIMONY		X							
CADMIUM		X							
CHROMIUM		X							
LEAD		X							
MANGANESE		X							
SELENIUM		X							

Notes:
An "X" indicates that the chemical was retained as a COPC for the corresponding receptor.

TABLE 7-13

ACID VOLATILE SULFIDE, SIMULTANEOUSLY EXTRACTED METALS, AND BULK SEDIMENT RESULTS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Sample Numbers	SEM/AVS[1]	AVS	SEM Results (umo/g)						Bulk Sediment Results (mg/kg)[2]					
			Cadmium	Copper	Lead	Mercury	Nickel	Zinc	Cadmium	Copper	Lead	Mercury	Nickel	Zinc
									ERL = 1.2	ERL = 34	ERL = 46.7	ERL =0.15	ERL = 20.9	ERL = 150
Subtidal Locations														
G32-SD301-0.51.0	0.12	0.88 J	0.002 UJ	0.039 UJ	0.019 UJ	0.00003 U	0.034 UJ	0.11 J	0.049 UJ	11	9.5 J	0.0067 U	6.8 J	28.2 J
G32-SD301-000.5	0.25	0.88 J	0.002 UJ	0.069 UJ	0.031 J	0.00005 UJ	0.17 UJ	0.19 J	0.04 UJ	9.3	10.5 J	0.01 UJ	6.2 J	29.5 J
G32-SD302A-000.5	0.13	5.4 J	0.0034 UJ	0.14 J	0.062 J	0.00065	0.058 J	0.45 J	0.83 J	26.5 J	33.6 J	0.13	13.1 J	72.3
G32-SD302B-000.5	0.15	5.7 J	0.0017 UJ	0.16 J	0.08 J	0.00055	0.058 J	0.54 J	0.62 J	18.2 J	21.7 J	0.11	13 J	48.1
G32-SD302C-000.5	0.13	4.7 J	0.0012 UJ	0.088 J	0.045 J	0.0003	0.14 J	0.32 J	0.48 UJ	9.7 J	14.1 J	0.06	7.2 J	34.6 J
G32-SD302D-000.5	1.8	3.4 J	0.0098 UJ	2.4 J	0.05 J	0.00025	3.2 J	0.35 J	0.6 J	16.2 J	40.3 J	0.051	10 J	63.2
G32-SD302E-000.5	0.22	1.8 J	0.0013 UJ	0.063 UJ	0.044 J	0.0002	0.026 J	0.33 J	0.5 J	9.1 J	12.5 J	0.04	7.1 J	33.3 J
G32-SD303-0.51.0	0.25	1.9 J	0.0024 UJ	0.1 UJ	0.078 J	0.00033 U	0.39 UJ	0.4 J	0.16 UJ	14.3	20.5 J	0.066 U	9.6 J	49.2 J
G32-SD303-000.5	0.33	1.3 J	0.0022 UJ	0.066 UJ	0.074 J	0.00027 U	0.026 UJ	0.35 J	0.18 UJ	16.1	23.4 J	0.055 U	9.7 J	57.9 J
G32-SD304D-0.51.0	0.72	1.2 J	0.0031 UJ	0.17 J	0.089 J	0.00017 J	0.26 J	0.34 J	0.0056 UJ	14.8 J	15.7 J	0.034 J	6.5 J	31.7 J
G32-SD304D-000.5-AVG	0.265	5.3 J	0.003 UJ	0.205 J	0.1895 J	0.00024 J	0.3365 J	0.535 J	0.0055 UJ	25.15 J	39.5 J	0.048 J	8.1 J	44.6 J
G32-SD304A-000.5	0.073	11.5 J	0.0036 UJ	0.15 J	0.095 J	0.00021 J	0.039 J	0.56 J	0.0057 UJ	23.1 J	20.5 J	0.043 J	8.1 J	41 J
G32-SD304B-000.5	0.064	10.5 J	0.0051 UJ	0.17 J	0.11 J	0.00022 J	0.036 J	0.36 J	0.0053 UJ	15.7 J	23.5 J	0.045 J	7.9 J	39.7 J
G32-SD304C-000.5	0.29	3.1 J	0.038 J	0.16 J	0.16 J	0.00023 J	0.037 J	0.49 J	0.097 J	22.7 J	**59.6 J**	0.047 J	8.6 J	41.7 J
G32-SD304E-000.5	1.2	2.6 J	0.0031 UJ	0.14 J	2.1 J	0.00038 J	0.046 J	0.85 J	0.0056 UJ	23.2 J	41.9 J	0.076 J	8.5 J	98.1 J
G32-SD305D-0.51.0	0.46	2 J	0.0052 UJ	0.16 J	0.23 J	0.00027 J	0.048 J	0.49 J	0.0056 UJ	26 J	24.6 J	0.054 J	7.1 J	44.8 J
G32-SD305A-000.5	0.15	3.8 J	0.0059 UJ	0.1 J	0.075 J	0.00011 U	0.031 J	0.37 J	0.61 J	15 J	31.6 J	0.023 U	6.4 J	32.4 J
G32-SD305B-000.5	0.12	8 J	0.0016 UJ	0.15 J	0.19 J	0.0003	0.23 J	0.38 J	0.69 J	21.5 J	**55.5**	0.06	8 J	44 J
G32-SD305C-000.5	0.064	7.4 J	0.00086 UJ	0.077 J	0.057 J	0.00018 J	0.031 J	0.31 J	0.0054 UJ	23.3 J	35 J	0.036 J	7.6 J	47 J
G32-SD305D-000.5	0.34	5.9 J	0.0025 UJ	0.42 J	0.083 J	0.0003 J	1.2 J	0.33 J	0.0055 UJ	**38 J**	**48.8 J**	0.061 J	9.3 J	46.8 J
G32-SD305E-000.5	0.1	7.3 J	0.0073 UJ	0.17 J	0.088 J	0.00028 J	0.061 J	0.44 J	0.0055 UJ	23.8 J	29.4 J	0.057 J	9.8 J	50 J
G32-SD306C-0.51.0	0.084	6.1 J	0.0063 UJ	0.094 J	0.12 J	0.00017 J	0.037 UJ	0.3 J	0.0053 UJ	16.6 J	25.3 J	0.035 J	9.1 J	45.3 J
G32-SD306D-000.5-AVG	0.205	4.95 J	0.00345 UJ	0.119 J	0.395 J	0.00017 J	0.0365 UJ	0.425 J	0.0054 UJ	16 J	**77.35 J**	0.0345 J	8.75 J	42.9 J
G32-SD306E-000.5-AVG	0.17	3.3 J	0.0049 UJ	0.16 J	0.078 J	0.0002 J	0.073 UJ	0.32 J	0.00545 UJ	19.6 J	38.3 J	0.04 J	9.2 J	40.3 J
G32-SD306A-000.5	3.5	0.61 UJ	0.019 UJ	0.14 J	1.1 J	0.00022 J	0.031 UJ	0.92 J	0.0056 UJ	20.4 J	**419 J**	0.045 J	9.1 J	64.4 J
G32-SD306B-000.5	1	4 J	0.0061 UJ	0.39 J	2.3 J	0.00033 J	0.57 J	0.72 J	0.3 UJ	20.7	**690 J**	0.066 J	9.8 J	131 J
G32-SD306C-000.5	0.36	3.6 J	0.0064 UJ	0.21 J	0.24 J	0.00022 J	0.48 J	0.37 J	0.0053 UJ	14.1 J	**61.6 J**	0.045 J	8 J	40.5 J
G32-SD307-000.5	0.38	1.1 J	0.0014 UJ	0.11 J	0.052 J	0.00011 J	0.024 UJ	0.26 J	0.055 UJ	15.9	24.9 J	0.023 J	6.4 J	30.9 J
G32-SD308A-000.5	0.22	3.1 J	0.00086 UJ	0.098 J	0.026 UJ	0.00006 UJ	0.36 J	0.21 J	0.54 UJ	9.6 J	14 J	0.013 UJ	7.2 J	35.8 J
G32-SD308B-000.5	0.032	7.1 J	0.00088 UJ	0.022 UJ	0.03 UJ	0.00027	0.015 J	0.21 J	0.48 UJ	9 J	14.2 J	0.054	7.5 J	33.4 J
G32-SD308C-000.5	0.14	2.6 J	0.00098 UJ	0.068 UJ	0.043 J	0.00009 UJ	0.027 J	0.29 J	0.56 UJ	12.4 J	14.1 J	0.018 UJ	8.3 J	38.1 J
G32-SD308D-000.5	0.25	1.9 J	0.0016 UJ	0.063 UJ	0.034 J	0.00006 UJ	0.044 J	0.4 J	0.63 J	13 J	13.5 J	0.012 UJ	8.9 J	34.9 J
G32-SD308E-000.5	0.18	2.5 J	0.0028 UJ	0.09 J	0.035 J	0.00005 UJ	0.037 J	0.28 J	0.46 UJ	10.1 J	11.8 J	0.011 UJ	6.8 J	32 J
G32-SD309A-000.5	0.11	5.4 J	0.0028 UJ	0.091 UJ	0.069 J	0.00015 J	0.2 UJ	0.5 J	0.0053 UJ	11.6 J	14.9 J	0.03 J	8.1 J	46.2 J
G32-SD309B-000.5	0.16	2.7 J	0.0029 UJ	0.08 UJ	0.048 UJ	0.00018 J	0.032 UJ	0.42 J	0.069 UJ	17.7	16.6 J	0.037 J	10.4 J	34 J
G32-SD309C-000.5	0.58	1.7 J	0.0045 UJ	0.071 UJ	0.05 UJ	0.00016 J	0.24 UJ	0.99 J	0.066 UJ	11.3	9.3 J	0.032 J	6.4 J	35.1 J

TABLE 7-13

ACID VOLATILE SULFIDE, SIMULTANEOUSLY EXTRACTED METALS, AND BULK SEDIMENT RESULTS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Sample Numbers	SEM/AVS[1]	AVS	SEM Results (umo/g)						Bulk Sediment Results (mg/kg)[2]					
			Cadmium	Copper	Lead	Mercury	Nickel	Zinc	Cadmium	Copper	Lead	Mercury	Nickel	Zinc
									ERL = 1.2	ERL = 34	ERL = 46.7	ERL =0.15	ERL = 20.9	ERL = 150
Subtidal Locations (cont.)														
G32-SD309D-000.5	0.21	1.4 J	0.004 UJ	0.055 UJ	0.059 J	0.00011 J	0.2 UJ	0.24 J	0.046 UJ	13.9	9.5 J	0.023 J	6.8 J	39 J
G32-SD309E-000.5	0.075	8.4 J	0.0044 UJ	0.12 J	0.076 J	0.00022 J	0.051 UJ	0.43 J	0.13 UJ	15.1	**127 J**	0.045 J	8.7 J	42.1 J
G32-SD310A-000.5-AVG	0.295	1.4 J	0.0023 UJ	0.06175 J	0.0415 UJ	0.000145 J	0.04 UJ	0.265 J	0.076 UJ	20.7	9.85 J	0.0295 J	9 J	40.15 J
G32-SD310B-000.5	0.12	6.6 J	0.0021 UJ	0.077 J	0.31 J	0.00012 J	0.036 UJ	0.43 J	0.13 UJ	24.5	**178 J**	0.025 J	14.8 J	65.8 J
G32-SD310C-000.5	0.14	2.2 J	0.0023 UJ	0.063 UJ	0.035 UJ	0.00013 J	0.065 UJ	0.31 J	**3.2 J**	20.7	11.7 J	0.027 J	11 J	44.9 J
G32-SD310D-000.5	0.2	1.3 J	0.0023 UJ	0.057 UJ	0.039 UJ	0.00018 J	0.066 UJ	0.26 J	0.11 UJ	14.7	13.2 J	0.036 J	5.9 J	51.6 J
G32-SD310E-000.5	0.91	0.57 J	0.002 UJ	0.12 J	0.048 J	0.00003 U	0.1 UJ	0.35 J	0.077 UJ	15.9	14.1 J	0.007 U	7.7 J	55.1 J
G32-SD311-0.51.0	0.31	1.1 J	0.0021 UJ	0.076 UJ	0.055 J	0.00009 U	0.022 UJ	0.29 J	0.22 UJ	20.7	27.2	0.019 U	8.5 J	42.1 J
G32-SD311-000.5	0.45	0.97 J	0.0023 UJ	0.14 J	0.057 J	0.00012 U	0.043 UJ	0.24 J	0.13 UJ	18	19.6 J	0.024 U	8 J	38.9 J
G32-SD312-0.51.0	0.04	19.8 J	0.0015 UJ	0.13 J	0.068 J	0.00026 J	0.034 J	0.56 J	0.32 UJ	25.2	23.4 J	0.052 J	7.7 J	67.4 J
G32-SD312-000.5	0.033	33.7 J	0.0018 UJ	0.33 J	0.075 J	0.00021 J	0.099 J	0.62 J	0.18 UJ	25.3	18.3 J	0.042 J	9.1 J	55.6 J
G32-SD313D-000.5-AVG	0.39	1.45 J	0.0165 J	0.165 J	0.0455 J	0.00008 UJ	0.0325 J	0.29 J	**12.3 J**	27.25 J	16.55 J	0.017 UJ	9.5 J	38.4 J
G32-SD313A-000.5	0.085	12.3 J	0.00098 UJ	0.2 J	0.075 J	0.00009 UJ	0.034 J	0.74 J	0.64 UJ	18	14.8 J	0.018 UJ	8.7 J	42.2 J
G32-SD313B-000.5	0.22	1.3 J	0.0012 UJ	0.069 UJ	0.028 UJ	0.00011 UJ	0.051 J	0.23 J	0.47 UJ	11.8	13.2 J	0.022 UJ	7.8 J	35 J
G32-SD313C-000.5	0.17	8.5 J	0.037 J	0.49 J	0.19 J	0.0001 UJ	0.075 J	0.62 J	1.2 UJ	**42.7**	21.3 J	0.02 UJ	**23.9 J**	48.2 J
G32-SD313E-000.5	**1.5**	0.61 UJ	0.0031 UJ	0.21 J	0.13 J	0.0001 UJ	0.053 J	0.5 J	0.75 J	20.9 J	15.8 J	0.02 UJ	7.8 J	45.7 J
G32-SD314-0.51.0	0.15	1.3 J	0.002 UJ	0.042 UJ	0.033 J	0.00017 U	0.022 UJ	0.16 J	0.048 UJ	13.6	12.8 J	0.035 U	10.9 J	42.3 J
G32-SD314-000.5-AVG	0.1085	4.45 J	0.00225 UJ	0.07025 J	0.045 J	0.00015 U	0.2415 UJ	0.295 J	0.0745 UJ	13.35	13.25 J	0.0305 U	9.8 J	40.7 J
G32-SD315-000.5	0.071	6.6 J	0.0016 UJ	0.071 J	0.1 J	0.00013 J	0.026 UJ	0.3 J	0.15 UJ	17.2	14 J	0.026 J	6.9 J	36.8 J
G32-SD316-0.51.0	0.46	13.3 J	0.0045 UJ	1.2 J	0.54 J	0.0011 J	0.12 J	4.2 J	0.48 UJ	**92.5**	**90.6 J**	**0.22 J**	12.5 J	144 J
G32-SD316-000.5	0.051	22.1 J	0.0072 UJ	0.2 J	0.12 J	0.00095 J	0.066 J	0.73 J	0.29 UJ	**42.5**	**90.6 J**	**0.19 J**	10.2 J	95.9 J
G32-SD317-000.5	0.16	3.8 J	0.0021 UJ	0.19 J	0.17 J	0.00004 J	0.078 UJ	0.26 J	**398**	**36.5**	**56.4 J**	0.0099 J	8.7 J	145 J
Intertidal Locations														
G32-SD302F-000.5	0.075	10.2 J	0.0023 UJ	0.33 J	0.074 J	0.00003 U	0.037 UJ	0.36 J	0.31 UJ	**35.1**	23.4 J	0.0068 U	11.6 J	54.1 J
G32-SD304F-000.5	0.51	0.9 J	0.0021 UJ	0.1 J	0.22 J	0.00003 UJ	0.02 UJ	0.14 J	**1.6 J**	**46.8**	**21200**	0.0077 UJ	10.8 J	54.4 J
G32-SD305F-000.5	0.02	7.9 J	0.0021 UJ	0.083 UJ	0.028 UJ	0.00003 U	0.11 UJ	0.16 J	0.47 UJ	**77.8**	17.7 J	0.0072 U	19 J	39.5 J
G32-SD306F-000.5	0.14	7 J	0.0043 UJ	0.19 J	0.28 J	0.0037	0.036 UJ	0.49 J	0.21 UJ	32.6	**177**	**0.74**	8.7 J	64.4 J
G32-SD308F-000.5	0.14	5.7 J	0.0022 UJ	0.34 J	0.056 J	0.00004 UJ	0.5 UJ	0.43 J	0.41 UJ	26.4	18.9 J	0.0095 UJ	6.4 J	34.7 J
G32-SD309F-000.5-AVG	0.055	18.5 J	0.0114 UJ	0.19 J	0.0865 J	0.00015 U	0.0615 UJ	0.555 J	0.9125 J	30.55	32.8 J	0.0305 U	9.25 J	122.95 J
G32-SD310F-000.5	0.15	14.3 J	0.0033 UJ	0.2 J	0.11 J	0.00025 U	0.082 UJ	1.9 J	0.36 UJ	33.4	32.6 J	0.05 U	11 J	73 J
G32-SD313F-000.5	0.81	0.83 J	0.002 UJ	0.28 J	0.11 J	0.00004 UJ	0.061 UJ	0.28 J	0.6 UJ	**64.4**	17.9 J	0.008 UJ	**47.4 J**	39.7 J

Notes:

1 - Cells in SEM/AVS column are shared grey if the value is greater than 1.0.

2 - Cells in bulk sediment results columns are shared black if the values are greater than the sediment screening level selected (ERL).

AVS - Acid volatile sulfides

SEM - Simultaneously extracted metals

TABLE 7-14

TERRESTRIAL FOOD CHAIN MODEL - LESS CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		American Woodcock		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Semivolatile Organic Compounds								
BENZO(A)ANTHRACENE	1.0E-03	1.0E-04	3.2E-02	3.2E-03	1.2E-02	1.2E-03	8.3E-02	8.3E-03
CHRYSENE	1.0E-03	1.0E-04	3.3E-02	3.3E-03	1.2E-02	1.2E-03	8.4E-02	8.4E-03
Pesticides/PCBs								
AROCLOR-1260	2.2E-04	2.2E-05	5.8E-04	5.8E-05	1.3E-01	1.3E-02	2.4E-01	2.4E-02
Metals								
CADMIUM	6.0E-03	1.4E-03	4.5E-02	5.1E-03	3.1E-01	7.1E-02	4.2E-01	4.7E-02
MERCURY	4.4E-02	4.4E-03	3.4E-02	6.8E-03	5.7E-01	5.7E-02	8.0E-02	1.6E-02
ZINC	7.0E-02	7.7E-03	2.5E-02	1.2E-02	2.6E+00	2.9E-01	1.7E-01	8.4E-02

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 7-15

TERRESTRIAL FOOD CHAIN MODEL - LESS CONSERVATIVE SCENARIO
PISCIVOROUS RECEPTORS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Chemical	Piscivorous Receptors EEQs			
	Herring Gull		Raccoon	
	NOAEL	LOAEL	NOAEL	LOAEL
Pesticides/PCBs				
AROCLOR-1260	3.2E-02	3.2E-03	9.8E-02	9.8E-03
TOTAL AROCLOR	3.2E-02	3.2E-03	9.8E-02	9.8E-03
Inorganics				
CADMIUM	1.2E-02	2.7E-03	2.6E-02	2.9E-03
CHROMIUM	6.4E-02	1.1E-02	8.5E-02	3.5E-03
LEAD	4.3E-01	1.6E-02	1.8E-01	4.6E-03

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE 8-1

THIRD AND FOURTH TIER CONCEPTUAL SITE MODEL – CONTAMINANTS IN SURFACE SOIL
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

SURFACE SOIL: 0-2 FEET

Contaminant	Fate and Transport	Receptors Affected	Predicted Risk
PCBs	Adhere to soil particles, possible erosion and physical transport Hydrophobic, lipophilic Do not decompose Bioaccumulate in animal tissues Do not move with groundwater	None	NA
VOCs	Degrade to breakdown products Chlorinated solvents sink, potentially to bedrock	None	NA
	Lighter solvents dissolve, move with groundwater Volatilize from ground slowly	None	NA
PAHs	Dispersion, dilution Adhere to soil particles, possible erosion and physical transport Hydrophobic and resist dissolution in water Degrade or decompose over time Volatilize (lighter fractions)	Terrestrial Plants, Invertebrates Current and Future Industrial Workers	Possible Mortality Cancer Risk
Petroleum	Volatilize (lighter fractions) Some fractions may dissolve and move with groundwater	None	NA
Cyanide	Dissolve/Disperse Dissipate in water Remnants may remain	None	NA
Metals	Adsorption to soil Possible erosion and physical transport Precipitation under certain conditions Transport to shoreline through pipeline flow	Terrestrial Plants, Invertebrates	Possible Mortality
		Insectiverous Birds	Uptake of Zinc
		Current and Future Industrial Workers	Cancer Risk

TABLE 8-2

THIRD AND FOURTH TIER CONCEPTUAL SITE MODEL – CONTAMINANTS IN SUBSURFACE SOIL
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

SUBSURFACE SOIL 0-10 FEET

Contaminant	Fate and Transport	Receptors	Predicted Risk
PCBs	Adhere to soil particles, possible erosion and physical transport Hydrophobic, lipophilic Do not decompose Bioaccumulate in animal tissues Do not move with groundwater	Future Industrial Worker	Non-Cancer Risk
VOCs	Degrade to breakdown products Chlorinated solvents sink, potentially to bedrock	None	NA
	Lighter solvents dissolve, move with groundwater Volatilize from ground slowly	None	NA
PAHs	Dispersion, dilution Hydrophobic Degrade or decompose over time Volatilize (lighter fractions) Adhere to soil particles, possible erosion and physical transport	Future Industrial Worker	Cancer Risk
Petroleum	Volatilize (lighter fractions) to soil gas Dissolved fraction will move with groundwater Residual petroleum trapped in soil will degrade over time	None	NA
Cyanide	Dissolve/Disperse Dissipate in water Remnants may remain	None	NA
Metals	Adsorption to soil Precipitation under certain conditions Transport to shoreline through pipeline flow Erosion and physical transport of dust particles	Future Industrial Worker Future Construction Worker	Cancer Risk, Non-Cancer Risk

TABLE 8-3

THIRD AND FOURTH TIER CONCEPTUAL SITE MODEL – CONTAMINANTS IN GROUNDWATER
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

GROUNDWATER IN WELLS

Contaminants	Fate and Transport	Receptors	Predicted Risk
VOCs (TCE, PCE, toluene, benzene)	Dissolve/disperse Volatilize Will not bioaccumulate	None	NA
PAHs, Phenols	Soluble fraction will be transported with groundwater, disperse when released to surface water bodies.	None	NA

WATER (AND MODELED AIR EXPOSURES) IN TEST PITS

Contaminants	Fate and Transport	Receptors	Predicted Risk
VOCs	Dissolve/disperse Volatilize Will not bioaccumulate	Future Construction Worker	Cancer Risk
PCBs	Adhere to soil particles, possible erosion and physical transport Hydrophobic, lipophilic Do not decompose Bioaccumulate in animal tissues Do not move with groundwater	Future Construction Worker	Cancer, Non-Cancer Risk
PAHs	Soluble fraction will be transported with groundwater, disperse when released to surface water bodies.	Future Construction Worker	Cancer, Non-Cancer Risks
Metals	Adsorption to soil Precipitation under certain conditions Transport to shoreline through pipeline flow Erosion and physical transport of disturbed and soluble metals	Future Construction Worker	Non-Cancer Risk

TABLE 8-4

THIRD AND FOURTH TIER CONCEPTUAL SITE MODEL – CONTAMINANTS IN SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Intertidal Sediment

Contaminants	Fate and Transport	Receptors	Predicted Risk
Solvents, VOCs	Dissolve, Disperse, Volatilize	None	NA
PCBs	Strong adhesion to fine sediments, movement with sediment	Marine Organisms	Toxicity
Metals	Disperse Some bioaccumulate	Marine Organisms Future Child Recreational Visitor	Toxicity Non-Cancer Risk
Cyanide	Dissolve, disperse or precipitate Some adsorption to sediments	None	NA
PAHs	Adhesion to fine sediments, movement with sediment, biodegradation over time	Marine Organisms	Toxicity

Subtidal Sediment

Contaminants	Fate and Transport	Receptors	Predicted Risk
Solvents, VOCs	Dissolve, Disperse, Volatilize	None	NA
PCBs	Strong adhesion to fine sediments, movement with sediment	Marine Organisms	Toxicity
Metals	Disperse Some bioaccumulate	Marine Organisms	Toxicity
Cyanide	Dissolve, disperse or precipitate Some adsorption to sediments	None	NA
PAHs	Adhesion to fine sediments, movement with sediment, biodegradation over time	Marine Organisms	Toxicity

TABLE 8-5

THIRD AND FOURTH TIER CONCEPTUAL SITE MODEL – CONTAMINANTS IN BIOTA
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Biota

Contaminant	Fate and Transport	Receptors	Predicted Risk
Polychlorinated Biphenyls (PCBs)	Bioaccumulate in animal tissues, will be passed up through the food chain PCBs do not metabolize	Humans Ingesting Mussels or Clams	Cancer Risk, Non-Cancer Risk
PAHs	Adhesion to fine sediments, movement with sediment, biodegradation over time, metabolized by many marine organisms	Marine Organisms Humans Ingesting Mussels	Toxicity Cancer Risk
Metals	Dissolve, disperse or precipitate Some adsorption to sediments, some bioaccumulate	Humans Ingesting Mussels or Clams	Cancer Risk, Non-Cancer Risk

TABLE 8-6

FOURTH TIER CONCEPTUAL SITE MODEL - HUMAN HEALTH RISKS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Surface Soil 0-2 feet						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Recreational Visitor	Adult	RME	1.70E-06	NA	<0.01	NA
	Adult	CTE	1.30E-07	NA	<0.01	NA
	Child	RME	3.40E-06	NA	0.03	NA
	Child	CTE	2.40E-07	NA	<0.01	NA
Current Trespasser	Adolescent	RME	2.30E-06	NA	<0.01	NA
	Adolescent	CTE	1.40E-07	NA	<0.01	NA
Current And Future Industrial Worker	Adult	RME	1.10E-05	PAHs, As	0.02	NA
	Adult	CTE	1.10E-06	NA	<0.01	NA

Soil 0-10 Feet						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Industrial Worker	Adult	RME	1.06E-05	PAHs, As	1.4	PCBs, As, Cd, Cr
	Adult	CTE	1.40E-06	PAHs, As	0.5	NA
Future Construction Worker	Adult	RME	5.10E-06	NA	1.4	Cd
	Adult	CTE	7.08E-08	NA	0.3	NA

Subsurface Soil Dust						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Industrial Worker	Adult	RME	2.80E-07	NA	<0.01	NA
	Adult	CTE	3.40E-08	NA	<0.01	NA
Future Construction Worker	Adult	RME	1.18E-03	Cd, Cr	14.50	Cr
	Adult	CTE	1.77E-04	Cd, Cr	2.18	Cr

Shallow Groundwater (From Test Pits)						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Construction Worker	Adult	RME	1.80E-03	PAHs, Pcp	1.40	NA (1)
	Adult	CTE	7.10E-04	PAHs, Pcp	0.23	NA

Pcp = Pentachlorophenol

Trench Air (Modeled from Shallow Groundwater)(2)						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Construction Worker	Adult	RME	4.00E+00	PCBs, PAHs	626.00	PCBs, PAHs
	Adult	CTE	1.20E+00	PCBs, PAHs	19.90	PCBs, PAHs

Intertidal Sediment						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Future Recreational Visitor	Adult	RME	1.20E-06	NA	0.28	NA
	Adult	CTE	8.70E-08	NA	0.01	NA
	Child	RME	2.30E-06	NA	2.36	Chromuim
	Child	CTE	1.64E-07	NA	0.10	NA
Current Trespasser	Adolescent	RME	6.76E-06	NA	0.50	NA
	Adolescent	CTE	1.62E-07	NA	0.02	NA

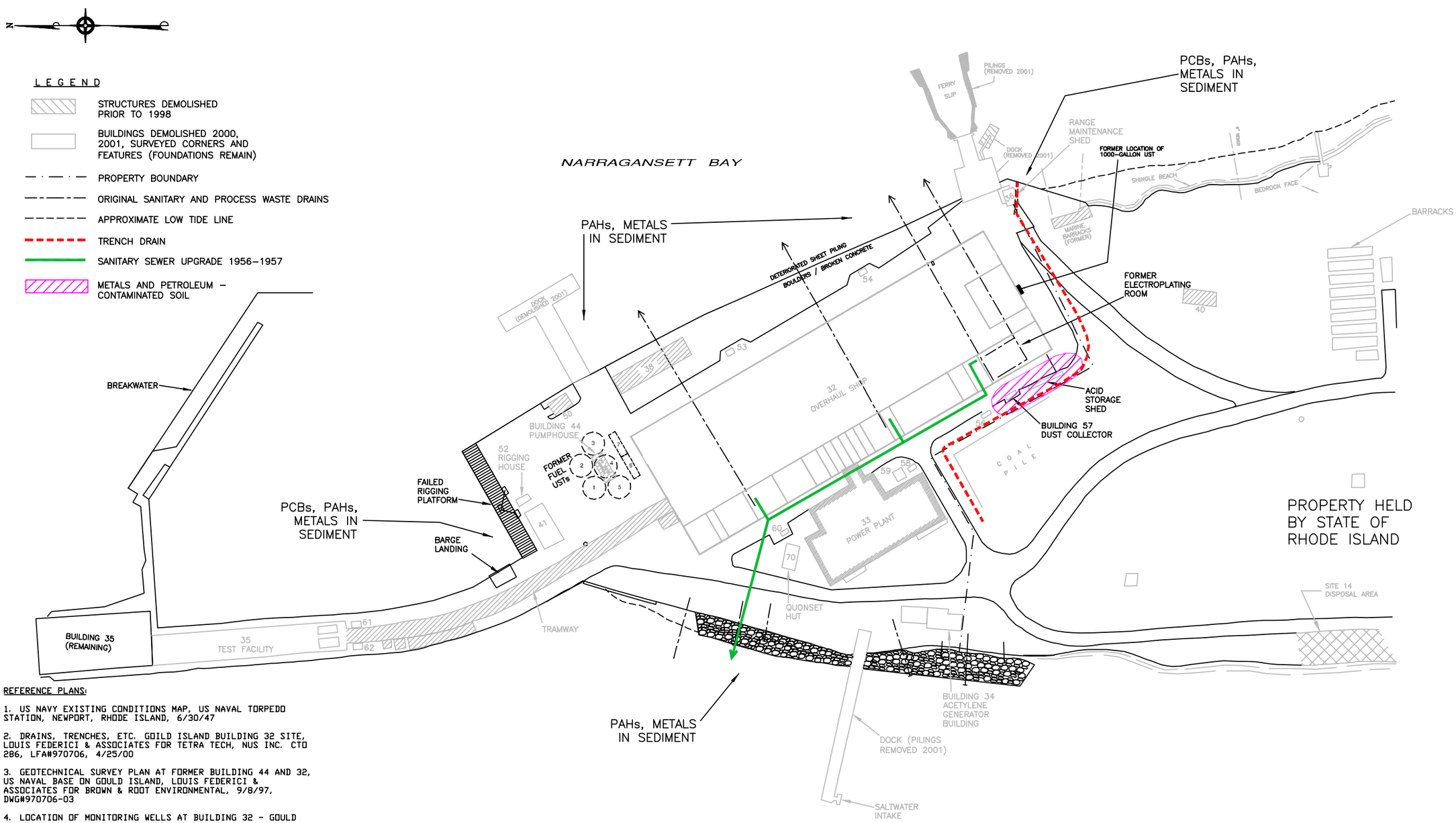
Clams and Mussels (3)						
Receptor		Type	Cancer Risk and Drivers		Non Cancer HI and Drivers	
Current/Future Clam Ingestion	Adult	RME	1.40E-03	PCBs, As	12.50	PCBs, As
	Adult	CTE	6.50E-05	PCBs, As	1.50	As
	Child	RME	5.10E-04	PCBs, As	18.20	PCBs, As, Th
	Child	CTE	1.90E-05	As	2.00	As
Current/Future Mussel Ingestion	Adult	RME	1.40E-03	PCBs, PAHs, As	23.10	PCBs, As
	Adult	CTE	6.40E-05	PCBs, PAHs, As	2.90	PCBs, As
	Child	RME	5.10E-04	PCBs, PAHs, As	33.80	PCBs, As
	Child	CTE	1.90E-05	As	3.80	PCBs, As

Notes:

All calculated risks are provided in Tables 9-1 through 9-7, Appendix G-1.
(1) No organ specific HI or chemical specific HQ > 1.0 was determined for this receptor
(2) Trench air risk is based on trench dimensions and is biased high
(3) For shellfish ingestion, RME=Subsistence level exposure, and CTE=Recreational exposure
NA - Not Applicable, calculated risk is below acceptable levels.

