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Lower Subase Remedial Investigation

for

Naval Submarine Base New London

Groton, Connecticut

Volume II - Text

Northern Division
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FOR
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GROTON, CONNECTICUT

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ACRONYMS AND ABBREVIATIONS

4,4-DDT	1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane
4,4'-DDD	1,1-dichloro-2,2-bis(4-chlorophenyl)ethane
4,4'-DDE	1,1-dichloro-2,2-bis(4-chlorophenyl)ethene
ARARs	applicable, relevant, or appropriate requirements
AST	aboveground storage tank
ASTM	American Society for Testing of Materials
AVS/SEM	acid volatile sulfides/simultaneously extracted metals
AWQC	ambient water quality criterion
B&R	Brown & Root
BCF	bioconcentration factor
BEHP	bis(2-ethylhexyl)phthalate
BERA	baseline ecological risk assessment
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
$CaCO_3$	calcium carbonate
CAWQC	chronic ambient water quality critierion
CDD	chlorinated dibenzo-p-dioxins
CERCLA	Comprehensive Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CN	cyanide
COC	chemical of concern
CRDL	contract required detection limit
CRQL	contract required quantitation limit
CSF	cancer slope factor
CTDEP	Connecticut Department of Environmental Protection
CTE	central tendency exposure
CTO	Contract Task Order
DEIS	draft environmental impact statement
DO	dissolved oxygen
DQO	data quality objectives
DPT	direct push technique

DRMO	Defense Reutilization and Marketing Office
DTW	depth to water
EA	environmental assessment
Eh	oxidation/reduction potential
EIS	environmental impact statement
EPC	exposure point concentration
EqP	equilibrium partitioning
ERA	ecological risk assessment
ER-L	effects range - low
ER-M	effects range - medium
ESG	ecological screening guideline
FCV	final chronic value
FDA	Food and Drug Administration
FDEP	Florida Department of Environmental Protection
FEIS	final environmental impact statement
FFA	Federal Facilities Agreement
fpc	fraction of organic carbon
FS	feasibility study
ft^3/s	cubic feet per second
ft/s	feet per second
GPS	Global Positioning System
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HNUS	Halliburton NUS Corporation
HQ	Hazard Quotient
HSA	hollow stem augering
HSWA	Hazardous and Solid Waste Amendment of 1984
IAS	initial assessment study
ICP	Inductively Coupled Plasma
ID	inside diameter
IDL	instrument detection limit
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program

K_d	distribution coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
LC_{so}	aqueous concentration of a contaminant lethal to 50% of the test population
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
mlw	mean low water
MOE	Ontario Ministry of the Environment
msl	mean sea level
NACIP	Navy Assessments and Control of Installation Pollutants
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Department of the Navy
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NEPA	National Environmental Policy Act
NESO	Naval Environmental Support Office
NFEC	Naval Facilities Engineering Command
NFESC	Naval Facilities Engineering Service Center
NGVD	National Geodetic Vertical Datum
NLDS	New London Disposal Site
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSB-NLON	Naval Submarine Base - New London
NUWC	Naval Undersea Warfare Center
OBDA	over bank disposal area
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OVA	organic vapor analyzer
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PEL	probable effects level
PID	photoionization detector
ppm	parts per million

ppt	parts per thousand
PVC	polyvinyl chloride
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QSAR	quantitative structure-activity relationship
RBC	risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RMS	root mean square
RPD	relative percent difference
RSE	removal site evaluation
RSR	Remediation Standard Regulations (State of Connecticut)
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SECWA	Southeastern Connecticut Water Authority
SEL	severe effects level
SI	site investigation
SMDP	scientific management decision point
SOP	standard operating procedure
SOW	statement of work
SPLP	synthetic precipitation leaching procedure
SQB	sediment quality benchmark
SSL	soil screening level
SVOC	semivolatile organic compound
SWPC	Surface Water Protection Criteria (State of Connecticut)
TAL	Target Analyte List
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TEF	toxicity equivalence factor
TOC	total organic carbon
TPH	total petroleum hydrocarbons

TSCA	Toxic Substances Control Act
UCL	upper confidence limit
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UST	underground storage tank
VOC	volatile organic compounds
WPCA	Water Pollution Control Authority
WQS	water quality standards
WWTP	wastewater treatment plant

8.0 ZONE 5

8.1 SITE DESCRIPTION

Zone 5 consists of Site 22, which includes Pier 33, Building 175, and approximately 400 lineal feet of additional river front property adjacent to these two structures. The Thames River lies to the west and Providence and Worcester Railroad lies to the east. Zone 5 lies to the north of Zone 6. Figure 8-1 illustrates the site and zone boundaries for Zone 5.

Building 175 was originally used to house several above-ground battery acid (sulfuric acid) storage tanks. These storage tanks and the associated transfer piping have since been removed. The building is currently used for miscellaneous storage. Steam and condensate ducts and fuel oil distribution lines do not extend to Zone 5 from the southern part of the Lower Subase. Stream 6 from the Area A Downstream discharges to the Thames River at the northern end of Zone 5.

8.1.1 Site 22 - Pier 33

Site 22 includes Pier 33, Building 175, and approximately 800 feet of additional property adjacent to these two structures. Building 175 is located northeast of Pier 33 and was originally used to house several above-ground battery acid (sulfuric acid) storage tanks. The building was completely filled with large above-ground storage tanks. Transfer lines from the battery acid storage tanks were extended in trenches along Amberjack Road to the piers (not shown on Figure 8-1). These storage tanks and the associated transfer piping have been removed. There are no known or reported spills from the storage tanks or transfer system. Building 175 is currently used for miscellaneous storage and administrative purposes. No underground steam or fuel-oil utilities service Building 175.

A 1,000-gallon UST was located adjacent to the southern side of Building 175. The age and type of the tank are unknown. Based on a tank test performed on May 22, 1990, no leakage was identified. Stained soil was observed around the fill pipe of the UST, and concentrations of TPH detected in shallow and deep soil samples collected in the vicinity of the UST exceeded state and Federal criteria (Atlantic, 1995a). This information indicated that the UST was the source of the TPH contamination; this tank has since been excavated, removed, and replaced by a new 1,000-gallon UST. A 250-gallon diesel-fuel UST is located adjacent to the northern side of Building 175. This tank services an emergency generator for the sewage lift station. The age and type of this tank are unknown.

8.1.2 Storm Sewers

As can be seen on Figure 8-1, four storm sewers discharge to the Thames River from Zone 5 and the area just south of Zone 5. Invert elevations for the storm sewer outfalls to the Thames River were not readily available; however, invert elevations for several catch basins upgradient of the outfalls were available. The invert elevations for the catch basins ranged from –0.45 feet msl [Catch Basin No. 764 (NOVA) south of Zone 5] to 3.96 feet msl (Catch Basin 766 on the southwest side of Building 175). These elevations were taken from the Navy drawing, *Utility Map, Storm Drainage* (Drawing Number 1142295, Sheet 2 of 19, July 27, 1967). The elevation of the Thames River fluctuates daily and seasonally, but the elevation of the river typically ranges between approximately 0.00 feet msl to 4.00 feet msl. Therefore, the storm sewer system will be submerged to varying degrees depending on the time of day and time of year.

In accordance with the requirements of the basewide General NPDES Stormwater Permit, the stormwater sewer located halfway between Building 175 in Zone 5 and Building 174 in Zone 6 is monitored annually during a storm event. This storm sewer, referred to as NOVA, was last sampled during a storm event on June 19, 1997. Results of the chemical and toxicity testing performed on this stormwater are presented in Section 8.2.3.

8.2 SITE INVESTIGATIONS

The following investigations were conducted at Zone 5:

- Pier 33 and Berth 16/Former Incinerator Site Investigation (Atlantic, 1995a)
- Existing Data Summary Report for Lower Subase Remedial Investigation (B&R Environmental, 1997a)
- Annual NPDES Stormwater Monitoring Program (Navy, 1997)

8.2.1 Pier 33 and Berth 16/Former Incinerator SI

Site 22 - Pier 33 has been investigated as part of the Pier 33 and Berth 16/Former Incinerator Site Investigation (SI) (Atlantic, 1995a). In addition, in 1989, subsurface soil samples were collected in the vicinity of Building 175 as part of a geotechnical investigation for the replacement of the quay wall. This investigation was conducted by Morrison Geotechnical Engineering and is discussed as part of the SI Report. Sediment sampling in 1990 at Piers 33 and 32 was conducted as part of the EIS for the Seawolf Class Submarine.

The SI summarizes information from the geotechnical investigation conducted by Morrison Geotechnical Engineering in 1989 for the replacement of the quay wall. During this investigation, No. 2 fuel oil was detected in subsurface soils in front of Building 175. Approximately 16 soil borings were installed during this investigation and are shown on Figure 8-1. One soil and one water sample were collected from a soil boring location (B-30) during this investigation. The samples were analyzed for metals, VOCs, TPH, oil type by fluorescence, pesticides, and PCBs. Several metals and TPH were detected in both samples. TPH was detected at 1,100 ppm in soil and 13 ppm in water, and fluorescence analysis indicated that the hydrocarbons present were No. 2 fuel oil. Petroleum contamination was also evident based on odor and/or visual examination in borings B-21 and B-25.

Following discovery of petroleum hydrocarbon contamination in the soils at Site 22 - Pier 33, this site was added to the IR Program. Atlantic conducted an SI at the site to determine the presence or absence and the magnitude of specific contaminants and to determine if the results warranted an RI/FS. The field investigation consisted of a soil-gas survey, a utility-manhole inspection, soil boring installation, monitoring well installation, and soil, groundwater, and sediment sampling and analysis. Four soil borings (19TB1 through 19TB4) and three borings converted to monitoring wells (19MW2 through 19MW4) were installed within Zone 5. One soil boring (19MW1) was also installed east of Zone 5 at the golf course as an upgradient monitoring location. Atlantic collected 15 soil samples from the soil borings and one round of groundwater samples from the monitoring wells. In addition, Atlantic collected one surface soil sample (19SS1) from stained soil on the south side of Building 175 and two sediment samples (19SD1 and 19SD2) from storm sewer drains. Samples were analyzed for TCL organics and TAL inorganics. Some samples were also analyzed for TPH, TCLP metals, and oil identification by fluorescence. The locations of the borings, monitoring wells, and surface soil and sediment samples are shown in Figure 8-1.

Seven utility manholes were inspected as part of the SI. The observed utilities consisted of storm sewer, sanitary sewer, and electric, and telephone manholes. All accessible manholes in the study area were opened and inspected. Any visual evidence of oil contamination, such as an oil sheen on water, discolored sediments, or any petroleum odors, was noted. Only one manhole had a slight sheen on the water; however, because this station is a sanitary sewer, the sheen may not be a result of petroleum.

8.2.2 Existing Data Summary Investigation for Lower Subase

The Existing Data Summary Report for the Lower Subase RI was developed as part of the first tier of data collection to accumulate data from several studies, including the Phase II RI and the Pier 33 and Berth 16/Former Incinerator SI, and to identify potential data gaps that would then be filled in during the Lower Subase RI.

With respect to Zone 5, the Existing Data Summary Report recommended further investigation of stained soils at the southwestern corner of Building 175, metal contaminants in storm sewer drains, and any soils containing TCLP lead levels greater than 150 µg/L. Also, testing of any USTs and piping not recently tested was recommended to eliminate the possibility of an ongoing petroleum source. Additional investigation of site operations and sediment analysis of the storm sewer system was also recommended to determine the extent and source of sediment contamination. Removal and disposal of contaminated sediments and modification of any site operations identified as a contributor to the contaminated sediment were also recommended. In addition, the report recommended that confirmation soil sampling and analysis for lead, using the SPLP method, are necessary to evaluate the nature of lead contamination at the site. Finally, the report recommended that further characterization activities at Zone 5 be coordinated with sediment sampling of the Thames River in the vicinity of Zone 5 to aid in the identification of source areas and contaminants of concern.

8.2.3 Annual NPDES Stormwater Monitoring Program

In accordance with the requirements of the basewide General NPDES Stormwater Permit, the storm sewer located halfway between Building 175 in Zone 5 and Building 174 in Zone 6 is monitored annually during a storm event. During a 0.27-inch storm of 45-minute duration on June 19, 1997, this storm sewer was sampled and analyzed. The analyses indicated that the storm sewer contained 170 mg/L of total suspended solids. Analytical results also indicated concentrations of oil/grease (less than 1.0 mg/L), fecal coliform (100 col/100 ml), copper (0.08 mg/L), lead (0.08 mg/L), and zinc (0.47 mg/L). The pH was measured at 5.41. Toxicity tests run on the same sample indicated a 48-hour mortality for *Daphnia pulex* to be 78.1 percent. This area was used as a "laydown" area for construction equipment. The Navy has eliminated this practice to improve the quality of surface water runoff.

8.2.4 Lower Subase Remedial Investigation

Six test borings (TB1-5RI through TB5-5RI) were installed to the water table in Zone 5 using DPT. Boring locations are illustrated in Figure 8-1, and boring log sheets are provided in Appendix A. Two soil samples were collected from each boring from shallow (0 to 5 feet) and deep (greater than 5 feet) depths. SVOC analyses were performed on both shallow and deep samples. TPH analysis was performed on shallow soil samples from each location in Zone 5, and TAL metals and SPLP lead analyses were performed on shallow and deep soil samples from each location. Soil sample log sheets are included in Appendix B.1.

Groundwater samples were collected from two existing monitoring wells (19MW2 and 19MW3). Existing monitoring well 19MW4 was not sampled because it had been destroyed. Groundwater samples were

collected using low-flow purging and sampling techniques, as described in Section 2.3.2. Samples were analyzed for TPH, TCL SVOCs, filtered and unfiltered TAL metals, and natural attenuation parameters. Groundwater sample log sheets and purge data sheets are provided in Appendix B.2.

Four sediment samples (SD1-5RI through SD4-5RI) were collected from locations in the Thames River along Zone 5. Sediment sampling locations are illustrated on Figure 8-1. Surface water quality measurements were taken from each sediment sampling location at the surface and the bottom of the water column. All sediment samples were analyzed for TCL SVOCs, TAL metals, TOC, grain size, AVS/SEM, pH, and ammonia. In addition, sample SD4-5RI was analyzed for TCL pesticides. Surface water quality parameters that were measured include temperature, salinity, turbidity, pH, specific conductance, and dissolved oxygen. Sediment sample log sheets with surface water measurements are provided in Appendix B.3.

8.3 PHYSICAL CHARACTERISTICS

The following sections summarize information provided in the SI report (Atlantic, 1995a) on topography and surface water features, soil characteristics, geology, and hydrogeology.

8.3.1 Topography, Surface Features and Surface Water Features

Figure 8-1 illustrates the site and zone boundaries for Zone 5. Zone 5 is located along the Thames River north of Zone 6 and approximately 1,400 feet south of Site 6-DRMO. Pier 33 is located southwest of Building 175. Zone 5 is generally level and covered by Building 175 and pavement. Surface elevation ranges from 5 to 7 feet msl across the site and increases rapidly east of Building 175 to the 30-foot terrace underlying the golf course.

Surface water runoff from Zone 5 drains into the Thames River via storm sewers illustrated in Figure 8-1. A box culvert between Buildings 175 and 176 conveys surface drainage (i.e., Stream 6) from the Area A Downstream Site, east of Zone 5, to the Thames River.

8.3.2 Soil Characteristics, Geology, and Hydrogeology

The soils of Zone 5 are mapped as Udorthents - Urban Land with a 0 to 15 percent slope (USDA, 1983), and the surficial geology is mapped within the 30-foot terrace deposit flanking the Thames River (USGS, 1960). A north-south cross-section of Zone 5 is illustrated in Drawing 7, and a west-east cross-section of Zone 5 is illustration in Figure 8-2. Five borings for this investigation and 22 borings from previous investigations confirm the mapped lithology of Zone 5. The site is underlain by fill consisting of sand or

sand and gravel. Fill extends to bedrock and ranges from 5 feet in the eastern portion of the site to 20 feet at the edge of the quay wall.

Several geotechnical borings installed by Morrison Geotechnical Engineering in 1989 were advanced to bedrock, confirming the bedrock lithology for Zone 5 as mapped by USGS (USGS, 1967). Zone 5 lies along the contact of the Alaskite gneiss to the north and the Granite gneiss to the south. The bedrock surface is approximately 6 to 12 feet below grade along the Thames River.

The unconfined water table at Zone 5 lies within the sand and gravel backfill and the natural sand unit at a depth of approximately 4 feet bgs. Groundwater flow is to the west toward the Thames River. Based on water-level measurements of wells located approximately 50 to 55 feet from the Thames River, the groundwater at Zone 5 is only slightly influenced by tidal fluctuations in the Thames River.

No aquifer tests have been performed at Zone 5 to date. However, the sand and gravel fill material underlying Zone 5 is similar to the fill material underlying Zone 2 and is, therefore, assumed to have a similar average hydraulic conductivity of 74 feet per day, based on slug tests conducted by Atlantic (1992) in Zone 2. Insufficient water-level data were available to determine the hydraulic gradient across Zone 5; however, based on the proximity and similar lithology of Zone 5 to Zone 6, an average hydraulic gradient to the Thames River of 0.0092 during low tide is assumed.

The volumetric rate of groundwater discharge through the sand and gravel fill material in Zone 5 to the Thames River was estimated to be 3,366 cubic feet per day, using Darcy's Law $Q = -KA(dh/dl)$, where Q = the volumetric discharge, K = the average hydraulic conductivity, A = the cross-sectional area (i.e., the saturated fill thickness by the width of the fill material along the Thames River), and dh/dl = the hydraulic gradient. An average saturated fill thickness of 12 feet and a width of 412 feet of fill along the Thames River in Zone 5 was assumed.

Generic contaminant loading rates for groundwater discharge into the Thames River from Zone 5 were generated using an estimated groundwater discharge rate (Q, discounting tidal effects) of 2,957 cubic feet/day; a 0.75 factor applied to this flux rate to account for the lack of groundwater discharge during periods of high tide (assumed to be about 6 hours/day over two tidal cycles); hypothetical solute concentrations (C) of 10, 100, and 1,000 µg/L; and the following mass flux equation: Mass flux = Q x 0.75 x C. The corresponding daily discharge rates from Zone 5 into the Thames River are 0.00157, 0.0157, and 0.157 lbs/day for solute concentrations of 10, 100, and 1,000 µg/L, respectively. Actual discharge rates for individual dissolved constituents can be approximated by using these generic discharge rates and the average concentration of the constituent. For example, a compound present at

an average concentration of 25 µg/L in groundwater would have a loading rate 2.5 times the generic rate calculated for a solute present at the 10 µg/L concentration. This loading estimate does not factor in retardation and degradation of solutes, which may be substantial in some cases and would reduce the loading rate.

8.4 NATURE AND EXTENT OF CONTAMINATION

This section is a discussion of the nature and extent of contamination of Zone 5 at the Lower Subase. The general site location of Zone 5 is shown in Figure 1-2. A detailed drawing of this zone is shown in Figure 8-1. Soil, groundwater, sediment, and surface water samples were collected during the Pier 33 and Berth 16/Former Incinerator Site Inspection, the Annual NPDES Stormwater Monitoring Program, and the Lower Subase RI. Summaries of the sampling and analytical programs are provided on Tables 8-1 through 8-3. The complete database for Zone 3 is contained in Appendix H of this report, including both chemical and physical parameters for all investigative samples.

8.4.1 Soil

Positive analytical results for all soil samples collected in Zone 5, as well as for the off-site upgradient sample discussed in Section 8.2.1, are presented in Table 8-4. Positive TCLP and SPLP results for soil samples are presented in Tables 8-5 and 8-6, respectively. Table 8-7 provides a summary of analytical results for all on-site soil samples collected from Zone 5. Table 8-8 provides a summary of fluorescence spectroscopy data for Zone 5 soil samples; these observations were obtained from the text of the Pier 33 and Berth 16/Former Incinerator SI (Atlantic, 1995a). Background concentrations of inorganics in soil, as presented in Table 1-4 and used for comparison with on-site soil concentrations, were taken from the Background Concentrations of Inorganics in Soil Report (Atlantic, 1995b).

Figures 8-3 and 8-4 show, for Zone 5 shallow and deep soil samples, respectively, the locations and concentrations of parameters that were detected in excess of COC selection criteria. Drawings 8 through 11 (Volume III) show the distribution of TPH and lead contamination in soil in all zones, including Zone 5, being investigated as part of the Lower Subase RI. Drawings 8 and 10 show TPH and lead isoconcentration contours, respectively, for shallow soils, and Drawings 9 and 11 show the same respective contours for deep soils.

8.4.1.1 Shallow Soil

Twenty-one inorganic constituents were detected in Zone 5 shallow soil samples (0 to 4 feet bgs). Maximum concentrations of eight inorganics were detected in the soil sample collected from location

19TB3. Boron, calcium, cyanide, lead, nickel, potassium, sodium, and zinc were detected in onsite shallow soils at maximum concentrations greater than background. Calcium, potassium, and sodium are naturally occurring, abundant constituents of soil. Boron was detected at a concentration greater than background in a shallow soil sample from only one onsite location (19MW3). Concentrations of inorganics in onsite shallow soil samples were generally similar, but in several cases less than, concentrations of inorganics in samples collected from the offsite upgradient location (19MW1). Concentrations of inorganics in Zone 5 onsite shallow soils were also similar to observed soil concentrations throughout other zones at the Lower Subase. Drawing 10 shows isoconcentration contours for lead for shallow soil samples collected at the Lower Subase, including Zone 5.

TCLP extraction followed by RCRA metals analysis was performed for surface soil sample 19SS1 and the shallow soil sample from the offsite upgradient location (19MW1). The lead concentration reported for the TCLP leachate of surface soil sample 19SS1 exceeded the Connecticut remediation standard pollutant mobility criteria for GB classified area. No TCLP leachate concentrations reported for Zone 5 shallow soil samples exceeded the Federal toxicity characteristic regulatory levels. SPLP extraction followed by analysis for lead was performed for shallow soil samples collected from two locations (TB1-5RI, which is located near location 19SS1, and TB6-5RI). Detected concentrations of lead in the SPLP leachates were less than both the Federal toxicity characteristic regulatory level and the Connecticut remediation standard pollutant mobility criterion for GB areas. Concerning potential migration, the results of the recent SPLP analyses do not support the results of the historical TCLP analyses.

Five VOCs were detected in Zone 5 shallow soil samples at concentrations ranging from 3 µg/kg (toluene) to 150 µg/kg (xylenes). With the exceptions of acetone and methylene chloride, which are common laboratory contaminants, VOCs were infrequently detected. Ethylbenzene, toluene, and xylenes, which are typical constituents of petroleum contamination, were each detected in one or two samples. Ethylbenzene (38 µg/kg), toluene (10 µg/kg), and xylenes (150 µg/kg) were detected in the shallow soil sample collected from location 19MW4, located in the vicinity of the stained soils and the UST adjacent to the southern side of Building 175. Toluene (2 µg/kg) was detected in the shallow soil sample collected from location 19MW2, located near the northwestern corner of Building 175.

Several SVOCs, primarily PAHs, were detected in shallow soils. PAH concentrations in the onsite shallow soils tend to be greater than the PAH concentrations reported for the offsite shallow soil samples (19MW1). 2-Methylnaphthalene was detected at a concentration of 960 µg/kg in the onsite shallow soil sample collected from well 19MW4. All other SVOCs were detected at concentrations ranging from 18 µg/kg (fluorene) to 520 µg/kg (fluoranthene) in the onsite soils. Maximum concentrations of 13 SVOCs were detected in the shallow soil sample collected from boring TB4-5RI, located on Amberjack Road just

outside the western edge of Site 22. Although no SVOCs were reported for surface soil sample 19SS1, matrix interferences for the sample required a dilution prior to analysis, resulting in elevated SVOC reporting limits of 20,000 µg/kg. In addition, dilution of the shallow soil sample from location 19MW4 was also required based on sample matrix interferences, resulting in elevated reporting limits of 1,400 µg/kg for this sample. Therefore, the presence of SVOCs in shallow soil samples from locations 19SS1 and 19MW4 could not be confirmed since concentrations of SVOCs less than 20,000 µg/kg and 1,400 µg/kg, respectively, may not have been detected. These samples were both collected in the vicinity of the stained soils. Therefore, the matrix interference effects noted during laboratory analysis indicate that high levels of contamination are likely to be present in the shallow soil in this area.

4,4'-DDE was detected at a concentration of 56 µg/kg in shallow soil sample 19SS1. Aroclor 1260 was detected in shallow soil samples from three Zone 5 locations (19TB4, 19MW3, and 19MW2) at concentrations ranging from 55 µg/kg to 140 µg/kg. Four pesticides with concentrations ranging up to 640 µg/kg (4,4'-DDT), were detected in the offsite upgradient shallow soil sample collected from well 19MW1. The presence of pesticides in the onsite and offsite soil samples is most likely associated with maintenance of the NSB-NLON golf course located just east and upgradient of Zone 7. PCBs were not detected in the offsite, upgradient shallow soil samples, indicating that the presence of Aroclor 1260 is likely to be attributable to site activities.

TPH was detected in all the 10 Zone 5 shallow soil samples for which TPH analysis was performed. The maximum concentration (6,800 mg/kg) was detected in shallow soil sample 19SS1. This sample was collected from the stained soil adjacent to the south of Building 175. The remaining concentrations ranged from 53 mg/kg to 1,900 mg/kg. TPH was not detected in the soil sample and associated field duplicate sample from off-site upgradient location 19MW1. Drawing 8 shows TPH isoconcentration contours for shallow soil samples collected at the Lower Subase, including Zone 5.

Fluorescence spectroscopy performed for surface soil sample 19SS1 indicated the presence of No. 2 diesel fuel oil in the stained soils on the southern side of Building 175. The results of the fluorescence spectroscopy analysis are provided in Table 8-8.

8.4.1.2 Deep Soil

Eighteen inorganic constituents were detected in Zone 5 deep soil samples (greater than 4 feet bgs). Calcium, copper, cyanide, manganese, nickel, sodium, and zinc were detected at maximum concentrations greater than background (presented in Table 1-4). Copper and manganese were each detected above background in only one deep soil sample (from locations 19MW3 and 19TB4,

respectively), and zinc was detected above background in two deep soil samples (from locations 19MW3 and TB6-5RI). All concentrations of calcium and most concentrations of sodium were greater than background; however, as previously noted, calcium and sodium are naturally occurring, abundant constituents of soil. Concentrations of metals detected in deep soil sampling collected from Zone 5 were similar to concentrations detected throughout the Lower Subase and in shallow offsite soil from location 19MW1.

Drawing 11 shows isoconcentration contours of lead concentrations measured in Zone 5 deep soil samples. The contours show that lead concentrations are lower (less than 15 mg/kg) in deep soils than in shallow soils (less than 92 mg/kg) of Zone 5. The concentrations of lead in the deep soils do not exceed background.

TCLP extraction followed by analysis for RCRA metals was performed for eight Zone 5 deep soil samples. The lead concentration reported for the TCLP leachate of the deep soil sample collected from location 19MW2 exceeded Connecticut standards for a GB classified area. No TCLP leachate concentrations of chemicals in excess of Federal toxicity characteristic regulatory levels were detected in Zone 5 deep soil samples. SPLP extraction followed by analysis for lead was performed for deep soil samples from two Zone 5 locations, TB1-5RI and TB6-5RI. Location TB6-5RI is near location 19MW2. Concentrations of lead detected in the SPLP leachates were less than both Federal toxicity characteristic regulatory levels and Connecticut remediation standard pollutant mobility criteria for a GB area. Concerning potential migration, the results of the recent SPLP analyses do not support the results of the historical TCLP analyses.

Six VOCs were detected in Zone 5 deep soil samples. With the exceptions of acetone and methylene chloride, which are common laboratory contaminants, VOCs were infrequently detected at concentrations ranging from 3 µg/kg (toluene) to 32 µg/kg (ethylbenzene). 2-Butanone (5 µg/kg), toluene (3 µg/kg), and xylenes (7 µg/kg) were detected in the deep soil sample collected from location 19TB2. Ethylbenzene (33 µg/kg) and xylenes (32 µg/kg) were detected in the deep soil sample collected from location 19MW4. Concentrations of volatiles detected in deep soil samples were similar to those detected in shallow soil samples, with the exception of xylenes, which were detected at a concentration of 150 µg/kg in the shallow soil sample collected from location 19MW4.

Several SVOCs, primarily PAHs, were detected in deep soil samples. PAH concentrations in the onsite deep soils tend to be greater than the PAH concentrations reported for the offsite shallow soil samples (19MW1). Concentrations of SVOCs detected in deep soil samples were generally two to four times greater than those detected in shallow soils, although concentrations of some SVOCs in deep soils

exceeded shallow soil concentrations by more than 10 times. 2-Methylnaphthalene was detected at concentrations of 23,000 µg/kg, 21,000 µg/kg, and 9,700 µg/kg in the deep soil samples collected from locations 19MW3, TB1-5RI, and 19MW4, respectively. Concentrations of other SVOCs ranged from 21 µg/kg (anthracene) to 7,000 µg/kg (phenanthrene). Maximum concentrations of eight SVOCs were detected in the deep soil sample collected from boring TB4-5RI, located on Amberjack Road just outside the western edge of Site 22. However, the greatest total SVOC concentrations were found in deep soil samples from locations TB1-5RI (36,500 µg/kg), 19MW3 (30,000 µg/kg), and 19MW4 (9,700 µg/kg). Although no SVOCs were reported for the deep soil sample collected from location 19TB2, matrix interferences for this sample required a dilution prior to analysis, resulting in SVOC reporting limits of 22,000 µg/kg. Therefore, the presence of SVOCs in this sample could not be confirmed since concentrations less than 22,000 µg/kg may not have been detected. The matrix interference effects noted during laboratory analysis indicate that high levels of contamination are likely to be present in the deep soil in the area of location 19TB2.

Pesticides were not detected in deep soil samples. Aroclor 1260 was detected in deep soil samples from three locations (19MW2, 19TB4, and 19TB2) at concentrations ranging from 42 µg/kg to 130 µg/kg. PCBs were not detected in the offsite, upgradient shallow soils, indicating that the presence of this chemical is likely to be attributable to site activities.

TPH concentrations in deep soil samples collected west and south of Building 175 ranged from 3,300 mg/kg to 6,200 mg/kg. These concentrations result in a distinct area of contamination on Drawing 9. The maximum detection of TPH in shallow soil is similar to TPH concentrations in deep soil. Outside this distinct area of contamination, TPH concentrations were less than 500 mg/kg.

Based on soil analytical results, an area of elevated petroleum contamination is apparent west and south of Building 175 associated with the stained soils and UST adjacent to the south of Building 175. Contamination was detected from ground surface to a depth of approximately 8 feet. With the exception of PCBs and sporadic detections of PAHs, VOCs and SVOCs detected at Zone 5 are within the area of petroleum contamination. Moderate to high concentrations of BTEX detected in several soil-gas sample locations also generally correlate with the area of petroleum contamination. Also, minor oil staining or sheens were observed in shallow and subsurface soils at boring locations 19MW3, 19MW4, and 19TB2. Fluorescence spectroscopy for deep soils identified this area as containing No. 2 diesel fuel (detected in samples collected from locations 19MW3, 19MW4, and 19TB2).

Several PAHs (at 19MW2 and TB6-5RI) and Aroclor 1260 (at 19MW2 and 19TB4) were also detected in soils collected west and northwest of the UST adjacent to the north of Building 175. Concentrations of

these organic chemicals ranged up to 1,000 µg/kg (phenanthrene at location TB6-5RI). Fluorescence spectroscopy results (Table 8-8) for deep samples in this area indicated No. 6 fuel oil residuals at 19TB3, 19TB4, and 19MW2. This No. 6 fuel oil residual was also detected in 19TB1. TPH concentrations in deep soils at these sample locations, however, were low (i.e., less than 85 µg/kg) or nondetectable.

8.4.2 Groundwater

Positive analytical results for all groundwater samples collected from Zone 5 are presented in Table 8-9. Table 8-10 summarizes analytical results for groundwater samples collected from Zone 5 during historical investigations (i.e., the Pier 33 and Berth 16/Former Incinerator SI) and during the Lower Subase RI.

Table 8-11 provides a summary of groundwater fluorescence spectroscopy data collected for Zone 5; these observations were obtained from the text of the Pier 33 and Berth 16/Former Incinerator SI (Atlantic, 1995a). Table 8-12 provides a summary of natural attenuation and water quality parameters for Zone 5 groundwater samples; these parameters are discussed in Section 8.5.3.

Figure 8-5 depicts, for data collected during the Lower Subase RI only, the locations and concentrations of parameters that were detected in excess of COC selection criteria. Drawings 12 through 14 (Volume III) show the distribution of TPH and lead contamination in groundwater for all zones, including Zone 5 of the Lower Subase. These drawings include only recent groundwater data collected during the Lower Subase RI. Drawing 12 shows isoconcentration contours of TPH concentrations measured in groundwater. Isoconcentration contours of unfiltered (total) and filtered (dissolved) lead concentrations in groundwater are presented on Drawings 13 and 14, respectively.

8.4.2.1 Historical Data

Groundwater samples were collected from three monitoring wells during one round of sampling in 1993. Seven metals (calcium, cobalt, iron, magnesium, manganese, potassium, and sodium) were detected in both unfiltered and filtered groundwater samples, and concentrations detected in unfiltered and filtered groundwater samples were similar (i.e., at the same order of magnitude). Six metals (aluminum, arsenic, barium, boron, lead, and zinc) were detected in filtered groundwater samples only. For both filtered and unfiltered samples, the maximum concentrations of all metals except sodium were detected in samples from either well 19MW3 or well 19MW4.

The distribution of lead in unfiltered and filtered groundwater samples is shown on Drawings 13 and 14, respectively. No detections of lead were measured in the unfiltered groundwater samples (Drawing 13),

and only low levels of lead (i.e., slightly above the instrument detection limit) were detected in the filtered samples (Drawing 14). In either case, the levels of lead measured in the groundwater do not indicate that there is extensive lead contamination in Zone 5 groundwater.

A limited number of organic compounds were detected in Zone 5 groundwater samples. Three VOCs (in 19MW4) and six SVOCs (in 19MW3 and 19MW4) were detected at low concentrations (less than 80 µg/L). Notably, all of these VOCs and SVOCs were detected in Zone 5 soils; 2-methylnaphthalene, fluorene, naphthalene, and phenanthrene were detected at relatively high concentrations in subsurface soils. No organic compounds were detected in the groundwater sample from well 19MW2. TPH, pesticides, and PCBs (chemicals detected in soil) were not detected in groundwater samples collected from Zone 5. Fluorescence spectroscopy identified residual fuel oil or road tar at 19MW2 and No. 4 or No. 6 fuel oil at 19MW3 and 19MW4 (Table 8-11). The fluorescence data for groundwater do not correspond well with the fluorescence data obtained for soils at Zone 5.

Although limited contamination was detected in groundwater samples collected from Zone 5, the source of contaminants detected in groundwater samples collected from wells 19MW3 and 19MW4 appears to be from contaminated soil and the UST located on the southern and western sides of Building 175.

8.4.2.2 Lower Subase RI

Groundwater samples were collected from two monitoring wells (19MW2 and 19MW3) during the Lower Subase RI. Monitoring well 19MW4 had been destroyed and, therefore, samples could not be collected from this location. Nine metals (barium, calcium, copper, iron, magnesium, manganese, potassium, sodium, and zinc) were detected in both filtered and unfiltered groundwater samples. Lead, mercury, and vanadium were detected in unfiltered groundwater samples only. In general, the concentrations of metals detected in groundwater samples collected from monitoring wells 19MW2 and 19MW3 during the Lower Subase RI were greater than respective concentrations detected in samples from these wells during the Pier 33 and Berth 16/Former Incinerator SI.

Groundwater samples collected during the Lower Subase RI were not analyzed for VOCs. Six SVOCs were detected in the groundwater sample collected from well 19MW3. The SVOC concentrations ranged from 0.6 µg/L (di-n-butyl phthalate) to 2 µg/L (fluorene).

TPH was not detected in the groundwater samples from either well. Based on the sensitivity of the method used for analysis, the reporting limits for TPH were greater than the Connecticut remediation criterion of 500 µg/L. Therefore the presence of TPH below the reporting limits could not be confirmed

since TPH at concentrations less than the reporting limits would not have been reported. Based on convention, one-half the reporting limit is shown on Drawing 12 for each well. The values provided on Drawing 12 (550 µg/L) are just slightly above the Connecticut remediation criterion of 500 µg/L.

8.4.3 Surface Water/Sediment

Surface water and sediment samples were collected from the Thames River adjacent to Zone 5. The nature and extent of contamination in Thames River surface water and sediment samples, as well as the impact of the activities and contamination at the Lower Subase (including Zone 5) on the Thames River surface water and sediments, are discussed in Section 11.4.

As part of the basewide General NPDES Stormwater Monitoring Program, four annual storm sewer surface water samples have been collected from the storm sewer, referred to as NOVA, located halfway between Building 175 in Zone 5 and Building 174 in Zone 6. The storm sewer surface water sampling location is shown on Figure 8-1. Positive analytical results for these storm sewer surface water samples are presented in Table 8-16.

Copper was detected at a maximum concentration of 80 µg/L in three of the four (unfiltered) storm water samples, including the most recent sample (collected in June 1997). Maximum detected concentrations of lead (80 µg/L) and zinc (470 µg/L) were also reported for the June 1997 sample. Iron and sodium, for which analysis had not been performed during the first three sampling events, were detected at concentrations of 540 µg/L and 4,150 µg/L in the surface water sample from the June 1997 sampling event. Concentrations of oil and grease ranged from 2,300 µg/L to 3,180 µg/L during the first three rounds of sampling; however, this parameter was not detected in the June 1997 storm sewer surface water sample. Several miscellaneous parameters, as further discussed in Section 11.7, were also detected.

Two sediment samples were collected from the storm sewer system that runs through Zone 5. Positive analytical results for storm sewer sediment samples collected from Zone 5 are presented in Table 8-13. Table 8-14 provides a summary of analytical results for sediment samples collected from Zone 5 storm sewers. One sample, 19SD1, was collected from the drain located near the southern end of the Building 175, on the sewer line that runs along the western side of the building. The other sample, 19SD2, was collected from the drain located approximately 200 feet south of Building 175, on the sewer line that runs along the eastern side of the building. The storm sewer sediment sampling locations are shown in Figure 8-1.

Twenty-three inorganics were detected in the storm sewer sediments. Antimony, cadmium, calcium, chromium, copper, lead, mercury, nickel, silver, sodium, and zinc were detected above NSB-NLON background soil concentrations. In particular, antimony, cadmium, lead, and silver at 19SD1 and copper at 19SD2 were detected at concentrations at least an order of magnitude greater than background. With the exception of lead, the concentrations of metals detected in storm sewer sediments are generally similar to those detected in soils at Zone 5. However, lead was detected in storm sewer sediment samples 19SD1 and 19SD2 at concentrations of 85,600 mg/kg and 185 mg/kg, respectively, as compared to a maximum concentration of lead in Zone 5 soil samples of 91.2 mg/kg.

Three VOCs were detected in storm sewer sediments. Toluene (4 µg/kg), acetone (220 µg/kg), and methylene chloride (9 µg/kg) were detected in the sample from location 19SD1, and acetone (58 µg/kg) and methylene chloride (12 µg/kg) were detected in the sample from location 19SD2. Fifteen SVOCs, predominantly PAHs, were detected in Zone 5 storm sewer sediment samples. Five SVOCs were detected in sample 19SD2 at concentrations ranging from 510 µg/kg (phenanthrene) to 2,100 µg/kg [bis(2-ethylhexyl)phthalate]. Fourteen SVOCs were detected in sample 19SD1 at concentrations ranging from 7,300 µg/kg (acenaphthene) to 44,000 µg/kg (fluoranthene). The concentrations of SVOCs in storm sewer sediment sample 19SD1 were generally at least an order of magnitude greater than SVOC concentrations detected in Zone 5 soil samples. TPH was detected at concentrations of 3,300 mg/kg and 1,800 mg/kg in samples 19SD1 and 19SD2, respectively. Results of fluorescence spectroscopy indicate that either No. 4 or No. 6 fuel oil was present at location 19SD1 and that No. 6 fuel oil was present at location 19SD2 (Table 8-15). Although pesticides and PCBs were detected in the Zone 5 soil samples, these chemicals were not detected in the storm sewer sediment samples.

Inorganic contamination in Zone 5 appears to be related to recent site activities (possibly paint removal operations or lead ballast storage) and is not related to historical site conditions or disposal activities. A small amount of paint chips were observed in 19SD2, where copper was observed above background. Copper is a common additive in antifouling boat bottom paint (Atlantic, 1995a). Although not observed in sediment samples, lead ballast (generally 3 mm sized balls) was observed on the ground in several locations on the north side of Building 175. The hoppers used to transport and load the lead ballast onto ships are often stored in the paved area adjacent to the north side of Building 175 (Atlantic, 1995a). The SVOCs detected in storm sewer sediments are likely a result of petroleum constituents, and contamination likely resulted from surface water runoff or spills.

8.5 CONTAMINANT FATE AND TRANSPORT

8.5.1 General Contaminant Fate and Transport Processes

The major area of concern for Zone 5 is impacted soil, as evidenced by detection of PAHs and the presence of stained soil in the vicinity of the 1,000-gallon UST that had been used for the storage of heating oil. In addition, several VOCs were also detected in the samples from Zone 5. The soils at Zone 5 also contained several metals (boron, lead, and zinc) at elevated concentrations relative to background concentrations.

PAHs are generally considered to be fairly immobile in the environment. As noted in Section 3.3.2.4, PAHs have very low solubilities, vapor pressures, and Henry's Law constants, and high K_{oc}s and K_{ow}s. The low-molecular weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) are more mobile (higher solubilities, etc.) than the high-molecular-weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.). PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than go into solution. PAHs can be degraded via aerobic bacteria, but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorous and nitrogen.

Within Zone 5, TPH, as well as the PAHs, were found in both shallow and deep soils. The highest concentrations were detected in the area around the 1,000-gallon UST that was used for the storage of heating oil. In addition, the soils in that area were visibly stained. Consequently, the presence of PAHs in deep soil samples is most likely the result of leakage or spillage from this tank as it was being filled. Some of the low-molecular-weight PAHs were detected in the groundwater samples collected within Zone 5, indicating that some migration of the PAHs to the groundwater may have occurred.

VOCs are typically considered to be fairly soluble and have a low capacity for retention by soil organic carbon. Therefore, VOCs are the organic compounds most frequently detected in groundwater. These types of chemicals may migrate through the soil column after being released by a spill event or by subsurface waste disposal as infiltrating precipitation solubilizes them. Some portion of these compounds will be retained by the soil, but most will continue migrating downward until they reach the water table. At Zone 5, VOCs were detected at low concentrations in the soil samples and the historical groundwater samples. However, because of the low concentrations and infrequent detections, the VOCs detected at Zone 5 do not appear to be migrating.

As noted in Section 3.3.2.9, metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

In addition, under normal conditions, metals are not very mobile in the environment. Because metals frequently remain bound to particulate matter, the major transport mechanism for metals is bulk movement processes (erosion). However, metals can become mobile in the environment under certain conditions. The mobility of metals is influenced primarily by their physical or chemical properties in conjunction with the physical and chemical properties of the soil matrix. Factors that assist in predicting the mobility of metals are the soil/pore water pH, REDOX potential, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity. The effect of REDOX potential varies for each metal.

The sample results for Zone 5 attest to the concept that metals do not normally migrate. Although some of the metals were detected in soil samples from Zone 5 at concentrations greater than those detected in the background samples, the concentrations were not significantly higher. The concentrations of metals in the shallow soil samples were comparable to the concentrations in the deep soil samples. And the metals that were detected in the groundwater samples were detected at low concentrations.

8.5.2 Effects of Cross Contamination on Other Zones and the Thames River

TPH is an indicator of petroleum hydrocarbon contamination. PAHs are the primary components of fuel oils such as No. 2, which was stored in USTs at the site. The TPH contamination detected at the site is therefore assumed to be comprised of PAHs and other semivolatile compounds. As shown in Drawings 8 and 9 in Volume III of this RI report, concentrations of TPH in shallow and deep soil, respectively, are elevated in Zone 5. The krigging results indicate that the area of elevated TPH concentrations in shallow soil extend beyond the boundary of Zone 5 on the south and east; however, because these results are somewhat speculative, it is uncertain whether cross contamination to areas outside Zone 5 has occurred.

VOCs (acetone and methylene chloride) and SVOCs (mainly PAHs) were detected in shallow and deep soil at Zone 5. VOCs (ethylbenzene, toluene, and xylenes) and SVOCs (mainly PAHs) were also detected in Zone 5 groundwater. TPH was not detected in groundwater at Zone 5 during the latest sampling round. VOCs (2-butanone and acetone) and SVOCs (mainly PAHs) were detected in Zone 5 sediment samples. Low and high molecular weight PAHs were detected in soil and sediment samples, whereas only the low molecular weight PAHs were detected in groundwater. Concentrations of PAHs in sediments are of similar magnitude as those concentrations detected in soil. This suggests that migration of SVOCs to the

Thames River sediments adjacent to Zone 5 may have occurred. Also, concentrations of VOCs and SVOCs in Zone 5 sediment samples are of similar magnitude as those concentrations detected in sediment samples collected from locations upstream and downstream of the Lower Subase. Therefore, observed contamination in the Thames River may be attributable to other off-property sources of contamination.

Several inorganics (i.e., boron, lead, and zinc) have been detected in shallow and/or deep soil samples at concentrations of at least 4 times higher than background levels. Zinc was the only inorganic detected at a slightly elevated level in groundwater samples. Zinc was also detected in Thames River sediment samples, but the concentrations were similar to those detected in Zone 5 soil samples and background sediment samples. These results indicate that migration of inorganics to the Thames River has not occurred.

As shown in Drawings 10 and 11, concentrations of lead are within background levels except for a small area in deep soil located at the southern end of Building 175. Concentrations of total and dissolved lead in groundwater are shown on Drawings 13 and 14, respectively. Total lead was detected in only one groundwater sample. Dissolved lead was not detected in any groundwater sample during the latest round of sampling. It does not appear that lead is migrating from soil to groundwater at Zone 5. The maximum concentration of lead detected in sediment samples collected adjacent to Zone 5 was approximately 2 times higher than background lead sediment concentrations. Also, with the exception of the small area at the southern end of Building 175, concentrations of lead in sediment samples are higher than those in site soil samples. Concentrations of lead in sediment samples collected adjacent to Zone 5 are typically lower than lead concentrations in sediment samples collected upstream and downstream of the site. Therefore, the data indicate that soil and groundwater at Zone 5 are not acting to cross contaminant the Thames River.

A storm sewer that discharges to the Thames River is located in Zone 5. Oil and grease, copper, lead, and zinc, which were analyzed for as part of the NPDES permit monitoring program, have been detected at elevated levels in storm sewer surface water samples. This indicates that the storm sewer may be a source of contamination to the Thames River.

There may be other off-property sources that may be contributing to contamination detected in Thames River sediments. The Thames River is tidally influenced and contaminants may be migrating in the river from upstream and downstream sources. Also, the contamination may be a result of spillage that may have occurred during historical refueling of submarines and tugboats at the Lower Subase.

8.5.3 Evaluation of Natural Attenuation Data

Soil and groundwater samples were collected in Zone 5 and analyzed in the field or by a fixed-based laboratory. The resulting data provide the information necessary to answer the three following questions:

- Are contaminants present in either medium that could be remediated via natural attenuation or bioremediation?
- Is natural attenuation currently in progress in the groundwater?
- Are the conditions in the groundwater favorable for natural attenuation or bioremediation?

For Zone 5, TPH concentrations in soil and groundwater were contoured and the results are presented on Drawings 8, 9, and 12. Drawings 8 (shallow soil) and 9 (deep soil) show that high levels of TPH (i.e., indicative of petroleum hydrocarbons) are present in the soil of Zone 5. The maximum TPH concentrations were detected in 19SS1 (6,800 mg/kg, shallow soil) and 19TB2 (6,200 mg/kg, deep soil). As discussed in Section 8.4, PAHs were also frequently detected in the shallow and deep soil of Zone 5, which confirms the TPH concentrations. TPH was not detected in the groundwater of Zone 5 above the detection limit. PAHs and BTEX compounds were detected in the groundwater in the same area where high levels of petroleum contamination was detected in the soil. These results indicate that petroleum hydrocarbons are present mainly in the soil and are migrating to some extent to the groundwater. As discussed previously, petroleum hydrocarbons in either media can be treated successfully via natural attenuation or bioremediation.

The procedure for evaluating natural attenuation data for groundwater was previously outlined in Section 3.3.4 and is followed in this section. Table 8-12 summarizes the parameters that were measured to determine if natural attenuation is occurring in the groundwater of Zone 5. Other information in the table includes parameter-specific concentration ranges and frequency of detections. Drawings showing the distribution of key parameters were also prepared to aid in the interpretation of the data. The drawings that were prepared include the following:

- Drawing 2 - High Tide Potentiometric Surface Map
- Drawing 4 - Low Tide Potentiometric Surface Map
- Drawing 15 - Dissolved Oxygen
- Drawing 16 - REDOX potential
- Drawing 17 - Divalent Iron
- Drawing 18 - Specific Conductivity

The following conclusions were reached after review and evaluation of the data presented in Table 8-12 and Drawings 2, 4, and 15 through 18.

- The limited available dissolved oxygen data (i.e., 2 samples) indicate that both aerobic and anaerobic regions exist at Zone 5. The dissolved oxygen concentration at 19MW2 (6.96 mg/L), which is located to the north of Building 175, is similar to the value detected at MW1-6RI (5.07 mg/L). The dissolved oxygen concentration at 19MW3 (0.71 mg/L), which is located towards the center Building 175 and closer to the known area of contamination on the southern side of Building 175, is indicative of a slightly anaerobic region.

- The REDOX potential measurements from monitoring wells 19MW2 and 19MW3 are consistent with the dissolved oxygen concentrations from these wells which further supports the fact that there are aerobic (north) and anaerobic (south/central) regions in the Zone 5 groundwater.

- The nitrate results indicate that denitrification may be occurring near 19MW3. The concentration of nitrate was below detection limit at this well. The groundwater at 19MW2 had a nitrate concentration (1.2 mg/L) that was similar to the concentration detected at MW1-6RI (1.4 mg/L).

- Divalent iron was detected in the groundwater at 19MW3, which indicates that iron reduction is occurring in the south/central region of Zone 5. Divalent iron was not detected in 19MW2.

- The sulfate concentrations detected in 19MW2 and 19MW3 were above and below, respectively, the 20 mg/L criterion. These results indicate that sulfate reduction is occurring in the vicinity of 19MW3.

- Methane was detected in one well of Zone 5 (19MW3), indicating that methanogenesis is occurring in the south/central portion of this zone.

- Concentrations of alkalinity detected in the groundwater were normal compared to other zones; however, the maximum detection of hardness (4,000 mg/L) was higher than concentrations in other zones. Both alkalinity and hardness levels detected in Zone 5 were higher than the levels found in MW1-6RI.

- Groundwater temperature and pH were normal for Zone 5.

- Ammonia was detected in 19MW3. The nitrate was not detected in this well, which further suggests that denitrification is occurring at this well.

- Phosphorous was detected in the groundwater and is available as a nutrient.

- Salinity and chloride concentrations were significantly higher in 19MW2 (9.74 ppt and 3,900 mg/L) than those detected in 19MW3 (0.35 ppt and 150 mg/L). Both wells are in the same proximity to the Thames River. Drawings 2 and 4 indicate that the water level in 19MW2 is influenced more by the Thames River than the water levels in 19MW3. This data indicates that there is a better hydraulic connection between the groundwater at 19MW2 and the Thames River.

The conclusions provided above indicate that natural attenuation is probably occurring in the south/central portion of Zone 5 (i.e., near the former 1000-gallon UST on the south side of Building 175). The fact that TPH, VOCs, and SVOCs were either not detected or were detected very infrequently in the groundwater is most likely the result of a variety of factors (i.e., condition, type, and age of source, natural attenuation, mobility of contaminants, unique hydrogeologic conditions, and tidal flushing). Due to the variety of factors influencing Zone 5 and the limited contaminant plume, it is unlikely that bioremediation or other more active remedial technologies are practical or necessary for the groundwater of this zone. It is likely that a combination of monitored natural attenuation or a tiered groundwater monitoring program and source control would be a viable remedial strategy for this zone. If monitored natural attenuation is selected as part of the remedial strategy for Zone 5, additional investigations would need to be completed to provide the preliminary data required for the remedial alternative and to monitor the progress of the alternative. Monitoring of the non-tidally influenced areas of Zone 5 would provide the best indication that natural attenuation processes are working in the groundwater.

8.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the baseline risk assessment performed for soil and groundwater exposures at Zone 5 of the Lower Subase. Section 8.6.1 contains a discussion on the selection of COCs, Section 8.6.2 contains information on the potential receptors considered and the routes by which they might be exposed, Section 8.6.3 contains the numerical results of the risk assessment, and Section 8.6.4 presents site-specific uncertainties associated with the risk assessment.

8.6.1 Data Evaluation

COCs were identified for Zone 5 of the Lower Subase using risk-based COC screening levels, as described in Section 3.4.3. All validated data collected during the Phase I and II RIs, the Lower Subase RI, and additional investigations, except soil data collected from depths greater than 10 feet, were used to

identify COCs. Table 8-17 presents a summary of the COCs for Zone 5. Appendix I.9 contains the COC summary screening tables for the site.

A medium-specific discussion of COCs is presented in the following subsections. Within a given medium, discussions of direct exposure COCs (i.e., those chemicals detected at concentrations in excess of Federal and state direct exposure criteria) and additional COCs are provided. Additional COCs are identified based on contaminant migration tendencies; migration from soil to groundwater and from groundwater to the Thames River. These additional COCs are not quantitatively addressed in the human health risk assessment (i.e., numerical risk estimates are not developed) because they are not considered to be significant contributors to the direct exposure pathways identified for potential human receptors.

8.6.1.1 Soil Chemicals of Concern

The following chemicals were identified as direct exposure COCs for soil based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for residential land use and Connecticut RSRs for direct exposure (residential and industrial land use):

- PAHs [benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene]
- Inorganics (arsenic, beryllium, iron, and manganese)
- TPH

Benzo(b)fluoranthene, beryllium, and manganese were selected as COCs for the "all soils" (soil from depths of 0 to 10 feet) category only. TPH was qualitatively identified as a COC for shallow soil because the maximum detected concentration exceeded the Connecticut RSR for residential direct exposure. Detected concentrations of TPH in shallow and subsurface soil exceeded the Connecticut RSRs for residential and industrial direct exposure.

Maximum detections in soil were also compared to generic USEPA SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area. Maximum concentrations of the following chemicals exceeded the generic soil pollutant mobility criteria, indicating the potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater:

- VOCS (methylene chloride).
- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene].

- Inorganics (arsenic, chromium, lead, and nickel).
- TPH.

Carbazole, naphthalene, and nickel were retained as COCs for the "all soil" category only.

Under the Connecticut RSR (CTDEP, 1996), concerns regarding the mobility of inorganics in soil are addressed using TCLP and SPLP data. A comparison of site-specific TCLP and SPLP data and state RSRs for pollutant mobility is provided in Tables 8-5 and 8-6. Lead concentrations in TCLP extracts from two soil samples exceeded the state pollutant mobility criteria. However, recently collected SPLP extracts from Zone 5 soils were less than the state criteria.

Although the use of generic mobility criteria (rather than site-specific criteria) results in a conservative identification of additional COCs for soil, the mobility of some chemicals is supported by the groundwater data available for the site. Of the chemicals previously identified as migration COCs for soil, naphthalene, arsenic, and lead were detected in groundwater samples collected from the site. Arsenic was only detected once in a historic groundwater sample which does not indicate a significant mobility concern. The results of the confirmatory SPLP analyses indicate that lead is not mobile. However, TCLP/SPLP analyses were not performed for all soil samples collected at the site; therefore, there is still some uncertainty regarding the mobility of lead. A discussion of COCs for groundwater is provided in the following subsection.

8.6.1.2 Groundwater Chemicals of Concern

COCs for groundwater were selected using unfiltered and filtered data. Although groundwater at the site is not currently used or expected to be used in the future as a drinking water supply because of saline conditions, a conservative list of direct exposure COCs was developed for this medium based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for tap water, Federal and state MCLs, and Connecticut RSRs for the protection of groundwater. Inorganic chemicals retained as direct exposure COCs include: aluminum, arsenic, barium, iron, manganese, and sodium.

Aluminum and arsenic were identified as COCs for the filtered sample matrix only. These chemicals were not detected in unfiltered groundwater samples. Sodium was retained as a COC because the maximum detections for this chemical in unfiltered and filtered groundwater samples were in excess of the state Notification Level. However, elevated levels of sodium in groundwater are anticipated because of nearby saltwater intrusion from the Thames River.

Since Zone 5 borders the Thames River, maximum concentrations in groundwater were also compared to the Connecticut WQSs for aquatic life (chronic saltwater criteria) and for the protection of human health (water and organisms). These criteria were used to evaluate the potential for contaminant migration to the water body. The following chemicals were detected at maximum concentrations in excess of the state WQSs:

- PAHs (acenaphthylene, phenanthrene)
- Inorganics (arsenic, copper, mercury, and zinc)

Mercury was identified as an additional COC for the unfiltered sample matrix only. Mercury was not detected in filtered groundwater samples. Arsenic and zinc were identified as COCs for the filtered matrix only. Arsenic was not detected in the unfiltered groundwater samples. Reported concentrations of zinc in the unfiltered groundwater samples were less than Connecticut WQSs.

The actual impact on the water quality in the Thames River is not expected to be as significant as the qualitative comparison implies since significant dilution and tidal mixing are anticipated, thereby reducing contaminant concentrations. For example, the maximum detected concentrations of some of the chemicals previously identified as migration COCs (copper and zinc) are within one order of magnitude of the Connecticut WQSs. Appropriate alternative surface water protection criteria can be calculated by multiplying the lower of human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. Consequently, these chemicals are not considered to be problematic since the maximum concentration of these chemicals would be less than the alternative SWPC. In addition, most migration COCs were detected infrequently in groundwater samples. A separate evaluation of the water and sediment quality in the Thames River is provided in Section 11.0.

8.6.1.3 Exposure Point Concentrations

Exposure point concentrations were developed for direct exposure COCs only using the methodologies presented in Section 3.4.1. The average and maximum detected concentrations for all COCs in shallow soil and groundwater and inorganics in subsurface soil were used for the RME and CTE, respectively. The 95 percent UCL was used for organics in subsurface soil. Groundwater exposure concentrations were developed using USEPA Region I guidance (USEPA, 1994f). A summary of the exposure point

concentrations used to estimate potential risks associated with direct exposure COCs for Zone 5 is provided in Table 8-18.

Compounds considered as essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs or quantitatively evaluated in the risk assessment. TPH was identified as a direct exposure COC for soil based on a qualitative analysis. However, exposure to this chemical could not be quantitatively evaluated because of the lack of dose-response parameters. In addition, USEPA Region I does not advocate a quantitative evaluation of exposure to aluminum, copper, and iron, although they may be identified as COCs, because the only available toxicity criteria for these chemicals are provisional reference doses based on daily allowable intakes rather than adverse effect levels. Exposure to these chemicals is addressed in the general uncertainty section of the baseline human health risk assessment, Section 3.4.5.

8.6.2 Exposure Assessment

This section presents a summary of the persons potentially exposed to soil and groundwater at Zone 5 of the Lower Subase and describes the routes by which they might be exposed. Details on the exposure parameters used in the quantitative risk assessment were provided in Section 3.4.3.

The most likely receptors at this site include any full-time adult employees or military personnel assigned to the various buildings. These persons could be exposed to shallow soil via direct contact (incidental ingestion or dermal contact). They are assumed to be exposed 150 days/year for 6 years for the CTE and for 25 years for the RME.

A construction worker scenario was also evaluated for Zone 5. A construction project is assumed to take between 80 (CTE) and 120 (RME) days in a 1-year period. These persons could come into contact with "all soil" (soil from depths of 0 to 10 feet) via dermal contact and incidental ingestion. These receptors may also be dermally exposed to groundwater during ground-intrusive activities.

Since the site is located along the Thames River and waterfront property is typically regarded as an attractive location for residential development, future residents were evaluated as potential receptors. This exposure scenario is dependent upon base closure, which is considered to be highly unlikely because of the critical nature of the facility with respect to support of the submarine fleet and national defense. Therefore, this scenario is primarily evaluated for informational purposes only (i.e., to aid in decision making and risk management decisions). Future potential residents are not expected to come in contact with groundwater at the site because saline conditions that exist near the river would preclude

domestic use of groundwater. Receptors are assumed to be exposed to "all soil" (soil from depths of 0 to 10 feet) via incidental ingestion and dermal contact. Soil exposures were assumed to occur 150 days/year for a total of 7 years under the CTE and 30 years for the RME.

There are no dermal absorption factors available for beryllium and manganese. As requested by EPA Region I, dermal exposures to these COCs will be evaluated using a generic absorption factor of 0.01 and the results will be discussed in the uncertainty analysis presented in Section 8.6.4.

The identified potential receptors could also be exposed to chemicals in soil via inhalation of fugitive dust and volatile emissions. This exposure pathway is evaluated in a qualitative fashion by a comparison of maximum soil concentrations to generic USEPA SSLs for the inhalation pathway, as summarized in the site-specific COC summary screening tables in Appendix I.9. Maximum detections for all soil chemicals were below the inhalation SSLs, indicating that the inhalation pathway is not expected to be a significant exposure route. Consequently, this exposure route was eliminated from further quantitative risk evaluation.

8.6.3 Risk Characterization

A summary of the quantitative risk assessment for Zone 5 is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for the RME and CTE scenarios, are outlined in Table 8-19 for the construction worker, full-time employee, and future resident. Sample calculations are provided in Appendix I.3. Appendix I.9 contains the chemical-specific risks for Zone 5.

8.6.3.1 Noncarcinogenic Risks

Cumulative Hazard Indices (HIs) for all receptors are less than unity, indicating that no averse effects are anticipated for these receptors under both RME and CTE scenarios.

8.6.3.2 Carcinogenic Risks

Cancer risks ranged from 5.0E-7 for the full-time employee (CTE) to 2.8E-5 for the future resident (RME). All cancer risks are within or below the USEPA target risk range (1E-4 to 1E-6). However, the cumulative incremental cancer risk for the future resident (2.8E-5) under the RME scenario exceeded the CTDEP cumulative target risk level of 1E-5. The exposure routes of concern for the future resident under the RME scenario is incidental ingestion and dermal contact with soil. As summarized in Table 8-20, the chemical-

specific incremental cancer risk for benzo(a)pyrene exceed 1E-5 and the cancer risks for benzo(b)fluoranthene, dibenzo(a,h)anthraene, and arsenic exceed 1E-6 but were less than 1E-5.

8.6.4 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.4.5. Site-specific uncertainties for Zone 5 risk evaluation are presented below.

Dermal exposure to beryllium and manganese in soil could not be quantitatively evaluated in the risk assessment since there are no dermal absorption factors available for these compounds. Therefore, as requested by EPA Region I, a screening analysis was performed for dermal exposures to beryllium and manganese in soil using a generic absorption factor for inorganics of 0.01. Cancer risks could not be calculated for beryllium and manganese since no oral cancer slope factors are available for these compounds. Hazard indices are as follows:

	Scenario	
Receptor	**RME**	**CTE**
Construction Worker	0.05	0.0007
Full-time Employee	Not applicable	Not applicable
Future Resident	0.02	0.002

All cumulative hazard indices for the RME and CTE scenarios are more than an order of magnitude less the acceptable level of 1.0. Consequently, no adverse health effects are anticipated as a result of dermal exposure to beryllium and manganese in soil under the conditions evaluated in the risk assessment.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring background levels. Background levels for inorganics in soil at NSB-NLON, developed by Atlantic Environmental Services were presented in Table 1-4. All reported concentrations of aluminum, arsenic, barium, beryllium, chromium, cobalt, iron, magnesium, mercury, potassium, thallium, and vanadium in the site soils were less than the established background levels.

The calculated risks for exposure to soil under current site conditions are to some degree overestimated. Most of the soil samples collected at the site were obtained from locations beneath pavement. All soil samples (currently exposed and beneath pavement) were used to conservatively evaluate potential risks for the site. Therefore, actual exposure under current site conditions is less than exposure that is assumed for this risk assessment.

8.7 SUMMARY AND RECOMMENDATIONS

This section presents a summary of major findings for Zone 5 of the Lower Subase. A summary of the nature and extent of contamination is provided in Section 8.7.1. Section 8.7.2 includes a summary of contaminant fate and transport information and Section 8.7.3 provides a synopsis of the baseline human health risk assessment for Zone 5. Section 8.7.4 provides recommendations regarding additional action and investigatory efforts for the soil and groundwater of Zone 5. A summary of the ecological risks for the Thames River adjacent to Zone 5 and the corresponding recommendations for the river are provided in Section 11.0.

8.7.1 Nature and Extent of Contamination

Contamination originating from the tank on the southern side of Building 175 is evident at Zone 5. This contamination may be from a tank leak or from spillage during tank filling. TPH and SVOCs, primarily PAHs, are the predominant contaminants detected in this area. To a lesser degree, contamination originating from the tank adjacent to the north of Building 175 is also evident based on analytical results for SVOCs in soil samples. Lead was detected at concentrations exceeding the Connecticut remediation standard pollutant mobility criteria for GB classified groundwater in the TCLP leachates of samples collected near each of these two tanks (19SS1 and 19MW2). However, SPLP leachates of samples collected near these tanks (TB1-5RI and TB6-5RI) did not yield concentrations of lead exceeding Federal or state standards. Contaminated sediments collected from the storm sewers in this zone generally contained the highest concentrations of contaminants. Lead in particular was detected at concentrations as high as 85,600 mg/kg. Contamination in the storm sewers may be related to recent activities at the site. Groundwater results indicated that the soil contamination has only had minor impacts on groundwater quality.

8.7.2 Contaminant Fate and Transport

VOCs, SVOCs, and petroleum hydrocarbons, as well as a few inorganic concentrations in excess of background, have been detected in the soil of Zone 5. Analytical results from the groundwater sampling activities indicate that the petroleum hydrocarbons in the soil have migrated to the groundwater. The Thames River, which is downgradient of Zone 5, showed some potential evidence of cross-contamination from SVOCs. An evaluation of natural attenuation indicated that this process is viable for the soil because of the presence of biodegradable contaminants (i.e., petroleum hydrocarbons and SVOCs. Key parameters indicated that natural attenuation is occurring in a limited portion of the groundwater of Zone 5 and petroleum-related compounds were detected in the groundwater. Therefore, a combination of

monitored natural attenuation and a tiered groundwater monitoring program should be evaluated further as part of the remedial strategy for Zone 5.

8.7.3 Baseline Human Health Risk Assessment

The baseline human health risk assessment for Zone 5 focused on three potential receptor groups: construction workers, full-time employees, and future residents. Noncarcinogenic risks for all receptor groups were less than the USEPA and CTDEP acceptable limit of one. Carcinogenic risks for all receptors at all zones were either less than or within USEPA's acceptable target risk range (1E-4 to 1E-6). With the exception of the future resident under the RME scenario, all cancer risks were less than the CTDEP acceptable cumulative risk level of 1E-5. Benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthraene, and arsenic were the main contributors to the cancer risk for the future resident.

Maximum detected concentrations of VOCs, PAHs, metals, and TPH in soil exceeded their respective generic mobility criteria which indicates the potential exists for chemicals to migrate form soil to groundwater. Although the maximum detected concentrations of methylene chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, chromium, and nickel exceeded the generic mobility criteria, these chemicals were not detected in groundwater samples collected at Zone 5. The mobility of naphthalene may be supported by the groundwater data. The maximum detected concentration of arsenic and chromium exceeded the generic mobility criteria but were within background levels.

Maximum concentrations in groundwater were compared to Connecticut salt water WQSs since Zone 5 borders the Thames River. Several migration COCs in groundwater were identified as exceeding the Connecticut salt water WQSs. Use of the Connecticut salt water WQSs to determine groundwater impacts on the Thames River is very conservative since the WQSs do not account for the dilutional effects of the groundwater mixing with the river. Appropriate alternative surface water protection criteria can be calculation by multiplying the lower of the human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. The maximum detected concentrations of some migration COCs (copper and zinc) are within one order of magnitude of the Connecticut WQSs. Therefore, the actual impact on water quality in the Thames River is expected to be minimal because significant dilution is anticipated, thereby reducing chemical concentrations in the Thames River. In addition most migration COCs were detected infrequently in groundwater samples (i.e., one or two samples).

8.7.4 Recommendations

It is recommended for this zone, which includes Site 22 - Pier 33, Building 175 and adjacent property, proceed to a feasibility study to evaluate appropriate remedial alternatives. Because of the extensive amount of underground utilities in Zone 5 and the nature of the activities conducted at this location (i.e., national security), the feasibility study for this zone should evaluate to the extent possible alternatives that include institutional controls to limit exposure to contaminated soil and passive and/or in-situ remedial alternatives. A "hot spot" removal action for the petroleum contamination in the soil of Zone 5 should also be included in one of the alternatives evaluated during the feasibility study. It is also recommended that the feasibility study evaluate limited action scenarios for the groundwater and storm sewer system of Zone 5 in conjunction with the soil remedial alternatives. A combination of monitored natural attenuation and a tiered groundwater monitoring program should be evaluated for the groundwater. Cleaning and repair of the Zone 5 storm sewer system should also be considered during the feasibility study. These recommendations are based on the following information:

- The nature and extent of organic and inorganic contamination in the soil and groundwater are well defined to the extent practical considering infrastructure limitations.

- The contamination detected at Zone 5 is related to the former UST used to store heating oil and not to the battery acid ASTs that were in Building 175. The UST has been replaced; therefore, the main source of the contamination has been eliminated.

- Monitored natural attenuation or bioremediation could be feasible alternatives for the petroleum contamination in the soil.

- Evidence suggests that limited organic contamination may be migrating from the site. Natural attenuation processes seem to be at work in the groundwater. These processes can reduce concentrations of petroleum contamination that reach the aquifer and convert the petroleum contamination to a less toxic form. Monitored natural attenuation should be further evaluated as part of the remedial strategy for the Zone 5 to confirm the effectiveness of these processes. The monitored natural attenuation program should include or be part of a tiered groundwater monitoring program, similar to the ones currently being implemented at other NSB-NLON IRP sites. These programs confirm or disprove that contamination present in the soil is mobile and impacting other media and allow for further actions to be completed if the results show significant impacts.

- The baseline human health risk assessment indicates that there are minimal risks to human receptors. None of the risks were in excess of the USEPA acceptable risk range; but the risk to the hypothetical future resident under the RME scenario slightly exceeded the CTDEP risk level. In addition, lead was not a COC for this zone; therefore, modeling was not necessary to evaluate exposure to lead.

- Although reported concentrations of TPH in site soil samples exceeded the state RSRs for direct exposure and pollutant mobility, the chemical-specific risk assessment for those compounds, assumed to be the major constituents of the observed TPH contamination, indicated minimal risks to potential human receptors.

- The zone is generally covered with pavement and a building, which minimizes direct exposure to the contaminated soil by human receptors.

- Elevated levels of inorganics, particularly lead, were detected in the sediment collected from a catch basin between Zones 5 and 6. Both zones contribute surface water to this catch basin. Slightly elevated levels of inorganics were also detected in the surface water samples collected from the storm sewer system for the NPDES permit. Therefore, the storm sewer system in Zone 5 may be acting as a migration pathway for inorganic contaminants. The lead contamination is believed to be the result of storage of lead ballast in this area and surface water runoff. The Navy has eliminated the storage of ballast in this area.

- A limited evaluation of the invert elevations of the storm sewer system indicate that portions of the system are submerged by varying amounts during a given day or time of year. Because of the age of parts of the system (i.e., greater than 40 years) and the material that it was constructed with (i.e., vitrified clay), it is likely that the system is cracked and groundwater will infiltrate into the storm sewers.

- The ecological risk assessment for the Thames River adjacent to Zone 5 (See Section 11.0) shows that the risks to ecological receptors in this area are relatively low.

- The groundwater at Zone 5 is not currently or anticipated to be used in the future as a potable water source because it is brackish; therefore, there is no imminent threat to human health.

- The Thames River provides significant dilution and mixing which minimizes the impact of contaminant migration from Zone 5.

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TABLE 8-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 5
PIER 33 AND BERTH 16/FORMER INCINERATOR SITE INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals[1] + Cyanide		RCRA Metals [2]	Lead	TPH	Fluorescence	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
SOIL											
19MW1-0.252.25	0.3-2.3	●	●	●	●		●		●		
19MW11-0.252.25 [3]	0.3-2.3	●	●	●	●		●		●		
19MW2-0204	2-4	●	●	●	●						
19MW2-0406	4-6	●	●	●	●		●		●	●	
19MW12-0406 [4]	4-6	●	●	●	●		●		●		
19MW3-0002	0-2	●	●	●	●						
19MW3-0406	4-6	●	●	●	●		●		●	●	
19MW4-0002	0-2	●									
19MW4-0004	0-4		●	●	●						
19MW4-0608	6-8	●	●	●	●		●		●	●	
19SS1	0-0.5	●	●	●	●		●		●	●	
19TB1-0002	0-2	●									
19TB1-0004	0-4		●	●	●						
19TB1-0608	6-8	●	●	●	●		●		●	●	
19TB2-0002	0-2	●	●	●	●						
19TB2-0608	6-8	●	●	●	●		●		●	●	
19TB3-0204	2-4	●	●	●	●						
19TB3-1012	10-12	●	●	●	●		●		●	●	
19TB4-0002	0-2	●	●	●	●						
19TB4-0204	2-4							●			
19TB4-0406	4-6	●	●	●	●		●		●	●	
GROUNDWATER											
19GW2	NA	●	●	●	●	●			●	●	
19GW3	NA	●	●	●	●	●			●	●	
19MW4	NA	●	●	●	●	●			●	●	
SEDIMENT											
19SD1	NA	●	●	●	●				●	●	
19SD2	NA	●	●	●	●				●	●	

1 Analysis for boron was also performed.
2 Toxicity Characteristic Leaching Procedure (TCLP) extraction followed by analysis for RCRA metals.
3 19MW11-0.252.25 is a field duplicate of 19MW1-0.252.25.
4 19MW12-0406 is a field duplicate of 19MW2-0406.
NA = Not applicable.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 8-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 5
ANNUAL NPDES STORMWATER MONITORING PROGRAM
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Date of Collection	Analysis									
		Target Compound List (TCL)			TAL Metals		RCRA Metals	Lead	TPH [1]	Fluorescence	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
SURFACE WATER											
NOVA	09/21/93				● [2]				●		● [4]
NOVA	02/28/95				● [2]				●		● [5]
NOVA	10/08/96				● [2]				●		● [5]
NOVA	06/19/97				● [3]				●		● [6]

1 Oil and grease analysis performed.
2 Analysis for copper, lead, and zinc only.
3 Analysis for copper, iron, lead, mercury, nickel, silver, sodium, and zinc only.
4 Miscellaneous parameters for this sample include: Chemical Oxygen Demand (COD), Fecal Coliform, Nitrate (as Nitrogen), pH, Total Dissolved Solids (TDS), Total Kjeldahl Nitrogen (TKN), Total Phosphorous, and Total Suspended Solids (TSS).
5 Miscellaneous parameters for this sample include: COD, Fecal Coliform, Nitrate (as Nitrogen), pH, TKN, Total Phosphorous, and TSS.
6 Miscellaneous parameters for this sample include: Reactive Cyanide, Ammonia (as Nitrogen), COD, Chloride, Fecal Coliform, MBAS (Surfactants), Nitrate (as Nitrogen), pH, Sulfate, TDS, TKN, Total Phosphorous, and TSS.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 8-3

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 5
LOWER SUBASE REMEDIAL INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals		RCRA Metals	Lead[1]	TPH	Fluorescence	Misc[2]
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
SOIL											
LS5SB0010101	2-4		●		●			●	●		
SBFD003 [3]	2-4		●		●			●	●		
LS5SB0010201	5-7		●		●			●			
LS5SB0020101	2-4		●						●		
LS5SB0020201	5-6		●								
LS5SB0030101	2-4		●						●		
SBFD004 [4]	2-4		●						●		
LS5SB0030201	5-6		●								
LS5SB0040101	1-3		●						●		
SBFD006 [5]	1-3		●						●		
LS5SB0040201	5-7		●								
LS5SB0050101	1-3		●						●		
LS5SB0050201	4-5.5		●								
LS5SB0060101	2-4		●		●			●	●		
LS5SB0060201	5.5-6.5		●		●			●			
GROUNDWATER											
LS5GW19MW201	NA		●		●	●			●		●
LS5GW19MW301	NA		●		●	●			●		●

1 Synthetic Precipitation Leaching Procedure (SPLP) extraction followed by analysis for lead.
2 Miscellaneous parameters include: Alkalinity (as $CaCO_3$), Ammonia (as Nitrogen), Chloride, Dissolved Oxygen, Divalent Iron, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), pH, Phosphorous, Redox Potential, Salinity, Specific Conductivity, Sulfate, Temperature, Total Organic Cargon, Turbidity, and Dissolved Methane.
3 SBFD003 is a field duplicate of LS5SB0010101.
4 SBFD004 is a field duplicate of LS5SB0030101.
5 SBFD006 is a field duplicate of LS5SB0040101.
NA = Not applicable.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 8-4 (PAGE 1 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW1-0.252.25	19MW11-0.252.25	19MW2-0204	19MW2-0406	19MW12-0406	19MW3-0002
DEPTH (feet):	0.3 - 2.3'	0.3 - 2.3'	2 - 4'	4 - 6'	4 - 6'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/24/93	03/24/93	03/24/93	03/25/93
LOCATION:	19MW1	19MW1	19MW2	19MW2	19MW2	19MW3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		19MW1-0.252.25			19MW2-0406	
VOLATILES (µg/kg)						
2-BUTANONE	12 U	12 U	11 U	11 U	11 U	10 U
ACETONE	12 U	9 BJ	7 J	8 J	14	23 B
ETHYLBENZENE	12 U	12 U	11 U	11 U	11 U	10 U
METHYLENE CHLORIDE	9 BJ	9 BJ	6 BJ	5 BJ	8 BJ	7 BJ
TOLUENE	12 U	12 U	3 J	11 U	11 U	10 U
XYLENES, TOTAL	12 U	12 U	11 U	11 U	11 U	10 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	32 J	51 J	360 U	390 U	370 U	370 U
ACENAPHTHENE	410 U	400 U	360 U	390 U	370 U	370 U
ACENAPHTHYLENE	410 U	400 U	360 U	390 U	370 U	370 U
ANTHRACENE	1 J	8 J	360 U	390 U	370 U	370 U
BENZO(A)ANTHRACENE	24 J	77 J	360 U	390 U	190 J	230 J
BENZO(A)PYRENE	38 J	56 J	360 U	390 U	370 U	370 U
BENZO(B)FLUORANTHENE	32 J	87 J	360 U	390 U	310 J	200 J
BENZO(G,H,I)PERYLENE	410 U	400 U	360 U	390 U	370 U	370 U
BENZO(K)FLUORANTHENE	25 J	84 J	360 U	390 U	370 U	370 U
BIS(2-ETHYLHEXYL)PHTHALATE	20 J	32 J	360 U	390 U	370 U	370 U
BUTYLBENZYL PHTHALATE	410 U	24 J	360 U	390 U	370 U	370 U
CARBAZOLE	410 U	400 U	360 U	390 U	370 U	370 U
CHRYSENE	62 J	76 J	360 U	390 U	370 U	370 U
DI-N-BUTYL PHTHALATE	410 U	400 U	360 U	390 U	370 U	370 U
DI-N-OCTYL PHTHALATE	410 U	62 J	360 U	390 U	370 U	370 U

TABLE 8-4 (PAGE 2 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW1-0.252.25	19MW11-0.252.25	19MW2-0204	19MW2-0406	19MW12-0406	19MW3-0002
DEPTH (feet):	0.3 - 2.3'	0.3 - 2.3'	2 - 4'	4 - 6'	4 - 6'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/24/93	03/24/93	03/24/93	03/25/93
LOCATION:	19MW1	19MW1	19MW2	19MW2	19MW2	19MW3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		19MW1-0.252.25			19MW2-0406	
SEMIVOLATILES (µg/kg)						
DIBENZO(A,H)ANTHRACENE	410 U	400 U	360 U	390 U	370 U	370 U
DIBENZOFURAN	410 U	400 U	360 U	390 U	370 U	370 U
FLUORANTHENE	72 J	120 J	220 J	390 U	340 J	480
FLUORENE	410 U	400 U	360 U	390 U	370 U	370 U
INDENO(1,2,3-CD)PYRENE	410 U	400 U	360 U	390 U	370 U	370 U
NAPHTHALENE	22 J	400 U	360 U	390 U	370 U	370 U
PHENANTHRENE	64 J	100 J	360 U	390 U	370 U	370 U
PYRENE	41 J	88 J	200 J	390 U	310 J	420
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	10 P	12 P	3.6 U	3.6 U	3.7 U	3.6 U
4,4'-DDE	350	430	3.6 U	3.6 U	3.7 U	3.6 U
4,4'-DDT	520	640	3.6 U	3.6 U	3.7 U	3.6 U
ALPHA-CHLORDANE	5	5.9	1.8 U	1.9 U	1.9 U	1.8 U
AROCLOR-1260	79 U	81 U	140	36 U	42	56
METALS (mg/kg)						
ALUMINUM	12200	13600	4300	5120	3530	4980
ARSENIC	3.5	3	1.5 BS	1.1 B	0.81 B	1 B
BARIUM	44.7	47.8	29.6 B	29.2 B	23.3 B	35.4 B
BERYLLIUM	0.91 B	0.83 B	0.18 B	0.17 B	0.12 B	0.21 B
BORON	109 U	95.4 U	2.7 U	3.3 U	3.8 U	19.7 B
CALCIUM	896 B	455 B	918	1770	1200	849 B
CHROMIUM	23.4	18.4	8.4	10.5	6.9	12.4

TABLE 8-4 (PAGE 3 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW1-0.252.25	19MW11-0.252.25	19MW2-0204	19MW2-0406	19MW12-0406	19MW3-0002
DEPTH (feet):	0.3 - 2.3'	0.3 - 2.3'	2 - 4'	4 - 6'	4 - 6'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/24/93	03/24/93	03/24/93	03/25/93
LOCATION:	19MW1	19MW1	19MW2	19MW2	19MW2	19MW3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		19MW1-0.252.25			19MW2-0406	
METALS (mg/kg)						
COBALT	3.9 B	4.3 B	4 B	4.7 B	3 B	4.7 B
COPPER	10.4	9.5	14.9	17.6	18	18.4
CYANIDE	1.1 U	1.2 U	0.24 B	0.16 U	0.17 U	0.17 U
IRON	11300	13100	5950	7580	5140	10400
LEAD	15.6	15.5	6.6 S	6.4 S	5.6 S	13.3 S
MAGNESIUM	1490	1510	1970	2590	1580	2860
MANGANESE	300	281	112	121	105	94.1
MERCURY	0.1	0.09	0.04 U	0.05 U	0.11 U	0.33 U
NICKEL	7 B	7.3 B	7.6	7.2 B	3.1 B	9.4
POTASSIUM	239 B	256 B	1260	1070	928 B	1240
SELENIUM	1.1 B	0.67 B	0.18 U	0.17 U	0.17 U	0.19 U
SODIUM	119 B	113 B	179 B	313 B	150 B	296 B
THALLIUM	0.23 U	0.21 U	0.11 U	0.1 UW	0.1 UW	0.11 UW
VANADIUM	19.7	22.9	10.9	14.6	8.8 B	15.6
ZINC	32.4	39.9	22.8	22	15.3	32.2
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	75 U	78 U		67 U	82	

TABLE 8-4 (PAGE 4 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW3-0406	19MW4-0002	19MW4-0004	19MW4-0608	19SS1	19TB1-0002
DEPTH (feet):	4 - 6'	0 - 2'	0 - 4'	6 - 8'	0 - 0.5'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/25/93	03/23/93	03/23/93	03/23/93	04/07/93	03/23/93
LOCATION:	19MW3	19MW4	19MW4	19MW4	19SS1	19TB1
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE	2800 U	55 U		57 U	11 U	10 U
ACETONE	2800 U	140		180	140	25
ETHYLBENZENE	2800 U	38 J		33 J	11 U	10 U
METHYLENE CHLORIDE	1900 BJ	20 BJ		19 BJ	8 JB	6 BJ
TOLUENE	2800 U	10 J		57 U	11 U	10 U
XYLENES, TOTAL	2800 U	150		32 J	11 U	10 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	23000		960 J	9700 J	20000 U	
ACENAPHTHENE	12000 U		1400 U	10000 U	20000 U	
ACENAPHTHYLENE	12000 U		1400 U	10000 U	20000 U	
ANTHRACENE	12000 U		1400 U	10000 U	20000 U	
BENZO(A)ANTHRACENE	12000 U		1400 U	10000 U	20000 U	
BENZO(A)PYRENE	12000 U		1400 U	10000 U	20000 U	
BENZO(B)FLUORANTHENE	12000 U		1400 U	10000 U	20000 U	
BENZO(G,H,I)PERYLENE	12000 U		1400 U	10000 U	20000 U	
BENZO(K)FLUORANTHENE	12000 U		1400 U	10000 U	20000 U	
BIS(2-ETHYLHEXYL)PHTHALATE	12000 U		1400 U	10000 U	20000 U	
BUTYLBENZYL PHTHALATE	12000 U		1400 U	10000 U	20000 U	
CARBAZOLE	12000 U		1400 U	10000 U	20000 U	
CHRYSENE	12000 U		1400 U	10000 U	20000 U	
DI-N-BUTYL PHTHALATE	12000 U		1400 U	10000 U	20000 U	
DI-N-OCTYL PHTHALATE	12000 U		1400 U	10000 U	20000 U	

TABLE 8-4 (PAGE 5 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW3-0406	19MW4-0002	19MW4-0004	19MW4-0608	19SS1	19TB1-0002
DEPTH (feet):	4 - 6'	0 - 2'	0 - 4'	6 - 8'	0 - 0.5'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/25/93	03/23/93	03/23/93	03/23/93	04/07/93	03/23/93
LOCATION:	19MW3	19MW4	19MW4	19MW4	19SS1	19TB1
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
DIBENZO(A,H)ANTHRACENE	12000 U		1400 U	10000 U	20000 U	
DIBENZOFURAN	12000 U		1400 U	10000 U	20000 U	
FLUORANTHENE	12000 U		1400 U	10000 U	20000 U	
FLUORENE	12000 U		1400 U	10000 U	20000 U	
INDENO(1,2,3-CD)PYRENE	12000 U		1400 U	10000 U	20000 U	
NAPHTHALENE	12000 U		1400 U	10000 U	20000 U	
PHENANTHRENE	7000 J		1400 U	10000 U	20000 U	
PYRENE	12000 U		1400 U	10000 U	20000 U	
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.7 U		3.5 U	3.8 U	36 U	
4,4'-DDE	3.7 U		3.5 U	3.8 U	56	
4,4'-DDT	3.7 U		3.5 U	3.8 U	36 U	
ALPHA-CHLORDANE	1.9 U		1.8 U	2 U	18 U	
AROCLOR-1260	37 U		35 U	38 U	360 U	
METALS (mg/kg)						
ALUMINUM	3190		4770	3210	4290	
ARSENIC	0.34 B		1.3 B	1.7 BW	1.5 BN	
BARIUM	26.4 B		23.7 B	17.4 B	24.9 B	
BERYLLIUM	0.21 B		0.19 B	0.12 B	0.27 B	
BORON	3.3 U		3.3 U	3.2 U	1.8 U	
CALCIUM	1000		781 B	521 B	760 B	
CHROMIUM	6.9		6.7	5.5	8.5	

TABLE 8-4 (PAGE 6 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW3-0406	19MW4-0002	19MW4-0004	19MW4-0608	19SS1	19TB1-0002
DEPTH (feet):	4 - 6'	0 - 2'	0 - 4'	6 - 8'	0 - 0.5'	0 - 2'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/25/93	03/23/93	03/23/93	03/23/93	04/07/93	03/23/93
LOCATION:	19MW3	19MW4	19MW4	19MW4	19SS1	19TB1
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
COBALT	3.1 B		3.5 B	2.1 B	3.1 B	
COPPER	43.8		7.7	6.9	19.7	
CYANIDE	0.16 U		0.16 U	0.19 U	0.15 U	
IRON	4580		6150	4270	6520	
LEAD	14.6		12.5	4.4 S	48.4	
MAGNESIUM	1100		1680	1350	1630	
MANGANESE	48.2		96.5	57	84.9	
MERCURY	0.08 U		0.06 U	0.05 U	0.02 U	
NICKEL	8.1		4.6 B	3 B	8.1	
POTASSIUM	544 B		1090	1010	1060	
SELENIUM	0.2 U		0.16 U	0.2 U	0.15 UN	
SODIUM	116 B		94.6 B	50.7 B	60.9 BE	
THALLIUM	0.12 U		0.1 UW	0.12 UW	0.18 BNW	
VANADIUM	7.9 B		11	7.7 B	12.1	
ZINC	43		21.74	13	38.7	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	5300			3300	6800	

TABLE 8-4 (PAGE 7 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB1-0004	19TB1-0608	19TB2-0002	19TB2-0608	19TB3-0204	19TB3-1012
DEPTH (feet):	0 - 4'	6 - 8'	0 - 2'	6 - 8'	2 - 4'	10 - 12'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/23/93	03/23/93	03/22/93	03/22/93	03/24/93	03/24/93
LOCATION:	19TB1	19TB1	19TB2	19TB2	19TB3	19TB3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE		13 U	10 U	5 BJ	11 U	11 U
ACETONE		28	8 J	44	20	26
ETHYLBENZENE		13 U	10 U	11 U	11 U	11 U
METHYLENE CHLORIDE		6 BJ	4 BJ	7 BJ	6 BJ	7 BJ
TOLUENE		13 U	10 U	3 J	11 U	11 U
XYLENES, TOTAL		13 U	10 U	7 J	11 U	11 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	350 U	390 U	340 U	22000 U	370 U	370 U
ACENAPHTHENE	350 U	390 U	340 U	22000 U	370 U	370 U
ACENAPHTHYLENE	350 U	390 U	340 U	22000 U	370 U	370 U
ANTHRACENE	350 U	390 U	340 U	22000 U	370 U	370 U
BENZO(A)ANTHRACENE	350 U	390 U	340 U	22000 U	370 U	370 U
BENZO(A)PYRENE	350 U	390 U	340 U	22000 U	370 U	370 U
BENZO(B)FLUORANTHENE	350 U	390 U	340 U	22000 U	370 U	370 U
BENZO(G,H,I)PERYLENE	350 U	390 U	340 U	22000 U	370 U	370 U
BENZO(K)FLUORANTHENE	350 U	390 U	340 U	22000 U	370 U	370 U
BIS(2-ETHYLHEXYL)PHTHALATE	350 U	390 U	340 U	22000 U	370 U	370 U
BUTYLBENZYL PHTHALATE	350 U	390 U	340 U	22000 U	370 U	370 U
CARBAZOLE	350 U	390 U	340 U	22000 U	370 U	370 U
CHRYSENE	350 U	390 U	340 U	22000 U	370 U	370 U
DI-N-BUTYL PHTHALATE	350 U	390 U	340 U	22000 U	370 U	370 U
DI-N-OCTYL PHTHALATE	350 U	390 U	340 U	22000 U	370 U	370 U

TABLE 8-4 (PAGE 8 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB1-0004	19TB1-0608	19TB2-0002	19TB2-0608	19TB3-0204	19TB3-1012
DEPTH (feet):	0 - 4'	6 - 8'	0 - 2'	6 - 8'	2 - 4'	10 - 12'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/23/93	03/23/93	03/22/93	03/22/93	03/24/93	03/24/93
LOCATION:	19TB1	19TB1	19TB2	19TB2	19TB3	19TB3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
DIBENZO(A,H)ANTHRACENE	350 U	390 U	340 U	22000 U	370 U	370 U
DIBENZOFURAN	350 U	390 U	340 U	22000 U	370 U	370 U
FLUORANTHENE	350 U	390 U	340 U	22000 U	370 U	370 U
FLUORENE	350 U	390 U	340 U	22000 U	370 U	370 U
INDENO(1,2,3-CD)PYRENE	350 U	390 U	340 U	22000 U	370 U	370 U
NAPHTHALENE	350 U	390 U	340 U	22000 U	370 U	370 U
PHENANTHRENE	350 U	390 U	340 U	22000 U	370 U	370 U
PYRENE	350 U	390 U	340 U	22000 U	370 U	370 U
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	4 U	3.9 U	3.4 U	3.6 U	3.6 U	3.7 U
4,4'-DDE	4 U	3.9 U	3.4 U	3.6 U	3.6 U	3.7 U
4,4'-DDT	4 U	3.9 U	3.4 U	3.6 U	3.6 U	3.7 U
ALPHA-CHLORDANE	2 U	2 U	1.7 U	1.9 U	1.9 U	1.9 U
AROCLOR-1260	40 U	39 U	34 U	130	36 U	37 U
METALS (mg/kg)						
ALUMINUM	3360	1880	1940	5250	6930 J	5500
ARSENIC	0.52 BW	0.39 BW	1 B	2.2	0.46 J	2.4
BARIUM	23.4 B	13.6 B	33.1 B	34.4	53.6 J	40.7
BERYLLIUM	0.16 B	0.08 U	0.09 B	0.2 B	0.24 U	0.12 B
BORON	3 U	3.3 U	3.2 U	2.7 U	3.2 UJ	3.5 U
CALCIUM	1560	706 B	881 B	673 B	842 J	936 B
CHROMIUM	7.7	2.5	5	9.2	15.9 J	11.6

TABLE 8-4 (PAGE 9 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB1-0004	19TB1-0608	19TB2-0002	19TB2-0608	19TB3-0204	19TB3-1012
DEPTH (feet):	0 - 4'	6 - 8'	0 - 2'	6 - 8'	2 - 4'	10 - 12'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/23/93	03/23/93	03/22/93	03/22/93	03/24/93	03/24/93
LOCATION:	19TB1	19TB1	19TB2	19TB2	19TB3	19TB3
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
COBALT	2.6 B	0.98 B	1.9 B	4.3 B	4.8 J	4 B
COPPER	9.4	2.7 B	5.5	8	5.6 J	12.7
CYANIDE	0.16 U	0.18 U	0.16 U	0.15 U	0.15 UJ	0.17 B
IRON	5820	3450	4290	8620	10400 J	7010
LEAD	13.7	1.3 S	6.1 S	2.7 S	1.7 J	1.9 S
MAGNESIUM	1570	796 B	882 B	2160	3160 J	2550
MANGANESE	90.2	48.4	120	101	148 J	144
MERCURY	0.04 U	0.07 U	0.06 U	0.07 U	0.11 U	0.09 U
NICKEL	4 B	2 U	2 U	6.1 B	6.4 J	7.5 B
POTASSIUM	1360	765 B	655 B	1910	3100 J	1670
SELENIUM	0.19 U	0.22 U	0.18 U	0.19 U	0.2 UJ	0.17 U
SODIUM	63.2 B	59.7 B	73.8 B	125 B	318 J	529 B
THALLIUM	0.11 UW	0.13 U	0.11 UW	0.11 UW	0.13 UJ	0.1 UW
VANADIUM	8.9	4.3 B	5.9 B	14.3	18.3 J	13.6
ZINC	26.5	10.9	14	20	22.9 J	17.2
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		82		6200		66 U

TABLE 8-4 (PAGE 10 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB4-0002	19TB4-0204	19TB4-0406	LS5SB0010101	SBFD003	LS5SB0010201
DEPTH (feet):	0 - 2'	2 - 4'	4 - 6'	2 - 4'	2 - 4'	5 - 7'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	03/24/93	03/24/93	03/24/93	09/24/97	09/24/97	09/24/97
LOCATION:	19TB4	19TB4	19TB4	TB1-5RI	TB1-5RI	TB1-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					LS5SB0010101	
VOLATILES (µg/kg)						
2-BUTANONE	11 U		11 U			
ACETONE	28 B		120 B			
ETHYLBENZENE	11 U		11 U			
METHYLENE CHLORIDE	9 BJ		8 BJ			
TOLUENE	11 U		11 U			
XYLENES, TOTAL	11 U		11 U			
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 U		370 U	360 U	27 J	21000
ACENAPHTHENE	360 U		370 U	20 J	360 U	7300 U
ACENAPHTHYLENE	360 U		370 U	360 U	360 U	7300 U
ANTHRACENE	360 U		370 U	43 J	22 J	7300 U
BENZO(A)ANTHRACENE	360 U		370 U	160 J	150 J	7300 U
BENZO(A)PYRENE	360 U		370 U	160 J	150 J	7300 U
BENZO(B)FLUORANTHENE	360 U		370 U	170 J	170 J	7300 U
BENZO(G,H,I)PERYLENE	360 U		370 U	79 J	84 J	7300 U
BENZO(K)FLUORANTHENE	360 U		370 U	130 J	120 J	7300 U
BIS(2-ETHYLHEXYL)PHTHALATE	360 U		370 U	360 U	360 U	7300 U
BUTYLBENZYL PHTHALATE	360 U		370 U	360 U	360 U	7300 U
CARBAZOLE	360 U		370 U	25 J	21 J	7300 U
CHRYSENE	360 U		370 U	170 J	140 J	7300 U
DI-N-BUTYL PHTHALATE	360 U		370 U	360 U	360 U	7300 U
DI-N-OCTYL PHTHALATE	360 U		370 U	360 U	360 UJ	7300 UJ

TABLE 8-4 (PAGE 11 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB4-0002	19TB4-0204	19TB4-0406	LS5SB0010101	SBFD003	LS5SB0010201
DEPTH (feet):	0 - 2'	2 - 4'	4 - 6'	2 - 4'	2 - 4'	5 - 7'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	03/24/93	03/24/93	03/24/93	09/24/97	09/24/97	09/24/97
LOCATION:	19TB4	19TB4	19TB4	TB1-5RI	TB1-5RI	TB1-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					LS5SB0010101	
SEMIVOLATILES (µg/kg)						
DIBENZO(A,H)ANTHRACENE	360 U		370 U	32 J	46 J	7300 U
DIBENZOFURAN	360 U		370 U	360 U	360 U	7300 U
FLUORANTHENE	360 U		370 U	270 J	210 J	7300 U
FLUORENE	360 U		370 U	360 U	360 U	4100 J
INDENO(1,2,3-CD)PYRENE	360 U		370 U	93 J	91 J	7300 U
NAPHTHALENE	360 U		370 U	360 U	360 U	4500 J
PHENANTHRENE	360 U		370 U	200 J	130 J	5800 J
PYRENE	360 U		370 U	290 J	230 J	1100 J
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.5 U		3.7 U			
4,4'-DDE	3.5 U		3.7 U			
4,4'-DDT	3.5 U		3.7 U			
ALPHA-CHLORDANE	1.8 U		1.9 U			
AROCLOR-1260	55		120			
METALS (mg/kg)						
ALUMINUM	4300 J		4610	4460	3730	2890
ARSENIC	0.52 J		0.74 B	1.6	1.3	2.2
BARIUM	33.1 J		36 B	34.4	29.2	15.1
BERYLLIUM	0.29 U		0.2 B	0.16 U	0.14 U	0.08 U
BORON	3.4 UJ		3.2 U			
CALCIUM	753 J		770 B	836 J	671 J	478 J
CHROMIUM	7.1 J		10.8	8.0	8.7	5.4

TABLE 8-4 (PAGE 12 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19TB4-0002	19TB4-0204	19TB4-0406	LS5SB0010101	SBFD003	LS5SB0010201
DEPTH (feet):	0 - 2'	2 - 4'	4 - 6'	2 - 4'	2 - 4'	5 - 7'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	03/24/93	03/24/93	03/24/93	09/24/97	09/24/97	09/24/97
LOCATION:	19TB4	19TB4	19TB4	TB1-5RI	TB1-5RI	TB1-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					LS5SB0010101	
METALS (mg/kg)						
COBALT	3.4 J		4.9 B	2.8	2.4	2.2
COPPER	18.1 J		14.7	19.7	13.2	6.4
CYANIDE	0.17 UJ		0.19 U			
IRON	5890 J		6800	6800	5510	3500
LEAD	10.4 U	31.5 U	12.3	91.2	73.5	3.6
MAGNESIUM	1670		2160	1900 J	1560 J	1110 J
MANGANESE	150		209	142	97.5	43.1
MERCURY	0.12 U		0.06 U	0.01 J	0.02 J	0.01 UJ
NICKEL	5.7 B		5.9 B	7.0 J	6.0 J	5.4 J
POTASSIUM	993 B		1450	1150	1100	741
SELENIUM	0.19 U		0.21 U	0.31 U	0.28 U	0.38 U
SODIUM	277 U		235 B	66.7	57.2	47.0
THALLIUM	0.11 U		0.12 UW	0.80 U	0.71 U	0.98 U
VANADIUM	9.2 B		11.9	11.6	10.0	6.6
ZINC	36.3		29.3	73.5	54.1	12.2
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH			78	53	59	

TABLE 8-4 (PAGE 13 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5SB0020101	LS5SB0020201	LS5SB0030101	SBFD004	LS5SB0030201	LS5SB0040101
DEPTH (feet):	2 - 4'	5 - 6'	2 - 4'	2 - 4'	5 - 6'	1 - 3'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/24/97	09/24/97	09/24/97	09/13/97	09/24/97	09/25/97
LOCATION:	TB2-5RI	TB2-5RI	TB3-5RI	TB3-5RI	TB3-5RI	TB4-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:				LS5SB0030101		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	530 UR	360 U	330 U	330 U	360 U	330 UJ
ACENAPHTHENE	530 UR	360 U	330 U	330 U	360 U	330 U
ACENAPHTHYLENE	530 UR	360 U	330 U	330 U	360 U	25 J
ANTHRACENE	530 UR	21 J	45 J	40 J	640	39 J
BENZO(A)ANTHRACENE	530 UR	44 J	76 J	130 J	210 J	200 J
BENZO(A)PYRENE	29 J	59 J	200 J	120 J	260 J	210 J
BENZO(B)FLUORANTHENE	32 J	88 J	84 J	150 J	140 J	330
BENZO(G,H,I)PERYLENE	51 J	100 J	330 U	120 J	170 J	160 J
BENZO(K)FLUORANTHENE	530 UR	20 J	150 J	91 J	190 J	330 U
BIS(2-ETHYLHEXYL)PHTHALATE	530 U	360 U	330 U	330 U	360 U	330 U
BUTYLBENZYL PHTHALATE	530 UR	360 U	330 U	330 UJ	360 U	330 U
CARBAZOLE	530 UR	360 U	23 J	23 J	360 U	26 J
CHRYSENE	28 J	51 J	190 J	160 J	280 J	260 J
DI-N-BUTYL PHTHALATE	530 UR	360 U	330 U	330 U	360 U	330 U
DI-N-OCTYL PHTHALATE	530 UR	360 U	330 UJ	330 UJ	360 U	330 U
DIBENZO(A,H)ANTHRACENE	530 UR	360 U	330 U	46 J	360 U	330 U
DIBENZOFURAN	530 UR	360 U	330 U	330 U	360 U	330 U
FLUORANTHENE	39 J	53 J	150 J	190 J	670	470
FLUORENE	530 UR	360 U	330 U	18 J	360 U	21 J
INDENO(1,2,3-CD)PYRENE	530 UR	70 J	330 U	90 J	130 J	140 J
NAPHTHALENE	530 UR	360 U	330 U	330 U	360 U	330 U
PHENANTHRENE	530 UR	50 J	130 J	200 J	360 U	210 J

TABLE 8-4 (PAGE 14 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5SB0020101	LS5SB0020201	LS5SB0030101	SBFD004	LS5SB0030201	LS5SB0040101
DEPTH (feet):	2 - 4'	5 - 6'	2 - 4'	2 - 4'	5 - 6'	1 - 3'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/24/97	09/24/97	09/24/97	09/13/97	09/24/97	09/25/97
LOCATION:	TB2-5RI	TB2-5RI	TB3-5RI	TB3-5RI	TB3-5RI	TB4-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:				LS5SB0030101		
SEMIVOLATILES (µg/kg)						
PYRENE	47 J	59 J	230 J	300 J	810	410
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	530		1800	1900		260 J

TABLE 8-4 (PAGE 15 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	SBFD006	LS5SB0040201	LS5SB0050101	LS5SB0050201	LS5SB0060101	LS5SB0060201
DEPTH (feet):	1 - 3'	5 - 7'	1 - 3'	4 - 5.5'	2 - 4'	5.5 - 6.5'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/24/97	09/24/97
LOCATION:	TB4-5RI	TB4-5RI	TB5-5RI	TB5-5RI	TB6-5RI	TB6-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	LS5SB0040101					
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 UJ	400 U	330 UJ	360 UJ	330 U	43 J
ACENAPHTHENE	360 U	400 U	330 U	360 U	330 U	48 J
ACENAPHTHYLENE	30 J	400 U	330 U	360 U	20 J	49 J
ANTHRACENE	39 J	400 U	330 U	360 U	26 J	130 J
BENZO(A)ANTHRACENE	220 J	700	37 J	31 J	190 J	380
BENZO(A)PYRENE	230 J	1100	39 J	34 J	180 J	300 J
BENZO(B)FLUORANTHENE	210 J	1200	36 J	40 J	200 J	310 J
BENZO(G,H,I)PERYLENE	210 J	600	45 J	35 J	110 J	120 J
BENZO(K)FLUORANTHENE	290 J	400 U	49 J	18 J	150 J	260 J
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	400 U	330 U	360 U	330 U	360 U
BUTYLBENZYL PHTHALATE	360 U	400 U	330 U	360 U	330 U	360 U
CARBAZOLE	25 J	400 U	330 U	360 U	330 U	61 J
CHRYSENE	250 J	850	43 J	43 J	170 J	360 J
DI-N-BUTYL PHTHALATE	19 J	400 U	330 U	360 U	330 U	360 U
DI-N-OCTYL PHTHALATE	360 U	400 U	330 U	360 U	330 UJ	360 UJ
DIBENZO(A,H)ANTHRACENE	120 J	400 UJ	330 U	360 U	54 J	77 J
DIBENZOFURAN	360 U	400 U	330 U	360 U	330 U	57 J
FLUORANTHENE	520	1900	78 J	58 J	270 J	750
FLUORENE	18 J	400 U	330 U	360 U	330 U	110 J
INDENO(1,2,3-CD)PYRENE	180 J	530	34 J	24 J	110 J	180 J
NAPHTHALENE	360 U	400 U	330 U	360 U	330 U	25 J
PHENANTHRENE	160 J	920	32 J	31 J	140 J	1000

TABLE 8-4 (PAGE 16 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	SBFD006	LS5SB0040201	LS5SB0050101	LS5SB0050201	LS5SB0060101	LS5SB0060201
DEPTH (feet):	1 - 3'	5 - 7'	1 - 3'	4 - 5.5'	2 - 4'	5.5 - 6.5'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/24/97	09/24/97
LOCATION:	TB4-5RI	TB4-5RI	TB5-5RI	TB5-5RI	TB6-5RI	TB6-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	LS5SB0040101					
SEMIVOLATILES (µg/kg)						
PYRENE	390	1600	65 J	48 J	300 J	990
METALS (mg/kg)						
ALUMINUM					3470	3790
ARSENIC					1.0	1.2
BARIUM					27.2	35.8
BERYLLIUM					0.12 U	0.17 U
CALCIUM					2810 J	1880 J
CHROMIUM					7.2	14.0
COBALT					2.4	4.4
COPPER					11.2	13.3
IRON					6030	6720
LEAD					9.6	7.6
MAGNESIUM					1810 J	1960 J
MANGANESE					99.8	119
MERCURY					0.01 UJ	0.01 UJ
NICKEL					5.5 J	7.4 J
POTASSIUM					1220	1130
SELENIUM					0.32 U	0.34 U
SODIUM					146	286
THALLIUM					0.83 U	0.87 U
VANADIUM					9.9	11.1
ZINC					23.8	116

TABLE 8-4 (PAGE 17 OF 17)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	SBFD006	LS5SB0040201	LS5SB0050101	LS5SB0050201	LS5SB0060101	LS5SB0060201
DEPTH (feet):	1 - 3'	5 - 7'	1 - 3'	4 - 5.5'	2 - 4'	5.5 - 6.5'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/24/97	09/24/97
LOCATION:	TB4-5RI	TB4-5RI	TB5-5RI	TB5-5RI	TB6-5RI	TB6-5RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	LS5SB0040101					
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	500 J		810 J		1400	

TABLE 8-5 (PAGE 1 OF 2)

SUMMARY OF POSITIVE TCLP ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19MW1-0.252.25	19MW11-0.252.25	19MW12-0406	19MW2-0406	19MW3-0406	19MW4-0608
DEPTH (feet):	0.3 - 2.3'	0.3 - 2.3'	4 - 6'	4 - 6'	4 - 6'	6 - 8'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/24/93	03/24/93	03/25/93	03/23/93
LOCATION:	19MW1	19MW1	19MW2	19MW2	19MW3	19MW4
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		19MW1-0.252.25	19MW2-0406			
TCLP METALS (mg/L)*						
BARIUM (100.0/10.0)	0.305	0.26	0.371	0.333	0.275	0.277
CADMIUM (1.0/0.05)	0.0028 B	0.002 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
CHROMIUM (5.0/0.5)	0.004 U	0.004 U	0.0324	0.0142	0.0039 U	0.0084 B
LEAD (5.0/0.15)	0.028 U	0.026 U	0.06	0.419	0.0562	0.114
SILVER (5.0/0.36)	0.004 U	0.004 U	0.0194 N	0.0025 UN	0.0108 N	0.0025 UN

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 8-5 (PAGE 2 OF 2)

SUMMARY OF POSITIVE TCLP ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19SS1	19TB1-0608	19TB2-0608	19TB3-1012	19TB4-0406	
DEPTH (feet):	0 - 0.5'	6 - 8'	6 - 8'	10 - 12'	4 - 6'	
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	
SAMPLE DATE:	04/07/93	03/23/93	03/22/93	03/24/93	03/24/93	/ /
LOCATION:	19SS1	19TB1	19TB2	19TB3	19TB4	
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
TCLP METALS (mg/L)*						
BARIUM (100.0/10.0)	0.557	0.217	0.265	0.417	0.304	
CADMIUM (1.0/0.05)	0.0018 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	
CHROMIUM (5.0/0.5)	0.0031 U	0.0039 U	0.006 B	0.0104	0.0054 B	
LEAD (5.0/0.15)	0.173	0.0124	0.0127	0.0397	0.0434	
SILVER (5.0/0.36)	0.0029 U	0.0025 UN	0.0098 BN	0.0025 UN	0.0025 UN	

. ederal Toxicity Characteristic Regulatory Level (58 FR 46049)/Conr. .cut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 8-6

SUMMARY OF POSITIVE SPLP ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5SB0010101	SBFD003	LS5SB0010201	LS5SB0060101	LS5SB0060201	
DEPTH (feet):	2 - 4'	2 - 4'	5 - 7'	2 - 4'	5.5 - 6.5'	
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	
SAMPLE DATE:	09/24/97	09/24/97	09/24/97	09/24/97	09/24/97	/ /
LOCATION:	TB1-5RI	TB1-5RI	TB1-5RI	TB6-5RI	TB6-5RI	
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:		LS5SB0010101				
SPLP METALS (mg/L)*						
LEAD (5.0/0.15)	0.0101	0.006 J	0.0014 J	0.002 J	0.0016 J	

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 8-7

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
2-Butanone	0/8	ND	ND	1/8	5	19TB2
Acetone	8/8	7 - 140	19MW4/19SS1	7/8	8 - 180	19MW4
Ethylbenzene	1/8	38	19MW4	1/8	33	19MW4
Methylene chloride	8/8	4 - 20	19MW4	8/8	5 - 1900	19MW3
Toluene	2/10	3 - 10	19MW4	1/8	3	19TB2
Xylenes, total	1/10	150	19MW4	2/8	7 - 32	19MW4
SEMIVOLATILE ORGANICS (ug/kg)						
2-Methylnaphthalene	2/16	27 - 960	19MW4	4/14	43 - 23000	19MW3
Acenaphthene	1/16	20	TB1-5RI	1/14	48	TB6-5RI
Acenaphthylene	3/16	20 - 30	TB4-5RI	1/14	49	TB6-5RI
Anthracene	7/16	22 - 45	TB3-5RI	3/14	21 - 640	TB3-5RI
Benzo(a)anthracene	9/16	37 - 230	19MW3	6/14	31 - 700	TB4-5RI
Benzo(a)pyrene	9/17	29 - 230	TB4-5RI	5/14	34 - 1100	TB4-5RI
Benzo(b)fluoranthene	10/17	32 - 330	TB4-5RI	6/14	40 - 1200	TB4-5RI
Benzo(g,h,i)perylene	8/17	45 - 210	TB4-5RI	5/14	35 - 600	TB4-5RI
Benzo(k)fluoranthene	7/16	49 - 290	TB4-5RI	4/14	18 - 260	TB6-5RI
Carbazole	6/16	21 - 26	TB4-5RI	1/14	61	TB6-5RI
Chrysene	9/17	28 - 260	TB4-5RI	5/14	43 - 850	TB4-5RI
Di-N-butyl phthalate	1/16	19	TB4-5RI	0/14	ND	ND
Dibenzo(a,h)anthracene	5/16	32 - 120	TB4-5RI	1/14	77	TB6-5RI
Dibenzofuran	0/16	ND	ND	1/14	57	TB6-5RI
Fluoranthene	11/17	39 - 520	TB4-5RI	6/14	53 - 1900	TB4-5RI
Fluorene	3/16	18 - 21	TB4-5RI	2/14	110 - 4100	TB1-5RI
Indeno(1,2,3-Cd)pyrene	7/16	34 - 180	TB4-5RI	5/14	24 - 530	TB4-5RI

TABLE 8-7

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Naphthalene	0/16	ND	ND	2/14	25 - 4500	TB1-5RI
Phenanthrene	8/16	32 - 210	TB4-5RI	6/14	31 - 7000	19MW3
Pyrene	11/17	47 - 420	19MW3	7/14	48 - 1600	TB4-5RI
PESTICIDES/PCBs (ug/kg)						
4,4'-DDE	1/8	56	19SS1	0/8	ND	ND
Aroclor-1260	3/8	55 - 140	19MW2	3/8	42 - 130	19TB2
INORGANICS (mg/kg)						
Aluminum	11/11	1940 - 6930	19TB3	10/10	1880 - 5500	19TB3
Arsenic	11/11	0.46 - 1.6	TB1-5RI	10/10	0.34 - 2.4	19TB3
Barium	11/11	23.4 - 53.6	19TB3	10/10	13.6 - 40.7	19TB3
Beryllium	6/11	0.09 - 0.27	19SS1	7/10	0.12 - 0.21	19MW3
Boron	1/8	19.7	19MW3	0/8	ND	ND
Calcium	11/11	671 - 2810	TB6-5RI	10/10	478 - 1880	TB6-5RI
Chromium	11/11	5 - 15.9	19TB3	10/10	2.5 - 14	TB6-5RI
Cobalt	11/11	1.9 - 4.8	19TB3	10/10	0.98 - 4.9	19TB4
Copper	11/11	5.5 - 19.7	19SS1/TB1-5RI	10/10	2.7 - 43.8	19MW3
Cyanide	1/8	0.24	19MW2	1/8	0.17	19TB3
Iron	11/11	4290 - 10400	19MW3	10/10	3450 - 8620	19TB2
Lead	10/12	1.7 - 91.2	TB1-5RI	10/10	1.3 - 14.6	19MW3
Magnesium	11/11	882 - 3160	19TB3	10/10	796 - 2590	19MW2
Manganese	11/11	84.9 - 150	19TB4	10/10	43.1 - 209	19TB4
Mercury	2/11	0.01 - 0.02	TB1-5RI	0/10	ND	ND
Nickel	10/11	4 - 9.4	19MW3	9/10	3 - 8.1	19MW3
Potassium	11/11	655 - 3100	19TB3	10/10	544 - 1910	19TB2
Sodium	10/11	57.2 - 318	19TB3	10/10	47 - 529	19TB3

TABLE 8-7

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Thallium	1/11	0.18	19SS1	0/10	ND	ND
Vanadium	11/11	5.9 - 18.3	19TB3	10/10	4.3 - 14.6	19MW2
Zinc	11/11	14 - 73.5	TB1-5RI	10/10	10.9 - 116	TB6-5RI
TCLP METALS (mg/L)						
Barium	1/1	0.557	19SS1	7/7	0.217 - 0.417	19TB3
Chromium	0/1	ND	ND	5/7	0.0054 - 0.0142	19MW2
Lead	1/1	0.173	19SS1	7/7	0.0124 - 0.419	19MW2
Silver	0/1	ND	ND	2/7	0.0098 - 0.0108	19MW3
SPLP METALS (mg/L)						
Lead	3/3	0.002-0.0101	TB1-5RI	2/2	0.0014-0.0016	TB6-5RI
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	10/10	53 - 6800	19SS1	6/8	78 - 6200	19TB2

1 Includes samples 19MW2-0204, 19MW3-0002, 19MW4-0002, 19MW4-0004, 19SS1, 19TB1-0002, 19TB1-0004, 19TB2-0002, 19TB3-0204, 19TB4-0002, 19TB4-0204, LS5SB0010101, LS5SB0020101, LS5SB0030101, LS5SB0040101, LS5SB0050101, LS5SB0060101, SBFD003 (field duplicate of LS5SB0010101), SBFD004 (field duplicate of LS5SB0030101), SBFD006 (field duplicate of LS5SB0040101).

2 Includes samples 19MW12-0406 (field duplicate of 19MW2-0406 (93)), 19MW2-0406, 19MW3-0406, 19MW4-0608, 19TB1-0608, 19TB2-0608, 19TB3-1012, 19TB4-0406, LS5SB0010201, LS5SB0020201, LS5SB0030201, LS5SB0040201, LS5SB0050201, LS5SB0060201.

ND - Not Detected.

NA - Not Analyzed.

TABLE 8-8

SUMMARY OF SOIL FLUORESCENCE SPECTROSCOPY DATA - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Depth (ft)	Observations
19MW2	4-6	No. 6 fuel oil
19MW3	4-6	No. 2 diesel fuel oil
19MW4	6-8	No. 2 diesel fuel oil
19SS1	0-0.5	No. 2 diesel fuel oil
19TB1	6-8	No. 6 fuel oil
19TB2	6-8	No. 2 diesel fuel oil
19TB3	10-12	No. 6 fuel oil
19TB4	4-6	No. 6 fuel oil

TABLE 8-9 (PAGE 1 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19GW2	19GW2	LS5GW19MW201	LS5GW19MW201-F	19GW3	19GW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/29/93	04/29/93
LOCATION:	19MW2	19MW2	19MW2	19MW2	19MW3	19MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
ETHYLBENZENE	1 U				1 U	
TOLUENE	1 U				1 U	
XYLENES, TOTAL	1 U				5 U	
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	10 U		12 U		37	
ACENAPHTHENE	10 U		12 U		3 J	
ACENAPHTHYLENE	10 U		12 U		11 U	
DI-N-BUTYL PHTHALATE	10 U		12 U		11 U	
DIBENZOFURAN	10 U		12 U		2 J	
FLUORENE	10 U		12 U		4 J	
NAPHTHALENE	10 U		12 U		15	
PHENANTHRENE	10 U		12 U		1 J	
METALS (µg/L)						
ALUMINUM	143 U	136 B	146 U	12.5 U	153 U	172 B
ARSENIC	2.5 U	2 U	2.5 U	2.5 U	4.3 U	2 U
BARIUM	43.7 U	43.7 B	324	295	72.8 U	72.8 B
BORON	243 U	162 BE			247 U	184 BE
CALCIUM	22700 J	23900	182000	165000	33300 J	36400
COBALT	3 U	3 U	2.9 U	2.9 U	3 U	3 U
COPPER	3 U	3 U	4.2	3.2	3 U	3 U
IRON	30.9 U	42.5 B	220 U	22.2 U	10700 J	11600
LEAD	1.3 U	1.4 B	1.3 J	1.3 U	4.4 U	2.2 B
MAGNESIUM	3360 JB	3410 B	391000	351000	4410 JB	4850 B
MANGANESE	6.2 U	7.6 B	4.6 J	1.6 U	912 J	1000

TABLE 8-9 (PAGE 2 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19GW2	19GW2	LS5GW19MW201	LS5GW19MW201-F	19GW3	19GW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/29/93	04/29/93
LOCATION:	19MW2	19MW2	19MW2	19MW2	19MW3	19MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.18 U	0.18 U	0.04 U	0.01 U	0.18 U	0.18 U
POTASSIUM	3840 JB	4030 B	113000	100000	4540 JB	4980 B
SODIUM	63400 J	66700	3090000	2770000	57400 J	63100
VANADIUM	5 U	5 U	2.9 UJ	2.9 UJ	5 U	5 U
ZINC	3 U	3.3 B	21.3 J	185 J	4.4 U	11 U
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)			6.96			
REDOX POTENTIAL (MV)			54.6			
SALINITY (PPT)			9.74			
SPECIFIC CONDUCTIVITY (MS/CM)			16.53			
TEMPERATURE (C)			16.93			
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)			80			
AMMONIA, AS NITROGEN (MG/L)			0.10 U			
CHLORIDE (MG/L)			3900			
DIVALENT IRON (MG/L)			0			
HARDNESS AS CaCO3 (MG/L)			1900			
METHANE (UG/L)			5.4 U			
NITRATE, AS NITROGEN (MG/L)			1.2			
PHOSPHORUS (MG/L)			0.29 J			
SULFATE (MG/L)			890			
TOTAL ORGANIC CARBON (MG/L)			2.6 J			
TURBIDITY (NTU)			-0.2 R			

TABLE 8-9 (PAGE 3 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19GW2	19GW2	LS5GW19MW201	LS5GW19MW201-F	19GW3	19GW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/29/93	04/29/93
LOCATION:	19MW2	19MW2	19MW2	19MW2	19MW3	19MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
GENERAL CHEMISTRY						
PH			6.36			

TABLE 8-9 (PAGE 4 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5GW19MW301	LS5GW19MW301-F	19MW4	19MW4		
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95		
SAMPLE DATE:	10/28/97	10/28/97	04/27/93	04/27/93	/ /	/ /
LOCATION:	19MW3	19MW3	19MW4	19MW4		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered		
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
ETHYLBENZENE			4			
TOLUENE			0.8 J			
XYLENES, TOTAL			13			
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	11 U		75			
ACENAPHTHENE	11 U		2 J			
ACENAPHTHYLENE	2 J		10 U			
DI-N-BUTYL PHTHALATE	0.6 J		10 U			
DIBENZOFURAN	1 J		2 J			
FLUORENE	2 J		3 J			
NAPHTHALENE	0.6 J		73			
PHENANTHRENE	11 U		2 J			
METALS (µg/L)						
ALUMINUM	47.9 U	26.8 U	238 U	153 B		
ARSENIC	2.5 U	2.5 U	30.2 UW	34.3		
BARIUM	177	370	66.1 U	58.2 B		
BORON			190 U	206 BE		
CALCIUM	53100	50600	72800 J	68300		
COBALT	2.9 U	2.9 U	11.5 JB	10.5 B		
COPPER	2.4 J	11.4	3 UJ	3 U		
IRON	19500	18400	31900 J	31100		
LEAD	1.3 U	1.3 U	1.7 U	1 U		
MAGNESIUM	5900	5670	4090 JB	4010 B		
MANGANESE	741	703	4140 J	4090		

TABLE 8-9 (PAGE 5 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5GW19MW301	LS5GW19MW301-F	19MW4	19MW4		
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95		
SAMPLE DATE:	10/28/97	10/28/97	04/27/93	04/27/93	/ /	/ /
LOCATION:	19MW3	19MW3	19MW4	19MW4		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered		
FIELD DUPLICATE OF:						
METALS (µg/L)						
MERCURY	0.41	0.04 U	0.18 UJ	0.18 U		
POTASSIUM	7690	7210	6480 J	6440		
SODIUM	75800	74800	21900 J	21600		
VANADIUM	2.9 U	3.0 J	5 UJ	5 U		
ZINC	15.7 U	88.5 J	9.6 U	4.8 B		
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	0.71					
REDOX POTENTIAL (MV)	-98.5					
SALINITY (PPT)	0.35					
SPECIFIC CONDUCTIVITY (MS/CM)	0.709					
TEMPERATURE (C)	16.44					
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	160					
AMMONIA, AS NITROGEN (MG/L)	1.4					
CHLORIDE (MG/L)	150					
DIVALENT IRON (MG/L)	8					
HARDNESS AS CaCO3 (MG/L)	160					
METHANE (UG/L)	660					
NITRATE, AS NITROGEN (MG/L)	0.050 U					
PHOSPHORUS (MG/L)	1.5 J					
SULFATE (MG/L)	3.5					
TOTAL ORGANIC CARBON (MG/L)	38 J					
TURBIDITY (NTU)	6.08					

TABLE 8-9 (PAGE 6 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5GW19MW301	LS5GW19MW301-F	19MW4	19MW4		
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95		
SAMPLE DATE:	10/28/97	10/28/97	04/27/93	04/27/93	/ /	/ /
LOCATION:	19MW3	19MW3	19MW4	19MW4		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered		
FIELD DUPLICATE OF:						
GENERAL CHEMISTRY						
PH	6.14					

TABLE 8-10

SUMMARY OF HISTORICAL AND LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Historical Data[1]				Lower Subase RI[2]		
	Frequency of Detection	Concentration Range	Maximum Detection		Frequency of Detection	Concentration Range	Location of Maximum Detection
			Location	Investigation[3]			
VOLATILE ORGANICS (µg/L)							
Ethylbenzene	1/3	4	19MW4	AESSI95	NA	NA	ND
Toluene	1/3	0.8	19MW4	AESSI95	NA	NA	ND
Xylenes, total	1/3	13	19MW4	AESSI95	NA	NA	ND
SEMIVOLATILE ORGANICS (µg/L)							
2-Methylnaphthalene	2/3	37 - 75	19MW4	AESSI95	0/2	ND	ND
Acenaphthene	2/3	2 - 3	19MW3	AESSI95	1/2	2	19MW3
Di-N-butyl phthalate	0/3	ND	ND	ND	1/2	0.6	19MW3
Dibenzofuran	2/3	2	19MW3/19MW4	AESSI95/AESSI95	1/2	1	19MW3
Fluorene	2/3	3 - 4	19MW3	AESSI95	1/2	2	19MW3
Naphthalene	2/3	15 - 73	19MW4	AESSI95	1/2	0.6	19MW3
Phenanthrene	2/3	1 - 2	19MW4	AESSI95	0/2	ND	ND
INORGANICS (µg/L)							
Aluminum, filtered	3/3	136 - 172	19MW3	AESSI95	0/2	ND	ND
Arsenic, filtered	1/3	34.3	19MW4	AESSI95	0/2	ND	ND
Barium	0/3	ND	ND	ND	2/2	177 - 324	19MW2
Barium, filtered	3/3	43.7 - 72.8	19MW3	AESSI95	2/2	295 - 370	19MW3
Boron, filtered	3/3	162 - 206	19MW4	AESSI95	NA	NA	ND
Calcium	3/3	22700 - 72800	19MW4	AESSI95	2/2	53100 - 182000	19MW2
Calcium, filtered	3/3	23900 - 68300	19MW4	AESSI95	2/2	50600 - 165000	19MW2
Cobalt	1/3	11.5	19MW4	AESSI95	0/2	ND	ND
Cobalt, filtered	1/3	10.5	19MW4	AESSI95	0/2	ND	ND
Copper	0/3	ND	ND	ND	2/2	2.4 - 4.2	19MW2
Copper, filtered	0/3	ND	ND	ND	2/2	3.2 - 11.4	19MW3
Iron	2/3	10700 - 31900	19MW4	AESSI95	1/2	19500	19MW3
Iron, filtered	3/3	42.5 - 31100	19MW4	AESSI95	1/2	18400	19MW3
Lead	0/3	ND	ND	ND	1/2	1.3	19MW2

TABLE 8-10

SUMMARY OF HISTORICAL AND LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Historical Data[1]				Lower Subase RI[2]		
	Frequency of Detection	Concentration Range	Maximum Detection		Frequency of Detection	Concentration Range	Location of Maximum Detection
			Location	Investigation[3]			
Lead, filtered	2/3	1.4 - 2.2	19MW3	AESSI95	0/2	ND	ND
Magnesium	3/3	3360 - 4410	19MW3	AESSI95	2/2	5900 - 391000	19MW2
Magnesium, filtered	3/3	3410 - 4850	19MW3	AESSI95	2/2	5670 - 351000	19MW2
Manganese	2/3	912 - 4140	19MW4	AESSI95	2/2	4.6 - 741	19MW3
Manganese, filtered	3/3	7.6 - 4090	19MW4	AESSI95	1/2	703	19MW3
Mercury	0/3	ND	ND	ND	1/2	0.41	19MW3
Potassium	3/3	3840 - 6480	19MW4	AESSI95	2/2	7690 - 113000	19MW2
Potassium, filtered	3/3	4030 - 6440	19MW4	AESSI95	2/2	7210 - 100000	19MW2
Sodium	3/3	21900 - 63400	19MW2	AESSI95	2/2	75800 - 3090000	19MW2
Sodium, filtered	3/3	21600 - 66700	19MW2	AESSI95	2/2	74800 - 2770000	19MW2
Vanadium	0/3	ND	ND	ND	1/2	3	19MW3
Zinc	0/3	ND	ND	ND	1/2	21.3	19MW2
Zinc, filtered	2/3	3.3 - 4.8	19MW4	AESSI95	2/2	88.5 - 185	19MW2

1 Includes samples 19GW2, 19GW3, 19MW4.
2 Includes samples LS5GW19MW201, LS5GW19MW301.
3 AESS195 = Pier 33 and Berth 16/Former Incinerator Site Investigation.
NA - Not Analyzed.
ND - Not Detected.