Yellow shading indicates exceedance of RIDEM acceptable risk (Cancer risk >/= 1E-5).
Red shading indicates exceedance of RIDEM and USEPA acceptable risk
(Cancer risk >/= 1E-4 and Non-Cancer HI >/= 1.0)

FIGURES



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOILD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U. S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.

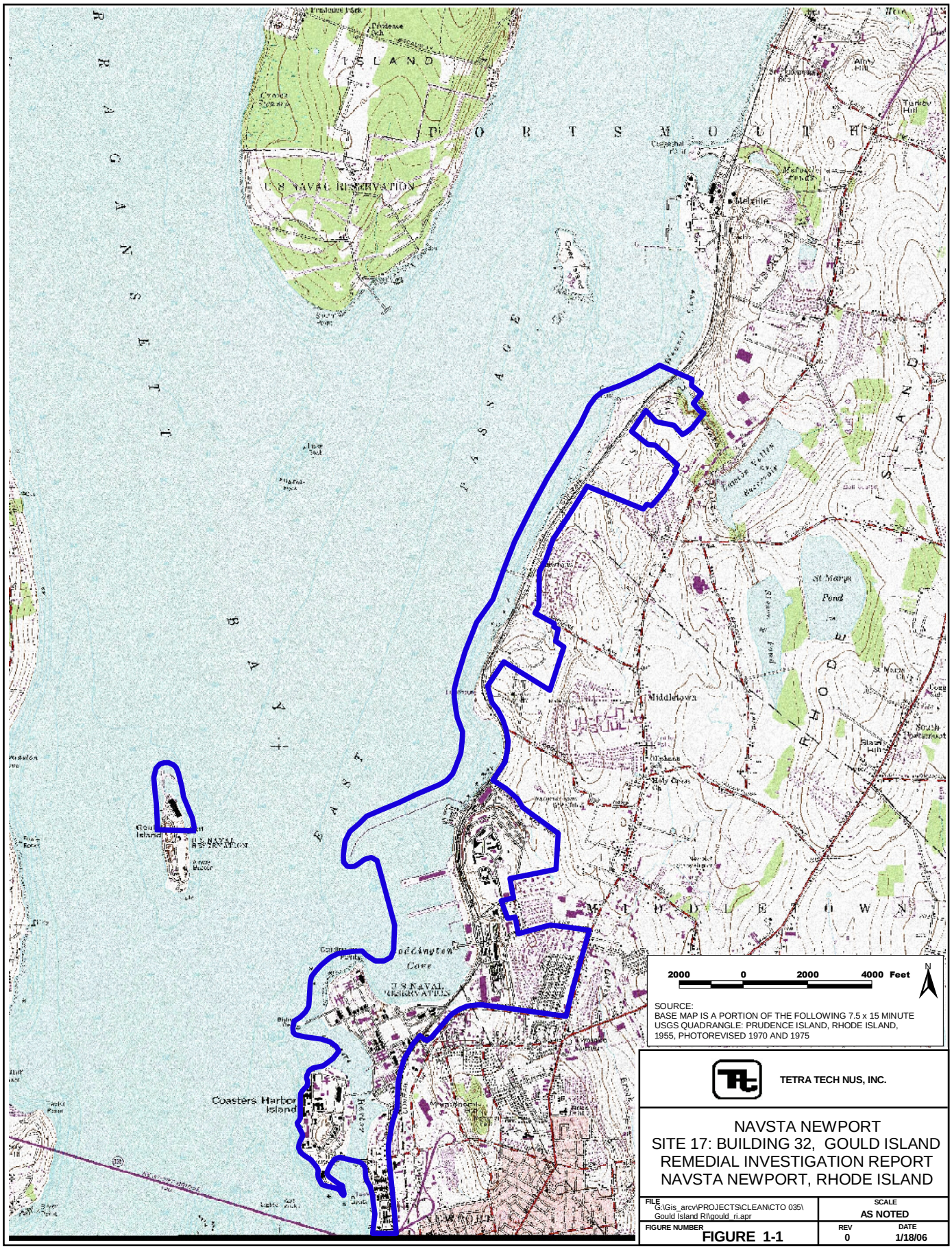
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS.

GRAPHIC SCALE

0' 150' 300'

SUMMARY OF FINDINGS			FIGURE E–1
SITE 17: BUILDING 32, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			TETRA TECH NUS, INC.
DRAWN BY:	D.W. MACDOUGALL	REV.: 0	55 Jonspin Road Wilmington, MA 01887 (978)658–7899
CHECKED BY:	S. PARKER	DATE: MARCH 24, 2006	
SCALE:	AS SHOWN	FILE NO.: DWG\00065\0410\FIG_E–1.DWG	



TETRA TECH NUS, INC.

NAVSTA NEWPORT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE	
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\ Gould Island RI\gould_ri.apr	AS NOTED	
FIGURE NUMBER	REV	DATE
FIGURE 1-1	0	1/18/06

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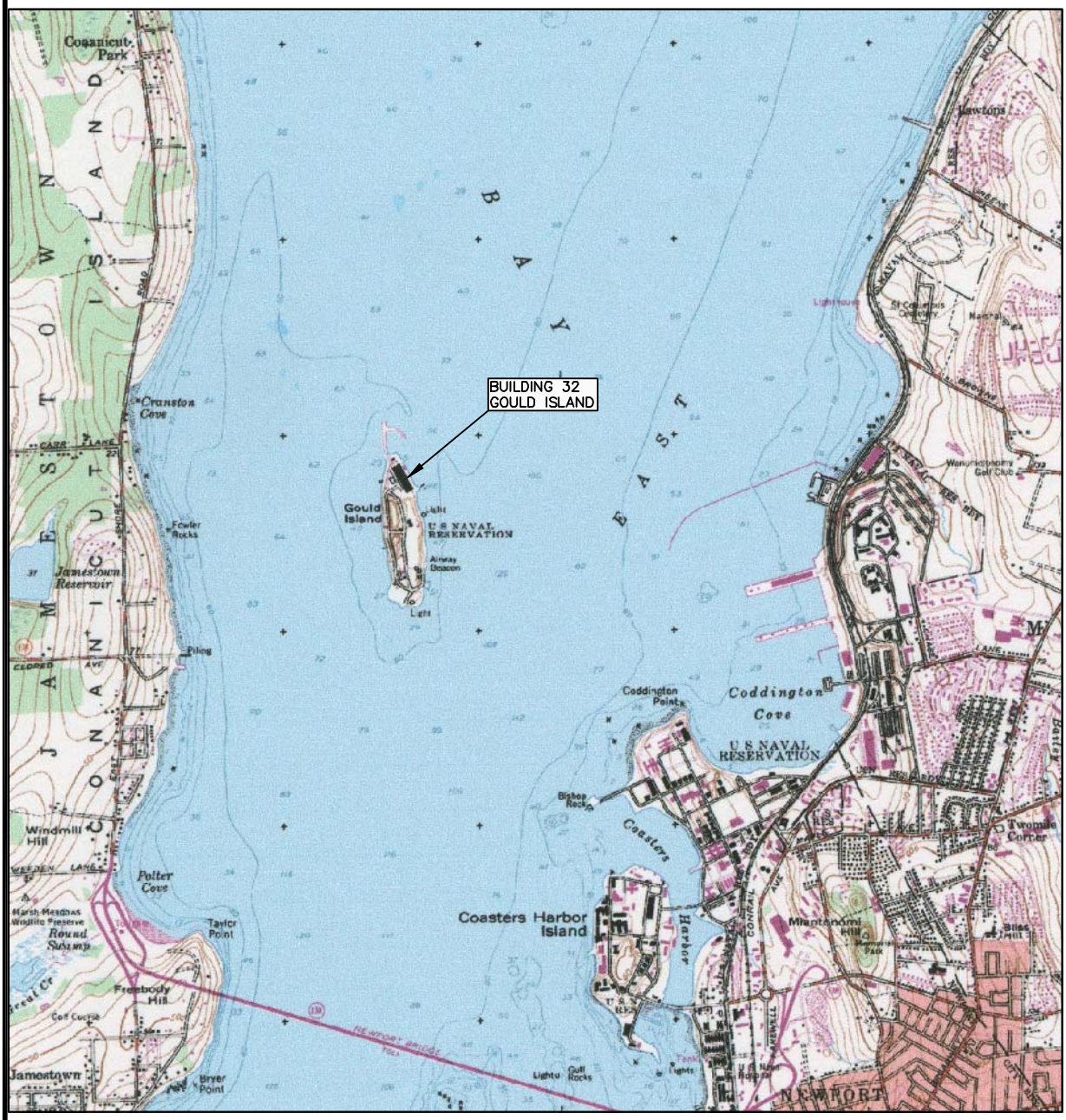


BASE MAP IS A PORTION OF THE FOLLOWING 7.5 X 15 MINUTE U.S.G.S. QUADRANGLE:
PRUDENCE ISLAND, RHODE ISLAND, 1955, PHOTOREVISED 1970 AND 1975

GRAPHIC SCALE
0 0.5 MILE 1 MILE

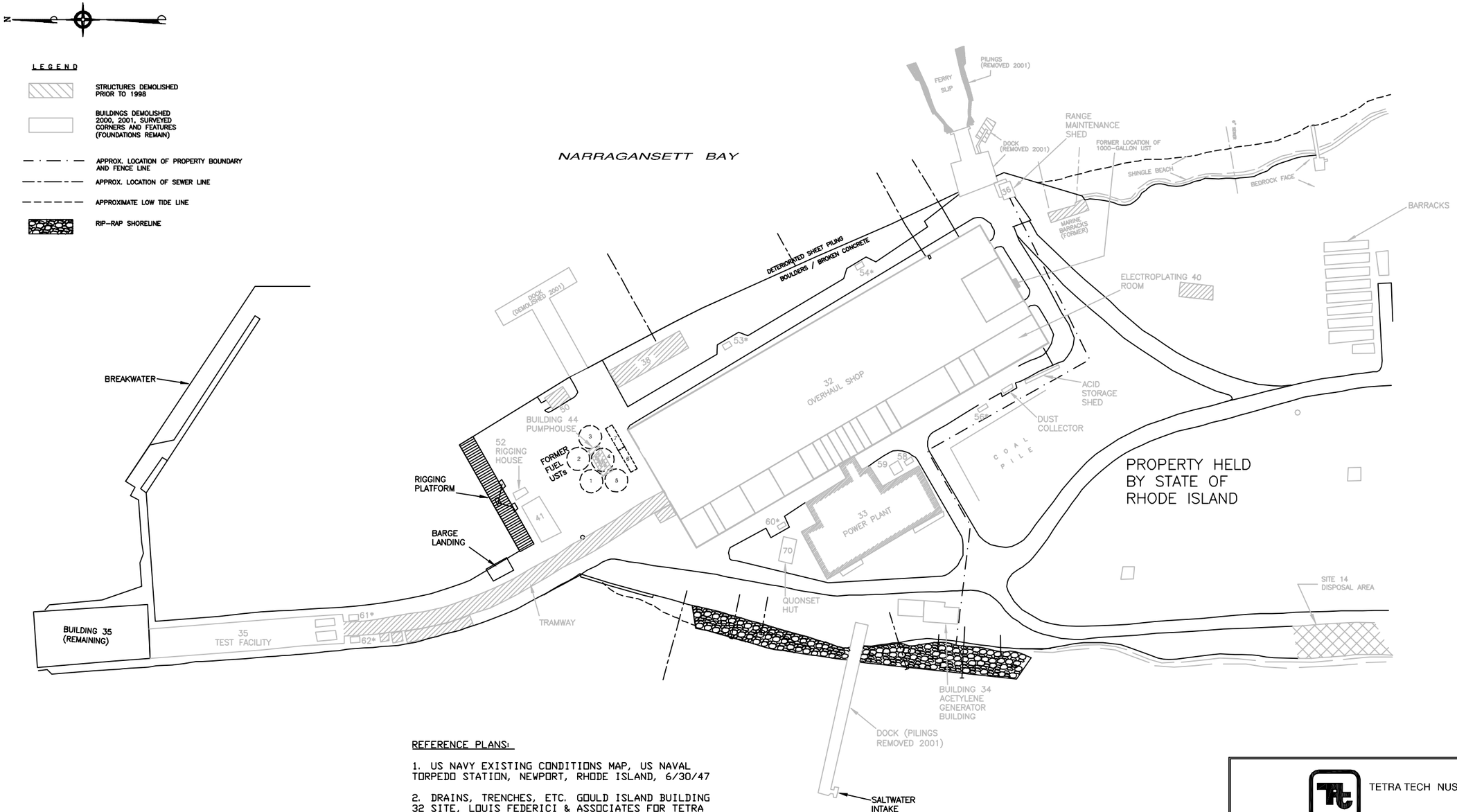
QUADRANGLE LOCATION

TETRA TECH NUS, INC.

SITE LOCUS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

SCALE	AS NOTED
FILE	00065\0410\USGS.DWG
REV 0	DATE 05/01/06
FIGURE NUMBER	1-2

ACAD: 00065\0410\BASE_MAP.DWG 05/01/06 DWM



NOTES:

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2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

GRAPHIC SCALE

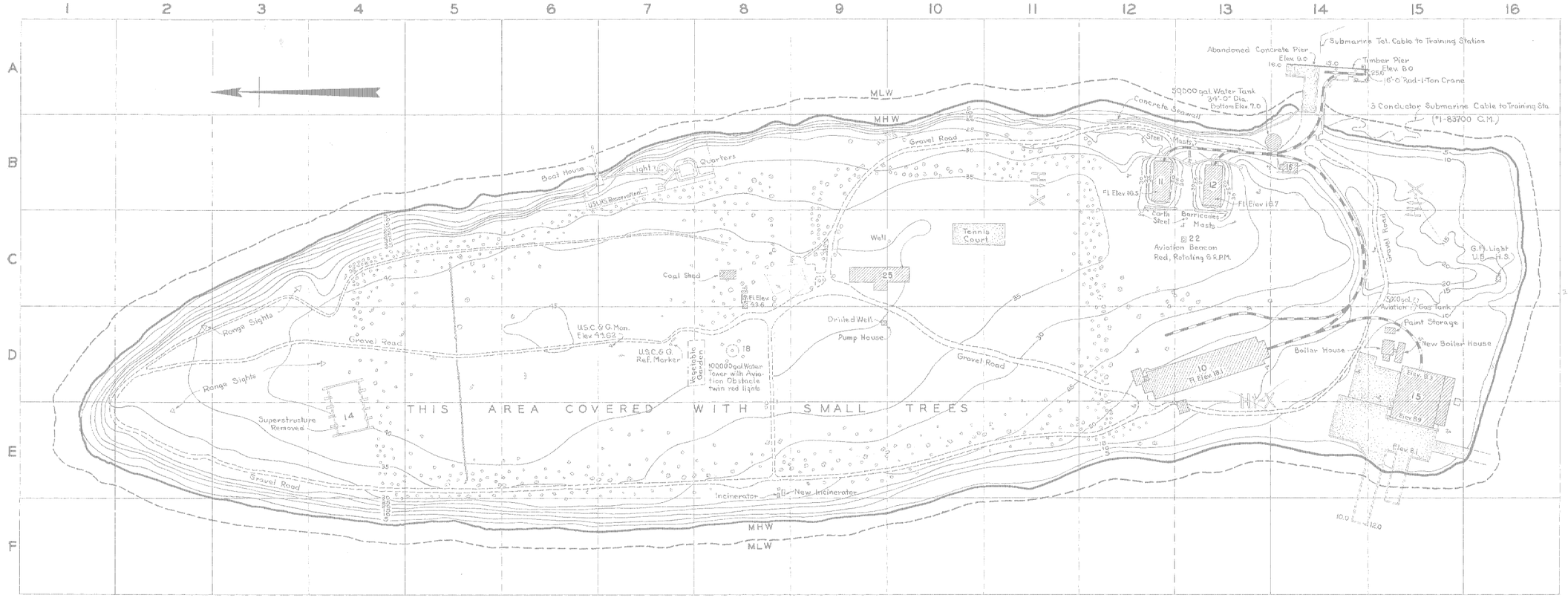
0' 150' 300'

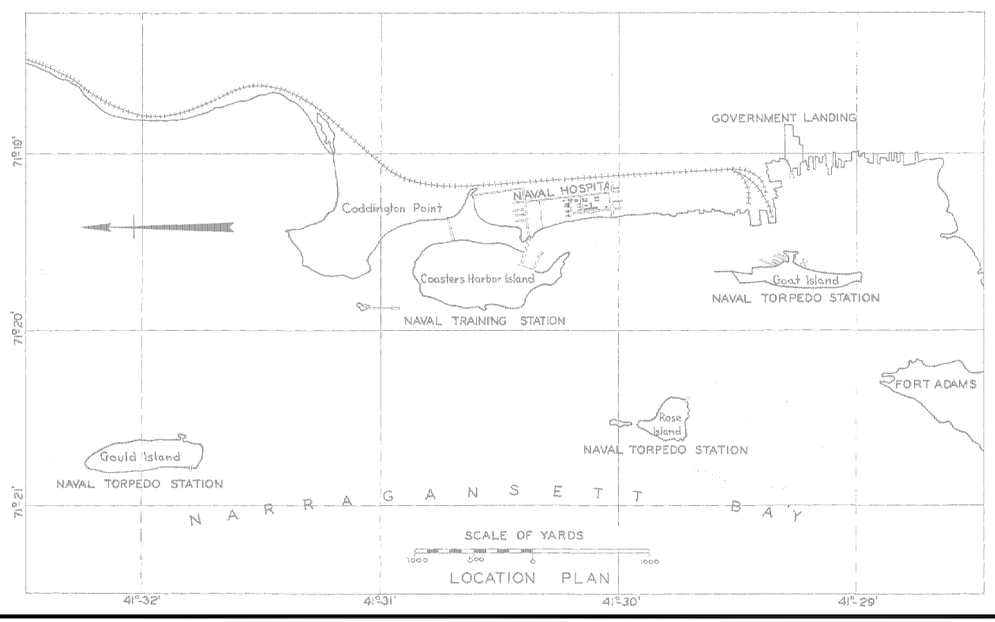
TETRA TECH NUS, INC.

BASE MAP
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE
00065\0410\BASE_MAP.DWG	AS NOTED
FIGURE NUMBER 1-3	REV 0 / DATE 05/01/06

ACAD: 00065\0410\HIST_SHORE.DWG 05/01/06 DWM





DEPT.	№	LOC	DESIGNATION
"	17	C-8	Coal Shed
S	10	D-13	Torpedo Storehouse
"	11	B-12	Warhead "
"	12	B-13	" "
Ma.	16	B-14	Waiting Room
A	14	E-9	Hanger Foundation
"	15	D-15	Seaplane Hanger
Mil.	25	C-9	B'ks. for Enlisted Personnel
	22	C-13	Aviation Beacon
	18	D-8	Water Tower

LEGEND

Railroad
Hydrant
Power Pole
Electric Light

Mil.=Military, Ma.=Maintenance
S.=Supply A.=Aviation

ELEVATIONS

Mean High Water	+3.7
Mean Low Water	0.0

AREAS

Total Area To M.L.W.	51.85 Acres.
Area to M.H.W. exclusive of U.S.L.H.S. Reservation	45.85 "
Area of U.S.L.H.S. Reservation	0.62 "

SOURCE: MAP OF GOULD ISLAND, U.S. NAVAL TORPEDO STATION SHOWING CONDITIONS ON JUNE 30, 1941, NEWPORT, R.I., U.S. NAVY, CORRECTED APRIL 1, 1943

TETRA TECH NUS, INC.

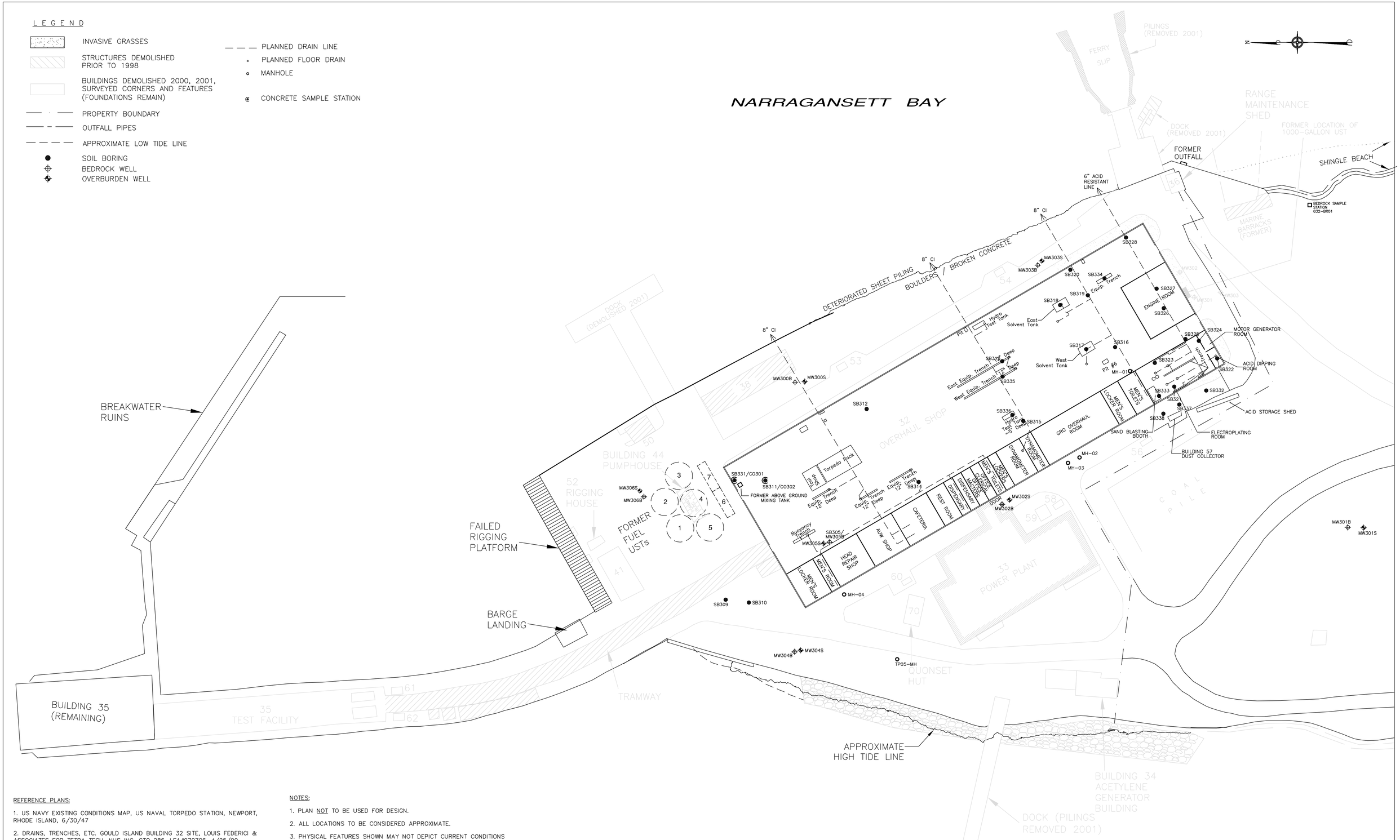
HISTORICAL SHORELINE
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE
00065\0410\HIST_SHORE.DWG	AS NOTED

FIGURE NUMBER	REV	DATE
1-4	0	05/01/06

LEGEND

- INVASIVE GRASSES
- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- SOIL BORING
- BEDROCK WELL
- OVERBURDEN WELL
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE
- CONCRETE SAMPLE STATION



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

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5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.

2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.

5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)

6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.

7. LOCATIONS FOR MW303S AND MW306S ARE APPROXIMATED BASED ON FIELD NOTES.

GRAPHIC SCALE

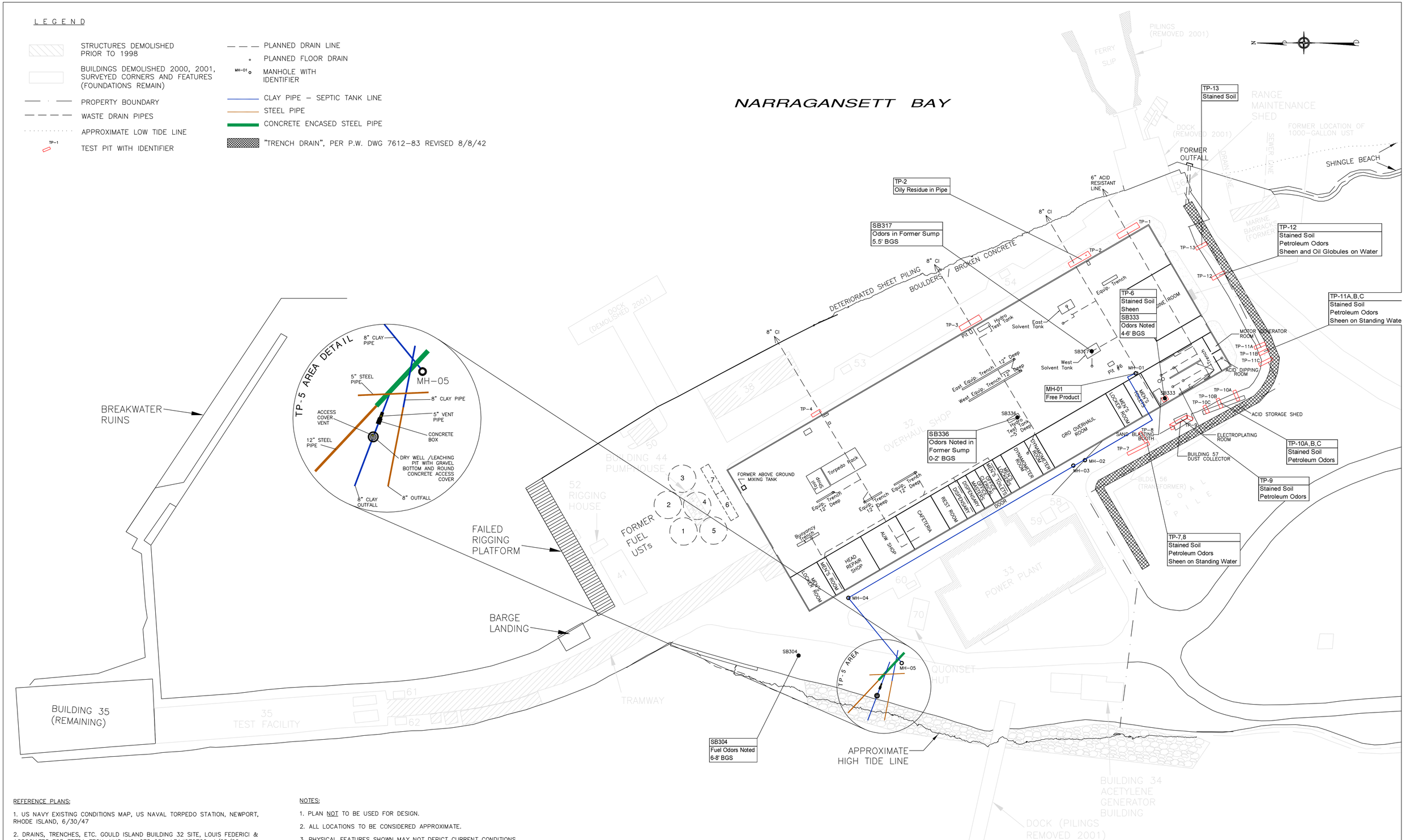
50' 0' 50' 100'

DRAWN BY: D.W.M. / R.G.D.	TITLE: SOIL BORING, MONITORING WELL, & CONCRETE SAMPLE LOCATIONS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: L. SEYDEWITZ	
CHECKED BY: S. PARKER	
	SOURCE: SEE NOTES
	SCALE: AS SHOWN; DATE: MAY 1, 2006; PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 2-1; ACFILE NAME: \00065\0410\BORINGS-WELLS.DWG; REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

LEGEND

- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- WASTE DRAIN PIPES
- APPROXIMATE LOW TIDE LINE
- TP-1 TEST PIT WITH IDENTIFIER
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MH-01 MANHOLE WITH IDENTIFIER
- CLAY PIPE – SEPTIC TANK LINE
- STEEL PIPE
- CONCRETE ENCASED STEEL PIPE
- "TRENCH DRAIN", PER P.W. DWG 7612-83 REVISED 8/8/42



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/‰
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.
7. LOCATIONS FOR MW303S AND MW306S ARE APPROXIMATED BASED ON FIELD NOTES.

GRAPHIC SCALE

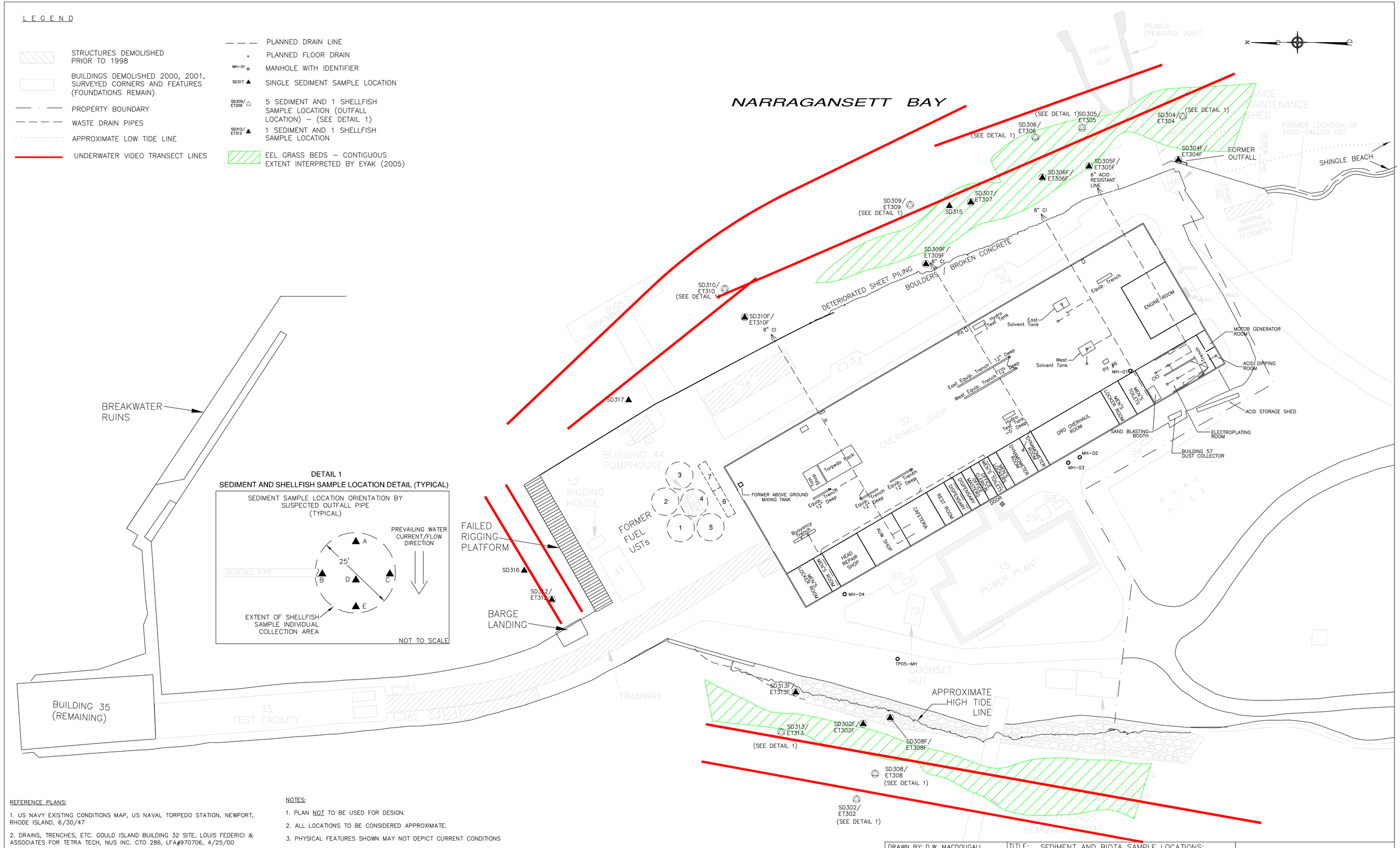
50' 0' 50' 100'

DRAWN BY: D.W. MACDOUGALL	TITLE: TEST PIT LOCATIONS, MANHOLES, UNDERGROUND STRUCTURES INVESTIGATED SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: L. SEYDEWITZ	
CHECKED BY: S. PARKER	SOURCE: SEE NOTES
	SCALE: AS SHOWN; DATE: OCTOBER 20, 2006; PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 2-2; ACFILE NAME: \00065\0440\PIPING-TEST_PITS.DWG; REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

LEGEND

- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- WASTE DRAIN PIPES
- APPROXIMATE LOW TIDE LINE
- UNDERWATER VIDEO TRANSECT LINES
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MH-01 MANHOLE WITH IDENTIFIER
- SD317 SINGLE SEDIMENT SAMPLE LOCATION
- SD309/ET309 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION (OUTFALL LOCATION) – (SEE DETAIL 1)
- SD312/ET312 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION
- EEL GRASS BEDS – CONTIGUOUS EXTENT INTERPRETED BY EYAK (2005)



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 05/09/00.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.

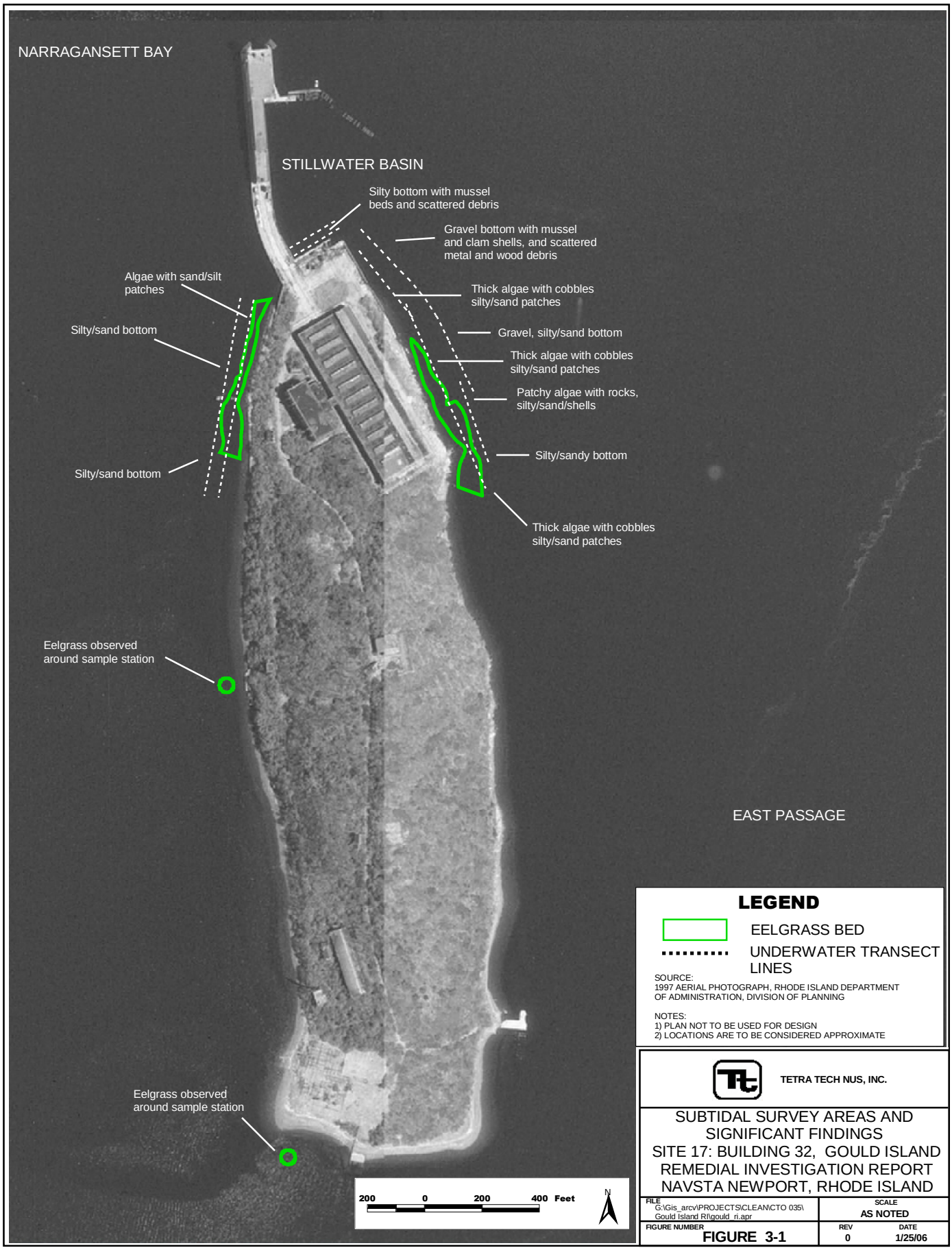
GRAPHIC SCALE

50' 0' 50' 100'

DRAWN BY: D.W. MACDOUGALL	TITLE: SEDIMENT AND BIOTA SAMPLE LOCATIONS: NORTH END OF GOULD ISLAND SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: L. SEYDEWITZ	
CHECKED BY: S. PARKER	
	SOURCE: SEE NOTES
	SCALE: AS SHOWN; DATE: MAY 1, 2006; PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 2-3; ACFILE NAME: \00065\0410\SEDIMENT.DWG; REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

NARRAGANSETT BAY
STILLWATER BASIN
SD312/
ET312
SD316
SD317
SD310/ET310
SD310F/ET310F
SD313/ET313
SD313F/
ET313F
SD302/ET302
SD302F/
ET302F
SD308/ET308
SD308F/
ET308F
SD309F/
ET309F
SD309/ET309
SD315
SD307
SD306F/
ET306F
SD306/ET306
SD305F/
ET305F
SD305/ET305
SD304F/
ET304F
SD304/ET304
SD303/
ET303
SD311/
ET311
EAST PASSAGE
SD301/
ET301
SD314
200 0 200 400 Feet
N
LEGEND
SEDIMENT AND BIOTA
SAMPLE LOCATIONS
SOURCE:
1997 AERIAL PHOTOGRAPH, RHODE ISLAND DEPARTMENT
OF ADMINISTRATION, DIVISION OF PLANNING
NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) LOCATIONS ARE TO BE CONSIDERED APPROXIMATE
TETRA TECH NUS, INC.
SEDIMENT AND BIOTA SAMPLE
STATIONS OVERVIEW, GOULD ISLAND
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND
FILE
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\
Gould Island RI\gould_ri.apr
SCALE
AS NOTED
FIGURE NUMBER
FIGURE 2-4
REV
0
DATE
1/25/06



LEGEND

EELGRASS BED

UNDERWATER TRANSECT LINES

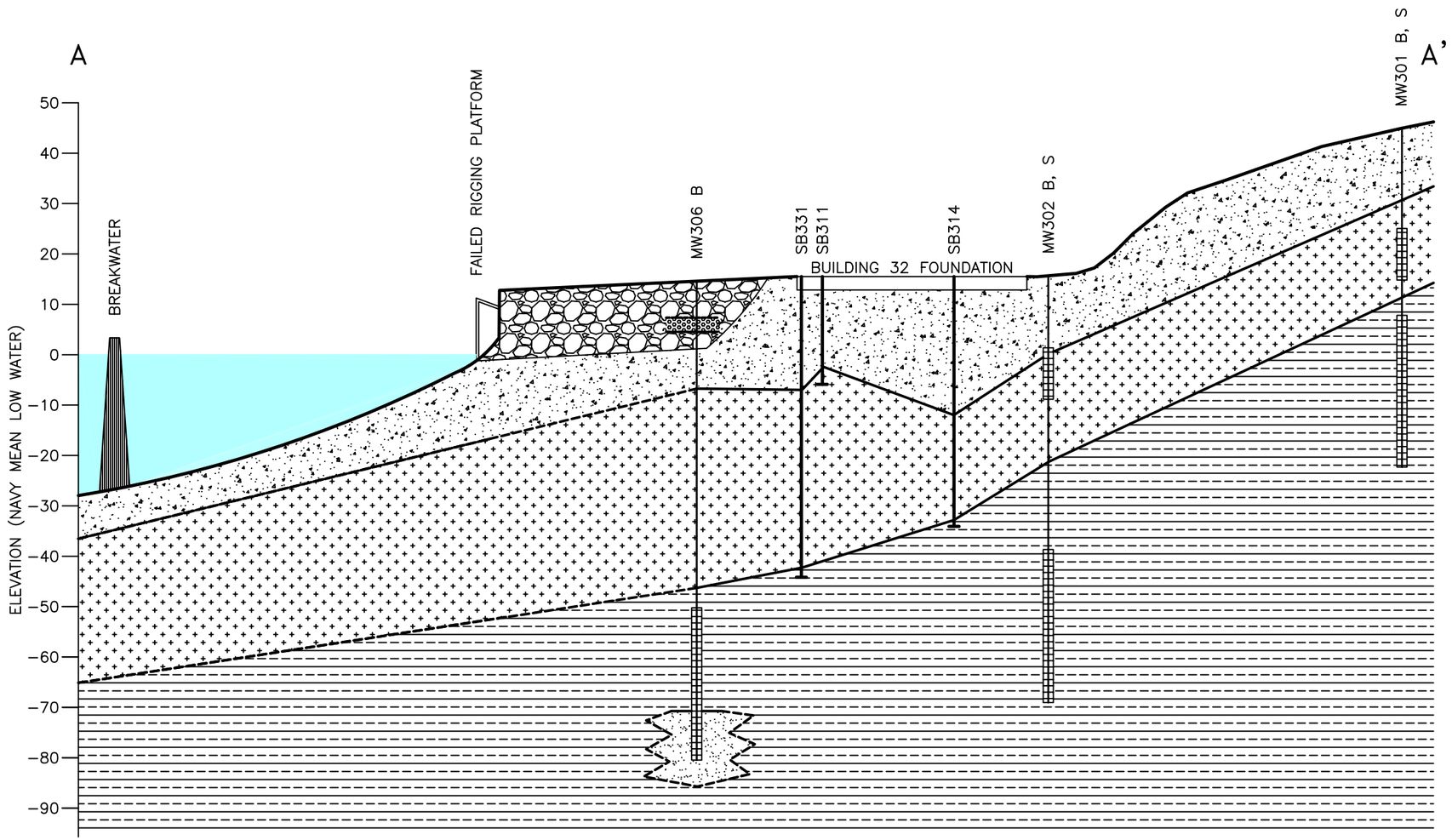
SOURCE:
1997 AERIAL PHOTOGRAPH, RHODE ISLAND DEPARTMENT OF ADMINISTRATION, DIVISION OF PLANNING

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) LOCATIONS ARE TO BE CONSIDERED APPROXIMATE

TETRA TECH NUS, INC.

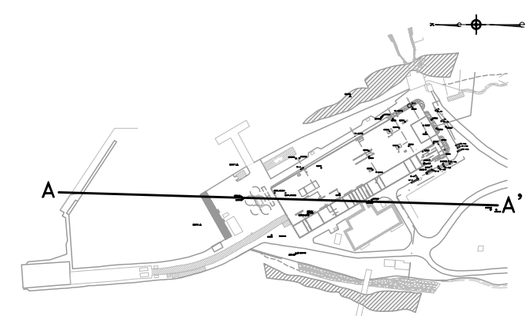
SUBTIDAL SURVEY AREAS AND SIGNIFICANT FINDINGS
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE	
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\ Gould Island RI\gould_ri.apr	AS NOTED	
FIGURE NUMBER	REV	DATE
FIGURE 3-1	0	1/25/06



LEGEND

- FILL
- SILTY SAND AND GRAVEL FINE TO MEDIUM SAND, SILT, GRAVEL, AND ROCK FRAGMENTS
- TILL DENSE FINE TO MEDIUM SAND, SILT, GRAVEL, AND ROCK FRAGMENTS
- BEDROCK PHYLLITE
- BEDROCK METASANDSTONE
- CONCRETE
- MW304 — MONITORING WELL NUMBER
- MONITORING WELL
- SCREENED INTERVAL
- END OF BORING
- SB310 — BORING NUMBER
- SOIL BORING
- END OF BORING



GRAPHIC SCALE

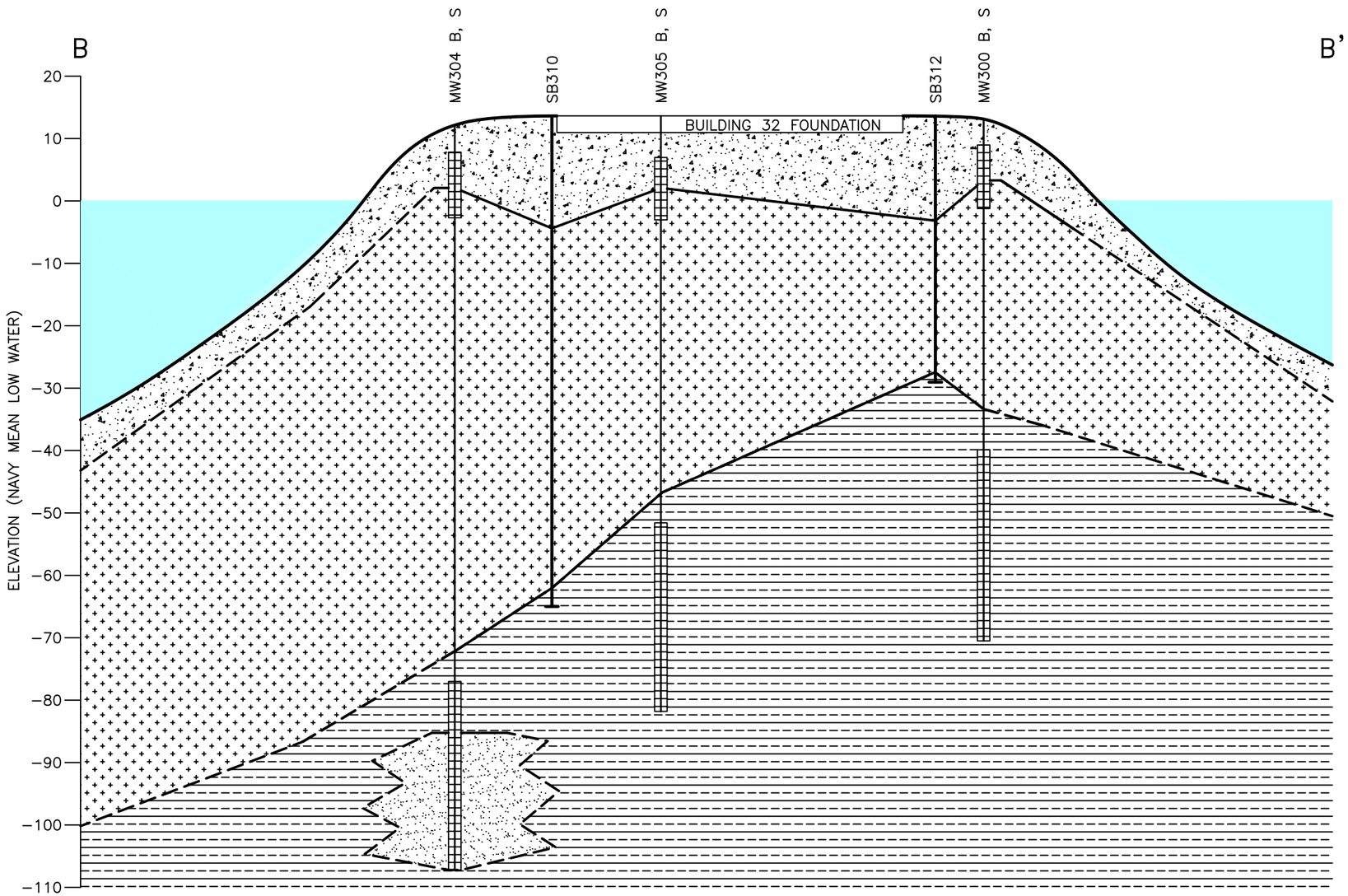
0' 160' 320'

VERTICAL EXAGGERATION = 6.25

NOTES

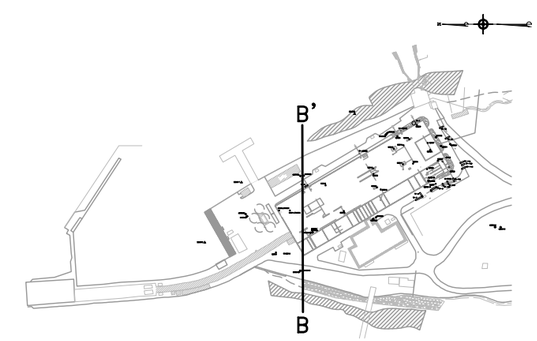
1. THE DEPTHS AND THICKNESSES DETERMINED FOR THE SUBSURFACE STRATA WERE GENERALIZED FROM AND INTERPOLATED BETWEEN TEST BORINGS. THE STRATIFICATION LINES REPRESENT AN APPROXIMATE BOUNDARY BETWEEN STRATAGRAPHIC UNITS; THE TRANSITION MAY BE GRADUAL. INFORMATION ON SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS; THEREFORE, IT IS POSSIBLE THAT THE SUBSURFACE CONDITIONS MAY VARY FROM THOSE INDICATED.
2. HORIZONTAL DATUM IS BASED ON THE RI STATE PLANE COORDINATE SYSTEM NAD 1927. VERTICAL DATUM IS BASED ON NAVAL BASE MEAN LOW WATER.
3. DASHED LINES INDICATE UNCERTAINTY.
4. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
5. PLAN NOT TO BE USED FOR DESIGN.

GEOLOGIC CROSS–SECTION A – A'			FIGURE 3–2
SITE 17, BUILDING 32, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658–7899
DRAWN BY:	MK BOND	REV.: 0	
CHECKED BY:	B. O'NEIL	DATE: 01/25/2006	
SCALE:	1" = 160'	FILE NO.: 112G00065\0410\112G00065GX01.DWG	



LEGEND

- SILTY SAND AND GRAVEL FINE TO MEDIUM SAND, SILT, GRAVEL, AND ROCK FRAGMENTS
- TILL DENSE FINE TO MEDIUM SAND, SILT, GRAVEL, AND ROCK FRAGMENTS
- BEDROCK PHYLLITE
- BEDROCK METASANDSTONE
- MW304 — MONITORING WELL NUMBER
- MONITORING WELL
- SCREENED INTERVAL
- END OF BORING
- SB310 — BORING NUMBER
- SOIL BORING
- END OF BORING



GRAPHIC SCALE

0' 80' 160'

VERTICAL EXAGGERATION = 4.0

NOTES

1. THE DEPTHS AND THICKNESSES DETERMINED FOR THE SUBSURFACE STRATA WERE GENERALIZED FROM AND INTERPOLATED BETWEEN TEST BORINGS. THE STRATIFICATION LINES REPRESENT AN APPROXIMATE BOUNDARY BETWEEN STRATAGRAPHIC UNITS; THE TRANSITION MAY BE GRADUAL. INFORMATION ON SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS; THEREFORE, IT IS POSSIBLE THAT THE SUBSURFACE CONDITIONS MAY VARY FROM THOSE INDICATED.
2. HORIZONTAL DATUM IS BASED ON THE RI STATE PLANE COORDINATE SYSTEM NAD 1927. VERTICAL DATUM IS BASED ON NAVAL BASE MEAN LOW WATER.
3. DASHED LINES INDICATE UNCERTAINTY.
4. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
5. PLAN NOT TO BE USED FOR DESIGN.