TABLE 8-11

SUMMARY OF GROUNDWATER FLUORESCENCE SPECTROSCOPY DATA - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Observations
19MW2	Residual fuel oil or road tar
19MW3	May contain No. 4 or No. 6 fuel oil
19MW4	May contain No. 4 or No. 6 fuel oil

TABLE 8-12

SUMMARY OF NATURAL ATTENUATION AND WATER QUALITY PARAMETERS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Lower Subase RI[1]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS			
Alkalinity as CaCO3 (mg/L)	2/2	80 - 160	19MW3
Ammonia, as nitrogen (mg/L)	1/2	1.4	19MW3
Chloride (mg/L)	2/2	150 - 3900	19MW2
Dissolved oxygen (mg/L)	2/2	0.71 - 6.96	19MW2
Divalent iron (mg/L)	1/2	8	19MW3
Hardness as CaCO3 (mg/L)	2/2	160 - 1900	19MW2
Methane (mg/L)	1/2	660	19MW3
Nitrate, as nitrogen (mg/L)	1/2	1.2	19MW2
pH	2/2	6.14 - 6.36	19MW2
Phosphorus (mg/L)	2/2	0.29 - 1.5	19MW3
Redox potential (mV)	2/2	-98.5 - 54.6	19MW2
Salinity (ppt)	2/2	0.35 - 9.74	19MW2
Specific conductivity (ms/cm)	2/2	0.709 - 16.53	19MW2
Sulfate (mg/L)	2/2	3.5 - 890	19MW2
Temperature (C)	2/2	16.44 - 16.93	19MW2
Total organic carbon (mg/L)	2/2	2.6 - 38	19MW3
Turbidity (NTU)	1/1	6.08	19MW3

1 Includes samples LS5GW19MW201, LS5GW19MW301.

TABLE 8-13 (PAGE 1 OF 3)

SUMMARY OF POSITIVE STORM SEWER SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19SD1	19SD2				
DEPTH (feet):						
INVESTIGATION:	AESSI95	AESSI95				
SAMPLE DATE:	04/07/93	04/07/93	/ /	/ /	/ /	/ /
LOCATION:	19SD1	19SD2				
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
ACETONE	220	58				
METHYLENE CHLORIDE	9 JB	12 JB				
TOLUENE	4 J	13 U				
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE	7300 J	870 U				
ANTHRACENE	9500 J	870 U				
BENZO(A)ANTHRACENE	17000	870 U				
BENZO(A)PYRENE	18000	870 U				
BENZO(B)FLUORANTHENE	26000	530 J				
BENZO(G,H,I)PERYLENE	10000 J	870 U				
BIS(2-ETHYLHEXYL)PHTHALATE	14000 U	2100				
CARBAZOLE	8100 J	870 U				
CHRYSENE	19000	870 U				
FLUORANTHENE	44000	630 J				
FLUORENE	8000 J	870 U				
INDENO(1,2,3-CD)PYRENE	9900 J	870 U				
NAPHTHALENE	8600 J	870 U				
PHENANTHRENE	40000	510 J				
PYRENE	31000	680 J				
METALS (mg/kg)						
ALUMINUM	2740	2610				
ANTIMONY	9270 N	3.3 UN				

TABLE 8-13 (PAGE 2 OF 3)

SUMMARY OF POSITIVE STORM SEWER SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19SD1	19SD2				
DEPTH (feet):						
INVESTIGATION:	AESSI95	AESSI95				
SAMPLE DATE:	04/07/93	04/07/93	/ /	/ /	/ /	/ /
LOCATION:	19SD1	19SD2				
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ARSENIC	3 N	2.1 BN				
BARIUM	28.8 B	22.5 B				
BERYLLIUM	0.18 B	0.23 B				
CADMIUM	12.4 N	0.48 UN				
CALCIUM	915 B	1930				
CHROMIUM	20.8	25.1				
COBALT	4.2 B	2.7 B				
COPPER	74	342				
CYANIDE	0.55 B	1.1				
IRON	8570	6330				
LEAD	85600	185				
MAGNESIUM	1720	1120 B				
MANGANESE	72.8	69.9				
MERCURY	0.05 U	0.11 B				
NICKEL	8.9 B	11				
POTASSIUM	1110 B	560 B				
SILVER	14.4 N	0.78 UN				
SODIUM	134 BE	622 BE				
THALLIUM	0.14 BN	0.15 UN				
VANADIUM	13.1	8.7 B				
ZINC	107	168				
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						

TABLE 8-13 (PAGE 3 OF 3)

SUMMARY OF POSITIVE STORM SEWER SEDIMENT ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	19SD1	19SD2				
DEPTH (feet):						
INVESTIGATION:	AESSI95	AESSI95				
SAMPLE DATE:	04/07/93	04/07/93	/ /	/ /	/ /	/ /
LOCATION:	19SD1	19SD2				
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	3300	1800				

TABLE 8-14

SUMMARY OF STORM SEWER SEDIMENT ANALYTICAL RESULTS - ZONE 5[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (μg/kg)			
Acetone	2/2	58 - 220	19SD1
Methylene chloride	2/2	9 - 12	19SD2
Toluene	1/2	4	19SD1
SEMIVOLATILE ORGANICS (μg/kg)			
Acenaphthene	1/2	7300	19SD1
Anthracene	1/2	9500	19SD1
Benzo(a)anthracene	1/2	17000	19SD1
Benzo(a)pyrene	1/2	18000	19SD1
Benzo(b)fluoranthene	2/2	530 - 26000	19SD1
Benzo(g,h,i)perylene	1/2	10000	19SD1
Bis(2-Ethylhexyl)phthalate	1/2	2100	19SD2
Carbazole	1/2	8100	19SD1
Chrysene	1/2	19000	19SD1
Fluoranthene	2/2	630 - 44000	19SD1
Fluorene	1/2	8000	19SD1
Indeno(1,2,3-Cd)pyrene	1/2	9900	19SD1
Naphthalene	1/2	8600	19SD1
Phenanthrene	2/2	510 - 40000	19SD1
Pyrene	2/2	680 - 31000	19SD1
INORGANICS (mg/kg)			
Aluminum	2/2	2610 - 2740	19SD1
Antimony	1/2	9270	19SD1
Arsenic	2/2	2.1 - 3	19SD1
Barium	2/2	22.5 - 28.8	19SD1
Beryllium	2/2	0.18 - 0.23	19SD2
Cadmium	1/2	12.4	19SD1
Calcium	2/2	915 - 1930	19SD2
Chromium	2/2	20.8 - 25.1	19SD2
Cobalt	2/2	2.7 - 4.2	19SD1
Copper	2/2	74 - 342	19SD2
Cyanide	2/2	0.55 - 1.1	19SD2
Iron	2/2	6330 - 8570	19SD1
Lead	2/2	185 - 85600	19SD1
Magnesium	2/2	1120 - 1720	19SD1
Manganese	2/2	69.9 - 72.8	19SD1
Mercury	1/2	0.11	19SD2
Nickel	2/2	8.9 - 11	19SD2
Potassium	2/2	560 - 1110	19SD1
Silver	1/2	14.4	19SD1

TABLE 8-14

SUMMARY OF STORM SEWER SEDIMENT ANALYTICAL RESULTS - ZONE 5[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Sodium	2/2	134 - 622	19SD2
Thallium	1/2	0.14	19SD1
Vanadium	2/2	8.7 - 13.1	19SD1
Zinc	2/2	107 - 168	19SD2
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	2/2	1800 - 3300	19SD1

1 Includes samples 19SD1 and 19SD2.

TABLE 8-15

SUMMARY OF STORM SEWER SEDIMENT FLUORESCENCE SPECTROSCOPY DATA - ZONE 5 LOWER SUBASE NSB-NLON, GROTON, CONNECTICUT

Sample	Observations
19SD1	No. 4 or No. 6 fuel oil
19SD2	No. 6 fuel oil

TABLE 8-16

SUMMARY OF POSITIVE STORM SEWER SURFACE WATER ANALYTICAL RESULTS FOR ZONES 5 AND 6 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	NOVA	NOVA	NOVA	NOVA		
INVESTIGATION:	ST_SEWER	ST_SEWER	ST_SEWER	ST_SEWER		
SAMPLE DATE:	09/21/93	02/28/95	10/08/96	06/19/97	/ /	/ /
LOCATION:	NOVA	NOVA	NOVA	NOVA		
VALIDATED:						
FILTERING:	UNFILTERED	UNFILTERED	UNFILTERED	UNFILTERED		
FIELD DUPLICATE OF:						
METALS (µg/L)						
COPPER	80	37	80	80		
IRON				540		
LEAD	20	42	80	80		
SODIUM				4150		
ZINC	210	130	380	470		
PETROLEUM HYDROCARBONS (µg/L)						
OIL & GREASE	2800	2300	3810	1000 U		
MISCELLANEOUS PARAMETERS (mg/L)						
AMMONIA, AS NITROGEN				0.4		
CHEMICAL OXYGEN DEMAND	41	5	192	18.7		
CHLORIDE				9.5		
FECAL COLIFORM	140 E	100 U	3500	100		
NITRATE, AS NITROGEN	5	1.1	1.34	0.8		
PH	6.4	6.3	8.63	5.41		
TOTAL DISSOLVED SOLIDS	1301			14		
TOTAL KJELDAHL NITROGEN	1.26	0.57	0.7	1.12		
TOTAL PHOSPHORUS	0.09	0.07	0.31	0.29		
TOTAL SUSPENDED SOLIDS	22	94	210	170		

TABLE 8-17

CHEMICALS OF CONCERN - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNNECTICUT

Chemicals of Concern[1]		
Shallow Soil (0 - 5 Feet)	**All Soil (0 - 10 Feet)**	**Groundwater[2]**
Methylene Chloride	Methylene Chloride	Acenaphthylene
Benzo(a)anthracene	Benzo(a)anthracene	Phenanthrene
Benzo(a)pyrene	Benzo(a)pyrene	Aluminum (filtered only)
Benzo(b)fluoranthene	Benzo(b)fluoranthene	Arsenic (filtered only)
Dibenzo(a,h)anthracene	Carbazole	Barium
Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Copper
Arsenic	Indeno(1,2,3-cd)pyrene	Iron
Chromium (total)	Naphthalene	Manganese
Iron	Arsenic	Mercury (unfiltered only)
TPH	Beryllium	Sodium
	Chromium (total)	Zinc (filtered only)
	Iron	
	Manganese	
	Nickel	
	TPH	

1 Chemical is identified as a Chemical of Concern (COC) if the maximum detection in a single sample exceeds one or more criteria (i.e., Region III COC screening level, State Remediation Standards, Federal Soil Screening Levels, etc.).

2 Unless otherwise noted, the inorganic chemicals presented are COCs for the unfiltered and filtered groundwater sample matrix.

TABLE 8-18

EXPOSURE CONCENTRATIONS FOR DIRECT EXPOSURE CHEMICALS OF CONCERN - ZONE 5 LOWER SUBASE NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration		
	Surface Soil[1] (mg/kg)	All Soil[1] (mg/kg)	Groundwater[2] (mg/L)
Semivolatile Organic Compounds			
Benzo(a)pyrene	0.15/0.23	1.1[3]	NA[4]
Benzo(b)fluoranthene	NA	1.2[3]	NA
Dibenzo(a,h)anthracene	0.10/0.12	0.12[5]	NA
Metals			
Arsenic	1.0/1.6	1.2/2.2	NA
Arsenic, filtered	NA	NA	0.0122/0.0343
Barium	NA	NA	0.104/0.173
Beryllium	NA	0.10/0.20	NA
Manganese	NA	127/209	1.66/4.14

1 UCL if single concentration is presented, otherwise average concentration is used for CTE and maximum detected concentration is used for RME unless otherwise noted. See Section 3.3.1.

2 Average concentration is used for CTE and maximum concentration is used for RME. Maximum is defined as the highest average concentration in a single well, and the average is defined as the overall average concentration of all well-specific averages.

3 Maximum concentration is presented since UCL is greater than maximum detected concentration.

4 NA - Not applicable. Chemical is not a chemical of concern for this medium.

5 Maximum concentration is presented since average concentration exceeds the maximum detected concentration.

TABLE 8-19

ESTIMATED RISKS [1] - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

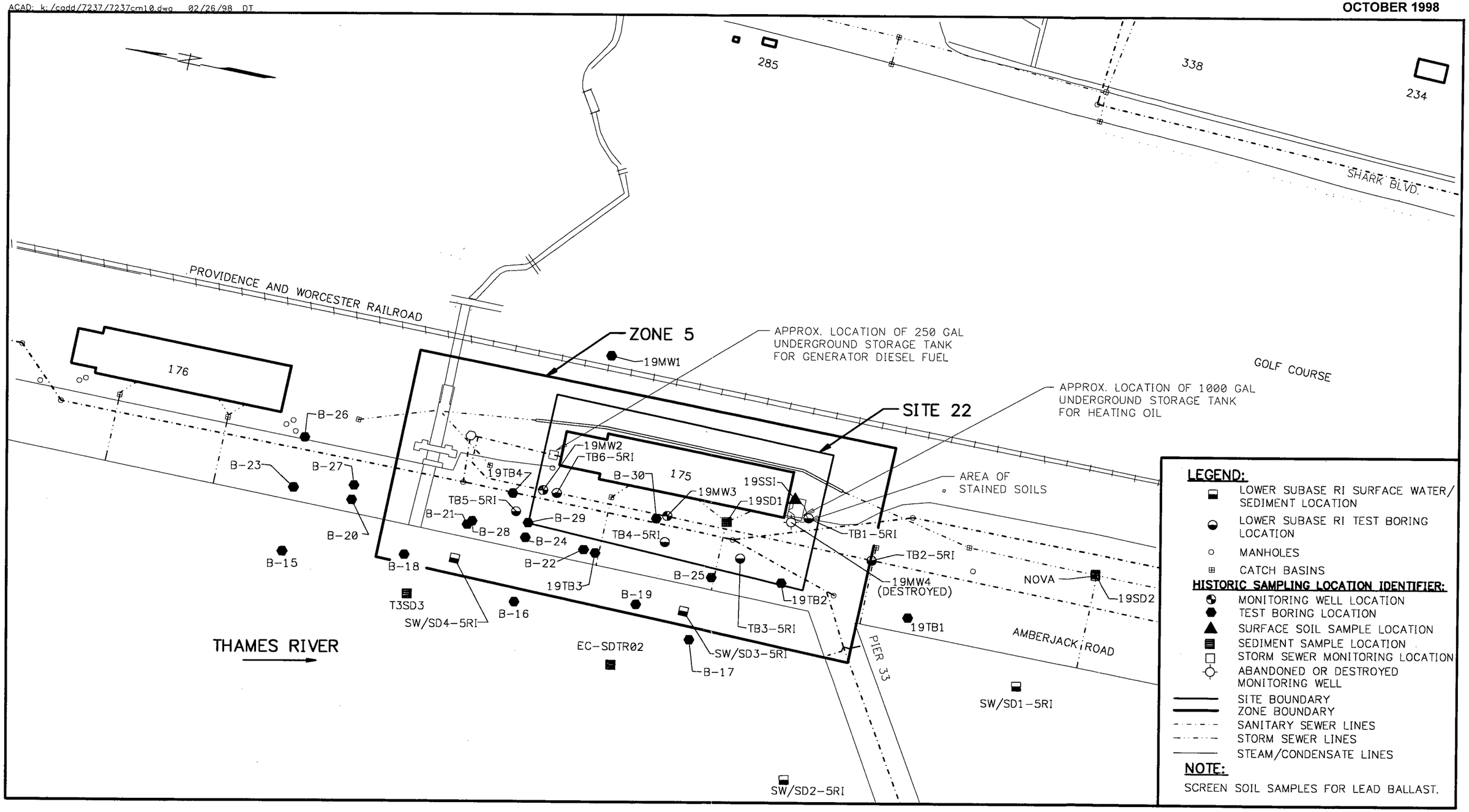
Exposure Route	Construction Worker		Full-Time Employee		Future Resident	
	RME[2]	CTE[3]	RME	CTE	RME	CTE
HAZARD INDEX						
Incidental Ingestion of Soil	0.020	0.004	0.003	0.001	0.014	0.002
Dermal Contact with Soil[4]	0.004	0.0003	0.004	0.0005	0.007	0.0008
Total Risk from Soil	0.024	0.0043	0.007	0.0015	0.021	0.0028
Dermal Contact with Groundwater	0.85	0.23	NA	NA	NA	NA
Cumulative Risk:	0.87	0.23	0.007	0.0015	0.021	0.0028
INCREMENTAL CANCER RISK						
Incidental Ingestion of Soil	4.2E-07	1.2E-07	1.0E-06	8.4E-08	8.8E-06	6.2E-07
Dermal Contact with Soil[4]	3.9E-07	5.1E-08	3.6E-06	5.0E-07	1.9E-05	1.2E-06
Total Risk from Soil	8.1E-07	1.7E-07	4.6E-06	5.8E-07	2.8E-05	1.8E-06
Dermal Contact with Groundwater	1.1E-07	2.7E-08	NA	NA	NA	NA
Cumulative Risk:	9.2E-07	2.0E-07	4.6E-06	5.8E-07	2.8E-05	1.8E-06

1 Chemical-specific risks presented in Appendix I.9.
2 RME - Reasonable Maximum Exposure.
3 CTE - Central Tendency Exposure.
4 Quantitative evaluation performed for cadmium, dioxins, and PCBs (if detected).
5 NA - Not applicable; exposure route not evaluated for this receptor.

TABLE 8-20

SUMMARY OF MAJOR CONTRIBUTORS TO RISK - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemical	Cancer Risk	Percent Contribution
Full-time Employee - RME	Benzo(a)pyrene	2.0E-06	113%
	Dibenzo(a,h)anthracene	1.0E-06	59%
Future Resident - RME	Benzo(a)pyrene	2.0E-05	72%
	Benzo(b)fluoranthene	2.2E-06	8%
	Dibenzo(a,h)anthracene	2.2E-06	8%
	Arsenic	3.5E-06	13%
Future Resident - CTE	Benzo(a)pyrene	1.3E-06	76%



SAMPLE LOCATION MAP
ZONE 5
NSB-NLON, GROTON, CONNECTICUT

0 80 160
SCALE IN FEET

FIGURE 8-1

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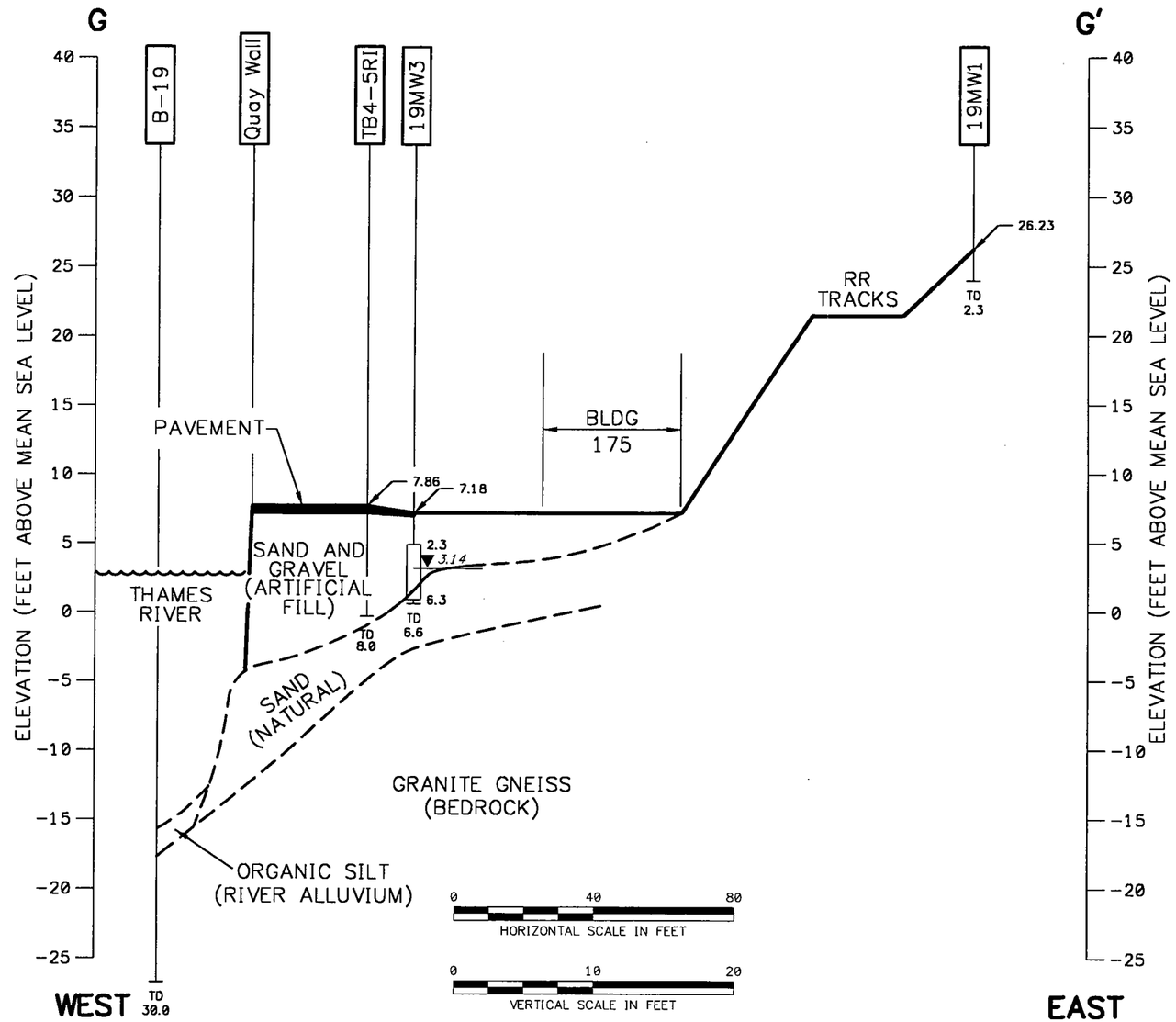
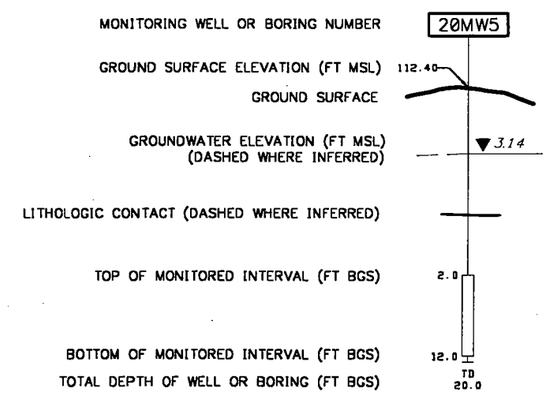
CTO 0260

ACAD:7237gx06.dwg 09/30/98 HJP



LEGEND



NOTES

1.) ELEVATIONS BASED ON SUBASE VERTICAL DATUM (1982)

2.) POTENTIOMETRIC SURFACE FOR LOW TIDE OCTOBER 27, 1997

3.) SEE DRAWING 6 FOR CROSS SECTION LOCATION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 2/15/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

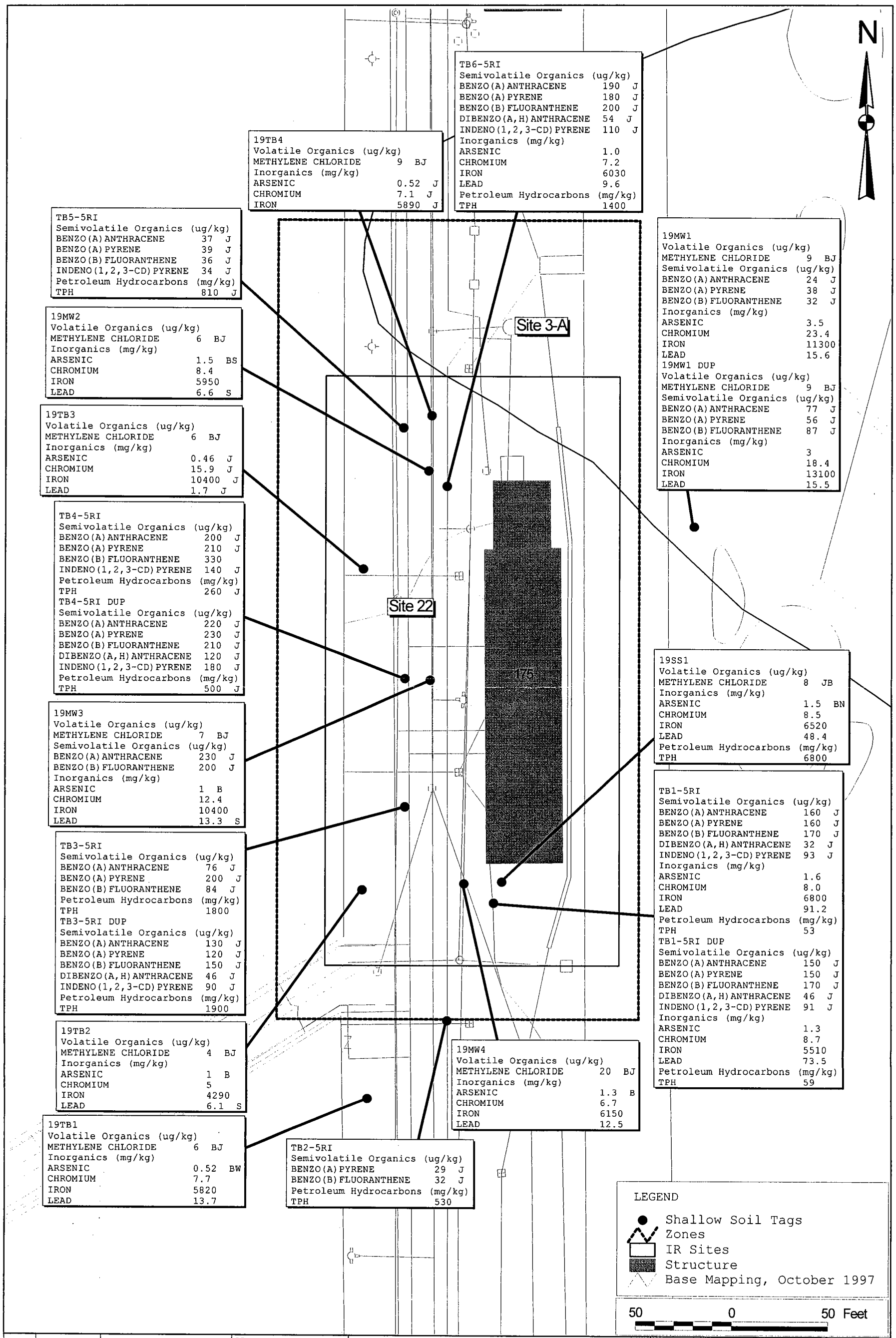
Brown & Root Environmental

GENERALIZED GEOLOGIC CROSS SECTION G – G'
ZONE 5
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO. 7237
OWNER NO. 0260
APPROVED BY Corey A. Reid DATE 10/7/98
APPROVED BY DATE
DRAWING NO. FIGURE 8-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

P:\GIS\NLON\NLONTAGS.APR 24-FEB-98 SMT ZONE 5 SHALLOW SOIL TAG LAYOUT



NO.	DATE	REVISIONS	DRAWN BY D. PERRY	DATE 16-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 5 SHALLOW SOIL COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A Phil	DATE 4/15/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 8-3	REV. 0

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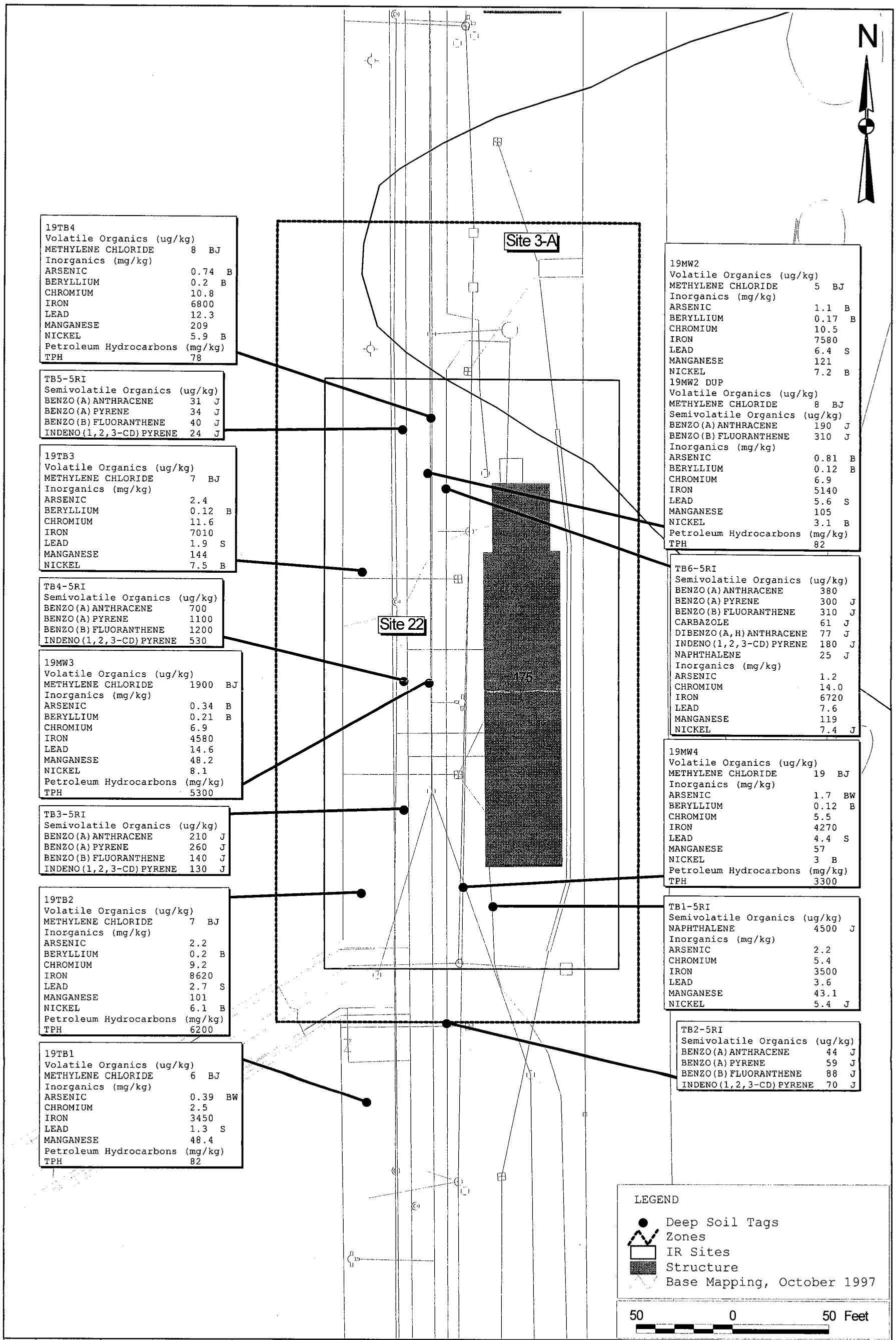
CTO 0260

REVISION 1
OCTOBER 1998

P:\GIS\NLON\NLONTAGS-DEEP.APR 24-FEB-98 DNP ZONE 5 DEEP SOIL TAG LAYOUT



NO.	DATE	REVISIONS	DRAWN BY D. PERRY	DATE 24-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 5 DEEP SOIL COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A Pail	DATE 4/15/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 8-4	REV. 0

019806/P

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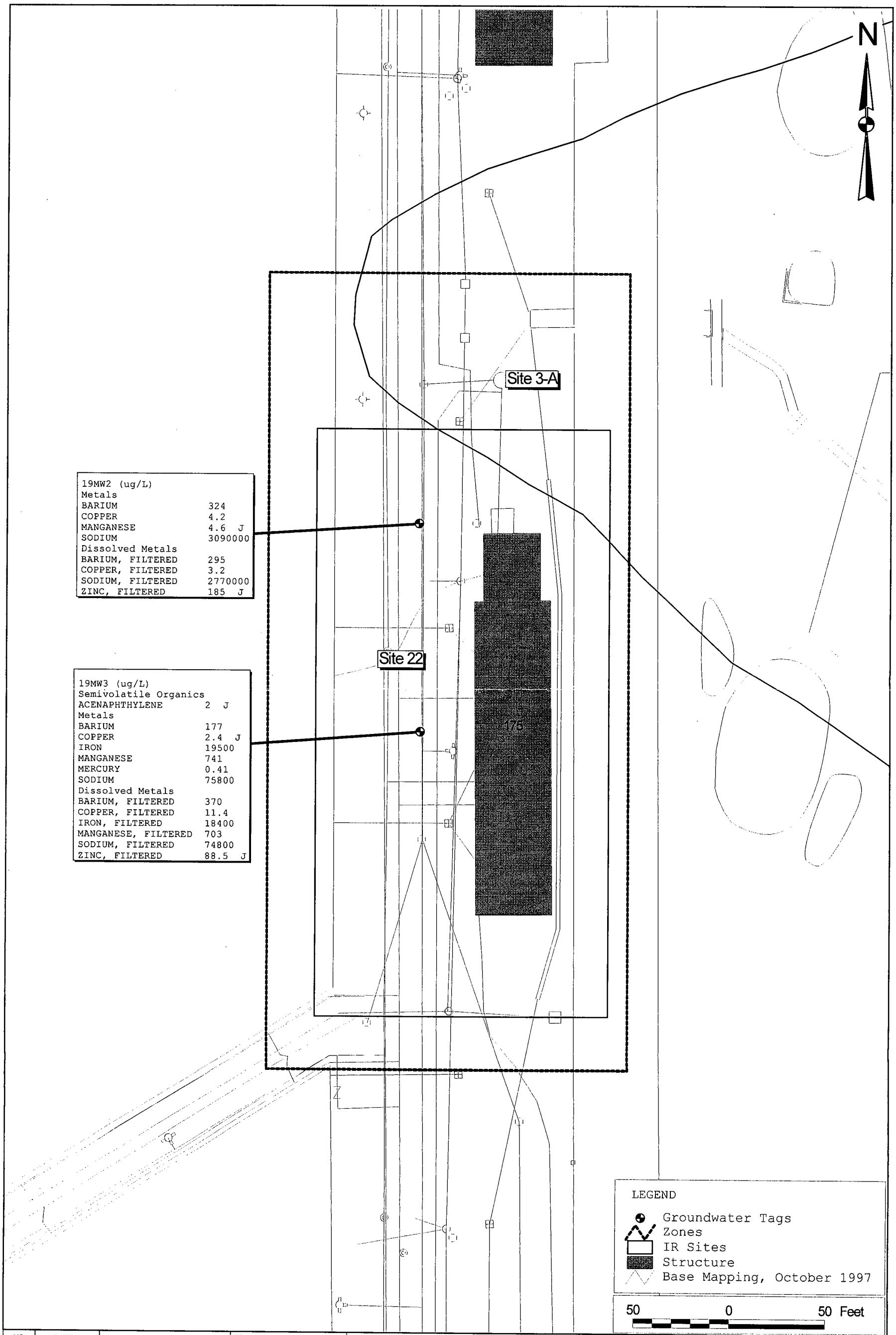
CTO 0260

REVISION 1
OCTOBER 1998

P:\GIS\NLON\NLONTAGS.APR 25-FEB-98 SMT ZONE 5 GROUNDWATER TAG LAYOUT



NO.	DATE	REVISIONS	DRAWN BY S. TABLER	DATE 25-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 5 GROUNDWATER COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A Pail	DATE 4/15/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 8-5	REV. 0

9.0 ZONE 6

9.1 SITE DESCRIPTION

Zone 6 is located east of Pier 32 in the northern section of the Lower Subase. It includes Building 174, which is identified as Site 24 - Central Paint Accumulation Area. Steam and condensate ducts and fuel oil distribution lines from the southern section of the Lower Subase do not extend into Zone 6. The limits of Zone 6 and Site 24 are shown in Figure 9-1. Sewer lines within Zone 6 are also illustrated. Photographs of Zone 6 sites are provided in Appendix G.

9.1.1 Site 24 - Central Paint Accumulation Area

Building 174 was used as the primary paint storage facility for all paints used in boat maintenance. In 1982, the building was retrofitted to also house boat sandblasting and paint activities.

9.1.2 Storm Sewers

As can be seen on Figure 9-1, two storm sewers discharge to the Thames River from Zone 6. Invert elevations for the storm sewer outfalls to the Thames River were not readily available; however, invert elevations for the two catch basins upgradient of the outfalls were available. The invert elevations for the catch basins were 3.53 feet msl (Catch Basin No. 761 on the northwest side of Building 174) and 4.07 feet msl (Catch Basin 760 on the southwest side of Building 174). These elevations were taken from the Navy drawing, *Utility Map, Storm Drainage* (Drawing Number 1142295, Sheet 2 of 19, July 27, 1967). The elevation of the Thames River fluctuates daily and seasonally, but the elevation of the river typically ranges between approximately 0.00 feet msl to 4.00 feet msl. Therefore, the storm sewer system will be submerged to varying degrees depending on the time of day and time of year.

In accordance with the requirements of the basewide General NPDES Stormwater Permit, the stormwater sewer located halfway between Building 175 in Zone 5 and Building 174 in Zone 6 is monitored annually during a storm event. This storm sewer, referred to as NOVA, was last sampled during a storm event on June 19, 1997. Results of the chemical and toxicity testing performed on this stormwater are presented in Section 9.2.1.

9.2 SITE INVESTIGATIONS

No investigation of the soil or groundwater has been conducted at this site. Sediment sampling in 1990 at Piers 33 and 32 was conducted as part of the EIS for the Seawolf Class Submarine. The storm sewer

referred to in the previous section, located halfway between Zones 5 and 6, is sampled annually during a storm event as part of the basewide General Stormwater Permit. This program is discussed below.

9.2.1 Annual NPDES Stormwater Monitoring Program

In accordance with the requirements of the basewide General NPDES Stormwater Permit, the storm sewer located halfway between Building 175 in Zone 5 and Building 174 in Zone 6 is monitored annually during a storm event. During a 0.27-inch storm of 45-minute duration on June 19, 1997, this storm sewer, referred to as NOVA, was sampled and analyzed. The analyses indicated that the storm sewer contained 170 mg/L of total suspended solids. Analytical results also indicated concentrations of oil/grease (less than 1.0 mg/L), fecal coliform (100 col/100 ml), copper (0.08 mg/L), lead (0.08 mg/L), and zinc (0.47 mg/L). The pH was measured at 5.41. Toxicity tests run on the same sample indicated a 48-hour mortality for *Daphnia pulex* to be 78.1 percent. This area was used as a "laydown" area for construction equipment. The Navy has eliminated this practice to improve the quality of surface water runoff.

9.2.2 Lower Subase Remedial Investigation

Four test borings (TB2-6RI through TB5-6RI) were installed and converted to monitoring wells (MW2-6RI through MW5-6RI, respectively) in Zone 6 using HAS techniques. One additional test boring (TB1-6RI) was installed and converted to a monitoring well (MW1-6RI) east of Zone 6 as an upgradient monitoring location. Monitoring well screen intervals were installed across the water table. Boring locations are illustrated in Figure 9-1, and boring log sheets and monitoring well construction sheets are provided in Appendix A. Two soil samples were collected from each boring from shallow (0 to 5 feet) and deep (greater than 5 feet) depths. Shallow and deep soil samples from each location were analyzed for TPH, TCL SVOCs, TCL VOCs, and TAL metals. SPLP followed by TAL metals analysis was performed on shallow and deep soil samples collected from TB1-6RI/MW1-6RI, TB3-6RI/MW3-6RI and TB4-6RI/MW4-6RI. Soil sample log sheets are included in Appendix B.1.

Groundwater samples were collected from the five installed monitoring wells. Groundwater samples were collected using low-flow purging and sampling techniques, as described in Section 2.3.2. Samples were analyzed for TPH, TCL SVOCs, TCL VOCs, filtered, and unfiltered TAL metals and natural attenuation parameters. Groundwater sample log sheets and purge data sheets are provided in Appendix B.2.

Two sediment samples (SD1-6RI through SD2-6RI) were collected from locations in the Thames River along Zone 6. Sediment sampling locations are illustrated on Figure 9-1. Surface water quality measurements were taken from each sediment sampling location at the surface and the bottom of the water column. Sediment samples were analyzed for TCL SVOCs, TAL metals, TOC, grain size,

AVS/SEM, pH, and ammonia. Surface water quality parameters included temperature, salinity, turbidity, pH, specific conductance, and dissolved oxygen. Sediment sample log sheets with surface water measurements are provided in Appendix B.3.

9.3 PHYSICAL CHARACTERISTICS

Physical characteristics for the Lower Subase are generally discussed in Sections 1.3 and 1.4. Site-specific physical characteristics for Zone 6 are discussed below.

9.3.1 Topography, Surface Features, and Surface Water Features

Zone 6 is relatively level from Building 174 west to the Thames River, with elevations of approximately 6 to 7 feet msl. Topography increases rapidly east of Building 174 to the 30-foot terrace on which the NSB-NLON golf course is built. The Providence and Worcester Railroad lies between Zone 6 and the golf course. Zone 6 is paved and covered by Building 174.

No unique surface water features exist in Zone 6, and surface water runoff within the zone drains to the river via storm sewers. Catch basins and storm sewers in Zone 6 are shown on Figure 9-1. Two storm sewer outfalls from Zone 6 discharge stormwater to the Thames River.

9.3.2 Soil Characteristics, Geology and Hydrogeology

Soils in Zone 6 are mapped as Udorthents - Urban Land with 0 to 15 percent slope (USDA, 1983), and the surficial geology is mapped as stratified glacial drift deposits of the 30-foot terrace along the Thames River (USGS, 1960). A north-south cross-section of Zone 6 is illustrated in Drawing 7, and a west-east cross-section of Zone 6 is illustrated in Figure 9-2. Sand and gravel fill extends to at least 8 feet bgs in Zone 6 along Amberjack Road adjacent to the river. Natural deposits were not encountered in the three borings along Amberjack Road but were encountered in MW1-6RI at approximately 8 feet bgs to the bottom of the boring at a depth of 36 feet. The natural deposits of interbedded sand and gravel units are interpreted as stratified drift deposits. The bottom of the stratified drift was not encountered; therefore, its depth is unknown. Bedrock was not encountered during boring installation and its depth is also unknown. However, the USGS bedrock map (USGS, 1967) identifies Granite Gneiss underlying Zone 6, and the Phase II RI report (B&R Environmental, 1997b) estimates the bedrock to be greater than 30 feet below msl (approximately 40 feet bgs).

Depth to the unconfined water in Zone 6 is approximately 2 to 4 feet bgs along Amberjack Road and 27 feet on the 30-foot terrace. Groundwater is estimated to flow to the west toward the Thames River.

No aquifer tests have been performed at Zone 6 to date. However, the sand and gravel fill material underlying Zone 6 is similar to the fill material underlying Zone 2 and is, therefore, assumed to have a similar average hydraulic conductivity of 74 feet per day, based on slug tests conducted by Atlantic (1992) in Zone 2. The hydraulic gradient across Zone 6 to the Thames River is 0.0092, based on water-level data from wells MW5-6RI and MW4-6RI during low tide on October 27, 1997.

The volumetric rate of groundwater discharge through the sand and gravel fill material in Zone 6 to the Thames River was estimated to be 2,957 cubic feet per day, using Darcy's Law $Q = -KA(dh/dl)$, where Q = the volumetric discharge, K = the average hydraulic conductivity, A = the cross-sectional area (i.e., the saturated fill thickness by the width of the fill material along the Thames River), and dh/dl = the hydraulic gradient. An average saturated fill thickness of 12 feet and a width of 362 feet of fill along the Thames River in Zone 6 were assumed.

Generic contaminant loading rates for groundwater discharge into the Thames River from Zone 6 were generated using an estimated groundwater discharge rate (Q, discounting tidal effects) of 2,957 cubic feet/day; a 0.75 factor applied to this flux rate to account for the lack of groundwater discharge during periods of high tide (assumed to be about 6 hours/day over two tidal cycles); hypothetical solute concentrations (C) of 10, 100, and 1,000 µg/L; and, the following mass flux equation: Mass flux = Q x 0.75 x C. The corresponding daily discharge rates from Zone 6 into the Thames River are 0.00138, 0.0138, and 0.138 lbs/day for solute concentrations of 10, 100, and 1,000 µg/L, respectively. Actual discharge rates for individual dissolved constituents can be approximated by using these generic discharge rates and the average concentration of the constituent. For example, a compound present at an average concentration of 25 µg/L in groundwater would have a loading rate 2.5 times the generic rate calculated for a solute present at the 10 µg/L concentration. This loading estimate does not factor in retardation and degradation of solutes, which may be substantial in some cases and would reduce the loading rate.

9.4 NATURE AND EXTENT OF CONTAMINATION

This section is a discussion of the nature and extent of contamination of Zone 6 at the Lower Subase. The general site location of Zone 6 is shown on Figure 1-2. A detailed drawing of this zone is shown on Figure 9-1. Soil, groundwater, and storm sewer surface water samples were collected from Zone 6 during the Annual NPDES Stormwater Monitoring Program and the Lower Subase RI. Summaries of the sampling and analytical programs are provided in Tables 9-1 and 9-2. The complete database for Zone 6

is contained in Appendix H of this report, including both chemical and physical parameters for all investigative samples.

9.4.1 Soil

Positive analytical results for all soil samples collected in Zone 6, as well as for the off-site upgradient sample discussed in Section 9.2.2, are presented in Table 9-3. Positive SPLP results for all soil samples are presented in Table 9-4. Table 9-5 provides a summary of analytical results for all on-site soil samples collected from Zone 6. Background concentrations of inorganics in soil, as presented in Table 1-4 and used for comparison with on-site soil concentrations, were taken from the Background Concentrations of Inorganics in Soil Report (Atlantic, 1995b).

Figures 9-3 and 9-4 show, for Zone 6 shallow and deep soil samples, respectively, the locations and concentrations of parameters that were detected in excess of COC selection criteria used in the risk assessment. Drawings 8 through 11 (Volume III) show the distribution of TPH and lead contamination in soil in all zones, including Zone 6, being investigated as part of the Lower Subase RI. Drawings 8 and 10 show TPH and lead isoconcentration contours, respectively, for shallow soils, and Drawings 9 and 11 show the same respective contours for deep soils.

9.4.1.1 Shallow Soil

The four on-site shallow soil samples (0 to 4 feet bgs) collected from Zone 6 were analyzed for VOCs, SVOCs, TAL metals, and TPH. TAL metals analysis following SPLP extraction was also performed for two of the shallow soil samples.

Magnesium and zinc were each detected in one sample (MW3-6RI) at a concentration exceeding NSB-NLON background levels. Reported concentrations of calcium, nickel, and sodium exceeded background levels for all Zone 6 shallow soil samples. However, calcium, magnesium, and sodium are all naturally occurring, abundant constituents of soil. Lead was detected in all four on-site shallow soil samples at concentrations ranging from 3.1 mg/kg to 12.4 mg/kg (all less than the background level for lead and the concentration of lead detected in the off-site, upgradient shallow soil sample). Maximum concentrations of 16 of 18 detected metals were reported for the shallow soil sample collected from well MW3-6RI, located west and toward the southern end of Building 174 along the sanitary sewer line. Concentrations of metals in on-site shallow soil samples were generally similar to concentrations of metals in the off-site upgradient shallow soil sample from well MW1-6RI.

SPLP extraction followed by TAL metals analysis was performed for two on-site shallow soil samples. Eleven metals were detected in the SPLP leachates of these samples. However, none of the detected concentrations exceeded Federal toxicity characteristic regulatory levels or Connecticut remediation standard pollutant mobility criteria for a GB classified area.

No VOCs were detected in Zone 6 shallow soil samples. Several SVOCs, primarily PAHs, were detected. With the exception of pyrene in the shallow soil sample from well MW4-6RI (1,000 µg/kg), all SVOCs were reported at concentrations ranging from 19 µg/kg to 500 µg/kg. Two-thirds of the maximum SVOC concentrations were detected in the shallow soil sample collected from well MW4-6RI, located west and slightly north of the central portion of Building 174 along the sanitary sewer line. No SVOCs were detected in the shallow soil sample collected from the off-site and upgradient location, MW1-6RI, located just outside the eastern border of Site 7.

TPH was detected in all four shallow soil samples at concentrations ranging from 120 mg/kg to 4,000 mg/kg. As shown on Drawing 8, the maximum TPH concentration was detected in the sample from well MW5-6RI, located northwest of Building 174. TPH was not detected in the off-site, upgradient sample.

9.4.1.2 Deep Soil

The four deep soil samples (greater than 4 feet bgs) collected from Zone 6 were analyzed for VOCs, SVOCs, TAL metals, and TPH. TAL metals analysis following SPLP extraction was also performed for two of the deep soil samples.

Three of four reported concentrations of nickel and all reported calcium and sodium concentrations exceeded NSB-NLON background levels. As previously noted, calcium and sodium are naturally occurring, abundant constituents of soil (presented in Table 1-4). Lead was detected in three of the four on-site deep soil samples at concentrations ranging from 2 mg/kg to 7.1 mg/kg. Concentrations of metals in deep soil samples were generally less than concentrations of metals in the associated shallow soil samples. With the exceptions of arsenic, calcium, manganese, and sodium, concentrations of metals in all on-site deep soil samples were also less than the respective concentrations in the deep soil sample from the off-site, upgradient location.

SPLP extraction followed by TAL metals analysis was performed for two on-site deep soil samples. Only calcium, manganese, potassium, and sodium were detected in the SPLP leachates of these samples.

Neither Federal toxicity characteristic regulatory levels nor Connecticut remediation standard pollutant mobility criteria for GB classified areas exist for these four metals.

No VOCs were detected in any of the on-site Zone 6 deep soil samples. Several SVOCs, primarily PAHs, were detected in the Zone 6 deep soil samples, although the total number of SVOCs detected, the frequencies of detection, and the detected concentrations were less than those associated with Zone 6 shallow soil samples. All reported SVOC concentrations in deep soil samples ranged from 19 µg/kg to 290 µg/kg. All but three of the maximum detected concentrations were reported for the deep soil sample from well MW2-6RI, located south of Building 174. The total concentration of SVOCs detected in the deep soil from this location (1,509 µg/kg) was only slightly less than the total SVOC concentration detected in the shallow soil from this location (1,733 µg/kg). Total SVOC concentrations detected in deep soil samples from the other Zone 6 locations were less than half the total SVOC concentrations detected in respective shallow soil samples. No SVOCs were detected in the deep soil sample collected from the off-site and upgradient location, MW1-6RI, located just outside the eastern border of Zone 6.

TPH was detected in three of the four on-site deep soil samples at concentrations ranging from 140 mg/kg to 1,200 mg/kg. The maximum concentration was detected in the sample from well MW2-6RI, located south of Building 174. As shown on Drawings 8 and 9, TPH concentrations in deep soil samples from wells MW5-6RI and MW4-6RI (located west of the northern half of Building 174) were more than five times less than concentrations detected in the respective shallow soil samples, and TPH concentrations in deep soil samples collected from wells MW3-6RI and MW2-6RI (located west and south of the southern half of Building 174) were more than three times greater than concentrations detected in respective shallow soil samples. TPH was detected in the off-site, upgradient deep soil sample at a concentration of 78 mg/kg.

9.4.2 Groundwater

Positive analytical results for all groundwater samples collected from Zone 6, as well as for the off-site upgradient samples collected from well MW1-6RI, are presented in Table 9-6. Table 9-7 provides a summary of analytical results for all Zone 6 on-site groundwater samples. Table 9-8 summarizes natural attenuation and water quality parameters associated with on-site groundwater samples; these parameters are discussed in Section 9.5.3.

Figure 9-5 depicts, for data collected during the Lower Subase RI only, the locations and concentrations of parameters that were detected in excess of COC selection criteria. Drawings 12 through 14 (Volume III) show the distribution of TPH and lead contamination in groundwater for all zones, including Zone 6, of the Lower Subase. Drawing 12 shows isoconcentration contours of TPH concentrations measured in

groundwater. Isoconcentration contours of unfiltered (total) and filtered (dissolved) lead concentrations in groundwater are presented on Drawings 13 and 14, respectively.

Fourteen metals were detected in the groundwater samples collected from the five on-site wells. The maximum concentrations of all total and dissolved metals except dissolved barium and dissolved zinc were detected in the groundwater samples collected from well MW2-6RI, located south of Building 174. Barium, calcium, magnesium, manganese, potassium, and sodium were detected in all the filtered and unfiltered samples. Antimony, chromium, cobalt, iron, lead, thallium, and vanadium were detected in on-site samples collected from well MW2-6RI only. Concentrations of metals detected in filtered and unfiltered groundwater samples were generally similar in magnitude. Concentrations of most metals detected in on-site groundwater samples were similar to those detected in the off-site upgradient sample, although maximum concentrations of total and dissolved calcium, iron, magnesium, potassium, and sodium exceeded off-site concentrations by more than five times.

VOCs were not detected in any of the on-site groundwater samples. Acenaphthene, acenaphthylene, fluoranthene, and fluorene were detected at low concentrations (from 0.6 µg/L to 3 µg/L) in the groundwater sample and/or the field duplicate sample collected from well MW2-6RI only.

TPH was not detected in any of the Zone 6 groundwater samples. Based on the sensitivity of the method used for analysis, the reporting limits for TPH were greater than the Connecticut remediation criterion of 500 µg/L. The presence of TPH below the reporting limits could not be confirmed since TPH concentrations less than the reporting limits would not have been reported. Based on convention, one-half the reporting limit is shown on Drawing 12 for each well. The values provided on Drawing 12 (from 550 µg/L to 600 µg/L) for Zone 3 samples are slightly greater than the Connecticut remediation criteria of 500 µg/L.

9.4.3 Surface Water/Sediment

Surface water and sediment samples were collected from the Thames River adjacent to Zone 6. The nature and extent of contamination in Thames River surface water and sediment samples, as well as the impact of the activities and contamination at the Lower Subase (including Zone 6) on Thames River surface water and sediments, are discussed in Section 11.4.

As part of the basewide General NPDES Stormwater Monitoring Program, four annual storm sewer surface water samples have been collected from the storm sewer, referred to as NOVA, located halfway between Building 175 in Zone 5 and Building 174 in Zone 6. The storm sewer surface water sampling

location is shown on Figure 9-1. Positive analytical results for these storm sewer surface water samples are presented in Table 9-9.

Copper was detected at a maximum concentration of 80 µg/L in three of the four storm water samples, including the most recent sample (collected in June 1997). The maximum detected concentrations of lead (80 µg/L) and zinc (470 µg/L) were also reported for the June 1997 sample. Iron and sodium, for which analysis had not been performed during the first three sampling events, were detected at concentrations of 540 µg/L and 4,150 µg/L in the surface water sample from the June 1997 sampling event. Concentrations of oil and grease ranged from 2,300 µg/L to 3,810 µg/L during the first three sampling rounds; however, this parameter was not detected in the June 1997 storm sewer surface water sample. Several miscellaneous parameters, as further discussed in Section 11.7, were also detected.

9.5 CONTAMINANT FATE AND TRANSPORT

9.5.1 General Contaminant Fate and Transport Processes

The major area of concern for Zone 6 is impacted soil, as evidenced by detection of PAHs in both shallow and deep soil samples. The source of the PAHs in soil at Zone 6 is unknown since the Zone contains only Building 174, which was used for sandblasting and paint activities, and the fuel oil distribution lines do not extend into Zone 6. Zone 6 soil also contains several metals (nickel and zinc) at elevated concentrations relative to background concentrations.

As noted in Section 3.3.2.4, PAHs are generally considered to be fairly immobile in the environment. These compounds, when found in the soil, generally do not migrate to a great extent. Instead, they are more likely to adhere to soil particles and be transported from the site via surface runoff and erosional processes. However, several low-molecular-weight PAHs (acenaphthene, acenaphthylene, fluoranthene, and fluorene) were also detected at low concentrations in the groundwater samples, indicating that some form of PAH migration has occurred.

As noted in Section 3.3.2.9, metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

In addition, under normal conditions, metals are not very mobile in the environment. Because metals frequently remain bound to particulate matter, the major transport mechanism for metals is bulk movement processes (erosion). However, metals can become mobile in the environment under certain conditions (acidic soil conditions). The concentrations of the metals detected in the soils samples from Zone 6 are

generally similar to the concentrations detected in the off-site upgradient soil samples, indicating that the soils have not been impacted by site activities.

In addition, the concentrations of metals detected in the groundwater samples at Zone 6 are generally similar to the concentrations detected in the off-site upgradient sample, indicating that the groundwater does not appear to have been impacted by site activities. It should be noted, however, that the concentrations of calcium, iron, magnesium, potassium and sodium in the groundwater samples from Zone 6 are significantly higher than the concentrations detected in the off-site upgradient well. The concentrations of these compounds in the groundwater at Zone 6 are comparable to the concentrations detected in the other zones, indicating that the groundwater at Zone 6 is being impacted to some degree by the tidal fluctuations of the Thames River.

9.5.2 Effects of Cross Contamination on Other Zones and the Thames River

As shown in Drawings 8 and 9 (Volume III), concentrations of TPH (mainly PAHs) in shallow and deep soil, respectively, are elevated in Zone 6. The area of elevated TPH concentrations in shallow and deep soil extends beyond the boundary of Zone 6 on the north and south, indicating that cross contamination to areas outside of Zone 6 has occurred.

TPH was not detected in groundwater at Zone 6 during the latest sampling round. VOCs (2-butanone and acetone) and SVOCs (mainly PAHs) were detected in Zone 6 sediment samples. Both low and high molecular weight PAHs were detected in the shallow soil, deep soil, and sediment samples, whereas only the low molecular weight PAHs were detected in groundwater. Concentrations of SVOCs in sediments were generally higher than those in soil. Also, concentrations of VOCS and SVOCs in Zone 6 sediment samples are on the same order of magnitude as those concentrations detected in sediment samples collected upstream and downstream of the Lower Subase. It is not clear if zone-specific soils and groundwater or other areas are the source for contaminated sediments at Zone 6.

Several inorganics (i.e., calcium, magnesium, nickel, sodium, and zinc) have been detected in shallow and subsurface soil samples at concentrations exceeding background levels. These inorganics were not detected in the groundwater samples at significant concentrations (i.e., in excess of risk-based concentrations). These inorganics were however detected in Thames River sediment samples at concentrations exceeding background, indicating that migration of some inorganics to the Thames River may have occurred. However, it is not clear if zone-specific soils and groundwater or other areas are the sources for contaminated sediments at Zone 6.

As shown in Drawings 10 and 11, lead has been detected at concentrations that are within background levels in shallow and deep soils. Concentrations of total and dissolved lead in groundwater are shown on Drawings 13 and 14, respectively. Total lead was detected in only one groundwater sample. Dissolved lead was not detected in any groundwater sample during the latest round of sampling. It does not appear that soil or groundwater has been impacted by lead at Zone 6. Concentrations of lead in sediment samples collected adjacent to Zone 6 are higher than background lead sediment concentrations (Table 1-3) and site lead soil concentrations. Concentrations of lead in sediment samples collected adjacent to Zone 6 are lower than lead concentrations in sediment samples collected upstream and downstream of the site. Although it appears the sediments adjacent to the site are contaminated with lead, the data indicate that soil and groundwater at Zone 6 are not the source of the contamination.

A storm sewer that discharges to the Thames River is located in Zone 6. Oil and grease, copper, lead, and zinc, sampled as part of the NPDES permit, were detected at elevated levels in storm sewer surface water samples. This indicates that the storm sewer may be a source of contamination to the Thames River.

There may be other off-property sources contributing to the contamination detected in Thames River sediments. The Thames River is tidally influenced and contaminants may be migrating in the river from upstream and downstream sources. Also, the contamination may be a result of spillage that may have occurred during historical refueling of submarines and tugboats at the Lower Subase.

9.5.3 Evaluation of Natural Attenuation Data

Soil and groundwater samples were collected in Zone 6 and analyzed in the field or by a fixed-base laboratory. The resulting data provide the information necessary to answer the three following questions:

- Are contaminants present in either medium that could be remediated via natural attenuation or bioremediation?
- Is natural attenuation currently in progress in the groundwater?
- Are the conditions in the groundwater favorable for natural attenuation or bioremediation?

For Zone 6, TPH concentrations in soil and groundwater were contoured and the results are presented on Drawings 8, 9, and 12. Drawings 8 (shallow soil) and 9 (deep soil) show that high levels of TPH (i.e., indicative of petroleum hydrocarbons) are present in soil of Zone 6. The maximum TPH concentrations were detected in MW5-6RI (4,000 mg/kg, shallow soil) and MW2-6RI (1,200 mg/kg, deep soil). As discussed in Section 9.4, PAHs were also frequently detected in the shallow and deep soil of Zone 6,

which confirms the TPH concentrations. Neither TPH or VOCs were detected in the groundwater of Zone 6 above the detection limit. Low concentrations of four SVOCs were detected in the groundwater at MW2-6RI. SVOCs were not detected in any other Zone 6 monitoring well, with the exception of MW1-6RI in which butylbenzyl phthalate was detected. These results indicate that petroleum hydrocarbons are present mainly in the soil and are migrating to a limited extent into the groundwater near MW2-6RI. As discussed previously, petroleum hydrocarbons in either media can be treated successfully via natural attenuation or bioremediation.

The procedure for evaluating natural attenuation data for groundwater was previously outlined in Section 3.3.4 and is followed in this section. Table 9-8 summarizes the parameters that were measured to determine if natural attenuation is occurring in the groundwater of Zone 6. Other information in the table includes parameter-specific concentration ranges and frequency of detections. Drawings showing the distribution of key parameters were also prepared to aid in the interpretation of the data. The drawings that were prepared include the following:

- Drawing 2 - High Tide Potentiometric Surface Map
- Drawing 4 - Low Tide Potentiometric Surface Map
- Drawing 15 - Dissolved Oxygen
- Drawing 16 - REDOX potential
- Drawing 17 - Divalent Iron
- Drawing 18 - Specific Conductivity

The following conclusions were reached after review and evaluation of the data presented in Table 9-8 and Drawings 2, 4, and 15 through 18.

- The dissolved oxygen data suggest that Zone 6 groundwater is aerobic with all concentrations greater than 1 mg/L. These data do not correspond well with the REDOX potential measurements; therefore, the measurements are suspect. As discussed previously, the dissolved oxygen probe may be the cause of the suspect measurements.

- The REDOX potential measurements indicate that the groundwater upgradient of Zone 6 is aerobic and the groundwater beneath Zone 6 is anaerobic. As discussed in Section 4, REDOX potential is easier to measure in the field and it is likely that the REDOX potential measurements are more representative of the actual Zone 6 groundwater conditions than are the dissolved oxygen concentrations.

- Nitrate concentrations in MW2-6RI, MW4-6RI, and MW5-6RI were either below detection limit or the criterion of 1 mg/L. The nitrate concentration detected in MW3-6RI was similar to the concentration detected in MW1-6RI. This information suggests that denitrification is occurring in certain regions of the groundwater of Zone 6.

- Divalent iron was only detected in monitoring well MW2-6RI. This was the only well that had any detectable concentrations of SVOCs. The detection of divalent iron indicates that iron reduction is occurring in this area.

- Sulfate concentrations detected in Zone 6 groundwater were all above the 20 mg/L criterion, indicating that sulfate reduction is not occurring.

- Methane was detected in monitoring well MW2-6RI indicating that methanogenesis is occurring in the vicinity of this well. The groundwater samples from MW3-6RI, MW4-6RI, and MW5-6RI were not analyzed for methane because of a laboratory error. Therefore, no conclusions can be drawn regarding methanogenesis for these wells. The presence of methane at MW2-6RI confirms that a portion of the groundwater of Zone 6 is anaerobic.

- Concentrations of alkalinity and hardness in the groundwater were normal compared to other zones; however, the alkalinity concentrations in MW2-6RI and MW3-6RI and the hardness concentration in MW2-6RI were significantly higher than the concentrations detected in MW1-6RI.

- Groundwater temperature and pH were normal for Zone 6.

- Ammonia was not detected in the groundwater and this information does not correlate with the nitrate concentrations detected in Zone 6. Therefore, because ammonia is an intermediate product of denitrification, these results may indicate that the ammonia that may have been generated has been subsequently used as a nutrient.

- Phosphorous was detected in the groundwater and is available as a nutrient.

- Salinity and chloride concentrations were generally low when compared to the levels in the Thames River. The highest salinity and chloride levels were detected in MW2-6RI (0.95 ppt and 520 mg/L, respectively). Concentrations in MW2-6RI, MW3-6RI, and MW4-6RI exceeded the concentrations detected in MW1-6RI (0.08 ppt and 29 mg/L). Drawings 2 and 4 indicate that the western portion of Zone 6 is tidally influenced during high tide.

The information provided above indicates that natural attenuation is occurring only in the southern portion of Zone 6 (i.e., near MW2-6RI). The fact that four SVOCs were the only organic contaminants detected in the groundwater is most likely the result of a variety of factors (i.e., condition, type, and age of source, natural attenuation, mobility of contaminants, unique hydrogeologic conditions, and tidal flushing). Due to the variety of factors influencing Zone 6 and the limited contaminant plume, it is unlikely that bioremediation or other more active remedial technologies are practical or necessary for the groundwater of this zone. It is likely that a combination of monitored natural attenuation or a tiered groundwater monitoring program and source control would be a viable remedial strategy for this zone. If monitored natural attenuation is selected as part of the remedial strategy for Zone 6, additional investigations would need to be completed to provide the preliminary data required for the remedial alternative and to monitor the progress of the alternative. Monitoring of the non-tidally influenced areas of Zone 6 would provide the best indication that natural attenuation processes are working in the groundwater.

9.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the baseline risk assessment performed for soil and groundwater exposures at Zone 6 of the Lower Subase. Section 9.6.1 contains a discussion on the selection of COCs, Section 9.6.2 contains information on the potential receptors considered and the routes by which they might be exposed, Section 9.6.3 contains the numerical results of the risk assessment, and Section 9.6.4 presents site-specific uncertainties associated with the risk assessment.

9.6.1 Data Evaluation

COCs were identified for Zone 6 of the Lower Subase using risk-based COC screening levels, as described in Section 3.4.3. All validated data collected during the Lower Subase RI and the additional investigations, except soil data collected from depths greater than 10 feet, were used to identify COCs. Table 9-10 presents a summary of the COCs for Zone 6. Appendix I.10 contains the COC summary screening tables for the site.

A medium-specific discussion of COCs is presented in the following subsections. Within a given medium, discussions of direct exposure COCs (i.e., those chemicals detected at concentrations in excess of Federal and state direct exposure criteria) and additional COCs are provided. Additional COCs are identified based on contaminant migration tendencies; migration from soil to groundwater and from groundwater to the Thames River. These additional COCs are not quantitatively addressed in the human health risk assessment (i.e., numerical risk estimates are not developed) because they are not considered to be significant contributors to the direct exposure pathways identified for potential human receptors.

9.6.1.1 Soil Chemicals of Concern

The following compounds were identified as direct exposure COCs for soil based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for residential land use and Connecticut RSRs for direct exposure (residential and industrial land use):

- PAHs [benzo(a)pyrene]
- Inorganics (aluminum, arsenic, beryllium, iron, and manganese)
- TPH

Aluminum was selected as a COC for the "all soils" (soil from depths of 0 to 10 feet) category only. TPH was qualitatively identified as a COC for shallow soil and "all soils" because the maximum detected concentrations exceeded the Connecticut RSRs for residential and industrial direct exposure.

Maximum detections in soil were also compared to generic USEPA SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area. Maximum concentrations of the following chemicals exceeded the generic soil pollutant mobility criteria, indicating a potential for these chemicals to migrate to groundwater and potentially impact the quality of groundwater:

- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene].
- Inorganics (arsenic, chromium, and nickel).
- TPH.

Under the Connecticut RSR (CTDEP, 1996), concerns regarding the mobility of inorganics in soil are addressed using SPLP data. A comparison of site-specific SPLP data and state RSRs for pollutant mobility is provided in Table 9-4. None of the inorganic concentrations reported in the SPLP extracts for the site soil samples exceeded the available state RSRs.

The use of generic mobility criteria (rather than site-specific criteria) results in a conservative identification of additional COCs in soil. However, the mobility of only chromium is supported by the groundwater data available for the site. A discussion of the COCs for groundwater is provided in the following subsection.

9.6.1.2 Groundwater Chemicals of Concern

COCs for groundwater were selected using unfiltered and filtered data. Although groundwater at the site is not currently used or expected to be used in the future as a drinking water supply because of saline conditions, a conservative list of direct exposure COCs was developed for this medium based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for tap water, Federal and state MCLs, and Connecticut RSRs for the protection of groundwater. The following inorganics chemicals were retained as direct exposure COCs: antimony, barium, iron, manganese, sodium, and thallium.

Maximum concentrations of antimony, barium, and thallium exceeded the risk-based COC screening levels in filtered groundwater samples only. Antimony and thallium were not detected in unfiltered groundwater samples. The maximum concentration of barium in unfiltered groundwater samples was less than the risk-based COC screening level. Thallium was the only metal detected at a maximum concentration exceeding a health-based Federal MCL. Sodium was retained as a COC because the maximum detections for this chemical in unfiltered and filtered groundwater samples were in excess of the State Notification Level. However, elevated levels of sodium in groundwater are anticipated because of nearby saltwater intrusion from the Thames River.

Since Zone 6 borders the Thames River, maximum concentrations in groundwater were also compared to the Connecticut WQSs for aquatic life (chronic saltwater criteria) and for the protection of human health (water and organisms). These criteria were used to qualitatively evaluate the potential for adverse affects should groundwater contaminants migrate to the Thames River. The following chemicals were detected at maximum concentrations in excess of the state WQSs:

- Acenaphthylene
- Inorganics (thallium and zinc)

Maximum concentrations of thallium and zinc exceeded state WQSs in filtered groundwater samples only. These metals were not detected in unfiltered groundwater samples. Detected concentrations of acenaphthylene were low (i.e., less than 1 µg/L).

The actual impact on the water quality in the Thames River is not expected to be as significant as the qualitative comparison implies since significant dilution and tidal mixing are anticipated, thereby reducing contaminant concentrations. For example the maximum detected concentrations of some of the chemicals previously identified as migration COCs (thallium and zinc) are within one order of magnitude of

the Connecticut WQSs. Appropriate alternative surface water protection criteria can be calculated by multiplying the lower of the human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. Consequently, these chemicals are not considered to be problematic since the maximum concentration of these chemicals would be less than the alternative SWPC. In addition migration COCs were detected infrequently in groundwater samples (i.e., one or two samples). A separate evaluation of the water and sediment quality of the Thames River is provided in Section 11.0.

9.6.1.3 Exposure Point Concentrations

Exposure point concentrations were developed for direct exposure COCs only using the methodologies presented in Section 3.4.1. The average and maximum detected concentrations for soil and groundwater were typically used for the RME and CTE, respectively. The 95 percent UCL was not used for soil because of the limited amount of validated data available for a given data set. Groundwater exposure concentrations were developed using USEPA Region I guidance (USEPA, 1994f). A summary of the exposure point concentrations used to estimate potential risks associated with direct exposure COCs for Zone 6 is provided in Table 9-11.

Because of the lack of published dose-response parameters, some essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs or quantitatively evaluated in the baseline human health risk assessment. TPH was identified as a direct exposure COC based on a qualitative analysis. However, exposure to this chemical could not be quantitatively evaluated because of the lack of dose-response parameters. In addition, although aluminum and iron may be identified as COCs, USEPA Region I does not advocate a quantitative evaluation of exposure to them because the only available toxicity criteria for these chemicals are provisional reference doses based on daily allowable intakes rather than adverse effect levels. Exposure to these chemicals is addressed in the general uncertainty section of the baseline human health risk assessment, Section 3.4.5.

9.6.2 Exposure Assessment

This section presents a summary of the persons potentially exposed to soil and groundwater at Zone 6 of the Lower Subase and describes the routes by which they might be exposed. Details on the exposure parameters used in the quantitative risk assessment were provided in Section 3.4.3.

The most likely receptors at this site include any full-time adult employees or military personnel assigned to the various buildings. These persons could be exposed to shallow soil via direct contact (incidental ingestion or dermal contact). They are assumed to be exposed 150 days/year for 6 years for the CTE and for 25 years for the RME.

A construction worker scenario was also evaluated for Zone 6. A construction project is assumed to take between 80 (CTE) and 120 (RME) days in a 1-year period. This receptor could contact "all soil" (soil from depths of 0 to 10 feet) via dermal contact and incidental ingestion. The construction worker may also be dermally exposed to groundwater during ground-intrusive activities.

Since the site is located along the Thames River and waterfront property is typically regarded as an attractive location for residential development, future residents were evaluated as potential receptors. This exposure scenario is dependent upon base closure, which is considered to be highly unlikely because of the critical nature of the facility with respect to support of the submarine fleet and national defense. Therefore, this scenario is primarily evaluated for informational purposes only (i.e., to aid in decision making and risk management decisions). Future potential residents are not expected to come in contact with groundwater at the site because saline conditions that exist near the river would preclude domestic use of groundwater. Receptors are assumed to be exposed to "all soil" (soil from depths of 0 to 10 feet) via incidental ingestion and dermal contact. Soil exposures were assumed to occur 150 days/year for a total of 7 years under the CTE and 30 years for the RME.

There are no dermal absorption factors available for beryllium and manganese. As requested by EPA Region I, dermal exposures to these COCs will be evaluated using a generic absorption factor of 0.01 and the results will be discussed in the uncertainty analysis presented in Section 9.6.4

The identified potential receptors could also be exposed to chemicals in soil via inhalation of fugitive dust and volatile emissions. This exposure pathway is evaluated in a qualitative fashion by a comparison of maximum soil concentrations to generic USEPA SSLs for the inhalation pathway, as summarized in the site-specific COC summary screening tables in Appendix I.10. Maximum detections for all soil chemicals were less than the inhalation SSLs, indicating that the inhalation pathway is not expected to be a significant exposure route. Consequently, this exposure route was eliminated from further quantitative risk evaluation.

9.6.3 Risk Characterization

A summary of the quantitative risk assessment for Zone 6 is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for the RME and CTE scenarios, are outlined in Table 9-12 for the construction worker, full-time employee, and future resident. Sample calculations are provided in Appendix I.3. Appendix I.10 contains the chemical-specific risks for Zone 6.

9.6.3.1 Noncarcinogenic Risks

Cumulative Hazard Indices (HIs), for all receptors (the construction worker, full-time employee, and future residents) are less than unity, indicating that no averse effects are anticipated under both the RME and CTE scenarios.

9.6.3.2 Carcinogenic Risks

Cumulative incremental cancer risks for Zone 6 ranged from 5.2E-8 for the construction worker (CTE) to 1.2E-5 for the future resident (RME). All incremental cancer risks were within or less than the USEPA target risk range of 1E-4 to 1E-6 and below the CTDEP cumulative target cancer risk level of 1E-5 with the exception of the cancer risk estimate for the hypothetical future resident (1.2E-5) under the RME scenario.

The exposure routes of concern for the future resident under the RME is incidental ingestion and dermal contact with soil. As summarized in Table 9-13, the chemical specific cancer risks for benzo(a)pyrene and arsenic exceeded 1E-6 but were less than 1E-5.

9.6.3.3 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.4.5. Site-specific uncertainties for Zone 6 risk evaluation are presented below.

Dermal exposure to beryllium and manganese in soil could not be quantitatively evaluated in the risk assessment since there are no dermal absorption factors available for these compounds. Therefore, as requested by EPA Region I, a screening analysis was performed for dermal exposures to beryllium and manganese in soil using a generic absorption factor for inorganics of 0.01. Cancer risks could not be calculated for beryllium and manganese since no oral cancer slope factors are available for these compounds. Hazard indices are as follows:

	Scenario	
Receptor	**RME**	**CTE**
Construction Worker	0.08	0.0008
Full-time Employee	0.01	0.001
Future Resident	0.02	0.002

All cumulative hazard indices for the RME and CTE scenarios are more than an order of magnitude less the acceptable level of 1.0. Consequently, no adverse health effects are anticipated as a result of dermal exposure to beryllium and manganese in soil under the conditions evaluated in the risk assessment.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring background levels. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services were presented in Table 1-4. All reported concentrations of aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, manganese, mercury, potassium, and vanadium in the site soils were less than the established background levels.

The calculated risks for exposure to soil under current site conditions are to some degree overestimated. Most of the soil samples collected at the site were obtained from locations beneath pavement. All soil samples (currently exposed and beneath pavement) were used to conservatively evaluate potential risks for the site. Therefore, actual exposure under current site conditions is less than exposure that is assumed for this risk assessment.

9.7 SUMMARY AND CONCLUSIONS

This section presents a summary of major findings for Zone 6 of the Lower Subase. A summary of the nature and extent of contamination is provided in Section 9.7.1. Section 9.7.2 includes a summary of contaminant fate and transport information and Section 9.7.3 provides a synopsis of the baseline human health risk assessment for Zone 6. Section 9.7.4 provides recommendations regarding additional action and investigatory efforts for the soil and groundwater of Zone 6. A summary of the ecological risks for the Thames River adjacent to Zone 6 and the corresponding recommendations for the river are provided in Section 11.0.

9.7.1 Nature and Extent of Contamination

Low levels of contamination are evident in Zone 6. TPH and SVOCs, primarily PAHs, were the primary contaminants detected in this area. The locations where the greatest concentrations of metals, SVOCs,

and TPH were detected varied per analytical fraction among shallow soil samples. However, the greatest concentrations of SVOCs and TPH in deep soil samples and of SVOCs and metals in groundwater samples were reported for samples collected from well MW2-6RI, located south of Building 174.

9.7.2 Contaminant Fate and Transport

Petroleum hydrocarbons and SVOCs, as well as a few inorganic concentrations in excess of background, have been detected in the soil of Zone 6. Analytical results from the groundwater sampling activities indicate that the petroleum hydrocarbons in the soil are generally not migrating to the groundwater but that inorganic contamination may be migrating to the groundwater and to downgradient locations. The Thames River, which is downgradient of Zone 6, showed some potential evidence of cross-contamination from inorganics. An evaluation of natural attenuation indicated that this process is viable for the soil because of the presence of biodegradable contaminants (i.e., petroleum hydrocarbons and SVOCs). Key parameters indicate that natural attenuation is occurring in a limited portion of the groundwater of Zone 6; however, petroleum-related compounds were detected infrequently and at low concentrations in the groundwater. Therefore, a tiered groundwater monitoring program versus monitored natural attenuation may be an option that could be evaluated further as part of the remedial strategy for Zone 6.

9.7.3 Baseline Human Health Risk Assessment

The baseline human health risk assessment for Zone 6 focused on three potential receptor groups: construction workers, full-time employees, and future residents. Noncarcinogenic risks for all receptor groups were less than the USEPA and CTDEP acceptable limit. Carcinogenic risks for all receptors were either less than or within USEPA's acceptable target risk range of 1E-4 to 1E-6. With the exception of the future resident under the RME scenario all cancer risks were less than CTDEP acceptable risk level of 1E-5. Benzo(a)pyrene and arsenic were the main contributors to the cancer risk for the future resident.

Maximum detected concentrations of PAHs, metals, and TPH in soil exceeded their respective generic mobility criteria which indicates the potential exists for these chemicals to migrate from soil to groundwater. Although the maximum detected concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, and nickel exceeded the generic mobility criteria, these chemicals were not detected in groundwater samples collected at Zone 6. The mobility of chromium may be supported by the groundwater data. The maximum detected concentration of arsenic and chromium exceeded the generic mobility criteria but were within background levels.

Maximum concentrations in groundwater were compared to Connecticut salt water WQSs since Zone 6 borders the Thames River. Several migration COCs in groundwater were identified as exceeding the Connecticut salt water WQSs. Use of the Connecticut salt water WQSs to determine groundwater impacts on the Thames River is very conservative since the WQSs do not account for the dilutional effects of the groundwater mixing with the river. Appropriate alternative surface water protection criteria can be calculated by multiplying the lower of the human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. The maximum detected concentrations of some migration COCs (thallium and zinc) are within one order of magnitude of the Connecticut WQSs. Therefore, the actual impact on water quality in the Thames River is expected to be minimal because significant dilution is anticipated, thereby reducing chemical concentrations in the Thames River. In addition most migration COCs were detected infrequently in groundwater samples (i.e., one or two samples).

9.7.4 Recommendations

It is recommended that this zone, which includes Site 24 - Central Paint Accumulation Area, proceed to a feasibility study to evaluate appropriate remedial alternatives. Because of the extensive amount of underground utilities in Zone 6 and the nature of the activities conducted at this location (i.e., national security), the feasibility study for this zone should evaluate to the extent possible alternatives that include institutional controls to limit exposure to contaminated soil and passive and/or in-situ remedial alternatives. It is also recommended that the feasibility study evaluate limited action scenarios for the groundwater and storm sewer system of Zone 6 in conjunction with the soil remedial alternatives. A tiered groundwater monitoring program and cleaning and repair of the Zone 6 storm sewer system should be evaluated during the feasibility study. These recommendations are based on the following information:

- The nature and extent of organic and inorganic contamination in the soil are well defined to the extent practical considering infrastructure limitations. Organic and inorganic contamination was infrequently detected at low concentrations in the groundwater.

- The contaminants generally detected at Zone 6 are related to petroleum hydrocarbons and not to the historic operations at Site 24 - Central Paint Accumulation Area.

- The baseline human health risk assessment indicates that there are minimal risks to human receptors and they are not in excess of the USEPA acceptable risk range and only the hypothetical future

resident under the RME scenario slightly exceeds the CTDEP risk level. In addition, lead was not a COC for this zone; therefore, modeling was not necessary to evaluate exposure to lead.

- Although reported concentrations of TPH in site soil samples exceeded the state RSRs for direct exposure and pollutant mobility, the chemical-specific risk assessment for those compounds assumed to be the major constituents of the observed TPH contamination (PAHs) indicated minimal risks to potential human receptors.

- Evidence suggests that organic contamination is generally not migrating from the site but that limited inorganic contamination may be migrating from the site. Natural attenuation processes seem to be at work in the groundwater. These processes can reduce concentrations of petroleum contamination that reaches the aquifer and convert the petroleum contamination to a less toxic form. Groundwater monitoring will confirm natural attenuation and the limited migration of inorganics.

- A tiered groundwater monitoring program will allow for further actions to be completed if the results show significant impacts.

- The ecological risk assessment for the Thames River adjacent to Zone 6 (see Section 11.0) shows that the risks to ecological receptors in this area are relatively low.

- The Thames River provides significant dilution and mixing which minimizes the impact of any contaminant migration from Zone 6.

- The zone is generally covered with pavement and a building, which minimizes direct exposure to the contaminated soil by human receptors.

- The groundwater at Zone 6 is not currently or anticipated to be used in the future as a potable water source because it is brackish; therefore, there is no imminent threat to human health.

- Elevated levels of inorganics, particularly lead, were detected in the sediment collected from a catch basin between Zones 5 and 6. Both zones contribute surface water to this catch basin. Slightly elevated levels of inorganics were also detected in the surface water samples collected from the storm sewer system for the NPDES permit. Therefore, the storm sewer system in Zone 6 may be acting as a migration pathway for inorganic contaminants. The lead contamination is believed to be the result of storage of lead ballast in this area and surface water runoff. The Navy has eliminated the storage of ballast in this area.

- A limited evaluation of the invert elevations of the storm sewer system indicate that portions of the system are submerged by varying amounts during a given day or time of year. Because of the age of parts of the system (i.e., greater than 40 years) and the material that it was constructed with (i.e., vitrified clay), it is likely that the system is cracked and groundwater will infiltrate into the storm sewers.

TABLE 9-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONES 5 AND 6
ANNUAL NPDES STORMWATER MONITORING PROGRAM
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Date of Collection	Analysis						
		Target Compound List (TCL)		TAL Metals		TPH [1]	Fluorescence	Misc
		Volatiles	Semivolatiles	Total	Dissolved			
SURFACE WATER								
NOVA	09/21/93			● [2]		●	●	● [4]
NOVA	02/28/95			● [2]		●	●	● [5]
NOVA	10/08/96			● [2]		●	●	● [5]
NOVA	06/19/97			● [3]		●	●	● [6]

1 Oil and grease analysis performed.
2 Analysis for copper, lead, and zinc only.
3 Analysis for copper, iron, lead, mercury, nickel, silver, sodium, and zinc only.
4 Miscellaneous parameters for this sample include: Chemical Oxygen Demand (COD), Fecal Coliform, Nitrate (as Nitrogen), pH, Total Dissolved Solids (TDS), Total Kjeldahl Nitrogen (TKN), Total Phosphorous, and Total Suspended Solids (TSS).
5 Miscellaneous parameters for this sample include: COD, Fecal Coliform, Nitrate (as Nitrogen), pH, TKN, Total Phosphorous, and TSS.
6 Miscellaneous parameters for this sample include: Reactive Cyanide, Ammonia (as Nitrogen), COD, Chloride, Fecal Coliform, MBAS (Surfactants), Nitrate (as Nitrogen), pH, Sulfate, TDS, TKN, Total Phosphorous, and TSS.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 9-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 6
LOWER SUBASE REMEDIAL INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis						
		Target Compound List (TCL		TAL Metals		SPLP Metals[1]	TPH	Misc[2]
		Volatiles	Semivolatiles	Total	Dissolved			
SOIL								
L6SB0010201	2-4	●	●	●		●	●	
L6SB0010401	6-8	●	●	●		●	●	
L6SB0020201	2-4	●	●	●			●	
L6SB0020301	5-6	●	●	●			●	
L6SB0030201	0.5-2	●	●	●		●	●	
L6SB0030301	5-6	●	●	●		●	●	
L6SB0040101	0.5-1.5	●	●	●		●	●	
L6SB0040301	5-6	●	●	●		●	●	
L6SB0050101	0.5-2	●	●	●			●	
L6SB0050301	5-6	●	●	●			●	
GROUNDWATER								
LS6GW00101	NA	●	●	●	●		●	●
GWFD002[3]	NA	●	●	●	●		●	●[5]
LS6GW00201	NA	●	●	●	●		●	●
DUPLICATE004[4]	NA	●	●	●	●		●	●[5]
LS6GW00301	NA	●	●	●	●		●	●[6]
LS6GW00401	NA	●	●	●	●		●	●[6]
LS6GW00501	NA	●	●	●	●		●	●[6]

1 Synthetic Precipitation Leaching Procedure (SPLP) extraction followed by analysis for TAL metals.
2 Unless otherwise noted, miscellaneous parameters include: Alkalinity (as $CaCO_3$), Ammonia as Nitrogen, Chloride, Dissolved Oxygen, Divalent Iron, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), pH, Phosphorous, Redox Potential, Salinity, Specific Conductivity, Sulfate, Temperature, Total Organic Carbon, Turbidity, and Dissolved Methane.
3 GWFD002 is a field duplicate of LS6GW00101.
4 DUPLICATE004 is a field duplicate of LS6GW00201.
5 Miscellaneous parameters include: Alkalinity (as $CaCO_3$), Ammonia as Nitrogen, Chloride, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), Phosphorous, Sulfate, Total Organic Carbon, and Dissolved Methane.
6 This sample was not analyzed for dissolved methane because of laboratory error.
NA = Not applicable.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 9-3 (PAGE 1 OF 4)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SB0010201	LS6SB0010401	LS6SB0020201	LS6SB0020301	LS6SB0030201	LS6SB0030301
DEPTH (feet):	2 - 4'	6 - 8'	2 - 4'	5 - 6'	0.5 - 2'	5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/30/97	09/30/97	09/24/97	09/24/97	09/25/97	09/25/97
LOCATION:	MW1-6RI	MW1-6RI	MW2-6RI	MW2-6RI	MW3-6RI	MW3-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
ACETONE	10 U	90	11 U	120 U	67 U	140 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	330 U	330 U	360 U	360 U	360 U	360 U
ACENAPHTHENE	330 U	330 U	360 U	360 U	360 U	360 U
ACENAPHTHYLENE	330 U	330 U	360 U	360 U	360 U	360 U
ANTHRACENE	330 U	330 U	35 J	19 J	360 U	360 U
BENZO(A)ANTHRACENE	330 U	330 U	160 J	150 J	40 J	360 U
BENZO(A)PYRENE	330 U	330 U	160 J	180 J	31 J	360 U
BENZO(B)FLUORANTHENE	330 U	330 U	160 J	130 J	37 J	360 U
BENZO(G,H,I)PERYLENE	330 U	330 U	110 J	90 J	26 J	360 U
BENZO(K)FLUORANTHENE	330 U	330 U	100 J	150 J	26 J	360 U
BUTYLBENZYL PHTHALATE	330 U	330 U	360 U	43 J	19 J	22 J
CARBAZOLE	330 U	330 U	360 U	360 U	360 U	360 U
CHRYSENE	330 U	330 U	150 J	150 J	45 J	28 J
DI-N-OCTYL PHTHALATE	330 U	330 U	360 U	360 UJ	32 J	360 U
DIBENZO(A,H)ANTHRACENE	330 U	330 U	50 J	360 U	360 U	360 U
DIBENZOFURAN	330 U	330 U	360 U	360 U	360 U	360 U
FLUORANTHENE	330 U	330 U	260 J	180 J	90 J	21 J
FLUORENE	330 U	330 U	360 U	360 U	360 U	360 U
INDENO(1,2,3-CD)PYRENE	330 U	330 U	98 J	80 J	26 J	360 U
PHENANTHRENE	330 U	330 U	130 J	90 J	25 J	360 U
PYRENE	330 U	330 U	320 J	290 J	56 J	33 J

TABLE 9-3 (PAGE 2 OF 4)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SB0010201	LS6SB0010401	LS6SB0020201	LS6SB0020301	LS6SB0030201	LS6SB0030301
DEPTH (feet):	2 - 4'	6 - 8'	2 - 4'	5 - 6'	0.5 - 2'	5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/30/97	09/30/97	09/24/97	09/24/97	09/25/97	09/25/97
LOCATION:	MW1-6RI	MW1-6RI	MW2-6RI	MW2-6RI	MW3-6RI	MW3-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ALUMINUM	8250	7150	4720	2410	6150	4380
ARSENIC	1.8	1.4	2.2	0.87 J	1.6	1.6
BARIUM	38.6	37.2	29.2	16.8	45.0	28.5
BERYLLIUM	0.33 U	0.32 U	0.18 U	0.08 U	0.22	0.19 U
CALCIUM	588	611	982 J	779 J	1680	743
CHROMIUM	15.2	15.2	11.7	5.8	13.9	6.9 J
COBALT	6.4	5.1	3.8	2.1	5.1	3.0
COPPER	12.2	10.0	12.7	6.8	24.5	9.6
IRON	10200	8760	7510	4010	10400	6230
LEAD	18.0	8.5	9.3	7.1	12.4 J	4.4 U
MAGNESIUM	3160	3170	2180 J	1200 J	3810	2040
MANGANESE	158	145	136	75.2	182	121
MERCURY	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.04 J	0.002 UJ
NICKEL	12.5	10.6	9.1 J	4.8 J	10.4	7.9
POTASSIUM	1680	1710	1370	711	1840	1370
SILVER	0.46	0.46 U	0.21 U	0.20 U	0.18 U	0.23 U
SODIUM	74.9	93.9	93.6	56.9	172	140
VANADIUM	19.6	16.8	13.3	8.5	16.9	10.7
ZINC	26.1	24.3	27.8	19.2	50.1	19.8
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	25 U	78.0 J	360	1200	120 J	690 J

TABLE 9-3 (PAGE 3 OF 4)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SB0040101	LS6SB0040301	LS6SB0050101	LS6SB0050301		
DEPTH (feet):	0.5 - 1.5'	5 - 6'	0.5 - 2'	5 - 6'		
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI		
SAMPLE DATE:	09/24/97	09/24/97	09/24/97	09/24/97	/ /	/ /
LOCATION:	MW4-6RI	MW4-6RI	MW5-6RI	MW5-6RI		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
ACETONE	10 U	21 U	10 U	11 U		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	330 U	360 U	30 J	360 U		
ACENAPHTHENE	42 J	360 U	22 J	360 U		
ACENAPHTHYLENE	330 U	360 U	29 J	360 U		
ANTHRACENE	86 J	360 U	69 J	360 U		
BENZO(A)ANTHRACENE	330	360 U	150 J	42 J		
BENZO(A)PYRENE	460 J	360 U	330 U	360 U		
BENZO(B)FLUORANTHENE	240 J	360 U	330 U	31 J		
BENZO(G,H,I)PERYLENE	88 J	360 U	330 U	360 U		
BENZO(K)FLUORANTHENE	280 J	360 U	330 U	26 J		
BUTYLBENZYL PHTHALATE	19 J	360 U	330 U	360 U		
CARBAZOLE	28 J	360 U	330 U	360 U		
CHRYSENE	360	360 U	120 J	59 J		
DI-N-OCTYL PHTHALATE	330 UJ	360 U	330 UJ	360 UJ		
DIBENZO(A,H)ANTHRACENE	330 UJ	360 U	330 U	360 U		
DIBENZOFURAN	330 U	360 U	30 J	360 U		
FLUORANTHENE	500	360 U	40 J	72 J		
FLUORENE	34 J	360 U	330 U	360 U		
INDENO(1,2,3-CD)PYRENE	130 J	360 U	330 U	360 U		
PHENANTHRENE	340	360 U	120 J	37 J		
PYRENE	1000	360 U	230 J	96 J		

TABLE 9-3 (PAGE 4 OF 4)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SB0040101	LS6SB0040301	LS6SB0050101	LS6SB0050301		
DEPTH (feet):	0.5 - 1.5'	5 - 6'	0.5 - 2'	5 - 6'		
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI		
SAMPLE DATE:	09/24/97	09/24/97	09/24/97	09/24/97	/ /	/ /
LOCATION:	MW4-6RI	MW4-6RI	MW5-6RI	MW5-6RI		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ALUMINUM	4890	3610	4660	4000		
ARSENIC	2.1	1.8	1.7	2.0		
BARIUM	34.5	27.8	31.7	25.0		
BERYLLIUM	0.18	0.12 U	0.14 U	0.15 U		
CALCIUM	722 J	608 J	963 J	818 J		
CHROMIUM	10.2	7.2	10.5	10.3		
COBALT	3.7	2.9	3.5	3.4		
COPPER	8.7	7.1	11.0	9.2		
IRON	6720	4610	7170	5100		
LEAD	4.8	2.0	3.1	3.7		
MAGNESIUM	1990 J	1380 J	2180 J	1620 J		
MANGANESE	156	93.2	131	160		
MERCURY	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ		
NICKEL	9.2 J	6.8 J	8.5 J	8.3 J		
POTASSIUM	1310	834	1280	1020		
SILVER	0.16 U	0.19 U	0.19 U	0.18 U		
SODIUM	125	82.4	122	65.0		
VANADIUM	14.3	9.5	23.1	10.0		
ZINC	16.8	10.7	15.8	12.1		
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	830	140	4000	330		

TABLE 9-4

SUMMARY OF POSITIVE SPLP ANALYTICAL RESULTS FOR ZONE 6 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SB0010201	LS6SB0010401	LS6SB0030201	LS6SB0030301	LS6SB0040101	LS6SB0040301
DEPTH (feet):	2 - 4'	6 - 8'	0.5 - 2'	5 - 6'	0.5 - 1.5'	5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/30/97	09/30/97	09/25/97	09/25/97	09/24/97	09/24/97
LOCATION:	MW1-6RI	MW1-6RI	MW3-6RI	MW3-6RI	MW4-6RI	MW4-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SPLP METALS (mg/L)*						
ALUMINUM (NA/NA)	0.861	0.48	0.355 U	0.0894 U	0.535 U	0.0424 U
BARIUM (100.0/10.0)	0.3	0.238	0.0184 U	0.0174 U	0.236	0.0491 U
CALCIUM (NA/NA)	1.6	0.736	7.92	1.48	0.728	0.81
CHROMIUM (5.0/0.5)	0.0052 U	0.0052 U	0.0012 U	0.00068 U	0.00093 J	0.00068 U
COPPER (NA/13)	0.0035	0.0015 U	0.00074 U	0.00074 U	0.00096 J	0.00074 U
IRON (NA/NA)	0.661	0.343 U	0.0554 U	0.0141 U	0.363	0.0134 U
LEAD (5.0/0.15)	0.0054 U	0.0016 U	0.0019 U	0.0013 U	0.0029 J	0.0013 U
MAGNESIUM (NA/NA)	0.522	0.429	0.316 U	0.16 U	0.123 U	0.145 U
MANGANESE (NA/0.16)	0.0525	0.0733	0.00038 U	0.0016	0.0242	0.0185
NICKEL (NA/1.0)	0.0062 U	0.0062 U	0.00075 U	0.00075 U	0.0012 J	0.00075 U
POTASSIUM (NA/NA)	1.55	1.42 U	0.799	0.67	1.05	0.864
SODIUM (NA/NA)	1.93	1.99	3.52	2.5	4.06	1.19
VANADIUM (NA/0.5)	0.0029 U	0.0029 U	0.002 U	0.00063 U	0.00083 J	0.00055 U
ZINC (NA/50)	0.109	0.0801 U	0.0175 U	0.0224 U	0.126 U	0.0203 U

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 9-5

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (μg/kg)						
2-Methylnaphthalene	1/4	30	MW5-6RI	0/4	ND	ND
Acenaphthene	2/4	22 - 42	MW4-6RI	0/4	ND	ND
Acenaphthylene	1/4	29	MW5-6RI	0/4	ND	ND
Anthracene	3/4	35 - 86	MW4-6RI	1/4	19	MW2-6RI
Benzo(a)anthracene	4/4	40 - 330	MW4-6RI	2/4	42 - 150	MW2-6RI
Benzo(a)pyrene	3/4	31 - 460	MW4-6RI	1/4	180	MW2-6RI
Benzo(b)fluoranthene	3/4	37 - 240	MW4-6RI	2/4	31 - 130	MW2-6RI
Benzo(g,h,i)perylene	3/4	26 - 110	MW2-6RI	1/4	90	MW2-6RI
Benzo(g,h,i)perylene	3/4	26 - 110	MW2-6RI	1/4	90	MW3-6RI
Benzo(k)fluoranthene	3/4	26 - 280	MW4-6RI	2/4	26 - 150	MW2-6RI
Butylbenzyl phthalate	2/4	19	MW4-6RIMW3-6RI	2/4	22 - 43	MW2-6RI
Carbazole	1/4	28	MW4-6RI	0/4	ND	ND
Chrysene	4/4	45 - 360	MW4-6RI	3/4	28 - 150	MW2-6RI
Di-n-octyl phthalate	1/4	32	MW3-6RI	0/4	ND	ND
Dibenzo(a,h)anthracene	1/4	50	MW2-6RI	0/4	ND	ND
Dibenzofuran	1/4	30	MW5-6RI	0/4	ND	ND
Fluoranthene	4/4	40 - 500	MW4-6RI	3/4	21 - 180	MW2-6RI
Fluorene	1/4	34	MW4-6RI	0/4	ND	ND
Indeno(1,2,3-cd)pyrene	3/4	26 - 130	MW4-6RI	1/4	80	MW2-6RI
Phenanthrene	4/4	25 - 340	MW4-6RI	2/4	37 - 90	MW3-6RI
Phenanthrene	4/4	25 - 340	MW4-6RI	2/4	37 - 90	MW4-6RI
Pyrene	4/4	56 - 1000	MW4-6RI	3/4	33 - 290	MW2-6RI
INORGANICS (mg/kg)						
Aluminum	4/4	4660 - 6150	MW3-6RI	4/4	2410 - 4720	MW2-6RI
Arsenic	4/4	1.6 - 2.2	MW2-6RI	4/4	0.87 - 2	MW5-6RI

TABLE 9-5

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Barium	4/4	29.2 - 45	MW3-6RI	4/4	16.8 - 29.2	MW2-6RI
Beryllium	2/4	0.18 - 0.22	MW3-6RI	0/4	ND	ND
Calcium	4/4	722 - 1680	MW3-6RI	4/4	608 - 818	MW5-6RI
Chromium	4/4	10.2 - 13.9	MW3-6RI	4/4	5.8 - 10.3	MW5-6RI
Cobalt	4/4	3.5 - 5.1	MW3-6RI	4/4	2.1 - 3.4	MW5-6RI
Copper	4/4	8.7 - 24.5	MW3-6RI	4/4	6.8 - 9.6	MW3-6RI
Iron	4/4	6720 - 10400	MW3-6RI	4/4	4010 - 6230	MW3-6RI
Lead	4/4	3.1 - 12.4	MW3-6RI	3/4	2 - 7.1	MW2-6RI
Magnesium	4/4	1990 - 3810	MW3-6RI	4/4	1200 - 2040	MW3-6RI
Manganese	4/4	131 - 182	MW3-6RI	4/4	75.2 - 160	MW5-6RI
Mercury	1/4	0.04	MW3-6RI	0/4	ND	ND
Nickel	4/4	8.5 - 10.4	MW3-6RI	4/4	4.8 - 8.3	MW5-6RI
Potassium	4/4	1280 - 1840	MW3-6RI	4/4	711 - 1370	MW3-6RI
Sodium	4/4	93.6 - 172	MW3-6RI	4/4	56.9 - 140	MW3-6RI
Vanadium	4/4	13.3 - 23.1	MW5-6RI	4/4	8.5 - 10.7	MW3-6RI
Zinc	4/4	15.8 - 50.1	MW3-6RI	4/4	10.7 - 19.8	MW3-6RI
SPLP METALS (mg/L)						
Barium	1/2	0.236	MWS4-6RI	0/2	ND	ND
Calcium	2/2	0.728 - 7.92	MW3-6RI	2/2	0.81 - 1.48	MW3-6RI
Chromium	1/2	0.0009	MW4-6RI	0/2	ND	ND
Copper	1/2	0.001	MW4-6RI	0/2	ND	ND
Iron	1/2	0.363	MW4-6RI	0/2	ND	ND
Lead	1/2	0.0029	MW4-6RI	0/2	ND	ND
Manganese	1/2	0.0242	MW4-6RI	1/2	0.0016 - 0.0185	MW4-6RI
Nickel	1/2	0.0012	MW4-6RI	0/2	ND	ND
Potassium	2/2	0.799 - 1.05	MW4-6RI	2/2	0.67 - 0.864	MW4-6RI

TABLE 9-5

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Sodium	2/2	3.52 - 4.06	MW4-6RI	2/2	1.19 - 2.5	MW3-6RI
Vanadium	1/2	0.0008	MW4-6RI	0/2	ND	ND
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	4/4	120 - 4000	MW5-6RI	3/4	140 - 1200	MW2-6RI

1 Includes samples LS6SB0020201, LS6SB0030201, LS6SB0040101, LS6SB0050101.
2 Includes samples LS6SB0020301, LS6SB0030301, LS6SB0040301, LS6SB0050301.
ND - Not Detected.
NA - Not Analyzed.

TABLE 9-6 (PAGE 1 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6GW00101	GWFD002	GWFD002-F	LS6GW00101-F	LS6GW00201	DUPLICATE004
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/30/97	10/30/97	10/30/97	10/30/97	11/04/97	11/04/97
LOCATION:	MW1-6RI	MW1-6RI	MW1-6RI	MW1-6RI	MW2-6RI	MW2-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:		LS6GW00101	LS6GW00101-F			LS6GW00201
VOLATILES (µg/L)						
CHLOROFORM	23	21			10 U	10 U
STYRENE	1 J	1 J			10 U	10 U
SEMIVOLATILES (µg/L)						
ACENAPHTHENE	11 U	11 U			3 J	2 J
ACENAPHTHYLENE	11 U	11 U			0.8 J	0.6 J
BUTYLBENZYL PHTHALATE	0.7 J	0.7 J			13 U	12 UJ
FLUORANTHENE	11 U	11 U			13 U	0.6 J
FLUORENE	11 U	11 U			0.7 J	12 U
METALS (µg/L)						
ANTIMONY	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
BARIUM	25.2	24.8	83.2	292	124	125
CALCIUM	11800	11900	12200	11900	109000	106000
CHROMIUM	0.80 U	0.68 U	0.68 U	0.70 U	0.89 J	0.89 J
COBALT	1.9	1.8	1.7	0.83 J	0.99 J	0.94 J
IRON	73.8 U	67.7 U	13.0 U	13.0 U	619	557
LEAD	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	2.5 J
MAGNESIUM	3220	3250	3280	3200	27300	26400
MANGANESE	420	426	439	418	449	447
NICKEL	5.3	5.0	5.6	5.3	1.5 U	1.1 U
POTASSIUM	2540	2580 U	2370	2240 U	15500	14600
SODIUM	18200	18100	20500	19500	239000	226000
THALLIUM	6.5 J	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U
VANADIUM	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U
ZINC	26.6	24.1	70.8	102	8.3 U	10.8 U

TABLE 9-6 (PAGE 2 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6GW00101	GWFD002	GWFD002-F	LS6GW00101-F	LS6GW00201	DUPLICATE004
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/30/97	10/30/97	10/30/97	10/30/97	11/04/97	11/04/97
LOCATION:	MW1-6RI	MW1-6RI	MW1-6RI	MW1-6RI	MW2-6RI	MW2-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:		LS6GW00101	LS6GW00101-F			LS6GW00201
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	5.07				38.85 R	
REDOX POTENTIAL (MV)	52.8				-151.5	
SALINITY (PPT)	0.08				0.95	
SPECIFIC CONDUCTIVITY (MS/CM)	0.176				1.864	
TEMPERATURE (C)	12.00				15.91	
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	20 U	20 U			180	180
CHLORIDE (MG/L)	29	29			450	520
DIVALENT IRON (MG/L)	0.00				0.6	
HARDNESS AS CaCO3 (MG/L)	45	45			330	330
METHANE (UG/L)	5.4 U	5.4 U			2400	2600
NITRATE, AS NITROGEN (MG/L)	1.4	1.4			0.15	0.14
PHOSPHORUS (MG/L)	0.13 J	0.39 J			0.17 J	0.21 J
SULFATE (MG/L)	25	25			78	77
TOTAL ORGANIC CARBON (MG/L)	1.4 J	1.6 J			4.1 J	5.3 J
TURBIDITY (NTU)	3.75				1.42	
GENERAL CHEMISTRY						
PH	5.81				7.06	

TABLE 9-6 (PAGE 3 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	DUPLICATE004-F	LS6GW00201-F	LS6GW00301	LS6GW00301-F	LS6GW00401	LS6GW00401-F
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	11/04/97	11/04/97	11/03/97	11/03/97	11/03/97	11/03/97
LOCATION:	MW2-6RI	MW2-6RI	MW3-6RI	MW3-6RI	MW4-6RI	MW4-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Filtered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:	LS6GW00201-F					
VOLATILES (µg/L)						
CHLOROFORM			10 U		10 UR	
STYRENE			10 U		10 UR	
SEMIVOLATILES (µg/L)						
ACENAPHTHENE			11 U		11 U	
ACENAPHTHYLENE			11 U		11 U	
BUTYLBENZYL PHTHALATE			11 UJ		11 UJ	
FLUORANTHENE			11 U		11 U	
FLUORENE			11 U		11 U	
METALS (µg/L)						
ANTIMONY	2.8 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
BARIUM	119	112	48.2	374	37.1	33.1
CALCIUM	104000	98900	18100	16600	24700	22700
CHROMIUM	0.68 U	0.72 U	3.1 U	3.5 U	3.1 U	3.1 U
COBALT	1.2	0.88 J	2.9 U	2.9 U	2.9 U	2.9 U
IRON	608 J	525 J	16.9 U	37.8 U	24.0 U	12.6 U
LEAD	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
MAGNESIUM	26500	24600	3020	2850	3780	3520
MANGANESE	428	418	296	298	29.0	30.7
NICKEL	1.3 U	1.2 U	9.0 U	9.0 U	9.0 U	9.0 U
POTASSIUM	14900	13900	15300	14000	4890	4800
SODIUM	230000	221000	99100	93800	33200	30600
THALLIUM	4.8 U	6.2 J	4.8 U	4.8 U	4.8 U	4.8 U
VANADIUM	0.68	0.55 U	2.9 U	2.9 U	2.9 U	2.9 U
ZINC	7.9 U	9.4 U	6.9 U	98.5	15.7 U	11.5 U

TABLE 9-6 (PAGE 4 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	DUPLICATE004-F	LS6GW00201-F	LS6GW00301	LS6GW00301-F	LS6GW00401	LS6GW00401-F
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	11/04/97	11/04/97	11/03/97	11/03/97	11/03/97	11/03/97
LOCATION:	MW2-6RI	MW2-6RI	MW3-6RI	MW3-6RI	MW4-6RI	MW4-6RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Filtered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:	LS6GW00201-F					
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)			4.51		2.45	
REDOX POTENTIAL (MV)			-62.6		-42.3	
SALINITY (PPT)			0.27		0.15	
SPECIFIC CONDUCTIVITY (MS/CM)			0.553		0.321	
TEMPERATURE (C)			15.8		17.1	
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)			180		27 J	
CHLORIDE (MG/L)			37		64	
DIVALENT IRON (MG/L)			0		0	
HARDNESS AS CaCO3 (MG/L)			51		71	
NITRATE, AS NITROGEN (MG/L)			1.1		0.07 J	
PHOSPHORUS (MG/L)			0.26 U		0.10 U	
SULFATE (MG/L)			41		51	
TOTAL ORGANIC CARBON (MG/L)			6.7 J		2.1 J	
TURBIDITY (NTU)			1.18		0.64	
GENERAL CHEMISTRY						
PH			7.25		6.92	

TABLE 9-6 (PAGE 5 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6GW00501	LS6GW00501-F				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	11/03/97	11/03/97	/ /	/ /	/ /	/ /
LOCATION:	MW5-6RI	MW5-6RI				
VALIDATED:	VALIDATED	VALIDATED				
FILTERING:	Unfiltered	Filtered				
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
CHLOROFORM	10 U					
STYRENE	10 U					
SEMIVOLATILES (µg/L)						
ACENAPHTHENE	11 U					
ACENAPHTHYLENE	11 U					
BUTYLBENZYL PHTHALATE	11 UJ					
FLUORANTHENE	11 U					
FLUORENE	11 U					
METALS (µg/L)						
ANTIMONY	2.5 U	2.5 U				
BARIUM	21.4	21.8				
CALCIUM	15700	16200				
CHROMIUM	3.1 U	3.1 U				
COBALT	2.9 U	2.9 U				
IRON	15.8 U	13.1 U				
LEAD	1.3 U	1.3 U				
MAGNESIUM	1960	2040				
MANGANESE	72.0	74.3				
NICKEL	9.0 U	9.0 U				
POTASSIUM	3460	3500				
SODIUM	11200	11800				
THALLIUM	4.8 U	4.8 U				
VANADIUM	2.9 U	2.9 U				
ZINC	10.6 U	19.0 U				

TABLE 9-6 (PAGE 6 OF 6)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6GW00501	LS6GW00501-F				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	11/03/97	11/03/97	/ /	/ /	/ /	/ /
LOCATION:	MW5-6RI	MW5-6RI				
VALIDATED:	VALIDATED	VALIDATED				
FILTERING:	Unfiltered	Filtered				
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	1.47					
REDOX POTENTIAL (MV)	-64.5					
SALINITY (PPT)	0.07					
SPECIFIC CONDUCTIVITY (MS/CM)	0.157					
TEMPERATURE (C)	17.18					
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	25 J					
CHLORIDE (MG/L)	17					
DIVALENT IRON (MG/L)	0					
HARDNESS AS CaCO3 (MG/L)	47					
NITRATE, AS NITROGEN (MG/L)	0.05 U					
PHOSPHORUS (MG/L)	0.28 U					
SULFATE (MG/L)	27					
TOTAL ORGANIC CARBON (MG/L)	1.3 J					
TURBIDITY (NTU)	19.7					
GENERAL CHEMISTRY						
PH	6.8					

TABLE 9-7

SUMMARY OF LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Lower Subase RI[1]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (µg/L)			
Acenaphthene	2/5	2 - 3	MW2-6RI
Acenaphthylene	2/5	0.6 - 0.8	MW2-6RI
Fluoranthene	1/5	0.6	MW2-6RI
Fluorene	1/5	0.7	MW2-6RI
INORGANICS (µg/L)			
Antimony, filtered	1/5	2.8	MW2-6RI
Barium	5/5	21.4 - 125	MW2-6RI
Barium, filtered	5/5	21.8 - 374	MW3-6RI
Calcium	5/5	15700 - 109000	MW2-6RI
Calcium, filtered	5/5	16200 - 104000	MW2-6RI
Chromium	2/5	0.89	MW2-6RI
Cobalt	2/5	0.94 - 0.99	MW2-6RI
Cobalt, filtered	2/5	0.88 - 1.2	MW2-6RI
Iron	2/5	557 - 619	MW2-6RI
Iron, filtered	2/5	525 - 608	MW2-6RI
Lead	1/5	2.5	MW2-6RI
Magnesium	5/5	1960 - 27300	MW2-6RI
Magnesium, filtered	5/5	2040 - 26500	MW2-6RI
Manganese	5/5	29 - 449	MW2-6RI
Manganese, filtered	5/5	30.7 - 428	MW2-6RI
Potassium	5/5	3460 - 15500	MW2-6RI
Potassium, filtered	5/5	3500 - 14900	MW2-6RI
Sodium	5/5	11200 - 239000	MW2-6RI
Sodium, filtered	5/5	11800 - 230000	MW2-6RI
Thallium, filtered	1/5	6.2	MW2-6RI
Vanadium, filtered	1/5	0.68	MW2-6RI
Zinc, filtered	1/5	98.5	MW3-6RI

1 Includes samples LS6GW00201, DUPLICATE004 (field duplicate of LS6GW00201), LS6GW00301, LS6GW00401, LS6GW00501.

TABLE 9-8

SUMMARY OF NATURAL ATTENUATION AND WATER QUALITY PARAMETERS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Lower Subase RI[1]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS			
Alkalinity as CaCO3 (mg/L)	5/7	25 - 180	MW2-6RI/MW3-6RI
Chloride (mg/L)	7/7	17 - 520	MW2-6RI
Dissolved oxygen (mg/L)	4/4	1.47 - 5.07	MW1-6RI
Divalent iron (mg/L)	1/5	0.6	MW2-6RI
Hardness as CaCO3 (mg/L)	7/7	45 - 330	MW2-6RI
Methane (mg/L)	2/4	2400 - 2600	MW2-6RI
Nitrate, as nitrogen (mg/L)	6/7	0.07 - 1.4	MW1-6RI
pH	5/5	5.81 - 7.25	MW3-6RI
Phosphorus (mg/L)	4/7	0.13 - 0.39	MW1-6RI
Redox potential (mV)	5/5	-151.5 - -52.8	MW1-6RI
Salinity (ppt)	5/5	0.07 - 0.95	MW2-6RI
Specific conductivity (ms/cm)	5/5	0.157 - 1.864	MW2-6RI
Sulfate (mg/L)	7/7	27 - 78	MW2-6RI
Temperature (C)	5/5	12 - 17.18	MW5-6RI
Total organic carbon (mg/L)	7/7	1.3 - 6.7	MW3-6RI
Turbidity (NTU)	5/5	0.64 - 19.7	MW5-6RI

1 Includes samples LS6GW00101, GWFD002 (field duplicate of LS6GW00101), LS6GW00201, DUPLICATE004 (field duplicate of LS6GW00201), LS6GW00301, LS6GW00401, LS6GW00501.

TABLE 9-9

SUMMARY OF POSITIVE STORM SEWER SURFACE WATER ANALYTICAL RESULTS FOR ZONES 5 AND 6 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	NOVA	NOVA	NOVA	NOVA		
INVESTIGATION:	ST_SEWER	ST_SEWER	ST_SEWER	ST_SEWER		
SAMPLE DATE:	09/21/93	02/28/95	10/08/96	06/19/97	/ /	/ /
LOCATION:	NOVA	NOVA	NOVA	NOVA		
VALIDATED:						
FILTERING:	UNFILTERED	UNFILTERED	UNFILTERED	UNFILTERED		
FIELD DUPLICATE OF:						
METALS (µg/L)						
COPPER	80	37	80	80		
IRON				540		
LEAD	20	42	80	80		
SODIUM				4150		
ZINC	210	130	380	470		
PETROLEUM HYDROCARBONS (µg/L)						
OIL & GREASE	2800	2300	3810	1000 U		
MISCELLANEOUS PARAMETERS (mg/L)						
AMMONIA, AS NITROGEN				0.4		
CHEMICAL OXYGEN DEMAND	41	5	192	18.7		
CHLORIDE				9.5		
FECAL COLIFORM	140 E	100 U	3500	100		
NITRATE, AS NITROGEN	5	1.1	1.34	0.8		
PH	6.4	6.3	8.63	5.41		
TOTAL DISSOLVED SOLIDS	1301			14		
TOTAL KJELDAHL NITROGEN	1.26	0.57	0.7	1.12		
TOTAL PHOSPHORUS	0.09	0.07	0.31	0.29		
TOTAL SUSPENDED SOLIDS	22	94	210	170		

TABLE 9-10

CHEMICALS OF CONCERN - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Chemicals of Concern[1]		
Shallow Soil (0 - 4 Feet)	**All Soil (0 - 10 Feet)**	**Groundwater[2]**
Benzo(a)anthracene	Benzo(a)anthracene	Acenaphthylene
Benzo(a)pyrene	Benzo(a)pyrene	Antimony (filtered only)
Benzo(b)fluoranthene	Benzo(b)fluoranthene	Barium (filtered only)
Dibenzo(a,h)anthracene	Dibenzo(a,h)anthracene	Iron
Indeno(1,2,3-cd)pyrene	Indeno(1,2,3-cd)pyrene	Manganese
Arsenic	Aluminum	Sodium
Beryllium	Arsenic	Thallium (filtered only)
Chromium (total)	Beryllium	Zinc (filtered only)
Iron	Chromium (total)	
Manganese	Iron	
Nickel	Manganese	
TPH	Nickel	
	TPH	

1 Chemical is identified as a Chemical of Concern (COC) if the maximum detection in a single sample exceeds one or more criteria (i.e., Region III COC screening level, State Remediation Standards, Federal Soil Screening Levels, etc.).

2 Unless otherwise noted, the inorganic chemicals presented are COCs for the unfiltered and filtered groundwater sample matrix.

TABLE 9-11

EXPOSURE CONCENTRATIONS FOR DIRECT EXPOSURE CHEMICALS OF CONCERN - ZONE 6 LOWER SUBASE NSB-NLON, GROTON, CONNECTICUT

Direct Exposure Chemical of Concern	Exposure Concentration		
	Surface Soil[1] (mg/kg)	All Soil[1] (mg/kg)	Groundwater[2] (mg/L)
Semivolatile Organic Compounds			
Benzo(a)pyrene	0.20/0.46	0.19/0.46	NA[3]
Inorganics			
Antimony, filtered	NA	NA	0.0014/0.002
Arsenic	1.9/2.2	1.7/2.2	NA
Barium, filtered	NA	NA	0.136/0.374
Beryllium	0.14/0.22	0.10/0.22	NA
Manganese	151/182	132/182	0.211/0.448
Thallium, filtered	NA	NA	0.0029/0.0043

1 UCL if single concentration is presented, otherwise average concentration is used for CTE and maximum detected concentration is used for RME unless otherwise noted. See Section 3.3.1.

2 Average concentration is used for CTE and maximum concentration is used for RME. Maximumis defined as the highest average concentration in a single well,and the average is defined as the overall average concentration of all well-specific averages.

3 NA - Not applicable. Chemical is not a chemical of concern for this medium.

TABLE 9-12

ESTIMATED RISKS[1] - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Construction Worker		Full-Time Employee		Future Resident	
	RME[2]	CTE[3]	RME	CTE	RME	CTE
HAZARD INDEX						
Incidental Ingestion of Soil	0.020	0.005	0.005	0.002	0.015	0.003
Dermal Contact with Soil	0.004	0.0004	0.005	0.0009	0.007	0.001
Total Risk from Soil	0.024	0.0054	0.010	0.003	0.022	0.004
Dermal Contact with Groundwater	0.28	0.11	NA[4]	NA	NA	NA
Cumulative Risk:	0.30	0.12	0.010	0.003	0.022	0.004
INCREMENTAL CANCER RISK						
Incidental Ingestion of Soil	2.1E-07	4.2E-08	1.4E-06	1.2E-07	4.5E-06	2.1E-07
Dermal Contact with Soil	1.5E-07	9.7E-09	4.8E-06	4.8E-07	7.5E-06	2.2E-07
Total Risk from Soil	3.6E-07	5.2E-08	6.2E-06	6.0E-07	1.2E-05	4.3E-07
Dermal Contact with Groundwater	–[5]	–[5]	–[5]	–[5]	–[5]	–[5]
Cumulative Risk:	3.6E-07	5.2E-08	6.2E-06	6.0E-07	1.2E-05	4.3E-07

1 Chemical-specific risks presented in Appendix I.10.
2 RME - Reasonable Maximum Exposure.
3 CTE - Central Tendency Exposure.
4 NA - Exposure route not evaluated/not applicable for this receptor.
5 No cancer slope factors are available for the identified COCs/exposure route.

TABLE 9-13

SUMMARY OF MAJOR CONTRIBUTORS TO RISK - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemical	Cancer Risk	Percent Contribution
Full-time Employee - RME	Benzo(a)pyrene	4.6E-06	75%
	Arsenic	1.5E-06	25%
Future Resident - RME	Benzo(a)pyrene	8.4E-06	70%
	Arsenic	3.5E-06	30%

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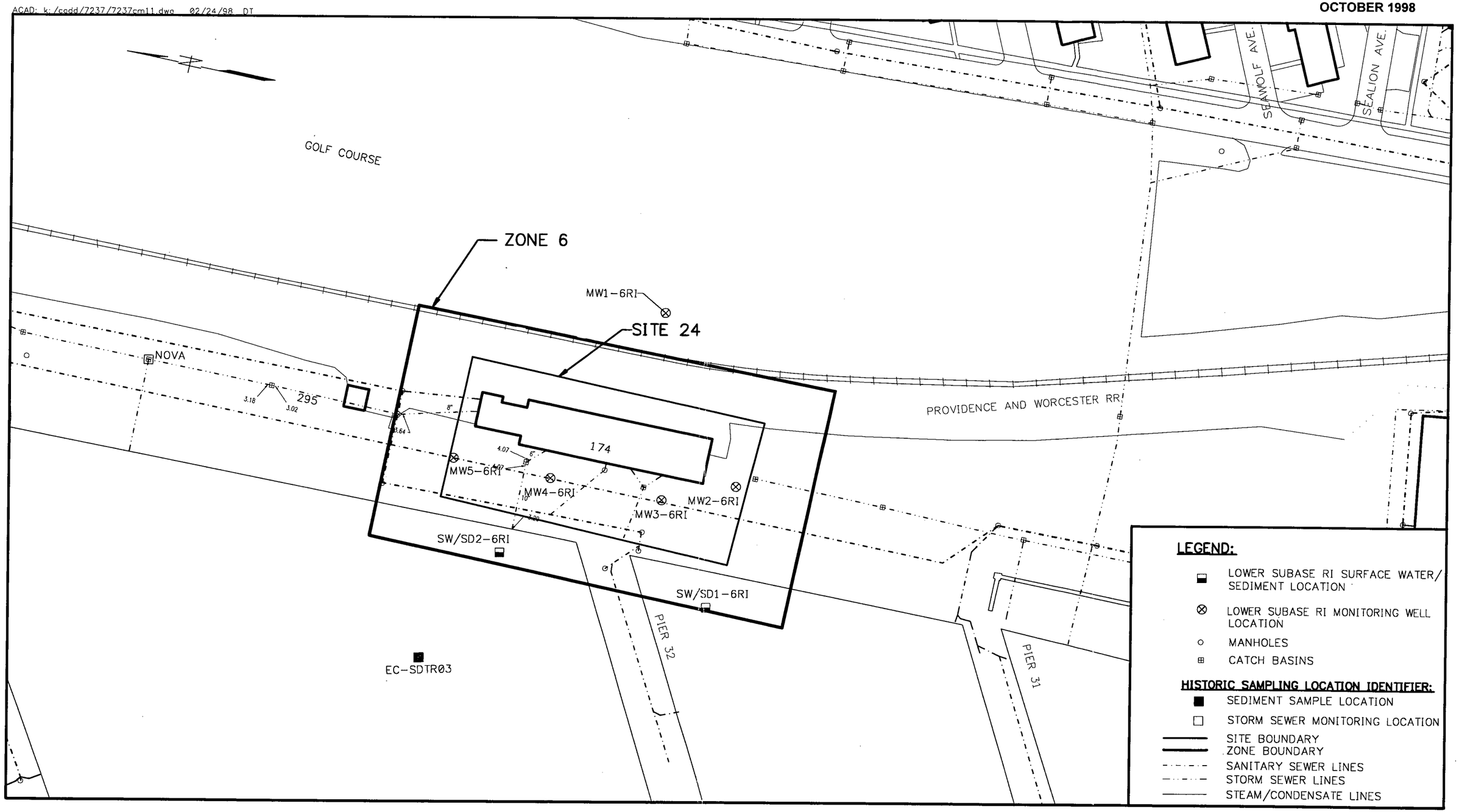


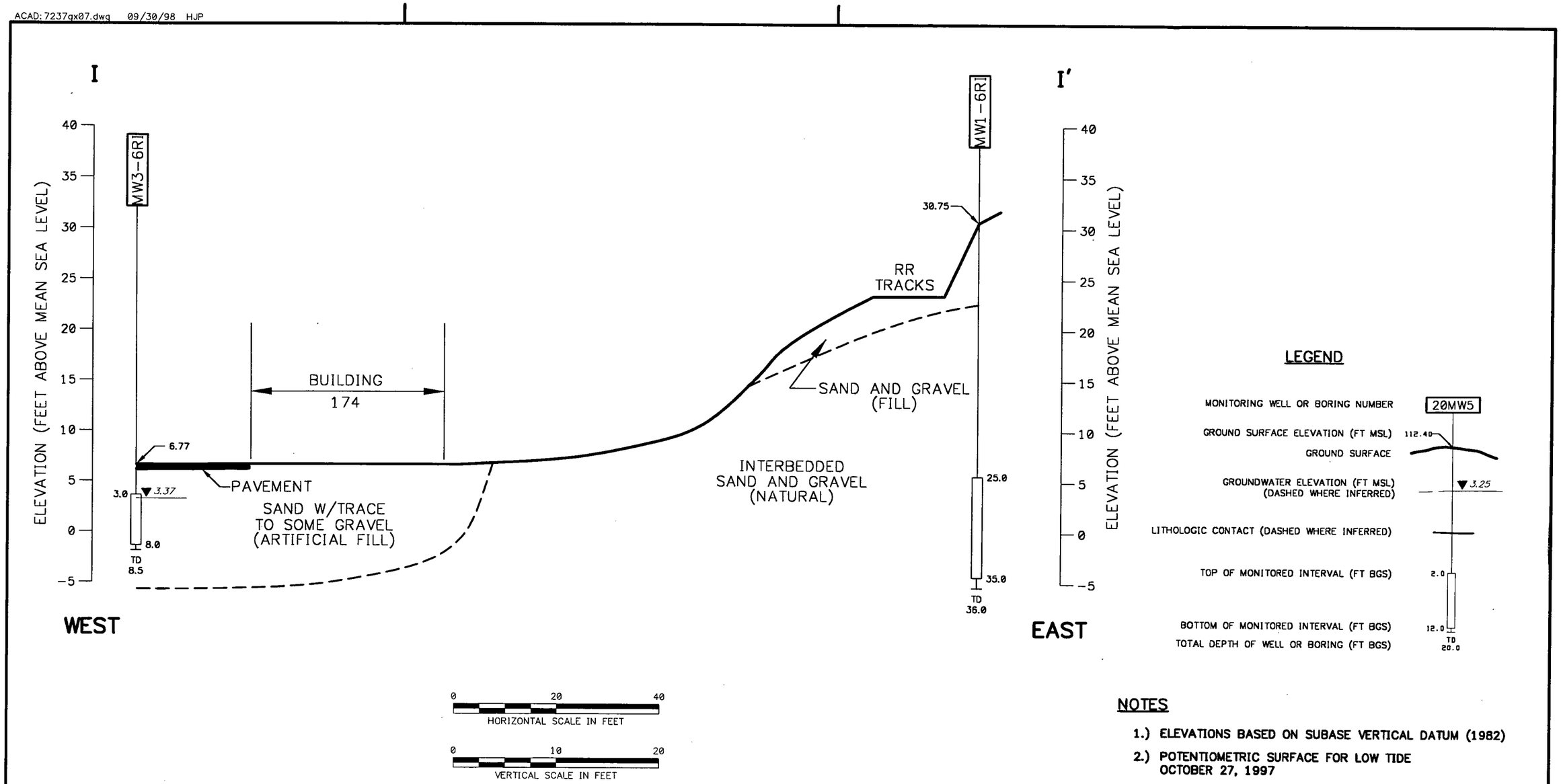
FIGURE 9-1

SAMPLE LOCATION MAP
ZONE 6
NSB-NLON, GROTON, CONNECTICUT

0 80 160
SCALE IN FEET

Brown & Root Environmental

ACAD: 7237gx07.dwg 09/30/98 HJP



NOTES

1.) ELEVATIONS BASED ON SUBASE VERTICAL DATUM (1982)

2.) POTENTIOMETRIC SURFACE FOR LOW TIDE OCTOBER 27, 1997

3.) SEE DRAWING 6 FOR CROSS SECTION LOCATION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 2/15/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

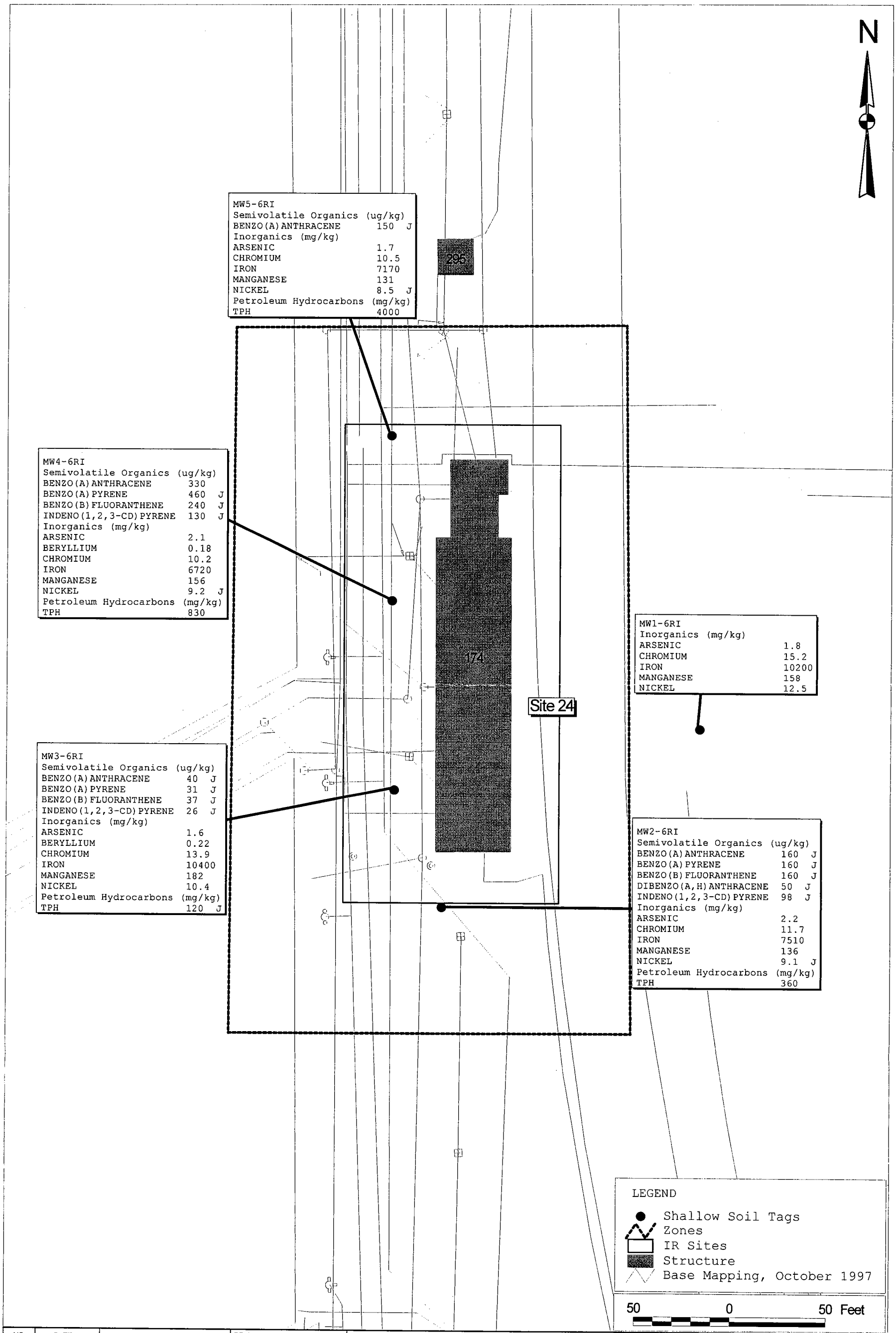
Brown & Root Environmental

GENERALIZED GEOLOGIC CROSS SECTION I – I'
ZONE 6
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO. 7237
OWNER NO. 0260
APPROVED BY Gary A. Pirl DATE 10/7/98
APPROVED BY DATE
DRAWING NO. FIGURE 9-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

P:\GIS\NLON\NLONTAGS.APR 24-FEB-98 SMT ZONE 6 SHALLOW TAG LAYOUT



NO.	DATE	REVISIONS	DRAWN BY D. PERRY	DATE 17-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 6 SHALLOW SOIL COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A. Rice	DATE 4/16/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 9-3	REV. 0

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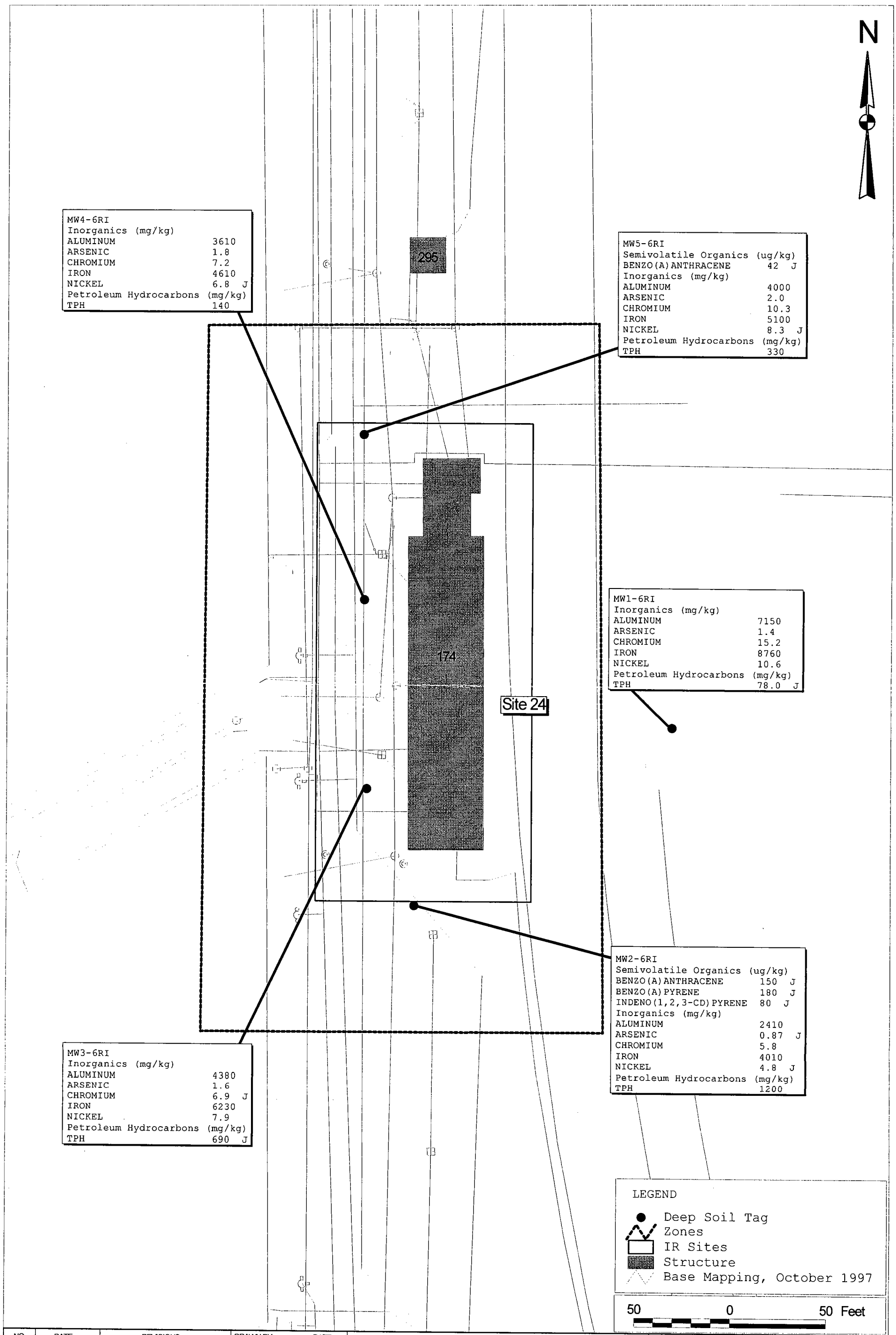
CTO 0260

REVISION 1
OCTOBER 1998

P:\GIS\NLON\NLONTAGS-DEEP.APR 25-FEB-98 DNP ZONE 6 DEEP TAG LAYOUT



NO.	DATE	REVISIONS	DRAWN BY D. PERRY	DATE 25-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 6 DEEP SOIL COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey O'Neil	DATE 4/16/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 9-4	REV. 0

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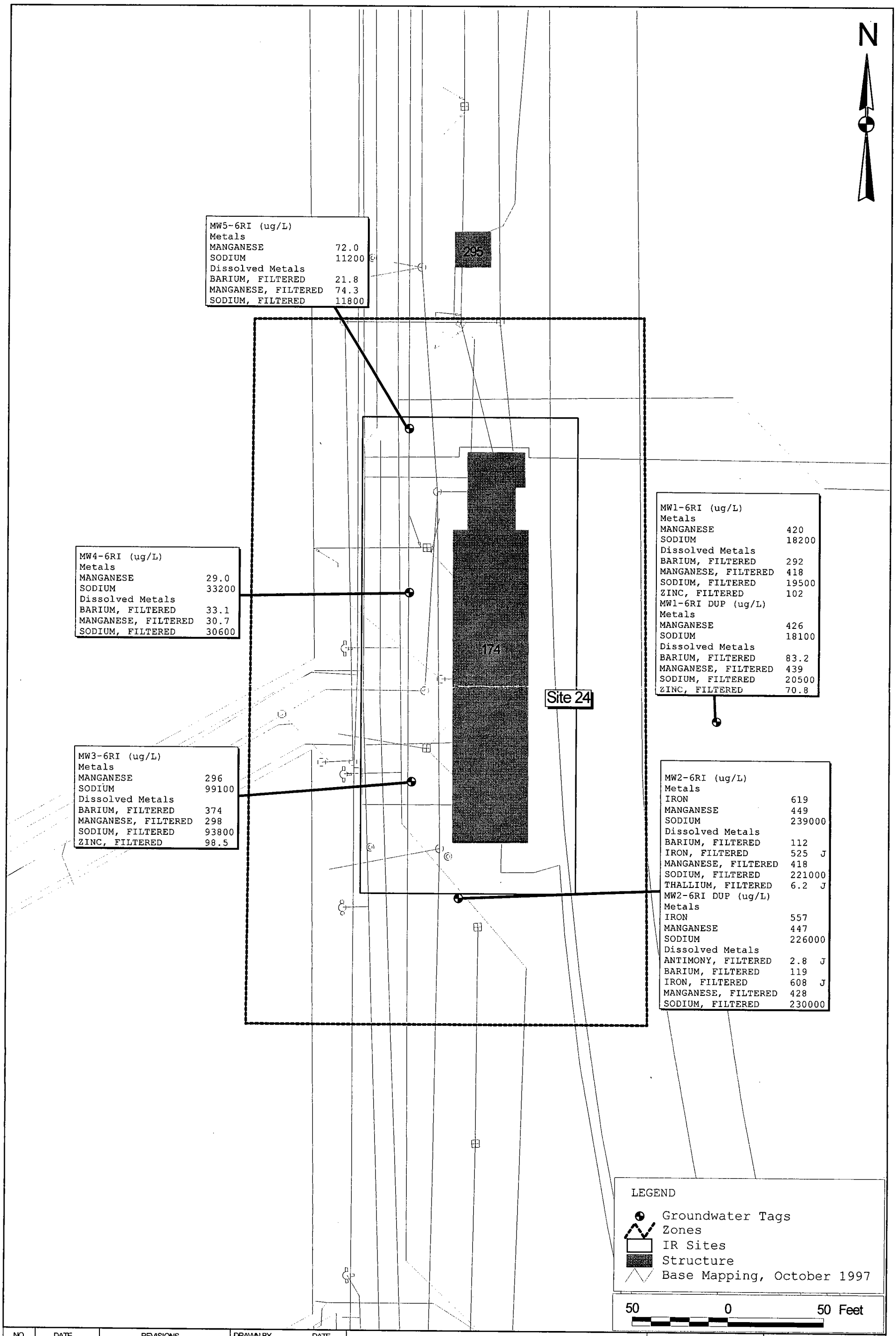

NO.	DATE	REVISIONS	DRAWN BY S. TABLER	DATE 25-FEB-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY	DATE	ZONE 6 GROUNDWATER COPC POSITIVE DETECTS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A Rail	DATE 4/16/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. FIGURE 9-5	REV. 0

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9-57

CTO 0260

REVISION 1
OCTOBER 1998

10.0 ZONE 7

10.1 SITE DESCRIPTION

Zone 7 extends from just north of Building 478 to the southern side of Dorado Road and includes Site 21 - Berth 16, Site 25 - Classified Materials Incinerator, and Transformers at Building 157 Vault 31. Fuel oil distribution lines were historically located in Zone 7, but they have been abandoned. Steam, condensate, and electrical ducts are also located within Zone 7. Berth 16 formerly included a 250-gallon underground diesel-fuel storage tank located adjacent to the northern wall of Building 157. The storage tank was connected to the diesel-fuel transfer lines. Figure 10-1 illustrates Zone 7 and site boundaries in Zone 7.