GEOLOGIC CROSS–SECTION B – B'

SITE 17, BUILDING 32, GOULD ISLAND

NAVSTA NEWPORT, RHODE ISLAND

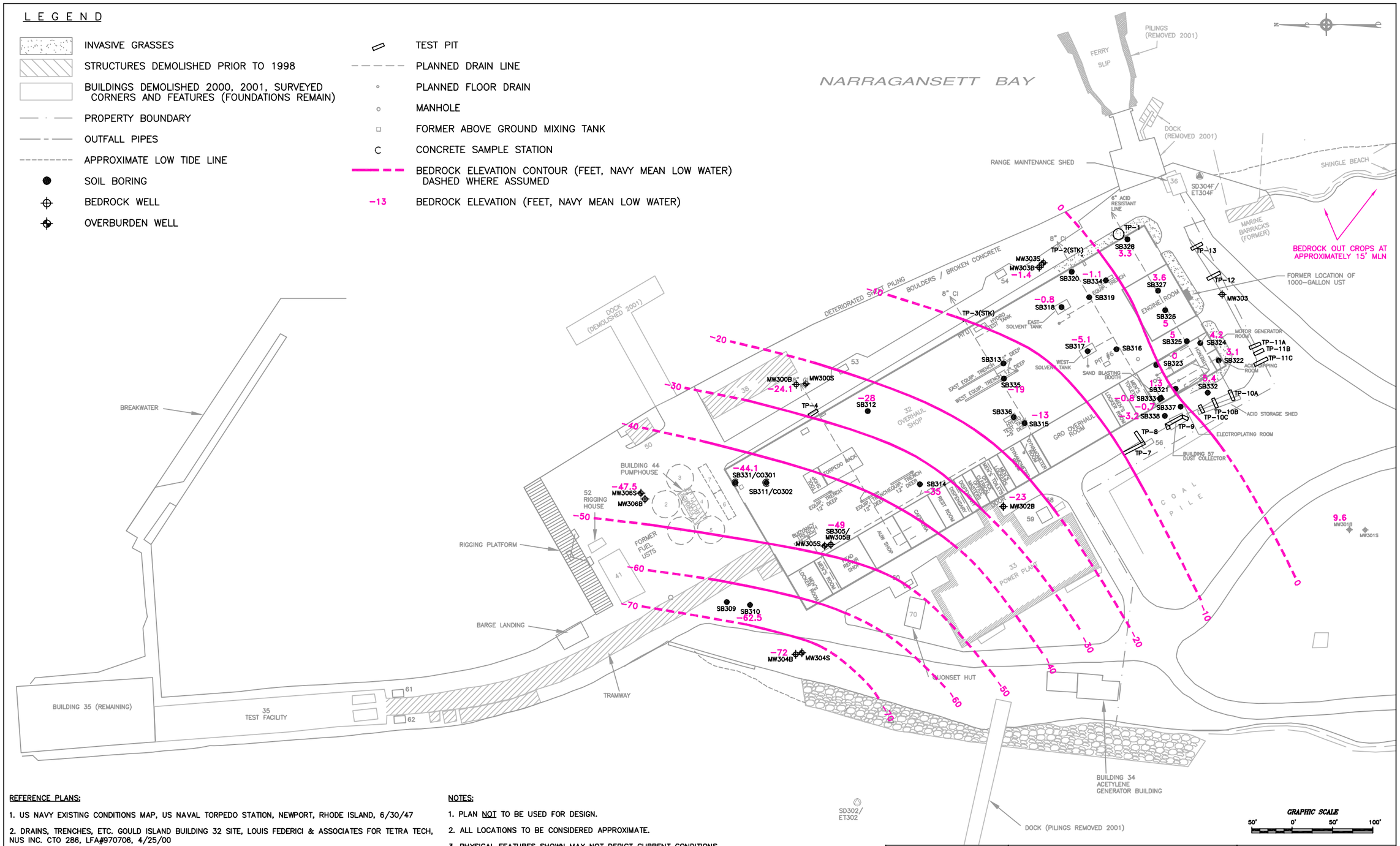
DRAWN BY:	MK BOND	REV.:	0
CHECKED BY:	B. O'NEIL	DATE:	01/25/2006
SCALE:	1" = 80'	FILE NO.:	112G00065\0410\112G00065GX01.DWG

FIGURE 3–3

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658–7899

LEGEND

- INVASIVE GRASSES
- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- SOIL BORING
- BEDROCK WELL
- OVERBURDEN WELL
- TEST PIT
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE
- FORMER ABOVE GROUND MIXING TANK
- C CONCRETE SAMPLE STATION
- BEDROCK ELEVATION CONTOUR (FEET, NAVY MEAN LOW WATER) DASHED WHERE ASSUMED
- −13 BEDROCK ELEVATION (FEET, NAVY MEAN LOW WATER)



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/‰
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

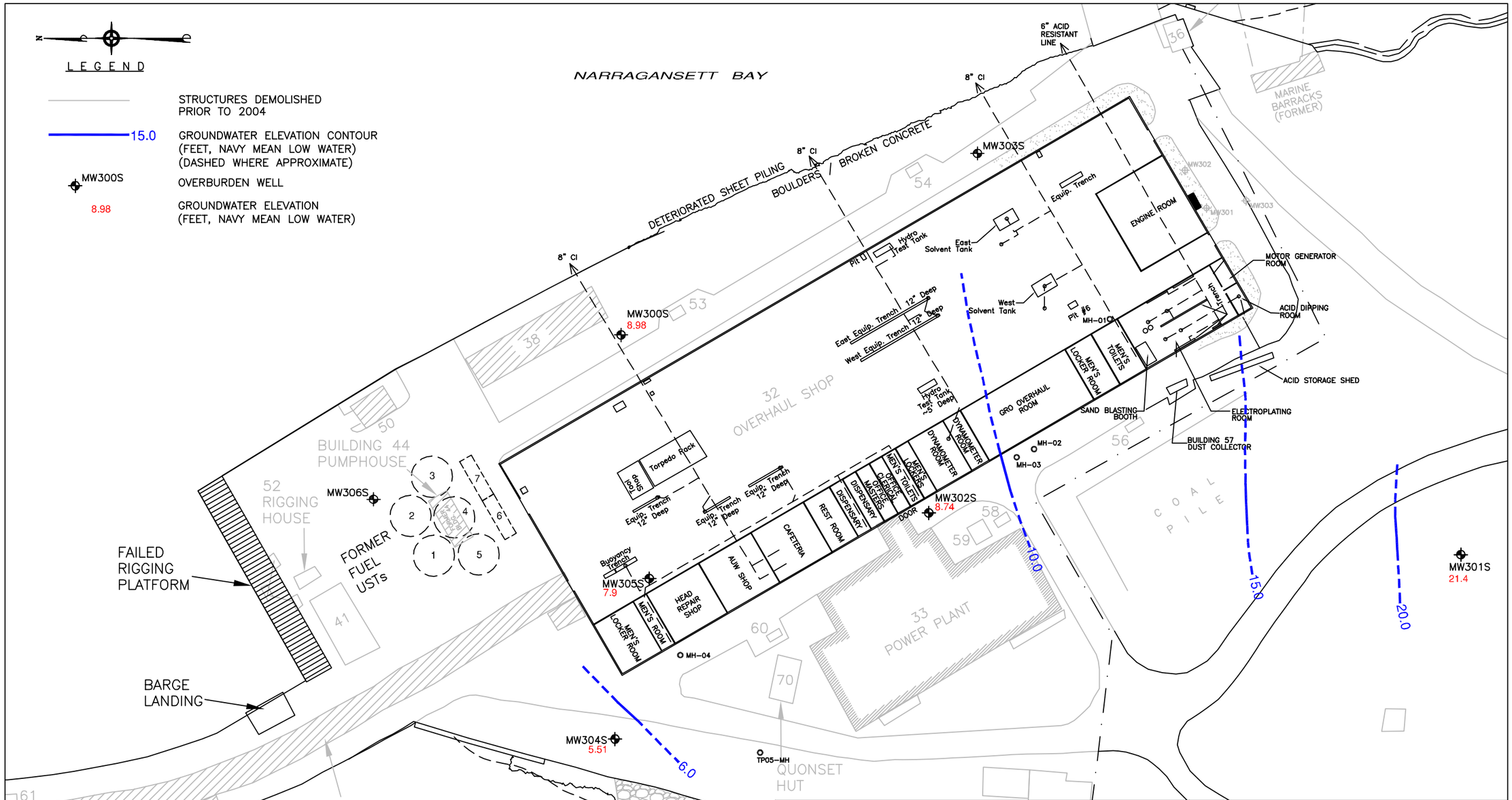
1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.
7. LOCATIONS FOR MW303S AND MW306S ARE APPROXIMATED BASED ON FIELD NOTES.

DRAWN BY: MK BOND	INTERPRETED BEDROCK SURFACE ELEVATION CONTOUR MAP SITE 17, BUILDING 32 GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND		TETRA TECH NUS, INC. 55 JONSPIN ROAD WILMINGTON, MASSACHUSETTS 01887 (978)658-7899
PREPARED BY: L. SEYDEWITZ			
CHECKED BY: S. PARKER	SOURCE: SEE NOTES		
	SCALE: AS SHOWN	DATE: DECEMBER 23, 2005	PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: FIGURE 3-4	ACFILE NAME: 112G000065\0410\112G000065GM01.DWG	REV: 0
PROGRAM MANAGER: J. TREPANOWSKI			

TETRA TECH NUS, INC.

GROUNDWATER CLASSIFICATIONS, RIGIS SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE	
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\Gould Island\gould_ri_3_2.apr	AS NOTED	
FIGURE NUMBER	REV	DATE
FIGURE 3-5	0	1/26/06



NOTES:

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

INTERPRETED OVERBURDEN GROUNDWATER CONTOURS – AUGUST 30, 2005

SITE 17: BUILDING 32, GOULD ISLAND

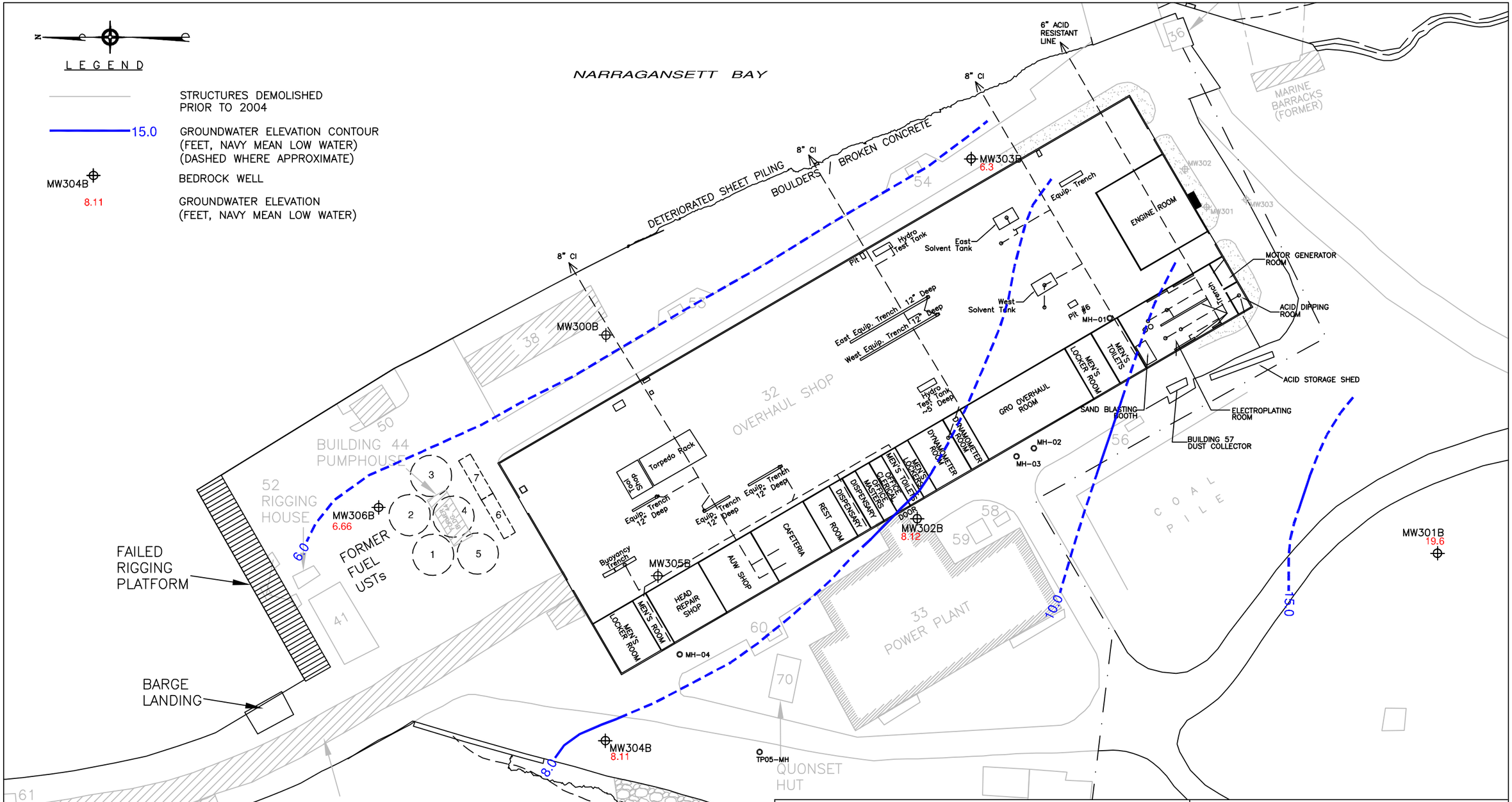
NAVSTA NEWPORT, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	J. TRAUT	DATE:	JANUARY 26, 2005
SCALE:	AS NOTED	FILE NO.:	00065\0410\OVERBURDEN_CONTOUR.DWG

FIGURE 3–6A

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658–7899



NOTES:

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

INTERPRETED BEDROCK GROUNDWATER CONTOURS – AUGUST 30, 2005

SITE 17: BUILDING 32, GOULD ISLAND

NAVSTA NEWPORT, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	J. TRAUT	DATE:	JANUARY 26, 2005
SCALE:	AS NOTED	FILE NO.:	00065\0410\BEDROCK_CONTOUR.DWG

FIGURE 3–6B

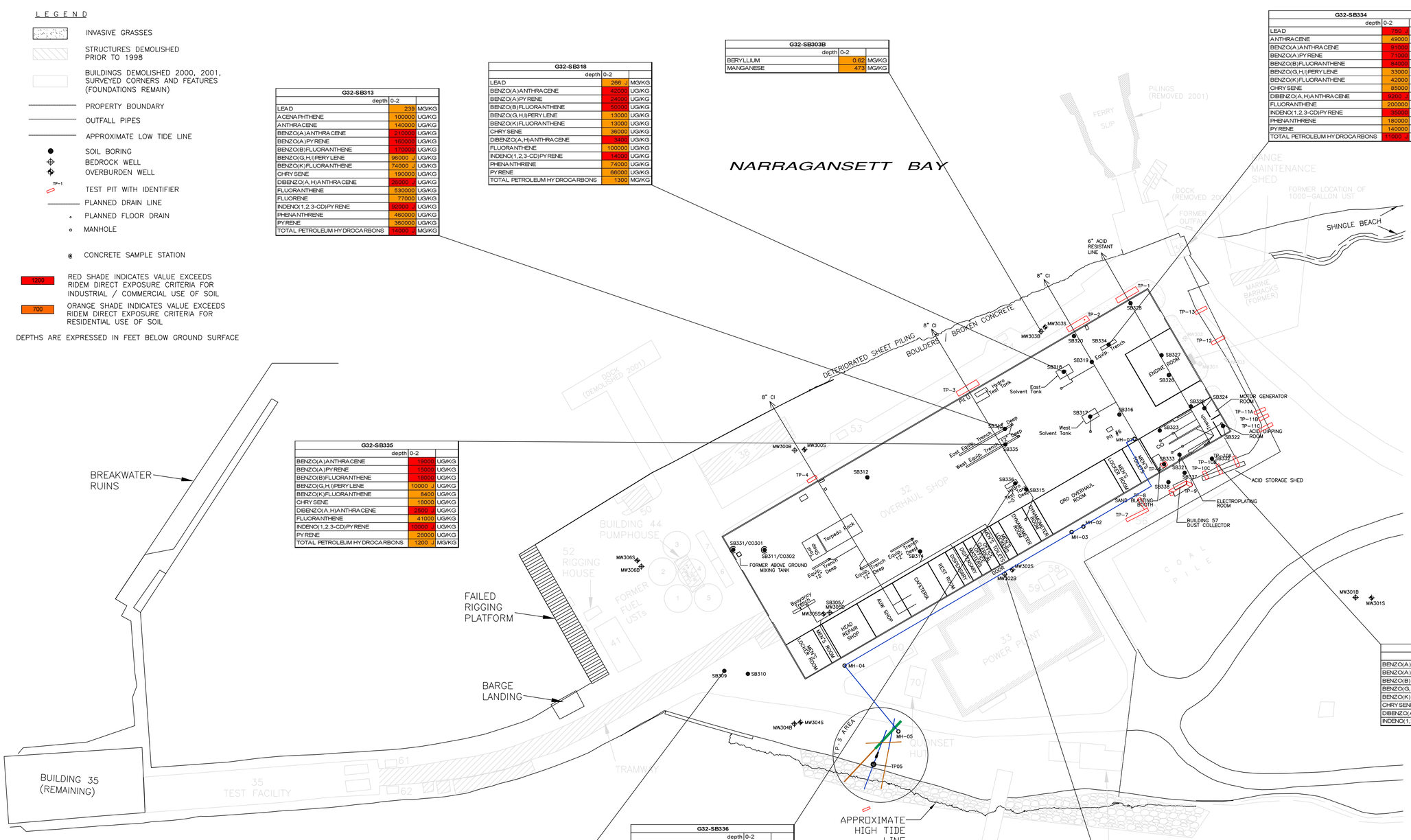
TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

LEGEND

- INVASIVE GRASSES
- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- SOIL BORING
- BEDROCK WELL
- OVERBURDEN WELL
- TP-1 TEST PIT WITH IDENTIFIER
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE
- CONCRETE SAMPLE STATION
- 1200 RED SHADE INDICATES VALUE EXCEEDS RIDEM DIRECT EXPOSURE CRITERIA FOR INDUSTRIAL / COMMERCIAL USE OF SOIL
- 700 ORANGE SHADE INDICATES VALUE EXCEEDS RIDEM DIRECT EXPOSURE CRITERIA FOR RESIDENTIAL USE OF SOIL

DEPTHS ARE EXPRESSED IN FEET BELOW GROUND SURFACE



G32-SB313		
depth	0-2	
LEAD	239	MG/KG
ACENAPHTHENE	100000	UG/KG
ANTHRACENE	140000	UG/KG
BENZO(A)ANTHRACENE	210000	UG/KG
BENZO(A)PYRENE	160000	UG/KG
BENZO(B)FLUORANTHENE	170000	UG/KG
BENZO(G,H,I)PERYLENE	96000 J	UG/KG
BENZO(K)FLUORANTHENE	74000 J	UG/KG
CHRYSENE	190000	UG/KG
DIBENZO(A,H)ANTHRACENE	26000 J	UG/KG
FLUORANTHENE	530000	UG/KG
FLUORENE	77000	UG/KG
INDENO(1,2,3-CD)PYRENE	92000 J	UG/KG
PHENANTHRENE	460000	UG/KG
PYRENE	360000	UG/KG
TOTAL PETROLEUM HYDROCARBONS	14000 J	MG/KG

G32-SB318		
depth	0-2	
LEAD	266 J	MG/KG
BENZO(A)ANTHRACENE	42000	UG/KG
BENZO(A)PYRENE	24000	UG/KG
BENZO(B)FLUORANTHENE	50000	UG/KG
BENZO(G,H,I)PERYLENE	13000	UG/KG
BENZO(K)FLUORANTHENE	13000	UG/KG
CHRYSENE	36000	UG/KG
DIBENZO(A,H)ANTHRACENE	3400	UG/KG
FLUORANTHENE	100000	UG/KG
INDENO(1,2,3-CD)PYRENE	14000	UG/KG
PHENANTHRENE	74000	UG/KG
PYRENE	66000	UG/KG
TOTAL PETROLEUM HYDROCARBONS	1300	MG/KG

G32-SB303B		
depth	0-2	
BERYLLIUM	0.62	MG/KG
MANGANESE	473	MG/KG

G32-SB334		
depth	0-2	
LEAD	750 J	MG/KG
ANTHRACENE	49000	UG/KG
BENZO(A)ANTHRACENE	91000	UG/KG
BENZO(A)PYRENE	71000	UG/KG
BENZO(B)FLUORANTHENE	84000	UG/KG
BENZO(G,H,I)PERYLENE	33000	UG/KG
BENZO(K)FLUORANTHENE	42000	UG/KG
CHRYSENE	85000	UG/KG
DIBENZO(A,H)ANTHRACENE	9200 J	UG/KG
FLUORANTHENE	200000	UG/KG
INDENO(1,2,3-CD)PYRENE	35000	UG/KG
PHENANTHRENE	180000	UG/KG
PYRENE	140000	UG/KG
TOTAL PETROLEUM HYDROCARBONS	1100 J	MG/KG

G32-SB335		
depth	0-2	
BENZO(A)ANTHRACENE	19000	UG/KG
BENZO(A)PYRENE	15000	UG/KG
BENZO(B)FLUORANTHENE	18000	UG/KG
BENZO(G,H,I)PERYLENE	10000 J	UG/KG
BENZO(K)FLUORANTHENE	8400	UG/KG
CHRYSENE	18000	UG/KG
DIBENZO(A,H)ANTHRACENE	2500 J	UG/KG
FLUORANTHENE	41000	UG/KG
INDENO(1,2,3-CD)PYRENE	10000 J	UG/KG
PYRENE	28000	UG/KG
TOTAL PETROLEUM HYDROCARBONS	1200 J	MG/KG

G32-SB332		
depth	0-2	
BENZO(A)ANTHRACENE	2900	UG/KG
BENZO(A)PYRENE	3600	UG/KG
BENZO(B)FLUORANTHENE	2900	UG/KG
BENZO(G,H,I)PERYLENE	1400 J	UG/KG
BENZO(K)FLUORANTHENE	1300	UG/KG
CHRYSENE	3000	UG/KG
DIBENZO(A,H)ANTHRACENE	440 J	UG/KG
INDENO(1,2,3-CD)PYRENE	1500 J	UG/KG

G32-SB336		
depth	0-2	
LEAD	250	MG/KG
ANTHRACENE	44000	UG/KG
BENZO(A)ANTHRACENE	110000	UG/KG
BENZO(A)PYRENE	91000	UG/KG
BENZO(B)FLUORANTHENE	120000	UG/KG
BENZO(G,H,I)PERYLENE	56000 J	UG/KG
BENZO(K)FLUORANTHENE	51000 J	UG/KG
CHRYSENE	100000	UG/KG
DIBENZO(A,H)ANTHRACENE	14000 J	UG/KG
FLUORANTHENE	240000	UG/KG
INDENO(1,2,3-CD)PYRENE	58000 J	UG/KG
PHENANTHRENE	150000	UG/KG
PYRENE	170000	UG/KG
TOTAL PETROLEUM HYDROCARBONS	1500	MG/KG

G32-SB309		
depth	0-2	
CHRYSENE	470	UG/KG

G32-SB302B		
depth	0-2	
BENZO(A)PYRENE	440 J	UG/KG
CHRYSENE	420	UG/KG

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/‰
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.
7. LOCATIONS FOR MW303S AND MW306S ARE APPROXIMATED BASED ON FIELD NOTES.

GRAPHIC SCALE

60′ 0′ 60′ 120′

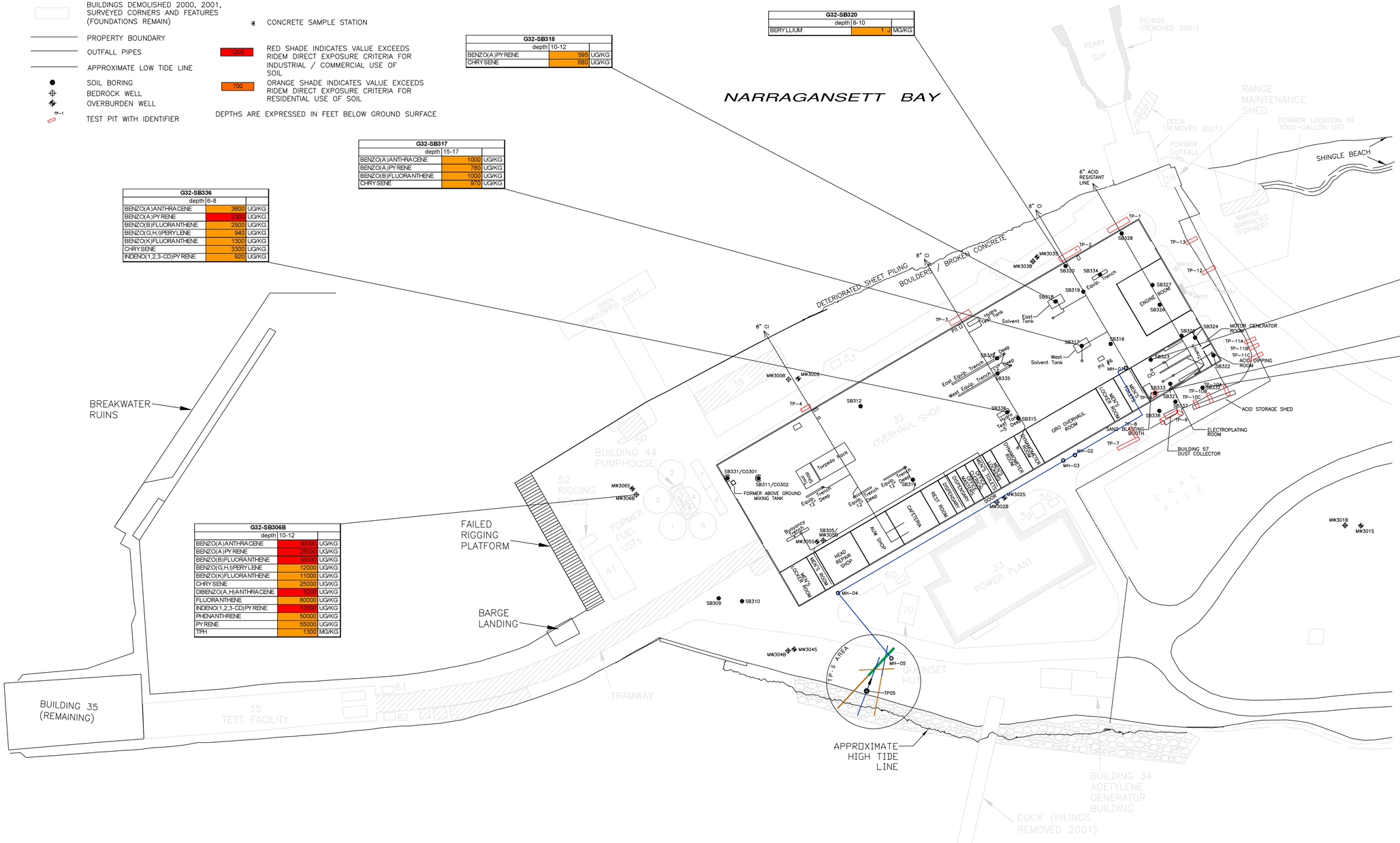
DRAWN BY: D.W.M. / R.G.D.	TITLE: SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: J. TRAUT	
CHECKED BY: S. PARKER	
	SOURCE: SEE NOTES
	SCALE: AS SHOWN / DATE: MAY 1, 2006 / PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 4-1A / ACFILE NAME: \00065\0410\SURF_SOIL_TAGS.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

TETRA TECH NUS, INC.
55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

LEGEND

- INVASIVE GRASSES
- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- SOIL BORING
- BEDROCK WELL
- OVERBURDEN WELL
- TP-1 TEST PIT WITH IDENTIFIER
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE
- CONCRETE SAMPLE STATION
- 1200 RED SHADE INDICATES VALUE EXCEEDS RIDEM DIRECT EXPOSURE CRITERIA FOR INDUSTRIAL / COMMERCIAL USE OF SOIL
- 700 ORANGE SHADE INDICATES VALUE EXCEEDS RIDEM DIRECT EXPOSURE CRITERIA FOR RESIDENTIAL USE OF SOIL

DEPTHS ARE EXPRESSED IN FEET BELOW GROUND SURFACE



G32-SB320		
depth	8-10	
BERYLLIUM	1 U	MG/KG

G32-SB318		
depth	10-12	
BENZO(A)PYRENE	595	UG/KG
CHRYSENE	680	UG/KG

G32-SB317		
depth	15-17	
BENZO(A)ANTHRACENE	1000	UG/KG
BENZO(A)PYRENE	780	UG/KG
BENZO(B)FLUORANTHENE	1000	UG/KG
CHRYSENE	970	UG/KG

G32-SB336		
depth	6-8	
BENZO(A)ANTHRACENE	3600	UG/KG
BENZO(A)PYRENE	2300	UG/KG
BENZO(B)FLUORANTHENE	2900	UG/KG
BENZO(G,H,I)PERYLENE	940	UG/KG
BENZO(K)FLUORANTHENE	1300	UG/KG
CHRYSENE	3300	UG/KG
INDENO(1,2,3-CD)PYRENE	920	UG/KG

G32-SB306B		
depth	10-12	
BENZO(A)ANTHRACENE	30000	UG/KG
BENZO(A)PYRENE	25000	UG/KG
BENZO(B)FLUORANTHENE	36000	UG/KG
BENZO(G,H,I)PERYLENE	12000	UG/KG
BENZO(K)FLUORANTHENE	11000	UG/KG
CHRYSENE	25000	UG/KG
DIBENZO(A,H)ANTHRACENE	3200	UG/KG
FLUORANTHENE	80000	UG/KG
INDENO(1,2,3-CD)PYRENE	12000	UG/KG
PHENANTHRENE	50000	UG/KG
PYRENE	55000	UG/KG
TPH	1300	MG/KG

G32-SB323		
depth	10-12	
ARSENIC	23.1 J	MG/KG

G32-SB333		
depth	12-14	
BENZO(A)PYRENE	410	UG/KG
CHRYSENE	480	UG/KG

G32-SB332		
depth	4-6	
ARSENIC	8.5 J	MG/KG

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/‰

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GRAPHIC SCALE

60′ 0′ 60′ 120′

DRAWN BY: D.W.M. / R.G.D.	TITLE: SUMMARY OF SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS FROM BORINGS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: J. TRAUT	
CHECKED BY: S. PARKER	
	SOURCE: SEE NOTES
	SCALE: AS SHOWN / DATE: MAY 1, 2006 / PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 4-1B / ACFILE NAME: \00065\D410\SUB_SOIL_TAGS.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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LEGEND

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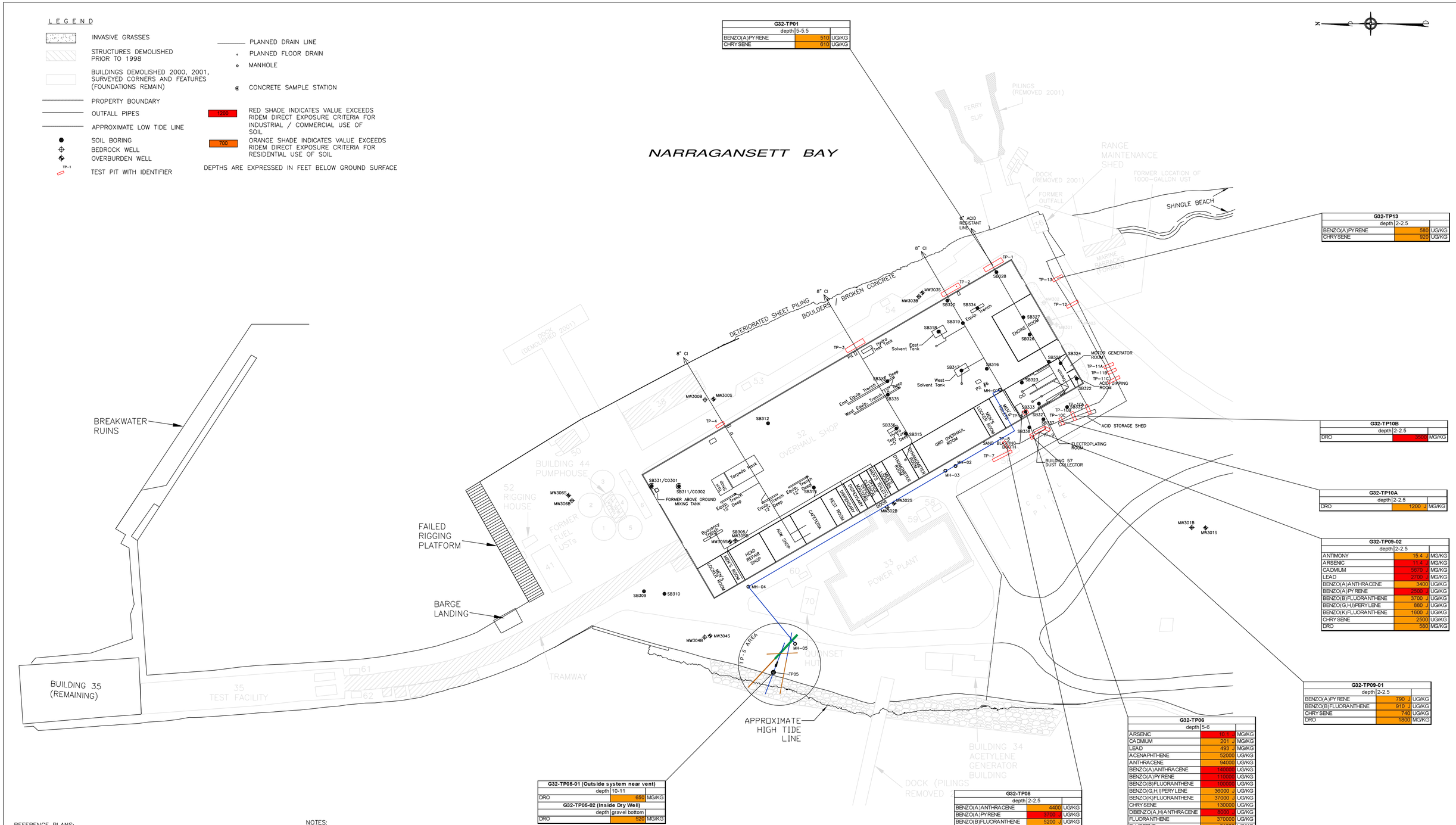
DEPTHS ARE EXPRESSED IN FEET BELOW GROUND SURFACE



G32-TP01		
depth	5-5.5	
BENZO(A)PYRENE	510	UG/KG
CHRYSENE	610	UG/KG

G32-TP13		
depth	2-2.5	
BENZO(A)PYRENE	580	UG/KG
CHRYSENE	920	UG/KG

G32-TP10B		
depth	2-2.5	
DRO	3500	MG/KG

G32-TP10A		
depth	2-2.5	
DRO	1200 J	MG/KG

G32-TP09-02		
depth	2-2.5	
ANTIMONY	15.4 J	MG/KG
ARSENIC	11.4 J	MG/KG
CADMIUM	5670 J	MG/KG
LEAD	2700 J	MG/KG
BENZO(A)ANTHRACENE	3400	UG/KG
BENZO(A)PYRENE	2500 J	UG/KG
BENZO(B)FLUORANTHENE	3700 J	UG/KG
BENZO(G,H,I)PERYLENE	880 J	UG/KG
BENZO(K)FLUORANTHENE	1600 J	UG/KG
CHRYSENE	2500	UG/KG
DRO	580	MG/KG

G32-TP09-01		
depth	2-2.5	
BENZO(A)PYRENE	790 J	UG/KG
BENZO(B)FLUORANTHENE	910 J	UG/KG
CHRYSENE	740	UG/KG
DRO	1800	MG/KG

G32-TP06		
depth	5-6	
ARSENIC	10.1 J	MG/KG
CADMIUM	201 J	MG/KG
LEAD	493 J	MG/KG
ACENAPHTHENE	52000	UG/KG
ANTHRACENE	94000	UG/KG
BENZO(A)ANTHRACENE	140000	UG/KG
BENZO(A)PYRENE	110000	UG/KG
BENZO(B)FLUORANTHENE	100000	UG/KG
BENZO(G,H,I)PERYLENE	36000 J	UG/KG
BENZO(K)FLUORANTHENE	37000 J	UG/KG
CHRYSENE	130000	UG/KG
DIBENZO(A,H)ANTHRACENE	8000 J	UG/KG
FLUORANTHENE	370000	UG/KG
FLUORENE	61000	UG/KG
INDENO(1,2,3-CD)PYRENE	34000 J	UG/KG
PHENANTHRENE	360000	UG/KG
PYRENE	260000	UG/KG
DRO	4600	MG/KG

G32-TP08		
depth	2-2.5	
BENZO(A)ANTHRACENE	4400	UG/KG
BENZO(A)PYRENE	3700 J	UG/KG
BENZO(B)FLUORANTHENE	5200 J	UG/KG
BENZO(G,H,I)PERYLENE	1100 J	UG/KG
BENZO(K)FLUORANTHENE	1900 J	UG/KG
CHRYSENE	3700	UG/KG
INDENO(1,2,3-CD)PYRENE	1300 J	UG/KG

G32-TP05-01 (Outside system near vent)		
depth	10-11	
DRO	550	MG/KG
G32-TP05-02 (Inside Dry Well)		
depth	gravel bottom	
DRO	520	MG/KG

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/‰
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

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7. LOCATIONS FOR MW303S AND MW306S ARE APPROXIMATED BASED ON FIELD NOTES.

GRAPHIC SCALE

60′ 0′ 60′ 120′

DRAWN BY: D.W.M. / R.G.D.	TITLE: SUMMARY OF TEST PIT SOIL SAMPLE ANALYTICAL RESULTS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: J. TRAUT	
CHECKED BY: S. PARKER	SOURCE: SEE NOTES
	SCALE: AS SHOWN / DATE: APRIL 28, 2006 / PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 4-1C / ACFILE NAME: \00065\0410\TP_TAGS.DWG / REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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LEGEND

- INVASIVE GRASSES
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- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
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- OUTFALL PIPES
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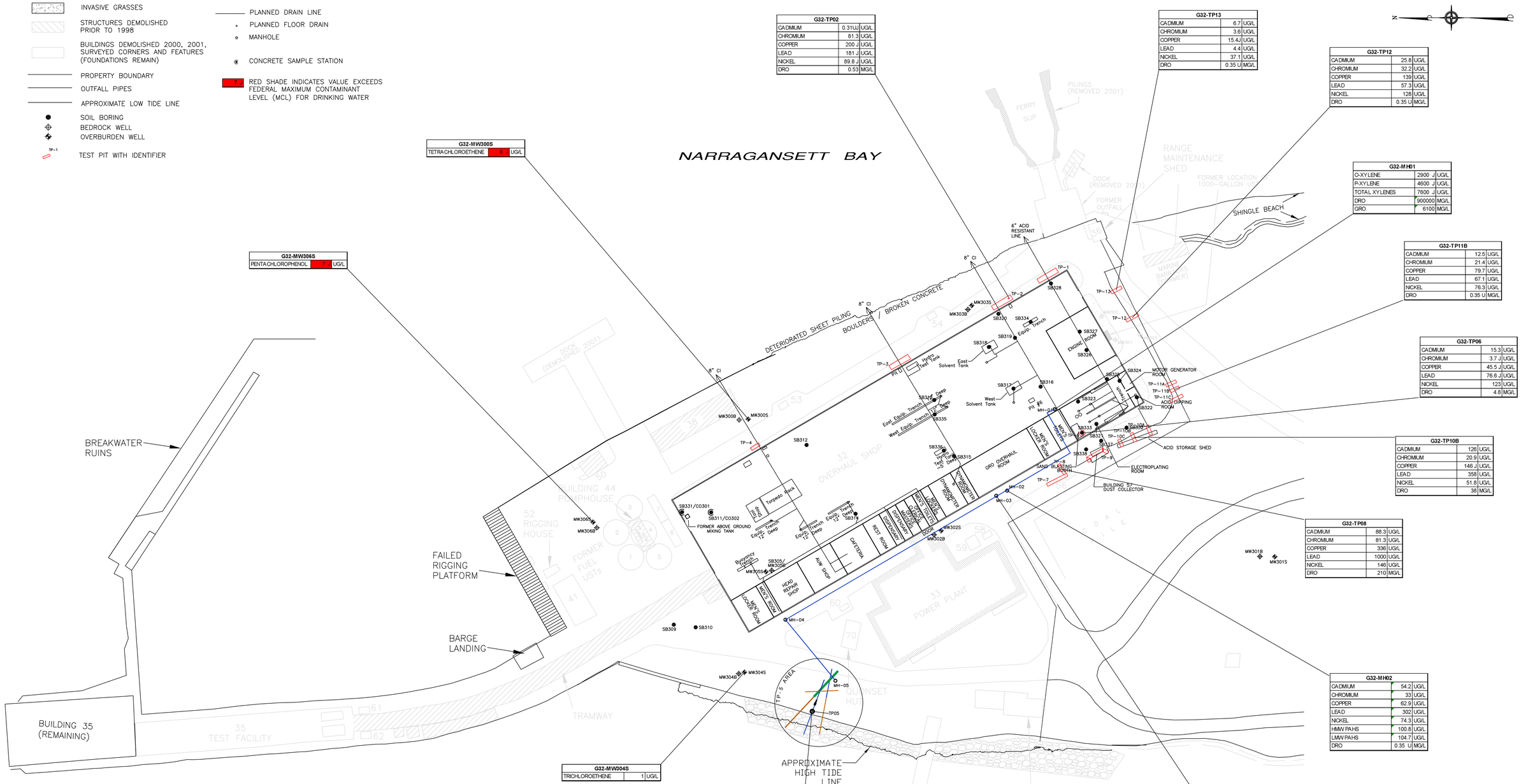
- BEDROCK WELL
- OVERBURDEN WELL
- TP-1 TEST PIT WITH IDENTIFIER
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE
- CONCRETE SAMPLE STATION
- 7.4 RED SHADE INDICATES VALUE EXCEEDS FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL) FOR DRINKING WATER



G32-TP02		
CADMIUM	0.31UJ	UG/L
CHROMIUM	81.3	UG/L
COPPER	200 J	UG/L
LEAD	181 J	UG/L
NICKEL	89.8 J	UG/L
DRO	0.53	MG/L

G32-TP13		
CADMIUM	6.7	UG/L
CHROMIUM	3.6	UG/L
COPPER	15.4J	UG/L
LEAD	4.4	UG/L
NICKEL	37.1	UG/L
DRO	0.35 U	MG/L

G32-TP12		
CADMIUM	25.8	UG/L
CHROMIUM	32.2	UG/L
COPPER	139	UG/L
LEAD	57.3	UG/L
NICKEL	128	UG/L
DRO	0.35 U	MG/L

G32-MW300S		
TETRACHLOROETHENE	6 J	UG/L

G32-MW306S		
PENTACHLOROPHENOL	7.4	UG/L

G32-MH01		
O-XYLENE	2900 J	UG/L
P-XYLENE	4600 J	UG/L
TOTAL XYLENES	7600 J	UG/L
DRO	900000	MG/L
GRO	6100	MG/L

G32-TP11B		
CADMIUM	12.5	UG/L
CHROMIUM	21.4	UG/L
COPPER	79.7	UG/L
LEAD	67.1	UG/L
NICKEL	76.3	UG/L
DRO	0.35 U	MG/L

G32-TP06		
CADMIUM	15.3	UG/L
CHROMIUM	3.7 J	UG/L
COPPER	45.5 J	UG/L
LEAD	76.6 J	UG/L
NICKEL	123	UG/L
DRO	4.8	MG/L

G32-TP10B		
CADMIUM	126	UG/L
CHROMIUM	20.9	UG/L
COPPER	146 J	UG/L
LEAD	358	UG/L
NICKEL	51.8	UG/L
DRO	38	MG/L

G32-TP08		
CADMIUM	88.3	UG/L
CHROMIUM	81.3	UG/L
COPPER	336	UG/L
LEAD	1000	UG/L
NICKEL	146	UG/L
DRO	210	MG/L

G32-MH02		
CADMIUM	54.2	UG/L
CHROMIUM	33	UG/L
COPPER	62.9	UG/L
LEAD	302	UG/L
NICKEL	74.3	UG/L
HMW PAHS	100.8	UG/L
LMW PAHS	104.7	UG/L
DRO	0.35 U	MG/L

G32-MW304S		
TRICHLOROETHENE	1	UG/L

G32-MH03		
CADMIUM	14.7	UG/L
COPPER	63.3	UG/L
LEAD	119	UG/L
NICKEL	28.2	UG/L
HMW PAHS	2.07	UG/L
LMW PAHS	1.61	UG/L
DRO	0.35 U	MG/L

G32-TP05		
CADMIUM	0.28 UJ	UG/L
CHROMIUM	1 UJ	UG/L
COPPER	6.3 UJ	UG/L
LEAD	11 UJ	UG/L
NICKEL	2.7	UG/L
DRO	0.35 U	MG/L

GRAPHIC SCALE

60′ 0′ 60′ 120′

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
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DRAWN BY: D.W.M. / R.G.D.
PREPARED BY: J. TRAUT
CHECKED BY: S. PARKER
PROJECT MANAGER: S. PARKER
PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
SELECTED AQUEOUS SAMPLE ANALYTICAL RESULTS
SITE 17: BUILDING 32, GOULD ISLAND
NAVSTA NEWPORT, RHODE ISLAND

SOURCE: SEE NOTES
SCALE: AS SHOWN
DATE: MAY 1, 2006
PROJ. NO: 112G000065
DRAWING NO: 4-2
ACFILE NAME: \00065\0410\GW_TAGS.DWG
REV: 0

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WILMINGTON, MASSACHUSETTS 01887
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LEGEND

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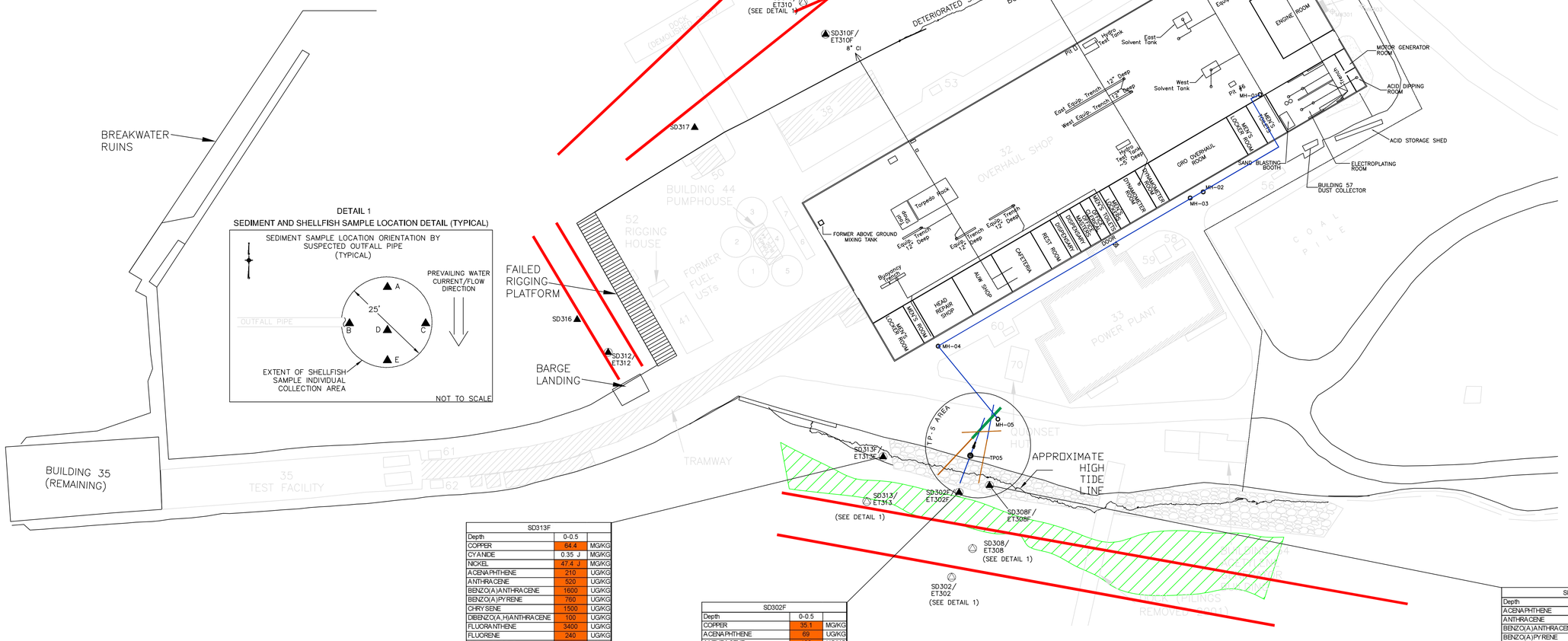
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- UNDERWATER VIDEO TRANSECT LINES
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MH-01 MANHOLE WITH IDENTIFIER
- SD317 SINGLE SEDIMENT SAMPLE LOCATION
- SD309/ET309 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION (OUTFALL LOCATION) – (SEE DETAIL 1)
- SD312/ET312 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION
- EEL GRASS BEDS – CONTIGUOUS EXTENT INTERPRETED BY EYAK (2005)
- 1200 RED SHADE INDICATES VALUE EXCEEDS NOAA ERM CRITERIA
- 700 ORANGE SHADE INDICATES VALUE EXCEEDS NOAA ERL CRITERIA

DEPTHS ARE EXPRESSED IN FEET BELOW GROUND SURFACE



DETAIL 1

SEDIMENT AND SHELLFISH SAMPLE LOCATION DETAIL (TYPICAL)

SD306F		
Depth	0-0.5	
LEAD	177	MG/KG
MERCURY	0.74	MG/KG
TOTAL AROCLOR	190	UG/KG

SD305F		
Depth	0-0.5	
COPPER	77.8	MG/KG
GAMMA-CHLORDANE	2.7 J	UG/KG
TOTAL AROCLOR	310	UG/KG

SD304F		
Depth	0-0.5	
ANTIMONY	43.5 J	MG/KG
CADMIUM	1.6 J	MG/KG
CHROMIUM	391.0	MG/KG
COPPER	46.8	MG/KG
LEAD	21200	MG/KG
BENZO(A)ANTHRACENE	420	UG/KG
FLUORANTHENE	800	UG/KG
TOTAL AROCLOR	360	UG/KG

SD309F		
Depth	0-0.5	
TRICHLOROETHENE	2 J	UG/KG
ACENAPHTHENE	38.2 J	UG/KG
ANTHRACENE	89 J	UG/KG
FLUORENE	42 J	UG/KG
PHENANTHRENE	313 J	UG/KG
TOTAL AROCLOR	93.25	UG/KG

SD313F		
Depth	0-0.5	
COPPER	64.4	MG/KG
CYANIDE	0.35 J	MG/KG
NICKEL	47.4 J	MG/KG
ACENAPHTHENE	210	UG/KG
ANTHRACENE	520	UG/KG
BENZO(A)ANTHRACENE	1600	UG/KG
BENZO(A)PYRENE	760	UG/KG
CHRYSENE	1500	UG/KG
DIBENZO(A,H)ANTHRACENE	100	UG/KG
FLUORANTHENE	3400	UG/KG
FLUORENE	240	UG/KG
PHENANTHRENE	1500	UG/KG
PYRENE	2800	UG/KG

SD302F		
Depth	0-0.5	
COPPER	35.1	MG/KG
ACENAPHTHENE	69	UG/KG
ANTHRACENE	160	UG/KG
BENZO(A)ANTHRACENE	380	UG/KG
FLUORANTHENE	830	UG/KG
FLUORENE	71	UG/KG
PHENANTHRENE	600	UG/KG
PYRENE	680	UG/KG

SD308F		
Depth	0-0.5	
ACENAPHTHENE	88	UG/KG
ANTHRACENE	300	UG/KG
BENZO(A)ANTHRACENE	1000	UG/KG
BENZO(A)PYRENE	510	UG/KG
CHRYSENE	850	UG/KG
FLUORANTHENE	3100	UG/KG
FLUORENE	120	UG/KG
PHENANTHRENE	1100	UG/KG
PYRENE	2400	UG/KG

GRAPHIC SCALE

60' 0' 60' 120'

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 05/09/00.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.

DRAWN BY: D.W. MACDOUGALL	TITLE: SUMMARY OF INTERTIDAL SEDIMENT SAMPLE ANALYTICAL RESULTS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: T. CAMPBELL	
CHECKED BY: S. PARKER	
	SOURCE: SEE NOTES
	SCALE: AS SHOWN; DATE: OCTOBER 9, 2006; PROJ. NO: 112G000065
PROJECT MANAGER: S. PARKER	DRAWING NO: 4-3A; ACFILE NAME: \00065\0410\SEDIMENT_F_TAGS.DWG; REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

TETRA TECH NUS, INC.
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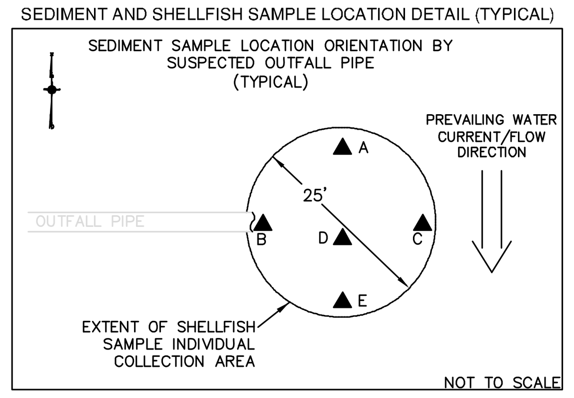
(978)658-7899

LEGEND

- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- UNDERWATER VIDEO TRANSECT LINES
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MANHOLE WITH IDENTIFIER
- SINGLE SEDIMENT SAMPLE LOCATION
- 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION (OUTFALL LOCATION) – (SEE DETAIL 1)
- 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION
- EEL GRASS BEDS – CONTIGUOUS EXTENT INTERPRETED BY EYAK (2005)
- RED SHADE INDICATES VALUE EXCEEDS NOAA ERM CRITERIA
- ORANGE SHADE INDICATES VALUE EXCEEDS NOAA ERL CRITERIA
- YELLOW SHADE INDICATES VALUE EXCEEDS REFERENCE CONCENTRATION

DEPTHS ARE EXPRESSED IN FEET BELOW GROUND SURFACE

DETAIL 1
SEDIMENT AND SHELLFISH SAMPLE LOCATION DETAIL (TYPICAL)



Sample_id	SD306A	SD306B	SD306C	SD306C	SD306D	SD306E	
Depth	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	0-0.5	
TRICHLOROETHENE	6 U	6 U	8 U	6 U	6 U	1 J	UG/KG
ANTIMONY	2.4 J	0.05 U	3 J	2.2 J	2.6 J	2.6 J	MG/KG
LEAD	419 J	690 J	61.6 J	25.3 J	77.35 J	38.3 J	MG/KG
2-METHYLNAPHTHALENE	3.3 U	3.3 U	110	3.3 U	3.325	4.275	UG/KG
ACENAPHTHENE	6.3	4.6	500	6.8	19.35	41 J	UG/KG
ANTHRACENE	22	17	830	43	54.5 J	173 J	UG/KG
BENZO(A)ANTHRACENE	47	39	1100	99	104 J	295 J	UG/KG
BENZO(A)PYRENE	43	26	820	130	88.5 J	260 J	UG/KG
CHRYSENE	29	27	1100	83	70.5 J	285 J	UG/KG
DIBENZO(A,H)ANTHRACENE	9.3	8.6	150	20	16.7 J	47 J	UG/KG
FLUORANTHENE	68	50	2700	120	256 J	725 J	UG/KG
FLUORENE	5.1	4.8	390	6.4	15.8	38 J	UG/KG
NAPHTHALENE	3.3 U	4.3	290	3.3 U	5.85	8.05 J	UG/KG
PHENANTHRENE	33	28	2400	46	136 J	385 J	UG/KG
PYRENE	82	58	2100	220	186 J	615 J	UG/KG
GAMMA-CHLORDANE	3.6	2.2 U	6	1.7 U	1.7 U	1.7 U	UG/KG
TOTAL AROCLOR	230	100	520	33 U	93.25	45.25	UG/KG

Sample_id	SD305A	SD305B	SD305C	SD305D	SD305D	SD305E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	
ANTIMONY	0.41 U	0.52 U	3.2 J	2.8 J	2 J	3.2 J	MG/KG
COPPER	15 J	21.5 J	23.3 J	38 J	26 J	23.8 J	MG/KG
LEAD	31.6 J	55.5	35 J	48.8 J	24.6 J	29.4 J	MG/KG
ACENAPHTHENE	4.5	25	25	16	21	12	UG/KG
FLUORENE	4.5	25	21	12	21	11	UG/KG
GAMMA-CHLORDANE	2.2 U	1.7 U	1.7 U	8.5 U	2 R	1.9 J	UG/KG
TOTAL AROCLOR	42 U	180	230	2200	350	220	UG/KG

Sample_id	SD315	
Depth	0-0.5	
4,4'-DDE	5.1 J	UG/KG
GAMMA-CHLORDANE	11	UG/KG
TOTAL AROCLOR	500	UG/KG

Sample_id	SD310A	SD310B	SD310C	SD310D	SD310E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
CADMIUM	0.076 UJ	0.13 UJ	3.2 J	0.11 UJ	0.077 UJ	MG/KG
CYANIDE	0.13 J	0.12 UJ	0.12 UJ	0.14 UJ	0.12 UJ	MG/KG
LEAD	9.85 J	178 J	11.7 J	13.2 J	14.1 J	MG/KG
2-METHYLNAPHTHALENE	4.025	3.3 U	3.3 U	220	3.3 U	UG/KG
ACENAPHTHENE	41 J	3.3 U	17	1300	3.8	UG/KG
ANTHRACENE	57.5 J	7.5	24	1300	16	UG/KG
BENZO(A)ANTHRACENE	115	17	39	1400	35	UG/KG
BENZO(A)PYRENE	104	21	42	980	27	UG/KG
CHRYSENE	107.5	22	41	1200	40	UG/KG
DIBENZO(A,H)ANTHRACENE	15	3.6	6.5	140	3.7	UG/KG
FLUORANTHENE	235 J	34	97	3400	77	UG/KG
FLUORENE	24 J	3.3 U	11	820	3.7	UG/KG
NAPHTHALENE	10.05 J	3.3 U	6.6	730	3.3 U	UG/KG
PHENANTHRENE	170 J	16	72	3300	26	UG/KG
PYRENE	190 J	29	76	2600	47	UG/KG
TOTAL AROCLOR	43 U	41	46 U	43 U	41 U	UG/KG

Sample_id	SD309A	SD309B	SD309C	SD309D	SD309E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
LEAD	14.9 J	16.6 J	9.3 J	9.5 J	127 J	MG/KG
ACENAPHTHENE	14	3.3 U	12	3.3 U	27	UG/KG
FLUORENE	12	3.3 U	14	3.3 U	31	UG/KG
TOTAL AROCLOR	33 U	42 U	50	46 U	52 U	UG/KG

Sample_id	SD317	
Depth	0-0.5	
CADMIUM	398	MG/KG
COPPER	36.5	MG/KG
LEAD	56.4 J	MG/KG

Sample_id	SD304A	SD304B	SD304C	SD304D	SD304D	SD304E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0.5-1.0	0-0.5	
ANTIMONY	2.6 J	3.1 J	3 J	2.85 J	1.9 J	4.2 J	MG/KG
CYANIDE	0.12 UJ	0.12 UJ	0.12 UJ	0.115 UJ	0.13 UJ	0.14 J	MG/KG
LEAD	20.5 J	23.5 J	59.6 J	39.5 J	15.7 J	41.9 J	MG/KG
ACENAPHTHENE	75	80	47	43.5 J	100 J	28	UG/KG
ANTHRACENE	330	220	100 J	129 J	310 J	84	UG/KG
BENZO(A)ANTHRACENE	540	350	170 J	230 J	550	200	UG/KG
BENZO(A)PYRENE	420 J	280 J	160 J	260 J	480	180	UG/KG
CHRYSENE	490	320	130 J	200 J	550	130	UG/KG
DIBENZO(A,H)ANTHRACENE	89	57	27 J	44.5 J	90 J	30	UG/KG
FLUORANTHENE	1300	720	410	420 J	1300	320	UG/KG
FLUORENE	98	86	36 J	38.5 J	96 J	29	UG/KG
PHENANTHRENE	820	720	290 J	265 J	850	180	UG/KG
PYRENE	1000	750	350	410 J	1100	440	UG/KG
GAMMA-CHLORDANE	13 J	51 J	66	12 R	2.4 R	47 J	UG/KG
TOTAL AROCLOR	880	3600	3800	880	300	3300	UG/KG

THE LOCATIONS FOR THE TAGS BELOW ARE NOT FOUND ON THIS FIGURE THEY ARE TO THE SOUTH OF WHAT IS SHOWN: SEE FIGURE 4–3C

Sample_id	SD301	SD301	
Depth	0-0.5	0.5-1.0	
CYANIDE	0.3 J	0.12 U	MG/KG
ACENAPHTHENE	68 J	81	UG/KG
ANTHRACENE	170	170	UG/KG
BENZO(A)ANTHRACENE	430	320	UG/KG
FLUORANTHENE	890	890	UG/KG
FLUORENE	70 J	77	UG/KG
PHENANTHRENE	650	690	UG/KG
PYRENE	700	710	UG/KG