10.1.1 Site 21 - Berth 16

The following structures are included in Site 21:

Building	Original Use	Current Use
103	Instruction	Instruction
173	Substation	Electrical Distribution
106	Photolab and Electronics	Storage
157	Periscope Shop	Optical Shop
456, 478	Maintenance Shop	Maintenance Shop

Buildings 103, 173, 106, and 157 were constructed sometime between 1918 and 1944. Buildings 456 and 478 were constructed sometime after the incinerator (Site 25) was demolished in 1979. Berth 16 formerly included an underground, 250-gallon diesel-fuel storage tank that was located adjacent to the northern wall of Building 157. The storage tank was connected to the diesel-fuel transfer line that extended from the storage tank and along Pier 15, east of Building 173, and an underground diesel-fuel transfer line that extended from the storage tank and along Pier 15, east of Building 173. The storage tank was used to power the emergency generator for the sewage-lift station. Besides a former septic tank with a leaching field that serviced Building 173, no other underground tanks are reported to be located within Zone 7. The exact locations of the former septic tank and leaching field are not known.

10.1.2 Site 25 - Classified Materials Incinerator

Between 1944 and 1963, the incinerator located within Building 97 was used to burn classified materials and other wastes generated at NSB-NLON. The incinerator was demolished in 1979, and Buildings 456 and 478 were constructed.

All materials generated by base operations that were not salvageable were incinerated at Site 25. Residual ash produced by materials burning were disposed in the Goss Cove Landfill (USEPA, the State of Connecticut, and the Navy, 1995). Adjacent to the incinerator was a dumpster-cleaning operation. The incinerator became inoperable in 1963 and operations ceased.

10.1.3 Transformers at Building 157 Vault 31

Transformers, which formerly contained PCB-based oils, were located in an outdoor electrical vault (Vault 31) at Building 157. The transformers reportedly contained approximately 140 gallons of PCB-containing dielectric fluid. These transformers were replaced by non-PCB-containing transformers. Secondary containment was constructed around the new (non-PCB) transformers.

10.1.4 Fuel Oil Distribution Lines and Utility Ducts

As late as 1954, underground diesel-fuel lines serviced Berth 16. The underground diesel lines currently do not go farther north than Pier 13. The method of abandonment of these lines is unknown.

Utility ducts and trenches run through Zone 7. Descriptions of the utility ducts and trenches are provided in Section 1.4.1.4. The locations of these are shown in Figure 10-1.

10.1.5 Storm Sewers

As can be seen on Figure 10-1, three storm sewers discharge to the Thames River from Zone 7. Invert elevations for the storm sewer outfalls to the Thames River and upgradient catch basins were not readily available, with the exception of Catch Basin No. 899 which is located on the southwest side of Building 478. The invert elevation for the catch basin was –1.42 feet msl. This elevation was taken from the Navy drawing, *Utility Map, Storm Drainage* (Drawing Number 1142295, Sheet 2 of 19, July 27, 1967). The elevation of the Thames River fluctuates daily and seasonally, but the elevation of the river typically ranges between approximately 0.00 feet msl to 4.00 feet msl. Therefore, the storm sewer system will be submerged to varying degrees depending on the time of day and time of year.

10.2 SITE INVESTIGATIONS

The following investigations were conducted at Zone 7 and are discussed in the sections following:

- Environmental Assessment for Pier 17 Replacement (Maguire, 1994)
- Pier 33 and Berth 16/Former Incinerator Site Investigation (Atlantic, 1995a)
- Existing Data Summary Report for Lower Subase Remedial Investigation (B&R Environmental, 1997a)

No remedial investigations have been conducted at Site 25 or at the transformers at Building 157. In addition, storm water discharging from this zone is not monitored as part of the NPDES permit monitoring program.

10.2.1 Environmental Assessment for Pier 17 Replacement

In September 1994, Maguire Group prepared an Environmental Assessment (EA) for the proposed pier replacement and dredging alongside Pier 15 and Pier 17. The EA was conducted to determine if the proposed action would affect the offshore environment. Surface water (elutriate), sediment, and benthic species sampling in the vicinity of Pier 15 and 17 were conducted.

10.2.2 Pier 33 and Berth 16/Former Incinerator Site Inspection

The SI summarizes information from the geotechnical investigation conducted by Morrison Geotechnical Engineering in 1989 for the replacement of the quay wall. Seven soil borings were installed northwest of Building 157 (B32, B34 through B37, B39, and B40). The locations are shown on Figure 10-1. Only one boring was sampled (B32). Soil and groundwater samples were collected at this location. The soil sample was analyzed for metals, VOCs, TPH, oil type by fluorescence, pesticides, and PCBs. The groundwater sample was only analyzed for VOCs. Low concentrations of metals and TPH were detected in the soil, and the fluorescence analysis indicated that the hydrocarbons that were present were No. 2 fuel oil. VOCs, pesticides, and PCBs were not detected in the soil sample and VOCs were not detected in the groundwater sample. Petroleum contamination was evident based on odor and visual examination in all the borings except B-35. Another soil sample was collected from a trench dug north of Building 157 and analyzed for TPH, VOCs, PAHs, PCBs, and TCLP metals. This sample (N.BLDG.157) contained concentrations of TPH of 490 mg/kg, trichloroethane of 1.1 mg/kg, and TCLP lead of 245 mg/L.

Following discovery of petroleum hydrocarbon contamination in the soils at Berth 16/Former Incinerator in 1989, this site was added to the IR Program. Atlantic conducted an SI at the site to determine the presence or absence, as well as the magnitude, of specific contaminants and to determine if the results

warranted an RI/FS. The field investigation consisted of soil gas surveys, a utility-manhole inspection, drilling soil borings, installing monitoring wells, and soil, groundwater, and sediment sampling and analysis. Seven soil borings (20TB1 through 20TB7) and six soil borings, converted to monitoring wells (20MW2 through 20MW7), were installed within Zone 7. One soil boring (20MW1) was also installed east of Zone 7 as an upgradient monitoring location. Atlantic collected 25 soil samples from the borings and one round of groundwater samples from the monitoring wells. In addition, Atlantic collected two sediment samples (20SD1 and 20SD2) from storm sewer drains. Samples were analyzed for TCL organics and TAL inorganics. Some samples were also analyzed for TPH, TCLP metals, oil identification by fluorescence, and dioxin.

Forty-nine utility manholes were inspected as part of the SI. The observed utilities consisted of storm sewer, sanitary sewer, electric, telephone, and steam-line manholes. All accessible manholes in the study area were opened and inspected. Any visual evidence of oil contamination, such as an oil sheen on water, discolored sediments, or any petroleum odors, was noted. An apparent petroleum sheen was noted in nine of the manholes inspected. None of the manholes displayed evidence of any major petroleum contamination. Visual inspection of Zone 7 did not indicate evidence of contamination or spillage.

10.2.3 Existing Data Summary Investigation for Lower Subase

The Existing Data Summary Report for the Lower Subase RI was developed as part of the first tier of data collection to accumulate data from several studies, including the Phase II RI and the Pier 33 and Berth 16/Former Incinerator SI, and to identify potential data gaps that would then be filled in during the Lower Subase RI.

With respect to Zone 7, the Existing Data Summary Report recommended further investigation of soils and groundwater containing petroleum constituents, contamination in storm sewer catch basins, extent of ash disposal in the vicinity of 20MW6, and any soils containing TCLP lead levels greater than 150 μg/L. Also, testing of any UST and piping not recently tested was recommended to eliminate the possibility of an ongoing petroleum source. Additional investigation of site operations and sediment analysis of the storm sewer system was also recommended to determine the extent and source of sediment contamination. Removal and disposal of contaminated sediments and modification of any site operations identified as a contributor to the contaminated sediment were also recommended. In addition, the report recommended that lead levels continue to be monitored in the deep soil to determine the mobility of this contaminant through sampling and analysis using the SPLP method. Finally, the report recommended that further

characterization activities at Zone 7 be coordinated with sediment sampling of the Thames River in the vicinity of Zone 7 to aid in the identification of source areas and contaminants of concern.

With respect to the utility ducts and storm sewers located in Zone 7, the report recommends that fuel line leak detection systems be evaluated to ensure against leakage, past and present fuel line leaks be identified and repaired, and utility ducts and trenches and storm sewers be inspected and that any contaminated material found be removed.

10.2.4 Lower Subase Remedial Investigation

Eleven test borings (TB1-7RI through TB11-7RI) were installed in Zone 7. Six borings (TB1-7RI, TB2-7RI, TB5-7RI, TB8-7RI, TB9-7RI, and TB11-7RI) were installed to the water table using DPT. Borings TB3-7RI, TB4-7RI, TB6-7RI, TB7-7RI, and TB10-7RI were installed using HSA techniques and converted to water monitoring wells MW1-7RI, MW2-7RI, MW3-7RI, MW4-7RI, and MW5-7RI, respectively. Boring locations are illustrated in Figure 10-1, and boring log sheets and monitoring well construction sheets are provided in Appendix A. Two samples were collected from each boring from shallow (0 to 5 feet) and deep (greater than 5 feet) depths. Soil samples from each test boring location were analyzed for SVOCs. Shallow soil samples were analyzed for TPH at locations TB1-7RI through TB11-7RI. Shallow and deep soil samples from TB6-7RI, TB9-7RI, TB10-7RI, and TB11-7RI were analyzed for TAL metals. Shallow and deep soil samples from TB6-7RI and TB10-7RI were analyzed for SPLP lead. Soil sample log sheets are included in Appendix B.1.

Groundwater samples were collected from six existing monitoring wells (20MW2, 20MW3, 20MW4, 20MW5, 20MW6, and 20MW7) and the five newly installed monitoring wells. Groundwater samples were collected using low-flow purging and sampling techniques, as described in Section 2.3.2. Samples were analyzed for TPH, TCL SVOCs, filtered and unfiltered TAL metals, and natural attenuation parameters. Groundwater sample log sheets and purge data sheets are provided in Appendix B.2.

Three sediment samples (SD1-7RI through SD3-7RI) were collected from locations in the Thames River along Zone 7. Sediment sampling locations are illustrated on Figure 10-1. Surface water quality measurements were taken from each sediment sampling location at the surface and the bottom of the water column. Sediment samples were analyzed for TCL SVOCs, TAL metals, TOC, grain size, AVS/SEM, pH, and ammonia. Surface water quality parameters that were measured include temperature, salinity, turbidity, pH, specific conductance, and dissolved oxygen. Sediment sample log sheets with surface water measurements are provided in Appendix B.3.

10.3 PHYSICAL CHARACTERISTICS

The following sections summarize information provided in the Pier 33 and Berth 16/Former Incinerator Site Investigation (Atlantic, 1995a) on topography and surface water features, soil characteristics, geology, and hydrogeology. General physical characteristics of the Lower Subase are provided in Sections 1.3 and 1.4.

10.3.1 Topography, Surface Features, and Surface Water Features

The Zone 7 topography slopes gently from an elevation of approximately 10 feet on the eastern side to approximately 7 feet along the river. Zone 7 is entirely covered with pavement and buildings. The ground surface rises rapidly east of Buildings 456 and 478 to the 30-foot terrace east of Zone 7.

Surface water runoff from Zone 7 drains into the Thames River via storm sewers as illustrated in Figure 10-1. Catch basins and storm sewers in Zone 7 are shown on Figure 10-1. Four storm water outfalls within Zone 7 discharge into the Thames River.

10.3.2 Soil Characteristics, Geology and Hydrogeology

The soils of Zone 7 are mapped as Urban Land (USDA, 1983), and the surficial geology is mapped as artificial fill (USGS, 1960). A north-south cross-section of Zone 7 is illustrated in Drawing 7 and a west-east cross-section of Zone 7 is illustrated in Figure 10-2. Zone 7 is underlain by 6 to 16 feet of sand and gravel fill underlain by natural gravelly sand and gravel units to approximately 50 feet bgs. Bedrock underlies the gravelly sand and gravel units. The USGS bedrock map (USGS, 1967) maps Zone 7 as overlying the bedrock contact between the Mamacoke Formation and the Alaskite Gneiss. In 1989, geotechnical borings by Morrison Geotechnical Engineering confirmed the presence of the Mamacoke Formation in the southern part of Zone 7. Borings were not advanced to bedrock in the northern part of Zone 7.

An area of fill mixed with metal, brick, glass, plastic, concrete, and other types of debris extends from approximately 20MW5 and 20MW6 in the north to MW5-7RI and 20TB3 in the south. The debris fill thickens from 8 to 12 feet at 20TB3 and 20MW5, respectively, to greater than 16 feet at 20TB4 and MW5-7RI.

Groundwater flow across Zone 7 is to the west toward the Thames River, with a slight low in the area of 20MW5. Depth to the unconfined water table varies from 3 to 6 feet bgs across Zone 7. Monitoring wells within approximately 100 feet of the Thames River at Zone 7 are tidally influenced. However, the tidal influence is minimal, with less than 0.75-foot change of water levels in monitoring wells for 4 feet of

change in the Thames River. Drawings 2 and 4 illustrate groundwater flow for low and high tides at Zone 7.

No aquifer tests have been performed at Zone 7 to date. However, the sand and gravel fill material underlying Zone 7 is similar to the fill material underlying Zone 2 and is, therefore, assumed to have a similar average hydraulic conductivity of 74 feet per day, based on slug tests conducted in Zone 2 by Atlantic Environmental Services (Atlantic, 1992). The hydraulic gradient across Zone 7 to the Thames River is 0.00527, based on water-level data from wells MW1-7RI and 20MW2 during low tide on October 27, 1997.

The volumetric rate of groundwater discharge through the sand and gravel fill material in Zone 7 to the Thames River was estimated to be 4,043 cubic feet per day, using Darcy's Law $Q = -KA(dh/dl)$, where Q = the volumetric discharge, K = the average hydraulic conductivity, A = the cross-sectional area (i.e., the saturated fill thickness by the width of the fill material along the Thames River), and dh/dl = the hydraulic gradient. An average saturated fill thickness of 12 feet and a width of 864 feet of fill along the Thames River in Zone 7 were assumed.

Generic contaminant loading rates for groundwater discharge into the Thames River from Zone 7 were generated using an estimated groundwater discharge rate (Q, discounting tidal effects) of 4,043 cubic feet/day; a 0.75 factor applied to this flux rate to account for the lack of groundwater discharge during periods of high tide (assumed to be about 6 hours/day over two tidal cycles); hypothetical solute concentrations (C) of 10, 100, and 1,000 µg/L; and the following mass flux equation: Mass flux = Q x 0.75 x C. The corresponding daily discharge rates from Zone 7 into the Thames River are 0.00189, 0.0189, and 0.189 lbs/day for solute concentrations of 10, 100, and 1,000 µg/L, respectively. Actual discharge rates for individual dissolved constituents can be approximated by using these generic discharge rates and the average concentration of the constituent. For example, a compound present at an average concentration of 25 µg/L in groundwater would have a loading rate 2.5 times the generic rate calculated for a solute present at the 10 µg/L concentration. This loading estimate does not factor in retardation and degradation of solutes, which may be substantial in some cases and would reduce the loading rate.

10.4 NATURE AND EXTENT OF CONTAMINATION

This section is a discussion of the nature and extent of contamination of Zone 7 at the Lower Subase. The general site location of Zone 7 is shown on Figure 1-2, and a more detailed drawing of Zone 7, including sample locations, is shown on Figure 10-1. Soil, groundwater, and storm sewer sediment

sampling was conducted at Zone 7 during both the Pier 33 and Berth 16/Former Incinerator SI and the Lower Subase RI. Summaries of the sampling and analytical programs for each investigation are provided on Tables 10-1 and 10-2. The complete database for Zone 7, including both chemical and physical parameters for all investigative samples, is contained in Appendix H of this report.

10.4.1 Soil

Positive analytical results for all soil samples collected in Zone 7, as well as for the soil sample and field duplicate sample collected from the off-site upgradient location (20MW1) discussed in Section 10.2.2, are presented in Table 10-3. Positive TCLP and SPLP results for all Zone 7 soil samples are presented in Tables 10-4 and 10-5, respectively. Table 10-6 provides a summary of positive analytical results for all on-site soil samples collected from Zone 7. In addition, observations made based on fluorescence spectroscopy of Zone 7 soil samples are summarized in Table 10-7; these observations were obtained from the text and appendices of the Pier 33 and Berth 16/Former Incinerator SI (Atlantic, 1995a). Background concentrations of inorganics in soil, used for comparison with Zone 7 soil sample concentrations, were taken from the Background Concentrations of Inorganics in Soil Report (Atlantic, 1995b). These background concentrations are listed in Table 1-4.

Figures 10-3 and Figure 10-4 depict, for Zone 7 shallow and deep soil samples, respectively, the locations and concentrations of parameters that were detected at concentrations in excess of COC selection criteria used in the risk assessment. Drawings 8 through 11 (Volume III) delineate TPH and lead concentrations in soil in all zones, including Zone 7, being investigated as part of the Lower Subase RI. Drawings 8 and 9 depict TPH isoconcentration contours for shallow soil and deep soil, respectively, and Drawings 10 and 11 depict lead isoconcentration contours in shallow soil and deep soil, respectively.

10.4.1.1 Shallow Soil

As shown on Table 10-6, 23 inorganics were detected in Zone 7 shallow soil samples (0 to 4 feet bgs). Antimony, arsenic, barium, cadmium, calcium, cobalt, copper, cyanide, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc were detected at concentrations exceeding NSB-NLON background levels. However, concentrations of most of these inorganics exceeded background levels in only one (cobalt, cyanide, iron, manganese, potassium, vanadium), two (arsenic, magnesium), or three (antimony, cadmium) of the Zone 7 shallow soil samples. In general, concentrations of inorganics detected in Zone 7 shallow soil samples were at the same order of magnitude, but greater than concentrations of inorganics detected in the shallow soil samples collected from the off-site, upgradient location (20MW1).

Lead was detected at a significant concentration (189,000 mg/kg) in the shallow soil sample collected from location 20MW6. Drawing 10 shows isoconcentration contours of lead concentrations measured in Zone 7 shallow soil samples. The contours indicate the presence of an area of lead contamination extending from the southern end of Building 478, along the western side of Building 456, to the northern ends of Buildings 103 and 106. Drawing 10 also indicates that the greatest level of lead contamination is located along the western side of Building 456, toward the northern half of the building, and that concentrations of lead present in the shallow soils in this area are greater than concentrations of lead present in shallow soils throughout all other zones of the Lower Subase. Based on boring log information the borings for 20MW6, located west of Building 456, and 20TB4, located near the northeastern corner of Building 157, were installed in construction debris and ash, which may be the source of the high concentrations of lead.

TCLP extraction followed by RCRA metals analysis was performed only for the shallow soil sample and field duplicate sample collected from the off-site, upgradient location. Barium was detected in the TCLP leachates of both of these samples at concentrations less than both the Federal toxicity characteristic regulatory level and the Connecticut remediation standard pollutant mobility criterion of a GB area. SPLP extraction followed by analysis for lead was performed for three soil samples collected during the Lower Subase RI. Lead was detected in the SPLP leachates of two of the three samples; however, the concentrations of lead were less than both the Federal toxicity characteristic regulatory level and the Connecticut remediation standard pollutant mobility criterion for lead.

Although moderate to high concentrations of BTEX were detected at a number of Zone 7 sample locations during the soil-gas survey, acetone and methylene chloride were the only VOCs detected in Zone 7 shallow soil samples. These compounds, which are both common laboratory contaminants, were detected at concentrations ranging from 5 μg/L to 51 μg/L in from four to five of the 13 Zone 7 shallow soil samples analyzed for VOCs .

Twenty-one SVOCs, primarily PAHs, were detected in Zone 7 shallow soil samples at concentrations ranging from 17 μg/kg (carbazole) to 19,000 μg/kg (fluoranthene). SVOCs were detected in shallow soil samples collected throughout Zone 7; the greatest concentrations were detected in shallow soil samples collected from well 20MW6 (located west of Building 456), boring TB11-7RI (located near the northeastern corner of Building 157), and well 20MW3 (located north of Building 173, near steam condensate and sanitary sewer lines). SVOCs were not detected in shallow soil samples collected from locations 20MW7, 20TB2, 20TB4, and MW3-7RI; with the exceptions of these four shallow soil samples, concentrations of PAHs detected in Zone 7 shallow soil samples were generally greater than concentrations of respective SVOCs detected in the off-site, upgradient sample.

4,4'-DDD and 4,4'-DDT were each detected in the shallow soil samples collected from location 20TB6 (3.5 µg/kg and 17 µg/kg, respectively) and location 20TB7 (35 µg/kg and 43 µg/kg, respectively). Both of these sample borings are located along the eastern boundary of Zone 7. Neither pesticides nor PCBs were detected in any of the other Zone 7 on-site shallow soil samples analyzed for this analytical fraction. However, several pesticides, including 4,4'-DDD and 4,4'-DDT, were detected at concentrations ranging from 3.9 µg/kg to 31 µg/kg in the shallow soil sample collected from the off-site, upgradient location (20MW1). Therefore, the presence of pesticides in the on-site and off-site shallow soil samples is likely to be associated with activities (possibly lawn maintenance) conducted off-site and east of Zone 7.

Analysis for dioxins/furans was performed for four Zone 7 on-site shallow soil samples. Dioxin was detected in one sample at a concentration of 0.16 µg/kg. This sample was collected from well 20MW6, located west of Building 456. Analysis for dioxins/furans was not performed for the off-site, upgradient sample.

TPH was detected in all 14 of the Zone 7 shallow soil samples analyzed for this parameter, at concentrations ranging from 45 mg/kg to 2,600 mg/kg. The maximum concentration (2,600 mg/kg) was detected in the shallow soil sample collected from location MW5-7RI, located near the southeastern corner of Building 157. Drawing 8, which depicts isoconcentration contours of TPH concentrations measured in shallow soil samples, indicates the presence of two areas of TPH contamination within Zone 7. One area of TPH contamination includes most of the southern third of Zone 7, in the areas surrounding Buildings 157 and 106. The second area of TPH contamination is located in the northwestern corner of Zone 7, west of Building 478. TPH was not detected in the shallow soil samples collected from the off-site, upgradient location, indicating that the presence of TPH is likely to be attributable to site activities.

10.4.1.2 Deep Soil

As shown on Table 10-6, 25 inorganics were detected in Zone 7 deep soil samples (greater than 4 feet bgs). With the exception of aluminum and thallium, maximum concentrations of all detected inorganics exceeded NSB-NLON background levels (Table 1-4). However, concentrations of several of these inorganics exceeded background levels in only one (beryllium, chromium, cobalt, cyanide, selenium), two (boron, iron, potassium), or three (arsenic, magnesium, vanadium) of the Zone 7 deep soil samples.

A majority of the maximum concentrations of inorganics were detected in the deep soil sample collected from boring 20TB4, located near the northeastern corner of Building 157. Concentrations of several inorganics (antimony, arsenic, boron, cadmium, calcium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc) detected in the deep soil sample collected from this location were from

six (manganese) to 233 (antimony) times greater than the concentrations of respective inorganics detected in the shallow soil sample collected from this location. As previously noted, boring logs indicate that boring 20TB4 was installed in construction debris and ash, which may the be source of the high concentrations of inorganics. In general, with the exception of the deep soil sample collected from boring 20TB4, concentrations of inorganics detected in Zone 7 deep soil samples were at the same order of magnitude as concentrations of inorganics detected in Zone 7 shallow soil samples. In addition, concentrations of inorganics detected in Zone 7 deep soil samples are at the same order of magnitude, but greater, than concentrations of inorganics detected in the shallow soil samples collected from the off-site, upgradient location (20MW1).

Concentrations of lead detected in Zone 7 deep soil samples ranged from 2.0 mg/kg to 13,300 mg/kg, with the maximum concentration of lead detected in the deep soil sample collected from location MW5-7RI, located near the southeastern corner of Building 157. Drawing 11 shows isoconcentration contours of lead concentrations measured in Zone 7 deep soil samples. The contours indicate the presence of an area of lead contamination extending from just south of boring 20TB5, along the western side of Building 456, to the southern side of Building 106. The greatest levels of lead contamination are evident in the area surrounding the eastern side of Building 157 and the southwestern corner of Building 456; as shown in Drawing 11, concentrations of lead present in the deep soils in this area are greater than concentrations of lead present in deep soils throughout all other zones of the Lower Subase. Based on boring log information, the borings for 20MW6, located west of Building 456, and 20TB4, located near the northeastern corner of Building 157, were installed in construction debris and ash, which may be the source of the high concentrations of lead. The maximum concentration of lead measured in Zone 7 deep soil samples (13,300 mg/kg) is roughly 14 times less than the maximum concentration of lead measured in Zone 7 shallow soil samples (189,000 mg/kg at boring 20MW6). However, a comparison of Drawings 10 and 11 indicates that, although the area of lead contamination in Zone 7 shallow soil samples is slightly more widespread than the area of lead contamination in Zone 7 deep soil samples, the lead contamination in Zone 7 deep soil samples is generally present at greater concentrations.

TCLP extraction followed by RCRA metals analysis was performed for 15 Zone 7 deep soil samples collected during the Pier 33 and Berth 16/Former Incinerator SI. Arsenic, barium, cadmium, chromium, lead, and silver were detected in the TCLP leachates of these soil samples. As shown in Table 10-4, concentrations of lead detected in the TCLP leachates of deep soil samples collected from locations 20MW5 and 20MW6 (both located west of Building 456) exceeded both the Federal toxicity characteristic regulatory level and the Connecticut remediation standard pollutant mobility criterion for lead. Concentrations of lead in the TCLP leachates of deep soil samples collected from locations 20MW3

(located west of Building 157 and north of Building 173) and 20TB7 (located along the eastern side of Building 456) exceeded only the Connecticut remediation standard pollutant mobility criterion for lead.

SPLP extraction followed by analysis for lead was performed for three Zone 7 deep soil samples collected during the Lower Subase RI. These samples were collected from locations west of Building 456 (MW3-7RI), near the southeastern corner of Building 157 (MW5-7RI), and southwest of Building 173 (TB1-7RI). Lead was detected in the SPLP leachate of one of the three samples at a concentration (0.0301 mg/L) less than both the Federal toxicity characteristic regulatory level and the Connecticut remediation standard pollutant mobility criterion for lead. Concerning potential migration, the results of the recent SPLP analyses do not support the results of the historical TCLP analyses.

Five VOCs were detected in Zone 7 deep soil samples. Carbon disulfide and toluene were detected in from two to four deep on-site soil samples at concentrations ranging from 3 µg/kg to 7 µg/kg. Acetone, 2-butanone, and methylene chloride, which are all common laboratory contaminants, were each detected in from one to seven of 15 on-site deep soil samples at concentrations ranging from 5 µg/kg to 20 µg/kg. Acetone and methylene chloride were also detected in the off-site, upgradient shallow soil samples at concentrations ranging from 7µg/kg to 9 µg/kg.

As shown on Table 10-6, 19 SVOCs were detected in Zone 7 on-site deep soil samples at concentrations ranging from 18 µg/kg (fluoranthene) to 11,000 µg/kg (pyrene). The majority of the SVOCs detected in the deep soil samples were PAHs. Maximum concentrations of eight SVOCs (all PAHs) were detected in the deep soil sample collected from well MW2-7RI, located west of Building 157. In general, concentrations of SVOCs detected in most Zone 7 deep soil samples are at the same order of magnitude or less than concentrations of SVOCs detected in respective Zone 7 shallow soil samples. However, concentrations of SVOCs detected in deep soil samples collected from locations MW2-7RI, MW5-7RI, TB2-7RI, and TB9-7RI are generally from two to five times greater than concentrations of SVOCs detected in respective shallow soil samples. SVOCs were not detected in the deep soil samples collected from locations 20MW2, 20MW4, 20MW7, 20TB1, 20TB2, and MW1-7RI, although several SVOC results for the deep soil sample collected from location 20MW7 were rejected during data validation. With the exceptions of these six samples, concentrations of SVOCs detected in Zone 7 on-site deep soil samples generally exceeded SVOC concentrations detected in the off-site, upgradient shallow soil sample collected from well 20MW1.

Fifteen Zone 7 deep soil samples were analyzed for pesticides/PCBs. 4,4'-DDD (4.4 µg/kg) was detected only in the deep soil sample collected from boring 20TB6. 4,4'-DDT was detected at concentrations ranging from 4.4 µg/kg to 71 µg/kg in the three deep soil samples collected from borings 20TB6 and 20TB7. Both of these sample borings are located along the eastern boundary of Zone 7. As noted in Section 10.4.1.1,

several pesticides, including 4,4'-DDD and 4,4'-DDT, were detected at concentrations ranging from 3.9 µg/kg to 31 µg/kg in the shallow soil samples collected from the off-site, upgradient location (20MW1). Therefore, the presence of pesticides in the on-site deep soil samples and off-site shallow soil samples is likely to be associated with activities (possibly lawn maintenance) conducted off-site and east of Zone 7.

TPH was detected in 10 of 15 Zone 7 deep soil samples at concentrations ranging from 86 mg/kg to 2,500 mg/kg. Drawing 9 depicts isoconcentration contours for TPH based on data collected for Zone 7 deep soil samples. Notable areas of TPH contamination are present southwest of Building 478, in the area surrounding the eastern side of Building 157, and northwest of Building 157 along the Thames River at the base of Pier 15. A comparison of Drawings 8 and 9 indicates that TPH contamination in Zone 7 deep soils is less widespread and present at lesser concentrations than TPH contamination in Zone 7 shallow soils. TPH results for Zone 7 deep soil samples correlate well with visual observations made during drilling; visual petroleum contamination was noted in soil borings installed in these areas. TPH was not detected in the shallow soil samples collected from the off-site, upgradient location (20MW1), indicating that the presence of TPH in on-site deep soil samples is likely to be attributable to on-site activities.

Fluorescence spectroscopy was performed for deep soil samples collected from 13 sampling points located within the northern half and southwestern portion of Zone 7. Fluorescence spectroscopy results (Table 10-7) for Zone 7 deep soil samples indicate the presence of petroleum hydrocarbons in deep soils throughout these areas of Zone 7. Heavy fuel oil (i.e., No. 6 fuel oil) was identified in deep soil samples collected from locations 20MW6, 20TB3, 20TB4, and 20TB5. Heavy residual fuel oil or road tar was identified in the deep soil samples collected from locations 20MW2, 20MW4, 20MW7, and 20TB1. No. 2 diesel fuel oil was identified in the deep soil sample collected from location 20MW5. Unknown spectra, similar to spectra for heavy equipment "off road" industrial lubrication oil or bituminous pavement, were observed for deep soil samples collected from locations 20MW3, 20TB6, and 20TB7. Unknown light aromatic compounds were observed in the deep soil sample collected from location 20TB2. Heavy fuel oil (i.e., No. 6 fuel oil) was also identified in the shallow soil sample collected from the off-site, upgradient location (20MW1), indicating that off-site sources of petroleum hydrocarbons may also exist.

10.4.2 Groundwater

Positive analytical results for all groundwater samples collected from Zone 7 are presented in Table 10-8. Table 10-9 summarizes analytical results for groundwater samples collected from Zone 7 during historical investigations (i.e., the Pier 33 and Berth 16/Former Incinerator SI) and during the Lower Subase RI. In addition, observations made based on fluorescence spectroscopy of Zone 7 groundwater samples are summarized in Table 10-10; these observations were obtained from the text of Pier 33 and Berth

16/Former Incinerator SI Report (Atlantic, 1995a). Table 10-11 provides a summary of natural attenuation and water-quality parameters for Zone 7 groundwater samples; these parameters will be discussed in Section 10.5.3.

Figure 10-5 shows, for data collected during the Lower Subase RI only, the locations and concentrations of parameters that were detected in excess of COC selection criteria used in the risk assessment. Drawings 12 through 14 (Volume III) delineate TPH and lead concentrations in Lower Subase groundwater. Drawing 12 depicts isoconcentration contours of TPH in groundwater, and Drawings 13 and 14 show lead isoconcentration contours in unfiltered and filtered groundwater, respectively (i.e., for total and dissolved lead).

10.4.2.1 Historical Groundwater Data

Groundwater samples were collected from six Zone 7 monitoring wells during the Pier 33 and Berth 16/Former Incinerator SI. Twelve metals were detected in both unfiltered and filtered groundwater samples. In general, a comparison of the analytical results indicates that concentrations of metals detected in Zone 7 unfiltered and filtered historical groundwater samples are similar (i.e., at the same order of magnitude). Six metals (aluminum, arsenic, boron, cadmium, nickel, and thallium) were detected in filtered groundwater samples only. For both unfiltered and filtered historical groundwater samples, two-thirds of the maximum concentrations of metals were detected in groundwater samples collected from wells 20MW2 and 20MW6. Based on historical data (i.e., data collected prior to the Lower Subase RI), concentrations of metals detected in unfiltered and filtered groundwater samples collected from Zone 7 were similar to (i.e., at the same order of magnitude), although generally greater than, concentrations of metals detected in groundwater samples collected from other zones of the Lower Subase. However, concentrations of lead and zinc in the unfiltered and filtered groundwater samples collected from well 20MW6, barium in the unfiltered and filtered groundwater samples collected from well 20MW5, and manganese in the unfiltered and filtered groundwater samples collected from wells 20MW2 and 20MW3 were as much as 100 times greater than concentrations of these metals detected in groundwater samples collected from other Zone 7 locations and from locations throughout other zones of the Lower Subase.

Lead was detected at concentrations of 117 µg/L and 97.5 µg/L, respectively, in the unfiltered and filtered groundwater samples collected from well 20MW6, located west of Building 456, during the Pier 33 and Berth 16/Former Incinerator SI. Concentrations of lead detected in all other Zone 7 historical groundwater samples ranged from 1.5 µg/L to 6 µg/L. Therefore, the data collected during the 1993 SI indicate the presence of a concentrated area of lead contamination located west of Building 456.

A small number of organic compounds were detected in groundwater samples collected from Zone 7 during the Pier 33 and Berth 16/Former Incinerator SI. Three VOCs were detected at concentrations ranging from 0.6 µg/L to 2 µg/L in groundwater samples collected from wells 20MW4 and 20MW6. Seven PAHs were detected at low concentrations (ranging from 1 µg/L to 10 µg/L) in groundwater samples collected from wells 20MW3, 20MW4, 20MW5, and 20MW7; most of the SVOCs were detected in the groundwater samples collected from wells 20MW3 and 20MW5. Neither pesticides, PCBs, nor TPH were detected in any of the historical groundwater samples collected from Zone 7. However, fluorescence spectroscopy data (Table 10-10) identified the presence of heavy fuel oil (No. 4 or No. 6) in all Zone 7 historical groundwater samples.

10.4.2.2 Lower Subase RI

Groundwater samples were collected from six existing groundwater monitoring wells and five newly installed groundwater monitoring wells within Zone 7 during the Lower Subase RI. Fourteen metals were detected in both unfiltered and filtered groundwater samples, although vanadium was detected in only the unfiltered (2.3 µg/L) and filtered (1.8 µg/L) groundwater samples collected from well 20MW3. Aluminum, chromium, copper, and selenium were detected only in from one to three unfiltered groundwater samples. The sample locations associated with maximum concentrations varied among the detected metals, indicating that no specific area of metals contamination is present within Zone 7, based on groundwater data collected during the Lower Subase RI. In general, concentrations of metals detected in unfiltered and filtered groundwater samples collected during the Lower Subase RI were similar (i.e., at the same order of magnitude). As noted for the historical Zone 7 groundwater samples, concentrations of lead and zinc in the groundwater samples collected from well 20MW6, barium in the groundwater samples collected from well 20MW5, and manganese in the groundwater samples collected from well 20MW2 were generally greater than concentrations of these metals detected in groundwater samples collected from other Zone 7 locations, although, with the exception of manganese, concentrations of these metals detected during the Lower Subase RI were less than concentrations detected during the Pier 33 and Berth 16/Former Incinerator SI. In addition, concentrations of manganese detected in the groundwater samples collected from well MW4-7RI and of zinc in the groundwater samples collected from well 20MW3 were at the same order of magnitude as the concentrations of these metals detected in the samples previously mentioned.

The maximum concentrations of lead detected in Zone 7 groundwater samples collected during the Lower Subase RI were once again detected in the groundwater samples collected from well 20MW6, located west of Building 456. However, lead concentrations detected in the unfiltered (97.3 µg/L) and filtered (25.6 µg/L) groundwater samples collected from this well were less than the respective historical concentrations of lead. The large difference between concentrations detected in the unfiltered and filtered

sample suggests that lead contamination may be associated with suspended solids in the groundwater samples. The distribution of total and dissolved lead in groundwater based on analytical results collected during the Lower Subase RI for Zone 7 unfiltered and filtered groundwater samples is shown on Drawings 13 and 14, respectively. Drawing 13 identifies one primary area of lead contamination, with its center located west of Building 456, and two smaller, less significant areas of lead contamination, located near the southeastern corner of Building 157 and at the edge of the Thames River near the Base of Pier 15. Drawing 13 also indicates that the concentrations of lead detected in groundwater samples collected from the primary area of lead contamination (west of Building 456) are greater than lead concentrations detected in unfiltered groundwater samples throughout all other zones of the Lower Subase. Drawing 14 identifies a single, less contaminated area of lead contamination (with its center located west of Building 456) based on analytical results for filtered groundwater samples collected from Zone 7 during the Lower Subase RI.

Analysis for VOCs was not performed for Zone 7 groundwater samples collected during the Lower Subase RI. Eleven SVOCs were detected at low concentrations (ranging from 0.6 µg/L to 9 µg/L) in from one to four Zone 7 groundwater samples. Eight of the 11 SVOCs were detected in only the groundwater sample collected from well MW2-7RI, located west of Building 157 at the juncture of three steam condensate lines and two sanitary sewer lines.

TPH was not detected in any of the Zone 7 groundwater samples collected during the Lower Subase RI. Based on the sensitivity of the method used for analysis, the reporting limits for TPH were greater than the Connecticut remediation criterion of 500 µg/L. The presence of TPH below the reporting limits could not be confirmed since TPH at concentrations less than the reporting limits would not have been reported. Based on convention, one-half the reporting limit is shown on Drawing 12 for each sample in which TPH was not detected. The values provided on Drawing 12 for Zone 7 groundwater samples (500 µg/L to 600 µg/L) are equal to or slightly greater than the Connecticut remediation criterion of 500 µg/L.

10.4.3 Surface Water/Sediment

Surface water and sediment samples were collected from the Thames River adjacent to Zone 7. The nature and extent of contamination in Thames River surface water and sediment samples, as well as the impact of the activities and contamination at the Lower Subase (including Zone 7) on Thames River surface water and sediments, are discussed in Section 11.4.

Table 10-12 presents the positive analytical results for two storm sewer sediment samples collected from Zone 7. Nineteen inorganics were detected in sediment sample 20SD1, and 23 inorganics were detected

in sediment sample 20SD2. With the exceptions of arsenic, barium, nickel, sodium, thallium, and zinc, concentrations of all inorganics detected in sediment sample 20SD2 were greater than concentrations of inorganics detected in sediment sample 20SD1. Lead was detected in sediment samples 20SD1 and 20SD2 at concentrations of 47.5 mg/kg and 102 mg/kg, respectively. Concentrations of calcium, copper, cyanide, lead, nickel, sodium, and zinc detected in both sediment samples exceeded NSB-NLON background levels (Table 1-4). In addition, concentrations of cadmium, mercury, and silver detected in sediment sample 20SD2 exceeded background levels. With the exception of cyanide, maximum concentrations of all inorganics detected in Zone 7 storm sewer sediment samples were equal to or less than maximum concentrations of inorganics detected in Zone 7 soil samples.

Four VOCs were detected in the Zone 7 storm sewer sediment samples. 4-Methyl-2-pentanone (6 µg/kg) was detected in sediment sample 20SD2, and carbon disulfide (10 µg/kg) was detected in sediment sample 20SD1. In addition, acetone and methylene chloride, which are both common laboratory contaminants, were detected in both sediment samples at concentrations ranging from 11 µg/kg to 120 µg/kg.

Bis(2-ethylhexyl)phthalate and butylbenzyl phthalate, which are both common laboratory contaminants, and three PAHs were detected in sediment sample 20SD1. In addition bis(2-ethylhexyl)phthalate, butylbenzyl phthalate, and 10 PAHs were detected in sediment sample 20SD2. Concentrations of PAHs detected in sediment sample 20SD1, located southwest of Site 25, ranged from 440 µg/kg (benzo(b)fluoranthene) to 580 µg/kg (pyrene). Concentrations of PAHs detected in sediment sample 20SD2, located southwest of Building 173, ranged from 310 µg/kg [benzo(g,h,i)perylene] to 1,200 µg/kg (fluoranthene and pyrene). Maximum concentrations of PAHs detected in Zone 7 storm sewer sediment samples were from 10 to 25 times less than maximum concentrations of PAHs detected in Zone 7 shallow soil samples and from five to 11 times less than maximum concentrations of PAHs detected in Zone 7 deep soil samples.

No pesticides or PCBs were detected in either of the Zone 7 storm sewer sediment samples. TPH was detected in both sediment samples 20SD1 (1,300 mg/kg) and 20SD2 (1,100 mg/kg). Concentrations of TPH detected in Zone 7 sediment samples are approximately one-half the maximum TPH concentrations detected in Zone 7 shallow and deep soil samples.

10.5 CONTAMINANT FATE AND TRANSPORT

10.5.1 General Contaminant Fate and Transport Processes

The major area of concern for Zone 7 is impacted soil, as evidenced by the widespread detection of PAHs and the detection of lead at extremely high concentrations. In addition, Zone 7 soils also contain several other metals (antimony, arsenic, barium, beryllium, boron, iron, cadmium, chromium, cobalt, copper, cyanide, mercury, manganese, nickel, selenium, vanadium, and zinc) at elevated concentrations relative to background concentrations.

PAHs are generally considered to be fairly immobile in the environment. As noted in Section 3.3.2.4, PAHs have very low solubilities, vapor pressures, and Henry's Law constants, and high K_{oc}s and K_{ow}s. The low-molecular weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) are more mobile (higher solubilities, etc.) than the high-molecular-weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.). PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than go into solution. PAHs can be degraded via aerobic bacteria, but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorous and nitrogen.

Within Zone 7, PAHs were found in both shallow and deep soils. Generally, the concentrations of PAHs detected in the shallow soil samples were slightly higher (within the same order of magnitude) than the concentrations detected in the deep soil samples. There does not appear to be a correlation between the concentrations detected in the shallow soil and the concentrations detected in the deep soils (i.e., the highest concentrations detected in the deep soils were in different areas than the highest shallow soil concentrations). In addition, the concentrations in the shallow and deep soils were generally similar. Consequently, it appears that the presence of PAHs is indicative of the fill material used at Zone 7 and that significant migration of the PAHs is not occurring.

PAHs have also been detected in some of the groundwater samples at Zone 7. As noted above, PAHs have very low solubilities and generally do not enter into solution. However, the PAHs that have been detected in the groundwater are the low-molecular weight PAHs that would have the highest solubilities and highest mobility of the PAHs detected. In addition, the concentrations that were detected were in the range of 0.6 to 10 µg/L. These low concentrations indicate that the PAHs detected in the groundwater samples may be the result of soil particles present in the groundwater samples (i.e., samples with high turbidity).

As noted in Section 3.3.2.9, metals are highly persistent environmental contaminants. They do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

In addition, under normal conditions, metals are not very mobile in the environment. Because metals frequently remain bound to particulate matter, the major transport mechanism for metals is bulk movement processes (erosion). However, metals can become mobile in the environment under certain conditions. The mobility of metals is influenced primarily by their physical or chemical properties in conjunction with the physical and chemical properties of the soil matrix. Factors that assist in predicting the mobility of metals are the soil/pore water pH, REDOX potential, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity. The effect of REDOX potential varies for each metal.

Within Zone 7, lead was detected in shallow soil samples and deep soil samples at significant concentrations, although in a limited area. In addition, other metals were also detected at elevated concentrations relative to background concentrations. The presence of metals in the soil samples may be indicative of the fill material used to construct the Lower Subase. However, the presence of lead in shallow and deep soil samples at the concentrations detected may be more likely the result of handling of lead batteries used in submarines for underwater propulsion until the 1950's. Because of the low pH acid present in the batteries, the lead in the batteries would have been extremely mobile, and if the batteries had been spilled on the ground surface, the lead would have migrated much farther than under normal conditions.

Lead was also detected at elevated concentrations in groundwater samples collected at Zone 7. However, the elevated concentrations were detected in only one monitoring well (20MW6), which is in the same area as the elevated lead concentrations in soil. Consequently, lead has migrated to the groundwater, but the migration is not widespread.

Because the use of the lead acid batteries was discontinued in the 1950's, it is likely that the pH of the media in the area of Zone 7 has increased to its present level (groundwater pH between 6.3 and 7.76 and soil pH unknown). In soil with a pH of 6 to 8, lead may form insoluble organic lead complexes, or if the soil has less organic matter at the same pH, hydrous lead oxide complexes may form or lead may precipitate out with carbonate or phosphate ions. As long as the pH in the soil remains above 6, the lead present in the soil may continue to be relatively immobile and the lead concentration in the groundwater may decrease over time as it is flushed out.

10.5.2 Effects of Cross Contamination on Other Zones and the Thames River

TPH is an indicator of petroleum hydrocarbons contamination. PAHs are the primary components of diesel fuel, which was stored in the UTSs at Zone 7, and fuel oils such as No. 2 and No. 6, which are used throughout the Lower Subase and distributed through the fuel lines that ran throughout Zone 7. Therefore, observed TPH contamination at the site is assumed to be mainly comprised of PAHs and other semivolatile compounds. As shown in Drawings 8 and 9 in Volume III of this RI report, concentrations of TPH in shallow and subsurface soil, respectively, are elevated in Zone 7. The area of elevated TPH concentrations in shallow soil extends beyond the boundary of Zone 7 on the northern and southeastern sides of the site. The area of elevated TPH concentrations in subsurface soil extends beyond the boundary of Zone 7 on the northeastern side of the site. This indicates that cross contamination to areas outside of Zone 7 may have occurred.

VOCs (acetone, carbon disulfide, and methylene chloride) and SVOCs (mainly PAHs) were detected in surface and subsurface soil at Zone 7. VOCs (1,1,1-trichloroethane, chloroform, and trichloroethene) and SVOCs (mainly PAHs) were detected in Zone 7 groundwater. However, TPH, which was detected in the soil, was not detected in groundwater at Zone 7. SVOCs (mainly PAHs) were detected in Zone 7 sediment samples. Low and high molecular weight PAHs were detected in soil and sediment samples, whereas only the low molecular weight PAHs were detected in groundwater. Concentrations of SVOCs in sediments were generally lower than those in soil (i.e., by as much as an order of magnitude). Concentrations of SVOCs in Zone 7 sediments were slightly higher than those collected from upstream and downstream of the Lower Subase. This suggests that migration of PAHs to the Thames River sediments adjacent to Zone 7 may have occurred.

Several inorganics (i.e., antimony, arsenic, barium, beryllium, boron, calcium, chromium, cobalt, cadmium, copper, cyanide, iron, lead, magnesium, manganese, nickel, mercury, potassium, selenium, silver, sodium, vanadium, and zinc) have been detected in soil samples at concentrations exceeding background levels. With the exception of a few chemicals, these inorganics were also detected in groundwater samples collected from Zone 7. Most of these inorganics were also detected in Thames River sediment samples at concentrations exceeding background, indicating that migration of some inorganics to the Thames River may have occurred.

As shown in Drawings 10 and 11, lead has been detected at concentrations exceeding background levels in subsurface soils. Concentrations of lead are highest in the eastern section of Zone 7. Based on the krigging results, the area of elevated lead concentrations extends beyond the boundary of Zone 7 to the

northeastern and southeastern portions of the site, indicating that cross-contamination to areas outside of Zone 7 may have occurred.

The distribution of total and dissolved lead in groundwater is shown on Drawings 13 and 14, respectively. The total and dissolved data from well 20MW6 indicate that a plume of lead contamination is centralized in the groundwater west of Building 456. This location is consistent with the high concentrations of lead detected in the soil. Wells downgradient of 20MW6 do not show any concentrations of dissolved lead above detection limit. These data could indicate that the lead is not migrating downgradient. The data could also indicate that tidal fluctuations, which influence this region, flush the groundwater from this location, and therefore, cause lead to migrate from Zone 7 to the Thames River.

There may be other off-property contaminant sources contributing to the contamination detected in Thames River sediments. The Thames River is tidally influenced and contaminants may be migrating in the river from upstream and downstream sources. Also, the observed sediment contamination may be a result of spillage that may have occurred during historical refueling of submarines and tugboats at the Lower Subase.

10.5.3 Evaluation of Natural Attenuation Data

Soil and groundwater samples were collected in Zone 7 and analyzed in the field or by a fixed-based laboratory. The resulting data provide the information necessary to answer the three following questions:

- Are contaminants present in either medium that could be remediated via natural attenuation or bioremediation?
- Is natural attenuation currently in progress in the groundwater?
- Are the conditions in the groundwater favorable for natural attenuation or bioremediation?

For Zone 7, TPH concentrations in soil and groundwater were contoured and the results are presented on Drawings 8, 9, and 12. Drawings 8 (shallow soil) and 9 (deep soil) show that high levels of TPH (i.e., indicative of petroleum hydrocarbons) are present in soil of Zone 7. The maximum TPH concentrations in shallow soil were detected in MW4-7RI (1,500 mg/kg, north) and MW5-7RI (2,600 mg/kg, south). The maximum TPH concentrations in deep soil were detected in 20MW7 (2,500 mg/kg, north) and 20TB4 (1,500 mg/kg, south). As discussed in Section 10.4, PAHs were also frequently detected in the shallow and deep soil of Zone 7, which confirms the TPH concentrations. TPH was not detected in the groundwater of Zone 7 above the detection limit. Low concentrations of VOCs and SVOCs were infrequently detected in the groundwater. These results indicate that petroleum hydrocarbons are present

mainly in the soil and are migrating to a limited extent to the groundwater. As discussed previously, petroleum hydrocarbons in either media can be treated successfully via natural attenuation or bioremediation.

The procedure for evaluating natural attenuation data for groundwater was previously outlined in Section 3.3.4 and is followed in this section. Table 10-11 summarizes the parameters that were measured to determine if natural attenuation is occurring in the groundwater of Zone 7. Other information in the table includes parameter-specific concentration ranges and frequency of detections. Drawings showing the distribution of key parameters were also prepared to aid in the interpretation of the data. The drawings that were prepared include the following:

- Drawing 2 - High Tide Potentiometric Surface Map
- Drawing 4 - Low Tide Potentiometric Surface Map
- Drawing 15 - Dissolved Oxygen
- Drawing 16 - REDOX potential
- Drawing 17 - Divalent Iron
- Drawing 18 - Specific Conductivity

The following conclusions were reached after review and evaluation of the data presented in Table 10-11 and Drawings 2, 4, and 15 through 18.

- The dissolved oxygen data suggest that Zone 7 groundwater is slightly aerobic, with most concentrations near 1 mg/L. As discussed below, these data do not correspond well with the REDOX potential or methane measurements; therefore, the measurements are suspect. The discrepancies may be related to problems encountered with the dissolved oxygen probe and/or calibration of the probe.

- The REDOX potential measurements (i.e., 10 of 11 negative measurements) indicate that the groundwater beneath Zone 7 is generally anaerobic, except near 20MW5. The REDOX potential measured at 20MW5 (61.9 mV) was similar to the value measured at MW1-6RI (52.8 mV).

- The nitrate results (i.e., all concentrations below the criterion of 1 mg/L and the concentration at the upgradient well MW1-6RI of 1.4 mg/L) suggest that denitrification is probably occurring in Zone 7 groundwater.

- Divalent iron was detected in monitoring wells 20MW2, 20MW6, 20MW7, MW1-7RI, MW5-7RI. This data indicates that iron reduction is occurring in three general regions of Zone 7 including the north-central, southeast, and southwest regions.

- Sulfate concentrations detected in 20MW2, 20MW5, 20MW7, MW1-7RI, MW3-7RI, and MW4-7RI were all below the criterion of 20 mg/L and the concentration detected in MW1-6RI (25 mg/L). Concentrations of sulfate detected in the remaining Zone 7 wells ranged from 22 mg/L to 51 mg/L. This data suggests that sulfate reduction may be occurring in isolated areas of Zone 7.

- Methane was detected in all eleven of the monitoring wells that were sampled in Zone 7 indicating that the groundwater is generally anaerobic and that methanogenesis is occurring. Concentrations of methane were detected in excess of 1 mg/L in 20MW2, 20MW5, 20MW7 and MW1-7RI. Generally, these are the same wells that had low concentrations of sulfate and detectable levels of divalent iron.

- Concentrations of alkalinity and hardness in the groundwater were low compared to other zones; however, a majority of the concentrations were in excess of concentrations detected at MW1-6RI.

- A maximum temperature of 55°C was measured in the groundwater in MW2-7RI. The high temperature is similar to the maximum temperature measured in Zone 1 and is most likely the result of the groundwater being in contact with an underground steam line. Slightly higher temperatures (22.1°C and 21.79°C, respectively) were also detected in 20MW4 and MW1-7RI.

- Groundwater pH was generally normal for Zone 7. The highest pH values (7.72 and 7.76, respectively) were detected in MW2-7RI and 20MW7.

- Ammonia was detected in eight of 11 wells. This information further collaborates the idea that denitrification is occurring because ammonia is an intermediate product of denitrification.

- Phosphorous was detected in the groundwater and is available as a nutrient.

- Salinity and chloride concentrations were generally low when compared to the levels in the Thames River. Most concentrations detected in Zone 7 wells exceeded the concentrations detected in MW1-6RI, but not significantly. Drawings 2 and 4 indicate that the western portion of Zone 7 is tidally influenced during high tide and the northwestern portion of the zone is influenced during low tide.

The information provided above indicates that natural attenuation is occurring in three regions of Zone 7 (i.e., the north-central, southeast, and southwest regions). The fact that SVOCs were infrequently detected and VOCs were not detected in the groundwater during the latest round of sampling is most likely the result of a variety of factors (i.e., condition, type, and age of source, natural attenuation, mobility of contaminants, unique hydrogeologic conditions, and tidal flushing). Due to the variety of factors influencing Zone 7 and the limited contaminant plume, it is unlikely that bioremediation or other more active remedial technologies are practical or necessary for the groundwater of this zone. It is likely that a combination of monitored natural attenuation or a tiered groundwater monitoring program and source control would be a viable remedial strategy for this zone. If monitored natural attenuation is selected as part of the remedial strategy for Zone 7, additional investigations would need to be completed to provide the preliminary data required for the alternative and to monitor the progress of the alternative. Monitoring of the non-tidally influenced areas of Zone 7 would provide the best indication that natural attenuation processes are working in the groundwater.

10.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the baseline risk assessment performed for soil and groundwater exposures at Zone 7 of the Lower Subase. Section 10.6.1 contains a discussion on the selection of COCs, Section 10.6.2 contains information on the potential receptors considered and the routes by which they might be exposed, Section 10.6.3 contains the numerical results of the risk assessment, and Section 10.6.4 presents site-specific uncertainties associated with the risk assessment.

10.6.1 Data Evaluation

COCs were identified for Zone 7 of the Lower Subase using risk-based COC screening levels, as described in Section 3.4.3. All validated data collected during the Lower Subase RI and additional investigations, except soil data collected from depths greater than 10 feet, were used to identify COCs. Table 10-14 provides a list of COCs for Zone 7. Appendix I.11 contains the COC summary screening tables for the site.

A medium-specific discussion of COCs is presented in the following subsections. Within a given medium, discussions of direct exposure COCs (i.e., those chemicals detected at concentrations in excess of Federal and state direct exposure criteria) and additional COCs are provided. Additional COCs are identified based on contaminant migration tendencies: migration from soil to groundwater and from groundwater to the Thames River. These additional COCs are not quantitatively addressed in the human health risk assessment (i.e., numerical risk estimates are not developed) because they are not considered to be significant contributors to the direct exposure pathways identified for potential human receptors.

10.6.1.1 Soil Chemicals of Concern

The following chemicals were identified as direct exposure COCs for soil based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for residential land use and Connecticut RSRs for direct exposure (residential and industrial land use):

- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene].
- Inorganics (aluminum, antimony, arsenic, beryllium, copper, iron, lead, manganese, and vanadium).
- TPH.

Copper, manganese, and vanadium were selected as COCs for the "all soils" (soil from depths of 0 to 10 feet) category only. TPH was qualitatively identified as a COC for shallow soil and "all soil" because the maximum detected concentrations exceeded the Connecticut RSRs for residential and industrial direct exposure.

Maximum detections in soil were also compared to generic USEPA SSLs for migration from soil to groundwater and Connecticut RSRs for pollutant mobility in a GB classified area. Maximum concentrations of the following chemicals exceeded the generic soil pollutant mobility criteria, indicating the potential for these chemicals to migrate to groundwater and potentially impact the water quality:

- Methylene chloride.
- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene].
- Inorganics (antimony, arsenic, barium, cadmium, chromium, lead, nickel, selenium, and zinc).
- TPH.

Under the Connecticut RSR (CTDEP, 1996), concerns regarding the mobility of inorganics in soil are addressed using TCLP and SPLP data. A comparison of site-specific TCLP and SPLP data and state RSRs for pollutant mobility is provided in Tables 10-4 and 10-5. Lead concentrations in the TCLP extracts from several subsurface soil samples exceeded the state GB pollutant mobility criteria. However, lead concentrations in the SPLP extracts from recently collected soil samples were less than the state criteria.

Although the use of generic mobility criteria (rather than site-specific criteria) results in a conservative identification of additional COCs for soil, the mobility of inorganics chemicals (including lead) is supported

by the groundwater data available for the site. Of the chemicals previously identified as migration COCs for soil, a few PAHs (carbazole, chrysene, and dibenzo(a,h)anthracene) and several inorganics (antimony, arsenic, barium, cadmium, chromium, lead, nickel, selenium, and zinc) were detected in groundwater samples collected from the site. A discussion of COCs for groundwater is provided in the following subsection.

10.6.1.2 Groundwater Chemicals of Concern

COCs for groundwater were selected using unfiltered and filtered data. Although groundwater at the site is not currently used or expected to be used in the future as a drinking water supply because of saline conditions, a conservative list of direct exposure COCs was developed for this medium based on a comparison of maximum detected concentrations to USEPA Region III COC screening levels for tap water, Federal and state MCLs, and Connecticut RSRs for the protection of groundwater. Chemicals retained as direct exposure COCs include the following:

- Chloroform
- Inorganics (aluminum, antimony, arsenic, barium, boron, cadmium, iron, lead, manganese, selenium, sodium, and thallium)

Boron, cadmium, and thallium were identified as COCs for the filtered sample matrix only. Boron, cadmium, and thallium were not detected in unfiltered groundwater samples. Selenium was identified as a COC for the unfiltered sample matrix only. Concentrations of selenium in filtered groundwater samples were below screening criteria. Sodium was retained as a COC because maximum detections for this chemical in unfiltered and filtered groundwater samples were in excess of the State Notification Level. However, elevated levels of sodium in groundwater are anticipated because of nearby saltwater intrusion from the Thames River.

Since Zone 7 borders the Thames River, maximum concentrations in groundwater were also compared to the Connecticut WQSs for aquatic life (chronic saltwater criteria) and for the protection of human health (water and organisms). These criteria were used to evaluate the potential for contaminant migration to the water body. The following chemicals were detected at maximum concentrations in excess of the state WQSs:

- PAHs (acenaphthylene, chrysene, and phenanthrene)
- Inorganics (antimony, arsenic, copper, lead, nickel, thallium, and zinc)

Antimony was identified as an additional COC for the unfiltered sample matrix only. Reported concentrations of antimony in the unfiltered groundwater samples were less than Connecticut WQSs. Thallium was identified as a COC for the filtered matrix only. Thallium was not detected in the unfiltered groundwater samples.

The actual impact on the water quality in the Thames River is not expected to be as significant as the qualitative comparison implies since significant dilution and tidal mixing are anticipated, thereby reducing contaminant concentrations. For example, the maximum detected concentrations of most of the inorganic chemicals previously identified as migration COCs (antimony, copper, nickel, thallium, and zinc) are within one order of magnitude of the Connecticut WQSs. Appropriate alternative surface water protection criteria can be calculated by multiplying the lower of the human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. Consequently, these chemicals are not considered to be problematic since the maximum concentration of these chemicals would be less than the alternative SWPC. In addition organic migration COCs were detected infrequently in groundwater samples (i.e., less than 11 percent of the samples). A separate evaluation of the water and sediment quality in the Thames River is provided in Section 11.0.

10.6.1.3 Exposure Point Concentrations

Exposure point concentrations were developed for direct exposure COCs only using the methodologies presented in Section 3.4.1. The average and maximum detected concentrations for soil and groundwater were typically used for the RME and CTE, respectively. The 95 percent UCL was not used for soil in most cases because the distribution of the data set could not be defined. Groundwater exposure concentrations were developed using USEPA Region I guidance (USEPA, 1994f). A summary of the exposure point concentrations used to estimate potential risks associated with direct exposure COCs for Zone 7 is provided in Table 10-15.

Because of a lack of published dose-response parameters, some essential human nutrients (calcium, magnesium, potassium, and sodium) detected in the site media were not identified as COCs or quantitatively evaluated in the risk assessment. TPH was identified as a direct exposure COC based on a qualitative analysis. However, exposure to this chemical could not be quantitatively evaluated because of the lack of dose-response parameters. In addition, although aluminum, copper, and iron may be identified as COCs, USEPA Region I does not advocate a quantitative evaluation of exposure to them because the only available toxicity criteria for these chemicals are provisional reference doses based on daily allowable

intakes rather than adverse effect levels. Exposure to these chemicals is addressed in the general uncertainty section of the baseline human health risk assessment, Section 3.4.5.

10.6.2 Exposure Assessment

This section presents a summary of the persons potentially exposed to soil and groundwater at Zone 7 of the Lower Subase and describes the routes by which they might be exposed. Details on the exposure parameters used in the quantitative risk assessment were provided in Section 3.4.3.

The most likely receptors at this site include any full-time adult employees or military personnel assigned to the various buildings. These persons could be exposed to shallow soil via direct contact (incidental ingestion or dermal contact). They are assumed to be exposed 150 days/year for 6 years for the CTE and for 25 years for the RME.

A construction worker scenario was also evaluated for Zone 7. A construction project is assumed to take between 80 (CTE) and 120 (RME) days in a 1-year period. These persons could come into contact with "all soil" (soil from depths of 0 to 10 feet) via dermal contact and incidental ingestion. These receptors may also be dermally exposed to groundwater during ground-intrusive activities.

Since the site is located along the Thames River and waterfront property is typically regarded as an attractive location for residential development, future residents were evaluated as potential receptors. This exposure scenario is dependent upon base closure, which is considered to be highly unlikely because of the critical nature of the facility with respect to support of the submarine fleet and national defense. Therefore, this scenario is primarily evaluated for informational purposes only (i.e., to aid in decision making and risk management decisions). Future potential residents are not expected to come in contact with groundwater at the site because saline conditions that exist near the Thames River would preclude domestic use of groundwater. Receptors are assumed to be exposed to "all soil" (soil from depths of 0 to 10 feet) via incidental ingestion and dermal contact. Soil exposures were assumed to occur 150 days/year for a total of 7 years under the CTE and 30 years for the RME.

There are no dermal absorption factors available for antimony, beryllium, manganese, and vanadium. As requested by EPA Region I, dermal exposures to these COCs will be evaluated using a generic absorption factor of 0.01 and the results will be discussed in the uncertainty analysis presented in Section 10.6.4.

The identified potential receptors could also be exposed to chemicals in soil via inhalation of fugitive dust and volatile emissions. This exposure pathway is evaluated in a qualitative fashion by a comparison of maximum soil concentrations to generic USEPA SSLs for the inhalation pathway, as summarized in the site-specific COC summary screening tables in Appendix I.11. Maximum detections for all soil chemicals were less than the inhalation SSLs, indicating that the inhalation pathway is not expected to be a significant exposure route. Consequently, this exposure route was eliminated from further quantitative risk evaluation.

10.6.3 Risk Characterization

A summary of the quantitative risk assessment for Zone 7 is provided in this section. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for the RME and CTE scenarios, are outlined in Table 10-16. Sample calculations are provided in Appendix I.3. Appendix I.11 contains the chemical-specific risks for Zone 7.

10.6.3.1 Noncarcinogenic Risks

With the exception of the construction worker under the RME scenario, cumulative Hazard Indices (HIs) for all receptors are less than unity, indicating that no adverse effects are anticipated for these receptors under both RME and CTE scenarios. The cumulative HI for the construction worker exposed to soil and groundwater under the RME scenario is 1.59.

Although all chemical-specific Hazard Quotients (HQs) for the RME construction worker are less than unity, the cumulative HI for this receptor slightly exceeded unity. Noncarcinogenic hazards for the construction worker under the RME are primarily attributable to inorganics (antimony in soil and manganese in groundwater). To identify whether toxic effects are likely under the RME scenario, a discussion of target organ effects is necessary for those chemicals contributing significantly to the cumulative risks. Chemical-specific HQs are not truly cumulative unless similar target organs or mechanisms of action are observed. Toxicological studies indicate that the primary target organs for exposure to those chemicals contributing the most to the cumulative risk for the construction worker are as follows:

Chemical	Hazard Quotient	Target Organ
Antimony	0.90	Whole body, Blood
Manganese	0.43	Central nervous system

Based on the information presented above, it is unlikely that a total HI for a single target organ would exceed unity. Therefore, no toxic effects are anticipated for the construction worker under the RME scenario.

10.6.3.2 Carcinogenic Risks

Cumulative incremental cancer risks for Zone 7 ranged from 6.6E-7 for the construction worker (CTE) to 1.5E-4 for the future resident (RME). The cancer risk for the full-time employee (2.0E-4) and the future resident (1.5E-4) exceeds the USEPA target risk range of 1E-4 to 1E-6 and the CTDEP cumulative target risk level of 1E-5. Cancer risks for all other receptor groups were within or less than the USEPA and CTDEP cumulative target risk range.

The exposure routes of concern for the full-time employee and future resident under the RME scenario are incidental ingestion and dermal contact with soil. As summarized in Table 10-17, benzo(a)pyrene and dibenzo(a,h)anthracene are the major contributors to the elevated cancer risk. For the RME full-time employee, chemical-specific cancer risks for benzo(a)pyrene were greater than 1E-4 and benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene were greater than 1E-5. For the RME future resident, chemical-specific cancer risks for benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were greater than 1E-5 and cancer risks for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and arsenic were greater than 1E-6 but less than 1E-5.

10.6.3.3 Exposure to Lead

Lead was identified as a potential COC for soil and groundwater at the Lower Subase. Maximum detections of the chemical in site media exceeded the associated screening criteria. Soil lead exposure to small children at Zone 7 was addressed using the USEPA IEUBK Model, as discussed in Section 3.4.3. The UCL for "all soil," as well as several default parameters, were used to calculate estimated blood-lead levels for children in a residential setting. The estimated geometric mean blood-lead level for children exposed to lead in site soil was 205 µg/dL for CTE and RME scenarios, which is greater than the established level of "concern" of 10 µg/dL. The IEUBK model estimates that 100 percent of children are expected to have blood-lead levels greater than 10 µg/dL. This percentage is greater than the acceptable level of 5 percent. The IEUBK results indicate that adverse effects are anticipated for children exposed to lead in shallow and subsurface soil at Zone 7.

As discussed in Section 3.4.3, exposures to lead by nonresidential adults were evaluated by use of a slope-factor approach developed by the USEPA Technical Review Workgroup for Lead (USEPA, 1996f and 1996g). The estimated 95th percentile fetal blood-lead level in women exposed to lead in site soil was

575 µg/dL (CTE) and 1,143 µg/dL (RME) for future employees and 4,373 µg/dL (RME) for construction workers. The CTE scenario could not be evaluated for the construction worker since the exposure frequency of 80 days a year is less than the model recommended minimal exposure frequency of 90 days a year. The values for the future employee and future construction worker are greater than the established level of "concern" of 10 µg/dL indicating that adverse effects are possible for the fetuses of pregnant women workers exposed to lead in surface and subsurface soil at Zone 7. The estimated 95th percentile blood-lead level for women exposed to lead in site soil was 188 µg/dL (CTE) and 375 µg/dL (RME) for future employees and 1,434 µg/dL (RME) for construction workers. These values are greater than the OSHA permissible blood-lead level of 40 µg/dL for adults, indicating that adverse effects are possible for adults exposed to lead in surface and subsurface soil at Zone 7.

The USEPA IEUBK Model was not used to assess exposure to lead in groundwater at Zone 7 since this medium is not expected to be used as a potable water supply. If groundwater were to be used for domestic purposes, it is expected that adverse effects would be experienced by potential receptors as reported groundwater detections exceeded drinking water standards.

10.6.4 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 3.4.5. Site-specific uncertainties for Zone 7 risk evaluation are presented below.

Dermal exposure to antimony, beryllium, manganese, and vanadium in soil could not be quantitatively evaluated in the risk assessment since there are no dermal absorption factors available for these compounds. Therefore, as requested by EPA Region I, a screening analysis was performed for dermal exposures to antimony, beryllium, manganese, and vanadium in soil using a generic absorption factor for inorganics of 0.01. Cancer risks could not be calculated for antimony, beryllium, manganese, and vanadium since no oral cancer slope factors are available for these compounds. Hazard indices are as follows:

	Scenario	
Receptor	**RME**	**CTE**
Construction Worker	0.21	0.01
Full-time Employee	0.005	0.001
Future Resident	0.34	0.03

As discussed in Section 10.6.3.1, the hazard quotient for incidental ingestion of antimony in soil was 0.9. The hazard quotient resulting from dermal contact with antimony in soil is 0.07. The total hazard index for incidental ingestion and dermal contact with antimony in soil is 0.97 which is slightly less than the acceptable level of 1.0. These results suggest that adverse health effects from exposures to antimony in soil may result if the dermal absorption factor for antimony is significantly greater than 0.01.

Some inorganic chemicals detected in site soil samples may be attributable to naturally occurring background levels. Background levels for metals in soil at NSB-NLON, developed by Atlantic Environmental Services, were presented in Table 1-4. All reported concentrations of aluminum and thallium in the site soils were less than the established background levels.

Based on a review of the historical data for Zone 7, it was noted that dioxins were detected in one of four soil samples (20MW6 from 2 to 4 ft). The detection is associated with a total dioxin-equivalent concentration of 0.16 µg/kg (Atlantic, 1995a). The analytical results for this sample were not validated; consequently, they were not used in the risk assessment. The low level of dioxin detected at this location is greater than the USEPA Region III RBC for residential exposures but is less than the 1 µg/kg screening level used at other Superfund sites. The probable source of dioxins is assumed to be ashes, which are located in a large soil layer encountered at a depth of 3 to 10 feet. Other than locations 20MW6 and 20TB7, the only other ash observed was a trace of cinders at an approximate depth of 5 feet at 20TB5. Since dioxins were detected in only one subsurface soil at a low concentration, no significant adverse health risks are expected from overall exposure to site media.

The calculated risks for exposure to soil under current site conditions are to some degree overestimated. Most of the soil samples collected at the site were obtained from locations beneath pavement. All soil samples (currently exposed and beneath pavement) were used to conservatively evaluate potential risks for the site. Therefore, actual exposure under current site conditions is less than the exposure that is assumed for the risk assessment.

10.7 SUMMARY AND RECOMMENDATIONS

This section presents a summary of major findings for Zone 7 of the Lower Subase. A summary of the nature and extent of contamination is provided in Section 10.7.1. Section 10.7.2 includes a summary of contaminant fate and transport information and Section 10.7.3 provides a synopsis of the baseline human health risk assessment for Zone 7. Section 10.7.4 provides recommendations regarding additional action and investigatory efforts for the soil and groundwater of Zone 7. A summary of the ecological risks for the

Thames River adjacent to Zone 7 and the corresponding recommendations for the river are provided in Section 11.0.

10.7.1 Nature and Extent of Contamination

A large area of lead contamination was identified based on analytical data for both shallow and deep soils collected within Zone 7. This area covers most of the eastern half of Zone 7. The greatest concentrations of lead in Zone 7 shallow soils were noted along the western side of Building 456 and the greatest concentrations of lead in Zone 7 deep soils were noted in the area surrounding the eastern side of Building 157. Concentrations of lead in the soils within this area of contamination are greater than lead concentrations detected in soils in all other zones of the Lower Subase. Lead contamination was also noted in the groundwater samples collected from this area, particularly in the unfiltered groundwater samples collected along the western side of Building 456.

Two general areas of TPH contamination were identified in Zone 7 soils. These areas are in the northwestern corner of Zone 7 and in the southern third of Zone 7. TPH contamination in Zone 7 shallow soils is more widespread and is present at greater concentrations than TPH contamination in Zone 7 deep soils.

Several SVOCs, primarily PAHs, were detected in Zone 7 shallow and deep soil samples. Pesticides were also noted in shallow and deep soil samples collected from two borings located along the eastern boundary of Zone 7. Based on the analytical results of the off-site, upgradient shallow soil sample, it is likely that the source of pesticide contamination is from off-site activities. Dioxin was also detected in one Zone 7 shallow soil sample.

Little organic contamination was noted in Zone 7 groundwater samples. As previously noted, two areas of lead contamination were identified, based analytical data for groundwater samples collected from Zone 7.

Several inorganics, PAHs, and TPH were detected in the two sediment samples collected from the storm drains within Zone 7. The exact source of these contaminants is not known.

10.7.2 Contaminant Fate and Transport

Petroleum hydrocarbons and SVOCs, as well as inorganic concentrations in excess of background (namely lead), have been detected in the soil of Zone 7. Geostatistical analysis of the soil data indicates that contamination in Zone 7 may be impacting regions outside the zone. Analytical results from the groundwater sampling activities indicate that the petroleum hydrocarbons in the soil are generally not

migrating to the groundwater but that inorganics (namely lead) are migrating to the groundwater. The Thames River, which is downgradient of Zone 7, showed some potential evidence of cross-contamination from PAHs and inorganics. Lead, which was detected in the soil and groundwater of Zone 7, was not a contaminant of concern in the Thames River. An evaluation of natural attenuation indicated that this process is feasible for the soil because of the presence of biodegradable contaminants (i.e., petroleum hydrocarbons and SVOCs). Key parameters indicate that natural attenuation is occurring in limited portions of the groundwater of Zone 7; however, petroleum-related compounds were detected infrequently and at low concentrations in the groundwater. Therefore, a tiered groundwater monitoring program versus monitored natural attenuation may be an option that could be evaluated further as part of the remedial strategy for Zone 7.

10.7.3 Baseline Human Health Risk Assessment

The baseline human health risk assessment for Zone 7 focused on three potential receptor groups: construction workers, full-time employees, and future residents. Noncarcinogenic risks for all receptor groups were less than the USEPA and CTDEP acceptable limit of one, except for the construction workers under the RME scenario. Although the RME HI for the construction workers slightly exceeded unity, adverse impacts are not anticipated since the major contributors (antimony and manganese) to the cumulative risk do not affect the same target organs. Cumulative risks to each individual target organ are expected to be less than unity. The cancer risk for the full-time employee and future resident under the RME scenario exceeded the USEPA target risk range of 1E-4 to 1E-6 and the CTDEP cumulative target risk level of 1E-5. Cancer risks for all other receptors were within or less than the USEPA and CTDEP target risk levels. The elevated risks are attributable to PAHs and arsenic in soil.

Lead was detected at concentrations exceeding the 400 mg/kg OSWER soil screening level for residential land use and the 15 µg/L federal drinking water Action Level. Evaluation of lead using the IEUBK model for children and the interim slope-factor approach for adult workers indicates that adverse health effects are anticipated for these receptors from exposure to lead in Zone 7 soil.

Calculated risks associated with current soil exposure (for full-time employees) are overestimated to some degree. Although the risk assessment was conducted using all soil data collected from Zone 7, most of the soil samples were obtained from locations beneath pavement. Under current site conditions, potential receptors would not be exposed to these soils.

Maximum detected concentrations of PAHs, metals, and TPH in soil exceeded their respective generic mobility criteria which indicates the potential exists for these chemicals to migrate from soil to

groundwater. Although the maximum detected concentrations of methylene chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the generic mobility criteria, these chemicals were not detected in groundwater samples collected at Zone 7. The mobility of the remaining PAHs and the inorganics may be supported by the groundwater data.

Maximum concentrations in groundwater were compared to Connecticut salt water WQSs since Zone 7 borders the Thames River. Several migration COCs in groundwater were identified as exceeding the Connecticut salt water WQSs. Use of the Connecticut salt water WQSs to determine groundwater impacts on the Thames River is very conservative since the WQSs do not account for the dilutional effects of the groundwater mixing with the river. Appropriate alternative surface water protection criteria can be calculated by multiplying the lower of the human health or aquatic life criterion in the latest Connecticut WQSs by a site-specific dilution factor. Recently calculated site-specific dilution factors for the DRMO (Site 6) and Goss Cove Landfill (Site 8), other NSB-NLON IRP sites located along the Thames River, were 226 and 118, respectively. The maximum detected concentrations of some migration COCs (antimony, copper, nickel, thallium, and zinc) are within one order of magnitude of the Connecticut WQSs. Therefore, the actual impact on water quality in the Thames River by these chemicals is expected to be minimal because significant dilution is anticipated, thereby reducing chemical concentrations in the Thames River. In addition organic migration COCs were detected infrequently in groundwater samples (i.e., less than 11 percent of the samples).

10.7.4 Recommendations

It is recommended that this zone, which includes Site 21 - Berth 16, Site 25 - Classified Materials Incinerator, and Transformers at Building 157, Vault 31, proceed to a feasibility study for evaluation of appropriate remedial alternatives for the soil. Because of the extensive amount of underground utilities in Zone 7 and the nature of the activities conducted at this location (i.e., national security), the feasibility study for this zone should evaluate to the extent possible alternatives that include institutional controls to limit exposure to contaminated soil and passive and/or in-situ remedial alternatives. "Hot Spot" removal actions for the lead contamination should also be evaluated during the feasibility study. In addition, it is recommended that the feasibility study evaluate limited action scenarios for the groundwater and storm sewer system of Zone 7 in conjunction with the soil remedial alternatives. The scenarios should include a tiered groundwater monitoring program and cleaning and repair of the Zone 7 storm sewer system. These recommendations are based on the following information:

- The nature and extent of organic and inorganic contamination in the soil are well defined to the extent practical considering infrastructure limitations.

- The baseline human health risk assessment indicates that carcinogenic risks for full-time employees and hypothetical future residents under the RME scenario are in excess of the USEPA acceptable risk range and the CTDEP cumulative target cancer risk level. In addition, modeling performed to evaluate exposure to lead showed that all receptors (i.e., small children, fetuses of pregnant women, future employees, and construction workers) are at risk in Zone 7. These elevated risks (for lead, as well as other chemicals) assume that sometime in the future soils currently covered by pavement or buildings are exposed and available for human contact.

- Evidence suggests that inorganic contamination (mainly lead) is migrating from the soil to the groundwater.

- Natural attenuation or bioremediation could be feasible alternatives for the petroleum contamination in the soil.

- The Navy has decommissioned the fuel lines that were once within Zone 7. Therefore, the historic source of petroleum contamination has been eliminated.

- The zone is covered with pavement or buildings, which minimizes direct exposure to the contaminated soil by human receptors.

- The data do not suggest that the petroleum contamination in the soil is significantly migrating to the groundwater. In addition, natural attenuation processes seem to be at work in the groundwater. These processes can reduce concentrations of petroleum contamination that reach the aquifer and convert the petroleum contamination to a less toxic form. Groundwater monitoring will confirm this information.

- A tiered groundwater monitoring program will allow for further actions to be completed if the results show significant impacts.

- The source of the lead contamination in the groundwater is the unsaturated soil of Zone 7. Appropriate remedial alternatives for the Zone 7 soil will be evaluated in the feasibility study. Once the appropriate actions are taken, concentrations of lead in the groundwater will decrease. Furthermore, the ecological risk assessment for the Thames River adjacent to Zone 7 (see Section

11.0) shows that the risks to ecological receptors in the sediment adjacent to Zone 7 are relatively low and that lead is not a significant threat to ecological receptors. Groundwater monitoring will confirm this information.

- The groundwater at Zone 7 is not currently or anticipated to be used in the future as a potable water source because it is brackish; therefore, there is no imminent threat to human health.

- The Thames River provides significant dilution and mixing which minimizes the impact of any contaminant migration from Zone 7.

- A limited evaluation of the invert elevations of the storm sewer system indicate that portions of the system are submerged by varying amounts during a given day or time of year. Because of the age of parts of the system (i.e., greater than 40 years) and the material that it was constructed with (i.e., vitrified clay), it is likely that the system is cracked and groundwater will infiltrate into the storm sewers.

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TABLE 10-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 7
PIER 33 AND BERTH 16/FORMER INCINERATOR SITE INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals[1] + Cyanide		RCRA Metals[2]	TPH	Fluorescence	Dioxin	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
SOIL											
20MW1-0.52.5	0.5-2.5	●	●	●	●		●	●	●		
20MW11-0.52.5[3]	0.5-2.5	●	●	●	●		●	●			
20MW2-0002	0-2	●	●	●	●						
20MW2-1416	14-16	●	●	●	●		●	●	●		
20MW3-0204	2-4	●	●	●	●						
20MW3-0810	8-10	●	●	●	●		●	●	●		
20MW4-0204	2-4	●	●	●	●						
20MW4-0406	4-6	●	●	●	●		●	●	●		
20MW5-0002	0-2	●	●	●	●					●	
20MW5-0608	6-8	●	●	●	●		●	●	●		
20MW6-0204	2-4	●	●	●	●					●	
20MW6-1214	12-14	●	●	●	●		●	●	●		
20MW7-0204	2-4	●	●	●	●					●	
20MW7-0406	4-6	●	●	●	●		●	●	●		
20TB1-0204	2-4	●	●	●	●						
20TB1-0608	6-8	●	●	●	●		●	●	●		
20TB11-0608[4]	6-8	●	●	●	●		●	●	●		
20TB2-0204	2-4	●	●	●	●						
20TB2-1416	14-16	●	●	●	●		●	●	●		
20TB3-0204	2-4	●	●	●	●						
20TB3-1012	10-12	●	●	●	●		●	●	●		
20TB4-0002	0-2	●	●	●	●						
20TB4-0406	4-6									●	
20TB4-1416	14-16	●	●	●	●		●	●	●		
20TB5-0002	0-2	●	●	●	●					●	
20TB5-0406	4-6	●	●	●	●		●	●	●		
20TB6-0002	0-2	●	●	●	●						
20TB6-0810	8-10	●	●	●	●		●	●	●	●	

TABLE 10-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 7
PIER 33 AND BERTH 16/FORMER INCINERATOR SITE INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals[1] + Cyanide		RCRA Metals[2]	TPH	Fluorescence	Dioxin	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
20TB7-3242	2.7-3.5	●	●	●	●						
20TB7-4852	4-4.3	●									
20TB17-4852[5]	4-4.3	●									
20TB7-4856	4-4.7		●	●	●		●	●	●		
20TB17-4856[6]	4-4.7		●	●	●		●	●	●		
GROUNDWATER											
20GW5	NA	●	●	●	●	●		●	●		
20GW7	NA	●	●	●	●	●		●	●		
20MW2	NA	●	●	●	●	●		●	●		
20MW3	NA	●	●	●	●	●		●	●		
20MW4	NA	●	●	●	●	●		●	●		
20MW6	NA	●	●	●	●	●		●	●		
SEDIMENT											
20SD1	NA	●	●	●	●			●	●		
20SD2	NA	●	●	●	●			●	●		

1 Analysis for boron was also performed.
2 Toxicity Characteristic Leaching Procedure (TCLP) extraction followed by analysis for RCRA metals.
3 20MW11-0.52.5 is a field duplicate of 20MW1-0.52.5.
4 20TB11-0608 is a field duplicate of 20TB1-0608.
5 20TB17-4852 is a field duplicate of 20TB7-4852.
6 20TB17-4856 is a field duplicate of 20TB7-4856.
NA = Not applicable.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 10-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 7
LOWER SUBASE REMEDIAL INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals		SPLP Lead[1]	TPH	Fluorescence	Dioxin	Misc[2]
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
SOIL											
LS7SB0010101	2-4		●					●			
LS7SB0010201	5.5-6		●								
LS7SB0020101	2-4		●					●			
LS7SB0020201	5.5-6		●								
LS7SB0030201	2-4		●					●			
LS7SB0030301	5-6		●								
LS7SB0040201	2-4		●					●			
LS7SB0040301	5-6		●								
LS7SB0050101	2-4		●					●			
LS7SB0050201	5.5-6		●								
LS7SB0060201	2-4		●		●	●	●	●			
SBFD009[3]	2-4		●		●	●	●	●			
LS7SB0060301	5-6		●		●	●	●				
LS7SB0070101	0.5-2		●					●			
SBFD005[4]	0.5-2		●					●			
LS7SB0070301	5-6		●								
LS7SB0080101	2-4		●					●			
LS7SB0080201	7-8		●								
LS7SB0090101	2-4		●		●			●			
LS7SB0090201	5-6		●		●						
LS7SB0100201	2-4		●		●	●		●			
SBFD007[5]	2-4		●		●	●		●			
LS7SB0100301	5-6		●		●	●					
LS7SB0110101	2-4		●		●			●			
LS7SB0110201	6-7		●		●						
GROUNDWATER											
LS7GW001001	NA		●		●	●		●			●
GWFD001[6]	NA		●		●	●		●			●[7]
LS7GW00301	NA		●		●	●		●			●
LS7GW00401	NA		●		●	●		●			●
LS7GW00701	NA		●		●	●		●			●

TABLE 10-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ZONE 7
LOWER SUBASE REMEDIAL INVESTIGATION
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Sample ID	Sample Depth (feet below ground)	Analysis									
		Target Compound List (TCL)			TAL Metals		SPLP Lead[1]	TPH	Fluorescence	Dioxin	Misc[2]
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved					
LS7GW00901	NA		●		●	●		●			●
LS7GW20MW201	NA		●		●	●		●			●
LS7GW20MW301	NA		●		●	●		●			●
LS7GW20MW401	NA		●		●	●		●			●
LS7GW20MW501	NA		●		●	●		●			●
LS7GW20MW601	NA		●		●	●		●			●
GWFD003[8]	NA		●		●	●		●			●[9]
LS7GW20MW701	NA		●		●	●		●			●

1 Synthetic Precipitation Leaching Procedure (SPLP) extraction followed by analysis for lead.
2 Unless otherwise noted, miscellaneous parameters include Alkalinity (as $CaCO_3$), Ammonia as Nitrogen, Chloride, Dissolved Oxygen, Divalent Iron, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), pH, Phosphorous, Redox Potential, Salinity, Specific Conductivity, Sulfate, Temperature, Total Organic Carbon, Turbidity, and Dissolved Methane.
3 SBFD009 is a field duplicate of LS7SB0060201.
4 SBFD005 is a field duplicate of LS7SB0070101.
5 SBFD007 is a field duplicate of LS7SB0100201.
6 GWFD001 is a field duplicate of LS7GW001001.
7 Miscellaenous parameters include Alkalinity (as $CaCO_3$), Ammonia as Nitrogen, Chloride, Divalent Iron, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), Phosphorous, Sulfate, Total Organic Carbon, and Dissolved Methane.
8 GWFD003 is a field duplicate of LS7GW20MW601.
9 Miscellaneous parameters include Alkalinity (as $CaCO_3$), Ammonia as Nitrogen, Chloride, Hardness (as $CaCO_3$), Nitrate (as Nitrogen), Phosphorous, Sulfate, Total Organic Carbon, and Dissolved Methane.
NA = Not applicable.
● = Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 10-3 (PAGE 1 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW1-0.52.5	20MW11-0.52.5	20MW2-0002	20MW2-1416	20MW3-0204	20MW3-0810
DEPTH (feet):	0.5 - 2.5'	0.5 - 2.5'	0 - 2'	14 - 16'	2 - 4'	8 - 10'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/31/93	03/31/93	04/01/93	04/01/93
LOCATION:	20MW1	20MW1	20MW2	20MW2	20MW3	20MW3
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		20MW1-0.52.5 (93)				
VOLATILES (µg/kg)						
2-BUTANONE	11 U	11 U	11 U	12 U	11 U	11 U
ACETONE	7 JB	7 JB	14 U	12 U	12 U	19 U
CARBON DISULFIDE	11 U	11 U	11 U	12 U	11 U	11 U
METHYLENE CHLORIDE	9 JB	9 JB	11 U	12 U	11 U	11 U
TOLUENE	11 U	11 U	11 U	12 U	11 U	11 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	370 U	390 U	340 U	400 U	11000 U	1500 U
4-CHLORO-3-METHYLPHENOL	370 U	390 U	340 U	400 U	11000 U	1500 U
ACENAPHTHENE	370 U	390 U	340 U	400 U	11000 U	1100 J
ACENAPHTHYLENE	370 U	390 U	340 U	400 U	11000 U	1500 U
ANTHRACENE	370 U	2 J	340 U	400 U	11000 U	1500 U
BENZO(A)ANTHRACENE	32 J	23 J	350	400 U	11000 U	1500 U
BENZO(A)PYRENE	35 J	33 J	380 J	400 U	11000 U	1500 UJ
BENZO(B)FLUORANTHENE	46 J	36 J	430 J	400 U	9500 J	1500 UJ
BENZO(G,H,I)PERYLENE	370 U	390 U	340 UJ	400 U	11000 U	1500 UJ
BENZO(K)FLUORANTHENE	30 J	23 J	330 J	400 U	11000 U	1500 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	93 J	32 J	340 U	400 U	11000 U	1500 U
CARBAZOLE	370 U	390 U	340 U	400 U	11000 U	1500 U
CHRYSENE	55 J	49 J	350	400 U	11000 U	1500 U
DI-N-BUTYL PHTHALATE	370 U	390 U	340 U	400 U	11000 U	1500 U
DI-N-OCTYL PHTHALATE	41 J	390 U	340 UJ	400 U	11000 U	1500 UJ
DIBENZO(A,H)ANTHRACENE	370 U	390 U	340 UJ	400 U	11000 U	1500 UJ

TABLE 10-3 (PAGE 2 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW1-0.52.5	20MW11-0.52.5	20MW2-0002	20MW2-1416	20MW3-0204	20MW3-0810
DEPTH (feet):	0.5 - 2.5'	0.5 - 2.5'	0 - 2'	14 - 16'	2 - 4'	8 - 10'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/31/93	03/31/93	04/01/93	04/01/93
LOCATION:	20MW1	20MW1	20MW2	20MW2	20MW3	20MW3
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		20MW1-0.52.5 (93)				
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN	370 U	390 U	340 U	400 U	11000 U	1500 U
FLUORANTHENE	76 J	66 J	670	400 U	15000	2100 J
FLUORENE	370 U	390 U	340 U	400 U	11000 U	1200 J
INDENO(1,2,3-CD)PYRENE	370 U	390 U	340 UJ	400 U	11000 U	1500 UJ
NAPHTHALENE	370 U	390 U	340 U	400 U	11000 U	1500 U
PHENANTHRENE	60 J	42 J	220 J	400 U	13000	1500 U
PYRENE	78 J	59 J	650	400 U	9400 J	1200 J
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.7 U	3.8 U	3.5 U	3.9 U	3.5 U	3.7 U
4,4'-DDE	17	15	3.5 U	3.9 U	3.5 U	3.7 U
4,4'-DDT	31	28	3.5 U	3.9 U	3.5 U	3.7 U
ALPHA-CHLORDANE	12	12	1.8 U	2 U	1.8 U	1.9 U
GAMMA-CHLORDANE	7.5	7.3	1.8 U	2 U	1.8 U	1.9 U
HEPTACHLOR EPOXIDE	4 P	3.9 P	1.8 U	2 U	1.8 U	1.9 U
METALS (mg/kg)						
ALUMINUM	10300	12000	4470 J	4350 J	4410 J	4620 J
ANTIMONY	5.5 U	6.7 U	1.8 U	2.5 UJ	2.2 UJ	2.3 UJ
ARSENIC	3	3.1	1 J	0.79 J	1.2 J	1.1 J
BARIUM	46.3	53.3	25.2 J	29.6 J	27.3 J	33.8 J
BERYLLIUM	0.67 B	0.78 B	0.22 U	0.19 U	0.29 U	0.33 J
BORON	91.5 U	112 U	1.2 UJ	5.7 U	3.7 U	3.4 U
CADMIUM	0.37 U	0.45 U	0.25 UJ	0.37 UJ	0.32 UJ	0.34 UJ

TABLE 10-3 (PAGE 3 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW1-0.52.5	20MW11-0.52.5	20MW2-0002	20MW2-1416	20MW3-0204	20MW3-0810
DEPTH (feet):	0.5 - 2.5'	0.5 - 2.5'	0 - 2'	14 - 16'	2 - 4'	8 - 10'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/31/93	03/31/93	04/01/93	04/01/93
LOCATION:	20MW1	20MW1	20MW2	20MW2	20MW3	20MW3
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:		20MW1-0.52.5 (93)				
METALS (mg/kg)						
CALCIUM	367 B	454 B	832 J	723 J	2590 J	896 J
CHROMIUM	12.9	13.8	6.4 J	4.6 J	8 J	9.1 J
COBALT	4.5 B	4.7 B	2.8 U	2.8 U	3.7 J	4.3 J
COPPER	8.6	7.4	10 J	3.5 U	26.6 J	15.6 J
CYANIDE	1 U	0.94 U	0.16 UJ	0.19 UJ	0.18 J	0.19 UJ
IRON	9730	11800	5960 J	6130 J	6980 J	6830 J
LEAD	14	12.6	65.1 J	2.3 J	60.7 J	38.3 J
MAGNESIUM	1390	1700	1400 J	1540 J	1830 J	2060 J
MANGANESE	230	248	100 J	79.2 J	109 J	79.8 J
MERCURY	0.06 U	0.06 U	0.06 UJ	0.02 UJ	0.06 UJ	0.03 U
NICKEL	7.5	9.1	4.9 J	5.2 J	11.5 J	7.5 J
POTASSIUM	327 B	4.8 B	1120 J	1290 J	975 J	1690 J
SELENIUM	0.69 B	0.76 B	0.18 UJ	0.22 UJ	0.2 UJ	0.18 U
SILVER	0.73 U	0.89 U	0.41 UJ	0.59 UJ	0.51 UJ	0.54 UJ
SODIUM	134 B	140 B	49.5 U	159 J	164 J	237 J
THALLIUM	0.19 U	0.19 U	0.11 UJ	0.13 UJ	0.12 UJ	0.1 UJ
VANADIUM	18.1	20.7	10 J	10.7 J	14.9 J	15.1 J
ZINC	29.8	35.8	23.1 J	12.8 J	68.1 J	41.5 J
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	70 U	70 U		72 U		970

TABLE 10-3 (PAGE 4 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW4-0204	20MW4-0406	20MW5-0002	20MW5-0608	20MW6-0204	20MW6-1214
DEPTH (feet):	2 - 4'	4 - 6'	0 - 2'	6 - 8'	2 - 4'	12 - 14'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	03/26/93	03/26/93	03/26/93	03/26/93
LOCATION:	20MW4	20MW4	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE	11 U	11 U	11 U	12 U	12 U	11 U
ACETONE	18 U	17 U	32 U	35 U	12 U	20 U
CARBON DISULFIDE	11 U	11 U	11 U	7 J	12 U	11 U
METHYLENE CHLORIDE	11 U	11 U	11 U	13 U	12 U	11 U
TOLUENE	11 U	11 U	11 U	12 U	12 U	11 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 U	380 UJ	350 U	1500 U	11000 UJ	370 U
4-CHLORO-3-METHYLPHENOL	360 U	380 UJ	350 U	1500 U	11000 UJ	370 U
ACENAPHTHENE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
ACENAPHTHYLENE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
ANTHRACENE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
BENZO(A)ANTHRACENE	360 U	380 U	570 J	1500 U	9500 J	250 J
BENZO(A)PYRENE	360 UJ	380 U	700	1500 U	14000 J	260 UJ
BENZO(B)FLUORANTHENE	360 UJ	380 U	1400	1500 U	16000 J	230 UJ
BENZO(G,H,I)PERYLENE	360 UJ	380 U	560	1500 U	7300 J	370 UJ
BENZO(K)FLUORANTHENE	360 UJ	380 U	350 U	1500 U	9700 J	290 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
CARBAZOLE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
CHRYSENE	360 U	380 U	690	1500 U	11000 J	270 J
DI-N-BUTYL PHTHALATE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
DI-N-OCTYL PHTHALATE	360 U	380 U	350 U	1500 U	11000 UJ	370 UJ
DIBENZO(A,H)ANTHRACENE	360 UJ	380 U	190 R	1500 U	11000 UJ	370 UJ

TABLE 10-3 (PAGE 5 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW4-0204	20MW4-0406	20MW5-0002	20MW5-0608	20MW6-0204	20MW6-1214
DEPTH (feet):	2 - 4'	4 - 6'	0 - 2'	6 - 8'	2 - 4'	12 - 14'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	03/26/93	03/26/93	03/26/93	03/26/93
LOCATION:	20MW4	20MW4	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN	360 UJ	380 U	350 U	1500 U	11000 UJ	370 U
FLUORANTHENE	200 J	380 U	910	1200 J	19000 J	660 J
FLUORENE	360 U	380 U	350 U	1500 U	11000 UJ	370 U
INDENO(1,2,3-CD)PYRENE	360 UJ	380 U	450	1500 U	7000 J	370 UJ
NAPHTHALENE	860 U	380 UJ	350 U	1500 U	11000 UJ	370 U
PHENANTHRENE	360 U	380 U	310 J	1500 U	7600 J	400 J
PYRENE	360 U	380 U	860 J	850 J	14000 J	560
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.5 U	3.7 U	3.5 U	3.9 U	3.7 U	3.7 U
4,4'-DDE	3.5 U	3.7 U	3.5 U	3.9 U	3.7 U	3.7 U
4,4'-DDT	3.5 U	3.7 U	3.5 U	3.9 U	3.7 U	3.7 U
ALPHA-CHLORDANE	1.8 U	1.9 U	1.8 U	2 U	1.9 U	1.9 U
GAMMA-CHLORDANE	1.8 U	1.9 U	1.8 U	2 U	1.9 U	1.9 U
HEPTACHLOR EPOXIDE	1.8 U	1.9 U	1.8 U	2 U	1.9 U	1.9 U
DIOXINS/FURANS (ng/kg)						
DIOXIN			0 U		0.16	
METALS (mg/kg)						
ALUMINUM	7280 J	3590 J	3860 J	6530 J	136 J	5050
ANTIMONY	2.3 UJ	2.1 UJ	5.3 U	14.3 J	7580 UJ	17.4
ARSENIC	0.4 J	0.32 J	0.89 J	2.2 J	1.9 J	2.8
BARIUM	56.8 J	20.3 J	30.7 J	101 J	170 J	127
BERYLLIUM	0.31 J	0.18 U	0.17 U	0.3 J	0.05 U	1.2

TABLE 10-3 (PAGE 6 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW4-0204	20MW4-0406	20MW5-0002	20MW5-0608	20MW6-0204	20MW6-1214
DEPTH (feet):	2 - 4'	4 - 6'	0 - 2'	6 - 8'	2 - 4'	12 - 14'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	03/26/93	03/26/93	03/26/93	03/26/93
LOCATION:	20MW4	20MW4	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BORON	1.8 U	1.5 UJ	1.6 UJ	2 U	2.3 UJ	4 B
CADMIUM	0.33 UJ	0.31 UJ	0.34 UJ	0.5 J	6.8 UJ	1.4
CALCIUM	1490 J	678 J	670 J	2410 J	631 J	4660
CHROMIUM	11 J	4.1 U	9.1 J	12.8 J	4.1 J	19.3
COBALT	5.3 J	2.2 U	3.4 J	4.7 J	1.1 J	4.4 B
COPPER	11.6 J	4.7 J	122 J	123 J	74.9 J	142
CYANIDE	0.19 UJ	0.19 UJ	0.17 UJ	0.21 UJ	0.21 UJ	0.19 U
IRON	10400 J	5570 J	6850 J	10100 J	4510 J	37800
LEAD	20.4 J	12 J	128 J	1040 J	189000 J	1540
MAGNESIUM	2560 J	1250 J	1520 J	2120 J	47.9 J	1530
MANGANESE	149 J	99.1 J	113 J	97.7 J	32.7 J	194
MERCURY	0.02 UJ	0.02 UJ	0.12 J	0.09 U	1.2 U	0.14
NICKEL	7.8 J	3.7 J	4.8 J	11 J	1.8 J	254
POTASSIUM	1970 J	1280 J	1420 J	1210 J	53 J	960 B
SELENIUM	0.19 U	0.22 U	0.2 UJ	0.18 U	1.7 UJ	0.17 UJ
SILVER	0.54 UJ	0.5 UJ	0.54 UJ	0.49 UJ	5.4 UJ	0.75 B
SODIUM	95.2 J	158 J	103 J	107 J	68.1 J	1880
THALLIUM	0.12 UJ	0.11 UJ	0.12 UJ	0.11 UJ	1 UJ	0.1 UJ
VANADIUM	20.4 J	9 J	10.7 J	15.2 J	1.9 J	213
ZINC	22.5 J	13.1 J	146 J	229 J	608 J	682
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		200		720		150

TABLE 10-3 (PAGE 7 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW7-0204	20MW7-0406	20TB1-0204	20TB1-0608	20TB11-0608	20TB2-0204
DEPTH (feet):	2 - 4'	4 - 6'	2 - 4'	6 - 8'	6 - 8'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	04/02/93	04/02/93	04/02/93	03/31/93
LOCATION:	20MW7	20MW7	20TB1	20TB1	20TB1	20TB2
VALIDATED:	VALIDATED	VALIDATED				VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					20TB1-0608 (93)	
VOLATILES (µg/kg)						
2-BUTANONE	11 U	12 U	11 U	11 U	11 U	10 U
ACETONE	26 U	20 U	11 U	11 U	38	13 U
CARBON DISULFIDE	11 U	12 U	11 U	11 U	11 U	10 U
METHYLENE CHLORIDE	11 U	12 U	6 JB	7 JB	9 JB	10 U
TOLUENE	11 U	12 U	11 U	11 U	11 U	10 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	370 U	370 U	350 U	390 U	370 U	360 U
4-CHLORO-3-METHYLPHENOL	370 U	370 U	350 U	390 U	370 U	360 U
ACENAPHTHENE	370 U	370 U	350 U	390 U	370 U	360 U
ACENAPHTHYLENE	370 U	370 U	350 U	390 U	370 U	360 U
ANTHRACENE	370 U	370 U	350 U	390 U	370 U	360 U
BENZO(A)ANTHRACENE	370 U	370 U	190 J	390 U	370 U	360 U
BENZO(A)PYRENE	370 U	370 R	350 U	390 U	370 U	360 U
BENZO(B)FLUORANTHENE	370 U	370 R	230 J	390 U	370 U	360 U
BENZO(G,H,I)PERYLENE	370 U	370 R	350 U	390 U	370 U	360 U
BENZO(K)FLUORANTHENE	370 U	370 R	350 U	390 U	370 U	360 U
BIS(2-ETHYLHEXYL)PHTHALATE	370 U	370 U	350 U	390 U	370 U	360 U
CARBAZOLE	370 U	370 U	350 U	390 U	370 U	360 U
CHRYSENE	370 U	370 U	190 J	390 U	370 U	360 U
DI-N-BUTYL PHTHALATE	370 U	370 U	350 U	390 U	370 U	360 U
DI-N-OCTYL PHTHALATE	370 U	370 R	350 U	390 U	370 U	360 U
DIBENZO(A,H)ANTHRACENE	370 U	370 R	350 U	390 U	370 U	360 U

TABLE 10-3 (PAGE 8 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW7-0204	20MW7-0406	20TB1-0204	20TB1-0608	20TB11-0608	20TB2-0204
DEPTH (feet):	2 - 4'	4 - 6'	2 - 4'	6 - 8'	6 - 8'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	04/02/93	04/02/93	04/02/93	03/31/93
LOCATION:	20MW7	20MW7	20TB1	20TB1	20TB1	20TB2
VALIDATED:	VALIDATED	VALIDATED				VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					20TB1-0608 (93)	
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN	370 U	370 U	350 U	390 U	370 U	360 U
FLUORANTHENE	370 U	370 U	340 J	390 U	370 U	360 U
FLUORENE	370 U	370 U	350 U	390 U	370 U	360 U
INDENO(1,2,3-CD)PYRENE	370 U	370 R	350 U	390 U	370 U	360 U
NAPHTHALENE	370 U	370 U	350 U	390 U	370 U	360 U
PHENANTHRENE	370 U	370 U	350 U	390 U	370 U	360 U
PYRENE	370 U	370 U	290 J	390 U	370 U	360 U
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.7 U	3.8 U	3.5 U	3.9 U	3.7 U	3.6 U
4,4'-DDE	3.7 U	3.8 U	3.5 U	3.9 U	3.7 U	3.6 U
4,4'-DDT	3.7 U	3.8 U	3.5 U	3.9 U	3.7 U	3.6 U
ALPHA-CHLORDANE	1.9 U	1.9 U	1.8 U	2 U	1.9 U	1.8 U
GAMMA-CHLORDANE	1.9 U	1.9 U	1.8 U	2 U	1.9 U	1.8 U
HEPTACHLOR EPOXIDE	1.9 U	1.9 U	1.8 U	2 U	1.9 U	1.8 U
DIOXINS/FURANS (ng/kg)						
DIOXIN	0 U					
METALS (mg/kg)						
ALUMINUM	3220 J	3880 J	5680	4570	4530	5780 J
ANTIMONY	2.3 UJ	2.5 UJ	2.3 UN	2.1 UN	2.7 UN	2.1 UJ
ARSENIC	0.32 J	0.49 J	1 BN	1.4 BN	0.96 BN	2 J
BARIUM	25 J	21.5 J	23.7 B	29.7 B	29.2 B	24.1 J
BERYLLIUM	0.17 U	0.19 U	0.3 B	0.19 B	0.19 B	0.23 U

TABLE 10-3 (PAGE 9 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW7-0204	20MW7-0406	20TB1-0204	20TB1-0608	20TB11-0608	20TB2-0204
DEPTH (feet):	2 - 4'	4 - 6'	2 - 4'	6 - 8'	6 - 8'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/30/93	03/30/93	04/02/93	04/02/93	04/02/93	03/31/93
LOCATION:	20MW7	20MW7	20TB1	20TB1	20TB1	20TB2
VALIDATED:	VALIDATED	VALIDATED				VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					20TB1-0608 (93)	
METALS (mg/kg)						
BORON	1.6 UJ	2.7 U	1.7 B	1.5 U	1.9 U	1.5 UJ
CADMIUM	0.33 UJ	0.37 UJ	0.33 UN	0.31 UN	0.4 UN	0.3 UJ
CALCIUM	471 J	578 J	889 B	830 B	770 B	661 J
CHROMIUM	4.1 U	6.1 J	7.6	6.4	7.4	6.5 J
COBALT	2.6 U	4 J	3.4 B	3 B	3.4 B	3.4 J
COPPER	3 J	6.4 J	8.4	4.4	5.1 B	9.2 J
CYANIDE	0.18 UJ	0.17 UJ	0.17 U	0.19 U	0.18 U	0.17 UJ
IRON	5190 J	6550 J	6500	6320	6000	5770 J
LEAD	6.3 J	6.2 J	35.5	2.2 N	6.1 NS	33.6 J
MAGNESIUM	1320 J	1620 J	1630	1710	1600	1410 J
MANGANESE	120 J	104 J	111	87.7	80.5	117 J
MERCURY	0.07 UJ	0.04 UJ	0.03 U	0.03 U	0.04 U	0.09 U
NICKEL	2.5 J	4.6 J	3.9 B	3.5 B	4.4 B	6.1 J
POTASSIUM	1460 J	1230 J	1120	1600	1250	593 J
SELENIUM	0.2 UJ	0.22 UJ	0.14 UN	0.18 UN	0.15 UN	0.14 UJ
SILVER	0.54 UJ	0.6 UJ	0.53 UN	0.5 UN	0.64 UN	0.49 UJ
SODIUM	123 J	164 J	68.4 BE	102 BE	97.9 BE	141 J
THALLIUM	0.12 UJ	0.13 UJ	0.18 BNW	0.18 BNW	0.11 UNW	0.08 UJ
VANADIUM	8.2 J	10.7 J	12.8	10	9.9 B	11.3 J
ZINC	13.6 J	14 J	16.9	13.9	13	26.8 J
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		2500		68 U	69 U	

TABLE 10-3 (PAGE 10 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB2-1416	20TB3-0204	20TB3-1012	20TB4-0002	20TB4-0406	20TB4-1416
DEPTH (feet):	14 - 16'	2 - 4'	10 - 12'	0 - 2'	4 - 6'	14 - 16'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/31/93	03/29/93	03/29/93	03/31/93	03/31/93	03/31/93
LOCATION:	20TB2	20TB3	20TB3	20TB4	20TB4	20TB4
VALIDATED:		VALIDATED		VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE	11 U	11 U	11 U	11 U		14 U
ACETONE	17 U	19 U	20 U	9 J		45
CARBON DISULFIDE	11 U	11 U	11 U	11 U		14 U
METHYLENE CHLORIDE	11 U	11 U	11 U	5 JB		7 JB
TOLUENE	11 U	11 U	11 U	11 U		14 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 U	350 U	360 U	390 U		1800 U
4-CHLORO-3-METHYLPHENOL	360 U	350 U	360 U	390 U		1800 U
ACENAPHTHENE	360 U	350 U	360 U	390 U		1800 U
ACENAPHTHYLENE	360 U	350 U	360 U	390 U		1800 U
ANTHRACENE	360 U	350 U	360 U	390 U		1800 U
BENZO(A)ANTHRACENE	360 U	260 J	360 U	390 U		1800 U
BENZO(A)PYRENE	360 U	210 J	360 U	390 U		1800 U
BENZO(B)FLUORANTHENE	360 U	240 J	360 U	390 U		1800 U
BENZO(G,H,I)PERYLENE	360 U	350 U	360 U	390 U		1800 U
BENZO(K)FLUORANTHENE	360 U	230 J	360 U	390 U		1800 U
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	350 U	360 U	390 U		1800 U
CARBAZOLE	360 U	350 U	360 U	390 U		1800 U
CHRYSENE	360 U	250 J	360 U	390 U		1800 U
DI-N-BUTYL PHTHALATE	360 U	350 U	360 U	390 U		1800 U
DI-N-OCTYL PHTHALATE	360 U	350 U	360 U	390 U		1800 U
DIBENZO(A,H)ANTHRACENE	360 U	350 U	360 U	390 U		1800 U

TABLE 10-3 (PAGE 11 OF 30)

SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB2-1416	20TB3-0204	20TB3-1012	20TB4-0002	20TB4-0406	20TB4-1416
DEPTH (feet):	14 - 16'	2 - 4'	10 - 12'	0 - 2'	4 - 6'	14 - 16'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/31/93	03/29/93	03/29/93	03/31/93	03/31/93	03/31/93
LOCATION:	20TB2	20TB3	20TB3	20TB4	20TB4	20TB4
VALIDATED:		VALIDATED		VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN	360 U	350 U	360 U	390 U		1800 U
FLUORANTHENE	360 U	400 J	290 J	390 U		1300 J
FLUORENE	360 U	350 U	360 U	390 U		1800 U
INDENO(1,2,3-CD)PYRENE	360 U	350 U	360 U	390 U		1800 U
NAPHTHALENE	360 U	350 U	360 U	390 U		1800 U
PHENANTHRENE	360 U	190 J	360 U	390 U		1800 U
PYRENE	360 U	410	230 J	390 U		1200 J
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.6 U	3.6 U	3.7 U	3.9 U		4.8 U
4,4'-DDE	3.6 U	3.6 U	3.7 U	3.9 U		4.8 U
4,4'-DDT	3.6 U	3.6 U	3.7 U	3.9 U		4.8 U
ALPHA-CHLORDANE	1.9 U	1.8 U	1.9 U	2 U		2.5 U
GAMMA-CHLORDANE	1.9 U	1.8 U	1.9 U	2 U		2.5 U
HEPTACHLOR EPOXIDE	1.9 U	1.8 U	1.9 U	2 U		2.5 U
DIOXINS/FURANS (ng/kg)						
DIOXIN					0 U	
METALS (mg/kg)						
ALUMINUM	3430	5390	3590	4510		3460
ANTIMONY	2.4 B	2.2 U	2.5 U	7.8 B		1820
ARSENIC	0.73 B	0.75 B	0.52 B	1.4 B		50
BARIUM	17.7 B	31.9 B	29 B	364		550
BERYLLIUM	0.14 B	0.26 B	0.19 B	0.22 B		0.34 B

TABLE 10-3 (PAGE 12 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB2-1416	20TB3-0204	20TB3-1012	20TB4-0002	20TB4-0406	20TB4-1416
DEPTH (feet):	14 - 16'	2 - 4'	10 - 12'	0 - 2'	4 - 6'	14 - 16'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/31/93	03/29/93	03/29/93	03/31/93	03/31/93	03/31/93
LOCATION:	20TB2	20TB3	20TB3	20TB4	20TB4	20TB4
VALIDATED:		VALIDATED		VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BORON	1.7 U	1.5 U	1.8 U	2.9 B		25.1 B
CADMIUM	0.34 U	0.32 U	0.37 U	0.39 U		4
CALCIUM	619 B	906	675 B	5480		35000
CHROMIUM	5.7	7.1	4.5	6.6		44.4
COBALT	2.6 B	4.3 B	2.2 B	3.5 B		12.3 B
COPPER	5.4	11.2	4.2 B	59.4		9010
CYANIDE	0.2 U	0.18 U	0.16 U	0.2 U		0.46 B
IRON	4730	7630	5460	6140		186000
LEAD	20.7 S	66.1	16.6	726		9770
MAGNESIUM	1260	2260	1210	2060		7610
MANGANESE	54	129	72	162		956
MERCURY	0.03 U	0.03 B	0.02 U	0.06 U		1.3
NICKEL	4.5 B	6.4 B	5 B	5.4 B		149
POTASSIUM	961	1390	1060	1240		596 B
SELENIUM	0.15 U	0.15 UW	0.2 UW	0.18 U		0.26 UW
SILVER	0.53 U	0.51 U	0.59 U	0.63 U		4.1
SODIUM	201 B	90.9 B	66.8 B	162 B		427 B
THALLIUM	0.09 UW	0.09 UW	0.12 UW	0.11 U		1.6 U
VANADIUM	8.2 B	13.2	8.3 B	11.9		38.7
ZINC	11	28.8	14.2	188		3440
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	66 U		65 U			1500

TABLE 10-3 (PAGE 13 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB5-0002	20TB5-0406	20TB6-0002	20TB6-0810	20TB7-3242	20TB7-4852
DEPTH (feet):	0 - 2'	4 - 6'	0 - 2'	8 - 10'	2.7 - 3.5'	4 - 4.3'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/29/93	03/29/93	03/25/93	03/31/93	04/06/93	04/06/93
LOCATION:	20TB5	20TB5	20TB6	20TB6	20TB7	20TB7
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE	10 U	11 U	10 U	20	10 U	11 U
ACETONE	23	25	11	97 B	51	11 U
CARBON DISULFIDE	10 U	11 U	10 U	6 J	10 U	11 U
METHYLENE CHLORIDE	5 JB	5 JB	6 JB	11 JB	10 JB	9 JB
TOLUENE	10 U	11 U	10 U	13 U	10 U	11 U
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	340 U	360 U	340 U	430 U	340 U	
4-CHLORO-3-METHYLPHENOL	340 U	360 U	340 U	430 U	340 U	
ACENAPHTHENE	340 U	360 U	340 U	610	340 U	
ACENAPHTHYLENE	340 U	360 U	340 U	430 U	340 U	
ANTHRACENE	260 J	360 U	340 U	230 J	340 U	
BENZO(A)ANTHRACENE	610	310 J	300 J	340 J	340 U	
BENZO(A)PYRENE	720	260 J	280 J	430 U	340 U	
BENZO(B)FLUORANTHENE	720	320 J	350	430 U	240 J	
BENZO(G,H,I)PERYLENE	320 J	360 U	340 U	430 U	340 U	
BENZO(K)FLUORANTHENE	770	220 J	340 U	430 U	340 U	
BIS(2-ETHYLHEXYL)PHTHALATE	340 U	360 U	340 U	430 U	340 U	
CARBAZOLE	340 U	360 U	340 U	430 U	340 U	
CHRYSENE	630	350 J	290 J	330 J	340 U	
DI-N-BUTYL PHTHALATE	340 U	360 U	340 U	430 U	320 J	
DI-N-OCTYL PHTHALATE	340 U	360 U	340 U	430 U	340 U	
DIBENZO(A,H)ANTHRACENE	340 U	360 U	340 U	430 U	340 U	

TABLE 10-3 (PAGE 14 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB5-0002	20TB5-0406	20TB6-0002	20TB6-0810	20TB7-3242	20TB7-4852
DEPTH (feet):	0 - 2'	4 - 6'	0 - 2'	8 - 10'	2.7 - 3.5'	4 - 4.3'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/29/93	03/29/93	03/25/93	03/31/93	04/06/93	04/06/93
LOCATION:	20TB5	20TB5	20TB6	20TB6	20TB7	20TB7
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN	340 U	360 U	340 U	430 U	340 U	
FLUORANTHENE	1100	540	480	590	220 J	
FLUORENE	340 U	360 U	340 U	390 J	340 U	
INDENO(1,2,3-CD)PYRENE	330 J	360 U	340 U	430 U	340 U	
NAPHTHALENE	340 U	360 U	340 U	430 U	340 U	
PHENANTHRENE	790	340 J	340 U	760	340 U	
PYRENE	1200	590	490	720	180 J	
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.4 U	3.6 U	3.5 P	4.4 P	35 P	
4,4'-DDE	3.4 U	3.6 U	3.5 U	4.4 U	35 U	
4,4'-DDT	14 U	3.6 U	17	4.4	43	
ALPHA-CHLORDANE	1.7 U	1.9 U	1.8 U	2.3 U	18 U	
GAMMA-CHLORDANE	1.7 U	1.9 U	1.8 U	2.3 U	18 U	
HEPTACHLOR EPOXIDE	1.7 U	1.9 U	1.8 U	2.3 U	18 U	
DIOXINS/FURANS (ng/kg)						
DIOXIN	0 U			0 U		
METALS (mg/kg)						
ALUMINUM	5040 J	7730 J	4200	4750	8670	
ANTIMONY	3.8 U	2.6 UJ	2.7 UN	3.6 UN	1.9 UN	
ARSENIC	1.4 J	3 J	1.8 S	2.2	0.91 BN	
BARIUM	45.3 J	38 J	38.4	29.7 B	97.3	
BERYLLIUM	0.26 U	0.35 J	0.15 B	0.19 B	0.51 B	

TABLE 10-3 (PAGE 15 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB5-0002	20TB5-0406	20TB6-0002	20TB6-0810	20TB7-3242	20TB7-4852
DEPTH (feet):	0 - 2'	4 - 6'	0 - 2'	8 - 10'	2.7 - 3.5'	4 - 4.3'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/29/93	03/29/93	03/25/93	03/31/93	04/06/93	04/06/93
LOCATION:	20TB5	20TB5	20TB6	20TB6	20TB7	20TB7
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BORON	2.6 U	2 U	3.1 U	4.3 U	1.4 U	
CADMIUM	0.32 UJ	0.39 UJ	0.46 U	0.63 U	0.28 UN	
CALCIUM	2220 J	1140 J	1520	1190 B	3640	
CHROMIUM	11.1 J	10.4 J	7.8	9.9	21.4	
COBALT	3.8 J	4 J	2.7 B	3.1 B	9.1	
COPPER	37.8 J	21.7 J	71.9	16.1	27.6	
CYANIDE	0.18 UJ	0.19 UJ	0.15 U	0.2 U	0.19 U	
IRON	8060 J	8480 J	5530	6610	18900	
LEAD	220 J	31.8 J	476	24.4	47.7	
MAGNESIUM	2080 J	1660 J	1550	1400	5650	
MANGANESE	113 J	114 J	108	58.3	317	
MERCURY	0.11 J	0.25 J	0.1	0.05 U	0.03 U	
NICKEL	9.7 J	7.6 J	17.7	3.8 B	11.2	
POTASSIUM	1520 J	839 J	928	843 B	5240	
SELENIUM	0.2 UJ	0.21 U	0.15 U	0.22 BW	0.15 UN	
SILVER	0.52 UJ	0.62 UJ	0.46 U	0.63 U	0.45 UN	
SODIUM	95.1 J	99.9 J	56.3 B	82.3 B	92.4 BE	
THALLIUM	0.12 UJ	0.11 UJ	0.09 UW	0.13 UW	0.16 BNW	
VANADIUM	16.5 J	16 J	16.8	9.9 B	44.1	
ZINC	101 J	53.7 J	114	50.4	92	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		170		220		

TABLE 10-3 (PAGE 16 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB17-4852	20TB7-4856	20TB17-4856	LS7SB0030201	LS7SB0030301	LS7SB0040201
DEPTH (feet):	4 - 4.3'	4 - 4.7'	4 - 4.7'	2 - 4'	5 - 6'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	04/06/93	04/06/93	04/06/93	09/27/97	09/27/97	09/27/97
LOCATION:	20TB7	20TB7	20TB7	MW1-7RI	MW1-7RI	MW2-7RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	20TB7-4852 (93)		20TB7-4856 (93)			
VOLATILES (µg/kg)						
2-BUTANONE	11 U					
ACETONE	58					
CARBON DISULFIDE	11 U					
METHYLENE CHLORIDE	12 B					
TOLUENE	3 J					
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE		340 U	710 U	360 UJ	360 UJ	22
4-CHLORO-3-METHYLPHENOL		340 U	710 U	34 J	360 U	360 U
ACENAPHTHENE		850	1400	360 U	360 U	36 J
ACENAPHTHYLENE		340 U	710 U	360 U	360 U	86 J
ANTHRACENE		810	660 J	360 U	360 U	160 J
BENZO(A)ANTHRACENE		570	560 J	360 U	360 U	900
BENZO(A)PYRENE		370	710 U	360 UJ	360 U	800
BENZO(B)FLUORANTHENE		720	490 J	360 UJ	360 U	900
BENZO(G,H,I)PERYLENE		340 U	710 U	360 UJ	360 U	560
BENZO(K)FLUORANTHENE		340 U	710 U	360 UJ	360 U	760
BIS(2-ETHYLHEXYL)PHTHALATE		340 U	710 U	360 U	360 U	360 U
CARBAZOLE		180 J	710 U	360 U	360 U	39 J
CHRYSENE		640	510 J	360 U	360 U	840
DI-N-BUTYL PHTHALATE		340 U	710 U	360 U	360 U	360 U
DI-N-OCTYL PHTHALATE		340 U	710 U	360 UJ	360 U	360 U
DIBENZO(A,H)ANTHRACENE		340 U	710 U	360 UJ	360 U	230 J

TABLE 10-3 (PAGE 17 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB17-4852	20TB7-4856	20TB17-4856	LS7SB0030201	LS7SB0030301	LS7SB0040201
DEPTH (feet):	4 - 4.3'	4 - 4.7'	4 - 4.7'	2 - 4'	5 - 6'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	04/06/93	04/06/93	04/06/93	09/27/97	09/27/97	09/27/97
LOCATION:	20TB7	20TB7	20TB7	MW1-7RI	MW1-7RI	MW2-7RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	20TB7-4852 (93)		20TB7-4856 (93)			
SEMIVOLATILES (µg/kg)						
DIBENZOFURAN		490	770	360 U	360 U	37 J
FLUORANTHENE		2500	2900	360 U	360 U	1700
FLUORENE		940	1600	360 U	360 U	76 J
INDENO(1,2,3-CD)PYRENE		340 U	710 U	360 UJ	360 U	560
NAPHTHALENE		340 U	710 U	360 U	360 U	360 U
PHENANTHRENE		2800	3600	360 U	360 U	690
PYRENE		1500	1900	360 U	360 U	1500
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD		35 U	36 U			
4,4'-DDE		35 U	36 U			
4,4'-DDT		61	71 P			
ALPHA-CHLORDANE		18 U	19 U			
GAMMA-CHLORDANE		18 U	19 U			
HEPTACHLOR EPOXIDE		18 U	19 U			
METALS (mg/kg)						
ALUMINUM		6670	8120			
ANTIMONY		1.9 UN	3.4 BN			
ARSENIC		1 BN	0.81 BN			
BARIUM		72.2	95.3			
BERYLLIUM		0.43 B	0.46 B			
BORON		1.4 U	1.4 B			
CADMIUM		0.42 BN	0.47 BN			