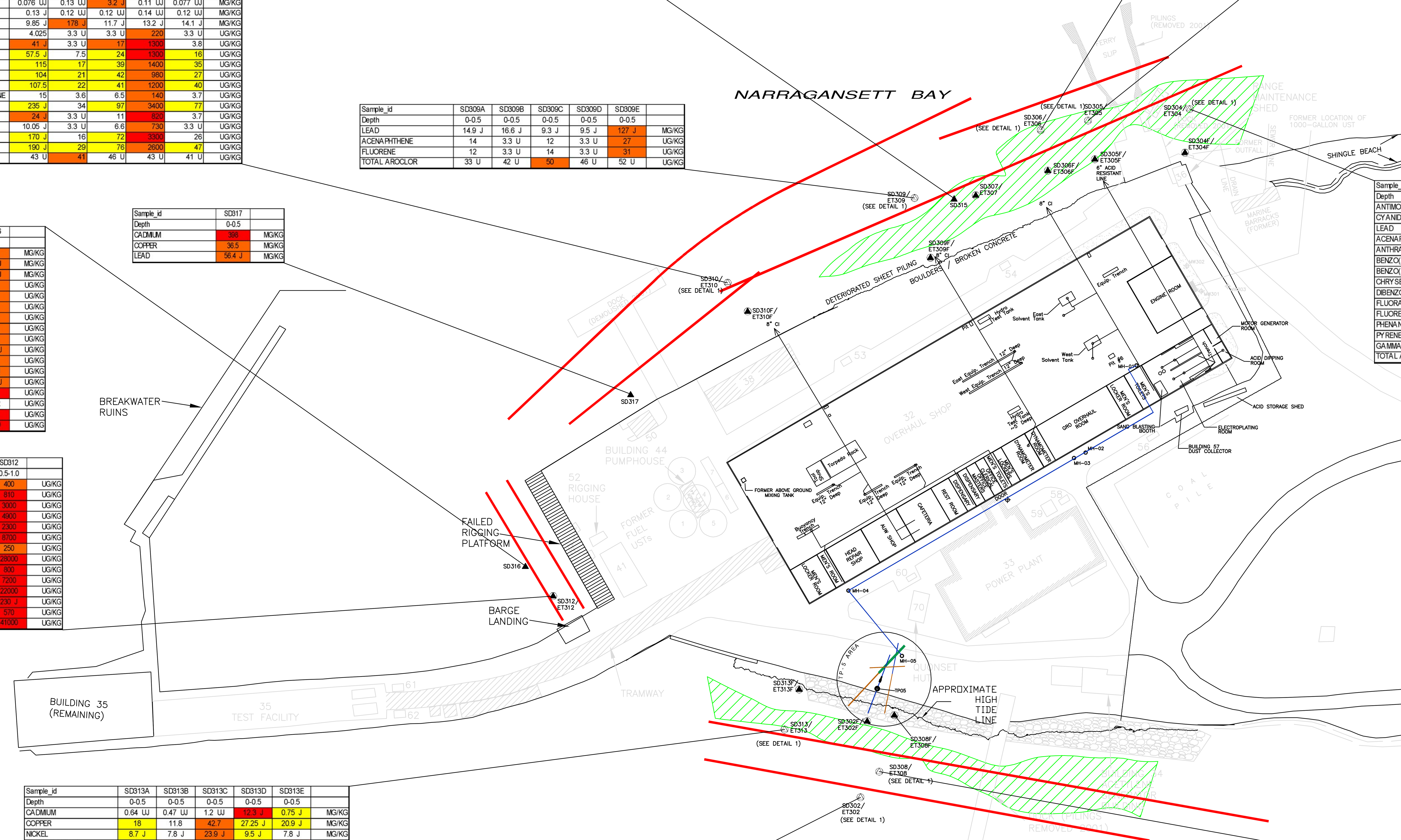
Sample_id	SD303	SD303	
Depth	0-0.5	0.5-1.0	
2-METHYLNAPHTHALENE	130	3.3 U	UG/KG
ACENAPHTHENE	1000	13	UG/KG
ANTHRACENE	1200	29	UG/KG
BENZO(A)ANTHRACENE	1700	64	UG/KG
BENZO(A)PYRENE	1400	66	UG/KG
CHRYSENE	1600	80 EB	UG/KG
DIBENZO(A,H)ANTHRACENE	190	10	UG/KG
FLUORANTHENE	3100	140	UG/KG
FLUORENE	690	13	UG/KG
NAPHTHALENE	350	3.6	UG/KG
PHENANTHRENE	3000	110	UG/KG
PYRENE	2800	140	UG/KG
TOTAL AROCLOR	120	85	UG/KG

Sample_id	SD311	SD311	
Depth	0-0.5	0.5-1.0	
CYANIDE	0.12 U	0.31 J	MG/KG
FLUORANTHENE	700	80	UG/KG

Sample_id	SD314	SD314	
Depth	0-0.5	0.5-1.0	
ACENAPHTHENE	62.5 J	43	UG/KG
ANTHRACENE	120 J	95	UG/KG
FLUORENE	59.5 J	40	UG/KG
PHENANTHRENE	400 J	290	UG/KG
GAMMA-CHLORDANE	3.15 J	1.7 U	UG/KG
TOTAL AROCLOR	230	33 U	UG/KG

Sample_id	SD316	SD316	
Depth	0.5-1.0	0-0.5	
COPPER	92.5	42.5	MG/KG
LEAD	90.6 J	90.6 J	MG/KG
MERCURY	0.22 J	0.19 J	MG/KG
ACENAPHTHENE	20	54	UG/KG
ACENAPHTHYLENE	52	74	UG/KG
ANTHRACENE	140	270	UG/KG
BENZO(A)ANTHRACENE	200	590	UG/KG
BENZO(A)PYRENE	300	490	UG/KG
CHRYSENE	300	960	UG/KG
FLUORANTHENE	700	2000 J	UG/KG
FLUORENE	31	72	UG/KG
PHENANTHRENE	280	960 J	UG/KG
PYRENE	1600	2200 J	UG/KG
4,4'-DDE	220 J	69	UG/KG
DDT	420 J	360 R	UG/KG
GAMMA-CHLORDANE	600	250	UG/KG
TOTAL AROCLOR	22000	22000	UG/KG

Sample_id	SD312	SD312	
Depth	0-0.5	0.5-1.0	
ACENAPHTHENE	210	400	UG/KG
ACENAPHTHYLENE	300	810	UG/KG
ANTHRACENE	900	3000	UG/KG
BENZO(A)ANTHRACENE	2000	4900	UG/KG
BENZO(A)PYRENE	1200 J	2300	UG/KG
CHRYSENE	4400	8700	UG/KG
DIBENZO(A,H)ANTHRACENE	120	250	UG/KG
FLUORANTHENE	10000	28000	UG/KG
FLUORENE	260	800	UG/KG
PHENANTHRENE	3600	7200	UG/KG
PYRENE	8600	22000	UG/KG
4,4'-DDE	53 R	230 J	UG/KG
GAMMA-CHLORDANE	26 U	570	UG/KG
TOTAL AROCLOR	8900	41000	UG/KG



Sample_id	SD313A	SD313B	SD313C	SD313D	SD313E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
CADMIUM	0.64 UJ	0.47 UJ	1.2 UJ	12.3 J	0.75 J	MG/KG
COPPER	18	11.8	42.7	27.25 J	20.9 J	MG/KG
NICKEL	8.7 J	7.8 J	23.9 J	9.5 J	7.8 J	MG/KG
ACENAPHTHENE	16	24	40	16.3 J	19	UG/KG
ANTHRACENE	52	65	110	64 J	58	UG/KG
BENZO(A)ANTHRACENE	120	290	210	142.5 J	100	UG/KG
FLUORENE	16	20	45	15.5	19	UG/KG
PHENANTHRENE	140	200	310	175 J	150	UG/KG

Sample_id	SD302A	SD302B	SD302C	SD302D	SD302E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
ACENAPHTHENE	23	52	48	12	12	UG/KG
ANTHRACENE	59	120	180	41	37	UG/KG
BENZO(A)ANTHRACENE	120	230	280	75	72	UG/KG
FLUORENE	24	49	63	17	14	UG/KG
PHENANTHRENE	190	360	510	120	110	UG/KG
TOTAL AROCLOR	46	33 U	33 U	33	33 U	UG/KG

Sample_id	SD308A	SD308B	SD308C	SD308D	SD308E	
Depth	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
2-METHYLNAPHTHALENE	3.7	3.3 U	14	3.8	280	UG/KG
ACENAPHTHENE	9.1	9.8	25	19	620	UG/KG
ANTHRACENE	48	28	98	44	880	UG/KG
BENZO(A)ANTHRACENE	72	74	310 J	87	1200	UG/KG
BENZO(A)PYRENE	64	63	290	74	960	UG/KG
CHRYSENE	47	53	210	59	1300	UG/KG
DIBENZO(A,H)ANTHRACENE	14	13	59	16	190	UG/KG
FLUORANTHENE	160	150	510	170	2400	UG/KG
FLUORENE	11	9.5	33	14	510	UG/KG
NAPHTHALENE	5.4	4.6	16	6.6	220	UG/KG
PHENANTHRENE	90	81	290	110	2400	UG/KG
PYRENE	150	110	460	140	2200	UG/KG

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706–03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 05/09/00.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P–201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H–2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.
7. ORGANIC ANALYTICAL RESULTS ARE IN MICROGRAMS PER KILOGRAM AND INORGAINC ANALYTICAL RESULTS ARE IN MILLIGRAMS PER KILOGRAM

GRAPHIC SCALE
80' 0' 80' 160'

DRAWN BY: D.W. MACDOUGALL	TITLE: SUMMARY OF SUBTIDAL SEDIMENT SAMPLE ANALYTICAL RESULTS SITE 17: BUILDING 32, GOULD ISLAND NAVSTA NEWPORT, RHODE ISLAND
PREPARED BY: T. CAMPBELL	
CHECKED BY: S. PARKER	SOURCE: SEE NOTES
	SCALE: AS SHOWN — DATE: OCTOBER 9, 2006 — PROJ. NO: 112G00065
PROJECT MANAGER: S. PARKER	DRAWING NO: 4–3B — ACFILE NAME: \00065\0410\SEDIMENT_TAGS.DWG — REV: 0
PROGRAM MANAGER: J. TREPANOWSKI	

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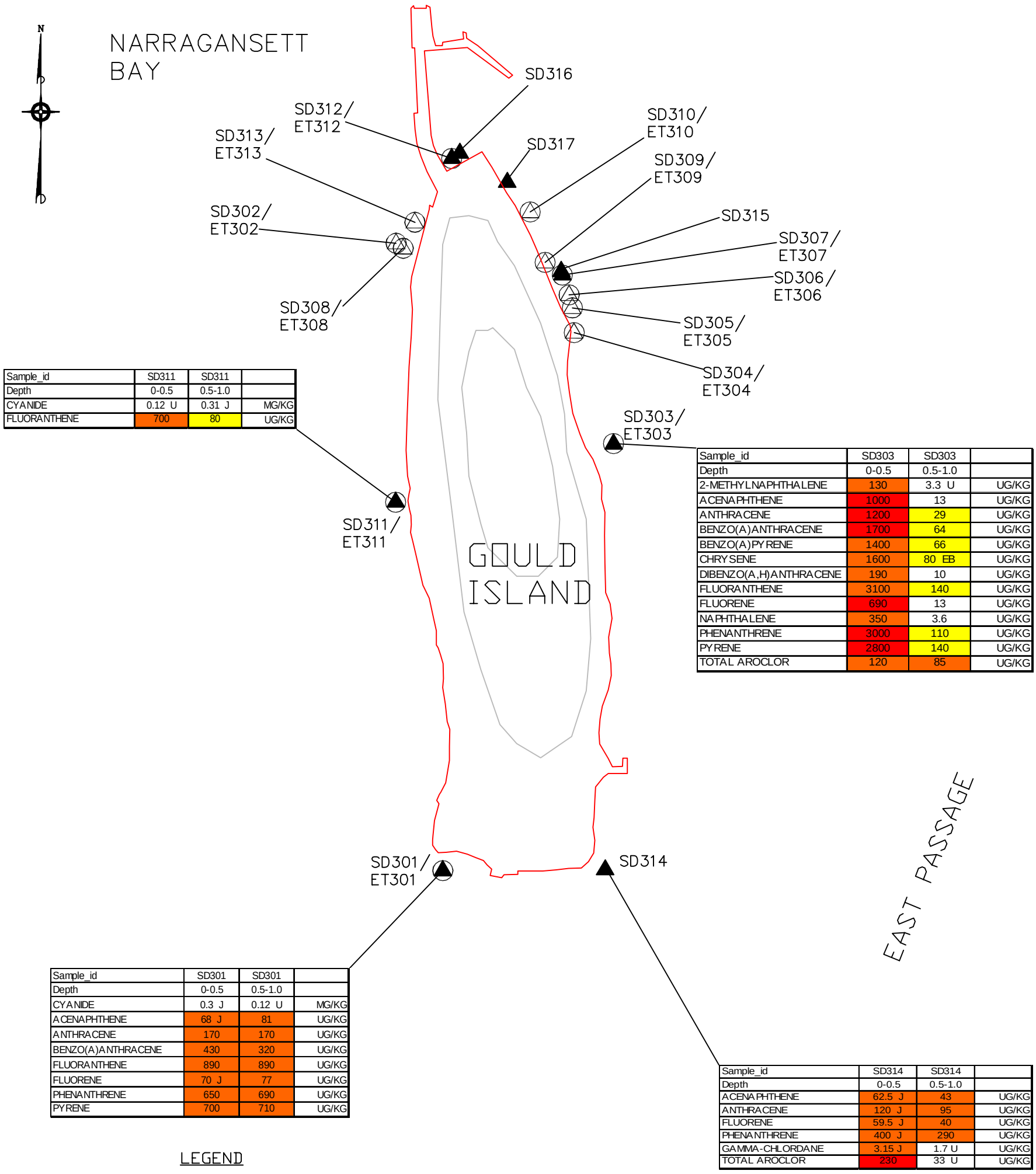


Sample_id	SD311	SD311	
Depth	0-0.5	0.5-1.0	
CYANIDE	0.12 U	0.31 J	MG/KG
FLUORANTHENE	700	80	UG/KG

Sample_id	SD303	SD303	
Depth	0-0.5	0.5-1.0	
2-METHYLNAPHTHALENE	130	3.3 U	UG/KG
ACENAPHTHENE	1000	13	UG/KG
ANTHRACENE	1200	29	UG/KG
BENZO(A)ANTHRACENE	1700	64	UG/KG
BENZO(A)PYRENE	1400	66	UG/KG
CHRYSENE	1600	80 EB	UG/KG
DIBENZO(A,H)ANTHRACENE	190	10	UG/KG
FLUORANTHENE	3100	140	UG/KG
FLUORENE	690	13	UG/KG
NAPHTHALENE	350	3.6	UG/KG
PHENANTHRENE	3000	110	UG/KG
PYRENE	2800	140	UG/KG
TOTAL AROCLOR	120	85	UG/KG

Sample_id	SD301	SD301	
Depth	0-0.5	0.5-1.0	
CYANIDE	0.3 J	0.12 U	MG/KG
ACENAPHTHENE	68 J	81	UG/KG
ANTHRACENE	170	170	UG/KG
BENZO(A)ANTHRACENE	430	320	UG/KG
FLUORANTHENE	890	890	UG/KG
FLUORENE	70 J	77	UG/KG
PHENANTHRENE	650	690	UG/KG
PYRENE	700	710	UG/KG

Sample_id	SD314	SD314	
Depth	0-0.5	0.5-1.0	
ACENAPHTHENE	62.5 J	43	UG/KG
ANTHRACENE	120 J	95	UG/KG
FLUORENE	59.5 J	40	UG/KG
PHENANTHRENE	400 J	290	UG/KG
GAMMA-CHLORDANE	3.15 J	1.7 U	UG/KG
TOTAL AROCLOR	230	33 U	UG/KG

LEGEND

SHORELINE

SURFICIAL CONTOUR

SD316 ▲ SEDIMENT SAMPLE LOCATION

SD305/ ET305 — 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATIONS (OUTFALL LOCATIONS)

SD301/ ET301 — 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION

1200 — RED SHADE INDICATES VALUE EXCEEDS REFERENCE NOAA ERM CRITERIA

700 — ORANGE SHADE INDICATES VALUE EXCEEDS REFERENCE NOAA ERL CRITERIA

300 — YELLOW SHADE INDICATES VALUE EXCEEDS REFERENCE CONCENTRATION

NOTES

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. SEE FIGURES 4-3A AND 4-3B FOR ANALYTICAL RESULTS FOR NORTHERN SEDIMENT SAMPLES.

GRAPHIC SCALE

0′ 500′ 1000′

SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS

FIGURE 4-3C

SITE 17: BUILDING 32, GOULD ISLAND

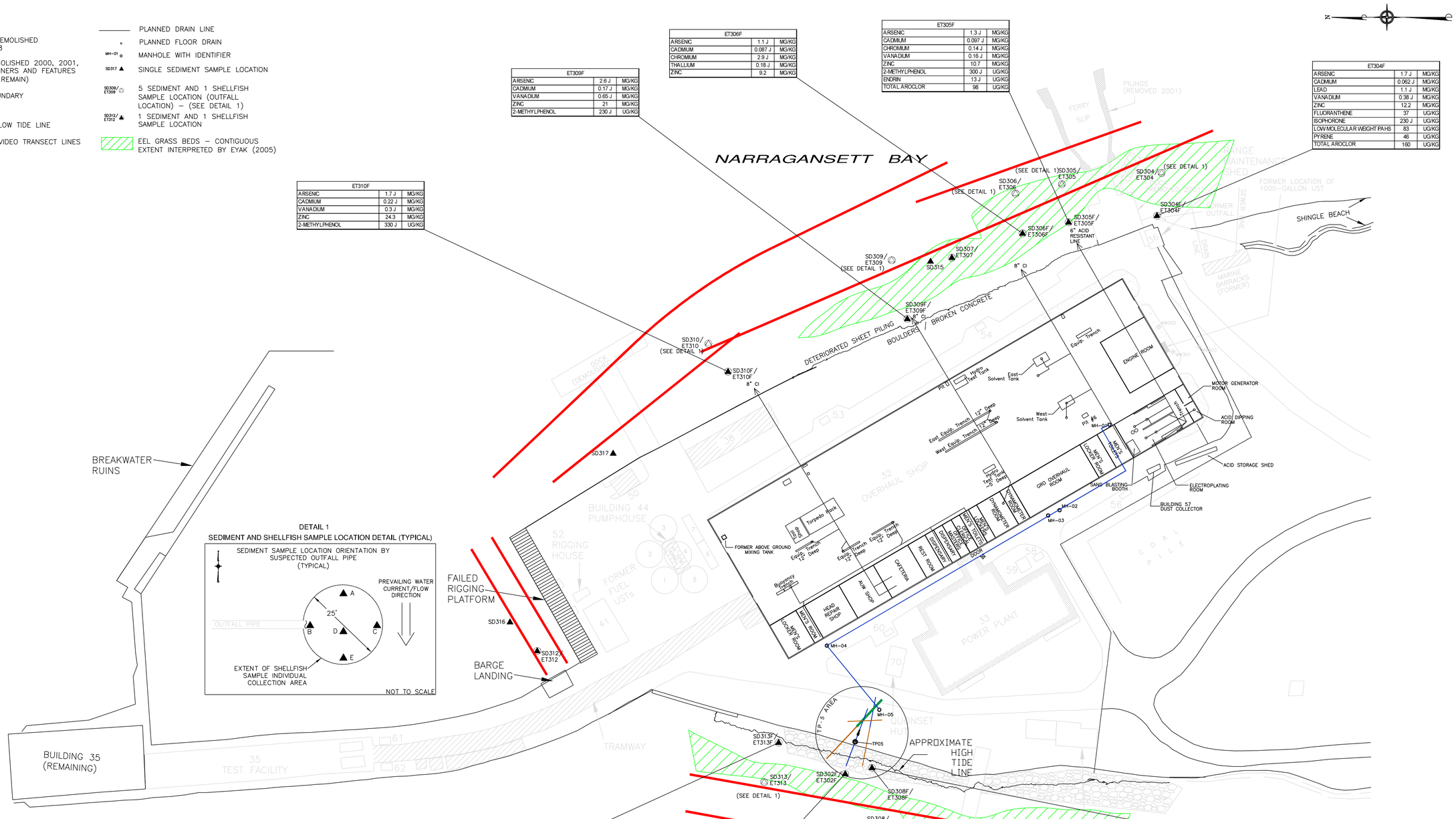
NAVSTA NEWPORT, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	S. PARKER	DATE:	OCTOBER 9, 2006
SCALE:	AS NOTED	FILE NO.:	\00065\0410\SEDIMENT_SOUTH.DWG

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899

LEGEND

- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- UNDERWATER VIDEO TRANSECT LINES
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MH-01 MANHOLE WITH IDENTIFIER
- SD317 SINGLE SEDIMENT SAMPLE LOCATION
- SD309/ET309 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION (OUTFALL LOCATION) – (SEE DETAIL 1)
- SD312/ET312 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION
- EEL GRASS BEDS – CONTIGUOUS EXTENT INTERPRETED BY EYAK (2005)



DETAIL 1
SEDIMENT AND SHELLFISH SAMPLE LOCATION DETAIL (TYPICAL)

ET309F		
ARSENIC	2.6 J	MG/KG
CADMIUM	0.17 J	MG/KG
VANADIUM	0.65 J	MG/KG
ZINC	21	MG/KG
2-METHYLPHENOL	230 J	UG/KG

ET306F		
ARSENIC	1.1 J	MG/KG
CADMIUM	0.067 J	MG/KG
CHROMIUM	2.9 J	MG/KG
THALLIUM	0.18 J	MG/KG
ZINC	9.2	MG/KG

ET305F		
ARSENIC	1.3 J	MG/KG
CADMIUM	0.097 J	MG/KG
CHROMIUM	0.14 J	MG/KG
VANADIUM	0.16 J	MG/KG
ZINC	10.7	MG/KG
2-METHYLPHENOL	300 J	UG/KG
ENDRIN	13 J	UG/KG
TOTAL AROCLOR	98	UG/KG

ET304F		
ARSENIC	1.7 J	MG/KG
CADMIUM	0.062 J	MG/KG
LEAD	1.1 J	MG/KG
VANADIUM	0.38 J	MG/KG
ZINC	12.2	MG/KG
FLUORANTHENE	37	UG/KG
ISOPHORONE	230 J	UG/KG
LOW MOLECULAR WEIGHT PAHS	83	UG/KG
PYRENE	46	UG/KG
TOTAL AROCLOR	160	UG/KG

ET310F		
ARSENIC	1.7 J	MG/KG
CADMIUM	0.22 J	MG/KG
VANADIUM	0.3 J	MG/KG
ZINC	24.3	MG/KG
2-METHYLPHENOL	330 J	UG/KG

ET313F		
ARSENIC	1.9 J	MG/KG
CADMIUM	0.08 J	MG/KG
VANADIUM	0.14 J	MG/KG
ZINC	12.4	MG/KG
2-METHYLPHENOL	400 J	UG/KG

ET302F		
ARSENIC	1.9 J	MG/KG
BERYLLIUM	0.0056 J	MG/KG
CADMIUM	0.2 J	MG/KG
THALLIUM	0.072 J	MG/KG
ZINC	24.6	MG/KG
2-METHYLPHENOL	220 J	UG/KG

ET308F		
ARSENIC	2.4 J	MG/KG
CADMIUM	0.22 J	MG/KG
VANADIUM	0.25 J	MG/KG
ZINC	36.1	MG/KG
2-METHYLPHENOL	600 J	UG/KG

GRAPHIC SCALE
60' 0' 60' 120'

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 05/09/00.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS
4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.
5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H-2, GOULD ISLAND TORPEDO STATION)
6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.

DRAWN BY: D.W. MACDOUGALL
PREPARED BY: T. CAMPBELL
CHECKED BY: S. PARKER
PROJECT MANAGER: S. PARKER
PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
SUMMARY OF INTERTIDAL BIOTA SAMPLE ANALYTICAL RESULTS
SITE 17: BUILDING 32, GOULD ISLAND
NAVSTA NEWPORT, RHODE ISLAND

SOURCE: SEE NOTES
SCALE: AS SHOWN
DATE: OCTOBER 1, 2006
PROJ. NO: 112G000065
DRAWING NO: 4-4A
ACFILE NAME: \00065\0410\BIOTA_F_TAGS.DWG
REV: 0

TETRA TECH NUS, INC.
55 JONSPIN ROAD
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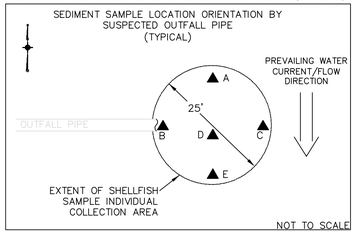
(978)658-7899

LEGEND

- STRUCTURES DEMOLISHED PRIOR TO 1998
- BUILDINGS DEMOLISHED 2000, 2001, SURVEYED CORNERS AND FEATURES (FOUNDATIONS REMAIN)
- PROPERTY BOUNDARY
- OUTFALL PIPES
- APPROXIMATE LOW TIDE LINE
- UNDERWATER VIDEO TRANSECT LINES
- PLANNED DRAIN LINE
- PLANNED FLOOR DRAIN
- MH-01 MANHOLE WITH IDENTIFIER
- SD317 SINGLE SEDIMENT SAMPLE LOCATION
- SD309/ET309 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION (OUTFALL LOCATION) – (SEE DETAIL 1)
- SD312/ET312 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION
- EEL GRASS BEDS – CONTIGUOUS EXTENT INTERPRETED BY EYAK (2005)

DETAIL 1

SEDIMENT AND SHELLFISH SAMPLE LOCATION DETAIL (TYPICAL)



THE LOCATIONS FOR THE TAGS BELOW ARE NOT FOUND ON THIS FIGURE THEY ARE TO THE SOUTH OF WHAT IS SHOWN: SEE FIGURE 4–4C

ET301		
ARSENIC	1.4 J	MG/KG
CADMIUM	0.138 J	MG/KG
MANGANESE	15.375 J	MG/KG
ZINC	9.75	MG/KG

ET303		
ARSENIC	3.3 J	MG/KG
BERYLLIUM	0.0077 J	MG/KG
CADMIUM	0.15 J	MG/KG
MANGANESE	38.6 J	MG/KG
VANADIUM	1.2 J	MG/KG
ZINC	17.4	MG/KG

ET311		
ARSENIC	1.3 J	MG/KG
CHROMIUM	0.59 J	MG/KG
ZINC	11	MG/KG
2,4-DIMETHYLPHENOL	2000 J	UG/KG

ET307		
ARSENIC	3.9 J	MG/KG
BERYLLIUM	0.012 J	MG/KG
CADMIUM	0.73 J	MG/KG
MANGANESE	12.5 J	MG/KG
VANADIUM	0.25 J	MG/KG
ZINC	13.6	MG/KG

ET306		
ARSENIC	1.7 J	MG/KG
BERYLLIUM	0.0059 J	MG/KG
VANADIUM	0.13 J	MG/KG
ZINC	16.9	MG/KG

ET305		
ARSENIC	2.1 J	MG/KG
CADMIUM	0.13525 J	MG/KG
CHROMIUM	0.475 J	MG/KG
COBALT	0.141	MG/KG
COPPER	1.93 J	MG/KG
LEAD	0.2185 J	MG/KG
MANGANESE	9.25 J	MG/KG
MERCURY	0.0051 J	MG/KG
NICKEL	0.405	MG/KG
VANADIUM	0.27 J	MG/KG
ZINC	15 J	MG/KG

ET304		
ARSENIC	2 J	MG/KG
BERYLLIUM	0.0055 J	MG/KG
CADMIUM	0.14 J	MG/KG
CHROMIUM	0.29 J	MG/KG
COBALT	0.17	MG/KG
COPPER	1.2 J	MG/KG
MERCURY	0.0088 J	MG/KG
NICKEL	0.42	MG/KG
VANADIUM	0.11 J	MG/KG
ZINC	10.6 J	MG/KG
BIS(2-ETHYLHEXYL)PHTHALATE	210 J	UG/KG
BETA-BHC	6.6	UG/KG
GAMMA-BHC (LINDANE)	2.5 J	UG/KG
TOTAL AROCLOR	170	UG/KG

ET309		
ARSENIC	2.9 J	MG/KG
BERYLLIUM	0.006 J	MG/KG
VANADIUM	0.17 J	MG/KG
ZINC	7.1	MG/KG
4-CHLORO-3-METHYLPHENOL	560 J	UG/KG