TABLE 10-3 (PAGE 18 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB17-4852	20TB7-4856	20TB17-4856	LS7SB0030201	LS7SB0030301	LS7SB0040201
DEPTH (feet):	4 - 4.3'	4 - 4.7'	4 - 4.7'	2 - 4'	5 - 6'	2 - 4'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	1997RI	1997RI	1997RI
SAMPLE DATE:	04/06/93	04/06/93	04/06/93	09/27/97	09/27/97	09/27/97
LOCATION:	20TB7	20TB7	20TB7	MW1-7RI	MW1-7RI	MW2-7RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	20TB7-4852 (93)		20TB7-4856 (93)			
METALS (mg/kg)						
CALCIUM		2610	3720			
CHROMIUM		16.1	16.7			
COBALT		6.9 B	7.5 B			
COPPER		27.8	25			
CYANIDE		0.16 U	0.16 U			
IRON		13900	13100			
LEAD		59.4	129			
MAGNESIUM		3790	4280			
MANGANESE		208	195			
MERCURY		0.03 U	0.05			
NICKEL		10.6	11.2			
POTASSIUM		3580	3980			
SELENIUM		0.16 UN	0.17 UN			
SILVER		0.46 UN	0.45 UN			
SODIUM		100 BE	154 BE			
THALLIUM		0.16 UNW	0.14 BNW			
VANADIUM		27.4	28			
ZINC		84.1	104			
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		86	190	560 J		680 J

TABLE 10-3 (PAGE 19 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0040301	LS7SB0060201	SBFD009	LS7SB0060301	LS7SB0070101	SBFD005
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	0.5 - 2'	0.5 - 2'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/27/97	09/27/97	09/27/97	09/27/97	09/25/97	09/25/97
LOCATION:	MW2-7RI	MW3-7RI	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0060201			LS7SB0070101
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	75 J	360 U	360 U	400 UJ	24 J	25 J
4-CHLORO-3-METHYLPHENOL	360 U	360 U	360 U	400 U	330 U	330 U
ACENAPHTHENE	160 J	360 U	360 U	400 U	330 U	330 U
ACENAPHTHYLENE	160 J	360 U	360 U	400 U	34 J	43 J
ANTHRACENE	760	360 U	360 U	400 U	54 J	150 J
BENZO(A)ANTHRACENE	5700	360 U	360 U	27 J	390	470 J
BENZO(A)PYRENE	5000	360 U	360 UJ	28 J	320 J	450 J
BENZO(B)FLUORANTHENE	5500	360 U	360 UJ	24 J	400 J	560 J
BENZO(G,H,I)PERYLENE	2500	360 U	360 UJ	400 U	260 J	280 J
BENZO(K)FLUORANTHENE	360 U	360 U	360 UJ	23 J	240 J	320 J
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	360 U	360 U	400 U	330 U	360 U
CARBAZOLE	210 J	360 U	360 U	400 U	330 U	17 J
CHRYSENE	5500	360 U	360 U	36 J	410	540 J
DI-N-BUTYL PHTHALATE	360 U	360 U	360 U	400 U	330 U	30 J
DI-N-OCTYL PHTHALATE	360 U	360 U	360 UJ	400 U	330 UJ	330 UJ
DIBENZO(A,H)ANTHRACENE	1300	360 U	360 UJ	400 U	110 J	120 J
DIBENZOFURAN	220 J	360 U	360 U	400 U	330 U	330 U
FLUORANTHENE	8100	360 U	360 U	36 J	430	430
FLUORENE	340 J	360 U	360 U	400 U	330 U	330 U
INDENO(1,2,3-CD)PYRENE	2600	360 U	360 UJ	400 U	230 J	260 J
NAPHTHALENE	86 J	360 U	360 U	400 U	330 U	330 U
PHENANTHRENE	3400	360 U	360 U	20 J	200 J	150 J

TABLE 10-3 (PAGE 20 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0040301	LS7SB0060201	SBFD009	LS7SB0060301	LS7SB0070101	SBFD005
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	0.5 - 2'	0.5 - 2'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/27/97	09/27/97	09/27/97	09/27/97	09/25/97	09/25/97
LOCATION:	MW2-7RI	MW3-7RI	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0060201			LS7SB0070101
SEMIVOLATILES (µg/kg)						
PYRENE	11000	360 U	360 U	52 J	830	880 J
METALS (mg/kg)						
ALUMINUM		3710	2810	2950		
ANTIMONY		0.41 UJ	0.45 UJ	0.53 UJ		
ARSENIC		0.65 J	0.60 J	0.55 U		
BARIUM		30.9	23.7	25.2		
BERYLLIUM		0.12 U	0.12 U	0.12 U		
CADMIUM		0.04 U	0.04 U	0.05 U		
CALCIUM		460 J	512 J	460		
CHROMIUM		7.0	4.5	4.4		
COBALT		1.7	1.8	1.6		
COPPER		3.0	3.5	3.6		
IRON		6100	4880	5190		
LEAD		1.6	1.8	2.0		
MAGNESIUM		2180 J	1310 J	1430		
MANGANESE		116	105	113		
MERCURY		0.01 UJ	0.01 UJ	0.01 UJ		
NICKEL		3.0	3.0	2.7		
POTASSIUM		2370	1420	1490		
SELENIUM		0.31 U	0.34 U	0.40 U		
SILVER		0.18 U	0.20 U	0.23 U		
SODIUM		102	85.1	96.1		

TABLE 10-3 (PAGE 21 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0040301	LS7SB0060201	SBFD009	LS7SB0060301	LS7SB0070101	SBFD005
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	0.5 - 2'	0.5 - 2'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/27/97	09/27/97	09/27/97	09/27/97	09/25/97	09/25/97
LOCATION:	MW2-7RI	MW3-7RI	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0060201			LS7SB0070101
METALS (mg/kg)						
THALLIUM		0.81 UJ	0.88 UJ	1.0 U		
VANADIUM		8.6	7.3	7.5		
ZINC		16.5	12.2	13.2		
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		51.0 J	150 J		1500 J	1300 J

TABLE 10-3 (PAGE 22 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0070301	LS7SB0100201	SBFD007	LS7SB0100301	LS7SB0010101	LS7SB0010201
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/26/97	09/26/97	09/26/97	09/26/97	09/26/97
LOCATION:	MW4-7RI	MW5-7RI	MW5-7RI	MW5-7RI	TB1-7RI	TB1-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0100201			
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	360 UJ	42 J	51 J	98 J	28 J	120 J
4-CHLORO-3-METHYLPHENOL	360 U	360 U	360 U	400 U	330 U	360 U
ACENAPHTHENE	360 U	20 J	350 J	650	170 J	360
ACENAPHTHYLENE	360 U	42 J	24 J	20 J	330 U	45 J
ANTHRACENE	360 U	110 J	900	1500	770 J	1100 J
BENZO(A)ANTHRACENE	28 J	310 J	1400	3000	2400 J	2300 J
BENZO(A)PYRENE	31 J	370	1200	2300	1600	1600
BENZO(B)FLUORANTHENE	38 J	400	1300	2700	1800	1700
BENZO(G,H,I)PERYLENE	28 J	340 J	1100 J	1600 J	980	1000
BENZO(K)FLUORANTHENE	360 U	180 J	650 J	400 U	1100	1200 J
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	360 U	360 U	400 U	330 U	360 U
CARBAZOLE	360 U	34 J	360 J	880	130 J	340 J
CHRYSENE	36 J	370 J	1400	3100	2100 J	2000 J
DI-N-BUTYL PHTHALATE	360 U	360 U	360 U	400 U	330 UJ	360 UJ
DI-N-OCTYL PHTHALATE	360 U	360 UJ	360 UJ	400 UJ	330 U	360 U
DIBENZO(A,H)ANTHRACENE	21 J	110 J	410	840	520	540
DIBENZOFURAN	360 U	19 J	160 J	300 J	120 J	340 J
FLUORANTHENE	45 J	550	2800	8200	5600	4600
FLUORENE	360 U	33 J	300 J	620	310 J	660
INDENO(1,2,3-CD)PYRENE	31 J	220 J	820	1400	1300	1300
NAPHTHALENE	360 U	36 J	56 J	110 J	63 J	270 J
PHENANTHRENE	360 U	440	3500	7600	2700 J	3900

TABLE 10-3 (PAGE 23 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0070301	LS7SB0100201	SBFD007	LS7SB0100301	LS7SB0010101	LS7SB0010201
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/26/97	09/26/97	09/26/97	09/26/97	09/26/97
LOCATION:	MW4-7RI	MW5-7RI	MW5-7RI	MW5-7RI	TB1-7RI	TB1-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0100201			
SEMIVOLATILES (µg/kg)						
PYRENE	48 J	520 J	2700 J	8300	6000	4400 J
METALS (mg/kg)						
ALUMINUM		7740	6910	6020		
ANTIMONY		2.5	3.0	160		
ARSENIC		5.5	6.0	19.0		
BARIUM		84.5	88.0	148		
BERYLLIUM		0.32	0.30	0.55		
CADMIUM		2.0	2.0	1.2		
CALCIUM		16700	16800	9590		
CHROMIUM		16.9	15.5	10.7		
COBALT		3.7	3.6	4.0		
COPPER		37.6	33.3	5810		
IRON		9400	8900	8510		
LEAD		1570	1750	13300		
MAGNESIUM		3730	3370	1360		
MANGANESE		123	131	109		
MERCURY		0.28 J	0.36 J	1.9 J		
NICKEL		12.8	12.6	20.9		
POTASSIUM		806	865	950		
SELENIUM		0.48 U	0.51 U	2.5 J		
SILVER		0.18 U	0.23 U	1.5		
SODIUM		159	152	278		

TABLE 10-3 (PAGE 24 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0070301	LS7SB0100201	SBFD007	LS7SB0100301	LS7SB0010101	LS7SB0010201
DEPTH (feet):	5 - 6'	2 - 4'	2 - 4'	5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/26/97	09/26/97	09/26/97	09/26/97	09/26/97
LOCATION:	MW4-7RI	MW5-7RI	MW5-7RI	MW5-7RI	TB1-7RI	TB1-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS7SB0100201			
METALS (mg/kg)						
THALLIUM		0.83 U	1.0 U	1.1 U		
VANADIUM		21.6	19.9	246		
ZINC		961	859	1420		
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		2600 J	1600 J		250 J	

TABLE 10-3 (PAGE 25 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0110101	LS7SB0110201	LS7SB0020101	LS7SB0020201	LS7SB0050101	LS7SB0050201
DEPTH (feet):	2 - 4'	6 - 7'	2 - 4'	5.5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/26/97	09/26/97
LOCATION:	TB11-7RI	TB11-7RI	TB2-7RI	TB2-7RI	TB5-7RI	TB5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	300 J	110 J	330 UJ	50 J	330 U	360 U
4-CHLORO-3-METHYLPHENOL	360 U	360 U	330 U	360 U	330 U	360 U
ACENAPHTHENE	620	390	330 U	29 J	69 J	360 U
ACENAPHTHYLENE	600	130 J	160 J	450	330 U	360 U
ANTHRACENE	2500	1300	79 J	360	200 J	360 U
BENZO(A)ANTHRACENE	7100	2300	630	2400	680	37 J
BENZO(A)PYRENE	8700	2400	890	2600	490	76 J
BENZO(B)FLUORANTHENE	8700	2300	1400	4400	580	63 J
BENZO(G,H,I)PERYLENE	5400	2100 J	790	1800	440	92 J
BENZO(K)FLUORANTHENE	360 U	2200 J	330 U	360 U	430	67 J
BIS(2-ETHYLHEXYL)PHTHALATE	360 U	360 U	330 U	360 U	330 U	360 U
CARBAZOLE	950	710	22 J	45 J	56 J	360 U
CHRYSENE	7700	2200	680	2500	700	59 J
DI-N-BUTYL PHTHALATE	360 U	360 U	18 J	360 U	330 U	360 U
DI-N-OCTYL PHTHALATE	360 UJ	360 UJ	330 U	360 U	330 UJ	360 U
DIBENZO(A,H)ANTHRACENE	3100	1100 J	340	360 U	160 J	27 J
DIBENZOFURAN	530	380	330 U	22 J	35 J	360 U
FLUORANTHENE	9700	4300 J	800	3100	1800	55 J
FLUORENE	1200	870	330 U	64 J	59 J	360 U
INDENO(1,2,3-CD)PYRENE	5200	2000 J	630	1600	440	94 J
NAPHTHALENE	510	130 J	330 U	74 J	330 U	360 U
PHENANTHRENE	4400	2800 J	140 J	700	880	26 J

TABLE 10-3 (PAGE 26 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0110101	LS7SB0110201	LS7SB0020101	LS7SB0020201	LS7SB0050101	LS7SB0050201
DEPTH (feet):	2 - 4'	6 - 7'	2 - 4'	5.5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/26/97	09/26/97
LOCATION:	TB11-7RI	TB11-7RI	TB2-7RI	TB2-7RI	TB5-7RI	TB5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
PYRENE	11000	4000	780	2700	990	60 J
METALS (mg/kg)						
ALUMINUM	5880	7540				
ANTIMONY	0.92 J	0.35 UJ				
ARSENIC	1.9	2.1				
BARIUM	30.9	35.7				
BERYLLIUM	0.22	0.30				
CADMIUM	0.24 U	0.16				
CALCIUM	758	769				
CHROMIUM	9.5 J	16.5				
COBALT	3.3	4.3				
COPPER	12.1	13.0				
IRON	7090	9600				
LEAD	197 J	44.9 J				
MAGNESIUM	1770	2660				
MANGANESE	125	162				
MERCURY	0.01 J	0.05 J				
NICKEL	8.6	11.2				
POTASSIUM	1020	1600				
SELENIUM	0.37 U	0.27 U				
SILVER	0.21 U	0.15 U				
SODIUM	88.6	105				

TABLE 10-3 (PAGE 27 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0110101	LS7SB0110201	LS7SB0020101	LS7SB0020201	LS7SB0050101	LS7SB0050201
DEPTH (feet):	2 - 4'	6 - 7'	2 - 4'	5.5 - 6'	2 - 4'	5.5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	09/26/97	09/26/97
LOCATION:	TB11-7RI	TB11-7RI	TB2-7RI	TB2-7RI	TB5-7RI	TB5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
THALLIUM	0.95 U	0.69 U				
VANADIUM	13.9	17.4				
ZINC	106	69.2				
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	620 J		120 J		250 J	

TABLE 10-3 (PAGE 28 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0080101	LS7SB0080201	LS7SB0090101	LS7SB0090201		
DEPTH (feet):	2 - 4'	7 - 8'	2 - 4'	5 - 6'		
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI		
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	/ /	/ /
LOCATION:	TB8-7RI	TB8-7RI	TB9-7RI	TB9-7RI		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	330 UJ	330 UJ	360 U	27 J		
4-CHLORO-3-METHYLPHENOL	330 U	330 U	360 U	400 U		
ACENAPHTHENE	330 U	330 U	19 J	150 J		
ACENAPHTHYLENE	330 U	330 U	29 J	77 J		
ANTHRACENE	46 J	330 UJ	120 J	570		
BENZO(A)ANTHRACENE	230 J	330 UJ	370	1300		
BENZO(A)PYRENE	270 J	330 UJ	470	1100		
BENZO(B)FLUORANTHENE	490	330 UJ	580	1000		
BENZO(G,H,I)PERYLENE	220 J	330 UJ	370 J	900 J		
BENZO(K)FLUORANTHENE	330 U	330 UJ	360	970		
BIS(2-ETHYLHEXYL)PHTHALATE	330 U	330 U	360 U	400 U		
CARBAZOLE	26 J	330 UJ	37 J	220 J		
CHRYSENE	280 J	330 UJ	460	1500		
DI-N-BUTYL PHTHALATE	330 U	330 UJ	360 U	400 U		
DI-N-OCTYL PHTHALATE	330 U	330 UJ	360 UJ	400 UJ		
DIBENZO(A,H)ANTHRACENE	330 U	330 UJ	360 U	390 J		
DIBENZOFURAN	330 U	330 U	360 U	78 J		
FLUORANTHENE	480	18 J	690	2700		
FLUORENE	330 U	330 U	19 J	160 J		
INDENO(1,2,3-CD)PYRENE	190 J	330 UJ	300 J	770		
NAPHTHALENE	330 U	330 U	360 U	41 J		
PHENANTHRENE	160 J	330 UJ	210 J	1400		

TABLE 10-3 (PAGE 29 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0080101	LS7SB0080201	LS7SB0090101	LS7SB0090201		
DEPTH (feet):	2 - 4'	7 - 8'	2 - 4'	5 - 6'		
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI		
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	/ /	/ /
LOCATION:	TB8-7RI	TB8-7RI	TB9-7RI	TB9-7RI		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
PYRENE	450	25 J	610	2400		
METALS (mg/kg)						
ALUMINUM			5630	12000		
ANTIMONY			1.7 J	0.49 UJ		
ARSENIC			1.7	5.5		
BARIUM			29.7	68.6		
BERYLLIUM			0.24	0.51		
CADMIUM			0.25	0.04 U		
CALCIUM			1150	3070		
CHROMIUM			8.0 J	16.5		
COBALT			2.4	5.0		
COPPER			16.4	18.5		
IRON			6870	16000		
LEAD			434 J	2580 J		
MAGNESIUM			1670	2300		
MANGANESE			90.8	253		
MERCURY			0.08 J	0.04 J		
NICKEL			5.6	10.3		
POTASSIUM			984	800		
SELENIUM			0.28 U	0.44 J		
SILVER			0.16 U	0.21 U		
SODIUM			126	277		

TABLE 10-3 (PAGE 30 OF 30)
SUMMARY OF POSITIVE SOIL ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SB0080101	LS7SB0080201	LS7SB0090101	LS7SB0090201		
DEPTH (feet):	2 - 4'	7 - 8'	2 - 4'	5 - 6'		
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI		
SAMPLE DATE:	09/25/97	09/25/97	09/25/97	09/25/97	/ /	/ /
LOCATION:	TB8-7RI	TB8-7RI	TB9-7RI	TB9-7RI		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
THALLIUM			0.72 U	0.95 U		
VANADIUM			12.7	27.1		
ZINC			57.3	198		
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	210 J		45 J			

TABLE 10-4 (PAGE 1 OF 3)
SUMMARY OF POSITIVE TCLP ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW1-0.52.5	20MW11-0.52.5	20MW2-1416	20MW3-0810	20MW4-0406	20MW5-0608
DEPTH (feet):	0.5 - 2.5'	0.5 - 2.5'	14 - 16'	8 - 10'	4 - 6'	6 - 8'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	04/30/93	04/30/93	03/31/93	04/01/93	03/30/93	03/26/93
LOCATION:	20MW1	20MW1	20MW2	20MW3	20MW4	20MW5
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
TCLP METALS (mg/L)*						
ARSENIC (5.0/0.5)	0.02 U	0.02 U	0.0321 U	0.0321 U	0.0321 U	0.0321 U
BARIUM (100.0/10.0)	0.44	0.412	0.173 B	0.235	0.203	0.687
CADMIUM (1.0/0.05)	0.002 U	0.002 U	0.0018 U	0.0018 U	0.0018 U	0.0045 B
CHROMIUM (5.0/0.5)	0.004 U	0.004 U	0.004 B	0.0041 B	0.0119	0.007 B
LEAD (5.0/0.15)	0.028 U	0.028 U	0.094	1.81 S	0.0208	45.9
SILVER (5.0/0.36)	0.004 U	0.004 U	0.0029 U	0.0029 U	0.0029 U	0.0081 B

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 10-4 (PAGE 2 OF 3)
SUMMARY OF POSITIVE TCLP ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW6-1214	20MW7-0406	20TB1-0608	20TB11-0608	20TB2-1416	20TB3-1012
DEPTH (feet):	12 - 14'	4 - 6'	6 - 8'	6 - 8'	14 - 16'	10 - 12'
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95
SAMPLE DATE:	03/26/93	03/30/93	04/02/93	04/02/93	03/31/93	03/29/93
LOCATION:	20MW6	20MW7	20TB1	20TB1	20TB2	20TB3
VALIDATED:		VALIDATED				
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
TCLP METALS (mg/L)*						
ARSENIC (5.0/0.5)	0.0321 U	0.0321 U	0.0321 U	0.0321 U	0.0321 U	0.0321 U
BARIUM (100.0/10.0)	0.685	0.223	0.189 B	0.192 B	0.122 B	0.378
CADMIUM (1.0/0.05)	0.0108	0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.0018 U
CHROMIUM (5.0/0.5)	0.0133	0.0166	0.0031 U	0.0031 U	0.0031 U	0.0041 B
LEAD (5.0/0.15)	17.4	0.0064	0.004	0.0074	0.0736	0.0676
SILVER (5.0/0.36)	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U

ederal Toxicity Characteristic Regulatory Level (58 FR 46049)/Conn. .cut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 10-4 (PAGE 3 OF 3)
SUMMARY OF POSITIVE TCLP ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20TB4-1416	20TB5-0406	20TB6-0810	20TB17-4856	20TB7-4856	
DEPTH (feet):	14 - 16'	4 - 6'	6 - 10'	4 - 4.7'	4 - 4.7'	
INVESTIGATION:	AESSI95	AESSI95	AESSI95	AESSI95	AESSI95	
SAMPLE DATE:	03/31/93	03/29/93	03/25/93	04/06/93	04/06/93	/ /
LOCATION:	20TB4	20TB5	20TB6	20TB7	20TB7	
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
TCLP METALS (mg/L)*						
ARSENIC (5.0/0.5)	0.146	0.0321 U	0.0234 U	0.0321 U	0.0321 U	
BARIUM (100.0/10.0)	4.21	0.403	0.282	0.546	0.503	
CADMIUM (1.0/0.05)	0.0052	0.0028 B	0.0025 U	0.0035 B	0.004 B	
CHROMIUM (5.0/0.5)	0.046	0.0032 B	0.0039 U	0.0052 B	0.0033 B	
LEAD (5.0/0.15)	0.0655 W	0.088	0.112	0.784	1.31 S	
SILVER (5.0/0.36)	0.0029 U	0.0029 U	0.0025 UN	0.0029 U	0.0029 U	

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 10-5
SUMMARY OF POSITIVE SPLP ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	SBFD009	LS7SB0060201	LS7SB0060301	SBFD007	LS7SB0100201	LS7SB0100301
DEPTH (feet):	2 - 4'	2 - 4'	5 - 6'	2 - 4'	2 - 4'	5 - 6'
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	09/27/97	09/27/97	09/27/97	09/26/97	09/26/97	09/26/97
LOCATION:	MW3-7RI	MW3-7RI	MW3-7RI	MW5-7RI	MW5-7RI	MW5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:	LS7SB0060201			LS7SB0100201		
SPLP METALS (mg/L)*						
LEAD (5.0/0.15)	0.0013 U	0.0013 U	0.0013 U	0.0121	0.0075	0.0301

*Federal Toxicity Characteristic Regulatory Level (58 FR 46049)/Connecticut Remediation Standard Pollutant Mobility Criteria for GB Waters

TABLE 10-6

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
2-Butanone	0/13	ND	ND	1/15	20	20TB6
Acetone	4/13	9 - 15	20TB7	5/15	25 - 97	20TB6
Carbon disulfide	0/13	ND	ND	2/15	6 - 7	20MW5
Methylene chloride	5/13	5 - 10	20TB7	7/15	5 - 12	20TB7
Toluene	0/13	ND	ND	4/15	3	20MW2/20MW5/20MW7/20TB7
SEMIVOLATILE ORGANICS (ug/kg)						
2-Methylnaphthalene	7/27	22 - 300	TB11-7RI	6/26	27 - 120	TB1-7RI
4-Chloro-3-methylphenol	1/27	34	MW1-7RI	0/26	ND	ND
Acenaphthene	7/27	19 - 620	TB11-7RI	10/26	29 - 1400	20TB7
Acenaphthylene	8/27	24 - 600	TB11-7RI	6/26	20 - 450	20TB4/TB2-7RI
Anthracene	12/27	46 - 2500	TB11-7RI	9/26	230 - 1500	MW5-7RI
Benzo(a)anthracene	18/27	190 - 9500	20MW6	14/26	27 - 5700	MW2-7RI
Benzo(a)pyrene	17/27	210 - 14000	20MW6	11/25	28 - 5000	MW2-7RI
Benzo(b)fluoranthene	20/27	230 - 16000	20MW6	12/25	24 - 5500	MW2-7RI
Benzo(g,h,i)perylene	14/27	220 - 7300	20MW6	8/25	28 - 2500	MW2-7RI
Benzo(k)fluoranthene	12/27	180 - 9700	20MW6	6/25	25 - 2200	TB11-7RI
Carbazole	10/27	17 - 950	TB11-7RI	7/26	45 - 880	MW5-7RI
Chrysene	18/27	190 - 11000	20MW6	14/26	36 - 5500	MW2-7RI
Di-N-butyl phthalate	3/27	18 - 320	20TB7	0/26	ND	ND
Dibenzo(a,h)anthracene	9/26	110 - 3100	TB11-7RI	7/25	21 - 1300	MW2-7RI
Dibenzofuran	6/27	19 - 530	TB11-7RI	8/26	22 - 770	20TB7
Fluoranthene	21/27	200 - 19000	20MW6	19/26	18 - 8200	MW5-7RI
Fluorene	7/27	19 - 1200	TB11-7RI	10/26	64 - 1600	20TB7
Indeno(1,2,3-Cd)pyrene	14/27	190 - 7000	20MW6	8/25	31 - 2600	MW2-7RI
Naphthalene	4/27	36 - 510	TB11-7RI	6/26	41 - 270	TB1-7RI
Phenanthrene	17/27	140 - 13000	20MW3	13/26	20 - 7600	MW5-7RI
Pyrene	20/27	180 - 14000	20MW6	19/26	25 - 11000	MW2-7RI

TABLE 10-6

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
PESTICIDES/PCBs (μg/kg)						
4,4'-DDD	2/13	3.5 - 35	20TB7	1/15	4.4	20TB6
4,4'-DDT	2/13	17 - 43	20TB7	3/15	4.4 - 71	20TB7
DIOXINS/FURANS (μg/kg)						
Dioxin	1/4	0.16	20MW6	0/2	ND	ND
INORGANICS (mg/kg)						
Aluminum	19/19	136 - 8670	20TB7	19/19	2950 - 12000	TB9-7RI
Antimony	5/19	0.92 - 7.8	20TB4	6/19	2.4 - 1820	20TB4
Arsenic	19/19	0.32 - 6	MW5-7RI	18/19	0.32 - 50	20TB4
Barium	19/19	23.7 - 364	20TB4	19/19	17.7 - 550	20TB4
Beryllium	10/19	0.15 - 0.51	20TB7	15/19	0.14 - 1.2	20MW6
Boron	2/13	1.7 - 2.9	20TB4	3/15	1.4 - 25.1	20TB4
Cadmium	3/19	0.25 - 2	MW5-7RI	7/19	0.16 - 4	20TB4
Calcium	19/19	460 - 16800	MW5-7RI	17/19	460 - 35000	20TB4
Chromium	18/19	4.1 - 21.4	20TB7	18/19	4.4 - 44.4	20TB4
Cobalt	17/19	1.1 - 9.1	20TB7	17/19	1.6 - 12.3	20TB4
Copper	19/19	3 - 122	20MW5	16/19	3.6 - 9010	20TB4
Cyanide	1/13	0.18	20MW3	1/15	0.46	20TB4
Iron	19/19	4510 - 18900	20TB7	19/19	4730 - 186000	20TB4
Lead	19/19	1.6 - 189000	20MW6	19/19	2.0 - 13300	MW5-7RI
Magnesium	19/19	47.9 - 5650	20TB7	19/19	1210 - 7610	20TB4
Manganese	19/19	32.7 - 317	20TB7	19/19	54 - 956	20TB4
Mercury	8/19	0.01 - 0.36	MW5-7RI	7/19	0.04 - 1.9	MW5-7RI
Nickel	19/19	1.8 - 17.7	20TB6	19/19	2.7 - 254	20MW6
Potassium	19/19	53 - 5240	20TB7	19/19	596 - 3980	20TB7
Selenium	0/19	ND	ND	3/19	0.22 - 2.5	MW5-7RI
Silver	0/19	ND	ND	3/19	0.75 - 4.1	20TB4
Sodium	18/19	56.3 - 164	20MW3	19/19	66.8 - 1880	20MW6

TABLE 10-6

SUMMARY OF SOIL ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	SHALLOW SOILS (<4 FEET)[1]			DEEP SOILS (>4 FEET)[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Thallium	2/19	0.16 - 0.18	TB9-7RI	2/19	0.14 - 0.18	20TB1
Vanadium	19/19	1.9 - 44.1	20TB7	19/19	7.5 - 246	MW5-7RI
Zinc	19/19	12.2 - 961	MW5-7RI	19/19	11 - 3440	20TB4
TCLP METALS (mg/L)						
Arsenic	NA	NA	ND	1/15	0.146	20TB4
Barium	NA	NA	ND	11/15	0.203-4.21	20TB4
Cadmium	NA	NA	ND	3/15	0.0045-0.046	20MW6
Chromium	NA	NA	ND	7/15	0.004-0.046	20TB4
Lead	NA	NA	ND	15/15	0.004-45.9	20MW5
Silver	NA	NA	ND	1/15	0.0081	20MW5
SPLP Metals (mg/L)						
Lead	2/3	0.0075-0.0121	MW3-7RI	1/3	0.0301	MW5-7RI
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	14/14	45 - 2600	MW5-7RI	10/15	86 - 2500	20MW7

1 Includes samples 20MW1-0.52.5, 20MW11-0.52-5, 20MW2-0002, 20MW3-0204, 20MW4-0204, 20MW5-0002, 20MW6-0204, 20MW7-0204, 20TB1-0204, 20TB2-0204, 20TB3-0204, 20TB4-0002, 20TB5-0002, 20TB6-0002, 20TB7-3242, LS7SB0010101, LS7SB0020101, LS7SB0030201, LS7SB0040201, LS7SB0050101, LS7SB0060201, LS7SB0070101, LS7SB0080101, LS7SB0090101, LS7SB0100201, LS7SB0110101, SBFD005 (field duplicate of LS7SB0070101), SBFD007 (field duplicate of LS7SB0100201), SBFD009 (field duplicate of LS7SB0060201).

2 Includes samples 20MW2-1416, 20MW3-0810, 20MW4-0406, 20MW5-0608, 20MW6-1214, 20MW7-0406, 20TB1-0608, 20TB11-0608 (field duplicate of 20TB1-0608), 20TB17-4852 (field duplicate of 20TB7-4852), 20TB17-4856, 20TB2-1416, 20TB3-1012, 20TB4-0406, 20TB4-1416, 20TB5-0406, 20TB6-0810, 20TB7-4852, 20TB7-4856, LS7SB0010201, LS7SB0020201, LS7SB0030301, LS7SB0040301, LS7SB0050201, LS7SB0060301, LS7SB0070301, LS7SB0080201, LS7SB0090201, LS7SB0100301, LS7SB0110201.

ND - Not Detected.

NA - Not Analyzed.

TABLE 10-7

SUMMARY OF SOIL FLUORESCENCE SPECTROSCOPY DATA - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Sample Depth (ft)	Observation
20MW1	0.5-2.5	Spectra typical of heavy fuel oil (No. 6).
20MW2	14-16	Spectra typical of heavy residual fuel oil/road tar.
20MW3	8-10	Spectra unknown. Similar to heavy equipment/"off road" industrial lube oil/bituminous concrete.
20MW4	4-6	Spectra typical of heavy residual fuel oil/road tar.
20MW5	6-8	Spectra typical of No. 2/Diesel fuel oil.
20MW6	12-14	Spectra typical of heavy fuel oil (No. 6).
20MW7	4-6	Spectra typical of heavy residual fuel oil/road tar.
20TB1	6-8	Spectra typical of heavy residual fuel oil/road tar.
20TB11[1]	6-8	Spectra typical of heavy residual fuel oil/road tar.
20TB2	14-16	Unknown spectra consisting of light aromatic compounds.
20TB3	10-12	Spectra typical of heavy fuel oil (No. 6).
20TB4	14-16	Spectra typical of heavy fuel oil (No. 6).
20TB5	4-6	Spectra typical of heavy fuel oil (No. 6).
20TB6	8-10	Spectra unknown. Similar to heavy equipment/"off road" industrial lube oil.
20TB7	4-4.7	Spectra unknown. Similar to heavy equipment/"Off road" industrial lube oil/bituminous concrete.
20TB17[2]	4-4.7	Spectra typical of bituminous concrete.

1 Field duplicate of 20TB1 (6-8).
2 Field duplicate of 20TB7 (4-4.7).

TABLE 10-8 (PAGE 1 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW2	20MW2	LS7GW20MW201	LS7GW20MW201-F	20MW3	20MW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/28/93	04/28/93	10/30/97	10/30/97	04/28/93	04/28/93
LOCATION:	20MW2	20MW2	20MW2	20MW2	20MW3	20MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U				1 U	
CHLOROFORM	1 U				1 U	
TRICHLOROETHENE	1 U				1 U	
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	11 U		12 U		11 U	
ACENAPHTHENE	11 U		12 U		10 J	
ACENAPHTHYLENE	11 U		12 U		1 J	
ANTHRACENE	11 U		12 U		11 U	
CARBAZOLE	11 UJ		12 U		11 U	
CHRYSENE	11 U		12 U		11 U	
DIBENZOFURAN	11 U		12 U		11 U	
FLUORANTHENE	11 U		12 UJ		1 J	
FLUORENE	11 U		12 U		11 U	
NAPHTHALENE	11 U		12 U		11 U	
PHENANTHRENE	11 U		12 U		11 U	
PYRENE	11 U		12 U		1 J	
METALS (µg/L)						
ALUMINUM	158 U	151 B	31.5 U	10.0 UJ	191 U	156 B
ANTIMONY	30 U	30 U	2.5 U	2.5 U	30 UJ	30 U
ARSENIC	4.9 U	5.7 B	6.0	6.1	3.8 U	4 BW
BARIUM	131 B	141 B	40.6	256	72.8 U	71 B
BORON	340 U	344 BE			407 U	396 BE
CADMIUM	2 U	3.1 B	0.22 U	0.25 U	2 UJ	2 U
CALCIUM	54700 J	56300	25700	27200	75600 J	69900

TABLE 10-8 (PAGE 2 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW2	20MW2	LS7GW20MW201	LS7GW20MW201-F	20MW3	20MW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/28/93	04/28/93	10/30/97	10/30/97	04/28/93	04/28/93
LOCATION:	20MW2	20MW2	20MW2	20MW2	20MW3	20MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
METALS (µg/L)						
CHROMIUM	4 U	4 U	0.79 U	1.0 U	4 UJ	4 U
COBALT	4.4 B	3.1 B	0.80 U	0.80 U	3 UJ	3 U
COPPER	3 U	3 U	0.74 U	2.4 U	3 UJ	3 U
IRON	12000	12500	8690	8670	1910 UJ	1570
LEAD	1 U	1.8 B	1.3 U	1.3 U	1.8 U	1.6 B
MAGNESIUM	20400 J	21200	8890	9380	27000 J	24800
MANGANESE	3490 J	3600	886	912	1450 J	1330
NICKEL	9 U	9 U	0.78 J	9.0 U	9 UJ	9 U
POTASSIUM	21400 J	22100	17000	17500	14200 J	13000
SELENIUM	1 U	1 U	1.9 U	1.9 U	1 UJ	1 UW
SODIUM	143000 J	148000	113000	123000	156000 J	144000
THALLIUM	5.4 U	1.9 B	4.8 U	4.8 U	3.7 U	1.2 BW
VANADIUM	5 U	5 U	0.55 U	0.55 U	5 UJ	5 U
ZINC	3.2 U	6.4 B	3.6 U	95.4 J	9.8 U	3 U
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)			1.54			
REDOX POTENTIAL (MV)			-181.5			
SALINITY (PPT)			0.37			
SPECIFIC CONDUCTIVITY (MS/CM)			0.756			
TEMPERATURE (C)			20.5			
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)			160			
AMMONIA, AS NITROGEN (MG/L)			0.91			
CHLORIDE (MG/L)			150			

TABLE 10-8 (PAGE 3 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20MW2	20MW2	LS7GW20MW201	LS7GW20MW201-F	20MW3	20MW3
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/28/93	04/28/93	10/30/97	10/30/97	04/28/93	04/28/93
LOCATION:	20MW2	20MW2	20MW2	20MW2	20MW3	20MW3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
MISCELLANEOUS PARAMETERS						
DIVALENT IRON (MG/L)			6			
HARDNESS AS CaCO3 (MG/L)			100			
METHANE (UG/L)			2400			
NITRATE, AS NITROGEN (MG/L)			0.050 U			
PHOSPHORUS (MG/L)			0.31 J			
SULFATE (MG/L)			9.2			
TOTAL ORGANIC CARBON (MG/L)			6.8 J			
TURBIDITY (NTU)			4.48			
GENERAL CHEMISTRY						
PH			6.88			

TABLE 10-8 (PAGE 4 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW301	LS7GW20MW301-F	20MW4	20MW4	LS7GW20MW401	LS7GW20MW401-F
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95	1997RI	1997RI
SAMPLE DATE:	11/04/97	11/04/97	04/28/93	04/28/93	10/30/97	10/30/97
LOCATION:	20MW3	20MW3	20MW4	20MW4	20MW4	20MW4
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE			1 U			
CHLOROFORM			2			
TRICHLOROETHENE			1 U			
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	12 U		11 U		12 U	
ACENAPHTHENE	12 U		11 U		12 U	
ACENAPHTHYLENE	12 U		1 J		12 U	
ANTHRACENE	12 U		11 U		12 U	
CARBAZOLE	12 U		11 U		12 U	
CHRYSENE	12 U		11 U		12 U	
DIBENZOFURAN	12 U		11 U		12 U	
FLUORANTHENE	12 U		11 U		12 UJ	
FLUORENE	12 U		11 U		12 U	
NAPHTHALENE	12 U		11 U		12 U	
PHENANTHRENE	12 U		11 U		12 U	
PYRENE	12 U		11 U		12 U	
METALS (µg/L)						
ALUMINUM	339	94.5 U	158 U	136 B	10.0 UJ	10.0 UJ
ANTIMONY	2.5 U	2.5 U	30 UJ	30 U	2.5 U	2.5 U
ARSENIC	4.1 J	3.6 J	4.2 U	2.7 B	2.8 J	2.8 J
BARIUM	7.9	6.9	27.3 U	26.5 B	17.2	315
BORON			924 U	939 E		
CADMIUM	0.51 U	0.22 U	2 UJ	2 U	0.27 U	0.39 U
CALCIUM	3740	3740	18900 J	19900	32300	33400

TABLE 10-8 (PAGE 5 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW301	LS7GW20MW301-F	20MW4	20MW4	LS7GW20MW401	LS7GW20MW401-F
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95	1997RI	1997RI
SAMPLE DATE:	11/04/97	11/04/97	04/28/93	04/28/93	10/30/97	10/30/97
LOCATION:	20MW3	20MW3	20MW4	20MW4	20MW4	20MW4
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
METALS (µg/L)						
CHROMIUM	2.9	1.3 U	4 UJ	4 U	0.68 U	0.68 U
COBALT	1.1 J	1.1 J	3 UJ	3 U	0.80 U	0.80 U
COPPER	22.7 J	3.0 U	3 UJ	3 U	2.6 U	4.3 U
IRON	794	516 J	64.4 U	39.1 B	78.6 U	13.0 U
LEAD	6.6	1.3 U	2.2 U	1.8 B	1.3 U	1.3 U
MAGNESIUM	2820	2810	8030 J	8210	7510	7880
MANGANESE	28.0	26.6	92.7 J	100	109	108
NICKEL	12.5	11.2	9 UJ	9 U	0.75 U	9.0 U
POTASSIUM	2780 U	2910	11800 J	12200	11800	12000
SELENIUM	1.9 U	1.9 U	1 UJ	1 UW	1.9 U	1.9 U
SODIUM	24000	23400	11400 J	115000	108000	118000
THALLIUM	4.8 U	4.8 U	4.1 U	2 B	4.8 U	4.8 U
VANADIUM	2.3	1.8	5 UJ	5 U	0.70 U	0.76 U
ZINC	330	161	6.8 U	3.5 B	26.6	116 J
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	8.4				0.45	
REDOX POTENTIAL (MV)	-101.6				-11.7	
SALINITY (PPT)	0.07				0.34	
SPECIFIC CONDUCTIVITY (MS/CM)	0.143				.707	
TEMPERATURE (C)	18.16				22.1	
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	20 U				180	
AMMONIA, AS NITROGEN (MG/L)	0.15 J				0.10 U	
CHLORIDE (MG/L)	26				120	

TABLE 10-8 (PAGE 6 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW301	LS7GW20MW301-F	20MW4	20MW4	LS7GW20MW401	LS7GW20MW401-F
INVESTIGATION:	1997RI	1997RI	AESSI95	AESSI95	1997RI	1997RI
SAMPLE DATE:	11/04/97	11/04/97	04/28/93	04/28/93	10/30/97	10/30/97
LOCATION:	20MW3	20MW3	20MW4	20MW4	20MW4	20MW4
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
MISCELLANEOUS PARAMETERS						
DIVALENT IRON (MG/L)	0				0	
HARDNESS AS CaCO3 (MG/L)	27				110	
METHANE (UG/L)	3 J				140	
NITRATE, AS NITROGEN (MG/L)	0.05 U				0.089 J	
PHOSPHORUS (MG/L)	0.35 J				0.28 J	
SULFATE (MG/L)	28				37	
TOTAL ORGANIC CARBON (MG/L)	4.9 J				5.0 J	
TURBIDITY (NTU)	8.49				1.89	
GENERAL CHEMISTRY						
PH	6.44				6.92	

TABLE 10-8 (PAGE 7 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20GW5	20GW5	LS7GW20MW501	LS7GW20MW501-F	20MW6	20MW6
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/28/93	04/28/93
LOCATION:	20MW5	20MW5	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE	1 U				0.6 J	
CHLOROFORM	1 U				1 U	
TRICHLOROETHENE	1 U				0.6 J	
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	11 U		12 U		11 U	
ACENAPHTHENE	4 J		0.6 J		11 U	
ACENAPHTHYLENE	11 U		12 U		11 U	
ANTHRACENE	11 U		12 U		11 U	
CARBAZOLE	11 UJ		12 U		11 U	
CHRYSENE	11 U		12 U		11 U	
DIBENZOFURAN	11 U		12 U		11 U	
FLUORANTHENE	11 R		12 UJ		11 U	
FLUORENE	2 J		12 U		11 U	
NAPHTHALENE	11 U		12 U		11 U	
PHENANTHRENE	1 J		12 U		11 U	
PYRENE	11 U		12 U		11 U	
METALS (µg/L)						
ALUMINUM	210 U	163 B	82.9 U	36.5 U	144 U	133 B
ANTIMONY	30 U	30 U	2.5 U	2.5 U	30 U	30 U
ARSENIC	4.5 U	2 U	2.5 U	2.5 U	2.9 U	3.8 BW
BARIUM	398	382	966	1200	58.2 U	58.2 B
BORON	374 U	316 BE			220 U	241 BE
CADMIUM	2 U	2 U	0.22 U	0.22 U	3.1 U	2 U
CALCIUM	44300 J	42200	53500	52900	30500 J	30000

TABLE 10-8 (PAGE 8 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20GW5	20GW5	LS7GW20MW501	LS7GW20MW501-F	20MW6	20MW6
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/28/93	04/28/93
LOCATION:	20MW5	20MW5	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
METALS (µg/L)						
CHROMIUM	4 U	4 U	3.1 U	3.1 U	4 U	4 U
COBALT	3 U	3 U	2.9 U	2.9 U	3 U	3 U
COPPER	3 U	3 U	1.5 U	1.5 U	24.4 B	21.1 B
IRON	68.6 U	28.3 B	375	256 U	44.3 U	80.2 B
LEAD	6 W	1.5 B	7.0	1.3 U	117 J	97.5
MAGNESIUM	9740 J	9350	10000	9830	4030 JB	4000 B
MANGANESE	191 J	174	156 U	152 U	14.8 U	16.9
NICKEL	9 U	9 U	10.2 J	9.0 U	9 U	13.1 B
POTASSIUM	7870 J	7640	9540	9230	5440 J	5390
SELENIUM	1 U	1 U	1.9 U	1.9 U	1.3 B	1.2 B
SODIUM	31800 J	29800	40700	45800	18700 J	18600
THALLIUM	1 UW	1 U	4.8 U	4.8 U	2.6 U	1.3 BW
VANADIUM	5 U	5 U	2.9 U	2.9 U	5 U	5 U
ZINC	3.3 U	6.4 B	11.0 U	24.1 J	816	780
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)			8.1			
REDOX POTENTIAL (MV)			61.9			
SALINITY (PPT)			0.01			
SPECIFIC CONDUCTIVITY (MS/CM)			0.027			
TEMPERATURE (C)			14.8			
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)			170			
AMMONIA, AS NITROGEN (MG/L)			0.61			
CHLORIDE (MG/L)			76			

TABLE 10-8 (PAGE 9 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20GW5	20GW5	LS7GW20MW501	LS7GW20MW501-F	20MW6	20MW6
INVESTIGATION:	AESSI95	AESSI95	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	04/29/93	04/29/93	10/28/97	10/28/97	04/28/93	04/28/93
LOCATION:	20MW5	20MW5	20MW5	20MW5	20MW6	20MW6
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
MISCELLANEOUS PARAMETERS						
DIVALENT IRON (MG/L)			0			
HARDNESS AS CaCO3 (MG/L)			170			
METHANE (UG/L)			1900			
NITRATE, AS NITROGEN (MG/L)			0.084 J			
PHOSPHORUS (MG/L)			0.41 J			
SULFATE (MG/L)			1.2 J			
TOTAL ORGANIC CARBON (MG/L)			4.1 J			
TURBIDITY (NTU)			3.6			
GENERAL CHEMISTRY						
PH			6.62			

TABLE 10-8 (PAGE 10 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW601	GWFD003	GWFD003-F	LS7GW20MW601-F	20GW7	20GW7
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	04/29/93	04/29/93
LOCATION:	20MW6	20MW6	20MW6	20MW6	20MW7	20MW7
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:		LS7GW20MW601	LS7GW20MW601-F			
VOLATILES (µg/L)						
1,1,1-TRICHLOROETHANE					1 U	
CHLOROFORM					1 U	
TRICHLOROETHENE					1 UJ	
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	12 U	11 U			3 J	
ACENAPHTHENE	12 U	11 U			2 J	
ACENAPHTHYLENE	12 U	11 U			10 U	
ANTHRACENE	12 U	11 U			10 U	
CARBAZOLE	12 U	11 U			10 UJ	
CHRYSENE	12 U	11 U			10 U	
DIBENZOFURAN	12 U	11 U			10 U	
FLUORANTHENE	12 U	11 U			10 U	
FLUORENE	12 U	11 U			10 U	
NAPHTHALENE	12 U	11 U			10 U	
PHENANTHRENE	12 U	11 U			10 U	
PYRENE	12 U	11 U			10 U	
METALS (µg/L)						
ALUMINUM	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	215 U	149 U
ANTIMONY	9.3	15.7	4.8 J	4.5 J	30 UJ	30 UJ
ARSENIC	3.5 J	8.9	2.5 U	2.5 U	3.9 U	4.9 U
BARIUM	82.2	78.4	277	196	71.6 U	72.8 U
BORON					353 U	261 U
CADMIUM	0.63 U	1.0 U	0.43 U	0.49 U	2 UJ	2 UJ
CALCIUM	35800	37000	34200	33700	89200 J	92300 J

TABLE 10-8 (PAGE 11 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW601	GWFD003	GWFD003-F	LS7GW20MW601-F	20GW7	20GW7
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	04/29/93	04/29/93
LOCATION:	20MW6	20MW6	20MW6	20MW6	20MW7	20MW7
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:		LS7GW20MW601	LS7GW20MW601-F			
METALS (µg/L)						
CHROMIUM	0.90 U	1.5 U	0.68 U	0.68 U	4 UJ	4 UJ
COBALT	1.1 J	1.7	0.80 U	0.80 U	3 UJ	3 UJ
COPPER	11.4 U	10.7 U	6.9 U	7.8 U	3 UJ	3 UJ
IRON	1190	1220	913 J	877 J	1600 J	1550 J
LEAD	89.3	97.3	25.6 J	17.0 J	1.9 U	1.6 U
MAGNESIUM	6480	6370	6250	6120	14100 J	14500 J
MANGANESE	188	187	174	159	461 J	444 J
NICKEL	8.2	8.4	7.2	7.7	9 UJ	9 UJ
POTASSIUM	6650	6430	6520	6370	11100 J	11500 J
SELENIUM	7.7 J	33.6 J	1.9 U	1.9 U	1 UJ	1 UJ
SODIUM	35000	34300	36100	38000	45200 J	46700 J
THALLIUM	4.8 U	24.2 U	4.8 U	4.8 U	1 UJ	1 UJ
VANADIUM	0.55 U	0.74 U	0.55 U	0.64 U	5 UJ	5 UJ
ZINC	351	337	366	378	3.6 U	6.8 U
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	2.18					
REDOX POTENTIAL (MV)	-45.9					
SALINITY (PPT)	0.19					
SPECIFIC CONDUCTIVITY (MS/CM)	0.396					
TEMPERATURE (C)	16.9					
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	69	69				
AMMONIA, AS NITROGEN (MG/L)	0.10 U	0.10 U				
CHLORIDE (MG/L)	74	74				

TABLE 10-8 (PAGE 12 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW601	GWFD003	GWFD003-F	LS7GW20MW601-F	20GW7	20GW7
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	AESSI95	AESSI95
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	04/29/93	04/29/93
LOCATION:	20MW6	20MW6	20MW6	20MW6	20MW7	20MW7
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:		LS7GW20MW601	LS7GW20MW601-F			
MISCELLANEOUS PARAMETERS						
DIVALENT IRON (MG/L)	1					
HARDNESS AS CaCO3 (MG/L)	110	110				
METHANE (UG/L)	350	340				
NITRATE, AS NITROGEN (MG/L)	0.45	0.44				
PHOSPHORUS (MG/L)	0.15 J	0.20 J				
SULFATE (MG/L)	24	24				
TOTAL ORGANIC CARBON (MG/L)	1.6 J	2.5 J				
TURBIDITY (NTU)	4.37					
GENERAL CHEMISTRY						
PH	6.62					

TABLE 10-8 (PAGE 13 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW701	LS7GW20MW701-F	LS7GW00301	LS7GW00301-F	LS7GW00401	LS7GW00401-F
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	10/29/97	10/29/97
LOCATION:	20MW7	20MW7	MW1-7RI	MW1-7RI	MW2-7RI	MW2-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	1 J		12 U		13 U	
ACENAPHTHENE	3 J		12 U		1 J	
ACENAPHTHYLENE	12 UJ		12 U		13 U	
ANTHRACENE	12 UJ		12 U		2 J	
CARBAZOLE	12 UJ		12 U		1 J	
CHRYSENE	12 UJ		12 U		0.9 J	
DIBENZOFURAN	12 UJ		12 U		1 J	
FLUORANTHENE	12 UJ		12 U		5 J	
FLUORENE	3 J		12 U		3 J	
NAPHTHALENE	12 UJ		12 U		0.7 J	
PHENANTHRENE	12 UJ		12 U		9 J	
PYRENE	12 UJ		12 U		5 J	
METALS (µg/L)						
ALUMINUM	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	225 U	169 U
ANTIMONY	12.2	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
ARSENIC	18.8	20.0	7.9	9.1	2.5 U	2.5 U
BARIUM	32.3	31.4	12.5	282	10.0	294
CADMIUM	1.1 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U
CALCIUM	57800	48300	5770	6600	16800	17000
CHROMIUM	0.68 U	0.68 U	0.68 U	0.68 U	3.1 U	3.1 U
COBALT	0.80 U	0.83 J	0.80 U	0.80 U	2.9 U	2.9 U
COPPER	2.4 U	2.7 U	2.4 U	3.0 U	1.5 U	1.5 U
IRON	1350	1060 J	538	575 J	62.0 U	55.9 U
LEAD	11.0	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U

TABLE 10-8 (PAGE 14 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW701	LS7GW20MW701-F	LS7GW00301	LS7GW00301-F	LS7GW00401	LS7GW00401-F
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	10/29/97	10/29/97
LOCATION:	20MW7	20MW7	MW1-7RI	MW1-7RI	MW2-7RI	MW2-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
METALS (µg/L)						
MAGNESIUM	7630	6960	1680	1910	1280	1390
MANGANESE	129	114	168	191	11.9 U	11.4 U
NICKEL	0.75 U	0.75 U	0.75 U	0.93 J	9.0 U	9.0 U
POTASSIUM	10800	10300	4240	4250	3780	4000
SELENIUM	56.1 J	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
SODIUM	47000	44800	39400	47200	26700	35300
THALLIUM	24.2 U	4.8 U	4.8 U	4.8 U	4.8 U	4.8 U
VANADIUM	1.0 U	0.63 U	0.55 U	1.1 U	2.9 U	2.9 U
ZINC	14.4 U	10.4 U	4.7 U	41.2	4.2 U	15.5 U
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	2.64		1.01		0.46	
REDOX POTENTIAL (MV)	-238		-151.1		-274.9	
SALINITY (PPT)	0.25		0.11		0.12	
SPECIFIC CONDUCTIVITY (MS/CM)	0.51		0.23		0.278	
TEMPERATURE (C)	18.33		21.79		55.07	
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	160		68		42	
AMMONIA, AS NITROGEN (MG/L)	0.80 J		0.15 J		0.58	
CHLORIDE (MG/L)	77		39		51	
DIVALENT IRON (MG/L)	0.9		0.6		0	
HARDNESS AS CaCO3 (MG/L)	150		29		45	
METHANE (UG/L)	4600		1800		79	
NITRATE, AS NITROGEN (MG/L)	0.05 U		0.05 U		0.050 UJ	
PHOSPHORUS (MG/L)	0.51 J		0.45 J		0.49 J	

TABLE 10-8 (PAGE 15 OF 19)

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW20MW701	LS7GW20MW701-F	LS7GW00301	LS7GW00301-F	LS7GW00401	LS7GW00401-F
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/31/97	10/31/97	10/31/97	10/31/97	10/29/97	10/29/97
LOCATION:	20MW7	20MW7	MW1-7RI	MW1-7RI	MW2-7RI	MW2-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
MISCELLANEOUS PARAMETERS						
SULFATE (MG/L)	1.0 U		2.0		22	
TOTAL ORGANIC CARBON (MG/L)	6.2 J		4.6 J		16 J	
TURBIDITY (NTU)	1.59		5.6		1.84	
GENERAL CHEMISTRY						
PH	7.76		7.26		7.72	

TABLE 10-8 (PAGE 16 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW00701	LS7GW00701-F	LS7GW00901	LS7GW00901-F	LS7GW001001	GWFD001
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97
LOCATION:	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI	MW5-7RI	MW5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						LS7GW001001
SEMIVOLATILES (µg/L)						
2-METHYLNAPHTHALENE	12 U		12 U		12 U	13 U
ACENAPHTHENE	0.8 J		12 U		12 U	13 U
ACENAPHTHYLENE	12 U		12 U		12 U	13 U
ANTHRACENE	12 U		12 U		12 U	13 U
CARBAZOLE	12 U		12 U		12 U	13 U
CHRYSENE	12 U		12 U		12 U	13 U
DIBENZOFURAN	12 U		12 U		12 U	13 U
FLUORANTHENE	12 UJ		12 UJ		12 UJ	13 UJ
FLUORENE	12 U		12 U		12 U	13 U
NAPHTHALENE	12 U		12 U		12 U	13 U
PHENANTHRENE	12 U		12 U		12 U	13 U
PYRENE	12 U		12 U		12 U	13 U
METALS (µg/L)						
ALUMINUM	19.4 U	12.9 U	18.2 U	18.0 U	10.0 UJ	16.5 U
ANTIMONY	2.5 U	2.5 U	2.5 U	2.5 U	9.8	10.1
ARSENIC	2.5 U	2.5 U	11.0	8.9	9.5	9.6
BARIUM	42.5	359	58.2	365	149	154
CADMIUM	0.22 U	0.22 U	0.22 U	0.22 U	0.23 U	0.22 U
CALCIUM	23100	23500	45200	39400	37600	37300
CHROMIUM	3.1 U	3.1 U	3.1 U	3.1 U	0.68 U	0.68 U
COBALT	2.9 U	2.9 U	2.9 U	2.9 U	1.1 J	0.82 J
COPPER	1.5 U	1.5 U	1.5 U	1.5 U	2.1 U	1.6 U
IRON	420	327	9100	8720	22600	21900
LEAD	1.3 U	1.3 U	1.3 U	1.3 U	9.9	9.4

TABLE 10-8 (PAGE 17 OF 19)

SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW00701	LS7GW00701-F	LS7GW00901	LS7GW00901-F	LS7GW001001	GWFD001
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97
LOCATION:	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI	MW5-7RI	MW5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						LS7GW001001
METALS (µg/L)						
MAGNESIUM	8500	8290	12300	11100	5400	5330
MANGANESE	673	599	862	812	632	617
NICKEL	9.0 U	9.0 U	9.0 U	9.0 U	13.2	13.2
POTASSIUM	9270	9160	14500	13000	20200	20000
SELENIUM	1.9 U	1.9 U	1.9 U	1.9 U	3.1 U	1.9 U
SODIUM	119000	119000	65200	61200	79200	78700
THALLIUM	4.8 U	4.8 U	4.8 U	4.8 U	6.5 U	4.8 U
VANADIUM	2.9 U	2.9 U	2.9 U	2.9 U	0.55 U	0.55 U
ZINC	5.8 U	102 J	6.0 U	89.4 J	315	313
WATER QUALITY PARAMETERS						
DISSOLVED OXYGEN (MG/L)	1.89		0.54		2.16	
REDOX POTENTIAL (MV)	-62.6		-172.2		-93.3	
SALINITY (PPT)	0.39		0.31		0.33	
SPECIFIC CONDUCTIVITY (MS/CM)	0.785		0.642		0.683	
TEMPERATURE (C)	18.8		18.24		18.81	
MISCELLANEOUS PARAMETERS						
ALKALINITY AS CACO3 (MG/L)	160		220		83	85
AMMONIA, AS NITROGEN (MG/L)	0.10 U		1.6		0.43	0.54
CHLORIDE (MG/L)	190		78		140	140
DIVALENT IRON (MG/L)	0		0		6	7
HARDNESS AS CaCO3 (MG/L)	79		150		120	110
METHANE (UG/L)	86		630		350	320
NITRATE, AS NITROGEN (MG/L)	0.44 J		0.050 UJ		0.10	0.050 U
PHOSPHORUS (MG/L)	0.28 J		0.39 J		0.33 J	0.35 J

TABLE 10-8 (PAGE 18 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW00701	LS7GW00701-F	LS7GW00901	LS7GW00901-F	LS7GW001001	GWFD001
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97	10/29/97
LOCATION:	MW3-7RI	MW3-7RI	MW4-7RI	MW4-7RI	MW5-7RI	MW5-7RI
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						LS7GW001001
MISCELLANEOUS PARAMETERS						
SULFATE (MG/L)	11		3.5		51	51
TOTAL ORGANIC CARBON (MG/L)	4.6 J		8.5 J		6.2 J	3.3 J
TURBIDITY (NTU)	1.45		1.63		1.4	
GENERAL CHEMISTRY						
PH	7.02		6.77		6.3	

TABLE 10-8 (PAGE 19 OF 19)
SUMMARY OF POSITIVE GROUNDWATER ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7GW001001-F	GWFD001-F				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	10/29/97	10/29/97	/ /	/ /	/ /	/ /
LOCATION:	MW5-7RI	MW5-7RI				
VALIDATED:	VALIDATED	VALIDATED				
FILTERING:	Filtered	Filtered				
FIELD DUPLICATE OF:		LS7GW001001-F				
METALS (µg/L)						
ALUMINUM	10.0 UJ	10.0 UJ				
ANTIMONY	9.9	10.7				
ARSENIC	9.5	10.0				
BARIUM	183	484				
CADMIUM	0.27 U	0.35 U				
CALCIUM	33500	36600				
CHROMIUM	0.76 U	0.68 U				
COBALT	0.98 J	0.80 U				
COPPER	2.6 U	2.8 U				
IRON	19000	20100				
LEAD	1.3 U	1.3 U				
MAGNESIUM	4940	5360				
MANGANESE	520	586				
NICKEL	11.1	16.1				
POTASSIUM	18500	19200				
SELENIUM	1.9 U	1.9 U				
SODIUM	75900	83900				
THALLIUM	4.8 U	4.8 U				
VANADIUM	0.55 U	0.55 U				
ZINC	282 J	495 J				

TABLE 10-9

SUMMARY OF HISTORICAL AND LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Analyte	Historical Data[1]				Lower Subase RI[2]		
	Frequency of Detection	Concentration Range	Maximum Detection		Frequency of Detection	Concentration Range	Location of Maximum Detection
			Location	Investigation[3]			
VOLATILE ORGANICS (μg/L)							
1,1,1-Trichloroethane	1/6	0.6	20MW6	AESSI95	NA	NA	ND
Chloroform	1/6	2	20MW4	AESSI95	NA	NA	ND
Trichloroethene	1/6	0.6	20MW6	AESSI95	NA	NA	ND
SEMIVOLATILE ORGANICS (μg/L)							
2-Methylnaphthalene	1/6	3	20MW7	AESSI95	1/13	1	20MW7
Acenaphthene	3/6	2 - 10	20MW3	AESSI95	4/13	0.6 - 3	20MW7
Acenaphthylene	2/6	1	20MW3/20MW4	AESSI95	0/13	ND	ND
Anthracene	0/6	ND	ND	ND	1/13	2	MW2-7RI
Carbazole	0/6	ND	ND	ND	1/13	1	MW2-7RI
Chrysene	0/6	ND	ND	ND	1/13	0.9	MW2-7RI
Dibenzofuran	0/6	ND	ND	ND	1/13	1	MW2-7RI
Fluoranthene	1/5	1	20MW3	AESSI95	1/13	5	MW2-7RI
Fluorene	1/6	2	20MW5	AESSI95	2/13	3	20MW7/MW2-7RI
Naphthalene	0/6	ND	ND	ND	1/13	0.7	MW2-7RI
Phenanthrene	1/6	1	20MW5	AESSI95	1/13	9	MW2-7RI
Pyrene	1/6	1	20MW3	AESSI95	1/13	5	MW2-7RI
INORGANICS (μg/L)							
Aluminum	0/6	ND	ND	ND	1/13	339	20MW3
Aluminum, filtered	5/6	133 - 163	20MW5	AESSI95	0/13	ND	ND
Antimony	0/6	ND	ND	ND	5/13	9.3 - 15.7	20MW6
Antimony, filtered	0/6	ND	ND	ND	4/13	4.5 - 10.3	MW5-7RI
Arsenic	0/6	ND	ND	ND	10/13	2.8 - 18.8	20MW7
Arsenic, filtered	4/6	2.7 - 5.7	20MW2	AESSI95	8/13	2.8 - 20	20MW7
Barium	2/6	131 - 398	20MW5	AESSI95	13/13	7.9 - 966	20MW5
Barium, filtered	5/6	26.5 - 382	20MW5	AESSI95	13/13	6.9 - 1200	20MW5
Boron, filtered	5/6	241 - 939	20MW4	AESSI95	NA	NA	ND

TABLE 10-9

SUMMARY OF HISTORICAL AND LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Analyte	Historical Data[1]				Lower Subase RI[2]		
	Frequency of Detection	Concentration Range	Maximum Detection		Frequency of Detection	Concentration Range	Location of Maximum Detection
			Location	Investigation[3]			
Cadmium, filtered	1/6	3.1	20MW2	AESSI95	0/13	ND	ND
Calcium	6/6	18900 - 89200	20MW7	AESSI95	13/13	3740 - 57800	20MW7
Calcium, filtered	6/6	19900 - 92300	20MW7	AESSI95	13/13	3740 - 52900	20MW5
Chromium	0/6	ND	ND	ND	1/13	2.9	20MW3
Cobalt	1/6	4.4	20MW2	AESSI95	5/13	0.82 - 1.7	20MW6
Cobalt, filtered	1/6	3.1	20MW2	AESSI95	3/13	0.83 - 1.1	20MW3
Copper	1/6	24.4	20MW6	AESSI95	1/13	22.7	20MW3
Copper, filtered	1/6	21.1	20MW6	AESSI95	0/13	ND	ND
Iron	2/6	1600 - 12000	20MW2	AESSI95	11/13	375 - 22600	MW5-7RI
Iron, filtered	6/6	28.3 - 12500	20MW2	AESSI95	10/13	327 - 20100	MW5-7RI
Lead	2/6	6 - 117	20MW6	AESSI95	7/13	6.6 - 97.3	20MW6
Lead, filtered	5/6	1.5 - 97.5	20MW6	AESSI95	2/13	17.0 - 25.6	20MW6
Magnesium	6/6	4030 - 27000	20MW3	AESSI95	13/13	1280 - 12300	MW4-7RI
Magnesium, filtered	6/6	4000 - 24800	20MW3	AESSI95	12/13	1390 - 11100	MW4-7RI
Manganese	5/6	92.7 - 3490	20MW2	AESSI95	11/13	28 - 886	20MW2
Manganese, filtered	6/6	16.9 - 3600	20MW2	AESSI95	11/13	26.6 - 912	20MW2
Nickel	0/6	ND	ND	ND	7/13	0.78 - 13.2	MW5-7RI
Nickel, filtered	1/6	13.1	20MW6	AESSI95	6/13	0.93 - 16.1	MW5-7RI
Potassium	6/6	5440 - 21400	20MW2	AESSI95	12/13	3780 - 20200	MW5-7RI
Potassium, filtered	6/6	5390 - 22100	20MW2	AESSI95	13/13	2910 - 19200	MW5-7RI
Selenium	1/6	1.3	20MW6	AESSI95	3/13	7.7 - 56.1	20MW7
Selenium, filtered	1/6	1.2	20MW6	AESSI95	0/13	ND	ND
Sodium	6/6	11400 - 156000	20MW3	AESSI95	13/13	24000 - 119000	MW3-7RI
Sodium, filtered	6/6	18600 - 148000	20MW2	AESSI95	13/13	23400 - 123000	20MW2
Thallium, filtered	4/6	1.2 - 2	20MW4	AESSI95	0/13	ND	ND
Vanadium	0/6	ND	ND	ND	1/13	2.3	20MW3
Vanadium, filtered	0/6	ND	ND	ND	1/13	1.8	20MW3

TABLE 10-9

SUMMARY OF HISTORICAL AND LOWER SUBASE RI GROUNDWATER ANALYTICAL RESULTS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Analyte	Historical Data[1]				Lower Subase RI[2]		
	Frequency of Detection	Concentration Range	Maximum Detection		Frequency of Detection	Concentration Range	Location of Maximum Detection
			Location	Investigation[3]			
Zinc	1/6	816	20MW6	AESSI95	6/13	26.6 - 351	20MW6
Zinc, filtered	4/6	3.5 - 780	20MW6	AESSI95	11/13	24.1 - 495	MW5-7RI
TOTAL PETROLEUM HYDROCARBONS							
TPH	0/6	ND	ND	ND	0/13	ND	ND

1 Includes samples 20GW5, 20GW7, 20MW2, 20MW3, 20MW4, 20MW6.

2 Includes samples LS7GW001001, GWFD001 (field duplicate of LS7GW001001), LS7GW00301, LS7GW00401, LS7GW00701, LS7GW00901, LS7GW20MW201, LS7GW20MW301, LS7GW20MW401, LS7GW20MW501, LS7GW20MW601, GWFD003 (field duplicate of LS7GW20MW601), LS7GW20MW701.

3 AESSI95 = Pier 33 and Berth 16/Former Incinerator SI.

NA - Not Analyzed.

ND - Not Detected.

TABLE 10-10

SUMMARY OF GROUNDWATER FLUORESCENCE SPECTROSCOPY DATA - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Observations
20MW2	Spectra typical of a heavy fuel oil (No. 4 or No. 6).
20MW3	Spectra typical of a heavy fuel oil (No. 4 or No. 6).
20MW4	Spectra typical of a heavy fuel oil (No. 4 or No. 6).
20MW5	Spectra typical of a heavy fuel oil (No. 4 or No. 6).
20MW6	Spectra typical of a heavy fuel oil (No. 4 or No. 6).
20MW7	Spectra typical of a heavy fuel oil (No. 4 or No. 6).

TABLE 10-11

SUMMARY OF NATURAL ATTENUATION AND WATER QUALITY PARAMETERS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Lower Subase RI[1]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS			
Alkalinity as CaCO3 (mg/L)	12/13	42 - 220	MW4-7RI
Ammonia, as nitrogen (mg/L)	9/13	0.15 - 1.6	MW4-7RI
Chloride (mg/L)	13/13	26 - 190	MW3-7RI
Dissolved oxygen (mg/L)	11/11	0.45 - 8.4	20MW3
Divalent iron (mg/L)	6/12	0.6 - 7	MW5-7RI
Hardness as CaCO3 (mg/L)	13/13	27 - 170	20MW5
Methane (mg/L)	13/13	3 - 4600	20MW7
Nitrate, as nitrogen (mg/L)	6/13	0.084 - 0.45	20MW6
pH	11/11	6.3 - 7.76	20MW7
Phosphorus (mg/L)	13/13	0.15 - 0.51	20MW7
Redox potential (mV)	11/11	-274.9 - 61.9	20MW5
Salinity (ppt)	11/11	0.01 - 0.39	MW3-7RI
Specific conductivity (ms/cm)	11/11	0.027 - 0.785	MW3-7RI
Sulfate (mg/L)	12/13	1.2 - 51	MW5-7RI
Temperature (C)	11/11	14.8 - 55.07	MW2-7RI
Total organic carbon (mg/L)	13/13	1.6 - 16	MW2-7RI
Turbidity (NTU)	11/11	1.4 - 8.49	20MW3

1 Includes samples LS7GW001001, GWFD001 (field duplicate of LS7GW001001), LS7GW00301, LS7GW00401, LS7GW00701, LS7GW00901, LS7GW20MW201, LS7GW20MW301, LS7GW20MW401, LS7GW20MW501, LS7GW20MW601, GWFD003 (field duplicate of LS7GW20MW601), LS7GW20MW701.

TABLE 10-12 (PAGE 1 OF 2)

SUMMARY OF POSITIVE STORM SEWER SEDIMENT ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20SD1	20SD2				
DEPTH (feet):						
INVESTIGATION:	AESSI95	AESSI95				
SAMPLE DATE:	04/07/93	04/07/93	/ /	/ /	/ /	/ /
LOCATION:	20SD1	20SD2				
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
4-METHYL-2-PENTANONE	13 U	6 J				
ACETONE	86	120				
CARBON DISULFIDE	10 J	13 U				
METHYLENE CHLORIDE	11 JB	15 B				
SEMIVOLATILES (µg/kg)						
ANTHRACENE	850 U	260 J				
BENZO(A)ANTHRACENE	850 U	530				
BENZO(A)PYRENE	850 U	550				
BENZO(B)FLUORANTHENE	440 J	1000				
BENZO(G,H,I)PERYLENE	850 U	310 J				
BIS(2-ETHYLHEXYL)PHTHALATE	2300	2400				
BUTYLBENZYL PHTHALATE	470 J	520				
CHRYSENE	850 U	620				
FLUORANTHENE	520 J	1200				
INDENO(1,2,3-CD)PYRENE	850 U	320 J				
PHENANTHRENE	850 U	1100				
PYRENE	580 J	1200				
METALS (mg/kg)						
ALUMINUM	1930	3380				
ARSENIC	1.4 BN	1.2 BN				
BARIUM	24.9 B	20.7 B				
BERYLLIUM	0.15 B	0.2 B				

TABLE 10-12 (PAGE 2 OF 2)
SUMMARY OF POSITIVE STORM SEWER SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	20SD1	20SD2				
DEPTH (feet):						
INVESTIGATION:	AESSI95	AESSI95				
SAMPLE DATE:	04/07/93	04/07/93	/ /	/ /	/ /	/ /
LOCATION:	20SD1	20SD2				
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BORON	1.7 U	1.8 B				
CADMIUM	0.35 UN	0.46 BN				
CALCIUM	1790	1910				
CHROMIUM	12.5	14.1				
COBALT	2.1 B	3.8 B				
COPPER	51.6	107				
CYANIDE	0.39 B	1.1				
IRON	6560	8880				
LEAD	47.5	102				
MAGNESIUM	1380	3040				
MANGANESE	97.8	111				
MERCURY	0.04 U	0.08 B				
NICKEL	21.5	14.4				
POTASSIUM	512 B	895				
SILVER	0.57 UN	1.2 BN				
SODIUM	495 BE	359 BE				
THALLIUM	0.18 BN	0.15 UN				
VANADIUM	7 B	10.7				
ZINC	101	87.3				
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH	1300	1100				

TABLE 10-13

SUMMARY OF STORM SEWER SEDIMENT FLUORESCENCE SPECTROSCOPY DATA - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Observations
20SD1	Spectra typical of a heavy fuel oil (No. 6).
20SD2	Spectra typical of a heavy fuel oil (No. 6).

TABLE 10-14

CHEMICALS OF CONCERN - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNNECTICUT

Chemicals of Concern[1]		
Shallow Soil (0 - 5 Feet)	**All Soil (0 - 10 Feet)**	**Groundwater[2]**
Methylene Chloride	Methylene Chloride	Chloroform
Benzo(a)anthracene	Benzo(a)anthracene	Acenaphthylene
Benzo(a)pyrene	Benzo(a)pyrene	Chrysene
Benzo(b)fluoranthene	Benzo(b)fluoranthene	Phenanthrene
Benzo(k)fluoranthene	Benzo(k)fluoranthene	Aluminum
Carbazole	Carbazole	Antimony
Chrysene	Chrysene	Arsenic
Dibenzo(a,h)anthracene	Dibenzo(a,h)anthracene	Barium
Indeno(1,2,3-cd)pyrene	Indeno(1,2,3-cd)pyrene	Boron (filtered only)
Antimony	Aluminum	Cadmium (filtered only)
Arsenic	Antimony	Copper
Barium	Arsenic	Iron
Beryllium	Barium	Lead
Cadmium	Beryllium	Manganese
Chromium (total)	Cadmium	Nickel
Iron	Chromium (total)	Selenium (unfiltered only)
Lead	Copper	Sodium
Nickel	Iron	Thallium (filtered only)
Zinc	Lead	Zinc
TPH	Manganese	
	Nickel	
	Selenium	
	Vanadium	
	Zinc	
	TPH	

1 Chemical is identified as a Chemical of Concern (COC) if the maximum detection in a single sample exceeds one or more criteria (i.e., Region III COC screening level, State Remediation Standards, Federal Soil Screening Levels, etc.).

2 Unless otherwise noted, the inorganic chemicals presented are COCs for the unfiltered and filtered groundwater sample matrix.

TABLE 10-15

EXPOSURE CONCENTRATIONS FOR DIRECT EXPOSURE CHEMICALS OF CONCERN - ZONE 7 LOWER SUBASE NSB-NLON, GROTON, CONNECTICUT

Direct Exposure Chemical of Concern	Exposure Concentration		
	Surface Soil[1] (mg/kg)	All Soil[1] (mg/kg)	Groundwater[2] (mg/L)
VOLATILE ORGANIC COMPOUNDS			
Chloroform	NA[4]	NA	0.00075/0.002
SEMIVOLATILE ORGANIC COMPOUNDS			
Benzo(a)anthracene	1.5/9.5	3.5	NA
Benzo(a)pyrene	1.8/14	3.4	NA
Benzo(b)fluoranthene	2.2/16	4.6	NA
Benzo(k)fluoranthene	1.0/9.7	0.83/9.7	NA
Dibenzo(a,h)anthracene	0.89/3.1	0.72/3.1	NA
Indeno(1,2,3-cd)pyrene	1.2/7.0	1.0/7.0	NA
INORGANICS			
Antimony	7.8[5]	160[5]	0.0068/0.0138
Arsenic	2.5	3.9	0.0051/0.011
Barium	NA	NA	0.106/0.682
Beryllium	0.21	0.32	NA
Boron, filtered	NA	NA	0.394/0.939
Cadmium, filtered	NA	NA	0.00046/0.0016
Lead	189000	189000	0.0123/0.105
Manganese	NA	119/253	0.535/2.19
Selenium	NA	NA	0.0043/0.0283
Vanadium	NA	23.8/246	NA
Thallium, filtered	NA	NA	0.002[5]

1 UCL if single concentration is presented, otherwise average concentration is used for CTE and maximum detected concentration is used for RME unless otherwise noted. See Section 3.3.1.
2 Average concentration is used for CTE and maximum concentration is used for RME. Maximum is defined as the highest average concentration in a single well, and the average is defined as the overall average concentration of all well-specific averages.
3 Maximum concentration is presented since UCL is greater than maximum detected concentration.
4 NA - Not applicable. Chemical is not a chemical of concern for this medium.
5 Maximum concentration is presented since average concentration exceeds the maximum detected concentration.

TABLE 10-16

ESTIMATED RISKS[1] - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Construction Worker		Full-Time Employee		Future Resident	
	RME[2]	CTE[3]	RME	CTE	RME	CTE
HAZARD INDEX						
Incidental Ingestion of Soil	1.0	0.31	0.016	0.0082	0.71	0.18
Dermal Contact with Soil	0.007	0.001	0.006	0.001	0.01	0.003
Total Risk from Soil	1.0	0.31	0.22	0.0092	0.72	0.18
Dermal Contact with Groundwater	0.60	0.14	NA[4]	NA	NA	NA
Cumulative Risk:	1.6	0.45	0.22	0.0092	0.72	0.18
INCREMENTAL CANCER RISK						
Incidental Ingestion of Soil	2.1E-06	4.6E-07	3.2E-05	6.8E-07	4.4E-05	2.3E-06
Dermal Contact with Soil	2.3E-06	1.9E-07	1.7E-04	5.2E-06	1.1E-04	4.3E-06
Total Risk from Soil	4.4E-06	6.5E-07	2.0E-04	5.9E-06	1.5E-04	6.6E-06
Dermal Contact with Groundwater	3.6E-08	1.1E-08	NA	NA	NA	NA
Cumulative Risk:	4.4E-06	6.6E-07	2.0E-04	5.9E-06	1.5E-04	6.6E-06

1 Chemical-specific risks presented in Appendix I.11.
2 RME - Reasonable Maximum Exposure.
3 CTE - Central Tendency Exposure.
4 NA - Not applicable; exposure route not evaluated for this receptor.

TABLE 10-17

SUMMARY OF MAJOR CONTRIBUTORS TO RISK - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemical	Cancer Risk	Percent Contribution
Construction Worker - RME	Benzo(a)pyrene	1.7E-06	40%
	Dibenzo(a,h)anthracene	1.6E-06	36%
Full-Time Employee - RME	Benzo(a)anthracene	9.5E-06	5%
	Benzo(a)pyrene	1.4E-04	70%
	Benzo(b)fluoranthene	1.6E-05	8%
	Dibenzo(a,h)anthracene	3.1E-05	15%
	Indeno(1,2,3-cd)pyrene	1.5E-06	1%
	Arsenic	1.7E-06	1%
Future Resident - RME	Benzo(a)anthracene	6.4E-06	4%
	Benzo(a)pyrene	6.2E-05	40%
	Benzo(b)fluoranthene	8.4E-06	5%
	Benzo(k)fluoranthene	1.8E-06	1%
	Dibenzo(a,h)anthracene	5.7E-05	37%
	Indeno(1,2,3-cd)pyrene	1.3E-05	8%
	Arsenic	6.3E-06	4%
Future Resident - CTE	Benzo(a)pyrene	4.1E-06	63%

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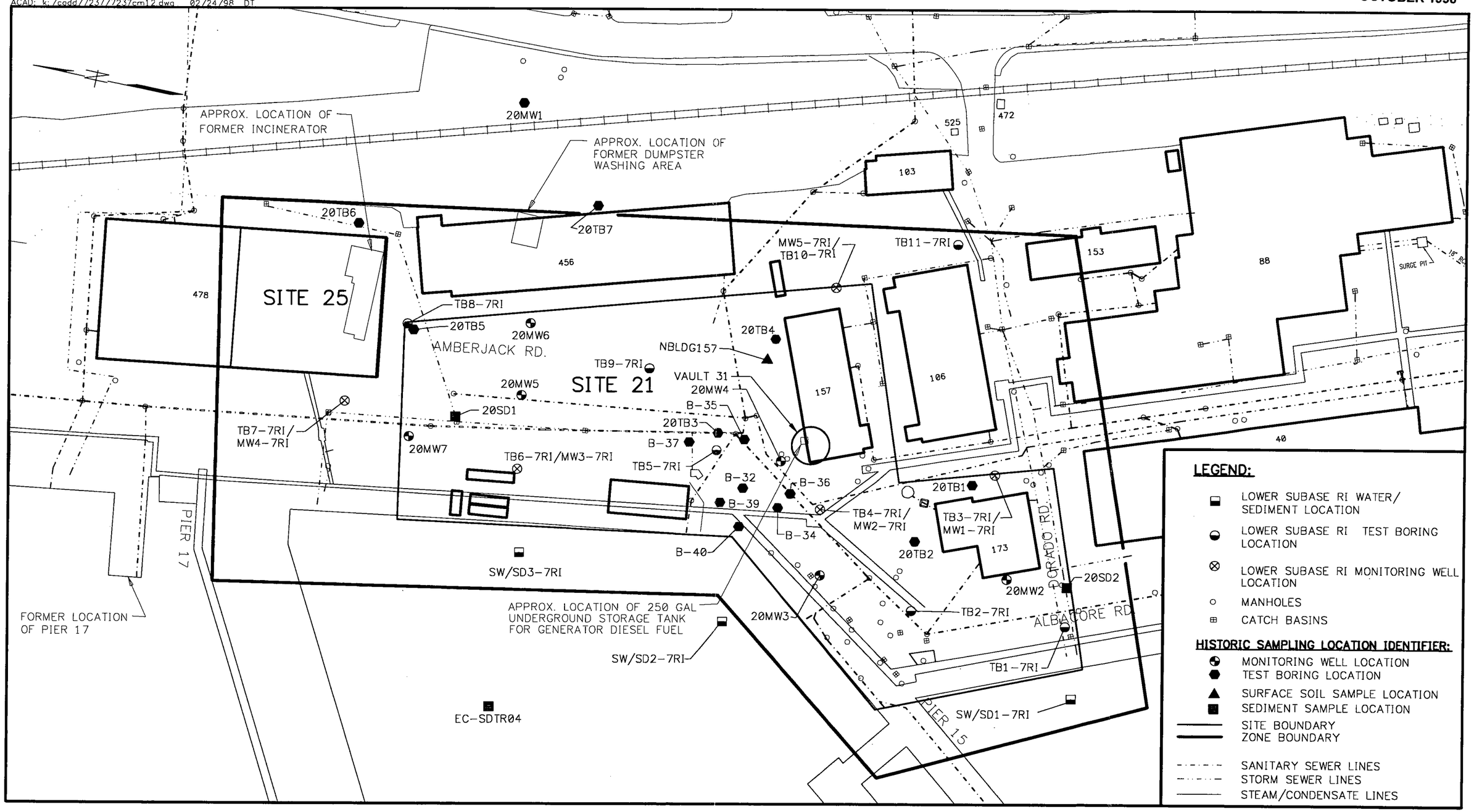


FIGURE 10-1

SAMPLE LOCATION MAP
ZONE 7
NSB-NLON, GROTON, CONNECTICUT

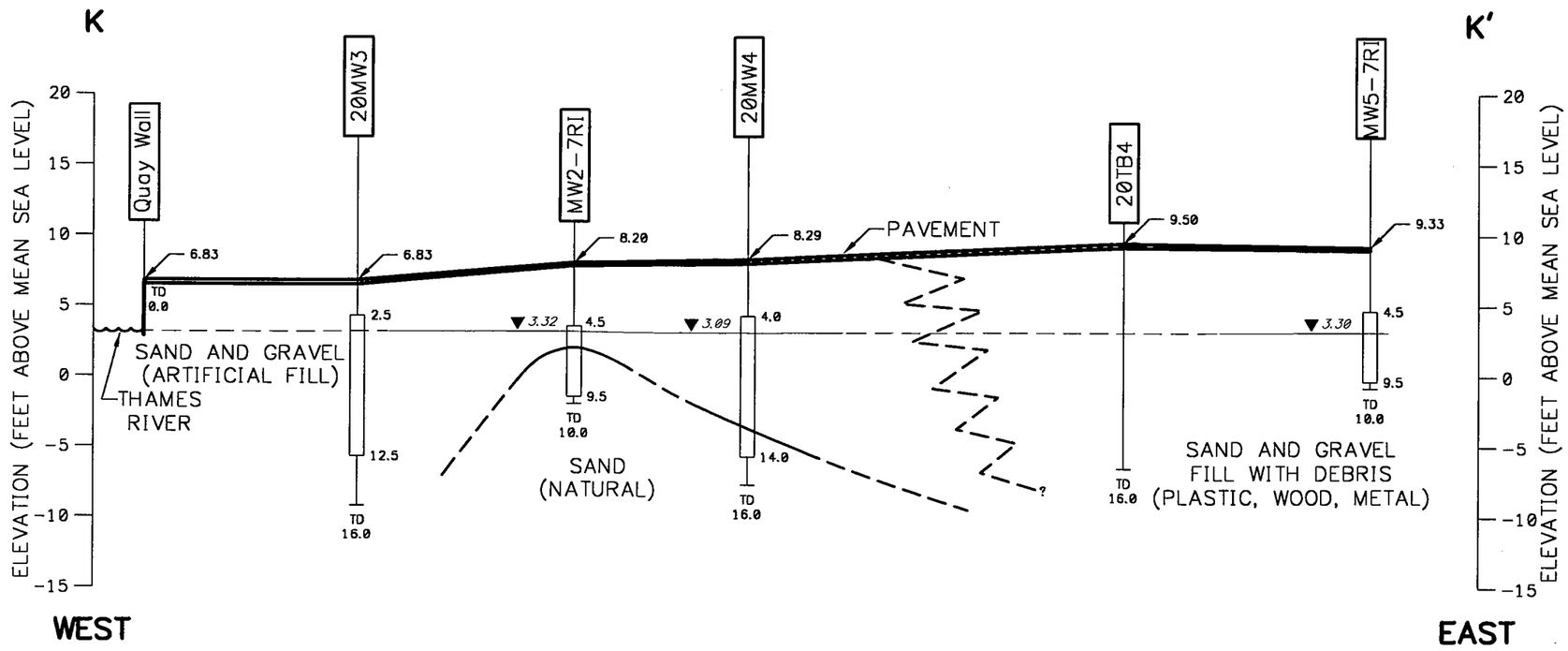
0 80 160
SCALE IN FEET

Brown & Root Environmental

019809/P

CTO 0260

ACAD:7237gx08.dwg 09/30/98 HJP



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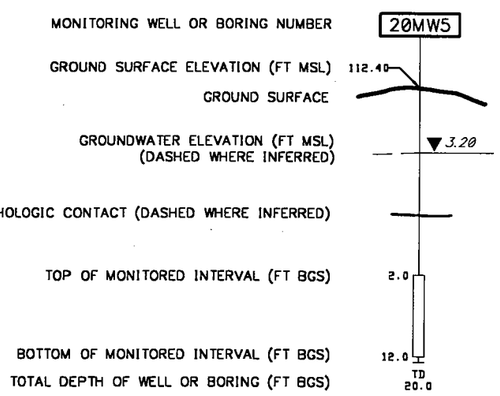
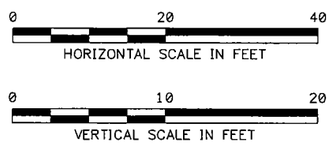




NOTES

1.) ELEVATIONS BASED ON SUBASE VERTICAL DATUM (1982)

2.) POTENTIOMETRIC SURFACE FOR LOW TIDE OCTOBER 27, 1997

3.) SEE DRAWING 6 FOR CROSS SECTION LOCATION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 2/15/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

Brown & Root Environmental

GENERALIZED GEOLOGIC CROSS SECTION K – K'
ZONE 7
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO. 7237
OWNER NO. 0260
APPROVED BY Corey A. Pal DATE 10/7/98
APPROVED BY DATE
DRAWING NO. FIGURE 10-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NORTHERN DIVISION

NAVAL BASE — PHILADELPHIA, PA

ZONE 7 SHALLOW SOIL COPC POSITIVE DETECTS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

APPROVED — DATE — NORTHDIV FOR COMMANDER, NAVFAC

SEAL AREA

SAT TO — DATE

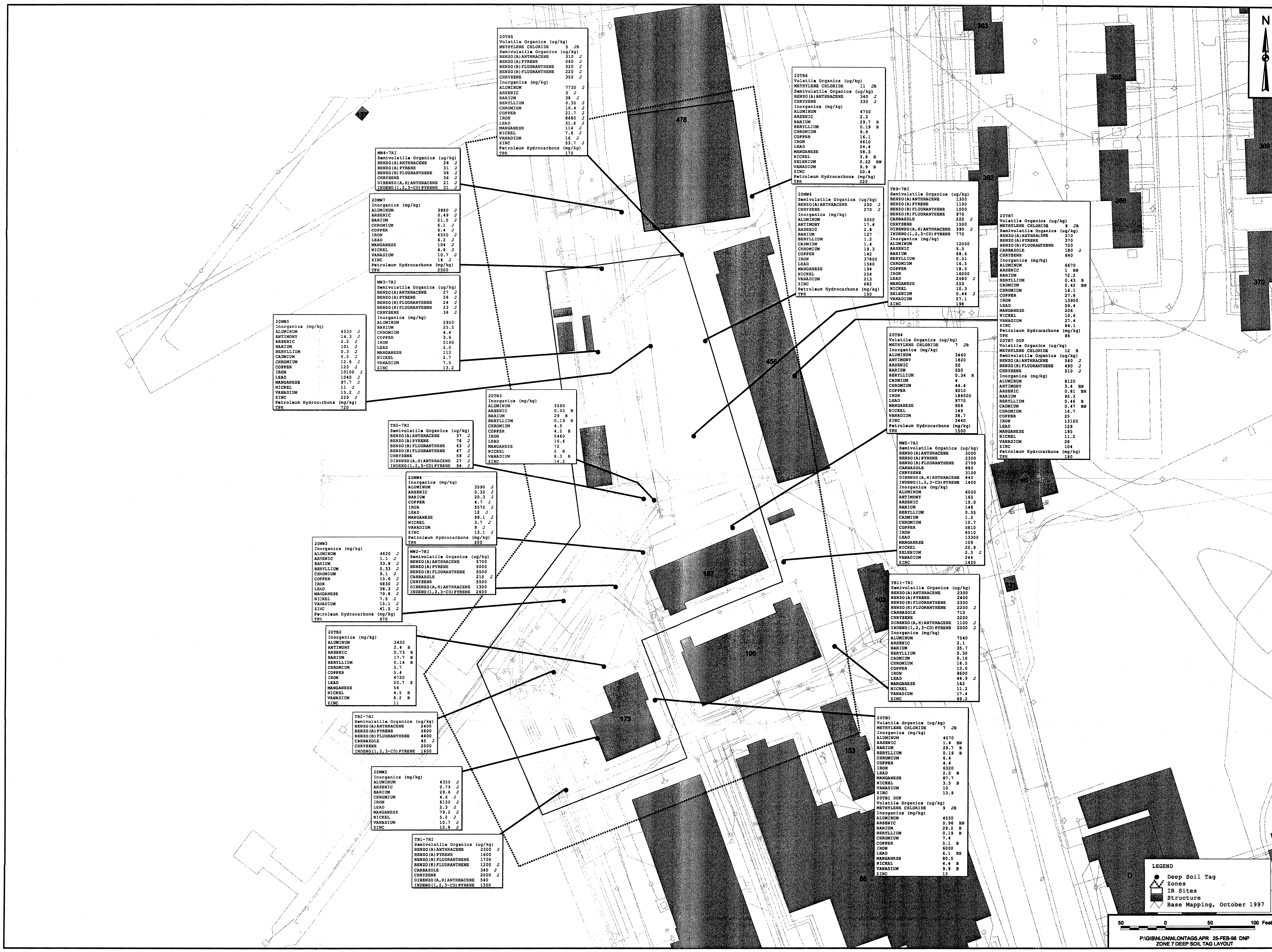
CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET — OF
SIZE: D — DIS. SH. NO. 10-3

REV	DESCRIPTION	PREP BY	DATE	APPRVD

Brown & Root Environmental
PORTER PLAZA
801 KEDRON AVENUE
MT PLEASANT, PA 15666

DESIGN: D. M. SMITH
SUBMITTED BY: J. FRED MCDANIEL
DR: R. SMITH
CHK:
SUBMITTED TO: Long Island Rail Road
NORTHDIV — PE — DR — OFFICER IN CHARGE
DATE — APPROVED

ClibPDF - www.fastio.com



Brown & Root Environmental
FOSTER PLAZA 661 ANDERSEN DRIVE PITTSBURGH, PA 15220

DSGN: DR: D. PERRY 25-FEB-98 CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV HD:
DM: HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

REV	DESCRIPTION	PREP BY	DATE	APPRVD

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL BASE PHILADELPHIA, PA

NORTHERN DIVISION

ZONE 7 DEEP SOIL COPC POSITIVE DETECTS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

APPROVED DATE NORTHDIV FOR COMMANDER, NAVFAC

SEAL AREA

SAT TO DATE
CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONSTR. CONTR. NO.
NAVFAC DRAWING NO.
SHEET _ OF _
SIZE: D DIS. SH. NO. 10-4

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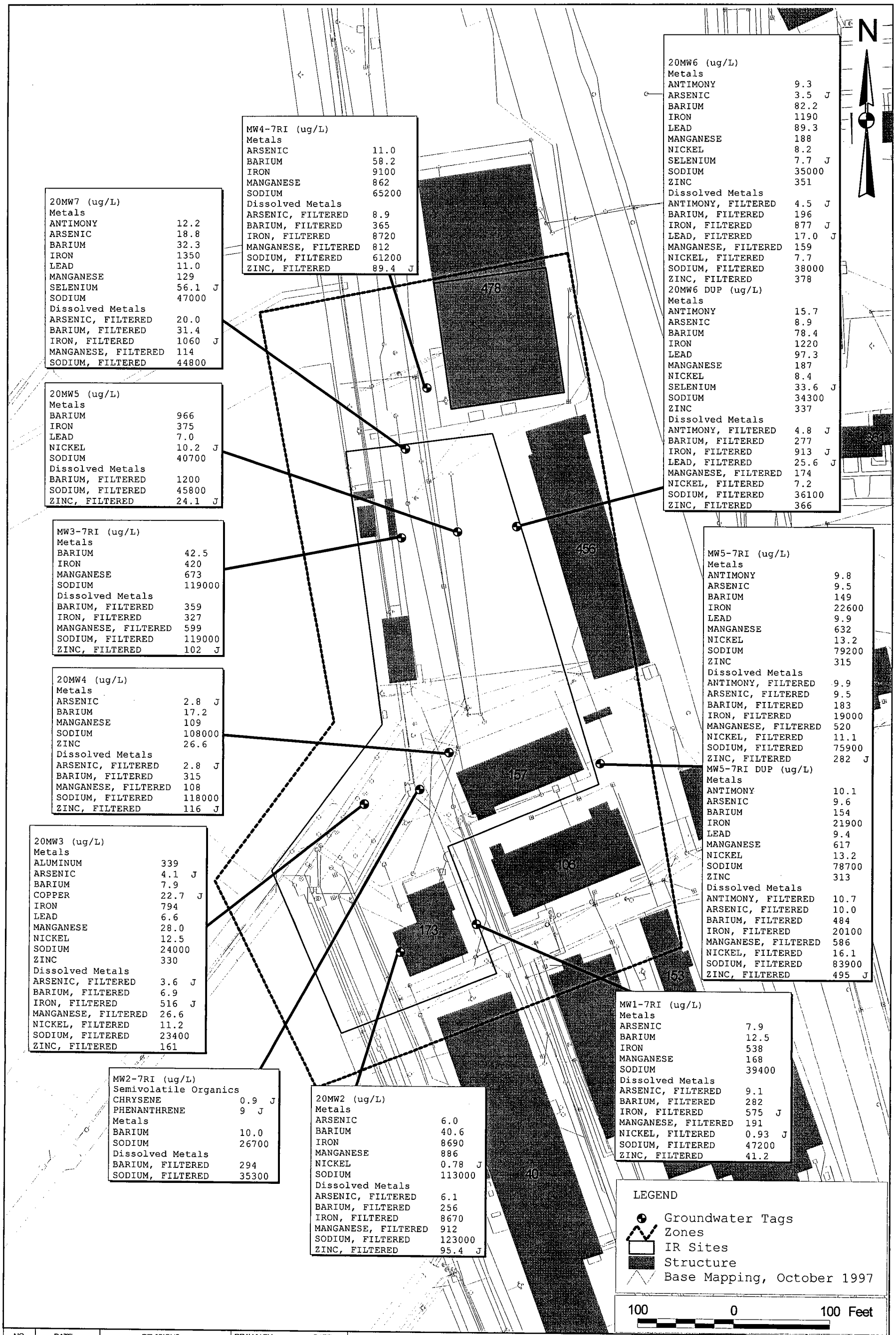
P:\GIS\NLON\NLONTAGS.APR 25-FEB-98 SMT ZONE 7 GROUNDWATER TAG LAYOUT



20MW7 (ug/L)

Metals		
ANTIMONY	12.2	
ARSENIC	18.8	
BARIUM	32.3	
IRON	1350	
LEAD	11.0	
MANGANESE	129	
SELENIUM	56.1	J
SODIUM	47000	
Dissolved Metals		
ARSENIC, FILTERED	20.0	
BARIUM, FILTERED	31.4	
IRON, FILTERED	1060	J
MANGANESE, FILTERED	114	
SODIUM, FILTERED	44800	

MW4-7RI (ug/L)

Metals		
ARSENIC	11.0	
BARIUM	58.2	
IRON	9100	
MANGANESE	862	
SODIUM	65200	
Dissolved Metals		
ARSENIC, FILTERED	8.9	
BARIUM, FILTERED	365	
IRON, FILTERED	8720	
MANGANESE, FILTERED	812	
SODIUM, FILTERED	61200	
ZINC, FILTERED	89.4	J

20MW6 (ug/L)

Metals		
ANTIMONY	9.3	
ARSENIC	3.5	J
BARIUM	82.2	
IRON	1190	
LEAD	89.3	
MANGANESE	188	
NICKEL	8.2	
SELENIUM	7.7	J
SODIUM	35000	
ZINC	351	
Dissolved Metals		
ANTIMONY, FILTERED	4.5	J
BARIUM, FILTERED	196	
IRON, FILTERED	877	J
LEAD, FILTERED	17.0	J
MANGANESE, FILTERED	159	
NICKEL, FILTERED	7.7	
SODIUM, FILTERED	38000	
ZINC, FILTERED	378	

20MW6 DUP (ug/L)

Metals		
ANTIMONY	15.7	
ARSENIC	8.9	
BARIUM	78.4	
IRON	1220	
LEAD	97.3	
MANGANESE	187	
NICKEL	8.4	
SELENIUM	33.6	J
SODIUM	34300	
ZINC	337	
Dissolved Metals		
ANTIMONY, FILTERED	4.8	J
BARIUM, FILTERED	277	
IRON, FILTERED	913	J
LEAD, FILTERED	25.6	J
MANGANESE, FILTERED	174	
NICKEL, FILTERED	7.2	
SODIUM, FILTERED	36100	
ZINC, FILTERED	366	

20MW5 (ug/L)

Metals		
BARIUM	966	
IRON	375	
LEAD	7.0	
NICKEL	10.2	J
SODIUM	40700	
Dissolved Metals		
BARIUM, FILTERED	1200	
SODIUM, FILTERED	45800	
ZINC, FILTERED	24.1	J

MW3-7RI (ug/L)

Metals		
BARIUM	42.5	
IRON	420	
MANGANESE	673	
SODIUM	119000	
Dissolved Metals		
BARIUM, FILTERED	359	
IRON, FILTERED	327	
MANGANESE, FILTERED	599	
SODIUM, FILTERED	119000	
ZINC, FILTERED	102	J

MW5-7RI (ug/L)

Metals		
ANTIMONY	9.8	
ARSENIC	9.5	
BARIUM	149	
IRON	22600	
LEAD	9.9	
MANGANESE	632	
NICKEL	13.2	
SODIUM	79200	
ZINC	315	
Dissolved Metals		
ANTIMONY, FILTERED	9.9	
ARSENIC, FILTERED	9.5	
BARIUM, FILTERED	183	
IRON, FILTERED	19000	
MANGANESE, FILTERED	520	
NICKEL, FILTERED	11.1	
SODIUM, FILTERED	75900	
ZINC, FILTERED	282	J

MW5-7RI DUP (ug/L)

Metals		
ANTIMONY	10.1	
ARSENIC	9.6	
BARIUM	154	
IRON	21900	
LEAD	9.4	
MANGANESE	617	
NICKEL	13.2	
SODIUM	78700	
ZINC	313	
Dissolved Metals		
ANTIMONY, FILTERED	10.7	
ARSENIC, FILTERED	10.0	
BARIUM, FILTERED	484	
IRON, FILTERED	20100	
MANGANESE, FILTERED	586	
NICKEL, FILTERED	16.1	
SODIUM, FILTERED	83900	
ZINC, FILTERED	495	J

20MW4 (ug/L)

Metals		
ARSENIC	2.8	J
BARIUM	17.2	
MANGANESE	109	
SODIUM	108000	
ZINC	26.6	
Dissolved Metals		
ARSENIC, FILTERED	2.8	J
BARIUM, FILTERED	315	
MANGANESE, FILTERED	108	
SODIUM, FILTERED	118000	
ZINC, FILTERED	116	J

20MW3 (ug/L)

Metals		
ALUMINUM	339	
ARSENIC	4.1	J
BARIUM	7.9	
COPPER	22.7	J
IRON	794	
LEAD	6.6	
MANGANESE	28.0	
NICKEL	12.5	
SODIUM	24000	
ZINC	330	
Dissolved Metals		
ARSENIC, FILTERED	3.6	J
BARIUM, FILTERED	6.9	
IRON, FILTERED	516	J
MANGANESE, FILTERED	26.6	
NICKEL, FILTERED	11.2	
SODIUM, FILTERED	23400	
ZINC, FILTERED	161	

MW1-7RI (ug/L)

Metals		
ARSENIC	7.9	
BARIUM	12.5	
IRON	538	
MANGANESE	168	
SODIUM	39400	
Dissolved Metals		
ARSENIC, FILTERED	9.1	
BARIUM, FILTERED	282	
IRON, FILTERED	575	J
MANGANESE, FILTERED	191	
NICKEL, FILTERED	0.93	J
SODIUM, FILTERED	47200	
ZINC, FILTERED	41.2	

MW2-7RI (ug/L)

Semivolatile Organics		
CHRYSENE	0.9	J
PHENANTHRENE	9	J
Metals		
BARIUM	10.0	
SODIUM	26700	
Dissolved Metals		
BARIUM, FILTERED	294	
SODIUM, FILTERED	35300	

20MW2 (ug/L)

Metals		
ARSENIC	6.0	
BARIUM	40.6	
IRON	8690	
MANGANESE	886	
NICKEL	0.78	J
SODIUM	113000	
Dissolved Metals		
ARSENIC, FILTERED	6.1	
BARIUM, FILTERED	256	
IRON, FILTERED	8670	
MANGANESE, FILTERED	912	
SODIUM, FILTERED	123000	
ZINC, FILTERED	95.4	J

NO.	DATE	REVISIONS	DRAWN BY	DATE
			S. TABLER	25-FEB-98
			CHECKED BY	DATE
			COST/SCHED-AREA	
			SCALE AS NOTED	

Brown & Root Environmental

ZONE 7 GROUNDWATER
COPC POSITIVE DETECTS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

CONTRACT NO. | OWNER NO.

APPROVED BY Corey A Rich DATE 4/16/98

APPROVED BY DATE

DRAWING NO. FIGURE 10-5 REV. 0

REVISION 1
OCTOBER 1998

11.0 THAMES RIVER

11.1 SITE DESCRIPTION

The Thames River is a tidal estuary formed at the confluence of the Shetucket and Yantic Rivers in Norwich, Connecticut. The river flows southward approximately 16 miles to Long Island Sound. NSB-NLON and the Town of Groton are on the east bank of the river, approximately 6 miles north of Long Island Sound. The City of New London is located on the west bank of the river. Land development along the southern portion of the river is primarily industrial. Chemical companies, oil terminals, power plants, and wastewater treatment plants occupy both banks of the river.

The river receives significant waterborne traffic at marine terminals located along its entire length. Numerous water-dependent industries line the eastern and western banks of the lower portion of the river. Pfizer Pharmaceutical, Hess Oil Company, and Electric Boat facilities are located on the east bank. City Coal Company, Naval Undersea Warfare Center, New London City and State Piers occupy the west bank of the river. North of the I-95 bridge are the U.S. Coast Guard Academy, NSB-NLON, a Northeast Utilities fossil fuel power station, a cogeneration power plant, and Dow Chemical Company.

In addition to being a significant receiver of waterborne traffic, the Thames River is also a major conveyor of wastewater and industrial discharge. Depicted in Figure 11-1 are the major municipal and industrial discharge sources existing in the Thames River subregional drainage basin. The Norwich Wastewater Treatment Plant (WWTP) is the dominant discharge source in the upper river. The Montville Power Plant, Montville WWTP, Dow Chemical, AES Thames Cogeneration Plant, and the NSB-NLON power plant are the most significant sources in the mid-river reach. Pfizer Chemical, Electric Boat Division of General Dynamics, New London WWTP, and the WWTP that services both the City of Groton and the Town of Groton are the principal dischargers in the lower river. Non-point discharges from road, agricultural, and other runoff sources occur throughout the river's drainage basin and account for a significant source of water, sediment, and chemical constituents in the river.

The Thames River is utilized by recreational boaters and fishermen. Numerous marinas line both banks of the river from New London harbor to the City of Norwich. Shellfish beds are located in the area of Mamacoke Island and in Ledyard, north of NSB-NLON as well. These act as relay beds for the first several years, and then oysters and hard-shelled clams are transported to purging beds outside the river for depuration.

Several parks and beaches, including Ocean Beach State Park, Harkness Memorial Park, and Bluff Point State Park, are located at the mouth of the Thames River.

NSB-NLON borders the Thames River for approximately 1.5 miles (Figure 11-2). The NSB-NLON facility is highly developed along the Thames River in the vicinity of the Lower Subase. There are 15 piers at NSB-NLON. The ground elevation along these piers and at the facility boundary is less than 10 feet. The 100-year flood level for NSB-NLON is 11.2 feet above msl. This elevation is higher than most of the western portion of NSB-NLON; therefore, this area is susceptible to flooding.

Adjacent to the northern boundary of NSB-NLON, the land is relatively undeveloped, with scattered residences. Further north, the land is residential, commercial, recreational, and open-space. To the immediate south of NSB-NLON along the Thames River, the land is primarily residential with open spaces. Along the Thames River, tributary streams and wetlands are prevalent.

11.2 SITE INVESTIGATIONS

The Thames River was evaluated as part of the following investigations:

- Environmental Assessment for Pier 17 Replacement (Maguire, 1994)
- Final Environmental Impact Statement for the Seawolf Class Submarine Homeporting on the East Coast of the United States (Maguire, 1995)
- After Dredge Surveys for Pier 17 Replacement and Seawolf Homeporting Projects (Gahagen & Bryant, 1996)
- Phase II Remedial Investigation (B&R Environmental, 1997b)
- Phase II RI Supplemental Ecological Investigation (B&R Environmental, 1997b)
- Existing Data Summary Report (B&R Environmental, 1997a)

11.2.1 Environmental Assessment for Pier 17 Replacement

In September 1994, Maguire Group prepared an Environmental Assessment (EA) for the proposed replacement of Pier 17 and dredging alongside Pier 15 and Pier 17. The EA was conducted to determine whether the proposed pier replacement would affect the offshore environment. As part of the assessment,

surface water, sediment, and fish and benthic species sampling at and in the vicinity of Piers 15 and 17 was conducted.

The sediment sampling program was performed as part of the assessment to characterize the physical and chemical nature of sediments to be dredged around Piers 15 and 17. Sediment samples were collected from the proposed dredging area and analyzed for TOC, metals, SVOCs, pesticides, and PCBs. Sediment sampling locations are discussed in more detail in Section 11.2.5. Three samples were collected at each location, one from the upper strata (0 to 3 feet) and two from the lower strata (approximately 3 to 6 feet and 6 to 10 feet). Benthic toxicity tests were conducted on composite samples from the top 3 feet of material from each pier. Three sediment grab samples were also collected in the vicinity of Piers 15 and 17 to provide a general description of the benthic communities associated with the sediments of the two piers and to provide an assessment of potential impacts to fauna in the area. Elutriate tests were conducted on three grab samples (one north and south of Pier 17 and one south of Pier 15) to determine whether chemical constituents in the sediment were likely to be released to the water column during dredging and/or disposal operations. The more highly contaminated sediments (in the upper strata) were used for the test. Sediment sampling locations are shown in Figure 11-2. Figure 11-3 provides more detail regarding sediment sampling locations in the area of Piers 15 and 17.

Upper sediments (0 to 3 feet) contained higher concentrations of metals and PAHs than lower sediment layers. Pesticides and PCBs were also detected at low levels in the upper sediment layer. Maximum concentrations were generally detected in the sample collected on the southern side of Pier 17. However, results of a 10-day benthic toxicity test on *Ampelisca abdita* showed that amphipod mortality using site-specific sediment was not statistically greater than mortality using reference sediment (i.e., site-specific results did not exceed reference test results by more than 20 percent).

Samples collected adjacent to Pier 17 to assess benthic communities contained a relatively low number of species and individuals. The EA Report suggested that the results are indicative of an area that was highly disturbed and/or is subjected to stressful environmental conditions. The sample collected from Pier 15 contained a high number of species and individuals. The fauna collected from Pier 15 was more characteristic of organisms (both numerically and in terms of species richness) associated with many areas in the Thames River estuary.

Based on the results of the elutriate tests, release of contaminants to surface water during dredging was not likely to result in unacceptable concentrations in surface water.

The report concluded, based on the results of sampling in the vicinity of Piers 15 and 17, that the proposed action (replacement of Pier 17 and dredging at Piers 15 and 17) would have short-term effects on Thames River water quality and minimal effects on fish and benthic species. The Navy has completed the dredging activities associated with this replacement project.

11.2.2 Final Environmental Impact Statement for the SEAWOLF Class Submarine Homeporting on the East Coast of the United States

In 1991, a Draft Environmental Impact Statement (DEIS) was prepared by Maguire Group for proposed dredging of the Thames River for transit of the lead ship of the SEAWOLF class submarine from its manufacturer, General Dynamics' Electric Boat Division, to Pier 33 at NSB-NLON for operational testing, known as sea trials. Approximately 2.7 million cubic yards of sediment were proposed to be dredged from the main river channel and from Piers 32 and 33. At that time, no decision had been made as to the homeport location for the SEAWOLF submarines. In 1994, President Clinton announced that the preferred homeporting alternative for the SEAWOLF submarines was NSB-NLON. This decision modified the proposed dredging action to the degree that the NEPA process had to be re-initiated.

A revised DEIS was prepared by Maguire Group and was issued in February 1995. The Final EIS (FEIS) was subsequently issued in July 1995. The preferred action in the FEIS was to berth the SEAWOLF submarines at Piers 8 and 10. By changing the berthing location for the submarines from Piers 32 and 33 to Piers 8 and 10 and making changes to the required dredging depths, the amount of dredge spoils that required disposal was reduced from 2.7 million cubic yards to 1.1 million cubic yards. The final proposed dredged depths were -39 feet mean low water (mlw) in the navigation channel of the Thames River and -42 feet mlw in the berths. The dredged spoils were to be disposed offbase at the New London Disposal Site (NLDS).

Sediment sampling programs were conducted in 1990, 1992, 1994, and 1995 in support of the proposed dredging projects. The sediment sampling locations for these four programs, shown in Figure 11-2, are discussed in more detail in Section 11.2.5. The purpose of the sampling programs was to characterize existing biological, physical, and chemical conditions of the sediment to be dredged from the Thames River. The analytical results for the sediment samples showed that the sediments to be dredged were very similar to sediments previously dredged from the Thames River and disposed at the NLDS. The analytical results also showed that sediments from the channel tended to be less contaminated than sediments collected near the pier areas.

Benthic toxicity results on project sediments indicated that sediments to be dredged were not toxic to bottom-dwelling organisms. However, bioaccumulation testing revealed that channel sediments near the Subase piers could cause accumulation of organic contaminants in the tissues of benthic organisms. Also, sediments at Piers 8 and 10 contained comparable contaminant levels and would likely cause similar bioaccumulation effects. These sediments would be capped at the disposal site with clean sediments from the channel.

11.2.3 Phase II Remedial Investigation

The field investigation of the Thames River conducted by B&R Environmental for the Phase II RI included surface water, sediment, and biota sampling. The investigation included portions of the Thames River upgradient of NSB-NLON; in the vicinity of the Defense Reutilization and Marketing Office (DRMO), which is located north of the Lower Subase; the Lower Subase; Goss Cove, which is located south of the Lower Subase; and downgradient of NSB-NLON. Sediment samples were collected from portions of the Thames River at a point near the shoreline and at a point near the centerline of the river for each portion investigated. At the portions bounding NSB-NLON (i.e., DRMO, Lower Subase, and Goss Cove), additional samples were taken between the near shore and midstream stations. A quantitative benthic study was also performed using these sediments. The goal of the study was to characterize the structure of the macroinvertebrate community. Sediment sampling stations are depicted on Figure 11-2.

Surface water samples were collected from seven stations in the Thames River, covering the river from upstream of NSB-NLON to downstream. In between, samples were collected along the shoreline in the vicinity of the DRMO, from the vicinity of the Lower Subase, and from the area near Goss Cove. Except for one station, samples were collected from both the surface (S) and bottom (B) of the river. Surface water sampling stations are depicted on Figure 11-4.

Several species of native shellfish were collected from the Thames River for analysis. Oysters, blue mussels, and hardshell clams were collected to determine the concentrations of chemicals present in the tissues of these organisms. The native shellfish sampling locations are shown on Figure 11-5. In addition, a caged mussel study was performed in which ribbed mussels were purchased and deployed in replicate at five different stations (with the exception of CMU3 for which only one set was deployed). Two sets of undeployed ribbed mussels were sent for chemical analysis as a control set. After 28 days, the mussels were retrieved. Samples were collected and sent to the analytical laboratory for homogenization and analysis. The concentrations of chemicals detected in the deployed mussels were compared to the chemical concentrations present in the unexposed (control) samples. These comparisons provided an indication of the extent to which chemicals present in the Thames River were biologically available and

could be concentrated in the tissues of these and other species of aquatic organisms. Locations of native and deployed shellfish samples are depicted on Figure 11-5.

11.2.4 Phase II RI Supplemental Ecological Investigation

The data collected during the initial sampling of the Phase II RI determined that several metals and organic compounds (i.e., PAHs) were present at concentrations in excess of benchmark values protective of aquatic biota, indicating that aquatic biota inhabiting this section of the river could be adversely impacted. Generally, the benchmark values used were media- and receptor-specific chronic values. In some cases, chronic benchmark values were developed using acute benchmark values and a conversion factor.

In response to these results, additional sediment samples were collected from the Thames River in 1995. The intent of the Phase II RI Supplemental Ecological Investigation was to focus more closely on the potential impacts that these chemicals might have on aquatic biota and to determine whether the chemicals were biologically available in concentrations that could represent an actual risk to the aquatic community.

Stations sampled during the Phase II RI Supplemental Ecological Investigation were located closer to NSB-NLON because of concerns about contamination detected in the original Phase II RI upstream and downstream reference stations. Three of the 10 stations sampled in the supplemental investigation were the same as those sampled in the original Phase II RI. Sediment sample locations are shown in Figure 11-2.

11.2.5 After Dredge Surveys for Pier 17 Replacement and SEAWOLF Homeporting Projects

Dredging of the navigation channel of the Thames River and the appropriate berths at NSB-NLON for the Pier 17 Replacement and SEAWOLF Homeporting projects was conducted between November 1995 and February 1996. Hydrographic post-dredging surveys were completed by Gahagan & Bryant Associates during the same time period as discrete portions of the dredging activities were completed. Survey data were obtained with a Trimble 4000 Differential Global Positioning System, Polarfix Range-Azimuth System, Deso 20 Fathometer, and the survey vessel SEA SCAN.

Figures 11-2 and 11-3 show the limits of dredging as determined by the after dredge surveys. A complete set of sampling locations and limits of dredging for the Thames River is shown on Figure 11-2. The reach of the Thames River shown on the figure corresponds to the reach sampled for the Phase II RI. Additional sampling was conducted as part of the SEAWOLF Homeporting project south of the reach. However,

these locations are not relevant to this project and are not shown on Figure 11-2. The sampling locations and the limits of dredging in the vicinity of Piers 15 and 17 are shown in more detail on Figure 11-3.

Only analytical data for surface sediment composite samples (C1 through C6), collected as part of the Pier 17 Replacement project, have been included in the database for this project. Any data that fell within the limits of dredging have been marked as "excavated" in the database. Additional data from the two projects were incorporated into the database and have been evaluated as part of this Lower Subase RI.

11.2.6 Lower Subase Remedial Investigation

Twenty sediment samples and 40 surface water quality measurements were collected in the Thames River at the stations presented on Figure 11-6. Sediment was collected at each sampling location with a modified, stainless-steel Van Veen dredge sampler and transferred to sample containers with a stainless-steel trowel. Sediment samples were analyzed for TCL semivolatiles, TAL inorganics, AVS/SEM, TOC, ammonia, pH, and grain size. Surface water quality parameters were measured at each sediment sampling location prior to sediment sampling. The measurements were collected over a period of approximately 1 hour prior to and 1 hour after low tide. At each location, surface water quality was measured using a YSI® water quality meter at the water surface (shallow) and near the sediment surface (deep). Water quality parameters that were measured included pH, temperature, specific conductivity, DO, turbidity, salinity, depth, and Eh (oxidation/reduction potential).

Sampling activities were conducted from a boat equipped with a global positioning system (GPS) unit so that survey information could be recorded for each sample station. The boat was anchored at each sample station and the engines were shut off while sampling activities were conducted.

11.3 PHYSICAL CHARACTERISTICS

This section presents a summary of physical characteristics of the Thames River based on information provided in the Phase II RI report (B&R Environmental, 1997b). Surrounding topography and surface features, surface water, soils, geology, and hydrogeology are discussed in the subsections that follow.

11.3.1 Surrounding Topography and Surface Features

NSB-NLON borders the Thames River for approximately 1.5 miles. The NSB-NLON facility is highly developed along the Thames River in the vicinity of the Lower Subase. There are 15 piers at NSB-NLON. The ground elevation along these piers and at the facility boundary is less than 10 feet. The 100-year

flood level for NSB-NLON is 11.2 feet above msl. This elevation is higher than most of the western portion of NSB-NLON; therefore, this area is susceptible to flooding.

Adjacent to the northern boundary of NSB-NLON, the land is relatively undeveloped, with scattered residences. Further north, the land is residential, commercial, recreational, and open-space. To the immediate south of NSB-NLON along the Thames River, the land is primarily residential with open spaces. Along the Thames River, tributary streams and wetlands are prevalent. Other high-profile industries along the Thames River include General Dynamics' Electric Boat Division (south of NSB-NLON on east shore), Pfizer Chemical Company (south of NSB-NLON on east shore), and Dow Chemical Company (north of NSB-NLON on east shore).

11.3.2 Surface Water Features

The Thames River and its tributaries drain approximately 1,500 square miles of eastern Connecticut, western Rhode Island, and south-central Massachusetts. The Thames River originates at the confluence of the Shetucket and Yantic Rivers in Norwich, Connecticut and discharges into Long Island Sound approximately 6 miles south of NSB-NLON and the town of Groton. The total length of the Thames River is 16 miles. The Yantic River has a drainage basin of 88 square miles. Average, minimum, and maximum flows in the Yantic River have been reported at 170, 3.5, and 13,400 cubic feet per second (ft^3/s), respectively. The Shetucket River, which has a 1,390-square-mile drainage basin, has reported average, minimum, and maximum flows of 2,000, 14, and 52,300 ft^3/s, respectively. Other sources of inflow to the Thames River are reportedly minor in comparison to these flows and to the volume of tidal exchange. Other sources of inflow include wastewater treatment facilities in Norwich, Montville, New London, the City of Groton, and the Town of Groton, combined sewer overflows in Norwich, industrial discharges, and several small streams. Both surface water runoff and groundwater from NSB-NLON discharge to the Thames River.

Widths of the river vary from 1.5 miles at New London Harbor to approximately 500 feet at Norwich Harbor. A dredged channel runs north to south in the river. Depths in the dredged channel are approximately 40 feet below msl. At NSB-NLON, the width of the river ranges from approximately 1,300 to 3,000 feet, and the width of the dredged channel ranges from 600 to 900 feet (see Figure 11-6). Outside the channel (near the west shore of the river), river depths are relatively shallow (2 to 10 feet). There are shallow coves upstream and downstream of NSB-NLON that empty into the river. Most of the coves are at least partially cut off from the river by a rail bed.

The Thames River is a salt wedge estuary that is highly stratified with fresher water on the surface and denser saline water on the bottom. At the NSB-NLON, the measured tidal range is about 2.2 feet. Estimated freshwater flushing time is 0.5 to 2 days from Norwich to Long Island Sound. In comparison, estimated flushing time for bottom water is greater than 19 days. The average freshwater flow discharging to the sound from the Thames River has been estimated at 222 million cubic feet per day. However, streamflow in the river is small in comparison to intertidal volume and exchange. Very little vertical mixing occurs in the Thames River. The north-south alignment, steep banks, and narrow channel do not permit much wind-induced mixing. Therefore, the freshwater outflows reach Long Island Sound in a well-defined surface layer.

Studies of the Thames River indicate that net flow in the upper layer of water is downstream at velocities of 0.06 to 0.3 feet per second. The current velocities in this area vary according to tide and freshwater flow from upstream. Velocities of up to 1.6 feet per second have been measured in the river during periods of storm runoff. The lower layer of water has a net up-estuary flow at velocities of 0.03 to 0.2 feet per second. The velocity of the lower layer is dominated by the tide and is reportedly relatively insensitive to stream flow.

As stated above, the Thames River estuary is stratified with relatively fresh water on the surface and saline water on the bottom. Historical records show that the salinity in the water at the bottom of the river is relatively constant at 30 parts per thousand (ppt). Salinity measurements taken in the Thames River adjacent to NSB-NLON in May 1995 for the Supplemental Ecological Investigation (B&R Environmental, 1997b) confirmed the constant 30 ppt salinity level. Measurements taken near the bottom in the channel of the Thames River ranged from 29.4 to 30 ppt. The salinity of the water at the surface of the river is more variable, with the salinity ranging from 28 ppt at the mouth of the river to 2 ppt at the upstream end of the estuary at Norwich.

11.3.3 Soil Characteristics

As discussed in Section 1.3.4, soil in the vicinity of the Lower Subase is either Udorthents-Urban Land or Urban Land. In addition, most of the land at NSB-NLON along the Thames River is also mapped as either Udorthents-Urban Land or Urban Land. Along the Thames River, Udorthents-Urban Land is identified in the northern portion of NSB-NLON, and Urban Land occurs in the southern portion of NSB-NLON. A small area of Hinkley loam has been identified in the vicinity of the northernmost portion of the facility along the river. This soil is found on stream terraces and outwash plains and consists of a dark, gravelly, sand loam. Native materials along the Thames River were most likely of this type.

11.3.4 Geology and Hydrogeology

Geology and hydrogeology in the vicinity of the Lower Subase are discussed in Sections 1.3.5 and 1.3.6, respectively. Groundwater along the shore flows west from NSB-NLON, discharges into the Thames River, and is tidally influenced. During low tide, groundwater flows toward the Thames River. During high tide, the hydraulic gradient along the Thames River reverses and estuarine water intrudes into NSB-NLON. The reversal in the hydraulic gradient occurs only near the river, generally within 300 feet of the Thames River. Groundwater flow in upgradient areas is not significantly altered.

11.3.5 Ecological Habitat

Various surveys have been conducted to identify the ecological habitat of the Thames River. Results of surveys on plankton, marine algae, benthic invertebrates, shellfish, finfish, and birds are summarized below.

Little information exists on the phytoplankton community present in the Thames River. Results of surveys suggest that, although densities are generally low, greater *chlorophyll a* concentrations were present in the upper surface water than in the river's deeper, more saline waters. Members of the class *Bacillariophyceae* tend to dominate samples collected from the river. Zooplankton samples are dominated by adult copepods, particularly *Acartia hudsonica* and *A. tonsa*. Other groups found in zooplankton samples collected from this portion of the river include barnacle and crab larval forms. Studies of ichthyoplankton conducted during the summer of 1988 reported the presence of bay anchovy, winter flounder eggs and larvae, tautog eggs, and rainbow smelt larvae.

Few species of macroalgae have been collected from this portion of the river and populations are generally low and sporadic in distribution. Results of a survey conducted in 1983 reported that the algal populations present in the nonindustrialized portions of the river were typical of those associated with northeastern rocky coastlines. Populations found in industrialized sections of the river tend to be sparse and dominated by relatively few species. The depth and lack of appropriate substrate in dredged portions of the river preclude algal growth. In fact, the general lack of suitable substrate accounts for the generally low algal species diversity and density throughout this section of the Thames River.

Results of macroninvertebrate surveys conducted in this portion of the Thames River have determined that the communities differ moving from north to south and between the channelized and nonchannelized portions of the river. The benthic community south of the I-95 bridge (2 miles south of NSB-NLON) is typical of that found in Long Island Sound. As with most estuarine rivers, benthic community abundance and species richness increases toward the more saline waters of Long Island Sound. The benthic

macroinvertebrate community is dominated by several taxonomic groups, including several species of bivalves and polychaetes.

Although shellfish beds are found throughout this portion of the river, recreational shellfishing has been closed due to fecal bacterial contamination. Shellfish found in these beds include hardshell clams and oysters. In addition to shellfish, both lobsters and blue crabs are harvested from the river.

The Thames River contains a relatively diverse fish community and includes year-round residents such as winter flounder, tomcod, and mummichogs as well as coastal (e.g., menhaden and bluefish) and seasonal (tautog and whiting) migrants. Anadromous species associated with the river include the American shad, alewife, blueback herring, and rainbow smelt. Stripped bass also overwinter in the estuarine portions of the river and form the basis of an important local recreational fishery.

Birds observed frequently along the Thames River in the vicinity of the NSB-NLON include herring gulls, cormorants, great-backed gulls, mute swans, and several species of ducks. Many duck species, in particular mallards, are observed on the river and overwinter in the coves around Mamacoke Island, opposite the river from NSB-NLON. During summer, 10 to 12 mallards and black ducks are normally present in this area; however, during the winter, up to 1,000 ducks have been observed. These include large numbers of canvasback, hooded merganser, mallard, black, gadwall, and redhead ducks. Greater scaup and common goldeneye ducks are occasionally observed in the area.

11.4 NATURE AND EXTENT OF CONTAMINATION

This section is a discussion of the nature and extent of contamination of the Thames River in areas upstream, adjacent to, and downstream of the Lower Subase. Figure 1-2 displays all the zones studied as part of the Lower Subase RI. Figures 11-1 through 11-6 identify sampling locations within the Thames River. Surface water, sediment, and biota samples were collected from the Thames River adjacent to Zones 1 through 7 of the Lower Subase, the DRMO, Goss Cove, and at upstream and downstream locations during the Phase II and Lower Subase RIs, as well as during the other investigations discussed in Section 11.2. Tables 11-1 through 11-13 provide a summary of each of the sampling and analytical programs involving the collection of environmental samples from the Thames River. The results of the environmental investigations of surface water, sediment, and biota are summarized in Sections 11.4.1, 11.4.2, and 11.4.3, respectively. Appendix H contains the complete database for the Thames River.

11.4.1 Surface Water

Summaries of the sampling and analytical programs for Thames River surface water investigations conducted during the Phase II and Lower Subase RIs are provided in Table 11-1. Figures 11-4 and 11-6 show surface water sampling locations for the Phase II RI and the Lower Subase RI, respectively. Positive analytical results for all Thames River surface water samples are presented in Table 11-14. Descriptive statistics (i.e., frequency of detection, concentration range detected, location of maximum positive detection) for Thames River surface water data are summarized in Table 11-15. The surface water data are not segregated by zones but are discussed as one unit.

Background concentrations of inorganics in surface water, used for comparison with Thames River surface water sample concentrations, were taken from the Phase II RI report (B&R Environmental, 1997b). A tabular summary of these background values is presented in Table 1-2.

The concentrations of most metals detected in surface water samples were fairly similar among the locations sampled. This is probably a consequence of two factors: contaminant migration can occur in both the upstream and downstream directions because of tidal influence, and contaminants potentially released from the site are likely to be well-mixed prior to entering the main flow of the Thames River. With the possible exceptions of aluminum, iron, and manganese concentrations in surface water samples collected near the DRMO, the water quality near the site does not appear to differ from the water quality noted at locations distant from NSB-NLON. Concentrations of aluminum, iron, manganese, and mercury exceed background concentrations (Table 1-2) in surface water samples collected from all locations, including the upstream location. All detected concentrations of cadmium, chromium, lead, and vanadium also exceeded background; however, with the exception of chromium, these parameters were not detected at concentrations greater than background levels in the upstream samples. Potassium concentrations in samples collected from the bottom layer at 200 feet from the shoreline of the DRMO, Lower Subase, Goss Cove, and Area A Downstream/OBDA also exceeded background concentrations.

Organic contaminants were detected infrequently and at low concentrations (i.e., ranging from 0.14 µg/L to 3 µg/L) in the surface water samples collected from the Thames River. Trichloroethene (3 µg/L) and butyl benzyl phthalate (0.5 µg/L) were detected in the shallow surface water sample collected from upstream sampling station 6SW1. Di-n-butyl phthalate (0.6 µg/L) was detected in shallow surface water sample T3SW1S (collected near the DRMO), and endrin aldehyde (0.14 µg/L) was detected in deep surface water sample, T3SW2B, collected adjacent to the Lower Subase.

As shown in Tables 11-14 and 11-15, several miscellaneous water quality parameters were also measured in the Thames River surface water samples. These parameters will be discussed in Section 11.7.

11.4.2 Sediment

The analytical data for sediment samples collected from the Thames River are segregated by zones for the purpose of evaluation. The Thames River zones used for evaluation are depicted in Figures 11-2 and 11-6. Summaries of the sampling and analytical programs for all investigations of Thames River sediment are provided by zone in Tables 11-2 through 11-12. Analytical results and descriptive statistics (i.e., frequency of detection, concentration range detected, location of maximum positive detection) for any chemical detected at least once in sediment samples are summarized by zone in Tables 11-16 through 11-37. The sediment discussion is organized by zone (in order of upstream to downstream) and includes Zones 1 through 7, the DRMO, Goss Cove, and areas upstream and downstream of the NSB-NLON.

Analytical results for sediment samples taken from locations that were subsequently dredged are not considered in this discussion of nature and extent of contamination. In addition, although analytical results for TOC, AVS, AVS/SEM, and other miscellaneous parameters are provided in the tables summarizing analytical results, these parameters are associated with the ecological risk assessment and will therefore be discussed in Section 11.7.

Background concentrations of inorganics in sediment, used for comparison with Thames River sediment sample concentrations, were taken from the Phase II RI report (B&R Environmental, 1997b). A tabular summary of these background values is presented in Table 1-3.

Figure 11-7 depicts the locations and concentrations of parameters that were detected in Thames River sediment samples at concentrations exceeding COC selection criteria used in the risk assessment.

11.4.2.1 Upstream

Sediment samples were collected at three locations in the Thames River upstream of the NSB-NLON (EC-SDTR01; T1SD1; T1SD2). Positive analytical results and descriptive statistics for these samples are provided in Tables 11-16 and 11-17, respectively.

Twenty metals were detected in the upstream sediment samples. The maximum concentrations of several metals (antimony, arsenic, chromium, copper, lead, mercury, and zinc) exceed the background concentrations listed in Table 1-3. Eighteen of the 20 detected metals were present in all three sediment

samples. Mercury was detected in only two of the three sediment samples, and boron was detected in only one of the sediment samples. With the exceptions of boron, lead, and nickel, the maximum concentrations of all metals were detected in the sediment sample collected from location T1SD1.

Only one of the three upstream sediment samples (EC-SDTR01) was analyzed for VOCs. Acetone (19 µg/kg), a common laboratory contaminant, was the only VOC detected. All three samples were also analyzed for SVOCs. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in all three samples; with the exception of benzo(g,h,i)perylene (maximum concentration detected at location T1SD1), maximum concentrations of these nine PAHs were detected in the sample collected from location T1SD2. Acenaphthylene, benzo(k)fluoranthene, carbazole, di-n-octyl phthalate, and dibenzo(a,h)anthracene were each detected in one sediment sample only. Concentrations of detected PAHs ranged from 66 µg/kg to 1,100 µg/kg. PAHs (which are fuel components/combustion by-products) are the primary contaminants detected in soils at NSB-NLON. Di-n-octyl phthalate, a common laboratory contaminant, was detected in sample EC-SDTR01-02 at a concentration of 9 µg/kg.

All three upstream sediment samples were analyzed for pesticides. 4,4'-DDD, 4,4'-DDE, alpha-chlordane, dieldrin, endrin aldehyde, gamma-chlordane, and heptachlor were each detected in at least one upstream sediment sample. No pesticides were detected in the sediment sample collected from location EC-SDTR01. Concentrations of 4,4'-DDD (ranging from 14 µg/kg to 17 µg/kg) exceed the reported concentrations of the other detected pesticides.

11.4.2.2 DRMO

Nine sediment samples were collected from the Thames River adjacent to the DRMO. Positive analytical results and descriptive statistics for these samples are provided in Tables 11-18 and 11-19, respectively.

Twenty-one metals were detected in the DRMO sediment samples. Of the 21 detected metals, boron and cadmium were the only metals not detected in all nine DRMO sediment samples. The maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc) exceeded background concentrations (Table 1-3). Maximum concentrations of all metals detected in sediment samples adjacent to the DRMO exceeded maximum concentrations of respective metals detected in the upstream sediment samples. Maximum concentrations of all metals were detected in samples collected from either location T3SD4 or location P1.

One sample, EC-T3SD4-02, was analyzed for VOCs; only acetone, a common laboratory contaminant, was detected at a concentration of 18 µg/kg. PAHs, 4-methylphenol, butylbenzyl phthalate, and di-n-butyl phthalate were the SVOCs detected in DRMO sediment samples. 4-Methylphenol (130 µg/kg), butylbenzyl phthalate (420 µg/kg), and di-n-butyl phthalate (58 µg/kg) were detected only in sample EC-T3SD4-02. PAHs were the most frequently detected organic constituents in DRMO sediment samples. Benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in at least 75 percent of the sediment samples analyzed for these parameters. Concentrations of PAHs in DRMO sediment samples ranged from 49 µg/kg to 1,300 µg/kg. A majority of the maximum concentrations of SVOCs were reported for sediment samples collected from location T3SD4. In general, sediment samples from locations T3SD4, P1, and 1 contained higher concentrations of PAH constituents than sediment samples collected from locations farther from shore. In general, concentrations of SVOCs detected in DRMO sediment samples were similar (i.e., at the same order of magnitude) to respective SVOC concentrations detected in upstream sediment samples. TPH was detected at a concentration of 103 mg/kg in the single DRMO sediment sample analyzed for this parameter.

Six DRMO sediment samples were analyzed for pesticides and PCBs. 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin aldehyde, and heptachlor were detected in one or both of the samples collected from location T3SD4 at concentrations ranging from 4.2 µg/kg (heptachlor) to 110 µg/kg (4,4'-DDD). In addition, dieldrin (4.8 µg/kg) and heptachlor (3.6 µg/kg) were detected in the field duplicate sample collected from location T5SD4. Maximum concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and endrin aldehyde in DRMO sediment samples exceeded the maximum concentrations of pesticides detected in the upstream sediment samples. As discussed in the Phase II RI report (B&R Environmental, 1997b), 4,4'-DDT and related compounds were frequently detected in sediment samples collected from streams located within the Area A Downstream Site of NSB-NLON. Two streams that originate in the Area A Downstream Site discharge into the Thames River in the vicinity of the DRMO Zone and Zone 5. Therefore, the pesticides detected in Thames River sediment samples collected adjacent to the DRMO may have originated in the Area A Downstream Site.

11.4.2.3 Zone 5

Fifteen sediment samples were collected from the Thames River adjacent to Lower Subase Zone 5. Positive analytical results for these samples are provided in Table 11-20. Descriptive statistics for Zone 5 sediment samples are provided in Table 11-21.

Twenty-two metals were detected in the Zone 5 sediment samples. Antimony, beryllium, boron, cadmium, mercury, and silver were the only metals that were not detected in all sediment samples analyzed for those specific parameters. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, silver, and zinc) exceeded background concentrations (Table 1-3). With few exceptions, maximum concentrations of metals reported for samples associated with Zone 5 also exceed respective concentrations of metals reported for upstream samples. The majority of the maximum metals concentrations (70 percent) were reported for the sample collected from location EC-SDTR02.

Only one of the Zone 5 sediment samples (EC-SDTR02-02) was analyzed for VOCs. Acetone and 2-butanone were detected in this sample at concentrations of 320 µg/kg and 61 µg/kg, respectively. Both of these compounds are considered to be common laboratory contaminants. Several SVOCs, primarily PAHs, were detected in Zone 5 sediment samples. PAHs are predominant environmental contaminants at NSB-NLON. Concentrations of the PAHs detected in Zone 5 sediment samples ranged from 28 µg/kg to 2,200 µg/kg. Anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and pyrene were each detected in more than 80 percent of the Zone 5 sediment samples. Maximum concentrations of 10 of 17 PAHs were detected in the sample collected from location EC-SDTR02. TPH was detected in three of four Zone 5 sediment samples at concentrations ranging from 1,420 mg/kg to 27,981 mg/kg. PAHs and TPH are primary contaminants at the NSB-NLON.

The pesticides detected in the Zone 5 sediment samples are similar in type and magnitude of concentration to pesticide results reported for the upstream locations. 4,4'-DDD was detected in four of nine Zone 5 sediment samples, with a maximum concentration of 28 µg/kg reported for the sediment sample collected from location SW/SD4-5RI. 4,4-DDE was detected in three of nine sediment samples, with a maximum concentration of 6.3 µg/kg (location T4SD3). In addition, aldrin (5.1 µg/kg), endrin aldehyde (14 µg/kg), and heptachlor (5.9 µg/kg) were each detected in one Zone 5 sediment sample. As discussed in the Phase II RI report (B&R Environmental, 1997b), 4,4'-DDT and related compounds were frequently detected in sediment samples collected from streams located within the Area A Downstream Site of NSB-NLON. Two streams that originate in the Area A Downstream Site discharge into the Thames River in the vicinity of the DRMO and Zone 5. Therefore, the pesticides detected in Thames River sediment samples collected adjacent to Zone 5 of the Lower Subase may have originated in the Area A Downstream Site.

11.4.2.4 Zone 6

Seven sediment samples were collected from the Thames River adjacent to Zone 6 of the Lower Subase. Positive analytical results and descriptive statistics for these samples are provided in Tables 11-22 and 11-23, respectively.

Twenty-two metals were detected in the sediment samples collected from Zone 6. Antimony and mercury were the only detected metals not reported at a 100 percent frequency of detection. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc) exceeded background concentrations (Table 1-3). The maximum concentrations of 14 of the 22 metals were detected in the sediment sample collected from location EC-SDTR03, and the maximum concentrations of cadmium, chromium, copper, lead, and nickel were reported for the two samples collected from location P2. Both of these sampling locations are located near the eastern shoreline of the Thames River, along the western boundary of Zone 6 of the Lower Subase. Most maximum concentrations of metals reported for sediment samples associated with Zone 6 exceed respective maximum concentrations reported for the upstream sediment samples.

Only one of the Zone 6 sediment samples (EC-SDTR03-02) was analyzed for VOCs. Acetone and 2-butanone, both common laboratory contaminants, were detected in this sample at concentrations of 430 µg/kg and 120 µg/kg, respectively. Several PAHs, carbazole, dibenzofuran, and phenol were detected in Zone 6 sediment samples. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene (which are all PAHs) were detected with the greatest frequency (in at least 80 percent of all samples analyzed for these parameters). Concentrations of PAHs detected in Zone 6 sediment samples ranged from 23 to 4,700 µg/kg. The maximum concentrations of over half of the PAHs were reported for the sample collected from location SW/SD1-6RI. This sample location is also located along the eastern shoreline of the Thames River, along the western boundary of Zone 6 of the Lower Subase. With few exceptions, maximum concentrations of SVOCs detected in Zone 6 sediment samples exceeded maximum concentrations of SVOCs detected in the upstream sediment samples.

Pesticides/PCBs were not detected in either of the two Zone 6 sediment samples analyzed for these parameters. A single sample, collected from location 4, was analyzed for TPH; the TPH concentration reported for this sample was 589 mg/kg.

11.4.2.5 Zone 7

Thirty-five sediment samples were collected from the Thames River adjacent to the Lower Subase Zone 7. Positive analytical results for these samples are provided in Table 11-24. With the exception of seven sediment samples that were collected from locations that were subsequently dredged, descriptive statistics for Zone 7 sediment samples are provided in Table 11-25.

Twenty-two metals were detected in sediment samples collected from Zone 7 of the Thames River. Aluminum, arsenic, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc were detected in 100 percent of the sediment samples analyzed for these specific parameters. Cadmium, lead, and mercury were detected in at least 55 percent of the sediment samples, and the remaining metals (antimony, beryllium, selenium, and silver) were detected in less than 15 percent of the sediment samples. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc) exceeded background concentrations (Table 1-3). The maximum concentrations of aluminum, cobalt, iron, magnesium, manganese, potassium, sodium, and vanadium were reported for the sediment sample collected from location SW/SD1-7RI. Maximum concentrations of antimony, chromium, copper, lead, mercury, nickel, selenium, and zinc were noted in the sediment sample collected from location P2. With the exception of antimony, maximum concentrations of all metals detected in Zone 7 sediment samples exceeded maximum concentrations of metals detected in the upstream sediment samples. Noticeably high concentrations of metals detected in Zone 7 sediment samples include chromium (240 mg/kg), copper (1,570 mg/kg), lead (406 mg/kg), mercury (3.1 mg/kg), and zinc (1,150 mg/kg); these concentrations exceed the respective concentrations of metals detected in sediment samples collected from all zones located north of Zone 7. In addition, these concentrations are from three to 20 times greater than respective maximum concentrations detected in the upstream sediment samples

Only one Zone 7 sediment sample (EC-SDTR04-02) was analyzed for TCL VOCs. A second sediment sample (MG-9020) was analyzed only for methylene chloride. No VOCs were detected in either of these samples.

Several SVOCs (including PAHs, phthalates, carbazole, dibenzofuran, and hexachlorocyclopentadiene) were detected in the Zone 7 sediment samples. The maximum concentrations of most SVOCs were reported for the composite sediment sample collected from location P2/P3. Concentrations of PAHs in Zone 7 sediment samples ranged from 41 µg/kg to 25,000 µg/kg. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene were detected at the greatest frequency (i.e., in at least 50

percent of the sediment samples analyzed for these parameters) and at maximum concentrations ranging from 1,000 µg/kg to 25,000 µg/kg. In overview, the maximum PAH concentrations noted in the Zone 7 sediment samples exceeded respective concentrations of PAHs noted in sediment samples collected from all Thames River zones located north of Zone 7. In addition, maximum PAH concentrations in Zone 7 sediment samples are from two to 46 times greater than maximum concentrations noted in sediment samples collected from the upstream area. Bis(2-ethylhexyl)phthalate, di-n-octyl phthalate, and di-n-butyl phthalate were each detected in from 17 to 22 of 26 sediment samples at concentrations ranging from 54 µg/kg to 11,000 µg/kg. Hexachlorocyclopentadiene was detected in the composite sample collected from location P2/P3 at a concentration of 2,800 µg/kg. TPH was not detected in the single Zone 7 sediment sample analyzed for this parameter.

Sixteen pesticides were detected in the 24 Zone 7 sediment samples analyzed for pesticides/PCBs. Fourteen pesticides were detected in from only one to seven of the 24 sediment samples. Heptachlor epoxide (40 percent frequency of detection) and Endosulfan I (50 percent frequency of detection) were the most frequently detected pesticides. Concentrations of the pesticides, in general, ranged from 1.8 to 2 µg/kg. The maximum detections were scattered among samples collected from locations P2, P2/P3, C4-Pier17-South, C2-Pier17-North, and C1-Pier17-North. Although a wider range of pesticides was detected in the sediments from Zone 7, the maximum concentrations of pesticides were similar to the maximum concentrations of pesticides reported for samples collected from the upstream area.

PCBs (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were detected in Zone 7 sediment samples at maximum concentrations of 120 µg/kg, 81 µg/kg, and 170 µg/kg, respectively. These PCBs were detected in from seven to 10 of the 24 samples analyzed for PCBs. Maximum concentrations of PCBs were not detected at any single sampling location. PCBs were not detected at the upstream sampling locations. Building 157 vault 31, located in Zone 7 of the Lower Subase, was a transformer area and may be the source of the PCB contamination.

11.4.2.6 Zone 1

Nine sediment samples were collected from the Thames River adjacent to the Lower Subase Zone 1. Positive analytical results for these samples are provided in Table 11-26. With the exception of four sediment samples that were collected from locations that were subsequently dredged, descriptive statistics for Zone 1 sediment samples are provided in Table 11-27.

Twenty-two metals were detected in sediment samples collected from Zone 1. Of the 22 metals detected, antimony, cadmium, mercury, and silver were the only metals that were not detected in all sediment

samples analyzed for these parameters. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, silver, and zinc) exceeded background concentrations. The maximum concentrations of more than 70 percent of the metal analytes were detected in the sediment sample collected from location SW/SD3-1RI. In general, maximum concentrations of metals detected in Zone 1 sediment samples were similar in magnitude, although greater, than maximum concentrations of metals detected in sediment samples collected from the upstream area.

A single Zone 1 sediment sample (EC-SDTR05-02) was analyzed for VOCs. Acetone and 2-butanone were detected in this sample at concentrations of 200 µg/kg and 74 µg/kg, respectively. Both of these compounds are considered to be common laboratory contaminants. Di-n-butyl phthalate, carbazole, chrysene, and several PAHs were also detected in Zone 1 sediment samples. The maximum concentrations of detected SVOCs were scattered among the sampling locations. Di-n-butyl phthalate was detected in three of five samples analyzed for SVOCs; however, phthalates are considered to be common laboratory contaminants. 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 were detected in all five sediment samples. Concentrations of PAHs detected in Zone 1 sediment samples ranged from 59 µg/kg to 2,900 µg/kg. Similar results were reported for SVOCs for sediment samples collected from the upstream sampling locations. Pesticides/PCBs were not detected in the single sample analyzed for this analytical fraction.

11.4.2.7 Zone 2

Five sediment samples were collected from the Thames River adjacent to the Lower Subase Zone 2. Positive analytical results for these samples are provided in Table 11-28. With the exception of two sediment samples that were collected from locations that were subsequently dredged, descriptive statistics for Zone 2 sediment samples are provided in Table 11-29.

Twenty-two metals were detected in Zone 2 sediment samples. Seventeen of the 22 metals were detected in all three sediment samples. Beryllium, cadmium, selenium, and silver were detected in two of the three sediment samples analyzed. The maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, selenium, silver, and zinc) exceeded background concentrations (Table 1-3). The majority of maximum concentrations of metals were detected in the sediment sample collected from location SW/SD1-2RI. In general, maximum concentrations of metals detected in Zone 2 sediment samples are similar to, but greater than, maximum concentrations of metals detected in sediment samples collected from the upstream area.

Zone 2 sediment samples were not analyzed for VOCs. However, all three Zone 2 sediment samples were analyzed for SVOCs. Nineteen SVOCs, primarily PAHs, were detected. The maximum concentrations of 13 of the 19 SVOCs were detected in the sediment sample collected from location SW/SD1-2RI. Concentrations of PAHs detected in Zone 2 sediment samples ranged from 63 µg/kg to 4,700 µg/kg. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in all three sediment samples. All but one of the other PAHs listed in Table 11-29 were detected in two of the three sediment samples. Maximum detections for benzo(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene exceeded 1,000 µg/kg. Pesticides/PCBs were not detected in the single sediment sample analyzed for this analytical fraction.

11.4.2.8 Zone 3

Six sediment samples were collected from the Thames River adjacent to Zone 3 of the Lower Subase. Positive analytical results and descriptive statistics for these samples are provided in Tables 11-30 and 11-31, respectively.

Twenty-three metals were detected in sediment samples collected from Zone 3. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc) exceeded background concentrations. Of the 23 metals detected, antimony, boron, and cadmium were the only metals not detected in all samples analyzed for these specific parameters. The maximum concentrations of metals were typically detected in samples collected from locations T4SD2 and SW/SD2-3RI. Lead was detected at significant concentrations (1,040 mg/kg and 1,380 mg/kg, respectively) in the sediment sample and field duplicate sample collected from location SW/SD2-3RI. This sample location is near the eastern shoreline of the Thames River, along the western boundary of Zone 3 of the Lower Subase. A lead removal action was performed at Building 31 in Zone 3 due to high concentrations of lead in on-site soils. Therefore, the soils beneath and surrounding Building 31 are likely to be the source of lead detected in the sediment samples collected from Zone 3 of the Thames River.

Only one of the Zone 3 sediment samples (EC-T4SD2-02) was analyzed for VOCs. Acetone and 2-butanone were detected in this sample at concentrations of 240 µg/kg and 58 µg/kg, respectively. Both of these compounds are considered to be common laboratory contaminants.

The semivolatile constituents 4-methylphenol, carbazole, dibenzofuran, phenol, three phthalates, and several PAHs were detected in Zone 3 sediment samples. Phthalates are considered to be common laboratory contaminants. With the exception of acenaphthylene and bis(2-ethylhexyl) phthalate, maximum

concentrations of all SVOCs were detected in the sediment sample collected from location SW/SD2-3RI. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in at least five of the six sediment samples. Concentrations of the PAHs detected in the sediment samples ranged from 52 µg/kg to 12,000 µg/kg. Maximum concentrations of PAHs and carbazole detected in the Zone 3 sediment samples were from two to 12 times greater than maximum concentrations of PAHs detected in sediment samples collected from the upstream area.

Three of the Zone 3 sediment samples were analyzed for pesticides/PCBs. Only gamma-BHC, at a concentration of 3.8 µg/kg in the sediment sample collected from location T4SD2, was detected.

11.4.2.9 Zone 4

Eight sediment samples were collected from the Thames River adjacent to Zone 4 of the Lower Subase. Positive analytical results and descriptive statistics for these samples are provided in Tables 11-32 and 11-33, respectively.

Twenty-four metals were detected in sediment samples collected from Zone 4. Maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc) exceeded background concentrations (Table 1-3). Antimony, cadmium, mercury, selenium, silver, and thallium were the only metals that were not detected in all samples analyzed for these analytes. The maximum concentrations of all the metals detected in Zone 4 sediment samples were scattered among all the sample locations. In general, maximum concentrations of metals detected in Zone 4 sediment samples exceeded respective maximum concentrations of metals detected in the sediment samples collected from the upstream area. Noticeably high concentrations of metals in Zone 4 sediment samples include chromium at 400 mg/kg in the sediment sample collected from location SW/SD3-4RI and lead and zinc at concentrations of 569 mg/kg and 1,650 mg/kg, respectively, in the sediment sample collected from location SW/SD1-4RI.

Two of the Zone 4 sediment samples were analyzed for VOCs. Acetone and 2-butanone were detected in these samples at maximum concentrations of 640 µg/kg and 190 µg/kg, respectively. Both of these compounds are considered to be common laboratory contaminants.

The semivolatile constituents carbazole, dibenzofuran, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and several PAHs were detected in Zone 4 sediment samples. Phthalates are considered to be common laboratory contaminants. Concentrations of PAHs detected in Zone 4 sediments ranged from 53 µg/kg to

16,000 µg/kg. 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 were detected in all the samples analyzed for these parameters. Maximum concentrations of PAHs and carbazole detected in the Zone 4 sediment samples were from two to 16 times greater than maximum concentrations of PAHs detected in sediment samples collected from the upstream area. TPH was detected at a concentration of 589 mg/kg in the single Zone 4 sediment sample analyzed for this parameter.

11.4.2.10 Goss Cove

Ten sediment samples were collected from the Thames River near Goss Cove. In the remainder of this section, Thames River sediment samples collected in the vicinity of Goss Cove will be referred to as Goss Cove sediment samples. Positive analytical results for these samples are provided in Table 11-34. With the exception of three sediment samples that were collected from locations that were subsequently dredged, descriptive statistics for Goss Cove sediment samples are provided in Table 11-35.

Twenty-two metals were detected in Goss Cove sediment samples. The maximum concentrations of several metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) exceeded background concentrations. Boron, cadmium, and mercury were the only metals not detected in all samples analyzed for these specific metals. More than one-half of the maximum concentrations of all metals were detected in the sediment sample collected from location T3SD1. In general, maximum concentrations of metals detected in Goss Cove sediment samples were similar, but slightly greater, than maximum concentrations of metals detected in sediment samples collected from the upstream area.

Three of the Goss Cove sediment samples were analyzed for VOCs. Carbon disulfide (7 µg/kg) was detected in only the sample collected from location T3SD1. Acetone and 2-butanone, which are both common laboratory contaminants, were each detected in one or two of the three samples, at concentrations ranging from 30 µg/kg to 96 µg/kg.

Several PAHs and di-n-butyl phthalate were also detected in Goss Cove sediment samples. Di-n-butyl phthalate, a common laboratory contaminant, was detected in two of four Goss Cove sediment samples at concentrations ranging from 57 µg/kg to 88 µg/kg. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were detected in at least 65 percent of the sediment samples analyzed for these compounds. Maximum concentrations of 10 of 13 PAHs were detected in the sample collected from location T5SD1. Sampling location T5SD1 is located in the central portion of the

Thames River and is the farthest of the five Goss Cove sediment sampling locations from the boundary of NSB-NLON. However, the concentrations of PAHs did not vary greatly in samples taken close to shore as opposed to samples taken in the middle of the river. Concentrations of PAHs ranged from 48 to 1,200 µg/kg.

Five Goss Cove sediment samples were analyzed for pesticides/PCBs. 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, endrin, and heptachlor were detected in these samples at concentrations ranging from 4.5 µg/kg to 64 µg/kg. 4,4'-DDT and heptachlor were each detected in two of five Goss Cove sediment samples. The remaining pesticides were each detected in only one sediment sample. The maximum concentrations of 4,4'-DDE and heptachlor were detected in the sediment sample collected from location T5SD1. The maximum concentrations of the remaining pesticides were detected in the sediment sample collected from location T3SD1.

11.4.2.11 Downstream

Eleven sediment samples were collected from the Thames River in the area downstream of NSB-NLON. Positive analytical results for these samples are provided in Table 11-36. All but two of the downstream sediment samples were collected from areas that were subsequently dredged. Therefore, descriptive statistics for the two remaining Goss Cove sediment samples are provided in Table 11-37.

Twenty-four metals were detected in the downstream sediment samples. Maximum concentrations of 20 of the 24 metals were detected in the sediment sample collected from location T2SD1. Concentrations of antimony, arsenic, cadmium, copper, lead, mercury, and zinc detected in both downstream sediment samples exceeded background concentrations, while the concentrations of chromium, selenium, and silver detected in only the sediment sample collected from T2SD1 exceeded background concentrations. In general, concentrations of metals detected in sediment samples collected downstream of the NSB-NLON were similar, but slightly greater, than concentrations of metals detected in sediment samples from the area upstream of NSB-NLON. Concentrations of lead and zinc, however, were approximately two times greater in the downstream sediment samples than the respective concentrations of these metals in the upstream sediment samples.

VOCs were not detected in the single downstream sediment sample analyzed for this analytical fraction. However, 13 PAHs and carbazole were detected in the sediment samples. Acenaphthylene, anthracene, benzo(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene were detected in both samples. Approximately half of the maximum SVOC concentrations were detected in each of the two samples. Concentrations of PAHs in the downstream sediment samples ranged from 100 µg/kg to 1,100 µg/kg.

Both downstream sediment samples were also analyzed for pesticides/PCBs. 4,4'-DDD, 4,4'-DDE, endrin aldehyde, and heptachlor were detected in both downstream sediments. Dieldrin was detected in only one of the two sediment samples. Concentrations of pesticides ranged from 5 µg/kg (dieldrin) to 12 µg/kg (4,4'-DDD). In general, concentrations of pesticides detected in downstream sediment samples were less than concentrations of pesticides detected in sediment samples collected from the upstream area.

11.4.3 Biota

The sampling and analytical program for biota samples collected from the Thames River is provided in Table 11-13. All biota sampling was completed as part of the Phase II RI. Positive analytical results for biota samples are presented in Table 11-38. Biota sampling locations are shown in Figure 11-5.

11.4.3.1 Caged Ribbed Mussels

The caged mussel deployment stations in the Thames River were selected to represent potential source locations at the NSB-NLON (DRMO, Lower Subase, and Goss Cove Landfill). Upstream and downstream locations were selected to characterize the biological availability of chemicals in areas outside the immediate influence of the NSB-NLON. Tissue concentrations were reported and are discussed in this section on a wet weight basis. The results of the tissue analyses conducted on these samples are summarized in Table 11-38.

VOCs detected in deployed ribbed mussels included methylene chloride, carbon disulfide, 2-butanone, tetrachloroethene, styrene, benzene, ethylbenzene, toluene, and xylenes. With the exception of tetrachloroethene and styrene, these compounds were also detected in the control mussels not deployed in the Thames River. It is likely that low levels of VOCs are ubiquitous in bivalve shellfish. Concentrations of most of these compounds were similar in deployed and control mussels.

Few SVOCs were detected in the deployed ribbed mussel samples. PAHs were not detected in upstream and downstream samples but were present in DRMO and Goss Cove samples at levels similar to the control samples (see Table 11-38). The exception to this pattern was the Lower Base (Station CMU3), where concentrations of several PAHs as well as 2-methylphenol, dibenzofuran, benzyl alcohol, and benzoic acid were detected in the mussels at concentrations well above those detected in the control samples. The PAHs may be attributable to activities in that area. Benzoic acid was detected in each of the deployed ribbed mussel samples at concentrations above those detected in the control samples. This compound can occur naturally.

Low concentrations of organochlorine pesticides were detected in deployed mussel samples, including alpha-, beta-, and gamma-BHC, heptachlor, aldrin, 4,4'-DDE, endrin aldehyde, and gamma-chlordane. However, concentrations of most of these pesticides were equivalent to, or less than, concentrations of these pesticides measured in the non-deployed control mussels. PCBs were not detected in either the deployed or non-deployed mussels.

In general, concentrations of metals in deployed ribbed mussels were similar to those measured in the non-deployed control mussels. The exception was mercury, which was not detected in control mussels but was detected in one of the two samples from off Goss Cove at a concentration of 1.6 mg/kg wet weight.

11.4.3.2 Native Shellfish

Native blue mussels, oysters, and hardshell clams were collected from the river and analyzed for SVOCs, PCBs and pesticides, and metals. Sampling locations are shown on Figure 11-5 and results are summarized in Table 11-38. Results are on a wet weight basis. The oysters were collected from commercial shellfish beds in the river. The hardshell clams were collected from locations adjacent to the commercial shellfish beds. Blue mussels were collected from areas of the river where they are abundant and from pilings along the Lower Subase.

Few SVOCs were detected in native shellfish. Two PAHs were detected in only one blue mussel sample from the Lower Subase. The detection of PAHs in this sample may be due to activities at the Lower Subase. Bis(2-ethylhexyl)phthalate and di-n-octyl phthalate were detected in many of the shellfish samples at concentrations ranging from 18 to 160 µg/kg wet weight. These compounds are ubiquitous in the environment and are common laboratory contaminants. Benzyl alcohol was detected in one hardshell clam sample from the Long Cove area upstream of NSB-NLON.

Relatively few pesticides were detected in the native Thames River mussels, oysters, and clams. Heptachlor was detected in most samples at concentrations ranging from 2 to 4.5 µg/kg wet weight. 4,4'-DDT and its metabolites and gamma-chlordane were detected in native blue mussel samples from adjacent to the Nautilus Museum, Lower Subase, and the channel off Mill Cove, upstream of NSB-NLON. Gamma-chlordane was also detected in a hardshell clam sample from Long Cove north of NSB-NLON. 4,4'-DDE and 4,4'-DDD concentrations ranged from 5 to 16 µg/kg wet weight. Gamma-chlordane concentrations ranged from 2.1 to 13 µg/kg wet weight. PCBs were not detected in the native shellfish samples.

Of the inorganics detected in Thames River native shellfish, arsenic, cadmium, chromium, and selenium were detected at low levels in most samples. The concentrations were similar among locations and shellfish species. Boron was only detected in two blue mussel samples, from the Lower Subase and the Nautilus Museum pilings at concentrations of 70.9 and 77.5 mg/kg wet weight, respectively. Concentrations of copper, silver, and zinc varied considerably among species. Silver was not detected in mussels but was found in hardshell clams and oysters. Copper concentrations in blue mussels and hardshell clams ranged from 1.8 to 7.5 mg/kg wet weight but ranged from 62.9 to 253 mg/kg wet weight in oysters. Zinc concentrations ranged from 18.1 to 34.6 mg/kg wet weight in blue mussels and hardshell clams but ranged from 1,210 to 2,960 mg/kg wet weight in oysters.

11.5 CONTAMINANT FATE AND TRANSPORT

The chemicals detected in the Thames River in the vicinity of NSB-NLON consist primarily of PAHs, pesticides, and metals. Typically, these chemicals are not particularly soluble and tend to sorb to sediments. All three groups of chemicals are persistent in anaerobic environments, which indicates that the concentrations are not likely to decrease as a function of time. The three classes of chemicals may exist and be transported in several phases: dissolved; adsorbed to suspended sediments; associated with dissolved organic carbon; adsorbed to sediments that have settled to the bottom; dissolved in the interstitial water of the bottom sediments; and associated with dissolved organic carbon in the interstitial water of the bottom sediments.

The fate and transport of PAHs, pesticides, and metals in the Thames River are governed by various physical and chemical processes. The physical processes affecting contaminant fate and transport are related to the flow of water in the river. Processes such as advection, dispersion, diffusion, and settling/resuspension of sediment are typical physical processes. The Thames River is a tidally influenced river, and tidal dispersion would also be a physical process affecting contaminant transport. Tidal dispersion encompasses mixing attributable to the temporal variation of tidal velocity, lateral and vertical velocity gradients, and density differences.

The Thames River is stratified, with relative fresh water flowing downstream at velocities of 0.06 to 0.03 ft/s, overlying saline water, flowing upstream at velocities of 0.3 to 0.2 ft/s. The fresh-water flushing time of the Thames River is 0.5 to 2 days from Norwich to the Long Island Sound (Welsh and Stewart, 1984) and the saline water flushing time was estimated to be greater than 19 days. The salinity of the fresh water in the Thames River ranges from 28 parts per thousand (ppt) at the mouth of the river to 2 ppt at the upstream end of the estuary at Norwich. The salinity of the saline water is relatively constant at

30 ppt. The density of water increases with increased salinity. Very little vertical mixing occurs in the Thames River between the fresh water and the saline water. Based on the opposing flow directions in the upper (freshwater) and lower (saline) layers, it is apparent that contaminant migration can occur in both the "upstream" and "downstream" directions.

The chemical processes affecting PAH, pesticide, and metal fate and transport in the Thames River are related to the biological and chemical reactions that occur in the ecosystem. For example, bioaccumulation, biodegradation, volatilization, photolysis, adsorption/desorption, and diffusive exchange are typical chemical/physical processes. Fate and transport parameters are summarized in Section 3.3. Table 3-3 summarizes the parameters for PAHs and pesticides. The parameters included in the table are specific gravity, vapor pressure, solubility, K_{ow}, K_{oc}, Henry's Law constant, and the bioconcentration factor. Table 3-4 summarizes parameters for metals including the molecular weight, the distribution coefficient, and the bioconcentration factor.

11.6 BASELINE HUMAN HEALTH RISK ASSESSMENT

This section contains the site-specific risk assessment performed for the Thames River. No new data were collected during the current investigation for the human health risk assessment. Consequently, the human health risk assessment for the Thames River presented below is the same one presented in the Phase II RI report (B&R Environmental, 1997b). The selection of COCs is discussed in Section 11.6.1, the exposure scenarios and potential receptors are identified in Section 11.6.2, and the results of the risk assessment are contained in Section 11.6.3.

11.6.1 Data Evaluation

COCs were selected for surface water, shellfish (i.e., oysters and clams), and finfish. Given the manmade shoreline, steep banks, depth of the river, tidal flow, and heavily industrialized nature of this reach of the river, exposure to sediment in the river is considered unlikely since small children are not expected to wade in the river waters and recreational users would not contact deep sediments. Therefore, sediments are not considered to be a medium of concern.

All surface water and biota data collected during the Phase II RI and additional investigations were used to select COCs for the Thames River. COC summary screening tables for all media are contained in Appendix I.12.

Surface water samples were collected from locations upstream and downstream of NSB-NLON and from several locations along NSB-NLON's shore. Surface water samples collected at shallow depths were used

to identify COCs for human exposure. Exposure to surface water at depth is not anticipated. The following analytes were selected as COCs for direct contact with shallow surface water:

- Trichloroethene
- Metals (boron, cadmium, and manganese)

As discussed in Section 3.4.1, these chemicals were retained based on a comparison of site data to risk-based COC screening levels for residential groundwater ingestion. Consequently, the list of COCs is conservative because of the anticipated limited use and exposure to surface water.

The measured tissue concentrations of chemicals in oysters and clams were also used to determine COCs for ingestion of these species. These results were compared to the risk-based COC screening levels for ingestion of fish tissue. The following COCs were thereby selected for oysters:

- Heptachlor
- Metals (arsenic, cadmium, chromium, manganese, silver, and zinc)

The following chemicals were retained for clams:

- Heptachlor
- Metals (arsenic, cadmium, chromium, manganese, selenium, and silver)

A list of COCs for finfish (and other unspecified shellfish) was selected by calculating a tissue concentration from the maximum surface water concentration and chemical-specific bioconcentration factors. Estimated tissue concentrations were then compared to risk-based COC screening levels for finfish ingestion. The following are COCs for finfish:

- Trichloroethene
- Di-n-butyl phthalate
- Cadmium

USEPA Region I does not advocate a quantitative evaluation of exposure to copper and iron because the only available toxicity criteria for these chemicals are provisional reference doses based on allowable daily intakes rather than adverse effect levels.

Because of the limited number of samples collected for surface water and biota, average and maximum concentrations were used as exposure concentrations for CTE and RME, respectively. All COCs and their respective exposure concentrations are shown in Table 11-39.

11.6.2 Exposure Assessment

Only one receptor group was considered to be potentially exposed to Thames River surface water and biota. This receptor was identified as the adult recreational user. The size, depth, and flow of the river; the steep, manmade banks of the river; and the industrialized nature of the waterfront would most likely preclude children from wading. It was assumed that adults may boat or water ski in the Thames River and could potentially ingest oysters, clams, or finfish caught in the river. As discussed previously, exposure to river sediments is not considered to be likely because of the depth of the river.

Clams and oysters are the only edible shellfish species found in the river that were sampled. For the risk assessment, exposure to these media were assumed to occur. However, individuals are not permitted to harvest shellfish in the area and there are no licensed recreational shellfishing areas in the Thames River. Commercially harvested oysters are depurated for 45 days in Long Island Sound. As a worst-case scenario, it was assumed that these oysters are not mixed with those from other beds and could be eaten (illegally) by local residents. Clams are not harvested in the Thames River, but a worst-case ingestion scenario was considered. Ribbed mussels and blue mussels found in the river are not usually consumed by humans and therefore were not considered in the risk assessment. Finfish ingestion was considered. The general category of finfish is meant to include all other edible species that might be harvested by individuals.

Local residents could be exposed indirectly to surface water chemicals via ingestion of shellfish or finfish. Default ingestion rates proposed by USEPA Region I were used in the evaluation of these receptors under CTE and RME. Ingestion rates of 0.003 (CTE) and 0.055 (RME) kg/day were used for shellfish. Ingestion rates of 0.0095 (CTE) and 0.054 (RME) kg/day were employed for finfish. Exposure to shellfish and finfish was assumed to occur 234 days per year for the CTE and 350 days per year for the RME. The exposure durations were set at 9 (CTE) and 30 (RME) years, respectively.

It is also assumed that local residents could come into full-body contact with surface water while water-skiing in the river. The CTE scenario is evaluated as 2.6 hours per day for 8 days per year for 9 years. Under RME, the receptor is assumed to be exposed 2.6 hours per day for 16 days per year for 30 years. During each hour exposed, 0.05 liter of water is assumed to be ingested accidentally. Additional details on the receptor exposure parameters are presented in Table 3-16.

11.6.3 Risk Characterization

This section contains a summary of the quantitative risk assessment. Noncarcinogenic and carcinogenic risks were calculated for the ingestion of contaminated oysters, clams, and finfish obtained from the Thames River, as well as for ingestion of and dermal contact with surface water. Table 11-40 presents the estimated risks for the adult recreational user under CTE and RME. Sample calculations are provided in Appendix I.3. Chemical-specific risks are provided in Appendix I.12.

11.6.3.1 Noncarcinogenic Risks

Cumulative HIs for the adult receptor are 3.3E+1 for RME and 5.3E-1 for CTE. Direct exposure to surface water (via incidental ingestion and dermal contact) does not present a significant human health risk. Elevated noncarcinogenic risks for RME are primarily attributable to the direct ingestion of shellfish and finfish contaminated with several inorganics. Under this scenario for the ingestion of oysters, the chemical-specific HQs for arsenic, cadmium, and zinc alone exceed unity (as seen in Appendix I.12). Arsenic is the main contributor to the total RME HI for clam ingestion. Elevated risks associated with finfish ingestion under RME are attributable to cadmium, which has an associated HQ of 0.96 (Appendix I.12). Although shellfish exposures are unlikely to occur because of the lack of licensed recreational shellfishing, adverse health effects would be expected for the adult receptor who is exposed to maximum detected concentrations in oysters and clams.

11.6.3.2 Carcinogenic Risks

Cumulative incremental cancer risks for the adult recreational user are 3.9E-3 for RME and 1.7E-5 for CTE. The cumulative incremental cancer risk for the RME scenario exceeds the USEPA target risk range (1E-4 to 1E-6) and the CTDEP cumulative target risk level (1E-5). The cumulative incremental cancer risk for the CTE scenario is within the USEPA target risk range but slightly exceeds the CTDEP cumulative target cancer level.

Cancer risks for ingestion of finfish and direct contact with surface water are minimal (i.e., less than or equal to 1E-6 for the RME and CTE scenarios). Heptachlor and arsenic are the only carcinogens detected in the oysters and clams. The incremental cancer risks associated with heptachlor via shellfish ingestion exceed 1E-6 but are less than 1E-5. Arsenic is the main contributor to the elevated carcinogenic risks. The chemical-specific incremental cancer risks associated with this chemical exceeded the target risk levels (i.e., 1E-4 the upper limit of the USEPA target risk range and 1E-5 the CTDEP cumulative target

cancer level) for shellfish ingestion. Ingestion of oysters and clams are the exposure route of concern for the adult recreational user.

11.6.3.3 Uncertainties

Since the status of arsenic as an oral carcinogen has not been confirmed by USEPA, some uncertainty is associated with the carcinogenic evaluation of this chemical. Section 3.4.5 provided a discussion of the uncertainty associated with the carcinogenicity of arsenic. In addition, the Agency for Toxic Substances and Disease Registry (ATSDR, 1991a) has indicated that arsenic in the tissues of aquatic organisms exists as arsenocholine and arsenobetaine. These forms of arsenic are not believed to be carcinogenic. Therefore, the carcinogenic risks based on shellfish consumption may be substantially overestimated. ATSDR also indicates that the mean level of arsenic in fish and seafood is usually 4 to 5 mg/kg. Concentrations in the Thames River clams and oysters are comparable to this concentration range.

11.6.3.4 Qualitative Risk Assessment

Several analytes were detected in the surface water at concentrations that exceeded the AWQCs for protection of human health. Both state and Federal criteria for ingestion of fish were used for comparison. Routine ingestion of water is not considered because the river is not used for potable water supplies.

Trichloroethene, which was detected at a concentration of 3 µg/L in the upstream surface water sample, is not expected to present a potential public health problem, based on the state and Federal criteria of 61 µg/L and 80.7 µg/L, respectively. However, mercury was detected in multiple samples at concentrations that exceed state and Federal criteria. The state criterion for mercury (1.5E-4 µg/L) is based on the dissolved fraction, which is well below the current detection limit of 0.2 µg/L. Therefore, mercury would be considered to cause a potential public health concern if only the water data are assessed. However, the biota data indicated that mercury was not detected in any of the oysters or clams, which are the two edible species sampled. The detection limit (0.1 mg/kg) was below the level of potential public health concern based on the risk-based COC screening criteria.

11.7 ECOLOGICAL RISK ASSESSMENT

This section presents the results of the ERA performed for Zones 1 through 7 and the Thames River area surrounding the base. It consists of discussion of the preliminary problem formulation and effects evaluation, exposure estimate and risk calculation, site-specific uncertainties, and conclusions for each zone.

11.7.1 Ecological Risk Assessment for Zone 1

11.7.1.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 1 are discussed in Sections 4.1 through 4.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 1. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.1.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure concentrations included the NSB-NLON Phase II RI and Lower Subase RI data sets described in Section 3.5. The data set for Zone 1 included samples LS1SD001, LS1SD002, LS1SD003, and LS1SD004 from Lower Subase RI sampling and sample EC-SDTR05-02 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data were also available for the samples listed above. The maximum and average concentrations of analytes from these samples were compared to guidelines in the risk calculation step, presented below.

A caged ribbed mussel sample (CMU3) was deployed near Piers 10 and 12 as part of the NSB-NLON Phase II RI ERA. In addition to chemical analyses, sediment from sample EC-SDTR05-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was also used for toxicity testing using two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus*. The results of these toxicity tests and the caged mussel sample are discussed below.

An NPDES-regulated storm water outfall is located near Building 89 (BLDG 89). NPDES monitoring data for this outfall are available for the 1992-1993 and 1994-1995 sampling periods. Parameters measured during monitoring include several physical parameters and inorganics. As mentioned in Section 3.5,

emphasis was placed on interpretation of the amount of copper, lead, and zinc in the effluent since the focus of this ERA is on chemical contamination. Interpretation of storm water monitoring data from the Building 89 outfall is presented below. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

Contaminant Screening

The maximum concentrations of the following inorganics in Zone 1 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc (Table 11-41). Only one organic, benzo(a)pyrene, had a maximum concentration in excess of its guideline and was retained as a maximum concentration COC (Table 11-41).

The average concentrations of the following inorganics in Zone 1 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: arsenic, barium, copper, lead, mercury, and zinc. Boron, beryllium, cobalt, and vanadium were retained as COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. Only one organic, benzo(a)pyrene, had an average concentration in excess of its guideline (Table 11-42). Toxicity profiles for ecological COCs are presented in Appendix J.

The maximum and average concentrations of AVS in Zone 1 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-43).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-44 presents less conservative guidelines for contaminants.

Inorganics

Each of the five AVS inorganics (cadmium, copper, nickel, lead, and zinc) were detected at maximum concentrations that exceeded ER-Ls. Of these inorganics, copper, lead, and zinc were present at average concentrations that also exceeded ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations

of SEM, it is unlikely that cadmium, copper, nickel, lead, and zinc are bioavailable and eliciting toxic effects to sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and conservative guideline, but its average concentration did not exceed background. The maximum concentration of this inorganic did not exceed the alternate guideline presented on Table 11-44 (an SEL). Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

Antimony had a maximum detection in excess of its background concentration and guideline, although its average concentration did not exceed the guideline. The maximum HQ was relatively low (HQ = 1.3) and the maximum concentration was much lower than the ER-M (Table 11-44). Antimony was detected in one of five samples. Specifically, it was detected in a NSB-NLON Phase II RI Supplemental Ecological Investigation sample (EC-SDTR05-02); it was not detected in the four Lower Subase RI samples collected in 1997. Ecotoxicological data for antimony are lacking, although antimony does not appear to bioconcentrate appreciably in fish and aquatic organisms (ATSDR, 1992a).

The maximum and average concentrations of arsenic in Zone 1 sediments exceeded the ER-L, with HQs of 1.93 and 1.63, respectively. The maximum and average concentrations of arsenic were much lower than the less conservative ER-M, PEL, and SEL values presented on Table 11-44.

The maximum detected concentration of chromium was equal to the ER-L, and the average concentration was less than the ER-L. The maximum concentration of chromium (80.7 mg/kg) is much less than the less conservative ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg) shown in Table 11-44.

Mercury had maximum and average concentrations in excess of the ER-L for that metal, although the background concentration of that metal was greater than the ER-L as well. The maximum and average concentrations of mercury, 0.39 and 0.331 mg/kg respectively, were roughly halfway between the ER-L and the ER-M (Table 11-44). The ER-M and PEL are almost identical. The maximum concentration of mercury is about an order of magnitude lower than the SEL (2.0 mg/kg).

No sediment guidelines were available for barium, beryllium, boron, cobalt, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background. The maximum and average concentrations of barium exceeded its guideline, with HQs of 2.99 and 2.62, respectively. No less conservative alternate guidelines were available for barium. Vanadium is generally

not considered to be toxic in the environment (Mailman, 1980). None of the inorganics listed above were concluded to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene was the only organic in Zone 1 sediments that had a maximum concentration in excess of its guideline (an EqP value). The average concentration of this PAH also exceeded the guideline. HQ values for benzo(a)pyrene using the EqP guideline were relatively low: 2.75 and 2.04 for maximum and average, respectively. The maximum concentration of this organic (880 µg/kg) was lower than the ER-M (1,600 µg/kg) but slightly exceeded the PEL (763 µg/kg) as shown in Table 11-44. No SEL was available.

Historical Data and Analyses

As mentioned above, sediment from sample EC-STDR05-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing of two invertebrate species. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* was not significantly different in test sediments than in reference sediments, suggesting that sediments in that sampling area are not toxic to benthic organisms.

A caged ribbed mussel sample (CMU3) was deployed near Piers 10 and 12 as part of the NSB-NLON Phase II RI ERA. The NSB-NLON Phase II RI concluded that concentrations of some PAHs, 2-methylphenol, dibenzofuran, benzyl alcohol, and benzoic acid were elevated relative to concentrations in "control" samples, which were deployed mussel samples upstream and downstream of NSB-NLON. The Phase II RI also concluded that PAHs in CMU3 may be attributable to Lower Subase activities. The maximum concentration among all PAHs detected in CMU3 was 130 µg/kg for pyrene. The total concentration of PAHs in CMU3 was 446 µg/kg. The concentrations of 2-methylphenol, dibenzofuran, benzyl alcohol, and benzoic acid were 44, 20, 70, and 870 µg/kg, respectively. Data for CMU3 are provided in Appendix H. Benzoic acid was detected in all the caged mussel samples from the NSB-NLON Phase II RI at concentrations above controls; the NSB-NLON Phase II RI noted that this compound can occur naturally. No toxicity or concentration data for 2-methylphenol, dibenzofuran, benzyl alcohol, or benzoic acid in bivalve tissue were available.

NOAA has compiled bivalve tissue contaminant data as part of their National Status and Trends Program for marine environmental quality (NOAA, 1995). NOAA collected seven different species of mollusks at 154 sampling sites throughout coastal areas of the United States from 1986 to 1993. Data for all species

were pooled for individual years. NOAA points out that concentrations of organics were relatively similar between species, indicating that pooling of interspecies data was appropriate. From those data, the average concentrations plus one standard deviation were designated as "high" concentrations for several contaminants and contaminant classes. However, these concentrations should be interpreted with caution because one standard deviation above the average is not necessarily associated with effects. NOAA concedes that the "highs serve as a basis for categorizing sites but ... are not always indicative of environmental contamination" and "there is no reason to suppose that such concentrations cause harm to marine organisms or to man" (NOAA, 1995).

The total concentration of PAHs in CMU3 was 446 µg/kg. NOAA presents a "high" total PAH concentration of 255 µg/kg (wet weight). Eisler (1987b) presents some ranges of total PAHs in bivalves as follows: 106 to 986 in bay mussels (*Mettles eludes*) near an industrialized area in Oregon, 127 µg/kg in edible portions of the sea scallop (*Placopectin magellanicus*) in New York Bight, 55 to 520 µg/kg in the soft parts of the American oyster (*Crassostrea virginica*) in the spring months in South Carolina residential areas, and 555 µg/kg in the soft-shell clam (*Mya arenaria*) in a contaminated Oregon site. Eisler also presents total PAHs up to 1,290 and 328 µg/kg in two species of crustacean, the rock crab (*Cancer irroratus*) and the American lobster (*Homarus americanus*), respectively, in Long Island Sound.

PAHs were not detected in CMU5, the mussel sample deployed upstream of the base. Thus, PAHs detected in CMU3 may be due to the Lower Subase. Yet, in general, the total PAH concentration in CMU3 was within or only slightly higher than the ranges listed above. Benzo(a)pyrene, the only Zone 1 PAH that exceeded its conservative guideline, was not detected in CMU3. Additionally, mercury, which was elevated relative to its ER-L in Zone 1, was not detected in CMU3. Some organics were elevated in CMU3 relative to controls; however, the bioavailability of contaminants to bivalves in Zone 1 does not appear to be significant.

Concentrations of copper, lead, and zinc in storm water at BLDG 89 were 0.57, 0.31, and 0.62 mg/L, respectively, in 1992/1993 samples and 0.023, 0.064, and 0.12 mg/L, respectively, in 1994/1995 samples. NPDES standards for that copper, lead, and zinc in that outfall in the most recent General Permit are 0.1, 0.05, and 0.5 mg/L, respectively. Hence, copper was elevated in 1992/1993, lead was elevated in 1992/1993 and 1994/1995, and zinc was elevated in 1992/1993 relative to NPDES standards.

The maximum concentrations of these inorganics exceeded ER-Ls and background in NSB-NLON Phase II RI/Lower Subase RI samples collected in Zone 1. Therefore, BLDG 89 could be contributing those inorganics to Thames River sediments in Zone 1. However, these are AVS inorganics and, as discussed earlier, the maximum and average amount of AVS in NSB-NLON Phase II RI/Lower Subase RI sediment

samples in Zone 1 exceeded total SEM concentrations, indicating that these inorganics are not bioavailable.

Surface Water and Sediment Physical Parameter Analyses

Dissolved oxygen (DO) ranged from 8.38 to 8.84 mg/L in Zone 1 surficial samples and from 7.55 to 7.68 in water overlying sediments (Table 11-45). For pH, values ranged from 7.5 to 7.87 in surficial samples and from 7.76 to 7.85 in water overlying sediments. Salinity ranged from 26.27 to 27.02 ppt in surficial samples and from 28.06 to 29.01 ppt in water overlying sediments.

Maximum and average pH values in Lower Subase RI sediments were 8.4 and 8.1, respectively. Maximum and average ammonia concentrations in those sediment samples were 150 and 91.6 mg/kg, respectively. Sediment samples LS1SD001, LS1SD002, and LS1SD003 were composed of 91, 94, and 94 percent fine-grained sediment particles (silts/clays), respectively (Table 11-46). Sample LS1SD004 had larger percentages of coarse material, with 54 percent fine-grained particles.

DO was slightly higher in surficial samples in Zone 1 than in deep samples, but all measurements were above a minimum for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 1 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the northeast. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 1 was 26.27 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 1.

Three Lower Subase RI sediment samples were each composed of over 90 percent fine-grained sediment particles (silts/clays) as shown in Table 11-46. The fourth Lower Subase RI sediment sample, LS1SD004, had larger percentages of coarse material with 54 percent fine-grained particles. As discussed in Section 3.5, since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some inorganics. Sediment in depositional areas often contains higher percentages of finer particles than sediments in other areas. With the possible exception of sample LS1SD004, the sediment samples collected in Zone 1 appear to be from depositional areas and therefore probably provide a conservative estimate of sediment contamination. Also, finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 1 was 4.23 percent. Little guidance exists regarding the interpretation of TOC relative to bioavailability, but EPA suggests a conservative default

value of 1 percent for calculating organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 1 value of 4.23 percent probably represents relatively high TOC.

11.7.1.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 5), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-STDR05-02) was used for toxicity testing in Zone 1 in the NSB-NLON Phase II RI and only one caged mussel sample (CMU3) was deployed in Zone 1. Thus, the limited sample size for these analyses precludes thorough determination of sediment toxicity and bioavailability.

Several inorganics were detected in Zone 1 sediments (beryllium, boron, cobalt, and vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these inorganics precludes an evaluation of their presence in Zone 1 sediments.

Also, uncertainties are inherent in the Zone 1 surface water parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality. Similarly, the storm water data are collected at only one time, providing only a snapshot of storm water characteristics.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of those cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed in order to further evaluate potential risks, but uncertainties remain. This was the case for iron, antimony, arsenic, chromium, mercury, and benzo(a)pyrene in Zone 1 sediments.

11.7.1.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 1 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including antimony, arsenic, chromium, iron, and mercury, indicating that potential risks may be present. However, average concentrations of some of these inorganics were below conservative guidelines. The maximum concentration HQ values for those inorganics using conservative guidelines were relatively low (all 2.6 or less). Also, all the maximum concentrations of these inorganics were much lower than the less conservative guidelines presented (e.g.,

ER-Ms). The AVS/SEM analysis suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, boron, cobalt, and vanadium were retained as COCs since no conservative sediment guidelines were available; no alternate guideline was available for barium, whose maximum exceeded the conservative guideline. Toxicity data for these inorganics are scarce, but they were concluded not to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene was the only organic in Zone 1 sediments that had a maximum in excess of its guideline. Its average concentration also exceeded the guideline. HQ values were relatively low for the maximum and average concentrations, 2.75 and 2.04, respectively. The maximum concentration of that organic was much lower than its ER-M.

Despite exceedances of guidelines by several COCs, no significant toxicity was observed in sediment toxicity tests from the NSB-NLON Phase II RI using two invertebrate species. A deployed ribbed mussel sample in Zone 1 from the NSB-NLON Phase II RI contained elevated concentrations of some organics relative to controls. The concentrations of those organics were comparable to or slightly higher than the ranges of those contaminants detected in shellfish from several studies in the literature.

Table 11-47 presents a weight of evidence summary of ecological analyses discussed above. The weight of evidence suggests that potential risks to sediment-dwelling organisms from contaminants in Zone 1 sediment are present but that those potential risks are relatively low.

11.7.2 Ecological Risk Assessment for Zone 2

11.7.2.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 2 are discussed in detail in Sections 5.1 through 5.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 2. The methods for guideline selection are

described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.2.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure included the NSB-NLON Phase II RI and Lower Subase RI data sets described in Section 3.5. The data set for Zone 2 included samples LS2SD001 and LS2SD002 from Lower Subase RI sampling and sample T3SD2 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data were available for LS2SD001 and LS2SD002. The maximum and average concentrations of analytes from these data were compared to guidelines in the risk calculation step, presented below.

In addition, macroinvertebrate community analyses were performed on sediment sample T3SD2 from the NSB-NLON Phase II RI sampling. Parameters measured and indices calculated included taxa richness, total number of individuals, Shannon-Weaver diversity index, species richness, observed vs. expected number of taxa, and Bray-Curtis similarity index. The results of these analyses are discussed below. An interpretation of surface water and sediment parameters, obtained during the Lower Subase RI, is also presented below.

Contaminant Screening

The maximum concentrations of the following inorganics in Zone 2 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: antimony, arsenic, barium, chromium, copper, iron, lead, mercury, selenium, and zinc (Table 11-48). Two organics, benzo(a)pyrene and phenol, had maximum concentrations in excess of their guidelines and were retained as maximum concentration COCs (Table 11-48).

The average concentrations of the following metals in Zone 2 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: antimony, arsenic, barium, copper, iron, lead, mercury, selenium, and zinc. Beryllium, cobalt, and vanadium were retained as ecological COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. Only two organics, benzo(a)pyrene and phenol, had average concentrations in excess of their guidelines (Table 11-49).

Both the maximum and average concentrations of AVS in Zone 2 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-50).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-51 presents less conservative guidelines for contaminants.

Inorganics

Three of the five AVS inorganics (copper, lead, and zinc) were detected at maximum concentrations that exceeded ER-Ls. Copper, lead, and zinc also had average concentrations that exceeded ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations of SEM, it is unlikely that copper, lead, and zinc are bioavailable and causing toxic effects in sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and conservative guideline, although the maximum concentration of this metal did not exceed the alternate guideline presented on Table 11-51 (an SEL). Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

Arsenic had a maximum concentration in excess of the ER-L and an average concentration slightly in excess of the ER-L (HQ = 1.52). However, the maximum concentration of arsenic (15.5 mg/kg) is much lower than the ER-M (70 mg/kg) and PEL (41.6 mg/kg) and is roughly one-half the SEL (33 mg/kg; Table 11-51).

The maximum concentration of chromium was almost identical to the ER-L. The average concentration of chromium was less than the ER-L. The maximum concentration of chromium (81.5 mg/kg) is much lower than the ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg) for that metal (Table 11-51).

Selenium was detected in two of three sediment samples at a maximum (1.1 mg/kg) in excess of its guideline. However, the background concentration is three times higher than the guideline, indicating that the guideline (i.e., a Washington State Department of Ecology value) may be overly conservative in this case. The maximum concentration is approximately two times the background concentration. No alternate guidelines were available for selenium. Additional background concentrations of selenium in

marine environments or toxic sediment concentrations of selenium were unavailable. Eisler notes that selenium is frequently found in lake sediments near smelters and in fly ash ponds at concentrations in excess of 5.0 mg/kg. Selenium is an essential nutrient but is harmful at higher concentrations (Eisler, 1985).

Mercury had maximum and average concentrations in excess of its ER-L, although its background concentration was greater than the ER-L as well. The maximum concentration of mercury (0.63) is slightly less than the ER-M (0.71 mg/kg), as shown in Table 11-51. The average concentration of mercury (0.49 mg/kg) was roughly halfway between the ER-L (0.15 mg/kg) and the ER-M (0.7 mg/kg). The ER-M and PEL are almost identical. The maximum concentration of mercury is an order of magnitude lower than the SEL (2.0 mg/kg).

No sediment guidelines were available for beryllium, boron, cobalt, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background. Barium was also not detected in background, and its maximum and average concentration exceeded its guideline, with HQs of 4.82 and 3.7, respectively. No less conservative alternate guidelines were available for barium. Antimony was detected in one of three samples at a concentration in excess of its ER-M, but no other alternate guidelines were available. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). None of these inorganics were concluded to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene and phenol were the only organics in Zone 2 sediments that had maximum concentrations in excess of guidelines. Phenol was detected in one of three samples at a maximum concentration equal to the guideline (HQ = 1.00). The guideline was calculated by dividing the acute AWQC by 100. This approach is probably conservative. Since the maximum concentration of phenol is equal to and does not exceed this conservative guideline, the presence in one sample of that concentration would suggest that the likelihood of potential risks is not great.

The maximum and average concentrations of benzo(a)pyrene slightly exceeded the EqP guideline. Maximum and average concentration HQ values for benzo(a)pyrene were relatively low, 2.21 and 1.82 for maximum and average, respectively. The maximum concentration of this organic in Zone 2 sediments (720 µg/kg) was lower than the ER-M (1,600 µg/kg) and slightly less than the PEL (763 µg/kg) as shown in Table 11-51. No SEL was available.

Historical Data and Analyses

As mentioned above, macroinvertebrate community analyses were performed on sediment sample T3SD2 from the NSB-NLON Phase II RI sampling. Parameters and indices measured and their results are as follows: taxa richness = 18, total number of individuals = 406.7, Shannon-Weaver diversity index = 1.282, species richness = 2.39, ratio of observed vs. expected number of taxa = 1.41, and the Bray-Curtis similarity index indicated similarity to four other samples. NSB-NLON benthic macroinvertebrate data are presented in Appendix J.

Taxa richness, or the total number of taxa per station, was 18 in T3SD2, compared to 55 in sample T5SD2, which was collected directly across the river. The total number of individuals was 406 in T3SD2, and T5SD2 contained 680 individuals. Yet, T3SD2 had more individuals than the upstream and downstream samples. T5SD2 also had a higher Shannon-Weaver diversity index than T5SD2, which is a reflection of the high number of taxa in that sample. The ratio of observed versus expected number of taxa for T3SD2 was relatively high. Bray-Curtis similarity index indicated similarity to four other samples collected throughout the Thames River. The NSB-NLON Phase II RI indicated a fairly high degree of similarity among sampling stations.

Although the sample collected directly across the river contains a higher diversity and abundance than the sample in Zone 2, Zone 2 macroinvertebrate parameters were, in general, similar to other samples collected in the Thames River and some were better than in upstream samples. Macroinvertebrate populations vary by season, natural surface water and sediment conditions, and microhabitat. Thus, conclusions regarding the results of macroinvertebrate analyses in T3SD2 cannot be easily made, especially with regard to toxicity from chemical contamination.

Surface Water and Sediment Physical Parameter Analyses

DO ranged from 7.58 to 7.68 mg/L in Zone 2 surficial samples and from 6.89 to 6.92 in water overlying sediments (Table 11-52). For pH, values for both surficial samples were 7.82. Values for pH ranged from 7.84 to 7.85 in water overlying sediments. Salinity ranged from 27.32 to 27.36 ppt in surficial samples and from 29.13 to 29.17 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 8.4 and 8.2, respectively. Maximum and average ammonia concentrations in those sediment samples were 150 and 124 mg/kg, respectively.

DO was slightly higher in surficial samples in Zone 2 than in deep samples, but all measurements were within the range normally associated with adequate DO for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 2 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 2 was 27.32 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 2.

Sediment samples LS2SD001 and LS2SD002 were composed of 95 and 91 percent fine-grained sediment particles (silts/clays), as shown in Table 11-53. The matrix spike/matrix spike duplicate for LS2SD002 contained 94 percent fine-grained particles. As discussed in Section 3.5 since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some metals. Sediments in depositional areas often contain higher percentages of finer particles than sediments in other areas. The sediment samples collected in Zone 2 appear to be from depositional areas and therefore probably provide a conservative estimate of sediment contamination. Also, finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 2 was 4.3 percent. Little guidance exists regarding the interpretation of TOC relative to bioavailability, but EPA suggests a conservative default value of 1 percent for calculation organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 2 value of 4.3 percent probably represents relatively high TOC.

11.7.2.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 3), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (T3SD2) was used for benthic macroinvertebrate analysis in Zone 2.

Several metals were detected in Zone 2 sediments (beryllium, boron, cobalt, and vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these metals precludes an evaluation of their presence in Zone 2 sediments.

Also, uncertainties are inherent in the Zone 2 surface water parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of those cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, arsenic, chromium, mercury, selenium, benzo(a)pyrene, and phenol in Zone 2 sediments.

11.7.2.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 2 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including antimony, arsenic, chromium, iron, selenium, and mercury, indicating that potential risks may be present. However, average concentrations of some of those metals were below conservative guidelines. The maximum concentration HQ values for those metals using conservative guidelines were relatively low (all 1.89 or less), with the exception of mercury (HQ = 4.2) and selenium (HQ = 11.0). Also, the maximum concentrations of arsenic and chromium were much less than the less conservative guidelines presented (e.g., ER-Ms). The maximum concentration of mercury was slightly less than the ER-M but much lower than the SEL. No alternate guidelines were available for selenium. The AVS/SEM analysis suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

The inorganics beryllium, boron, cobalt, and vanadium were retained as COCs since no conservative sediment guidelines were available. No alternate guideline was available for barium, whose maximum exceeded the conservative guideline. Toxicity data for those metals are scarce, but they were concluded not to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene and phenol were the only organics in Zone 2 sediments that had maximum concentrations in excess of guidelines. The average concentration of benzo(a)pyrene also exceeded the guideline. HQ values were relatively low for the maximum and average concentrations, 2.21 and 1.82, respectively. The maximum concentration of benzo(a)pyrene was much lower than its ER-M. Phenol was detected in one sample at a concentration equal to the guideline.

In general, the parameters from the macroinvertebrate sample collected in Zone 2 as part of the NSB-NLON Phase II RI were similar to upstream and downstream samples, but only limited interpretation can be conducted due to temporal fluctuations.

Table 11-54 presents a weight of evidence summary of the ecological analyses discussed above. The weight of evidence suggests that potential risks to sediment-dwelling organisms from contaminants in Zone 2 sediment are present but that those potential risks are relatively low.

11.7.3 Ecological Risk Assessment for Zone 3

11.7.3.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 3 are discussed in Sections 6.1 through 6.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 3. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.3.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure concentrations included the NSB-NLON Phase II RI and Lower Subase RI data sets described in Section 3.5. The data set for Zone 3 included samples LS3SD001 and LS3SD002 from Lower Subase RI sampling and samples T4SD2 and EC-T4SD2-02 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data were also available for the samples listed above, with the exception of T4SD2. The maximum and average concentrations of analytes from these data were compared to guidelines in the risk calculation step presented below.

In addition to chemical analyses, sediment from sample EC-T4SD2-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was also used for toxicity testing using the two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus*. Macroinvertebrate community analyses were performed on sediment sample T4SD2 from the NSB-NLON Phase II RI sampling.

Parameters and indices included taxa richness, total number of individuals, Shannon-Weaver diversity index, species richness, observed vs. expected number of taxa, and Bray-Curtis similarity index. The results of these analyses are discussed below. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

Contaminant Screening

The maximum concentrations of the following inorganics in Zone 3 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc (Table 11-55). Three organics, benzo(a)pyrene, 4-methylphenol, and phenol, had maximum concentrations in excess of their guidelines and were retained as maximum concentration COCs (Table 11-55).

The average concentrations of the following inorganics in Zone 3 sediments exceeded background concentrations and conservative guidelines and were retained as average concentration COCs: antimony, arsenic, barium, chromium, copper, iron, lead, mercury, nickel, selenium, and zinc. Boron, beryllium, cobalt, and vanadium were retained as COCs since their maximum and average concentrations exceeded background levels and no suitable sediment guidelines were available. Three organics, benzo(a)pyrene, 4-methylphenol, and phenol, had average concentrations in excess of their guidelines or no conservative guidelines were available (Table 11-56).

Both the maximum and average concentrations of AVS in Zone 3 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-57).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-58 presents less conservative guidelines for contaminants.

Inorganics

Each of the five AVS inorganics (cadmium, copper, nickel, lead, and zinc) were detected at maximum concentrations that exceeded ER-Ls. Of these inorganics, copper, lead, and zinc were present at average concentrations that also exceeded ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations

of SEM, it is unlikely that cadmium, copper, nickel, lead, and zinc are bioavailable and causing toxic effects to sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and conservative guideline, but its average concentration did not exceed the alternate guideline presented on Table 11-58 (an SEL). Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

The maximum and average concentrations of arsenic in Zone 3 sediments slightly exceeded the ER-L, with HQs of 2.26 and 1.78, respectively. The maximum (18.5 mg/kg) and average concentrations (14.6 mg/kg) of arsenic were much lower than the less conservative ER-M (70 mg/kg) and PEL (41.6 mg/kg), and were both approximately one-half the SEL (33 mg/kg), as shown in Table 11-58.

The maximum detected concentration of chromium (100 mg/kg) was slightly higher than the ER-L (HQ = 1.23), and the average concentration was also slightly higher than the ER-L (HQ = 1.04). The maximum concentration of chromium is substantially lower than the less conservative ER-M (370 mg/kg) and PEL (160 mg/kg) and slightly lower than the SEL (110 mg/kg), as shown in Table 11-58.

Selenium was detected in two of four sediment samples, and the maximum was in excess of its guideline. However, the background concentration is three times higher than the guideline, indicating that the guideline (i.e., a Washington State Department of Ecology value) may be overly conservative in this case. The maximum concentration is approximately three times the background concentration. No alternate guidelines were available for selenium. Background concentrations of selenium in marine environments or toxic sediment concentrations of selenium were also unavailable. Eisler notes that selenium is frequently found in lake sediments near smelters and in fly ash ponds at concentrations in excess of 5.0 mg/kg. Selenium is an essential nutrient but is harmful at higher concentrations (Eisler, 1985).

Silver was detected in three of four samples at a maximum concentration only slightly higher than the ER-L (HQ = 1.4), and its average concentration was less than the ER-L. Again, the ER-L is conservative for several reasons, and the maximum concentration (1.4 mg/kg) only slightly exceeds that value. The maximum concentration was approximately one-third the ER-M (3.7 mg/kg) and slightly lower than the PEL (1.77 mg/kg; Table 11-58). No SEL was available. Recent studies have indicated that silver may bind to AVS in a manner similar to copper (Mahony, 1997). Since the amount of AVS in Zone 3 sediments exceeded the amount of SEM, the silver in Zone 3 sediments could bind to AVS, reducing its bioavailability.

In addition, silver forms strong complexes with functional groups found on humic acids at pH ranging from 2 to 10 (Sujari and Bowen, 1986). Zone 3 sediments have pH values within this range (see below). Thus, humic acids in Thames River sediments could bind to silver present in sediments and reduce its bioavailability. Yet, the site-specific bioavailability of silver is not known.

Mercury had maximum and average concentrations in excess of the ER-L for that inorganic, although the background concentration of mercury was also greater than the ER-L. The maximum concentration of mercury (0.56 mg/kg) is slightly less than the ER-M (0.71 mg/kg), as shown in Table 11-58. The average concentration of mercury, 0.49 mg/kg, was roughly halfway between the ER-L and ER-M. The ER-M and PEL are almost identical. The maximum concentration of mercury is an order of magnitude lower than the SEL.

No sediment guidelines were available for beryllium, boron, cobalt, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background samples. Barium was also not detected in background, and its maximum and average concentration exceeded its guideline, with HQs of 4.00 and 3.48, respectively. Less conservative alternate guidelines were unavailable for barium. Antimony was detected in three of four samples at a maximum concentration in excess of its ER-M, but no other alternate guidelines were available. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Beryllium, boron, cobalt, and vanadium were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene, phenol, and 4-methylphenol were the only organics in Zone 3 sediments that had maximum concentrations in excess of guidelines or no guidelines were available. Maximum and average concentration HQ values for benzo(a)pyrene, using the EqP guideline, were 6.85 and 4.71 for maximum and average concentrations, respectively. The maximum (1,550 µg/kg) and average (1,305 µg/kg) concentrations were slightly lower than the ER-M (1,600 µg/kg) and were approximately two times the PEL (763 µg/kg), as shown in Table 11-58. No SEL was available for benzo(a)pyrene.

Phenol was detected in one of four samples at a maximum concentration approximately 2.5 times the guideline used. The guideline was calculated by dividing the acute AWQC by 100. This approach is probably conservative. Therefore, since the maximum concentration of phenol does not substantially

exceed this conservative guideline, the presence of it in one sample at that concentration indicates that the likelihood of potential risks from phenol is low.

The compound 4-methylphenol was detected in one of four samples, but since no water quality guideline was available, an EqP guideline could not be calculated. The detected concentration of this SVOC (68 µg/kg) was an order of magnitude less than the only guideline available, which was a Washington State Department of Ecology value (670 µg/kg), as shown in Table 11-58. Sediment toxicity data for 4-methylphenol are scarce.

Historical Data and Analyses

As mentioned above, sediment from sample EC-T4SD2-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing using two invertebrate species. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* was not significantly different than survival in reference sediments. Macroinvertebrate community analyses were performed on sediment sample T4SD2 from the NSB-NLON Phase II RI sampling. Parameters and indices measured in that sample and their results are as follows: taxa richness = 23, total number of individuals = 462, Shannon-Weaver diversity index = 1.54, species richness = 3.04, ratio of observed vs. expected number of taxa = 0.68, and the Bray-Curtis similarity index indicated similarity to seven other samples. NSB-NLON Phase II RI benthic invertebrate data are presented in Appendix J.

Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in EC-T4SD02-02 sediments was not significantly different than percent survival in reference sediments, suggesting that sediments in that sampling area are not toxic to benthic organisms.

Macroinvertebrate community analyses were performed on sediment sample T4SD2 from the NSB-NLON Phase II RI sampling. Taxa richness for this sample (23) was within the general range of that found in most other Thames River samples (18 to 55), as was the total number of individuals (462), which ranged from 178 to 1,242 in Thames River samples. The Shannon-Weaver diversity index of 1.54 was also well within the range of Thames River values (1.01 to 2.5). The ratio of observed vs. expected number of taxa (0.68) was generally lower than expected. The Bray-Curtis similarity index indicated similarity to seven other samples. The NSB-NLON Phase II RI indicated a fairly high degree of similarity among sampling stations.

Zone 3 macroinvertebrate parameters were, in general, similar to other samples collected in the Thames River and some were better than in upstream samples. Macroinvertebrate populations vary by season,

natural surface water and sediment conditions, and microhabitat. Thus, conclusions regarding the results of macroinvertebrate analyses in T3SD2 cannot be easily made, especially with regard to toxicity from chemical contamination. Since no significant toxicity was observed in the Zone 3 toxicity test sample, it does not appear that sediments are toxic to benthic macroinvertebrates.

Surface Water and Sediment Physical Parameter Analyses

DO ranges from 7.86 to 8.21 mg/L in Zone 3 surficial samples and from 6.9 to 7.0 in water overlying sediments (Table 11-59). For pH, values ranged from 7.74 to 7.82 in surficial samples and from 7.82 to 7.84 in water overlying sediments. Salinity ranged from 27.49 to 27.57 ppt in surficial samples and from 29.09 to 29.21 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 9.2 and 8.6, respectively. Maximum and average ammonia concentrations in those sediment samples were 140 and 76.8 mg/kg, respectively.

DO was slightly higher in surficial samples in Zone 3 than in deep samples, but all measurements were above the minimum for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 3 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 3 was 27.49 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 3.

Sediment samples LS3SD001 and LS3SD002 were composed of 95 and 84 percent fine-grained sediment particles (silts/clays), as shown in Table 11-60. Sample SDFD001, the duplicate for LS3SD002, had 86 percent fine-grained particles. As discussed in Section 3.5, since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some inorganics. Sediments in depositional areas often contain higher percentages of finer particles than sediments in other areas. The sediment samples collected in Zone 3 appear to be from depositional areas and therefore probably provide a conservative estimate of sediment contamination. Also, finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 3 was 3.67 percent. Little guidance exists regarding the interpretation of TOC relative to bioavailability, but EPA suggests a conservative default value of 1 percent for calculating organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 3 value of 3.67 percent probably represents relatively high TOC.

11.7.3.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 4), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-T4SD2-02) was used for toxicity testing and one sample was used for benthic macroinvertebrate analysis (T4SD2) from the NSB-NLON Phase II RI in Zone 3. Therefore, the limited sample size for these analyses precludes thorough determination of sediment toxicity and bioavailability.

Several contaminants were detected in Zone 3 sediments (4-methylphenol, beryllium, boron, cobalt, and vanadium) for which no sediment guidelines were available. As stated above, these compounds are not generally associated with ecotoxicity. Nonetheless, the general lack of toxicity data for these metals precludes a thorough toxicological evaluation of their presence in Zone 3 sediments.

Also, uncertainties are inherent in the Zone 3 surface water parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of those cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, antimony, arsenic, chromium, selenium, silver, mercury, benzo(a)pyrene, and phenol in Zone 3 sediments.

11.7.3.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 3 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including antimony, arsenic, iron, chromium, selenium, silver, and mercury, indicating that potential risks may be present. However, average concentrations of some of these inorganics were below conservative guidelines. The maximum concentration HQ values for those metals using conservative guidelines were relatively low (all 3.73 or less), with the exception of selenium (HQ = 11.0). Also, the maximum concentrations of arsenic, chromium, and silver were much lower than the less conservative guidelines presented (e.g., ER-Ms). The maximum concentration of mercury was slightly lower than the ER-M and much lower than the SEL. No alternate guidelines were available for selenium. The AVS/SEM analysis indicates that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, boron, cobalt, and vanadium were retained as COCs since conservative sediment guidelines were unavailable; no alternate guideline was available for barium, whose maximum exceeded the conservative guideline. Toxicity data for these inorganics are scarce, but they were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene and phenol were the only organics in Zone 3 sediments that had maximum concentrations in excess of guidelines. The average concentration of benzo(a)pyrene also exceeded the guideline. The maximum and average concentrations were slightly lower than benzo(a)pyrene's ER-M. Phenol was detected in one sample at a concentration slightly higher than the guideline.

In general, the parameters from the macroinvertebrate sample collected in Zone 3 as part of the Phase II RI were similar to upstream and downstream samples, but only limited interpretation can be conducted due to temporal fluctuations. No significant toxicity was observed in Zone 3 sediment toxicity tests from the NSB-NLON Phase II RI.

Table 11-61 presents a weight of evidence summary of the ecological analyses discussed above. The weight-of-evidence appears to indicate that potential risks to sediment-dwelling organisms from contaminants in Zone 3 sediment are present but that those potential risks are relatively low.

11.7.4 Ecological Risk Assessment for Zone 4

11.7.4.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 4 are discussed in Sections 7.1 through 7.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 4. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources.

When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.4.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure concentrations included the NSB-NLON Phase II RI/Lower Subase RI data sets described in Section 3.5. The data set for Zone 4 included samples LS4SD001, LS4SD002, and LS4SD003 from Lower Subase RI sampling and sample EC-STDR06-02 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data are also available for these samples. The maximum and average concentrations of analytes from these samples were compared to guidelines in the risk calculation step presented below.

A native blue mussel sample (MU5) was collected a few hundred feet south of Zone 4 as part of the NSB-NLON Phase II RI ERA. In addition to chemical analyses, sediment from sample EC-SDTR06-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was also used for toxicity testing using two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus*. The results of the toxicity tests and the native blue mussel sample are discussed below.

An NPDES-regulated storm water outfall is located near Building 85 (BLDG 85). NPDES monitoring data for this outfall are available for the 1994-1995, 1995-1996, and 1996-1997 sampling periods. Parameters measured during monitoring include several physical parameters and inorganics. Also, acute toxicity testing data from storm water monitoring are available for the water flea (*Daphia pulex*) for 1994-1995, 1995-1996, and 1996-1997 and the fathead minnow (*Pimephales promelas*) for 1994-1995. However, as mentioned in Section 3.5, emphasis was placed on interpretation of the amount of copper, lead, and zinc in the effluent since the focus of this ERA is on chemical contamination. Interpretation of storm water monitoring data from the Building 85 outfall is presented below. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

<u>Contaminant Screening</u>

The maximum concentrations of the following inorganics in Zone 4 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: arsenic, barium, chromium, copper, iron, lead, mercury, nickel, selenium, and zinc (Table 11-62). One organic, benzo(a)pyrene, had a maximum concentration in excess of its guideline and was retained as a maximum concentration COC (Table 11-62).

The average concentrations of the following inorganics in Zone 3 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: arsenic, barium, chromium, copper, iron, lead, mercury, nickel, selenium, and zinc. Boron, beryllium, cobalt, thallium, and vanadium were retained as COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. One organic, benzo(a)pyrene, had an average concentration in excess of its guideline (Table 11-63).

Both the maximum and average concentrations of AVS in Zone 4 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-64).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-65 presents less conservative guidelines for contaminants.

Inorganics

Four of the five AVS inorganics (copper, nickel, lead, and zinc) were detected at maximum concentrations that exceeded ER-Ls. Copper, lead, and zinc were present at average concentrations that also exceeded ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations of SEM, it is unlikely that copper, nickel, lead, and zinc are bioavailable and causing toxic effects to sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and conservative guideline; its average concentration did not exceed the alternate guideline presented on Table 11-65 (an SEL). Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

The maximum and average concentrations of arsenic in Zone 4 sediments slightly exceeded the ER-L, with HQs of 1.95 and 1.58, respectively. The maximum (16.0 mg/kg) and average (13.0 mg/kg) concentration of arsenic were much lower than the less conservative ER-M (70 mg/kg), PEL (41.6 mg/kg), and SEL (33 mg/kg), as shown in Table 11-65.

Selenium was detected in all three sediment samples at a maximum in excess of its guideline. However, the background concentration is three times higher than the guideline, indicating that the guideline (i.e., a

Washington State Department of Ecology value) may be overly conservative in this case. The maximum concentration (0.9 mg/kg) is approximately three times the background concentration. No alternate guidelines were available for selenium. Background concentrations of selenium in marine environments or toxic sediment concentrations of selenium are also unavailable. Eisler notes that selenium is frequently found in lake sediments near smelters and in fly ash ponds at concentrations in excess of 5.0 mg/kg. Selenium is an essential nutrient but is harmful at higher concentrations (Eisler, 1985).

Chromium was detected at maximum and average concentrations that exceeded the ER-L. HQ values for the maximum and average comparisons were 4.94 and 2.14, respectively. In addition, the maximum concentration (400 mg/kg) exceeded the less conservative ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg), as shown in Table 11-65. The average concentration (173.3 mg/kg) was roughly one-half the ER-M but slightly exceeded both the PEL and SEL. Eisler presents concentrations of chromium in marine sediments near a Rhode Island electroplating plant of 60 to 80 mg/kg and 80 to 3,000 mg/kg near a Maine tannery (Eisler, 1986). The maximum and average concentrations of chromium in Zone 4 sediments were higher than the former range of those two studies and in between the latter. However, chromium was not detected in the native mussel sample collected near Zone 4 (MU5).

Mercury was detected in three of four samples and had maximum and average concentrations in excess of its ER-L, although the background concentration of mercury was also greater than the ER-L. The maximum concentration of mercury (0.47 mg/kg) was less than the ER-M (Table 11-65). The average concentration of mercury, 0.38 mg/kg, was roughly halfway between the ER-L and ER-M. The maximum concentration of mercury was an order of magnitude lower than the SEL (2.0 mg/kg).

Sediment guidelines were unavailable for beryllium, boron, cobalt, thallium, and vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background. Barium was also not detected in background, and its maximum and average concentration exceeded its guideline, with HQs of 3.78 and 3.4, respectively. Less conservative alternate guidelines were unavailable for barium. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Beryllium, boron, cobalt, thallium, and vanadium were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene was the only organic in Zone 4 sediments that had a maximum concentration in excess of its guideline. HQ values for benzo(a)pyrene using the EqP guideline were 7.54 and 4.87, respectively.

The maximum concentration (1,900 µg/kg) slightly exceeded the ER-M (1,600 µg/kg) and was approximately 2.5 times the PEL (763 µg/kg), as shown in Table 11-65. No SEL was available.

Historical Data and Analyses

As mentioned above, sediment from sample EC-STDR06-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing of two invertebrate species. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* was not significantly different than in reference sediments, suggesting that sediments in this sampling area are not toxic to benthic organisms.

A native blue mussel sample (MU5) was collected a few hundred feet south of Zone 4 as part of the NSB-NLON Phase II RI ERA. The NSB-NLON Phase II RI concluded that low levels of some contaminants were present in this sample. These included some PAHs, with a maximum among all PAHs of 32 µg/kg for fluoranthene. Total PAHs in that sample were present at a concentration of 60 µg/kg. Two pesticides were detected in this sample, 16 µg/kg for 4,4'-DDE and 3.1 µg/kg for heptachlor. Several metals were detected in that sample. The most notable was the concentration of boron (70.9 mg/kg).

Boron was detected at 77.5 mg/kg in the blue mussel sample collected at the Nautilus Museum pilings (MU6), several hundred feet south of Zone 4. Boron was detected at 5.8 mg/kg in deployed mussel sample CMU2, which was deployed between MU5 and MU6. That concentration was similar to the concentrations present in control samples.

NOAA has compiled bivalve tissue contaminant data as part of its National Status and Trends Program for marine environmental quality (NOAA, 1995). NOAA collected seven different species of mollusks at 154 sampling sites throughout coastal areas of the United States from 1986 to 1993. Data for all species were pooled for individual years. NOAA points out that concentrations of organics were relatively similar between species, indicating that pooling of interspecies data was appropriate. From those data, the mean concentrations plus one standard deviation were designated as "high" concentrations for several contaminants and contaminant classes. However, these concentrations should be interpreted with caution because one standard deviation above the mean is not necessarily associated with effects. NOAA concedes that the "'highs serve as a basis for categorizing sites but ... are not always indicative of environmental contamination" and "there is no reason to suppose that such concentrations cause harm to marine organisms or to man" (NOAA, 1995).

The total concentration of PAHs in MU5 was 60 µg/kg. NOAA presents a "high" total PAH concentration of 255 µg/kg (wet weight). Eisler presents some ranges of total PAHs in bivalves as follows: 106 to 986 in

bay mussels (*Mytilus edulis*) near an industrialized area in Oregon, 127 µg/kg in edible portions of the sea scallop (*Placopectin magellanicus*) in New York Bight, 55 to 520 µg/kg in the soft parts of the American oyster (*Crassostrea virginica*) in the spring months in South Carolina residential areas, and 555 µg/kg in the softshell clam (*Mya arenaria*) in a contaminated Oregon site. Eisler also presents total PAHs up to 1,290 and 328 µg/kg in two species of crustacean, the rock crab (*Cancer irroratus*) and the American lobster (*Homarus americanus*), respectively, in Long Island Sound (Eisler, 1987b).

The "high" concentration for DDTR in bivalves as presented by NOAA is 30 µg/kg on a wet weight basis (NOAA, 1995). The concentration of 4,4-DDE in MU5 was much less than this concentration, and other DDTR compounds were not detected. The concentration of heptachlor in MU5 was within the range of that compound detected in MU1, MU2, and MU3, the mussel samples collected upstream of the base. Heptachlor in those samples ranged from 2.0 to 4.5 µg/kg.

The concentration of boron in MU5 (and in sample MU6) is difficult to interpret due to the lack of toxicity data and regional concentrations for that inorganic in mollusks. It was not detected in upstream blue mussel samples. Boron was elevated in Zone 4 sediments relative to background. Boron is widely distributed in the environment and can be naturally elevated in marine sediments (Eisler, 1990a). As stated above, the NSB-NLON Phase II RI ERA for the Thames River concluded that, given the limited information available with respect to boron's toxicity and based on the concentrations detected, aquatic biota were not at risk as a result of exposure to boron. Eisler presents boron concentrations in soft parts of two species of mussels in British Columbia ranging from 0.9 to 5.3 mg/kg (Eisler, 1990a). The boron concentrations in MU5 (70.9 mg/kg) and in MU6 (77.5 mg/kg) were much higher than this range. Juvenile Pacific oysters (*Crassostrea gigas*) accumulated boron in relation to availability and showed no prolonged retention of boron following cessation of exposure (Thompson et al., 1976).

PAHs were not detected in MU1, MU2, or MU3. Thus, PAHs detected in MU5 may be due to the Lower Subase. Yet, the total PAH concentration in MU5 was within or less than published ranges. Pesticide concentrations in MU5 also do not appear to be elevated. Benzo(a)pyrene, the only Zone 4 PAH that exceeded its conservative guideline, was not detected in MU5. Additionally, mercury, which was elevated relative to its ER-L in Zone 4 sediments, was not detected in MU5. Chromium, which had a maximum concentration in excess of its ER-M in Zone 4 sediments, was not detected in MU5. Boron was detected at high concentrations in MU5 and MU6. Boron's potential for toxicity to mollusks near the Lower Subase is unclear, but boron was concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA. For these reasons, potential risks to bivalves from PAHs in Zone 1 do not appear to be significant, even though some analytes were elevated in MU5 relative to controls.

Concentrations of copper, lead, and zinc in storm water BLDG 85 were 0.12, 0.083, and 0.12 mg/L in 1994/1995 samples, respectively. Concentrations of copper, lead, and zinc in 1995/1996 samples were 0.26, 0.17, 0.45 mg/L, respectively. Concentrations of copper, lead, and zinc were 0.01, 0.19, and 0.01 mg/L in 1996/1997 samples. NPDES standards for copper, lead, and zinc in that outfall, based on the most recent General Permit, are 0.1, 0.05, and 0.5 mg/L, respectively. Therefore, copper was elevated in 1994/1995 and 1995/1996, and lead was elevated in 1994/1995, 1995/1996, and 1996/1997 relative to NPDES standards. The maximum concentrations of these inorganics exceeded ER-Ls and background in NSB-NLON Phase II RI/Lower Subase RI samples and, therefore, could be contributing these inorganics to Zone 4 sediments. However, these are AVS inorganics. As discussed earlier, the maximum and average amount of AVS in NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 4 exceeded total SEM concentrations, indicating that these inorganics are not bioavailable.

Surface Water and Sediment Physical Parameter Analyses

DO ranged from 7.23 to 7.95 mg/L in Zone 4 surficial samples and from 6.8 to 6.99 in water overlying sediments (Table 11-66). For pH, values ranged from 7.6 to 7.81 in surficial samples and from 7.74 to 7.84 in water overlying sediments. Salinity ranged from 27.14 to 27.73 ppt in surficial samples and from 28.42 to 29.23 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 9.2 and 8.6, respectively. Maximum and average ammonia concentrations in those sediment samples were 140 and 76.8 mg/kg, respectively.

DO was slightly higher in surficial samples in Zone 4 than in deep samples, but all measurements were above the minimum for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 4 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 4 was 27.14 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 4.

Sediment sample LS4SD002 was composed of 94 percent fine-grained sediment particles (silts/clays), and samples LS4SD001 and LS4SD003 contained 35 and 62 percent, respectively, and therefore had larger percentages of coarse material (See Table 11-67). As discussed in Section 3.5, since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some metals. Sediments in depositional areas often contain higher percentages of finer particles than sediments in other areas. One of the sediment samples

collected in Zone 4 appears to be from a depositional area and therefore probably provides a conservative estimate of sediment contamination. The other two samples do not appear to have been collected in a depositional area, but results are inconclusive. Finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 4 was 3.33 percent. Guidance available regarding the interpretation of TOC relative to bioavailability is limited, but EPA suggests a conservative default value of 1 percent for calculating organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 4 value of 3.33 percent probably represents relatively high TOC.

11.7.4.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 4), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-STDR06-02) was used for toxicity testing and one blue mussel sample was collected (MU5) as part of the NSB-NLON Phase II RI in Zone 4.

Several metals were detected in Zone 4 sediments (beryllium, boron, cobalt, thallium, or vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these metals precludes an evaluation of their presence in Zone 4 sediments.

Also, uncertainties are inherent in the Zone 4 surface water parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality. Similarly, the storm water data are collected at only one time, providing only a snapshot of storm water characteristics.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of those cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, arsenic, selenium, and mercury in Zone 4 sediments.

Boron was detected in blue mussel samples MU5 and MU6 at what appear to be elevated concentrations. Data are scarce regarding the toxicological effects of boron on mollusks. Although boron was not concluded to be of ecological significance, uncertainties remain regarding its presence in these samples.

11.7.4.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 4 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including arsenic, iron, chromium, selenium, and mercury, indicating that potential risks may be present. The maximum concentration HQ values for these inorganics using conservative guidelines were relatively low (all 1.95 or less), with the exception of chromium (HQ = 4.94) and selenium (HQ = 9.0). Also, the maximum concentrations of arsenic and mercury were much lower than the less conservative guidelines presented (e.g., ER-Ms). No alternate guidelines were available for selenium. The AVS/SEM analysis suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, boron, cobalt, thallium, and vanadium were retained as COCs since conservative sediment guidelines were unavailable; no alternate guideline was available for barium, whose maximum exceeded the conservative guideline. Toxicity data for these inorganics are scarce, but they were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene was the only organic in Zone 4 sediments that had maximum concentrations in excess of guidelines. The average concentration of benzo(a)pyrene also exceeded the guideline. The maximum concentration slightly exceeded its ER-M.

Despite exceedances of guideline values by several COCs, no significant toxicity was observed in Zone 4 sediment toxicity tests from the NSB-NLON Phase II RI. Low concentrations of some PAHs were detected in a native blue mussel sample collected in Zone 4 as part of the NSB-NLON Phase II RI ERA. Chromium, mercury, and benzo(a)pyrene were not detected in that sample, indicating that they were probably not bioavailable. Boron was detected in the blue mussel sample from Zone 4 and in the blue mussel sample collected south of Zone 4 at concentrations greatly exceeding background and control concentrations. The toxicological significance is unclear due a lack to toxicity data for that metal. The NSB-NLON Phase II RI concluded that boron was not of ecological significance in the Thames River.

Table 11-68 presents a weight of evidence summary of the ecological analyses discussed above. The weight of evidence appears to indicate that potential risks to sediment-dwelling organisms from contaminants in Zone 4 sediment are present and that those potential risks are low to moderate.

11.7.5 Ecological Risk Assessment for Zone 5

11.7.5.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 5 are discussed in Sections 8.1 through 8.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 5. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.5.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure concentrations included the NSB-NLON Phase II RI and Lower Subase RI data described in Section 3.5. The data set for Zone 5 included samples LS5SD001, LS5SD002, LS5SD003, and LS5SD004 from Lower Subase RI sampling and samples EC-SDTR02-02 and T3SD3 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data were also available for the samples listed above, with the exception of sample T3SD3. The maximum and average concentrations of analytes from these samples were compared to guidelines during risk calculation, presented below.

In addition to chemical analyses, sediment from sample EC-SDTR02-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was also used for toxicity testing using two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus*. Macroinvertebrate community analyses were performed on sediment sample T3SD3 from the NSB-NLON Phase II RI sampling. Parameters and indices included taxa richness, total number of individuals, Shannon-Weaver diversity index, species richness, observed vs. expected number of taxa, and Bray-Curtis similarity index. The results of these analyses are discussed below.

Sediment samples were collected near Pier 33 for the SEAWOLF Homeporting Environmental Impact Statement (EIS) in 1991 and used for 10-day toxicity testing using the amphipod *Ampelisca abdita*. Twenty-eight day bioaccumulation tests for inorganics and PAHs with *Macoma nasuta* and *Nereis virens* were also performed. The EIS refers to the samples used for these analyses as "Pier 32 and 33" samples, but it is unclear from the text which specific samples were used. It is inferred that a composite of three samples collected north of Pier 33 was used for the bioassays and therefore those results will be discussed below for Zone 5.

An NPDES-regulated storm water outfall is located between Zones 5 and 6 near Building 295 (NOVA). NPDES monitoring data for this outfall are available for the 1992-1993, 1994-1995, 1995-1996, and 1996-1997 sampling periods. Parameters measured during monitoring include several physical parameters and inorganics. Also, acute toxicity testing data from storm water monitoring are available for the water flea (*Daphia pulex*) for 1995-1996 and 1996-1997. However, as mentioned in Section 3.5, emphasis was placed on interpretation of the amount of copper, lead, and zinc in the effluent since the focus of this ERA is on chemical contamination. Interpretation of storm water monitoring data from the Building 295 outfall is presented below. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

Contaminant Screening

The maximum concentrations of the following inorganics in Zone 5 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: antimony, arsenic, barium, chromium, copper, iron, lead, mercury, and zinc (Table 11-69). Only three organics, benzo(a)pyrene, 4-4'-DDD, and phenol, had maximum concentrations in excess of their guidelines and were retained as maximum concentration COCs (Table 11-69).

The average concentrations of the following inorganics in Zone 5 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: antimony, arsenic, barium, copper, iron, lead, and mercury. Boron, beryllium, cobalt, and vanadium were retained as COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. Only two organics, benzo(a)pyrene and phenol, had average concentrations in excess of their guidelines (Table 11-70).

Both the maximum and average concentrations of AVS in Zone 5 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-71).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-72 presents less conservative guidelines for contaminants.

Inorganics

Three of the five AVS inorganics (copper, lead, and zinc) were detected at maximum concentrations that exceeded background and ER-Ls. Lead and copper were present at average concentrations that also exceeded ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations of SEM, it is unlikely that copper, lead, and zinc are bioavailable and eliciting toxic effects to sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and slightly exceeded its conservative guideline (HQ = 1.62), but its average concentration did not exceed the background concentration. Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

The maximum and average concentrations of arsenic in Zone 5 sediments slightly exceeded the ER-L, with HQs of 1.84 and 1.11, respectively. The maximum (15.1 mg/kg) and average (9.1 mg/kg) concentrations of arsenic were much lower than the less conservative ER-M (70 mg/kg), PEL (41.6 mg/kg), and SEL (33 mg/kg), as shown in Table 11-72.

Chromium was detected at a maximum concentration that slightly exceeded the ER-L (HQ = 1.03). The average concentration of chromium did not exceed background or the ER-L. In addition, the maximum concentration (83.1 mg/kg) was much less than the ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg), as shown in Table 11-72.

Mercury was detected in five of six samples. The maximum and average concentrations were in excess of the ER-L for mercury, although the background concentration for mercury was also greater than the ER-L. The maximum concentration of mercury (0.43 mg/kg) was roughly halfway between the ER-L (0.15 mg/kg) and ER-M (0.71 mg/kg). The ER-M and PEL are almost identical. The maximum concentration of mercury is an order of magnitude lower than the SEL. The average concentration of mercury (0.25 mg/kg) slightly exceeded the ER-L (HQ = 1.63).

No significant differences between the test sediment survival of *Ampelisca abdita* and control/reference survival were present in sediment samples collected near Pier 33 for the SEAWOLF Homeporting EIS in 1991. Mercury also did not bioaccumulate in *Macoma* or *Nereis* tissue. Therefore, it does not appear that mercury is bioavailable in Zone 5 sediments.

No sediment guidelines were available for beryllium, boron, cobalt, thallium, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background. Barium was also not detected in background, and its maximum and average concentrations exceeded its guideline, with HQs of 3.47 and 2.18, respectively. Less conservative alternate guidelines were unavailable for barium. Antimony was detected at a maximum in excess of the ER-M, although the average did not exceed the ER-M. No PEL or SEL was available for antimony. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Beryllium, boron, cobalt, thallium, and vanadium were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene, phenol, and 4,4'-DDD were the only organics in Zone 5 sediments that had maximum concentrations in excess of guidelines. Maximum and average concentration HQ values for benzo(a)pyrene, using the EqP guideline, were 4.37 and 2.2 for maximum and average concentrations, respectively. The maximum concentration (870 µg/kg) was much less than the ER-M (1,600 µg/kg) and slightly exceeded the PEL (763 µg/kg) as shown in Table 11-72. No SEL was available for benzo(a)pyrene.

Phenol was detected in one of six samples at a maximum that slightly exceeded its conservative guideline (HQ = 1.73). Alternate guidelines were unavailable for phenol. The guideline was calculated by dividing the acute AWQC by 100. This approach is probably conservative. Since the maximum concentration of phenol does not substantially exceed this conservative guideline, the presence of this organic in one sample at that concentration indicates that the likelihood of potential risks from phenol is low.

The pesticide 4,4'-DDD was detected in two of three samples at a maximum concentration (28 µg/kg) that slightly exceeded its conservative EqP guideline (HQ = 1.17). The average concentration did not exceed the guideline. The maximum and average concentrations (12.1 µg/kg) of 4,4'-DDD exceeded the PEL (7.81 µg/kg) but were much less than the SEL (60 µg/kg).

The CAWQC for 4,4'-DDT was used in the calculation of the EqP guideline. The CAWQC for 4,4'-DDT (0.001 µg/L) is based on a final residue value for a wildlife feeding study. In order to base the EqP value on effects to aquatic species, alternative water quality guidelines would have to be used. For DDTR, a Secondary Chronic Value (SCV) is available from the Oak Ridge National Laboratory toxicity database (Sample et al., 1996). The SCV (0.04 µg/L) is a Tier II value that is calculated to be a conservative equivalent to a Final Chronic Value (FCV). If that value were to be used in the EqP calculation, the guideline would be an order of magnitude higher and the maximum detected concentration of 4,4'-DDD would no longer exceed the guideline.

Historical Data and Analyses

As mentioned above, sediment from sample EC-STDR02-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing using two invertebrate species. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* was not significantly different than reference sediments, suggesting that sediments are not toxic to benthic organisms.

Macroinvertebrate community analyses were performed on sediment sample T3SD3 from the NSB-NLON Phase II RI sampling. Taxa richness for this sample (24) was within the general range of that found in most other Thames river samples (18 to 55). The total number of individuals (923) was higher than in most Thames River samples, which ranged from 178 to 1,242. The Shannon-Weaver diversity index of 1.093 was in the lower range of Thames River values (1.01 to 2.5). The ratio of observed vs. expected number of taxa (0.53) was generally lower than expected. Bray-Curtis similarity index indicated similarity to three other samples collected from throughout the Thames River. The NSB-NLON Phase II RI indicated a fairly high degree of similarity among sampling stations.

Zone 5 macroinvertebrate parameters were, in general, similar to other samples collected in the Thames River and some were better than in upstream samples. Macroinvertebrate populations vary by season, natural surface water and sediment conditions, and microhabitat. Thus, conclusions regarding the results of macroinvertebrate analyses in T3SD3 cannot be easily made, especially with regard to toxicity from chemical contamination. Since no significant toxicity was observed in the Zone 5 toxicity test sample, it does not appear that sediments are toxic to benthic macroinvertebrates.

Sediment samples were collected near Pier 33 for the SEAWOLF Homeporting EIS in 1991 and used for 10-day toxicity testing using the amphipod *Ampelisca abdita*. Control survival was 86 percent, reference

survival was 88 percent, and test sediment survival was 76 percent. No significant differences between the test sediment survival and control/reference survival were present.

Twenty-eight-day toxicity/bioaccumulation tests for inorganics and PAHs with *Macoma nasuta* and *Nereis virens* were also performed with Pier 33 sediments in support of the SEAWOLF EIS. Survival for *Nereis virens* was 80, 98, and 98 percent for the control, reference, and test sediment samples, respectively. Therefore, survival was higher in the test sediment than in control/reference sediments. Survival for *Macoma nasuta* was 86.7, 89.6, and 71.2 percent for control, reference, and test sediments, respectively. Although toxicity to *Macoma nasuta* does not appear to be high, it was significantly lower than survival in control and reference sediments. The EIS states that these significant differences disappear if an outlier is removed, but neither specifies which data point constitutes the outlier, nor is it readily apparent. No significant bioaccumulation of inorganics or PAHs was detected in either *Macoma* or *Nereis*.

Concentrations of copper, lead, and zinc in storm water NOVA were 0.08, 0.02, and 0.21 mg/L in 1992/1993 samples, respectively. Concentrations of copper, lead, and zinc were 0.037, 0.042, and 0.13 mg/L respectively, for 1994/1995 samples. Concentrations of copper, lead, and zinc were 0.08, 0.08, and 0.38 mg/L for 1995/1996 samples, respectively. Concentrations of copper, lead, and zinc were 0.08, 0.08, and 0.47 mg/L, respectively, for samples collected in 1996-1997. NPDES standards for copper, lead, and zinc in that outfall, based on the most recent General Permit, are 0.1, 0.05, and 0.5 mg/L, respectively. Therefore, lead was elevated in 1995/1996 and 1996/1997. The maximum concentrations of this metal exceeded its ER-L and background in NSB-NLON Phase II RI/Lower Subase RI samples and therefore could be contributing lead to Zone 5 sediments. However, lead is an AVS metal. As discussed earlier, the maximum and average amount of AVS in NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 5 exceeded total SEM concentrations, indicating that lead was not bioavailable.

Surface Water and Sediment Physical Parameter Analyses

DO ranged from 8.42 to 8.72 mg/L in Zone 5 shallow surface water samples and from 7.27 to 7.53 in water overlying sediments (Table 11-73). For pH, values ranged from 7.78 to 7.82 in surficial samples and from 7.75 to 7.81 in water overlying sediments. Salinity ranged from 23.78 to 24.34 ppt in surficial samples and from 26.2 to 28.08 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 9.0 and 8.2, respectively. Maximum and average ammonia concentrations in those sediment samples were 110 and 30.9 mg/kg, respectively.

DO was slightly higher in shallow surface water samples in Zone 5 than in deep surface water samples, but all measurements were above the minimum for survival of most aquatic life of 4 mg/L. Therefore, DO

is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 5 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 5 was 23.78 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 5.

Sediment sample LS5SD002 was comprised of 95 percent fine-grained sediment particles (silts/clays), as shown in Table 11-74. Samples LS5SD001, LS5SD003, and LS5SD004 had larger percentages of coarse material, with 66, 10, and 11 percent fine-grained particles, respectively. As discussed in Section 3.5, since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some metals. Sediments in depositional areas often contain higher percentages of finer particles than sediments in other areas. One of the sediment samples collected in Zone 5 may be from depositional areas and therefore probably provides a conservative estimate of sediment contamination. It is unclear whether the other three samples were collected in depositional areas, but they do not appear to have been. Finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 5 was 2.63 percent. Guidance regarding the interpretation of TOC relative to bioavailability is limited, but EPA suggests a conservative default value of 1 percent for calculating organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 5 value of 2.63 percent probably represents a moderate amount of TOC.

11.7.5.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 6), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-SDTR02-02) was used for toxicity testing and one sample (T3SD3) was used for benthic macroinvertebrate analysis as part of the NSB-NLON Phase II RI in Zone 5.

Several inorganics were detected in Zone 5 sediments (beryllium, boron, cobalt, thallium, or vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these inorganics precludes an evaluation of their presence in Zone 5 sediments.

Also, uncertainties are inherent in the Zone 5 surface water physical parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide

only a "snapshot" of water quality. Similarly, the storm water data are collected at only one time, providing only a snapshot of storm water characteristics.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of those cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, arsenic, chromium, mercury, benzo(a)pyrene, phenol, and 4,4;-DDD in Zone 5 sediments.

11.7.5.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 5 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including antimony, arsenic, iron, chromium, and mercury, indicating that potential risks may be present. The average concentrations of some of those organics did not exceed conservative guidelines. The maximum concentration HQ values for these inorganics, using conservative guidelines, were relatively low (all 2.87 or less). Also, the maximum concentrations of arsenic, iron, chromium, and mercury were much lower than the less conservative guidelines presented (e.g., ER-Ms). No alternate guidelines were available for selenium. The maximum concentration of antimony exceeded the ER-M. The AVS/SEM suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, boron, cobalt, thallium, and vanadium were retained as COCs since conservative sediment guidelines were unavailable; no alternate guideline was available for barium, whose maximum exceeded the conservative guideline. Toxicity data for these inorganics are scarce, but they were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene, phenol, and 4,4'-DDD were the only organics in Zone 5 sediments that had maximum concentrations in excess of guidelines. The discharges from Streams 5 and 6, which convey surface water runoff from the Area A Downstream Site and empty into the Thames River adjacent to the DRMO and Zone 5 of the Lower Subase, respectively, are the probable sources of 4,4'-DDD contamination in the Thames River sediment. Remedial design efforts are currently in progress at Area A Downstream to eliminate pesticide contamination at the site. This site has proceeded through the feasibility study and Proposed Plan stages and a Record of Decision (ROD) has been signed. The average concentration of benzo(a)pyrene also exceeded the guideline. The maximum concentration of benzo(a)pyrene was much

less than its ER-M. Phenol was detected in one sample, at a concentration that slightly exceeded the guideline. The maximum concentration of 4,4'-DDD slightly exceeded its guideline.

Despite exceedances of guideline values by several COCs, no significant toxicity was observed in Zone 5 sediment toxicity tests from the NSB-NLON Phase II RI using two benthic invertebrate species. No significant toxicity was observed in SEAWOLF EIS toxicity testing with *Ampelisca* in Pier 33 sediments. No significant toxicity was observed using *Nereis* in SEAWOLF EIS toxicity tests; some significant toxicity was observed using *Macoma*. No significant bioaccumulation of inorganics or PAHs was observed in either *Nereis* or *Macoma*.

In general, the parameters from the macroinvertebrate sample collected in Zone 5 as part of the Phase II RI were similar to upstream and downstream samples, but limited interpretation can only be conducted due to temporal fluctuations.

Table 11-75 presents a weight of evidence summary of the ecological analyses discussed above. The weight of evidence suggests that potential risks to sediment-dwelling organisms from contaminants in Zone 5 sediment are present but that these potential risks are relatively low.

11.7.6 Ecological Risk Assessment for Zone 6

11.7.6.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 6 are discussed in Sections 9.1 through 9.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 6. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.6.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure included the NSB-NLON Phase II RI and Lower Subase RI data sets described in Section 3.5. The data set for Zone 6 included samples LS6SD001 and LS6SD002 from Lower Subase RI sampling and sample EC-SDTR03-02 from NSB-NLON Phase II RI sampling (Figure 11-2). AVS/SEM data were also available for the samples listed above. The maximum and average concentrations of analytes from these samples were compared to guidelines in the risk calculation step, presented below.

In addition to chemical analyses, sediment from sample EC-SDTR03-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing using two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus,* and AVS/SEM analysis. The results of these toxicity tests are discussed below. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

Contaminant Screening

The maximum concentrations of the following inorganics in Zone 6 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration COCs: antimony, arsenic, barium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc (Table 11-76). Only two organics, benzo(a)pyrene and phenol, had maximum concentrations in excess of their guidelines and were retained as maximum concentration COCs (Table 11-76).

The average concentrations of the following inorganics in Zone 3 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: arsenic, barium, copper, lead, mercury, and zinc. Boron, beryllium, cobalt, and vanadium were retained as COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. Only two organics, benzo(a)pyrene and phenol, had average concentrations in excess of their guidelines (Table 11-77).

Both the maximum and average concentrations of AVS in Zone 6 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-78).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with

sufficient risk to require additional study or remediation. Table 11-79 presents less conservative guidelines for contaminants.

Inorganics

Four of the five AVS inorganics (copper, nickel, lead, and zinc) were detected at maximum concentrations that exceeded background and ER-Ls. Copper, lead, and zinc were present at average concentrations that also exceeded background and ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations of SEM, it is unlikely that copper, nickel, lead, and zinc are bioavailable and causing toxic effects in sediment-dwelling organisms.

The maximum detected concentration of iron exceeded its background concentration and slightly exceeded its conservative guideline (HQ = 1.73), but its average concentration did not exceed the background concentration. Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

The maximum and average concentrations of arsenic in Zone 6 sediments exceeded the ER-L, with HQs of 2.02 and 1.35, respectively. The maximum (16.6 mg/kg) and average (11.1 mg/kg) concentrations of arsenic were much lower than the less conservative ER-M (70 mg/kg), PEL (41.6 mg/kg), and SEL (33 mg/kg), as shown in Table 11-79.

The maximum concentration of chromium (88.4 mg/kg) barely exceeded the ER-L (HQ = 1.09). The average concentration of chromium did not exceed background or the ER-L. In addition, the maximum concentration was much less than the ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg), as shown in Table 11-79.

Silver was detected at a maximum concentration that only slightly exceeded its ER-L (HQ = 1.4). Its average concentration was less than the ER-L. The maximum concentration of silver (1.4 mg/kg) was less than the ER-M (3.7 mg/kg) and PEL (1.77 mg/kg); no SEL was available (Table 11-79). Recent studies have indicated that silver may bind to AVS in a manner similar to copper (Mahony, 1997). Since the amount of AVS in Zone 6 sediments exceeded the amount of SEM, the silver in Zone 6 sediments could bind to AVS and reduce its bioavailability. In addition, silver forms strong complexes with functional groups found on humic acids at pH ranging from 2 to 10 (Sujari and Bowen, 1986). Zone 6 sediments had pH values within this range, as discussed in the physical parameters section below. Thus, humic acids in

Thames River sediments could bind up silver and reduce its bioavailability. The site-specific bioavailability of silver is not known.

Mercury was detected in two of three samples and had maximum and average concentrations in excess of the ER-L, although the background concentration of mercury was also greater than the ER-L. The maximum concentration of mercury (0.32 mg/kg) was roughly halfway between the ER-L (0.15 mg/kg) and ER-M (0.71 mg/kg). The ER-M and PEL are almost identical. The maximum concentration of mercury is much lower than the SEL (2.0 mg/kg). The average concentration of mercury (0.2 mg/kg) slightly exceeded the ER-L (HQ = 1.31).

No sediment guidelines were available for beryllium, boron, cobalt, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background. Barium was also not detected in background, and its maximum and average concentrations exceeded its guidelines, with HQs of 3.24 and 2.1, respectively. Less conservative alternate guidelines were unavailable for barium. Antimony was detected at a maximum in excess of the ER-L (HQ = 1.15), although the average did not exceed the ER-L. No PEL or SEL was available for antimony. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Beryllium, boron, cobalt, and vanadium were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. However, without adequate sediment toxicity guidelines, the potential risks from these inorganics cannot be fully assessed.

Organics

Benzo(a)pyrene and phenol were the only organics in Zone 6 sediments that had maximum concentrations in excess of guidelines. Maximum and average HQ values for benzo(a)pyrene using the EqP guideline were 3.63 and 2.76, respectively. The maximum concentration (750 µg/kg) was less than the ER-M (1,600) and slightly less than the PEL (763 µg/kg), as shown in Table 11-79. No SEL was available for benzo(a)pyrene.

Phenol was detected in one of three samples at a maximum that slightly exceeded its conservative guideline (HQ = 1.67). Alternate guidelines were unavailable for phenol. The guideline was calculated by dividing the acute AWQC by 100, a conservative approach since the maximum concentration of phenol only slightly exceeds this conservative guideline. The presence of this organic in one sample at that concentration indicates that the likelihood of potential risks from that organic is low.

Historical Data and Analyses

As mentioned above, sediment from sample EC-STDR03-02 from the NSB-NLON Phase II RI Supplement Ecological Investigation was used for toxicity testing of two invertebrate species. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* was not significantly different than reference sediments, suggesting that sediments in this sampling area are not toxic to benthic organisms.

Surface Water and Sediment Physical Parameter Analyses

DO ranged from 8.80 to 8.84 mg/L in Zone 6 shallow surface water samples and from 7.52 to 8.0 in water overlying sediments (Table 11-80). For pH, values ranged from 7.61 to 7.87 in surficial samples and from 7.68 to 7.84 in water overlying sediments. Salinity ranged from 23.76 to 25.09 ppt in surficial samples and from 26.23 to 28.14 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 8.2 and 8.1, respectively. Ammonia was not detected in these samples.

DO was slightly higher in shallow surface water samples in Zone 6 than in deep surface water samples, but all measurements were above the range minimum for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 6 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 6 was 23.76 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 6.

Sediment sample LS6SD001 was composed of 94 percent fine-grained sediment particles (silts/clays), as shown in Table 11-81. Sample LS6SD002 had larger percentages of coarse material, with seven percent fine-grained particles. As discussed in Section 3.5, since finer-grained sediments contain more binding sites, they can potentially contain higher concentrations of contaminants and can reduce the bioavailability of organics and some inorganics. Sediments in depositional areas often contain higher percentages of finer particles than sediments in other areas. One of the sediment samples collected in Zone 5 may be from depositional areas and therefore probably provides a conservative estimate of sediment contamination. It is unclear whether the other sample was collected in a depositional area. Finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 6 was 2.73 percent. Guidance regarding the interpretation of TOC relative to bioavailability is limited, but EPA suggests a conservative default value of 1 percent for calculating organic

sediment guidelines when site-specific TOC is not known. As a result, the Zone 6 value of 2.73 percent probably represents a moderate amount of TOC.

11.7.6.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 3), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-STDR03-02) was used for toxicity testing as part of the NSB-NLON Phase II RI in Zone 6. Thus, the limited sample size for these analyses precludes thorough determination of sediment toxicity and bioavailability.

Several inorganics were detected in Zone 6 sediments (beryllium, boron, cobalt, or vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these inorganics precludes an evaluation of their presence in Zone 6 sediments.

Uncertainties are also inherent in the Zone 6 surface water physical parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of these cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, arsenic, chromium, silver, mercury, and benzo(a)pyrene in Zone 6 sediments.

11.7.6.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 6 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including antimony, arsenic, iron, chromium, silver, and mercury, indicating that potential risks may be present. The average concentrations of some of these inorganics did not exceed conservative guidelines. The maximum concentration HQ values for these inorganics, using conservative guidelines, were relatively low (all 2.13 or less). The maximum concentrations of arsenic, iron, chromium, silver, and mercury were much lower than the less conservative guidelines presented (e.g., ER-Ms). No alternate guidelines were available for selenium. The AVS/SEM analysis suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, boron, cobalt, and vanadium were retained as COCs since conservative sediment guidelines were unavailable. No alternate guideline was available for barium, for which the maximum detected concentration exceeded the conservative guideline. Toxicity data for these inorganics, plus antimony, are scarce, but they were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene and phenol were the only organics in Zone 6 sediments that had maximum concentrations in excess of guidelines. The average concentration of benzo(a)pyrene also exceeded the guideline. The maximum concentration of that organic was much less than its ER-M. Phenol was detected in one sample at a concentration that slightly exceeded the guideline.

Despite exceedances of guideline values by several COCs, no significant toxicity was observed in Zone 6 sediment toxicity tests from the NSB-NLON Phase II RI using two benthic invertebrate species.

Table 11-82 presents a weight of evidence summary of the ecological analyses discussed above. The weight of evidence appears to indicate that potential risks to sediment-dwelling organisms from contaminants in Zone 6 sediment are present but that these potential risks are relatively low.

11.7.7 Ecological Risk Assessment for Zone 7

11.7.7.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. Contaminant sources and release mechanisms for Zone 7 are discussed in detail in Sections 10.1 through 10.3. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI.

For the ecological effects evaluation, conservative screening guidelines (i.e., concentrations of contaminants protective of ecological receptors) were compared to exposure point concentrations of detected analytes in sediment to determine COCs in Zone 7. The methods for guideline selection are described in Section 3.5. Briefly, ER-L values were used for inorganics and site-specific guidelines were calculated for organics using EqP. When either ER-L values or sufficient information were not available to calculate site-specific guidelines, surrogate values were gathered from several widely accepted sources. When those conservative guidelines were exceeded, less conservative guidelines from several sources were presented, including ER-Ms, FDEP PELs, EPA SQBs, and MOE SELs (Jones et al., 1996).

11.7.7.2 Preliminary Exposure Estimate and Risk Calculation

The data used to obtain sediment exposure concentrations included the NSB-NLON Phase II RI and Lower Subase RI data described in Section 3.5. The data set for Zone 7 included samples LS7SD001, LS7SD002, and LS7SD003 from Lower Subase RI sampling (Figure 11-6). NSB-NLON Phase II RI sediment data were unavailable since the one NSB-NLON Phase II RI sediment sampling location has since been dredged. AVS/SEM data were also available for the samples listed above. The maximum and average concentrations of analytes from these samples were compared to guidelines in the risk calculation step, presented below.

A native mussel sample (MU4) was deployed near Pier 15 as part of the NSB-NLON Phase II RI ERA. In addition to chemical analyses, sediment from sample EC-STDR04-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing using two estuarine invertebrate species, *Ampelisca abdita* and *Leptocheirus plumulosus*. However, sample location EC-SDTR04-02 has been since been dredged as part of Navy dredging activities. It is unclear whether location MU4 has been subsequently dredged. Data from these samples are discussed below.

Several ecological analyses were performed on sediments around Piers 15 and 17 as part of the Pier 17 replacement EA (Maguire, 1994). The upper 3 feet of material from samples collected on the northern and southern sides of Pier 17 were composited, and the upper 3 feet of material from samples collected on the southern side of Pier 15 were composited. Ten-day toxicity tests were conducted using *Ampelisca abdita* on these two composites. Twenty-eight-day bioassay/bioaccumulation tests were conducted on these sediments using *Macoma nasuta* (a bivalve) and *Nereis virens* (a polychaete). Benthic macroinvertebrate surveys were also conducted and benthic community analyses were conducted on sediments collected from near Piers 15 and 17. The results of these analyses are summarized in the risk calculation discussion, presented below. However, summaries of the analyses are presented for informational purposes only since most of the Pier 17 EA sediment sampling locations have been subsequently dredged. Therefore, the use of the Pier 17 EA ecological analyses for assessing the current potential risks to sediment-dwelling organisms is limited. An interpretation of surface water and sediment physical parameters, obtained during the Lower Subase RI, is also presented below.

<u>Contaminant Screening</u>

The maximum concentrations of the following inorganics in Zone 7 sediment exceeded background concentrations and conservative guidelines and were, therefore, retained as maximum concentration

COCs: arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc (Table 11-83). Only one organic, benzo(a)pyrene, had a maximum concentration in excess of its guideline and was retained as a maximum concentration COC (Table 11-83).

The average concentrations of the following inorganics in Zone 7 sediments exceeded background concentrations and conservative guidelines and were, therefore, retained as average concentration COCs: arsenic, barium, cadmium, copper, iron, lead, mercury, and zinc. Beryllium, cobalt, and vanadium were retained as COCs since their maximum and average concentrations exceeded background and no suitable sediment guidelines were available. Only one organic, benzo(a)pyrene, had an average concentration in excess of its guideline (Table 11-84).

Both the maximum and average concentrations of AVS in Zone 7 sediments exceeded the maximum and average concentrations of SEM, respectively (Table 11-85).

The following is a discussion of these exceedances in light of other risk characterization concerns and uncertainties. The discussion was undertaken to separate COCs with low potential risk from COCs with sufficient risk to require additional study or remediation. Table 11-86 presents less conservative guidelines for contaminants.

Inorganics

The five AVS inorganics (cadmium, copper, nickel, lead, and zinc) were detected at maximum concentrations that exceeded background and ER-Ls. These five inorganics were present at average concentrations that also exceeded background and ER-Ls. Since both the maximum and average concentrations of AVS in NSB-NLON Phase II RI/Lower Subase RI samples exceeded the maximum and average concentrations of SEM, it is unlikely that cadmium, copper, nickel, lead, and zinc are bioavailable and eliciting toxic effects to sediment-dwelling organisms.

The maximum and average detected concentrations of iron exceeded iron's background concentration and slightly exceeded its conservative guideline, with HQs of 1.62 and 1.49, respectively. Iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability.

The maximum and average concentrations of arsenic in Zone 7 sediments exceeded the ER-L, with HQs of 2.00 and 1.75, respectively. The maximum (16.4 mg/kg) and average (14.3 mg/kg) concentrations of

arsenic were much lower than the less conservative ER-M (70 mg/kg), PEL (41.6 mg/kg), and SEL (33 mg/kg), as shown in Table 11-86.

Chromium was detected at a maximum that slightly exceeded the ER-L (HQ = 1.04). The ER-L is conservative for several reasons and the maximum concentration only slightly exceeds that value. The average concentration of chromium (74.2 mg/kg) did not exceed the ER-L. In addition, the maximum concentration (84.6 mg/kg) was much less than the ER-M (370 mg/kg), PEL (160 mg/kg), and SEL (110 mg/kg), as shown in Table 11-86.

Mercury was detected in all three samples and had maximum and average concentrations in excess of its ER-L, although the background concentration of mercury was also greater than the ER-L. The maximum concentration of mercury (0.52 mg/kg) was less than the ER-M (0.71 mg/kg) and the average concentration (0.4 mg/kg) was roughly halfway between the ER-L and ER-M. The ER-M and PEL are almost identical. The maximum concentration of mercury is much lower than the SEL (2.0 mg/kg).

No sediment guidelines were available for beryllium, cobalt, or vanadium, making interpretation of their concentrations difficult. None of these inorganics were detected in background samples. Barium was also not detected in background samples and its maximum and average concentrations exceeded its guideline, with HQs of 2.89 and 2.7, respectively. Less conservative alternate guidelines were unavailable for barium. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Beryllium, cobalt, and vanadium were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Organics

Benzo(a)pyrene was the only organic in Zone 7 sediments that had a maximum concentration in excess of its guideline. Maximum and average HQ values for benzo(a)pyrene, using the conservative EqP guideline, were relatively low, 1.39 and 1.11 for maximum and average concentrations, respectively. The maximum concentration (630 µg/kg; Table 11-83) was an order of magnitude less than the ER-M (1,600 µg/kg) and slightly less than the PEL (763 µg/kg; Table 11-86). No SEL was available for benzo(a)pyrene.

Historical Data and Analyses

A native mussel sample (MU4) was collected near Pier 15 as part of the NSB-NLON Phase II RI ERA. SVOCs were not detected in the sample. The NSB-NLON Phase II RI noted that only relatively low

concentrations of some inorganics were detected in the sample (mercury was not detected), as well as relatively low concentrations of some pesticides. The maximum among all detected pesticides was 13.0 µg/kg for gamma-chlordane. Chlordane was not analyzed in Zone 7 sediments due to its general absence in historical sediment samples in that zone. It was analyzed in Zone 5 sediments but was not detected. NOAA presents a "high" concentration of chlordane in mollusks of 7.75 µg/kg (wet weight). An upstream sample (MU3) contained 2.5 µg/kg for chlordane. Eisler presents concentrations of chlordane in bivalves around the world, but very few for the United States. Eisler presents a range of concentrations in soft parts of 1.6 to 58 and 1.4 to 23 µg/kg for cis- and trans-chlordane, respectively, from oysters in Hawaii (Eisler, 1990b). The concentration of chlordane in MU4 does not appear to be significantly elevated relative to the concentrations presented above. Data for sample MU4 are presented in Appendix H.

Sediment from sample EC-STDR04-02 from the NSB-NLON Phase II RI Supplemental Ecological Investigation was used for toxicity testing using invertebrate species, but that sampling location has subsequently been dredged. Survival of *Leptocheirus plumulosus* was not significantly different than reference sediments, but survival of *Ampelisca* was significantly lower than reference sediment.

Several ecological analyses were performed on sediments around Piers 15 and 17 as part of the Pier 17 replacement EA (Maguire, 1994). For *Ampelisca* toxicity tests, control and reference sediment survival were 93 and 94 percent, respectively. Survival for Pier 15 and Pier 17 sediments were 76 and 84 percent, respectively. Survival in test sediments was not significantly different from control/reference sediment survival. This indicates that Zone 7 sediments, in general, do not appear to be toxic to benthic invertebrates although the data are not completely definitive.

In the Pier 15 and Pier 17 bioaccumulation tests conducted as part of the EA, some PAHs biaccumulated significantly in the tissues of *Macoma* and *Nereis* relative to reference sediments. The maximum concentration among all PAHs detected in *Nereis* samples was 140 µg/kg for acenapthylene. The maximum concentration among all PAHs detected in *Macoma* samples was 810 µg/kg, also for acenapthylene. PCBs bioaccumulated significantly in *Nereis* but not in *Macoma*. The maximum total PCB concentration detected among all *Nereis* test sediment samples was 110 µg/kg. No statistically significant bioaccumulation of inorganics occurred in either test species.

The results of the Pier 17 EA benthic surveys indicated that the samples collected near Pier 17 had low species diversity and abundance. In contrast, the Pier 15 samples had relatively high species diversity and abundance. The EA suggests that the Pier 17 benthos is disturbed and/or subject to environmental stress. Sediment samples collected for this study near Pier 17 contained higher concentrations of PAHs and some inorganics than sediments near Pier 15.

Since the Pier 15 and 17 area has been dredged, exhaustive interpretation of the biaccumulation tests and benthic analyses was not conducted for this ERA. Only a reduction in toxicity (or in this case bioaccumulation) would be expected since the sediments were replaced with "clean" sediments, although this cannot be confirmed without additional testing. Moreover, the results of those tests using the clam (*Macoma*) differ from the results of the native and caged mussel studies in the Lower Subase. Although species-specific differences in bioaccumulation are expected and Zone 7 concentrations were different than those in other zones, the bioassay accumulation of PAHs [in particular benzo(a)pyrene] and PCBs was much higher than the concentrations measured in native and caged mussel samples from the Lower Subase. As noted above, no SVOCs were detected in the native blue mussel sample MU4 collected in Zone 7. This may be because the laboratory bivalves did not have time to metabolize or excrete these compounds or did not have the adaptive capacity to do so. As stated in the NSB-NLON Phase II RI ERA, the rates at which contaminants are taken up by aquatic invertebrates depends greatly on external physiochemical factors and are generally beyond the short-term physiological control of the organisms (Rainbow, 1996).

Surface Water and Sediment Physical Parameter Analyses

DO ranged from 8.79 to 10.12 mg/L in Zone 7 shallow surface water samples and from 7.27 to 7.96 in water overlying sediments (Table 11-87). For pH, values ranged from 7.88 to 7.89 in surficial samples and from 7.84 to 7.85 in water overlying sediments. Salinity ranged from 25.58 to 26.58 ppt in surficial samples and from 28.01 to 29.0 ppt in water overlying sediments. Maximum and average pH values in Lower Subase RI sediments were 8.1 and 8.0, respectively. Maximum and average ammonia concentrations in those sediment samples were 150 and 77 mg/kg, respectively.

DO was slightly higher in shallow surface water samples in Zone 7 than in deep samples, but all measurements were above the minimum for survival of most aquatic life of 4 mg/L. Therefore, DO is present at the water/sediment interface that could oxidize AVS. Nonetheless, the results of the AVS/SEM analysis indicate that the amount of AVS in Zone 7 samples exceeded the amount of SEM. In addition, pH measurements in surface water were within ranges normally associated with estuarine systems in the Northeastern United States. As defined in 40 CFR 131, saltwater guidelines are applicable for water bodies with salinity values greater than 10 ppt. The lowest salinity value measured in Zone 7 was 25.58 ppt, indicating that the use of estuarine sediment guidelines was appropriate for Zone 7.

Sediment samples LS7SD001, LS7SD002, and LS7SD003 were composed of 95, 90, and 90 percent fine-grained sediment particles (silts/clays) as shown in Table 11-88. As discussed in Section 3.5, since finer-

grained sediments contain more binding sites, they can potentially contains higher concentrations of contaminants and can reduce the bioavailabilily of organics and some inorganics. Sediment in depositional areas often contains higher percentages of finer particles than sediments in other areas. As a result, the sediment samples collected in Zone 7 may be from depositional areas and therefore probably provide a conservative estimate of sediment contamination. Finer grain size is correlated with increasing TOC. Average TOC for NSB-NLON Phase II RI/Lower Subase RI sediment samples in Zone 7 was 6.0 percent. Guidance regarding the interpretation of TOC relative to bioavailability is limited, but EPA suggests a conservative default value of 1 percent for calculating organic sediment guidelines when site-specific TOC is not known. As a result, the Zone 7 value of 6.0 percent probably represents relatively high TOC.

11.7.7.3 Site-Specific Uncertainties

The sample size for sediment chemistry was relatively low (n = 3), reducing confidence in the use of the average concentration as a representative exposure concentration. In addition, only one sediment sample (EC-STDR04-02) was used for toxicity testing and one blue mussel sample was collected (MU4) as part of the NSB-NLON Phase II RI in Zone 7. Thus, the limited sample size for these analyses precludes thorough determination of sediment toxicity and bioavailability.

Several inorganics were detected in Zone 7 sediments (beryllium, cobalt, or vanadium) for which no sediment guidelines were available. The general lack of toxicity data for these metals precludes an evaluation of their presence in Zone 7 sediments.

Also, uncertainties are inherent in the Zone 7 surface water physical parameter data. As discussed above, these parameters vary as a result of several influences (e.g., tides, rainfall). Thus, they provide only a "snapshot" of water quality.

Several of the detected analytes had maximum concentrations in excess of conservative guidelines, such as ER-Ls. In most of these cases, the maximum concentration was between the conservative guideline and a less conservative guideline (e.g., ER-M). Since potential toxicity at concentrations in the range between the two guidelines cannot be fully defined, only qualitative statements about the potential risks can be made. Other factors were assessed to further evaluate potential risks, but uncertainties remain. This was the case for iron, arsenic, chromium, mercury, and benzo(a)pyrene in Zone 7 sediments.

Several ecological analyses were conducted as part of the Pier 17 EA, including sediment toxicity tests and bioaccumulation studies. The Pier 15 and Pier 17 area was subsequently dredged as part of Navy

activities and only a reduction in toxicity or bioaccumulation would be expected since the sediments were replaced with "clean" sediments. This cannot be confirmed without additional testing.

Furthermore, the results of these tests using a clam (*Macoma*) differ from the results of the native and caged mussel studies in the Lower Subase. Several contaminants accumulated in *Macoma* were not detected in caged mussels or native mussels. Specifically, benzo(a)pyrene, which is generally considered to be the most toxic of the PAHs, was detected in *Macoma* but was not detected in any of the caged or native mussels, native oysters, or native clams collected in the Thames River. These differences may be due to species-specific differences in physiology or site-specific concentrations, but uncertainties remain regarding its uptake and retention by *Macoma* as it relates to zone-specific toxicity.