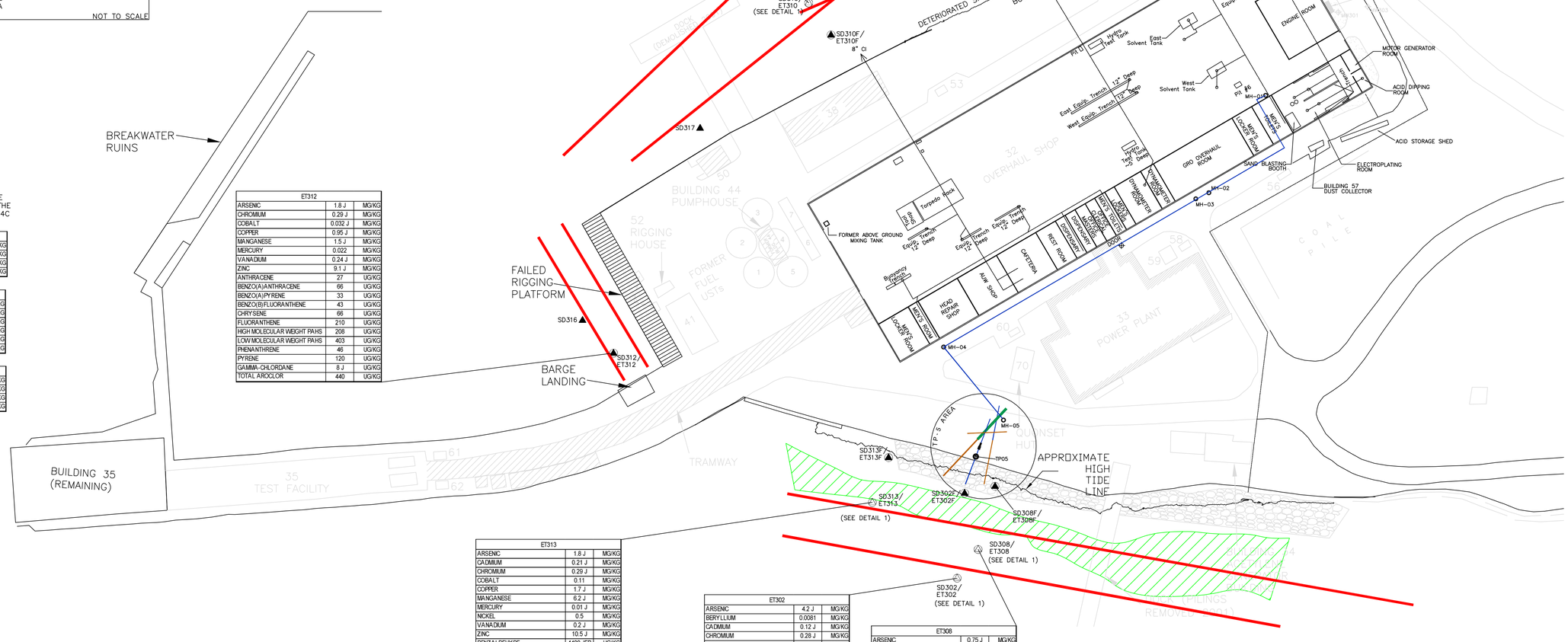
ET310		
ARSENIC	1.5 J	MG/KG
BERYLLIUM	0.0078 J	MG/KG
ZINC	13.2	MG/KG
ENDRIN ALDEHYDE	13 J	UG/KG

ET312		
ARSENIC	1.8 J	MG/KG
CHROMIUM	0.29 J	MG/KG
COBALT	0.032 J	MG/KG
COPPER	0.95 J	MG/KG
MANGANESE	1.5 J	MG/KG
MERCURY	0.022	MG/KG
VANADIUM	0.24 J	MG/KG
ZINC	9.1 J	MG/KG
ANTHRACENE	27	UG/KG
BENZO(A)ANTHRACENE	66	UG/KG
BENZO(A)PYRENE	33	UG/KG
BENZO(B)FLUORANTHENE	43	UG/KG
CHRYSENE	66	UG/KG
FLUORANTHENE	210	UG/KG
HIGH MOLECULAR WEIGHT PAHS	208	UG/KG
LOW MOLECULAR WEIGHT PAHS	403	UG/KG
PHENANTHRENE	46	UG/KG
PYRENE	120	UG/KG
GAMMA-CHLORDANE	8 J	UG/KG
TOTAL AROCLOR	440	UG/KG

ET313		
ARSENIC	1.8 J	MG/KG
CADMIUM	0.21 J	MG/KG
CHROMIUM	0.29 J	MG/KG
COBALT	0.11	MG/KG
COPPER	1.7 J	MG/KG
MANGANESE	6.2 J	MG/KG
MERCURY	0.01 J	MG/KG
NICKEL	0.5	MG/KG
VANADIUM	0.2 J	MG/KG
ZINC	10.5 J	MG/KG
BENZALDEHYDE	4400 JEB	UG/KG

ET302		
ARSENIC	4.2 J	MG/KG
BERYLLIUM	0.0081	MG/KG
CADMIUM	0.12 J	MG/KG
CHROMIUM	0.28 J	MG/KG
COBALT	0.21	MG/KG
COPPER	2.1 J	MG/KG
MANGANESE	4.8 J	MG/KG
MERCURY	0.011 J	MG/KG
NICKEL	0.59	MG/KG
VANADIUM	0.92 J	MG/KG
ZINC	16.1 J	MG/KG
BENZALDEHYDE	8700 JEB	UG/KG

ET308		
ARSENIC	0.75 J	MG/KG
CHROMIUM	6.1 J	MG/KG
COBALT	0.12	MG/KG
COPPER	0.59 J	MG/KG
MANGANESE	4.4 J	MG/KG
NICKEL	0.46	MG/KG
VANADIUM	0.17 J	MG/KG
ZINC	10.6 J	MG/KG



GRAPHIC SCALE

60′ 0′ 60′ 120′

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706–03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 – GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 05/09/00.

5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P–201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.

2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

4. THE TRANSFORMER VAULTS AND BUILDINGS 53, 54, 56, 60, 61, AND 62 WERE DEMOLISHED IN 2001.

5. VERTICAL = LOCAL MEAN LOW WATER (NAVY BENCH MARK H–2, GOULD ISLAND TORPEDO STATION)

6. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1927.

DRAWN BY: D.W. MACDOUGALL
PREPARED BY: T. CAMPBELL
CHECKED BY: S. PARKER
PROJECT MANAGER: S. PARKER
PROGRAM MANAGER: J. TREPANOWSKI

TITLE:
SUMMARY OF SUBTIDAL BIOTA SAMPLE ANALYTICAL RESULTS
SITE 17: BUILDING 32, GOULD ISLAND
NAVSTA NEWPORT, RHODE ISLAND

SOURCE: SEE NOTES
SCALE: AS SHOWN
DATE: OCTOBER 9, 2006
PROJ. NO: 112G000065
DRAWING NO: 4–4B
ACFILE NAME: \00065\0410\BIOTA_TAGS.DWG
REV: 0

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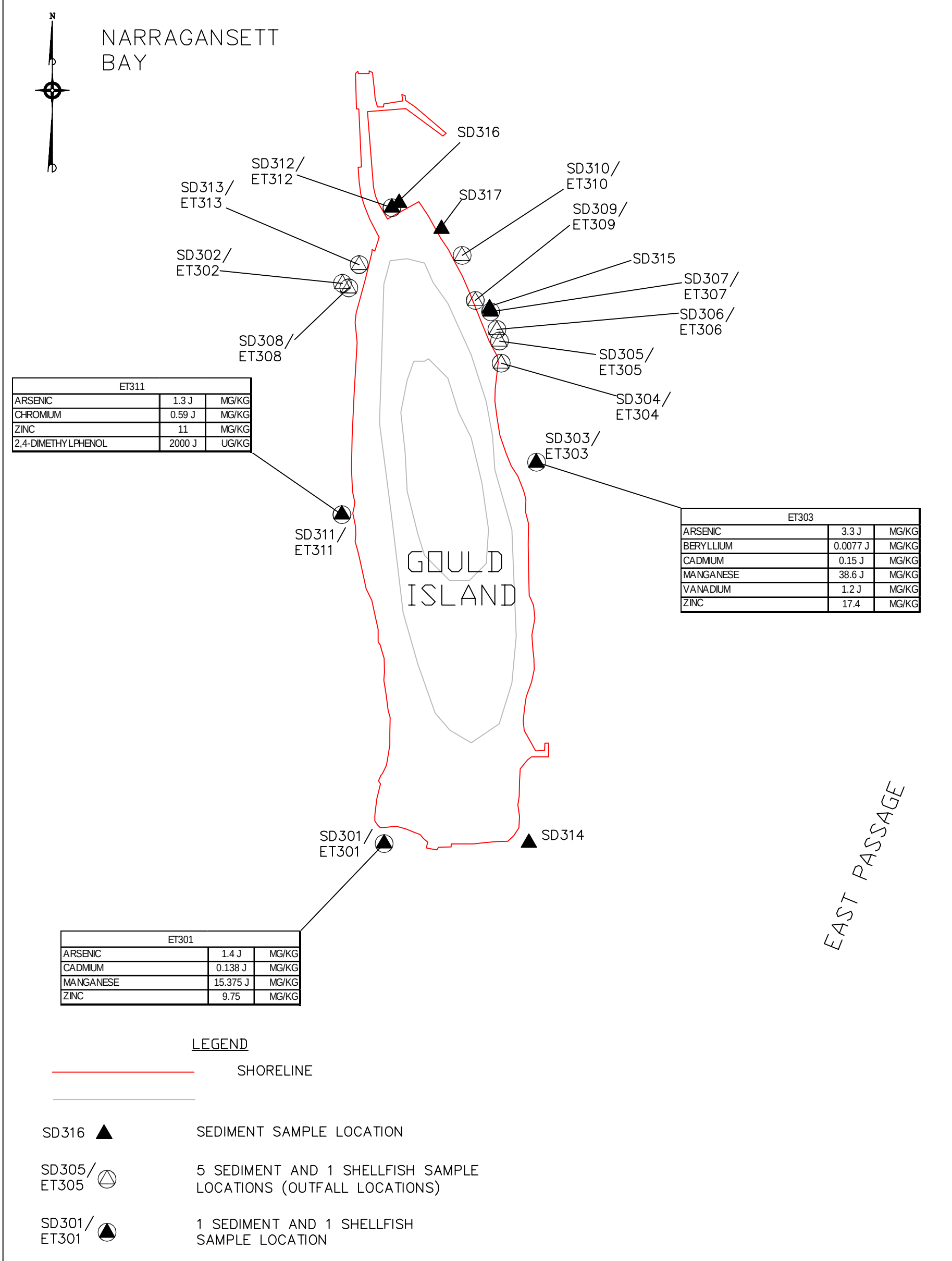
(978)658–7899



ET311		
ARSENIC	1.3 J	MG/KG
CHROMIUM	0.59 J	MG/KG
ZINC	11	MG/KG
2,4-DIMETHYLPHENOL	2000 J	UG/KG

ET303		
ARSENIC	3.3 J	MG/KG
BERYLLIUM	0.0077 J	MG/KG
CADMIUM	0.15 J	MG/KG
MANGANESE	38.6 J	MG/KG
VANADIUM	1.2 J	MG/KG
ZINC	17.4	MG/KG

ET301		
ARSENIC	1.4 J	MG/KG
CADMIUM	0.138 J	MG/KG
MANGANESE	15.375 J	MG/KG
ZINC	9.75	MG/KG

LEGEND

SHORELINE

SD316 ▲ SEDIMENT SAMPLE LOCATION

SD305/ ET305 5 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATIONS (OUTFALL LOCATIONS)

SD301/ ET301 1 SEDIMENT AND 1 SHELLFISH SAMPLE LOCATION

NOTES

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. SEE FIGURES 4-4A AND 4-4B FOR ANALYTICAL RESULTS FOR NORTHERN BIOTA SAMPLES.

GRAPHIC SCALE
0′ 500′ 1000′

SUMMARY OF BIOTA SAMPLE ANALYTICAL RESULTS

FIGURE 4-4C

SITE 17: BUILDING 32, GOULD ISLAND

NAVSTA NEWPORT, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	S. PARKER	DATE:	OCTOBER 9, 2006
SCALE:	AS NOTED	FILE NO.:	\00065\0410\BIOTA_SOUTH.DWG

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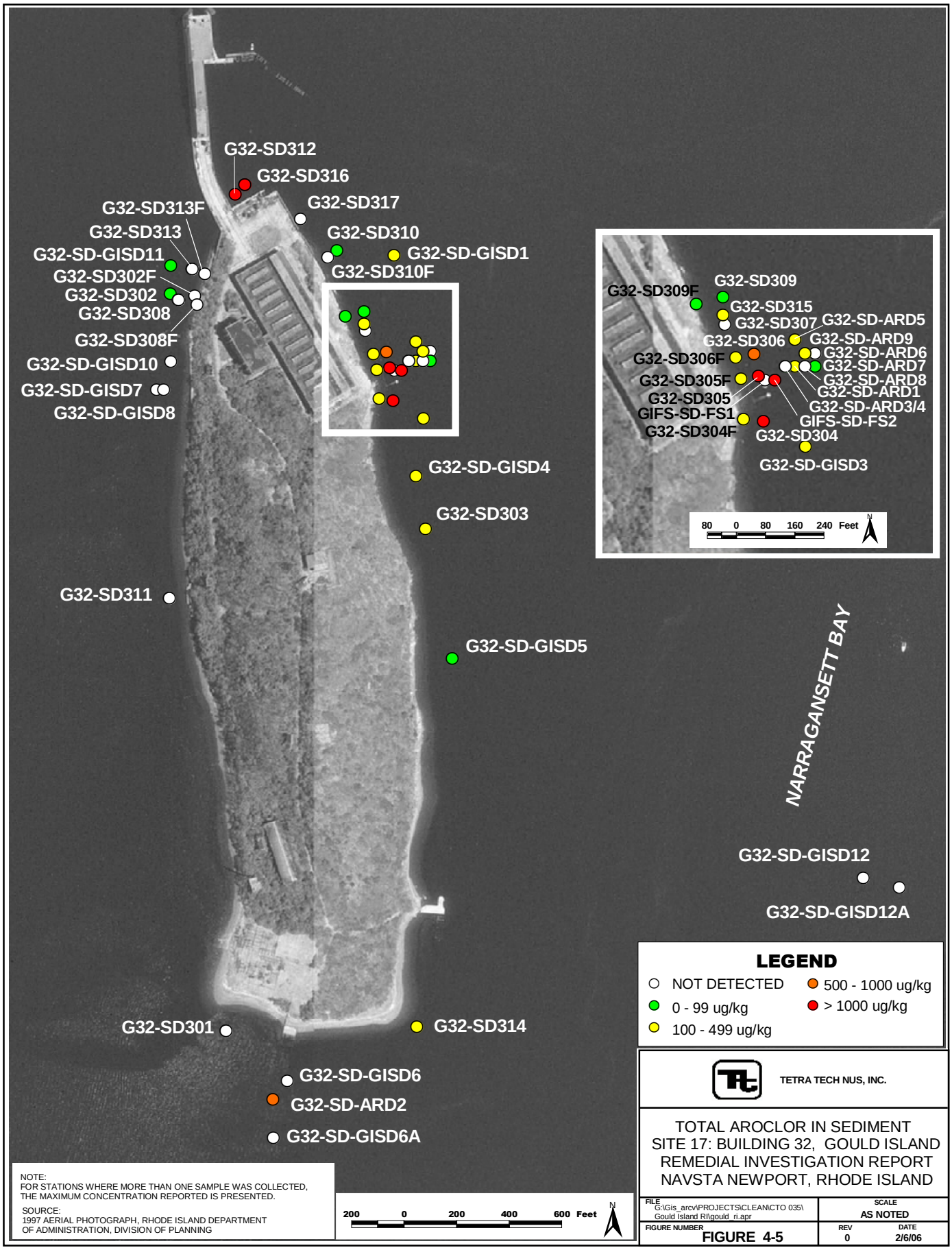
(978)658-7899



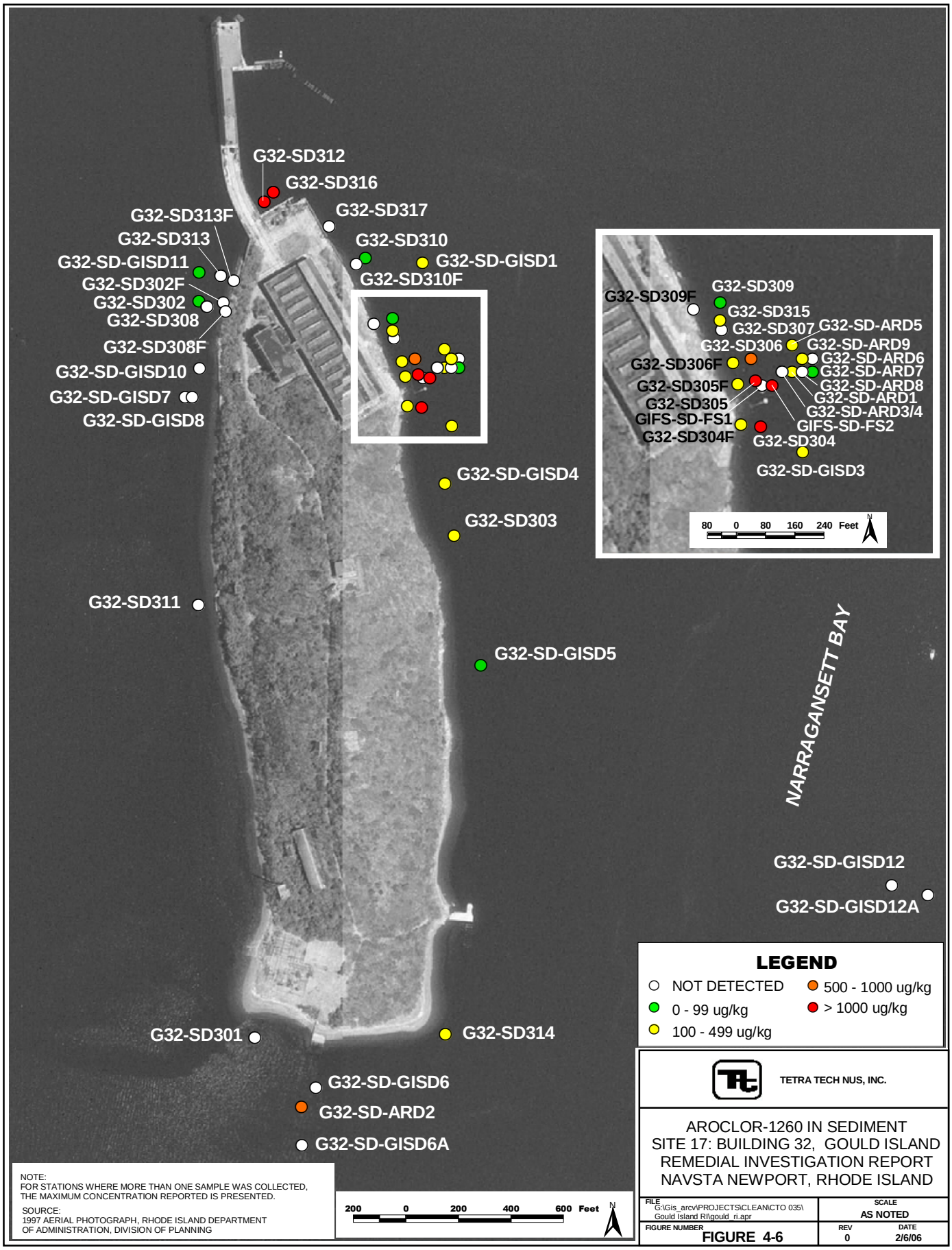
NOTE:
FOR STATIONS WHERE MORE THAN ONE SAMPLE WAS COLLECTED, THE MAXIMUM CONCENTRATION REPORTED IS PRESENTED.

SOURCE:
1997 AERIAL PHOTOGRAPH, RHODE ISLAND DEPARTMENT OF ADMINISTRATION, DIVISION OF PLANNING

TETRA TECH NUS, INC.

TOTAL AROCLOR IN SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE	
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\ Gould Island RI\gould_ri.apr	AS NOTED	
FIGURE NUMBER	REV	DATE
FIGURE 4-5	0	2/6/06



NOTE:
FOR STATIONS WHERE MORE THAN ONE SAMPLE WAS COLLECTED, THE MAXIMUM CONCENTRATION REPORTED IS PRESENTED.

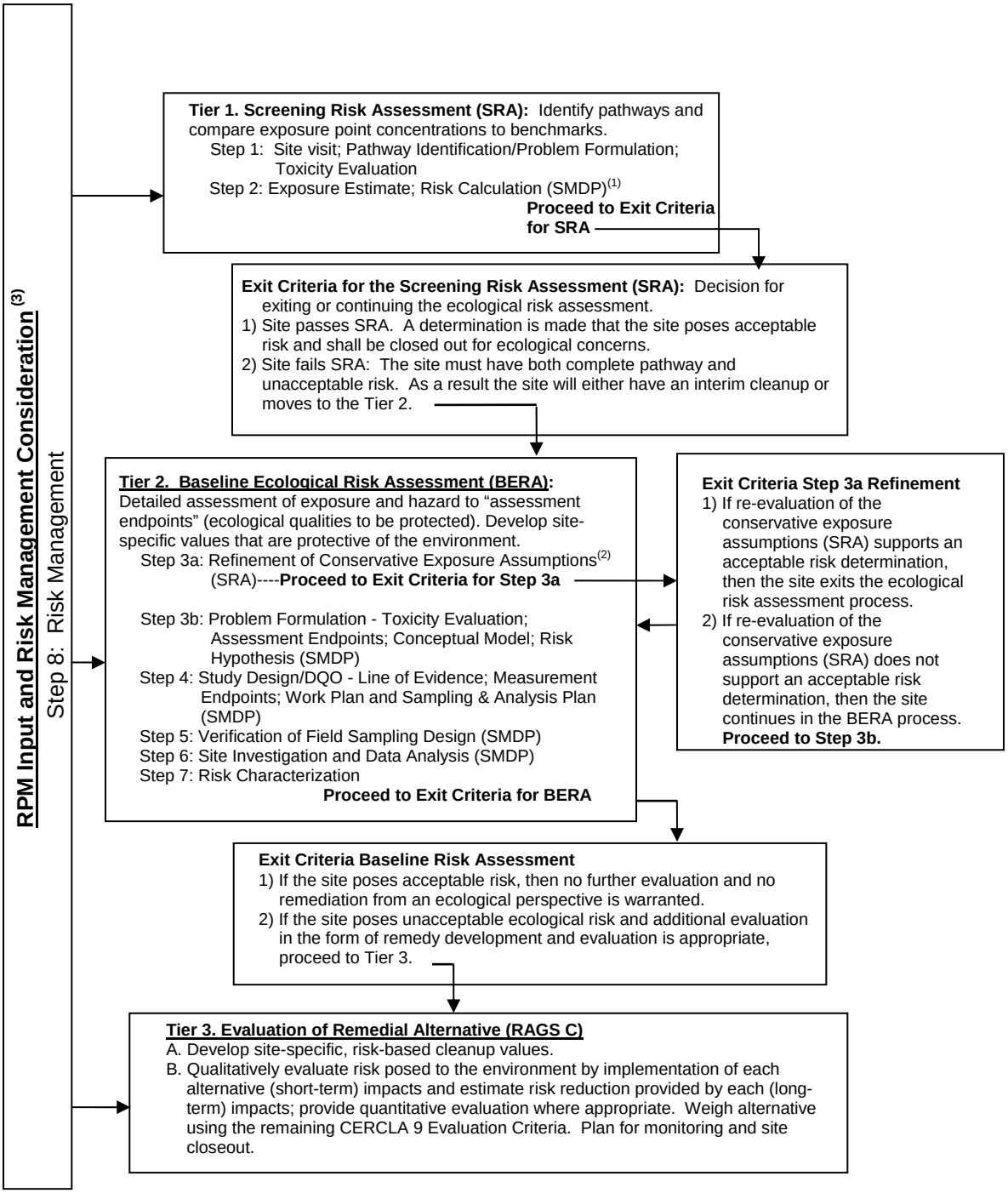
SOURCE:
1997 AERIAL PHOTOGRAPH, RHODE ISLAND DEPARTMENT OF ADMINISTRATION, DIVISION OF PLANNING

TETRA TECH NUS, INC.

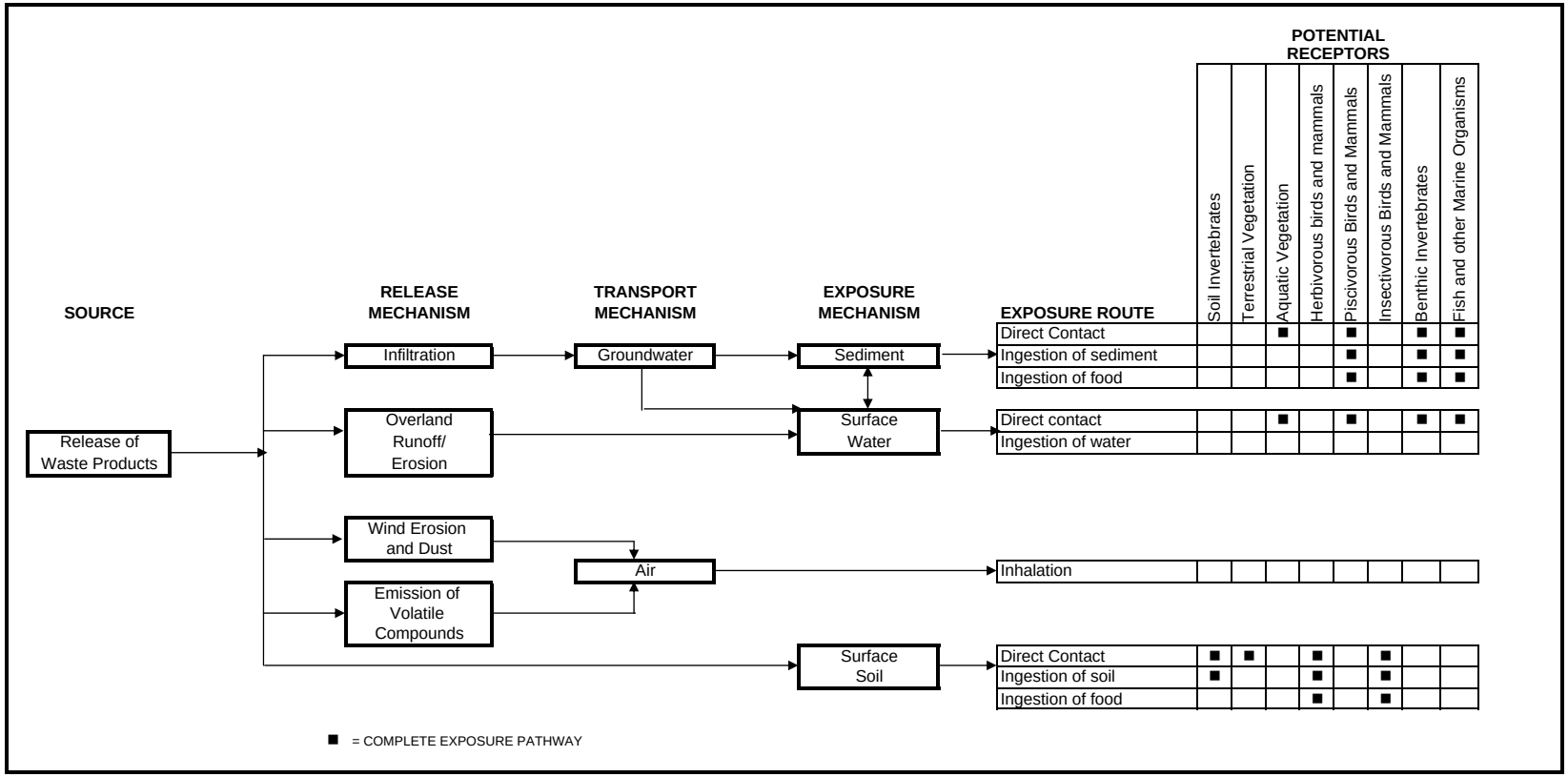
AROCLOR-1260 IN SEDIMENT
SITE 17: BUILDING 32, GOULD ISLAND
REMEDIAL INVESTIGATION REPORT
NAVSTA NEWPORT, RHODE ISLAND

FILE	SCALE	
G:\Gis_arcv\PROJECTS\CLEAN\CTO 035\ Gould Island RI\gould_ri.apr	AS NOTED	
FIGURE NUMBER	REV	DATE
FIGURE 4-6	0	2/6/06

FIGURE 7-1
NAVY ECOLOGICAL RISK ASSESSMENT TIERED APPROACH
SITE 17: BUILDING 32, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND



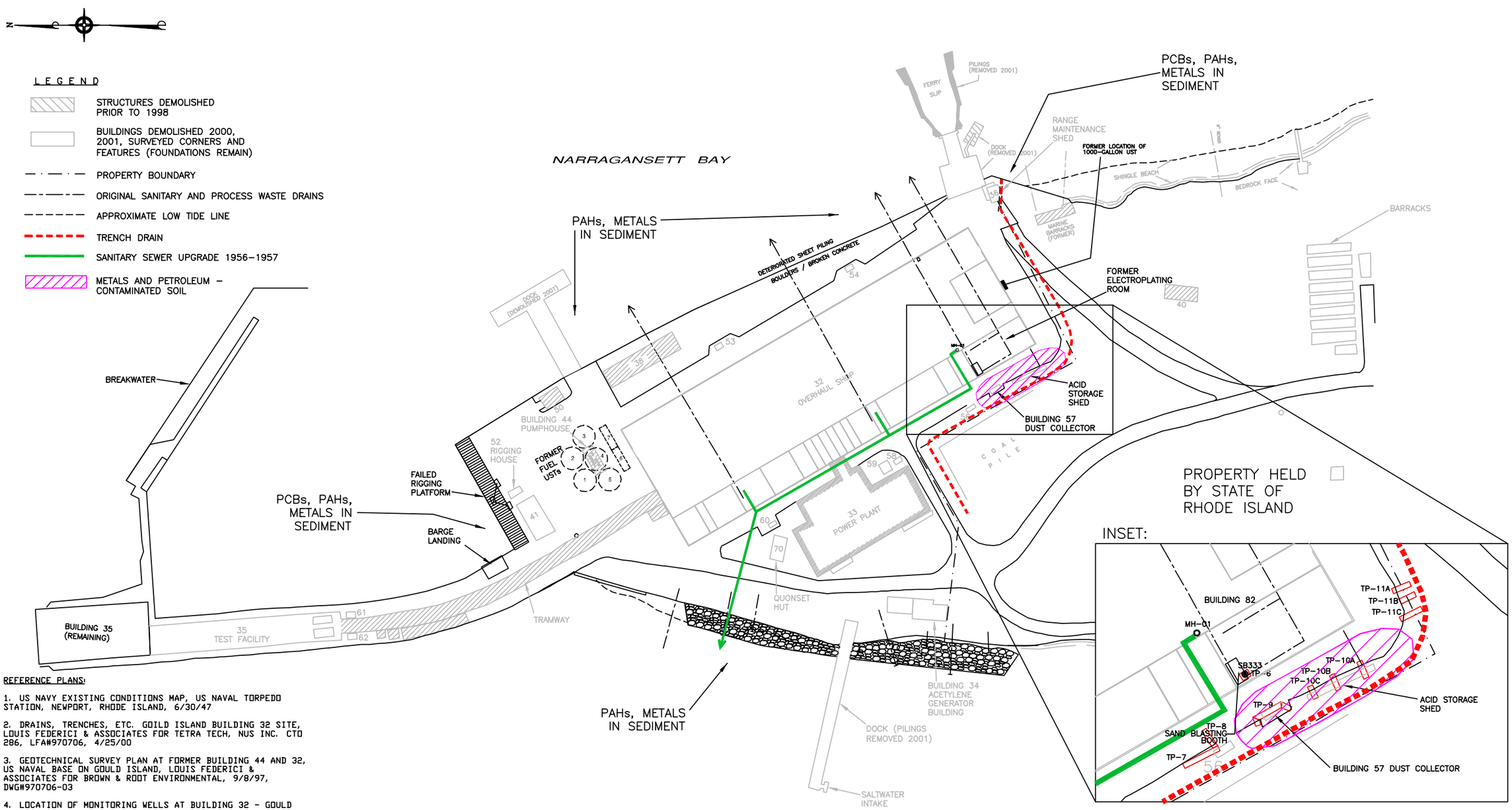
Notes: 1 See U.S. EPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2 Refinement Includes but is not limited to background, bioavailability, detection frequency, etc.
3 Risk management is incorporated throughout the tiered approach.