11.7.7.4 Conclusions

Maximum concentrations of several non-AVS inorganics in Zone 7 sediments near the Lower Subase exceeded conservative guidelines (e.g., ER-Ls), including arsenic, iron, chromium, and mercury, indicating that potential risks may be present. The average concentrations of some of these inorganics did not exceed conservative guidelines. The maximum concentration HQ values for these inorganics, using conservative guidelines, were relatively low (all 3.47 or less). Also, the maximum concentrations of arsenic, iron, chromium, silver, and mercury were much lower than the less conservative guidelines presented (e.g., ER-Ms). No alternate guidelines were available for selenium. The AVS/SEM analysis suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable.

Beryllium, cobalt, and vanadium were retained as COCs since no conservative sediment guidelines were available; no alternate guideline was available for barium, for which the maximum detected concentration exceeded the conservative guideline. Toxicity data for these inorganics are scarce, but they were concluded to not be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Benzo(a)pyrene was the only organic in Zone 7 sediments that had maximum and average concentrations in excess of guidelines. HQ values were low, 1.39 for the maximum concentration and 1.11 for the average concentration. The maximum concentration of benzo(a)pyrene was much less than its ER-M.

Significant toxicity was not observed in Zone 7 sediment toxicity tests from the NSB-NLON Phase II RI using *Leptocheirus*. Survival of *Ampelisca* was significantly lower than survival in reference sediments. Significant mortality was not observed in Pier 17 EA toxicity tests with *Ampelisca*. The Pier 17 EA benthic community analyses concluded that the Pier 15 benthic community was relatively healthy, and the Pier 17 benthic community appeared to be disturbed.

Significant bioaccumulation of some PAHs were observed Pier 17 EA bioaccumulation studies with *Macoma* and *Nereis*. Some bioaccumulation of PCBs was noted in *Nereis* but not in *Macoma*. Significant bioaccumulation of inorganics was not observed in either species. Low concentrations of some inorganics and pesticides were detected in a blue mussel sample collected in Zone 7.

Table 11-89 presents a weight of evidence summary of the ecological analyses discussed above. The weight of evidence appears to be equivocal, suggesting significant potential risks to sediment-dwelling organisms from contaminants in Zone 7 near Pier 17 but not near Pier 15. However, most of the Pier 15 and Pier 17 sediments have been subsequently dredged making interpretation of biological analyses from historical studies difficult. Sediments were replaced with "clean" fill after dredging, which may have ameliorated some of the potential risks. The NSB-NLON Phase II RI suggested that potential risk in the Lower Subase were confined to the Piers 15 and 17 area.

11.7.8 Ecological Risk Assessment for the Thames River

11.7.8.1 Preliminary Problem Formulation and Ecological Effects Evaluation

Preliminary problem formulation includes a discussion of available habitats, ecological receptors, contaminant sources, release mechanisms, migration pathways, exposure routes, analytes to be assessed, assessment and measurement endpoints, and the conceptual site model. The remaining elements of the ERA, as presented in Section 3.5, do not differ among the seven zones investigated in this RI and the Thames River in the stretch of the Thames River slightly upstream, adjacent to, and slightly downstream of NSB-NLON. In addition, a detailed description of the Thames River ecology is presented in Section 1.3.8. Contaminant sources and release mechanisms for the Thames River as a whole are discussed in detail in Sections 11.1 through 11.3.

Unlike Sections 11.7.1 through 11.7.7, which present quantitative assessments for each zone, this Thames River assessment is primarily qualitative (as mentioned in Section 3.5) for reasons that will be discussed in detail below. Briefly, the purpose of this section is twofold: first, to evaluate the overall potential risks to ecological receptors in the Lower Subase area of the Thames River as a whole (i.e, among all zones); and secondly, to compare ecological data from the Lower Subase area of the Thames River to data from other portions of the river to obtain a broader perspective of the potential risks from the Lower Subase.

For the ecological effects evaluation, this section evaluates the Thames River as a whole and incorporates data from other sources that were not used in the zone-specific assessments. Results of the zone-specific assessments were integrated with these data.

A large portion of the data not used in the zone-specific assessments were obtained from samples collected in several other sections of the Thames River, and some of the data are older and unvalidated. As such, it was not appropriate to make quantitative comparisons of concentrations to guidelines. Therefore, the conservative guidelines for inorganics that were used to identify COCs among all seven zones are used in this section for qualitative comparison to contaminant concentrations from various sources. Less conservative guidelines used in zone-specific assessments are also used to provide balance.

Since guidelines for organics were zone specific based on TOC concentrations, they are not presented in this section. Due to the nature of some of the available Thames River data sets, it was not appropriate or feasible to calculate site-specific sediment organic guidelines for this section. Other guidelines for organics used in zone-specific assessments are presented to provide balance, including ER-Ms, FDEP PELs, and MOE SELs (Jones et al., 1996).

11.7.8.2 Preliminary Exposure Estimate and Risk Calculation

The sediment chemistry data used in the zone-specific ERAs included data from the NSB-NLON Phase II RI and the Lower Subase RI. Data from samples collected near the Lower Subase as part of the NSB-NLON Phase II RI were used. All Lower Subase RI sediment samples were collected in the Thames River near the Lower Subase. Sediment data near the Lower Subase were available from the Pier 17 EA (Maguire, 1994) and from several rounds of sampling performed for the SEAWOLF EIS (Maguire, 1995). Sediment data from these two studies were unvalidated and a significant portion of these data is several years old. Thames River sediment data from the NSB-NLON Phase II RI, Pier 17 EA, and SEAWOLF EIS were also available from upstream and downstream (of the base) locations, from the middle of the river, from the western side of the river, near the DRMO, and near Goss Cove.

Although a large portion of the available sediment data were not appropriate for use in quantitative risk assessment near the Lower Subase, these data can be used to investigate the nature and extent of contamination throughout the stretch of the river in the vicinity of the base. They can also be used to qualitatively assess the potential risks to benthic receptors in a broader range of areas in the river and for comparison to zone-specific risks assessed earlier. Hence, all the available sediment data collected in locations other than the Lower Subase area were combined with the NSB-NLON Phase II RI/Lower

Subase data near the Lower Subase. Since this data set included sediment chemistry data from all possible sources, it can be considered "all-inclusive." The presentation and qualitative assessment of Thames River contaminant data in this section focuses only on the COCs determined for Zones 1 through 7.

A range of detected contaminant concentrations in these stretches of the river was generated from all available data. This ERA placed emphasis on stretches of the river upstream and downstream of the Lower Subase. Contaminant concentrations in these areas were compared to Lower Subase contaminant concentrations. For conservatism, the maximum concentrations in these areas were the focus of this assessment. Also, emphasis was placed on comparisons of Lower Subase contaminant concentrations in the Thames River to upstream concentrations. As stated earlier in this ERA, due to the tidal influence, no true "upstream reference area" can be designated for the Thames River. The three upstream sampling locations were located north of the DRMO, with two of them located several thousand feet north of the DRMO. These data cannot be used as true reference or background data; however, it is unlikely that these areas have been significantly impacted by base-related contaminants.

In addition to chemical analyses, several biological analyses have been conducted in the Thames River in support of the SEAWOLF EIS (Maguire, 1995). A benthic macroinvertebrate study was conducted in March 1990 in the Thames River. Benthic communities were divided into two categories for sampling and study. The first category was the status of the benthic community north of and south of the I-95 bridge. The second category was the status of the benthic community in the river channel and outside the river channel. Macroinvertebrate abundance, species composition, and species richness were measured at 10 sampling locations from near Hess Oil to near Pier 33. The results of the 1990 survey are discussed in Section 11.7.2.2 as they relate to potential risks in the Thames River near the Lower Subase.

Sediment toxicity testing using *Ampelisca* and toxicity/bioaccumulation studies using *Macoma* and *Nereis* were also conducted as part of the SEAWOLF EIS in the Thames River. Samples were collected near the I-95 bridge, Electric Boat facility, in the river channel across from Mamacoke Hill, and near Piers 32 and 33. The Pier 32/33 samples are discussed in the Zone 5 assessment. The results from the other samples are discussed in Section 11.7.2.2 as they relate to potential risks in the Thames River near the Lower Subase. Toxicity test results and benthic macroinvertebrate analysis summaries from the NSB-NLON Phase II RI are presented in Appendices H and J, respectively.

In addition to the Thames River SEAWOLF EIS biological analyses, sediment toxicity testing using *Ampelisca* and *Leptocheirus* was conducted as part of the NSB-NLON Phase II RI. Benthic macroinvertebrate analyses were also conducted. Samples were collected at numerous locations in the

Thames River from adjacent to the U.S. Coast Guard Academy to several thousand feet north of the DRMO (Figure 11-2).

Native shellfish and deployment of caged ribbed mussels were also collected in the Thames River in support of the NSB-NLON Phase II RI. These samples were analyzed for contaminants in order to investigate the bioavailability of contaminants in the river. Native shellfish species that were collected include blue mussels, oysters, and hardshell clams. The oysters were collected from commercial shellfish beds in the river. The hardshell clams were collected from locations adjacent to the oyster beds. Blue mussels were collected from areas of the river where they are abundant. Caged mussel samples were deployed in the Thames River from adjacent to the U.S. Coast Guard Academy to several thousand feet north of the DRMO. Shellfish and caged mussel sampling locations are shown on Figure 11-5. The results of the shellfish analyses, AVS/SEM analysis, and toxicity testing conducted for the Thames River for the NSB-NLON Phase II RI are discussed in the risk calculation portion of this section as they relate to potential risks in the Thames River near the Lower Subase. Shellfish contaminant data from the NSB-NLON Phase II RI are also presented in Appendix H.

Results and Discussion

Since the Thames River assessment consists of qualitative comparisons, the results of the data and analyses mentioned above are presented below along with the related discussion. Table 11-90 lists all of the analytes that were retained as COCs from all of the zone-specific ERAs (Sections 11.7.1 through 11.7.7) using the maximum contaminant concentrations in each zone. Each of those COCs and contaminant classes (e.g., inorganics) are discussed individually below with regards to trends among zones, overall risks among all zones, and relation to concentrations in other sections of the Thames River. In addition, the results of the biological analyses in the Thames River are discussed below. Additional toxicity data for all ecological COCs are presented in Appendix J.

Inorganic COCs

The maximum and average concentrations of AVS measured in NSB-NLON Phase II RI and Lower Subase RI sediment samples collected near the Lower Subase exceeded the maximum and average concentrations of SEM in all zones. AVS/SEM concentrations were measured also in four NSB-NLON Phase II RI sediment samples that were collected from different sections of the river, including upstream of the base (EC-SDTR01), near the DRMO (T3SD4), near Goss Cove (EC-T3SD1), and downstream of the base (EC-SDTR07). Sampling locations are presented on Figures 11-2 and 11-6. The concentrations of AVS in these four samples exceeded the concentrations of SEM, resulting in negative SEM:AVS ratios

(Appendix H). Thus, AVS exceeded SEM in 20 NSB-NLON Phase II RI/Lower Subase RI sediment samples collected in the Lower Subase and four samples collected from different sections of the river. These data suggest that the five AVS metals (cadmium, copper, nickel, lead, and zinc) are not bioavailable in Thames River sediments. As a result, it is unlikely that cadmium, copper, nickel, lead, and zinc are causing toxicity in sediment-dwelling organisms in the river.

The maximum concentration of antimony among all NSB-NLON Phase II RI/Lower Subase RI sediment samples (41.1 mg/kg) collected near the Lower Subase exceeded the ER-M (25 mg/kg) as shown in Table 11-90. However, the maximum concentration of antimony among these samples was within the range of maximums from other sections of the Thames River, which all also exceeded the ER-M (Table 11-91). The maximum concentrations among these areas was quite similar, 38.1 mg/kg (upstream) to 42.7 mg/kg (Goss Cove), and all the maximums were detected in NSB-NLON Phase II RI samples. Thus, antimony may be naturally elevated in Thames River sediments. Antimony was not concluded to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River. Ecotoxicological data for antimony are lacking, although it does not appear to bioconcentrate appreciably in fish and aquatic organisms (ATSDR, 1992).

The maximum concentration of arsenic among all NSB-NLON Phase II RI/Lower Subase RI sediment samples (18.5 mg/kg) collected near the Lower Subase exceeded the ER-L (8.2 mg/kg) as shown in Table 11-90. However, it was much less than the ER-M (70 mg/kg), the SEL (33 mg/kg), and the PEL (41.6 mg/kg), as shown in Table 11-90. The range among zones was quite small (15.1 to 18.5 mg/kg; Table 11-91). It was also similar to the range of maximums detected in other sections of the Thames River (Table 11-91). Maximums in these areas ranged from 10.9 mg/kg (upstream) to 16 mg/kg (DRMO). Thus, it appears that the concentration of arsenic in Thames River sediments is fairly uniform, with no appreciable inputs from the Lower Subase. The maximum upstream and downstream concentrations were detected in NSB-NLON Phase II RI samples and the maximum DRMO and Goss Cove concentrations were detected in historical samples.

Arsenic is present in the environment in several forms, but arsenic trioxides are generally more toxic than pentoxides. The relative amounts of these two forms in Thames River sediments are not known but will depend on several complex physical characteristics of the sediments (Eisler, 1988). On the whole, the laboratory toxicity test data that were used to derive ER-Ls used the most toxic forms of the contaminants assessed and are, therefore, highly conservative. It is unlikely that all the arsenic in Thames River sediments is trivalent arsenic, the more toxic form. As such, the maximum and average concentrations of arsenic in Zone 1 sediments only slightly exceeded the conservative ER-L. In addition, Eisler (Eisler,

1988) notes an average arsenic concentration in certain oceanic sediments of 33.7 mg/kg (dry weight) and arsenic in naturally elevated sediments up to 500 mg/kg (dry weight).

All of the seven zone-specific maximum concentrations of barium in NSB-NLON Phase II RI/Lower Subase RI sediment samples collected near the Lower Subase exceeded the sediment guideline (Tables 11-90 and 11-91). The guideline (20 mg/kg) was a Region V EPA value for freshwater, as used in the NSB-NLON Phase II RI. Less conservative guidelines were not available. The maximum concentrations of barium in other areas of the river also exceeded the guideline (Table 11-90). The upstream concentration (48.5 mg/kg) was lower than the range among zones (57.8 to 96.4 mg/kg) and the DRMO (77 mg/kg), Goss Cove (67 mg/kg), and downstream (73 mg/kg) concentrations (Table 11-91). Thus, some contribution of barium to the Thames River from the Lower Subase is possible. Yet, the differences between the upstream maximum concentrations and maximums in other areas do not appear to be significant.

The maximum upstream concentration of barium was from a NSB-NLON Phase II RI sample, and some of the maximums in other sections of the river were obtained from historical data. Ecotoxicological data for barium are scarce, making interpretation of sediment concentrations difficult. The guideline used may be overly conservative since it was exceeded by the concentrations of barium in all sediment samples collected in the Thames River. Barium was not concluded to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Ecotoxicological data for beryllium are scarce. Sediment guidelines were not available. The maximum concentration of beryllium among all NSB-NLON Phase II RI/Lower Subase RI sediment samples collected near the Lower Subase (7.6 mg/kg) exceeded the upstream concentration of beryllium (0.69 mg/kg; Table 11-91). However, the remainder of the zone-specific maximums near the Lower Subase were 1.2 mg/kg or less (Sections 11.7.1 through 11.7.7). These concentrations are similar to the concentrations from other areas of the river, indicating that the 7.6 mg/kg concentration (from Zone 4) is not indicative of concentrations in most areas of the river, including the Lower Subase area. All the maximum concentrations of beryllium in non-Lower Subase sections of the river were detected in NSB-NLON Phase II RI samples. Beryllium was not concluded to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

The maximum concentration of boron among all NSB-NLON Phase II RI/Lower Subase RI sediment samples collected in Zone 4 near the Lower Subase (70.2 mg/kg) exceeded the upstream concentration (26.5 mg/kg; Table 11-91). Although boron was not detected near the Lower Subase in two zones, the maximum concentrations in the other five zones were in a narrow range (55.8 to 70.2 mg/kg), and each of

these maxima exceeded the upstream concentration. The maximum downstream concentration (129 mg/kg) was the highest among all Thames River sediment samples (Table 11-91). All the maximum concentrations of boron in each section of the Thames River outside the Lower Subase area were detected in NSB-NLON Phase II RI samples, which were all validated. It appears that the Lower Subase may be contributing boron to the Thames River.

Ecotoxicological data for boron are scarce. Conservative or less conservative sediment guidelines were not available for this inorganic. The absence of sediment guidelines for boron is due, in part, to its general lack of ecotoxicity. Boron is widely distributed in the environment and can be naturally elevated in marine sediments (Eisler, 1990). The NSB-NLON Phase II RI ERA for the Thames River concluded from the limited information available on boron's toxicity that aquatic biota were not at risk as a result of exposure to boron at the concentrations detected.

Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in Zone 4 sediments (EC-SDTR06-02) was not significantly different than percent survival in reference sediments. This may indicate that boron is not eliciting toxicity in Zone 4 sediments. Boron was elevated in native blue mussel samples MU5 and MU6, which were collected south of Zone 4 as part of the NSB-NLON Phase II RI. Eisler presents boron concentrations in soft parts of two species of mussels in British Columbia ranging from 0.9 to 5.3 mg/kg (Eisler, 1990). The boron concentrations in MU5 (70.9) and in MU6 (77.5) were much higher than this range. Juvenile Pacific oysters (*Crassostrea gigas*) accumulated boron in relation to availability, and showed no prolonged retention of boron following cessation of exposure (Thompson et al., 1976). Boron was either not detected or was detected only at low concentrations in all other shellfish samples collected as part of the NSB-NLON Phase II RI. Therefore, regardless of potential toxicity in the areas around and including MU5 and MU6, accumulation of boron is isolated in that area and is not widespread.

All the maximum detected concentrations of chromium in the seven zones near the Lower Subase exceeded the ER-L and the upstream concentration (79.6 mg/kg; Table 11-91), although the upstream concentration was almost equal to the ER-L. With the exception of Zone 4 (discussed below), the maximum concentration exceedances of the ER-L for chromium were relatively minor near the Lower Subase. These maxima ranged from 80.7 to 100 mg/kg (Sections 11.7.1 through 11.7.7). All these concentrations only slightly exceed the conservative ER-L and are generally much less than the ER-M (370 mg/kg), SEL (110 mg/kg), and PEL (160 mg/kg). The Goss Cove concentration (91.5 mg/kg) and downstream concentrations of chromium (81.6 mg/kg) were also fairly similar to the upstream concentration and the zone-specific maxima near the Lower Subase. The maximum upstream, Goss Cove, and downstream concentrations of chromium were detected in NSB-NLON Phase II RI samples,

which were validated. Hence, chromium contamination does not appear to be widespread near the Lower Subase, and it does not appear that the Lower Subase is contributing chromium to the Thames River.

The maximum concentration in Zone 4 near the Lower Subase was 400 mg/kg (Table 11-90), which exceeds the less conservative guidelines mentioned above. Eisler presents concentrations of chromium in marine sediments near a Rhode Island electroplating plant of 60 to 80 mg/kg and 80 to 3,000 mg/kg near a Maine tannery (Eisler, 1986). The maximum and average concentrations of chromium in Zone 4 sediments were higher than the Rhode Island range and between the Maine range of concentrations. Nonetheless, survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in EC-SDTR06-02 sediments was not significantly different than percent survival in reference sediments, indicating that chromium may not be bioavailable. Chromium was also not detected in the native mussel sample collected near Zone 4 (MU5). For these reasons, chromium does not appear to be bioavailable in Zone 4 sediments.

All the maximum detected concentrations of cobalt in the seven zones near the Lower Subase exceeded the maximum upstream concentration (Table 11-91). Yet for the most part, these maxima were fairly similar to the maximum upstream concentration. With the exception of one zone, all the maximum concentrations near the Lower Subase were 10 mg/kg or less compared to the 7.0 mg/kg maximum upstream concentration. The exception (13.1 mg/kg in Zone 4) was about twice the upstream concentration. Also, the maximum downstream and maximum Goss Cove concentrations, 8.5 mg/kg and 8.3 mg/kg, respectively, were comparable to the maximum upstream concentration. As a result, it does not appear that the Lower Subase has contributed cobalt to the Lower Subase area and downstream of the base.

Ecotoxicological data for cobalt are scarce. Conservative or less conservative sediment guidelines were not available for this inorganic. Cobalt was concluded not to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

All the maximum detected concentrations of iron in the seven zones near the Lower Subase exceeded the maximum upstream concentration (Table 11-91). Each of these maxima also exceeded the downstream, DRMO, and Goss Cove concentrations (Table 11-91), indicating that the Lower Subase may be contributing iron to the Thames River near the base. Upstream, downstream DRMO, and Goss Cove maxima were detected in NSB-NLON Phase II RI samples, which were validated. However, iron is one of the most common elements in the earth's crust and is an essential nutrient. The NSB-NLON Phase II RI ERA for the Thames River suggested that much of the iron in sediments is bound to sulfide, limiting its bioavailability. All the maximum detected concentrations of iron in Thames River sediment samples

collected near the Lower Subase and in other sections of the river exceeded the ER-L, indicating that iron is ubiquitously elevated or that the ER-L is excessively conservative.

The range of maximum mercury concentrations in sediment samples collected near the Lower Subase was quite narrow among the seven zones (0.32 to 0.63 mg/kg; Table 11-91). All of these maxima exceeded the ER-L (0.15 mg/kg). Yet, the maximum upstream (0.5 mg/kg), downstream (0.44 mg/kg), DRMO (0.62 mg/kg), and Goss Cove (0.66 mg/kg) concentrations exceeded the ER-L as well (Table 11-83), as did the background concentration (0.169 mg/kg) used in each zone-specific ERA. None of the concentrations mentioned above exceeded the ER-L (0.71 mg/kg), PEL (0.7 mg/kg), or SEL (2.0 mg/kg), as shown in Table 11-83. Therefore, it appears as though the concentration of mercury in the Thames River is quite uniform. In light of the narrow range of concentrations throughout the river, it appears unlikely that the Lower Subase is contributing mercury to the Thames River.

All the maxima for mercury in non-Lower Subase areas of the river discussed above were detected in NSB-NLON Phase II RI samples, which were validated. Again, emphasis in this ERA was placed on newer, validated data. However, a concentration higher than the concentration range listed above was detected in a historical sample. Sample P2, collected near Pier 32 (Zone 7) as part of SEAWOLF EIS sediment sampling in 1991, had a mercury concentration of 3.1 mg/kg. This concentration exceeds the less conservative guidelines presented on Table 11-83. Nonetheless, the sample was unvalidated and analyzed using outdated methods and appears to be an isolated elevated detection.

The background concentration of mercury used in the zone-specific ERAs exceeded the ER-L. Eisler does not present background concentrations of mercury in United States estuarine waters but refers to "uncontaminated" sediments as those with usually less than 1.0 mg/kg (Eisler, 1987a). The maximum concentration of mercury in NSB-NLON Phase II RI sediment samples collected near the Lower Subase (0.63 mg/kg) is less than this value.

Nearly all sediment toxicity tests conducted using Thames River sediments near the Lower Subase as part of Pier 17 indicated that the sediments were not toxic to benthic invertebrates. This suggests that mercury, which is widespread throughout Thames River sediments, is not causing toxicity in Thames River sediments near the Lower Subase. The exception was significantly lower survival for *Ampelisca* relative to control and reference sediments from sample EC-SDTR04-02, collected as part of the NSB-NLON Phase II RI. That sample was collected in Zone 7 near the Lower Subase. Nonetheless, the maximum concentration of mercury in sediments near the Lower Subase in Zone 7 (0.52 mg/kg) was approximately equal to the upstream concentration (0.5 mg/kg). Also, Pier 17 replacement EA *Ampelisca* toxicity tests in Zone 7 indicated survival in test sediments was not significantly different than

control/reference sediment survival. No statistically significant bioaccumulation of metals occurred in *Macoma* or *Neries* bioassays using Zone 7 sediments conducted in support of the Pier 17 EA. Mercury was not detected in any native shellfish samples collected in the Thames River (as discussed below), including a native blue mussel sample collected in Zone 7, as part of NSB-NLON Phase II RI activities. It was detected in one caged mussel sample in the Thames River (one of the two samples off Goss Cove).

Fine sediment particles have the greatest capacity to adsorb dissolved mercury (Baudo et al., 1990). As much as 34 mg/kg (dry weight) has been reported to be bound to some particulate matter (Cranston and Buckley, 1972). The adsorptive capacity for mercury is exponentially proportional to the mean specific surface area of the particles smaller than 75 µm. The factor that controls the amount of mercury in sediments is often the binding capacity of the organic matter since most of the mercury is associated with this fraction (Baudo et al., 1990). As the amount of TOC in sediments increases, the binding capacity of the sediment for mercury also increases. The adsorption of mercury onto the organic matter decreases the bioavailability, resulting in decreased toxicity of mercury to aquatic and semi-aquatic receptors. Sediments that have elevated concentrations of mercury can elicit little or no toxic effects from mercury if the mercury is not bioavailable. It is possible that sufficient TOC exists in Lower Subase sediments to reduce mercury bioavailability.

Selenium was detected in sediment samples in three of seven zones near the Lower Subase up to a maximum of 1.1 mg/kg (Table 11-91). It was not detected in upstream, DRMO, or Goss Cove sediment samples (Table 11-91). The maximum concentration in the three zones exceeded the guideline used. However, the background concentration used in the zone-specific ERAs is three times higher than the guideline, indicating that the guideline is overly conservative relative to these background data. Only one guideline was available for selenium in sediments, the Washington State Department of Ecology value (0.1 mg/kg), as used in the NSB-NLON Phase II RI. No alternate guideline values were available. Selenium was detected at a concentration of 0.51 mg/kg in one NSB-NLON Phase II RI downstream sample. Qualitatively, the infrequent detections and concentrations do not indicate that potential risks from selenium are widespread, significant, or originate from the Lower Subase. Yet, definitive conclusions regarding the potential risks from selenium in Thames River sediments cannot be made without adequate toxicity data.

No additional background concentrations of selenium in marine environments or toxic sediment concentrations of selenium were available. Eisler notes that selenium is frequently found in lake sediments near smelters and in fly ash ponds at concentrations in excess of 5.0 mg/kg. Selenium is an essential nutrient but is harmful at higher concentrations (Eisler, 1985).

The maximum detected concentration of selenium in sediment samples collected near the Lower Subase was in Zones 3 and 2. Yet, survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in Zone 3 (EC-T4SD02-02) sediments was not significantly different than percent survival in reference sediments, indicating that sediments in this area were not toxic. Selenium was not elevated in any shellfish samples collected as part of the NSB-NLON Phase II RI relative to reference or control samples.

Silver was a maximum concentration COC in two of seven zones (Zones 3 and 6) from the zone-specific ERAs as a result of exceedances of the ER-L (Sections 11.7.1 through 11.7.7). The average concentrations of silver in those zones did not exceed the ER-L. The maximum concentration of silver among all zones near the Lower Subase was 1.4 mg/kg, which was below the ER-M (3.7 mg/kg) and the PEL (1.77 mg/kg), as shown in Table 11-83. No SEL was available. Silver was not detected in upstream, DRMO, or Goss Cove sediment samples. It was detected in one downstream sediment sample collected as part of the NSB-NLON RI (1.2 mg/kg; Table 11-83).

Recent studies have indicated that silver may bind to AVS in a manner similar to copper (Mahony, 1997). Since the amount of AVS in all Thames River sediments exceeded the amount of SEM, the silver in those sediments could bind to AVS and reduce its bioavailability. In addition, silver forms strong complexes with functional groups found on humic acids at pH ranging from 2 to 10 (Sujari and Bowen, 1986). Thames River sediments had pH values within these ranges. Thus, humic acids in Thames River sediments could bind silver and reduce its bioavailability. Yet, the site-specific bioavailability of silver in Zones 3, 6, and downstream of the base is not known. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in Zone 3 (sample EC-T4SD02-02) and Zone 6 (EC-STDR03-02) sediments was not significantly different than percent survival in reference sediments, indicating that sediments in this area were not toxic. The Phase II RI concluded that silver was not present in native blue mussels throughout the Thames River and that only low levels of silver were present in clams, oysters, and caged ribbed mussels.

Thallium was detected only in one zone (Zone 4) near the Lower Subase in NSB-NLON/Phase II RI samples. Furthermore, it was detected only in one of four samples in that zone (2.3 mg/kg). Overall, 20 sediment samples were collected as part of NSB-NLON Phase II RI/Lower Subase RI sampling activities near the Lower Subase, resulting in a total frequency of detection of 1 of 20 for thallium. Thallium was not detected in upstream or DRMO samples. It was detected in one downstream and one Goss Cove sample from the NSB-NLON Phase II RI at 0.76 and 2.0 mg/kg, respectively (Table 11-90). Thallium was detected infrequently in Thames River sediments.

No sediment guidelines were available for thallium. The general absence of sediment guidelines for thallium is due, in part, to its general lack of ecotoxicity. Thallium was concluded not to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

The maximum detected concentrations of vanadium in NSB-NLON Phase II RI/Lower Subase sediment samples in all seven zones (51 to 64.3 mg/kg) exceeded the maximum upstream concentration (38.7 mg/kg), as shown in Table 11-91. However, the range of concentrations among the seven zones was narrow, indicating a uniform concentration in the Lower Subase that may or may not be related to the facility. Downstream, DRMO, and Goss Cove maximum concentrations were 37.7, 54.2, and 45.1 mg/kg, respectively (Table 11-90). Each of those three concentrations were detected in NSB-NLON sediment samples, which were all validated.

No sediment guidelines were available for vanadium. Vanadium is generally not considered to be toxic in the environment (Mailman, 1980). Vanadium was concluded not to be of ecological significance in the NSB-NLON Phase II RI ERA for the Thames River.

Organic COCs

Benzo(a)pyrene was a maximum and average concentration COC in all seven zones from the zone-specific ERAs (Sections 4.7 through 10.7). The maximum concentration among all zones (1,900 µg/kg in Zones 3 and 4) slightly exceeded the ER-M (1,600 µg/kg; Table 11-91). Benzo(a)pyrene was detected in all other sections of the Thames River (Table 11-84). The upstream concentration (620 µg/kg) was similar to the maximum concentrations in Zones 1, 2, 5, 6, and 7, which ranged from 630 to 880 µg/kg. The upstream, downstream, DRMO, and Goss Cove maximum concentrations were in a narrow range (610 to 780 µg/kg), indicating that this organic may be a ubiquitous environmental contaminant in the Thames River. The maxima from each of these sections of the river were detected in NSB-NLON sediment samples, which were validated, except for the maximum in DRMO sediments, which was obtained from an unvalidated historical sample.

As discussed in Sections 11.7.1 through 11.7.7, benzo(a)pyrene, among the most toxic PAHs, is not considered to be a naturally occurring chemical. However, due to omnipresent anthropogenic influences, PAHs, including benzo(a)pyrene, have become ubiquitous environmental contaminants. Penobscot Bay, Maine sediments have benzo(a)pyrene concentrations ranging from 10 to 540 µg/kg (Johnson et al., 1985). For the most part, Lower Subase and other sections of the Thames River had maximum concentrations in sediment only slightly higher than that range. A higher concentration of 2,200 µg/kg was

detected in sample P2/P3, which was collected near Pier 17 as part of 1994 Pier 17 EA sampling. This sample was not validated.

The maximum concentrations in NSB-NLON Phase II RI/Lower Subase RI samples collected from Zones 3 and 4 (1,900 µg/kg) were higher than the Penobscot Bay range of detections. This suggests that the Lower Subase near Zones 3 and 4 could be contributing benzo(a)pyrene to Thames River sediments. However, survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in Zone 3 (EC-T4SD02-02) and Zone 4 (EC-SDTR06-02) sediments was not significantly different than percent survival in reference sediments. Also, benzo(a)pyrene was not detected in blue mussels collected near Zone 4 (MU5). The results of these analyses indicate that, despite the exceedances of less conservative guidelines in Zones 3 and 4, benzo(a)pyrene may not be bioavailable.

Phenol was detected in four zones as part of NSB-NLON Phase II RI/Lower Subase RI sampling. It was detected in four of 16 samples in these four zones combined (maximum = 150 µg/kg) and four of 20 samples collected near the Lower Subase total. It was not detected in other parts of the Thames River (Table 11-91), suggesting that the Lower Subase may be the source of phenol in those four zones.

However, the guideline used was calculated by dividing the acute AWQC by 100, an approach which is probably conservative. Therefore, since the maximum concentration of phenol does not substantially exceed this conservative guideline, the presence of it in one sample at that concentration indicates that the likelihood of potential risks from phenol are low. Alternate guidelines were not available for phenol. Phenol was not detected in any shellfish samples collected as part of the NSB-NLON Phase II RI.

The organic 4-methylphenol was detected only in Zone 4 near the Lower Subase in NSB-NLON/Phase II RI samples. Furthermore, it was detected only in one of four samples in that zone (68 µg/kg). As a result, the total frequency of detection from that data set is one of 20. It was not detected in upstream, downstream, or DRMO Goss Cove sediment samples but was detected in one of five DRMO samples (130 µg/kg). No guidelines were available for 4-methylphenol, and toxicity data for this organic are scarce. As such, its toxicity in Thames River sediments cannot be fully assessed. Yet, the extremely low frequency of detection for this organic indicates that potential risks are probably low and not widespread. 4-Methylphenol was not detected in any shellfish samples collected as part of the NSB-NLON Phase II RI.

The pesticide 4,4'-DDD was a maximum concentration COC in Zone 5 near the Lower Subase using NSB-NLON/Phase II RI samples. The maximum concentration of 28 µg/kg slightly exceeded the EqP guideline used (23.8 µg/kg). The average concentration of 4,4'-DDD did not exceed the guideline. The maximum

and average concentrations (12.1 µg/kg) of 4,4'-DDD exceeded the PEL (7.81 µg/kg) but were much less than the SEL (60 µg/kg) as shown in Tables 11-90 and 11-91, respectively.

The CAWQC for 4,4'-DDT was used in the calculation of the EqP guideline. The CAWQC for 4,4'-DDT (0.001 µg/L) is based on a final residue value for a wildlife feeding study. In order to base the EqP value on effects to aquatic species, alternative water quality guidelines would have to be used. For DDTR, a Secondary Chronic Value (SCV) is available from Oak Ridge National Laboratory toxicity database (ORNL, 1996). The SCV (0.04 µg/L) is a Tier II value that is calculated to be a conservative equivalent to a Final Chronic Value (FCV). If that value were to be used in the EqP calculation, the guideline would be an order of magnitude higher, and the maximum detected concentration of 4,4'-DDD would no longer exceed the guideline.

Also, 4,4'-DDD was detected in all other areas in the Thames River that were sampled, indicating that the Lower Subase may not be the source, or only source, of 4,4'-DDD to the Thames River. The discharges from Streams 5 and 6, which convey surface water runoff from the Area A Downstream Site and empty into the Thames River adjacent to the DRMO and Zone 5 of the Lower Subase, respectively, are the probable sources of 4,4'-DDD contamination in the Thames River sediment. Remedial design efforts are currently in progress at the Area A Downstream to eliminate pesticide contamination at the site. This site has proceeded through the feasibility study and proposed plan stages and a ROD has been signed. 4,4'-DDD was detected in a maximum upstream concentration of 17 µg/kg (Table 11-91). The DRMO concentration was 130 µg/kg, which was the highest detection in all the Thames River samples. Low concentrations of organochlorine pesticides are often ubiquitous in sediments around industrial areas since their historical use was widespread. The maximum concentrations in sections of the river other than the Lower Subase were all detected in NSB-NLON Phase II RI samples, which were validated. The NSB-NLON Phase II RI concluded that only low concentrations of pesticides, including 4,4'-DDD, were present in Thames River shellfish and deployed shellfish samples.

Benthic Macroinvertebrates

As mentioned earlier, a benthic macroinvertebrate study was conducted in March 1990 in the Thames River as part of the SEAWOLF EIS. Benthic communities were divided into two categories for sampling and study. The first category was the status of the benthic community north and south of the I-95 bridge ("upper river" and "lower river"). The second category was the status of the benthic community in the river channel and outside the river channel. Macroinvertebrate abundance, species composition, and species richness were measured at 10 sampling locations from Hess Oil to near Pier 33.

The results of that study indicated that the Thames River has two distinct species habitats. The lower river (near the ocean) benthic community was similar to communities typically found in deeper coastal habitats of Long Island Sound with regard to dominant species. The upper river (inland) had lower benthic abundances than the lower river, but community composition was similar. The authors attribute this to several factors, including shallower depth, lower salinities, and increasing riverine influences. The area near the Subase appears to represent a transition zone between the two types of conditions. These areas typically have reduced faunal richness.

Since the section of the Thames River along the Subase experiences the physical stressors noted in the 1990 study, subtle contaminant effects on benthos relative to Lower Subase influences would be difficult to discern. Also, the NSB-NLON Phase II RI concluded that, in general, the benthic communities near the Lower Subase were similar to the benthic communities upstream and downstream. Both the SEAWOLF and NSB-NLON benthic community studies represent a snapshot in time and therefore the populations can fluctuate due to natural factors.

As discussed earlier, a benthic community analysis was conducted near Piers 15 and 17 as part of the Pier 17 EA (Maguire, 1994). The study indicated that the benthic community near Pier 17 was disturbed, and the community near Pier 15 was relatively typical of benthic communities in the river. Since that study measured PAHs and some inorganics at higher concentrations near Pier 17 than near Pier 15, it suggested that contaminants may be causing toxic effects in that area. Nonetheless, the Piers 15/17 area has subsequently been dredged and replaced with "clean" sediment. More importantly, the Pier 17 area (where the benthos were disturbed) represents only a small portion of the Lower Subase area and an even smaller portion of the Thames River.

Sediment Toxicity Testing

Sediment toxicity testing using *Ampelisca* and toxicity/bioaccumulation studies using *Macoma* and *Nereis* were also conducted as part of the SEAWOLF EIS in the Thames River. Samples were collected near the I-95 bridge, Electric Boat facility, in the river channel across from Mamacoke Hill, and near Piers 32 and 33. The Pier 32/33 samples are discussed in the Zone 5 assessment (Section 11.7.8). No statistically significant mortality differences were observed in sediments from any sampling location for *Ampelisca*.

No statistically significant mortality was observed for *Nereis* in sediments from any SEAWOLF sampling location. No statistically significant mortality for *Macoma* was observed for I-95, Mamacoke, or Electric boat sediments. Survival for *M. nasuta* in Piers 32/33 sediments was significantly lower than survival in control and reference sediments. The EIS states that the significant differences between test and

control/reference sediments disappear if an outlier is removed, but neither specifies which data point constitutes the outlier nor is it readily apparent. Survival of *Ampelisca abdita* and *Leptocheirus plumulosus* in EC-STDR02-02 sediments (collected near Pier 33) was not significantly different than percent survival in reference sediments. No significant bioaccumulation of inorganics or PAHs was detected in either *Macoma* or *Nereis* from the SEAWOLF analyses. Statistically significant accumulation of lead was observed in *Macoma* exposed to Mamacoke sediment. For the most part, the results of the SEAWOLF analyses indicate that Thames River sediments are not toxic to sediment-dwelling organisms and that accumulation of inorganics and PAHs in these sediments by sediment-dwelling organisms is low.

The results of NSB-NLON Phase II RI ERA toxicity testing with *Ampelisca abdita* and *Leptocheirus plumulosus* suggest a similar trend, both near the Lower Subase and in other sections of the river. No statistically significant mortality was observed in any *Leptocheirus* toxicity tests using sediments near the Lower Subase and in other sections of the river. The nine sampling locations are presented in Figure 11-2. Two of nine *Ampelisca* sediment samples exhibited statistically significant mortality. Survival of *Ampelisca abdita* in EC-STDR04-02 sediment was significantly lower than reference sediment survival in the sample collected near Pier 17. Yet, as discussed in Section 11.2.1, Pier 17 Replacement EA *Ampelisca* toxicity tests indicated survival in test sediments was not significantly different than control/reference sediment survival. Also, sediment sampling locations for these two studies have subsequently been dredged and replaced with "clean" sediment. The other NSB-NLON sediment sample (EC-T3SD4-02) that exhibited toxicity to *Ampelisca* was collected near the DRMO. It is unlikely that toxicity in that area is due to the Lower Subase.

More importantly, from a broader perspective of toxicity in the entire Thames River, toxicity to *Ampelisca* is localized. A total of nine sampling locations throughout the Thames River (including several near the Lower Subase) were used for toxicity testing with *Ampelisca* and *Leptocheirus* in the NSB-NLON Phase II RI (18 tests combined). Two sampling locations near Piers 15 and 17 were used for *Ampelisca* toxicity testing in the Pier 17 EA. Four locations in the Thames River were used for toxicity testing with *Ampelisca*, *Macoma*, and *Nereis*, including near Piers 32 and 33. Of all the toxicity testing listed above, only one sample collected near the Lower Subase (*Ampelisca* using sediment sample EC-SDTR4-02) was toxic to benthos. One *Macoma* sample "may or may not be" toxic near Piers 32 and 33 (significantly; Maguire, 1995). For these reasons, the results of sediment toxicity tests near the Lower Subase appear to be similar to other sections of the Thames River, and any potential toxicity to benthos near the Lower Subase is localized. As a result, broader community and ecosystem effects from sediment contaminants near the Lower Subase may be unlikely.

Shellfish Tissue Analyses

As discussed in detail in zone-specific ERAs, native blue mussels were collected at several locations near the Lower Subase and caged ribbed mussel samples were deployed at a few locations near the Lower Subase as part of the NSB-NLON Phase II RI (Figure 11-5). Tissues from these samples were analyzed for contaminants. In addition to these samples, oysters, clams, and native blue mussels were collected in other sections of the Thames River, including upstream, across from, and downstream of the base. Caged mussel samples were also deployed in some of these areas. A discussion of the shellfish samples from sections of the Thames River other than near the Lower Subase is provided below as they relate to the Lower Subase samples.

The NSB-NLON Phase II RI concluded that only low concentrations of pesticides were present in caged ribbed mussels deployed throughout the river. Concentrations of these compounds were equivalent to or less than concentrations of pesticides in the native mussels. PCBs were not detected in either the deployed or native mussels. PAHs were not detected in upstream or downstream deployed mussel samples. A few of these compounds were present in samples collected near DRMO and Goss Cove at concentrations similar to the control samples. The exception was sample CMU3, which was collected near the Lower Subase (Zone 1). PAHs and other VOCs were detected in this sample at concentrations higher than controls. Yet, in general, the total PAH concentration in CMU3 was within or only slightly higher than published lists of concentrations of PAHs found in other studies. Benzo(a)pyrene, the only Zone 1 sediment PAH that exceeded its conservative guideline, was not detected in CMU3. It appears that the SVOCs detected in CMU3 may be due to Lower Subase activities since they were elevated relative to controls, but the concentrations do not appear to be significant.

The NSB-NLON Phase II RI concluded that only low concentrations of SVOCs were present in native shellfish collected throughout the Thames River. Two PAHs were detected in one blue mussel sample collected near the Lower Subase. However, as discussed in Section 11.4.3, these concentrations do not appear to be significant. Relatively few pesticides were detected in native mussels, oysters, and clams. Arsenic, cadmium, chromium, and selenium were detected at low concentrations in most samples. The concentrations were similar among locations and species. Boron was detected in two samples, one from the Lower Subase (MU5) and one near the Nautilus Museum (MU6). These samples are discussed in detail in Section 11.4.3. Concentrations of copper, silver, and zinc varied considerably among species. Silver was not detected in mussels but was found in hardshell clams and oysters. Copper concentrations in blue mussels and hardshell clams ranged from 1.8 to 7.5 mg/kg but ranged from 62.9 to 253 mg/kg in oysters. Zinc concentrations ranged from 18.1 to 34.6 mg/kg in blue mussels and hardshell clams but ranged from 1,210 to 2,960 mg/kg in oysters.

The NSB-NLON Phase II RI notes that the variability in the bioaccumulation data are difficult to interpret. Even intraspecifically, the concentration of contaminants, especially inorganics, may vary greatly as a result of genetic variability. Since no oysters or clams were collected near the Lower Subase, it is difficult to relate concentrations of contaminants in these species to the Lower Subase. The NSB-NLON Phase II RI states that the tissue concentrations in mollusk samples would have been more easily interpreted if impacts on growth or body condition had been recorded.

As mentioned above, some contaminants, mainly PAHs, were detected in some native and caged mussel samples near the Lower Subase that were not detected in native and caged mussels collected in other sections of the Thames River. For the most part, though, the concentrations of these contaminants in Lower Subase samples are not elevated relative to typical concentrations in shellfish from several studies in the literature. Moreover, SVOCs were not detected in one of the native mussel samples collected in the Lower Subase (MU4). Again, detailed discussion of these shellfish samples collected near the Lower Subase is included in the zone-specific sections.

11.7.8.3 Conclusions

AVS concentrations exceeded SEM concentrations at all sampling locations where they were measured in the Thames River, including in all zones near the Lower Subase. This suggests that cadmium, copper, nickel, lead, and zinc are not bioavailable in Thames River sediments.

The maximum concentrations of several inorganics exceeded conservative guidelines in all zones near the Lower Subase. Nearly all these inorganics had a narrow range of maximum concentrations among zones that was similar to upstream and downstream maximum concentrations. The maximum concentrations of a few inorganics were significantly elevated relative to background and/or the upstream and downstream concentrations. These include the maximum concentrations of beryllium and chromium in Zone 4. Maximum concentrations of beryllium and chromium in the other zones were much lower than in Zone 4. Boron was detected in five of seven zones at maxima in excess of the upstream concentration and background, though in the same order or magnitude. The range of these five maxima are narrow.

Benzo(a)pyrene was a maximum and average concentration COC in several zones near the Lower Subase. Its maxima in Zones 3 and 4 slightly exceeded the ER-M. It was detected in all other sections of the Thames River in a narrow range of concentrations, which was similar to the range of concentrations in the other zones near the Lower Subase. It appears to be ubiquitous in Thames River sediments.

The results of SEAWOLF EIS, Pier 17 EA, and NSB-NLON Phase II RI ERA benthic macroinvertebrate analyses indicated that the benthic macroinvertebrate communities in the Thames River near the Lower Subase are similar to those in similar environments, and upstream and downstream differences in communities are probably due to natural influences. The exception was in samples collected near Pier 17 in support of the Pier 17 EA, which was determined to be disturbed. The interpretability of these analyses is limited due to temporal fluctuations in naturally occurring conditions and subsequent dredging activities.

The overwhelming majority of sediment toxicity testing from the SEAWOLF EIS, Pier 17 EA, and NSB-NLON Phase II RI studies indicated the absence of significant toxicity to test species. The exceptions were significant mortality for one species in a NSB-NLON Phase II RI sample collected near Pier 17 and in one SEAWOLF sample collected near Pier 33 (although these data were equivocal). Sediment toxicity is localized to a few portions of the Lower Subase.

For the most part, only low concentrations of a few contaminants were detected in deployed caged ribbed mussel samples and native blue mussel samples collected in the Lower Subase as part of the NSB-NLON Phase II RI. Boron was detected in two native blue mussel samples near Zone 4 at concentrations elevated relative to background and control samples.

Table 11-92 presents a weight of evidence summary of the ecological analyses discussed above. In summary, the weight of evidence suggests that potential risks to sediment-dwelling organisms are present near the Lower Subase. Yet the weight of evidence also suggests that most of these risks are low. This concurs with the NSB-NLON Phase II RI ERA, which concluded that risks in Thames River sediments near the base were localized and represent a minimal risk to ecological receptors. The results of this ERA also indicate that areas in the Lower Subase with contaminant concentrations indicative of more significant risks are localized.

The weight of evidence suggests that additional ecological study in Thames River sediments near the Lower Subase is not necessary. Although the potential risks in that area could be further characterized with additional study, the utility of additional study is questionable since low potential risks indicate that a remedial effort is not necessary. Because the Lower Subase sediments contained concentrations of several chemicals that exceeded conservative and a few less conservative guidelines, a tiered monitoring program, including groundwater at each zone as the first tier and surface water and sediment as the second tier, may be useful to ensure that future contaminant inputs to sediments do not occur. Groundwater monitoring is currently recommended for each of the seven zones of the Lower Subase. In addition, a tiered monitoring program will be completed at the DRMO and the conceptual approach for the program has been accepted by the regulatory agencies.

11.8 SUMMARY AND RECOMMENDATIONS

This section presents a summary of major findings for the Thames River. A summary of the nature and extent of contamination is provided in Section 11.8.1. Section 11.8.2 includes a summary of contaminant fate and transport information and Section 11.8.3 provides a synopsis of the baseline human health risk assessment. A brief summary of the ecological risk assessment is provided in Section 11.8.4 and Section 11.8.5 provides recommendations for the Thames River.

11.8.1 Nature and Extent of Contamination

Little variation in the nature and extent of contamination was noted for surface water samples collected from upstream to downstream locations in the Thames River. Organic compounds (trichloroethene, butylbenzyl phthalate, di-n-butyl phthalate, and endrin aldehyde) were detected infrequently and at low concentrations (i.e., ranging from 0.14 µg/L to 3 µg/L). Several metals were detected in the surface water samples. However, with the possible exceptions of aluminum, iron, and manganese concentrations in surface water samples collected near the DRMO, the water quality near NSB-NLON does not appear to differ significantly from the water quality noted at locations distant from NSB-NLON.

In general, concentrations of metals detected in Thames River sediment samples did not differ significantly from upstream to downstream locations, although maximum concentrations of metals detected in all areas located south of the upstream area generally exceeded concentrations of metals detected in the upstream area. Maximum concentrations of several metals (including antimony, arsenic, chromium, copper, lead, mercury, and zinc) exceeded background concentrations for samples collected from all areas, including the upstream area. However, a few noticeably significant concentrations of metals were detected in the sediment samples. Maximum concentrations of chromium (240 mg/kg), copper (1,570 mg/kg), lead (406 mg/kg), mercury (3.1 mg/kg), and zinc (1,150 mg/kg) detected in Zone 7 sediment samples were from three to 20 times greater than respective maximum concentrations detected in the upstream sediment samples. The maximum concentration of lead detected in sediment samples collected from Zone 3 was 1,380 mg/kg; lead contamination in this zone is most likely associated with Building 31 (a building located within Zone 3 of the Lower Subase where a lead removal action was conducted). In addition, chromium, lead, and zinc were detected in sediment samples collected from Zone 4 at concentrations of 400 mg/kg, 569 mg/kg, and 1,650 mg/kg, respectively. However, with the exception of lead and zinc (for which maximum concentrations detected in sediments collected from the downstream area were approximately two times greater than respective concentrations in upstream sediment samples), concentrations of metals detected in sediment samples collected from the

downstream area were similar to concentrations of metals detected in sediment samples collected from the upstream area.

Only three VOCs were detected in Thames River sediment samples. Acetone and 2-butanone, which are both common laboratory contaminants, were detected in sediment samples collected from more than half of the zones. Acetone (ranging from 18 µg/kg to 640 µg/kg) was detected in nine of 12 sediment samples analyzed for VOCs. These included samples from each location, with the lowest concentrations in the DRMO and upstream locations and the highest concentrations detected in the areas of Berth 16 and the Lower Subase. 2-Butanone was detected at concentrations ranging from 30 µg/kg to 190 µg/kg in sediment samples collected from several zones. The highest concentrations of 2-butanone were detected in sediment samples collected in the areas near Berth 16 and the Lower Subase. Carbon disulfide (0.007 mg/kg) was detected in sediment sample T3SD1 (collected near Goss Cove).

PAHs were by far the most prevalent organic compounds detected in Thames River sediment samples. Increases in the concentrations of PAHs detected in sediment samples were noted for samples collected from zones adjacent to the Lower Subase RI. In general, the maximum concentrations of PAHs were detected in the composite sample collected from location P2/P3, which is located adjacent to Lower Subase Zone 7. Phenanthrene was detected in this sample at a concentration of 25,000 µg/kg. Elevated concentrations of PAHs were also noted for samples collected from Zones 3 and 4. In general, fluoranthene and pyrene were detected at higher concentrations than all the other PAHs. However, no additional impact was observed downstream. Concentrations of PAHs detected in the sediment samples collected from near Goss Cove and the downstream area were similar to concentrations of PAHs detected in sediment samples collected from the upstream area. 4-Methylphenol, carbazole, dibenzofuran, phenol, and phthalate esters were also sporadically detected in sediment samples at concentrations ranging from concentration below the CRQL (330 µg/kg) to 11,000 µg/kg.

Analysis for TPH was not performed for a large number of Thames River sediment samples. TPH was detected in three of four sediment samples collected from Zone 5 at concentrations ranging from 1,420 mg/kg to 27,981 mg/kg. TPH was also detected in sediment samples collected from locations adjacent to the DRMO (103 mg/kg), Zone 6 (589 mg/kg), and Zone 4 (589 mg/kg).

Several pesticides, at concentrations ranging from 3.1 µg/kg to 110 µg/kg, were detected in Thames River sediment samples collected from a majority of the zones. However, the frequency of detection of pesticides in sediment samples was generally below 50 percent. 4,4'-DDT and related compounds were most frequently detected. The greatest concentrations of pesticides were detected in samples collected from locations adjacent to the DRMO. As discussed in the Phase II RI report (B&R Environmental,

1997b), 4,4'-DDT and related compounds were frequently detected in sediment samples collected from streams located within the Area A Downstream Site of NSB-NLON. Two streams that originate in the Area A Downstream Site discharge into the Thames River in the vicinity of the DRMO Zone and Zone 5. Therefore, the pesticides detected in Thames River sediment samples collected adjacent to the DRMO may have originated in the Area A Downstream Site.

PCBs (Aroclor 1248, Aroclor 1254, and Aroclor 1260) were detected at concentrations ranging from 12 to 170 µg/kg in samples collected from Zone 7 only. Building 157, Vault 31, located within Zone 7, was a transformer area.

Ribbed mussels were deployed in cages for 28 days. Although this period may have not have allowed tissue concentrations to reach equilibrium, this exposure period was long enough for these organisms to accumulate biologically available contaminants for comparison to control samples. Analyses of the mussels indicated that chemical constituents were present. However, those same constituents were also detected at relatively the same concentrations in the control mussel samples. Mercury detected in a sample collected near Goss Cove and semivolatile compounds detected in the caged mussel samples adjacent to the Lower Subase represent two exceptions.

Chemical contaminants were also detected in native shellfish samples. However, the results were generally inconclusive in establishing a link with contamination detected at NSB-NLON. PAHs were detected in one blue mussel sample located adjacent to the Lower Subase. This may be indicative of impacts from NSB-NLON. A majority of the native shellfish samples were collected from the commercial shellfish beds that were located either across the Thames River on the other side of NSB-NLON or somewhat upstream of NSB-NLON. No commercial shellfish beds are located near NSB-NLON for sampling and monitoring purposes.

11.8.2 Contaminant Fate and Transport

Sediments in the Thames River in the vicinity of NSB-NLON located downgradient of Zones 1 through 7 showed some potential evidence of cross-contamination with detections of inorganics and PAHs. In general, concentrations of PAHs and inorganics detected in Thames River sediment samples did not differ significantly from upstream to downstream locations. Although the data indicate that site-related chemicals have migrated from the site to the Thames River, it does not appear that site-related chemicals have significantly impacted areas downstream of the site.

11.8.3 Baseline Human Health Risk Assessment

The baseline human health risk assessment for Thames River focused on adult recreational users. Noncarcinogenic risks were greater than the USEPA and CTDEP acceptable level of one for ingestion of shellfish and finfish. Arsenic, cadmium, and zinc were the main contributors to the HI. The cancer risk for the adult recreational user under the RME scenario exceed the USEPA target range of 1E-4 to 1E-6 and the CTDEP acceptable target risk level of 1E-5. The cancer risk for the CTE scenario also exceeded the CTDEP target cancer level but was within the USEPA target risk range. Arsenic (via incidental ingestion of clams and oysters) was the main contributor to the cancer risk. Incremental cancer risks for this chemical exceeded target risk levels (i.e., the upper limit of the USEPA target risk range and the 1E-5 CTDEP cumulative target cancer level).

The estimated risks associated with shellfish (oysters and clams) ingestion are overestimated to some degree. For the purposes of this risk assessment, exposure to shellfish was assumed to occur. However, individuals are not permitted to harvest shellfish from the Thames River near the Lower Subase. Also, there are no licensed recreational shellfishing areas in the Thames River.

11.8.4 Ecological Risk Assessment

Ecological risk assessments were performed for sediments in each of the seven zones near the Lower Subase. Maximum and average concentrations of contaminants detected in sediments from each zone were compared to both conservative and less conservative ecological guidelines. Historical ecological data from each zone, including toxicity testing, benthic macroinvertebrate analyses, and bioaccumulation studies, were also assessed, when available. A weight of evidence approach was used to assess potential risks that incorporated the results of the guideline screening and historical ecological analyses in each zone.

The weight of evidence indicated that potential risks to sediment-dwelling receptors were present from contaminants in Zones 1, 2, 3, 5, and 6 near the Lower Subase but were relatively low. Potential risks were present also in Zones 4 and 7 near the Lower Subase and were low to moderate. Potential risks in Zone 7 may have been ameliorated by recent dredging activities. For the most part, potential risks among all zones were confined to some metals, primarily arsenic, chromium, and mercury. Maximum and average acid-volatile sulfide (AVS) concentrations exceeded maximum and average semi-extractable metals (SEM) concentrations in all zones, suggesting that cadmium, copper, nickel, lead, and zinc were not bioavailable in sediments near the Lower Subase. The PAH compound benzo(a)pyrene was also determined to pose low to moderate risks among the zones.

Contaminant concentrations and the results of the ecological analyses conducted using sediments from the seven zones as a whole near the Lower Subase were compared to contaminant concentrations and ecological analyses conducted in other sections of the Thames River. The other sections of the Thames River that were investigated included upstream and downstream of NSB-NLON, near Goss Cove, and near the DRMO. The weight-of-evidence approach was used to determine whether the seven zones as a whole posed potential risks to sediment-dwelling receptors in the Thames River.

Similar to the Thames River sediments near the Lower Subase, AVS concentrations exceeded SEM concentrations at all locations in other sections of the Thames River where they were analyzed. In general, the range of contaminant concentrations in sediments near the Lower Subase was similar to the range of concentrations in other sections of the Thames River. Only some spotty elevated concentrations of a few metals and benzo(a)pyrene were present near the Lower Subase relative to other sections of the river. On the whole, the results of the benthic invertebrate analyses, shellfish bioaccumulation studies, and toxicity testing conducted using sediments near the Lower Subase were similar to those in other sections of the river, with a few exceptions. These included significant mortality in a toxicity test sample near Pier 17 (Zone 7) and Pier 33 (Zone 5), decreased benthic abundance near Pier 17, and elevated boron in two blue mussel samples collected near Zone 4. Again, potential risks near Pier 17 may have been reduced by recent dredging activities.

The weight of evidence suggests that potential risks are present in sediments near the Lower Subase as a whole. However, the risks are low to moderate and are generally similar to those in sections of the Thames River that do not appear to be influenced by NSB-NLON.

11.8.5 Recommendations

It is recommended that the Thames River adjacent to the Lower Subase proceed to a Feasibility Study. A limited action scenario should be evaluated in the Feasibility Study for the river adjacent to Zones 1, 2, 3, 5, and 6. The limited action recommendation indicates that the river should be further evaluated only if the recommended zone-specific, tiered groundwater monitoring programs indicate potential migration problems. If migration problems are identified, further evaluation of the Thames River should include additional surface water and sediment sampling and testing. A Data Gap Investigation is recommended for the Thames River adjacent to Zones 4 and 7. The investigation should include additional sediment sampling and testing. The results of the investigation should be combined with the results of this RI to determine the overall risks to ecological receptors adjacent to Zones 4 and 7 and the appropriate remedial alternatives to be evaluated in the Feasibility Study. If risks are shown to be significant in a zone-specific segment of the river as a result of additional testing, an active remedial action such as "hot spot" removal

should be considered as an alternative for that segment of the river. These recommendations are based on the following information:

- The nature and extent of organic and inorganic contamination in the sediment adjacent to Zones 1, 2, 3, 5, and 6 is sufficiently characterized, but further characterization of the sediment adjacent to Zones 4 and 7 is required.

- The quality of the surface water near NSB-NLON does not appear to differ significantly from the water quality noted at locations distant from NSB-NLON.

- The baseline human health risk assessment for exposure to surface water in the Thames River indicates that noncarcinogenic risks could be greater than the USEPA and CTDEP acceptable level of one for ingestion of shellfish and finfish and that carcinogenic risks could be greater than the USEPA acceptable target risk range and the CTDEP acceptable target risk level for incidental ingestion of clams and oysters. These risks are generally overestimated because exposure to shellfish was assumed to occur; however, individuals are not permitted to harvest shellfish from the Thames River near the Lower Subase and there is no recreational shellfishing areas in the Thames River.

- The zone-specific ecological risk assessments, which considered only the Lower Subase RI data and the Phase II RI data, indicate that the risks to ecological receptors are low, with the exception of Zones 4 and 7, where the estimated risks are low to moderate. All calculated HQs were less than 12.0.

- The overall Thames River ecological risk assessment, which considered all data available from recent and historic sampling events, indicates that there are potential risks to sediment dwelling organisms near the Lower Subase but that most of the risks are low and are generally similar to those in sections of the river that do not appear to be influenced by NSB-NLON.

- There is some uncertainty associated with the estimated risks because there are other significant potential sources of contamination to the Thames River upstream and downstream of the Lower Subase and NSB-NLON. The Thames River is tidally influenced and these other sources may be contributing to the contamination detected near the Lower Subase.

- The depth of the Thames River within the navigational channel is maintained so that vessels can navigate the Thames River to various ports. The depth is maintained via dredging. Dredging activities are also completed along the piers of the Lower Subase to allow submarines to dock at the

piers. Dredging occurs approximately once every 10 to 15 years. It is likely that the recent dredging activities completed along the Lower Subase for the new class of submarine removed historically contaminated sediments.

TABLE 11-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SURFACE WATER - ALL ZONES
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Sample ID	Sample Depth	Analysis					
		Target Compound List (TCL)			TAL Metals[3]		Misc.
		Volatiles	Semivolatile	Pesticides/PCBs	Total	Dissolved	
SURFACE WATER - PHASE II RI							
T3SW1S	Surface	●	●	●	●		●[2]
T3SW2S	Surface	●	●	●	●		●[2]
T3SW2B	Bottom	●	●	●	●		●[2]
T3SW3S	Surface	●	●	●	●		●[2]
T3SW3B	Bottom	●	●	●	●		●[2]
T3SW1AS	Surface	●	●	●	●	●	●[2]
T3SW1AS-D[1]	Surface	●	●	●	●	●	●[2]
T3SW1AB	Bottom	●	●	●	●		●[2]
T3SW1BS	Surface	●	●	●	●		●[2]
T3SW1BB	Bottom	●	●	●	●		●[2]
T3SW1BB-D[5]	Bottom	●	●	●	●		●[2]
6SW1S	Surface	●	●	●	●	●	●[2]
6SW1B	Bottom	●	●	●	●	●	●[2]
8SW1S	Surface	●	●	●	●	●	●[2]
8SW1B	Bottom	●	●	●	●	●	●[2]
SURFACE WATER - LOWER SUBASE RI							
LS1SW00101S	Surface						●[4]
LS1SW00101D	Bottom						●[4]
LS2SW00101S	Surface						●[4]
LS2SW00101D	Bottom						●[4]
LS3SW00101S	Surface						●[4]
LS3SW00101D	Bottom						●[4]
LS4SW00101S	Surface						●[4]

TABLE 11-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SURFACE WATER - ALL ZONES
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Sample ID	Sample Depth	Analysis					
		Target Compound List (TCL)			TAL Metals[3]		Misc.
		Volatiles	Semivolatile	Pesticides/PCBs	Total	Dissolved	
LS4SW00101D	Bottom						●[4]
LS5SW00101S	Surface						●[4]
LS5SW00101D	Bottom						●[4]
LS6SW00101S	Surface						●[4]
LS6SW00101D	Bottom						●[4]
LS7SW00101S	Surface						●[4]
LS7SW00101D	Bottom						●[4]
LS1SW00201S	Surface						●[4]
LS1SW00201D	Bottom						●[4]
LS2SW00201S	Surface						●[4]
LS2SW00201D	Bottom						●[4]
LS3SW00201S	Surface						●[4]
LS3SW00201D	Bottom						●[4]
LS4SW00201S	Surface						●[4]
LS4SW00201D	Bottom						●[4]
LS5SW00201S	Surface						●[4]
LS5SW00201D	Bottom						●[4]
LS6SW00201S	Surface						●[4]
LS6SW00201D	Bottom						●[4]
LS7SW00201S	Surface						●[4]
LS7SW00201D	Bottom						●[4]
LS1SW00301S	Surface						●[4]
LS1SW00301D	Bottom						●[4]
LS4SW00301S	Surface						●[4]

TABLE 11-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SURFACE WATER - ALL ZONES
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

Sample ID	Sample Depth	Analysis					
		Target Compound List (TCL)			TAL Metals[3]		Misc.
		Volatiles	Semivolatile	Pesticides/PCBs	Total	Dissolved	
LS4SW00301D	Bottom						●[4]
LS5SW00301S	Surface						●[4]
LS5SW00301D	Bottom						●[4]
LS7SW00301S	Surface						●[4]
LS7SW00301D	Bottom						●[4]
LS1SW00401S	Surface						●[4]
LS1SW00401D	Bottom						●[4]
LS5SW00401S	Surface						●[4]
LS5SW00401D	Bottom						●[4]

1 T3SW1AS-D is a field duplicate of T3SW1AS.
2 Miscellaneous parameters include Hardness (as $CaCO_3$).
3 Analysis for boron was also performed.
4 Miscellaenous parameters include dissolved oxygen, pH, redox potential, salinity, specific conductivity, temperature and turbidity.
5 T3SW1BB-D is a field duplicate of T3SW1BB.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - UPSTREAM
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis							
		Target Compound List (TCL)			TAL Metals[1]		AVS/SEM	AVS	Misc[2]
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved			
SEDIMENT PHASE II RI									
T1SD1	0 - 0.5		●	●	●				●
T1SD2	0 - 0.5		●	●	●				●
SEDIMENT - PHASE II RI SUPPLEMENTAL									
EC-SDTR01-02	0 - 0.5	●	●	●	●		●	●	●

1 Analysis for boron was also performed.
2 Miscellaneous parameters include Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-3

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER - DRMO
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
1 (MG-9023)	0 - 4.3		●(1)	●	●(2)					●(3)
1 (MG-9035)	0 - 4.3								●	
P1A	0 - 3		●(1)		●(2)					●(4)
P1B	3 - 6		●(1)		●(2)					●(4)
SEDIMENT - PHASE II RI										
T3SD4	0 - 0.5		●	●	●					●(4)
T4SD4	0 - 0.5		●	●	●					●(4)
T5SD4	0 - 0.5		●	●	●					●(4)
T5SD4-D	0 - 0.5		●	●	●					
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-T3SD4-02	0 - 0.5	●	●	●	●		●	●		●(4)

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.2.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.2.
3 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
4 Miscellaneous parameters include Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-4

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT- ZONE 5
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
2 (MG-9001)	0 - 3.8		●(1)	●	●(2)					●(4)
2 (MG-9015)	0 - 3.8								●	
3 (MG-9003)	0 - 6		●(1)	●						●(5)
3 (MG-9016)	0 - 6				●(2)				●	
5 (MG-9008)	0 - 5.9		●(1)	●	●(2)				●	●(4)
6 (MG-9006)	0 - 5		●(1)	●	●(2)					●(4)
SEDIMENT - PHASE II RI										
T3SD3	0 - 0.5		●	●	●(3)					●(4)
T4SD3	0 - 0.5		●	●	●(3)					●(4)
T5SD3	0 - 0.5		●	●	●(3)					●(4)
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-SDTR02-02	0 - 0.5	●	●	●	●(3)		●	●		●(4)
SEDIMENT - LOWER SUBASE RI										
LS5SD00101	0 - 0.5		●		●		●	●		●(6)
LS5SD00201	0 - 0.5		●		●		●	●		●(6)
LS5SD00301	0 - 0.5		●		●		●	●		●(6)
LS5SD00401	0- 0-.5		●	●	●		●	●		●(6)

TABLE 11-4

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT- ZONE 5
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.7.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.7.
3 Analysis for boron was also performed.
4 Miscellaneous parameters include Total Organic Carbon.
5 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
6 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.

AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-5

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - ZONE 6
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID Sample	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
4 (MG-9009)	0 - 7.6		●(1)	●	●(2)					●(5)
4 (MG-9018)	0 -7.6								●	
P2A	0 - 3		●(1)		●(2)					●(4)
P2B	3 - 6		●(1)		●(2)					●(4)
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-SDTR03-02	0 - 0.5	●	●	●	●(3)		●	●		●(4)
SEDIMENT - LOWER SUBASE RI										
LS6SD00101	0 - 0.5		●		●		●	●		●(6)
LS6SD00201	0 - 0.5		●		●		●	●		●(6)

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.8.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.8.
3 Analysis for boron was also performed.
4 Miscellaneous parameters include Total Organic Carbon.
5 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
6 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-6

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT- ZONE 7
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
B	0 - 3		●(1)	●	●(2)					●(6)
7 (MG-9030)	0 - 3.8		●(1)	●	●(2)					●(6)
8 (MG-9002)	0 - 4.5		●(1)	●	●(2)					
9 (MG-9007)	0 - 5.1		●(1)	●	●(2)					●(7)
9 (MG-9017)	0 - 5.1								●	
9 (MG-9020)	0 - 5.1	●(5)								
9 (MG-9021)	0 - 5.1				●(3)					
P2-2	3 - 6		●(1)	●	●(2)					●(6)
P2-2	6 - 8		●(1)	●	●(2)					●(6)
P2-2	8 - 10		●(1)	●	●(2)					●(6)
P2/P3	0 - 3		●(1)	●	●(2)					●(6)
SEDIMENT - PIER 15/17 REPLACEMENT(8)										
C1A-1/C1B-1/C1C-1	0 - 3		●	●	●					●(6)
C1B-1	3 - 6		●	●	●					●(6)
C1B-1	6 - 13		●	●	●					●(6)
C2-B1	3 - 6									●(6)
C2-B1	6 - 10		●	●	●					●(6)
C2A-1/C2B-1/C2C-1	0 - 3		●	●	●					●(6)
C2B-1	3 - 6		●	●	●					
C3A-1/C3B-1/C3C-1	0 - 3		●	●	●					●(6)
C3B-1	3 - 6		●	●	●					●(6)
C3B-1	6 - 9		●	●	●					

TABLE 11-6

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT- ZONE 7
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
C3B-1	9 - 12		●	●	●					
C4A-1/C4B-1/C4C-1	0 - 3		●	●	●					●(6)
C4B-1	3 - 7		●	●	●					
C4B-1	7 - 11		●	●	●					
C5A-1/C5B-1/C5C-1	0 - 3		●	●	●					●(6)
C5B-1	3 - 6		●	●	●					
C5B-1	6 - 8		●	●	●					
C6A-1/C6B-1/C6C-1	0 - 3		●(1)	●	●(2)					●(6)
C6B-1	3 - 6		●(1)	●	●(2)					
C6B-1	6 - 13		●(1)	●	●(2)					
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-SDTR04-02	0 - 0.5	●	●	●	●(4)		●	●		●(6)
SEDIMENT - LOWER SUBASE RI										
LS7SD00101	0 - 0.5		●		●		●	●		●(8)
LS7SD00201	0 - 0.5		●		●		●	●		●(8)
LS7SD00301	0 - 0.5		●		●		●	●		●(8)

TABLE 11-6

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT- ZONE 7
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.9.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.9.
3 This sample was analyzed for cyanide only.
4 Analysis for boron was also performed.
5 This sample was only analyzed for methylene chloride.
6 Miscellaneous parameters include Total Organic Carbon.
7 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
8 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.

AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-7

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - ZONE 1
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
10S	0 - 6		●(1)	●	●(2)					●(4)
8N	0 - 6		●(1)	●	●(2)					●(4)
M1A	0 - 3		●(1)		●(2)					●(4)
M1B	3 - 6		●(1)		●(2)					●(4)
SEDIMENT- PHASE II RI SUPPLEMENTAL										
EC-SDTR05-02	0 - 0.5	●	●	●	●(3)		●	●		●(4)
SEDIMENT - LOWER SUBASE RI										
LS1SD00101	0 - 0.5		●		●		●	●		●(5)
LS1SD00201	0 - 0.5		●		●		●			●(5)
LS1SD00301	0 - 0.5		●		●		●			●(5)
LS1SD00401	0 - 0.5		●		●		●			●(5)

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.3.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.3.
3 Analysis for boron was also performed.
4 Miscellaneous parameters include Total Organic Carbon.
5 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-8

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - ZONE 2
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
10 (MG-9004)	0 - 3.8		●(1)	●	●(2)					●(4)
8S	0 - 6		●(1)	●	●(2)					●(4)
SEDIMENT - PHASE II RI										
T3SD2	0 - 0.5		●	●	●(3)					●(4)
SEDIMENT - LOWER SUBASE RI										
LS2SD00101	0 - 0.5		●		●		●			●(5)
LS2SD00201	0 - 0.5		●		●		●			●(5)

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.4.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.4.
3 Analysis for boron was also performed.
4 Miscellaneous parameters include Total Organic Carbon.
5 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-9

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - ZONE 3
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - PHASE II RI										
T4SD2	0 - 0.5		●	●	●(1)					●(2)
T5SD2	0- 0.5		●	●	●(1)					●(2)
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-T4SD2-02	0 - 0.5	●	●	●	●(1)		●	●		●(2)
SEDIMENT - LOWER SUBASE RI										
LS3SD00101	0 - 0.5		●		●		●	●		●(3)
LS3SD00201	0 - 0.5		●		●		●	●		●(3)
SDFD001(4)	0 - 0.5		●		●		●	●		●(3)

1 Analysis for boron was also performed.
2 Miscellaneous parameters include Total Organic Carbon.
3 Miscellaneous parameters include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.
4 SDFD001 is a field duplicate of LS3SD00201.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-10

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - ZONE 4
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
11 (MG-9010)	0 - 5.1		●(2)	●	●(3)					●(5)
11 (MG-9019)	0 - 5.1								●	
11 (MG-9022)	0 - 5.1	●(1)	●(2)							
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-SDTR06-02	0 - 0.5	●(1)	●	●	●(4)		●	●		●(6)
DUP-07(8)	0 - 0.5	●(1)	●	●	●(4)		●	●		●(6)
SEDIMENT - LOWER SUBASE RI										
LS4SD00101	0 - 0.5		●		●		●	●		●(7)
LS4SD00201	0 - 0.5		●		●		●			●(7)
LS4SD00301	0 - 0.5		●		●		●			●(7)

1 This sample was analyzed for a shortened list of volatile organic compounds as shown in the database, Appendix H.4.1.6.
2 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.6.
3 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.6.
4 Analysis for boron was also performed.
5 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
6 Miscellaneous parameters include Total Organic Carbon.
7 Miscellaneous parametes include Ammonia as Nitrogen, pH, Grain Size Analysis, and Total Organic Carbon.
8 DUP-07 is a field duplicate of EC-SDTR06-02.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-11

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - GOSS COVE
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
12 (MG-9012)	0 - 2.8		●(1)	●	●(2)					●(5)
13 (MG-9011)	0 - 3.8		●(1)	●	●(2)					●(4)
14 (MG-9005)	0 - 3.3		●(1)	●	●(2)					
M2A	0 - 3		●(1)		●(2)					●(4)
M2B	3 - 6		●(1)		●(2)					●(4)
SEDIMENT - PHASE II RI										
T3SD1	0 - 0.5	●	●	●	●(3)					●(4)
T3SD1-D	0 - 0.5	●	●	●	●(3)					
T4SD1	0 - 0.5		●	●	●(3)					●(4)
T5SD1	0 - 0.5		●	●	●(3)					●(4)
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-T3SD1-02	0 - 0.5	●	●	●	●(3)		●	●		●(4)

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.10.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.10.
3 Analysis for boron was also performed.
4 Miscellaneous parameters include Total Organic Carbon.
5 Miscellaneous parameters include Total Organic Carbon, dibutyl tin, monobutyl tin, and tributyl tin.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-12

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER SEDIMENT - DOWNSTREAM
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis								
		Target Compound List (TCL)			TAL Metals		AVS/SEM	AVS	TPH	Misc[3]
		Volatiles	Semivolatiles	Pesticides/PCBs	Total	Dissolved				
SEDIMENT - SEAWOLF EIS										
C	0 - 3		●[1]	●	●[2]					●
D	0 - 3		●[1]	●	●[2]					●
E	0 - 3		●[1]	●	●[2]					●
15 (MG-9029)	0 - 3.8		●[1]	●	●[2]					●
16 (MG-9028)	0 - 4.4		●[1]	●	●[2]					●
17 (MG-9027)	0 - 4.4		●[1]	●	●[2]					●
18 (MG-9026)	0 - 5.5		●[1]	●	●[2]					●
19 (MG-9024)	0 - 5.5		●[1]	●	●[2]					●
SEDIMENT - PHASE II RI										
T2SD1	0 - 0.5		●	●	●					●
T2SD2	0 - 0.5		●	●	●					●
SEDIMENT - PHASE II RI SUPPLEMENTAL										
EC-SDTR07-02	0 - 0.5	●	●	●	●		●	●		●

1 This sample was analyzed for a shortened list of semivolatile organic compounds as shown in the database, Appendix H.4.1.11.
2 This sample was analyzed for a shortened list of metals as shown in the database, Appendix H.4.1.11.
3 Miscellaneous parameters include Total Organic Carbon.
AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.
TPH - Total Petroleum Hydrocarbons.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-13

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM FOR THAMES RIVER LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT

Sample ID	Sample Depth (feet below ground)	Analysis				
		Target Compound List (TCL)				TAL Metals[1]
		Volatiles	Semivolatiles	Pesticides	PCBs[2]	Total
BIOTA - PHASE II RI ROUND 1						
CMU1	NA	●	●	●	●	●
CMU1-R[3]	NA	●	●	●	●	●
CMU2	NA	●	●	●	●	●
CMU2-R[4]	NA	●	●	●	●	●
CMU3	NA	●	●	●	●	●
CMU4	NA	●	●	●	●	●
CMU4-R[5]	NA	●	●	●	●	●
CMU5	NA	●	●	●	●	●
CMU5-R[6]	NA	●	●	●	●	●
MU-C	NA	●	●	●	●	●
MU-CD[7]	NA	●	●	●	●	●
BVO1	NA		●	●	●	●
BVO2	NA		●	●	●	●
BVO3	NA		●	●	●	●
BV03-D[8]	NA		●	●	●	●
BVO4	NA		●	●	●	●
MU1	NA		●	●	●	●
MU2	NA		●	●	●	●
MU3	NA		●	●	●	●
MU4	NA		●	●	●	●
MU5	NA		●	●	●	●
MU6	NA		●	●	●	●
BVC1	NA		●	●	●	●
BVC2	NA		●	●	●	●
BVC3	NA		●	●	●	●

1 Analysis for boron was also performed.
2 Polychlorinated biphenyls.
3 CMU1-R is a replicate of CMU1.
4 CMU2-R is a replicate of CMU2.
5 CMU4-R is a replicate of CMU4.
6 CMU5-R is a replicate of CMU5.
7 MU-CD is a replicate of MU-C.
8 BV03-D is a repliacte of BV03.
NA - Not applicable.
● - Sample was analyzed for this parameter.
Blank cell indicates that this analysis was not performed for this sample.

TABLE 11-14 (PAGE 1 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	6SW1B	6SW1B-DISS	6SW1S	6SW1S-DISS	8SW1B	8SW1B-DISS
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	12/17/93	12/17/93	12/17/93	12/17/93	12/17/93	12/17/93
LOCATION:	6SW1	6SW1	6SW1	6SW1	8SW1	8SW1
VALIDATED:	VALIDATED		VALIDATED		VALIDATED	
FILTERING:	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
TRICHLOROETHENE	10 U		3 J		10 U	
SEMIVOLATILES (µg/L)						
BUTYLBENZYL PHTHALATE	10 U		0.5 J		10 U	
DI-N-BUTYL PHTHALATE	10 U		10 U		10 U	
PESTICIDES/PCBs (µg/L)						
ENDRIN ALDEHYDE	0.1 U		0.1 U		0.1 U	
METALS (µg/L)						
ALUMINUM	14.0 U	14.0 U	24.8 J	14.0 J	14.0 U	14.0 U
BARIUM	5.4 R	5.2 J	6.6 R	6.1 J	5.4 R	5.2 J
BORON	2540	2580 J	1450 J	1560 J	3330 J	3210 J
CADMIUM	2.0 UJ		2.0 UJ		2.0 UJ	
CALCIUM	198000	208000	116000	130000	261000	258000
CHROMIUM		3.4 J		3.0 UJ		3.0 UJ
IRON	81.9 J		120		51.0 J	
LEAD	10.0 UJ		1.0 UJ		10.0 UJ	
MAGNESIUM	658000	680000	372000	411000	858000	852000
MANGANESE	11.7 J	16.2	22.0	25.9	6.2 J	8.6 U
MERCURY	0.26		0.24		0.32	
POTASSIUM	344000	363000 J	159000	183000 J	503000	499000 J
SODIUM	685000		345000		890000	
VANADIUM	5.0 UJ	6.1 UJ	5.0 UJ	5.0 UJ	6.7 J	5.0 UJ
ZINC	2.0 UJ		2.0 UJ		2.0 UJ	
MISCELLANEOUS PARAMETERS (mg/L)						
HARDNESS AS CaCO3 (MG/L)	4840		2640		3760	

TABLE 11-14 (PAGE 2 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	8SW1S	8SW1S-DISS	LS1SW00101S	LS1SW00101D	LS2SW00101S	LS2SW00101D
INVESTIGATION:	PH2-1	PH2-1	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	12/17/93	12/17/93	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	8SW1	8SW1	SW/SD1-1RI	SW/SD1-1RI	SW/SD1-2RI	SW/SD1-2RI
VALIDATED:	VALIDATED					
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
VOLATILES (µg/L)						
TRICHLOROETHENE	10 U					
SEMIVOLATILES (µg/L)						
BUTYLBENZYL PHTHALATE	10 U					
DI-N-BUTYL PHTHALATE	10 U					
PESTICIDES/PCBs (µg/L)						
ENDRIN ALDEHYDE	0.1 U					
METALS (µg/L)						
ALUMINUM	29.5 J	14.0 U				
BARIUM	6.6 R	5.8 J				
BORON	2110 J	2160 J				
CADMIUM	10.2 J					
CALCIUM	169000	177000				
CHROMIUM		3.1 J				
IRON	114					
LEAD	10.0 UJ					
MAGNESIUM	549000	578000				
MANGANESE	17.6	19.9				
MERCURY	0.49					
POTASSIUM	268000	289000 J				
SODIUM	565000					
VANADIUM	5.0 UJ	5.8 J				
ZINC	2.0 UJ					
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)			8.54	7.66	7.68	6.92

TABLE 11-14 (PAGE 3 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	8SW1S	8SW1S-DISS	LS1SW00101S	LS1SW00101D	LS2SW00101S	LS2SW00101D
INVESTIGATION:	PH2-1	PH2-1	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	12/17/93	12/17/93	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	8SW1	8SW1	SW/SD1-1RI	SW/SD1-1RI	SW/SD1-2RI	SW/SD1-2RI
VALIDATED:	VALIDATED					
FILTERING:	Unfiltered	Filtered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
PH (NONE)			7.8	7.84	7.82	7.84
REDOX POTENTIAL (MV)			151.5	150.8	176.8	174.8
SALINITY (PPT)			27.02	28.99	27.36	29.13
SPECIFIC CONDUCTIVITY (MS/CM)			42.03	44.81	42.53	44.96
TEMPERATURE (C)			15.52	16.02	15.44	15.95
TURBIDITY (NTU)			0.8	3.5	-1.8 R	-0.7 R
MISCELLANEOUS PARAMETERS (mg/L)						
HARDNESS AS CaCO3 (MG/L)	3440					

TABLE 11-14 (PAGE 4 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS3SW00101S	LS3SW00101D	LS4SW00101S	LS4SW00101D	LS5SW00101S	LS5SW00101D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	SW/SD1-3RI	SW/SD1-3RI	SW/SD1-4RI	SW/SD1-4RI	SW/SD1-5RI	SW/SD1-5RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	8.21	7	7.47	6.88	8.72	7.53
PH (NONE)	7.82	7.84	7.81	7.81	7.78	7.75
REDOX POTENTIAL (MV)	174.4	174.3	172	166.3	162.2	162.6
SALINITY (PPT)	27.49	29.21	27.32	28.87	23.8	27.38
SPECIFIC CONDUCTIVITY (MS/CM)	42.65	45.02	42.45	44.49	37.44	42.56
TEMPERATURE (C)	15.48	15.92	15.58	15.93	13.72	15.81
TURBIDITY (NTU)	-2.3 R	-0.2 R	6.3	30.3	-1.9 R	-1.8 R

TABLE 11-14 (PAGE 5 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SW00101S	LS6SW00101D	LS7SW00101S	LS7SW00101D	LS1SW00201S	LS1SW00201D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	SW/SD1-6RI	SW/SD1-6RI	SW/SD1-7RI	SW/SD1-7RI	SW/SD2-1RI	SW/SD2-1RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	8.80	8	10.12	7.96	8.84	7.59
PH (NONE)	7.87	7.84	7.89	7.84	7.5	7.76
REDOX POTENTIAL (MV)	216.9	217.4	181.2	181.9	127.1	125.6
SALINITY (PPT)	25.09	28.14	26.58	28.79	26.82	29.01
SPECIFIC CONDUCTIVITY (MS/CM)	39.29	43.7	41.2	44.29	41.72	44.79
TEMPERATURE (C)	15.41	15.89	15.26	15.86	15.65	16.01
TURBIDITY (NTU)	0.9	0.9	5.60	2.2	0.8	1.4

TABLE 11-14 (PAGE 6 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS2SW00201S	LS2SW00201D	LS3SW00201S	LS3SW00201D	LS4SW00201S	LS4SW00201D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	SW/SD2-2RI	SW/SD2-2RI	SW/SD2-3RI	SW/SD2-3RI	SW/SD2-4RI	SW/SD2-4RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	7.58	6.89	7.86	6.9	7.95	6.99
PH (NONE)	7.82	7.85	7.74	7.82	7.81	7.84
REDOX POTENTIAL (MV)	197.5	154.3	181.4	179.3	199.1	196.9
SALINITY (PPT)	27.32	29.17	27.57	29.09	27.14	29.23
SPECIFIC CONDUCTIVITY (MS/CM)	42.44	45.03	43.76	44.9	42.36	45.1
TEMPERATURE (C)	15.48	15.94	14.23	15.97	15.14	15.92
TURBIDITY (NTU)	6.8	46.7	0.1	-1 R	6.8	7.4

TABLE 11-14 (PAGE 7 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS5SW00201S	LS5SW00201D	LS6SW00201S	LS6SW00201D	LS7SW00201S	LS7SW00201D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97	10/21/97
LOCATION:	SW/SD2-5RI	SW/SD2-5RI	SW/SD2-6RI	SW/SD2-6RI	SW/SD2-7RI	SW/SD2-7RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	8.42	7.34	8.84	7.52	8.79	7.27
PH (NONE)	7.8	7.81	7.61	7.68	7.88	7.85
REDOX POTENTIAL (MV)	169.8	169.9	208.3	201.1	214	209.2
SALINITY (PPT)	24.34	28.08	23.76	26.23	25.88	29
SPECIFIC CONDUCTIVITY (MS/CM)	38.44	43.56	37.42	40.95	40.4	44.79
TEMPERATURE (C)	14.84	15.91	13.61	15.42	15.52	15.96
TURBIDITY (NTU)	-1.4 R	-1.1 R	-1.8 R	-2.1 R	1	8.1

TABLE 11-14 (PAGE 8 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS1SW00301S	LS1SW00301D	LS4SW00301S	LS4SW00301D	LS5SW00301S	LS5SW00301D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/22/97	10/22/97
LOCATION:	SW/SD3-1RI	SW/SD3-1RI	SW/SD3-4RI	SW/SD3-4RI	SW/SD3-5RI	SW/SD3-5RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	8.6	7.68	7.23	6.8	8.44	7.39
PH (NONE)	7.87	7.85	7.60	7.74	7.81	7.78
REDOX POTENTIAL (MV)	223.6	220.1	207	204.4	156.8	157.7
SALINITY (PPT)	26.27	28.83	27.73	28.42	23.83	26.2
SPECIFIC CONDUCTIVITY (MS/CM)	40.99	44.4	43.02	44	37.52	40.87
TEMPERATURE (C)	15.71	15.92	15.55	16.06	14.19	16.36
TURBIDITY (NTU)	16.4	3.9	-1.7 R	-2.9 R	-1.7 R	-1.4 R

TABLE 11-14 (PAGE 9 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS7SW00301S	LS7SW00301D	LS1SW00401S	LS1SW00401D	LS5SW00401S	LS5SW00401D
INVESTIGATION:	1997RI	1997RI	1997RI	1997RI	1997RI	1997RI
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	10/21/97	10/22/97	10/22/97
LOCATION:	SW/SD3-7RI	SW/SD3-7RI	SW/SD4-1RI	SW/SD4-1RI	SW/SD4-5RI	SW/SD4-5RI
VALIDATED:						
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:						
WATER QUALITY PARAMETERS (mg/L)						
DISSOLVED OXYGEN (MG/L)	9.18	7.77	8.38	7.55	8.42	7.27
PH (NONE)	7.88	7.84	7.86	7.83	7.82	7.78
REDOX POTENTIAL (MV)	231.8	229.4	241.5	222.1	204	201
SALINITY (PPT)	25.58	28.01	26.76	28.06	23.78	27.49
SPECIFIC CONDUCTIVITY (MS/CM)	40.08	43.31	41.72	43.54	37.49	42.69
TEMPERATURE (C)	15.3	15.79	15.63	15.91	14.23	15.84
TURBIDITY (NTU)	0.9	0.4	0.5	29.3	-1.7 R	-1.5 R

TABLE 11-14 (PAGE 10 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T3SW1AB	T3SW1AS	T3SW1AS-D	T3SW1AS-DISS	T3SW1AS-DISS-D	T3SW1BB
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	12/17/93	12/17/93	12/17/93	12/17/93	12/17/93	12/17/93
LOCATION:	T3SW1AS/B	T3SW1AS/B	T3SW1AS/B	T3SW1AS/B	T3SW1AS/B	T3SW1BS/B
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			VALIDATED
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Filtered	Filtered	Unfiltered
FIELD DUPLICATE OF:			T3SW1AS		T3SW1AS-DISS	
VOLATILES (µg/L)						
TRICHLOROETHENE	10 U	10 U	10 U			10 U
SEMIVOLATILES (µg/L)						
BUTYLBENZYL PHTHALATE	10 U	10 U	10 U			10 U
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U			10 U
PESTICIDES/PCBs (µg/L)						
ENDRIN ALDEHYDE	0.1 U	0.1 U	0.1 U			0.1 U
METALS (µg/L)						
ALUMINUM	14.0 U	29.4 J	26.0 J	14.0 U	14.0 U	14.0 U
BARIUM	5.4 R	7.2 R	6.6 R	6.9 J	7.8 J	6.6 R
BORON	3130 J	1720 J	1560 J	1650 J	1600 J	2480 J
CADMIUM	2.0 UJ	2.0 UJ	2.0 UJ			2.0 UJ
CALCIUM	243000	140000	128000	135000	133000	193000
CHROMIUM				3.0 UJ	3.0 UJ	
IRON	57.0 J	132	122			90.2 J
LEAD	10.0 UJ	1.5 J	1.5 J			10.0 UJ
MAGNESIUM	801000	444000	410000	431000	421000	639000
MANGANESE	6.6 J	24.7	23.3	25.2	25.5	15.7
MERCURY	0.3	0.26	0.25			0.33
POTASSIUM	457000	202000	182000	194000 J	188000 J	333000
SODIUM	872000	426000	397000			693000
VANADIUM	5.0 UJ	6.9 J	5.0 UJ	5.0 UJ	5.6 J	5.0 J
ZINC	2.0 UJ	2.0 UJ	2.0 UJ			2.0 UJ
MISCELLANEOUS PARAMETERS (mg/L)						
HARDNESS AS CaCO3 (MG/L)	3560	2760	2560			4120

TABLE 11-14 (PAGE 11 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER: INVESTIGATION: SAMPLE DATE: LOCATION: VALIDATED: FILTERING: FIELD DUPLICATE OF:	T3SW3S PH2-1 12/17/93 T3SW3S/B VALIDATED Unfiltered	/ /	/ /	/ /	/ /	/ /
VOLATILES (µg/L)						
TRICHLOROETHENE	10 U					
SEMIVOLATILES (µg/L)						
BUTYLBENZYL PHTHALATE	10 U					
DI-N-BUTYL PHTHALATE	10 U					
PESTICIDES/PCBs (µg/L)						
ENDRIN ALDEHYDE	0.1 U					
METALS (µg/L)						
ALUMINUM	14.0 U					
BARIUM	6.6 R					
BORON	2210 J					
CADMIUM	2.0 UJ					
CALCIUM	176000					
IRON	95.9 J					
LEAD	10.0 UJ					
MAGNESIUM	575000					
MANGANESE	16.7					
MERCURY	0.31					
POTASSIUM	288000					
SODIUM	596000					
VANADIUM	5.3 J					
ZINC	2.0 UJ					
MISCELLANEOUS PARAMETERS (mg/L)						
HARDNESS AS CaCO3 (MG/L)	3560					

TABLE 11-14 (PAGE 12 OF 12)

SUMMARY OF POSITIVE SURFACE WATER ANALYTICAL RESULTS LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T3SW1BB-D	T3SW1BS	T3SW1S	T3SW2B	T3SW2S	T3SW3B
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	12/17/93	12/17/93	12/18/93	11/09/93	11/09/93	12/17/93
LOCATION:	T3SW1BS/B	T3SW1BS/B	T3SW1S/B	T3SW2S/B	T3SW2S/B	T3SW3S/B
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
FILTERING:	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered	Unfiltered
FIELD DUPLICATE OF:	T3SW1BB					
VOLATILES (µg/L)						
TRICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	10 U
SEMIVOLATILES (µg/L)						
BUTYLBENZYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	10 U	10 U	0.6 J	10 U	10 U	10 U
PESTICIDES/PCBs (µg/L)						
ENDRIN ALDEHYDE	0.1 U	0.1 U	0.1 U	0.14	0.1 U	0.1 U
METALS (µg/L)						
ALUMINUM	14.0 U	19.1 J	79.6 J	14.0 U	16.3	14.0 U
BARIUM	5.8 R	6.6 R	25.9 J	5.4 R	6.6 R	5.4 R
BORON	2430 J	1620 J	518	3100 J	1980 J	3210 J
CADMIUM	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ
CALCIUM	191000	129000	50900	240000	157000	249000
IRON	86.1 J	128	425	70.3 J	106	71.3 J
LEAD	10.0 UJ	1.0 J	1.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
MAGNESIUM	630000	416000	128000	800000	517000	826000
MANGANESE	12.8 J	23.4	148	6.7 J	19.4	7.7 J
MERCURY	0.29	0.3	0.25	0.39	0.41	0.36
POTASSIUM	324000	185000	46700	462000	248000	480000
SODIUM	6730000	462000	118000	867000	540000	117000
VANADIUM	6.9 J	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
ZINC	2.0 UJ	2.0 UJ	6.7 J	2.0 UJ	2.0 UJ	2.0 UJ
MISCELLANEOUS PARAMETERS (mg/L)						
HARDNESS AS CaCO3 (MG/L)	4360	2440	960	2400	3200	2240

TABLE 11-15

SUMMARY OF SURFACE WATER ANALYTICAL RESULTS - THAMES RIVER
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Shallow[1]			Deep[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (μg/L)						
Trichloroethene	1/7	3	6SW1	NA	NA	ND
SEMIVOLATILE ORGANICS (μg/L)						
Butylbenzyl phthalate	1/7	0.5	6SW1	0/8	ND	ND
Di-N-butyl phthalate	1/7	0.6	T3SW1S/B	0/8	ND	ND
PESTICIDES/PCBs (μg/L)						
Endrin aldehyde	0/7	ND	ND	1/8	0.14	T3SW2S/B
INORGANICS (μg/L)						
Aluminum	6/7	16.3 - 79.6	T3SW1S/B	1/8	26	T3SW1AS/B
Aluminum, filtered	1/3	14	6SW1	0/3	ND	ND
Barium	1/1	25.9	T3SW1S/B	R	R	ND
Barium, filtered	3/3	5.8 - 6.9	T3SW1AS/B	3/3	5.2 - 7.8	T3SW1AS/B
Boron	7/7	518 - 2210	T3SW3S/B	8/8	1560 - 3330	8SW1
Boron, filtered	3/3	1560 - 2160	8SW1	3/3	1600 - 3210	8SW1
Cadmium	1/7	10.2	8SW1	0/8	ND	ND
Calcium	7/7	50900 - 176000	T3SW3S/B	8/8	128000 - 261000	8SW1
Calcium, filtered	3/3	130000 - 177000	8SW1	3/3	133000 - 258000	8SW1
Chromium, filtered	1/3	3.1	8SW1	1/3	3.4	6SW1
Iron	7/7	95.9 - 425	T3SW1S/B	8/8	51 - 122	T3SW1AS/B
Lead	2/7	1 - 1.5	T3SW1AS/B	1/8	1.5	T3SW1AS/B
Magnesium	7/7	128000 - 575000	T3SW3S/B	8/8	410000 - 858000	8SW1
Magnesium, filtered	3/3	411000 - 578000	8SW1	3/3	421000 - 852000	8SW1
Manganese	7/7	16.7 - 148	T3SW1S/B	8/8	6.2 - 23.3	T3SW1AS/B
Manganese, filtered	3/3	19.9 - 25.9	6SW1	2/3	16.2 - 25.5	T3SW1AS/B
Mercury	7/7	0.24 - 0.49	8SW1	8/8	0.25 - 0.39	T3SW2S/B
Potassium	7/7	46700 - 288000	T3SW3S/B	8/8	182000 - 503000	8SW1
Potassium, filtered	3/3	183000 - 289000	8SW1	3/3	188000 - 499000	8SW1
Sodium	7/7	118000 - 596000	T3SW3S/B	8/8	117000 - 6730000	T3SW1BS/B

TABLE 11-15

SUMMARY OF SURFACE WATER ANALYTICAL RESULTS - THAMES RIVER
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Shallow[1]			Deep[2]		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Vanadium	2/7	5.3 - 6.9	T3SW1AS/B	3/8	5 - 6.9	T3SW1BS/B
Vanadium, filtered	1/3	5.8	8SW1	1/3	5.6	T3SW1AS/B
Zinc	1/7	6.7	T3SW1S/B	0/8	ND	ND
MISCELLANEOUS						
Dissolved oxygen (mg/L)	20/20	7.23 - 10.12	SW/SD1-7RI	20/20	6.8 - 8	SW/SD1-6RI
Hardness as CaCO3 (mg/L)	7/7	960 - 3560	T3SW3S/B	8/8	2240 - 4840	6SW1
pH	20/20	7.5 - 7.89	SW/SD1-7RI	20/20	7.68 - 7.85	SW/SD3-1RI SW/SD2-2RI SW/SD2-7RI
Redox potential (mV)	20/20	127.1 - 241.5	SW/SD4-1RI	20/20	125.6 - 229.4	SW/SD3-7RI
Salinity (ppt)	20/20	23.76 - 27.73	SW/SD3-4RI	20/20	26.2 - 29.23	SW/SD2-4RI
Specific conductivity (ms/cm)	20/20	37.42 - 43.76	SW/SD2-3RI	20/20	40.87 - 45.1	SW/SD2-4RI
Temperature (C)	20/20	13.61 - 15.71	SW/SD3-1RI	20/20	15.42 - 16.36	SW/SD3-5RI
Turbidity (NTU)	12/12	0.1 - 16.4	SW/SD3-1RI	11/11	0.4 - 46.7	SW/SD2-2RI

1 Includes samples 6SW1S, 8SW1S, LS1SW00101S, LS1SW00201S, LS1SW00301S, LS1SW00401S, LS2SW00101S, LS2SW00201S, LS3SW00101S, LS3SW00201S, LS4SW00101S, LS4SW00201S, LS4SW00301S, LS5SW00101S, LS5SW00201S, LS5SW00301S, LS5SW00401S, LS6SW00101S, LS6SW00201S, LS7SW00101S, LS7SW00201S, LS7SW00301S, T3SW1AS, T3SW1BS, T3SW1S, T3SW2S, T3SW3S.

2 Includes samples 6SW1B, 8SW1B, LS1SW00101D, LS1SW00201D, LS1SW00301D, LS1SW00401D, LS2SW00101D, LS2SW00201D, LS3SW00101D, LS3SW00201D, LS4SW00101D, LS4SW00201D, LS4SW00301D, LS5S200101D, LS5SW00201D, LS5SW00301D, LS5SW00401D, LS6SW00101D, LS6SW00201D, LS7SW00101D, LS7SW00201D, LS7SW00301D, T3SW1AB, T3SW1AS-D (field duplicate of T3SW1AS), T3SW1BB, T3SW1BB-D (field duplicate of T3SW1BB), T3SW2B, T3SW3B.

R - All analytical results were rejected for this parameter.

NA - Not Analyzed.

ND - Not Detected.

TABLE 11-16 (PAGE 1 OF 3)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - UPSTREAM LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR01-02	T1SD1	T1SD2			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	ECO-2	PH2-1	PH2-1			
SAMPLE DATE:	05/03/95	11/12/93	11/12/93	/ /	/ /	/ /
LOCATION:	EC-SDTR01	T1SD1	T1SD2			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
ACETONE	19					
SEMIVOLATILES (µg/kg)						
ACENAPHTHYLENE	570 U	1800 U	100 J			
ANTHRACENE	73 J	130 J	160 J			
BENZO(A)ANTHRACENE	360 J	410 J	500 J			
BENZO(A)PYRENE	470 J	510 J	620 J			
BENZO(B)FLUORANTHENE	570 U	880 J	1100 J			
BENZO(G,H,I)PERYLENE	200 J	380 J	370 J			
BENZO(K)FLUORANTHENE	620	1800 U	1200 U			
CARBAZOLE	570 U	1800 U	81 J			
CHRYSENE	480 J	570 J	680 J			
DI-N-OCTYL PHTHALATE	9 J	1800 UJ	1200 UJ			
DIBENZO(A,H)ANTHRACENE	66 J	1800 U	1200 U			
FLUORANTHENE	370 J	680 J	1000 J			
INDENO(1,2,3-CD)PYRENE	220 J	470 J	500 J			
PHENANTHRENE	170 J	380 J	540 J			
PYRENE	640	790 J	1000 J			
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	5.7 U	14 J	17 J			
4,4'-DDE	5.7 U	6.3 J	7.8 J			
ALPHA-CHLORDANE	2.9 U	92 U	3.1 J			
DIELDRIN	5.7 U	14 J	5.3 J			

TABLE 11-16 (PAGE 2 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - UPSTREAM
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR01-02	T1SD1	T1SD2			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	ECO-2	PH2-1	PH2-1			
SAMPLE DATE:	05/03/95	11/12/93	11/12/93	/ /	/ /	/ /
LOCATION:	EC-SDTR01	T1SD1	T1SD2			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
ENDRIN ALDEHYDE	5.7 U	180 U	7.5 J			
GAMMA-CHLORDANE	2.9 U	92 U	11 J			
HEPTACHLOR	2.9 U	14 J	64 U			
METALS (mg/kg)						
ALUMINUM	7230	13700	11500			
ANTIMONY	1.5	38.1 J	27 J			
ARSENIC	5.6	10.9 J	8.3 J			
BARIUM	27	48.5	41.6			
BERYLLIUM	0.47	0.69	0.55			
BORON	26.5	151 U	72.9 U			
CALCIUM	4140	5110 J	3230 J			
CHROMIUM	34	79.6 J	69 J			
COBALT	4.5	7	6.4			
COPPER	28.5	83.7	70.8			
IRON	13400	23800	18500			
LEAD	26.5	85.6	91.2			
MAGNESIUM	4700	7490	6120			
MANGANESE	162	234 J	190 J			
MERCURY	0.21 U	0.5 J	0.48 J			
NICKEL	14.3	22.6	23			
POTASSIUM	2600	3590	2720			
SODIUM	9450	16400	11100			

TABLE 11-16 (PAGE 3 OF 3)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - UPSTREAM LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR01-02	T1SD1	T1SD2			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	ECO-2	PH2-1	PH2-1			
SAMPLE DATE:	05/03/95	11/12/93	11/12/93	/ /	/ /	/ /
LOCATION:	EC-SDTR01	T1SD1	T1SD2			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
VANADIUM	23	38.7	33.4			
ZINC	58	130 J	119 J			
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	0.22					
CHROMIUM(SEM)	5.2					
COPPER(SEM)	7.5					
LEAD(SEM)	21					
NICKEL(SEM)	1.9					
ZINC(SEM)	3.1					
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	270					
TOTAL ORGANIC CARBON	662	13000	15000			

TABLE 11-17

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - UPSTREAM[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
Acetone	1/1	19	EC-SDTR01
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthylene	1/3	100	T1SD2
Anthracene	3/3	73 - 160	T1SD2
Benzo(a)anthracene	3/3	360 - 500	T1SD2
Benzo(a)pyrene	3/3	470 - 620	T1SD2
Benzo(b)fluoranthene	2/3	880 - 1100	T1SD2
Benzo(g,h,i)perylene	3/3	200 - 380	T1SD1
Benzo(k)fluoranthene	1/3	620	EC-SDTR01
Carbazole	1/3	81	T1SD2
Chrysene	3/3	480 - 680	T1SD2
Di-N-octyl phthalate	1/3	9	EC-SDTR01
Dibenzo(a,h)anthracene	1/3	66	EC-SDTR01
Fluoranthene	3/3	370 - 1000	T1SD2
Indeno(1,2,3-Cd)pyrene	3/3	220 - 500	T1SD2
Phenanthrene	3/3	170 - 540	T1SD2
Pyrene	3/3	640 - 1000	T1SD2
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	2/3	14 - 17	T1SD2
4,4'-DDE	2/3	6.3 - 7.8	T1SD2
Alpha-Chlordane	1/3	3.1	T1SD2
Dieldrin	2/3	5.3 - 14	T1SD1
Endrin aldehyde	1/3	7.5	T1SD2
Gamma-Chlordane	1/3	11	T1SD2
Heptachlor	1/3	14	T1SD1
INORGANICS (mg/kg)			
Aluminum	3/3	7230 - 13700	T1SD1
Antimony	3/3	1.5 - 38.1	T1SD1
Arsenic	3/3	5.6 - 10.9	T1SD1
Barium	3/3	27 - 48.5	T1SD1
Beryllium	3/3	0.47 - 0.69	T1SD1
Boron	1/3	26.5	EC-SDTR01
Cadmium (AVS/SEM)[2]	1/1	0.22	EC-SDTR01
Calcium	3/3	3230 - 5110	T1SD1
Chromium	3/3	34 - 79.6	T1SD1
Chromium (AVS/SEM)	1/1	5.2	EC-SDTR01
Cobalt	3/3	4.5 - 7	T1SD1
Copper	3/3	28.5 - 83.7	T1SD1
Copper (AVS/SEM)	1/1	7.5	EC-SDTR01
Iron	3/3	13400 - 23800	T1SD1

TABLE 11-17

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - UPSTREAM[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Lead	3/3	26.5 - 91.2	T1SD2
Lead (AVS/SEM)	1/1	21	EC-SDTR01
Magnesium	3/3	4700 - 7490	T1SD1
Manganese	3/3	162 - 234	T1SD1
Mercury	2/3	0.48 - 0.5	T1SD1
Nickel	3/3	14.3 - 23	T1SD2
Nickel (AVS/SEM)	1/1	1.9	EC-SDTR01
Potassium	3/3	2600 - 3590	T1SD1
Sodium	3/3	9450 - 16400	T1SD1
Vanadium	3/3	23 - 38.7	T1SD1
Zinc	3/3	58 - 130	T1SD1
Zinc (AVS/SEM)	1/1	3.1	EC-SDTR01
MISCELLANEOUS (mg/kg)			
Total organic carbon	3/3	662 - 15000	T1SD2
Acid volatile sulfide	1/1	270	EC-SDTR01

1 Includes samples EC-SDTR01-02, TISD1, TISD2.
2 AVS/SEM = Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-18 (PAGE 1 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9023	MG-9035	P1A	P1B	EC-T3SD4-02	T3SD4
DEPTH (feet):	0 - 4.3'	0 - 4.3'	0 - 3'	3 - 6'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1
SAMPLE DATE:	03/08/90	03/08/90	01/01/91	01/01/91	05/03/95	11/11/93
LOCATION:	1	1	P1	P1	T3SD4	T3SD4
VALIDATED:					VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
ACETONE					18 J	
SEMIVOLATILES (µg/kg)						
4-METHYLPHENOL					130 J	1500 UJ
ANTHRACENE			100 U	100 U	76 J	170 J
BENZO(A)ANTHRACENE	500		100 U	100 U	540 J	500 J
BENZO(A)PYRENE	610		600	100 U	570 J	570 J
BENZO(B)FLUORANTHENE			500	100 U	750 U	480 J
BENZO(G,H,I)PERYLENE			330	100 U	210 J	210 J
BENZO(K)FLUORANTHENE			600	100 U	1100	640 J
BUTYLBENZYL PHTHALATE					420 J	1500 U
CHRYSENE	155		800	100 U	680 J	650 J
DI-N-BUTYL PHTHALATE					58 J	1500 U
DIBENZO(A,H)ANTHRACENE			100 U	100 U	87 J	1500 U
FLUORANTHENE	378		1000	100 U	740 J	1100 J
INDENO(1,2,3-CD)PYRENE			350	100 U	270 J	360 J
PHENANTHRENE	20 U		430	100 U	310 J	400 J
PYRENE	192		1300	100 U	960	1000 J
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	20 U				110	35 J
4,4'-DDE	20 U				14 J	7.7 J
4,4'-DDT	20 U				25 J	46 J
DIELDRIN	20 U				7.5 U	150 U

TABLE 11-18 (PAGE 2 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9023	MG-9035	P1A	P1B	EC-T3SD4-02	T3SD4
DEPTH (feet):	0 - 4.3'	0 - 4.3'	0 - 3'	3 - 6'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1
SAMPLE DATE:	03/08/90	03/08/90	01/01/91	01/01/91	05/03/95	11/11/93
LOCATION:	1	1	P1	P1	T3SD4	T3SD4
VALIDATED:					VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
ENDRIN ALDEHYDE	20 U				14 J	150 U
HEPTACHLOR	20 U				3.9 U	4.2 J
METALS (mg/kg)						
ALUMINUM					6820 J	19100
ANTIMONY					2 UR	42.3 J
ARSENIC	7.68		16	16	12.2 J	12.6 J
BARIUM			77	45	28.1 J	64.2
BERYLLIUM					0.68 UR	0.8
BORON					68.2 J	200 U
CADMIUM	1.1		3.6	2.4	0.68 UR	0.76 UJ
CALCIUM					5510 J	6000 J
CHROMIUM	27.8		120	54	37.8 J	89.9 J
COBALT					4.3 J	9.9
COPPER	22.5		167	60	54.5 J	119
IRON					21500 J	30500
LEAD	28.3		160	47	47.5 J	123
MAGNESIUM					6310 J	10200
MANGANESE					170 J	293 J
MERCURY	0.09		0.4	0.1	0.38 U	0.62 J
NICKEL	13.4		63	50	16.6 J	28.6
POTASSIUM					3500 J	5160
SODIUM					20700 J	26700

TABLE 11-18 (PAGE 3 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9023	MG-9035	P1A	P1B	EC-T3SD4-02	T3SD4
DEPTH (feet):	0 - 4.3'	0 - 4.3'	0 - 3'	3 - 6'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1
SAMPLE DATE:	03/08/90	03/08/90	01/01/91	01/01/91	05/03/95	11/11/93
LOCATION:	1	1	P1	P1	T3SD4	T3SD4
VALIDATED:					VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
VANADIUM					30.7 J	54.2
ZINC	47.3		295	145	125 J	173 J
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)					0.22	
CHROMIUM(SEM)					3.9	
COPPER(SEM)					10	
LEAD(SEM)					19	
NICKEL(SEM)					1.7	
ZINC(SEM)					41	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		103				
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE					260	
TOTAL ORGANIC CARBON	28645		388900	75550	1432	14000

TABLE 11-18 (PAGE 4 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD4	T5SD4	T5SD4-D			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	PH2-1	PH2-1	PH2-1			
SAMPLE DATE:	11/11/93	11/11/93	11/11/93	/ /	/ /	/ /
LOCATION:	T4SD4	T5SD4	T5SD4			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:			T5SD4			
SEMIVOLATILES (µg/kg)						
4-METHYLPHENOL	1600 U	930 U	900 U			
ANTHRACENE	130 J	140 J	49 J			
BENZO(A)ANTHRACENE	300 J	360 J	170 J			
BENZO(A)PYRENE	320 J	400 J	200 J			
BENZO(B)FLUORANTHENE	200 J	230 J	120 J			
BENZO(G,H,I)PERYLENE	140 J	130 J	62 J			
BENZO(K)FLUORANTHENE	280 J	230 J	190 J			
BUTYLBENZYL PHTHALATE	1600 U	930 U	900 U			
CHRYSENE	340 J	350 J	190 J			
DI-N-BUTYL PHTHALATE	1600 U	930 U	900 U			
DIBENZO(A,H)ANTHRACENE	1600 U	930 U	900 U			
FLUORANTHENE	640 J	560 J	300 J			
INDENO(1,2,3-CD)PYRENE	160 J	170 J	90 J			
PHENANTHRENE	490 J	290 J	140 J			
PYRENE	530 J	720 J	330 J			
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	160 U	93 U	90 U			
4,4'-DDE	160 U	93 U	90 U			
4,4'-DDT	160 U	93 U	90 U			
DIELDRIN	160 U	93 U	4.8 J			
ENDRIN ALDEHYDE	160 U	93 U	90 U			
HEPTACHLOR	81 U	48 U	3.6 J			

TABLE 11-18 (PAGE 5 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD4	T5SD4	T5SD4-D			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	PH2-1	PH2-1	PH2-1			
SAMPLE DATE:	11/11/93	11/11/93	11/11/93	/ /	/ /	/ /
LOCATION:	T4SD4	T5SD4	T5SD4			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:			T5SD4			
METALS (mg/kg)						
ALUMINUM	7470	6120	5110			
ANTIMONY	14.9 J	12 J	9.8 J			
ARSENIC	4.9 J	2.2 J	2.7 J			
BARIUM	24.5	21.6	18.4			
BERYLLIUM	0.26	0.22	0.16			
BORON	66.4 U	43.5 U	59.3 U			
CADMIUM	0.29 UJ	0.29 UJ	0.29 UJ			
CALCIUM	4910 J	2010 J	4730 J			
CHROMIUM	27.8 J	23.6 J	20.4 J			
COBALT	3.6	3.4	3			
COPPER	28.3	20.3	16.9			
IRON	11400	8490	7150			
LEAD	28.2 J	20.8	17.4			
MAGNESIUM	4090	3320	2980			
MANGANESE	137 J	99.5 J	84.8 J			
MERCURY	0.14 UJ	0.14 UJ	0.17 J			
NICKEL	11.1	10.1	8.5			
POTASSIUM	1900	1460	1300			
SODIUM	5330	4080	4000			
VANADIUM	20.7	17.6	15.3			
ZINC	38.5 J	38.6 J	32.4 J			

TABLE 11-18 (PAGE 6 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD4	T5SD4	T5SD4-D			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	PH2-1	PH2-1	PH2-1			
SAMPLE DATE:	11/11/93	11/11/93	11/11/93	/ /	/ /	/ /
LOCATION:	T4SD4	T5SD4	T5SD4			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:			T5SD4			

MISCELLANEOUS PARAMETERS (mg/kg)

TOTAL ORGANIC CARBON	7600	7200				

TABLE 11-19

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
Acetone	1/1	18	T3SD4
SEMIVOLATILE ORGANICS (µg/kg)			
4-Methylphenol	1/5	130	T3SD4
Anthracene	5/7	49 - 170	T3SD4
Benzo(a)anthracene	6/8	170 - 540	T3SD4
Benzo(a)pyrene	7/8	200 - 610	1
Benzo(b)fluoranthene	5/7	120 - 500	P1
Benzo(g,h,i)perylene	6/7	62 - 330	P1
Benzo(k)fluoranthene	6/7	190 - 1100	T3SD4
Butylbenzyl phthalate	1/5	420	T3SD4
Chrysene	7/8	155 - 800	P1
Di-N-butyl phthalate	1/5	58	T3SD4
Dibenzo(a,h)anthracene	1/7	87	T3SD4
Fluoranthene	7/8	300 - 1100	T3SD4
Indeno(1,2,3-Cd)pyrene	6/7	90 - 360	T3SD4
Phenanthrene	6/8	140 - 490	T4SD4
Pyrene	7/8	192 - 1300	P1
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	2/6	35 - 110	T3SD4
4,4'-DDE	2/6	7.7 - 14	T3SD4
4,4'-DDT	2/6	25 - 46	T3SD4
Dieldrin	1/6	4.8	T5SD4
Endrin aldehyde	1/6	14	T3SD4
Heptachlor	2/6	3.6 - 4.2	T3SD4
INORGANICS (mg/kg)			
Aluminum	5/5	5110 - 19100	T3SD4
Antimony	4/4	9.8 - 42.3	T3SD4
Arsenic	8/8	2.2 - 16	P1/P1B
Barium	7/7	18.4 - 77	P1
Beryllium	4/4	0.16 - 0.8	T3SD4
Boron	1/5	68.2	T3SD4
Cadmium	3/7	1.1 - 3.6	P1
Cadmium (AVS/SEM)[2]	1/1	0.22	T3SD4
Calcium	5/5	2010 - 6000	T3SD4
Chromium	8/8	20.4 - 120	P1
Chromium (AVS/SEM)	1/1	3.9	T3SD4
Cobalt	5/5	3 - 9.9	T3SD4
Copper	8/8	16.9 - 167	P1
Copper (AVS/SEM)	1/1	10	T3SD4

TABLE 11-19

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DRMO[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Iron	5/5	7150 - 30500	T3SD4
Lead	8/8	17.4 - 160	P1
Lead (AVS/SEM)	1/1	19	T3SD4
Magnesium	5/5	2980 - 10200	T3SD4
Manganese	5/5	84.8 - 293	T3SD4
Mercury	5/8	0.09 - 0.62	T3SD4
Nickel	8/8	8.5 - 63	P1
Nickel (AVS/SEM)	1/1	1.7	T3SD4
Potassium	5/5	1300 - 5160	T3SD4
Sodium	5/5	4000 - 26700	T3SD4
Vanadium	5/5	15.3 - 54.2	T3SD4
Zinc	8/8	32.4 - 295	P1
Zinc (AVS/SEM)	1/1	41	T3SD4
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	1/1	103	1
MISCELLANEOUS (mg/kg)			
Total organic carbon	7/7	1432 - 388900	P1
Acid volatile sulfide	1/1	260	T3SD4

1 Includes samples MG-9023, MG-9035, P1A, P1B, EC-T3SD4-02, T3SD4, T4SD4, T5SD4, T5SD4-D (field duplicate of T5SD4).

2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-20 (PAGE 1 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9001	MG-9015	MG-9003	MG-9016	MG-9008	MG-9006
DEPTH (feet):	0 - 3.8'	0 - 3.8'	0 - 6'	0 - 6'	0 - 5.9'	0 - 5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF
SAMPLE DATE:	03/06/90	03/07/90	03/06/90	03/06/90	03/07/90	03/07/90
LOCATION:	2	2	3	3	5	6
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(A)ANTHRACENE	20 U		20 U		20 U	483
BENZO(A)PYRENE	20 U		20 U		20 U	78
CHRYSENE	20 U		20 U		67	70
FLUORANTHENE	20 U		20 U		20 U	85
PHENANTHRENE	20 U		20 U		20 U	20 U
PYRENE	103		106		88	20 U
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	20 U		20 U		20 U	20 U
4,4'-DDE	20 U		20 U		20 U	20 U
ALDRIN	20 U		20 U		20 U	20 U
ENDRIN ALDEHYDE	20 U		20 U		20 U	20 U
HEPTACHLOR	20 U		20 U		20 U	20 U
METALS (mg/kg)						
ARSENIC	7.3			4.26	4.78	4.58
CADMIUM	1.35			1.38	1.16	2.23
CHROMIUM	39.1			37.5	31.5	34.4
COPPER	40.9			38.7	25.5	24.1
LEAD	58.8			48	33.5	35.9
MERCURY	0.12			0.13	0.1	0.06
NICKEL	24.7			15.7	13.2	16.8
ZINC	83.6			81.3	49.7	61.3

TABLE 11-20 (PAGE 2 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9001	MG-9015	MG-9003	MG-9016	MG-9008	MG-9006
DEPTH (feet):	0 - 3.8'	0 - 3.8'	0 - 6'	0 - 6'	0 - 5.9'	0 - 5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF
SAMPLE DATE:	03/06/90	03/07/90	03/06/90	03/06/90	03/07/90	03/07/90
LOCATION:	2	2	3	3	5	6
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		157		142	27981	
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	36902		62876		27981	29415

TABLE 11-20 (PAGE 3 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR02-02	LS5SD00101	LS5SD00201	LS5SD00301	LS5SD00401	T3SD3
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	ECO-2	1997RI	1997RI	1997RI	1997RI	PH2-1
SAMPLE DATE:	05/03/95	10/22/97	10/22/97	10/22/97	10/22/97	11/11/93
LOCATION:	EC-SDTR02	SW/SD1-5RI	SW/SD2-5RI	SW/SD3-5RI	SW/SD4-5RI	T3SD3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE	61 J					
ACETONE	320					
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE	130 J	790 U	210 UJ	430 U	82 J	1800 U
ACENAPHTHYLENE	63 J	790 U	74 J	430 U	560 U	1800 U
ANTHRACENE	220 J	98 J	180 J	28 J	170 J	250 J
BENZO(A)ANTHRACENE	850 J	480 J	510 J	110 J	380 J	560 J
BENZO(A)PYRENE	870 J	350 J	490 J	90 J	230 J	600 J
BENZO(B)FLUORANTHENE	1000 U	430 J	540 J	90 J	200 J	760 J
BENZO(G,H,I)PERYLENE	410 J	260 J	180 J	62 J	140 J	240 J
BENZO(K)FLUORANTHENE	1700	360 J	370 J	90 J	200 J	480 J
CARBAZOLE	1000 U	62 J	1100 UJ	430 U	140 J	1800 U
CHRYSENE	1100	670 J	650 J	140 J	430 J	600 J
DIBENZO(A,H)ANTHRACENE	140 J	150 J	150 UJ	30 J	74 J	1800 UJ
DIBENZOFURAN	58 J	790 U	53 J	430 U	43 J	1800 U
FLUORANTHENE	1900	1100	1400 J	250 J	1100	1500 J
FLUORENE	60 J	45 J	94 J	430 U	80 J	1800 U
INDENO(1,2,3-CD)PYRENE	530 J	290 J	420 J	67 J	200 J	350 J
NAPHTHALENE	55 J	790 U	1100 UJ	430 U	560 U	1800 U
PHENANTHRENE	470 J	400 J	520 J	99 J	750	520 J
PHENOL	1000 U	790 U	72 J	430 U	560 U	1800 U
PYRENE	2200	1200	1300 J	290 J	900	970 J

TABLE 11-20 (PAGE 4 OF 8)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR02-02	LS5SD00101	LS5SD00201	LS5SD00301	LS5SD00401	T3SD3
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	ECO-2	1997RI	1997RI	1997RI	1997RI	PH2-1
SAMPLE DATE:	05/03/95	10/22/97	10/22/97	10/22/97	10/22/97	11/11/93
LOCATION:	EC-SDTR02	SW/SD1-5RI	SW/SD2-5RI	SW/SD3-5RI	SW/SD4-5RI	T3SD3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	10 U				28	5.4 J
4,4'-DDE	10 U				5.2 J	180 U
ALDRIN	5.3 U				2.8 U	94 U
ENDRIN ALDEHYDE	10 U				5.5 U	180 U
HEPTACHLOR	5.3 U				2.8 U	94 U
METALS (mg/kg)						
ALUMINUM	16000 J	11000 J	13300 J	5820 J	5630 J	15100
ANTIMONY	2.5 J	0.46 UJ	0.61 UJ	0.20 UJ	0.30 UJ	32.7 J
ARSENIC	15.1 J	8.8	13.8	2.9 J	3.8	10.2 J
BARIUM	64.3 J	37.0	43.2	20.7	27.1	69.3
BERYLLIUM	1.1 J	0.22 J	0.19 J	0.05 J	0.01 UJ	0.68
BORON	70.2 J					159 U
CADMIUM	0.71 UR	0.94	1.0 J	0.29 J	0.44	0.52 UJ
CALCIUM	8440 J	4930 J	5980 J	1900 J	4060 J	6480 J
CHROMIUM	83.1 J	52.3	59.3	16.0	18.4	59.8 J
COBALT	8.9 J	5.9	6.6	4.4	4.4	8.1
COPPER	109 J	79.1 J	94.5 J	29.2 J	30.5 J	80.8
IRON	32300 J	19900	26200	12300	13200	25500
LEAD	91.8 J	54.6 J	64.1 J	17.5 J	16.9 J	62.2
MAGNESIUM	11000 J	6510	8470	4180	4310	8620
MANGANESE	435 J	195	326	165	206	335 J
MERCURY	0.4 U	0.35 J	0.33 J	0.08 J	0.08 J	0.43 J

TABLE 11-20 (PAGE 5 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	EC-SDTR02-02	LS5SD00101	LS5SD00201	LS5SD00301	LS5SD00401	T3SD3
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	ECO-2	1997RI	1997RI	1997RI	1997RI	PH2-1
SAMPLE DATE:	05/03/95	10/22/97	10/22/97	10/22/97	10/22/97	11/11/93
LOCATION:	EC-SDTR02	SW/SD1-5RI	SW/SD2-5RI	SW/SD3-5RI	SW/SD4-5RI	T3SD3
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
NICKEL	32.8 J	18.8	22.1 J	8.0 J	9.6	25.2
POTASSIUM	5610 J	3210	4040	1860	2200	5220
SILVER	1.4 UR	0.67 J	0.74 J	0.16 J	0.19 J	1.3 U
SODIUM	25600 J	15700	22800	3970	6210	15000
VANADIUM	51 J	32.6	39.2	23.6	18.4	46.3
ZINC	179 J	136	159	57.4	60.8	132 J
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	0.6	0.61	0.68	0.12 U	0.28	
CHROMIUM(SEM)	17					
COPPER(SEM)	61	107 J	139 J	20.8 J	22.3 J	
LEAD(SEM)	78	68.4 J	72.1 J	18.4 J	20.0 J	
NICKEL(SEM)	6.9	12.8	17.0	3.9	5.7	
ZINC(SEM)	110	130 J	182 J	34.5 J	53.5 J	
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	1100	710 J	770 J	55 J	970 J	
AMMONIA, AS NITROGEN		11 U	110	8 U	8 U	
TOTAL ORGANIC CARBON	1821	42000	47000	31000	26000	10000
GENERAL CHEMISTRY						
PH		7.9	8	9	7.9	

TABLE 11-20 (PAGE 6 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD3	T5SD3				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	PH2-1	PH2-1				
SAMPLE DATE:	11/11/93	11/11/93	/ /	/ /	/ /	/ /
LOCATION:	T4SD3	T5SD3				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE	1900 U	1600 UJ				
ACENAPHTHYLENE	1900 U	82 J				
ANTHRACENE	180 J	130 U				
BENZO(A)ANTHRACENE	520 J	390 J				
BENZO(A)PYRENE	620 J	620 J				
BENZO(B)FLUORANTHENE	610 J	420 J				
BENZO(G,H,I)PERYLENE	300 J	350 J				
BENZO(K)FLUORANTHENE	430 J	650 J				
CARBAZOLE	1900 U	1600 U				
CHRYSENE	700 J	540 J				
DIBENZO(A,H)ANTHRACENE	1900 U	1600 UJ				
DIBENZOFURAN	1900 U	1600 UJ				
FLUORANTHENE	1300 J	1100 U				
FLUORENE	1900 U	1600 UJ				
INDENO(1,2,3-CD)PYRENE	440 J	450 J				
NAPHTHALENE	1900 U	1600 UJ				
PHENANTHRENE	420 J	460 U				
PHENOL	1900 U	1600 UJ				
PYRENE	980 J	860 U				
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	18 J	3.1 J				
4,4'-DDE	6.3 J	5.3 J				

TABLE 11-20 (PAGE 7 OF 8)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD3	T5SD3				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	PH2-1	PH2-1				
SAMPLE DATE:	11/11/93	11/11/93	/ /	/ /	/ /	/ /
LOCATION:	T4SD3	T5SD3				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
ALDRIN	5.1 J	81 U				
ENDRIN ALDEHYDE	14 J	160 U				
HEPTACHLOR	100 U	5.9 J				
METALS (mg/kg)						
ALUMINUM	15100	16400				
ANTIMONY	36.3 J	32.5 J				
ARSENIC	13.2 J	11.3 J				
BARIUM	58.2	54.1				
BERYLLIUM	0.71	0.7				
BORON	115 U	121 U				
CADMIUM	0.6 UJ	0.49 UJ				
CALCIUM	6010 J	7790 J				
CHROMIUM	73.3 J	77.7 J				
COBALT	8.1	7.3				
COPPER	90.7	76.7				
IRON	27200	23700				
LEAD	94	101				
MAGNESIUM	8760	7470				
MANGANESE	336 J	271 J				
MERCURY	0.41 J	0.37 J				
NICKEL	26.3	25.2				
POTASSIUM	4200	3900				

TABLE 11-20 (PAGE 8 OF 8)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 5
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T4SD3	T5SD3				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	PH2-1	PH2-1				
SAMPLE DATE:	11/11/93	11/11/93	/ /	/ /	/ /	/ /
LOCATION:	T4SD3	T5SD3				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
SILVER	1.4 U	1.4 U				
SODIUM	18600	14100				
VANADIUM	44.7	45				
ZINC	143 J	135 J				
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	14000	14000				

TABLE 11-21

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 5[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	1/1	61	EC-SDTR02
Acetone	1/1	320	EC-SDTR02
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthene	2/8	82 - 130	EC-SDTR02
Acenaphthylene	3/8	63 - 82	T5SD3
Anthracene	7/8	28 - 250	T3SD3
Benzo(a)anthracene	9/12	110 - 850	EC-SDTR02
Benzo(a)pyrene	9/12	78 - 870	EC-SDTR02
Benzo(b)fluoranthene	7/8	90 - 760	T3SD3
Benzo(g,h,i)perylene	8/8	62 - 410	EC-SDTR02
Benzo(k)fluoranthene	8/8	90 - 1700	EC-SDTR02
Carbazole	2/8	62 - 140	SW/SD4-5RI
Chrysene	10/12	67 - 1100	EC-SDTR02
Dibenzo(a,h)anthracene	4/8	30 - 150	SW/SD1-5RI
Dibenzofuran	3/8	43 - 58	EC-SDTR02
Fluoranthene	8/12	85 - 1900	EC-SDTR02
Fluorene	4/8	45 - 94	SW/SD2-5RI
Indeno(1,2,3-Cd)pyrene	8/8	67 - 530	EC-SDTR02
Naphthalene	1/8	55	EC-SDTR02
Phenanthrene	7/12	99 - 750	SW/SD4-5RI
Phenol	1/8	72	SW/SD2-5RI
Pyrene	10/12	88 - 2200	EC-SDTR02
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	4/9	3.1 - 28	SW/SD4-5RI
4,4'-DDE	3/9	5.2 - 6.3	T4SD3
Aldrin	1/9	5.1	T4SD3
Endrin aldehyde	1/9	14	T4SD3
Heptachlor	1/9	5.9	T5SD3
INORGANICS (mg/kg)			
Aluminum	8/8	5630 - 16400	T5SD3
Antimony	4/8	2.5 - 36.3	T4SD3
Arsenic	12/12	2.9 - 15.1	EC-SDTR02
Barium	8/8	20.7 - 69.3	T3SD3
Beryllium	7/8	0.05 - 1.1	EC-SDTR02
Boron	1/4	70.2	EC-SDTR02
Cadmium	8/11	0.29 - 2.23	6
Cadmium (AVS/SEM)[2]	4/5	0.28 - 0.68	SW/SD2-5RI
Calcium	8/8	1900 - 8440	EC-SDTR02
Chromium	12/12	16 - 83.1	EC-SDTR02
Chromium (AVS/SEM)	1/1	17	EC-SDTR02

TABLE 11-21

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 5[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Cobalt	8/8	4.4 - 8.9	EC-SDTR02
Copper	12/12	24.1 - 109	EC-SDTR02
Copper (AVS/SEM)	5/5	20.8 - 139	SW/SD2-5RI
Iron	8/8	12300 - 32300	EC-SDTR02
Lead	12/12	16.9 - 101	T5SD3
Lead (AVS/SEM)	5/5	18.4 - 78	EC-SDTR02
Magnesium	8/8	4180 - 11000	EC-SDTR02
Manganese	8/8	165 - 435	EC-SDTR02
Mercury	11/12	0.06 - 0.43	T3SD3
Nickel	12/12	8 - 32.8	EC-SDTR02
Nickel (AVS/SEM)	5/5	3.9 - 17	SW/SD2-5RI
Potassium	8/8	1860 - 5610	EC-SDTR02
Silver	4/7	0.16 - 0.74	SW/SD2-5RI
Sodium	8/8	3970 - 25600	EC-SDTR02
Vanadium	8/8	18.4 - 51	EC-SDTR02
Zinc	12/12	49.7 - 179	EC-SDTR02
Zinc (AVS/SEM)	5/5	34.5 - 182	SW/SD2-5RI
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	3/4	1420 - 27981	5
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	1/4	110	SW/SD2-5RI
pH	4/4	7.9 - 9	SW/SD3-5RI
Total organic carbon	12/12	1821 - 62876	3
Acid volatile sulfide	5/5	55 - 1100	EC-SDTR02

1 Includes samples MG-9001, MG-9003, MG-9006, MG-9008, MG-9015, MG-9016, EC-SDTR02-02, LS5SD00101, LS5SD00201, LS5SD00301, LS5SD00401, T3SD3, T4SD3, T5SD3.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-22 (PAGE 1 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9009	MG-9018	EC-SDTR03-02	P2A	P2B	LS6SD00101
DEPTH (feet):	0 - 7.6'	0 - 7.6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	03/06/90	03/06/90	05/03/95	01/01/91	01/01/91	10/21/97
LOCATION:	4	4	EC-SDTR03	P2	P2	SW/SD1-6RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE			120 J			
ACETONE			430			
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE			1100 U			1200 U
ACENAPHTHENE			1100 U	280	100 U	220 J
ACENAPHTHYLENE			56 J	100 U	100 U	1200 U
ANTHRACENE			160 J	270	100 U	250 J
BENZO(A)ANTHRACENE	223		570 J	970	420	1400 J
BENZO(A)PYRENE	168		680 J	680	300	750 J
BENZO(B)FLUORANTHENE			720 J	880	365	840 J
BENZO(G,H,I)PERYLENE			410 J	300	100 U	430 J
BENZO(K)FLUORANTHENE			690 J	660	330	790 J
CARBAZOLE			1100 U			90 J
CHRYSENE	108		780 J	1200	550	1500
DIBENZO(A,H)ANTHRACENE			180 J	100 U	100 U	190 J
DIBENZOFURAN			1100 U			79 J
FLUORANTHENE	221		1500	2200	890	4700
FLUORENE			70 J			130 J
INDENO(1,2,3-CD)PYRENE			410 J	320	100 U	450 J
NAPHTHALENE			1100 U	100 U	100 U	61 J
PHENANTHRENE	117		420 J	750	300	1100 J
PHENOL			1100 U			72 J

TABLE 11-22 (PAGE 2 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9009	MG-9018	EC-SDTR03-02	P2A	P2B	LS6SD00101
DEPTH (feet):	0 - 7.6'	0 - 7.6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	03/06/90	03/06/90	05/03/95	01/01/91	01/01/91	10/21/97
LOCATION:	4	4	EC-SDTR03	P2	P2	SW/SD1-6RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
PYRENE	347		1200	2400	890	2800
METALS (mg/kg)						
ALUMINUM			17100			14000 J
ANTIMONY			2.3			0.71 UJ
ARSENIC	8.34		16.6	9.4	9.7	13.1
BARIUM			64.7	50	64	47.6
BERYLLIUM			1.1			0.28 J
BORON			62.6			
CADMIUM	1.18		0.56	3.2	3.3	0.86
CALCIUM			8300			6130 J
CHROMIUM	34.7		88.4	86	94	62.4
COBALT			9.1			7.1
COPPER	34.7		121	139	99	102 J
IRON			34500			26500
LEAD	40		97.5	110	120	65.9 J
MAGNESIUM			10100			9030
MANGANESE			416			299
MERCURY	0.15		0.42 U	0.3	0.3	0.32 J
NICKEL	14.1		34.7	51	71	22.6
POTASSIUM			5870			4200
SILVER			1.4			0.75 J
SODIUM			18000			25400

TABLE 11-22 (PAGE 3 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9009	MG-9018	EC-SDTR03-02	P2A	P2B	LS6SD00101
DEPTH (feet):	0 - 7.6'	0 - 7.6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	03/06/90	03/06/90	05/03/95	01/01/91	01/01/91	10/21/97
LOCATION:	4	4	EC-SDTR03	P2	P2	SW/SD1-6RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
VANADIUM			54.1			42.6
ZINC	73.9		195	263	206	175
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)			0.54			0.92
CHROMIUM(SEM)			16			
COPPER(SEM)			60			98.7 J
LEAD(SEM)			73			78.2 J
NICKEL(SEM)			6.6			18.5
ZINC(SEM)			110			188 J
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		589				
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE			920			1900 J
TOTAL ORGANIC CARBON	27133		2003	21250	71250	59000
GENERAL CHEMISTRY						
PH						7.9

TABLE 11-22 (PAGE 4 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SD00201					
DEPTH (feet):	0 - 0.5'					
INVESTIGATION:	1997RI					
SAMPLE DATE:	10/22/97	/ /	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-6RI					
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB					
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	23 J					
ACENAPHTHENE	99 J					
ACENAPHTHYLENE	400 U					
ANTHRACENE	130 J					
BENZO(A)ANTHRACENE	470					
BENZO(A)PYRENE	280 J					
BENZO(B)FLUORANTHENE	420 J					
BENZO(G,H,I)PERYLENE	190 J					
BENZO(K)FLUORANTHENE	340 J					
CARBAZOLE	100 J					
CHRYSENE	830					
DIBENZO(A,H)ANTHRACENE	50 J					
DIBENZOFURAN	70 J					
FLUORANTHENE	2600					
FLUORENE	120 J					
INDENO(1,2,3-CD)PYRENE	200 J					
NAPHTHALENE	400 U					
PHENANTHRENE	1500					
PHENOL	400 U					
PYRENE	1800					
METALS (mg/kg)						
ALUMINUM	4680 J					

TABLE 11-22 (PAGE 5 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SD00201					
DEPTH (feet):	0 - 0.5'					
INVESTIGATION:	1997RI					
SAMPLE DATE:	10/22/97	/ /	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-6RI					
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB					
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ANTIMONY	0.22 UJ					
ARSENIC	3.5					
BARIUM	13.4					
BERYLLIUM	0.03 J					
CADMIUM	0.28					
CALCIUM	2010 J					
CHROMIUM	14.4					
COBALT	2.6					
COPPER	36.2 J					
IRON	8560					
LEAD	22.7 J					
MAGNESIUM	1980					
MANGANESE	78.4					
MERCURY	0.06 J					
NICKEL	8.8					
POTASSIUM	954					
SILVER	0.16 J					
SODIUM	3610					
VANADIUM	11.4					
ZINC	313					
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	0.19 U					

TABLE 11-22 (PAGE 6 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 6 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS6SD00201					
DEPTH (feet):	0 - 0.5'					
INVESTIGATION:	1997RI					
SAMPLE DATE:	10/22/97	/ /	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-6RI					
VALIDATED:	VALIDATED					
SAMPLE TYPE:	GRAB					
STATUS:						
FIELD DUPLICATE OF:						
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
COPPER(SEM)	34.9 J					
LEAD(SEM)	17.4 J					
NICKEL(SEM)	4.2					
ZINC(SEM)	289 J					
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	170 J					
TOTAL ORGANIC CARBON	21000					
GENERAL CHEMISTRY						
PH	8.2					

TABLE 11-23

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 6[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	1/1	120	EC-SDTR03
Acetone	1/1	430	EC-SDTR03
SEMIVOLATILE ORGANICS (µg/kg)			
2-Methylnaphthalene	1/3	23	SW/SD2-6RI
Acenaphthene	3/5	99 - 280	P2
Acenaphthylene	1/5	56	EC-SDTR03
Anthracene	4/5	130 - 270	P2
Benzo(a)anthracene	6/6	223 - 1400	SW/SD1-6RI
Benzo(a)pyrene	6/6	168 - 750	SW/SD1-6RI
Benzo(b)fluoranthene	5/5	365 - 880	P2
Benzo(g,h,i)perylene	4/5	190 - 430	SW/SD1-6RI
Benzo(k)fluoranthene	5/5	330 - 790	SW/SD1-6RI
Carbazole	2/3	90 - 100	SW/SD2-6RI
Chrysene	6/6	108 - 1500	SW/SD1-6RI
Dibenzo(a,h)anthracene	3/5	50 - 190	SW/SD1-6RI
Dibenzofuran	2/3	70 - 79	SW/SD1-6RI
Fluoranthene	6/6	221 - 4700	SW/SD1-6RI
Fluorene	3/3	70 - 130	SW/SD1-6RI
Indeno(1,2,3-Cd)pyrene	4/5	200 - 450	SW/SD1-6RI
Naphthalene	1/5	61	SW/SD1-6RI
Phenanthrene	6/6	117 - 1500	SW/SD2-6RI
Phenol	1/3	72	SW/SD1-6RI
Pyrene	6/6	347 - 2800	SW/SD1-6RI
INORGANICS (mg/kg)			
Aluminum	3/3	4680 - 17100	EC-SDTR03
Antimony	1/3	2.3	EC-SDTR03
Arsenic	6/6	3.5 - 16.6	EC-SDTR03
Barium	5/5	13.4 - 64.7	EC-SDTR03
Beryllium	3/3	0.03 - 1.1	EC-SDTR03
Boron	1/1	62.6	EC-SDTR03
Cadmium	6/6	0.28 - 3.3	P2
Cadmium (AVS/SEM)[2]	2/3	0.54 - 0.92	SW/SD1-6RI
Calcium	3/3	2010 - 8300	EC-SDTR03
Chromium	6/6	14.4 - 94	P2
Chromium (AVS/SEM)	1/1	16	EC-SDTR03
Cobalt	3/3	2.6 - 9.1	EC-SDTR03
Copper	6/6	34.7 - 139	P2
Copper (AVS/SEM)	3/3	34.9 - 98.7	SW/SD1-6RI
Iron	3/3	8560 - 34500	EC-SDTR03
Lead	6/6	22.7 - 120	P2

TABLE 11-23

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 6[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Lead (AVS/SEM)	3/3	17.4 - 78.2	SW/SD1-6RI
Magnesium	3/3	1980 - 10100	EC-SDTR03
Manganese	3/3	78.4 - 416	EC-SDTR03
Mercury	5/6	0.06 - 0.32	SW/SD1-6RI
Nickel	6/6	8.8 - 71	P2
Nickel (AVS/SEM)	3/3	4.2 - 18.5	SW/SD1-6RI
Potassium	3/3	954 - 5870	EC-SDTR03
Silver	3/3	0.16 - 1.4	EC-SDTR03
Sodium	3/3	3610 - 25400	SW/SD1-6RI
Vanadium	3/3	11.4 - 54.1	EC-SDTR03
Zinc	6/6	73.9 - 313	SW/SD2-6RI
Zinc (AVS/SEM)	3/3	110 - 289	SW/SD2-6RI
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	1/1	589	4
MISCELLANEOUS (MG/KG)			
pH	2/2	7.9 - 8.2	SW/SD2-6RI
Total organic carbon	6/6	2003 - 71250	P2
Acid volatile sulfide	3/3	170 - 1900	SW/SD1-6RI

1 Includes samples MG-9009, MG-9018, EC-SDTR03-02, P2A, P2B, LS6SD00101, LS6SD00201.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-24 (PAGE 1 OF19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9030	MG-9002	MG-9007	MG-9017	MG-9020	MG-9021
DEPTH (feet):	0 - 3.8'	0 - 4.5'	0 - 5.1'	0 - 5.1'	0 - 5.1'	0 - 5.1'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF
SAMPLE DATE:	03/08/90	03/06/90	03/07/90	03/07/90	03/07/90	03/07/90
LOCATION:	7	8	9	9	9	9
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:		EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
BENZO(A)ANTHRACENE	467	20 U	77			
BENZO(A)PYRENE	20 U	20 U	20 U			
CHRYSENE	109	20 U	87			
FLUORANTHENE	211	20 U	20 U			
PHENANTHRENE	20 U	20 U	20 U			
PYRENE	133	20 U	20 U			
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	20 U	20 U	20 U			
4,4'-DDE	20 U	20 U	20 U			
4,4'-DDT	20 U	20 U	20 U			
ALDRIN	20 U	20 U	20 U			
ALPHA-BHC	20 U	20 U	20 U			
AROCLOR-1248	10 U	10 U	10 U			
AROCLOR-1254	10 U	10 U	10 U			
AROCLOR-1260	10 U	10 U	10 U			
BETA-BHC	20 U	20 U	20 U			
DELTA-BHC	20 U	20 U	20 U			
DIELDRIN	20 U	20 U	20 U			
ENDOSULFAN I	20 U	20 U	20 U			
ENDOSULFAN II	20 U	20 U	20 U			
ENDOSULFAN SULFATE	20 U	20 U	20 U			
ENDRIN	20 U	20 U	20 U			

TABLE 11-24 (PAGE 2 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9030	MG-9002	MG-9007	MG-9017	MG-9020	MG-9021
DEPTH (feet):	0 - 3.8'	0 - 4.5'	0 - 5.1'	0 - 5.1'	0 - 5.1'	0 - 5.1'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF
SAMPLE DATE:	03/08/90	03/06/90	03/07/90	03/07/90	03/07/90	03/07/90
LOCATION:	7	8	9	9	9	9
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:		EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
ENDRIN ALDEHYDE	20 U	20 U	20 U			
GAMMA-BHC (LINDANE)	20 U	20 U	20 U			
HEPTACHLOR EPOXIDE	20 U	20 U	20 U			
METHOXYCHLOR	20 U	20 U	20 U			
METALS (mg/kg)						
ARSENIC	6.38	8.01	7.43			
CADMIUM	1.48	1.48	1.29			
CHROMIUM	35.4	34.9	29.4			
COPPER	24.5	26.4	22.4			
LEAD	34.6	41.8	30.1			
MERCURY	0.02 U	0.1	0.09			
NICKEL	15.9	18.1	15.5			
ZINC	54.7	77.6	59.2			
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH				242		
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	31183		25939			

TABLE 11-24 (PAGE 3 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	B	C1A-1/C1B-1/C1C-1	C1B-1	C1B-1	C2-B1	C2-B1
DEPTH (feet):	0 - 3'	0 - 3'	3 - 6'	6 - 13'	3 - 6'	6 - 10'
INVESTIGATION:	TR_DREDGE	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	01/01/94	04/11/94	04/11/94	04/11/94	04/11/94	04/11/94
LOCATION:	B	C1-PIER17-NORTH	C1-PIER17-NORTH	C1-PIER17-NORTH	C2-PIER17-NORTH	C2-PIER17-NORTH
VALIDATED:						
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED					
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE		200 U	69 U	68 U		70 U
ACENAPHTHENE	70 U	200 U	69 U	68 U		70 U
ACENAPHTHYLENE	99 U	240	69 U	68 U		70 U
ANTHRACENE	13	250	69 U	68 U		70 U
BENZO(A)ANTHRACENE	44	970	69 U	68 U		70 U
BENZO(A)PYRENE	66	870	69 U	68 U		70 U
BENZO(B)FLUORANTHENE	120	730	69 U	68 U		70 U
BENZO(E)PYRENE	93					
BENZO(G,H,I)PERYLENE	43	260	69 U	68 U		70 U
BENZO(K)FLUORANTHENE	28	880	69 U	68 U		70 U
BIPHENYL	24					
BIS(2-ETHYLHEXYL)PHTHALATE		1400	69 U	120		87
CHRYSENE	58	1200	69 U	68 U		70 U
DI-N-BUTYL PHTHALATE		320	170	92		170
DI-N-OCTYL PHTHALATE		2700	260	310		230
DIBENZO(A,H)ANTHRACENE	13 U	200 U	69 U	68 U		70 U
FLUORANTHENE	110	3000	69 U	68 U		70 U
FLUORENE	24	200 U	69 U	68 U		70 U
HEXACHLOROCYCLOPENTADIENE		200 U	69 U	68 U		70 U
INDENO(1,2,3-CD)PYRENE	47	550	69 U	68 U		70 U
NAPHTHALENE	41 U	200 U	69 U	68 U		70 U
PHENANTHRENE	46	720	69 U	68 U		70 U

TABLE 11-24 (PAGE 4 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	B	C1A-1/C1B-1/C1C-1	C1B-1	C1B-1	C2-B1	C2-B1
DEPTH (feet):	0 - 3'	0 - 3'	3 - 6'	6 - 13'	3 - 6'	6 - 10'
INVESTIGATION:	TR_DREDGE	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	01/01/94	04/11/94	04/11/94	04/11/94	04/11/94	04/11/94
LOCATION:	B	C1-PIER17-NORTH	C1-PIER17-NORTH	C1-PIER17-NORTH	C2-PIER17-NORTH	C2-PIER17-NORTH
VALIDATED:						
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED					
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
PYRENE	100	2800	69 U	68 U		70 U
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	7.9 U	10 U	6.9 U	6.7 U		7 U
4,4'-DDE	7.9 U	10 U	6.9 U	6.7 U		7 U
4,4'-DDT	7.9 U	10 U	6.9 U	6.7 U		7 U
ALDRIN	4 U	5 U	3.4 U	3.4 U		3.5 U
ALPHA-BHC	4 U	5 U	3.4 U	3.4 U		3.5 U
AROCLOR-1248	79 U	55 J	69 U	67 U		70 U
AROCLOR-1254	79 U	100 U	69 U	67 U		70 U
AROCLOR-1260	79 U	70 J	69 U	67 U		70 U
BETA-BHC	4 U	5.4	3.4 U	3.4 U		3.5 U
DELTA-BHC	4 U	5 U	3.4 U	3.4 U		3.5 U
DIELDRIN	7.9 U	10 U	6.9 U	6.7 U		7 U
ENDOSULFAN I	4 U	5 U	3.4 U	3.4 U		3.5 U
ENDOSULFAN II	7.9 U	10 U	6.9 U	6.7 U		7 U
ENDOSULFAN SULFATE	7.9 U	8.4 J	6.9 U	6.7 U		7 U
ENDRIN	7.9 U	10 U	6.9 U	6.7 U		7 U
ENDRIN ALDEHYDE	7.9 U	10 U	6.9 U	6.7 U		7 U
GAMMA-BHC (LINDANE)	4 U	5 U	3.4 U	3.4 U		3.5 U
HEPTACHLOR EPOXIDE	4 U	3.2 J	3.4 U	3.4 U		3.5 U
METHOXYCHLOR	40 U	50 U	34 U	34 U		35 U

TABLE 11-24 (PAGE 5 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	B	C1A-1/C1B-1/C1C-1	C1B-1	C1B-1	C2-B1	C2-B1
DEPTH (feet):	0 - 3'	0 - 3'	3 - 6'	6 - 13'	3 - 6'	6 - 10'
INVESTIGATION:	TR_DREDGE	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	01/01/94	04/11/94	04/11/94	04/11/94	04/11/94	04/11/94
LOCATION:	B	C1-PIER17-NORTH	C1-PIER17-NORTH	C1-PIER17-NORTH	C2-PIER17-NORTH	C2-PIER17-NORTH
VALIDATED:						
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED					
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ANTIMONY		3 U	2.1 U	2 U		2.1 U
ARSENIC	13.1	13.5	9.7	10		8.6
BERYLLIUM		1.5 U	1 U	1 U		1.1 U
CADMIUM	0.6	1.7	1 U	1 U		1.1
CHROMIUM	72.8	102	37.6	42		40.9
COPPER	34.9	127	14.2	16.3		17.3
LEAD	46.4	117	14.8	19		17.1
MERCURY	0.2	0.51	0.21 U	0.2 U		0.21 U
NICKEL	28.9	32.1	21.2	23.3		23.9
SELENIUM		1.5 U	1 U	1 U		1.1
SILVER		3 U	2.1 U	2 U		2.1 U
ZINC	165	200	55.4	65.0		60.3
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	73000	2600	960	710	130	1100

TABLE 11-24 (PAGE 6 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C2A-1/C2B-1/C2C-1	C2B-1	C3A-1/C3B-1/C3C-1	C3B-1	C3B-1	C3B-1
DEPTH (feet):	0 - 3'	3 - 6'	0 - 3'	3 - 6'	6 - 9'	9 - 12'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/11/94	04/11/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C2-PIER17-NORTH	C2-PIER17-NORTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	COMPOSITE	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	160 U	100 U	160 U	120 U	120 U	130 U
ACENAPHTHENE	160 U	100 U	160 U	120 U	120 U	130 U
ACENAPHTHYLENE	160 U	100 U	160 U	120 U	120 U	130 U
ANTHRACENE	160 U	100 U	160 U	120 U	120 U	130 U
BENZO(A)ANTHRACENE	210	100 U	360	120 U	120 U	130 U
BENZO(A)PYRENE	220	100 U	400	120 U	120 U	130 U
BENZO(B)FLUORANTHENE	220	100 U	300	120 U	120 U	130 U
BENZO(G,H,I)PERYLENE	160 U	100 U	270	120 U	120 U	130 U
BENZO(K)FLUORANTHENE	200	100 U	500	120 U	120 U	130 U
BIS(2-ETHYLHEXYL)PHTHALATE	830	110	470	250	180	940
CHRYSENE	250	100 U	530	120 U	120 U	130 U
DI-N-BUTYL PHTHALATE	380	190	290	120 U	120 U	150
DI-N-OCTYL PHTHALATE	11000	370	1200	2800	230	130 U
DIBENZO(A,H)ANTHRACENE	160 U	100 U	160 U	120 U	120 U	130 U
FLUORANTHENE	540	100 U	910	120 U	120 U	130 U
FLUORENE	160 U	100 U	160 U	120 U	120 U	130 U
HEXACHLOROCYCLOPENTADIENE	160 U	100 U	160 U	120 U	120 U	130 U
INDENO(1,2,3-CD)PYRENE	160 U	100 U	270	120 U	120 U	130 U
NAPHTHALENE	160 U	100 U	160 U	120 U	120 U	130 U
PHENANTHRENE	240	100 U	330	120 U	120 U	130 U
PYRENE	550	100 U	1100	120 U	120 U	130 U

TABLE 11-24 (PAGE 7 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C2A-1/C2B-1/C2C-1	C2B-1	C3A-1/C3B-1/C3C-1	C3B-1	C3B-1	C3B-1
DEPTH (feet):	0 - 3'	3 - 6'	0 - 3'	3 - 6'	6 - 9'	9 - 12'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/11/94	04/11/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C2-PIER17-NORTH	C2-PIER17-NORTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	COMPOSITE	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
4,4'-DDE	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
4,4'-DDT	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
ALDRIN	3.9 U	5 U	3.9 U	3.1 U	3 U	3.2 U
ALPHA-BHC	3.9 U	5 U	3.9 U	3.1 U	3 U	3.2 U
AROCLOR-1248	21 J	100 U	19 J	62 U	59 U	65 U
AROCLOR-1254	25 J	100 U	39 J	62 U	59 U	65 U
AROCLOR-1260	79 U	100 U	29 J	62 U	59 U	65 U
BETA-BHC	6.7	5 U	3.9	3.1 U	3 U	3.2 U
DELTA-BHC	3.9 U	5 U	3.9 U	3.1 U	3 U	3.2 U
DIELDRIN	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
ENDOSULFAN I	7.5	5 U	6.7	3.1 U	3 U	2.8 J
ENDOSULFAN II	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
ENDOSULFAN SULFATE	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
ENDRIN	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
ENDRIN ALDEHYDE	7.9 U	10 U	7.9 U	6.2 U	5.9 U	6.5 U
GAMMA-BHC (LINDANE)	3.9 U	5 U	3.9 U	3.1 U	3 U	3.2 U
HEPTACHLOR EPOXIDE	3.9 U	5 U	3.9 U	3.1 U	3 U	3.2 U
METHOXYCHLOR	39 U	50 U	39 U	31 U	30 U	32 U
METALS (mg/kg)						
ANTIMONY	2.4 U	3 U	2.4 U	1.9 U	1.8 U	2 U
ARSENIC	12.7	15.9	10.5	6.1	4.8	10.1

TABLE 11-24 (PAGE 8 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C2A-1/C2B-1/C2C-1	C2B-1	C3A-1/C3B-1/C3C-1	C3B-1	C3B-1	C3B-1
DEPTH (feet):	0 - 3'	3 - 6'	0 - 3'	3 - 6'	6 - 9'	9 - 12'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/11/94	04/11/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C2-PIER17-NORTH	C2-PIER17-NORTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH	C3-PIER17-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	COMPOSITE	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BERYLLIUM	1.2 U	1.5 U	1.2 U	0.93 U	0.89 U	0.98 U
CADMIUM	1.7	1.5 U	1.4	0.93 U	1	0.98 U
CHROMIUM	80.6	56.7	74.9	32.3	38	40.9
COPPER	82	21.2	77.3	11.4	12.3	14.1
LEAD	77.4	25.1	70.6	9.3 U	11.1	11.6
MERCURY	0.35	0.3 U	0.43	0.19	0.18	0.2
NICKEL	30.6	35.1	23.1	17.6	19.9	22.7
SELENIUM	1.2 U	1.5 U	1.2 U	0.93 U	0.89 U	0.98 U
SILVER	2.4 U	3 U	2.4 U	1.9 U	1.8 U	2 U
ZINC	157	86.7	129	41.3	50.4	55.8
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	1500		1700	630		

TABLE 11-24 (PAGE 9 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C4A-1/C4B-1/C4C-1	C4B-1	C4B-1	C5A-1/C5B-1/C5C-1	C5B-1	C5B-1
DEPTH (feet):	0 - 3'	3 - 7'	7 - 11'	0 - 3'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	COMPOSITE	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	190 U	170 U	140 U	160 U	140 U	130 U
ACENAPHTHENE	190 U	170 U	140 U	160 U	140	130 U
ACENAPHTHYLENE	350	240	170	160 U	140 U	130 U
ANTHRACENE	410	340	210	250	220	130 U
BENZO(A)ANTHRACENE	930	800	440	540	430	130 U
BENZO(A)PYRENE	1100	680	450	430	340	130 U
BENZO(B)FLUORANTHENE	980	1400	360	360	310	130 U
BENZO(G,H,I)PERYLENE	700	740	250	250	160	130 U
BENZO(K)FLUORANTHENE	1000	890	510	440	280	130 U
BIS(2-ETHYLHEXYL)PHTHALATE	1400	1300	960	380	410	700
CHRYSENE	1400	1100	610	730	560	130 U
DI-N-BUTYL PHTHALATE	190 U	260	330	400	150	130 U
DI-N-OCTYL PHTHALATE	1500	1300	650	160 U	140 U	4900
DIBENZO(A,H)ANTHRACENE	190 U	180	140 U	160 U	140 U	130 U
FLUORANTHENE	2200	2200	960	1700	1300	130 U
FLUORENE	250	200	960	160 U	160	130 U
HEXACHLOROCYCLOPENTADIENE	190 U	170 U	140 U	160 U	140 U	130 U
INDENO(1,2,3-CD)PYRENE	700	410	240	240	160	130 U
NAPHTHALENE	190 U	170 U	140 U	160 U	140 U	130 U
PHENANTHRENE	1200	840	410	490	470	130 U
PYRENE	2600	2300	1200	1600	1200	130 U

TABLE 11-24 (PAGE 10 OF 19)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C4A-1/C4B-1/C4C-1	C4B-1	C4B-1	C5A-1/C5B-1/C5C-1	C5B-1	C5B-1
DEPTH (feet):	0 - 3'	3 - 7'	7 - 11'	0 - 3'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	COMPOSITE	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	5.7 J	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
4,4'-DDE	7.8 J	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
4,4'-DDT	9.5 U	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
ALDRIN	5.3	4.2 U	3.6 U	2.8 J	3.4 U	3.2 U
ALPHA-BHC	4.7 U	4.2 U	3.6 U	4 U	3.4 U	3.2 U
AROCLOR-1248	39 J	33 J	33 J	29 J	38 J	64 U
AROCLOR-1254	81 J	45 J	28 J	81 U	22 J	64 U
AROCLOR-1260	91 J	34 J	72 U	25 J	69 U	64 U
BETA-BHC	2.8 J	4.2 U	3.6 U	4 U	3.4 U	3.2 U
DELTA-BHC	4.7 U	4.2 U	1.8 J	4 U	3.4 U	3.2 U
DIELDRIN	9.5 U	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
ENDOSULFAN I	18	7.4	5.4	7.7	5.2	3.2 U
ENDOSULFAN II	9.5 U	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
ENDOSULFAN SULFATE	5.6 J	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
ENDRIN	8.5 J	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
ENDRIN ALDEHYDE	9.5 U	8.5 U	7.2 U	8.1 U	6.9 U	6.4 U
GAMMA-BHC (LINDANE)	5.6	4.2 U	3.6 U	4 U	3.4 U	3.2 U
HEPTACHLOR EPOXIDE	4.6 J	2.8 J	2.1 J	2.9 J	2.3 J	3.2 U
METHOXYCHLOR	47 U	42 U	36 U	40 U	34 U	32 U
METALS (mg/kg)						
ANTIMONY	5.9 B	2.7 B	2.2 U	2.4 U	2.1 U	1.9 U
ARSENIC	17.1	12	10.1	11.8	11.2	8.8

TABLE 11-24 (PAGE 11 OF 19)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C4A-1/C4B-1/C4C-1	C4B-1	C4B-1	C5A-1/C5B-1/C5C-1	C5B-1	C5B-1
DEPTH (feet):	0 - 3'	3 - 7'	7 - 11'	0 - 3'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17	PIER15/17
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94	04/12/94
LOCATION:	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C4-PIER17-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH	C5-PIER15-SOUTH
VALIDATED:						
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	COMPOSITE	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
BERYLLIUM	1.4 U	1.3 U	1.1 U	1.2 U	1 U	0.96 U
CADMIUM	4.2	2.4	2.8	1.2 U	1 U	0.96 U
CHROMIUM	194	112	106	48.9	46.6	36.5
COPPER	377	138	122	39.9	154	14.2
LEAD	238	123	105	31.1	22.9	10.1
MERCURY	1	0.93	0.86	0.24 B	0.56	0.19
NICKEL	35.9	42.3	26.7	21.1	24	21.9
SELENIUM	1.4 U	1.3 U	1.1 U	1.2 U	1 U	0.96 U
SILVER	2.9 U	2.6 U	2.2 U	2.4 U	2.1 U	1.9 U
ZINC	441	291	207	86.5	75.3	51.4
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	2600			1300		

TABLE 11-24 (PAGE 12 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C6A-1/C6B-1/C6C-1	C6B-1	C6B-1	EC-SDTR04-02	P2-2	P2-2
DEPTH (feet):	0 - 3'	3 - 6'	6 - 13'	0 - 0.5'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	ECO-2	SEAWOLF	SEAWOLF
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	05/03/95	04/09/94	04/09/94
LOCATION:	C6-PIER15-SOUTH	C6-PIER15-SOUTH	C6-PIER15-SOUTH	EC-SDTR04	P2	P2
VALIDATED:				VALIDATED		
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:				EXCAVATED		
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE				93 J		
ACETONE				300		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	150 U	140 U	140 U	970 U	150 U	190
ACENAPHTHENE	150 U	140 U	140 U	970 U	160	700
ACENAPHTHYLENE	150 U	140 U	140 U	56 J	160	130 U
ANTHRACENE	150 U	140 U	140 U	200 J	240	480
BENZO(A)ANTHRACENE	200	140 U	140 U	820 J	530	520
BENZO(A)PYRENE	160	140 U	140 U	830 J	520	450
BENZO(B)FLUORANTHENE	150 U	140 U	140 U	970 U	360	310
BENZO(G,H,I)PERYLENE	150 U	140 U	140 U	480 J	300	220
BENZO(K)FLUORANTHENE	160	140 U	140 U	1300	570	450
BIS(2-ETHYLHEXYL)PHTHALATE	400	150	290	970 U	570	590
CARBAZOLE				56 J		
CHRYSENE	230	140 U	140 U	1100	820	640
DI-N-BUTYL PHTHALATE	560	230	240	160 J	150 U	130 U
DI-N-OCTYL PHTHALATE	3100	630	4300	970 U	240	250
DIBENZO(A,H)ANTHRACENE	150 U	140 U	140 U	220 J	150 U	130 U
DIBENZOFURAN				970 U		
FLUORANTHENE	320	140 U	140 U	2100	1200	1500
FLUORENE	150 U	140 U	140 U	79 J	210	550
HEXACHLOROCYCLOPENTADIENE	150 U	140 U	140 U	970 UJ	150 U	130 U

TABLE 11-24 (PAGE 13 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C6A-1/C6B-1/C6C-1	C6B-1	C6B-1	EC-SDTR04-02	P2-2	P2-2
DEPTH (feet):	0 - 3'	3 - 6'	6 - 13'	0 - 0.5'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	ECO-2	SEAWOLF	SEAWOLF
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	05/03/95	04/09/94	04/09/94
LOCATION:	C6-PIER15-SOUTH	C6-PIER15-SOUTH	C6-PIER15-SOUTH	EC-SDTR04	P2	P2
VALIDATED:				VALIDATED		
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:				EXCAVATED		
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
INDENO(1,2,3-CD)PYRENE	150 U	140 U	140 U	450 J	300	130 U
NAPHTHALENE	150 U	140 U	140 U	970 U	150 U	370
PHENANTHRENE	150 U	140 U	140 U	480 J	970	2000
PYRENE	400	140 U	140 U	1600	1400	1500
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	7.7 U	6.9 U	6.9 U	97 U	8.5	5.5 J
4,4'-DDE	7.7 U	6.9 U	6.9 U	97 U	7.7 U	3.5 J
4,4'-DDT	7.7 U	6.9 U	6.9 U	97 U	7.7 U	6.5 U
ALDRIN	3.9 U	3.4 U	3.4 U	50 U	5	19
ALPHA-BHC	3.9 U	3.4 U	3.4 U	50 U	2.6	3.2 U
AROCLOR-1248	15 J	69 U	69 U	970 U	77 U	65 U
AROCLOR-1254	12 J	69 U	69 U	970 U	77 U	65 U
AROCLOR-1260	77 U	69 U	69 U	970 U	170	68
BETA-BHC	3.9 U	3.4 U	3.4 U	50 U	4.5	4.9
DELTA-BHC	3.9 U	3.4 U	3.4 U	50 U	8	6.1
DIELDRIN	7.7 U	6.9 U	6.9 U	97 U	7.7 U	6.5 U
ENDOSULFAN I	5.6	3.4 U	2 J	50 U	9.6	5.2
ENDOSULFAN II	7.7 U	6.9 U	6.9 U	97 U	11	6.5 U
ENDOSULFAN SULFATE	7.7 U	6.9 U	6.9 U	97 U	7.5 J	6.5 U
ENDRIN	7.7 U	6.9 U	6.9 U	97 U	7.7 U	6.5 U
ENDRIN ALDEHYDE	7.7 U	6.9 U	6.9 U	22 R	7.7 U	6.5 U
GAMMA-BHC (LINDANE)	3.9 U	3.4 U	3.4 U	50 U	3.8 U	3.2 U

TABLE 11-24 (PAGE 14 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C6A-1/C6B-1/C6C-1	C6B-1	C6B-1	EC-SDTR04-02	P2-2	P2-2
DEPTH (feet):	0 - 3'	3 - 6'	6 - 13'	0 - 0.5'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	ECO-2	SEAWOLF	SEAWOLF
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	05/03/95	04/09/94	04/09/94
LOCATION:	C6-PIER15-SOUTH	C6-PIER15-SOUTH	C6-PIER15-SOUTH	EC-SDTR04	P2	P2
VALIDATED:				VALIDATED		
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:				EXCAVATED		
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
HEPTACHLOR EPOXIDE	3.9 U	3.4 U	3.4 U	50 U	9.7	3 J
METHOXYCHLOR	39 U	34 U	34 U	500 U	38 U	32 U
METALS (mg/kg)						
ALUMINUM				11600 J		
ANTIMONY	2.3 U	2.1 U	2.1 U	2 UR	6.5 B	2 U
ARSENIC	11.4	12.7	10.2	13.5 J	16	8.8
BARIUM				51.6 J		
BERYLLIUM	1.2 U	1 U	1 U	0.92 J	1.2 U	0.98 U
BORON				53.3 J		
CADMIUM	1.2 U	1 U	1 U	0.68 UR	3	1.1
CALCIUM				28200 J		
CHROMIUM	49.2	39.1	39.9	66.5 J	240	112
COBALT				7.3 J		
COPPER	40.8	14	14.6	132 J	1570	134
IRON				26200 J		
LEAD	33.8	10.5	11.4	79.7 J	406	184
MAGNESIUM				8650 J		
MANGANESE				290 J		
MERCURY	0.28	0.21 U	0.21 B	0.41 U	3.1	1.3
NICKEL	24.7	24.1	21.1	26.9 J	30.3	20.2
POTASSIUM				5420 J		
SELENIUM	1.2 U	1 U	1 U	3.4 UR	1.4 B	0.98 U

TABLE 11-24 (PAGE 15 OF 19)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	C6A-1/C6B-1/C6C-1	C6B-1	C6B-1	EC-SDTR04-02	P2-2	P2-2
DEPTH (feet):	0 - 3'	3 - 6'	6 - 13'	0 - 0.5'	3 - 6'	6 - 8'
INVESTIGATION:	PIER15/17	PIER15/17	PIER15/17	ECO-2	SEAWOLF	SEAWOLF
SAMPLE DATE:	04/12/94	04/12/94	04/12/94	05/03/95	04/09/94	04/09/94
LOCATION:	C6-PIER15-SOUTH	C6-PIER15-SOUTH	C6-PIER15-SOUTH	EC-SDTR04	P2	P2
VALIDATED:				VALIDATED		
SAMPLE TYPE:	COMPOSITE	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:				EXCAVATED		
FIELD DUPLICATE OF:						
METALS (mg/kg)						
SILVER	2.3 U	2.1 U	2.1 U	1.4 UR	2.3 U	2 U
SODIUM				23000 J		
VANADIUM				41.5 J		
ZINC	84.7	54.6	55.6	165 J	747	164
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)				0.77		
CHROMIUM(SEM)				15		
COPPER(SEM)				67		
LEAD(SEM)				70		
MERCURY(SEM)				0.0088		
NICKEL(SEM)				6.7		
ZINC(SEM)				110		
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE				1400		
TOTAL ORGANIC CARBON	670			1745	2300	980

TABLE 11-24 (PAGE 16 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	P2-2	P2/P3	LS7SD00101	LS7SD00201	LS7SD00301	
DEPTH (feet):	8 - 10'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	SEAWOLF	1997RI	1997RI	1997RI	
SAMPLE DATE:	04/09/94	04/09/94	10/21/97	10/21/97	10/21/97	/ /
LOCATION:	P2	P2/P3	SW/SD1-7RI	SW/SD2-7RI	SW/SD3-7RI	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	37 U	170 U	1300 U	310 J	990 U	
ACENAPHTHENE	37 U	8900	1300 U	820 J	990 U	
ACENAPHTHYLENE	37 U	320	1300 U	1200 U	990 U	
ANTHRACENE	41	2500	200 J	540 J	120 J	
BENZO(A)ANTHRACENE	74	4500	680 J	1400	570 J	
BENZO(A)PYRENE	67	2300	480 J	630 J	400 J	
BENZO(B)FLUORANTHENE	37 U	2600	520 J	860 J	420 J	
BENZO(G,H,I)PERYLENE	37 U	1000	350 J	570 J	290 J	
BENZO(K)FLUORANTHENE	66	1800	380 J	840 J	410 J	
BIS(2-ETHYLHEXYL)PHTHALATE	54	1000	1300 U	1200 U	990 U	
CARBAZOLE			1300 U	400 J	78 J	
CHRYSENE	88	4900	880 J	1900	750 J	
DI-N-BUTYL PHTHALATE	91	830	1300 U	1200 U	990 U	
DI-N-OCTYL PHTHALATE	160	2500	1300 UJ	1200 UJ	990 UJ	
DIBENZO(A,H)ANTHRACENE	37 U	530	140 J	200 J	180 J	
DIBENZOFURAN			1300 U	580 J	990 U	
FLUORANTHENE	160	16000	1500	7200	1500	
FLUORENE	37 U	8700	1300 U	610 J	52 J	
HEXACHLOROCYCLOPENTADIENE	37 U	2800	1300 UJ	1200 UJ	990 UJ	
INDENO(1,2,3-CD)PYRENE	37 U	1100	400 J	470 J	350 J	
NAPHTHALENE	37 U	6800	1300 U	440 J	990 U	
PHENANTHRENE	100	25000	450 J	5100	420 J	

TABLE 11-24 (PAGE 17 OF 19)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	P2-2	P2/P3	LS7SD00101	LS7SD00201	LS7SD00301	
DEPTH (feet):	8 - 10'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	SEAWOLF	1997RI	1997RI	1997RI	
SAMPLE DATE:	04/09/94	04/09/94	10/21/97	10/21/97	10/21/97	/ /
LOCATION:	P2	P2/P3	SW/SD1-7RI	SW/SD2-7RI	SW/SD3-7RI	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
PYRENE	210	11000	1200 J	4800	1200	
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	3.6 U	8.5 U				
4,4'-DDE	3.6 U	8.9				
4,4'-DDT	3.6 U	14				
ALDRIN	1.8 U	2.7 J				
ALPHA-BHC	1.8 U	4.3 U				
AROCLOR-1248	36 U	120				
AROCLOR-1254	36 U	85 U				
AROCLOR-1260	36 U	150				
BETA-BHC	1.8 U	3.6 J				
DELTA-BHC	1.8 U	4.6				
DIELDRIN	3.6 U	7.6 J				
ENDOSULFAN I	1.8 U	4.3 U				
ENDOSULFAN II	3.6 U	8.5 U				
ENDOSULFAN SULFATE	3.6 U	8.5 U				
ENDRIN	3.6 U	5 J				
ENDRIN ALDEHYDE	3.6 U	5.3 J				
GAMMA-BHC (LINDANE)	1.8 U	4.3 U				
HEPTACHLOR EPOXIDE	1.8 U	7.1				
METHOXYCHLOR	18 U	21 J				

TABLE 11-24 (PAGE 18 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	P2-2	P2/P3	LS7SD00101	LS7SD00201	LS7SD00301	
DEPTH (feet):	8 - 10'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	SEAWOLF	1997RI	1997RI	1997RI	
SAMPLE DATE:	04/09/94	04/09/94	10/21/97	10/21/97	10/21/97	/ /
LOCATION:	P2	P2/P3	SW/SD1-7RI	SW/SD2-7RI	SW/SD3-7RI	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ALUMINUM			17000 J	14000 J	14700 J	
ANTIMONY	1.1 U	4.3 B	0.84 UJ	0.73 UJ	0.72 UJ	
ARSENIC	1.4	13.3	16.4	13.1	13.5	
BARIUM			57.4	47.0	57.8	
BERYLLIUM	0.55 U	2.1	0.21 J	0.21 J	0.35 J	
CADMIUM	0.55 U	2.9	1.1	1.1	1.7	
CALCIUM			8180 J	9550 J	5170 J	
CHROMIUM	6.3	170	73.4	64.5	84.6	
COBALT			8.6	7.6	8.6	
COPPER	5	958	126 J	104 J	114 J	
IRON			32300	27300	29800	
LEAD	5.5 U	277	78.9 J	70.0 J	83.3 J	
MAGNESIUM			10900	9550	9210	
MANGANESE			397	322	308	
MERCURY	0.11 U	1.7	0.37 J	0.31 J	0.52 J	
NICKEL	4.8	64.0	36.5	24.9	28.3	
POTASSIUM			5190	4320	4370	
SELENIUM	0.55 U	1.3 U	1.0 U	0.68 U	1.2 U	
SILVER	1.1 U	2.6 U	0.91 J	0.83 J	0.93 J	
SODIUM			28500	26900	20300	
VANADIUM			51.6	48.1	45.0	
ZINC	10.1	1150	233	181	199	

TABLE 11-24 (PAGE 19 OF 19)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 7
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	P2-2	P2/P3	LS7SD00101	LS7SD00201	LS7SD00301	
DEPTH (feet):	8 - 10'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	SEAWOLF	1997RI	1997RI	1997RI	
SAMPLE DATE:	04/09/94	04/09/94	10/21/97	10/21/97	10/21/97	/ /
LOCATION:	P2	P2/P3	SW/SD1-7RI	SW/SD2-7RI	SW/SD3-7RI	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	COMPOSITE	GRAB	GRAB	GRAB	
STATUS:						
FIELD DUPLICATE OF:						
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)			0.99	0.63	1.1	
COPPER(SEM)			116 J	77.8 J	74.3 J	
LEAD(SEM)			85.0 J	63.0 J	68.9 J	
NICKEL(SEM)			21.6	15.2	17.5	
ZINC(SEM)			222 J	148 J	165 J	
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE			1100 J	1500 J	1000 J	
AMMONIA, AS NITROGEN			150	94 U	68 U	
TOTAL ORGANIC CARBON	55 U	2200	60000	68000	52000	
GENERAL CHEMISTRY						
PH			8.1	7.9	7.9	

TABLE 11-25

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 7[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (µg/kg)			
2-Methylnaphthalene	2/26	190 - 310	SW/SD2-7RI
Acenaphthene	5/26	140 - 8900	P2/P3
Acenaphthylene	6/26	160 - 350	C4-PIER17-SOUTH
Anthracene	13/26	41 - 2500	P2/P3
Benzo(a)anthracene	17/27	74 - 4500	P2/P3
Benzo(a)pyrene	16/27	67 - 2300	P2/P3
Benzo(b)fluoranthene	14/26	220 - 2600	P2/P3
Benzo(g,h,i)perylene	13/26	160 - 1000	P2/P3
Benzo(k)fluoranthene	16/26	66 - 1800	P2/P3
Bis(2-Ethylhexyl)phthalate	22/26	54 - 1400	C1-PIER17-NORTH C4-PIER17-SOUTH
Carbazole	2/3	78 - 400	SW/SD2-7RI
Chrysene	17/27	88 - 4900	P2/P3
Di-N-butyl phthalate	17/26	91 - 830	P2/P3
Di-N-octyl phthalate	20/26	160 - 11000	C2-PIER17-NORTH
Dibenzo(a,h)anthracene	5/26	140 - 530	P2/P3
Dibenzofuran	1/3	580	SW/SD2-7RI
Fluoranthene	17/27	160 - 16000	P2/P3
Fluorene	9/26	52 - 8700	P2/P3
Hexachlorocyclopentadiene	1/26	2800	P2/P3
Indeno(1,2,3-Cd)pyrene	12/26	160 - 1100	P2/P3
Naphthalene	3/26	370 - 6800	P2/P3
Phenanthrene	15/27	100 - 25000	P2/P3
Pyrene	17/27	133 - 11000	P2/P3
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	3/24	5.5 - 8.5	P2
4,4'-DDE	3/24	3.5 - 8.9	P2/P3
4,4'-DDT	1/24	14	P2/P3
Aldrin	5/24	2.7 - 19	P2
alpha-BHC	1/24	2.6	P2
Aroclor-1248	10/24	15 - 120	P2/P3
Aroclor-1254	7/24	12 - 81	C4-PIER17-SOUTH
Aroclor-1260	8/24	25 - 170	P2
beta-BHC	7/24	2.8 - 6.7	C2-PIER17-NORTH
delta-BHC	4/24	1.8 - 8	P2
Dieldrin	1/24	7.6	P2/P3
Endosulfan I	12/24	2 - 18	C4-PIER17-SOUTH
Endosulfan II	1/24	11	P2
Endosulfan sulfate	3/24	5.6 - 8.4	C1-PIER17-NORTH
Endrin	2/24	5 - 8.5	C4-PIER17-SOUTH
Endrin aldehyde	1/24	5.3	P2/P3
gamma-BHC (lindane)	1/24	5.6	C4-PIER17-SOUTH

TABLE 11-25

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 7[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Heptachlor epoxide	9/24	2.1 - 9.7	P2
Methoxychlor	1/24	21	P2/P3
INORGANICS (mg/kg)			
Aluminum	3/3	14000 - 17000	SW/SD1-7RI
Antimony	4/26	2.7 - 6.5	P2
Arsenic	27/27	1.4 - 17.1	C4-PIER17-SOUTH
Barium	3/3	47 - 57.8	SW/SD3-7RI
Beryllium	4/26	0.21 - 2.1	P2/P3
Cadmium	15/27	1 - 4.2	C4-PIER17-SOUTH
Cadmium (AVS/SEM)[2]	3/3	0.63 - 1.1	SW/SD3-7RI
Calcium	3/3	5170 - 9550	SW/SD2-7RI
Chromium	27/27	6.3 - 240	P2
Cobalt	3/3	7.6 - 8.6	SW/SD1-7RI / SW/SD3-7RI
Copper	27/27	5 - 1570	P2
Copper (AVS/SEM)	3/3	74.3 - 116	SW/SD1-7RI
Iron	3/3	27300 - 32300	SW/SD1-7RI
Lead	25/27	10.1 - 406	P2
Lead (AVS/SEM)	3/3	63 - 85	SW/SD1-7RI
Magnesium	3/3	9210 - 10900	SW/SD1-7RI
Manganese	3/3	308 - 397	SW/SD1-7RI
Mercury	20/27	0.18 - 3.1	P2
Nickel	27/27	4.8 - 64	P2/P3
Nickel (AVS/SEM)	3/3	15.2 - 21.6	SW/SD1-7RI
Potassium	3/3	4320 - 5190	SW/SD1-7RI
Selenium	2/26	1.1 - 1.4	P2
Silver	3/26	0.83 - 0.93	SW/SD3-7RI
Sodium	3/3	20300 - 28500	SW/SD1-7RI
Vanadium	3/3	45 - 51.6	SW/SD1-7RI
Zinc	27/27	10.1 - 1150	P2/P3
Zinc (AVS/SEM)	3/3	148 - 222	SW/SD1-7RI
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	1/3	150	SW/SD1-7RI
pH	3/3	7.9 - 8.1	SW/SD1-7RI
Total organic carbon	18/19	130 - 68000	SW/SD2-7RI
Acid volatile sulfide	3/3	1000 - 1500	SW/SD2-7RI

1 Includes samples C1A-1/C1B-1/C1C-1, C1B-1 (3-6), C1B-1 (6-13), C2-B1, C2A-1/C2B-1/C2C-1, C2B-1 (3-6), C2B-1 (6-10), C3A-1/C3B-1/C3C-1, C3B-1 (3-6), C3B-1 (6-9), C3B-1 (9-12), C4A-1/C4B-1/C4C-1, C4B-1 (3-7), C4B-1 (7-11), C5A-1/C5B-1/C5C-1, C5B-1(3-6), C5B-1 (6-8) C6A-1/C6B-1/C6C-1, C6B-1, P2-2 (3-6), P2-2 (6-8), P2-2 (8-10), P2/P3, LS7SD00101, LS7SD00201, LS7SD00301, MG-9030.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-26 (PAGE 1 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	10S	8N	EC-SDTR05-02	M1A	M1B	LS1SD00101
DEPTH (feet):	0 - 6'	0 - 6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	01/01/95	01/01/95	05/03/95	01/01/92	01/01/92	10/21/97
LOCATION:	10S	8N	EC-SDTR05	M1	M1	SW/SD1-1RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED	EXCAVATED		EXCAVATED	EXCAVATED	
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE			74 J			
ACETONE			200			
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE	350	520	1100 U	100 U	100 U	120 J
ACENAPHTHYLENE	89 U	77 U	69 J	300	600	1100 U
ANTHRACENE	120	170	200 J	400	850	530 J
BENZO(A)ANTHRACENE	190	260	1100	1400	2900	1200
BENZO(A)PYRENE	230	230	880 J	1300	2600	650 J
BENZO(B)FLUORANTHENE	210	230	740 J	1200	2400	670 J
BENZO(G,H,I)PERYLENE	130	140	520 J	500	880	440 J
BENZO(K)FLUORANTHENE	89	110	880 J	750	2300	750 J
CARBAZOLE			62 J			67 J
CHRYSENE	150 U	130 U	1300	1500	3100	1600
DI-N-BUTYL PHTHALATE			55 J			2900
DIBENZO(A,H)ANTHRACENE	30	38	220 J	100 U	240	180 J
DIBENZOFURAN			1100 U			73 J
FLUORANTHENE	510	610	1600	1600	3000	2900
FLUORENE	67	130	77 J			150 J
INDENO(1,2,3-CD)PYRENE	40	75	460 J	525	950	430 J
NAPHTHALENE	140	560	60 J	100 U	300	120 J
PHENANTHRENE	140	230	470 J	700	1900	870 J
PYRENE	730	520	2200	2700	5200	1900

TABLE 11-26 (PAGE 2 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	10S	8N	EC-SDTR05-02	M1A	M1B	LS1SD00101
DEPTH (feet):	0 - 6'	0 - 6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	01/01/95	01/01/95	05/03/95	01/01/92	01/01/92	10/21/97
LOCATION:	10S	8N	EC-SDTR05	M1	M1	SW/SD1-1RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED	EXCAVATED		EXCAVATED	EXCAVATED	
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
BETA-BHC	5.6	4 U	55 U			
METALS (mg/kg)						
ALUMINUM			12900			13500 J
ANTIMONY			2.6			0.67 UJ
ARSENIC	11.9	10.6	14.5	12	14	14.1
BARIUM			58.8	69	83	47.9
BERYLLIUM			0.93			0.18 J
BORON			55.8			
CADMIUM	1.1	1	0.66 U	2	3.3	0.96
CALCIUM			6680			8460 J
CHROMIUM	92.2	82.2	74.8	150	230	61.5
COBALT			8			7.1
COPPER	118	102	119	165	290	111 J
IRON			29600			27400
LEAD	188	127	96.7	170	250	96.1 J
MAGNESIUM			9300			9380
MANGANESE			322			314
MERCURY	0.6	0.5	0.53 U	0.6	0.9	0.35 J
NICKEL	32.5	24.9	31.2	49	59	24.3
POTASSIUM			5010			4230
SILVER			1.3 U			0.76 J
SODIUM			23400			25000

TABLE 11-26 (PAGE 3 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	10S	8N	EC-SDTR05-02	M1A	M1B	LS1SD00101
DEPTH (feet):	0 - 6'	0 - 6'	0 - 0.5'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	TR_DREDGE	TR_DREDGE	1997RI
SAMPLE DATE:	01/01/95	01/01/95	05/03/95	01/01/92	01/01/92	10/21/97
LOCATION:	10S	8N	EC-SDTR05	M1	M1	SW/SD1-1RI
VALIDATED:			VALIDATED			VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED	EXCAVATED		EXCAVATED	EXCAVATED	
FIELD DUPLICATE OF:						
METALS (mg/kg)						
VANADIUM			46.3			42.0
ZINC	251	196	231	189	345	236
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)			0.59			0.78
CHROMIUM(SEM)			15			
COPPER(SEM)			35			106 J
LEAD(SEM)			75			116 J
NICKEL(SEM)			6.3			18.8
ZINC(SEM)			110			273 J
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE			3300			2900 J
AMMONIA, AS NITROGEN						150
TOTAL ORGANIC CARBON	46000	36000	1270	74300	212500	53000
GENERAL CHEMISTRY						
PH						8.4

TABLE 11-26 (PAGE 4 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1 LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS1SD00201	LS1SD00301	LS1SD00401			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	1997RI	1997RI	1997RI			
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	/ /	/ /	/ /
LOCATION:	SW/SD2-1RI	SW/SD3-1RI	SW/SD4-1RI			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE	140 J	100 J	60 J			
ACENAPHTHYLENE	1100 U	1200 U	760 U			
ANTHRACENE	220 J	300 J	340 J			
BENZO(A)ANTHRACENE	930 J	1100 J	1400			
BENZO(A)PYRENE	530 J	560 J	640 J			
BENZO(B)FLUORANTHENE	580 J	630 J	820 J			
BENZO(G,H,I)PERYLENE	500 J	480 J	480 J			
BENZO(K)FLUORANTHENE	550 J	520 J	630 J			
CARBAZOLE	1100 U	1200 U	59 J			
CHRYSENE	1200	1300	1500			
DI-N-BUTYL PHTHALATE	1100 U	1300	760 U			
DIBENZO(A,H)ANTHRACENE	110 J	190 J	210 J			
DIBENZOFURAN	1100 U	1200 U	49 J			
FLUORANTHENE	2400	2900	2600			
FLUORENE	100 J	130 J	130 J			
INDENO(1,2,3-CD)PYRENE	440 J	400 J	540 J			
NAPHTHALENE	1100 U	1200 U	760 U			
PHENANTHRENE	730 J	980 J	860			
PYRENE	1900	2300	2400			
METALS (mg/kg)						
ALUMINUM	15000 J	17400 J	12200 J			
ANTIMONY	0.60 UJ	0.78 UJ	0.50 UJ			

TABLE 11-26 (PAGE 5 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS1SD00201	LS1SD00301	LS1SD00401			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	1997RI	1997RI	1997RI			
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	/ /	/ /	/ /
LOCATION:	SW/SD2-1RI	SW/SD3-1RI	SW/SD4-1RI			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ARSENIC	13.1	15.8	11.7			
BARIUM	50.6	59.8	44.9			
BERYLLIUM	0.38 J	0.48 J	0.20 J			
CADMIUM	1.0	1.2	0.92			
CALCIUM	6270 J	7760 J	6020 J			
CHROMIUM	64.2	80.7	53.6			
COBALT	7.8	9.2	6.4			
COPPER	272 J	146 J	110 J			
IRON	27800	34100	22300			
LEAD	80.1 J	111 J	71.7 J			
MAGNESIUM	9420	10600	6780			
MANGANESE	311	401	258			
MERCURY	0.30 J	0.39 J	0.35 J			
NICKEL	26.2	34.7	23.7			
POTASSIUM	4500	5120	3410			
SILVER	0.64 J	0.87 J	0.66 J			
SODIUM	25100	25700	13200			
VANADIUM	46.4	52.1	38.6			
ZINC	221	281	216			
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	0.71	0.83	0.61			
COPPER(SEM)	376 J	119 J	86.0 J			

TABLE 11-26 (PAGE 6 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 1
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS1SD00201	LS1SD00301	LS1SD00401			
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'			
INVESTIGATION:	1997RI	1997RI	1997RI			
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	/ /	/ /	/ /
LOCATION:	SW/SD2-1RI	SW/SD3-1RI	SW/SD4-1RI			
VALIDATED:	VALIDATED	VALIDATED	VALIDATED			
SAMPLE TYPE:	GRAB	GRAB	GRAB			
STATUS:						
FIELD DUPLICATE OF:						
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
LEAD(SEM)	84.0 J	103 J	61.7 J			
NICKEL(SEM)	17.8	21.3	13.2			
ZINC(SEM)	256 J	233 J	508 J			
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	1000 J	1100 J	1200 J			
AMMONIA, AS NITROGEN	85	100	63 U			
TOTAL ORGANIC CARBON	55000	61000	41000			
GENERAL CHEMISTRY						
PH	8	7.9	8			

TABLE 11-27

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 1[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	1/1	74	EC-SDTR05
Acetone	1/1	200	EC-SDTR05
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthene	4/5	60 - 140	SW/SD2-1RI
Acenaphthylene	1/5	69	EC-SDTR05
Anthracene	5/5	200 - 530	SW/SD1-1RI
Benzo(a)anthracene	5/5	930 - 1400	SW/SD4-1RI
Benzo(a)pyrene	5/5	530 - 880	EC-SDTR05
Benzo(b)fluoranthene	5/5	580 - 820	SW/SD4-1RI
Benzo(g,h,i)perylene	5/5	440 - 520	EC-SDTR05
Benzo(k)fluoranthene	5/5	520 - 880	EC-SDTR05
Carbazole	3/5	59 - 67	SW/SD1-1RI
Chrysene	5/5	1200 - 1600	SW/SD1-1RI
Di-N-butyl phthalate	3/5	55 - 2900	SW/SD1-1RI
Dibenzo(a,h)anthracene	5/5	110 - 220	EC-SDTR05
Dibenzofuran	2/5	49 - 73	SW/SD1-1RI
Fluoranthene	5/5	1600 - 2900	SW/SD1-1RI / SW/SD3-1RI
Fluorene	5/5	77 - 150	SW/SD1-1RI
Indeno(1,2,3-Cd)pyrene	5/5	400 - 540	SW/SD4-1RI
Naphthalene	2/5	60 - 120	SW/SD1-1RI
Phenanthrene	5/5	470 - 980	SW/SD3-1RI
Pyrene	5/5	1900 - 2400	SW/SD4-1RI
INORGANICS (mg/kg)			
Aluminum	5/5	12200 - 17400	SW/SD3-1RI
Antimony	1/5	2.6	EC-SDTR05
Arsenic	5/5	11.7 - 15.8	SW/SD3-1RI
Barium	5/5	44.9 - 59.8	SW/SD3-1RI
Beryllium	5/5	0.18 - 0.93	EC-SDTR05
Boron	1/1	55.8	EC-SDTR05
Cadmium	4/5	0.92 - 1.2	SW/SD3-1RI
Cadmium (AVS/SEM)[2]	5/5	0.59 - 0.83	SW/SD3-1RI
Calcium	5/5	6020 - 8460	SW/SD1-1RI
Chromium	5/5	53.6 - 80.7	SW/SD3-1RI
Chromium (AVS/SEM)	1/1	15	EC-SDTR05
Cobalt	5/5	6.4 - 9.2	SW/SD3-1RI
Copper	5/5	110 - 272	SW/SD2-1RI
Copper (AVS/SEM)	5/5	35 - 376	SW/SD2-1RI

TABLE 11-27

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 1[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Iron	5/5	22300 - 34100	SW/SD3-1RI
Lead	5/5	71.7 - 111	SW/SD3-1RI
Lead (AVS/SEM)	5/5	61.7 - 116	SW/SD1-1RI
Magnesium	5/5	6780 - 10600	SW/SD3-1RI
Manganese	5/5	258 - 401	SW/SD3-1RI
Mercury	4/5	0.3 - 0.39	SW/SD3-1RI
Nickel	5/5	23.7 - 34.7	SW/SD3-1RI
Nickel (AVS/SEM)	5/5	6.3 - 21.3	SW/SD3-1RI
Potassium	5/5	3410 - 5120	SW/SD3-1RI
Silver	4/5	0.64 - 0.87	SW/SD3-1RI
Sodium	5/5	13200 - 25700	SW/SD3-1RI
Vanadium	5/5	38.6 - 52.1	SW/SD3-1RI
Zinc	5/5	216 - 281	SW/SD3-1RI
Zinc (AVS/SEM)	5/5	110 - 508	SW/SD4-1RI
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	3/4	85 - 150	SW/SD1-1RI
pH	4/4	7.9 - 8.4	SW/SD1-1RI
Total organic carbon	5/5	1270 - 61000	SW/SD3-1RI
Acid volatile sulfide	5/5	1000 - 3300	EC-SDTR05

1 Includes samples ECSDTR05-02, LS1SD00101, LS1SD00201, LS1SD00301, LS1SD00401.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-28 (PAGE 1 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 2
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9004	8S	LS2SD00101	LS2SD00201	T3SD2	
DEPTH (feet):	0 - 3.8'	0 - 6'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	TR_DREDGE	1997RI	1997RI	PH2-1	
SAMPLE DATE:	03/07/90	01/01/95	10/21/97	10/21/97	11/09/93	/ /
LOCATION:	10	8S	SW/SD1-2RI	SW/SD2-2RI	T3SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED				
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
ACENAPHTHENE		430	230 J	760 J	1600 U	
ANTHRACENE		100	250 J	470 J	150 J	
BENZO(A)ANTHRACENE	20 U	240	1400	1100 J	460 J	
BENZO(A)PYRENE	20 U	210	720 J	540 J	520 J	
BENZO(B)FLUORANTHENE		200	900 J	680 J	450 J	
BENZO(G,H,I)PERYLENE		130	500 J	280 J	400 J	
BENZO(K)FLUORANTHENE		96	710 J	480 J	470 J	
CARBAZOLE			94 J	72 J	1600 U	
CHRYSENE	20 U	130 U	1600	1200 J	680 J	
DI-N-BUTYL PHTHALATE			1100 U	2900	1600 U	
DIBENZO(A,H)ANTHRACENE		31	210 J	120 J	1600 U	
DIBENZOFURAN			86 J	220 J	1600 U	
FLUORANTHENE	20 U	600	4700	4200	830 J	
FLUORENE		65	140 J	390 J	1600 U	
INDENO(1,2,3-CD)PYRENE		67	520 J	340 J	420 J	
NAPHTHALENE		220	63 J	1200 U	1600 U	
PHENANTHRENE	20 U	160	1100 J	1800	430 J	
PHENOL			68 J	1200 U	1600 U	
PYRENE	20 U	390	3100	2000	790 J	
PESTICIDES/PCBs (µg/kg)						
BETA-BHC	20 U	7.2			83 U	

TABLE 11-28 (PAGE 2 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 2
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9004	8S	LS2SD00101	LS2SD00201	T3SD2	
DEPTH (feet):	0 - 3.8'	0 - 6'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	TR_DREDGE	1997RI	1997RI	PH2-1	
SAMPLE DATE:	03/07/90	01/01/95	10/21/97	10/21/97	11/09/93	/ /
LOCATION:	10	8S	SW/SD1-2RI	SW/SD2-2RI	T3SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED				
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ALUMINUM			17900 J	16400 J	16400	
ANTIMONY			0.67 UJ	0.76 UJ	40.9 J	
ARSENIC	4.31	11.8	15.5	15.0	6.9 J	
BARIUM			96.4	62.0	63.5	
BERYLLIUM			0.94 J	0.87 U	0.63	
CADMIUM	1.25	1	0.74 J	0.85	0.51 UJ	
CALCIUM			7580 J	10100 J	8010 J	
CHROMIUM	24.9	76.6	81.5	74.9	65.6 J	
COBALT			9.1	8.6	7.5	
COPPER	10	93.5	136 J	129 J	80.5	
IRON			35800	32100	26500	
LEAD	24.4	121	128 J	223 J	95.7	
MAGNESIUM			10600	10600	8480	
MANGANESE			383	378	287 J	
MERCURY	0.03	0.5	0.39 J	0.46 J	0.63 J	
NICKEL	15.5	30.1	32.1	29.3	32.1	
POTASSIUM			5180	4950	4840	
SELENIUM			0.92 J	1.1	0.68 U	
SILVER			0.72 J	0.84 J	1.8 U	
SODIUM			22400	26200	16300	
VANADIUM			56.1	52.6	43.1	
ZINC	43.2	186	224	204	139 J	

TABLE 11-28 (PAGE 3 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 2
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9004	8S	LS2SD00101	LS2SD00201	T3SD2	
DEPTH (feet):	0 - 3.8'	0 - 6'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	SEAWOLF	TR_DREDGE	1997RI	1997RI	PH2-1	
SAMPLE DATE:	03/07/90	01/01/95	10/21/97	10/21/97	11/09/93	/ /
LOCATION:	10	8S	SW/SD1-2RI	SW/SD2-2RI	T3SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED				
FIELD DUPLICATE OF:						
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)			0.82	0.80		
COPPER(SEM)			96.5 J	116 J		
LEAD(SEM)			105 J	192 J		
NICKEL(SEM)			18.7	20.5		
ZINC(SEM)			186 J	224 J		
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE			450 J	2100 J		
AMMONIA, AS NITROGEN			98	150		
TOTAL ORGANIC CARBON	22532	40000	53000	64000	12000	
GENERAL CHEMISTRY						
PH			8	8.4		

TABLE 11-29

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 2[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthene	2/3	230 - 760	SW/SD2-2RI
Anthracene	3/3	150 - 470	SW/SD2-2RI
Benzo(a)anthracene	3/3	460 - 1400	SW/SD1-2RI
Benzo(a)pyrene	3/3	520 - 720	SW/SD1-2RI
Benzo(b)fluoranthene	3/3	450 - 900	SW/SD1-2RI
Benzo(g,h,i)perylene	3/3	280 - 500	SW/SD1-2RI
Benzo(k)fluoranthene	3/3	470 - 710	SW/SD1-2RI
Carbazole	2/3	72 - 94	SW/SD1-2RI
Chrysene	3/3	680 - 1600	SW/SD1-2RI
Di-N-butyl phthalate	1/3	2900	SW/SD2-2RI
Dibenzo(a,h)anthracene	2/3	120 - 210	SW/SD1-2RI
Dibenzofuran	2/3	86 - 220	SW/SD2-2RI
Fluoranthene	3/3	830 - 4700	SW/SD1-2RI
Fluorene	2/3	140 - 390	SW/SD2-2RI
Indeno(1,2,3-Cd)pyrene	3/3	340 - 520	SW/SD1-2RI
Naphthalene	1/3	63	SW/SD1-2RI
Phenanthrene	3/3	430 - 1800	SW/SD2-2RI
Phenol	1/3	68	SW/SD1-2RI
Pyrene	3/3	790 - 3100	SW/SD1-2RI
INORGANICS (mg/kg)			
Aluminum	3/3	16400 - 17900	SW/SD1-2RI
Antimony	1/3	40.9	T3SD2
Arsenic	3/3	6.9 - 15.5	SW/SD1-2RI
Barium	3/3	62 - 96.4	SW/SD1-2RI
Beryllium	2/3	0.63 - 0.94	SW/SD1-2RI
Cadmium	2/3	0.74 - 0.85	SW/SD2-2RI
Cadmium (AVS/SEM)[2]	2/2	0.8 - 0.82	SW/SD1-2RI
Calcium	3/3	7580 - 10100	SW/SD2-2RI
Chromium	3/3	65.6 - 81.5	SW/SD1-2RI
Cobalt	3/3	7.5 - 9.1	SW/SD1-2RI
Copper	3/3	80.5 - 136	SW/SD1-2RI
Copper (AVS/SEM)	2/2	96.5 - 116	SW/SD2-2RI
Iron	3/3	26500 - 35800	SW/SD1-2RI
Lead	3/3	95.7 - 223	SW/SD2-2RI
Lead (AVS/SEM)	2/2	105 - 192	SW/SD2-2RI
Magnesium	3/3	8480 - 10600	SW/SD1-2RI / SW/SD2-2RI
Manganese	3/3	287 - 383	SW/SD1-2RI
Mercury	3/3	0.39 - 0.63	T3SD2
Nickel	3/3	29.3 - 32.1	T3SD2 / SW/SD1-2RI

TABLE 11-29

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 2[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Nickel (AVS/SEM)	2/2	18.7 - 20.5	SW/SD2-2RI
Potassium	3/3	4840 - 5180	SW/SD1-2RI
Selenium	2/3	0.92 - 1.1	SW/SD2-2RI
Silver	2/3	0.72 - 0.84	SW/SD2-2RI
Sodium	3/3	16300 - 26200	SW/SD2-2RI
Vanadium	3/3	43.1 - 56.1	SW/SD1-2RI
Zinc	3/3	139 - 224	SW/SD1-2RI
Zinc (AVS/SEM)	2/2	186 - 224	SW/SD2-2RI
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	2/2	98 - 150	SW/SD2-2RI
pH	2/2	8 - 8.4	SW/SD2-2RI
Total organic carbon	3/3	12000 - 64000	SW/SD2-2RI
Acid volatile sulfide	2/2	450 - 2100	SW/SD2-2RI

1 Includes samples LS2SD00101, LS2SD00201, T3SD2.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-30 (PAGE 1 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 3
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS3SD00101	LS3SD00201	SDFD001	EC-T4SD2-02	T4SD2	T5SD2
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	1997RI	1997RI	1997RI	ECO-2	PH2-1	PH2-1
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	05/03/95	11/09/93	11/09/93
LOCATION:	SW/SD1-3RI	SW/SD2-3RI	SW/SD2-3RI	T4SD2	T4SD2	T5SD2
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS3SD00201			
VOLATILES (µg/kg)						
2-BUTANONE				58 J		
ACETONE				240		
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	1100 U	120 J	1100 U	940 U	2100 U	780 U
4-METHYLPHENOL	1100 U	68 J	1100 U	940 U	2100 U	780 U
ACENAPHTHENE	260 J	1100 J	560 J	940 U	140 J	780 U
ACENAPHTHYLENE	66 J	63 J	1100 U	52 J	170 J	780 U
ANTHRACENE	710 J	1600	950 J	220 J	680 J	780 U
BENZO(A)ANTHRACENE	2500	4100	2500	1100	2000 J	780 U
BENZO(A)PYRENE	1400	1900	1200	870 J	1400 J	88 J
BENZO(B)FLUORANTHENE	1500	2300	1400	940 U	1800 J	780 U
BENZO(G,H,I)PERYLENE	740 J	870 J	600 J	420 J	660 J	780 U
BENZO(K)FLUORANTHENE	1300	2000	1100 J	1400	880 J	780 U
BIS(2-ETHYLHEXYL)PHTHALATE	1100 U	1100 U	1100 U	940 U	2100 U	90 J
CARBAZOLE	230 J	340 J	180 J	84 J	140 J	780 U
CHRYSENE	2900	4500	3000	1300	2000 J	780 U
DI-N-BUTYL PHTHALATE	2300	11000	11000	50 J	160 J	780 U
DIBENZO(A,H)ANTHRACENE	340 J	440 J	240 J	200 J	2100 U	780 U
DIBENZOFURAN	100 J	460 J	200 J	940 U	110 J	780 U
DIMETHYL PHTHALATE	1100 U	1100 U	55 J	940 U	2100 U	780 U
FLUORANTHENE	8600	12000	8400	2900	5300	780 U
FLUORENE	200 J	700 J	410 J	80 J	190 J	780 U

TABLE 11-30 (PAGE 2 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 3
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS3SD00101	LS3SD00201	SDFD001	EC-T4SD2-02	T4SD2	T5SD2
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	1997RI	1997RI	1997RI	ECO-2	PH2-1	PH2-1
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	05/03/95	11/09/93	11/09/93
LOCATION:	SW/SD1-3RI	SW/SD2-3RI	SW/SD2-3RI	T4SD2	T4SD2	T5SD2
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS3SD00201			
SEMIVOLATILES (µg/kg)						
INDENO(1,2,3-CD)PYRENE	830 J	1100 J	730 J	450 J	850 J	780 U
NAPHTHALENE	110 J	230 J	160 J	66 J	2100 U	780 U
PHENANTHRENE	1500	4200	2000	470 J	2100 J	780 U
PHENOL	1100 U	150 J	120 J	940 U	2100 U	780 U
PYRENE	3600	6400	4100	2000	5300 J	780 U
PESTICIDES/PCBs (µg/kg)						
GAMMA-BHC (LINDANE)				48 U	3.8 J	81 U
METALS (mg/kg)						
ALUMINUM	14200 J	15700 J	17600 J	18500	17600	15200
ANTIMONY	0.54 UJ	1.2 J	0.61 UJ	2.6	41.1 J	30.4 J
ARSENIC	11.8	14.2	15.7	18.5	13.2 J	7.8 J
BARIUM	54.4	70.3	79.9	79	70	41.8
BERYLLIUM	0.73	0.85	1.1 J	1.2	0.78	0.54
BORON				69.2	160 U	185 U
CADMIUM	0.70	0.98	1.5 J	0.61	0.65 UJ	0.55 UJ
CALCIUM	6050 J	14900	11300	9440	6550 J	9840 J
CHROMIUM	68.6	79.7	89.7	100	83.5 J	37.1 J
COBALT	7.4	8.3	9.5	10.9	8.3	7.3
COPPER	105 J	140	202	176	118	22.6
IRON	27500	33500	35300	40400	28800	22400
LEAD	149 J	1040 J	1380 J	122	139	12.7
MAGNESIUM	9120	12200	10100	11900	9460	7930

TABLE 11-30 (PAGE 3 OF 3)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 3
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS3SD00101	LS3SD00201	SDFD001	EC-T4SD2-02	T4SD2	T5SD2
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	1997RI	1997RI	1997RI	ECO-2	PH2-1	PH2-1
SAMPLE DATE:	10/21/97	10/21/97	10/21/97	05/03/95	11/09/93	11/09/93
LOCATION:	SW/SD1-3RI	SW/SD2-3RI	SW/SD2-3RI	T4SD2	T4SD2	T5SD2
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:			LS3SD00201			
METALS (mg/kg)						
MANGANESE	297	354	361	466	356 J	245 J
MERCURY	0.38 J	0.46 J	0.53 J	0.43 U	0.56 J	0.28 UJ
NICKEL	26.1	32.0	35.4	54.6	34.3	18.8
POTASSIUM	4390	4570	4850	6280	4940	4330
SELENIUM	0.78	1.1	0.94 J	2.9 UJ	0.65 UJ	0.55 UJ
SILVER	0.56 J	0.83 J	0.89 J	1.4	2.2 U	1.1 U
SODIUM	23700	24300	20600	22900	21500	16500
VANADIUM	45.3	50.1	54.4	64.3	51	40.7
ZINC	186	286	349	235	194 J	59.6 J
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	1.2	1.0	1.2	0.59		
CHROMIUM(SEM)				15		
COPPER(SEM)	114 J	128 J	113 J	51		
LEAD(SEM)	178 J	1280 J	1230 J	76		
NICKEL(SEM)	22.2	22.2	21.1	8.1		
ZINC(SEM)	243 J	372 J	292 J	110		
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	1500 J	940 J	3100 J	1700		
AMMONIA, AS NITROGEN	57 U	140	110			
TOTAL ORGANIC CARBON	67000	63000	62000	1136	16000	11000
GENERAL CHEMISTRY						
PH	8.1	9.2	9.1			

TABLE 11-31

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 3[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	1/1	58	T4SD2
Acetone	1/1	240	T4SD2
SEMIVOLATILE ORGANICS (µg/kg)			
2-Methylnaphthalene	1/6	120	SW/SD2-3RI
4-Methylphenol	1/6	68	SW/SD2-3RI
Acenaphthene	4/6	140 - 1100	SW/SD2-3RI
Acenaphthylene	4/6	52 - 170	T4SD2
Anthracene	5/6	220 - 1600	SW/SD2-3RI
Benzo(a)anthracene	5/6	1100 - 4100	SW/SD2-3RI
Benzo(a)pyrene	6/6	88 - 1900	SW/SD2-3RI
Benzo(b)fluoranthene	4/6	1400 - 2300	SW/SD2-3RI
Benzo(g,h,i)perylene	5/6	420 - 870	SW/SD2-3RI
Benzo(k)fluoranthene	5/6	880 - 2000	SW/SD2-3RI
Bis(2-Ethylhexyl)phthalate	1/6	90	T5SD2
Carbazole	5/6	84 - 340	SW/SD2-3RI
Chrysene	5/6	1300 - 4500	SW/SD2-3RI
Di-N-butyl phthalate	5/6	50 - 11000	SW/SD2-3RI
Dibenzo(a,h)anthracene	4/6	200 - 440	SW/SD2-3RI
Dibenzofuran	4/6	100 - 460	SW/SD2-3RI
Dimethyl phthalate	1/6	55	SW/SD2-3RI
Fluoranthene	5/6	2900 - 12000	SW/SD2-3RI
Fluorene	5/6	80 - 700	SW/SD2-3RI
Indeno(1,2,3-Cd)pyrene	5/6	450 - 1100	SW/SD2-3RI
Naphthalene	4/6	66 - 230	SW/SD2-3RI
Phenanthrene	5/6	470 - 4200	SW/SD2-3RI
Phenol	2/6	120 - 150	SW/SD2-3RI
Pyrene	5/6	2000 - 6400	SW/SD2-3RI
PESTICIDES/PCBs (µg/kg)			
gamma-BHC (lindane)	1/3	3.8	T4SD2
INORGANICS (mg/kg)			
Aluminum	6/6	14200 - 18500	T4SD2
Antimony	4/6	1.2 - 41.1	T4SD2
Arsenic	6/6	7.8 - 18.5	T4SD2
Barium	6/6	41.8 - 79.9	SW/SD2-3RI
Beryllium	6/6	0.54 - 1.2	T4SD2
Boron	1/3	69.2	T4SD2
Cadmium	4/6	0.61 - 1.5	SW/SD2-3RI
Cadmium (AVS/SEM)[2]	4/4	0.59 - 1.2	SW/SD1-3RI/SW/SD2-3RI
Calcium	6/6	6050 - 14900	SW/SD2-3RI

TABLE 11-31

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - ZONE 3[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Chromium	6/6	37.1 - 100	T4SD2
Chromium (AVS/SEM)	1/1	15	T4SD2
Cobalt	6/6	7.3 - 10.9	T4SD2
Copper	6/6	22.6 - 202	SW/SD2-3RI
Copper (AVS/SEM)	4/4	51 - 128	SW/SD2-3RI
Iron	6/6	22400 - 40400	T4SD2
Lead	6/6	12.7 - 1380	SW/SD2-3RI
Lead (AVS/SEM)	4/4	76 - 1280	SW/SD2-3RI
Magnesium	6/6	7930 - 12200	SW/SD2-3RI
Manganese	6/6	245 - 466	T4SD2
Mercury	4/6	0.38 - 0.56	T4SD2
Nickel	6/6	18.8 - 54.6	T4SD2
Nickel (AVS/SEM)	4/4	8.1 - 22.2	SW/SD1-3RI/SW/SD2-3RI
Potassium	6/6	4330 - 6280	T4SD2
Selenium	3/6	0.78 - 1.1	SW/SD2-3RI
Silver	4/6	0.56 - 1.4	T4SD2
Sodium	6/6	16500 - 24300	SW/SD2-3RI
Vanadium	6/6	40.7 - 64.3	T4SD2
Zinc	6/6	59.6 - 349	SW/SD2-3RI
Zinc (AVS/SEM)	4/4	110 - 372	SW/SD2-3RI
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	2/3	110 - 140	SW/SD2-3RI
pH	3/3	8.1 - 9.2	SW/SD2-3RI
Total organic carbon	6/6	1136 - 67000	SW/SD1-3RI
Acid volatile sulfide	4/4	940 - 3100	SW/SD2-3RI

1 Includes samples LS3SD00101, LS3SD00201, SDF001 (field duplicate of LS3SD00201), EC-T4SD2-07, T4SD2, T5SD2.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-32 (PAGE 1 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9010	MG-9019	MG-9022	EC-SDTR06-02	DUP-07	LS4SD00101
DEPTH (feet):	0 - 5.1'	0 - 5.1'	0 - 5.1'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	ECO-2	ECO-2	1997RI
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	05/03/95	05/03/95	10/21/97
LOCATION:	11	11	11	EC-SDTR06	EC-SDTR06	SW/SD1-4RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					EC-SDTR06-02	
VOLATILES (µg/kg)						
2-BUTANONE				74 J	190 J	
ACETONE				390	640	
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE				1000 U	1100 U	53 J
ACENAPHTHENE				1000 U	1100 U	320 J
ACENAPHTHYLENE				1000 U	66 J	76 J
ANTHRACENE				280 J	340 J	1100
BENZO(A)ANTHRACENE	548			1300	1100	4400
BENZO(A)PYRENE	300			1100	1000 J	1900
BENZO(B)FLUORANTHENE				990 J	1000 J	2500
BENZO(G,H,I)PERYLENE				530 J	520 J	970
BENZO(K)FLUORANTHENE				1200	840 J	2000
BIS(2-ETHYLHEXYL)PHTHALATE				1000 U	1100 U	780
CARBAZOLE				67 J	75 J	280 J
CHRYSENE	310			1600	1600	4800
DI-N-BUTYL PHTHALATE				1000 U	58 J	690 U
DIBENZO(A,H)ANTHRACENE				240 J	240 J	510 J
DIBENZOFURAN				55 J	1100 U	190 J
FLUORANTHENE	463			3800	2700	16000
FLUORENE				87 J	100 J	300 J
INDENO(1,2,3-CD)PYRENE				570 J	500 J	1100
NAPHTHALENE				1000 U	1100 U	220 J

TABLE 11-32 (PAGE 2 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9010	MG-9019	MG-9022	EC-SDTR06-02	DUP-07	LS4SD00101
DEPTH (feet):	0 - 5.1'	0 - 5.1'	0 - 5.1'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	ECO-2	ECO-2	1997RI
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	05/03/95	05/03/95	10/21/97
LOCATION:	11	11	11	EC-SDTR06	EC-SDTR06	SW/SD1-4RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					EC-SDTR06-02	
SEMIVOLATILES (µg/kg)						
PHENANTHRENE	157			540 J	530 J	1600
PYRENE	187			2800	2600	12000
METALS (mg/kg)						
ALUMINUM				14100 J	15100	12800 J
ANTIMONY				2 UR	2 UJ	1.7 J
ARSENIC	5.82			13 J	14.6	8.7
BARIUM				59.7 J	65.8	63.6
BERYLLIUM				0.97 J	1	7.6
BORON				56.1 J	59.2	
CADMIUM	1.24			0.68 UR	0.66 U	1.1 J
CALCIUM				7800 J	8710	11300 J
CHROMIUM	50			75.3 J	83.1	128
COBALT				8.2 J	9	13.1
COPPER	36.9			112 J	128	268 J
IRON				30600 J	33300	25600
LEAD	58.1			105 J	114	569 J
MAGNESIUM				9690 J	10400	5770
MANGANESE				322 J	357	233
MERCURY	0.3			0.47 U	0.45 U	0.39 J
NICKEL	13.6			33.5 J	37.2	75.8
POTASSIUM				5480 J	5740	2650
SELENIUM				3.4 UR	3.3 UJ	0.48 J

TABLE 11-32 (PAGE 3 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9010	MG-9019	MG-9022	EC-SDTR06-02	DUP-07	LS4SD00101
DEPTH (feet):	0 - 5.1'	0 - 5.1'	0 - 5.1'	0 - 0.5'	0 - 0.5'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	ECO-2	ECO-2	1997RI
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	05/03/95	05/03/95	10/21/97
LOCATION:	11	11	11	EC-SDTR06	EC-SDTR06	SW/SD1-4RI
VALIDATED:				VALIDATED	VALIDATED	VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:						
FIELD DUPLICATE OF:					EC-SDTR06-02	
METALS (mg/kg)						
SILVER				1.4 UR	1.3 U	0.53 J
SODIUM				24800 J	25100	11900
THALLIUM				2.3 J	2 UJ	0.78 U
VANADIUM				49.6 J	54.1	31.3
ZINC	64.0			199 J	213	1650
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)				0.55	0.62	1.5
CHROMIUM(SEM)				13	14	
COPPER(SEM)				26	23	173 J
LEAD(SEM)				75	83	272 J
NICKEL(SEM)				6.6	6.5	46.0
ZINC(SEM)				120	110	1140 J
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
TPH		589				
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE				2800	3400	1200 J
AMMONIA, AS NITROGEN						68
TOTAL ORGANIC CARBON	42654			1499	1190	38000
GENERAL CHEMISTRY						
PH						8.3

TABLE 11-32 (PAGE 4 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS4SD00201	LS4SD00301				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	10/21/97	10/21/97	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-4RI	SW/SD3-4RI				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
2-METHYLNAPHTHALENE	1100 U	61 J				
ACENAPHTHENE	140 J	580 J				
ACENAPHTHYLENE	1100 U	830 U				
ANTHRACENE	220 J	1100				
BENZO(A)ANTHRACENE	760 J	3200				
BENZO(A)PYRENE	460 J	1500				
BENZO(B)FLUORANTHENE	460 J	2300				
BENZO(G,H,I)PERYLENE	320 J	730 J				
BENZO(K)FLUORANTHENE	430 J	1300				
BIS(2-ETHYLHEXYL)PHTHALATE	1100 U	830 U				
CARBAZOLE	1100 U	290 J				
CHRYSENE	850 J	3500				
DI-N-BUTYL PHTHALATE	1100 U	4700				
DIBENZO(A,H)ANTHRACENE	140 J	420 J				
DIBENZOFURAN	1100 U	240 J				
FLUORANTHENE	1700	9000				
FLUORENE	57 J	490 J				
INDENO(1,2,3-CD)PYRENE	380 J	920				
NAPHTHALENE	1100 U	140 J				
PHENANTHRENE	450 J	2800				
PYRENE	1400	6000				

TABLE 11-32 (PAGE 5 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS4SD00201	LS4SD00301				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	10/21/97	10/21/97	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-4RI	SW/SD3-4RI				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ALUMINUM	18500 J	13600 J				
ANTIMONY	0.83 UJ	0.52 J				
ARSENIC	16.0	13.4				
BARIUM	70.0	75.5				
BERYLLIUM	0.99	6.6				
CADMIUM	0.78 J	1.1 J				
CALCIUM	8550 J	20400 J				
CHROMIUM	85.8	400				
COBALT	9.5	12.3				
COPPER	140 J	278 J				
IRON	35700	30700				
LEAD	138 J	365 J				
MAGNESIUM	10800	8090				
MANGANESE	395	381				
MERCURY	0.42 J	0.47 J				
NICKEL	33.7	69.2				
POTASSIUM	5240	3600				
SELENIUM	0.90 J	0.66 J				
SILVER	0.95 J	0.76 J				
SODIUM	24400	15900				
THALLIUM	1.6 U	0.94 U				
VANADIUM	58.0	39.0				

TABLE 11-32 (PAGE 6 OF 6)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR ZONE 4
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	LS4SD00201	LS4SD00301				
DEPTH (feet):	0 - 0.5'	0 - 0.5'				
INVESTIGATION:	1997RI	1997RI				
SAMPLE DATE:	10/21/97	10/21/97	/ /	/ /	/ /	/ /
LOCATION:	SW/SD2-4RI	SW/SD3-4RI				
VALIDATED:	VALIDATED	VALIDATED				
SAMPLE TYPE:	GRAB	GRAB				
STATUS:						
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ZINC	224	810				
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)	0.65	1.4				
COPPER(SEM)	83.2 J	177 J				
LEAD(SEM)	140 J	510 J				
NICKEL(SEM)	18.2	51.1				
ZINC(SEM)	186 J	808 J				
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE	420 J	1400 J				
AMMONIA, AS NITROGEN	69 U	61 U				
TOTAL ORGANIC CARBON	24000	70000				
GENERAL CHEMISTRY						
PH	8.1	8.6				

TABLE 11-33

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER SEDIMENT - ZONE 4[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	2/2	74 - 190	EC-SDTR06
Acetone	2/2	390 - 640	EC-SDTR06
SEMIVOLATILE ORGANICS (µg/kg)			
2-Methylnaphthalene	2/5	53 - 61	SW/SD3-4RI
Acenaphthene	3/5	140 - 580	SW/SD3-4RI
Acenaphthylene	2/5	66 - 76	SW/SD1-4RI
Anthracene	5/5	220 - 1100	SW/SD3-4RI / SW/SD1-4RI
Benzo(a)anthracene	6/6	548 - 4400	SW/SD1-4RI
Benzo(a)pyrene	6/6	300 - 1900	SW/SD1-4RI
Benzo(b)fluoranthene	5/5	460 - 2500	SW/SD1-4RI
Benzo(g,h,i)perylene	5/5	320 - 970	SW/SD1-4RI
Benzo(k)fluoranthene	5/5	430 - 2000	SW/SD1-4RI
Bis(2-Ethylhexyl)phthalate	1/5	780	SW/SD1-4RI
Carbazole	4/5	67 - 290	SW/SD3-4RI
Chrysene	6/6	310 - 4800	SW/SD1-4RI
Di-N-butyl phthalate	2/5	58 - 4700	SW/SD3-4RI
Dibenzo(a,h)anthracene	5/5	140 - 510	SW/SD1-4RI
Dibenzofuran	3/5	55 - 240	SW/SD3-4RI
Fluoranthene	6/6	463 - 16000	SW/SD1-4RI
Fluorene	5/5	57 - 490	SW/SD3-4RI
Indeno(1,2,3-Cd)pyrene	5/5	380 - 1100	SW/SD1-4RI
Naphthalene	2/5	140 - 220	SW/SD1-4RI
Phenanthrene	6/6	157 - 2800	SW/SD3-4RI
Pyrene	6/6	187 - 12000	SW/SD1-4RI
INORGANICS (mg/kg)			
Aluminum	5/5	12800 - 18500	SW/SD2-4RI
Antimony	2/4	0.52 - 1.7	SW/SD1-4RI
Arsenic	6/6	5.82 - 16	SW/SD2-4RI
Barium	5/5	59.7 - 75.5	SW/SD3-4RI
Beryllium	5/5	0.97 - 7.6	SW/SD1-4RI
Boron	2/2	56.1 - 59.2	EC-SDTR06
Cadmium	4/5	0.78 - 1.24	11
Cadmium (AVS/SEM)[2]	5/5	0.55 - 1.5	SW/SD1-4RI
Calcium	5/5	7800 - 20400	SW/SD3-4RI
Chromium	6/6	50 - 400	SW/SD3-4RI
Chromium (AVS/SEM)	2/2	13 - 14	EC-SDTR06
Cobalt	5/5	8.2 - 13.1	SW/SD1-4RI
Copper	6/6	36.9 - 278	SW/SD3-4RI
Copper (AVS/SEM)	5/5	23 - 177	SW/SD3-4RI
Iron	5/5	25600 - 35700	SW/SD2-4RI

TABLE 11-33

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER SEDIMENT - ZONE 4[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Lead	6/6	58.1 - 569	SW/SD1-4RI
Lead (AVS/SEM)	5/5	75 - 510	SW/SD3-4RI
Magnesium	5/5	5770 - 10800	SW/SD2-4RI
Manganese	5/5	233 - 395	SW/SD2-4RI
Mercury	4/6	0.3 - 0.47	SW/SD3-4RI
Nickel	6/6	13.6 - 75.8	SW/SD1-4RI
Nickel (AVS/SEM)	5/5	6.5 - 51.1	SW/SD3-4RI
Potassium	5/5	2650 - 5740	EC-SDTR06
Selenium	3/4	0.48 - 0.9	SW/SD2-4RI
Silver	3/4	0.53 - 0.95	SW/SD2-4RI
Sodium	5/5	11900 - 25100	EC-SDTR06
Thallium	1/5	2.3	EC-SDTR06
Vanadium	5/5	31.3 - 58	SW/SD2-4RI
Zinc	6/6	64 - 1650	SW/SD1-4RI
Zinc (AVS/SEM)	5/5	110 - 1140	SW/SD1-4RI
TOTAL PETROLEUM HYDROCARBONS (mg/kg)			
TPH	1/1	589	11
MISCELLANEOUS (mg/kg)			
Ammonia, as nitrogen	1/3	68	SW/SD1-4RI
pH	3/3	8.1 - 8.6	SW/SD3-4RI
Total organic carbon	6/6	1190 - 70000	SW/SD3-4RI
Acid volatile sulfide	5/5	420 - 3400	EC-SDTR06

1 Includes samples MG-9010, MG-9019, MG-9022, EC-SDTR06-02, DUP-07 (field duplicate of EC-SDTR06-02), LS4SD00101, LS4SD00201, LS4SD00301.

2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-34 (PAGE 1 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9012	MG-9011	MG-9005	M2A	M2B	EC-T3SD1-02
DEPTH (feet):	0 - 2.8'	0 - 3.8'	0 - 3.3'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	01/01/92	01/01/92	05/03/95
LOCATION:	12	13	14	M2	M2	T3SD1
VALIDATED:						VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:		EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE						30 J
ACETONE						96
CARBON DISULFIDE						27 U
SEMIVOLATILES (µg/kg)						
ACENAPHTHYLENE				100 U	100 U	48 J
ANTHRACENE				100 U	100 U	110 J
BENZO(A)ANTHRACENE	160	20 U	20 U	540	100 U	390 J
BENZO(A)PYRENE	20 U	20 U	20 U	480	100 U	520 J
BENZO(B)FLUORANTHENE				480	100 U	880 J
BENZO(G,H,I)PERYLENE				100 U	100 U	340 J
BENZO(K)FLUORANTHENE				400	100 U	890 U
CHRYSENE	20 U	44	20 U	680	100 U	580 J
DI-N-BUTYL PHTHALATE						57 J
DIBENZO(A,H)ANTHRACENE				100 U	100 U	140 J
FLUORANTHENE	202	20 U	20 U	790	100 U	910
INDENO(1,2,3-CD)PYRENE				300	100 U	290 J
PHENANTHRENE	20 U	20 U	20 U	340	100 U	320 J
PYRENE	185	20 U	37	1050	100 U	830 J
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	20 U	20 U	20 U			89 U
4,4'-DDE	20 U	20 U	20 U			89 U
4,4'-DDT	20 U	20 U	20 U			89 U

TABLE 11-34 (PAGE 2 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9012	MG-9011	MG-9005	M2A	M2B	EC-T3SD1-02
DEPTH (feet):	0 - 2.8'	0 - 3.8'	0 - 3.3'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	01/01/92	01/01/92	05/03/95
LOCATION:	12	13	14	M2	M2	T3SD1
VALIDATED:						VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:		EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
ALDRIN	20 U	20 U	20 U			46 U
ENDRIN	20 U	20 U	20 U			89 U
HEPTACHLOR	20 U	20 U	20 U			46 U
METALS (mg/kg)						
ALUMINUM						13500
ANTIMONY						2.1 J
ARSENIC	7.89	5.77	8.7	9.3	14	12.7
BARIUM				67	59	59.9
BERYLLIUM						0.88
BORON						53.3
CADMIUM	1	1.3	1.38	3	2.7	0.54 U
CALCIUM						18700
CHROMIUM	31.6	30.4	29	78	54	69.3
COBALT						8.3
COPPER	32.1	21.2	21.3	129	59	88.1
IRON						28800
LEAD	41.1	31.4	31	100	51	80.9
MAGNESIUM						9090
MANGANESE						329
MERCURY	0.18	0.1	0.04	0.3	0.1	0.35 U
NICKEL	11	16.3	15.3	102	72	32.8
POTASSIUM						5470

TABLE 11-34 (PAGE 3 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9012	MG-9011	MG-9005	M2A	M2B	EC-T3SD1-02
DEPTH (feet):	0 - 2.8'	0 - 3.8'	0 - 3.3'	0 - 3'	3 - 6'	0 - 0.5'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	TR_DREDGE	TR_DREDGE	ECO-2
SAMPLE DATE:	03/07/90	03/07/90	03/07/90	01/01/92	01/01/92	05/03/95
LOCATION:	12	13	14	M2	M2	T3SD1
VALIDATED:						VALIDATED
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:		EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
METALS (mg/kg)						
SODIUM						18200
THALLIUM						2 J
VANADIUM						45.1
ZINC	62.7	55	56.3	269	171	158
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)						0.37
CHROMIUM(SEM)						12
COPPER(SEM)						39
LEAD(SEM)						61
NICKEL(SEM)						7
ZINC(SEM)						82
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE						1200
TOTAL ORGANIC CARBON	18711	22358		49900	43000	1169

TABLE 11-34 (PAGE 4 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T3SD1	T3SD1-D	T4SD1	T5SD1		
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'		
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1		
SAMPLE DATE:	11/09/93	11/09/93	11/09/93	11/09/93	/ /	/ /
LOCATION:	T3SD1	T3SD1	T4SD1	T5SD1		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:			EXCAVATED			
FIELD DUPLICATE OF:		T3SD1				
VOLATILES (µg/kg)						
2-BUTANONE	26 U	52				
ACETONE	140 U	200 U				
CARBON DISULFIDE	26 U	7 J				
SEMIVOLATILES (µg/kg)						
ACENAPHTHYLENE	1700 U	1700 U	100 J	130 J		
ANTHRACENE	150 J	130 J	190 J	230 J		
BENZO(A)ANTHRACENE	460 J	460 J	760 J	560 J		
BENZO(A)PYRENE	570 J	490 J	710 J	670 J		
BENZO(B)FLUORANTHENE	600 J	670 J	630 J	680 J		
BENZO(G,H,I)PERYLENE	320 J	410 J	420 J	480 J		
BENZO(K)FLUORANTHENE	460 J	300 J	540 J	460 J		
CHRYSENE	610 J	570 J	800 J	700 J		
DI-N-BUTYL PHTHALATE	1700 U	88 J	1900 U	1600 U		
DIBENZO(A,H)ANTHRACENE	1700 U	1700 U	1900 U	1600 U		
FLUORANTHENE	680 J	920 J	1100 J	1200 J		
INDENO(1,2,3-CD)PYRENE	410 J	460 J	500 J	550 J		
PHENANTHRENE	380 J	390 J	480 J	540 J		
PYRENE	1100 J	820 J	930 J	940 J		
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	6.3 J	170 U	190 U	160 U		
4,4'-DDE	170 U	170 U	190 U	7.2 J		
4,4'-DDT	64 J	11 J	190 U	160 U		

TABLE 11-34 (PAGE 5 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T3SD1	T3SD1-D	T4SD1	T5SD1		
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'		
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1		
SAMPLE DATE:	11/09/93	11/09/93	11/09/93	11/09/93	/ /	/ /
LOCATION:	T3SD1	T3SD1	T4SD1	T5SD1		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:			EXCAVATED			
FIELD DUPLICATE OF:		T3SD1				
PESTICIDES/PCBs (µg/kg)						
ALDRIN	10 J	87 U	97 U	81 U		
ENDRIN	40 J	170 U	190 U	160 U		
HEPTACHLOR	4.5 J	87 U	5.6 J	5.5 J		
METALS (mg/kg)						
ALUMINUM	15900	17000	14600	14000		
ANTIMONY	39.6 J	42.7 J	37.6 J	31.8 J		
ARSENIC	6.4 J	7.1 J	11.1 J	10.7 J		
BARIUM	60.4	65.6	63.9	52.5		
BERYLLIUM	0.57	0.73	0.5	0.53		
BORON	97.8 U	111 U	120 U	122 U		
CADMIUM	0.5 UJ	0.5 UJ	0.45 UJ	0.48 UJ		
CALCIUM	9150 J	8100 J	5880 J	5140 J		
CHROMIUM	64.3 J	67.6 J	58.6 J	91.5 J		
COBALT	7.6	8.1	7.2	6		
COPPER	81.5	86.3	66.1	91.7		
IRON	26000	27600	23300	23000		
LEAD	91.2	98.5	79.3	117		
MAGNESIUM	8400	8720	7540	6960		
MANGANESE	285 J	304 J	245 J	236 J		
MERCURY	0.49 J	0.56 J	0.35 J	0.66 J		
NICKEL	31.1	33.4	27.8	25.5		
POTASSIUM	4460	4640	3910	3500		

TABLE 11-34 (PAGE 6 OF 6)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	T3SD1	T3SD1-D	T4SD1	T5SD1		
DEPTH (feet):	0 - 0.5'	0 - 0.5'	0 - 0.5'	0 - 0.5'		
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1		
SAMPLE DATE:	11/09/93	11/09/93	11/09/93	11/09/93	/ /	/ /
LOCATION:	T3SD1	T3SD1	T4SD1	T5SD1		
VALIDATED:	VALIDATED	VALIDATED	VALIDATED	VALIDATED		
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB		
STATUS:			EXCAVATED			
FIELD DUPLICATE OF:		T3SD1				
METALS (mg/kg)						
SODIUM	16400	16200	12700	13400		
THALLIUM	0.76 UJ	0.75 UJ	0.68 UJ	3.6 UJ		
VANADIUM	42.3	45	39.3	40.8		
ZINC	133 J	142 J	121 J	153 J		
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	15000		12000	15000		

TABLE 11-35

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (µg/kg)			
2-Butanone	2/3	30 - 52	T3SD1
Acetone	1/3	96	T3SD1
Carbon disulfide	1/3	7	T3SD1
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthylene	2/6	48 - 130	T5SD1
Anthracene	4/6	110 - 230	T5SD1
Benzo(a)anthracene	6/7	160 - 560	T5SD1
Benzo(a)pyrene	5/7	480 - 670	T5SD1
Benzo(b)fluoranthene	5/6	480 - 880	T3SD1
Benzo(g,h,i)perylene	4/6	320 - 480	T5SD1
Benzo(k)fluoranthene	4/6	300 - 460	T3SD1/T5SD1
Chrysene	5/7	570 - 700	T5SD1
Di-N-butyl phthalate	2/4	57 - 88	T3SD1
Dibenzo(a,h)anthracene	1/6	140	T3SD1
Fluoranthene	6/7	202 - 1200	T5SD1
Indeno(1,2,3-Cd)pyrene	5/6	290 - 550	T5SD1
Phenanthrene	5/7	320 - 540	T5SD1
Pyrene	6/7	185 - 1100	T3SD1
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	1/5	6.3	T3SD1
4,4'-DDE	1/5	7.2	T5SD1
4,4'-DDT	2/5	11 - 64	T3SD1
Aldrin	1/5	10	T3SD1
Endrin	1/5	40	T3SD1
Heptachlor	2/5	4.5 - 5.5	T5SD1
INORGANICS (mg/kg)			
Aluminum	4/4	13500 - 17000	T3SD1
Antimony	4/4	2.1 - 42.7	T3SD1
Arsenic	7/7	6.4 - 14	M2
Barium	6/6	52.5 - 67	M2
Beryllium	4/4	0.53 - 0.88	T3SD1
Boron	1/4	53.3	T3SD1
Cadmium	3/7	1 - 3	M2
Cadmium (AVS/SEM)[2]	1/1	0.37	T3SD1
Calcium	4/4	5140 - 18700	T3SD1
Chromium	7/7	31.6 - 91.5	T5SD1
Chromium (AVS/SEM)	1/1	12	T3SD1
Cobalt	4/4	6 - 8.3	T3SD1
Copper	7/7	32.1 - 129	M2

TABLE 11-35

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - GOSS COVE[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Copper (AVS/SEM)	1/1	39	T3SD1
Iron	4/4	23000 - 28800	T3SD1
Lead	7/7	41.1 - 117	T5SD1
Lead (AVS/SEM)	1/1	61	T3SD1
Magnesium	4/4	6960 - 9090	T3SD1
Manganese	4/4	236 - 329	T3SD1
Mercury	6/7	0.1 - 0.66	T5SD1
Nickel	7/7	11 - 102	M2
Nickel (AVS/SEM)	1/1	7	T3SD1
Potassium	4/4	3500 - 5470	T3SD1
Sodium	4/4	13400 - 18200	T3SD1
Thallium	1/4	2	T3SD1
Vanadium	4/4	40.8 - 45.1	T3SD1
Zinc	7/7	62.7 - 269	M2
Zinc (AVS/SEM)	1/1	82	T3SD1
MISCELLAENOUS (mg/kg)			
Total organic carbon	6/6	1169 - 49900	M2
Acid volatile sulfide	1/1	1200	T3SD1

1 Includes samples MG-9012, M2A, M2B, EC-T3SD1-02, T3SD1, T3SD1-D (field duplicate of T3SD1), T5SD1.
2 AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

TABLE 11-36 (PAGE 1 OF 5)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9029	MG-9028	MG-9027	MG-9026	MG-9024	C
DEPTH (feet):	0 - 3.8'	0 - 4.4'	0 - 4.4'	0 - 5.5'	0 - 5.5'	0 - 3'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	TR_DREDGE
SAMPLE DATE:	03/08/90	03/08/90	03/08/90	03/08/90	03/08/90	01/01/94
LOCATION:	15	16	17	18	19	C
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED
FIELD DUPLICATE OF:						
SEMIVOLATILES (µg/kg)						
ACENAPHTHYLENE						91 U
ANTHRACENE						6.3
BENZO(A)ANTHRACENE	20 U	20 U	20 U	20 U	20 U	8.5
BENZO(A)PYRENE	20 U	20 U	20 U	20 U	20 U	14
BENZO(B)FLUORANTHENE						23
BENZO(E)PYRENE						23
BENZO(G,H,I)PERYLENE						24 U
BENZO(K)FLUORANTHENE						5.1
CHRYSENE	20 U	86	20 U	20 U	74	11 U
DIBENZO(A,H)ANTHRACENE						12 U
FLUORANTHENE	20 U	20 U	20 U	20 U	20 U	18
FLUORENE						5.8 U
INDENO(1,2,3-CD)PYRENE						5.3 U
PHENANTHRENE	20 U	20 U	20 U	20 U	20 U	9.1 U
PYRENE	20 U	20 U	20 U	20 U	20 U	16 U
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	20 U	20 U	20 U	20 U	20 U	7.3 U
4,4'-DDE	20 U	20 U	20 U	20 U	20 U	7.3 U
DIELDRIN	20 U	20 U	20 U	20 U	20 U	7.3 U
ENDRIN ALDEHYDE	20 U	20 U	20 U	20 U	20 U	7.3 U
HEPTACHLOR	20 U	20 U	20 U	20 U	20 U	3.8 U

TABLE 11-36 (PAGE 2 OF 5)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	MG-9029	MG-9028	MG-9027	MG-9026	MG-9024	C
DEPTH (feet):	0 - 3.8'	0 - 4.4'	0 - 4.4'	0 - 5.5'	0 - 5.5'	0 - 3'
INVESTIGATION:	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	SEAWOLF	TR_DREDGE
SAMPLE DATE:	03/08/90	03/08/90	03/08/90	03/08/90	03/08/90	01/01/94
LOCATION:	15	16	17	18	19	C
VALIDATED:						
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
STATUS:	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED	EXCAVATED
FIELD DUPLICATE OF:						
METALS (mg/kg)						
ARSENIC	4.32	6.79	5.43	7.91	5.65	3.9
CADMIUM	0.951	0.772	0.735	0.905	1.01	0.2
CHROMIUM	27.5	26.8	20.7	25.2	25.9	40.8
COPPER	18.8	18.3	10.4	15.2	14.8	27.5
LEAD	28	21.1	20.4	24.7	26.6	26
MERCURY	0.02 U	0.08	0.02	0.04	0.03	0.1
NICKEL	13.8	16	10.2	13	15.2	15.9
ZINC	67.9	46.3	38.7	55	44.9	84.2
MISCELLANEOUS PARAMETERS (mg/kg)						
TOTAL ORGANIC CARBON	19161	16944	16220	26595	16118	54000

TABLE 11-36 (PAGE 3 OF 5)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	D	E	EC-SDTR07-02	T2SD1	T2SD2	
DEPTH (feet):	0 - 3'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1	PH2-1	
SAMPLE DATE:	01/01/94	01/01/94	05/03/95	11/12/93	11/12/93	/ /
LOCATION:	D	E	EC-SDTR07	T2SD1	T2SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
VOLATILES (µg/kg)						
2-BUTANONE			20 J			
ACETONE			91			
SEMIVOLATILES (µg/kg)						
ACENAPHTHYLENE	89 U	86 U	620 U	170 J	100 J	
ANTHRACENE	6.8	8.8	620 U	150 J	190 J	
BENZO(A)ANTHRACENE	13	20	110 J	480 J	470 J	
BENZO(A)PYRENE	19	30	130 J	780 J	1400 U	
BENZO(B)FLUORANTHENE	42	47	100 J	340 J	1400 U	
BENZO(E)PYRENE	35	48				
BENZO(G,H,I)PERYLENE	24 U	23 U	82 J	610 J	1400 U	
BENZO(K)FLUORANTHENE	8.6	11	120 J	980 J	1400 U	
CARBAZOLE			620 U	1600 U	76 J	
CHRYSENE	15	23	120 J	460 J	660 J	
DIBENZO(A,H)ANTHRACENE	12 U	12 U	47 J	350 J	1400 U	
FLUORANTHENE	24	36	200 J	580 J	1100 J	
FLUORENE	5.6	5.4 U	620 U	1600 U	1400 U	
INDENO(1,2,3-CD)PYRENE	5.2 U	12	94 J	640 J	1400 U	
PHENANTHRENE	10	15	73 J	400 J	550 J	
PYRENE	23	52	180 J	1000 J	1100 J	
PESTICIDES/PCBs (µg/kg)						
4,4'-DDD	7.2 U	6.9 U	62 U	11 J	12 J	
4,4'-DDE	7.2 U	6.9 U	62 U	6.5 J	5.9 J	

TABLE 11-36 (PAGE 4 OF 5)

SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	D	E	EC-SDTR07-02	T2SD1	T2SD2	
DEPTH (feet):	0 - 3'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1	PH2-1	
SAMPLE DATE:	01/01/94	01/01/94	05/03/95	11/12/93	11/12/93	/ /
LOCATION:	D	E	EC-SDTR07	T2SD1	T2SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
PESTICIDES/PCBs (µg/kg)						
DIELDRIN	7.2 U	6.9 U	62 U	5 J	140 U	
ENDRIN ALDEHYDE	7.2 U	6.9 U	62 U	7.6 J	8.7 J	
HEPTACHLOR	3.7 U	3.5 U	32 U	9.8 J	10 J	
METALS (mg/kg)						
ALUMINUM			9810	13800	13300	
ANTIMONY			1.6 J	39	36.1 J	
ARSENIC	6.3	9.3	7.4	11.2	10.4 J	
BARIUM			37.8	73	57.9	
BERYLLIUM			0.64	1.3	0.72	
BORON			35.4	129	96.8 U	
CADMIUM	0.2	0.2	0.45 U	0.51	0.47 UJ	
CALCIUM			9620	4910	4600 J	
CHROMIUM	38.2	55	38.3	81.6	64.2 J	
COBALT			6.1	8.5	7.2	
COPPER	18.5	23.2	34.7	151	77.5	
IRON			20300	25400	22600	
LEAD	20.6	24	35.7	186	120	
MAGNESIUM			6690	6850	7160	
MANGANESE			230	256 J	249 J	
MERCURY	0.1	0.1	0.23 UR	0.44 J	0.38 J	
NICKEL	18	24.5	21.3	31.1	34	
POTASSIUM			3930	3600	3590	

TABLE 11-36 (PAGE 5 OF 5)
SUMMARY OF POSITIVE SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM
LOWER SUBASE; NSB-NLON; GROTON, CONNECTICUT

SAMPLE NUMBER:	D	E	EC-SDTR07-02	T2SD1	T2SD2	
DEPTH (feet):	0 - 3'	0 - 3'	0 - 0.5'	0 - 0.5'	0 - 0.5'	
INVESTIGATION:	TR_DREDGE	TR_DREDGE	ECO-2	PH2-1	PH2-1	
SAMPLE DATE:	01/01/94	01/01/94	05/03/95	11/12/93	11/12/93	/ /
LOCATION:	D	E	EC-SDTR07	T2SD1	T2SD2	
VALIDATED:			VALIDATED	VALIDATED	VALIDATED	
SAMPLE TYPE:	GRAB	GRAB	GRAB	GRAB	GRAB	
STATUS:	EXCAVATED	EXCAVATED	EXCAVATED			
FIELD DUPLICATE OF:						
METALS (mg/kg)						
SELENIUM			2.3 UJ	0.51	0.64 U	
SILVER			0.91 U	1.2	1.7 U	
SODIUM			12700	12100	13900	
THALLIUM			1.4 UJ	0.76	0.71 UJ	
VANADIUM			31.7	36.5	37.7	
ZINC	64.3	87	87.9	297	163 J	
AVS/SIMULTANEOUSLY EXTRACTED METALS (mg/kg)						
CADMIUM(SEM)			0.16			
CHROMIUM(SEM)			3.8			
COPPER(SEM)			8.5			
LEAD(SEM)			21			
NICKEL(SEM)			2.8			
ZINC(SEM)			35			
MISCELLANEOUS PARAMETERS (mg/kg)						
ACID VOLATILE SULFIDE			130			
TOTAL ORGANIC CARBON	93000	8000	956	13000	12000	

TABLE 11-37

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
SEMIVOLATILE ORGANICS (µg/kg)			
Acenaphthylene	2/2	100 - 170	T2SD1
Anthracene	2/2	150 - 190	T2SD2
Benzo(a)anthracene	2/2	470 - 480	T2SD1
Benzo(a)pyrene	1/2	780	T2SD1
Benzo(b)fluoranthene	1/2	340	T2SD1
Benzo(g,h,i)perylene	1/2	610	T2SD1
Benzo(k)fluoranthene	1/2	980	T2SD1
Carbazole	1/2	76	T2SD2
Chrysene	2/2	460 - 660	T2SD2
Dibenzo(a,h)anthracene	1/2	350	T2SD1
Fluoranthene	2/2	580 - 1100	T2SD2
Indeno(1,2,3-Cd)pyrene	1/2	640	T2SD1
Phenanthrene	2/2	400 - 550	T2SD2
Pyrene	2/2	1000 - 1100	T2SD2
PESTICIDES/PCBs (µg/kg)			
4,4'-DDD	2/2	11 - 12	T2SD2
4,4'-DDE	2/2	5.9 - 6.5	T2SD1
Dieldrin	1/2	5	T2SD1
Endrin aldehyde	2/2	7.6 - 8.7	T2SD2
Heptachlor	2/2	9.8 - 10	T2SD2
INORGANICS (mg/kg)			
Aluminum	2/2	13300 - 13800	T2SD1
Antimony	2/2	36.1 - 39	T2SD1
Arsenic	2/2	10.4 - 11.2	T2SD1
Barium	2/2	57.9 - 73	T2SD1
Beryllium	2/2	0.72 - 1.3	T2SD1
Boron	1/2	129	T2SD1
Cadmium	1/2	0.51	T2SD1
Calcium	2/2	4600 - 4910	T2SD1
Chromium	2/2	64.2 - 81.6	T2SD1
Cobalt	2/2	7.2 - 8.5	T2SD1
Copper	2/2	77.5 - 151	T2SD1
Iron	2/2	22600 - 25400	T2SD1
Lead	2/2	120 - 186	T2SD1
Magnesium	2/2	6850 - 7160	T2SD2
Manganese	2/2	249 - 256	T2SD1
Mercury	2/2	0.38 - 0.44	T2SD1
Nickel	2/2	31.1 - 34	T2SD2

TABLE 11-37

SUMMARY OF SEDIMENT ANALYTICAL RESULTS FOR THAMES RIVER - DOWNSTREAM[1]
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection
Potassium	2/2	3590 - 3600	T2SD1
Selenium	1/2	0.51	T2SD1
Silver	1/2	1.2	T2SD1
Sodium	2/2	12100 - 13900	T2SD2
Thallium	1/2	0.76	T2SD1
Vanadium	2/2	36.5 - 37.7	T2SD2
Zinc	2/2	163 - 297	T2SD1
MISCELLANEOUS			
Total organic carbon	2/2	12000 - 13000	T2SD1

1 Includes samples T2SD1, T2SD2.

TABLE 11-38 (PAGE 1 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	BV01	BV02	BV03	BV03-D	BV04	BVC1	BVC2
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93
TISSUE TYPE:	Oyster	Oyster	Oyster	Oyster	Oyster	Clam	Clam
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
2-METHYLPHENOL	330 U	330 U	330 U	330 U	330 U	330 U	330 U
ACENAPHTHENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
BENZOIC ACID	800 U	800 U	800 U	800 U	800 U	800 U	5400
BENZYL ALCOHOL	330 U	330 U	330 U	330 U	330 U	330 U	570
BIS(2-ETHYLHEXYL)PHTHALATE	89.0 J	98.0 J	330 U	330 U	160 J	330 U	82.0 J
DI-N-OCTYL PHTHALATE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
DIBENZOFURAN	330 U	330 U	330 U	330 U	330 U	330 U	330 U
FLUORANTHENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
FLUORENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
NAPHTHALENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
PHENANTHRENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
PYRENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U
4,4'-DDE	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U
4,4'-DDT	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U
ALDRIN	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U
ALPHA-BHC	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U
BETA-BHC	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U
DIELDRIN	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U
ENDRIN ALDEHYDE	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U	33.0 U
GAMMA-BHC (LINDANE)	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U
GAMMA-CHLORDANE	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	2.10 J	17.0 U
HEPTACHLOR	2.16 J	2.30 J	2.10 J	2.00 J	3.10 J	2.10 J	17.0 U
HEPTACHLOR EPOXIDE	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U	17.0 U
INORGANICS (MG/KG)							
ALUMINUM	37.9	37.2	40.6	21.1 U	33.6	12.1 U	25.3 U
ARSENIC	0.950 J	1.20 J	1.50 J	0.900 J	1.20 J	4.10 J	6.70 J
BARIUM	1.20	1.30	1.50	0.840	0.830	0.720	0.500
BOR[illegible]	3.70 U	3.40 U	3.90 U	4.50 U	3.30 U	3.40 U	2.70 U
CA[illegible]M	0.610	0.860	0[illegible]	0.710	0.920	0.140	0.590
CALCIUM	1400	2720	3[illegible]	2830	981	1470	885

TABLE 11-38 (PAGE 2 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	BV01	BV02	BV03	BV03-D	BV04	BVC1	BVC2
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93	11/18/93
TISSUE TYPE:	Oyster	Oyster	Oyster	Oyster	Oyster	Clam	Clam
INORGANICS (MG/KG)							
CHROMIUM	1.30	1.40	1.50	1.10	1.00	0.980	4.10
COPPER	99.2 J	253 J	169 J	62.9 J	139 J	7.50 J	6.60 J
IRON	79.1 J	75.0 J	75.7 J	48.3 J	64.3 J	36.3 J	48.0 J
LEAD	0.160 U	0.160 U	0.100 U	0.140 U	0.100 U	0.350 U	0.850 U
MAGNESIUM	646	548	549	776	578	790	726
MANGANESE	3.00	2.30	3.80	2.60	3.20	8.10	15.1
MERCURY	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
NICKEL	0.840	0.600	1.10	0.820	0.670	1.10	1.70
POTASSIUM	2070	2330	2480	1760	1800	2020	1990
SELENIUM	0.320	0.330	0.420	0.400	0.380	0.270	0.950
SILVER	2.20 J	1.90 J	1.30 J	0.790 J	2.50 J	0.100 UJ	1.10 J
SODIUM	3920 J	2920 J	2720 J	5020 J	3470 J	4740 J	4390 J
VANADIUM	0.160	0.200	0.150 U	0.150 U	0.150 U	0.150 U	0.580
ZINC	1760 J	2960 J	2080 J	1210 J	1830 J	19.8 J	34.6 J

TABLE 11-38 (PAGE 3 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	BVC3	CMU1	CMU1-R	CMU2	CMU2-R	CMU3	CMU4
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	11/18/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93
TISSUE TYPE:	Clam	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel
VOLATILES (UG/KG)							
2-BUTANONE		10.0 UJ	10.0 U	30.0	26.0	10.0 U	10.0 U
ACETONE		160 U	10.0 UR	480 U	10.0 UR	98.0	170
BENZENE		6.00 J	2.00 J	12.0 J	4.00 J	4.00 J	6.00 J
CARBON DISULFIDE		120 J	14.0 J	280 J	32.0 J	27.0	32.0 J
ETHYLBENZENE		10.0 UJ	1.00 J	8.00 J	2.00 J	2.00 J	10.0 UJ
METHYLENE CHLORIDE		28.0 J	12.0 J	20.0	18.0	4.00 J	34.0 J
STYRENE		10.0 UJ	10.0 U	1.00 J	10.0 U	10.0 U	10.0 UJ
TETRACHLOROETHENE		10.0 UJ	10.0 U	2.00 J	10.0 U	10.0 U	10.0 UJ
TOLUENE		12.0 J	4.00 J	24.0 J	6.00 J	9.00 J	10.0
XYLENES, TOTAL		10.0 J	7.00 J	40.0 J	11.0	13.0	8.00 J
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	330 U	330 U	330 U	330 U	330 U	20.0 J	330 U
2-METHYLPHENOL	330 U	330 U	330 U	330 U	330 U	44.0 J	330 U
ACENAPHTHENE	330 U	330 U	330 U	330 U	330 U	20.0 J	330 U
BENZOIC ACID	1600 U	110 J	100 J	140 J	38.0 J	870	76.0 J
BENZYL ALCOHOL	330 U	330 U	330 U	330 U	330 U	70.0 J	330 U
BIS(2-ETHYLHEXYL)PHTHALATE	59.0 J	330 U	330 U	330 U	330 U	74.0 J	330 U
DI-N-OCTYL PHTHALATE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
DIBENZOFURAN	330 U	330 U	330 U	330 U	330 U	20.0 J	330 U
FLUORANTHENE	330 U	330 U	330 U	330 U	330 U	120 J	16.0 J
FLUORENE	330 U	330 U	330 U	330 U	330 U	20.0 J	330 U
NAPHTHALENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
PHENANTHRENE	330 U	330 U	330 U	330 U	330 U	92.0 J	330 U
PYRENE	330 U	330 U	330 U	24.0 J	330 U	130 J	17.0 J
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	33.0 U	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ
4,4'-DDE	33.0 U	3.30 UJ	3.30 UJ	6.50 J	3.30 UJ	6.10 J	3.30 UJ
4,4'-DDT	33.0 U	3.30 UJ	3.30 UJ	3.3 UR	3.30 UJ	3.3 UR	3.30 UJ
ALDRIN	17.0 U	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ
ALPHA-BHC	17.0 U	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.80 J	1.70 UJ
BETA-BHC	17.0 U	1.70 UJ	1.70 UJ	3.40 J	3.00 J	3.60 J	3.00 J
DIE[illegible]	33.0 U	3.30 UJ	3.[illegible]	3.30 UJ	3.30 UJ	3.30 UJ	3.30 UJ
END[illegible] ALDEHYDE	33.0 U	3.30 UJ	3.[illegible]	3.50 J	3.30 UJ	3.30 UJ	3.30 UJ

TABLE 11-38 (PAGE 4 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	BVC3	CMU1	CMU1-R	CMU2	CMU2-R	CMU3	CMU4
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	11/18/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93	12/03/93
TISSUE TYPE:	Clam	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel
PESTICIDES/PCBs (UG/KG)							
GAMMA-BHC (LINDANE)	17.0 U	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ
GAMMA-CHLORDANE	17.0 U	1.70 UJ	1.70 UJ	1.70 J	1.70 UJ	1.70 UJ	1.70 UJ
HEPTACHLOR	2.00 J	1.70 UJ	1.70 J	1.90 J	2.00 J	2.10 J	1.90 J
HEPTACHLOR EPOXIDE	17.0 U	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ	1.70 UJ
INORGANICS (MG/KG)							
ALUMINUM	18.7 U	14.0	10.6	16.5	3.20 J	5.60	8.10
ARSENIC	5.30 J	1.00 J	1.00 J	0.800 J	0.830 J	0.610 J	0.690 J
BARIUM	0.860	0.300 U	0.300 U	0.300 U	0.300 U	0.300 U	0.300 U
BORON	2.90 U	4.10 J	4.40 J	5.10	5.80	3.00 J	3.40 J
CADMIUM	0.110	0.180 U	0.110 U	0.100 U	0.130 U	0.100 U	0.140 U
CALCIUM	2580	253	307	237	413	132	237
CHROMIUM	1.40	0.670	0.410	0.590	0.540	0.600	0.370
COPPER	2.90 J	3.00	3.60	2.40	2.50	2.20	2.10
IRON	40.2 J	46.0	50.9	29.7	13.4	38.6	48.2
LEAD	0.390 U	0.120 J	0.130 J	0.0600 J	0.0500 UJ	0.0900 J	0.0800 J
MAGNESIUM	757	542	603	548	501	289	464
MANGANESE	5.10	1.60	1.30	0.940	0.890	0.880	0.840
MERCURY	0.100 U	0.100 U	0.100 U	0.100 U	1.60	0.100 U	0.100 U
NICKEL	1.40	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U	0.550 U
POTASSIUM	1960	694	924	745	706	519	635
SELENIUM	0.360	0.280 J	0.370 J	0.280 J	0.280 J	0.170 J	0.220 J
SILVER	0.100 UJ	1.20 J	1.80 J	0.690 J	1.40 J	0.440 J	0.560 J
SODIUM	4420 J	3930	4380	4200	3610	2020	3010
VANADIUM	0.220	0.160 U	0.200 U	0.210 U	0.150 U	0.150 U	0.220 U
ZINC	18.1 J	8.90	12.0	6.70	7.90	4.60	6.70

TABLE 11-38 (PAGE 5 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER: INVESTIGATION: SAMPLE DATE: TISSUE TYPE:	CMU4-R PH2-1 12/03/93 Ribbed Mussel	CMU5 PH2-1 12/03/93 Ribbed Mussel	CMU5-R PH2-1 12/03/93 Ribbed Mussel	MU-4 PH2-1 12/18/93 Blue Mussel	MU-5 PH2-1 12/18/93 Blue Mussel	MU-6 PH2-1 12/18/93 Blue Mussel	MU-C PH2-1 12/06/93 Blue Mussel
VOLATILES (UG/KG)							
2-BUTANONE	10.0 U	10.0 U	10.0 UJ				10 U
ACETONE	140	75.0	100 U				110 U
BENZENE	10.0	3.00 J	4.00 J				10 U
CARBON DISULFIDE	60.0 J	40.0 J	110 J				35 J
ETHYLBENZENE	3.00 J	1.00 J	10.0 UJ				10 U
METHYLENE CHLORIDE	18.0 J	5.00 J	15.0 J				61
STYRENE	10.0 U	10.0 U	10.0 UJ				10 U
TETRACHLOROETHENE	10.0 U	10.0 U	10.0 UJ				10 U
TOLUENE	12.0	4.00 J	3.00 J				5 J
XYLENES, TOTAL	15.0	6.00 J	4.00 J				6 J
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
2-METHYLPHENOL	330 U	330 U	330 U	330 U	330 U	330 U	330 U
ACENAPHTHENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
BENZOIC ACID	69.0 J	71.0 J	100 J	1600 U	1600 U	1600 U	330 U
BENZYL ALCOHOL	330 U	330 U	330 U	330 U	330 U	330 U	330 U
BIS(2-ETHYLHEXYL)PHTHALATE	330 U	39.0 J	53.0 J	330 U	330 U	330 U	62 J
DI-N-OCTYL PHTHALATE	330 U	330 U	330 U	330 U	35.0 J	30.0 J	330 U
DIBENZOFURAN	330 U	330 U	330 U	330 U	330 U	330 U	330 U
FLUORANTHENE	330 U	330 U	330 U	330 U	32.0 J	330 U	330 U
FLUORENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
NAPHTHALENE	330 U	330 U	330 U	330 U	330 U	330 U	31 J
PHENANTHRENE	330 U	330 U	330 U	330 U	330 U	330 U	330 U
PYRENE	330 U	330 U	330 U	330 U	28.0 J	330 U	330 U
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	3.30 UJ	3.30 UJ	3.30 UJ	33.0 U	33.0 U	33.0 U	3.3 UJ
4,4'-DDE	4.70 J	3.30 UJ	3.30 UJ	7.10 J	16.0 J	11.0 J	6.8 J
4,4'-DDT	3.30 UR	3.30 UJ	3.30 UJ	33.0 U	33.0 U	33.0 U	3.3 UR
ALDRIN	4.30 J	1.70 UJ	1.70 UJ	2.40 J	17.0 U	17.0 U	1.7 UJ
ALPHA-BHC	1.70 UJ	1.70 UJ	1.70 UJ	17.0 U	17.0 U	17.0 U	1.7 UJ
BETA-BHC	1.80 J	1.70 UJ	2.00 J	17.0 U	17.0 U	17.0 U	4.5 J
DIE[illegible]	3.30 UJ	3.30 UJ	3.3[illegible]	33.0 U	33.0 U	33.0 U	3.7 J
END[illegible] ALDEHYDE	3.30 UJ	3.30 UJ	3.3[illegible]	33.0 U	33.0 U	33.0 U	4.3 J

TABLE 11-38 (PAGE 6 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER:	CMU4-R	CMU5	CMU5-R	MU-4	MU-5	MU-6	MU-C
INVESTIGATION:	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1	PH2-1
SAMPLE DATE:	12/03/93	12/03/93	12/03/93	12/18/93	12/18/93	12/18/93	12/06/93
TISSUE TYPE:	Ribbed Mussel	Ribbed Mussel	Ribbed Mussel	Blue Mussel	Blue Mussel	Blue Mussel	Blue Mussel
PESTICIDES/PCBs (UG/KG)							
GAMMA-BHC (LINDANE)	2.20 J	1.70 UJ	1.70 UJ	17.0 U	17.0 U	17.0 U	1.7 UJ
GAMMA-CHLORDANE	1.70 UJ	1.70 UJ	1.70 UJ	13.0 J	17.0 U	3.20 J	1.7 UJ
HEPTACHLOR	1.70 UJ	1.70 UJ	1.70 UJ	2.50 J	3.10 J	3.10 J	3.1 J
HEPTACHLOR EPOXIDE	1.70 UJ	1.70 UJ	1.70 UJ	17.0 U	17.0 U	17.0 U	2.7 J
INORGANICS (MG/KG)							
ALUMINUM	24.9	9.90	10.8	14.0	111	61.2	16.3
ARSENIC	0.630 J	1.00 J	0.660 J	1.40	1.10	2.50	1.9 J
BARIUM	0.350 U	0.370 U	0.300 U	1.20	1.20 U	1.20 U	0.3 U
BORON	4.20 J	5.10	2.90 J	10.0 U	70.9	77.5	4.1 J
CADMIUM	0.100 U	0.170 U	0.140 U	0.400 UJ	0.400 UJ	0.940 J	0.16 U
CALCIUM	262	320	288	447	774	474	531
CHROMIUM	0.680	0.590	0.380	0.600 U	0.600 U	0.600 U	0.55
COPPER	1.50	2.00	1.80	1.80	1.80	2.40	1.9
IRON	66.7	44.3	47.0	127	137	67.1	30
LEAD	0.150 J	0.100 J	0.110 J	1.50	0.780	0.860	0.05 J
MAGNESIUM	481	369	479	698	735	843	553
MANGANESE	1.60	1.20	0.880	1.50	3.00	1.80	1.8
MERCURY	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.1 U
NICKEL	0.550 U	0.550 U	0.550 U	2.20 U	2.20 U	2.20 U	0.55 U
POTASSIUM	620	581	727	777	1050	819	1470
SELENIUM	0.250 J	0.400 J	0.220 J	0.530 U	0.740 U	0.920 U	0.37 J
SILVER	0.200 J	0.510 J	0.220 J	0.400 U	0.400 U	0.400 U	0.36 J
SODIUM	3170	2200	3240	5360	5560	6310	4030
VANADIUM	0.150 U	0.150 U	0.160 U	0.600 U	0.600 U	0.600 U	0.31 U
ZINC	7.10	9.20	6.60	15.8	15.7	33.1	9.5

TABLE 11-38 (PAGE 7 OF 8)

SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER: INVESTIGATION: SAMPLE DATE: TISSUE TYPE:	MU-CD PH2-1 12/06/93 Blue Mussel	MU1 PH2-1 11/18/93 Blue Mussel	MU2 PH2-1 11/18/93 Blue Mussel	MU3 PH2-1 11/18/93 Blue Mussel	/ /	/ /	/ /
VOLATILES (UG/KG)							
2-BUTANONE	22 J						
ACETONE	470 U						
BENZENE	2 J						
CARBON DISULFIDE	170 J						
ETHYLBENZENE	4 J						
METHYLENE CHLORIDE	64						
STYRENE	12 U						
TETRACHLOROETHENE	12 U						
TOLUENE	12 J						
XYLENES, TOTAL	21 J						
SEMIVOLATILES (UG/KG)							
2-METHYLNAPHTHALENE	23 J	330 U	330 U	330 U			
2-METHYLPHENOL	330 U	330 U	330 U	330 U			
ACENAPHTHENE	330 U	330 U	330 U	330 U			
BENZOIC ACID	29 J	1300 U	800 U	800 U			
BENZYL ALCOHOL	330 U	330 U	330 U	330 U			
BIS(2-ETHYLHEXYL)PHTHALATE	57 J	130 J	330 U	120 J			
DI-N-OCTYL PHTHALATE	330 U	18.0 J	330 U	330 U			
DIBENZOFURAN	330 U	330 U	330 U	330 U			
FLUORANTHENE	10 J	330 U	330 U	330 U			
FLUORENE	330 U	330 U	330 U	330 U			
NAPHTHALENE	50 J	330 U	330 U	330 U			
PHENANTHRENE	330 U	330 U	330 U	330 U			
PYRENE	20 J	330 U	330 U	330 U			
PESTICIDES/PCBs (UG/KG)							
4,4'-DDD	3.3 J	33.0 U	33.0 U	5.00 J			
4,4'-DDE	7 J	33.0 U	33.0 U	33.0 U			
4,4'-DDT	4.9 J	33.0 U	33.0 U	33.0 U			
ALDRIN	1.7 UJ	17.0 U	17.0 U	17.0 U			
ALPHA-BHC	1.7 UJ	17.0 U	17.0 U	17.0 U			
BETA-BHC	1.7 UJ	17.0 U	17.0 U	17.0 U			
DIELDRIN	5 J	33.0 U	33.0 U	33.0 U			
ENDRIN ALDEHYDE	6 J	33.0 U	33.0 U	33.0 U			

TABLE 11-38 (PAGE 8 OF 8)
SUMMARY OF POSITIVE BIOLOGICAL TISSUE ANALYTICAL RESULTS
THAMES RIVER; NSB-NLON, GROTON, CONNECTICUT

SAMPLE NUMBER: INVESTIGATION: SAMPLE DATE: TISSUE TYPE:	MU-CD PH2-1 12/06/93 Blue Mussel	MU1 PH2-1 11/18/93 Blue Mussel	MU2 PH2-1 11/18/93 Blue Mussel	MU3 PH2-1 11/18/93 Blue Mussel	/ /	/ /	/ /
PESTICIDES/PCBs (UG/KG)							
GAMMA-BHC (LINDANE)	1.7 UJ	17.0 U	17.0 U	17.0 U			
GAMMA-CHLORDANE	1.8 J	17.0 U	17.0 U	3.50 J			
HEPTACHLOR	3 J	2.10 J	2.00 J	4.50 J			
HEPTACHLOR EPOXIDE	3.3 J	17.0 U	17.0 U	17.0 U			
INORGANICS (MG/KG)							
ALUMINUM	8.9	82.6	100	50.0			
ARSENIC	1.4 J	2.20 J	2.00 J	2.40 J			
BARIUM	0.3 U	0.840	1.40	0.630			
BORON	4.1 J	5.40 U	4.50 U	4.00 U			
CADMIUM	0.19 U	0.450	0.450	0.410			
CALCIUM	995	445	378	448			
CHROMIUM	0.39	1.10	1.50	1.00			
COPPER	2.3	4.00 J	3.30 J	3.40 J			
IRON	24.9	207 J	186 J	106 J			
LEAD	0.05 J	0.100 U	2.00 J	1.60 U			
MAGNESIUM	577	850	766	771			
MANGANESE	1.3	6.40	6.00	3.80			
MERCURY	0.1 U	0.100 U	0.100 U	0.100 U			
NICKEL	0.55 U	0.750	1.30	0.950			
POTASSIUM	1280	1630	1560	1490			
SELENIUM	0.43 J	1.10	0.830	0.960			
SILVER	0.68 J	0.100 UJ	0.100 UJ	0.100 UJ			
SODIUM	4290	5820 J	4760 J	5310 J			
VANADIUM	0.15 U	0.450	0.450	0.260			
ZINC	9.1	45.7 J	45.1 J	47.6 J			

TABLE 11-39

CHEMICALS OF CONCERN AND EXPOSURE CONCENTRATIONS - THAMES RIVER LOWER SUBASE NSB-NLON, GROTON, CONNECTICUT

Chemical of Concern	Exposure Concentration(1)			
	Surface Water(2) (mg/L)	Oysters (mg/kg)	Clams (mg/kg)	Finfish (mg/kg)(1)
Trichloroethene	0.003(3)	NA(4)	NA	0.29(3)
Di-n-butylphthalate	NA	NA	NA	28(3)
Heptachlor	NA	0.0024/0.0031	0.0021(3)	NA
Arsenic	NA	1.1/1.2	5.4/6.7	NA
Boron	1.65/2.21	NA	NA	NA
Cadmium	0.0023/0.0102	0.80/0.92	0.28/0.59	0.65(3)
Chromium	NA	1.3/1.4	2.2/4.1	NA
Manganese	0.0387/0.148	2.9/3.2	9.4/15.1	NA
Selenium	NA	NA	0.53/0.95	NA
Silver	NA	1.9/2.5	0.40/1.1	NA
Zinc	NA	2050/2960	NA	NA

1 Average for CTE and maximum for RME unless otherwise noted.
2 Shallow surface water used. Human exposure to deep surface water is not expected.
3 Maximum. Average exceeds maximum.
4 NA - Not applicable. Chemical is not a chemical of concern for this medium.