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable, potential exposure.

FIGURE 7-2

ECOLOGICAL CONCEPTUAL SITE MODEL
SITE 17 - GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOILD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U. S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.

2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS.

GRAPHIC SCALE

0' 150' 300'

SUMMARY OF FINDINGS			FIGURE 8–1
SITE 17: BUILDING 32, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	S. PARKER	DATE:	MARCH 24, 2006
SCALE:	AS SHOWN	FILE NO.:	DWG\00065\0410\FIG_8–1.DWG

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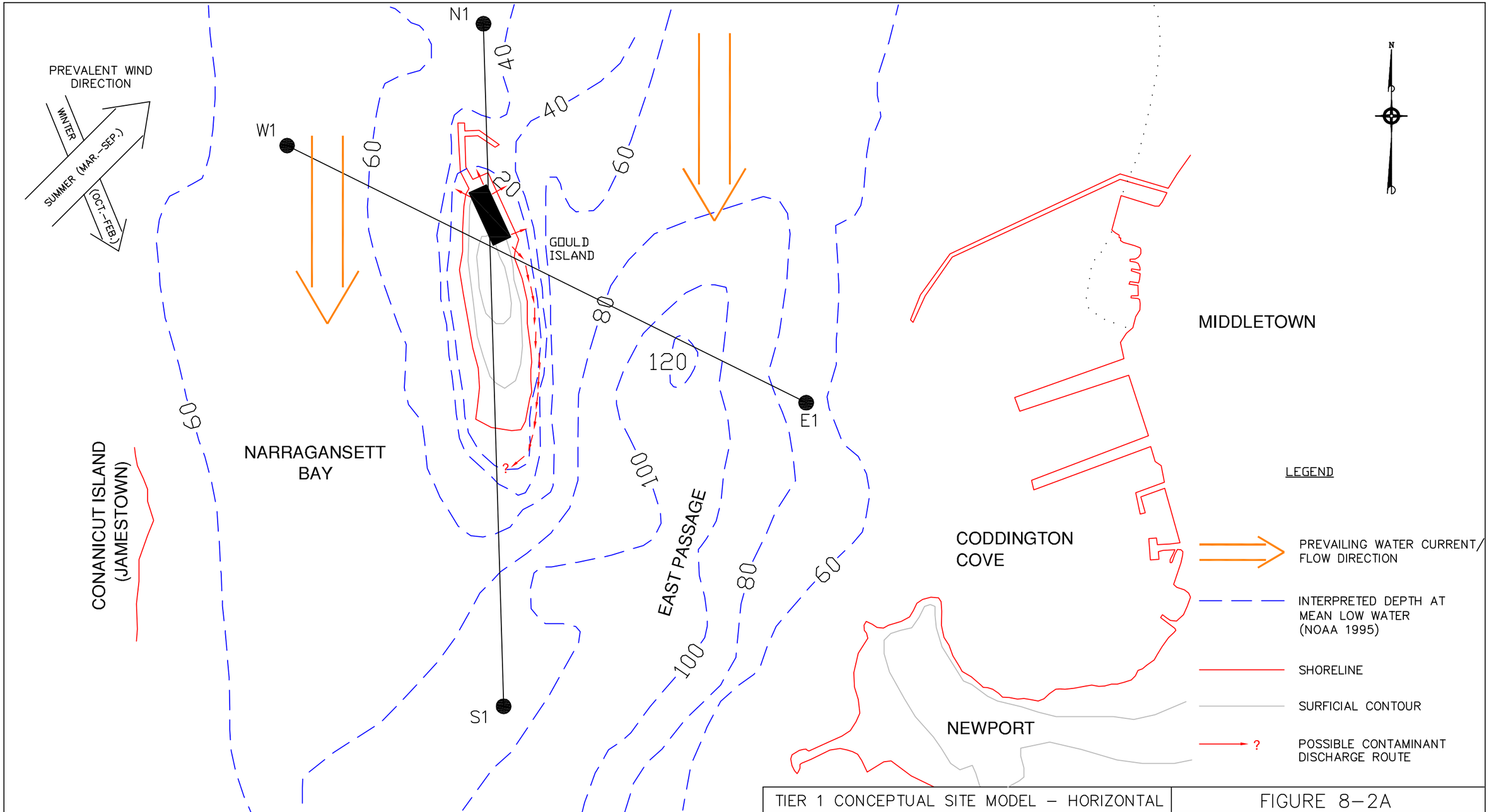
(978)658–7899



NOTES:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BOTTOM CONTOUR DATA INTERPRETED FROM NOAA CHART 13221, APRIL 15, 1995.
4. WIND ROSE INFORMATION FROM NORTHEAST REGIONAL CLIMATE CENTER, CORNELL UNIVERSITY, AUGUST 2000.

GRAPHIC SCALE

0′ 1200′ 2400′

TIER 1 CONCEPTUAL SITE MODEL – HORIZONTAL

SITE 17: BUILDING 32, GOULD ISLAND

NAVSTA NEWPORT, RHODE ISLAND

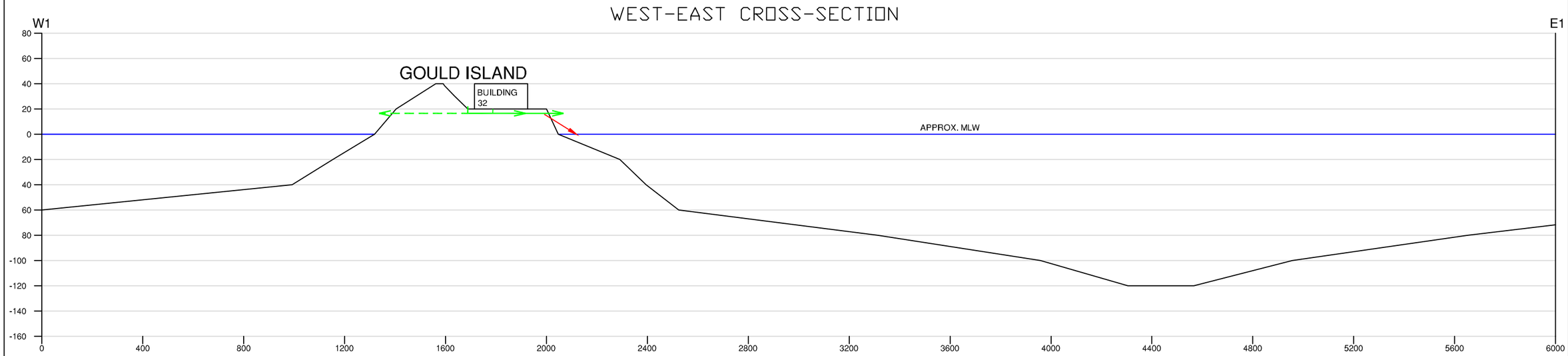
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MARCH 24, 2006
SCALE:	AS SHOWN	FILE NO.:	DWG\00065\0410\FIG_8–2A.DWG

FIGURE 8–2A

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658–7899

WEST-EAST CROSS-SECTION



NORTH-SOUTH CROSS-SECTION

L E G E N D

CONTAMINANT DISCHARGE ROUTE

PRE-CONSTRUCTION ELEVATION TAKEN FROM "GOULD ISLAND FACILITIES GENERAL PLAN", DATED DECEMBER 29, 1941

PIPE

MHW - MEAN HIGH WATER
MLW - MEAN LOW WATER

NOTES:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BOTTOM CONTOUR DATA INTERPRETED FROM NOAA CHART 13221, APRIL 15, 1995.

VERTICAL GRAPHIC SCALE

0′ 80′ 160′

HORIZONTAL GRAPHIC SCALE

0′ 400′ 800′

TIER 1 CONCEPTUAL SITE MODEL – VERTICAL			FIGURE 8–2B
SITE 17: BUILDING 32, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MARCH 24, 2006
SCALE:	AS SHOWN	FILE NO.:	DWG\00065\0410\FIG_8–2B.DWG

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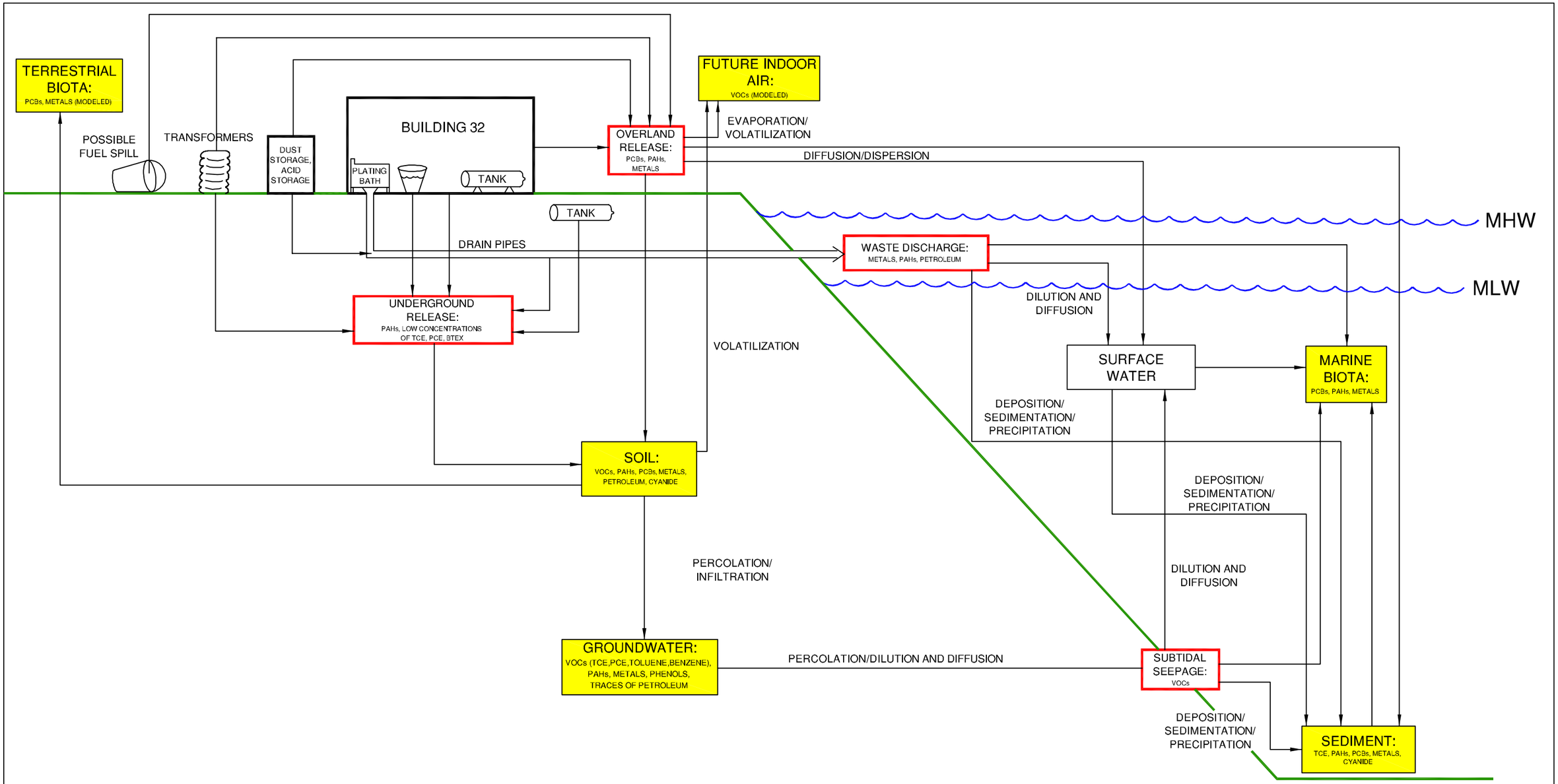

RED BOXES SIGNIFY CONFIRMED CONTAMINANT TRANSPORT ROUTES

YELLOW BOXES SIGNIFY MEDIA IMPACTED BY CONTAMINANTS FOUND (OR PREDICTED BY MODELING)

MHW - MEAN HIGH WATER
MLW - MEAN LOW WATER

TIER 2 CONCEPTUAL SITE MODEL			FIGURE 8-3
SITE 17: BUILDING 32, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			TETRA TECH NUS, INC.
DRAWN BY:	D.W. MACDOUGALL	REV.: 0	55 Jonspin Road Wilmington, MA 01887 (978)658-7899
CHECKED BY:	L. SEYDEWITZ	DATE: MARCH 24, 2006	
SCALE:	NOT TO SCALE	FILE NO.: DWG\00065\0410\FIG_8-3.DWG	

REFERENCES

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Brown & Root Environmental, October 1997, Underground Storage Tank (UST) Closure Assessment Report, Former Torpedo Overhaul Shop, Building 32 – Gould Island, Newport, Rhode Island, prepared for the Northern Division, Naval Facilities Engineering Command Under the Comprehensive Long-Term Environmental Action (CLEAN) Program.

Brown & Root Environmental, October 1997. Draft UST Site Investigation Report, Building 44 (Former Pump House). Contract Task Order 0143 Northern Division, NAVFAC, Contract No. N62472-90-D-1298.

Brown & Root Environmental, November 1997. Underground Storage Tank (UST) Closure Assessment Report, Former Torpedo Overhaul Shop, Building 32 – Gould Island. Contract Task Order 0143 Northern Division Naval Facilities Engineering Command, Contract No. N62472-90-D-1298. Naval Station Newport, Newport, Rhode Island.

Canadian Council of Ministers of the Environment (CCME). 1999a. Canadian Soil Quality Guidelines for Chromium. Scientific Supporting Document. National Guidelines and Standards Office, Environmental Quality Branch, Environment Canada. Ottawa.

Canadian Council of Ministers of the Environment (CCME). 1999b. Canadian Soil Quality Guidelines for Vanadium. Scientific Supporting Document. National Guidelines and Standards Office, Environmental Quality Branch, Environment Canada. Ottawa.

Canadian Council of Ministers of the Environment (CCME). Canadian Soil Quality Guidelines for Zinc. Scientific Supporting Document. National Guidelines and Standards Office, Environmental Quality Branch, Environment Canada. Ottawa.

CICEET, 2001. Progress Report for the Period 02/01/01 Through 08/15/01. Cooperative Institute for Coastal and Estuarine Environmental Toxicity.

CICEET, 2002. Progress Report for the Period 08/15/01 Through 1/31/02. Cooperative Institute for Coastal and Estuarine Environmental Toxicity.

Department of Navy (DON). 1999. Navy Policy for Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Department of the Navy, Washington, DC, April 5.

Department of the Navy, February 8, 2002. Navy/Marine Corps Installation Restoration Policy on Sediment Investigation and Response Actions. Office of the Chief of Naval Operations, Washington, DC.

Di Toro, D.M., J.A. McGrath, and D.J. Hansen. 2000. Technical Basis for Narcotic Chemicals and Polycyclic Aromatic Hydrocarbon Criteria. I. Water and Tissue. Environmental Toxicology and Chemistry. Vol. 19, No. 8. pp. 1951-1970.

Ely, Elanor. 2002. An Overview of Narragansett Bay. Rhode Island Sea Grant, Narragansett Rhode Island. seagrant.gso.uri.edu

ENSR Consulting and Engineering, February 14, 1992, Waste Inventory and Sampling Report for Buildings 32 and 35 (Inactive), Naval Underwater Systems Center (NUSC), Gould Island Annex, Newport, Rhode Island, prepared for the Northern Division, Naval Facilities Engineering Command under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program.

Envirodyne Engineers, Inc., March 1983, Final Initial Assessment Study of the Naval Education and Training Center, Newport, Rhode Island, prepared for the Navy Assessment and Control of Installation Pollutants (NACIP) Department.

Foster Wheeler Environmental Corporation, April 2002. Draft Phase I Sampling Report for the Characterization of PCB Contaminated Soils and Concrete Gould Island. Contract Task Order 0069 Northern Division, Contract No. N62472-99-D-0032. Naval Station Newport, Newport, Rhode Island.

Kowalski, Cadorette and Gautie, October, 1999. Naturally Occurring Arsenic in Soils: A Possible Impediment to Brownfield Development in Rhode Island. 15th Annual International Conference on Contaminated Soils and Water, UMASS Amherst.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management 19(1):81-97.

Loureiro Engineering Associates, May 15, 1986, Confirmation Study Report on Hazardous Waste Sites at Naval Education and Training Center, Newport, Rhode Island, prepared for the Northern Division, Naval Facilities Engineering Command.

Maughan, J.T. 1993. Ecological Assessment of Hazardous Waste Sites. Van Nostrand Reinhold. New York, New York.

Narragansett Bay Commission, November 2002. www.narrabay.com/baysRivers.asp Our Bays and Rivers. Once Service Road, Providence RI.

National Oceanic and Atmospheric Administration (NOAA), November 2001. Waste Site Reviews, Summary, Rhode Island. http://response.restoration.noaa.gov/cpr/wastesites/states.*

National Oceanic and Atmospheric Administration (NOAA), March 2002 General NOAA Oil Modeling Environment (GNOME) NOAA Ocean Service. Office of Response and Restoration, Hazardous Materials Response Division.

National Oceanic and Atmospheric Administration (NOAA), Not dated. Northwest Fisheries Science Center, National Benthic Surveillance Project. East Coast Sites Sampled in 1987, 1988 and 1989. http://www.nwfsc.noaa.gov/pubs/tm/tm4/hoztabs.htm

National Oceans Campaign, Not Dated. "Estuaries on The Edge: The Vital Link Between Land And Sea, Chapter Six, Narragansett Bay in Rhode Island".

ORNL (Oak Ridge National Laboratory). 2003. Toxicity and Chemical-Specific Factors Database. Oak Ridge National Laboratory Web Page, http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_9801.

ORNL (Oak Ridge National Laboratory). 1998. Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants. BJC/OR-133. September.

Quad Three Group Inc. (Q3G) 1996. Phase 1 Environmental Assessment, Building 44 Pump House, Gould Island. May.

Quinn, James, King, John and Tracey, Gregory, 1995. Final Work/Quality Assurance Project Plan, Narragansett Bay Ecorisk and Monitoring for Navy Sites. University of Rhode Island and SAIC Corporation, prepared under Contract with Brown and Root Environmental.

Rhode Island Department of Environmental Management, April 2000. Narragansett Bay Water Quality: Status and Trends, 2000. RIDEM Narragansett Bay Estuary Program, and Narragansett Bay Estuarine Research Reserve.

Rhode Island Department of Environmental Management, June 30, 2006. Comments on the Draft RI Report RIDEM Division of Waste Site Remediation, Providence, Rhode Island.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W., Suter II, and T.L. Ashwood. 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory. June. ES/ER/TM-220.

Sample, B.E., D.M. Opresko, and G.W. Suter II (Sample, et. al.), 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Oak Ridge National Laboratory, June.

Save the Bay, 2000. State of the Bay Report, 2000. Save the Bay, 434 Smith Street, Providence RI.

Tetra Tech FW, Inc. 2004. Final Project Closeout Report For Phase II PCB Contaminated Soils and Concrete Remediation, Gould Island. RAC Contract No. N62472-99-D0032, Contract Task Order 0069. October 29, 2004.

Tetra Tech NUS, Inc., 2000. Study Area Screening Evaluation for Building 32 – Phase I. Contract Task Order 0286 Northern Division Naval Facilities Engineering Command, Contract No. N62472-90-D-1298. Naval Station Newport, Newport, Rhode Island, December.

Tetra Tech NUS, Inc. 2001. Subsurface Investigation of PCBs, Building 54 – Gould Island, Jamestown Rhode Island. Contract Task Order 0842, Engineering Field Activity Northeast, Naval Facilities Engineering Command, Contract No. N62472-90-D-1298, Naval Station Newport, Newport Rhode Island, September.

Tetra Tech NUS, Inc., 2004. Work Plan for Remedial Investigation, Site 17, Building 32, Gould Island. Contract Task Order 0842, Engineering Field Activity Northeast, Naval Facilities Engineering Command, Contract No. N62467-94-D-0888, Naval Station Newport, Newport Rhode Island, July.

Tetra Tech NUS, Inc., 2004. corrective Action Groundwater Monitoring Rounds 4-6 Former Building 44 (Pump House), Naval Station Newport, Engineering Field Activity Northeast, January.

United States Environmental Protection Agency (U.S. EPA). 1986. Quality Criteria for Water- 1986. Office of Water Regulations and Standards. Washington, D.C. EPA/440/5-86-001. May.

United States Environmental Protection Agency (EPA), 1986. Guidelines for Carcinogenic Risk Assessment. EPA/630/R-00/004, Risk Assessment Forum, Washington, D.C.

United States Environmental Protection Agency (EPA), Region I, 1989a. Draft Final Supplemental Risk Assessment Guidance for the Superfund Program. EPA/901/5-89/001. Boston, Massachusetts. June.

United States Environmental Protection Agency (EPA), 1989b. Risk Assessment Guidance for Superfund - Volume I - Human Health Evaluation Manual (Part A) - Interim Final. EPA/540/1-89/002. Office of Emergency and Remedial Response. December.

United States Environmental Protection Agency (EPA), 1991a. Risk Assessment Guidance for Superfund - Volume I: Human Health Evaluation Manual - Supplemental Guidance - "Standard Default Exposure Factors" - Interim Final. OSWER Directive 9285.6-03. Office of Emergency and Remedial Response. March 25.

United States Environmental Protection Agency (EPA), 1991b, Risk Assessment Guidance for Superfund – Volume I: Human Health Evaluation Manual (Part B) Interim Guidance Office of Emergency and Remedial Response Publication 9285.7-01B. December.

United States Environmental Protection Agency (EPA), 1992. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Office of the Administrator, Washington, DC. February 26.

United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187a. Office of Research and Development. Washington, DC, 1993.

United States Environmental Protection Agency (EPA), 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/R-93/089. Environmental Criteria and Assessment Office. July.

United States Environmental Protection Agency (EPA), 1994a. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. EPA/540/R-93/081. Office of Emergency and Remedial Response, Washington, D.C. February.

United States Environmental Protection Agency (EPA), 1994b. Revised Interim Guidance on Establishing Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9355.4-12. July 14.

United States Environmental Protection Agency (EPA), Region I, 1994c. Risk Updates, Number 2. Waste Management Division, Boston, Massachusetts. August.

United States Environmental Protection Agency (EPA), Region I, 1995. Risk Updates, Number 3. Waste Management Division, Boston, Massachusetts. August.

United States Environmental Protection Agency (EPA), 1996a. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response, Washington, D.C. May.

United States Environmental Protection Agency (EPA), 1996b. PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures. EPA/600/P-96/001F. National Center for Environmental Assessment, Office of Research and Development, Washington, D.C. September.

United States Environmental Protection Agency (EPA), Region I, 1996c. Risk Updates, Number 4. Waste Management Division, Boston, Massachusetts. November.

United States Environmental Protection Agency, (U.S. EPA). 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Environmental Response Team, June 5.

United States Environmental Protection Agency (EPA), 1997a. Health Effects Assessment Summary Tables; FY 1997 Update, EPA 540/R-97-036, National Center for Environmental Assessment, Cincinnati, Ohio. July.

United States Environmental Protection Agency (EPA), 1997b. Exposure Factors Handbook. EPA/600/8-89/043. Office of Health and Environmental Assessment, Exposure Assessment Group. Washington, D.C. August.

United States Environmental Protection Agency (EPA), 1997c. Risk Assessment Guidance for Superfund – Volume I, Human Health Evaluation Manual – Part D – Interim Guidance. EPA/540/R-97/0333 OSWER Publication 9285.7-01D. December.

United States Environmental Protection Agency, (U.S. EPA). 1998. Final Guidelines for Ecological Risk Assessment. Effective April 30.

United States Environmental Protection Agency, July 1998. EPA, RI Dept of Health, Issue Warning About Fish and Other Public Health Risks From Woonasquatucket River. EPA Press Release 98-7-1.

United States Environmental Protection Agency (EPA), 1998. Memorandum: OSWER Directive: Clarification to the 1994 revised Interim soil Lead (Pb) guidance for CERCLA Sites and RCRA Corrective Action Facilities. EPA/540/F-98/030, OSWER directive #9200.4-27P. August.

United States Environmental Protection Agency (EPA), Region I, 1999. Risk Updates, Number 5. Waste Management Division, Boston, Massachusetts. September.

United States Environmental Protection Agency, (U.S. EPA). 2000. Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs. Office of Water, Office of Solid Waste. EPA 823-R-00-001. February.

United States Environmental Protection Agency, September 2001. Risk Assessment Guidance for Superfund (RAGs) - Volume I - Human Health Evaluation Manual (Part E) - Supplemental Guidance for Dermal Risk Assessment. Interim. EPA/540/R/99/005.

United States Environmental Protection Agency, February 2002. Program Profiles: Narragansett Bay. National Estuary Program, http://www.epa.gov/owow/estuaries

United States Environmental Protection Agency, National Priorities List, Active Superfund Sites, November 12, 2002. http://oaspub.epa.gov

United States Environmental Protection Agency (EPA), 2002a. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. Office of Solid Waste and Emergency Response, Washington, D.C. December.

United States Environmental Protection Agency (EPA), 2002b. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. EPA530-D-02-004 November.

United States Environmental Protection Agency (EPA), 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. U.S.EPA. Washington, DC. January. EPA-540-R-03-001. [URL: http://www.epa.gov/superfund/ programs/lead/adult.htm].

United States Environmental Protection Agency, 2003a. Ecological Screening Level for Aluminum, Interim Final. Office of Emergency and Remedial Response. OSWER Directive 9285.7-60. November.

United States Environmental Protection Agency, 2003b. Ecological Soil Screening Level for Iron, Interim Final. Office of Emergency and Remedial Response. OSWER Directive 9285.7-69. November.

United States Environmental Protection Agency (EPA), 2004b. Risk Assessment Guidance for Superfund, Volume I – Human Health Evaluation Manual – Part E, Supplemental Guidance for Dermal Risk Assessment – Final. July.

United States Environmental Protection Agency (EPA), 2004c. Region 9 Preliminary Remedial Goals Table. November.

United States Environmental Protection Agency (EPA), 2004d. ProUCL Version 3.0 User Guide. EPA/600/R04/079, April.

United States Environmental Protection Agency (EPA), 2005a. Guidelines for Carcinogenic Risk Assessment. EPA/630/P-03/001B, Risk Assessment Forum, Washington, D.C. March.

United States Environmental Protection Agency (EPA), 2005b. Region 3 Risk-Based Concentrations Table. April.

United States Environmental Protection Agency (EPA), 2006. Integrated Risk Information System, On-Line Data Base. February. [URL: http:// www.epa.gov/iris/index.html].

United States Food and Drug Administration (USFDA), 1993. Guidance Document for Arsenic in Shellfish, January.

U.S. Navy February 2001, Revised December 2001. Human Health Risk Assessment Guidance, Office of the Chief of Naval Operations, Washington DC.

Virginia Department of Environmental Quality (VDEQ), 2004. Voluntary Remediation Program Risk Assessment Guidance. www.deq.virginia.gov/vrprisk/raguide.html