TABLE 11-40

ESTIMATED RISKS[1] - THAMES RIVER
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Exposure Route	Recreational Adult User			
	Hazard Index		Incremental Cancer Risk	
	RME[2]	CTE[3]	RME	CTE
Ingestion of Oysters	1.3E+1	1.8E-1	5.9E-4	2.9E-6
Ingestion of Clams	1.9E+1	2.7E-1	3.3E-3	1.4E-5
Ingestion of Finfish/other Shellfish	1.2E+0	7.1E-2	1.0E-6	1.8E-8
Incidental Ingestion of Surface Water	4.2E-3	1.0E-3	1.2E-9	1.7E-10
Dermal Contact with Surface Water	3.6E-2	8.5E-3	1.1E-8	1.6E-9
Cumulative Risk:	**3.3E+1**	**5.3E-1**	**3.9E-3**	**1.7E-5**

1 Chemical-specific risks presented in Appendix I.12.
2 RME - Reasonable Maximum Exposure.
3 CTE - Central Tendency Exposure.

TABLE 11-41

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	5/5	54500	17400	LS1SD00301	27000	0.64	N
Antimony	1/5	0.405	2.6	EC-SDTR05-02	2	1.30	Y
Arsenic	5/5	6.75	15.8	LS1SD00301	8.2	1.93	Y
Barium	5/5	NA	59.8	LS1SD00301	20	2.99	Y
Beryllium	5/5	NA	0.93	EC-SDTR05-02	NA	NA	Y
Boron	1/1	NA	55.8	EC-SDTR05-02	NA	NA	Y
Cadmium	4/5	0.39	1.2	LS1SD00301	1.2	1.00	Y
Chromium	5/5	73	80.7	LS1SD00301	81	1.00	Y
Cobalt	5/5	NA	9.2	LS1SD00301	NA	NA	Y
Copper	5/5	36.8	272	LS1SD00201	34	8.00	Y
Iron	5/5	29250	34100	LS1SD00301	20000	1.71	Y
Lead	5/5	42.15	111	LS1SD00301	46.7	2.38	Y
Manganese	5/5	486	401	LS1SD00301	460	0.87	N
Mercury	4/5	0.169	0.39	LS1SD00301	0.15	2.60	Y
Nickel	5/5	34.5	34.7	LS1SD00301	20.9	1.66	Y
Silver	4/5	0.615	0.87	LS1SD00301	1	0.87	N
Vanadium	5/5	NA	52.1	LS1SD00301	NA	NA	Y
Zinc	5/5	112.45	281	LS1SD00301	150	1.87	Y
VOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Butanone	1/1	NA	74	EC-SDTR05-02	1.68E+04	0.00	N
Acetone	1/1	NA	200	EC-SDTR05-02	3.57E+04	0.01	N
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
Acenaphthene	4/5	NA	140	LS1SD00201	1.21E+04	0.01	N
Acenaphthylene	1/5	NA	69	EC-SDTR05-02	9.74E+04	0.00	N
Anthracene	5/5	NA	530	LS1SD00101	1.30E+05	0.00	N
Benzo(a)anthracene	5/5	NA	1400	LS1SD00401	2.21E+05	0.01	N

TABLE 11-41

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
Benzo(a)pyrene	5/5	NA	880	EC-SDTR05-02	3.19E+02	2.75	Y
Benzo(b)fluoranthene	5/5	NA	820	LS1SD00401	3.64E+05	0.00	N
Benzo(g,h,i)perylene	5/5	NA	520	EC-SDTR05-02	1.62E+06	0.00	N
Benzo(k)fluoranthene	5/5	NA	880	EC-SDTR05-02	2.24E+05	0.00	N
Carbazole	3/5	NA	67	LS1SD00101	8.70E+04	0.00	N
Chrysene	5/5	NA	1600	LS1SD00101	2.21E+05	0.01	N
Di-n-butyl phthalate	3/5	NA	2900	LS1SD00101	1.80E+05	0.02	N
Dibenzo(a,h)anthracene	5/5	NA	220	EC-SDTR05-02	2.81E+05	0.00	N
Dibenzofuran	2/5	NA	73	LS1SD00101	9.49E+03	0.01	N
Fluoranthene	5/5	NA	2900	LS1SD00101	8.07E+04	0.04	N
Fluorene	5/5	NA	150	LS1SD00101	2.12E+03	0.07	N
Indeno(1,2,3-cd)pyrene	5/5	NA	540	LS1SD00401	4.30E+06	0.00	N
Naphthalene	2/5	NA	120	LS1SD00101	2.08E+03	0.06	N
Phenanthrene	5/5	NA	980	LS1SD00301	8.50E+03	0.12	N
Pyrene	5/5	NA	2400	LS1SD00401	1.72E+05	0.01	N

NA None Available

TABLE 11-42

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metals Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/5	0.405	0.775	2	0.39	N
Arsenic	5/5	6.75	13.84	8.2	1.69	Y
Barium	5/5	NA	52.4	20	2.62	Y
Beryllium	5/5	NA	0.434	NA	NA	Y
Boron	1/1	NA	55.8	NA	NA	Y
Cadmium	4/5	0.39	0.882	1.2	0.74	N
Chromium	5/5	73	66.96	81	0.83	N
Cobalt	5/5	NA	7.7	NA	NA	Y
Copper	5/5	36.8	151.6	34	4.46	Y
Iron	5/5	29250	28240	20000	1.41	N
Lead	5/5	42.15	91.12	46.7	1.95	Y
Mercury	4/5	0.169	0.331	0.15	2.21	Y
Nickel	5/5	34.5	28.02	20.9	1.34	N
Vanadium	5/5	NA	45.08	NA	NA	Y
Zinc	5/5	112.45	237	150	1.58	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	5/5	NA	652	319.48	2.04	Y

NA None Available

TABLE 11-43

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (AVS)	5/5	0.59	0.83	0.704	LS1SD00301
Chromium (AVS)	1/1	15	15	15	EC-SDTR05-02
Copper (AVS)	5/5	35	376	144.4	LS1SD00201
Lead (AVS)	5/5	61.7	116	87.94	LS1SD00101
Nickel (AVS)	5/5	6.3	21.3	15.48	LS1SD00301
Zinc (AVS)	5/5	110	508	276	LS1SD00401
TOTAL SEM			1036.3	538.82	
Acid-Volatile Sulfides	5/5	1000	3300	1900	EC-SDTR05-02
[SEM - AVS]			-2263.7	-1361.18	

TABLE 11-44

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/5	2.6	0.775	25	NA	NA
Arsenic	5/5	15.8	13.84	70	41.6	33
Barium	5/5	59.8	52.4	NA	NA	NA
Beryllium	5/5	0.93	0.434	NA	NA	NA
Boron	1/1	55.8	55.8	NA	NA	NA
Cadmium	4/5	1.2	0.882	9.6	4.21	10
Chromium	5/5	80.7	66.96	370	160	110
Cobalt	5/5	9.2	7.7	NA	NA	NA
Copper	5/5	272	151.6	270	108	110
Iron	5/5	34100	28240	NA	NA	40000
Lead	5/5	111	91.12	218	112	250
Mercury	4/5	0.39	0.331	0.71	0.7	2
Nickel	5/5	34.7	28.02	51.6	42.8	75
Vanadium	5/5	52.1	45.08	NA	NA	NA
Zinc	5/5	281	237	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	5/5	880	652	1600	763	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-45

SURFACE WATER QUALITY PARAMETERS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample No.	Location	Parameter	Result	Units
LS1SW00101s	SW/SD1-1RI	TEMPERATURE	15.52	C
LS1SW00101d	SW/SD1-1RI	TEMPERATURE	16.02	C
LS1SW00201s	SW/SD2-1RI	TEMPERATURE	15.65	C
LS1SW00201d	SW/SD2-1RI	TEMPERATURE	16.01	C
LS1SW00301s	SW/SD3-1RI	TEMPERATURE	15.71	C
LS1SW00301d	SW/SD3-1RI	TEMPERATURE	15.92	C
LS1SW00401s	SW/SD4-1RI	TEMPERATURE	15.63	C
LS1SW00401d	SW/SD4-1RI	TEMPERATURE	15.91	C
LS1SW00101s	SW/SD1-1RI	DISSOLVED OXYGEN	8.54	MG/L
LS1SW00101d	SW/SD1-1RI	DISSOLVED OXYGEN	7.66	MG/L
LS1SW00201s	SW/SD2-1RI	DISSOLVED OXYGEN	8.84	MG/L
LS1SW00201d	SW/SD2-1RI	DISSOLVED OXYGEN	7.59	MG/L
LS1SW00301s	SW/SD3-1RI	DISSOLVED OXYGEN	8.6	MG/L
LS1SW00301d	SW/SD3-1RI	DISSOLVED OXYGEN	7.68	MG/L
LS1SW00401s	SW/SD4-1RI	DISSOLVED OXYGEN	8.38	MG/L
LS1SW00401d	SW/SD4-1RI	DISSOLVED OXYGEN	7.55	MG/L
LS1SW00101s	SW/SD1-1RI	SPECIFIC CONDUCTIVITY	42.03	MS/CM
LS1SW00101d	SW/SD1-1RI	SPECIFIC CONDUCTIVITY	44.81	MS/CM
LS1SW00201s	SW/SD2-1RI	SPECIFIC CONDUCTIVITY	41.72	MS/CM
LS1SW00201d	SW/SD2-1RI	SPECIFIC CONDUCTIVITY	44.79	MS/CM
LS1SW00301s	SW/SD3-1RI	SPECIFIC CONDUCTIVITY	40.99	MS/CM
LS1SW00301d	SW/SD3-1RI	SPECIFIC CONDUCTIVITY	44.4	MS/CM
LS1SW00401s	SW/SD4-1RI	SPECIFIC CONDUCTIVITY	41.72	MS/CM
LS1SW00401d	SW/SD4-1RI	SPECIFIC CONDUCTIVITY	43.54	MS/CM
LS1SW00101s	SW/SD1-1RI	REDOX POTENTIAL	151.5	MV
LS1SW00101d	SW/SD1-1RI	REDOX POTENTIAL	150.8	MV
LS1SW00201s	SW/SD2-1RI	REDOX POTENTIAL	127.1	MV
LS1SW00201d	SW/SD2-1RI	REDOX POTENTIAL	125.6	MV
LS1SW00301s	SW/SD3-1RI	REDOX POTENTIAL	223.6	MV
LS1SW00301d	SW/SD3-1RI	REDOX POTENTIAL	220.1	MV
LS1SW00401s	SW/SD4-1RI	REDOX POTENTIAL	241.5	MV
LS1SW00401d	SW/SD4-1RI	REDOX POTENTIAL	222.1	MV
LS1SW00101s	SW/SD1-1RI	PH	7.8	NONE
LS1SW00101d	SW/SD1-1RI	PH	7.84	NONE
LS1SW00201s	SW/SD2-1RI	PH	7.5	NONE
LS1SW00201d	SW/SD2-1RI	PH	7.76	NONE

TABLE 11-45

SURFACE WATER QUALITY PARAMETERS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Sample No.	Location	Parameter	Result	Units
LS1SW00301s	SW/SD3-1RI	PH	7.87	NONE
LS1SW00301d	SW/SD3-1RI	PH	7.85	NONE
LS1SW00401s	SW/SD4-1RI	PH	7.86	NONE
LS1SW00401d	SW/SD4-1RI	PH	7.83	NONE
LS1SW00101s	SW/SD1-1RI	TURBIDITY	0.8	NTU
LS1SW00101d	SW/SD1-1RI	TURBIDITY	3.5	NTU
LS1SW00201s	SW/SD2-1RI	TURBIDITY	0.8	NTU
LS1SW00201d	SW/SD2-1RI	TURBIDITY	1.4	NTU
LS1SW00301s	SW/SD3-1RI	TURBIDITY	16.4	NTU
LS1SW00301d	SW/SD3-1RI	TURBIDITY	3.9	NTU
LS1SW00401s	SW/SD4-1RI	TURBIDITY	0.5	NTU
LS1SW00401d	SW/SD4-1RI	TURBIDITY	29.3	NTU
LS1SW00101s	SW/SD1-1RI	SALINITY	27.02	PPT
LS1SW00101d	SW/SD1-1RI	SALINITY	28.99	PPT
LS1SW00201s	SW/SD2-1RI	SALINITY	26.82	PPT
LS1SW00201d	SW/SD2-1RI	SALINITY	29.01	PPT
LS1SW00301s	SW/SD3-1RI	SALINITY	26.27	PPT
LS1SW00301d	SW/SD3-1RI	SALINITY	28.83	PPT
LS1SW00401s	SW/SD4-1RI	SALINITY	26.76	PPT
LS1SW00401d	SW/SD4-1RI	SALINITY	28.06	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-46

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 1
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS1SD001	0%	0%	3%	6%	91%
LS1SD002	0%	0%	1%	5%	94%
LS1SD003	0%	0%	1%	5%	94%
LS1SD004	10%	7%	20%	9%	54%

TABLE 11-47

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 1
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Antimony, arsenic, barium, chromium, iron, mercury and benzo(a)pyrene had maximums in excess of background and/or conservative guidelines. All HQs were low (2.75 or less), with no exceedances of less conservative guidelines (ER-Ms).	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Caged Ribbed Mussel Tissue Analysis	Phase II RI	Concentrations of chemicals in tissue	Some PAHs, 2-methylphenol, dibenzofuran, benzyl alcohol, and benzoic acid slightly elevated relative to control samples. Benzo(a)pyrene and mercury not detected.	Moderate-Moderate variability between samples with similar sediment concentrations.	Low
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	Most samples were predominantly finer-grained and TOC was relatively high indicating high potential for binding organic chemicals.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

NA = Not Applicable

TABLE 11-48

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	3/3	54500	17900	LS2SD00101	27000	0.66	N
Antimony	1/3	0.405	40.9	T3SD2	2	20.45	Y
Arsenic	3/3	6.75	15.5	LS2SD00101	8.2	1.89	Y
Barium	3/3	NA	96.4	LS2SD00101	20	4.82	Y
Beryllium	2/3	NA	0.94	LS2SD00101	NA	NA	Y
Cadmium	2/3	0.39	0.85	LS2SD00201	1.2	0.71	N
Chromium	3/3	73	81.5	LS2SD00101	81	1.01	Y
Cobalt	3/3	NA	9.1	LS2SD00101	NA	NA	Y
Copper	3/3	36.8	136	LS2SD00101	34	4.00	Y
Iron	3/3	29250	35800	LS2SD00101	20000	1.79	Y
Lead	3/3	42.15	223	LS2SD00201	46.7	4.78	Y
Manganese	3/3	486	383	LS2SD00101	460	0.83	N
Mercury	3/3	0.169	0.63	T3SD2	0.15	4.20	Y
Nickel	3/3	34.5	32.1	T3SD2	20.9	1.54	N
Selenium	2/3	0.32	1.1	LS2SD00201	0.1	11.00	Y
Silver	2/3	0.615	0.84	LS2SD00201	1	0.84	N
Vanadium	3/3	NA	56.1	LS2SD00101	NA	NA	Y
Zinc	3/3	112.45	224	LS2SD00101	150	1.49	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
Acenaphthene	2/3	NA	760	LS2SD00201	1.23E+04	0.06	N
Anthracene	3/3	NA	470	LS2SD00201	1.32E+05	0.00	N

TABLE 11-48

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
Benzo(a)anthracene	3/3	NA	1400	LS2SD00101	2.25E+05	0.01	N
Benzo(a)pyrene	3/3	NA	720	LS2SD00101	3.25E+02	2.21	Y
Benzo(b)fluoranthene	3/3	NA	900	LS2SD00101	3.71E+05	0.00	N
Benzo(g,h,i)perylene	3/3	NA	500	LS2SD00101	1.65E+06	0.00	N
Benzo(k)fluoranthene	3/3	NA	710	LS2SD00101	2.28E+05	0.00	N
Carbazole	2/3	NA	94	LS2SD00101	8.85E+04	0.00	N
Chrysene	3/3	NA	1600	LS2SD00101	2.25E+05	0.01	N
Di-n-butyl phthalate	1/3	NA	2900	LS2SD00201	1.84E+05	0.02	N
Dibenzo(a,h)anthracene	2/3	NA	210	LS2SD00101	2.86E+05	0.00	N
Dibenzofuran	2/3	NA	220	LS2SD00201	9.65E+03	0.02	N
Fluoranthene	3/3	NA	4700	LS2SD00101	8.21E+04	0.06	N
Fluorene	2/3	NA	390	LS2SD00201	2.16E+03	0.18	N
Indeno(1,2,3-cd)pyrene	3/3	NA	520	LS2SD00101	4.37E+06	0.00	N
Naphthalene	1/3	NA	63	LS2SD00101	2.12E+03	0.03	N
Phenanthrene	3/3	NA	1800	LS2SD00201	8.65E+03	0.21	N
Phenol	1/3	NA	68	LS2SD00101	6.80E+01	1.00	Y
Pyrene	3/3	NA	3100	LS2SD00101	1.75E+05	0.02	N

NA None Available

TABLE 11-49

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metals Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/3	0.405	13.87	2	6.94	Y
Arsenic	3/3	6.75	12.47	8.2	1.52	Y
Barium	3/3	NA	73.97	20	3.7	Y
Beryllium	2/3	NA	0.67	NA	NA	Y
Chromium	3/3	73	74.00	81	0.91	N
Cobalt	3/3	NA	8.40	NA	NA	Y
Copper	3/3	36.8	115.17	34	3.39	Y
Iron	3/3	29250	31466.67	20000	1.57	Y
Lead	3/3	42.15	148.90	46.7	3.19	Y
Mercury	3/3	0.169	0.49	0.15	3.29	Y
Selenium	2/3	0.32	0.79	0.1	7.87	Y
Vanadium	3/3	NA	50.6	NA	NA	Y
Zinc	3/3	112.45	189	150	1.26	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	NA	593.33	325.15	1.82	Y
Phenol[1]	1/3	NA	489.33	67.98	7.2	Y

NA None Available
1 The mean concentration is higher than the maximum since one-half the detection limit was used for non-detects.

TABLE 11-50

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (SEM)	2/2	0.8	0.82	0.81	LS2SD00101
Copper (SEM)	2/2	96.5	116	106.25	LS2SD00201
Lead (SEM)	2/2	105	192	148.5	LS2SD00201
Nickel (SEM)	2/2	18.7	20.5	19.6	LS2SD00201
Zinc (SEM)	2/2	186	224	205	LS2SD00201
TOTAL SEM			553.32	480.16	
ACID-VOLATILE SULFIDES	2/2	450	2100	1275	LS2SD00201
[SEM - AVS]			-1546.68	-794.84	

TABLE 11-51

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/3	40.9	13.87	25	NA	NA
Arsenic	3/3	15.5	12.47	70	41.6	33
Barium	3/3	96.4	73.97	NA	NA	NA
Beryllium	2/3	0.94	0.67	NA	NA	NA
Chromium	3/3	81.5	74.00	370	160	110
Cobalt	3/3	9.1	8.40	NA	NA	NA
Copper	3/3	136	115.17	270	108	110
Iron	3/3	35800	31466.67	NA	NA	40000
Lead	3/3	223	148.90	218	112	250
Mercury	3/3	0.63	0.49	0.71	0.7	2
Selenium	2/3	1.1	0.79	NA	NA	NA
Vanadium	3/3	56.1	50.6	NA	NA	NA
Zinc	3/3	224	189	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	720	593.33	1600	763	NA
Phenol	1/3	68	489.33	NA	NA	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-52

SURFACE WATER QUALITY PARAMETERS - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample	Location	Parameter	Result	Units
LS2SW00101s	SW/SD1-2RI	TEMPERATURE	15.44	C
LS2SW00101d	SW/SD1-2RI	TEMPERATURE	15.95	C
LS2SW00201s	SW/SD2-2RI	TEMPERATURE	15.48	C
LS2SW00201d	SW/SD2-2RI	TEMPERATURE	15.94	C
LS2SW00101s	SW/SD1-2RI	DISSOLVED OXYGEN	7.68	MG/L
LS2SW00101d	SW/SD1-2RI	DISSOLVED OXYGEN	6.92	MG/L
LS2SW00201s	SW/SD2-2RI	DISSOLVED OXYGEN	7.58	MG/L
LS2SW00201d	SW/SD2-2RI	DISSOLVED OXYGEN	6.89	MG/L
LS2SW00101s	SW/SD1-2RI	SPECIFIC CONDUCTIVITY	42.53	MS/CM
LS2SW00101d	SW/SD1-2RI	SPECIFIC CONDUCTIVITY	44.96	MS/CM
LS2SW00201s	SW/SD2-2RI	SPECIFIC CONDUCTIVITY	42.44	MS/CM
LS2SW00201d	SW/SD2-2RI	SPECIFIC CONDUCTIVITY	45.03	MS/CM
LS2SW00101s	SW/SD1-2RI	REDOX POTENTIAL	176.8	MV
LS2SW00101d	SW/SD1-2RI	REDOX POTENTIAL	174.8	MV
LS2SW00201s	SW/SD2-2RI	REDOX POTENTIAL	197.5	MV
LS2SW00201d	SW/SD2-2RI	REDOX POTENTIAL	154.3	MV
LS2SW00101s	SW/SD1-2RI	PH	7.82	NONE
LS2SW00101d	SW/SD1-2RI	PH	7.84	NONE
LS2SW00201s	SW/SD2-2RI	PH	7.82	NONE
LS2SW00201d	SW/SD2-2RI	PH	7.85	NONE
LS2SW00101s	SW/SD1-2RI	TURBIDITY	-1.8	NTU
LS2SW00101d	SW/SD1-2RI	TURBIDITY	-0.7	NTU
LS2SW00201s	SW/SD2-2RI	TURBIDITY	6.8	NTU
LS2SW00201d	SW/SD2-2RI	TURBIDITY	46.7	NTU
LS2SW00101s	SW/SD1-2RI	SALINITY	27.36	PPT
LS2SW00101d	SW/SD1-2RI	SALINITY	29.13	PPT
LS2SW00201s	SW/SD2-2RI	SALINITY	27.32	PPT
LS2SW00201d	SW/SD2-2RI	SALINITY	29.17	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-53

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 2
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS2SD001	0%	0%	1%	4%	95%
LS2SD002	0%	0%	3%	6%	91%
LS2SD002 MS/MSD	0%	0%	1%	5%	94%

TABLE 11-54

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 2
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Antimony, arsenic, barium, chromium, iron, selenium, mercury, benzo(a)pyrene and phenol had maximum concentrations in excess of background and/or conservative guidelines. No less conservative guidelines (ER-Ms) were exceeded, with the exception of antimony in one sample.	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Macroinvertebrate Community Analysis	Phase II RI	Benthic diversity and abundance*	Parameters were generally similar to other sampling locations in the Thames River; some were better than in upstream samples.	Low to Moderate-data are a "snapshot" and are dependent on ephemeral physical factors.	Low
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	Most samples were predominantly finer-grained and TOC was relatively high indicating high potential for binding organic chemicals.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

* taxa richness, total no. of individuals, Shannon-Weaver Index, species richness, observed vs. expected taxa, and Bray-Curtis Similarity Index.
NA = Not Applicable

TABLE 11-55

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	4/4	54500	18500	EC-T4SD2-02	27000	0.69	N
Antimony	3/4	0.405	41.1	T4SD2	2	20.55	Y
Arsenic	4/4	6.75	18.5	EC-T4SD2-02	8.2	2.26	Y
Barium	4/4	NA	79.9	LS3SD00201-D	20	4.00	Y
Beryllium	4/4	NA	1.2	EC-T4SD2-02	NA	NA	Y
Boron	1/2	NA	69.2	EC-T4SD2-02	NA	NA	Y
Cadmium	3/4	0.39	1.5	LS3SD00201-D	1.2	1.25	Y
Chromium	4/4	73	100	EC-T4SD2-02	81	1.23	Y
Cobalt	4/4	NA	10.9	EC-T4SD2-02	NA	NA	Y
Copper	4/4	36.8	202	LS3SD00201-D	34	5.94	Y
Iron	4/4	29250	40400	EC-T4SD2-02	20000	2.02	Y
Lead	4/4	42.15	1380	LS3SD00201-D	46.7	29.55	Y
Manganese	4/4	486	466	EC-T4SD2-02	460	1.01	N
Mercury	3/4	0.169	0.56	T4SD2	0.15	3.73	Y
Nickel	4/4	34.5	54.6	EC-T4SD2-02	20.9	2.61	Y
Selenium	2/4	0.32	1.1	LS3SD00201	0.1	11.00	Y
Silver	3/4	0.615	1.4	EC-T4SD2-02	1	1.40	Y
Vanadium	4/4	NA	64.3	EC-T4SD2-02	NA	NA	Y
Zinc	4/4	112.45	349	LS3SD00201-D	150	2.33	Y
VOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Butanone	1/1	NA	58	EC-T4SD2-02	1.45E+04	0.00	N
Acetone	1/1	NA	240	EC-T4SD2-02	3.09E+04	0.01	N
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Methylnaphthalene	1/4	NA	120	LS3SD00201	7.54E+04	0.00	N
4-Methylphenol	1/4	NA	68	LS3SD00201	NA	NA	Y
Acenaphthene	3/4	NA	1100	LS3SD00201	1.05E+04	0.11	N

TABLE 11-55

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metals Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
Acenaphthylene	4/4	NA	170	T4SD2	8.45E+04	0.00	N
Anthracene	4/4	NA	1600	LS3SD00201	1.13E+05	0.01	N
Benzo(a)anthracene	4/4	NA	4100	LS3SD00201	1.92E+05	0.02	N
Benzo(a)pyrene	4/4	NA	1900	LS3SD00201	2.77E+02	6.85	Y
Benzo(b)fluoranthene	3/4	NA	2300	LS3SD00201	3.16E+05	0.01	N
Benzo(g,h,i)perylene	4/4	NA	870	LS3SD00201	1.41E+06	0.00	N
Benzo(k)fluoranthene	4/4	NA	2000	LS3SD00201	1.94E+05	0.01	N
Carbazole	4/4	NA	340	LS3SD00201	7.55E+04	0.00	N
Chrysene	4/4	NA	4500	LS3SD00201	1.92E+05	0.02	N
Di-n-butyl phthalate	4/4	NA	11000	LS3SD00201	1.57E+05	0.07	N
Dibenzo(a,h)anthracene	3/4	NA	440	LS3SD00201	2.44E+05	0.00	N
Dibenzofuran	3/4	NA	460	LS3SD00201	8.23E+03	0.06	N
Dimethyl phthalate	1/4	NA	55	LS3SD00201-D	1.47E+03	0.04	N
Fluoranthene	4/4	NA	12000	LS3SD00201	7.00E+04	0.17	N
Fluorene	4/4	NA	700	LS3SD00201	1.84E+03	0.38	N
Indeno(1,2,3-cd)pyrene	4/4	NA	1100	LS3SD00201	3.73E+06	0.00	N
Naphthalene	3/4	NA	230	LS3SD00201	1.81E+03	0.13	N
Phenanthrene	4/4	NA	4200	LS3SD00201	7.37E+03	0.57	N
Phenol	1/4	NA	150	LS3SD00201	5.80E+01	2.59	Y
Pyrene	4/4	NA	6400	LS3SD00201	1.50E+05	0.04	N

NA None Available

TABLE 11-56

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metals Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	3/4	0.405	11.18	2	5.59	Y
Arsenic	4/4	6.75	14.61	8.2	1.78	Y
Barium	4/4	NA	69.63	20	3.48	Y
Beryllium	4/4	NA	0.92	NA	NA	Y
Boron(1)	1/2	NA	74.60	NA	NA	Y
Cadmium	3/4	0.39	0.72	1.2	0.6	N
Chromium	4/4	73	84.20	81	1.04	Y
Cobalt	4/4	NA	8.88	NA	NA	Y
Copper	4/4	36.8	142.50	34	4.19	Y
Iron	4/4	29250	32775.00	20000	1.64	Y
Lead	4/4	42.15	405.00	46.7	8.67	Y
Mercury	3/4	0.169	0.41	0.15	2.75	Y
Nickel	4/4	34.5	37.18	20.9	1.78	Y
Selenium	2/4	0.32	0.89	0.1	8.94	Y
Silver	3/4	0.615	0.98	1	0.98	N
Vanadium	4/4	NA	53.21	NA	NA	Y
Zinc	4/4	112.45	233.13	150	1.55	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
4-Methylphenol(1)	1/4	NA	534.5	NA	NA	Y
Benzo(a)pyrene	4/4	NA	1305	277.20	4.71.	Y
Phenol(1)	1/4	NA	551.25	57.95	9.51	Y

NA None Available
1 The mean concentration is higher than the maximum since one-half the detection limit was used for non-detects.

TABLE 11-57

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (AVS)	4/4	0.59	1.2	0.96	LS3SD00201-D
Copper (AVS)	4/4	51	128	95.17	LS3SD00201
Lead (AVS)	4/4	76	1280	503.00	LS3SD00201
Nickel (AVS)	4/4	8.1	22.2	17.32	LS3SD00201
Zinc (AVS)	4/4	110	372	228.33	LS3SD00201
TOTAL SEM			1803.4	844.78	
ACID-VOLATILE SULFIDES	4/4	940	3100	1740	LS3SD00201-D
[SEM - AVS]			-1296.6	-895.22	

TABLE 11-58

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	3/4	41.1	11.18	25	NA	NA
Arsenic	4/4	18.5	14.61	70	41.6	33
Barium	4/4	79	69.63	NA	NA	NA
Beryllium	4/4	1.2	0.92	NA	NA	NA
Boron	1/2	69.2	74.60	NA	NA	NA
Cadmium	3/4	1.24	0.72	9.6	4.21	10
Chromium	4/4	100	84.20	370	160	110
Cobalt	4/4	10.9	8.88	NA	NA	NA
Copper	4/4	176	142.50	270	108	110
Iron	4/4	40400	32775.00	NA	NA	40000
Lead	4/4	1210	405.00	218	112	250
Mercury	3/4	0.56	0.41	0.71	0.7	2
Nickel	4/4	54.6	37.18	51.6	42.8	75
Selenium	2/4	1.02	0.89	NA	NA	NA
Silver	3/4	1.4	0.98	3.7	1.77	NA
Vanadium	4/4	64.3	53.21	NA	NA	NA
Zinc	4/4	317.5	233.13	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
4-Methylphenol	1/4	68	534.5	670*	NA	NA
Benzo(a)pyrene	4/4	1900	1305	1600	763	NA
Phenol	1/4	150	551.25	NA	NA	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996
* Washington State Department of Ecology

TABLE 11-59

SURFACE WATER QUALITY PARAMETERS - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Location	Parameter	Result	Units
LS3SW00101s	SW/SD1-3RI	TEMPERATURE	15.48	C
LS3SW00101d	SW/SD1-3RI	TEMPERATURE	15.92	C
LS3SW00201s	SW/SD2-3RI	TEMPERATURE	14.23	C
LS3SW00201d	SW/SD2-3RI	TEMPERATURE	15.97	C
LS3SW00101s	SW/SD1-3RI	DISSOLVED OXYGEN	8.21	MG/L
LS3SW00101d	SW/SD1-3RI	DISSOLVED OXYGEN	7	MG/L
LS3SW00201s	SW/SD2-3RI	DISSOLVED OXYGEN	7.86	MG/L
LS3SW00201d	SW/SD2-3RI	DISSOLVED OXYGEN	6.9	MG/L
LS3SW00101s	SW/SD1-3RI	SPECIFIC CONDUCTIVITY	42.65	MS/CM
LS3SW00101d	SW/SD1-3RI	SPECIFIC CONDUCTIVITY	45.02	MS/CM
LS3SW00201s	SW/SD2-3RI	SPECIFIC CONDUCTIVITY	43.76	MS/CM
LS3SW00201d	SW/SD2-3RI	SPECIFIC CONDUCTIVITY	44.9	MS/CM
LS3SW00101s	SW/SD1-3RI	REDOX POTENTIAL	174.4	MV
LS3SW00101d	SW/SD1-3RI	REDOX POTENTIAL	174.3	MV
LS3SW00201s	SW/SD2-3RI	REDOX POTENTIAL	181.4	MV
LS3SW00201d	SW/SD2-3RI	REDOX POTENTIAL	179.3	MV
LS3SW00101s	SW/SD1-3RI	PH	7.82	NONE
LS3SW00101d	SW/SD1-3RI	PH	7.84	NONE
LS3SW00201s	SW/SD2-3RI	PH	7.74	NONE
LS3SW00201d	SW/SD2-3RI	PH	7.82	NONE
LS3SW00101s	SW/SD1-3RI	TURBIDITY	-2.3	NTU
LS3SW00101d	SW/SD1-3RI	TURBIDITY	-0.2	NTU
LS3SW00201s	SW/SD2-3RI	TURBIDITY	0.1	NTU
LS3SW00201d	SW/SD2-3RI	TURBIDITY	-1	NTU
LS3SW00101s	SW/SD1-3RI	SALINITY	27.49	PPT
LS3SW00101d	SW/SD1-3RI	SALINITY	29.21	PPT
LS3SW00201s	SW/SD2-3RI	SALINITY	27.57	PPT
LS3SW00201d	SW/SD2-3RI	SALINITY	29.09	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-60

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 3
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS3SD001	0%	0%	1%	4%	95%
LS3SD002	1%	0%	4%	11%	84%
SDFD001	0%	0%	3%	11%	86%

TABLE 11-61

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 3
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Antimony, arsenic, barium, iron, chromium, selenium, silver, mercury, benzo(a)pyrene, 4-methylphenol, and phenol had maximum concentrations in excess of background and/or conservative guidelines. No less conservative guidelines (ER-Ms) were exceeded, with the exception of antimony.	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Macroinvertebrate Community Analysis	Phase II RI	Benthic diversity and abundance*	Parameters were generally similar to other sampling locations in the Thames River; some were better than in upstream samples.	Low to Moderate-data are a "snapshot" and are dependent on ephemeral physical factors.	Low
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	Most samples were predominantly finer-grained and TOC was relatively high indicating high potential for binding organic chemicals	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

* taxa richness, total no. of individuals, Shannon-Weaver Index, species richness, observed vs. expected taxa, and Bray-Curtis Similarity Index.
NA = Not Applicable

TABLE 11-62

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	4/4	54500	18500	LS4SD00201	27000	NA	N
Antimony	2/3	0.405	1.7	LS4SD00101	2	0.85	N
Arsenic	4/4	6.75	16	LS4SD00201	8.2	1.95	Y
Barium	4/4	NA	75.5	LS4SD00301	20	3.78	Y
Beryllium	4/4	NA	7.6	LS4SD00101	NA	NA	Y
Boron	1/1	NA	59.2	EC-SDTR06-02-D	NA	NA	Y
Cadmium	3/3	0.39	1.1	LS4SD00101	1.2	0.92	N
Chromium	4/4	73	400	LS4SD00301	81	4.94	Y
Cobalt	4/4	NA	13.1	LS4SD00101	NA	NA	Y
Copper	4/4	36.8	278	LS4SD00301	34	8.18	Y
Iron	4/4	29250	35700	LS4SD00201	20000	1.79	Y
Lead	4/4	42.15	569	LS4SD00101	46.7	12.18	Y
Manganese	4/4	486	395	LS4SD00201	460	0.86	N
Mercury	3/4	0.169	0.47	LS4SD00301	0.15	3.13	Y
Nickel	4/4	34.5	75.8	LS4SD00101	20.9	3.63	Y
Selenium	3/3	0.32	0.9	LS4SD00201	0.1	9.00	Y
Silver	3/3	0.615	0.95	LS4SD00201	1	0.95	N
Thallium	1/4	NA	2.3	EC-SDTR06-02	NA	NA	Y
Vanadium	4/4	NA	58	LS4SD00201	NA	NA	Y
Zinc	4/4	112.45	1650	LS4SD00101	150	11.00	Y
VOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Butanone	1/1	NA	190	EC-SDTR06-02-D	1.32E+04	0.01	N
Acetone	1/1	NA	640	EC-SDTR06-02-D	2.81E+04	0.02	N

TABLE 11-62

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Methylnaphthalene	2/4	NA	61	LS4SD00301	6.86E+04	0.00	N
Acenaphthene	3/4	NA	580	LS4SD00301	9.52E+03	0.06	N
Acenaphthylene	2/4	NA	76	LS4SD00101	7.69E+04	0.00	N
Anthracene	4/4	NA	1100	LS4SD00301	1.03E+05	0.01	N
Benzo(a)anthracene	4/4	NA	4400	LS4SD00101	1.75E+05	0.03	N
Benzo(a)pyrene	4/4	NA	1900	LS4SD00101	2.52E+02	7.54	Y
Benzo(b)fluoranthene	4/4	NA	2500	LS4SD00101	2.87E+05	0.01	N
Benzo(g,h,i)perylene	4/4	NA	970	LS4SD00101	1.28E+06	0.00	N
Benzo(k)fluoranthene	4/4	NA	2000	LS4SD00101	1.77E+05	0.01	N
Bis(2-Ethylhexyl)phthalate	1/4	NA	780	LS4SD00101	1.73E+05	0.00	N
Carbazole	3/4	NA	290	LS4SD00301	6.86E+04	0.00	N
Chrysene	4/4	NA	4800	LS4SD00101	1.75E+05	0.03	N
Di-n-butyl phthalate	2/4	NA	4700	LS4SD00301	1.42E+05	0.03	N
Dibenzo(a,h)anthracene	4/4	NA	510	LS4SD00101	2.22E+05	0.00	N
Dibenzofuran	3/4	NA	240	LS4SD00301	7.48E+03	0.03	N
Fluoranthene	4/4	NA	16000	LS4SD00101	6.37E+04	0.25	N
Fluorene	4/4	NA	490	LS4SD00301	1.67E+03	0.29	N
Indeno(1,2,3-cd)pyrene	4/4	NA	1100	LS4SD00101	3.39E+06	0.00	N
Naphthalene	2/4	NA	220	LS4SD00101	1.64E+03	0.13	N
Phenanthrene	4/4	NA	2800	LS4SD00301	6.71E+03	0.42	N
Pyrene	4/4	NA	12000	LS4SD00101	1.36E+05	0.09	N

NA None Available

TABLE 11-63

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metal Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Arsenic	4/4	6.75	12.975	8.2	1.58	Y
Barium	4/4	NA	68.0125	20	3.4	Y
Beryllium	4/4	NA	4.04375	NA	NA	Y
Boron	1/1	NA	57.65	NA	NA	Y
Chromium	4/4	73	173.25	81	2.14	Y
Cobalt	4/4	NA	10.875	NA	NA	Y
Copper	4/4	36.8	201.5	34	5.93	Y
Iron	4/4	29250	30987.5	20000	1.55	Y
Lead	4/4	42.15	295.375	46.7	6.32	Y
Mercury	3/4	0.169	0.3775	0.15	2.52	Y
Nickel	4/4	34.5	53.5125	20.9	2.56	Y
Selenium	3/3	0.32	0.68	0.1	6.8	Y
Thallium	1/4	NA	0.8275	NA	NA	Y
Vanadium	4/4	NA	45.0375	NA	NA	Y
Zinc	4/4	NA	722.5	150	4.82	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	4/4	NA	1227.5	252.08	4.87	Y

NA None Available

TABLE 11-64

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (AVS)	5/5	0.55	1.5	1.03	LS4SD00101
Copper (AVS)	5/5	23	177	114.43	LS4SD00301
Lead (AVS)	5/5	75	510	250.25	LS4SD00301
Nickel (AVS)	5/5	6.5	51.1	30.46	LS4SD00301
Zinc (AVS)	5/5	110	1140	562.25	LS4SD00101
TOTAL SEM			1879.6	958.42	
ACID-VOLATILE SULFIDES	5/5	420	3400	1530	EC-SDTR06-02-D
[SEM - AVS]			-1520.4	-571.58	

TABLE 11-65

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Arsenic	4/4	16	12.975	70	41.6	33
Barium	4/4	75.5	68.0125	NA	NA	NA
Beryllium	4/4	7.6	4.04375	NA	NA	NA
Boron	1/1	57.65	57.65	NA	NA	NA
Chromium	4/4	400	173.25	370	160	110
Cobalt	4/4	13.1	10.875	NA	NA	NA
Copper	4/4	278	201.5	270	108	110
Iron	4/4	35700	30987.5	NA	NA	40000
Lead	4/4	569	295.375	218	112	250
Mercury	3/4	0.47	0.3775	0.71	0.7	2
Nickel	4/4	75.8	53.5125	51.6	42.8	75
Selenium	3/3	0.9	0.68	NA	NA	NA
Thallium	1/4	1.65	0.8275	NA	NA	NA
Vanadium	4/4	58	45.0375	NA	NA	NA
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	4/4	1900	1227.5	1600	763	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-66

SURFACE WATER QUALITY PARAMETERS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample No.	Location	Parameter	Result	Units
LS4SW00101s	SW/SD1-4RI	TEMPERATURE	15.58	C
LS4SW00101d	SW/SD1-4RI	TEMPERATURE	15.93	C
LS4SW00201s	SW/SD2-4RI	TEMPERATURE	15.14	C
LS4SW00201d	SW/SD2-4RI	TEMPERATURE	15.92	C
LS4SW00301s	SW/SD3-4RI	TEMPERATURE	15.55	C
LS4SW00301d	SW/SD3-4RI	TEMPERATURE	16.06	C
LS4SW00101s	SW/SD1-4RI	DISSOLVED OXYGEN	7.47	MG/L
LS4SW00101d	SW/SD1-4RI	DISSOLVED OXYGEN	6.88	MG/L
LS4SW00201s	SW/SD2-4RI	DISSOLVED OXYGEN	7.95	MG/L
LS4SW00201d	SW/SD2-4RI	DISSOLVED OXYGEN	6.99	MG/L
LS4SW00301s	SW/SD3-4RI	DISSOLVED OXYGEN	7.23	MG/L
LS4SW00301d	SW/SD3-4RI	DISSOLVED OXYGEN	6.8	MG/L
LS4SW00101s	SW/SD1-4RI	SPECIFIC CONDUCTIVITY	42.45	MS/CM
LS4SW00101d	SW/SD1-4RI	SPECIFIC CONDUCTIVITY	44.49	MS/CM
LS4SW00201s	SW/SD2-4RI	SPECIFIC CONDUCTIVITY	42.36	MS/CM
LS4SW00201d	SW/SD2-4RI	SPECIFIC CONDUCTIVITY	45.1	MS/CM
LS4SW00301s	SW/SD3-4RI	SPECIFIC CONDUCTIVITY	43.02	MS/CM
LS4SW00301d	SW/SD3-4RI	SPECIFIC CONDUCTIVITY	44	MS/CM
LS4SW00101s	SW/SD1-4RI	REDOX POTENTIAL	172	MV
LS4SW00101d	SW/SD1-4RI	REDOX POTENTIAL	166.3	MV
LS4SW00201s	SW/SD2-4RI	REDOX POTENTIAL	199.1	MV
LS4SW00201d	SW/SD2-4RI	REDOX POTENTIAL	196.9	MV
LS4SW00301s	SW/SD3-4RI	REDOX POTENTIAL	207	MV
LS4SW00301d	SW/SD3-4RI	REDOX POTENTIAL	204.4	MV
LS4SW00101s	SW/SD1-4RI	PH	7.81	NONE
LS4SW00101d	SW/SD1-4RI	PH	7.81	NONE
LS4SW00201s	SW/SD2-4RI	PH	7.81	NONE
LS4SW00201d	SW/SD2-4RI	PH	7.84	NONE
LS4SW00301s	SW/SD3-4RI	PH	7.60	NONE
LS4SW00301d	SW/SD3-4RI	PH	7.74	NONE
LS4SW00101s	SW/SD1-4RI	TURBIDITY	6.3	NTU
LS4SW00101d	SW/SD1-4RI	TURBIDITY	30.3	NTU
LS4SW00201s	SW/SD2-4RI	TURBIDITY	6.8	NTU
LS4SW00201d	SW/SD2-4RI	TURBIDITY	7.4	NTU
LS4SW00301s	SW/SD3-4RI	TURBIDITY	-1.7	NTU
LS4SW00301d	SW/SD3-4RI	TURBIDITY	-2.9	NTU

TABLE 11-66

**SURFACE WATER QUALITY PARAMETERS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2**

Sample No.	Location	Parameter	Result	Units
LS4SW00101s	SW/SD1-4RI	SALINITY	27.32	PPT
LS4SW00101d	SW/SD1-4RI	SALINITY	28.87	PPT
LS4SW00201s	SW/SD2-4RI	SALINITY	27.14	PPT
LS4SW00201d	SW/SD2-4RI	SALINITY	29.23	PPT
LS4SW00301s	SW/SD3-4RI	SALINITY	27.73	PPT
LS4SW00301d	SW/SD3-4RI	SALINITY	28.42	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-67

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 4
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS4SD001	4%	5%	27%	29%	35%
LS4SD002	0%	0%	1%	5%	94%
LS4SD003	2%	5%	21%	10%	62%

TABLE 11-68

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 4
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Arsenic, barium, iron, chromium, selenium, mercury, and benzo(a)pyrene exceeded background and/or conservative guidelines. Benzo(a)pyrene and chromium exceeded ER-Ms.	High-Data obtained from recent, well-conducted studies.	Moderate
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Native Blue Mussel Sample	Phase II RI	Concentrations of chemicals in tissue	Low levels of some PAHs and pesticides were detected. Benzo(a)pyrene and chromium, which exceeded ER-Ms, were not detected. Boron was significantly elevated.	Moderate-Moderate variability between samples with similar sediment concentrations.	Moderate
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	One sample was predominantly fine-grained, while two samples had larger percentages of coarse material. TOC was relatively high. Hence, data are equivacal for bioavailability inferences.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low to Moderate**

NA = Not Applicable

TABLE 11-69

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	6/6	54500	16000	EC-SDTR02-02	27000	0.59	N
Antimony	2/6	0.405	32.7	T3SD3	2	16.35	Y
Arsenic	6/6	6.75	15.1	EC-SDTR02-02	8.2	1.84	Y
Barium	6/6	NA	69.3	T3SD3	20	3.47	Y
Beryllium	5/6	NA	1.1	EC-SDTR02-02	NA	NA	Y
Boron	1/2	NA	70.2	EC-SDTR02-02	NA	NA	Y
Cadmium	4/5	0.39	1	LS5SD00201	1.2	0.83	N
Chromium	6/6	73	83.1	EC-SDTR02-02	81	1.03	Y
Cobalt	6/6	NA	8.9	EC-SDTR02-02	NA	NA	Y
Copper	6/6	36.8	109	EC-SDTR02-02	34	3.21	Y
Iron	6/6	29250	32300	EC-SDTR02-02	20000	1.62	Y
Lead	6/6	42.15	91.8	EC-SDTR02-02	46.7	1.97	Y
Manganese	6/6	486	435	EC-SDTR02-02	460	0.95	N
Mercury	5/6	0.169	0.43	T3SD3	0.15	2.87	Y
Nickel	6/6	34.5	32.8	EC-SDTR02-02	20.9	1.57	N
Silver	4/5	0.615	0.74	LS5SD00201	1	0.74	N
Vanadium	6/6	NA	51	EC-SDTR02-02	NA	NA	Y
Zinc	6/6	112.45	179	EC-SDTR02-02	150	1.19	Y
VOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Butanone	1/1	NA	61	EC-SDTR02-02	1.04E+04	0.01	N
Acetone	1/1	NA	320	EC-SDTR02-02	2.22E+04	0.01	N
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
Acenaphthene	2/6	NA	130	EC-SDTR02-02	7.51E+03	0.02	N
Acenaphthylene	2/6	NA	74	LS5SD00201	6.06E+04	0.00	N
Anthracene	6/6	NA	250	T3SD3	8.10E+04	0.00	N
Benzo(a)anthracene	6/6	NA	850	EC-SDTR02-02	1.38E+05	0.01	N

TABLE 11-69

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
Benzo(a)pyrene	6/6	NA	870	EC-SDTR02-02	1.99E+02	4.37	Y
Benzo(b)fluoranthene	5/6	NA	760	T3SD3	2.27E+05	0.00	N
Benzo(g,h,i)perylene	6/6	NA	410	EC-SDTR02-02	1.01E+06	0.00	N
Benzo(k)fluoranthene	6/6	NA	1700	EC-SDTR02-02	1.39E+05	0.01	N
Carbazole	2/6	NA	140	LS5SD00401	5.41E+04	0.00	N
Chrysene	6/6	NA	1100	EC-SDTR02-02	1.38E+05	0.01	N
Dibenzo(a,h)anthracene	4/6	NA	150	LS5SD00101	1.75E+05	0.00	N
Dibenzofuran	3/6	NA	58	EC-SDTR02-02	5.91E+03	0.01	N
Fluoranthene	6/6	NA	1900	EC-SDTR02-02	5.02E+04	0.04	N
Fluorene	4/6	NA	94	LS5SD00201	1.32E+03	0.07	N
Indeno(1,2,3-cd)pyrene	6/6	NA	530	EC-SDTR02-02	2.67E+06	0.00	N
Naphthalene	1/6	NA	55	EC-SDTR02-02	1.30E+03	0.04	N
Phenanthrene	6/6	NA	750	LS5SD00401	5.29E+03	0.14	N
Phenol	1/6	NA	72	LS5SD00201	4.16E+01	1.73	Y
Pyrene	6/6	NA	2200	EC-SDTR02-02	1.07E+05	0.02	N
PESTICIDES AND PCBS (µg/kg)							
4,4'-DDD	2/3	NA	28	LS5SD00401	2.38E+01	1.17	Y
4,4'-DDE	1/3	NA	5.2	LS5SD00401	1.16E+02	0.04	N

NA - None Available

TABLE 11-70

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metal Concentrations	Mean Concentration	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	2/6	0.405	6.00	2	3.	Y
Arsenic	6/6	6.75	9.10	8.2	1.11	Y
Barium	6/6	NA	43.60	20	NA	Y
Beryllium	5/6	NA	0.37	NA	NA	Y
Boron[1]	1/2	NA	74.85	NA	NA	Y
Chromium	6/6	73	48.15	81	0.59	N
Cobalt	6/6	NA	6.38	NA	NA	Y
Copper	6/6	36.8	70.52	34	2.07	Y
Iron	6/6	29250	21566.67	20000	NA	N
Lead	6/6	42.15	51.18	46.7	1.1	Y
Mercury	5/6	0.169	0.25	0.15	1.63	Y
Vanadium	6/6	NA	35.18	NA	NA	Y
Zinc	6/6	112.45	120.70	150	0.8	N
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	6/6	NA	438.33	198.87	2.2	Y
Phenol[1]	1/6	NA	393.67	41.58	9.47	Y
PESTICIDES AND PCBS (µg/kg)						
4,4'-DDD	2/3	NA	12.8	23.8350325	0.54	N

NA - None available
1 The mean concentration is higher than the maximum since one-half the detection limit was used for non-detects.

TABLE 11-71

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (AVS)	4/5	0.28	0.68	0.45	LS5SD00201
Copper (AVS)	5/5	20.8	139	70.02	LS5SD00201
Lead (AVS)	5/5	18.4	78	51.38	EC-SDTR02-02
Nickel (AVS)	5/5	3.9	17	9.26	LS5SD00201
Zinc (AVS)	5/5	34.5	182	102.00	LS5SD00201
TOTAL SEM			416.68	233.11	
ACID-VOLATILE SULFIDES	5/5	55	1100	721	EC-SDTR02-02
[SEM - AVS]			-683.32	-487.89	

TABLE 11-72

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	2/6	32.7	6.00	25	NA	NA
Arsenic	6/6	15.1	9.10	70	41.6	33
Barium	6/6	69.3	43.60	NA	NA	NA
Beryllium	5/6	1.1	0.37	NA	NA	NA
Boron	1/2	70.2	74.85	NA	NA	NA
Chromium	6/6	83.1	48.15	370	160	110
Cobalt	6/6	8.9	6.38	NA	NA	NA
Copper	6/6	109	70.52	270	108	110
Iron	6/6	32300	21566.67	NA	NA	40000
Lead	6/6	91.8	51.18	218	112	250
Mercury	5/6	0.43	0.25	0.71	0.7	2
Vanadium	6/6	51	35.18	NA	NA	NA
Zinc	6/6	179	120.70	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	6/6	870	438.33	1600	763	NA
Phenol	1/6	72	393.67	NA	NA	NA
PESTICIDES AND PCBS						
4,4'-DDD	2/3	28	12.80	NA	7.81	60.

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-73

SURFACE WATER QUALITY PARAMETERS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample No.	Location	Parameter	Result	Units
LS5SW00101s	SW/SD1-5RI	TEMPERATURE	13.72	C
LS5SW00101d	SW/SD1-5RI	TEMPERATURE	15.81	C
LS5SW00201s	SW/SD2-5RI	TEMPERATURE	14.84	C
LS5SW00201d	SW/SD2-5RI	TEMPERATURE	15.91	C
LS5SW00301s	SW/SD3-5RI	TEMPERATURE	14.19	C
LS5SW00301d	SW/SD3-5RI	TEMPERATURE	16.36	C
LS5SW00401s	SW/SD4-5RI	TEMPERATURE	14.23	C
LS5SW00401d	SW/SD4-5RI	TEMPERATURE	15.84	C
LS5SW00101s	SW/SD1-5RI	DISSOLVED OXYGEN	8.72	MG/L
LS5SW00101d	SW/SD1-5RI	DISSOLVED OXYGEN	7.53	MG/L
LS5SW00201s	SW/SD2-5RI	DISSOLVED OXYGEN	8.42	MG/L
LS5SW00201d	SW/SD2-5RI	DISSOLVED OXYGEN	7.34	MG/L
LS5SW00301s	SW/SD3-5RI	DISSOLVED OXYGEN	8.44	MG/L
LS5SW00301d	SW/SD3-5RI	DISSOLVED OXYGEN	7.39	MG/L
LS5SW00401s	SW/SD4-5RI	DISSOLVED OXYGEN	8.42	MG/L
LS5SW00401d	SW/SD4-5RI	DISSOLVED OXYGEN	7.27	MG/L
LS5SW00101s	SW/SD1-5RI	SPECIFIC CONDUCTIVITY	37.44	MS/CM
LS5SW00101d	SW/SD1-5RI	SPECIFIC CONDUCTIVITY	42.56	MS/CM
LS5SW00201s	SW/SD2-5RI	SPECIFIC CONDUCTIVITY	38.44	MS/CM
LS5SW00201d	SW/SD2-5RI	SPECIFIC CONDUCTIVITY	43.56	MS/CM
LS5SW00301s	SW/SD3-5RI	SPECIFIC CONDUCTIVITY	37.52	MS/CM
LS5SW00301d	SW/SD3-5RI	SPECIFIC CONDUCTIVITY	40.87	MS/CM
LS5SW00401s	SW/SD4-5RI	SPECIFIC CONDUCTIVITY	37.49	MS/CM
LS5SW00401d	SW/SD4-5RI	SPECIFIC CONDUCTIVITY	42.69	MS/CM
LS5SW00101s	SW/SD1-5RI	REDOX POTENTIAL	162.2	MV
LS5SW00101d	SW/SD1-5RI	REDOX POTENTIAL	162.6	MV
LS5SW00201s	SW/SD2-5RI	REDOX POTENTIAL	169.8	MV
LS5SW00201d	SW/SD2-5RI	REDOX POTENTIAL	169.9	MV
LS5SW00301s	SW/SD3-5RI	REDOX POTENTIAL	156.8	MV
LS5SW00301d	SW/SD3-5RI	REDOX POTENTIAL	157.7	MV
LS5SW00401s	SW/SD4-5RI	REDOX POTENTIAL	204	MV
LS5SW00401d	SW/SD4-5RI	REDOX POTENTIAL	201	MV
LS5SW00101s	SW/SD1-5RI	PH	7.78	NONE
LS5SW00101d	SW/SD1-5RI	PH	7.75	NONE
LS5SW00201s	SW/SD2-5RI	PH	7.8	NONE
LS5SW00201d	SW/SD2-5RI	PH	7.81	NONE

TABLE 11-73

SURFACE WATER QUALITY PARAMETERS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Sample No.	Location	Parameter	Result	Units
LS5SW00301s	SW/SD3-5RI	PH	7.81	NONE
LS5SW00301d	SW/SD3-5RI	PH	7.78	NONE
LS5SW00401s	SW/SD4-5RI	PH	7.82	NONE
LS5SW00401d	SW/SD4-5RI	PH	7.78	NONE
LS5SW00101s	SW/SD1-5RI	TURBIDITY	-1.9	NTU
LS5SW00101d	SW/SD1-5RI	TURBIDITY	-1.8	NTU
LS5SW00201s	SW/SD2-5RI	TURBIDITY	-1.4	NTU
LS5SW00201d	SW/SD2-5RI	TURBIDITY	-1.1	NTU
LS5SW00301s	SW/SD3-5RI	TURBIDITY	-1.7	NTU
LS5SW00301d	SW/SD3-5RI	TURBIDITY	-1.4	NTU
LS5SW00401s	SW/SD4-5RI	TURBIDITY	-1.7	NTU
LS5SW00401d	SW/SD4-5RI	TURBIDITY	-1.5	NTU
LS5SW00101s	SW/SD1-5RI	SALINITY	23.8	PPT
LS5SW00101d	SW/SD1-5RI	SALINITY	27.38	PPT
LS5SW00201s	SW/SD2-5RI	SALINITY	24.34	PPT
LS5SW00201d	SW/SD2-5RI	SALINITY	28.08	PPT
LS5SW00301s	SW/SD3-5RI	SALINITY	23.83	PPT
LS5SW00301d	SW/SD3-5RI	SALINITY	26.2	PPT
LS5SW00401s	SW/SD4-5RI	SALINITY	23.78	PPT
LS5SW00401d	SW/SD4-5RI	SALINITY	27.49	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-74

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 5
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS5SD001	0%	3%	15%	16%	66%
LS5SD002	0%	0%	1%	4%	95%
LS5SD003	41%	20%	14%	15%	10%
LS5SD004	9%	6%	44%	30%	11%

TABLE 11-75

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 5
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Antimony, arsenic, barium, chromium, iron, mercury, benzo(a)pyrene, 4,4'-DDD, and phenol had maximum concentrations in excess of background and/or conservative guidelines. Antimony exceeded its ER-M in 1 of 6 samples.	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Macroinvertebrate Community Analysis	Phase II RI	Benthic diversity and abundance*	Parameters were generally similar to other sampling locations in the Thames River; some were better than in upstream samples	Low to Moderate-data are a "snapshot" and are dependent on ephemeral physical factors.	Low
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Toxicity Testing	SEAWOLF EIS	Survival of an amphibod (*Ampelisca*), clam (*Macoma nasuta*), and sandworm (*Nereis virens*) in site sediments.	No statistically significant differences in survival between test and reference sediments for *Ampelisca* or *Nereis*; survival was lower for *Macoma* but only if a data outlier is removed.	Moderate-Data are older than Lower Subase RI data and all raw data was not available.	Low
Bioaccumulation Testing	Phase II RI	Bioaccumulation of chemicals from Site Sediments for *Macoma nasuta* and *Nereis virens.*	No statistically significant bioaccumulation of PAHs or inorganics (the only analytes) was observed.	Moderate-Data are older than Lower Subase RI data.	Negligible
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	One sample was predominantly fine-grained, while three samples had larger percentages of coarse material. TOC was moderate. Hence, bioavailability of organics may be diminished.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

* taxa richness, total no. of individuals, Shannon-Weaver Index, species richness, observed vs. expected taxa, and Bray-Curtis Similarity Index.
NA = Not Applicable

TABLE 11-76

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	3/3	54500	17100	EC-SDTR03-02	27000	0.63	N
Antimony	1/3	0.405	2.3	EC-SDTR03-02	2	1.15	Y
Arsenic	3/3	6.75	16.6	EC-SDTR03-02	8.2	2.02	Y
Barium	3/3	NA	64.7	EC-SDTR03-02	20	3.24	Y
Beryllium	3/3	NA	1.1	EC-SDTR03-02	NA	NA	Y
Boron	1/1	NA	62.6	EC-SDTR03-02	NA	NA	Y
Cadmium	3/3	0.39	0.86	LS6SD00101	1.2	0.72	N
Chromium	3/3	73	88.4	EC-SDTR03-02	81	1.09	Y
Cobalt	3/3	NA	9.1	EC-SDTR03-02	NA	NA	Y
Copper	3/3	36.8	121	EC-SDTR03-02	34	3.56	Y
Iron	3/3	29250	34500	EC-SDTR03-02	20000	1.73	Y
Lead	3/3	42.15	97.5	EC-SDTR03-02	46.7	2.09	Y
Manganese	3/3	486	416	EC-SDTR03-02	460	0.90	N
Mercury	2/3	0.169	0.32	LS6SD00101	0.15	2.13	Y
Nickel	3/3	34.5	34.7	EC-SDTR03-02	20.9	1.66	Y
Silver	3/3	0.615	1.4	EC-SDTR03-02	1	1.40	Y
Vanadium	3/3	NA	54.1	EC-SDTR03-02	NA	NA	Y
Zinc	3/3	112.45	313	LS6SD00201	150	2.09	Y
VOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Butanone	1/1	NA	120	EC-SDTR03-02	1.08E+04	0.01	N
Acetone	1/1	NA	430	EC-SDTR03-02	2.30E+04	0.02	N

TABLE 11-76

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Methylnaphthalene	1/3	NA	23	LS6SD00201	5.61E+04	0.00	N
Acenaphthene	2/3	NA	220	LS6SD00101	7.80E+03	0.03	N
Acenaphthylene	1/3	NA	56	EC-SDTR03-02	6.29E+04	0.00	N
Anthracene	3/3	NA	250	LS6SD00101	8.41E+04	0.00	N
Benzo(a)anthracene	3/3	NA	1400	LS6SD00101	1.43E+05	0.01	N
Benzo(a)pyrene	3/3	NA	750	LS6SD00101	2.06E+02	3.63	Y
Benzo(b)fluoranthene	3/3	NA	840	LS6SD00101	2.35E+05	0.00	N
Benzo(g,h,i)perylene	3/3	NA	430	LS6SD00101	1.05E+06	0.00	N
Benzo(k)fluoranthene	3/3	NA	790	LS6SD00101	1.45E+05	0.01	N
Carbazole	2/3	NA	100	LS6SD00201	5.62E+04	0.00	N
Chrysene	3/3	NA	1500	LS6SD00101	1.43E+05	0.01	N
Dibenzo(a,h)anthracene	3/3	NA	190	LS6SD00101	1.82E+05	0.00	N
Dibenzofuran	2/3	NA	79	LS6SD00101	6.13E+03	0.01	N
Fluoranthene	3/3	NA	4700	LS6SD00101	5.21E+04	0.09	N
Fluorene	3/3	NA	130	LS6SD00101	1.37E+03	0.09	N
Indeno(1,2,3-cd)pyrene	3/3	NA	450	LS6SD00101	2.78E+06	0.00	N
Naphthalene	1/3	NA	61	LS6SD00101	1.35E+03	0.05	N
Phenanthrene	3/3	NA	1500	LS6SD00201	5.49E+03	0.27	N
Phenol	1/3	NA	72	LS6SD00101	4.32E+01	1.67	Y
Pyrene	3/3	NA	2800	LS6SD00101	1.11E+05	0.03	N

NA None Available

TABLE 11-77

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metal Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/3	0.405	0.92	2	0.46	N
Arsenic	3/3	6.75	11.07	8.2	1.35	Y
Barium	3/3	NA	41.90	20	2.1	Y
Beryllium	3/3	NA	0.47	NA	NA	Y
Boron	1/1	NA	62.60	NA	NA	Y
Chromium	3/3	73	55.07	81	0.68	N
Cobalt	3/3	NA	6.27	NA	NA	Y
Copper	3/3	36.8	86.40	34	2.54	Y
Iron	3/3	29250	23186.67	20000	1.16	N
Lead	3/3	42.15	62.03	46.7	1.33	Y
Mercury	2/3	0.169	0.20	0.15	1.31	Y
Nickel	3/3	34.5	22.03	20.9	1.05	N
Silver	3/3	0.615	0.77	1	0.77	N
Vanadium	3/3	NA	36.03	NA	NA	Y
Zinc	3/3	112.45	227.67	150	1.52	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	NA	570	206.43	2.76	Y
Phenol[1]	1/3	NA	274	43.16	6.35	Y

NA None Available
1 The mean concentration was higher than the maximum since one-half the detection limit was used for non-detects.

TABLE 11-78

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (AVS)	2/3	0.54	0.92	0.52	LS6SD00101
Copper (AVS)	3/3	34.9	98.7	64.53	LS6SD00101
Lead (AVS)	3/3	17.4	78.2	56.20	LS6SD00101
Nickel (AVS)	3/3	4.2	18.5	9.77	LS6SD00101
Zinc (AVS)	3/3	110	289	195.67	LS6SD00201
TOTAL SEM			485.32	326.69	
ACID-VOLATILE SULFIDES	3/3	170	1900	996.67	LS6SD00101
[SEM - AVS]			-1414.68	-669.98	

TABLE 11-79

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Antimony	1/3	2.3	0.92	25	NA	NA
Arsenic	3/3	16.6	11.07	70	41.6	33
Barium	3/3	64.7	41.90	NA	NA	NA
Beryllium	3/3	1.1	0.47	NA	NA	NA
Boron	1/1	62.6	62.60	NA	NA	NA
Chromium	3/3	88.4	55.07	370	160	110
Cobalt	3/3	9.1	6.27	NA	NA	NA
Copper	3/3	121	86.40	270	108	110
Iron	3/3	34500	23186.67	NA	NA	40000
Lead	3/3	97.5	62.03	218	112	250
Mercury	2/3	0.32	0.20	0.71	0.7	2
Nickel	3/3	34.7	22.03	51.6	42.8	75
Silver	3/3	1.4	0.77	3.7	1.77	NA
Vanadium	3/3	54.1	36.03	NA	NA	NA
Zinc	3/3	313	227.67	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	750	570	1600	763	NA
Phenol	1/3	72	274	NA	NA	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-80

SURFACE WATER QUALITY PARAMETERS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Location	Parameter	Result	Units
LS6SW00101s	SW/SD1-6RI	TEMPERATURE	15.41	C
LS6SW00101d	SW/SD1-6RI	TEMPERATURE	15.89	C
LS6SW00201s	SW/SD2-6RI	TEMPERATURE	13.61	C
LS6SW00201d	SW/SD2-6RI	TEMPERATURE	15.42	C
LS6SW00101s	SW/SD1-6RI	DISSOLVED OXYGEN	8.80	MG/L
LS6SW00101d	SW/SD1-6RI	DISSOLVED OXYGEN	8	MG/L
LS6SW00201s	SW/SD2-6RI	DISSOLVED OXYGEN	8.84	MG/L
LS6SW00201d	SW/SD2-6RI	DISSOLVED OXYGEN	7.52	MG/L
LS6SW00101s	SW/SD1-6RI	SPECIFIC CONDUCTIVITY	39.29	MS/CM
LS6SW00101d	SW/SD1-6RI	SPECIFIC CONDUCTIVITY	43.7	MS/CM
LS6SW00201s	SW/SD2-6RI	SPECIFIC CONDUCTIVITY	37.42	MS/CM
LS6SW00201d	SW/SD2-6RI	SPECIFIC CONDUCTIVITY	40.95	MS/CM
LS6SW00101s	SW/SD1-6RI	REDOX POTENTIAL	216.9	MV
LS6SW00101d	SW/SD1-6RI	REDOX POTENTIAL	217.4	MV
LS6SW00201s	SW/SD2-6RI	REDOX POTENTIAL	208.3	MV
LS6SW00201d	SW/SD2-6RI	REDOX POTENTIAL	201.1	MV
LS6SW00101s	SW/SD1-6RI	PH	7.87	NONE
LS6SW00101d	SW/SD1-6RI	PH	7.84	NONE
LS6SW00201s	SW/SD2-6RI	PH	7.61	NONE
LS6SW00201d	SW/SD2-6RI	PH	7.68	NONE
LS6SW00101s	SW/SD1-6RI	TURBIDITY	0.9	NTU
LS6SW00101d	SW/SD1-6RI	TURBIDITY	0.9	NTU
LS6SW00201s	SW/SD2-6RI	TURBIDITY	-1.8	NTU
LS6SW00201d	SW/SD2-6RI	TURBIDITY	-2.1	NTU
LS6SW00101s	SW/SD1-6RI	SALINITY	25.09	PPT
LS6SW00101d	SW/SD1-6RI	SALINITY	28.14	PPT
LS6SW00201s	SW/SD2-6RI	SALINITY	23.76	PPT
LS6SW00201d	SW/SD2-6RI	SALINITY	26.23	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-81

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 6
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS6SD001	0%	0%	3%	3%	94%
LS6SD002	15%	11%	54%	13%	7%

TABLE 11-82

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 6
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Antimony, arsenic, barium, iron, chromium, silver, mercury, benzo(a)pyrene, and phenol had maximum concentrations in excess of background and/or conservative guidelines. All HQs were low (2.13) and no conservative guidelines (ER-Ms) were exceeded.	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	High-Data obtained from recent, well-conducted studies.	Negligible
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	One sample was predominantly fine-grained, while one sample had larger percentages of coarse material. TOC was moderate. Hence, data are equivacal for bioavailability inferences.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

NA = Not Applicable

TABLE 11-83

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)							
Aluminum	3/3	545000	17000	LS7SD00101	27000	0.63	N
Arsenic	3/3	6.75	16.4	LS7SD00101	8.2	2.00	Y
Barium	3/3	NA	57.8	LS7SD00301	20	2.89	Y
Beryllium	3/3	NA	0.35	LS7SD00301	NA	NA	Y
Cadmium	3/3	0.39	1.7	LS7SD00301	1.2	1.42	Y
Chromium	3/3	73	84.6	LS7SD00301	81	1.04	Y
Cobalt	3/3	NA	8.6	LS7SD00101	NA	NA	Y
Copper	3/3	36.8	126	LS7SD00101	34	3.71	Y
Iron	3/3	29250	32300	LS7SD00101	20000	1.62	Y
Lead	3/3	42.15	83.3	LS7SD00301	46.7	1.78	Y
Manganese	3/3	486	397	LS7SD00101	460	0.86	N
Mercury	3/3	0.17	0.52	LS7SD00301	0.15	3.47	Y
Nickel	3/3	34.5	36.5	LS7SD00101	20.9	1.75	Y
Silver	3/3	0.62	0.93	LS7SD00301	1	0.93	N
Vanadium	3/3	NA	51.6	LS7SD00101	NA	NA	Y
Zinc	3/3	112.45	233	LS7SD00101	150	1.55	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)							
2-Methylnaphthalene	1/3	NA	310	LS7SD00201	1.23E+05	0.00	N
Acenaphthene	1/3	NA	820	LS7SD00201	1.71E+04	0.05	N
Anthracene	3/3	NA	540	LS7SD00201	1.85E+05	0.00	N
Benzo(a)anthracene	3/3	NA	1400	LS7SD00201	3.14E+05	0.00	N

TABLE 11-83

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
MAXIMUM CONCENTRATIONS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Analyte	Frequency of Detection	Background Metal Concentrations	Maximum Concentration	Location of Maximum	Screening Guideline	Maximum Hazard Quotient	Selected as COC (Y/N?)
Benzo(a)pyrene	3/3	NA	630	LS7SD00201	4.54E+02	1.39	Y
Benzo(b)fluoranthene	3/3	NA	860	LS7SD00201	5.17E+05	0.00	N
Benzo(g,h,i)perylene	3/3	NA	570	LS7SD00201	2.30E+06	0.00	N
Benzo(k)fluoranthene	3/3	NA	840	LS7SD00201	3.18E+05	0.00	N
Carbazole	2/3	NA	400	LS7SD00201	1.24E+05	0.00	N
Chrysene	3/3	NA	1900	LS7SD00201	3.14E+05	0.01	N
Dibenzo(a,h)anthracene	3/3	NA	200	LS7SD00201	3.99E+05	0.00	N
Dibenzofuran	1/3	NA	580	LS7SD00201	1.35E+04	0.04	N
Fluoranthene	3/3	NA	7200	LS7SD00201	1.15E+05	0.06	N
Fluorene	2/3	NA	610	LS7SD00201	3.01E+03	0.20	N
Indeno(1,2,3-cd)pyrene	3/3	NA	470	LS7SD00201	6.10E+06	0.00	N
Naphthalene	1/3	NA	440	LS7SD00201	2.96E+03	0.15	N
Phenanthrene	3/3	NA	5100	LS7SD00201	1.21E+04	0.42	N
Pyrene	3/3	NA	4800	LS7SD00201	2.45E+05	0.02	N

NA None Available

TABLE 11-84

SELECTION OF SEDIMENT CHEMICALS OF CONCERN (COCs)
AVERAGE CONCENTRATIONS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Background Metal Concentrations	Mean	Screening Guideline	Mean Hazard Quotient	Selected as COC (Y/N?)
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Arsenic	3/3	6.75	14.33	8.2	1.75	Y
Barium	3/3	NA	54.07	20	2.7	Y
Beryllium	3/3	NA	0.26	NA	NA	Y
Cadmium	3/3	0.39	1.30	1.2	1.08	Y
Chromium	3/3	73	74.17	81	0.92	N
Cobalt	3/3	NA	8.27	NA	NA	Y
Copper	3/3	36.8	114.67	34	3.37	Y
Iron	3/3	29250	29800.0	20000	1.49	Y
Lead	3/3	42.15	77.40	46.7	1.66	Y
Mercury	3/3	0.169	0.40	0.15	2.67	Y
Nickel	3/3	34.5	29.90	20.9	1.43	N
Vanadium	3/3	NA	48.23	NA	NA	Y
Zinc	3/3	112.45	204.33	150	1.36	Y
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	NA	503.33	453.70	1.11	Y

NA None Available

TABLE 11-85

SUMMARY OF ACID-VOLATILE SULFIDES AND SIMULTANEOUSLY EXTRACTED METALS
ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Range of Detections (mg/kg)		Average Concentration	Location of Maximum
		min	max		
SEM ANALYTE					
Cadmium (SEM)	3/3	0.63	1.1	0.91	LS7SD00301
Copper (SEM)	3/3	74.3	116	89.37	LS7SD00101
Lead (SEM)	3/3	63	85	72.30	LS7SD00101
Nickel (SEM)	3/3	15.2	21.6	18.10	LS7SD00101
Zinc (SEM)	3/3	148	222	178.33	LS7SD00101
TOTAL SEM			445.7	359.01	
ACID-VOLATILE SULFIDES	3/3	1000	1500	1200.00	LS7SD00201
[SEM - AVS]			-1054.3	-840.99	

TABLE 11-86

COMPARISON OF SEDIMENT CHEMICALS OF CONCERN (COCs)
TO OTHER GUIDELINES - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analyte	Frequency of Detection	Maximum Concentration	Mean Concentration	ER-M	PEL	SEL
METALS AND INORGANIC COMPOUNDS (mg/kg)						
Arsenic	3/3	16.4	14.33	70	41.6	33
Barium	3/3	57.8	54.07	NA	NA	NA
Beryllium	3/3	0.35	0.26	NA	NA	NA
Cadmium	3/3	1.7	1.30	9.6	4.21	10
Chromium	3/3	84.6	74.17	370	160	110
Cobalt	3/3	8.6	8.27	NA	NA	NA
Copper	3/3	126	114.67	270	108	110
Iron	3/3	32300	29800.00	NA	NA	40000
Lead	3/3	83.3	77.40	218	112	250
Mercury	3/3	0.52	0.40	0.71	0.7	2
Nickel	3/3	36.5	29.90	51.6	42.8	75
Vanadium	3/3	51.6	48.23	3.7	1.77	NA
Zinc	3/3	233	204.33	410	271	820
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)						
Benzo(a)pyrene	3/3	630	503.33	1600	763	NA

NA - None Available
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996

TABLE 11-87

SURFACE WATER QUALITY PARAMETERS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Sample No.	Location	Parameter	Result	Units
LS7SW00101s	SW/SD1-7RI	TEMPERATURE	15.26	C
LS7SW00101d	SW/SD1-7RI	TEMPERATURE	15.86	C
LS7SW00201s	SW/SD2-7RI	TEMPERATURE	15.52	C
LS7SW00201d	SW/SD2-7RI	TEMPERATURE	15.96	C
LS7SW00301s	SW/SD3-7RI	TEMPERATURE	15.3	C
LS7SW00301d	SW/SD3-7RI	TEMPERATURE	15.79	C
LS7SW00101s	SW/SD1-7RI	DISSOLVED OXYGEN	10.12	MG/L
LS7SW00101d	SW/SD1-7RI	DISSOLVED OXYGEN	7.96	MG/L
LS7SW00201s	SW/SD2-7RI	DISSOLVED OXYGEN	8.79	MG/L
LS7SW00201d	SW/SD2-7RI	DISSOLVED OXYGEN	7.27	MG/L
LS7SW00301s	SW/SD3-7RI	DISSOLVED OXYGEN	9.18	MG/L
LS7SW00301d	SW/SD3-7RI	DISSOLVED OXYGEN	7.77	MG/L
LS7SW00101s	SW/SD1-7RI	SPECIFIC CONDUCTIVITY	41.2	MS/CM
LS7SW00101d	SW/SD1-7RI	SPECIFIC CONDUCTIVITY	44.29	MS/CM
LS7SW00201s	SW/SD2-7RI	SPECIFIC CONDUCTIVITY	40.4	MS/CM
LS7SW00201d	SW/SD2-7RI	SPECIFIC CONDUCTIVITY	44.79	MS/CM
LS7SW00301s	SW/SD3-7RI	SPECIFIC CONDUCTIVITY	40.08	MS/CM
LS7SW00301d	SW/SD3-7RI	SPECIFIC CONDUCTIVITY	43.31	MS/CM
LS7SW00101s	SW/SD1-7RI	REDOX POTENTIAL	181.2	MV
LS7SW00101d	SW/SD1-7RI	REDOX POTENTIAL	181.9	MV
LS7SW00201s	SW/SD2-7RI	REDOX POTENTIAL	214	MV
LS7SW00201d	SW/SD2-7RI	REDOX POTENTIAL	209.2	MV
LS7SW00301s	SW/SD3-7RI	REDOX POTENTIAL	231.8	MV
LS7SW00301d	SW/SD3-7RI	REDOX POTENTIAL	229.4	MV
LS7SW00101s	SW/SD1-7RI	PH	7.89	NONE
LS7SW00101d	SW/SD1-7RI	PH	7.84	NONE
LS7SW00201s	SW/SD2-7RI	PH	7.88	NONE
LS7SW00201d	SW/SD2-7RI	PH	7.85	NONE
LS7SW00301s	SW/SD3-7RI	PH	7.88	NONE
LS7SW00301d	SW/SD3-7RI	PH	7.84	NONE
LS7SW00101s	SW/SD1-7RI	TURBIDITY	5.60	NTU
LS7SW00101d	SW/SD1-7RI	TURBIDITY	2.2	NTU
LS7SW00201s	SW/SD2-7RI	TURBIDITY	1	NTU
LS7SW00201d	SW/SD2-7RI	TURBIDITY	8.1	NTU
LS7SW00301s	SW/SD3-7RI	TURBIDITY	0.9	NTU
LS7SW00301d	SW/SD3-7RI	TURBIDITY	0.4	NTU

TABLE 11-87

SURFACE WATER QUALITY PARAMETERS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Sample No.	Location	Parameter	Result	Units
LS7SW00101s	SW/SD1-7RI	SALINITY	26.58	PPT
LS7SW00101d	SW/SD1-7RI	SALINITY	28.79	PPT
LS7SW00201s	SW/SD2-7RI	SALINITY	25.88	PPT
LS7SW00201d	SW/SD2-7RI	SALINITY	29	PPT
LS7SW00301s	SW/SD3-7RI	SALINITY	25.58	PPT
LS7SW00301d	SW/SD3-7RI	SALINITY	28.01	PPT

Sample Designation
s=Shallow
d=Deep

Units
C=Centigrade
MS/CM = Millisemens/corrective measure
MV = MilliVolts
NTU = Nephelometric Turbidity Unit
PPT = Parts per Thousand

TABLE 11-88

SEDIMENT GRAIN SIZE ANALYSIS - ZONE 7
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Sample No.	Gravel (> 4800 μm)	Coarse Sand (4880-2000 μm)	Medium Sand (2000-425 μm)	Fine Sand (425-75 μm)	Fines (Silt/Clay) (< 75 μm)
LS7SD001	0%	0%	1%	4%	95%
LS7SD002	0%	0%	5%	5%	90%
LS7SD003	0%	0%	1%	9%	90%

TABLE 11-89

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - ZONE 7
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI	Sediment concentrations associated with adverse effects.	Arsenic, barium, chromium, iron, mercury, and benzo(a)pyrene had maximum concentrations in excess of background and/or conservative guidelines. No less conservative guidelines (ER-Ms) were exceeded.	High-Data obtained from recent, well-conducted studies.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Native Blue Mussel Sample	Phase II RI	Concentrations of chemicals in tissue	Low levels of some inorganics and pesticides.	Moderate-Moderate variability between samples with similar sediment concentrations.	Low
Sediment Toxicity Testing	Phase II RI	Survival of Amphipods (*Ampelisca* and *Leptocheirus*) in site sediments.	No statistically significant differences in survival between test and reference sediments for *Leptocheirus*; survival significantly lower for *Ampelisca*.	Low-Sampling sites have been dredged. Dredging may have accomplished *de facto* remediation.	Moderate
Sediment Toxicity Testing	Pier 17 Replacement EA	Survival of Amphipods (*Ampelisca*) in site sediments.	No statistically significant differences in survival between test and reference sediments.	Low-Sampling sites have been dredged. Dredging may have accomplished *de facto* remediation.	Low
Benthic Macroinvertebrate Community Analysis	Pier 17 Replacement EA	Benthic diversity and abundance	Pier 15 community appeared to be healthy; Pier 17 appeared to be disturbed (i.e. low diversity and abundance.)	Low-Sampling sites have been dredged. Dredging may have accomplished *de facto* remediation.	Moderate
Bioaccumulation Testing	Pier 17 Replacement EA	Bioaccumulation of Chemicals from Site Sediments for *Macoma nasuta* and *Nereis virens*.	Statistically significant bioaccumulation of PAHs in *Macoma* and Nereis, and PCBs in *Nereis*.	Low-Sampling sites have been dredged. Dredging may have accomplished *de facto* remediation.	Moderate
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	All samples were predominantly finer-grained and TOC was relatively high indicating high potential for binding organic chemicals.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low to Moderate**

NA = Not Applicable

TABLE 11-90

COMPARISON OF SEDIMENT COC MAXIMUM CONCENTRATIONS
IN OTHER THAMES RIVER SEDIMENTS
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Lower Subase COC[1]	Maximum Upstream[(2)]	Maximum Downstream[(2)]	Maximum DRMO[(2)]	Maximum Goss Cove[(2)]	ER-M	SEL	PEL	Conservative Guideline
METALS AND INORGANIC COMPOUNDS (mg/kg)								
Antimony	38.1	39	42.3	42.7	25	NA	NA	2
Arsenic	10.9	11.2	16	14	70	33	41.6	8.2
Barium	48.5	73	77	67	NA	NA	NA	20
Beryllium	0.69	1.3	0.8	0.88	NA	NA	NA	NA
Boron	26.5	129	68.2	53.3	NA	NA	NA	NA
Cadmium	ND	0.51	3.6	3	9.6	10	4.21	1.2
Chromium	79.6	81.6	120	91.5	370	110	160	81
Cobalt	7	8.5	9.9	8.3	NA	NA	NA	NA
Copper	83.7	151	167	129	NA	110	108	34
Iron	23800	25400	30500	28800	NA	40000	NA	20000
Lead	91.2	186	160	117	218	250	112	46.7
Mercury	0.5	0.44	0.62	0.66	0.71	2	0.7	0.15
Nickel	23	34	63	102	51.6	75	42.8	20.9
Selenium	ND	0.51	ND	ND	NA	NA	NA	0.1
Silver	ND	1.2	ND	ND	3.7	NA	1.77	1
Thallium	ND	0.51	ND	ND	NA	NA	NA	NA
Vanadium	38.7	37.7	54.2	45.1	NA	NA	NA	NA
Zinc	130	297	295	269	410	820	271	150
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)								
4-Methylphenol	ND	ND	130	ND	NA	NA	NA	V
Benzo(a)pyrene	620	780	610	670	1600	NA	763	V
Phenol	ND	ND	ND	ND	NA	NA	NA	V

TABLE 11-90

COMPARISON OF SEDIMENT COC MAXIMUM CONCENTRATIONS
IN OTHER THAMES RIVER SEDIMENTS
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Lower Subase COC[1]	Maximum Upstream[(2)]	Maximum Downstream[(2)]	Maximum DRMO[(2)]	Maximum Goss Cove[(2)]	ER-M	SEL	PEL	Conservative Guideline
PESTICIDES (µg/kg)								
4,4'-DDD	17	12	110	6.3	NA	7.81	60	V

ND = Not Detected
NA = Not Available
V = Varies by zone depending on TOC concentration
ER-M - Effects Range Median
PEL - Probable Effects Level
SEL- Severe Effect Level
Source: Jones et al., 1996
1 COC from Zones 1-7 using maximum concentrations from NSB-NLON Phase II RI/Lower Subase RI Data and Conservative Guidelines.
2 Maximum from all available data including Pier 17 EA, Seawolf EIS, NSB-NLON Phase II RI, and Lower Subase RI Data.

TABLE 11-91

COMPARISON OF LOWER SUBASE RANGES OF COC CONCENTRATIONS IN SEDIMENTS TO MAXIMUM CONCENTRATIONS IN OTHER SECTIONS OF THE THAMES RIVER
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Lower Subase COC[1]	Range of Maximum Detections Among All Zones[2]	Maximum Upstream[3]	Maximum Downstream[3]	Maximum DRMO[3]	Maximum Goss Cove[3]
METALS AND INORGANIC COMPOUNDS (mg/kg)					
Antimony	ND-41.1	38.1	39	42.3	42.7
Arsenic	15.1-18.5	10.9	11.2	16	14
Barium	57.8-96.4	48.5	73	77	67
Beryllium	0.35-7.6	0.69	1.3	0.8	0.88
Boron	ND-70.2	26.5	129	68.2	53.3
Cadmium	0.85-1.7	ND	0.51	3.6	3
Chromium	80.7-400	79.6	81.6	120	91.5
Cobalt	8.6-13.1	7	8.5	9.9	8.3
Copper	121-278	83.7	151	167	129
Iron	32300-40400	23800	25400	30500	28800
Lead	83.3-1380	91.2	186	160	117
Mercury	0.32-0.63	0.5	0.44	0.62	0.66
Nickel	32.1-75.8	23	34	63	102
Selenium	ND-1.1	ND	0.51	ND	ND
Silver	0.84-1.4	ND	1.2	ND	ND
Thallium	ND-2.3	ND	0.76	ND	2
Vanadium	51-64.3	38.7	37.7	54.2	45.1
Zinc	171-1650	130	297	295	269
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
4-Methylphenol	ND-68	ND	ND	130	ND
Benzo(a)pyrene	630-1900	620	780	610	670

TABLE 11-91

COMPARISON OF LOWER SUBASE RANGES OF COC CONCENTRATIONS IN SEDIMENTS TO MAXIMUM CONCENTRATIONS IN OTHER SECTIONS OF THE THAMES RIVER
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2

Lower Subase COC[1]	Range of Maximum Detections Among All Zones[2]	Maximum Upstream[3]	Maximum Downstream[3]	Maximum DRMO[3]	Maximum Goss Cove[3]
Phenol	ND-150	ND	ND	ND	ND
PESTICIDES (µg/kg)					
4,4'-DDD	ND-28	17	12	110	6.3

ND = Not Detected

1 COC from Zones 1-7 using maximum concentrations from NSB-NLON Phase II RI/ Lower Subase RI Data and Conservative Guidelines.
2 Includes all maximum concentrations among all zones using NSB-NLON/Lower Subase RI sediment samples collected near the Lower Subase.
3 Maximum from all available data including Pier 17 EA, Seawolf EIS, NSB-NLON Phase II RI, and Lower Subase RI Data.

TABLE 11-92

WEIGHT OF EVIDENCE FOR POTENTIAL RISKS - THAMES RIVER/ALL ZONES
ASSESSMENT ENDPOINTS - PROTECTION OF BENTHIC INFAUNAL/EPIBENTHIC COMMUNITIES
LOWER SUBASE
NSB-NLON, GROTON, CONNECTICUT

Analysis	Source	Measurement Endpoint(s)	Results Summary	Confidence in Study Data/Conclusions	Magnitude of Potential Risks for Entire Lower Subase*
Sediment Chemistry (non-AVS/SEM)	Lower Subase RI/Phase II RI/SEAWOLF EIS/Pier 17 EA	Sediment concentrations associated with adverse effects.	Several inorganics (primarily mercury) and organics (primarily benzo(a)pyrene) were elevated throughout the 7 zones near the Lower Subase but the ranges among zones were similar to those upstream and downstream of NSB-NLON. Some spotty elevated detections of some inorganics were present in some zones but were not	Moderate to High-Data were available from both older and more recent studies. Some older data were unvalidated and not used in zone-specific ERAs.	Low
Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)	Lower Subase RI/Phase II RI	AVS/SEM ratios	AVS > SEM in all samples collected throughout the Thames River. Cadmium, copper, nickel, lead, and zinc not bioavailable.	High-Data obtained from recent, well-conducted studies.	Negligible
Shellfish Samples	Phase II RI	Concentrations of chemicals in tissue	For the most part, concentrations in shellfish near the Lower Subase were similar to those in upstream and downstream areas. Some spotty elevated hits of some chemicals were observed in the Lower Subase but were not widespread.	High-Data obtained from recent, well-conducted studies.	Low
Sediment Toxicity Testing	Phase II RI/Pier 17 EA/SEAWOLF EIS	Various species	Majority of sediment toxicity testing among all zones indicates a general absence of toxicity; toxicity in the Lower Subase is localized.	Moderate to High-Data were available from both older and more recent studies.	Low
Benthic Macroinvertebrate Community Analysis	Phase II RI/SEAWOLF EIS/Pier 17 EA	Benthic diversity and abundance.	Benthic communities along the Lower Subase are generally similar to those upstream and downstream of NSB-NLON; impacted areas in the Lower Subase are localized indicating the absence of widespread impacts.	Low to Moderate-data are a "snapshot" and are dependent on ephemeral physical factors.	Low
Sediment Grain Size and Total Organic Carbon (TOC)	Lower Subase RI/Phase II RI	NA	Most samples among all zones near the Lower Subase were predominantly finer-grained and TOC was relatively high indicating high potential for binding organic chemicals.	High-Data obtained from recent, well-conducted studies.	NA
Overall Rating of Potential Risks Based on the Entire Weight of Evidence					**Low**

NA = Not Applicable
* Overall risks for the Lower Subase as a whole (all zones combined) and the Lower Subase risks as a whole compared to other sections of the Thames River.

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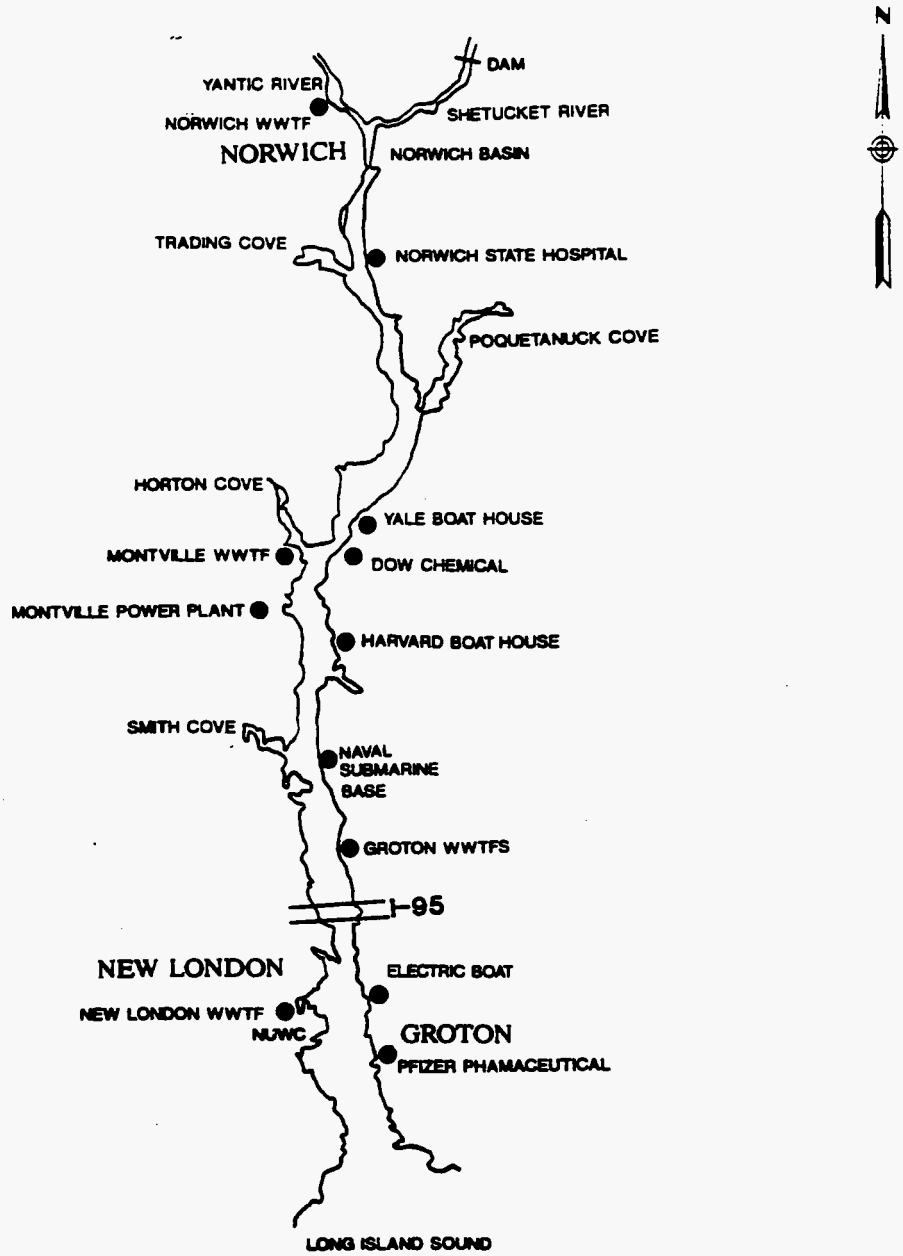

LEGEND:

● DISCHARGE

SOURCE: TAKEN FROM FINAL EIS SEAWOLF HOMEPORTING (MAGUIRE, 1995)

DRAWN BY ——— DATE ———	Brown & Root Environmental	CONTRACT NO. ———	OWNER NO. ———
CHECKED BY DATE	THAMES RIVER DISCHARGE SOURCES LOWER SUBASE RI NSB-NLON GROTON, CONNECTICUT	APPROVED BY Corey A Rice DATE 4/16/98	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE N.T.S.		DRAWING NO. 11-1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

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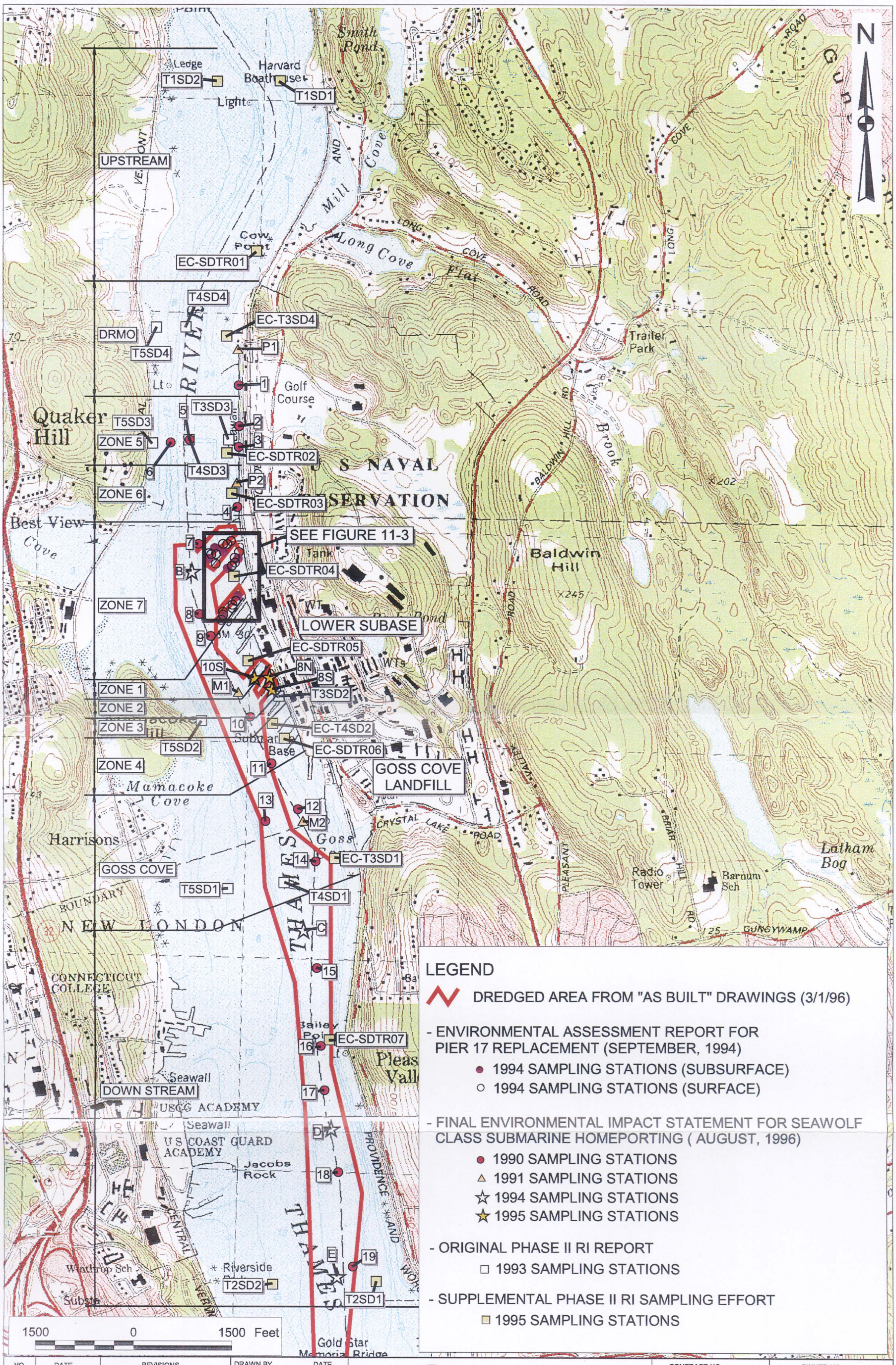

NO.	DATE	REVISIONS	DRAWN BY S. TABLER	DATE 8-APR-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY C. RICH	DATE 9-APR-98	HISTORIC SEDIMENT SAMPLE LOCATIONS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Gary A Rich	DATE 4/16/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. 11-2	REV. 0

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CTO 0260

REVISION 1
OCTOBER 1998

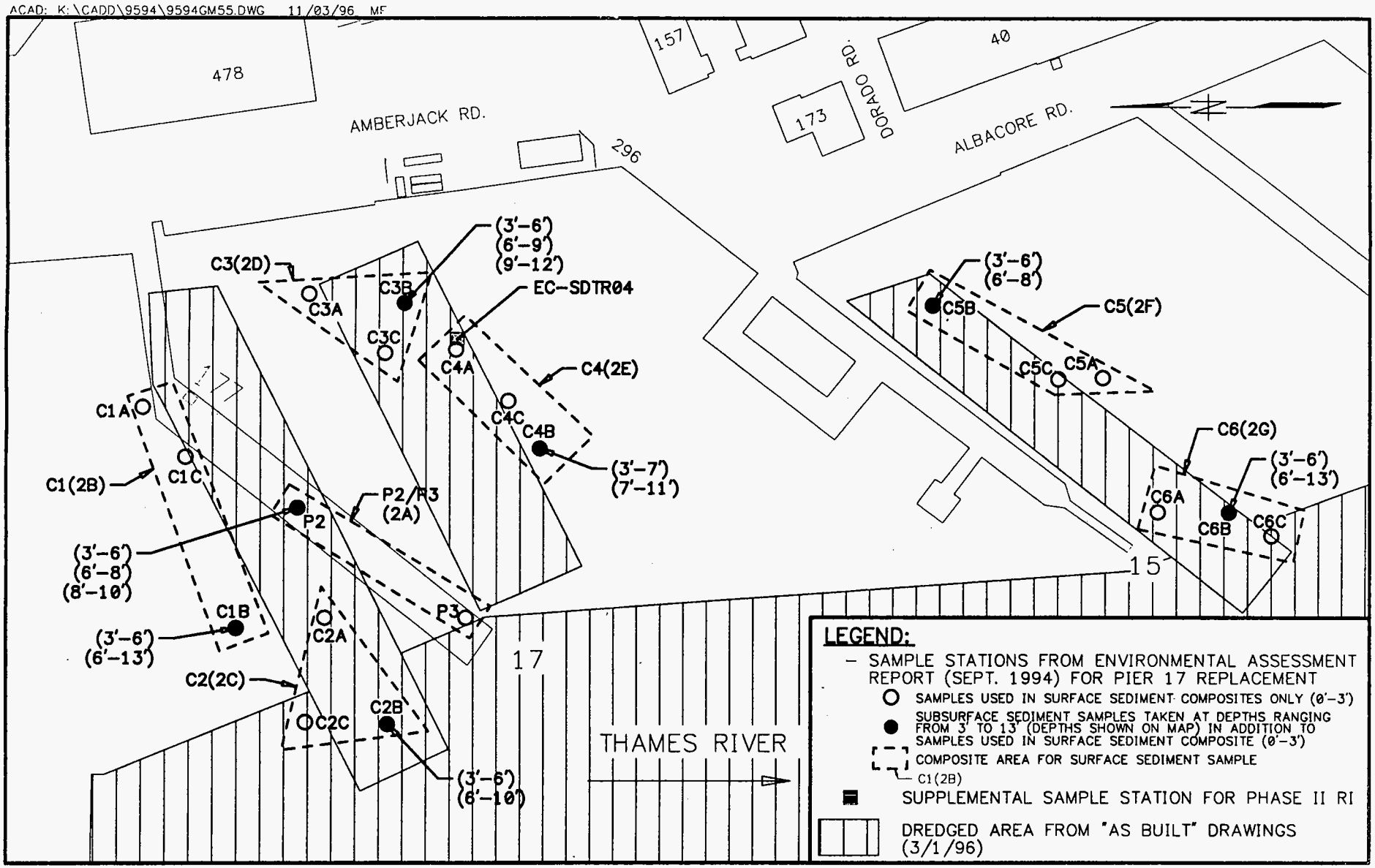

FIGURE 11-3

PIER 15/17 SEDIMENT SAMPLING LOCATIONS AND LIMIT OF DREDGING

NSB-NLON, GROTON, CONNECTICUT

0 150 300

SCALE IN FEET

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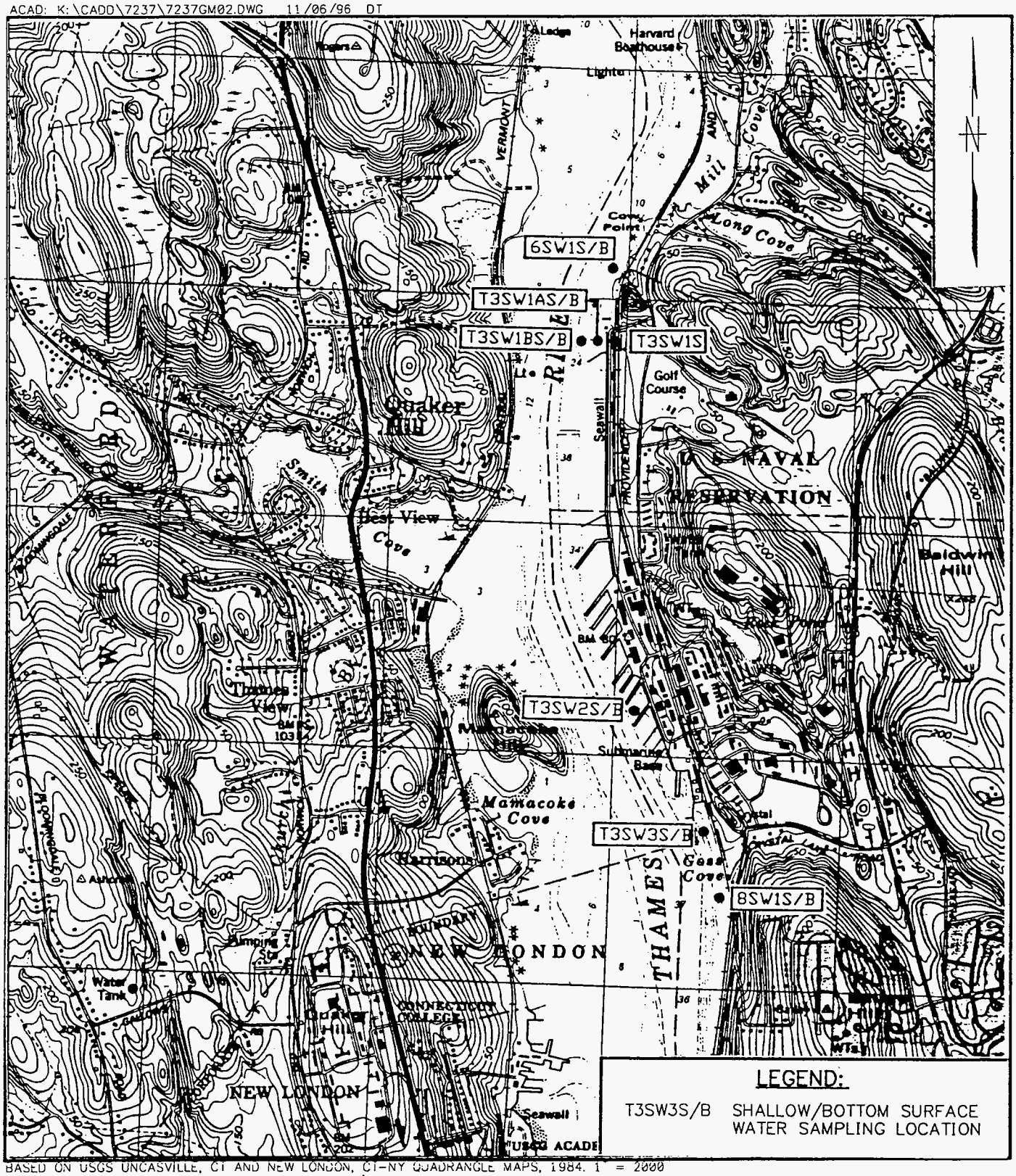

BASED ON USGS UNCASVILLE, CT AND NEW LONDON, CT-NY QUADRANGLE MAPS, 1984. 1" = 2000'

THAMES RIVER SURFACE WATER SAMPLING LOCATIONS
NSB-NLON, GROTON, CONNECTICUT

0 2000 4000
SCALE IN FEET

FIGURE 11-4

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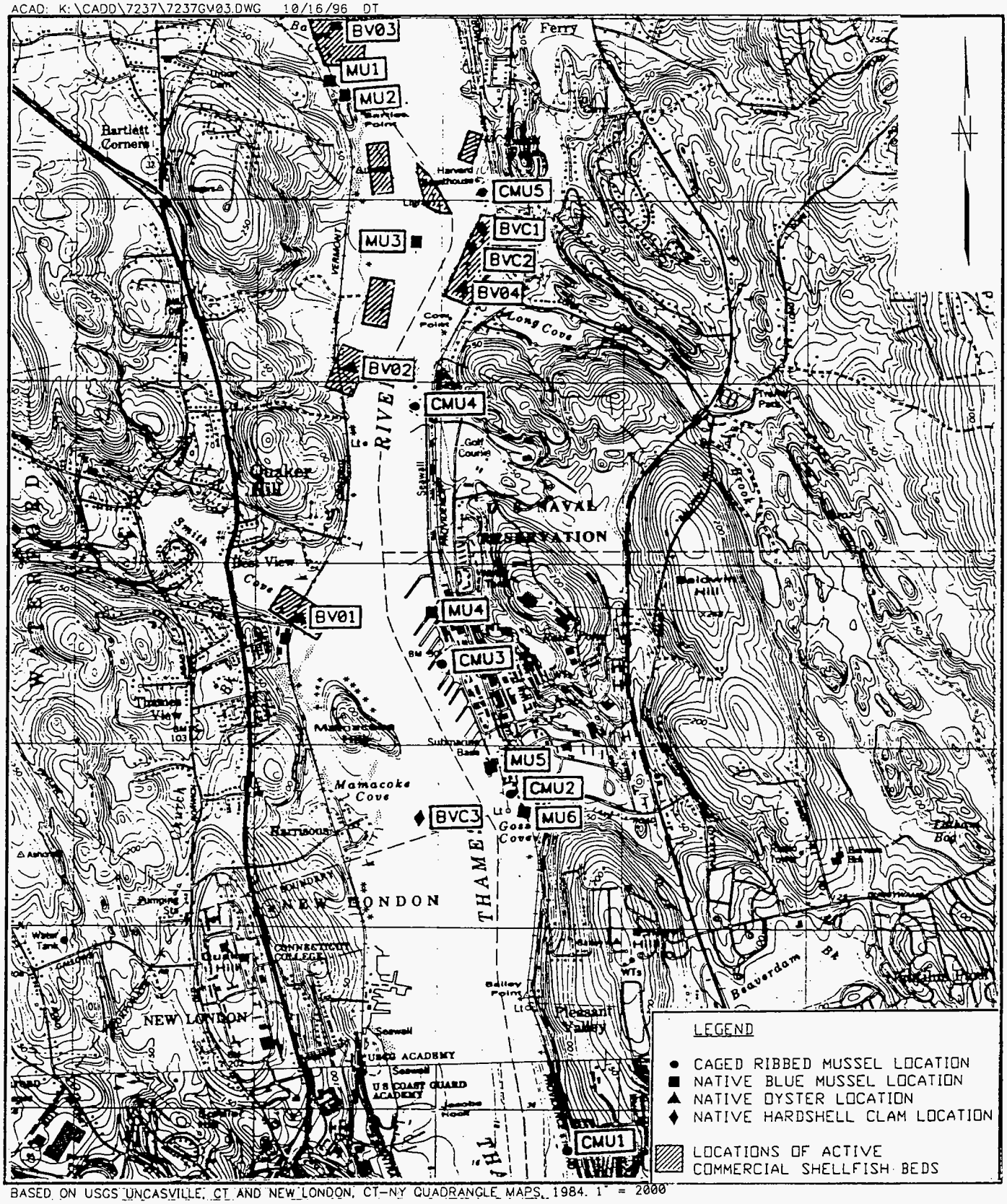

BASED ON USGS UNCASVILLE, CT AND NEW LONDON, CT-NY QUADRANGLE MAPS, 1984. 1" = 2000'

THAMES RIVER NATIVE AND DEPLOYED BIVALVE LOCATIONS

NSB-NLON, GROTON, CONNECTICUT

0 2500 5000

SCALE IN FEET

FIGURE 11-5

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NO.	DATE	REVISIONS	DRAWN BY S. TABLER	DATE 8-APR-98	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
			CHECKED BY C. RICH	DATE 9-APR-98	NEW SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS LOWER SUBASE RI NSB-NLON, GROTON, CONNECTICUT	APPROVED BY Corey A Rich	DATE 4/16/98
			COST/SCHED-AREA			APPROVED BY	DATE
			SCALE AS NOTED			DRAWING NO. 11-6	REV. 0

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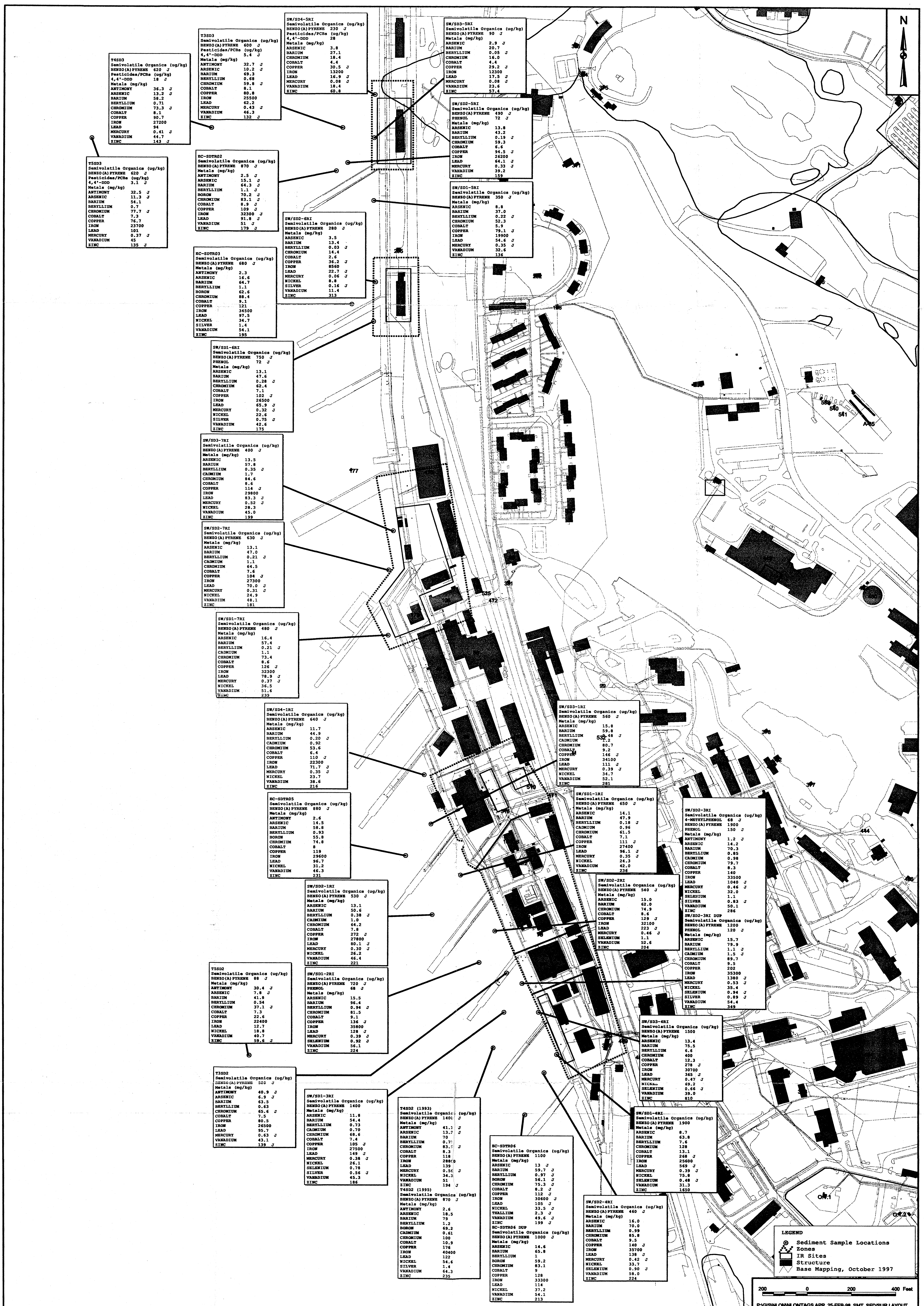
OCTOBER 1998



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SEAL AREA

DEPARTMENT OF THE NAVY | NAVAL FACILITIES ENGINEERING COMMAND

NORTHERN DIVISION

NAVAL BASE | PHILADELPHIA, PA

THAMES RIVER SEDIMENT
COC POSITIVE DETECTS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT

APPROVED | DATE | NORTHDIV FOR COMMANDER NAVFAC

REV	DESCRIPTION	PREP BY	DATE	APPRVD

Brown & Root Environmental
FOSTER PLAZA
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

DSGN: | DR: | CHK:
SUPV: Greg C. Ried 1/16/98 | CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: FPE: | HD: HD: DIR:
OFFICER IN CHARGE
APPROVED | DATE

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12.0 SUMMARY AND CONCLUSIONS

This section presents an overall summary of the conclusions and recommendations that were reached for the 7 zones and the Thames River that were investigated as part of the Lower Subase RI. Table 12-1 provides a brief synopsis of the recommendations for each of the sites studied. The table identifies the sites, the recommendations for the sites, and provides the rationales for the recommendations.

As shown in Table 12-1, it is recommended that all zones proceed to feasibility studies to evaluate appropriate remedial alternatives for soil, groundwater, and storm sewer systems. For the soil of each zone, a combination of three alternatives is suggested for further evaluation in the feasibility study. The alternatives include institutional controls, passive or insitu technologies, and "hot spot" removal actions. Zone-specific information (i.e., magnitude of risks, type and distribution of contaminants, contaminant migration potential, infrastructure interferences, and nature of activities conducted at the zone) was used to select the appropriate combination of alternatives for each zone. Zone-specific recommendations are provided below:

- Feasibility studies for the soil of Zones 1, 3, 4, 5, and 7 should evaluate a combination of all three alternatives.

- Feasibility study for the soil of Zone 2 should evaluate only institutional controls.

- Feasibility study for the soil of Zone 6 should evaluate institutional controls and passive or insitu technologies.

A combination of three alternatives are recommended for further evaluation in the zone-specific feasibility studies for groundwater and they include free-phase product removal, tiered groundwater monitoring program, and monitored natural attenuation. These recommendations were made using zone-specific information such as the type and distribution of contamination in the groundwater, presence of free-phase product, contaminant migration potential, and the results of the natural attenuation evaluation. The groundwater monitoring program will be tiered and will provide specific criteria that will be used to trigger moving to the next tier. The second tier will include additional surface water and sediment sampling in the Thames River. If warranted, a subsequent tier would include evaluation of "hot spot" removal actions in the Thames River. A similar tiered groundwater monitoring program is currently being enacted at another NSB-NLON IRP site (i.e., DRMO) along the Thames River. Zone-specific recommendations are provided below:

- Feasibility study for the groundwater of Zone 1 should evaluate all three alternatives.

- Feasibility study for the groundwater of Zones 2, 3, 4, 6 and 7 should evaluate a tiered groundwater monitoring program.

- Feasibility study for the groundwater of Zone 5 should evaluate monitored natural attenuation and tiered groundwater monitoring program.

Cleaning and repair of the storm sewer systems are recommended for each zone. This recommendation was made based on the following information:

- Elevated levels of inorganics were detected in the sediment of a catch basin between Zones 5 and 6.

- The analytical results from the NPDES permit sampling showed some elevated levels of inorganics and other contaminants in the surface water being discharged from the Lower Subase.

- The age and inverts of the storm sewer systems suggest that the system may act as a migration pathway for contaminated groundwater.

The Thames River adjacent to the Lower Subase should proceed to a Feasibility Study. A limited action scenario should be evaluated in the Feasibility Study for the Thames River adjacent to Zones 1, 2, 3, 5, and 6. For this scenario, no additional actions are recommended at the current time based on the results of the human health and ecological risk assessments, but additional surface water and sediment sampling or "hot spot" removal actions could be completed as part of the tiered groundwater sampling programs for the zones, if the data warrants. The human health risk assessment showed that there are elevated risks to human receptors from the Thames River surface water, but the risks are thought to be overestimated because the exposure route (i.e., ingestion of shellfish) that contributed significantly to the risks is considered to be hypothetical and overly conservative. The zone-specific and overall ecological risk assessments indicate that the current risks to sediment dwelling ecological receptors adjacent to Zones 1, 2, 3, 5, and 6 are low. A Data Gap Investigation is recommended for the Thames River adjacent to Zones 4 and 7. The investigation should include additional sediment sampling and testing. This recommendation is based on the results of the ecological risk assessment which indicates that the current risks to sediment dwelling ecological receptors adjacent to Zones 4 and 7 are low to moderate. The results of the investigation should be combined with the results of this RI to determine the overall risks to ecological receptors adjacent to Zones 4 and 7 and the appropriate remedial alternatives to be evaluated in the Feasibility Study.

TABLE 12-1

SUMMARY OF RECOMMENDATIONS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 2

Site	Recommended Action	Rationale
Zone 1	SO – FS (IC, PA/IN, HSRA) GW – FS (FP, MNA, LA) SS – FS (CR)	ARARs exceeded; elevated risks to human receptors; free-phase product in groundwater; groundwater is not used as a potable water source; contaminant migration occurring; and low risks to ecological receptors.
Zone 2	SO – FS (IC) GW – FS (LA) SS – FS (CR)	ARARs exceeded; risks to human receptors are minimal; groundwater is not used as a potable water source; potential contaminant migration; and low risks to ecological receptors.
Zone 3	SO – FS (IC, PA/IN, HSRA) GW – FS (LA) SS – FS (CR)	ARARs exceeded; risks to human receptors are minimal; groundwater is not used as a potable water source; time-critical removal action was completed to remediate lead contamination problem; remaining lead still poses risk to sensitive receptors; potential contaminant migration; and low risks to ecological receptors.
Zone 4	SO – FS (IC, PA/IN, HSRA) GW – FS (LA) SS – FS (CR)	ARARs exceeded; elevated risks to human receptors; groundwater is not used as a potable water source; limited contaminant migration; and low to moderate risks to ecological receptors.
Zone 5	SO – FS (IC, PA/IN, HSRA) GW – FS (MNA, LA) SS – FS (CR)	ARARs exceeded; risks to human receptors are minimal; groundwater is not used as a potable water source; petroleum contamination is localized; limited contaminant migration; elevated levels of inorganics in storm sewer system; and low risks to ecological receptors.
Zone 6	SO – FS (IC, PA/IN) GW – FS (LA) SS – FS (CR)	ARARs exceeded; risks to human receptors are minimal; groundwater is not used as a potable water source; potential contaminant migration; elevated levels of inorganics in storm sewer system; and low risks to ecological receptors.
Zone 7	SO – FS (IC, PA/IN, HSRA) GW – FS (LA) SS – FS (CR)	ARARs exceeded; elevated risks to human receptors; groundwater not used as a potable water source; contaminant migration occurring; and low to moderate risks to ecological receptors.
Thames River	Zone 1 - SW/SD - FS (LA) Zone 2 - SW/SD - FS (LA) Zone 3 - SW/SD - FS (LA) Zone 4 - SW/SD - FS (DG) Zone 5 - SW/SD - FS (LA) Zone 6 - SW/SD - FS (LA) Zone 7 - SW/SD - FS (DG)	Risks to human receptors from surface water are elevated only when a hypothetical exposure route (i.e., ingestion of shellfish) is considered. The weight-of-evidence approach used for the zone-specific ecological risk assessments and the overall Thames River ecological risk assessment indicates that there are potential risks to sediment dwelling ecological receptors, but they are generally low (Zones 1, 2, 3, 5, and 6) to moderate (Zones 4 and 7). All calculated HQs were less than 12.

TABLE 12-1

**SUMMARY OF RECOMMENDATIONS
LOWER SUBASE RI
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 2**

ARAR - Applicable, Relevant, or Appropriate Requirement
CR - Clean and Repair
DG - Data Gap Investigation
FS - Feasibility Study
FP - Free-Phase Product Removal
GW - Groundwater
HSRA - Hot Spot Removal Action
IC - Institutional Controls
LA - Limited Action - Includes a tiered Groundwater Monitoring Program with the second tier of the program including surface water and sediment sampling in the Thames River.
MNA - Monitored Natural Attenuation
PA/IN - Passive or Insitu Remedial Technologies
SO - Soil
SS - Storm Sewer System
SW/SD - Surface Water/Sediment

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